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C/025/0005
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Daron R. Haddock
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Oil, Gas & Mining
1594 West North Temple, Suite 1210
Salt Lake City, UT 84114-5801

Subject: **Re-Submittal for the North Private Lease , Alton Coal Development, LLC, Coal Hollow Mine, Kane County, Utah, C/025/0005,**

Dear Mr. Haddock,

Alton Coal Development, LLC (ACD) is re- submitting an amendment to expand the Coal Hollow Mine in Kane County to include the private properties known as the North Private Lease.

Additional baseline chemistry data for the North Private Lease is available that we will officially submit into the Division's on-line database when we receive authorization from the Division to do so (we were told previously by Division personnel that we were not to do it currently).

Changes to the MRP associated with this amendment have been uploaded to the DOGM's server for review. PDF versions of the drawing are not certified. Upon approval, 2 (two) clean hard copies of the text and certified drawings for insertion into the MRP will be submitted. Please do not hesitate to contact me if you have any questions 435-691-1551.

Sincerely

B. Kirk Nicholes
Environmental Specialist

1) R645-301-121.200 Combine all water monitoring sites for the Coal Hollow mine (South Lease, underground, and proposed North Private lease) into a single clear and concise water monitoring table. Symbolize or label all monitoring sites that have been destroyed by mining and sites that will be destroyed by mining activity in a footnote.

The monitoring plan tables have been combined as requested – see Tables 7-4 through 7-7.

2) R645-301-121.200 The Baseline Cumulative Impact Area Information in Chapter 7, pg 7-23, needs to clearly reference where hydrologic and geologic information can be found for the North Private lease area.

Requested information has been added to the text of Chapter 7, Section 725 Baseline Cumulative Impact Area Information.

3) R645-301-121.200 The application includes a reference to Figure X in Appendix 7-16, page 21. This reference needs to be corrected.

The incorrect reference has been removed from Appendix 7-16. A new updated version of Appendix 7-16 is provided.

4) R645-301-121.200 Drawing 5-62: is referenced in Appendix 7-16, but is not provided with the application.

A reference to Drawing 5-62 cannot be found in Appendix 7-16.

5) R645-301-130 Drill Hole or Well Completion Reports need to be provided for all drilling logs. This raw field data needs to include but is not limited to, the dates of collection and descriptions of the methodology used to collect and analyze the data.

The drill hole and well completion reports have been provided as requested in Appendix 7-16. A new updated version of Appendix 7-16 is provided.

6) R645-301-130 Additional information on the slug-test conducted by UII is required, including the raw field data and methodology used to collect and analyze these results (tables and/or graphs) must be included in the application.

The requested addition information on the UII slug test is provided in Appendix 7-16. A new updated version of Appendix 7-16 is provided.

7) R645-301-130 All appropriate baseline flow graphs (vertical axes in the thousands) of data in Figure 10, Appendix 7-16 will be graphed in logarithmic scale to clearly present the data.

For the intended purpose of the analysis (i.e. depiction of seasonal variability in water quantity) the base flow discharge information plotted in Figure 10 of the Petersen Hydrologic report is best presented in its current form. This information is also presented in a clear and concise form in Table 2a.

8) R645-301-130 In order to verify the data collected by the ultrasonic at the surface water monitoring point Kanab at CR, the application must provide the raw measurements of data recorded here.

Apparently, the Division has incorrectly assumed that the ultrasonic distance sensor device is being used to collect quarterly flow measurements at Kanab @ C.R. Baseline quarterly discharge measurements have always been performed using appropriate conventional methods on Kanab Creek below the county road crossing (other than the ultrasonic device). The ultrasonic distance sensor device was installed to provide a continuous flow record for supplemental streamflow characterization – primarily to quantify the magnitude of high-flow discharge events.

9) R645-301-521 The application meets the minimum requirements of R645-301-521 , however, there is a typo in Chapter 5 footer as the month and date were updated but the year was not. The footer should be updated to the correct year if the month and date are being updated. The Chapter 8 footer needs to be updated as well.

Corrected Footer in Chapters 5 and 8

10) R645-301-121.200 The Permittee must differentiate between identification efforts undertaken for the currently approved permit area and the proposed North Lease Expansion area. For clarity, identification and reporting efforts for each area must be discussed individually. Subheadings must also be included to clarify what reporting was undertaken for each area (i.e. the currently approved permit area versus proposed North Lease Expansion area). This applies to all discussions under R645-301-411.140 to R645-301-411.144.

Efforts undertaken for cultural and historic resources have been greatly expanded. Efforts undertaken are discussed separately for the Current Mine and the North Lease Expansion

11) R645-301-411.140 The Permittee must provide additional information/clarification so as to differentiate between the nature of archaeological and cultural resources located within the currently approved permit area and the proposed North Lease expansion area. The Permittee must describe efforts undertaken to identify archaeological and cultural resources within the permit boundaries including:

1. Describe previous identification efforts with regard to cultural resources in the both the South and North Private Lease areas, and each area must be addressed under the appropriate subheading. The discussion must include report titles, state project identification numbers, dates of inventory, results of each inventory (number of cultural resource sites Eligible for the National Register of Historic Places identified within the survey area), etc. If a report is referenced in this narrative, it needs to be included in the appropriate Appendix and referenced in the narrative

2. Language in this section needs to clearly state how many of the cultural resource sites identified in the appropriate report are located within the permit boundaries, as well as others immediately adjacent to the permit boundaries that will be monitored/avoided as part of Operational Plans/Compliance with R645-3Q1-411, 142, 1 (preventing Adverse Effects to Eligible cultural sites).

3. Provide Report U-05-MQ1568bp. It appears that this report addresses cultural resource inventory work associated with the North Lease area and is referenced in the application; however, it is not included in either Appendix 4-1 or Appendix 4-7.

4. The data recovery treatment plan developed for the North Lease area is cited as being included in Appendix 4-1; however, it is provided in Appendix 4-7. This needs to be corrected in the application.

5. The data recovery treatment plan for the proposed North Lease area addresses three sites (42KA3077, 42KA3097, and 42KA6088). While only 42KA3067 and 42KA3097 are being recommended for treatment/data recovery, it must be noted site 42KA6088 will be barricaded and monitored during construction/mining related activities to ensure No Adverse Effects to this site.

6. A reference location (Appendix number) for the "Cultural Resources Discovery Plan for the Alton Coal LLC, Coal Hollow Project in Kane County" must be provided, and it must be made clear to which parcel (north or south) this plan pertains.

Efforts undertaken for cultural and historic resources have been greatly expanded. Efforts undertaken are discussed separately for the Current Mine and the North Lease Expansion in Section 411.140. The "Cultural Resource Discovery Plan for the Alton Coal LLC, Coal Hollow Project in Kane County" has been added as Appendix 4-8.

12) R645-301.411.141 The Permittee must provide maps for the North Private Lease area either in Appendix 4-1 or Appendix 4-7. The narrative presented indicates cultural resource and historic maps are included in Appendix 4-1. The maps provided in Appendix 4-1 address the currently approved permit area only. The Permittee must also provide the title of the cultural resource inventory report containing said maps and provided in Appendix 4-1. For clarification, the report title must be included as well as a clear indication as to whether the report addresses the currently approved permit area or the proposed North Lease expansion area.

Exhibit 4-5 for the Current Coal Hollow Mine and Exhibit 4-6 for the North Private Lease depicting cultural and historic resources have been added to Appendix 4-1 and Appendix 4-7 respectively

13) R645-301-411.141.1 The heading of "Boundaries of Public Parks," is not appropriate as this section addresses map requirements for the permit. If the maps described under R645-301-411.141.1 are included and referenced under R645-301-411.141, then this section is not needed in the document.

This heading only clarifies that there are "no public parks in the permit area".

14) R645-301-411.142 The Permittee must describe coordination efforts with and present evidence of clearances by the SHPO. This includes documentation that coordination with SHPO (dates of letters sent/received) has taken place with regard with regard to the existing permit area (summary documentation regarding coordination efforts), as well as the three sites (42KA3077, 42KA3097, and 42KA6080), specifically concurrence with Adverse Effects to Eligible Historic Properties. The Division initiated Eligibility and Effects consultation with SHPO in a letter dated July 23, 2015. On July 28, 2015, SHPO provided their concurrence with the Division's determination of Adverse Effects to sites 42KA3077

and 42KA3097 in conjunction with proposed mining activities within the boundaries of the North Lease Expansion area

Section 411.142 of the MRP has been expanded to describe the coordination efforts with SHPO.

15) R645-301-411.142.1 The Permittee must provide the efforts proposed to mitigate Adverse Effects to sites 42KA3077 and 42KA3097, and limit project impacts to site 42KA6088. The proposed efforts must reference the proposed treatment and mitigation presented in the draft Archaeological Monitoring & Historical Properties Treatment Plan for the Alton Coal Northern Project Lease Area, Kane County, Utah presented in Appendix 4-7. Previous efforts undertaken to prevent or mitigate adverse impacts within that area must also be summarized in this section. For clarity, mitigation efforts for each area must be discussed individually. Subheadings must also be included to clarify what reporting was undertaken for each area (i.e. the currently approved permit area versus proposed North Lease Expansion area).

Section 411.142.1 of the MRP has been expanded to describe the mitigation/ avoidance efforts undertaken for the currently approved permit area and the proposed efforts to be undertaken for the North Private Lease expansion. This information is divided under appropriate separate headings

16) R645-301-411.142.2 The Permittee must revise this section to address the fact one site identified in the draft Archaeological Monitoring & Historical Properties Treatment Plan for the Alton Coal Northern Project Lease Area, Kane County, Utah presented in Appendix 4-7 is on land under the jurisdiction of the BLM. Efforts outlined in the draft treatment plan seek to ensure no project-related impacts occur to site 42KA6088, but it must be noted by not affecting site 42KA6088, no additional coordination will be required with the BLM.

Section 411.142.2 of the MRP has been expanded to address the valid existing rights and joint agency approvals necessary for the current and proposed activities.

17) R645-301-411.143 The Permittee must clarify this section. The narrative states "there will be no significant effects of mining on historical resources." The language is contradictory to previous statements made in 411.140, wherein two cultural sites Eligible for the National Register of Historic Places have been identified within the North Private Lease area. Mining activities have been determined to have an Adverse Effect to both of the sites. Sites Eligible for the National Register were also identified on the South Private Lease area; where it was similarly determined that mining activity would adversely impact those sites. The section must be edited to reflect this for both the currently approved permit area and the proposed North Lease expansion.

Section 411.143 has been revised to clarify effects of mining on historical resources in the currently approved permit area and the proposed North Private Lease area.

18) R645-301-411 .143.1, -143.2 and 143.3 The Permittee must conduct additional inventory/treatment/monitoring of cultural resource sites identified in the North Lease Expansion area. The requirements for this additional work must be developed through Division/SH PO consultation and

review of the draft Archaeological Monitoring & Historical Properties Treatment Plan for the Alton Coal Northern Project Lease Area, Kane County, Utah presented in Appendix 4-7.

Section 411.143 has been expanded with respect to the need to conduct additional information as actions necessitate.

19) R645-301-411.143.1 The Permittee must provide a map showing the inventory area for the proposed North Lease expansion area. The narrative indicates a map showing the inventory area covered for the purposes of identifying cultural resources is included in Appendix 4-1. The only map provided in Appendix 4-1 addresses lands inventoried for the currently approved permit area. A map is not provided for the North Lease Expansion area in either Appendix 4-1 or Appendix 4-7. The inventory conducted in 2005 (U-05-MQ1568bp) covered those lands associated with the North Private Lease area, but no copy of this inventory is provided in Appendix 4-1 or Appendix 4-7.

Exhibit 4-5 for the Current Coal Hollow Mine and Exhibit 4-6 for the North Private Lease depicting cultural and historic resources have been added to Appendix 4-1 and Appendix 4-7 respectively.

20) R645-301-411.144 The Permittee must follow the process for the development and implementation of an appropriate treatment and mitigation plan to address Adverse Effects to sites 42KA3077 and 42AK3097, and to ensure No Adverse Effects to site 42KA6088.

Section 411.144 has been added addressing the current Coal Hollow Mine and proposed North Private Lease.

21) R645-301-724.412-420 The application needs to provide an updated analysis of wind, rain, and temperature data from the continuously monitored on-site weather station. The climate information should include but is not limited to: an updated analysis of wind direction and velocity and the monthly wind rose plots from TO or the time of weather station installation up to the present; a plot of average daily mean, minimum, and maximum temperatures; a plot of rainfall accumulation and maximum rainfall intensities recorded by the tipping bucket rain gauge. The rainfall intensity data needs to be put into the context of a 24-hour and/or 6-hour return period as rated by the Atlas 14 precipitation frequency analysis.

ACD has previously provided the climate information required for approval of the Coal Hollow Mine permit. This included analysis of climate data for the 77-year period from 1928-2005 from the nearby Alton, Utah weather station (420086), updated current information on the PHDI climate index, and more recent daily climate data from the Coal Hollow Mine weather station. ACD is providing additional climate data here to supplement the existing data set. This information is provided in Appendix 7-16. A new updated version of Appendix 7-16 is provided.

22) R645-301-322.100 Species occurrences for the North lease area are provided by DWR, they include:

Sage-grouse (16 records), the information in table(45) suggests that impacts to this species should be addressed.

Meager Camissonia (Camissonia exilis) (1 record), the information in table suggests that There will be no impact to this species from mining in the study area.

Northern Leopard Frog (2 records),the information in table suggests that Although impacts to the local populations may be possible due to mining activities relatively close to the habitat, they area thought to be relatively minor.

ACD will need to consult with DOGM, DWR and FWS to determine if additional information or mitigation is required for the Meager Camissonia and Northern Leopard frog.

Table 45 in - VOLUME 12: Supplemental Report Vegetation & Wildlife of the North Private Lease Area has been updated with information regarding ongoing consultation for the Meager Camissonia and Northern Leopard frog.

23) R645-301-230 and R645-301-121.300 In Section 232.600 of the MRP, Dwg 2-3 is compared with Dwg 10 in Vol 11 for information on soil salvage depth. These two maps must be of the same scale to be of use as a comparison. Drawing 2-3 must show the correct proposed surface mining permit/disturbed area. Drawing 2-3 must outline the farmlands of statewide importance as shown on Soils Map 9 and indicate the acreage of farmlands of statewide importance.

Soils map 9 was updated to show no Prime Farmland east of Kanab Creek due to the lack of a "developed" irrigation supply. Changed scale on DWG 2-3 (both maps at 1:500, no updates needed).

24) R645-301-412.200 Appendices 4-3 and 4- 4 of the current MRP need to be revised to include comments of the landowners in the North lease parcel.

Appendices 4-3 and 4-4 are relevant to respective landowners in the current Coal Hollow Mine. Appendix 4-7 Management Plans for the North Private Lease has been added for land owners with in the North Private Lease.

25) R645-301-121.200 Soil Map 1 provides the locations for soil data collection. It does not portray push probe locations and piezometer locations very clearly. At least one soil sample location (13SA01) could not be found on the map For ease of review, the soils mapping locations should be coded by date of analysis, since the analyses are grouped according to date. Some of the soils analyses in Appendix C do not follow the laboratory Case Narrative and are therefore out of sequence. In addition the perimeter of the North Private Lease is vague at the south end. A better copy of Soils Map 1 must be provided and Appendix C must be organized according to case narrative. Finally sample location 13SA001 could not be found on Soil Map 1.

PDF copy of Soil Map 1 was distorted when combined for submittal. New pdf map exports were completed. Sample location 13AS01 is on Soils Map 1 and can by found by using the UTM tick marks on the sides of the map (use East 369800 on top of map North 414300 on the sides).

26) R645-302-313.200 Section 4 Vol 11 calculation of available water supply must include precipitation falling as snow during the months of interest and must include the month of April which is when grasses

and alfalfa begin to grow. The application must also make clear which sample locations were evaluated for AWC and to what depth. The available water capacity should be evaluated for the surface 50.8 cm (20 inches) which is the cut-off depth applied to all categories specified in Table 8. The Division reviewed the AWC in the upper 50 cm of those soils sampled within prime farmland on Soil Map 8, and found data was lacking for several locations. AWC for the upper 50 cm at sample locations 12SA019A, 13AS02, 13AS03, 13AS04, 13AS05, and 13AS06 fall within the Map 8 prime farmland designation and should also be evaluated for AWC and must be called out in table C-1 a of Appendix C.

Table C-1 has been updated with available water capacity data from hard copy lab report data sheets, where available. Some sample had inadequate amount to perform these tests. Appendix H added for explanation of selected May 21 to Oct 8 growing season. Available water capacity calculations for profiles (Table C-2) and soil family comparison (Table C-3) added to appendix C tables. Profile location 12AS019A was located within the GPS margin of error (approximately 8 feet) in order to install a piezometer, so the upper 8 feet of 12AS019 is representative of the upper 8 feet of 12AS019A (see pedon note at top of 12AS019A profile description).

27) R645-302-313.200 Section 4 Vol 11 must state whether there ever was historical irrigation south of the farm road.

An irrigation subsection was added in section 4 (Prime Farmland Evaluation) of the soil survey report. This new subsection discusses historical irrigation in the soil survey area with emphasis on the permit area.

28) R645-302-314.120 Appendix C contains soils laboratory analysis. The analysis of density is specified in Table 3 of the Order II soil survey, however, density information could not be found for the soils evaluated for prime farmland in Table C-1 a of Appendix C of Vol 11. Please provide the analysis of soil density in Tables C-1 a and C-1 b and specify the range of soil densities for each prime farmland soil unit in accordance with R645-302-314.120.

Bulk density data column was included in Table C. Including this column required that the coarse fragment column be hidden in order to provide enough space on the page for the bulk density column. The coarse fragment data is still available on the laboratory report data sheets.

29) R645-301-121.200 and R645-302-313, R645-302-314.120, R645-302-315.100, and R645-302-315.200 Consultation between the Division and the State Soil Conservationist (NRCS) is required for prime farmland investigation and for prime farmland soil survey, operation plan and reclamation plan. The applicant has coordinated and consulted on several occasions with the NRCS, but has not copied the Division on these communications. A very poor and partial copy of the NRCS assessment and determination of prime farmland is found in App. A. Vol 11. Please provide the Division with legible copies of all the NRCS prime farmland communications with the State Soil Scientist (Domeier, M) cited in Vol 11, in their entirety.

PDF copy of Appendix A was distorted when soils report was combined for submittal. Copies of all communications with the NRCS State Soil Scientist (Mike Domeier have been included in the updated Appendix A (NRCS Prime Farmland Evaluation).

30) R645-302-314.400 The method used to estimate biomass production was described as 'other methods' in the methods section of the Vol 12 vegetation report. The method included research with soil surveys and consultation with plant ecologist Benson. Please describe the method used and parameters evaluated by Mt. Nebo Scientific, Inc. biologists to arrive at the data provided in Table 43. Please provide productivity information by landowner.

The Methods section in - VOLUME 12: Supplemental Report Vegetation & Wildlife of the North Private Lease Area October 2015. Page 4 has been updated with additional information describing the method utilized. Also, additional information has been added to Table 43 in -VOLUME 12: Supplemental Report Vegetation & Wildlife of the North Private Lease Area October 2015.

31) R645-302-315 R645-302-315 makes clear that the authority with regard to prime farmland soils is the Secretary of Agriculture through the Utah NRCS State Soil Conservationist. The Division has initiated consultation with the State Conservationist per R645-301-315.100 and R645-301-315.200. Prior to approval, the State Conservationist is required to review and comment on the details of the proposed plan.

Included statement in chapter 2 under 317.200

32) R645-301-725 The application must expand upon the statement on p. 14, Appendix 7-16, ''It is common for Kanab Creek to have little or no discharge south of the tract during much of the year" by providing baseline data and graphs/charts/tables and a statistical analysis that clearly and concisely presents the data and supports these findings.

The requested information has been added to Appendix 7-16. A new updated version of Appendix 7-16 is provided.

33) R645-301-725, R645-301-728 The application does not meet the minimum hydrologic requirements of providing detailed hydrologic and geologic baseline cumulative impact area information on the alluvial aquifer. The application needs to provide a greater in depth analysis of the unconfined aquifer in the alluvial sediments within and adjacent to the Permit area. The Permittee needs to analyze the horizontal and vertical hydraulic conductivity of the aquifer at multiple areal locations in the permit area and at multiple vertical depths within the aquifer. The methodology of the study will be supported with calculations, plan-view and cross-sectional maps, and a detailed narrative of all procedures. A pumping drawdown test will be performed in the alluvial aquifer at multiple locations and at multiple screened interval depths. These results will be used to determine additional baseline information on the alluvial aquifer that includes but is not limited to the following variables: transmissivity (T), hydraulic conductivity (K), storativity (S), and specific yield. The application will need to provide the raw data collected in the field and the analyzed results with supporting graphs and charts of all slug-tests and pumping-tests performed. All analyses must specifically detail any assumptions made to justify the

chosen test method for the aquifer tests and detail any assumptions used in the equations for calculating all results. The book Construction Dewatering and Groundwater Control: New Methods and Applications By Powers and Herridge (2007) recommends the piezometer screen intervals should be located in the same stratigraphic horizon as the well screen and where the aquifer is relatively homogeneous for pumping tests. In order to provide long term monitoring data, the wells will be located so they will not be destroyed by mining activities.

ACD is currently preparing to implement the alluvial groundwater drilling plan and aquifer study in the Kanab Creek valley in the North Private Lease area as requested by the Division. ACD plans to commence those activities shortly. However, the completion of these activities will likely require a substantial amount of time. Therefore, ACD requests that the Division grant approval for mining in proposed mine pits 1-8 and Highwall Trench 1 (which are located in upland areas that will not substantially disturb saturated alluvial sediments in the Kanab Creek Valley), with approval for mining in the subsequent mine pits being granted after successful completion of the drilling program and alluvial groundwater study in the Kanab Creek valley.

34) R645-301-725; R645-301-728 In order to better determine the probable hydrologic consequences of the operation upon the quality and quantity of surface and ground water in the permit and adjacent areas a Gain/Loss study will need to be done on Kanab Creek as it passes through the permit area.

The results of a gain/loss study on Kanab Creek is provided in Appendix 7-16. A new updated version of Appendix 7-16 is provided.

35) R645-301-725; R645-301-728 The total volume of surface and groundwater outflow from the permit area will be calculated at the location of the monitoring well matrix just south of the permit area (See Groundwater Monitoring Plan for a complete description on the well matrix). The surface flow will be combined with the volume of groundwater discharged through the monitoring well matrix (cross-sectional area of alluvial aquifer perpendicular to flow, hydraulic conductivity, hydraulic gradient, transmissivity, etc.) to determine the total volume water outflow from the permit area. The methodology, calculations, a geologic cross-section(s), and stream cross-section must be given to support how each parameter variable is determined and ultimately used to determine the final outflow variable.

ACD is currently preparing to implement the alluvial groundwater drilling plan and aquifer study in the Kanab Creek valley in the North Private Lease area as requested by the Division. ACD plans to commence those activities shortly. However, the completion of these activities will likely require a substantial amount of time. Therefore, ACD requests that the Division grant approval for mining in proposed mine pits 1-8 and Highwall Trench 1 (which are located in upland areas that will not substantially disturb saturated alluvial sediments in the Kanab Creek Valley), with approval for mining in the subsequent mine pits being granted after successful completion of the drilling program and alluvial groundwater study in the Kanab Creek valley.

36) R645-301-726 The application needs to provide a groundwater model of the unconfined alluvial aquifer within and adjacent to the permit area. The alluvial aquifer will be modeled in three phases: 1)

Pre-mining, 2) Active mining, 3) Post-mining reclamation. Baseline data will be used to model the pre-mining groundwater conditions of recharge and discharge zones as well as no-flow boundaries. The pre-mining phase of the alluvial aquifer model will be calibrated to specific criteria, including but not limited to, recharge rates and discharge rates; locations and/or areas of recharge, discharge, and no-flow boundaries; seasonal fluctuations in the water table; and vertical and horizontal heterogeneities that influence/determine flow paths and equipotential lines. The active mining phase will model all associated active mining (pit advancement, highwall mining, etc.) at six month intervals during the planned 4 years of active mining. The model will predict groundwater drawdown in the surrounding alluvial aquifer as pits advance below the water table. The model will show the lateral extent of the radius of influence associated with the maximum expected hydraulic gradient for each six month interval. The active mining model will estimate the volume of water pumped from the alluvium during each six month interval. A post-reclamation groundwater model will be done on the backfilled pits and the surrounding undisturbed alluvial aquifer's response to these mined through areas as the third phase of modeling. The post-reclamation model will calculate the groundwater recharge rate of the backfill and of the undisturbed alluvial aquifer. The model will provide an estimate of the time it will take the alluvial aquifer to reach a pre-mining recharge and discharge equilibrium rate and discuss any potential affect this may have on the flow in Kanab creek in the meantime.

There is nothing in the rule cited that requires the creation of a numeric groundwater model as part of the mine permit application. As indicated in the rule, the applicant may choose to incorporate modeling techniques, interpolation or statistical techniques in the application; however, the rule indicates that the Division may find that the use of actual surface- and ground-water information will be required at each site rather than projections obtained from the use of modeling. ACD will utilize a suitable analytical technique to further refine the probable hydrologic consequences of mining in the Kanab Creek alluvium, which may or may not include the use of a numerical model.

The analysis will utilize the findings of the drilling and aquifer testing program requested by the Division. ACD is currently preparing to implement the alluvial groundwater drilling plan and aquifer study in the Kanab Creek valley in the North Private Lease area as requested by the Division. ACD plans to commence those activities shortly. However, the completion of these activities will likely require a substantial amount of time. Therefore, ACD requests that the Division grant approval for mining in proposed mine pits 1-8 and Highwall Trench 1 (which are located in upland areas that will not substantially disturb saturated alluvial sediments in the Kanab Creek Valley), with approval for mining in the subsequent mine pits being granted after successful completion of the alluvial groundwater study in the Kanab Creek valley and associated PHC refinement for the Kanab Creek alluvium.

37) R645-301-726 For each of the three modeling phases, the application will provide professionally certified plan view maps and cross-sections, a supporting narrative with calculations, and any appropriate and relevant data that was used in order to fully convey the accuracy and precision of the model. Each phase and interval of the groundwater model will must show a West-East A-A' cross-section that includes but is not limited to the parameters: equipotential lines; flow lines; the water table; no-flow boundaries; the radius of influence/cone of depression associated with the maximum hydraulic

gradient in the active mining areas; and the location and flow response of Kanab Creek to the Groundwater radius of influence.

There is nothing in the rule cited that requires the creation of a numeric groundwater model as part of the mine permit application. As indicated in the rule, the applicant may choose to incorporate modeling techniques, interpolation or statistical techniques in the application; however, the rule indicates that the Division may find that the use of actual surface- and ground-water information will be required at each site rather than projections obtained from the use of modeling. ACD will utilize a suitable analytical technique to further refine the probable hydrologic consequences of mining in the Kanab Creek alluvium, which may or may not include the use of a numerical model.

The analysis will utilize the findings of the drilling and aquifer testing program requested by the Division. ACD is currently preparing to implement the alluvial groundwater drilling plan and aquifer study in the Kanab Creek valley in the North Private Lease area as requested by the Division. ACD plans to commence those activities shortly. However, the completion of these activities will likely require a substantial amount of time. Therefore, ACD requests that the Division grant approval for mining in proposed mine pits 1-8 and Highwall Trench 1 (which are located in upland areas that will not substantially disturb saturated alluvial sediments in the Kanab Creek Valley), with approval for mining in the subsequent mine pits being granted after successful completion of the alluvial groundwater study in the Kanab Creek valley and associated PHC refinement for the Kanab Creek alluvium.

38) R645-301-727 The application needs to discuss any potential disruption of the return flow from the irrigated field located to the north of the permit area and up-gradient of planned open-pits.

The requested discussion has been added to Appendix 7-16. A new updated version of Appendix 7-16 is provided.

39) R645-301-728 The application will provide calculations and a supporting analysis of the cone of depression associated with each open-pit and highwall auger hole within the North Private lease. This analysis must be supported with cross-sectional and plan view maps, tables, and graphs. The analysis must provide a discussion on the response of flow in Kanab if the cone of depression is expected to extend to and/or beyond the creek. This analysis must also provide a discussion on any stratigraphic units encountered in drill holes that may have a stronger influence on the aquifer's response to drawdown. A discussion must be provided on any interruption of flow along the length of Kanab Creek that may result in material damage to the water resources within and adjacent to the permit area.

The analysis will utilize the findings of the drilling and aquifer testing program requested by the Division. ACD is currently preparing to implement the alluvial groundwater drilling plan and aquifer study in the Kanab Creek valley in the North Private Lease area as requested by the Division. ACD plans to commence those activities shortly. However, the completion of these activities will likely require a substantial amount of time. Therefore, ACD requests that the Division grant approval for mining in proposed mine pits 1-8 and Highwall Trench 1 (which are located in upland areas that will not substantially disturb saturated alluvial sediments in the Kanab Creek Valley), with approval for mining in the subsequent mine

pits being granted after successful completion of the alluvial groundwater study in the Kanab Creek valley and associated PHC refinement for the Kanab Creek alluvium.

40) R645-301-724.310, R645-301-731 Additional groundwater monitoring wells must be installed in the alluvial aquifer within and adjacent to the North Private lease and positioned so as not to be destroyed by mining activities. The intent of these wells is to monitor any impact that active mining may have on the quantity and quality of groundwater and surface water in Kanab Creek within and adjacent to the permit area. The alluvial aquifer groundwater must be monitored at multiple vertical depths and multiple areal locations in three zones: 1) just north of the permit area, 2) on both the east and west sides of Kanab Creek in-between the creek and the active mine workings, and 3) just south of the permit area. The methodology of selecting the specific well locations and identifying the screened interval lengths and depths based on relevant well log data must be outlined. When groundwater is measured at multiple vertical depths the wells will be tightly grouped, such as the C- and S-well groups found in the southern permit area. At a minimum the aquifer will be screened: 1) across the current existing water table, 2) roughly mid-depth in the aquifer, 3) at the base of the aquifer, but not within the underlying bedrock. The roughly mid-depth monitoring wells will be screened across gravel lenses with the highest permeability. The specific locations for these monitoring wells are:

ACD is currently preparing to implement the alluvial groundwater drilling plan and aquifer study in the Kanab Creek valley in the North Private Lease area as requested by the Division. ACD plans to commence those activities shortly. However, the completion of these activities will likely require a substantial amount of time. Therefore, ACD requests that the Division grant approval for mining in proposed mine pits 1-8 and Highwall Trench 1 (which are located in upland areas that will not substantially disturb saturated alluvial sediments in the Kanab Creek Valley), with approval for mining in the subsequent mine pits being granted after successful completion of the drilling program and alluvial groundwater study in the Kanab Creek valley.

41) 1) Groundwater monitoring wells must be installed within the alluvial aquifer directly north of the permit area and on the east and west banks of Kanab Creek. The wells will be no more than 100 yards from Kanab Creek and no more than 100 yards north of the permit area.

ACD is currently preparing to implement the alluvial groundwater drilling plan and aquifer study in the Kanab Creek valley in the North Private Lease area as requested by the Division. ACD plans to commence those activities shortly. However, the completion of these activities will likely require a substantial amount of time. Therefore, ACD requests that the Division grant approval for mining in proposed mine pits 1-8 and Highwall Trench 1 (which are located in upland areas that will not substantially disturb saturated alluvial sediments in the Kanab Creek Valley), with approval for mining in the subsequent mine pits being granted after successful completion of the drilling program and alluvial groundwater study in the Kanab Creek valley.

42) 2) Groundwater monitoring wells must be installed on the east and west banks of Kanab Creek. These wells will be installed between active mining and the creek. There will be at a minimum three

groundwater monitoring locations that will be roughly equally spaced along the length of the creek through the permit area.

ACD is currently preparing to implement the alluvial groundwater drilling plan and aquifer study in the Kanab Creek valley in the North Private Lease area as requested by the Division. ACD plans to commence those activities shortly. However, the completion of these activities will likely require a substantial amount of time. Therefore, ACD requests that the Division grant approval for mining in proposed mine pits 1-8 and Highwall Trench 1 (which are located in upland areas that will not substantially disturb saturated alluvial sediments in the Kanab Creek Valley), with approval for mining in the subsequent mine pits being granted after successful completion of the drilling program and alluvial groundwater study in the Kanab Creek valley.

43) 3) Groundwater monitoring wells must be installed downstream of the permit area no more than 140 yds downstream of the county road where it crosses Kanab Creek. The monitoring wells will be placed in the gravel alluvium (050 > 1 cm) at point where the quantity of surface flow in Kanab Creek is readily and accurately measured. A minimum of six wells will be installed in the bottom of the Kanab Creek channel floodplain in a 3 x 2 gridded matrix. The matrix will be positioned to have both the three well arrays running along cross-sections that are perpendicular to flow in Kanab Creek. Both three well arrays will be spaced no more than 15 yards apart. The wells will be fully screened from the water-table to the bottom of the alluvial sediments resting on the bedrock. The three wells along the perpendicular array will be equally spaced along the cross-section in the bottom of Kanab Creek's floodplain channel. Both three well arrays will have one well located on the opposite and narrower bank as measured along the cross-section.

ACD is currently preparing to implement the alluvial groundwater drilling plan and aquifer study in the Kanab Creek valley in the North Private Lease area as requested by the Division. ACD plans to commence those activities shortly. However, the completion of these activities will likely require a substantial amount of time. Therefore, ACD requests that the Division grant approval for mining in proposed mine pits 1-8 and Highwall Trench 1 (which are located in upland areas that will not substantially disturb saturated alluvial sediments in the Kanab Creek Valley), with approval for mining in the subsequent mine pits being granted after successful completion of the drilling program and alluvial groundwater study in the Kanab Creek valley.

44) 724.31 O; R645-301-731 An additional surface water monitoring point on Kanab Creek south of the permit area will be added to the surface-water monitoring plan. The surface water monitoring point will be along one of the two cross-sections in the groundwater monitoring well matrix located south of the permit area. This surface water monitoring point will be at a point where the stream is confined to one channel where by the quality and quantity of flow in Kanab Creek is readily and accurately measured. This surface water monitoring point will be monitored quarterly through active mining and reclamation of the site.

The existing Kanab Creek monitoring site Kanab @ C.R. is located at the probable location of the proposed south well matrix. This existing monitoring point should be satisfactory for the use proposed

by the Division. Thus, no new monitoring site is proposed. If the location of Kanab @ C.R. proves after the completion of the well drilling program to not be suitable, a new monitoring point will be established at that time.

45) R645-301-358.400, R645-301-521.100 through-521.130, R645-301-731.610 and R645-301-121.200 The application does not meet the minimum requirements of R645-301-358.400, R645-301-521.100 through-521.130, R645-301-731.610 and R645-301-121.200 by showing disturbance shading crossing into Kanab Creek Stream channel in Drawings 5-46 and not providing any cross sections of the existing arroyos geomorphology that will be destroyed during mining operations.

The stream buffer area, labeled as Undisturbed Kanab Creek (21.3 Acres) shows the associated area for a 100 ft. buffer from the stream center line, however, due to the extensive erosion and incised channel of Kanab Creek, some of the boundary of Year 1, Year 3 disturbance areas, and Undisturbed NE and N cross below the Ordinary High Water Mark on drawing 5-43. Kanab Creek is considered a water of the U.S. and fill placed below the OHWM would require USACE approval. In addition to the joint approval agency required, the reclamation of the incised channel slopes of Kanab Creek would require new engineering designs to achieve a stable slope post disturbance.

The Permittee shall provide:

• Drawing 5-46 edited to show all disturbance and undisturbed shadings outside the channel of Kanab Creek

• The corresponding acres to each of the labeled areas will also be updated on all relevant drawings throughout the MRP.

• Cross Sections of existing arroyos to demonstrate the existing geomorphology to be able to reconstruct the arroyos post mining operations to stable conditions .

All planned disturbance has been withdrawn from the crest of the Kanab Creek drainage with the exception of where diversion ditches bring undisturbed drainage into Kanab Creek. OHWM is an refers to the level at which a stream ordinarily flows and should not be confused with the crest of the drainage. Where disturbance to wetlands are to occur, coordination with the USACOE has been initiated.

46) R645-301-411.141.1 The Permittee must provide maps for the North Private Lease area that "clearly show" the boundaries ... and locations of any cultural and historical resources listed or eligible for listing in the National Register of Historic Places and known archaeological sites within the permit and adjacent areas. These are confidential in nature, but should be included in the appropriate Appendix. This includes, but is not limited to, a map showing the area inventoried during efforts to identify cultural resources within the North Private Lease area, a map showing identified sites in relation to the proposed lease area boundaries, etc.

Exhibit 4-5 for the Current Coal Hollow Mine and Exhibit 4-6 for the North Private Lease depicting cultural and historic resources have been added to Appendix 4-1 and Appendix 4-7 respectively

47) R645-301-358.400, R645-301-521.100 through-521.130, R645-301-731.610 and R645-301-121.200. The application does not meet the minimum requirements of R645-301-521.150 due to missing cross section drawings detailing the slope measurements utilized to take into account the natural variation in the slope to provide accurate representation of the range of natural slopes and reflect the geomorphic differences of the area being disturbed as represented in the large scale Drawing 5-45. Drawing 5-45 details the existing surface with four foot contours but does not detail the Middle Wash, West wash, in addition to the arroyo east of Kanab Creek that will be disturbed by mining operations. Drawing 5-71 does not show any engineered stabilized banks that will meet the minimum requirements of R645-301-358.400, R645-301-521.100 through-521.130, R645-301-731.610 and R645-301-121.200.

The Permittee will submit detail cross sections showing the existing geomorphology of any wash or arroyo that will be disturbed due to mining operations so that the reclamation of the arroyos will be able to match the a reasonable extent the existing geomorphology in detail cross section of Drawing 5-72.

Per landowner agreements, the west and center drainages will not be reconstructed. Post mining topography is shown on Drawings 5-74 and 5-75.

48) R645-301-728; R645-301-724.310 The application needs to provide maps, geologic and hydrogeology cross-sections, and a supporting narrative of the probable hydrologic consequences of highwall mining on the alluvial aquifer in the permit area. This includes specifically detailing the alluvial scour zones into the coal seam in the southern portion of the permit area. As well as areas where the alluvial sediments rest on top of the coal seam.

The subsurface geometry of the bedrock basement and overlying alluvial deposits will be further defined using the proposed alluvial drilling program. ACD will utilize this information to produce additional maps, geologic and hydrogeology cross-sections and a supporting narrative of the probable hydrologic consequences of highwall mining beneath saturated Kanab Creek alluvium. ACD is currently preparing to implement the alluvial groundwater drilling plan and aquifer study in the Kanab Creek valley in the North Private Lease area as requested by the Division. ACD plans to commence those activities shortly. However, the completion of these activities will likely require a substantial amount of time. Therefore, ACD requests that the Division grant approval for mining in proposed mine pits 1-8 and Highwall Trench 1 (which are located in upland areas that will not substantially disturb saturated alluvial sediments in the Kanab Creek Valley), with approval for mining in the subsequent mine pits being granted after successful completion of the drilling program and alluvial groundwater study in the Kanab Creek valley.

49) R645-301-722.500 The application must provide photos along the longitudinal length of all geomorphic features (streams, ephemeral channels, seeps, ponds, etc.) that will be disturbed or potentially disturbed by mining activities. These features include, but are not limited to: Kanab creek and all the major gullies within the permit area that will be disturbed. These photos will be referenced during reclamation phases.

Utah Adm. R. 645-301-722.500 requires slope measurements or contour maps to show the existing configuration along with measurements of natural variations in slope to show the range of

natural slopes and geomorphic differences of the area to be disturbed. The Division suggests that photos of the area will be used for post mining reclamation. Photographs are not required by the rule which clearly states that the operator provide measurements or contour maps to reflect a range of slopes and does not require that the land surface configuration be reclaimed to exact original contour, only to "approximate original contour."

50) R645-301-722.500 The application will provide measured cross-sections and longitudinal profiles of the premining geomorphic landscape

Utah Adm. R. R645-301-722.500 does not require measured cross sections and longitudinal profiles of premining geomorphic landscape. Alton Coal Development ("Alton") has already conducted an aerial flyover of this area. No further information is required.

51) R645-301-724.300 The application must include a plan view map of the Smirl coal seam line boundary, including but not limited to the surficial coal outcroppings and any Quaternary Alluvium scour zones that occur underground.

The Smirl coal seam line boundary is plotted on a plan view map on Figure 6 of Appendix 7-16. The projected locations of Smirl coal seam scoured zones are also plotted on Figure 6. The scour zone locations will be further refined through the proposed Kanab Creek valley alluvium drilling program.

52) R645-301-731.700 The Permittee has added an additional surface water monitoring point along Kanab creek about halfway through the permit area or roughly halfway between NLP-5 and NLP-11. This requires the application to update the water monitoring map needs to have the updated monitoring point in center of permit area along Kanab Creek.

The water monitoring map has been updated to show the new monitoring location on Kanab Creek.

53) R645-301-731.700 Figure 18 in Appendix 7-16 shows water level contours for the alluvial groundwater system. In order to easily interpret this map it also needs to show the high and low surface to groundwater values at each well site. This map needs to include equipotential lines and flow lines of groundwater movement as it enters, passes through, and exits the permit area.

A new figure (Figure 21) has been added to Appendix 7-16 that includes the requested information. A new updated version of Appendix 7-16 is provided.

54) R645-301-512.100 All required Hydrologic and Geologic plan view maps and cross-sections in Appendix 7-16 need to be professionally certified

All required hydrologic and geologic plan view maps and cross-sections in Appendix 7-16 are professionally certified.

55) R645-301-731.700; R645-301-512.100 The cross-sectional view of the alluvial groundwater system in Appendix 7-16 needs to portray seasonal differences of head and be based upon groundwater monitoring data. This map must be professionally certified.

The cross-sectional view of the alluvial groundwater system in Figure 7 of Appendix 7-16 has been modified to portray seasonal differences of head. A new updated version of Appendix 7-16 is provided.

56) R645-301-731.700 For all maps showing contours in Appendix 7-16, the contour interval needs to be stated in the legend.

A notation of the topographic map contour interval has been added to the requested maps in Appendix 7-16. A new updated version of Appendix 7-16 is provided.

57) R645-301-731.700 The application will provide a map of the location of wells that will be mined through in the permit area. The application will commit to a timetable of when these wells will be permanently closed and abandoned.

A map (Figure 20) has been added to Appendix 7-16 with this information. The text of Section 731 of Chapter 7 of the MRP has been modified to indicate the commitment to the closure and abandonment of these wells.

58) R645-301-411.144 The Permittee must follow the process for the development, approval, and implementation of an appropriate treatment and mitigation plan to address Adverse Effects to sites 42KA3077 and 42AK3097, and to ensure No Adverse Effects to site 42KA6088.

A section (411-144) has been added with a commitment to follow the process for the development

59) R645-301-330 The information in the application is not adequate to meet the requirements of this section of the regulations. Prior to approval the following information is required in accordance with R645-301-330;

ACD will need to provide verification of completion 1000 acres of sage grouse mitigation for the North Lease area;

ACD will need to consult with the Division to determine the specific criterion for implementing the following components of the sage grouse management plan for the North lease application: Employee Observations; Monthly Bird Surveys; GPS Collaring and Monitoring; Noise Detection and Sound Assessment; Habitat Mitigation; Vegetation Improvements and Monitoring and; Predator Control Activities.

Additional information may be required by DWR an or FWS.

Letters were forwarded from the Public Lands Policy Office PLPCO (on behalf of DWR) and the Fish and Wildlife Service. Alton Coal Development in consultation with John Harja of the PLPCO on October 7th discussed DWR comments and verified that the continued practice of completing mitigation for planned disturbances for the following year in the preceding year was an acceptable practice, thus completing 200 plus acres of mitigation prior to the planned 50 acres of disturbance (4:1 mitigation) in the first year of mining and so on, is an acceptable practice to meet the required 1,000 acres of total mitigation required for the North Private Lease.

60) R645-302-317.400 The plan states in Section 231.400 that Dwg 2-4 provides details for soil salvage by horizon in the prime farmland soils. But, there is little information provided for the prime farmland soils on Dwg 2-4. Section 317.400 describes salvage by horizon and stockpiled separately by landowner. In accordance with R645-302-317.400, the plan must state where the three prime farmland soil stockpiles for each landowner will be placed. The plan must also include stockpile and protection of prime farmland soils on the east side of Kanab Creek within the permit/disturbed area.

Drawing 2-4 has been updated with topsoil stockpiles for individual landowners for prime farmland with protection measures depicted.

61) R645-302-317.440 The plan must include descriptions for stabilization of soil stockpiles within 30 days

Specifications for stockpile stabilization were copied from R645-234.200 and adapted to the Prime Farmland conditions

62) R645-301-231.100 The soil salvage plan must include special handling for farmlands of statewide importance as described in the Order II Soil Survey. The soil salvage plan described in Section 317.432 must specify the equipment used to achieve the salvage of the A and 8/C horizons. The plan must include the consultant's recommendation that salvage depths should be monitored in close consultation with a Certified Professional Soil Scientist

Inserted the following statement in R645-317.432:

"Removal and stockpiling of all Prime Farmland soil horizons will be directly monitored by a Certified Professional Soil Scientist."

63) R645-301-231.100 Drawing 2.3 Soil survey provides a chart of soil salvage depth. Map Unit J is scheduled for a 7 inch salvage depth. However, Section 5 of Vol 11 clearly indicates that surface soils in map unit J are extreme in pH and should not be salvaged. Carbonate content greater than 30% at the surface is called out for 14 profile locations and is combined with clay textures and poor AWC, but the soil salvage map does not reflect this fact. The Permittee should review the information in Volume 11 and ensure that Dwg 2-3 salvage depths reflect that best available information.

Surface pH in profile 12AS024 is 9.1 in the upper 18 cm and ranges from 9.1 to 9.4 in the underlying soil. The estimated topsoil and subsoil salvage depths for map unit J in Table 14 take this into account. Unacceptable pH soils will be salvaged as subsoil. The majority of the map unit J area is within the 100 foot buffer on the centerline of Kanab Creek and will not be disturbed. DDD family soils are not the dominant soil in map J. This statement was corrected in line at bottom of page 43. Inserted paragraph at end of Section 5 before Table 14 discussing salvage of Unacceptable pH topsoil from map unit J. Salvage of all topsoil should be monitored by a Certified Professional Soil Scientist.

64) R645-301-231.400 Drawing 2-4 describes three temporary soil stockpiles to be used for live haul. By definition stockpiled materials are not being live-hauled. Therefore, the plan should include measures to be taken to stabilize any stockpiled soils, including seed and siltation structures.

Drawing 2-4 has been revised to correctly between live hauled and stockpiled soils.

65) R645-301-232.500, Section 232.720 R645-301-232.500, Section 232.720 describes the salvage of subsoil from adjacent soil units where subsoil is inadequate from soil map units A1, A2, A3, B, C, D and K. Section 317.420 also describes increased salvage depths in prime farmland soils to make up for a deficit of subsoil on soil map units A 1, A2, N and D which are limited by the depth to Tropic Shale. In both cases and in both sections, the plan should call out the depth of salvage and the map unit area to be salvaged to produce the volume required and indicate the location of salvage on a map.

Topsoil replacement edited to 13 inches in 232.200, 232.300, and 240. There will be an average topsoil depth of 13 inches and 31 inches of subsoil for an average total depth of 44 inches. Top 6 inches of overburden will be sampled to determine suitability, so that there is total reclamation profile of at least 48 inches.

66) R645-301-231.400 and R645-301-232.600 Chapter 2 should provide the timing for topsoil and subsoil salvage by area shown on Dwg 2-4. Chapter 2 must state the volumes to be salvaged and stored in stockpiles and a proposed method of tracking volumes salvaged, stockpiled and replaced on a weekly basis.

Drawing 2-4 has been updated along with drawings 5-48, 5-49 and 5-50 which show the sequence of topsoil stockpile salvage.

67) R645-302-317.500, Section 317.400 Section 317.400 describes sampling every 2 acres of prime farmland soils for analysis of several parameters. If the purpose of this sampling is to comply with R645-302-317.500, then the sampling should take place at final reclamation and this should be clear in the plan

Clarified that sampling of Prime Farmland area will be done before salvaging and also after restoration.

68) R645-301-330 The application needs to include the following information:

A monitoring frequency for the proposed reference areas V03 and V06 during active mining and the reclamation liability period; An alternative reference area for site sagebrush reference area V03;

Monitoring frequencies for reference areas have been added to Page 47 of Standards for Revegetation Success in - VOLUME 12: Supplemental Report Vegetation & Wildlife of the North Private Lease Area October 2015.

A vegetation sampling regimen for the riparian wetland vegetation communities located along Kanab creek below the southern end of the permit boundary (to be established in consultation with DOGM) and; A commitment to mitigate impacts to these wetland riparian vegetation communities located along Kanab creek below the southern end of the permit boundary.

Page 48 of "Standards for Revegetation Success in - VOLUME 12: Supplemental Report Vegetation & Wildlife of the North Private Lease Area October 2015" has been expanded to include a monitoring site for these communities.

69) R645-301-527.220, R645-301-358.400, R645-301-521.100 through-521.130, R645-301-731.610 and R645-301-121.200 The minimum requirements of R645-301-527.220 are not met due to no change within the MRP to detail how the natural drainage ways affected by coal mining operations will be reclaimed to meet requirements of R645-301-358.400, R645-301-521.100 through-521.130, R645-301-731.610 and R645-301-121.200. The Permittee will provide engineering drawings detailing that the reclaimed natural drainage ways will be reconstructed to meet the above requirements.

Per landowner agreements, the west and center drainages will not be reconstructed. Post mining topography is shown on Drawings 5-74 and 5-75.

70) R645-301-521.180, -526, -527 .210, -534.150 R645-301-521.180, -526, -527 .210, -534.150 are not met due to missing culvert labels on Drawing 5-4 7 of the facilities layout through the North Lease Area. No engineering analysis of the sizing of the culverts could also be located in Appendix 5-11 or 5-12. Culverts utilized within a disturbance area must meet R645 regulations, simply matching County DOT culverts is not a design analysis.

Drawing 5-47 has been updated with culvert labels. Appendix 5-12 has been update with information on culvert sizing and analysis.

71) R645-301-742.423 It is unclear how the runoff from the haul road will be handled. The Drawing 5-64 Sediment Control Area Watershed does not show the Kanab Creek crossing within any of the disturbed watersheds.

Drawing 5-64, now drawing 5-65, has been updated

72) R645-301-742.423.1; R645-301-742.423.5 Culvert sizing lacks supporting engineering calculations. No design calculations are provided for Drainage control along roads to safely pass a 10- year 6-hour rain event.

Appendix 5-12 has been updated with design calculations for drainage control along roads. All calculations for culverts are in appendix 5-12.

73) R645-301-512 .. 240, R645-301-533.110 through 533. 7.14 The application does not meet the minimum standards of R645-301-512 .. 240, R645-301-533.110 through 533. 7.14 due missing information within the text presented in Chapter 5 Section 512.240 and Section 526.300. R645-301-533.110 states coal mine waste impounding structures shall have a minimum static safety factor of 1.3 for a normal pool with steady sate seepage saturation conditions. The aforementioned sections reference Appendix 5-11 and Appendix 5-12, however, neither appendix contains a slope stability analysis for Sediment impoundment 5 through 7 as detailed in Drawings 5-65 through 5-67.

The Permittee will amend text within Chapter 5 Section 512.240 to clarify that a detailed geotechnical analysis was only conducted for the south Coal Hollow private lease in and the report can be found in Appendix 5-1. Text will be added to the section stating how the detail field investigation that was

conducted for the North Private Lease found the soils to be representative of the south lease negating the need for another detailed geotechnical analysis, specific slope stability.

Text has been updated in Section 512.240

74) R645-301-512.210, -528.310, -535 The application does not meet the minimum requirements of R645-301-512.210, -528.310, -535 due to no new slope stability calculations provided for the North Lease temporary excess spoil pile and no description of the design for the North Lease spoil placement and disposal sequencing. For example, Chapter 5 Section 512.210, 521.143 and various other sections call out that a professional engineer has certified the designs of the North Private Lease temporary excess spoil pile according to 535.100 and that the analysis can be viewed in Appendix 5-11. Appendix 5-11 is the GEM geotechnical report simply references the original slope stability report for the design of the southern Coal Hollow 150 ft. tall excess spoil pile. Stability factors stated throughout the MRP are for the design of the excess spoil pile detailed in the TGE report, not the final design of the Excess spoil pile or the temporary excess spoil pile located in the North Private Lease. The Permittee will submit text to detail the design, placement, and disposal sequencing of the North Lease temporary spoil pile with applicable designs and slope stability analysis as required by R645-301-535.

GEM performed updated stability modeling and has updated Appendix 5-11

75) R645-301-528 R645-301-528 is not met due to updated overburden calculations within Chapter 5 Section 528 detailing the volumes. The MRP does not detail what swell factor is utilized and the geotechnical report in Appendix 5-11 details a new the shrink factor of 15%. The Permittee will demonstrate the volumes with the new shrink factor of 15% or show details that the current volumes utilize 15% shrink factor.

Same as 141, verify text fixes in all sections

76) R645-301-742.200 Chapter 7 does not reference any North Private Lease drawings in this section. It is important to reference the North Private lease in this section to more easily navigate the MRP.

Text has been added to reference the North Private Lease drawings

77) R645-301-731-727, 731.800 The application proposes to use the production well located in the south lease to offset and or replace any interruption of groundwater and/or surface water sources within or adjacent to the North Private lease. While this may be an acceptable plan, there are multiple deficiencies within the permit application that need to be addressed. The Permittee lacks establishing the extent of the disturbance or potential material damage to down-stream water rights holders. The application must establish a point along Kanab Creek where any quantifiable impact to the hydrologic balance by mining activities would be negligible or a flow off-set point, such as when the creek reaches a large river, a lake, a reservoir, etc. The water rights potentially impacted along Kanab Creek and a sum of the total acre-feet for these water rights must be given from the flow off-set point up-stream to the permit area.

The well driller's report for this well shows that is has a pumped capacity of 150 gpm. Page 7-24 of the MRP shows that likely impacts to appropriated water sources are limited to interruption of flow at springs within the permit area drawing from the alluvial aquifer. The total maximum flow from these springs is 35 gpm. The existing well is capable of supplying this amount. The rule cited (R645-301-731.800) requires that only the baseline hydrologic data required elsewhere in the rules is to be used in evaluating a future claim for water replacement. The Utah Supreme Court has ruled that the water replacement requirement does not operate prospectively at the permit application stage, but only when a water user has demonstrated that its water supply has been affected by the mine. See Castle Valley S.S.D. v. Bd. Of Oil, Gas & Mining, 938 P.2d 248, 252-53 (Utah 1996). The change application for this water right has already been approved.

78) R645-301-731-727, R645-301-731.800 The application needs to demonstrate the production well is capable of replacing all affected water rights to the flow off-set point. This includes but is not limited to calculating the volume held in the aquifer and providing a narrative with supporting evidence of aquifer's hydrogeologic characteristics, recharge rates, and discharge rates. The application needs to commit to a timeline of procedures the Permittee will take to begin replacing water rights. This will include a timeline for filing the change application on the water right held by Alton Town Incorporated.

Establishing a downstream offset point on Kanab Creek exceeds what is required by the rule cited. In any event, Alton has already established the downstream extent of potential material damage by indicating in the PHC and on page 7-21 of the MRP that no adverse effect is expected outside the permit area. It has also identified every water-right holder who may be affected, as required by R645-301-727.

79) R645-301-731-727, R645-301-731.800 The application will provide a threshold value at multiple water monitoring sites (wells and streams) for determining when water right replacement will commence.

Alton need not compute a "threshold value" at which water-supply replacement will commence. Replacement of water supplies is triggered solely by a water-user's proven claim that his source has been affected by the mine. The Division would severely limit Alton's legal rights by requiring Alton to predetermine these facts. See Castle Valley S.S.D., 938 P.2d at 253.

80) R645-301-731.211 The application must provide a detailed discussion of how it will deal with alluvial groundwater intercepted in open pits and provide a monitoring plan for water discharged into the open-pits.

Text was added to Appendix 7-16 clarifying that the dewatering of mine pits in the North Private Lease will be performed in a manner similar to what has been used successfully at the existing Coal Hollow Mine area and that if groundwater inflows to a mine pit exceed one cfs in total, the Division will be notified.

81) R645-301-731.112.; R645-301-731.121; R645-301-731.122; R645-301-731.611 The application needs to provide a detailed narrative and map of the pit backfill sequence in six-months intervals.

Backfill follows mining within 60 days or 1500 lf thus the sequence is shown on drawing 5-53

82) R645-301-731.211 The application must provide a detailed discussion of how it will deal with alluvial groundwater intercepted in open pits and provide a monitoring plan for water discharged into the open-pits.

Text was added to Appendix 7-16 clarifying that the dewatering of mine pits in the North Private Lease will be performed in a manner similar to what has been used successfully at the existing Coal Hollow Mine area and that if groundwater inflows to a mine pit exceed one cfs in total, the Division will be notified.

Any potential discharges of groundwater from the mine pits will be regulated through the mine's UPDES discharge permit, administered through the Utah Division of Water Quality. Discharges of water with TDS concentrations exceeding the UPDES permit limits are not allowed.

A new updated version of Appendix 7-16 is provided.

83) R645-301-727 The application must provide a narrative of how mining activities will to slow or stop any material damage that may occur to flow rates along Kanab Creek above within and below the permit area.

Alton has provided all of the information necessary under the rule cited. The application clearly establishes that no adverse effects on the hydrologic balance will occur within or outside the permit area. MRP p. 7-21.

84) R645-301-731.220 The method for measuring quarterly flow measurements using an ultrasonic at Kanab at CR is unacceptable. The device cannot accurately and consistently measure flow in Kanab Creek at all flow stages. The application must detail a specific methodology that will accurately measure the flow volume in Kanab Creek at all flow stages at the surface water sampling site Kanab at CR.

The ultrasonic monitoring has been used as a supplemental measuring device but does not replace the manual measurement under the existing approved monitoring plan.

85) R645-301-731.121 The application must discuss how surface waters will be protected if groundwater discharge from the open-pits is high in TDS.

Any potential discharges of groundwater from the mine pits will be regulated through the mine's UPDES discharge permit, administered through the Utah Division of Water Quality. Discharges of water with TDS concentrations exceeding the UPDES permit limits are not allowed.

86) R645-301-742 The three Alternative Sediment Control Areas (ASCAs) on the west side of the North Lease area are not implementing the Best Technology Currently Available. The Best Technology Currently Available must be implemented at each of these Point Source discharges point where effluent exits the permit area. Appropriately sized sediment ponds must be placed at each of these three locations.

Ponds 5 and 6 have been designed and added to replace two ASCA's. All calculations can be found in Appendix 5-12. ASCA-1 will remain as deemed appropriate by DWQ and to be approved under the UPDES permit.

87) R645-301-742 Alternative Sediment Control Area 3 is in a position where it will accept runoff from 2.9 acres of the disturbed permit area and runoff from water discharged by sediment Pond 5. ASCA's may not receive discharge from sediment ponds. At the discharge location of ASCA-3, the Best Technology Currently Available must be implemented.

See response to #71

88) R645-301-751, R645-301-752.230 From the outfall of Pond 5, discharged effluent will flow for 200' within the permit area before draining through the southern permit boundary. While effluent passes through this disturbed area drainage it will pick up additional pollutants prior to leaving the site. Thus, the outfall of Pond 5 does not accurately represent effluent levels discharging from the permit area to waters of the U.S. Effluent sampled from Pond 5 may not flow through disturbed permit area prior to leaving the permit area and discharging to waters of the U.S.

See response to #71

89) R645-301-742.300; R645-301-742.423 There are multiple issues with diversion ditches in Drawing: 5-64 Sediment Control Area Watersheds. The ditches UD-18, DD-13, DD-10, DD-16, DD-12, DD-11, DD-05, and UD-14 cross from lower elevation contour lines to higher elevation contour lines. The design shows the ditch will not properly convey water at these low spots. These ditches need to be designed to convey all runoff they receive.

All diversion ditches have been reviewed and modified where necessary to ensure proper flow to the outflow points. See ditch profiles in Drawings 5-72 and 5-73.

90) R645-301-742.330 The sediment control watershed areas are not properly delineated in Drawing 5-64. The following watershed boundaries incorrectly follow surface flow paths: UA-4, UA-1, DA-1.

The watersheds in question have been re-analyzed and modified. See Drawing 5-66.

91) R645-301-742.330 DD-10 is graded to drain disturbed area drainage into Kanab Creek un-treated. Runoff effluent flowing from DD-10 must be treated with the Best Technology Currently Available.

DD-9 and DD-10 have both been modified to ensure each drainage area reports to ASCA-1. The profiles in Drawing 5-72 illustrate that this ASCA will be located on top of culvert backfill between the South Haul Road and the county bypass road. The ASCA will treat road and surface runoff prior to entering the drop pipe that connects to culvert c-2.

92) R645-301-742.210; R645-301-742.300 Design calculations, supporting narrative, and drawings must be given for all drainage ditches to show they will safely pass the volume and velocities of the design storm event. These calculations will include but are not limited to providing: watershed areas draining to

ditches, the runoff curve number(s) of the watershed, peak flow velocity, peak discharge volume, manning's n in the channel, flow depth, freeboard, etc.

See Appendix 5-12

93) R645-301-742.220 Provide engineered design and supporting calculations of mine water discharge conveyance system to sediment pond

See Appendix 5-12

94) R645-301-742.220 Sedimentation Pond deficiencies: Design calculations, a supporting narrative, and reference to appropriate drawings are required for Sediment impoundment Capacities

See Appendix 5-12

95) R645-301-742.220 The application must provide a sediment runoff budget from disturbed (and undisturbed) areas that will be captured by the pond. This sediment volume will be incorporated into the Sediment impoundment Capacities table(s).

Sedimentation calculations added to Appendix 5-12 and storage levels added to each of the ponds in Drawings 5-67 to 5-71.

96) R645-301-742.220 Calculate the approximate number of years it will take each sediment pond to reach a specified cleanout level.

Sedimentation calculations added to Appendix 5-12 and storage levels added to each of the ponds in Drawings 5-67 to 5-71.

97) R645-301-742.220 Provide a broken down and detailed narrative of cleanout level elevations for 60% and maximum storage capacity of 100%.

Sedimentation calculations added to Appendix 5-12 and storage levels added to each of the ponds in Drawings 5-67 to 5-71.

98) R645-301-742 Runoff from the disturbed area drainage DA-1 needs to be clearly discussed.

Sedimentation calculations added to Appendix 5-12 and storage levels added to each of the ponds in Drawings 5-67 to 5-71.

99) R645-301-742.220 Design calculations, supporting narrative, and drawings are required to show inlets and outlets of sediment ponds are stable and will pass the volume and velocities of the design storm event. Calculations will include inlet slopes, peak discharge, maximum flow velocity, and sizing of rip-rap if needed.

Inlet & Outlet calculations added to appendix 5-12. Inlet & Outlet locations added to Pond & Ditch detail drawings 5-67 to 5-73 with specifications on Rip Rap.

100) R645-301-742.220 Design calculations, supporting narrative, and drawings are required to show outlets of undisturbed diversion ditches are stable and will pass the volume and velocities of the design storm event.

Inlet & Outlet calculations added to appendix 5-12. Inlet & Outlet locations added to Pond & Ditch detail drawings 5-67 to 5-73 with specifications on Rip Rap

101) R645-301-742.220 The design of Pond 5 in Drawing 5-65 North Area Sediment impoundment 5, does not meet the design standards of 512.240. The embankment will need to be designed properly.

Pond 7 (was 5) has been designed with proper spillways

102) R645-301-742.220 Pond 7 is regulated under MSHA, 30 CFR 77.216(a). The current design shows a 24' berm on the downstream side of the embankment

MSHA reg. are for 20' or more of the upstream toe of the structure. Design for pond 8 (was 7) is 12' upstream and 23'+ downstream.

103) R645-301-742.220 Inflow and outflow calculations for design storm of sediment ponds.

Inlet & Outlet calculations added to appendix 5-12. Inlet & Outlet locations added to Pond & Ditch detail drawings 5-67 to 5-73 with specifications on Rip Rap

104) R645-301-742.220 Backwater pooling will occur up-gradient of Ponds 5 and 7. The design currently shows an upstream embankment will be located in the center of the channel, which will be at a higher elevation than base of the channel flowing to this area causing ponding in channel upstream of pond. Ponds 5 and 7 need to be designed so runoff will not pool behind the inlet embankments.

Same as 115

105) R645-301-742.220 In Drawing 5-65 North Area Sediment impoundment 5 Details, the dike elevation cross-section gives an incorrect elevation for the top of the embankment.

Top of embankment elevation has been corrected

106) R645-301-742.220 Pond 5 does not show a metal oil and grease skimmer cover.

Skimmers added to all primary spillways as shown in Drawings 5-67 to 5-71

107) R645-301-742.223 Pond 5, 6, 7 need emergency open channel spillways.

Emergency spillways added to pond designs as shown in Drawings 5-67 to 5-71 with sizing calculations in Appendix 5-12

108) R645-301-733.120 Ponds 5, 6, 7 need contour intervals for the topographic lines and designed embankments

All pond drawings have been updated to show contour intervals @ 2'

109) R645-301-733.120 The plan view of embankments for the sediment impoundment structures 5, 6, 7 need to be incorporated into the underlying topographic surface.

All pond drawings have been updated to show pond contours incorporated into the surrounding topography.

110) R645:301-7 42.411 Design calculations are needed for all culverts passing under primary roads in the North Private Lease area to show they will safely pass a 10-year 6-hour event.

All design calculations for culverts have been included in Appendix 5-12

111) R645-301-731. 720 The application must provide a map and narrative of the water conveyance and discharge system that will be used to de-water open-pits.

Text was added to Appendix 7-16 clarifying that the dewatering of mine pits in the North Private Lease will be performed in a manner similar to what has been used successfully at the existing Coal Hollow Mine area and that if groundwater inflows to a mine pit exceed one cfs in total, the Division will be notified.

A new updated version of Appendix 7-16 is provided.

112) R645-301-733.222 The application must provide a narrative on the de-watering of active pits. This narrative will provide a location(s) of where mine-water from the pits will be pumped to. The narrative will also discuss the water quality specifically the TDS of the mine-discharge and any adverse affect it may have on the receiving Kanab Creek.

Text was added to Chapter 7 clarifying that the dewatering of mine pits in the North Private Lease will be performed in a manner similar to what has been used successfully at the existing Coal Hollow Mine area.

Any potential discharges of groundwater from the mine pits will be regulated through the mine's UPDES discharge permit, administered through the Utah Division of Water Quality. Discharges of water with TDS concentrations exceeding the UPDES permit limits are not allowed.

113) R645-302-316.500 The plan should take note of this requirement for placement of water bodies during and following mining in prime farmland designated areas.

Existing Ponds 12-1, 12-2 and 12-3 are in prime farmland designated areas. The reclamation plan does not anticipate reconstructing these ponds or any other pond post mining (see drawing 5-71). Land owners have requested that ponds not be reconstructed post mining.

114) R645-301-738 The application needs to provide a timeline and narrative-of what wells will be destroyed during surface mining and replacement wells will be established.

A map (Figure 20) has been added to Appendix 7-16 with this information. The text of Section 731 of Chapter 7 of the MRP has been modified to indicate the commitment to the closure and abandonment of these wells.

115) R645-301-521.120 through-521.125, -521.140, -521.160 through 521.170 Drawing 5-47 details:

• A low spot in DD-10

• Designs to show the outfall of all ditches will not cause excessive erosion the banks of Kanab Creek.

• Pooling north of Pond 5, see the Division hydrologist deficiencies in accordance with spillway requirements in

R645-301-700, and the outfall is located so as to discharge into disturbed area before leaving the permit area and as shown details a dike of 103 ft in the typical cross section

• Pond 6 outfall located within the disturbed area

• Year 1 and Year 3 Disturbance cross into the OHWM of Kanab Creek.

• None of the Culverts discussed in Appendix 5-12 are shown in the map

There is no discussion or detail of updating the current Coal Hollow SWPPP which will require some measures in place to limit the amount of coal fines tracked outside the permit boundary due haul traffic onto a public road to the Crushing facility

Text within the MRP Chapter 5 section 521.141 states that Drawing 5-4 7 details the facilities of the North Private lease but is missing a discussion of how fill will be place and compacted in all applicable

Designs of Ponds and Ditches have been updated and clarified. Pond designs now agree with Ditch profiles. Low spots and pooling have been eliminated, and infall/outfall details have been added to each pond.

116) R645-301-742.212 A plan view map will be provided showing active mining operations in six month sequences for the duration of active mining. Each plan view map must include the layout for all water conveyance systems, sediment retention structures, active haul roads, ancillary roads, area of open pit disturbance, and reclaimed watersheds

Created Drawings 5-48 to 5-50 to show disturbance/construction sequence and 5-76B to show facilities reclamation.

117) R645-301-742.212 A narrative on the timing sequence for the construction of siltation structures is needed.

Drawings 5-48, 5-49 and 5-50 show timing for construction of siltation structures

118) R645-301-742 Fix Top of Dike Elev. 6955' in Drawing 5-65

Top of embankment elevation has been fixed

119) R645-301-521.140 The application does not meet the minimum requirements of R645-301-521.140 which requires maps that clearly show all mine plans due to erroneous and conflicting information presented on the following drawings:

Drawing 5-46 as detailed under Environmental Maps, Cross Sections Affected Area

Drawing 5-47 as detail under Mining Facilities maps

Drawing 5-71 and 5-72 are missing details showing engineered designs of reconstruction of natural drainage ways and of agricultural ponds destroyed during mining operations.

Drawings 5-73 shows reclamation activities below the OHWM, see discussions under Environmental maps above.

The referenced drawings have been updated

120) R645-301-724.310 There are no maps or a narrative of highwall mining in relation to the alluvial scour zones into the coal seam in the southern portion of the permit area.

ACD will further define the locations of the coal scour zone based on the findings of the alluvial groundwater drilling program. This information will be used to assist in planning the locations of highwall holes that extend beneath saturated Kanab Creek alluvium.

ACD plans to commence the alluvial drilling program shortly. ACD requests that the Division grant approval for mining in proposed mine pits 1-8 and Highwall Trench 1 (which are located in upland areas that will not substantially disturb saturated alluvial sediments in the Kanab Creek Valley), with approval for mining in the subsequent mine pits being granted after successful completion of the alluvial groundwater study in the Kanab Creek valley and associated PHC refinement for the Kanab Creek alluvium.

121) R645-301-541 The application does not meet the minimum requirements of R645-301-541 by not including any details as to how the described agricultural ponds in Section 521.124 which are located within the permit area will be returned to pre mining conditions or mention of any agreement with the landowner as to the final reclamation status of the ponds. The Permittee shall provide some documentation as what state the existing agricultural ponds will be returned to at the end of mining operations that meets the land owner's post mining land use.

As per the landowner request, agriculture ponds will not be rebuilt.

122) R645-301-542 The application does not meet the minimum requirements of R645-301-542 by the MRP using a swell factor of 10.25% for backfill volumes when the GEM geotechnical report details a shrink factor of 15% for the North Lease in Appendix 5-11. The Permittee will correct the volume calculations to match the geotechnical report for the site.

Same as 141

123) R645-301-358.400, R645-301-521.100 through-521.130, R645-301-731.610 and R645-301-121.200 The minimum requirements of R645-301-358.400, R645-301-521.100 through-521.130, R645-301-731.610 and R645-301-121.200 are not met due to no change within the MRP to detail how the natural drainage ways affected by coal mining operations will be reclaimed to a stable condition.

Per landowner agreements, the west and center drainages will not be reconstructed. Post mining topography is shown on Drawings 5-74 and 5-75.

124) R645-302-316.100 The Division understands that the North lease permit/disturbed area has been reduced and no longer includes the crop lands. The permit area boundary must equal the disturbed area boundary on all maps and exhibits. i.e. Soil Survey Dwg 2-3, and Exhibit 4-2.

Drawing 2-3 and Exhibit 4-2 have been modified to show only the permit boundary.

125) R645-301-342 ACD will need to provide a commitment to implement the criterion included in the sage grouse management plan for the North lease area during the reclamation liability period. Additional information may be required by DWR and FWS.

Reclamation of mining disturbance is focused on revegetation to improve habitat for sage-grouse. Monitoring of vegetation will continue during the reclamation liability period.

126) R645-301-553 The minimum requirements of R645-301-553 are not met within the application by the MRP using a swell factor of 10.25% for backfill volumes when the GEM geotechnical report details a shrink factor of 15% for the North Lease in Appendix 5-11. The Permittee will correct the volume calculations to match the geotechnical report for the site.

Same as 141

127) R645-301-764 The application will provide a timetable and plans for removal of all structures in the North Private Lease.

Same as 141

128) R645-302-315.300 and R645-302-317.210 R645-302-315.300 and R645-302-317.210 dictate that the NRCS has the primary authority for determining the requirements of the soil salvage and reconstruction plan. In addition R645-302-317.500 specifies the minimum characteristics of soils to be considered when developing reconstruction specifications. Density is one of those minimum requirements. Provide density information for the soils evaluated for prime farmland in Table C-1 a and Table C-1 b of Appendix C of Vol 11.

Bulk density column was added to Table C-1a-c. This required hiding the coarse fragment column.

129) R645-301-121.200 and R645-301-240 The plan specifies live haul of subsoil, a separate topsoil and subsoil stockpile is shown for pits 1 & 2 on Dwg 2-3. The plan describes Vessilla family soil within map unit C as having less than 6 inches of subsoil. this location with map unit C should be called out on Dwg 2-3.

Soil map unit C has been delineated as unit with soils less than 6 inches and rock outcrops on DWG 2-3.

130) R645-301-121.200 The plan describes 12 inches of topsoil replacement in Section 240 and 13 inches in Section 231 .100-231 .400. Please clarify

Topsoil replacement edited to 13 inches in 232.200, 232.300, and 240. There will be an avearage topsoil depth of 13 inches and 31 inches of subsoil for an average total depth of 44 inches. Top 6 inches of overburden will be sampled to determine suitability, so that there is total reclamation profile of at least 48 inches.

131) R645-301-243 Section 243 plans for sampling every 2 - 5 acres at final reclamation with a composite sample analyzed for N:P:K should be more specific as to sampling frequency and occurrence.

Change 2-5 acre range to "per 2 acres."

132) R645-301-731 Show peak hydrograph calculations for reclaimed watersheds. Calculations will include but are not limited to showing: time of concentration, curve numbers, drainage areas, design storm accumulation, peak discharge, runoff volumes, etc., and any assumptions made.

Hydrologic calculation for reclaimed watersheds are the same as undisturbed.

133) R645-301-727 The application must provide a discussion of long term water replacement for Kanab Creek.

Alton need not provide water-replacement data for any part of Kanab Creek. Water-replacement information under the rule cited is only required "If the probable hydrologic consequences determination required by R645-301-728 indicates that the proposed SURFACE COAL MINING AND RECLAMATION ACTIVITY may proximately result in contamination, diminution, or interruption of an underground or surface source of water . . . ." R645-301-727. The MRP shows that the proposed operations are not likely to be the cause of any impact to Kanab Creek. The Division reached the same conclusion in its CHIA: "Evaluation of the Coal Hollow Mine PHC and the preparation of this CHIA do not indicate that there is any evidence that such impacts [diminution, contamination or interruption of an appropriated water right, inter alia] will result from the proposed mining in the Alton/Sink Valley CIA, and as a consequence, there is no reason to require operators to propose alternatives for disposing of displaced water or other possible actions as part of the PAP." CHIA p. 45 (Mar. 14, 2014).

134) R645-302-317.622, R645-302-317.627 and R645-302-317.628 R645-302-317.622, R645-302-317.627 and R645-302-317.628 require the Division consult with the NRCS State Conservationist for the reference crop and the post mining land use evaluation. That coordinated review is ongoing and the recommendations made by the NRCS will be incorporated into the mining plan

Include statement that negotiations with NRCS in chap 2 are ongoing.

135) R645-301-542 The minimum requirements of R645-301-542 are not met within the application due to competing swell and shrink factors between the MRP volumes and the geotechnical report for the site. The Permittee will recalculate the backfill volumes and required grading based on the 15% shrink factor demonstrated in the GEM geotechnical report

Same as 141

136) R645-301-542 The minimum requirements of R645-301-542 are not met within the application as there is no discussion or engineering design provided to show that the natural drainages that will be destroyed due to mining operations will be placed back in a stable manor meeting the requirements of R645-301-358.400, R645-301-521.100 through-521.130, R645-301-731.610 and R645-301-121.200

Per landowner agreements, the west and center drainages will not be reconstructed. Post mining topography is shown on Drawings 5-74 and 5-75.

137) R645-301-542 The minimum requirements of R645-301-542 are not met within the application as there is no discussion or engineering design provided to show that the natural drainages that will be destroyed due to mining operations will be placed back in a stable manor meeting the requirements of R645-301-358.400, R645-301-521.100 through-521.130, R645-301-731.610 and R645-301-121.200. Drawing 5-71 and 5-72 will show stable engineered channels for the natural drainages affected by coal mining operations: along with relevant details and cross sections to illustrate that the above regulations have been fulfilled.

Per landowner agreements, the west and center drainages will not be reconstructed. Post mining topography is shown on Drawings 5-74 and 5-75.

138) R645-301-542 The minimum requirements of R645-301-542 are not met within the application as there is no text detailing that the preexisting ponds, shown on Figure 12 in appendix 7-16 will be placed back in a stable manor meeting The minimum requirements of R645-301-542 are not met within the application as there is no discussion or engineering design provided to show that the natural drainages that will be destroyed due to mining operations will be placed back in a stable manor meeting the requirements of R645-301-358.400, R645-301-521.100 through-521.130, R645-301-731.610 and R645-301-121.200.

Per landowner agreements, the preexisting ponds will not be reconstructed. Post mining topography is shown on Drawings 5-74 and 5-75.

139) R645-301-860.100 The application does not meet the minimum requirements of R645-301-860.100 as the applicant currently maintains a surety bond amount of $12, 750,000 which is held by Lexon Insurance Co with a rider held by lronshore Indemnity Inc for 342 disturbed acres. Chapter 8 submitted within the application details a January, may and July release that did not happen. Text within chapter 8 needs to be amended to reflect the actual bond releases. The bond according to Appendix 8-1 with the bond releases described for Year 1 would need to be $20,758,000.

Appendix 8-2 has been revised further revisions are being addressed for the September bond release

140) R645-301-860.100 The application does not meet the minimum requirements of R645-301-860.100 as the applicant currently maintains a surety bond amount of $12,750,000 which is held by Lexon Insurance Co with a rider held by lronshore Indemnity Inc for 342 disturbed acres. Chapter 8 submitted within the application details a January, may and July release that did not happen. Text within chapter 8

needs to be amended to reflect the actual bond releases. The bond according to Appendix 8-1 with the bond releases described for Year 1 would need to be $20,758,000.

Appendix 8-2 has been revised further revisions are being addressed for the September bond release

141) R645-301-830.140 The application does not meet the minimum requirements of R645-301-830.140 as the Permittee submitted detailed bond information in regards to the application which details a swell factor of 10.7 to 7.2 % while the geotechnical report submitted for the North Private Lease states a shrink factor of 15%. The Permittee shall correct the corresponding volumes throughout the bond estimate.

GEM Engineering geotechnical report has been updated to clarify the difference between 'swell' and 'shrinkage' factors in use on site. Bond calculations use weighted average of 10.725% 'swell' (bank to loose) factor as basis.

142) R645-302-317.220 The Division will use the soil-reconstruction specifications of R645-302-317.210 to carry out its responsibilities under R645-302-310 through R645-302-316 and R645-301-800. Soil reconstruction specifications must be considered adequate prior to approval.

Inserted the following at R645-317-210-

"The Division is in consultation with the NRCS State Conservationist to determine the preferred Prime Farmland soil-reconstruction. That coordinated review is ongoing and the recommendations made by the NRCS will be incorporated into the mining plan."

143) R645-302-240 The MRP does not contain any reference to the R645-302-240 regulations for auger mining operations. The Permittee shall add discussion to the relevant chapters detailing how the Augur mining rules -240 through -245.500 are met for the North Private Lease

These are addressed in Appendix 7-16

144) R645-302-240 The application does not include a written commitment to Special Categories of Mining R645-302-240 Auger Mining and Remining Operations in the North Lease area. The rules require an evaluation of the proposed auger mining areas and any potential mitigative measures that need to be addressed. These rules include, but are not limited to: R645-302-241.200, R645-302-242, R645-302-243, R645-302-244.200, R645-302-245.110, R645-302-245.120, R645-302-245.130, R645-302-245.210, R645-302-245.220, R645-302-245.221, R645-302-245.222, R645-302-245.230, R645-302-245.231, R645-302-245.232, R645-302-245.300

The necessary discussion has been added to Appendix 7-16. A new updated version of Appendix 7-16 has been provided.

145) R645-301-722 The application does not provide planned locations of hiqhwall mining locations in Appendix 7-16 Figure 3.

Planned highwall holes are on Drawing 5-53

Letters received late from coordinating Agencies

Additional, two letters addressed to DOGM were forwarded to ACD pertaining to the "Application Review and Deficiencies, North Private Lease" letter dated September 4, 2015. A letter dated August 27,2015 from the USF&WS and a letter dated September 14, 2015. Also, comments on **"**ARCHAEOLOGICAL MONITORING & HISTORICAL PROPERTIES TREATMENT PLAN FOR THE ALTON COAL NORTHERN PROJECT LEASE AREA, KANE COUNTY, UTAH" prepared August 10, 2015 by Jessica Montcalm were emailed September 22, 2015 by DOGM. Comments provided in these letters have been addressed as follows:

USFWS to DOGM dated August 27, 2015

The permit application includes information on the western yellow-billed cuckoo and the Southwestern willow flycatcher, species that are listed as threatened and endangered, respectively under the Endangered Species Act. We note that the text in Table 3-35 is not consistent with text on pages 34 and 36 of *Volume 12, Supplemental Report, Vegetation & Wildlife Habitat of the North Private Lease Area report prepared by Mt. Nebo Scientific, Inc. and revised on June 16, 2015*. We recommend that the text in Table 3-35 (page 3-37) reflect the commitments made on pages 34 and 36 for these two species.

Table 3-35 in MRP Chapter 3 was revised to be consistent with that in the supplemental report

Table 3-35, page 3-37: Please change the status of western yellow-billed cuckoo from Candidate to Listed Threatened.

The status in Table 3-35 in MRP Chapter 3 was updated

Conduct a suitable habitat assessment for yellow-billed cuckoo, based on guidance in *Guidelines for the identification of suitable habitat for WYBCU in Utah (June 2015) (Appendix A).* If suitable habitat exists, we recommend protocol-level surveys for the species.

An assessment has been added in APPENDIX A - VOLUME 12: Supplemental Report Vegetation & Wildlife of the North Private Lease Area October 2015 for the WYBCU

Conduct protocol-level surveys for Southwestern willow flycatcher in the project area.

Surveys information has been added in APPENDIX A - VOLUME 12: Supplemental Report Vegetation & Wildlife of the North Private Lease Area October 2015 for the Southwestern willow flycatcher.

We recommend you evaluate potential impacts to migratory birds and establish measures to avoid and minimize impacts to birds. We recommend you include these measures in the permit, should you determine to issue one to Alton Coal. The Migratory Bird Treaty Act (MBTA) prohibits the take of

migratory birds, their parts, nest, eggs, and nestlings. To ensure ground-disturbing activities do not result in the "take" of an active nest or migratory bird protected under the MBTA.

An evaluation and measures has been included as Migratory Birds in - MRP Chapter 3: Revision 10/02/15.

Public Lands Policy Coordinating Office (on behalf of DWR) to DOGM dated September 14, 2015

Sage-grouse, UDWR appreciates the inclusion of a Greater Sage-grouse management plan as part of the North Private Lease application. The mitigation plan discloses techniques and strategies, but the applicant also needs to disclose why avoidance and/or seasonal timing restrictions are not options for the North Private Lease area. UDWR recommends that the *Conservation Plan* be followed and referenced in the management plan. UDWR also recommends that a formal Mitigation Agreement between UDWR, Utah Division of Oil, Gas and Mining, and Alton Coal Development, LLC also be developed, which would ensure that functional mitigation actions are clearly identified, and funds are fully committed for the implementation of those actions prior to disturbance. UDWR further recommends that any greater sage-grouse mitigation projects and funds associated with this lease be channeled through the Watershed Restoration Initiative (WRI) to be reviewed by the WRI partners.

Alton Coal Development in consultation with John Harja of the PLPCO on October 7th discussed DWR comments and verified that the continued practice of completing mitigation for planned disturbances for the following year in the preceding year was an acceptable practice, thus completing 200 plus acres of mitigation prior to the planned 50 acres of disturbance (4:1 mitigation) in the first year of mining and so on, is an acceptable practice to meet the required 1,000 acres of total mitigation required for the North Private Lease.

Mule Deer, UDWR recommends that no construction /development occur in big game crucial summer habitat from May 15 to July 15. UDWR typically request that 4 acres of mitigation be required for every 1 acre of crucial habitat disturbance. UDWR recommends that any mule deer mitigation projects associated with this lease be channeled through the Watershed Restoration Initiative (WRI) and reviewed by WRI partners.

Alton Coal Development in consultation with John Harja of the PLPCO on October 7th discussed DWR comments and verified that the habitat improvements of 4:1 mitigation completed for the benefit of sage-grouse also benefited the mule deer and were adequate to meet the mitigation efforts for mule deer. It was further clarified by Dr. Petersen that past mitigation projects for sage-grouse were beneficial to the mule deer.

Additional deficiencies emailed by Daron Haddock on 9/22/2015 concerning Appendix 4-7

REVIEW OF ARCHAEOLOGICAL MONITORING & HISTORICAL PROPERTIES TREATMENT PLAN FOR THE ALTON COAL NORTHERN PROJECT LEASE AREA, KANE COUNTY, UTAH

Bighorn Archaeological Consultants under Contract with

Alton Coal Development, LLC

C/025/005
08/10/2015

General Comments: As no updated Class III inventory was conducted prior to the Determination of Eligibility and Effects letter DOGM drafted and submitted to SHPO, and site boundaries changed so significantly from the original (1986) recording to the last site revisit and update (2005), it is recommended that, at a minimum, the discrepancies between the site boundaries be reinvestigated. Similarly, attempts should be made to relocated and document previously identified features, as many of these features are called out as containing "undisturbed charcoal suitable for C14 analysis." This will streamline data recovery efforts by providing locations for test units wherein data recovery will most likely yield sufficient material to address the proposed research questions. *– See comments below.*

An Unanticipated Discoveries Plan needs to be provided in the document. *– See comments below.*

By some estimates, the Alton Amphitheatre has seen close to 8,000 years of use and occupation by various cultural groups. Rather than simply producing a technical report that will do little to provide the public with any useful information pertaining to the shared cultural heritage of the area, consider using the information and data gleaned to produce a presentation or product that convey the results/findings in a manner suitable for public consumption. *– Statement added to text indicating that we will complete public presentations outlining the results of the mitigation work.*

Comment #	Sheet/Page/ Map/Table #	Comments	Initials	Review Action

Comment #	Sheet/Page/ Map/Table #	Comments	Initials	Review Action
1	3 – 42KA3077	The site boundary defined in 1986 extended beyond the fence-line. As this site will be irrevocably lost once strip mining commences, effort should be made to determine the extent of the site past the fence and amend the site boundary as necessary. A surface investigation north of the fence line to determine presence/absence of additional cultural materials/features is recommended. Similarly, the area between the 1986 and 2005 boundaries should be investigated to ascertain presence/absence of features. *– Text within the proposed mitigation measures for the site has been amended to indicate that the surface investigation will be completed to include that area within the original 1986 site boundary.*	JfM	
2	3 – 42KA3077	The 1986 site description indicates a total of eight hearth features associated with this site. Effort should be made to relocate (if possible) these features and accurately document their location. This can be conducted concurrently as part of the site boundary assessment discussed above. Proposed excavation units can then be focused in those areas where features are identified. *– I have attempted to plot the approximate location of hearth features identified in 1986 that fall within the project boundary and indicated that the original site boundary will be included in the surface investigation.*	JfM	

Comment #	Sheet/Page/ Map/Table #	Comments	Initials	Review Action
3	5 – 42KA3097	As this site will be irrevocably lost once strip mining commences, effort should be made to determine the extent of the site, especially in the area between the 1986 and 2005 site boundaries. This site seems to represent the most definitive area of continued use by various cultural groups, and it warrants additional attention. *– Text within the proposed mitigation measures for the site has been amended to indicate that the surface investigation will be completed to include that area within the original 1986 site boundary.* The 1986 site description indicates the presence of 12 hearth features associated with this site. As with 42KA3077, effort should be made to relocate these features, document their location, and focus data recovery on them. *– I have attempted to plot the approximate location of hearth features identified in 1986 that fall within the project boundary and indicated that the original site boundary will be included in the surface investigation.*	Jfm	
4	5 – 42KA3097	The county road that presently bounds the site to the east corresponds with the Road to Kanab on the 1877 GLO map. Historic trash deposits were noted along the road in the 1986 recording of site 42KA3097, but no subsequent mention of the road or historic debris in any reports post 1986. A cursory review of the alignment prior to mining activities to determine presence/absence of historical resources is recommended. Mention of this road and its presence on the GLO map needs to be included in the write-up, especially since the alignment will be rerouted as part of mine expansion. *– I have added text to the document indicating that we will attempt to relocate any old road alignments that may still remain and complete an historic context if we are successful as mitigation of any eligible road segments.*	JfM	
5	6-7 – 42KA3097 and 42KA6080	Site 42KA6080 was broken out of site 42KA3097 during the 2005 inventory. Was the proposed new county road alignment inventoried? *– Not since the 2005 block inventory, however we will look at the proposed road corridor as it falls completely within the original boundary for 42KA3097 (see comments above).* In the interceding years, ground conditions may have changed sufficiently to allow for the identification of additional features. An inventory of the roadway is recommended prior to construction to identify and address any potential features that will require treatment prior to disturbance. This will serve to streamline the entire process by limiting the number of unanticipated discoveries along the roadway alignment during construction.	JfM	

Comment #	Sheet/Page/ Map/Table #	Comments	Initials	Review Action
6	6-7 – 42KA3097 and 42KA6080	What is the width of the proposed Right-of-Way? *- 20 m or 66 ft.* Will this include a buffer to keep construction activities away from the site? As it is presently mapped, the roadway corridor appears to be less than 50 feet from both the project boundary and the site boundary. *– I have included a statement that the road should be aligned so as to remain at least 30 m / 100 ft. from the site.*	JfM	
7	7 – 42KA6080	First paragraph, second line: "… open campsite of Late Archaic-Basketmaker II and Southern cultural affiliations…" Should it read "Southern Paiute"? *- Corrected*	JfM	
8	11 – Paleoindian Stage	Second paragraph, seventh line: "… site (42GR1956) in Green River County…" Should it read "Grand County"? *- Corrected*	JfM	
9	23 – Tier I Testing	Is there a reason why 1x1 m excavation blocks are being utilized as opposed to shovel test pits? Consider focusing STPs in areas for random testing, while placing excavation blocks in those areas where features are identified. *– You and I both know the effectiveness of STPs, but try talking to Lori about those and she won't hear of them. Maybe Chris will be more open to the idea as that's what I would much rather do if we aren't going to do any mechanical trenching. You can do many more STPs than you can 1 x 1 units and still get a really good idea of what's going on with the stratigraphy and depth potential. I'm with you on saving formal excavation units for areas where we may have features.*	JfM	
10	23 – Individual Site Treatments 42KA3077	As previously mentioned, a surface inventory of the area between the 1986 site boundary and the 2005 site boundary is recommended to ascertain presence/absence of previously identified features. Once this has been completed, a more focused placement of STPs/excavation blocks can be developed to most efficiently recover data pertinent to the research questions. *– See comments above. Text in document indicating that we will attempt to locate any previous or new features identified within the original site boundary and that we will excavate shovel probes and test units in high potential areas.*	JfM	

Comment #	Sheet/Page/ Map/Table #	Comments	Initials	Review Action
11	23 – Individual Site Treatments 42KA3097	As previously mentioned, a surface inventory of the area between the 1986 site boundary and the 2005 site boundary is recommended to ascertain presence/absence of previously identified features. Once this has been completed, a more focused placement of STPs/excavation blocks can be developed to most efficiently recover data pertinent to the research questions. *– See comments above. Text in document indicating that we will attempt to locate any previous or new features identified within the original site boundary and that we will excavate shovel probes and test units in high potential areas.*	JfM	
12	28 - Curation	Have the private landowners signed donation agreements with the College of Eastern Utah Museum? *–A statement has been placed in plan indicating letters will be obtained indicating private land owner's preferences. We have notice from one private land owner that they would like materials turned over to them once complete.*	JfM	
13	General	Although briefly mentioned in a few places, there is no standard Unanticipated Discoveries plan discussed in this document. Given the nature of the undertaking, one needs to be included. This way all parties understand how to proceed under that circumstance. It can be as brief as: "Discovery Clause: If during construction/mining-related activities, contractors encounter any subsurface archaeological deposits including, but not limited to, prehistoric artifacts or features (pithouses, charcoal staining from hearths, etc.), historic building foundations or walls, outhouse/privies, or dense trash deposits, work must be halted within 50' of the discovery and notification made to the responsible Agency (DOGM). Agency will continue to halt work until an assessment of the discovery is completed by a trained and State-permitted archaeologist retained by the proponent. If the discovery is considered a significant, or National Register Eligible property, the proponent will notify the Agency who will work with the Utah State Historic Preservation Office to coordinate and complete the mitigation of the discovery." *- Added to document. We also plan to follow the discovery measures in place for the Coal Hollow Mine, with an archaeological monitor present any time work is done in or near an eligible site, even if testing has been completed.*	JfM	

APPLICATION FOR COAL PERMIT PROCESSING

Permit Change ☒ New Permit ☐ Renewal ☐ Exploration ☐ Bond Release ☐ Transfer ☐

Permittee: Alton Coal Development, LLC
Mine: Coal Hollow Mine **Permit Number:** C/025/0005
Title: North Private Lease
Description, Include reason for application and timing required to implement:

Instructions: If you answer yes to any of the first eight questions, this application may require Public Notice publication.

☒ Yes ☐ No 1. Change in the size of the Permit Area? Acres: 295.60 Disturbed Area: 224.80 ☒ increase ☐ decrease.
☐ Yes ☒ No 2. Is the application submitted as a result of a Division Order? DO# ____
☒ Yes ☐ No 3. Does the application include operations outside a previously identified Cumulative Hydrologic Impact Area?
☐ Yes ☒ No 4. Does the application include operations in hydrologic basins other than as currently approved?
☐ Yes ☒ No 5. Does the application result from cancellation, reduction or increase of insurance or reclamation bond?
☒ Yes ☐ No 6. Does the application require or include public notice publication?
☒ Yes ☐ No 7. Does the application require or include ownership, control, right-of-entry, or compliance information?
☒ Yes ☐ No 8. Is proposed activity within 100 feet of a public road or cemetery or 300 feet of an occupied dwelling?
☐ Yes ☒ No 9. Is the application submitted as a result of a Violation? NOV # ____
☐ Yes ☒ No 10. Is the application submitted as a result of other laws or regulations or policies?
Explain: ____
☐ Yes ☒ No 11. Does the application affect the surface landowner or change the post mining land use?
☐ Yes ☒ No 12. Does the application require or include underground design or mine sequence and timing? (Modification of R2P2)
☒ Yes ☐ No 13. Does the application require or include collection and reporting of any baseline information?
☒ Yes ☐ No 14. Could the application have any effect on wildlife or vegetation outside the current disturbed area?
☒ Yes ☐ No 15. Does the application require or include soil removal, storage or placement?
☒ Yes ☐ No 16. Does the application require or include vegetation monitoring, removal or revegetation activities?
☐ Yes ☒ No 17. Does the application require or include construction, modification, or removal of surface facilities?
☒ Yes ☐ No 18. Does the application require or include water monitoring, sediment or drainage control measures?
☒ Yes ☐ No 19. Does the application require or include certified designs, maps or calculation?
☐ Yes ☒ No 20. Does the application require or include subsidence control or monitoring?
☒ Yes ☐ No 21. Have reclamation costs for bonding been provided?
☒ Yes ☐ No 22. Does the application involve a perennial stream, a stream buffer zone or discharges to a stream?
☒ Yes ☐ No 23. Does the application affect permits issued by other agencies or permits issued to other entities?
☒ Yes ☐ No 24. Does the application include confidential information and is it clearly marked and separated in the plan?

Please attach three (3) review copies of the application. If the mine is on or adjacent to Forest Service land please submit four (4) copies, thank you. (These numbers include a copy for the Price Field Office)

I hereby certify that I am a responsible official of the applicant and that the information contained in this application is true and correct to the best of my information and belief in all respects with the laws of Utah in reference to commitments, undertakings, and obligations, herein.

B. Kirk Nicholes	Environmental Specialist	10/15/2015	
Print Name	Position	Date	Signature (Right-click above choose certify then have notary sign below)

Subscribed and sworn to before me this 16 day of October, 2015

Notary Public: Marty Nichols, state of Utah.

My commission Expires: 9-11-2017
Commission Number: 670359
Address: 1670 E Millstone Cir
City: Enoch State: UT Zip: 84721

} ss:

Notary Public
MARTY NICHOLES
Commission #670359
My Commission Expires
Sept 11, 2017
State of Utah

For Office Use Only:	Assigned Tracking Number:	Received by Oil, Gas & Mining

APPLICATION FOR COAL PERMIT PROCESSING
Detailed Schedule Of Changes to the Mining And Reclamation Plan

Permittee: Alton Coal Development, LLC
Mine: Coal Hollow Mine **Permit Number:** C/025/0005
Title: North Private Lease

Provide a detailed listing of all changes to the Mining and Reclamation Plan, which is required as a result of this proposed permit application. Individually list all maps and drawings that are added, replaced, or removed from the plan. Include changes to the table of contents, section of the plan, or other information as needed to specifically locate, identify and revise the existing Mining and Reclamation Plan. Include page, section and drawing number as part of the description.

			DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☐ Add	☒ Replace	☐ Remove	(01) CHM MRP Introduction
☐ Add	☒ Replace	☐ Remove	(02) Chapter 1 TOC
☐ Add	☒ Replace	☐ Remove	(03) Chapter 1 Text
☒ Add	☐ Replace	☐ Remove	(04) Chapter 1, Appendix 1-10 (replaces last 9 pages)
☒ Add	☐ Replace	☐ Remove	(05) Chapter 1, Appendix 1-11
☐ Add	☒ Replace	☐ Remove	(06) Chapter 1, Drawing 1-1
☐ Add	☒ Replace	☐ Remove	(07) Chapter 1, Drawing 1-2
☐ Add	☒ Replace	☐ Remove	(08) Chapter 1, Drawing 1-3
☐ Add	☒ Replace	☐ Remove	(09) Chapter 1, Drawing 1-4
☐ Add	☒ Replace	☐ Remove	(10) Chapter 2, TOC
☐ Add	☒ Replace	☐ Remove	(11) Chapter 2, Text
☒ Add	☐ Replace	☐ Remove	(12) Chapter 2, Drawing 2-3
☒ Add	☐ Replace	☐ Remove	(13) Chapter 2 Drawing 2-4
☐ Add	☒ Replace	☐ Remove	(14) Chapter 3 TOC
☐ Add	☒ Replace	☐ Remove	(15) Chapter 3 Text
☒ Add	☐ Replace	☐ Remove	(16) Chapter 3 Drawing 3-8
☒ Add	☐ Replace	☐ Remove	(17) Chapter 3 Appendix 3-11
☐ Add	☒ Replace	☐ Remove	(18) Chapter 4 TOC
☐ Add	☒ Replace	☐ Remove	(19) Chapter 4 Text
☒ Add	☐ Replace	☐ Remove	(20) Chapter 4, Appendix 4-6
☒ Add	☐ Replace	☐ Remove	(21) Chapter 4, Appendix 4-7
☒ Add	☐ Replace	☐ Remove	(22) Chapter 4, Appendix 4-8
☐ Add	☒ Replace	☐ Remove	(23) Chapter 5, TOC
☐ Add	☒ Replace	☐ Remove	(24) Chapter 5, Text
☐ Add	☒ Replace	☐ Remove	(25) Chapter 5, Appendix 5-4
☒ Add	☐ Replace	☐ Remove	(26) Chapter 5, Appendix 5-11
☒ Add	☐ Replace	☐ Remove	(27) Chapter 5, Appendix 5-12
☒ Add	☐ Replace	☐ Remove	(28) Chapter 5, Appendix 5-13

Any other specific or special instruction required for insertion of this proposal into the Mining and Reclamation Plan.	**Received by Oil, Gas & Mining**

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			DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☒ Add	☐ Replace	☐ Remove	(29) Chapter 5, Drawing 5-45
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☒ Add	☐ Replace	☐ Remove	(33) Chapter 5, Drawing 5-49
☒ Add	☐ Replace	☐ Remove	(34) Chapter 5, Drawing 5-50
☒ Add	☐ Replace	☐ Remove	(35) Chapter 5, Drawing 5-51A
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☒ Add	☐ Replace	☐ Remove	(54) Chapter 5, Drawing 5-70
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☒ Add	☐ Replace	☐ Remove	(56) Chapter 5, Drawing 5-72

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			DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☒ Add	☐ Replace	☐ Remove	(57) Chapter 5, Drawing 5-73
☒ Add	☐ Replace	☐ Remove	(58) Chapter 5, Drawing 5-74
☒ Add	☐ Replace	☐ Remove	(59) Chapter 5, Drawing 5-75
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☒ Add	☐ Replace	☐ Remove	(61) Chapter 5, Drawing 5-76A
☒ Add	☐ Replace	☐ Remove	(62) Chapter 5, Drawing 5-76B
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☒ Add	☐ Replace	☐ Remove	(64) Chapter 5, Drawing 5-77
☒ Add	☐ Replace	☐ Remove	(65) Chapter 5, Drawing 5-78
☐ Add	☒ Replace	☐ Remove	(66) Chapter 6, Text
☒ Add	☐ Replace	☐ Remove	(67) Chapter 6, Add to end of Appendix 6-2
☐ Add	☒ Replace	☐ Remove	(68) Chapter 7, TOC
☐ Add	☒ Replace	☐ Remove	(69) Chapter 7, Text
☐ Add	☒ Replace	☐ Remove	(70) Chapter 7, Tables 7-1 through 7-7B
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☒ Add	☐ Replace	☐ Remove	(72) Chapter 7 Drawing 7-3N
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☒ Add	☐ Replace	☐ Remove	(76) Chapter 7, Appendix 7-16
☒ Add	☐ Replace	☐ Remove	(77) Chapter 7, Appendix 7-17
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☐ Add	☒ Replace	☐ Remove	(79) Chapter 8, Text
☒ Add	☐ Replace	☐ Remove	(80) Chapter 8, Appendix 8-2
☐ Add	☒ Replace	☐ Remove	(81) Volume 9 (Confidential) TOC
☒ Add	☐ Replace	☐ Remove	(82) *Confidential* Chapter 1, End of Appendix 1-2
☒ Add	☐ Replace	☐ Remove	(83) Volume 9 (Confidential) End of Appendix 4-1 Exhibit 4-5
☒ Add	☐ Replace	☐ Remove	(84) *Confidential* Chapter 4, Appendix 4-7

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			DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☒ Add	☐ Replace	☐ Remove	(85) *Confidential* Chapter 6, End of Appendix 6-1
☒ Add	☐ Replace	☐ Remove	(86) Vol. 10- Wetland Study
☒ Add	☐ Replace	☐ Remove	(87) Vol. 11 - Soil Survey
☒ Add	☐ Replace	☐ Remove	(88) Vol. 12 - Biology
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INTRODUCTION

The Alton coal field is located in T39S, R6W and T39S, R5W SLB&M, Kane County, Utah. Kane County is located in the southwest quarter of Utah. The town of Kanab, which is the Kane County Seat, is located about 30 miles south of the Alton coal field (see attached vicinity and location drawings).

Alton Coal Development, LLC (ACD) is ~~proposing the development of~~currently mining a portion of the Alton coal field. Th~~e proposed~~is development is the Coal Hollow Mining Project. The center of the Coal Hollow Project (CHP) is located approximately 3 miles south of the town of Alton, Utah. ACD is proposing the development of a portion north of the current CHP. The development is the North Private Lease. The center of the North Private Lease is located approximately 0.8 miles south east of the town of Alton, Utah.

ACD has initiated the processes involved to secure coal leases and a permit to mine coal from the project area. In 2004, ACD negotiated surface and coal leases for the private or fee areas of the Alton coal field. In 2004 ACD submitted a Lease by Application (LBA) to the Department of the Interior, Bureau of Land Management State Office, Salt Lake City, Utah for federal coal acreage contiguous to the secured private lease area. In 2006, ACD submitted a Mining and Reclamation Plan (MRP) to the Utah Division of Oil, Gas and Mining (UDOGM). This MRP submittal was determined to be administratively incomplete in August 2006. ACD addressed the deficiencies list provided by the Division and resubmitted the MRP in June of 2007. August 2007, UDOGM completed the Administrative Completeness Review of the June 2007 submission and provided ACD with a deficiencies list. January of 2008, ACD submitted a package addressing the August UDOGM deficiencies list.

The Coal Hollow Project involves a surface mining operation that will produce approximately 2,000,000 tons of coal annually. The coal will be transported from the

Alton coal field in trucks (and possibly rail) to markets in the surrounding region. Operations at the mine are expected to be conducted 24 hours a day, 6 days a week.

In early 2004, ACD initiated base line studies within the area of the Alton coal field. Base line studies are required by state and federal agencies prior to submitting a MRP application.

In 2004, ACD hand picked consultants and personnel to prepare field and base line studies for the Coal Hollow Project. Consultants were selected based on their technical expertise and professional ethical standards. The CHP will be a flagship coal mining operation and its culture of excellence will not start when the first ton of coal is mined, but rather from project inception. ACD seeks to develop a culture of high integrity extending to it personnel, mining operations, community relations, and environmental performance.

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R645-301-100

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R645-301-100. GENERAL CONTENTS

110 LEGAL, FINANCIAL, COMPLIANCE, and RELATED INFORMATION

110 INTRODUCTION

Alton Coal Development, LLC is submitting a Mining and Reclamation Plan for the Coal Hollow Project to the Utah Division of Oil, Gas and Mining pursuant to rules governing coal mine permitting at R645-301-100 et seq. Permit Area Base Drawing – Drawing 1-1.

112 IDENTIFICATION OF INTERESTS

112.100 Business Entity

Applicant, Alton Coal, LLC, is a limited liability company duly organized and validly existing under the laws of the State of Nevada, and authorized to conduct business under the laws of the State of Utah.

112.200 Names, address, telephone number, and employer identification number of:

112.210 **Applicant:**

Alton Coal Development, LLC
463 N. 100 W, Suite 1
Cedar City, UT 84721
Telephone (435) 867- 5331
EIN: 42-1655092

112.220 Resident Agent for **Applicant**:
B. Kirk Nicholes
463 N. 100 W., Suite 1
Cedar City, Utah 84721
(435) 867-5331

112.230 Person who will pay the Abandoned Mine and Reclamation Fee:

Robert C. Nead, Jr.

112.300 Ownership and Control Information

Description of Ownership and Chart showing the "Family Tree" for Alton Coal Development, LLC, attached in Appendix 1-10

112.310 **Applicant:**

Members Holding Ten Percent (10%) or more of Ownership of Applicant:

James Wayland
2841 Capistrano Way
Naples, FL 34105

SH Coal Investment, LLC
2375 Cambridge Rd.
Coshocton, Ohio 43818
EIN: 27-3192975

Owners of SH Coal Investment, LLC:

SH Coal Investment, LLC, is a Delaware limited liability company, which is a wholly owned company of Sleepy Hollow Mineral Investors, LLC, which is a Delaware limited liability company.

Sleepy Hollow Mineral Investors, LLC 100%
P.O. Box 1058
Coshocton, Ohio 43812
EIN: 27-3192842

Sleepy Hollow Mineral Investors, LLC, is owned as follows:

Charles Ungurean 50%
2375 Cambridge Road
Coshocton, Ohio 43812

Thomas Ungurean 50%
1690 Sleepy Hollow Drive
Coshocton, Ohio 43812

Managers and Officers of **Applicant**:

James Wayland – Manager

Larry Johnson – President for Operations
463 N. 100 W., Suite 1
Cedar City, Utah 84721
(435) 867-5331

Social Security numbers of Alton Coal Development, LLC's individual member, manager and officer and for Charles Ungurean and Thomas Ungurean provided in "CONFIDENTIAL BINDER" Appendix 1-1

112.320 Relationship to the **Applicant**

Ownership:

James Wayland	25.5%
SH Coal Investment, LLC	49.0%

Control:

James Wayland	Manager
Larry Johnson	President of Operations

SH Coal Investment, LLC (Owner) and Sleepy Hollow Mineral Investors, LLC:

Charles Ungurean	Manager
Thomas Ungurean	Manager

112.330 Title and Date of Position

Applicant:

James Wayland — Manager
September 9, 2004 (begin date)

Larry Johnson — President of Operations
Feburary 1, 2011 (begin date)

Robert C. Nead, Jr.
Person in charge of payments pursuant to R645-300-147
September 9, 2004 (begin date)

SH Coal Investments, LLC — Owner
Sleepy Hollow Mineral Investors, LLC — Manager of SH Coal Investments, LLC
August 2, 2010 (begin date)
Sleepy Hollow Mineral Investors, LLC
Charles Ungurean — Manager
August 2, 2010 (begin date)
Thomas Ungurean — Manager
August 2, 2010 (begin date)

112.340. Ownership or control of Other Coal Mining and Reclamation Operations

Applicant:

With the exception of Charles Ungurean and Thomas Ungurean, neither Alton Coal Development, LLC nor its manager or members has owned or controlled other coal mining or reclamation operations. *See* attached Appendix 1-10 for listing of Ungurean's operations.

112.350 Application Number – Other Pending Coal Mining and Reclamation Operations

Applicant:

With the exception of Charles Ungurean and Thomas Ungurean, neither, Alton Coal Development, LLC nor its manager or members has owned or controlled other coal mining or reclamation operations. The Ungurean's operations are described at Appendix 1-10.

112.400 Coal Mining and Reclamation Operations Owned or Controlled

Applicant:

With the exception of Charles Ungurean and Thomas Ungurean, neither, Alton Coal Development, LLC nor its manager or members has owned or controlled other coal mining or reclamation operations. The Ungurean's operations are described at Appendix 1-10.

112.410 Coal Mining and Reclamation Operations Owned or Controlled by Managers or Members of Alton Coal Development, LLC

Applicant:

With the exception of Charles Ungurean and Thomas Ungurean, neither, Alton Coal Development, LLC nor its manager or members has owned or controlled other coal mining or reclamation operations. The Ungurean's operations are described at Appendix 1-10.

112.420 Ownership and Control Relationship of Managers and Members of Alton Coal Development, LLC

Relationship to the **Applicant**

Applicant:

James Wayland Manager
September 9, 2004 (begin date)

Larry Johnson President of Operations
February 1, 2011 (begin date)

Robert C. Nead, Jr.
Person in charge of payments pursuant to R645-300-147
September 9, 2004 (begin date)
SH Coal Investments, LLC Owner

Sleepy Hollow Mineral Investors, LLC Manager of SH Coal Investment, LLC

August 2, 2010 (begin date)
Sleepy Hollow Mineral Investors, LLC
Charles Ungurean Manager
August 2, 2010 (begin date)
Thomas Ungurean Manager
August 2, 2010 (begin date)

112.500 Legal or Equitable Owner of the Surface and Mineral Properties

The legal and equitable owners of the properties to be affected by this mining operation during the duration of the permit period along with legal descriptions are included in this section. Surface and coal ownership are also shown on Drawings 1-3 and 1-4. The following table is a summary of the ownership within the Permit boundary.

Coal Hollow Permit Area Ownership (Acres)**				
	Fee	Federal	State	Total
Surface	721	0	0	721
Coal*	521	200	0	721
Total				
Note*: Federal minerals located within the Permit area are not planned for mining as part of this application. These areas have been included as part of the LBA application described in 112.800. Note**: Acreages are approximate based on legal descriptions				

The legal description for lands included within the Permit Boundary is provided below for each surface owner.

SURFACE OWNERSHIP:

Owner/Lessor:

C. Burton Pugh
533 N 650 E
Lindon, Utah 84042-1567
801-785-6220

Lessee:

Alton Coal Development, LLC

Legal Description (C. Burton Pugh Property):

TOWNSHIP 39 SOUTH-RANGE 05 WEST, SLB&M
Section 30: All of Section Lot #1 (NW¼ NW¼); NE¼ NW¼ ; N½ NE¼ ; ALSO: BEGINNING 3.50 chains West of the East Quarter corner of Said Section 30, and running South 34˚ 34’ West 22.64 chains to the 1/16 section line; thence West 2.64 chains to the Southwest corner of NE¼ SE¼ of Said Section 30; thence North 40.00 chains; thence East 20.00

chains; thence South 14.69 chains; thence southwesterly to the point of beginning.

….containing 217.64 acres, more or less.

TOWNSHIP 39 SOUTH-RANGE 05 WEST, SLB&M
Section 29: BEGINNING at the Northwest corner of Said Section 29, and running thence South 34.69 chains; thence North 33˚22' East 35.50 chains; thence North 40˚ West 0.58 chains; thence North 37˚30' East 12.30 chains; thence West 22.23 chains to the point of beginning.

….containing 36.04 acres, more or less.

TOWNSHIP 39 SOUTH-RANGE 05 WEST, SLB&M
Section 19: SW¼SE¼, E½SE¼, SE¼NE¼

….containing 160.0 acres, more or less

TOWNSHIP 39 SOUTH-RANGE 05 WEST, SLB&M
Section 20: SW¼

….containing 160.0 acres, more or less

COAL OWNERSHIP:

Owner/Lessor:	*Lessee:*
C. Burton Pugh 533 N 650 E Lindon, Utah 84042-1567 801-785-6220	Alton Coal Development, LLC
Roger M. Pugh 140 South 100 West Kanab, UT 84741	
Mark and Margaret Moyers 9397 Avanyu Drive Pleasant Grove, UT 84062	

SURFACE OWNERSHIP:

Owner/Lessor:	*Lessee:*
Alecia Swapp Dame Trust Through Richard Dame, Trustee 1620 Georgia Ave.	Alton Coal Development, LLC

Boulder City, NV 89005
702-293-4773

Legal Description (Alecia Dame Swapp Trust):

TOWNSHIP 39 SOUTH-RANGE 05 WEST, SLB&M
Section 30: BEGINNING at a point 5.31 chains North of the E¼ corner of Said Section 30, and running thence South 45.31 chains; thence West 20.00 chains; thence North 20.00 chains; thence East 2.64 chains; thence North 34˚ 34' East 22.64 chains to the 1/16 section line; thence North 33˚ 22' East to the point of beginning.

….containing 61.96 acres, more or less.

The following description is an addition to the original permit and constitutes an Incidental Boundary Change(IBC) as shown on Drawing 1-1. Coal contained in the IBC will be mined by highwall mining, no surface mining may take place on the leased premises.

TOWNSHIP 39 SOUTH-RANGE 05 WEST, SLB&M
Section 29: BEGINNING at the Northeast Corner of the Northwest Quarter of Section 29, Township 39 South, Range 5 West, Salt lake Base and Meridian and running thence South 14.97 chains; thence West 73 degrees North, 12.41 chains; thence South 36 degrees 45 minutes West to the Quarter Section Line of Section 29, Township 39 South, Range 5 West, Salt Lake Base and Meridian; thence South 36 degrees 45 minutes West 15.61 chains; thence South 5.20 chains to the center section line of Section 29, Township 29 South, Range 5 West, Salt lake Base and meridian; thence South 20.0 chains; thence West 10.96 chains to the west section line of Section 29, Township 39 South, Range 5 West, Salt lake Base meridian; thence North 20.0 chains to the Quarter Section Corner of Section 29, Township 39 South, Range 5 West, Salt Lake Base and meridian; thence North 25.31 chains; thence North 33 degrees 22 minutes East 35.50 chains; thence in a Northwesterly direction 2 rods; thence North 37 degrees 30 minutes East 12.30 chains to the North Section Line of Section 29, Township 39 South, Range 5 West, Salt Lake Base meridian; thence East 17.77 chains to the point of beginning.

….containing 85.88 acres, more or less.

COAL OWNERSHIP:

Owner/Lessor:	*Lessee:*
Alecia Swapp Dame Trust Through Richard Dame, Trustee 1620 Georgia Ave.	Alton Coal Development, LLC

Boulder City, NV 89005
702-293-4773

North Private Lease Permit Area Ownership (Acres)**				
	Fee	Federal	State	Total
Surface	296	0	0	296
Coal*	262	34	0	296
Total				
Note*: Federal minerals located within the Permit area are not planned for mining as part of this application. These areas have been included as part of the LBA application described in 112.800. Note**: Acreages are approximate based on legal descriptions				

The legal description for lands included within the Permit Boundary is provided below for each surface owner.

SURFACE OWNERSHIP:

Owner/Lessor: *Lessee:*

Heaton Brothers, LLC Alton Coal Development, LLC
P. O. Box 100008
Alton, Utah 84710

Legal Description (Heaton Brothers, LLC Property Tract 9-6-13-1 & 9-6-12-5):

TOWNSHIP 39 SOUTH-RANGE 06 WEST, SLB&M
Section 13: E½NE¼: SW¼NE¼

….containing 120.0 acres, more or less.

TOWNSHIP 39 SOUTH-RANGE 06 WEST, SLB&M
Section 12: BEGINNING at a point 20 chains West and 10 chains North of the South East corner of said Section 12; thence North 10 chains, thence East 3 chains, thence South 10 chains, thence West 3 chains to the point of beginning.

….containing 3.00 acres, more or less.

COAL OWNERSHIP:

Owner/Lessor: *Lessee:*

Heaton Brother, LLC Alton Coal Development, LLC
P.O. Box 100008
Alton, Utah 84010

SURFACE OWNERSHIP:

Owner/Lessor: *Lessee:*

G. Ferril & Dorothy M. Heaton Alton Coal Development, LLC
P.O. Box 100063
Alton, UT 84710

Legal Description (G. Ferril & Dorothy M. Heaton Property Tract 9-6-12-1, 9-5-7-3A, 9-5-18-5):

TOWNSHIP 39 SOUTH-RANGE 06 WEST, SLB&M
Section 12: E½E½SE½SE½: BEGINNING at a Southeast corner of Said Section 12, and running thence West 5.00 chains; thence North 20.00 chains; thence East 5.00 chains; thence South 20.00 chains to the point of beginning.

….containing 10.00 acres, more or less.

TOWNSHIP 39 SOUTH-RANGE 05 WEST, SLB&M
Section 7: BEGINNING at a point Southwest corner Said Section 7, and running thence East 15.00 chains; thence North 20.00 chains; thence West 15.00 chains; thence South 20.00 chains to the point of beginning.

….containing 30.00 acres, more or less.

TOWNSHIP 39 SOUTH-RANGE 05 WEST, SLB&M
Section 18: BEGINNING at the Northwest corner of Said Section 18, and running thence East 15.00 chains; thence South 20.00 chains; thence West 15.00 chains; thence North 20.00 chains to the point of beginning.

….containing 30.00 acres, more or less

COAL OWNERSHIP:

Owner/Lessor: *Lessee:*

Delbert R. Palmer Alton Coal Development, LLC
P.O. Box 6
Orderville, Utah 84758-0006

Elgin R. Palmer and Alton Coal Development, LLC

9670 Cove Avenue
Pensacola, Florida 32534-1034

SURFACE OWNERSHIP:

Owner/Lessor: *Lessee:*

G. Ferril & Dorothy M. Heaton Alton Coal Development, LLC
P.O. Box 100063
Alton, UT 84710

Legal Description (G. Ferril & Dorothy M. Heaton Property Tract 9-5-18-3A):

TOWNSHIP 39 SOUTH-RANGE 05 WEST, SLB&M
Section 18: The SW¼NW¼ (Lot 2) of Said Section 18.

….containing 38.34 acres, more or less.

COAL OWNERSHIP:

Owner/Lessor: *Lessee:*

Heaton Brothers, LLC Alton Coal Development, LLC
P.O. Box 100773
Alton, UT 84710

Delila B. Heaton
Inter Vivos Trust,
P.O. Box 100063
Alton, UT 84710

Ross E. Heaton
Family Trust,
P.O. Box 100063
Alton, UT 84710

SURFACE OWNERSHIP:

Owner/Lessor: *Lessee:*

Dean R. Heaton-Successor Alton Coal Development, LLC
Trustee of the Trust Dated
11/12/90
c/o Dean R. Heaton

P.O. Box 435
Fredonia, AZ 86022

Legal Description (Dean R. Heaton Property Tracts 9-6-12-2, 9-5-18-3, & 9-5-7-4A):

TOWNSHIP 39 SOUTH-RANGE 06 WEST, SLB&M
Section 12: BEGINNING at a point 5.00 chains West from the SE Corner of Said Section 12, and running thence North 20.00 chains; thence South 10.00 chains; thence West 5.00 chains; thence South 10.00 chains; thence West 10.00 chains; thence South 10.00 chains; thence East 15.00 chains to the point of beginning.

….containing 20.00 acres, more or less.

TOWNSHIP 39 SOUTH-RANGE 05 WEST, SLB&M
Section 18: BEGINNING at a point 60.00 rods East of the Northwest corner of Said Section 18, and running thence East 20.00 rods; thence South 80.00 rods; thence West 20.00 rods; thence North 80.00 rods to the point of beginning.

….containing 10.00 acres, more or less.

TOWNSHIP 39 SOUTH-RANGE 05 WEST, SLB&M
Section 18: BEGINNING at a point 60 rods East of the Southwest corner of Said Section 7, and running thence North 80.00 rods; thence East 33.00 rods; thence South 80.00 rods; thence West 33.00 rods to the point of beginning.

….containing 15.00 acres, more or less.

COAL OWNERSHIP:

Owner/Lessor: *Lessee:*

Dean R. Heaton-Successor Trustee of the Trust Dated 11/12/90
c/o Dean R. Heaton
P.O. Box 435
Fredonia, AZ 86022

Alton Coal Development, LLC

SURFACE OWNERSHIP:

Owner/Lessor: *Lessee:*

Orval & Greta Palmer Alton Coal Development, LLC
P.O. Box 100144
Alton, UT 84710-0144

Legal Description (Orval & Greta Palmer Property Tract 9-6-12-3):

TOWNSHIP 39 SOUTH-RANGE 06 WEST, SLB&M
Section 12: BEGINNING at a point 20.0 chains North & 10.0 chains West of the Southeast corner of Section 12 Township 39 South, Range 6 West, SLB&M; & run th South 10.0 chains; th West 7.0 chains; th North 10.0 chains; th East 7.0 chains to the point of beginning.

….containing 7.0 acres, more or less.

COAL OWNERSHIP:

Owner/Lessor: Lessee:

Orval & Greta Palmer Alton Coal Development, LLC
P.O. Box 100144
Alton, UT 84710-0144

SURFACE OWNERSHIP:

Owner/Lessor: Lessee:

Heaton Brothers, LLC
P.O. Box 100773
Alton, Utah 84710

Legal Description (Heaton Brothers, LLC Property Tract 9-6-12-5 and 9-6-13-2):

TOWNSHIP 39 SOUTH-RANGE 06 WEST, SLB&M
Section 12: BEGINNING 20.00 chains West from the Southeast corner of Section 12, T39S-R6W, S.L.B.&M., Running Thence North 20 chains, thence West 5 chains, thence South 20 chains, thence East 5 chains to the point of beginning.

….containing 10.00 acres, more or less.

TOWNSHIP 39 SOUTH-RANGE 06 WEST, SLB&M
Section 12: BEGINNING 20.00 chains West from the Southeast corner of Section 12, T39S-R6W, S.L.B.&M., Running Thence South 20 chains, thence West 20 chains, thence North 5 chains, thence East 15 chains, thence North 15 chains, thence East 5 chains to the point of beginning.

….containing 17.50 acres, more or less.

COAL OWNERSHIP:

Owner/Lessor:	*Lessee:*
USA	Not Leased

112.600 Owners of Record of Property Contiguous to Proposed Permit Area

Owners of surface properties contiguous to the proposed permit area are shown on Drawing 1-3 and the name and address of each such owner is as follows:

Department of the Interior, Bureau of Land Management
District and Regional Office
Salt Lake City, Utah

Darlynn and Arlene Sorensen
Orderville, Utah
435-648-2462

Keith R & Ann Marie Stanworth 9-5-18-2
119 N 300 W
Cedar City, Utah 84720-2507

Darrel A. & Georgia T. Heaton 9-6-12-4
PO Box 232
Fredonia, Arizona 86022-0232

William J. & Helen Palmer Mackel Prang 9-5-18-1
6562 Begonia Bay Ave.
Las Vegas, Nevada 89142

Gene Edward Roundy 9-6-12-8
440 E 200S
Cedar City, Utah 84720-3313

112.700 MSHA Numbers

The MSHA Mine Identification Number for the Coal Hollow and North Private Lease Project is 42-02519.

112.800 Interest in Contiguous Lands

The applicant has interest in lands contiguous to the permit area. A Lease by Application (LBA) is currently being processed by the United States Department of the Interior, Bureau of Land Management, Salt Lake City, Utah. Alton Coal Development, LLC, the sole party in interest, submitted the LBA application in September, 2004. The LBA is contiguous to the permit area and contains approximately 3,581 acres. Coal recovery within the LBA is amenable to both surface and underground mining. See Drawing 1-2 for LBA delineation.

In addition to the LBA application, Alton Coal Development, LLC also has property leased from C. Burton Pugh located east of the permit boundary. This property which is contiguous to the permit area, is part of a land tract (9-5-20-2) owned by Mr. Pugh that is split across the permit boundary and is located in Section 20, Township 30 South, Range 5 West. This entire tract was leased prior to the final determination of the Permit Boundary (9/10/04). The area leased from Mr. Pugh outside the Permit Boundary are not planned for development except for approximately 43 acres located in the SW¼, NW¼ Section 20 which is included as part of the LBA application. The 43 acres would possibly be developed for surface coal mining operations if the LBA mining rights are successfully acquired. Land tracts leased by Alton Coal Development, LLC within and contiguous to the permit area are identified on Drawing 1-3.

112.900 Certification of Submitted Information

After Alton Coal Development, LLC is notified that the application is approved, but before the permit is issued, Alton Coal will update, correct or indicate that no change has occurred in the information submitted under R645-301-112.100 through .800.

113 VIOLATION INFORMATION

Neither the applicant, affiliates, members or managers or persons controlled by or under common control with the applicant (including Charles Ungurean and Thomas Ungurean, as confirmed by the Applicant/Violator System (AVS) search, dated December 23, 2013) has: (i) had a federal or state mining permit suspended or revoked in the last five years; (ii) nor forfeited a mining bond or similar security deposited in lieu of a bond. Neither the applicant, affiliates, members or managers or persons controlled by or under common control with the applicant has received a violation during the last three year period. Compliance information on Ungurean's operations and the Coal Hollow Mine is attached at Appendix 1-10.

114 RIGHT OF ENTRY INFORMATION

Applicant bases its right to enter and begin coal mining activities in the permit area and the consent of the surface owner to extract coal by surface mining methods upon the following documents:

Lessor:	*Lessee:*
C. Burton Pugh	Alton Coal Development, LLC

Surface and Mineral Lease, dated 9/10/04; originally recorded 5/25/06

Lessor: *Lessee:*
Roger M. Pugh Alton Coal Development, LLC
Mineral Lease, dated 9/11/08; recorded 9/11/08

Lessor: *Lessee:*
Margaret and Mark Moyers Alton Coal Development, LLC
Mineral Lease, dated 6/26/08; recorded 7/21/08

Lessor: *Lessee:*
Alecia Swapp Dame Trust Alton Coal Development, LLC
Surface and Mineral Lease, dated 4/29/05; recorded 5/17/06
Mineral Lease, dated 10/23/13; recorded 10/23/13

Lessor: *Lessee:*
Heaton Brothers, LLC Alton Coal Development, LLC

Surface and Mineral Lease, dated 3/15/07
Surface and Mineral Lease, dated 10/22/14
Surface and Mineral Lease, dated 12/31/14

Lessor: *Lessee:*
G. Ferril & Dorothy M. Heaton Alton Coal Development, LLC

Surface Lease, dated 5/4/07
Surface Lease, dated 5/4/07
Surface Lease, dated 5/4/07
Surface Lease, dated 5/4/07

Lessor: *Lessee:*
Delbert R. Palmer Alton Coal Development, LLC

Mineral Lease, dated 7/2/14

Lessor: *Lessee:*
Elgin R. Palmer Alton Coal Development, LLC

Mineral Lease, dated 7/8/14

Lessor: *Lessee:*
Dean R. Heaton Alton Coal Development, LLC

Surface and Mineral Lease, dated 5/4/07
Surface and Mineral Lease, dated 5/4/07
Surface and Mineral Lease, dated 12/15/14

Lessor:	*Lessee:*
Orval & Greta Palmer	Alton Coal Development, LLC

Surface and Mineral Lease, dated 6/30/14

Copies of these lease assignments are included in Appendix 1-2 located in the Volume 9, Confidential binder.

115 STATUS OF UNSUITABILITY CLAIMS

115.100 The permit area is not within an area or under study as an area designated as unsuitable for mining under R645-103-400, nor has any petitions been filed with the UDOGM under R645-103-420 that could affect the proposed permit area. The Coal Hollow Project is located on private lands adjacent to federal lands, which after careful consideration were declared suitable for mining in 1980 by then Secretary of Interior Andrus. Secretary's Decision, Petition to Designate Certain Federal Lands In Southern Utah Unsuitable for Surface Coal Mining, OSM Ref No. 79-5-001, dated December 16, 1980, copy attached at Appendix 1-3.

This petition was filed under the provisions of section 522(c) of the federal Surface Mining Control and Reclamation Act ("SMCRA"). OSM Notice, Receipt of a Complete Petition for Designation of Lands as Unsuitable for Surface Coal Mining Operations, 45 fed. Reg. 3398, Jan. 17, 1980, attached at Appendix 1-3.

Those federal lands in the Petition area found suitable for mining include lands adjacent to the private lands which the Project has included in a federal lease by application and located in Kane County, Utah within Township 39 South, Ranges 5 and 6 West, SLM. Secretarial Decision at Paragraph 4. The Secretarial Decision was based on an extensive Administrative Record, including the Petition filed under Section 533 of SMCRA, 30 U.S.C. Section 1272, public hearings, a combined petition evaluation document and environmental impact statement published in two volumes on November 26, 1980 as, "Southern Utah Petition Evaluation Document" and the "Southern Utah Petition Evaluation Document - Comments and Responses." The Secretarial Decision was further supported by a 52 page Statement of Reasons, dated January 13, 1981, attached at Appendix 1-3.

The Secretarial Decision was upheld by the federal court in *Utah International, Inc. v. Watt*, 553 F. Supp. 872 (D. Utah 1982).

115.300 Coal mining and reclamation activities at the Coal Hollow Project are not planned within 300 feet, measured horizontally, of an occupied dwelling or 100 feet of a public road. Drawing 1-5 shows the proximity of the Swapp Ranch to the

planned operations. With the alternate highwall method, coal will be recovered by highwall mining beneath the Swapp Ranch. Engineering has been completed and incorporated into the plan such that subsidence does not occur to the surface.

116 PERMIT TERM

116.100 There are 3 mining phases associated with this permit term. The first phase of mining began on November 10, 2010. Phase 3 for the Coal Hollow Mine is anticipated to conclude in year 2017 beyond the current 5 year term. The North Private Lease is proposed to begin in 2015 before the end of the current 5 year term.

116.101 Coal Hollow Acres of disturbance per Mining Phase

Phase 1	250 acres
Phase 2	54 acres
Phase 3	38 acres

116.102 North Private Lease Acres of disturbance per Mining Phase

Phase 1	51.9 acres
Phase 2	115.7 acres
Phase 3	57.2 acres

116.200 Permit Term

The Coal Hollow Mine Project is proposed for a 5-year term under the Permanent Regulatory Program for 5 years

117 INSURANCE, PROOF OF PUBLICATION

Proof of publication pursuant to R645-303-322 is included in Appendix 1-5.

117.100 Certificate of Liability Insurance

A copy of the Certificate of Liability Insurance is found in Appendix 1-4.

118 PERMIT FILING FEE

A copy of this permit is on file with the Utah Division of Oil, Gas and Mining (UDOGM), P.O. Box 145801, Salt lake City, Utah 84114-5801. A filing fee of $5.00 accompanied permit submittal.

120 PERMIT APPLICATION FORMAT AND CONTENTS

This permit application contains information and will comply with R645-301-120. A notarized statement attesting to the accuracy of this information is set forth at Appendix 1-6.

130 REPORTING OF TECHNICAL DATA

All technical data submitted in the permit application will be accompanied by the name or organization responsible for the collection and analysis of data, dates of collection and descriptions of methodology used. Technical analyses will be planned by or under the direction of a qualified professional in the subject to be analyzed.

The following assisted or were consulted in the preparation of this permit application:

State of Utah, Department of Natural Resources
Division of Oil, Gas and Mining
Salt Lake City, Utah

Department of the Interior, Bureau of Land Management
District and Regional Office
Kanab and Salt Lake City, Utah

United States Geological Survey, Utah Region
Salt Lake City, Utah

United States Department of Agriculture
Natural Resources Conservation Service
Salt Lake City, Richfield and Cedar City, Utah

State of Utah, Department of Natural Resources
Division of Wildlife Resources (DWR)
Salt Lake City, Price and Cedar City, Utah

Dr. James E. Nelson
Brigham Young University
Provo, UT

Dr. Patrick D. Collins
Mt. Nebo Scientific Research & Consulting
Springville, UT

Talon Resources, Inc
Huntington, UT

Erik Petersen, P.G.
Petersen Hydrologic, LLC
Lehi, UT

C. Burton Pugh
Lindon, UT

John T. Boyd Company
James Boyd
Mining & Geological Consulting
Canonsburg, PA

Richard Dame
Boulder City, NV

John T. Boyd Company
Rich Bate
Mining & Geological Consulting
Denver, CO

Keith Montgomery
Montgomery Archaeological
Moab, UT

Dr. Stephen Petersen
~~Philomath~~Elk Ridge, ~~OR~~UT

Larry Hayden-Wing
Hayden-Wing Associates, LLC
Laramie, WY

Mark Page
Water Rights Consultant
Price, UT

D.A. Smith Drilling
Loma, CO

Kane County
76 North Main
Kanab, UT

Heaton Livestock
PO Box 100773
Alton, UT

Patricia Stavish
Montgomery Archeological
Moab, UT

Byron Caton
SGS North America, Inc
Denver, CO

Glenn Grossman
Will Spitzenberg, P.E.

Boss Engineering

University of Miami
Miami, FL

Geochron Laboratories
Cambridge, MA

Energy Labs
Billings, MT

Taylor Geo-Engineering
Alan O. Taylor
Lehi, UT

Long Resource Consultants
Robert E. Long
Morgan, UT

JBR Environmental, Inc.
Dawn Whaley
Sandy, UT

Bruce Chesler
Escalante, UT

A.H. Hamblin
Paleontogical Consulting
Cedar City, UT

Mike Shurtz, C.E.T
AGEC
Cedar City, UT

Inter-Mountain Laboratories
Karen Secor
1673 Terra Avenue
Sheridan, WY

Tom Campbell

TerraTek

Pleasant Grove, UT

Salt Lake City, UT

GEM Engineering, Inc.
Cedar City, UT

Dan Guy
Mining & Engineering Consultant
St. George, UT

David Newman, PhD P.E.
Appalachian Mining & Engineering, Inc.
Lexington, Kentucky

Dale Gourley
Bighorn Archaeological Consultants
3706 Nicholas Drive
Santa Clara, Utah 84765

Brown Consulting Engineers
163 West 1600 South #5
St. George, UT 84770

Southwest Energy LLC
Orica Mining Service
Tucson, AZ 85705

Jay S. Adams, RLS
Adams Surveying Inc.
Cedar City, Utah 84721

140 DRAWING AND PLANS

The Drawing and plans in the Mining and Reclamation Plan are submitted consistent with the requirement of R645-301-140.

150 COMPLETENESS

Alton Coal Development, LLC represents that the information contained in the Coal Hollow Mining and Reclamation Plan permit application to be complete and correct.

Entity Name or ID: 251418 (251418) Johnson Larry Begin Date: 6/3/2015 Mail To: Back To Reports

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1 of 1 Find | Next

Dept of the Interior/Office of Surface Mining

Applicant/Violator System

Violations for Entity (251418) Johnson

List of all violations preceding the date of the application: 6/3/2015

This report is designed to assist regulatory authorities with conducting a review of an applicant and operator's compliance history as disclosed in a permit application as required at 30 CFR 773.11. This report is also designed to assist applicants and operators with providing violation information to a regulatory authority as part of a permit application as required at 30 CFR 778.14. CAUTION: If someone wants to evaluate an entity to determine if they have any unabated violations of SMCRA, they should not use this report but instead should run an evaluation report in the entity module of AVS. For further clarification on how to use or interpret results from this generated report, contact an AVS User Liaison at 800.643.9748.

State	Permit No	Seq No	Violation No	Violation Type	Violation Status	Violation Date	MSHA ID(s)

1 of 1

Entity Name or ID: 036531 (036531) Nead Jr Robert Begin Date: 6/3/2015 Mail To: Back To Reports

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Dept of the Interior/Office of Surface Mining

Applicant/Violator System

Violations for Entity (36531) Nead Jr

List of all violations preceding the date of the application: 6/3/2015

This report is designed to assist regulatory authorities with conducting a review of an applicant and operator's compliance history as disclosed in a permit application as required at 30 CFR 773.11. This report is also designed to assist applicants and operators with providing violation information to a regulatory authority as part of a permit application as required at 30 CFR 778.14. CAUTION: If someone wants to evaluate an entity to determine if they have any unabated violations of SMCRA, they should not use this report but instead should run an evaluation report in the entity module of AVS. For further clarification on how to use or interpret results from this generated report, contact an AVS User Liaison at 800.643.9748.

State	Permit No	Seq No	Violation No	Violation Type	Violation Status	Violation Date	MSHA ID(s)

1 of 1

Entity Name or ID: 064574 (064574) Ungurean Thomas Begin Date: 6/3/2015 Mail To: Back To Reports

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Dept of the Interior/Office of Surface Mining

Applicant/Violator System

Violations for Entity (64574) Ungurean

List of all violations preceding the date of the application: 6/3/2015

This report is designed to assist regulatory authorities with conducting a review of an applicant and operator's compliance history as disclosed in a permit application as required at 30 CFR 773.11. This report is also designed to assist applicants and operators with providing violation information to a regulatory authority as part of a permit application as required at 30 CFR 778.14. CAUTION: If someone wants to evaluate an entity to determine if they have any unabated violations of SMCRA, they should not use this report but instead should run an evaluation report in the entity module of AVS. For further clarification on how to use or interpret results from this generated report, contact an AVS User Liaison at 800.643.9748.

State	Permit No	Seq No	Violation No	Violation Type	Violation Status	Violation Date	MSHA ID(s)

1 of 1

Entity Name or ID: 107810 (107810) Ungurean Charles Begin Date: 6/3/2015 Mail To: Back To Reports

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Dept of the Interior/Office of Surface Mining

Applicant/Violator System

Violations for Entity (107810) Ungurean

List of all violations preceding the date of the application: 6/3/2015

This report is designed to assist regulatory authorities with conducting a review of an applicant and operator's compliance history as disclosed in a permit application as required at 30 CFR 773.11. This report is also designed to assist applicants and operators with providing violation information to a regulatory authority as part of a permit application as required at 30 CFR 778.14. CAUTION: If someone wants to evaluate an entity to determine if they have any unabated violations of SMCRA, they should not use this report but instead should run an evaluation report in the entity module of AVS. For further clarification on how to use or interpret results from this generated report, contact an AVS User Liaison at 800.643.9748.

State	Permit No	Seq No	Violation No	Violation Type	Violation Status	Violation Date	MSHA ID(s)

1 of 1

Entity Name or ID: 247290 (247290) Wayland James Begin Date: 6/3/2015 Mail To: Back To Reports

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Dept of the Interior/Office of Surface Mining

Applicant/Violator System

Violations for Entity (247290) Wayland

List of all violations preceding the date of the application: 6/3/2015

This report is designed to assist regulatory authorities with conducting a review of an applicant and operator's compliance history as disclosed in a permit application as required at 30 CFR 773.11. This report is also designed to assist applicants and operators with providing violation information to a regulatory authority as part of a permit application as required at 30 CFR 778.14. CAUTION: If someone wants to evaluate an entity to determine if they have any unabated violations of SMCRA, they should not use this report but instead should run an evaluation report in the entity module of AVS. For further clarification on how to use or interpret results from this generated report, contact an AVS User Liaison at 800.643.9748.

State	Permit No	Seq No	Violation No	Violation Type	Violation Status	Violation Date	MSHA ID(s)

1 of 1

Entity Name or ID: 250907 (250907) SH Coal Investment LLC Begin Date: 6/3/2015 Mail To: Back To Reports

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Dept of the Interior/Office of Surface Mining

Applicant/Violator System

Violations for Entity (250907) SH Coal Investment LLC

List of all violations preceding the date of the application: 6/3/2015

This report is designed to assist regulatory authorities with conducting a review of an applicant and operator's compliance history as disclosed in a permit application as required at 30 CFR 773.11. This report is also designed to assist applicants and operators with providing violation information to a regulatory authority as part of a permit application as required at 30 CFR 778.14. CAUTION: If someone wants to evaluate an entity to determine if they have any unabated violations of SMCRA, they should not use this report but instead should run an evaluation report in the entity module of AVS. For further clarification on how to use or interpret results from this generated report, contact an AVS User Liaison at 800.643.9748.

State	Permit No	Seq No	Violation No	Violation Type	Violation Status	Violation Date	MSHA ID(s)

1 of 1

Entity Name or ID: 247248 (247248) Alton Coal Development LLC Begin Date: 6/3/2015 Mail To: Send Back To Reports

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1 of 1 Find | Next

Dept of the Interior/Office of Surface Mining

Applicant/Violator System

Violations for Entity (247248) Alton Coal Development LLC

List of all violations preceding the date of the application: 6/3/2015

This report is designed to assist regulatory authorities with conducting a review of an applicant and operator's compliance history as disclosed in a permit application as required at 30 CFR 773.11. This report is also designed to assist applicants and operators with providing violation information to a regulatory authority as part of a permit application as required at 30 CFR 778.14. CAUTION: If someone wants to evaluate an entity to determine if they have any unabated violations of SMCRA, they should not use this report but instead should run an evaluation report in the entity module of AVS. For further clarification on how to use or interpret results from this generated report, contact an AVS User Liaison at 800.643.9748.

State	Permit No	Seq No	Violation No	Violation Type	Violation Status	Violation Date	MSHA ID(s)

1 of 1

Alton Coal Development, LLC
Coal Hollow Mine

Permit Number	MSHA	Violation Number	Date of Issuance	Issued to	Issuing Agency	State	Brief Description of NOV	Action taken to Abate NOV	Current Status of NOV
C250005	42-02519	10123	6/19/2013	K.Nicholes	UDOGM	Utah	Failure to comply with Chapter 3	Amend MRP	Vacated
C250005	42-02519	10135	1/15/2015	K.Nicholes	UDOGM	Utah	Failure to rough backfill and grade within 60 days following coal removal from Pit #6 and Pit #9	Backfilled Pit # 6, amended MRP to leave Pit # 9 open	Terminated
C250005	42-02519	16149	1/26/2015	K.Nicholes	UDOGM	Utah	Failure to follow approved plan for reconstruction of Lower Robinson Creek	Amend MRP with new engineered design of LRC	In progress
C250005	42-02519	16150	4/1/2015	K.Nicholes	UDOGM	Utah	Failed to properly construct and maintain Ditch 1 & Ditch 4	Completed maintance Ditch 1, construted Ditch 4 to design	Terminated
C250005	42-02519	18150	4/28/2015	K.Nicholes	UDOGM	Utah	Failure to complete sage-grouse mitigation work on 355 acre BLM	Amended MRP to complete work by Oct. 31,2015	In progress

OXFORD MINING CO INC

Permit Number	Violation Number	Date of Issuance	Issuing Agency	State	Brief description of NOV	Action Taken to Abate NOV	STATUS
2319	29539	21-Jun-12	DMRM	OHIO	REMOVAL OF COAL WITHIN THE DESIGNATED BUFFER ZONE		
2097	29167	02-Jul-12	DMRM	OHIO	MINING IN WATERSHED W/O COMPLETED DRAINAGE CONTROL SYST		Terminated
1164	29844	10-Jul-12	DMRM	OHIO	FAILURE TO MAINTAIN PRIMARY SPILLWAY & DAM		Terminated
2376	29343	17-Aug-12	DMRM	OHIO	FAILURE TO FOLLOW BLASTING PLAN		Non-Remedial
2386	29540	19-Sep-12	DMRM	OHIO	AFFECTED ACRES EXCEEDS ACRES OF PERFORM BOND		Terminated
2325	29418	20-Nov-12	DMRM	OHIO	AFFECTED WITHIN THE BUFFER ZONE OF STREAM D		Terminated
2254	29353	28-Nov-12	DMRM	OHIO	MINING WITHIN A DESIGNATED AREA ONLY		Terminated
981	29249	29-Nov-12	DMRM	OHIO	FAILURE TO FOLLOW APPROVED DISPOSAL PLAN		Terminated
2319	29542	16-Jan-13	DMRM	OHIO	FAILURE TO MAINTAIN POND 003		Terminated
2369	29881	16-Apr-13	DMRM	OHIO	POND 9 LEAKING DISCHARGING THRU DEVELOPED SPRING		
2369	29903	08-May-13	DMRM	OHIO	POND 9 LEAKING EXCEEDING MAX LIMIT SUSP. SOLIDS		Terminated
2398	29900	15-May-13	DMRM	OHIO	BLASTING PPV EXCEEDED 2.0 LIMIT		Non-Remedial
2398	29898	15-May-13	DMRM	OHIO	FAILURE TO MONITOR & PROVIDE BLASTING DATA		Non-Remedial
2393	29421	11-Jun-13	DMRM	OHIO	ACID WATER PH 4.5 DISCHARGING FROM POND 002		Terminated
2376	29398	18-Jun-13	DMRM	OHIO	BLASTING PPV EXCEEDED LIMIT OF .50 IPS		Non-Remedial
2315	29901	26-Jun-13	DMRM	OHIO	FAILURE TO PASS ALL SURFACE DRAINAGE TUR SILT STRUC		Non-Remedial
2295	29845	23-Jul-13	DMRM	OHIO	EROSION EXITS AT POND 011 SPILLWAY & OFF PERMIT AREA		Terminated
2295	29846	24-Jul-13	DMRM	OHIO	SEDIMENT IN EXCESS OF POND CAPACITY		Terminated
2295	29848	24-Jul-13	DMRM	OHIO	EROSION EXISTS AT STREAM CROSSING & DIVERSION DITCHES		Terminated
2295	29847	24-Jul-13	DMRM	OHIO	ERIOSION EXISTSPOND 15 SPILLWAY TO RECEIVING STREAM		Terminated
2386	I13165	02-Aug-13	DMRM	OHIO	LANDSLIDE OCCURRED BEYOND PERMIT LIMITS		Terminated
2315	29908	13-Aug-13	DMRM	OHIO	BLAST EXCEEDED PPV OF 1.0 IPS LIMIT @ NEAREST DWELLING		Non-Remedial
2408	I-13170	10-Dec-13	DMRM	OHIO	LANDSLIDE HAS OCCURRED BEYOND PERMIT LIMITS		Terminated

Appendix 1-11

North Private Lease
County Road 136 (K3900) Relocation
Grant of Easement,Permit and Design

WHEN RECORDED, RETURN TO:

Kane County Attorney
76 North Main Street
Kanab, Utah 84741

GRANT OF EASEMENT FOR COUNTY ROAD K3900

THIS GRANT OF EASEMENT FOR COUNTY ROAD **K3900** (also referred to as County Road 136) (this "**Agreement**") is made and entered into as of the 18 day of Sept, 2015 (the "**Effective Date**"), by and between **HEATON BROTHERS, LLC,** ("**Grantor**" or "**Heaton Brothers**"), and **ALTON COAL DEVELOPMENT, LLC**, a Nevada limited liability company, ("**Alton**" or "**Grantor**") and Kane County, a political subdivision of the State of Utah ("**County**" or "**Grantee**"). Grantor, Grantee, Alton and County are sometimes hereinafter referred to as a "**Party**" and collectively referred to as the "**Parties.**"

RECITALS

A. County Road **K3900** currently intersects the Coal Hollow Mine North Private Lease Area crossing lands owned by Heaton Brothers, LLC ("**Heaton Brothers Property**") and leased by Alton ("**North Private Lease Area**," described at **Exhibit A** to this Agreement).

B. Approximately 0.6 miles of County Road will be temporarily relocated to allow for Alton's mining operations. This relocated section begins approximately 0.8 miles south of the Town of Alton and will reconnect with the original road approximately 1.4 miles south of the Town. The proposed relocation of the County road is within the North East Quarter, Section 13, Township 39 South, Range 6 West, SLB&M, Kane County, more particularly described on **Exhibit B** to this Agreement (the "**Temporary Relocation Easement Area**").

C. Alton intends to conduct coal mining activities on certain portions of the Heaton Brothers Property and following mining of these lands, seeks to replace the right of way for County Road **K3900** across the Heaton Brothers Property within an area described at Exhibit C to this Agreement (the "**Replacement Easement Area"**).

D. Alton and Kane County ("**County"**) have entered into an agreement regarding the relocation and replacement of County Road **K3900** ("**County Road K3900 Agreement**").

E. This Agreement seeks to grant an easement and right of way from Grantors on the North Private Lease Area and the Alton lease area to the County for temporary relocation and replacement of County Road **K3900.**

F. The Temporary Relocation Easement Area and the Replacement Easement Area burden certain portions of the North Private Lease Area more particularly described on Exhibits B and C and depicted on the maps and diagrams attached at **Exhibit D** to this Agreement (jointly referred to as the "**Easement Areas**").

G. Following mining and upon replacement of County Road **K3900** within the Replacement Easement, and removal of the County Road **3900** from the Temporary Relocation Easement Area, the County intends to reconvey the Temporary Relocation Easement Area to Grantors.

AGREEMENT

NOW, THEREFORE, for valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the Parties agree as follows:

1. Grant of Temporary Relocation Easement. Grantors hereby grant to the County a temporary, exclusive easement and right of way 66 feet in width for County Road **K3900** over, across, upon and within any area within the outlying boundaries within the Easement Area, for the purpose of constructing, owning, operating, maintaining, repairing and relocating County Road **K3900** (Temporary Relocation Easement Area).

2. Grant of Replacement Easement. Grantors hereby grant to the County a perpetual, exclusive easement and right of way 66 feet in width for County Road **K3900** over, across, upon and within any area within the outlying boundaries within the Easement Area, for the purpose of constructing, owning, operating, maintaining, repairing and replacing County Road **K3900** (Replacement Easement Area).

3. Construction and Use Requirements as Provided by the County Road K3900 Agreement. The County Road **K3900** within the Easement Area shall be constructed in accordance with County specifications and shall be owned by the County, and operated and maintained by County without any cost, expense or obligation on the part of Grantors. Further, the parties agreed to provide each other with written notice prior to commencing construction within the Easement Areas.

4. Obstructions. Grantors, by the terms of said agreement, shall not construct any fence, wall, or other barrier or structure of any kind on the Easement Areas which would prevent, obstruct or impair County's use and enjoyment of the Easement Areas and the operation of County Road **K3900.**

5. Term. The duration of this Agreement shall be perpetual unless all Parties mutually agree in writing to terminate this Agreement.

6. Successors and Assigns. This Agreement shall be binding upon and inure to the benefit of the Parties and their respective successors and assigns.

7. Notices. All notices, requests, demands or other communications hereunder shall be in writing and deemed given when delivered personally, when deposited to be sent via a nationally-recognized overnight courier keeping receipts of delivery, service prepaid or billed to sender, or on the day said communication is deposited with an overnight courier service, postage prepaid, addressed as follows:

To County: Kane County Commission
76 North Main Street
Kanab, Utah 84741

With a copy to: Kane County Attorney
76 North Main Street
Kanab, Utah 84741

To Grantee: ALTON COAL DEVELOPMENT, LLC
463 North 100 West, Suite 1
Cedar City, Utah 84720
Attention: Larry W. Johnson

With a copy to: Denise A. Dragoo, Esq.
Snell & Wilmer L.L.P.
15 West South Temple, Suite 1200
Salt Lake City, Utah 84101

To Grantor: Heaton Brothers, LLC
449 South 2050 West
Cedar City, Utah 84720

or to such other address as either Party may from time to time designate by notice in writing to the other Party. Rejection, refusal to accept delivery or inability to deliver due to changed address of which no notice has been given shall be deemed receipt by the addressee.

8. Governing Law. This Agreement shall be governed by and construed in accordance with the laws of the State of Utah, without giving effect to its choice of law principles.

9. Counterparts. This Agreement may be executed in one or more counterparts, each of which shall be deemed as an original but all of which together shall constitute one and the same instrument.

10. Entire Agreement. This Agreement supersedes all prior understandings, representations and agreements between the Parties with regard to the subject matter hereof and there are no other understandings, representations, warranties or agreements between them.

11. Amendment. Neither this Agreement nor any provision hereof may be changed, amended, modified, waived or discharged orally or by any course of dealing, but only by an instrument in writing signed by the Party against which enforcement of the change, amendment, modification, waiver or discharge is sought.

12. Authority. Each party hereto hereby represents, warrants and covenants unto the other that this Agreement has been duly authorized, executed and delivered by such party and constitutes the valid, legal and binding agreements and obligations of such party enforceable against such party in accordance with the terms hereof.

13. No Joint Venture. Nothing in this Agreement shall be construed to make the Parties partners or joint venturers or render any of the Parties liable for the debts or obligations of the other.

14. Agreement to Run with the Land; Running of Benefits and Burdens. All provisions of this Agreement touch, concern and run with the Heaton Brothers, LLC properties, tracts 9-6-13-1 and 9-6-13-2 and Easement Area and are binding upon and inure to the benefit of the successors and assigns of Grantor and Grantee.

IN WITNESS WHEREOF, the Parties have caused this Agreement to be executed by their duly authorized representatives effective as of the Effective Date.

Grantor:

HEATON BROTHERS, LLC

By: _____
Its: President

Grantor:

ALTON COAL DEVELOPMENT, LLC

By: _____
Its: General Manager

Grantee:

KANE COUNTY

By: _____
Chairman, Kane County Commission

STATE OF UTAH)
: ss.
COUNTY OF IRON)

The foregoing instrument was acknowledged before me this 18 day of Sept, 2015, by Larry W. Johnson, Manager of ALTON COAL DEVELOPMENT, LLC, a limited liability company.

Sherrie Prisbrey
NOTARY PUBLIC
Residing at: Cedar City Ut

My Commission Expires:

9/26/2015

SHERRIE PRISBREY
Notary Public
State of Utah
Comm. No. 648903
My Comm. Expires Sep 26, 2015

STATE OF UTAH)
: ss.
COUNTY OF UTAH)

The foregoing instrument was acknowledged before me this 18 day of Sept, 2015, by Ronald W. Heaton, President/Manager of HEATON BROTHERS, LLC, a limited liability company.

Sherrie Prisbrey
NOTARY PUBLIC
Residing at: Cedar City Ut

My Commission Expires:

9/26/2015

SHERRIE PRISBREY
Notary Public
State of Utah
Comm. No. 648903
My Comm. Expires Sep 26, 2015

RH

STATE OF UTAH)
: ss.
COUNTY OF KANE)

The foregoing instrument was acknowledged before me this 21st day of September 2015, by Douglas K. Heaton, Chairman of KANE COUNTY COMMISSION.

Karla Ipson
NOTARY PUBLIC
Residing at: 76 N Main Kanab, Ut 84741

My Commission Expires:
12/31/18

SEAL COUNTY CLERK/AUDITOR BE JUST KANE COUNTY STATE OF UTAH

County Clerk/Auditor
Attest: The foregoing instrument was acknowledged before me
by: Douglas K Heaton
on Sept 21, 2015
SEAL:

EXHIBIT A

Legal Description of the North Private Lease Area

The following described lands located in Kane County, Utah within Sec. 12 &13, T39S, R6W and within Sec. 7 &18, T39S, R5W:

Beginning at S 58^{0} 16' 29" W a distance of 1,920.87 ' from Section Corner 7-18-12-13, T39S, R5 R6W;thence N 89°29'27\ W a distance of 823.81'; thence S 00°00'38\ E a distance of 1313.93'; thence S 65°46'32\ E a distance of 479.40'; thence S 89°44'30\ E a distance of 1861.86'; thence S 54°58'33\ E a distance of 226.53'; thence S 89°45'07\ E a distance of 1235.50'; thence N 00°41'09\ E a distance of 1322.97'; thence N 00°41'09\ E a distance of 1322.97'; thence S 89°30'20\ E a distance of 241.42'; thence N 00°51'49\ E a distance of 1323.52'; thence N 89°22'59\ W a distance of 249.30'; thence N 89°56'02\ W a distance of 2923.34'; thence S 00°24'59\ W a distance of 2326.09'; which is the point of beginning, having an area of

12,877,780.47 square feet, or **295.633 acres**

EXHIBIT B

Legal Description of the Temporary Relocation Easement

HEATON BROTHERS, LLC LEASE AREA DESCRIPTION:

BEGINNING AT A POINT N52°09'23"E 4413.80 FEET FROM THE WEST QUARTER CORNER SECTION 13 TOWNSHIP 39 SOUTH RANGE 6 WEST SALT LAKE BASE AND MERIDIAN SAID POINT BEING THE CENTERLINE OF A PROPOSED BY PASS ROAD EASEMENT AND THE CENTERLINE OF AN EXISTING COUNTY ROAD; RUNNING THENCE ALONG THE BYPASS ROAD CENTERLINE THE FOLLOWING COURSES: S14°39'53"W 89.62 FEET TO THE PC OF A CURVE TO THE RIGHT; CURVE DATA: TANGENT 16.90' CHORD 33.75' COURSE N17°53'22"E RADIUS 300.00' DELTA 6°26'58" THENCE ALONG SAID CURVE 33.77 FEET TO THE PT; THENCE S21°06'51"W 192.60 FEET TO THE PC OF A CURVE TO THE RIGHT CURVE DATA: TANGENT 16.78' CHORD 127.38' COURSE N33°22'18"E RADIUS 300.00' DELTA 24°30'54" THENCE ALONG SAID CURVE 128.36 FEET TO THE PT; THENCE S45°37'44"W 469.48 FEET TO THE PC OF A CURVE TO THE LEFT; CURVE DATA: TANGENT 60.63' CHORD 118.85' COURSE S34°12'15"W RADIUS 300.00' DELTA 22°50'59" THENCE ALONG SAID CURVE 119.64 FEET TO THE PT; THENCE S22°46'45"W 228.51 FEET TO THE PC OF A CURVE TO THE LEFT; CURVE DATA: TANGENT 60.15' CHORD 117.95' COURSE S11°26'31"W RADIUS 300.00' DELTA 22°40'28" THENCE ALONG SAID CURVE 118.72 FEET TO THE PT; THENCE S00°06'16"W 256.42 FEET TO THE SOUTH LINE OF THE HEATON BROTHERS PROPERTY AND THE POINT OF ENDING.

ALTON COAL, LLC NORTH PRIVATE PERMIT LEASE AREA DESCRIPTION:

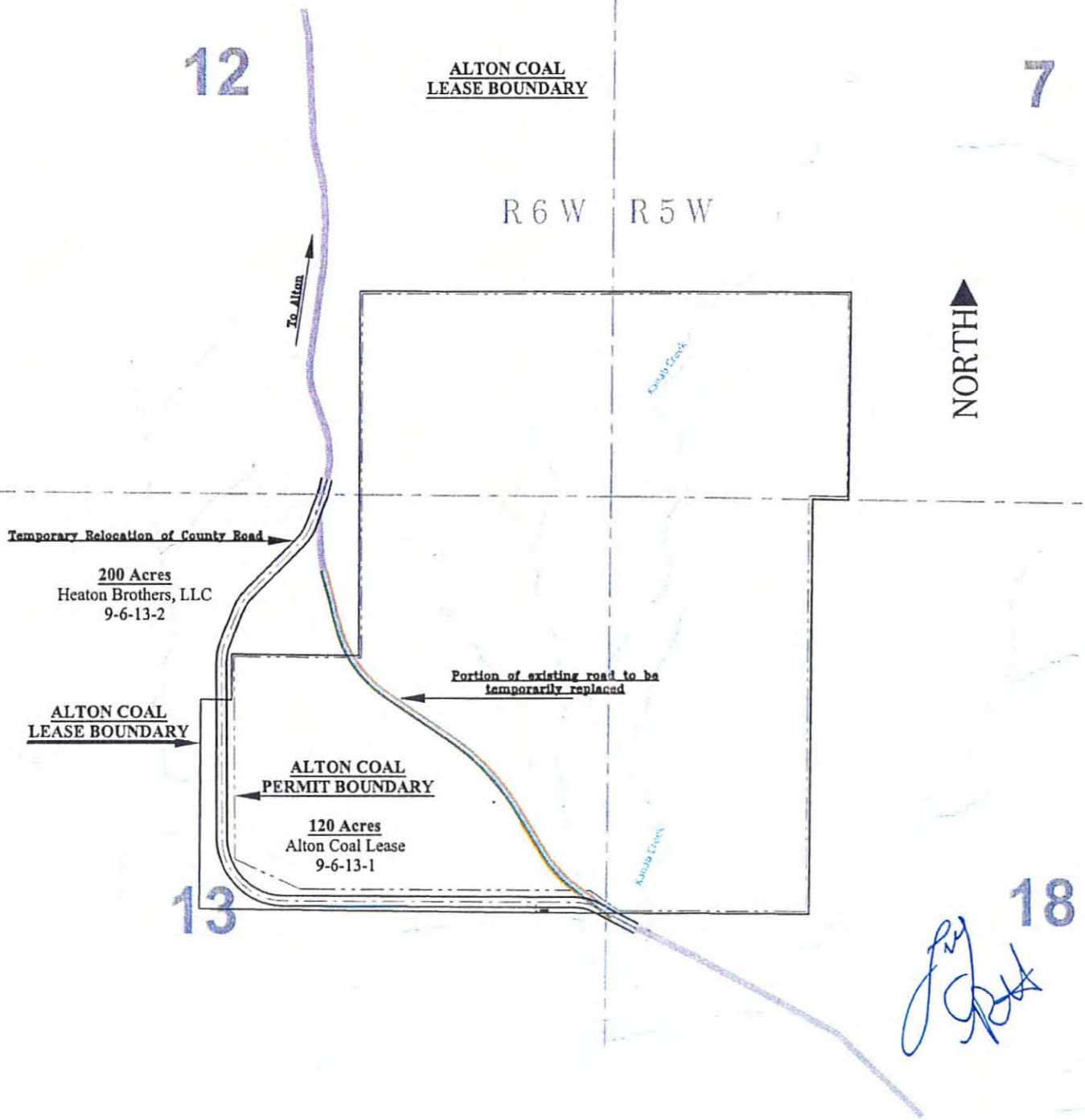
BEGINNING AT A POINT N65°11'15"E 3082.87 FEET FROM THE WEST QUARTER CORNER SECTION 13 TOWNSHIP 39 SOUTH RANGE 6 WEST SALT LAKE BASE AND MERIDIAN SAID POINT BEING THE CENTERLINE OF A PROPOSED BY PASS ROAD EASEMENT AND THE NORTH LINE OF THE NORTH PRIVATE PERMIT LEASE AREA PROPERTY; RUNNING THENCE ALONG SAID CENTERLINE THE FOLLOWING COURSES: S00°06'16"W 870.32 FEET TO THE PC OF A CURVE TO THE LEFT; CURVE DATA: TANGENT 398.58' CHORD 564.68' COURSE S44°47'37"E RADIUS 400' DELTA 89°47'48" THENCE ALONG SAID CURVE 626.90 FEET TO THE PT; THENCE S89°41'31"E 1877.24 FEET TO THE PC OF A CURVE TO THE RIGHT CURVE DATA: TANGENT 72.39' CHORD 140.74; COURSE S76°07'33"E RADIUS 300' DELTA 27°07'56" THENCE ALONG SAID CURVE 142.06 FEET TO THE PT; THENCE S62°33'35"E 76.59 FEET TO THE SOUTH LINE OF THE NORTH PRIVATE PERMIT LEASE AREA PROPERTY AND THE POINT OF ENDING.

EXHIBIT C

Legal Description of the Replacement Easement Area

BEGINNING AT A POINT N52°09'23"E 4413.80 FEET FROM THE WEST QUARTER CORNER SECTION 13 TOWNSHIP 39 SOUTH RANGE 6 WEST SALT LAKE BASE AND MERIDIAN SAID POINT BEING THE CENTERLINE OF THE REPLACEMENT ROAD EASEMENT AND THE CENTERLINE OF AN EXISTING COUNTY ROAD; RUNNING THENCE: S14°35'54"W 108.41 FEET; THENCE S11°35'34"W 111.22 FEET; THENCE S02°19'40"E 321.46 FEET; THENCE S13°27'08"E 444.10 FEET; THENCE S21°28'04"E 166.43 FEET; THENCE S42°42'54"E 323.24 FEET; THENCE S55°58'34"E 441.32 FEET; THENCE S52°00'18"E 312.75 FEET; THENCE S41°32'11"E 367.14 FEET; THENCE S31°48'12"E 407.12 FEET; THENCE S42°55'54"E 293.06 FEET; THENCE S55°10'16"E 217.66 FEET; THENCE S60°36'13"E 207.50 FEET TO THE SOUTH LINE OF THE NORTH PRIVATE PERMIT LEASE AREA PROPERTY AND THE POINT OF ENDING.

EXHIBIT D
Map of Easement Areas



Kane County GIS / Transportation Department

Excavation Permit Application

76 North Main St. – Kanab, UT 84741

(435) 644-4968 – FAX (435) 644-2052

www.kanerds@kanab.net

Permit # 12215

Applicant: Alton Coal Development, LLC Mailing Address: 463 North 100 West

Phone # 435-867-5331 City Cedar City, Utah Zip 84721

Project Address: 2060 South Alton Road, SE of Alton Town

Contractor: Alton Coal Development, LLC Phone: 435-867-5334 Contractors License #:

Liability Insurance Carrier: American Mining Insurance Company Policy #: AGL2521539-10

Date Work to Begin: April 2015 Date of Completion: August 2015

The APPLICANT shall be the party responsible for the work and to whom all communications are to be directed.
EXCAVATION PERMITS are valid for a period of **60 days from the date received.**
ALL EXCAVATIONS require a **48 hour** notice prior to work. All construction restoration must be completed within 5 working days of completion of excavation, unless extended in writing by the Kane County Transportation Director. All bonds are retained for a period not less than one year.

COUNTY ROAD RIGHT-OF-WAY EXCAVATION (Refer to Standard Specifications and Drawing Details For Design and Construction)
TYPE OF WORK: Check all that apply:

Utilities:[ ] Telephone:[ ] Gas:[ ] Electric:[ ] Water:[ ] Cable T.V.:[ ] Sanitary Sewer:[ ] Storm Drain: Culvert, Curb & Gutter:[ ]
Road Surface Type: Asphalt:[ ] Gravel:[X] Other:[ ]

PROJECT DESCRIPTION: Construct a Bypass road around mining operations boundaries

ASPHALT CUTS ARE NOT ALLOWED OCTOBER 15 – MAY 1 – IS ASPHALT CUT REQUIRED? NO
If YES, please explain in detail why other alternatives are infeasible or impractical:

Roads treated with any type of dust suppressant will be replaced by permit holder upon excavation completion

SIZE OF EXCAVATION: _____ Ft X _____ Ft = _____ SIZE OF ASPHALT CUT: _____ Ft X _____ Ft = Sq. Ft. _____

EXCAVATION / DIRECT BURIAL PERMIT FEE

$25 per Excavation (Up to 100 Ft in Length) $25 x _____ = $_____

$5 per Additional 100 Ft $5 x _____ = $_____

Driveway Culvert Installation $25 x _____ = $_____
($25 Per Driveway Opening) **Minimum size: 12" culvert / Pipe**

TOTAL FEES DUE $ NC

BOND REQUIREMENTS

Asphalt Roadway:

$1500 Completion bond (Up to 100 Ft in Length) $_____
$500 per Additional 100 Ft $500 X _____ = $_____
$20 per Square Foot of Asphalt Cut $20 X _____ = $_____

Gravel Roadway:

$500 Completion Bond (Up to 100 Ft in Length) $_____
$250 per Additional 100 Ft $250 X _____ = $_____

Driveway Culvert Bond per access - $250 X _____ = $_____
(Driveway bond releasable after final inspection, excluding paved roads)

TOTAL BONDS DUE $_____

SUBMITTAL REQUIREMENTS:

☐ 1. Completed Application ☐ 2. Completion Bond [ ] Cash, [ ] Performance, [ ] Surety, [ ] Letter of Credit, [ ] Other _____

☐ 3. Permit Fee ☐ 4. Detail Drawing of Work ☐ 5. Traffic Control Plan – **Per MUTCD**

☐ 6. Certificate of Insurance (On File _____)

By signing this application, the Applicant agrees to comply with all State and Federal Laws and Kane County Standard Specifications for Design and Construction.

Applicant's Signature: _____ Date: 1-22-15

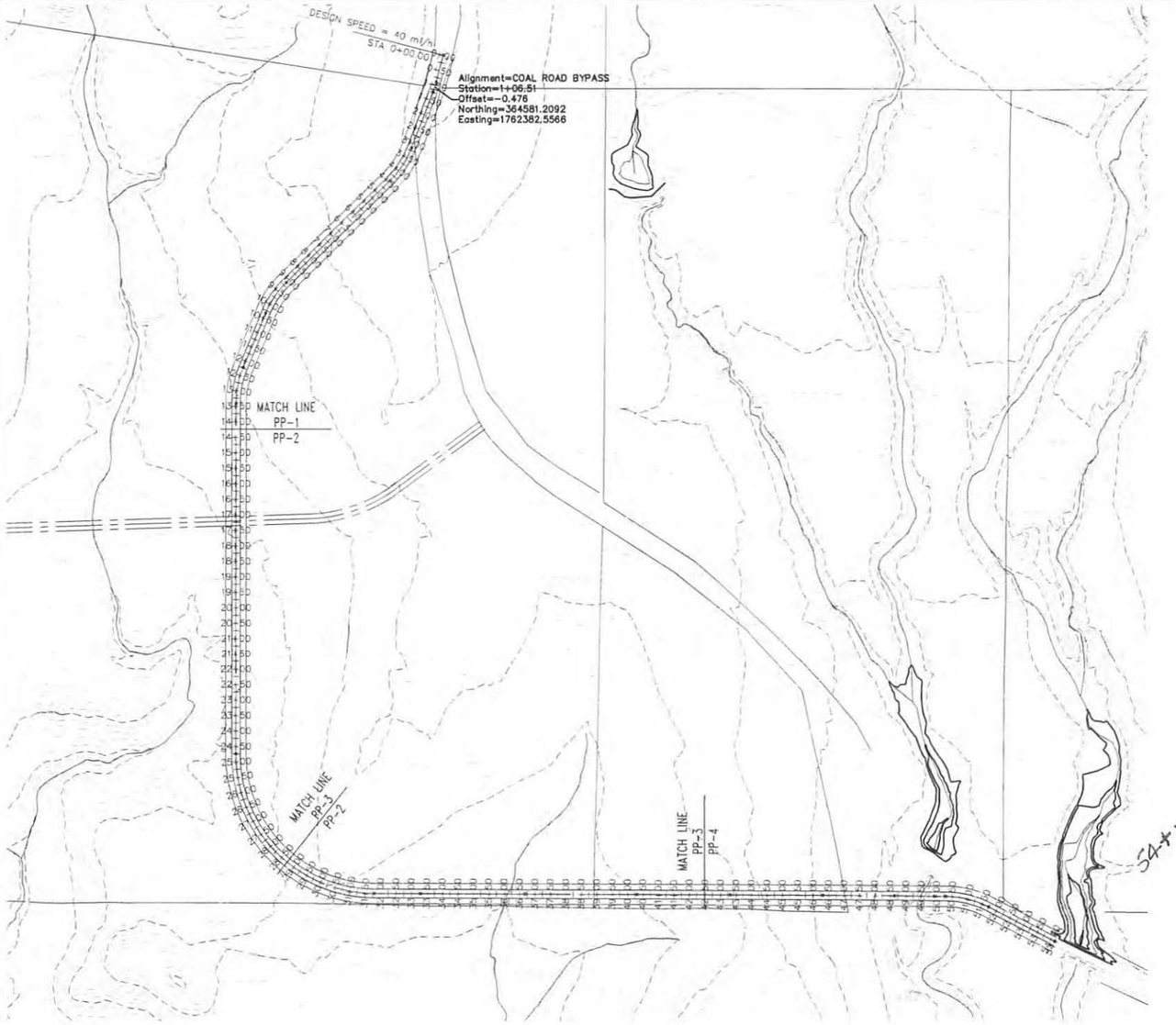
GIS / Transportation Director _____ Date: 1-22-15

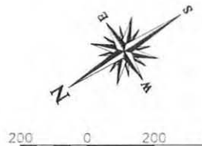
Final Inspection: _____ Date: _____

Bond Money Posted	Date Released
Completion _____	_____

A SIGNED COPY OF THIS PERMIT APPLICATION MUST BE AVAILABLE AT THE JOB SITE This permit is issued only as permission to excavate in the public right-of-way. It is not a grant of easement or other similar interest. Permittee shall acquire easements from affected fee owners as required.

Approval Date: February 25, 2008 Review Date: Two years from approval





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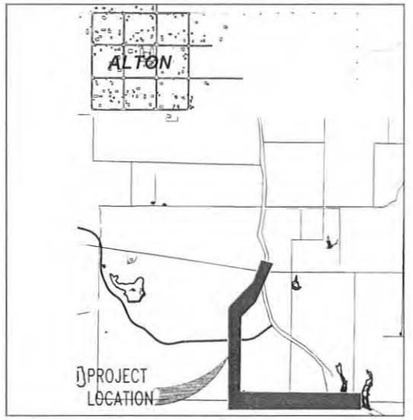

VICINITY MAP
(NO SCALE)

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C-C1	COVER SHEET
C-P1	COAL BYPASS ROAD STA: 0+00-14+25
C-P2	COAL BYPASS ROAD STA: 14+25-28+75
C-P3	COAL BYPASS ROAD STA: 28+75-42+50
C-P4	COAL BYPASS ROAD STA: 42+50-54+14.71

COAL BYPASS ROAD

LOCATED IN SECTION 13, T 39 S, R 6 W, SLB&M
KANE COUNTY, UTAH
AUGUST 2014

AVOID CUTTING UNDERGROUND UTILITIES. IT'S COSTLY
Call BEFORE YOU Dig
1-800-662-4111
(UNDERGROUND SERVICE (USA))

NOTICE!
THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE LOCATION, PROTECTION, AND RESTORATION OF ALL BURIED OR ABOVE GROUND UTILITIES, SHOWN OR NOT SHOWN ON THE PLANS.

NOTE: ALL WORK AND MATERIALS SHALL BE IN ACCORDANCE WITH CURRENT ST. GEORGE CITY STANDARDS

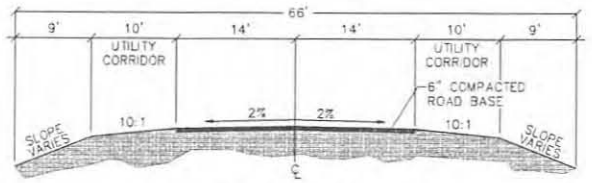
REVISIONS			
NO.	DESCRIPTION	DATE	BY

BROWN CONSULTING ENGINEERS, P.C.
CIVIL ENGINEERING-LAND SURVEYING-LAND PLANNING
163 WEST 1600 SOUTH, UNIT 5
ST. GEORGE, UTAH 84770
(435) 628-4700 FAX (435) 628-4725

COVER SHEET
FOR
COAL BYPASS ROAD
LOCATED IN SEC. 13, T39S, R6W, SLB & M.
KANE COUNTY, UTAH

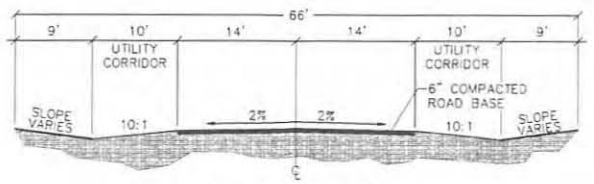
PRELIMINARY ONLY
NOT FOR
CONSTRUCTION

CHECKED BY : MLB
DRAWN BY : SWB
DATE : AUGUST 2014
JOB NO. : 14-32
SCALE : 1"=200'
SHEET NO. : C-C1



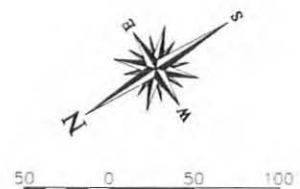
PRIVATE ROAD SECTION
66' RIGHT-OF-WAY

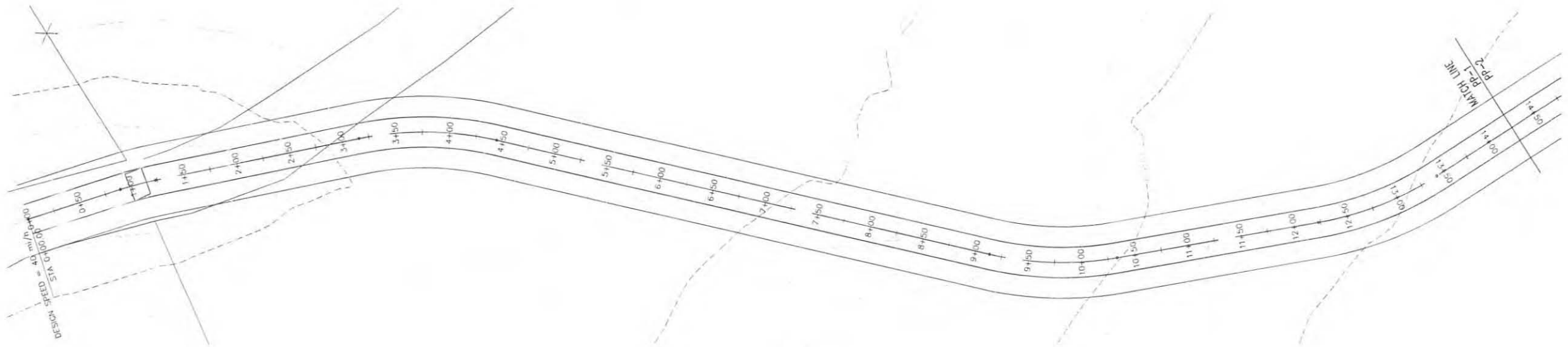
SCALE: 1"=10'



PRIVATE ROAD SECTION
66' RIGHT-OF-WAY

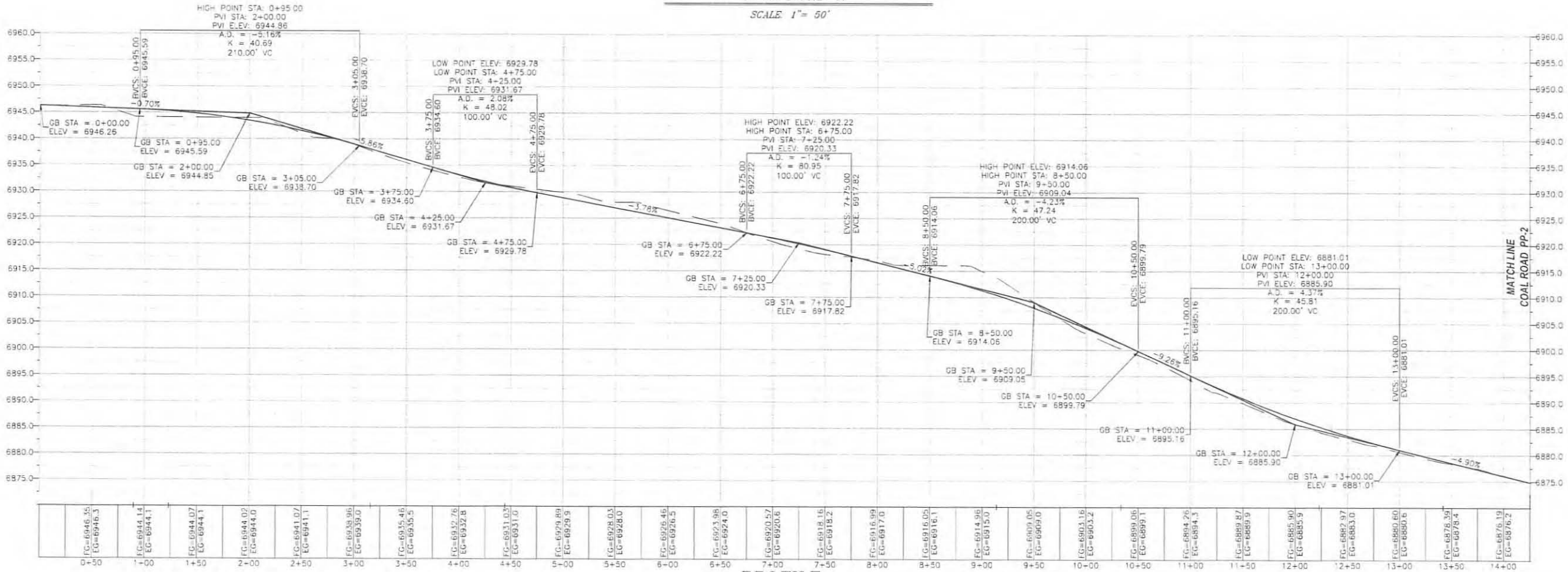
SCALE: 1"=10'





PLAN
COAL ROAD A

SCALE: 1"= 50'



PROFILE
STA. 0+00-14+25

SCALE: HORZ. 1"= 50'
VERT. 1"= 10'

REVISIONS

NO.	DESCRIPTION	DATE	BY

BROWN CONSULTING ENGINEERS, P.C.
CIVIL ENGINEERING-LAND SURVEYING-LAND PLANNING
163 WEST 1600 SOUTH, UNIT 5
ST. GEORGE, UTAH 84770
(435) 628-4700 FAX (435) 628-4725

PLAN AND PROFILE
STA: 0+00-14+25
FOR
COAL BYPASS ROAD
LOCATED IN SEC. 13, T39S, R6W, SLB & M.
KANE COUNTY, UTAH

PRELIMINARY ONLY
NOT FOR
CONSTRUCTION

CHECKED BY : MLB
DRAWN BY : SWB
DATE : AUGUST 2014
JOB NO. : 14-32

SCALE :
1"=50'

SHEET NO. :
C-P1

PLAN AND PROFILE
FOR
STA: 14+25-28+75
COAL BYPASS ROAD
LOCATED IN SEC. 13, T39S, R6W, SLB.&M.
KANE COUNTY, UTAH

PRELIMINARY ONLY
NOT FOR
CONSTRUCTION

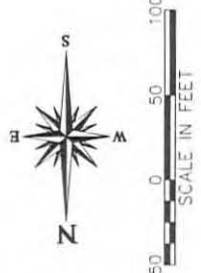
CHECKED BY : MLB
DRAWN BY : SWB
DATE : AUGUST 2014
JOB NO. : 14-32

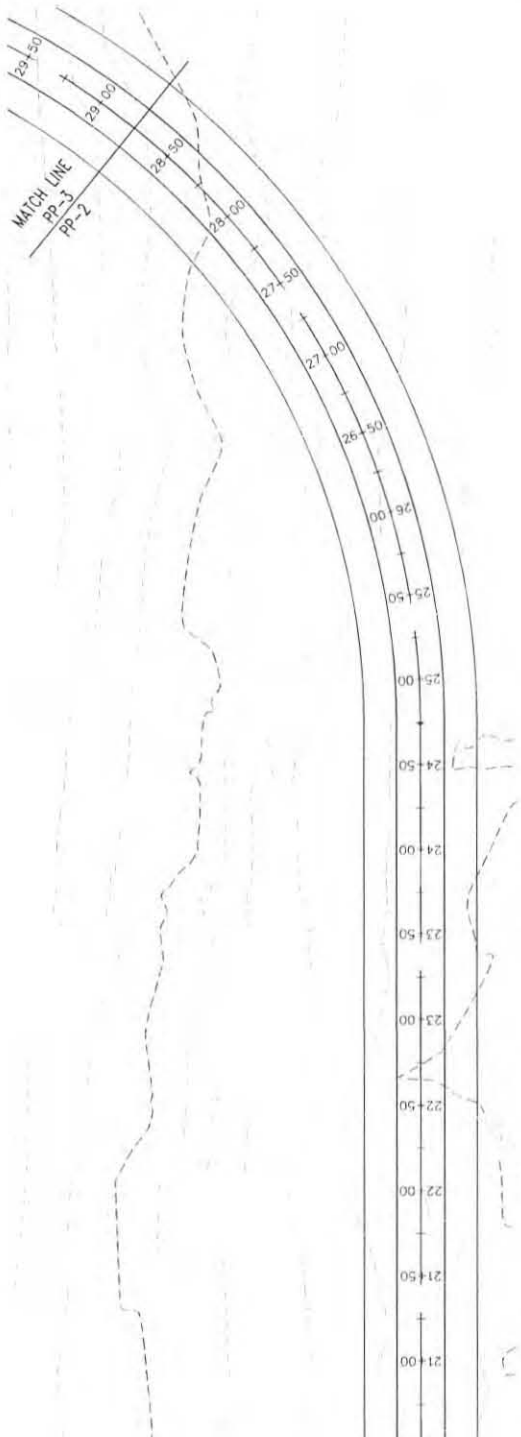
SCALE : 1"=50'

SHEET NO. : C-P2

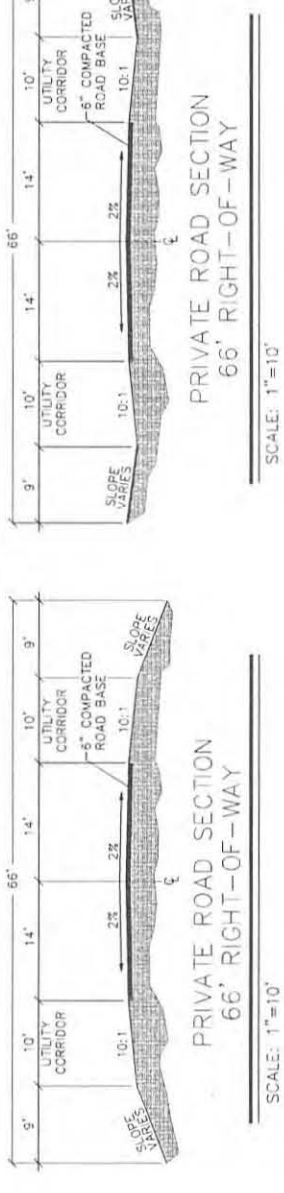
BROWN CONSULTING ENGINEERS, P.C.
CIVIL ENGINEERING-LAND SURVEYING-LAND PLANNING
163 WEST 1600 SOUTH, UNIT 5
ST. GEORGE, UTAH 84770
(435) 628-4700 FAX (435) 628-4725

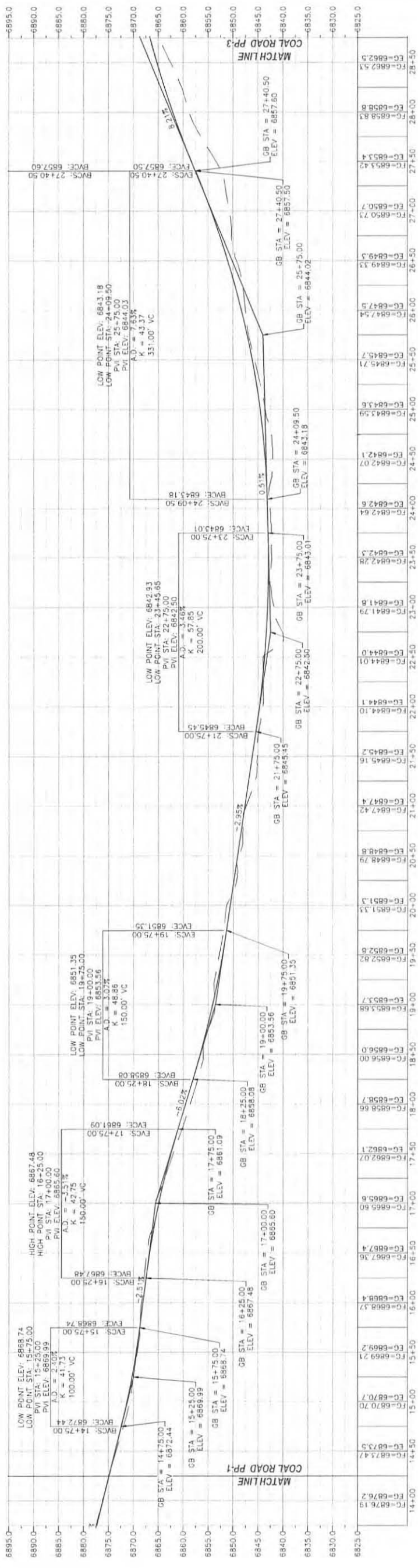
REVISIONS			
NO.	DESCRIPTION	DATE	BY





PLAN
COAL ROAD A
SCALE: 1"= 50'





PROFILE
STA. 14+25-28+75
SCALE: HORZ. 1"= 50'
VERT. 1"= 10'

PLAN AND PROFILE
FOR
COAL BYPASS ROAD
LOCATED IN SEC. 13, T39S, R6W, SLB.&M.
KANE COUNTY, UTAH

PRELIMINARY ONLY
NOT FOR
CONSTRUCTION

CHECKED BY : MJB
DRAWN BY : SWB
DATE : AUGUST 2014
JOB NO. : 14-32

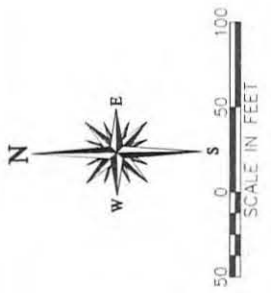
SCALE : 1"=50'

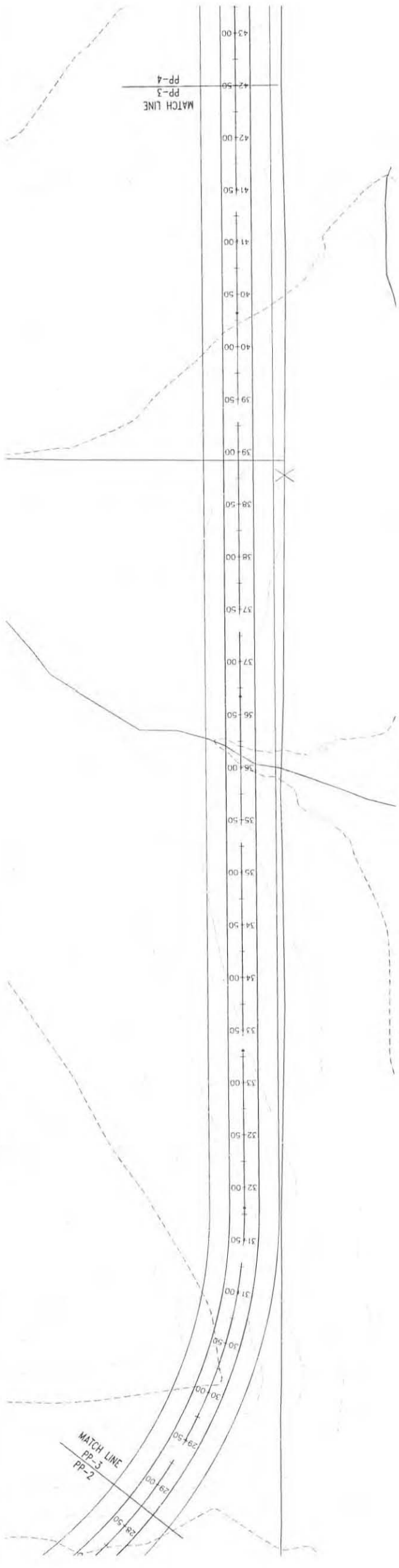
SHEET NO. : C-P3

BROWN CONSULTING ENGINEERS, P.C.
CIVIL ENGINEERING-LAND SURVEYING-LAND PLANNING
163 WEST 1600 SOUTH, UNIT 5
ST. GEORGE, UTAH 84770
(435) 628-4700 FAX (435) 628-4725

REVISIONS

NO.	DESCRIPTION	DATE	BY





PLAN
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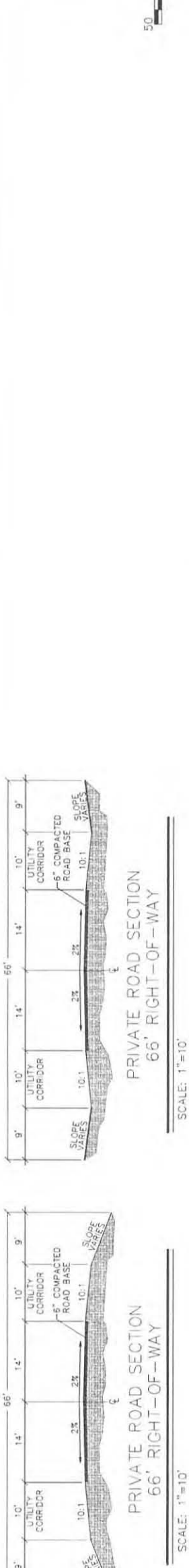
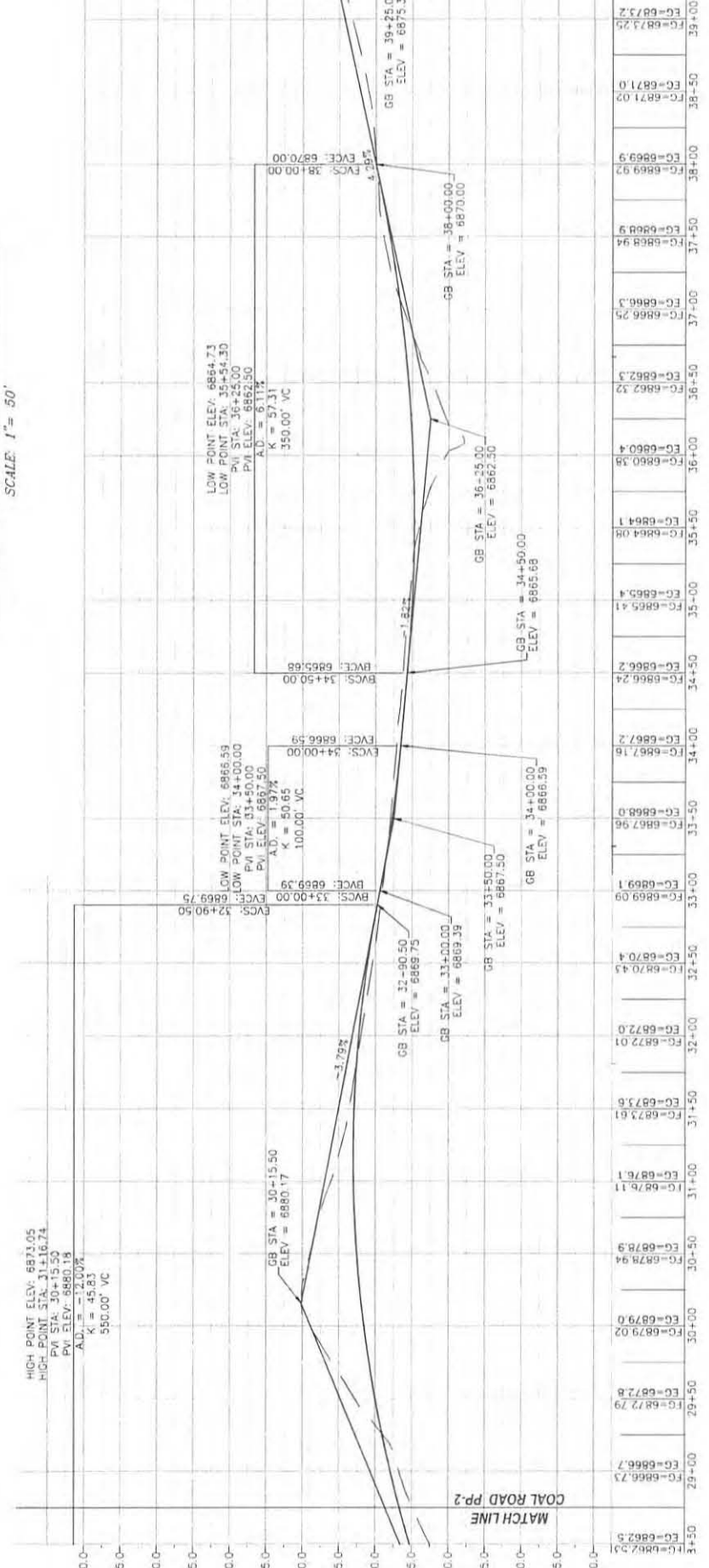


PRIVATE ROAD SECTION
66' RIGHT-OF-WAY
SCALE: 1"=10'

PRIVATE ROAD SECTION
66' RIGHT-OF-WAY
SCALE: 1"=10'



PROFILE
STA. 28+75-42+50
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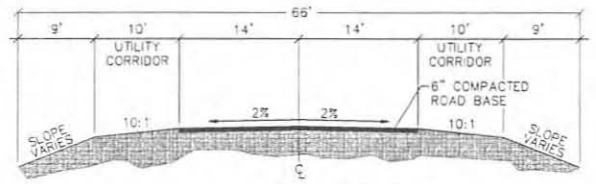

PRIVATE ROAD SECTION
66' RIGHT-OF-WAY

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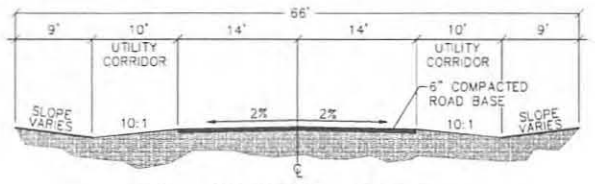

PRIVATE ROAD SECTION
66' RIGHT-OF-WAY

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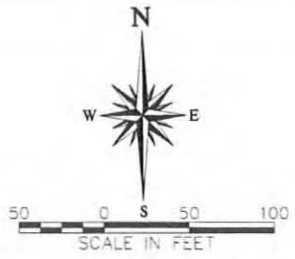
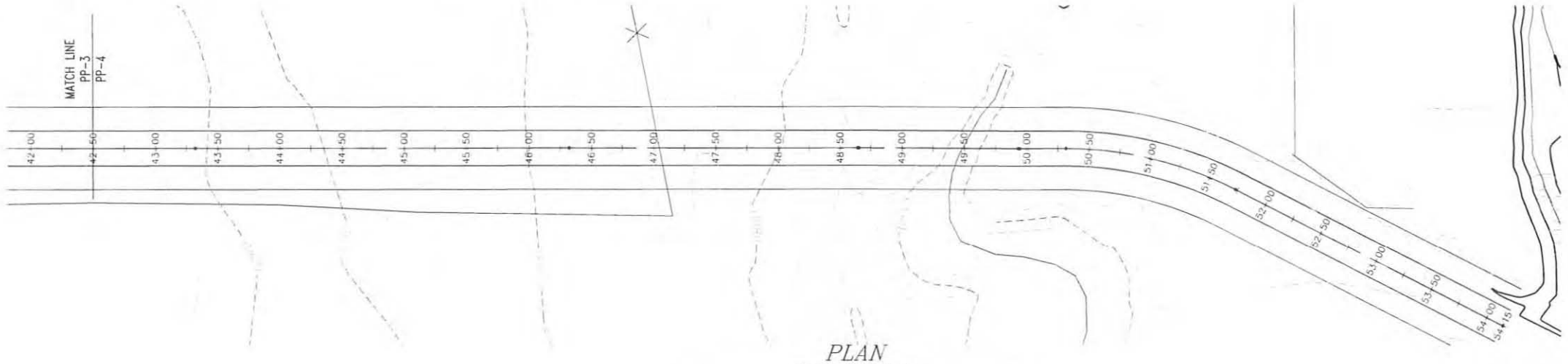
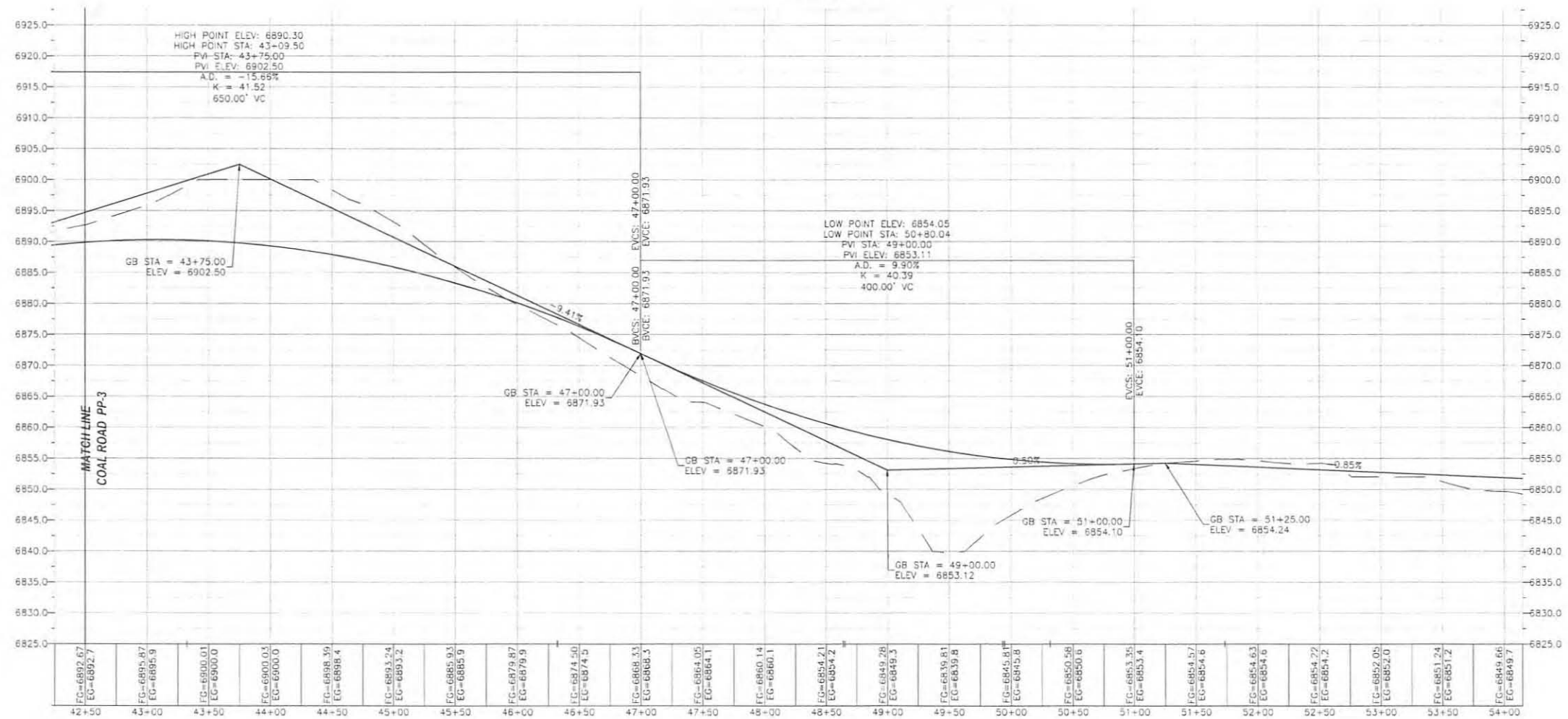




PLAN
COAL ROAD B

SCALE: 1"= 50'



PROFILE
STA. 42+50-54+14.71

SCALE: HORZ. 1"= 50'
VERT. 1"= 10'

REVISIONS

NO.	DESCRIPTION	DATE	BY

BROWN CONSULTING ENGINEERS, P.C.
CIVIL, ENGINEERING-LAND SURVEYING-LAND PLANNING
860 WEST 1400 SOUTH, UNIT 5
ST. GEORGE, UTAH 84770
(435) 628-4700 FAX (435) 628-4725

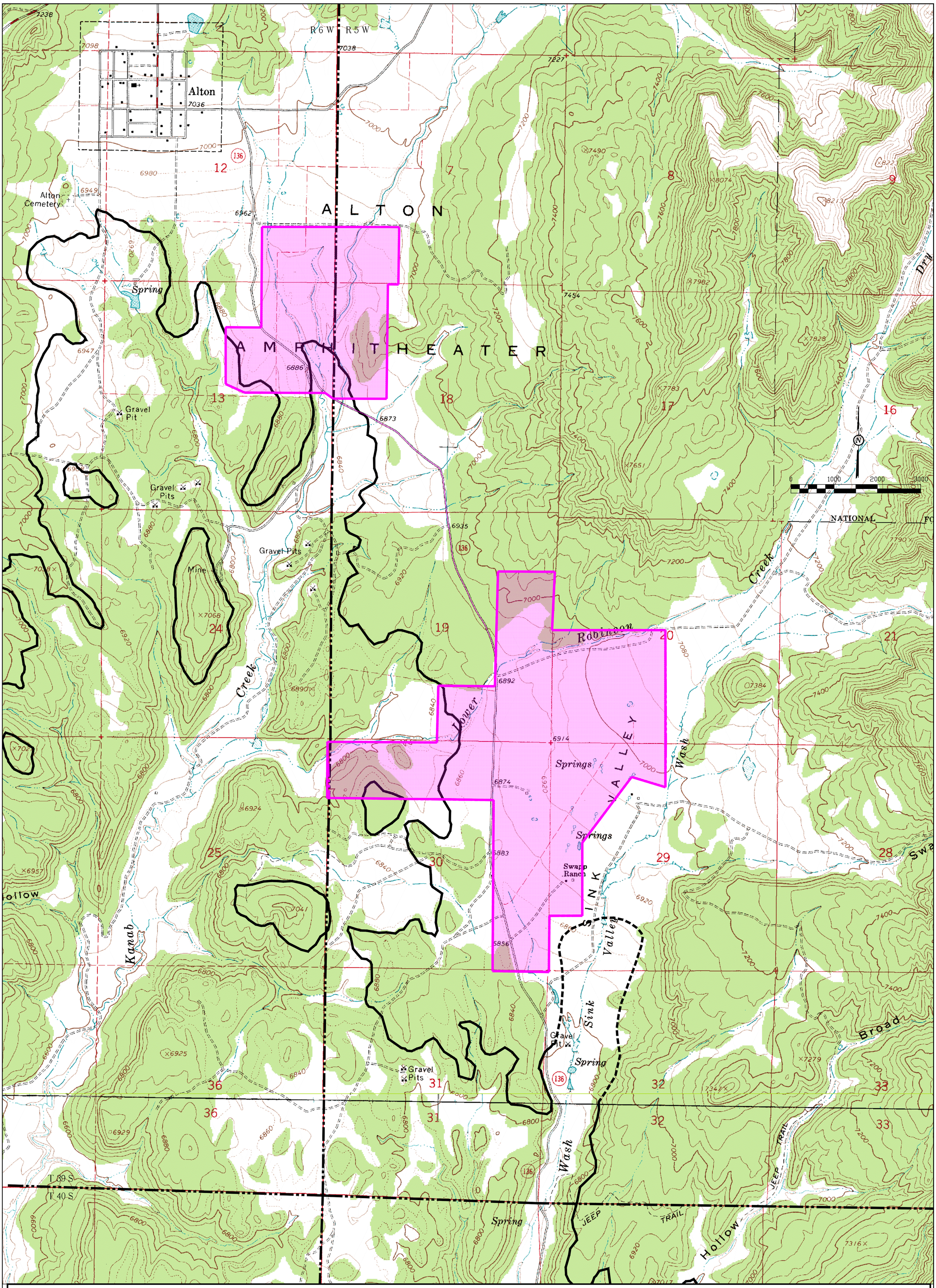
PLAN AND PROFILE
STA: 42+50-54+14.71
FOR
COAL BYPASS ROAD
LOCATED IN SEC. 13, T39S, R6W, S.L.B. & M.
KANE COUNTY, UTAH

PRELIMINARY ONLY NOT FOR CONSTRUCTION

CHECKED BY : MLB
DRAWN BY : SWB
DATE : AUGUST 2014
JOB NO. : 14-32

SCALE : 1"=50'

SHEET NO. : C-P4



LEGEND:

- PERMIT AREA
- COAL LINE BOUNDARY
- COUNTY ROAD

DRAWN BY: N. BUTKOVICH	CHECKED BY: APC
DRAWING: 1 – 1	DATE: 8/16/04
	SCALE: 1" = 1000'
JOB NUMBER: 1400	SHEET

REVISIONS

DATE:	BY:
8/25/08	CRM
10/18/13	KN
8/7/14	KN

PERMIT AREA

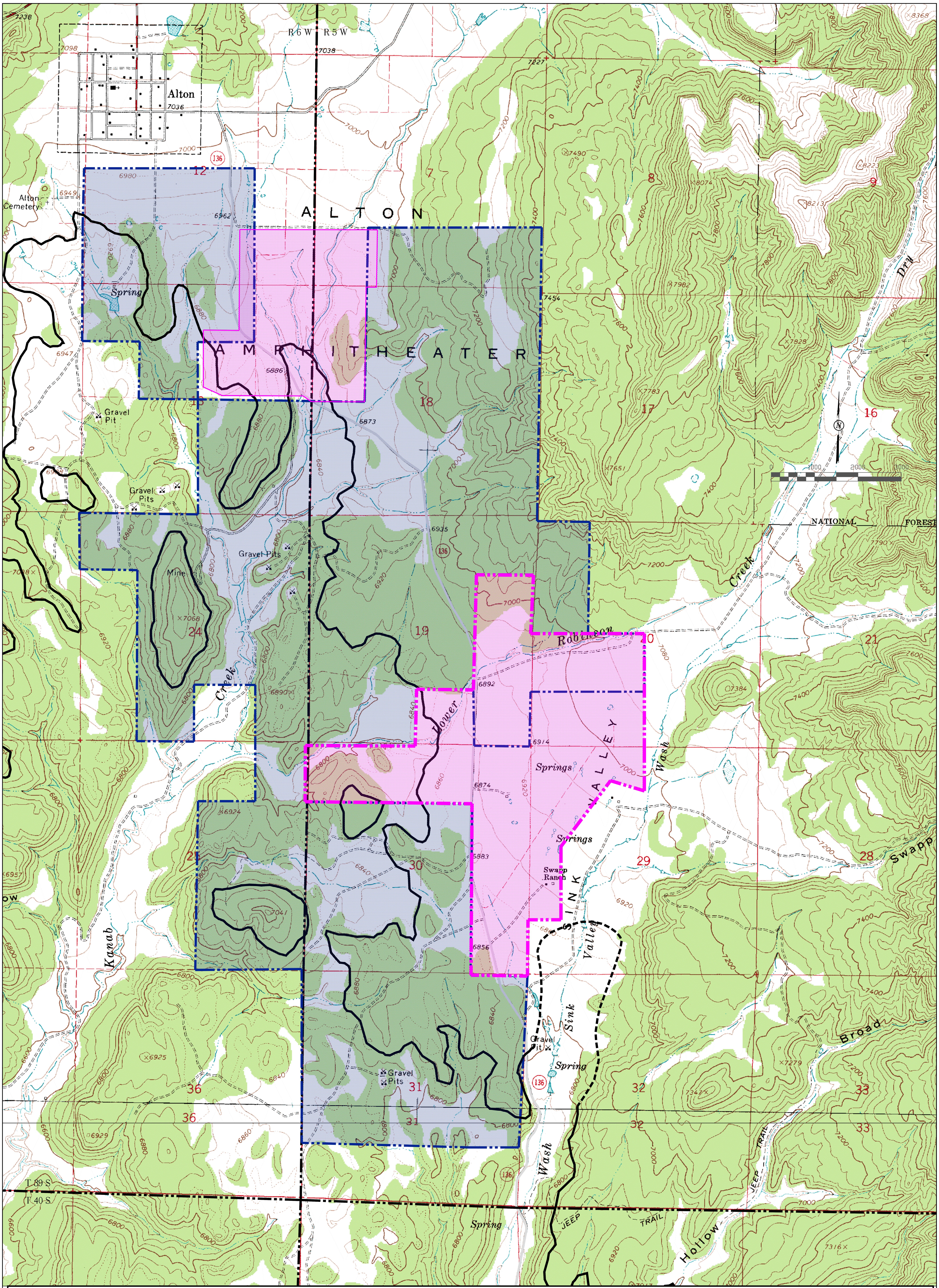
COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 1-1

UTAH REGISTERED #154168 DAN W. GUY PROFESSIONAL ENGINEER

Alton Coal Development
Coal Hollow Project

463 North 100 West, Suite 1
Cedar City, Utah 84721
Phone (435)867-5331
Fax (435)867-1192



LEGEND:
PROPOSED LBA BOUNDARY
PERMIT AREA
COAL LINE BOUNDARY
COUNTY ROAD

DRAWN BY: N. BUTKOVICH
CHECKED BY: DWG
DRAWING: 1-2
DATE: 8/16/04
SCALE: 1" = 1000'
JOB NUMBER: 1400
SHEET

REVISIONS	
DATE:	BY:
8/25/08	CRM
10/18/13	KN
8/7/14	KN

PERMIT AREA WITH LBA

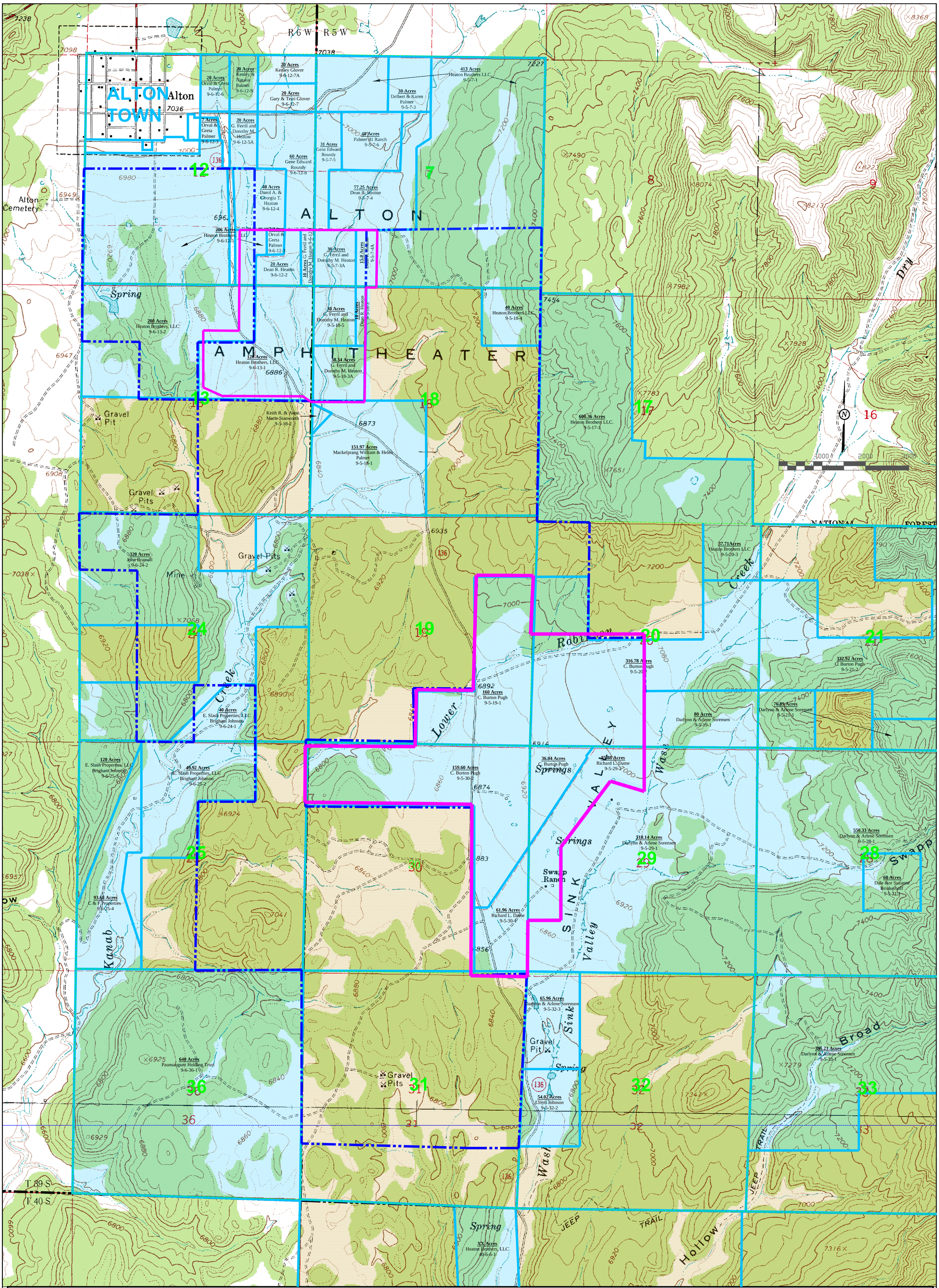
COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 1-2

UTAH REGISTERED PROFESSIONAL ENGINEER #154168 DAN W. GUY

Alton Coal Development
Coal Hollow Project

463 North 100 West, Suite 1
Cedar City, Utah 84721
Phone (435)867-5331
Fax (435)867-1192



LEGEND:

- PROPOSED LBA BOUNDARY
- PERMIT AREA
- BLM OWNERSHIP
- PRIVATE OWNERSHIP
- SURFACE OWNERSHIP BOUNDARY

DRAWN BY:	CHECKED BY:
N. BUTKOVICH	DWG
DRAWING: 1 – 3	DATE: 8/16/04
	SCALE: 1" = 1000'
JOB NUMBER: 1400	SHEET

REVISIONS

DATE:	BY:
7/1/13	KN
10/18/13	KN
8/7/14	KN

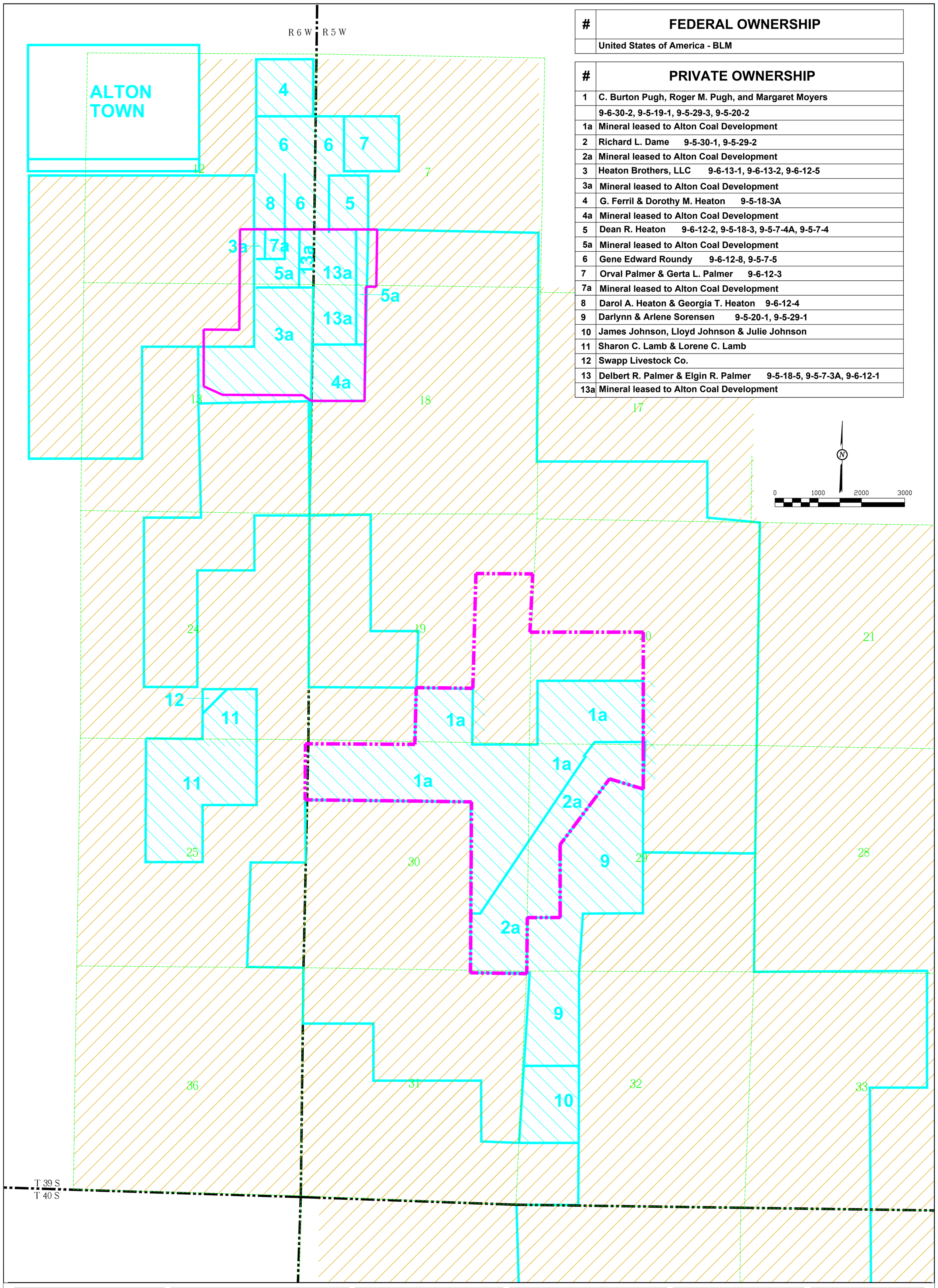
SURFACE OWNERSHIP

COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 1-3

UTAH REGISTERED #154168 DAN W. GUY PROFESSIONAL ENGINEER

Alton Coal Development
Coal Hollow Project
463 North 100 West, Suite 1
Cedar City, Utah 84721
Phone (435)867-5331
Fax (435)867-1192



#	FEDERAL OWNERSHIP
	United States of America - BLM

#	PRIVATE OWNERSHIP
1	C. Burton Pugh, Roger M. Pugh, and Margaret Moyers
	9-6-30-2, 9-5-19-1, 9-5-29-3, 9-5-20-2
1a	Mineral leased to Alton Coal Development
2	Richard L. Dame 9-5-30-1, 9-5-29-2
2a	Mineral leased to Alton Coal Development
3	Heaton Brothers, LLC 9-6-13-1, 9-6-13-2, 9-6-12-5
3a	Mineral leased to Alton Coal Development
4	G. Ferril & Dorothy M. Heaton 9-5-18-3A
4a	Mineral leased to Alton Coal Development
5	Dean R. Heaton 9-6-12-2, 9-5-18-3, 9-5-7-4A, 9-5-7-4
5a	Mineral leased to Alton Coal Development
6	Gene Edward Roundy 9-6-12-8, 9-5-7-5
7	Orval Palmer & Gerta L. Palmer 9-6-12-3
7a	Mineral leased to Alton Coal Development
8	Darol A. Heaton & Georgia T. Heaton 9-6-12-4
9	Darlynn & Arlene Sorensen 9-5-20-1, 9-5-29-1
10	James Johnson, Lloyd Johnson & Julie Johnson
11	Sharon C. Lamb & Lorene C. Lamb
12	Swapp Livestock Co.
13	Delbert R. Palmer & Elgin R. Palmer 9-5-18-5, 9-5-7-3A, 9-6-12-1
13a	Mineral leased to Alton Coal Development

LEGEND:

- PERMIT BOUNDARY
- BLM OWNERSHIP
- PRIVATE OWNERSHIP
- COAL OWNERSHIP BOUNDARY
- COUNTY ROAD

DRAWN BY:	CHECKED BY:
N. BUTKOVICH	DWG
DRAWING: 1 – 4	DATE: 8/16/04
	SCALE: 1" = 1000'
JOB NUMBER: 1400	SHEET

REVISIONS

DATE:	BY:
9/13/04	NLB
3/6/06	JAS
6/6/06	NLB
2/21/07	NLB
8/25/08	CRM
10/18/13	KN
8/7/14	KN

COAL OWNERSHIP

COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 1-4

UTAH REGISTERED #154168 DAN W. GUY PROFESSIONAL ENGINEER

Alton Coal Development
Coal Hollow Project
463 North 100 West, Suite 1
Cedar City, Utah 84721
Phone (435)867-5331
Fax (435)867-1192

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Chapter 2

R645-301-200

SOILS

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R645-301-200. SOILS

210. INTRODUCTION

211. Soil Removal

In this section, the Alton Coal Project will present a description of the pre-mining soil resources as specified under R645-301-221. Topsoil and subsoil to be saved under R645-301-232 will be separately removed and segregated from other materials.

212. Soil Redistribution

After removal, topsoil will be immediately redistributed in accordance with R645-301-242 and stockpiled pending redistribution under R645-301-234. For details refer to Section 5 of Appendix 2-1.

220. ENVIRONMENTAL DESCRIPTION

221. Prime Farmland Investigation

The Natural Resource Conservation Service conducted a prime farmland assessment in October 2006 and determined that "No Prime Farmland or Soils of Statewide Importance were found within the study area (Coal Hollow Mine area), per criteria outlined in the National Survey Handbook Part 622 and Exhibit UT603-1, respectively (C. Meier, 2006)." The assessment stated that the soils "..could classify as Soils of Statewide Importance, if irrigated.."

"An available and reliable source of moisture to sustain crops common to the area is the primary limiting factor that excludes the observed soils from classifying as Prime Farmland or SSI (C. Meier, 2006)."

"In addition to a lack of a reliable source of water, soils did not classify as Prime Farmland due to high pH, high electrical conductivity, excessive erosion potential on steep slopes and slow permeability (C. Meier, 2006)."

On January 28, 2014, the Natural Resource Conservation Service provided a prime farmland assessment for the Dame Lease IBC. It was determined that "About 80 acres of the area of interest meets the definition of "Statewide Important Farmland, if irrigated" . It is in map unit "1103- Sili-Sidshow- Gypsic Haplustepts complex, 2 to 15 percent slopes" .

A copy of the NRCS Prime Farmland Determination for both the 2006 (Coal Hollow Mine) and the 2014 (Dame Lease IBC) is included in Section 1 of Appendix 2-1.

The Natural Resource Conservation Service (NRCS) conducted a Prime Farmland assessment in December 2012 and determined that soil map unit 1111 is considered Prime Farmland, if irrigated." NRCS soil map unit 1111 is Naplene-Termote-Arboles Oxyaquic Ustifluvent complex, 2 to 8 percent slopes. The NRCS determined that there is "...approximately 292 of soil map unit 1111" which is irrigated and "...will be

converted." The NRCS Prime Farmland assessment can be seen in Appendix A of Volume 11: Supplemental Report section of the MRP in the report called: *Order 2 Soil Survey for the North Private Lease Expansion of the Coal Hollow Mine* (November 2014).

The NRCS Prime Farmland assessment is based on a broad Order 2 and Order 3, Soil Survey of Kane County, Utah.

An evaluation of potential Prime Farmland areas within the North Private Lease was conducted using field and lab data collected for the soil survey. The results found a difference between the soils mapped as part of the Kane County Area, Utah Soil Survey and those identified by the more intensive North Private Lease soil survey. The project specific evaluation of potential *Prime Farmland* map units was conducted using field and laboratory analysis data from the North Private Lease area and the criteria set forth in the *Code of Federal Regulations Title 7, Part 657.5 Identification of important farmlands*. The results of this evaluation can be seen in Section 4 of Volume 11: Supplemental Report section of the MRP in the report called: *Order 2 Soil Survey for the North Private Lease Expansion of the Coal Hollow Mine* (November 2014).

The results of this evaluation found that there is approximately 121 acres of Prime Farmland soil map units that are irrigated and approximately 130 acres of Farmland of Statewide Importance within the North Private Lease soil survey area. This total area of 251 acres is equivalent to the sum of all land that is currently under irrigation or has the potential of being irrigated with existing water rights.

222. Soil Survey

An order 2 soils survey has been completed in 2007 at the Coal Hollow Project. Appendix 2-1 contains a report that provides the details for this survey. Utilizing existing soils data, the soil map units were extended to include the Dame Lease IBC. Appendix 2-3 contains a report that provides details for this survey. The survey area is on private lands leased by Alton Coal Development (ACD) and adjacent lands. These soil surveys were prepared so that ACD could: 1) identify suitable sources of subsoil and topsoil; 2) determine topsoil and subsoil salvage depths and quantities; and, 3) develop a post mining reclamation plan using salvaged soil materials. These soil surveys cover approximately 716 acres.

An Order 2 soil survey was completed in the North Private Lease area in 2014. This soil survey report can be found in Volume 11: Supplemental Report section of the MRP in the report called: *Order 2 Soil Survey for the North Private Lease Expansion of the Coal Hollow Mine* (November 2014). The survey is on private lands leased by Alton Coal Development (ACD) and adjacent lands. This soil survey was prepared so that ACD could: 1) identify suitable sources of subsoil and topsoil; 2) determine topsoil and subsoil salvage depths and quantities; and, 3) develop a post mining reclamation plan using salvaged soil materials. These soil surveys cover approximately 428 acres.

222.100. Soils Map

A map with soil map unit delineations is shown on Drawing 2-1.

A map with soil map unit delineations for the North Private Lease is shown on Soils Map 2 in Volume 11: Supplemental Report section of the MRP in the report called: *Order 2 Soil Survey for the North Private Lease Expansion of the Coal Hollow Mine* (November 2014).

222.200. Soil Identification

Soils in the Coal Hollow project soil survey area have been grouped into thirteen soil map units based on taxonomic classification, depth to parent material, and slope. The composition of these map units is described in table 2-1. Detailed descriptions of each soil map unit are included in Appendix 2-1. The soil survey map is Drawing 2-1.

Table 2-1. Soil map unit composition for the Coal Hollow project area.

Map Unit	Pct	Soil Type[1]	Taxonomic Classification[2]	Modal Pedon[3]
1		**A Family – Wapiti Family complex, 3 to 8 percent slopes**		
	65	A Family	fine, mixed, superactive, mesic Aridic Calciustept	1
	15	Wapiti Family	fine-loamy, mixed, superactive, mesic Calcidic Argiustoll	32
	10	D	fine, mixed, superactive, mesic Aridic Calciustoll	33
	5	Manzanst Family	fine, mixed, superactive, mesic Aridic Haplustalf	48
	5	N Family	fine, mixed, superactive, frigid Aquic Calciustoll	26
2		**M Family - Calendar Family – D Family complex, 3 to 8 percent slopes**		
	60	M Family	fine, mixed, superactive, mesic Aridic Calciustepts	3
	25	Calendar Family	fine, mixed, superactive, mesic Aridic Haplustepts	4
	15	D Family	fine, mixed, superactive, mesic Aridic Calciustoll	2
3		**Cibeque Family – Wapiti Familiy complex, 3 to 8 percent slopes**		
	60	Cibeque Family	fine-loamy, mixed, superactive, mesic Aridic Calciustept	6
	30	Wapiti Family	fine-loamy, mixed, superactive, mesic Calcidic Argiustoll	31
	5	A Family	fine, mixed, superactive, mesic Aridic Calciustept	
	5	Calendar Family	fine, mixed, superactive, mesic Aridic Haplustepts	
4		**Jonale Family - Graystone Cobbly Substratum Family - Wapiti Family complex, 3 to 8 percent slopes**		
	50	Jonale Family	fine-loamy, mixed, superactive, mesic Aridic Calciustoll	17
	25	Graystone cobbly substratum Family	coarse-loamy, mixed, superactive, mesic Aridic Calciustoll	39
	15	Wapiti Family	fine-loamy, mixed, superactive, mesic Calcidic Argiustoll	19
	5	D Family	fine, mixed, superactive, mesic Aridic Calciustoll	
	5	A Family	fine, mixed, superactive, mesic Aridic Calciustept	

Map Unit	Pct	Soil Type[1]	Taxonomic Classification[2]	Modal Pedon[3]
5		**Calendar Family - M Family – Drififty Family complex, 8 to 25 percent slopes**		
	40	Calendar Family	fine, mixed, superactive, mesic Aridic Haplustepts	24
	30	M Family	fine, mixed, superactive, mesic Aridic Calciustept	25
	20	Drififty Family	loamy, mixed, superactive, calcareous, mesic Aridic Lithic Ustorthent	49
	10	Zigzag	Clayey, mixed, superactive, calcareous, mesic, shallow Aridic Ustorthent	
6		**Graystone - Cookcan – Jonale Family complex, 1 to 5 percent slopes**		
	45	Graystone	coarse-loamy, mixed, superactive, mesic Aridic Calciustoll	15
	20	Cookcan	coarse-loamy, mixed, superactive, frigid Typic Calciaquoll	9B
	20	Jonale Family	fine-loamy, mixed, superactive, mesic Aridic Calciustoll	16
	15	I Family	fine-loamy, mixed, superactive, frigid Aquic Calciustept	14
7		**Happyhollow Family - Alamosa complex, 1 to 5 percent slopes**		
	55	Happyhollow Family	fine, mixed, superactive frigid Aeric Epiaquept	38
	20	Alamosa	fine-loamy, mixed, superactive, frigid Typic Argiaquoll	18A
	10	Jicarilla Family	fine, mixed, superactive, frigid Typic Argiaquoll	43
	10	Tetonview Family	fine-loamy, mixed, superactive frigid Aeric Calciaquoll	40
	3	Brumley	fine-loamy, mixed, superactive, mesic Calcidic Haplustalf	
	2	Jonale Family	fine-loamy, mixed, superactive, mesic Aridic Calciustoll	
8		**Brumley – Graystone - Snilloc complex, 3 to 8 percent slopes**		
	40	Brumley	fine-loamy, mixed, superactive, mesic Calcidic Haplustalf	22
	30	Graystone Cobbly Substratum Family	coarse-loamy, mixed, superactive, mesic Aridic Calciustoll	20
	20	Snilloc	coarse-loamy, mixed, superactive, mesic Aridic Calciustept	21
	10	Jonale Family	fine-loamy, mixed, superactive, mesic Aridic Calciustoll	
9		**D Family - Deacon complex, 5 to 30 percent slopes**		
	55	D Family	fine, mixed, superactive, mesic Aridic Calciustoll	41
	30	Deacon	fine-loamy, mixed, superactive, mesic Aridic Haplustoll	42
	10	A Family	fine, mixed, superactive, mesic Aridic Calciustept	
	5		Creek bottom	
10		**Zigzag clay, 8 to 25 percent slopes**		
	85	Zigzag	Clayey, mixed, superactive, calcareous, mesic, shallow Aridic Ustorthent	50
	10	Drififty Family	loamy, mixed, superactive, calcareous, mesic Aridic Lithic Ustorthent	
	5	Calendar Family	fine, mixed, superactive, mesic Aridic Haplustepts	

Map Unit	Pct	Soil Type[1]	Taxonomic Classification[2]	Modal Pedon[3]
11		**A family clay, 8 to 25 percent slopes**		
	85	A Family	fine, mixed, superactive, mesic Aridic Calciustept	28
	10	Calendar Family	fine, mixed, superactive, mesic Aridic Haplustepts	
	5	Zigzag	Clayey, mixed, superactive, calcareous, mesic, shallow Aridic Ustorthent	
12		**Manzanst Taxadjunct Family clay, 3 to 12 percent slopes**		
	85	Manzanst Family	very fine, mixed, superactive, mesic Aridic Haplustalf	48
	10	Manzanst Family Deep	very fine, mixed, superactive, mesic Aridic Haplustalf	60
	5	A Family	fine, mixed, superactive, mesic Aridic Calciustept	
13		**A Family – Happyhollow Family complex, 1 to 5 percent slopes**		
	80	A Family	fine, mixed, superactive, mesic Aridic Calciustept	59
	15	Happyhollow Family	fine, mixed, superactive frigid Aeric Epiaquept	45
	5	I Family	fine-loamy, mixed, superactive, frigid Aquic Calciustept	52

Soils in the North Private Lease soil survey area were delineated with 12 soil map units and 1 miscellaneous land form. The composition of the soil map units is described in Table 6 in Volume 11: Supplemental Report section of the MRP in the report called: *Order 2 Soil Survey for the North Private Lease Expansion of the Coal Hollow Mine* (November 2014). Detailed descriptions of the soil map units can be seen in Section Three in Volume 11: Supplemental Report section of the MRP in the report called: *Order 2 Soil Survey for the North Private Lease Expansion of the Coal Hollow Mine* (November 2014).

222.300 Soil Descriptions

Based on the order 2 soils survey that was completed on 2007, the following soil map unit descriptions and productivities apply. Additional information describing each soil map unit is contained in Appendix 2-1.

1 A Family – Wapiti Family complex, 3 to 8 percent slopes

General Description

Map unit 1 is dominated by clayey soils with very slow hydraulic conductivity rates of less than 0.04 inches per hour based on the silty clay soil texture (p. 91, Renard, 1997). The depth to Tropic shale is greater than 40 inches in the major soils (A and Wapiti soil families), but minor inclusions with Tropic shale from 20 to 40 inches deep occur. The map unit is dominated by big sagebrush and grasses.

This map unit occurs at the north end of the map unit where the Coal Hollow project proposes to build facilities and establish topsoil and subsoil stockpiles.

Taxonomic Soil Classifications

Percent of Map Unit	Soil Series Family	Taxonomic Family	Typifying Soil Pedon
65	A Family	fine, mixed, superactive, mesic Aridic Calciustept	1*
20	Wapiti Family	fine-loamy, mixed, superactive, mesic Calcidic Argiustoll	32
10	D Family	fine, mixed, superactive, mesic Aridic Calciustoll	33
5	M	fine, mixed, superactive, mesic Aridic Haplustepts	26
* Lab analysis of typifying soil pedon for map unit.			

Map unit 1 description is continued on page 2-5.

Typifying Soil Pedon Descriptions

Soil colors are for dry soil unless specified otherwise.

The typifying soil pedon for A family soils in map unit 1 is soil pedon 1. The surface is a grayish brown clay loam 12 inches thick, dark grayish brown (moist). The subsoil (calcic) consists of light brownish gray silty clay, light olive brown (moist). Decomposing Tropic shale occurs at 42 inches below the surface.

The typifying soil pedon for the Wapiti family soils in map unit 1 is soil pedon 32. The mollic surface is a brown loam 8 inches thick, very dark grayish brown (moist). The subsurface (argillic) is a pale brown clay loam and silty clay, brown (moist). The subsoil (calcic) is pink loam to 6 feet, brown (moist). The underlying soil to nearly 12 feet is light yellowish brown silty clay over pink coarse sands with 10 percent faint strong brown mottles.

Supporting Soil Pedons

Soil family A is also represented by soil pits 27 and 30 in map unit A. Soil pit 27 does not have Tropic shale within 140 inches of the surface. Soil pit 30 has decomposing Tropic shale at 105 inches below the surface.

Laboratory Analysis

Analysis of soil samples from soil pit 1 had a poor soil pH (8.7) from 24 to 42 inches and fair lime percents (22.6 to 28.3 percent) throughout the soil profile. The silty clay texture at 24 inches is in the poor category for texture. SAR increases gradually with depth to 4.02 in the 24 to 42 inch horizon and then reaches 12.3 in the tropic shale below 42 inches.

Soil Inclusions

Small inclusions of D Family and N Family soils occur within map unit 1. D Family soils are similar to the A Family soils, but have a mollic epipedon (dark surface). The N family soils are very deep, similar to the D Family soil, but have aquic soil conditions below 20 inches and are located in concave depressions within map unit 1.

2 M Family – Calendar Family - D Family complex, 3 to 8 percent slopes

General Description

This map unit is dominated by soils with Tropic shale parent material at 20 to 72 inches below the surface. The map unit is dominated by big sagebrush and grasses with some pinyon pine and Utah juniper encroaching along edges of the map unit near map unit 5. This map unit is dominated by clayey soils with very slow hydraulic conductivity rates of less than 0.04 inches per hour based on the silty clay soil texture (p. 91, Renard, 1997).

This map unit occurs at the north end of the map unit where the Coal Hollow project proposes to build facilities. A second small delineation of map unit 2 occurs along the south boundary of the proposed year 1 mining area west of the county road.

Taxonomic Soil Classifications

Percent of Map Unit	Soil Series Family	Taxonomic Family	Typifying Soil Pedon
60	M Family	fine, mixed, superactive, mesic Aridic Calciustepts	3*
25	Calendar Family	fine, mixed, superactive, mesic Aridic Haplustepts	4*
15	D family	fine, mixed, superactive, mesic Aridic Calciustoll	2*
* Lab analysis of typifying soil pedon for map unit.			

Typifying Soil Pedon Descriptions

The typifying soil pedon for M family soils in map unit 2 is soil pedon 3. The surface is a brown loam 4 inches thick, dark brown (moist). The subsurface (cambic) is a grayish brown clay loam and silty clay loam 15 inches thick, brown (moist). The underlying subsoil to 33 inches is light brownish gray silty clay, light olive brown (moist). Tropic shale parent material occurs at 33 inches below the surface.

The typifying soil pedon for Calendar family soils in map unit 2 is pedon 4. The surface is pale brown silty clay 4 inches thick, dark grayish brown (moist). The subsurface (cambic) is light brownish gray silty clay moderate to strong structure, dark grayish brown (moist) to 31 inches. Tropic shale parent material occurs at 31 inches.

The typifying soil pedon for D family soils in map unit 2 is pedon 2. The surface (mollic) is brown clay loam 12 inches thick, very dark grayish brown (moist). The subsurface (cambic and calcic) is pale brown silty clay and clay to 48 inches deep, brown (moist).

The subsoil is white silty clay to 72 inches, brown (moist). Tropic shale parent material occurs at 72 inches below the surface.

Supporting Soil Pedons

Soil pedon 12 is representative of soil type M and is located in the delineation of map unit 2 along the south boundary of the year 1 mining area. The depth to Tropic shale in pedon 12 is 26 inches.

Laboratory Analysis

The main limiting feature of soils in map unit 2 is an increase of conductivity and SAR into the fair range as the soil depth reaches the interface with Tropic shale. The percent lime in the soil ranges from 18.6 to 27.5 above the Tropic shale. The saturation percentage increases with the percent clay, but remains in the fair range even with the clay and silty clay.

3 Cibeque Family - Wapiti Family complex, 3 to 8 percent slopes

General Description

Map unit 3 is characterized by very deep soils that show some indication of alluvial deposition most likely from the large alluvial fan that formed this portion of Sink Valley. Recent soil deposition from nearby Robinson Creek is indicated in pedon 6 by an increase of organic matter at 12 inches below the soil surface.

Taxonomic Soil Classifications

Percent of Map Unit	Soil Series Family	Taxonomic Family	Typifying Soil Pedon
60	Cibeque	fine-loamy, mixed, superactive, mesic Aridic Calciustept	6*
30	Wapiti	fine-loamy, mixed, superactive, mesic Calcidic Argiustoll	31
5	A Family	fine, mixed, superactive, mesic Aridic Calciustept	
5	Calendar Family	fine, mixed, superactive, mesic Aridic Haplustepts	
* Lab analysis of typifying soil pedon for map unit.			

Typifying Soil Pedon Descriptions

The typifying soil pedon for Cibeque family soils in map unit 3 is soil pedon 6. The surface is brown loamy sand 12 inches thick, dark yellowish brown (moist). The subsoil (calcic) is pale brown loam and sandy loam to 34 inches deep, brown (moist). The underlying soil to 60 inches is light grayish brown silty clay, brown (moist).

The typifying soil pedon for Wapiti family in map unit 3 is soil pedon 31. The surface (mollic) is dark grayish brown loam 7 inches thick, dark brown (moist). The subsurface (argillic) is light yellowish brown clay loam to 17 inches, dark yellowish brown (moist).

The subsoil (lower argillic and calcic) is light brownish gray and brown clay loam and loam to 52 inches, grayish brown and brown (moist). The underlying soil to 110 inches is very pale brown sandy loam and loamy sand, brown and yellowish brown (moist).

Supporting Soil Pedons

Soil pedon 13 is representative of Cibeque family in map unit 3.

Laboratory Analysis

Soil pH increases to the fair category (8.3 to 8.5) at 6 inches below the surface in pedon 6. The soil pH is consistent with percent lime in fair category (18.4 to 29.2). The loamy sand surface has a fair water holding capacity. Organic matter has an irregular increase at 12 inches from 0.7 in the A2 horizon to 2.6 in the upper Bk horizon.

Soil Inclusions

Small inclusions of A and Calendar soil families occur in map unit 3. A family soils are similar to Cibeque soils, but have a higher percentage of clay in the control section (10 to 40 inches). Calendar soils are very deep but do not have either an argillic horizon (increase in illuvial clays) or a calcic horizon within 40 inches of the soil surface.

4 Jonale Family – Graystone cobbly substratum Family - Wapiti Family complex, 3 to 8 percent slopes

General Description

Map unit 4 is characterized by very deep fine-loamy and coarse-loamy soils with mollic epipedons and calcic horizons. Lime accumulations below 12 to 22 inches are common in these soils. Soil pH is strongly alkaline below 22 inches in some soils. Vegetation in this map unit is big sagebrush and grasses.

Taxonomic Soil Classifications

Percent of Map Unit	Soil Series Family	Taxonomic Family	Typifying Soil Pedon
50	Jonale Family	fine-loamy, mixed, superactive, mesic Aridic Calciustoll	17*
25	Graystone cobbly substratum family	coarse-loamy, mixed, superactive, mesic Aridic Calciustoll	39*
15	Wapiti Family	fine-loamy, mixed, superactive, mesic Calcidic Argiustoll	19*
5	D Family	fine, mixed, superactive, mesic Aridic Calciustoll	7*
5	A Family	fine, mixed, superactive, mesic Aridic Calciustept	
* Lab analysis of typifying soil pedon for map unit.			

Typifying Soil Pedon Descriptions

The typifying soil pedon for Jonale family in map unit 4 is soil pedon 17. The surface (mollic) is a brown clay loam 9 inches thick, dark brown (moist). The subsurface (cambic) is a pale brown clay loam to 18 inches, brown (moist). The lower subsurface (Bwk) to 45 inches is light yellowish brown loam and clay loam, dark yellowish brown (moist). The underlying subsoil (calcic) is very pale brown clay loam and silty clay to 80 inches, yellowish brown (moist).

The typifying soil pedon for Graystone cobbly substratum family in map unit 4 is soil pedon 39. The surface is brown clay loam 12 inches thick, dark brown (moist). The subsurface (calcic) is a very pale brown to light yellowish brown sandy loam to 36 inches deep, yellowish brown (moist) with 0 to 15 percent gravels and cobbles. The underlying subsoil is very pale brown very cobbly loamy sand to 75 inches, brown (moist).

The typifying soil pedon for Wapiti family in map unit 4 is soil pedon 19. The surface (mollic) is a grayish brown loam 6 inches thick, very dark grayish brown (moist). The subsurface (upper argillic) is a brown and pale brown clay loam to 24 inches deep, dark grayish brown and yellowish brown (moist). The lower subsurface (lower argillic and upper calcic, Btk) is a pale brown loam to 37 inches deep, brown (moist). The underlying subsoil (calcic) is a pale brown and light yellowish brown sandy loam to 90 inches deep, yellowish brown (moist).

Supporting Soil Pedons

Jonale family is represented by soil pedons 5, 8, 10, 18B, 23, 34, and 35. Soil family H is represented by soil pedons 11, 36, and 37.

Laboratory Analysis

Jonale soil family is characterized by soil pH in the poor range of 8.6 to 9.0 (Utah DOGM, 2005) at depths below 22 to 40 inches. This strongly alkaline soil pH corresponds to lime percentages of greater than 30 in this same portion of the soil profile.

Graystone cobbly substratum soil family is dominated by sandy loam and loamy sand textures with some clay loam. Lime accumulation occurs below 12 to 16 inches, but percentages are lower relative to the fine-loamy type C soils. Soil pH becomes strongly alkaline at depths of 48 inches in some pedons. There is 15 to 45 percent gravels and cobbles below 36 inches.

Wapiti soil family has fair levels of carbonates throughout the soil profile. Soil pH was measured as poor below 68” in soil pedon 19.

Soil Inclusions

Soil family D is represented by pedon 7 in map unit 4. There are also small inclusions of

soil family A where map unit 4 borders map units 1 and 11.

5 Calendar Family - M Family – Drififty Family complex, 8 to 25 percent slopes

General Description

These soils are moderately deep (20 to 40 inches) to shallow (less than 20 inches to Tropic shale. The moderately deep soils have clayey textures, while the shallow soils are loamy. Vegetation is pinyon pine, Utah juniper, black sage and grasses.

Taxonomic Soil Classifications

Percent of Map Unit	Soil Series Family	Taxonomic Family	Typifying Soil Pedon
45	Calendar Family	fine, mixed, superactive, mesic Aridic Haplustepts	24*
30	M family	fine, mixed, superactive, mesic Aridic Calciustept	25*
20	Drififty Family	loamy, mixed, superactive, calcareous, mesic Aridic Lithic Ustorthent	49*
5	Zigzag	Clayey, mixed, superactive, calcareous, mesic, shallow Aridic Ustorthent	
* Lab analysis of typifying soil pedon for map unit.			

Typifying Soil Pedon Descriptions

The typifying soil pedon for Calendar family in map unit 5 is soil pedon 24. The surface is olive brown clay 5 inches thick, dark grayish brown (moist). The subsurface (cambic) is dark grayish brown and olive clay with moderate to strong blocky structure to 32 inches. Tropic shale parent material is at 32 inches.

The typifying soil pedon for M family in map unit 5 is soil pedon 25. The surface is covered with a half inch of decomposing needles and twigs. The soil surface is light brown clay 5 inches thick, brown (moist). The subsurface (calcic) is brown and strong brown clay with lime accumulations, dark brown (moist). Tropic shale parent material is at 32 inches.

The typifying soil pedon for Drififty family in map unit 5 is soil pedon 49. The surface light yellowish brown silty clay loam 3 inches thick, light olive brown (moist). The subsoil is a light olive brown loam to 10 inches, olive brown (moist). Interbeded sandstone and Tropic shale are at 10 inches.

Laboratory Analysis

Calendar soil family is characterized by percent clay of 44 to 47 with correspondingly high saturation percentages of 73.6 to 91.2. Conductivity increases to 7.8 at 17 inches below the surface.

Soil type M is characterized by percent clay of 40 to 47 with correspondingly high saturation percentages of 58.5 to 80.6 in the upper 20 inches of the soil profile. The percent clay decreases to 33 percent below 20 inches. Lime percentage is greater than 30 in the 5 to 20 inch depth, but less than 5 above and below this zone.

Drifity soil family is characterized by pH of 8.1 to 8.4, lime percentage of 18, and SAR of less than 0.1.

Soil Inclusions

There are some inclusions of Zigzag soils that are shallow (less than 20 inches) to Tropic shale. Zigzag soils are clayey.

6 Graystone – Cookcan – Jonale Family complex, 1 to 5 percent slopes

General Description

These medium to coarse textured soils are very deep. Wet soil conditions are present at varying depths in all of the map unit soils. The depth to wet soil conditions varies from 14 to 58 inches. This map unit is not a good source of subsoil. It is estimated that these soils are slower to warm up in the spring due to the wet soil conditions. Vegetation is grasses, sedges, and forbs.

Taxonomic Soil Classifications

Percent of Map Unit	Soil Series Family	Taxonomic Family	Typifying Soil Pedon
45	Graystone	coarse-loamy, mixed, superactive, mesic Aridic Calciustoll	15*
20	Cookcan	coarse-loamy, mixed, superactive, frigid Typic Calciaquoll	9B*
20	Jonale Family	fine-loamy, mixed, superactive, mesic Aridic Calciustoll	16*
15	I Family	fine-loamy, mixed, superactive, frigid Aquic Calciustept	14*
* Lab analysis of typifying soil pedon for map unit.			

Typifying Soil Pedon Descriptions

The typifying soil pedon for Graystone soils in map unit 6 is soil pedon 15. There is a dense root mat 1 inch thick on the surface. The surface is brown sandy loam 8 inches thick, dark brown (moist). The subsurface (cambic) is pale brown loam with moderate structure, dark yellowish brown (moist) to 20 inches. The subsoil (calcic) is very pale brown loam to 58 inches deep, yellowish brown (moist). The underlying soil is yellow and brownish yellow sandy loam with common prominent mottles to 96 inches, yellowish brown (moist).

The typifying soil pedon for Cookcan soils in map unit 6 is soil pedon 9B. The surface is dark grayish brown loam 6 inches thick, very dark grayish brown (moist). The lower surface is grayish brown sandy clay loam to 14 inches with few faint mottles, dark grayish brown (moist). The subsurface is light brownish gray sandy loam with common prominent mottles, dark gray (moist). The subsoil is light gray sandy loam with many prominent mottles, grayish brown (moist). The soil was wet below 48 inches.

The typifying soil pedon for Jonale soil family in map unit 6 is soil pedon 16. There is a dense root mat 1 ½ inch thick on the surface. The surface is dark grayish brown silty clay loam 8 inches thick, very dark grayish brown (moist). The subsurface (cambic) is pale brown silty clay to 18 inches, strong brown (moist). The subsoil is pink clay loam to 36 inches, brown (moist). The lower subsoil is pink silty clay loam and loam with few faint strong brown mottles to 68 inches, brown (moist). The underlying soil is light brownish gray clay loam with common prominent yellowish red mottles, grayish brown (moist).

Supporting Soil Pedons

Soil pedon 9A is similar to Graystone soils, but it has carbonates throughout the soil profile without any zone of accumulation.

Laboratory Analysis

Strongly alkaline soil pH (8.6 to 9.0) within 12 to 20 inches of the soil surface is the main limiting feature of the soils in map unit 6. Soil pedon 9A has very strongly alkaline pH (greater than 9.0) below 12 inches of the surface.

Lime percentage exceeds 30 in 3 of 5 pedons within 12 to 20 inches of the surface. Lime percentage ranges from 15 to 26 in the other two pedons from the surface to 48 inches.

Soil Inclusions

Soil pedon 14 is representative of I family soils within map unit 6 that do not have a mollic epipedon (dark surface) and have aquic (wet) soil conditions within 30 inches of the surface. These soils have a calcic horizon.

7 Happyhollow Family – Alamosa complex, 1 to 5 percent slopes

General Description

This soil map unit is located on a Tropic shale structural bench on the east side of the Sink Valley fault. Soils are characterized by clay and a high water table that is perched on top of the heavy clay soils. The high water table is at or within a foot of the soil surface during the wet period of the year. It is estimated that these soils are slower to warm up in the spring due to the wet soil conditions. Vegetation is sedges and forbs.

Taxonomic Soil Classifications

Percent of Map Unit	Soil Series Family	Taxonomic Family	Typifying Soil Pedon
55	Happyhollow Family	fine, mixed, superactive frigid Aeric Epiaquept	38*
20	Alamosa	fine-loamy, mixed, superactive, frigid Typic Argiaquoll	18A*
10	Jicarilla Family	fine, mixed, superactive, frigid Typic Argiaquoll	43
10	Tetonview Family	fine-loamy, mixed, superactive frigid Aeric Calciaquoll	40*
3	Brumley	fine-loamy, mixed, superactive, mesic Calcidic Haplustalf	
2	Jonale Family	fine-loamy, mixed, superactive, mesic Aridic Calciustoll	
* Lab analysis of typifying soil pedon for map unit.			

Typifying Soil Pedon Descriptions

The typifying soil pedon for Happyhollow family soils in map unit 7 is soil pedon 38. The surface is dark grayish brown (moist) silty clay 6 inches thick. The subsurface is a yellowish brown (moist) silty clay 6 inches thick. The calcic horizon begins at 12 inches below the surface and is a light yellowish brown (moist) to very pale brown (moist) silty clay. The calcic horizon continues to 48 inches or deeper. The water table was at 29 inches when the pit was described in March 2007. Mottles and gleyed soil were observed below 12 inches. Vegetation is grasses, sedges, widely scattered Wyoming big sagebrush, and wild rose.

The typifying soil pedon for Alamosa soils in map unit 7 is soil pedon 18A. The mollic surface is a very dark grayish brown (moist) loam to 7 inches. The cambic horizon is a brown (moist) loam to 15 inches deep. The calcic horizon is a light olive brown (moist) sandy loam to 30 inches. The underlying soil is grayish brown (moist) clay loam and sandy clay loam to 60 inches deep. Mottles were observed below 7 inches. The water table was at 51 inches when the described in September 2006.

Supporting Soil Pedons

Happyhollow family soil type was observed in pedon 45 within map unit 7 and a similar clayey soil in pedon 44. The Alamoss soil was also observed in pit 46.

Laboratory Analysis

The Happyhollow family soil is characterized by silty clay from the surface down to 24 inches or greater. Soil pH is 8.3 to 8.5 in the 12 to 24” horizon. Saturation percentage ranges from 69.9 to 81.8 in the upper 24 inches. The calcium carbonate equivalent ranges from 17.8 to 28.3 in the upper 20 inches and then increases to 44.5 below 20 inches. This soil pit was not sampled below 24 inches, because of the high water table.

Alamosa soil is characterized by medium textured soils (loam, clay loam, and sandy clay loam) in the upper 60 inches. The calcium carbonate equivalent ranges increases from 20.2 percent in the upper 7 inches to 29.3 percent in the 30 to 45 inch horizon.

Soil Inclusions

A soil similar to Alamosa soils, but with more clay in the control section is in localized areas. Soil mottles were observed and water was flowing into pit 43 when it was described in April 2007. The water table appeared to be perched on top of the underlying clay horizon at 54 inches.

Tetonview family soils were identified in soil pit 40. Mottles were observed below 6 inches and a water table at 23 inches when the pit was described in March 2007. This soil has a dark surface (mollic) and a calcic horizon.

Dry soil profiles occur on small isolated mounds within map unit 7. These non-hydric soils include Brumley and Jonale family soils. Both are very deep soils with a calcic horizon. Jonale family soils have a dark surface (mollic).

8 Brumley – Graystone Cobbly - Snilloc complex, 3 to 8 percent slopes

General Description

These soils developed in very deep alluvium on the east side of the Coal Hollow project area. They are medium to coarse textured. Evidence of a fluctuating water table was observed in most soils below 48 to 60 inches, depending on location and physiographic setting. This map unit would be a good source of cover material, but most of the planned disturbance in this area will be limited to cover soil stockpiles.

Taxonomic Soil Classifications

Percent of Map Unit	Soil Series Family	Taxonomic Family	Typifying Soil Pedon
40	Brumley	fine-loamy, mixed, superactive, mesic Calcidic Haplustalf	22*
30	Graystone	coarse-loamy, mixed, superactive, mesic Aridic Calciustoll	20*
20	Snilloc	coarse-loamy, mixed, superactive, mesic Aridic Calciustept	21*
10	Jonale Family	fine-loamy, mixed, superactive, mesic Aridic Calciustoll	
* Lab analysis of typifying soil pedon for map unit.			

Typifying Soil Pedon Descriptions

Colors are for dry soil unless otherwise noted.

The typifying soil pedon for the Brumley soils in map unit 8 is soil pedon 22. The surface is pale brown sandy loam to 6 inches. The argillic and upper calcic horizon is a light yellowish brown silty clay loam and sandy clay loam to 28 inches. The underlying soil is very pale brown sandy loam to 84 inches. Mottles increase significantly below 48 inches indicating that there is fluctuating water table during wet years. This soil supports Gamble oak, snowberry, grasses, and forbs.

The typifying soil pedon for the Graystone soil in map unit 8 is soil pedon 20. The surface is brown loam to 6 inches. The cambic horizon is light yellowish brown clay loam to 13 inches. The calcic horizon is very pale brown to light yellowish brown sandy loam and loamy sand to 54 inches. The underlying soil is a light yellowish brown loam to 72 inches and loamy sand to 96 inches. This soil supports Pinyon pine, Utah Juniper, Gamble oak, and snowberry.

The typifying soil pedon for Snilloc soils in map unit 8 is soil pedon 21. The surface is a light yellowish brown sandy clay loam to 8 inches. The calcic horizon is a pale brown sandy clay loam to 18 inches. The underlying soil is a pale brown strongly alkaline sandy loam to 96 inches. This soil was described in an opening of Wyoming big sagebrush within a larger area of Gamble oak.

Supporting Soil Pedons

A moist phase of the Brumley soil was observed in pit 47 in big sagebrush in map unit 8. A few faint mottles were observed below 24 inches. The amount of soil mottling increased significantly below 44 inches. This soil is on a low mound surrounded on three sides by wet soils in map unit 7. A water table was not observed when the pit was described in April 2007, but the mottles indicate that it is common for the water to rise within 44 inches of the surface in most years, and 24 inches in wet year.

Laboratory Analysis

The Brumley soil has calcium carbonate equivalents ranging from 17.5 to 23.8 percent.

The Graystone soil has a low saturation percentage in the 13 to 28 inch horizon (calcic). Calcium carbonate equivalents range from 16.5 to 25.4 percent. Available water capacity is 0.08 in layers of loamy sands below 28 inches.

The Snilloc family soil is characterized by strongly alkaline soil pH (8.7) below 36 inches. Calcium carbonate equivalents range from 16.8 to 29.8 percent.

Soil Inclusions

The Jonale family soils occur within this map unit. These soils are similar to Brumley soils, but have a dark surface (mollic).

9 D Family - Deacon complex, 5 to 30 percent slopes

General Description

These clayey soils are very deep and dominated by clayey textures. They have a dark surface (mollic epipedon). The D family soil has an increase in lime at 6 to 12 inches below the surface, while the Deacon soil has similar levels of lime throughout the soil profile. Soils in this map unit appear to have developed from the large alluvial fan that

covers most of Sink Valley. The map unit is delineated along Robinson Creek and in an area south of the creek that could be the remnants of a historic channel. Vegetation is dominantly big sagebrush, rabbitbrush, and grasses with pinyon pine and Utah juniper encroaching from adjacent areas.

Taxonomic Soil Classifications

Percent of Map Unit	Soil Series Family	Taxonomic Family	Typifying Soil Pedon
55	D Family	fine, mixed, superactive, mesic Aridic Calciustoll	41*
30	Deacon	fine-loamy, mixed, superactive, mesic Aridic Haplustoll	42*
10	A Family	fine, mixed, superactive, mesic Aridic Calciustept	
5		Creek bottom	
* Lab analysis of typifying soil pedon for map unit.			

Typifying Soil Pedon Descriptions

The typifying soil pedon for the D family soil in map unit 9 is soil pedon 41. The surface is brown sandy clay loam to 6 inches, dark brown (moist). The lower surface is brown clay to 12 inches, dark brown (moist). The subsurface (cambic) is pale brown silty clay to 36 inches, brown (moist). The subsoil (calcic) is very pale brown silty clay loam and sandy loam to 80 inches, yellowish brown (moist).

The typifying soil pedon for Deacon soils in map unit 9 is soil pedon 42. The surface is brown loam 9 inches thick, very dark grayish brown (moist). The subsurface (cambic) is pale brown silty clay to 24 inches, brown (moist). The upper subsoil (lower cambic) is pale brown sandy clay loam to 36 inches, brown (moist). The lower subsoil is light yellowish brown loam to 48 inches, yellowish brown (moist).

Supporting Soil Pedons

Soil pedon 29 is representative of the D family soil in map unit 9.

Laboratory Analysis

Poor soil pH at depth and clayey horizons characterize soils in map unit 9. Soil pH is poor below 64 inches in the D family soil (pit 41) and below 36 inches in the Deacon soil. Horizons of silty clay and clay occur in the D family soil (pit 41) between 6 and 36 inches. The clayey horizon in the Deacon soil is between 9 and 24 inches.

Soil Inclusions

The channel area of Robinson Creek comprises a small portion of this map unit. The creek bottom is not vegetated.

10 Zigzag clay, 8 to 25 percent slopes

General Description

These clayey soils are shallow to Tropic shale and formed along the Sink Valley escarpment. Vegetation is pinyon pine, Utah juniper, black sage, and Indian ricegrass.

Taxonomic Soil Classifications

Percent of Map Unit	Soil Series Family	Taxonomic Family	Typifying Soil Pedon
85	Zigzag	clayey, mixed, superactive, nonacid, mesic, shallow Aridic Ustorthent	50*
10	Drififty Family	loamy, mixed, superactive, nonacid, mesic Aridic Lithic Ustorthent	
5	Calendar Family	fine, mixed, superactive, mesic Aridic Haplustepts	
* Lab analysis of typifying soil pedon for map unit.			

Typifying Soil Pedon Description

The typifying soil pedon for the Zigzag soil in map unit 10 is soil pedon 50. The surface is light brownish gray clay to 4 inches, dark grayish brown (moist). The subsurface is light brownish gray clay to 19 inches, dark grayish brown and olive brown (moist). Tropic shale is at 19 inches.

Laboratory Analysis

Clayey soil texture is the main limiting feature to the Zigzag soil in map unit 10. Lime percentage is between 18 and 19 throughout the soil profile. SAR is less than 1. Soil pH is in the good to fair range (8.1 to 8.4).

Soil Inclusions

The Drififty family soil occurs along ridges where the Tropic shale is interbeded with sandstone. These soils are loamy and less than 20 inches deep.
Calendar family soil occur in concave toeslope areas. These soils are clayey and moderately deep (20 to 40 inches) to Tropic shale.

11 A Family clay, 8 to 25 percent slopes

General Description

These soils are very deep and are on the footslope and backslope of the Sink Valley fault escarpment. Vegetation is grasses, rabbitbrush, and big sagebrush.

Taxonomic Soil Classifications

Percent of Map Unit	Soil Series Family	Taxonomic Family	Typifying Soil Pedon
85	A Family	fine, mixed, superactive, mesic Aridic Calciustept	28*
10	Calendar Family	fine, mixed, superactive, mesic Aridic Haplustepts	
5	Zigzag	Clayey, mixed, superactive, nonacid, mesic, shallow Aridic Ustorthent	
* Lab analysis of typifying soil pedon for map unit.			

Typifying Soil Pedon Description

The typifying soil pedon for the A family soil in map unit 11 is soil pedon 28. The surface is grayish brown clay to 8 inches, dark grayish brown (moist). The subsurface (cambic) is gray clay with moderate blocky structure to 24 inches, grayish brown (moist). The upper subsoil (calcic, Bwk) is gray clay with common fine soft calcium carbonate masses to 48 inches, grayish brown (moist). The lower subsoil (calcic, Bk) is light grayish brown clay with common fine and medium soft calcium carbonate masses to 102 inches, grayish brown (moist).

Laboratory Analysis

Clay texture is the primary limiting feature with the A family soil in map unit 11. SAR and conductivity increase significantly in the 24 to 48 inch horizon, but both are still within the fair range (Utah DOGM, 2005). Lime percentage ranges from 17 to 19. Samples were not available for analysis for the 48 to 102 inch zone.

Soil Inclusions

Inclusions of the Calendar family soil occur along shoulders of hills and ridges. These soils are clayey and moderately deep (20 to 40 inches) to Tropic shale.

Small inclusions of the Zigzag soil occur on the summits of ridges and hills. These soils are clayey and shallow (less than 20 inches) to Tropic shale.

12 Manzanst Taxadjunct Family clay, 3 to 12 percent slopes

General Description

These clayey soils are deep to very deep to Tropic shale and formed on gently sloping to moderately steep slopes along the west side of Sink Valley. Vegetation is pinyon pine, Utah juniper, black sage, and Indian ricegrass. The very deep phase is on the backslopes and footslopes. The deep phase (40 to 60 inches to Tropic shale) of Manzanst family soil occurs on the shoulders of the hill sideslopes.

Taxonomic Soil Classifications

Percent of Map Unit	Soil Series Family	Taxonomic Family	Typifying Soil Pedon
85	Manzanst taxadjunct, very deep phase	very fine, mixed, superactive, nonacid, mesic, Aridic Ustorthent	48*
10	Manzanst taxadjunct, deep phase	very fine, mixed, superactive, nonacid, mesic, Aridic Ustorthent	60
5	A Family	fine, mixed, superactive, mesic Aridic Calciustepts	
* Lab analysis of typifying soil pedon for map unit.			

Typifying Soil Pedon Description

The typifying soil pedon for the Manzanst taxadjunct soil in map unit 10 is soil pedon 48. The surface is grayish brown clay (moist) 3 inches, very dark grayish brown (moist). The subsurface is light brownish gray clay to 30 inches, dark grayish brown (moist). The substratum is light brownish gray clay with 3 to 10 percent very fine and fine calcium carbonate masses to 84 inches, dark grayish brown (moist).

The typifying pedon for the Manzanst taxadjunct deep phase is pedon 60. It is similar to pedon 48. Tropic shale is at 48 inches.

Laboratory Analysis

Clayey soil texture and SAR are the main limiting features of the Manzanst soil family in map unit 12. The SAR ranges from 10.80 to 12.70 below 12 inches.

Soil Inclusions

The A family soil occurs on the toeslopes and in swales where alluvium has accumulated. These soils are clayey and very deep (greater than 60 inches). They have an accumulation of carbonates in the subsoil.

13 A Family – Happyhollow Family complex, 1 to 5 percent slopes

General Description

These clayey soils are very deep to Tropic shale and formed on nearly level to gently sloping slopes in the south central portion of Sink Valley. Vegetation is grasses. The very deep phase is on the backslopes and footslopes. The deep phase (40 to 60 inches to Tropic shale) of Manzanst family soil occurs on the shoulders of the hill sideslopes.

Taxonomic Soil Classifications

Percent of Map Unit	Soil Series Family	Taxonomic Family	Typifying Soil Pedon
80	A Family	fine, mixed, superactive, mesic Aridic Calciustepts	59
15	Happyhollow Family	fine, mixed, superactive frigid Aeric Epiaquept	45
5	I Family	fine-loamy, mixed, superactive, frigid Aquic Calciustept	52
* Lab analysis of typifying soil pedon for map unit.			

Typifying Soil Pedon Descriptions

The typifying soil pedon for the A family soil in map unit 13 is soil pedon 59. The surface is light yellowish brown clay loam to 10 inches, dark grayish brown (moist). The subsurface is light yellowish brown and very pale brown clay loam to 45 inches, yellowish brown and pale brown (moist). The substratum is very pale brown and pale yellow sandy clay loam to 76 inches. Reddish yellow medium and coarse mottles were observed below 62 inches.

The typifying soil pedon for the Happyhollow family soil is soil pedon 45. The surface is light brownish gray loam to 12 inches, dark grayish brown (moist). The subsurface is light gray and very pale brown sandy clay loam to 48 inches, gray and light yellowish brown (moist). The substratum is very pale brown sandy clay loam to 84 inches, light yellowish brown (moist). The lower substratum is light gray silty clay to 100 inches, gray (moist). Yellow and brownish yellow medium and coarse mottles were observed below 5 inches.

Laboratory Analysis

Field conductivity (ECe) measurements for soil pit 59 ranged from 0.39 to 1.30 mmhos/cm.

Lab analysis of soil pit 28 is representative of the A family soil in map unit 13. Clay texture is the primary limiting feature with the A family soil in map unit 13. SAR and conductivity increase significantly in the 24 to 48 inch horizon (pedon 28), but both are still within the fair range (Utah DOGM, 2005). Lime percentage ranges from 17 to 19. Samples were not available for analysis for the 48 to 102 inch zone.

Soil Inclusions

The I family soils are similar to the A family soil, but they have aquic conditions below 20 inches. Reddish yellow fine mottles were observed in soil pedon 52 below 24 inches.

Soil map unit descriptions for the North Private Lease soil survey area are in Section Three in Volume 11: Supplemental Report section of the MRP in the report called: *Order 2 Soil Survey for the North Private Lease Expansion of the Coal Hollow Mine* (November 2014).

222.400 Present and Potential Productivity of Existing Soils

Soils in the Coal Hollow project area support big sagebrush, grasses (native and introduced species), pinyon pine, Utah juniper, and Gambel oak. Detailed descriptions of the present and potential productivity of the soils are detailed in Chapter 3, Section 321.200.

Soils in the northern portion of the North Private Lease area are in agricultural production of alfalfa and small grains, while soils in the southern portion support big sagebrush, rabbitbrush, grasses (native and introduced species), pinyon pine, Utah juniper, Russian olive, and Gambel oak. Detailed descriptions of the present and potential productivity are detailed in Chapter 3, Section 321.200.

223. Soil Characterization

This soil survey was made in accordance with the guidelines for an order 2 soil survey as detailed in the Soil Survey manual (USDA 1993). Soils were classified using the Keys to Soil Taxonomy, Ninth Edition (USDA 2003). Soils for the New Dame Lease IBC were classified using the Keys to Soil Taxonomy, Eleventh Edition (NRCS 2010). Representative soil samples were submitted for laboratory analysis of the parameters outlined by the Utah Division of Oil Gas and Mining's *Guidelines for Management of Topsoil and Overburden* (2005).

The North Private Lease soil survey was made in accordance with the guideline for an order 2 soil survey as detailed in the Soil Survey manual (USDA NRCS 1993). Soils were classified using the Keys to Soil Taxonomy, Twelfth Edition (USDA NRCS 2014d). Representative soil samples were submitted for laboratory analysis of the parameters outlined by the Utah Division of Oil Gas and Mining's *Guidelines for Management of Topsoil and Overburden* (2005).

224. Substitute Topsoil

Based on the 2006-2007 order 2 soil survey, sufficient quantities of suitable topsoil and subsoil are available for reclamation within the project area. The Coal Hollow Project does not plan to use substitute material for topsoil at the time of reclamation. However, if in the future the Coal Hollow mine plan proposes to use selected overburden materials as a supplement or substitute for topsoil, an application will be provided to the DOGM that includes results of analyses, trials, and tests as described under R645-301-232.100 through R645-301-232.600, R645-301-234, R645-301-242, and R645-301-243. DOGM may also require the results of field-site trials or greenhouse tests as required under R645-301-233.

Based on the 2014 order 2 soil survey for the North Private Lease, sufficient quantities of suitable topsoil and subsoil are available for reclamation within the project area. The Coal Hollow mine does not plan to use substitute material for topsoil at the time of reclamation of North Private Lease expansion. However, if in the future the Coal Hollow mine plan proposes to use selected overburden materials as a supplement or substitute for topsoil, an application will be provided to the DOGM that includes results of analyses, trials, and tests as described under R645-301-232.100 through

R645-301-232.600, R645-301-234, R645-301-242, and R645-301-243. DOGM may also require the results of field-site trials or greenhouse tests as required under R645-301-233.

230. Operation Plan

231. General Requirements

231.100. Methods for Removing and Storing Subsoil and Topsoil

The methods for removing and storing topsoil, subsoil, and other materials will be to first remove the woody plants from the area and place them in piles for later placement in pit backfills. Next, dozers or scrapers will remove the topsoil layer to a depth determined by the soil survey. The topsoil will be stockpiled and protected from wind and water erosion. Stockpiles that will be in place for less than 1 year will be coated with a tackifier at the manufacturer's suggested rate for dust control applications. Those stockpiles that will be in place for at least one year will be seeded and covered with mulch during the appropriate season. Side slopes of stockpiles will be sloped to 3h:1v: The suitable subsoil will then be removed and stockpiled separately from the topsoil. The depth of topsoil and subsoil salvage will be determined by the aforementioned soil survey and in the field during mining by the Coal Hollow environmental technician in consultation with a certified professional soil scientist. Stockpiling of topsoil and subsoil will only occur when direct placement (or live hauling) is not operationally practical. Drawing 2-2 shows planned topsoil stockpiles and topsoil removal plans.

Drawing 2-4 shows planned topsoil stockpiles and topsoil removal plans in the North Private Lease.

231.200. Suitable Substitute Topsoil

The use of substitute topsoil is not planned based on the 2007 soil survey information. Demonstration studies of the suitability of topsoil substitutes or supplements will be submitted to the DOGM if the use of topsoil substitutes becomes necessary for future reclamation and revegetation.

The use of substitute topsoil is not planned based on the 2014 soil survey information. Demonstration studies of the suitability of topsoil substitutes or supplements will be submitted to the DOGM if the use of topsoil substitutes becomes necessary for future reclamation and revegetation.

231.300. Soil Testing for Reclamation

The final seedbed of the reclaimed areas will be prepared by first replacing the subsoil and topsoil in the same order it existed prior to removal by the mining activities. Next, a basic topsoil (top 8 inches of reclamation profile) sampling regime will be implemented prior to seeding that should identify fertility problems and will provide a basis for determining necessary soil amendments. The parameters analyzed will be:

Available phosphorus (P)
Soluble Potassium (K)
Nitrate-Nitrogen

One composite sample will be collected from approximately every 2 to 5 acres based on soil types and variability. Each composite will be comprised of at least 4 sub-samples.

Pre-testing of the soils has been conducted as part of the soils survey. Results from the pre-testing of topsoil and subsoil can be viewed in Table C-1 of Appendix 2-1 (native topsoil and subsoil) and Table C-2 (samples from core hole/overburden pits) of Appendix 2-1.

Pre-testing of the soils has been conducted as part of the North Private Lease soils survey. Results from the pre-testing of topsoil and subsoil can be viewed in Appendix C of Volume 11: Supplemental Report section of the MRP in the report called: *Order 2 Soil Survey for the North Private Lease Expansion of the Coal Hollow Mine* (November 2014).

231.400. Topsoil Handling

The topsoil will be removed from the mine area and either live hauled to a reclamation area or stored separately. All soil stockpiles piles will be seeded with an appropriate interim seed mix to prevent loss and deterioration by wind and water erosion. Soil stockpiles will have side slopes graded to a maximum 3h:1v. Piles will be bermed or otherwise treated to prevent the transport of sediments away from the pile. Details about soil horizons and zones planned for use as subsoil are detailed in Appendix 2-1. A detailed map showing stockpile designs/locations and soil removal are shown on Drawing 2-2.

Details about soils horizons and zones planned for use as subsoil in the North Private lease are shown on Drawing 2-4 and detailed in Volume 11: Supplemental Report section of the MRP in the report called: *Order 2 Soil Survey for the North Private Lease Expansion of the Coal Hollow Mine* (November 2014).

232. Topsoil and Subsoil Removal

232.100. Separate Layers
All soil materials will be removed in separate layers from the area to be disturbed, and segregated.
Based on soil map units, average depths have been estimated and will be used as a guide and monitored in the field. Refer to Table 4-2 in Appendix 2-1. Soil will be salvaged and directly placed or stockpiled as either topsoil or subsoil.

Based on soil map unit, average depths have been estimated and will be used as a guide and monitored in the field. Refer to Tables 13 and 14 in Volume 11: Supplemental Report section of the MRP in the report called: *Order 2 Soil*

Survey for the North Private Lease Expansion of the Coal Hollow Mine (November 2014).

232.200. Topsoil of Insufficient Quantity or Quality

Where the topsoil is of insufficient quantity or poor quality for sustaining vegetation, other materials approved by the DOGM in accordance with R645-301-233.100 will be removed as a separate layer from the area to be disturbed, and segregated.

Based on the Soil Survey, there should be sufficient quantities of topsoil to place an average of eight inches of topsoil across all reclaimed areas.

Based on the 2014 Soil Survey of the North Private Lease, there should be sufficient quantities of topsoil to place an average of ~~12~~ 13 inches of topsoil across all reclaimed areas.

232.300. Shallow Topsoil Handling

If topsoil is less than six inches thick, the operator may remove the topsoil and the unconsolidated materials immediately below the topsoil and treat the mixture as topsoil.

Sufficient quantities of topsoil are estimated to be available for replacement of an average eight inches of topsoil across reclamation, with a minimum of six inches. Therefore, mixing of topsoil with subsoil is not anticipated to be necessary.

Localized areas of the Vessilla family soil in map unit C of the North Private Lease may be less than 6 inches thick. Topsoil and subsoil will be stockpiled together as topsoil. Mixing of topsoil with subsoil is not anticipated to be necessary in other areas of the North Private Lease area.

Sufficient quantities of topsoil are estimated to be available in the North Private Lease that will allow replacement of an estimated average ~~12~~ 13 inches of topsoil. This estimate is based on some areas having more than 12 inches of native and some areas having less than ~~12~~ 13 inches.

232.400 - 232.420. Topsoil Removal Exceptions

UDOGM will not require the removal of topsoil for minor disturbances which occur at the site of small structures, such as power poles, signs, or fence lines. Removal of topsoil will not be required when the disturbances will not destroy the existing vegetation and will not cause erosion.

232.500. Subsoil Segregation

The Coal Hollow Project plans to remove soils as either topsoil or subsoil based on the completed soil survey. DOGM may require that the B horizon, C horizon, or other

underlying strata, or portions thereof, be removed and segregated, stockpiled, and redistributed as subsoil in accordance with the requirements of R645-301-234 and R645-301-242 if it finds that such subsoil layers are necessary to comply with the revegetation requirements of R645-301-353 through R645-301-357.

Refer to Table 4-2 in Appendix 2-1, which contains estimated subsoil salvage depths. In addition, substitute subsoil has been identified in the layers between the identified topsoil layer and the Tropic Shale. Sufficient quantities of this material are available to live haul most of the subsoil with the exception of one stockpile that will be constructed from the initial mining area and reserved for reclamation of the final mining area and one temporary stockpile that will be constructed from removal of the NW/4, NE/4, Section 30. All substitute subsoil materials will be sampled and tested for pH, conductivity, SAR, percent lime, and texture, prior to salvage and stockpiling.

Refer to Table 14 in Volume 11: Supplemental Report section of the MRP in the report called: *Order 2 Soil Survey for the North Private Lease Expansion of the Coal Hollow Mine* (November 2014) for subsoil salvage depths. ~~Sufficient quantities of subsoil are available to live haul most of the subsoil with the exception of Vessilla family soil areas in map unit C which are less than 6 inches thick. Substitute subsoil is available in sufficient quantities from adjacent soil map units.~~ The average subsoil replacement depth is estimated to be 31 inches.

In order to achieve a total reclamation soil profile depth of 48 inches of suitable cover ACD will test the surface 6 inches of overburden prior to placement of subsoil to ensure that it meets the suitability requirements for topsoil in the *Guidelines for Management of Topsoil and Overburden*. One composite sample will be collected from approximately every 2 to 5 acres based on soil types and variability. Each composite will be comprised of at least 4 sub-samples.

The majority of the soils in the North Private lease were sampled to 8 feet or bedrock. The soil analysis results can be seen in Appendix C of Volume 11: Supplemental Report section of the MRP in the report called: *Order 2 Soil Survey for the North Private Lease Expansion of the Coal Hollow Mine* (November 2014). Additional testing of substitute subsoil materials will be completed prior to removal and stockpiling. This additional analysis will include pH, conductivity, SAR, percent lime, and texture.

The following soil sampling program will be conducted during the initial mining process:

- Topsoil: Sampling will occur every 2 to 4 acres or approximately every 2,500 to 5,000 bank cubic yards.
- Subsoil: Sampling will occur every 2 to 3 acres or approximately every 10,000 to 15,000 bank cubic yards.

These samples are anticipated to be composites of individual samples taken throughout the week during the time frames that topsoil and subsoil are being salvaged. These individual samples would be taken five days a week and composited to a single sample representing the material moved each week. The parameters that will be analyzed for topsoil are found in Table 4-1 of Appendix 2-1.

Following the initial mining process (approximately 1 year), the sampling program was reviewed to determine the appropriate level of sampling necessary to ensure adequacy of topsoil and subsoil used in reclamation for all subsequent mining. It was determined that areas that exhibited an accumulation of salts after being placed, should at minimum be tested for elevated SAR ratio.

232.600. Timing

All material to be removed under R645-301-232 will be removed after the vegetative cover that would interfere with its salvage is cleared from the area to be disturbed, but before any drilling, blasting, mining, or other surface disturbance takes place. Drawing 2-2 shows the anticipated topsoil removal sequence and stockpiling.

Drawing 2-4 shows the anticipated topsoil removal sequence and stockpiling for the North Private Lease. Estimated average topsoil and subsoil salvage depths in the North Private Lease are detained in Soils map 10 in Volume 11: Supplemental Report section of the MRP in the report called: *Order 2 Soil Survey for the North Private Lease Expansion of the Coal Hollow Mine* (November 2014).

232.700. Topsoil & Subsoil Removal Under Adverse Conditions

An exception to the requirements of R645-301-232 to remove topsoil or subsoils in a separate layer from an area to be disturbed by surface operations may be granted by UDOGM where the operator can demonstrate;

232.710. Unsafe Conditions

The removal of soils in a separate layer from the area by the use of conventional machines would be unsafe or impractical because of the slope or other conditions of the terrain or because of the rockiness or limited depth of the soils.

These conditions are not anticipated in the Coal Hollow project area.

232.720. Lack of On-Site Material Available

If the requirements of R645-301-233 have been or will be fulfilled with regard to the use of substitute soil materials unless no available substitute material can be made suitable for achieving the revegetation standards of R645-301-356, then the operator will, as a condition of the permit, be required to import soil material of the quality and quantity necessary to achieve such revegetation standards.

The soil survey indicates that there are sufficient quantities of topsoil and subsoil to adequately reclaim the mined area with 48 inches of combined cover. If additional materials are needed, then Alton Coal Development (ACD) will salvage suitable overburden for use as substitute subsoil material from the zone below the topsoil layer (8 inches thick average) to a maximum depth of 30 feet, excluding any Tropic shale materials. ACD will do additional sampling to identify the zones in which suitable materials occur for maximum salvage potential of substitute subsoil. Representative overburden samples will be analyzed for pH, conductivity, SAR, percent lime, and texture. A detailed description of subsoil sampling is provided in Section 232.500.

~~The soil survey of the North Private Lease indicates that the amount of combined topsoil and subsoil in soil map units A1, A2, A3, B, C, D, and K is less than necessary to adequately reclaim the mined area with 48 inches of combined cover. However,~~ There are sufficient sources of native subsoil in adjacent soil map units to provide adequate amounts of native subsoil to cover all mined areas of the North Private Lease with a minimum ~~48~~ 44 inches of combined cover (~~12~~ 13 inches of topsoil plus ~~36~~ 31 inches of subsoil). The estimated combined salvage depths for each soil map unit are listed in Table 14 in Volume 11: Supplemental Report section of the MRP in the report called: *Order 2 Soil Survey for the North Private Lease Expansion of the Coal Hollow Mine* (November 2014).

In order to achieve a total reclamation soil profile depth of 48 inches of suitable cover ACD will test the surface 6 inches of overburden prior to placement of subsoil to ensure that it meets the suitability requirements for topsoil in the *Guidelines for Management of Topsoil and Overburden*. One composite sample will be collected from approximately every 2 to 5 acres based on soil types and variability. Each composite will be comprised of at least 4 sub-samples.

233.100 - 400 Topsoil Substitutes and Supplements.

Based on the Soil Survey contained in Appendix 2-1, topsoil substitutes and supplements are not anticipated to be necessary. This survey estimates that nine inches of topsoil can be replaced across the reclamation area.

Based on the Soil Survey, topsoil substitutes and supplements are not anticipated to be necessary. The North Private Lease soil survey estimates that thirteen inches of topsoil can be place over the entire mined area. Table 14 in Volume 11: Supplemental Report section of the MRP in the report called: *Order 2 Soil Survey for the North Private Lease Expansion of the Coal Hollow Mine* (November 2014) details the estimated depth of topsoil that can be salvaged from each soil map unit. The estimated average topsoil depth for soil map units C and J are 7 inches or less. However, the overall survey area estimated average topsoil salvage depth of approximately 13 inches will allow topsoil from adjacent areas to be used to achieve a minimum depth of ~~12~~ 13 inches in all mined areas.

234. Topsoil Storage

234.100. Stockpiles

Materials removed under R645-301-232.100, R645-301-232.200, and R645-301-232.300 will be segregated and stockpiled when it is impractical to redistribute such materials promptly on regraded areas. Drawing 2-2 shows the planned stockpile areas, anticipated storage time, quantities and size.

Drawing 2-4 shows the planned stockpile areas, anticipated storage time, quantities and size for the North Private Lease.

234.200. Requirements of Stockpiles

Stockpiled materials will be subject to the following conditions.

234.210. (a) They will be selectively placed on a stable site within the permit area. Areas are shown on Drawing 2-2.

Stockpile areas in the North Private Lease are shown on Drawing 2-4

234.220. (b) They will be protected from contaminants and unnecessary compaction that would interfere with revegetation.

234.230. (c) They will be protected from wind and water erosion through prompt establishment and maintenance of an effective, quick growing vegetative cover or through other measures approved by the UDOGM. The side slopes will be graded to a maximum 3h:1v. Drawing 2-2 shows the planned stockpile areas, anticipated storage time, quantities and size. Drawing 2-4 shows the planned stockpile areas, anticipated storage time, quantities and size for the North Private Lease. The interim seed mix for the stockpiles is the following:

Stockpile Interim Seed Mix		
		Rate (PLS/Acre)
Bromus carinatus	Mountain Brome	6
Elymus lanceolatus	Thickspike wheatgrass	4
Elymus amithii	Western wheatgrass	5
Elymus spicatus	Bluebunch wheatgrass	6
Poa pratensis	Kentucky bluegrass	0.4
Total		**21.40**

234.240. (d) They will not be moved until required for redistribution unless approved by the UDOGM. Anticipated storage time for each stockpile is shown on Drawing 2-2.

Drawing 2-4 shows the anticipated storage time for each stockpile in the North Private Lease.

234.300. Long-Term Disturbance & Stockpiling

When long-term disturbed areas will result from facilities and preparation plants and when stockpiling of materials removed under 8645-301-232.100 would be detrimental to the quality or quantity of those materials, DOGM may approve the temporary distribution of the soil materials removed to an approved site within the permit area to enhance the current use of that site until later when needed for reclamation, provided that the following conditions occur.

234.310. Such action will not permanently diminish the capability of the topsoil of the host site.

234.320. The material will be retained in a condition more suitable for redistribution than if stockpiled.

240. Reclamation Plan (General Requirements)

A detailed Order 2 soil survey has been completed in 2006 and 2007 and extended to include the New Dame Lease IBC in 2014. This information provides detail for onsite soil suitability, salvage depths, and volumes available for reclamation of the mine site. Dozers or Scrapers will replace the subsoil and topsoil. The topsoil is estimated to average 8 inches and the subsoil will be approximately 39 inches in thickness. The total profile of topsoil and subsoil is estimated to average 48 inches.

A detailed Order 2 soil survey of the North Private Lease was completed in 2014 and is detailed in Volume 11: Supplemental Report section of the MRP in the report called: *Order 2 Soil Survey for the North Private Lease Expansion of the Coal Hollow Mine* (November 2014). This information provides detail for onsite soil suitability, salvage depths, and volumes available for reclamation of the mine site. Dozers or Scrapers will replace the subsoil and topsoil. The topsoil is estimated to average ~~12~~ 13 inches and the subsoil will be approximately ~~36~~ 31 inches in thickness. The total profile of topsoil and subsoil is estimated to average ~~48~~ 44 inches.

242. Soil Redistribution

242.100. Topsoil materials removed under R645-301-232.100, R645-301-232.200, and R645-301-232.300 and stored under R645-30I-234 will be redistributed in a manner that meets the following conditions.

242.110. (a) The material achieves an approximately uniform, stable thickness consistent with the approved postmining land use, contours, and surface-water drainage systems. All slopes will be appropriately graded and leveled prior to placement of topsoil and subsoil layers. Soil layer thicknesses will be regularly checked using a high precision GPS system and spot checking by the ACD environmental technician.

242.120. (b) Reduced material handling of the soil resource prevents excess

compaction. Material handling will be minimized by direct hauling and placing materials when operationally practical rather than stockpiling. Materials will be spread by a dozer or scrapers and spread only as much as necessary to obtain the required uniform thickness. Traffic from rubber tired equipment across topsoil and subsoil will be minimized.

If heavy equipment operation results in excessive soil compaction at the surface of the reclaimed areas, they will then be ripped, disked, and harrowed to loosen the seedbed prior to seeding. Excessive compaction that could impact seeding success will be determined by observation and judgment of an environmental professional. In other areas where less compaction has occurred, the areas will be disked and harrowed. The disking and harrowing of all areas will be done parallel with the contour wherever possible to decrease the potential for water erosion downslope. In other areas where compaction is not a problem, dozer tracking can be used to roughen the surface, and to trap seed, fertilizer, mulch, and other amendments as well as decrease erosion by wind and water. In such cases seeding will be done immediately after this treatment, whereas soil amendments, where required, would be applied over the surface during seedbed preparations. Seeding will mainly occur in the early spring and late fall. Seeding will be accomplished by the seed drilling method followed by mulching as described in Section 244.200. Seed mixtures and rates can be viewed in Tables 3-37 through 3-42 in Chapter 3, Volume 2.

242.130. (c) Handling procedures will be implemented to protect the materials from wind and water erosion before and after seeding and planting. Reclamation will be graded to the planned slope angles, not to exceed 3h:1v. Soil layers will sloped as the material is relocated to the reclaim areas. Once soil is placed, seeding will occur at the earliest appropriate season suitable to planting conditions. If the season is not appropriate for seeding at the time of topsoil placement, the topsoil will then be coated with a tackifier at the manufacturer's suggested rate for dust control applications. Mulching will be implemented on all reclamation to control erosion following seeding.

242.200. Treatments of Material to be Redistributed

Before redistribution of the materials removed under R645-301-232, the regraded land will be treated if necessary to reduce potential slippage of the redistributed material and to promote root penetration. If no harm will be caused to the redistributed material and reestablished vegetation, such treatment may be conducted after the material is replaced. Potential for slippage is anticipated to be minimal based on the planned slope angles for reclamation.

242.300. Soil Redistribution on Impoundments & Roads

DOGM may not require the redistribution of topsoil or topsoil substitutes on the approved postmining embankments of permanent impoundments or roads if it determines the following.

242.310. (a) Placement of topsoil or topsoil substitutes on such embankments is inconsistent with the requirement to use the best technology currently available to prevent sedimentation.

242.320. (b) Such embankments will be otherwise stabilized.

243. Soil Nutrients & Amendments

Nutrients and soil amendments will be applied to the redistributed material when necessary to establish the vegetative cover. The final seedbed of the reclaimed areas will be prepared by first replacing the subsoil and topsoil. Next, a basic topsoil (top 8 inches of reclamation profile) sampling regime will be implemented prior to seeding that should identify fertility problems and will provide a basis for determining necessary soil amendments. The parameters analyzed will be:

Available phosphorus (P)
Soluble Potassium (K)
Nitrate-Nitrogen

One composite sample will be collected from approximately every 2 ~~to 5~~ acres based on soil types and variability. Each composite will be comprised of at least 4 sub-samples.

Pre-testing of the soils has been conducted as part of the soils survey. Results from the pre-testing of topsoil and subsoil can be viewed in Table C-1 of Appendix 2-1 (native topsoil and subsoil) and Table C-2 (samples from core hole/overburden pits) of Appendix 2-1.

Results from the pre-testing of topsoil and subsoil can be seen in ~~Table C-1~~ the laboratory analysis reports in Appendix C in Volume 11: Supplemental Report section of the MRP in the report called: *Order 2 Soil Survey for the North Private Lease Expansion of the Coal Hollow Mine* (November 2014).

244. Soil Stabilization

244.100. Erosion Protection from Wind & Water

All exposed surface areas will be protected and stabilized to effectively control erosion and air pollution attendant to erosion. Reclamation will be regraded to the planned slope angles, not to exceed 3h:1v. Soil layers will be sloped as the material is relocated to the reclaim areas. Once soil is placed, seeding will occur at the earliest appropriate season suitable to planting conditions. Grass matting, mulching and/or cross ditches will be implemented as necessary to control erosion. Surfaces of stockpiles will be roughened by pocking, gouging or ripping. Temporary stockpiles that will be in place for more than 1 year will be seeded with the temporary seed mix provided in Section 234.230 and mulched by one of the methods described in Section 244.200. Temporary stockpiles that will be in place

for less than one year will be coated with a tackifier at the manufacturer's suggested rate for dust control applications.

244.200. Mulch

Suitable mulch and other soil stabilizing practices will be used on all areas that have been regraded and covered by topsoil or topsoil substitutes. DOGM may waive this requirement if seasonal, soil, or slope factors result in a condition where mulch and other soil stabilizing practices are not necessary to control erosion and to promptly establish an effective vegetative cover.

Mulch will be placed on the seedbed surface once soil amendments have been incorporated. In most cases seeding will be accomplished after straw mulch has been placed to ensure seed is placed at the proper depth, exceptions would be for safety on steep slopes. Mulching will occur by one of the following methods:

- Certified noxious weed free straw applied at a rate of 1 ton/acre anchored by crimping or a chemical binder.
- Wood fiber hydromulch at a rate of ¾ ton per acre for slopes flatter than 3:1 and 1 ton per acre for slopes at 3:1 which is the steepest slope planned at the project. This hydromulch would be anchored with a chemical binder at the manufacturer's suggested rate.
- Live mulch by use of quick growing sterile nurse crop such as "Quick Guard" with recommended rates of 5-10 lbs. /acre.

The mulch should control erosion by wind and water, decrease evaporation and seed predation, and increase survivability of the seeded species. Since there is only one post mining land use, mulching will follow one of the above described methods for all reclaim areas.

244.300. Rills & Gullies

Rills and gullies that form in areas that have been regraded and topsoiled that cause the following conditions will have the topsoil replaced followed by reseeding or replanting if the following occurs.

244.310. (a) If they disrupt the approved postmining land use or the reestablishment of the vegetative cover.

244.320. (b) If they cause or contribute to a violation of water quality standards for receiving streams will be filled, regraded, or otherwise stabilized; topsoil will be replaced; and the areas will be reseeded or planted.

250. PERFORMANCE STANDARDS

251.Topsoil & Subsoil Removed

All topsoil, subsoil and topsoil substitutes or supplements will be removed, maintained and redistributed according to the plan given under R645-301-230

and R645-301-240.

252.Topsoil & Subsoil Stockpiled

All stockpiled topsoil, subsoil and topsoil substitutes or supplements will be located, maintained and redistributed according to plans given under R645-301-230 and R645-301-240.

R645-302-317 Prime Farmland Performance Standards

317.100 Scope and Purpose

317.200 Responsible Agencies

The Natural Resources Conservation Service and UDOGM will consult with ACD on Prime Farmland areas within the North Private Lease mine permit area.

R645-302-315 makes clear that the authority with regard to prime farmland soils is the Secretary of Agriculture through the Utah NRCS State Soil Conservationist. The Division has initiated consultation with the State Conservationist per R645-301-315.100 and R645-301-315.200. Prior to approval, the State Conservationist is required to review and comment on the details of the proposed plan.

317.210 Prime Farmland Specifications

The NRCS within Utah will establish specifications for prime farmland soil removal, storage, replacement, and reconstruction.

The Division is in consultation with the NRCS State Conservationist to determine the preferred Prime Farmland soil-reconstruction. That coordinated review is ongoing and the recommendations made by the NRCS will be incorporated into the mining plan.

317.220 Implementation of Prime Farmland Specifications

UDOGM will use the soil-reconstruction specifications established by the NRCS to carry out its responsibilities in accordance with R645-302-311 and R645-302-31.

317.300 Applicability

The requirements of the R645-302-317 will not apply to prime farmland that has been excluded in accordance with R645-302-311 and R645-302-312.

The current Coal Hollow mine was permitted after August 3, 1977.

317.400 Soil Removal and Stockpiling

Soil will be removed from Prime Farmland areas by horizon (A, B, and C) and stockpiled separately by landowner. Estimated salvage depths for the A, B, and C horizons for soil map units in the Prime Farmland areas can be found in Volume 11: Supplemental Report section of the MRP in the report called: *Order 2 Soil Survey for the North Private Lease Expansion of the Coal Hollow Mine* (November 2014).

Soil samples will be collected from the Prime Farmland areas prior to salvaging to a depth of 48 inches and analyzed ~~for~~ by horizons ~~depth,~~ for pH, density, sodium adsorption ratio~~n~~ (SAR), conductivity (ECe), texture, and available water capacity. Sample locations will be approximately one per 2 acres. Horizon samples will be limited to depths of approximately 12 inches. Additional analysis parameters may be included after consultation with UDOGM and the NRCS.

317.410 Timing

Prime farmland soils will be removed from the areas to be disturbed before drilling, blasting, or mining.

317.420 Salvage Depth of Prime Farmland Soils

The minimum depth of soil and substitute soil material to be reconstructed will be 48 inches, or a lesser depth equal to the depth to a subsurface horizon in the natural soil that inhibits or prevents root penetration, or a greater depth if determined necessary to restore the original soil productive capacity.

Table 13 in Volume 11: Supplemental Report section of the MRP in the report called: *Order 2 Soil Survey for the North Private Lease Expansion of the Coal Hollow Mine* (November 2014) details the estimated total salvage depths for Prime Farmland soil map unit. It is anticipated that the salvage depths of B an C horizons in adjacent Prime Farmland soil map units can be increased in order to achieve a minimum final reclamation soil profile depth of 48 inches. The estimated average soil depth that can be salvaged from soil map units A1, A2, N and D is limited by the depth to Tropic shale.

317.430 Soil Removal and Stockpiling

Soil removal and stockpiling will be conducted to:

317.431 Separate Removal and Stockpiling of Topsoil

The A horizon or topsoil in Prime Farmland areas will be removed and stockpiled separately by landowner in a manner that will create a final soil having a greater productive value than prior to mining. It is anticipated that the duration of stockpiling Prime Farmland topsoil will be of short duration, since the Prime Farmland areas are at the north end of the proposed mining sequence. Estimated average salvage depths of the A horizon or topsoil in Prime Farmland areas is detailed in Table 13 in Volume 11: Supplemental Report section of the MRP in the report called: *Order 2 Soil Survey for the North Private Lease Expansion of the Coal Hollow Mine* (November 2014).

317.432 Separate Removal and Stockpiling of B and C horizons

Removal and stockpiling of all Prime Farmland soil horizons will be directly monitored by a Certified Professional Soil Scientist.

The B and C horizons will be removed and stockpiled separately by landowner in a manner that will create a final soil having a greater productive value than prior to mining. It is anticipated that the duration of stockpiling Prime Farmland B and C soil horizons will be of short duration, since the Prime Farmland areas are at the north end of the proposed mining sequence. Estimated average salvage depths of the B and C horizons in Prime Farmland areas is detailed in Table 13 in Volume 11: Supplemental Report section of the MRP in the report called: *Order 2 Soil Survey for the North Private Lease Expansion of the Coal Hollow Mine* (November 2014).

The C horizon will be stockpiled and stockpiled as B horizon soil, if the depth of C horizon soil to be stockpiled is less than 6 inches. It is anticipated that this consolidation of materials will not diminish the quality of the B horizon.

C horizon materials will primarily consist of soils with pH greater than 8.5.

317.440 Protection of Prime Farmland Stockpiles

Stockpiles of salvaged soil from the A, B, and C horizons will be placed at locations within the permit area where they will not be disturbed or be subject to excessive erosion. If left in place for more than 30 days, stockpiles will meet the requirements of R645-301-232, R645-301-233.100, R645-301-234, R645-301-242, and R645-301-243.

Stockpiled Prime Farmland materials will be subject to the following conditions within 30 days of stockpiling.

(a) They will be selectively placed on a stable site within the permit area. Prime Farmland soils will be stockpiled by horizon and by landowner. Stockpile areas in the North Private Lease are shown on Drawing 2-4

(b) They will be protected from contaminants and unnecessary compaction that would interfere with revegetation.

(c) They will be protected from wind and water erosion through prompt establishment and maintenance of an effective, quick growing vegetative cover or through other measures approved by the UDOGM. The side slopes will be graded to a maximum 3h:1v. Drawing 2-4 shows the planned stockpile areas, anticipated storage time, quantities and size for the North Private Lease. The interim seed mix for the Prime Farmland stockpiles is the following:

Stockpile Interim Seed Mix		
		Rate (PLS/Acre)
Bromus carinatus	Mountain Brome	6
Elymus lanceolatus	Thickspike wheatgrass	4
Elymus amithii	Western wheatgrass	5
Elymus spicatus	Bluebunch wheatgrass	6
Poa pratensis	Kentucky bluegrass	0.4
Total		**21.40**

(d) They will not be moved until required for redistribution unless approved by the UDOGM. Drawing 2-4 shows the anticipated storage time for each stockpile in the North Private Lease.

317.500 Soil Replacement

317.510 Soil Profile Reconstruction

Prime Farmland topsoil and subsoil will be replaced by horizons in the order that they existed prior to removal with the A horizon being on top, the B horizon in the middle, and the C horizon on the bottom of the reconstructed soil profile. Soil samples will be collected from the final graded surface in the Prime Farmland areas on a basis of approximately one sample per two acres on a random statistical grid. The soil samples will be analyzed for horizon depth, pH, density, sodium adsorption ration (SAR), conductivity (ECe), texture, and available water capacity. Horizon samples will be limited to depths of approximately 12 inches.

317.520 Depth of Reconstructed Soil Profile

The combined depth of the reconstructed A, B, and C horizons will be a minimum of 48 inches. Substitute subsoil from adjacent soil map units will be incorporated as either B or C horizon material in areas where the soil depth was less than 48 inches prior to mining. Table 13 in Volume 11: Supplemental Report section of the MRP in the report called: *Order 2 Soil Survey for the North Private Lease Expansion of the Coal Hollow Mine* (November 2014) details the estimated soil profiles for each of the Prime Farmland soil map units.

317.530 Soil Compaction Monitoring

Soil compaction or density will be monitored during replacement of the A, B, and C horizons. The soil will be ripped or disked as needed to achieve soil densities similar to those documented in the Prime Farmland soils prior to removal and stockpiling as detailed in R645-302-317.400. The overlying soil horizon will not be reconstructed until the desired soil density has been achieved in the underlying soil horizon.

317.540 Replacement of B and C horizons

The combined depth of the B and C horizons will be sufficient to achieve a total minimum depth of 48 inches when the A horizon is included as part of the depth.

Substitute subsoil will be used as C horizon soil in areas where the combined original depth was less than 48 inches prior to mining.

317.550 Replacement of A horizon

The A horizon or topsoil will be replaced in Prime Farmland areas as the final soil surface layer. This surface soil layer will equal or exceed the thickness of the original surface soil layer. The thickness of the average original soil surface layer in Prime Farmland areas is detailed in Table 13 in Volume 11: Supplemental Report section of the MRP in the report called: *Order 2 Soil Survey for the North Private Lease Expansion of the Coal Hollow Mine* (November 2014).

317.600 Revegetation and Restoration of Soil Productivity

317.610 Vegetation Establishment

Following prime farmland soil replacement, the soil surface will be stabilized with a vegetative cover or other means that effectively controls soil loss by wind and water erosion. Vegetation will be planted in consultation with the landowner following reconstruction and seedbed preparation of Prime Farmland areas.

317.620 Restoration of Prime Farmland Productivity

317.621 Measurement of Prime Farmland Productivity

Productivity of the reconstructed Prime Farmland areas will be measured implementing a monitoring program developed in consultation with UDOGM and the NRCS.

317.622 Productivity Monitoring Program

The productivity of the reconstructed Prime Farmland areas will be measured with a statistically valid program with 90 percent or greater confidence developed in consultation with UDOGM and the NRCS.

The Division is in consultation with the NRCS State Conservationist to determine the preferred productivity monitoring program for the post mining land use evaluation. That coordinated review is ongoing and the recommendations made by the NRCS will be incorporated into the mining plan.

317.623 Monitoring Period

The measurement period for determining average annual crop production will be a minimum of three years prior to release of the performance bond.

317.624 Management Level

The level of management applied to the reconstructed Prime Farmland during the measurement period will be equal to the management level on non mined similar adjacent areas.

317.625 Restoration of Soil Productivity

Restoration of soil productivity will be considered achieved when the average yield during the measurement period equals or exceeds the average yield of the reference crop

established for the same period for non-mined soils of the same or similar texture or slope phase of the soil series in the surrounding area under equivalent management practices.

317.626 Reference Crop

The reference crop on which restoration of soil productivity is proven will be selected from the crops most commonly produced on the surrounding prime farmland. Where row crops are the dominant crops grown on prime farmland in the area, the row crop requiring the greatest rooting depth will be chosen as one of the reference crops.

317.6327 Reference Crop Yields

Reference crop yields for the selected reference crop will be determined from, either:

317.627.1 Yield Records

The current yield records of representative local farms in the surrounding area, with concurrence by the NRCS; or

The Division is in consultation with the NRCS State Conservationist for the yield records of representative local farms in the surrounding area for the post mining land use evaluation. That coordinated review is ongoing and the recommendations made by the NRCS will be incorporated into the mining plan.

317.627.2 Average County Yields

The average county yields recognized by the U.S. Department of Agriculture, which have been adjusted by the NRCS for local yield variation within the county that is associated with differences between non-mined prime farmland soil and all other soils that produce the reference crop; and

The Division is in consultation with the NRCS State Conservationist for the average county yields for the post mining land use evaluation. That coordinated review is ongoing and the recommendations made by the NRCS will be incorporated into the mining plan.

317.628 Adjustment of Reference Yields

Average reference crop yields in R645-302-317.627 may be adjusted, with concurrence of the NRCS, for:

The Division is in consultation with the NRCS State Conservationist to determine if the average reference yields should be adjusted for the post mining land use evaluation. That coordinated review is ongoing and the recommendations made by the NRCS will be incorporated into the mining plan.

317.628.1 Environmental Impacts

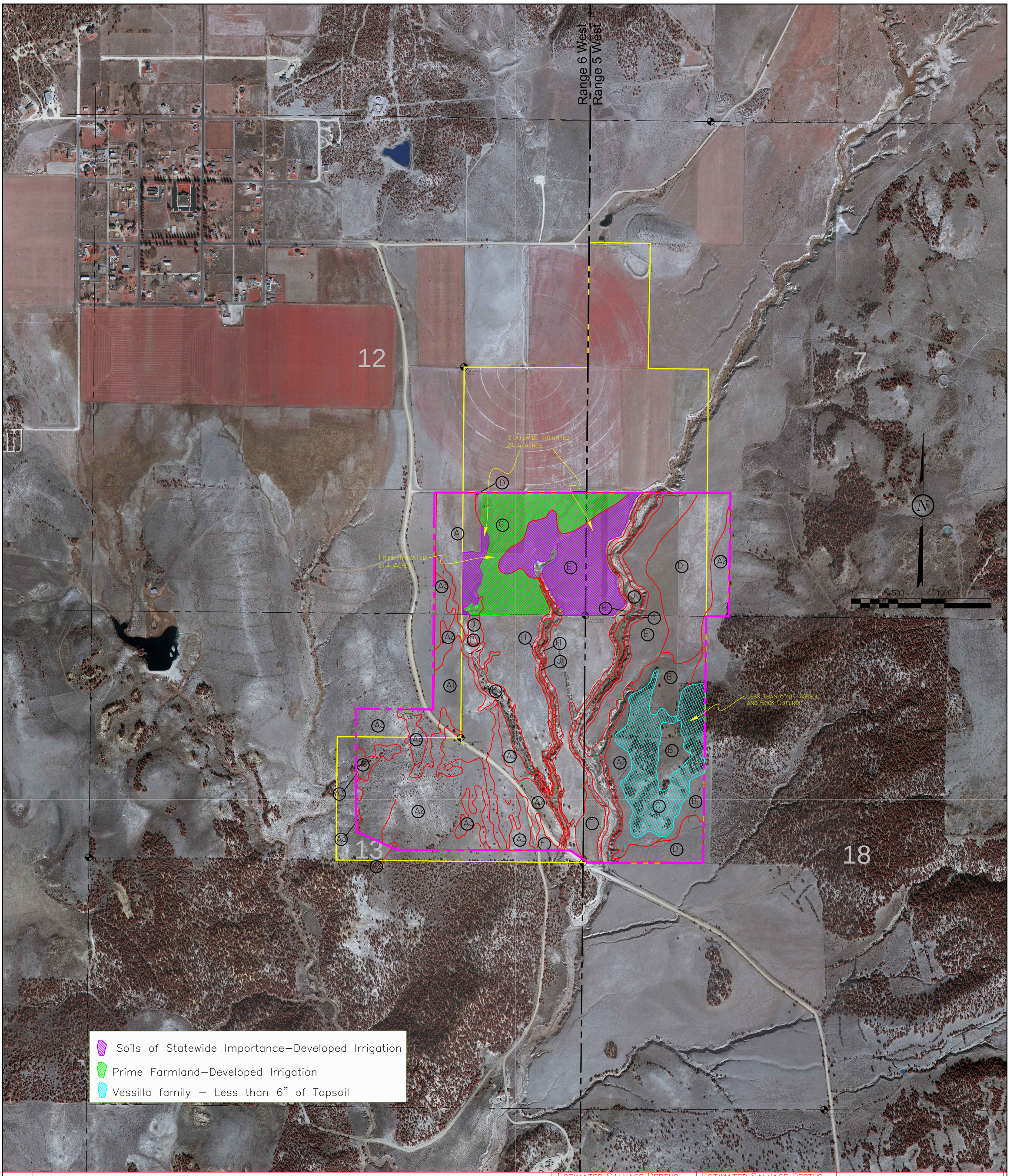
Disease, pest, and weather-related seasonal variations; or

The Division will be in consultation with the NRCS State Conservationist for the to determine if an environmental impacts should be taken into account as part of the post mining land use evaluation. That coordinated review is ongoing and the recommendations made by the NRCS will be incorporated into the mining plan.

317.628.2 Management Practices

Differences in specific management practices where the overall management practices of the crops being compared are equivalent.

The Division will be in consultation with the NRCS State Conservationist for the to determine if differences in management practices should be taken into account as part of the post mining land use evaluation. That coordinated review is ongoing and the recommendations made by the NRCS will be incorporated into the mining plan.



Map Unit	Map Unit Name	Estimated Salvage Depths Non Prime Farmland (1)			Estimated Salvage Depths Prime Farmland, if Irrigated		
		Topsoil Depth	Subsoil Depth	Total Salvage	A Horizon Depth	B Horizon Depth	C Horizon Depth
		--------Inches--------			--------Inches--------		
A1	Sideshow Family, 0 to 4 percent slope	14	31	46	8	35	4
A2	Sideshow - Teromote Families, 4 to 8 percent slopes	13	32	46	8	36	1
A3	Sideshow Family, 8 to 18 percent slopes	14	31	46	8	34	4
B	Flugle - Brumley Families, 8 to 15 percent slope	17	25	42	10	32	0
C	Quezcan Family - Vesilla Families, 20 to 45 percent slopes	6	12	18			
D	Wimmer - Teromote - Bobknoll, 2 to 8 percent slopes	14	31	46	8	36	0
E	Atatl - CCC Families, 0 to 4 percent slopes	13	35	48	6	38	4
F	Boxcanyon Family, 0 to 4 percent slopes	19	29	48	8	40	0
G	AAA Family, 0 to 5 percent slopes	11	37	48	8	37	2
H	BBB - Atlatl Family, 8 to 25 percent slopes	12	36	48			
J	Sideslide - DDD Families, 4 to 12 percent slopes	7	41	48			
K	BBB Family, 15 to 75 percent slopes	12	34	46			
P	Pond						

(1) Estimated salvage depths are weighted averages based on map unit components and percentage of each component in the map unit. Variations of salvage depth occur within each map unit and should be monitored during salvage operations

(2) Good/Fair subsoil is based on the soil meeting the good and fair suitability criteria for all parameters except clay textures in Guidelines for Management of Topsoil and Overburden (Utah DOGM, 2005)

LEGEND:
- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- SECTION LINE
- FOUND SECTION CORNER

DRAWN BY:	CHECKED BY:
K. NICHOLES	B. LONG
DRAWING: 2—3	DATE: 7/30/14
	SCALE: 1" = 500'
JOB NUMBER: 0001	SHEET

REVISIONS

DATE:	BY:
03/12/15	KN
10/03/15	KN

SOIL SURVEY MAP

NORTH
COAL HOLLOW
PROJECT
ALTON, UTAH

DRAWING: 2-3

Alton Coal Development
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PRIME FARMLAND TOPSOIL TO STOCKPILES
POLYGONS SEPARATED BY SOIL TYPE
AND OWNERSHIP

PRIME FARMLAND TOPSOIL TO STOCKPILES:
STOCKPILES SEPARATED BY OWNERSHIP
AND SOIL HORIZON. ALL STOCKPILES TO BE
PLACED WITH 3:1 SIDE SLOPES, SMOOTH
GRADED AND SEEDED. STOCKPILES TO BE
IN PLACE FOR AT LEAST ONE YEAR.

NORTH HAUL ROAD

TEMPORARY TOPSOIL STOCKPILE:
PLACED WITH 3:1 SIDE SLOPES,
AND TACKIFIER FOR STABILIZATION.
TO BE IN PLACE FOR LESS THAN SIX
MONTHS.

DRH-G-1
OGP-G
GDH-G
OGP-A1
DRH-E-1
OGP-E
DRH-E-2
DRH-A1
GDH-E
DRH-G-2
DRH-D
GDH_B - 37,800 CY Capacity
OGP_B - 37,800 CY Capacity
DRH_A - 24,900 CY Capacity
DRH_B - 93,100 CY Capacity
Temporary Topsoil Stockpile
60,000 C.Y.

ROUTE 136 (K3900) BYPASS
SOUTH HAUL ROAD
NORTH HAUL ROAD

Area 1 Disturbance	= 51.9 Acres	Topsoil Direct Placed for Reclaim
Area 2 Disturbance	= 115.7 Acres	Topsoil placed in Stockpile
Area 3 Disturbance	= 57.2 Acres	
Total Disturbance	= 224.8 Acres	
Undisturbed Area	= 70.8 Acres	
Total Permit Area	= 295.6 Acres	

LEGEND:
- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- SECTION LINE
- FOUND SECTION CORNER
- FOUND PROPERTY CORNER

DRAWN BY:	CHECKED BY:
A. CHRISTENSEN	DWG
DRAWING: 2–4	DATE: 4/10/15
	SCALE: 1" = 200'
JOB NUMBER: 0001	SHEET

REVISIONS

DATE:	BY:
10/12/15	AC

TOPSOIL HANDLING PLAN

NORTH
COAL HOLLOW
PROJECT
ALTON, UTAH

DRAWING: 2-4

UTAH REGISTERED #154168 DAN W. GUY PROFESSIONAL ENGINEER

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R645-301-300. BIOLOGY

310. INTRODUCTION

The following section has been created to be submitted to the State of Utah, Division of Oil, Gas & Mining (DOGM). It describes specific biological resources of the Coal Hollow Project near the town of Alton, Utah. Updates to the data sets herein will be a continuous undertaking. This chapter contains information including the following:

311. Vegetative, fish, and wildlife resources of the permit area and adjacent areas as described under R645-301-320.

312. Potential impacts to vegetative, fish and wildlife resources and methods proposed to minimize these impacts during coal mining and reclamation operations as described under R645-301-330 and R645-301-340.

313. Proposed reclamation designed to restore or enhance vegetative, fish, and wildlife resources to a condition suitable for the designated postmining land use as described under R645-301-340.

320. **ENVIRONMENTAL DESCRIPTION**

321. **VEGETATION INFORMATION**

321.100. Vegetation Mapping and Plant Community Data in the Permit Area

The first vegetation map prepared for the Coal Hollow Project delineated the plant communities that existed within the permit area. The plant communities for the permit area on this early map were drafted on a USGS quadrangle map using information from an existing vegetation map that was prepared from previous work in the area. The earlier work was accomplished in the late-1980s.

A new flight was conducted for the Coal Hollow Project in 2006 that provided aerial photography and more detailed information than had previously been available. This aerial photography and photogrammetric mapping has been used in preparation of many updated maps of the project area, including a revised vegetation map where the plant communities were delineated on the new aerial photographs. Also, new quantitative data were recorded in 2006 in some of the first plant communities proposed for disturbance along with reference areas that would *not* be disturbed. This next version of the vegetation map for the Coal Hollow project also provided sample locations of these recently studied areas. This map was submitted to DOGM in the last MRP submittal (*dated May 25, 2007*) along with the first vegetation quadrangle map, because it continued to provide support for some of the older vegetation data also submitted in the MRP at that time.

Like the earlier vegetation mapping information, and because the area has been studied previously, existing quantitative data sets were also available for the plant communities of the Coal Hollow Project area. These data were recorded in the late-1980s. The aforementioned earlier quadrangle vegetation map corresponded to this early vegetation information. The early datasets were included in the MRP provided to DOGM (*submittal date: May 25, 2007*). Although this information was valuable at that time because it provided initial baseline data for that time period, plans to re-sample the same plant communities to update the existing data were made. Consequently, new quantitative sampling was accomplished later in 2007 to provide updated information about the plant communities within the permit area. The updated data have been summarized and included in this MRP. Therefore, with the 2006 and 2007 quantitative data for the plant communities submitted in the MRP, the dataset for those plant communities proposed for disturbance in the current mine plan for the entire permit area is complete. **Therefore, the older vegetation datasets and maps created using information from the late- 1980s were replaced by the updated datasets and maps in the MRP**.

Reference areas chosen to represent future revegetation success standards were also chosen and sampled during the same sample periods in 2006 and 2007 as those proposed for disturbance by the mining operations. The meadow reference area and the Dame Meadow Sample Area (another potential reference area was included into the permit boundary in 2014. Although coal is to be removed from this area by undermining

only and the surface will not be disturbed, the meadow reference area will be relocated during the 2014 growing season to a representative area due south of the permit boundary that does not contain coal and will not be disturbed by mining operations.

Acreage of each plant community and map symbols shown on the revised Vegetation Map *(Drawing 3-1, dated 12/26/07)* for the Coal Hollow Project permit and adjacent areas are shown below.

Vegetation Communities of the Coal Hollow Permit Area			
MAP SYMBOL (see *Vegetation Map*, Drawing 3-1)	PLANT COMMUNITY	TOTAL ACREAGE	PERCENT OF TOTAL
S/G	Sagebrush/Grass	212.00	33.64
P	Pasture Land	192.00	30.48
P-J	Pinyon-Juniper	114.00	18.10
M	Meadow	69.00	10.95
OB	Oak Brush	40.00	6.35
RB/SB	Rabbitbrush/Sagebrush (Disturbed; previously Sagebrush/Grass)	3.00	0.48
	Total*	**630.00**	100.00

Color photographs of the plant communities within the Coal Hollow Project permit area are shown in **PHOTOGRAPHS** section near the end of this chapter.

The above plant communities exist within the boundaries of the Coal Hollow Project permit area and will be disturbed by the coal mining and related activities. Consequently, quantitative and qualitative data were recorded by sampling the plant communities in 2006 and 2007. For general, wide-angle views of the plant communities in the permit area, refer to Photographs 3-1, 3-2, 3-3 and 3-4.

[**NOTES**: 1:The rabbitbrush/sagebrush community was not sampled for baseline data information. This small area represented less than one-half of one percent of the permit area. Moreover, it was a *previously disturbed* sagebrush/grass community. Therefore, standards of revegetation success at final reclamation will be the same as those outlined for the *undisturbed* sagebrush/grass plant communities described in this document 2: Expansion of the mine has been proposed to include a new area north of the current operations. Vegetation information for that area can be found in VOLUME 12: Supplemental Report section of the MRP in the report called: *Vegetation & Wildlife Habitat of the North Private Lease Area, Coal Hollow Project Kane County, Utah (November 2014)*].

As mentioned other areas with similar plant communities were sampled within or near the permit area that will *not* be disturbed by mine-related activities. These native plant communities were chosen to be used as future revegetation success standards at the time of final reclamation of the mine site. Therefore, the same methods and parameters were employed in the reference areas that were used to sample the areas proposed for disturbance. The areas with like-communities sampled (the proposed disturbed area and reference area) for each community type, were compared statistically for their appropriateness as reference areas at this time. Similar comparisons (and additional comparisons) will also be conducted between the communities once the land is reclaimed. Complete results and methodologies used are shown in the final reports prepared from sampling these communities. These reports have been included in the appendices at the end of this chapter. The reports titles are: *Vegetation of the Sagebrush/Grass & Meadow Areas*: *2006* (**Appendix 3-2**) and *Vegetation Sampling in the Coal Hollow Project Area: 2007* (**Appendix 3-4**). Following is a summary of the results from sampling these communities.

Proposed Disturbed Sagebrush/Grass Community

One of the most common plant communities of the Coal Hollow permit area was sagebrush/grass (see *Vegetation Map*, *Drawing 3-1* and Photograph 3-5).

Sagebrush community types in the permit area can be dominated by either big sagebrush (*Artemisia tridentata*) or black sagebrush (*A. nova*). In the sagebrush/grass community that has been proposed for disturbance and sampled, both of these species were nearly equally represented. The dominant plant species as shown in the species cover table (Table 3-1) were big sagebrush, black sagebrush, jungrass (*Koeleria macrantha*), and Sandberg's bluegrass (*Poa secunda*).

The total living cover of this sagebrush/grass community was estimated at 54.73%, of which 52.40% of it was from understory cover and only 2.33% was from overstory [Table 3-2 (A)]. Shrubs dominated the composition here representing 64.09% of the total living understory cover, followed by grasses at 34.64%, and forbs at 1.28% [Table 3-2 (B)]. Woody species density was also measured; the total number of individuals per acre was estimated at 8,339 (Table 3-3).

Sagebrush/Grass Reference Area

The sagebrush/grass community chosen as a reference area to be used for future revegetation success standards was located northwest of the sagebrush/grass community that was proposed for disturbance, and just outside the permit area (see *Vegetation Map*, *Drawing 3-1* and Photograph 3-6).

This plant community will remain undisturbed and is similar to the proposed disturbed area. It had been chosen to be used for future revegetation success standards and had similar cover, composition, and woody species density. Cover and frequency by species of the sagebrush/grass reference area are shown on Table 3-4. The dominant shrub plant species here were big sagebrush and black sagebrush. The most common grass species were slender wheatgrass (*Elymus trachycaulus*), cheatgrass *(Bromus tectorum*), Kentucky bluegrass, and Sandberg's bluegrass.The total living cover in the area was estimated at 60.50%, all of which was from understory cover [Table 3-5(A)]. Woody species dominated the composition at 61.48%, whereas grasses comprised 29.86%, and forbs 8.65% [Table 3-5(B)].

The total number of plants per acre in the woody species density measurements was 8,331 (Table 3-6). Big sagebrush and black sagebrush dominated the woody species in the density measurements.

Proposed Disturbed Meadow (Dry) Community

There are different meadow lands located within the permit area. These meadows have somewhat been differentiated on the *Vegetation Map (Drawing: 3-1)* which show them as "M (Dry)" compared to those that retain more soil moisture, or shown as merely as "M" on the map. The year 1 mining operations would disturb a dry meadow community on the west side of the permit area (see Photograph 3-7).

Quantitative sampling was conducted in this meadow. As shown on Table 3-7, the dominant species in the proposed disturbed meadow were grass and grass-like species including sedge (*Carex* sp.), wiregrass (*Juncus arcticus*) and junegrass. Broom snakeweed (*Gutierrezia sarothrae*) was the dominant shrub, whereas the dominant forbs were yarrow (*Achillea millefolium*) and Pacific aster (*Aster ascendens*).

The total living cover was estimated at 73.00% [Table 3-8 (A)]. The composition of the understory was 75.70% grasses (and grass-likes), 13.28% forbs, and 11.01% shrubs [Table 3-8 (B)]. The total number of plants per acre in the woody species density measurements was 817 (Table 3-9). Black sagebrush was the only woody species present in the density measurements.

Meadow (Dry) Reference Area

The dry meadow reference area was chosen outside the permit area, but in close proximity to the dry meadow proposed to be disturbed by the mine (see *Vegetation Map*, *Drawing 3-1* and Photograph 3-8). The dominate grass and grass-like species in the dry meadow reference area were wiregrass, sedge, and junegrass (Table 3-10). The dominant forbs were yarrow, Pacific aster, and cinquefoil (*Potentilla anserina*). The only shrubs present in the sample quadrats were black sagebrush and broom snakeweed.

The total living cover of this reference area was 72.00% [Table 3-11(A)]. The understory cover composition was comprised of 71.05% grasses (and grass-likes), 22.31% forbs and 6.64% shrubs [Table 3-11 (B)]. The total woody species density of the community was 1,481 plants per acre and was comprised exclusively of black sagebrush (Table 3-12).

Proposed Disturbed Pinyon-Juniper Community

Several areas proposed for disturbance by mining activities currently support pinyon-juniper plant communities. For a representative picture of these sample areas see Photograph 3-9. Pinyon-juniper communities were sampled in two areas. One such area, shown as the “Prop. Dist. Pinyon-Juniper Sample Area (North)” on the *Vegetation Map, Drawing 3-1*, is located on the east side of the permit area and *north* of another pinyon-juniper sample area. This is a site where mining activities have been planned during the first year of mining activities. Another pinyon-juniper sample area or the “Prop. Dist. Pinyon-Juniper Sample Area (South)” on the map, is located near the south boundary of the permit area and also *south* of the other pinyon-juniper sample area. Disturbance from mining-related activities of the south sample area have been planned during the third year of mining. These two datasets have been combined to show the final results of the sample data for the proposed disturbed pinyon-juniper community as a whole, but the data could easily be separated at a later time if for some reason it is desired.

Overstory cover of the pinyon-juniper community was represented by only two species in the sample quadrats, but was dominated by Utah juniper (*Juniperus osteosperma*) and followed distantly by pinyon pine (*Pinus edulis*). Understory cover was dominated by black sagebrush, followed by Utah juniper and pinyon pine (Table 3-13). Grasses were few and forbs were absent in the sample quadrats.

The total living cover of the pinyon-juniper community was 43.00%, of which 25.00% was from understory and 18.00% was from overstory species [Table 3-14 (A)]. The understory composition by lifeform in this community was comprised of 95.88 % woody species [Table 3- 14 (B)]. Woody species density was measured at 2,657 individuals per acre (Table 3-15).

Pinyon-Juniper Reference Area

A reference area, or an area chosen to represent future revegetation success standards, was chosen and sampled in another pinyon-juniper plant community (see Photograph 3-10). This reference area will *not* be disturbed by the mining operations so it could be used for data comparisons following final reclamation at the mine site. The pinyon-juniper reference area was located near the *north* proposed disturbed pinyon-juniper community (see *Vegetation Map*, *Drawing 3-1*).

Like the above proposed disturbed community, the overstory cover of the reference area was dominated by Utah juniper followed by pinyon pine. Understory was also dominated by black sagebrush, Utah juniper and pinyon pine (Table 3-16). Again forbs were not present in the quadrats; grasses present were slender wheatgrass and squirreltail (*Elymus elymoides*).

The total living cover of the pinyon-juniper reference area was estimated at 39.00%, 11.50% of it was composed of overstory and 27.50% was understory cover [Table 3-17 (A)]. The composition of the understory in the pinyon-juniper reference area was calculated as 89.56% trees and shrubs and 10.44% grasses [Table 3-17 (B)]. Woody species density was dominated by black sagebrush and Utah juniper, but the total of all species was 4,215 individuals per acre (Table 3-18).

Proposed Disturbed Pasture Land Community

The areas called “pasture lands” in the text and maps of this document were plant communities that have been disturbed previously to artificially increase herbaceous cover and productivity for domestic livestock. Prior to pasture lands, these communities were probably native sagebrush/grass plant communities similar to those sampled and described in the 2006 report (*Vegetation of the Sagebrush/Grass & Meadow Areas: 2006*). Although differences occur between pastures due to grazing practices and species planted, representative pastures were sampled for this report (see Photographs 3-11 and 3-12). The sample areas were located near the center of the permit area (see *Vegetation Map, Drawing 3-1*). Again, different locations within this community were sampled, a *north* and a *south* area; and the data were combined for the summary tables in this report. The proposed disturbed pasture land (*north*) was an area proposed for disturbance by open pit mining during the first year of mining activities. The proposed disturbed pasture land (*south*) was an area proposed for disturbance by open pit mining in the second year of mining activities. The alternate Highwall mining would reduce the proposed surface disturbance whenever this type of mining is used.

The sampling results for the north and south pasture lands indicate that the most common plant species by cover and frequency for the combined data were intermediate wheatgrass (*Elymus hispidus*), Kentucky bluegrass (*Poa pratensis*), black sagebrush (Table 3-19). The annual plant called poverty weed (*Iva axillaris*) was also common in the sample areas.

The total living cover, all of it from understory species, was 44.50% [Table 3-20 (A)]. The composition of the pasture lands consisted of 52.16% grasses, 30.19% shrubs and 17.64% forbs [Table 3-20 (B)]. Woody species density measurements show the woody species density to be 1,349 individuals per acre with the most common species being big sagebrush *(Artemisia tridentata*), rubber rabbitbrush (*Chrysothamnus nauseosus*) and black sagebrush (Table 3-21).

Pasture Land Reference Area

Because the pasture lands were unnatural or comprised of non-native conditions, a native reference area to represent future revegetation success standards was not chosen. Appropriate standards of revegetation success will be developed using the site-specific knowledge gained by the landowners, regulatory agencies, as well as qualified botanists and wildlife biologists representing the coal company.

Proposed Disturbed Oak Brush Community

An oak brush community has been proposed for disturbance by future mining operations (see Photograph 3-13). This community was located in the northeast region of the permit area (*see Vegetation Map, Drawing 3-1*).

Overstory of this community was greater than the understory cover. The dominant overstory species by a wide margin was Gambel's oak (*Quercus gambelii*) with a 41.25% cover and was present in 85.00% of the samples. The dominant understory species were big sagebrush, snowberry (*Symphoricarpos oreophilus*) and Gambel's oak (Table 3-22).

The total living cover in the proposed disturbed oak brush community was estimated at 66.75%, 43.00% coming from overstory and 23.75% from understory plants [Table 3-23 (A)]. Woody species comprised 97.75% of the understory composition with the remaining 2.25% coming from grass species [Table 3-23 (B)]. Forbs were not present in the sample quadrats. Woody species density was estimated at 3,743 plants per acre and, like the cover results, the most common species consisted of snowberry, Gambel's oak and big sagebrush (Table 3-24).

Oak Brush Reference Area

A oak brush reference area was chosen to represent future success standards for revegetation (see Photograph 3-14). This reference area was located on the east side of the permit area *(see Vegetation Map, Drawing 3-1*). Like the proposed disturbed area it was chosen to represent, the reference area's cover was greater for overstory than that of the understory. The dominant overstory species by far was Gambel's oak. Dominant understory species were Gambel's oak, Kentucky bluegrass, Utah juniper, big sagebrush and snowberry (Table 3-25).

Overstory cover was estimated at 53.25%, whereas understory cover was 20.00%. The total living cover of those combined was 73.25% [Table 3-26 (A)]. Understory lifeform composition was comprised of 66.92% trees and shrubs and 33.08% grasses – no forbs were present [Table 3- 26 (B)]. Woody species density was estimated at 2,092 plants per acre with the most common by a wide margin being Gambel's oak, but also consisted of snowberry, big sagebrush, Rocky Mountain juniper (*Juniperus scopulorum*), pinyon pine and Utah juniper (Table 3-27).

Proposed Disturbed Meadow Community

Meadow areas in and adjacent to the project permit area have been studied (see *Vegetation Map, Drawing 3-1*). A dry meadow was mentioned above and reported in the 2006 document included in the MPR [*Vegetation of the Sagebrush/Grass & Meadow Areas: 2006* (**Appendix 3- 2**)]. However, another meadow community that retains more soil moisture has also been proposed for disturbance due to the mining (see Photograph 3-15). The complete report for this study has been include in the appendix section of Chapter 3 [*Vegetation Sampling in the Coal Hollow Project Area: 2007* (**Appendix 3-4**)].

The dominant plant species by cover and frequency in this community were wiregrass, Missouri iris (*Iris missouriensis*) and Wood's rose (*Rosa woodsii*). For a list of all species present in the sample quadrats refer to Table 3-28. This meadow community had a total living cover of 86.00% [Table 3-29 (A)]. Of this living cover 51.58% of it were comprised grasses or grass-like species, 32.54% were forbs and 15.88% were shrubs [Table 3-29 (B)]. Woody species density of the community was 384 individuals per acre, all of which was Wood's rose (Table 3-30).

Meadow Reference Area

The reference area, or area chosen to represent future revegetation success standards, was located just outside the permit area (*Vegetation Map, Drawing 3-1;* Photograph 3-16). Similar species dominated this community as were represented in the proposed disturbed area, namely wiregrass, Missouri iris, Kentucky bluegrass (*Poa pratensis*) and Wood's rose (Table 3-31). The total living cover in the reference area was estimated at 88.50% [Table 3-32 (A)]. Composition here was calculated to be comprised of 51.57% grass and grasslike species, 37.38% forbs and 11.04% shrubs [Table 3-32 (B)]. Woody species density in this area was estimated at 2,226 plants per acre (Table 3-33).

Other Meadow Communities

Other meadow communities were studies outside the permit area (see *Vegetation Map, Drawing 3-1*). These areas will not be disturbed by mining activities – they were studied to provide more information about the meadows in the area to provide companion studies for other studies such as alluvial valley floor determinations. Results from these studies can be found in the Chapter 3 appendices [*Vegetation Sampling in the Coal Hollow Project Area: 2007* (**Appendix 3-4)**].

NOTE: Expansion of the mine has been proposed to include a new area north of the current operations. Vegetation information for that area can be found in the VOLUME 12: Supplemental Report section of the MRP in the report called: *Vegetation & Wildlife Habitat of the North Private Lease Area, Coal Hollow Project Kane County, Utah* (November 2014).

Table 3-1: Alton Coal Project. Living Cover and Frequency by Plant Species (2006).			
Sagebrush/Grass (S/G) Proposed Disturbed			
	Mean Percent	Standard Deviation	Percent Frequency
OVERSTORY COVER			
Juniperus osteosperma	2.33	9.55	6.67
UNDERSTORY COVER			
TREES & SHRUBS			
Artemisia nova	14.93	17.10	50.00
Artemisia tridentata var. tridentata	15.23	20.48	26.67
Chrysothamnus depressus	2.07	5.90	16.67
Gutierrezia sarothrae	1.23	2.79	20.00
FORBS			
Eriogonum racemosa	0.33	1.25	6.67
Gilia aggregata	0.33	1.25	6.67
Linum perenne	0.10	0.54	3.33
GRASSES			
Bouteloua gracilis	2.33	8.54	10.00
Bromus tectorum	0.83	3.18	6.67
Elymus smithii	0.50	1.98	6.67
Elymus trachycaulus	0.50	1.98	6.67
Hordeum jubatum	0.83	1.86	16.67
Koeleria macrantha	4.17	10.25	23.33
Poa pratensis	3.17	7.69	16.67
Poa secunda	4.00	7.00	30.00
Stipa hymenoides	1.83	3.53	23.33

Table 3-2: Coal Hollow Project. Total Cover and Composition (2006).		
Sagebrush/Grass (S/G) Proposed Disturbed		
A. TOTAL COVER	Mean Percent	Standard Deviation
Overstory Cover (o)	2.33	9.55
Understory Cover (u)	52.40	13.67
Litter	16.17	10.90
Bareground	26.87	11.83
Rock	4.57	6.15
TOTAL LIVING (o + u)	54.73	13.52
B. % COMPOSITION (u)		
Shrubs	64.09	22.93
Forbs	1.28	3.55
Grasses	34.64	22.43

Table 3-3: Coal Hollow Project. Woody Species Density (2006).

Sagebrush/Grass (S/G) Proposed Disturbed	
SPECIES	**Individuals Per Acre**
Artemisia tridentata	2779.73
Artemisia nova	4100.11
Chrysothamnus depressus	833.92
Chrysothamnus nauseosus	69.49
Chrysothamnus viscidiflorus	138.99
Gutierrezia sarothrae	277.96
Juniperus osteosperma	138.99
TOTAL	**8339.20**

Table 3-4: Alton Coal Project. Living Cover and Frequency by Plant Species (2006).

Sagebrush/Grass (S/G) Reference Area	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Artemisia nova	23.85	18.18	75.00
Artemisia tridentata	10.90	13.39	55.00
Chrysothamnus nauseosus	2.10	3.78	25.00
Gutierrezia sarothrae	0.90	2.72	10.00
Juniperus osteosperma	0.25	1.09	5.00
FORBS			
Achillea millefolium	0.25	1.09	5.00
Aster ascendens	3.00	4.58	35.00
Erigeron religiosus	0.25	1.09	5.00
Iva axillaris	1.00	2.00	20.00
Sphraelcea coccinea	0.25	1.09	5.00
GRASSES			
Bromus tectorum	4.75	6.61	45.00
Elymus smithii	0.50	2.18	5.00
Elymus trachycaulus	5.25	9.93	30.00
Juncus arcticus	0.75	3.27	5.00
Poa pratensis	3.00	7.65	15.00
Poa secunda	2.75	5.36	25.00
Stipa hymenoides	0.75	0.75	10.00

Table 3-5: Coal Hollow Project. Total Cover and Composition (2006).		
Sagebrush/Grass (S/G) Reference Area		
A. TOTAL COVER	Mean Percent	Standard Deviation
Understory Cover (u)	60.50	13.03
Litter	13.05	4.81
Bareground	25.05	13.58
Rock	1.40	1.20
B. % COMPOSITION (u)		
Trees/Shrubs	61.48	17.01
Forbs	8.65	8.73
Grasses	29.86	14.18

Table 3-6: Coal Hollow Project. Woody Species Density (2006).

Sagebrush/Grass (S/G) Reference Area	
SPECIES	**Individuals Per Acre**
Artemisia tridentata	3644.87
Artemisia nova	3957.29
Chrysothamnus nauseosus	624.83
Gutierrezia sarothrae	208.28
TOTAL	**8331.13**

Table 3-7: Alton Coal Project. Living Cover and Frequency by Plant Species (2006).			
Meadow (M) Dry Proposed Disturbed			
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Artemisia nova	1.00	2.00	20.00
Gutierrezia sarothrae	7.20	4.80	85.00
FORBS			
Achillea millefolium	6.40	6.42	55.00
Aster ascendens	2.00	4.00	25.00
Eriogonum racemosa	0.25	1.09	5.00
Linum lewisii	1.00	3.39	10.00
Potentilla anserina	0.25	1.09	5.00
GRASSES			
Bouteloua gracilis	2.25	6.80	10.00
Carex sp.	27.50	19.46	75.00
Elymus elymoides	0.50	1.50	10.00
Elymus smithii	0.75	2.38	10.00
Hordeum jubatum	0.50	2.18	5.00
Juncus arcticus	10.25	13.27	70.00
Koeleria macrantha	8.00	10.17	55.00
Muhlenbergia asperifolia	0.50	2.18	5.00
Poa pratensis	4.65	10.62	25.00

Table 3-8: Coal Hollow Project. Total Cover and Composition (2006).		
Meadow (M) Dry Proposed Disturbed		
A. TOTAL COVER	Mean Percent	Standard Deviation
Understory Cover (u)	73.00	9.67
Litter	9.40	3.28
Bareground	16.50	9.67
Rock	1.10	0.30
B. % COMPOSITION (u)		
Shrubs	11.01	8.10
Forbs	13.28	8.74
Grasses	75.70	13.81

Table 3-9: Coal Hollow Project. Woody Species Density (2006).

Meadow (M) Dry (Proposed Disturbed)	
SPECIES	**Individuals Per Acre**
Artemisia nova	816.75
TOTAL	**816.75**

Table 3-10: Alton Coal Project. Living Cover and Frequency by Plant Species (2006).			
Meadow (M) Dry Reference Area			
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Artemisia nova	3.25	6.76	25.00
Gutierrezia sarothrae	1.50	3.91	15.00
FORBS			
Achillea millefolium	5.50	5.45	60.00
Artemisia campestris	1.25	3.83	10.00
Aster ascendens	5.00	6.12	50.00
Eriogonum racemosa	0.25	1.09	5.00
Linum lewsii	0.25	1.09	5.00
Potentilla anserina	3.25	7.12	20.00
GRASSES			
Bouteloua gracilis	1.75	5.76	10.00
Carex sp.	16.50	12.05	80.00
Elymus elymoides	0.75	3.27	5.00
Elymus smithii	0.50	2.18	5.00
Elymus spicatus	1.50	6.54	5.00
Elymus trachycaulus	4.00	9.82	15.00
Juncus arcticus	15.25	16.84	70.00
Koeleria macrantha	9.50	11.06	45.00
Muhlenbergia asperifolia	0.25	1.09	5.00
Poa pratensis	1.75	4.26	15.00

Table 3-11: Coal Hollow Project. Total Cover and Composition (2006).		
Meadow (M) Dry Reference Area		
A. TOTAL COVER	Mean Percent	Standard Deviation
Understory Cover (u)	72.00	8.86
Litter	11.70	5.16
Bareground	14.70	6.65
Rock	1.60	2.18
B. % COMPOSITION (u)		
Shrubs	6.64	10.29
Forbs	22.31	12.24
Grasses	71.05	12.91

Table 3-12: Coal Hollow Project. Woody Species Density (2006).

Meadow (M) Dry Reference Area	
SPECIES	**Individuals Per Acre**
Artemisia nova	1481.04
TOTAL	**1481.04**

Table 3-13: Coal Hollow Project. Living Cover and Frequency by Plant Species (2007).

Pinyon-Juniper (P-J) Proposed Disturbed			
	Mean Percent	Standard Deviation	Percent Frequency
OVERSTORY			
SHRUBS			
Juniperus osteosperma	16.75	18.66	55.00
Pinus edulis	1.25	5.45	5.00
UNDERSTORY			
SHRUBS			
Artemisia nova	17.50	14.87	70.00
Juniperus osteosperma	5.75	8.98	35.00
Pinus edulis	0.50	2.18	5.00
FORBS			
GRASSES			
Elymus elymoides	0.75	3.27	5.00
Elymus trachycaulus	0.50	1.50	10.00

Table 3-14: Coal Hollow Project. Total Cover and Composition (2007)		
Pinyon-Juniper (P-J) **Proposed Disturbed**		
A. TOTAL COVER		
	Mean Percent	Standard Deviation
OVERSTORY (o)	18.00	18.33
UNDERSTORY (u)	25.00	11.40
Litter	22.55	19.66
Bareground	48.40	17.18
Rock	4.05	2.27
TOTAL LIVING (o + u)	43.00	15.20
B. % COMPOSITION (u)		
Trees & Shrubs	95.88	13.26
Forbs	0.00	0.00
Grasses	4.13	13.26

Table 3-15: Coal Hollow Project. Woody Species Density (2007).

Pinyon-Juniper (P-J) **Proposed Disturbed**	
SPECIES	**Individuals Per Acre**
Artemisia tridentata	166.03
Artemisia nova	1627.12
Juniperus osteosperma	730.55
Pinus edulis	132.83
TOTAL	**2656.53**

Table 3-16: Coal Hollow Project. Living Cover and Frequency by Plant Species (2007).

Pinyon-Juniper (P-J) Reference Area			
	Mean Percent	Standard Deviation	Percent Frequency
OVERSTORY			
SHRUBS			
Juniperus osteosperma	9.00	13.56	40.00
Pinus edulis	2.50	10.90	5.00
UNDERSTORY			
SHRUBS			
Artemisia nova	17.75	12.70	80.00
Juniperus osteosperma	3.75	6.68	30.00
Pinus edulis	2.25	5.58	15.00
FORBS			
GRASSES			
Elymus elymoides	2.00	4.00	20.00
Elymus trachycaulus	1.75	4.26	15.00

Table 3-17: Coal Hollow Project. Total Cover and Composition (2007)		
Pinyon-Juniper (P-J) Reference Area		
A. TOTAL COVER	Mean Percent	Standard Deviation
OVERSTORY (o)	11.50	16.05
UNDERSTORY (u)	27.50	11.35
Litter	19.00	14.20
Bareground	46.50	19.69
Rock	7.00	2.45
TOTAL LIVING (o + u)	39.00	11.36
B. % COMPOSITION (u)		
Trees & Shrubs	89.56	14.77
Forbs	0.00	0.00
Grasses	10.44	14.77

Table 3-18: Coal Hollow Project. Woody Species Density (2007).

Pinyon-Juniper (P-J) Reference Area	
SPECIES	**Individuals Per Acre**
Artemisia tridentata	158.05
Artemisia nova	3213.71
Juniperus osteosperma	632.20
Pinus edulis	210.73
TOTAL	**4214.70**

Table 3-19: Coal Hollow Project. Living Cover and Frequency by Plant Species (2007).

Pasture Land (P) Proposed Disturbed			
	Mean Percent	Standard Deviation	Percent Frequency
SHRUBS			
Artemisia tridentata	3.67	9.74	20.00
Artemisia nova	5.67	9.37	33.33
Chrysothamnus nauseosus	3.17	6.77	20.00
Rosa woodsii	0.50	1.50	10.00
FORBS			
Achillea millefolium	1.00	3.27	10.00
Aster sp.	0.83	2.61	10.00
Iris missouriensis	0.83	3.67	6.67
Iva axillaris	4.50	8.69	26.67
GRASSES (and grass-likes)			
Agropyron cristatum	3.83	6.28	30.00
Bromus inermis	1.50	7.21	6.67
Bromus tectorum	2.83	6.67	16.67
Elymus hispidus	6.50	12.12	30.00
Elymus smithii	3.00	8.23	20.00
Elymus trachycaulus	0.33	1.80	3.33
Juncus arcticus	0.50	1.98	6.67
Poa pratensis	5.83	13.85	16.67

Table 3-20: Coal Hollow Project. Total Cover and Composition (2007)		
Pasture Land (P) **Proposed Disturbed**		
A. TOTAL COVER	Mean Percent	Standard Deviation
Understory Cover (u)	44.50	10.59
Litter	24.10	11.67
Bareground	29.63	10.53
Rock	1.77	1.48
B. % COMPOSITION (u)		
Shrubs	30.19	26.65
Forbs	17.64	22.73
Grasses	52.16	25.41

Table 3-21: Coal Hollow Project. Woody Species Density (2007).

Pasture Land (P) **Proposed Disturbed**	
SPECIES	**Individuals Per Acre**
Artemisia tridentata	618.30
Artemisia nova	348.50
Chrysothamnus nauseosus	303.53
Gutierrezia sarothrae	22.48
Rosa woodsii	56.21
TOTAL	**1349.02**

Table 3-22: Coal Hollow Project. Living Cover and Frequency by Plant Species (2007).			
Oak Brush (OB) Proposed Disturbed			
	Mean Percent	Standard Deviation	Percent Frequency
OVERSTORY			
SHRUBS			
Juniperus scopulorum	1.75	7.63	5.00
Quercus gambelii	41.25	24.33	85.00
UNDERSTORY			
SHRUBS			
Artemisia tridentata	11.10	15.91	45.00
Juniperus osteosperma	0.50	2.18	5.00
Juniperus scopulorum	2.75	7.33	15.00
Quercus gambelii	3.40	4.91	35.00
Symphoricarpos oreophilus	5.50	9.99	35.00
FORBS			
GRASSES			
Bromus carinatus	0.25	1.09	5.00
Poa pratensis	0.25	1.09	5.00

Table 3-23: Coal Hollow Project. Total Cover and Composition (2007)		
Oak Brush (OB) Proposed Disturbed		
A. TOTAL COVER	Mean Percent	Standard Deviation
OVERSTORY (o)	43.00	22.49
UNDERSTORY (u)	23.75	12.23
Litter	61.25	15.24
Bareground	13.25	9.51
Rock	1.75	1.41
TOTAL LIVING (o + u)	66.75	14.86
B. % COMPOSITION (u)		
Trees & Shrubs	97.75	6.80
Forbs	0.00	0.00
Grasses	2.25	6.80

Table 3-24: Coal Hollow Project. Woody Species Density (2007).

Oak Brush (OB) Proposed Disturbed	
SPECIES	**Individuals Per Acre**
Artemisia tridentata	888.89
Symphoricarpos oreophilus	1169.59
Gutierrezia sarothrae	46.78
Juniperus osteosperma	233.92
Juniperus scopulorum	374.27
Quercus gambelii	1029.24
TOTAL	**3742.70**

Table 3-25: Coal Hollow Project. Living Cover and Frequency by Plant Species (2007).

Oak Brush (OB) Reference Area			
	Mean Percent	Standard Deviation	Percent Frequency
OVERSTORY			
SHRUBS			
Juniperus osteosperma	3.75	11.28	10.00
Juniperus scopulorum	1.75	7.63	5.00
Quercus gambelii	47.75	23.21	85.00
UNDERSTORY			
SHRUBS			
Artemisia tridentata	2.40	6.32	15.00
Juniperus osteosperma	3.00	9.14	10.00
Juniperus scopulorum	1.75	7.63	5.00
Pinus edulis	0.50	2.18	5.00
Quercus gambelii	5.85	8.56	40.00
Symphoricarpos oreophilus	1.75	3.96	20.00
FORBS			
GRASSES			
Poa pratensis	0.75	2.38	10.00
Poa secunda	4.00	7.00	30.00

Table 3-26: Coal Hollow Project. Total Cover and Composition (2007)		
Oak Brush (OB) Reference Area		
A. TOTAL COVER	Mean Percent	Standard Deviation
OVERSTORY (o)	53.25	13.63
UNDERSTORY (u)	20.00	8.37
Litter	66.70	21.24
Bareground	8.30	13.49
Rock	5.00	16.07
TOTAL LIVING (o + u)	73.25	12.68
B. % COMPOSITION (u)		
Trees & Shrubs	66.92	43.92
Forbs	0.00	0.00
Grasses	33.08	43.92

Table 3-27: Coal Hollow Project. Woody Species Density (2007).

Oak Brush (OB) Reference Area	
SPECIES	**Individuals Per Acre**
Artemisia tridentata	209.16
Juniperus osteosperma	26.14
Juniperus scopulorum	130.72
Pinus edulis	52.29
Quercus gambelii	1333.37
Symphoricarpos oreophilus	339.88
TOTAL	**2091.57**

Table 3-28: Coal Hollow Project. Living Cover and Frequency by Plant Species (2007).

Meadow (M) Proposed Disturbed			
	Mean Percent	Standard Deviation	Percent Frequency
SHRUBS			
Artemisia nova	1.50	6.54	5.00
Rosa woodsii	11.75	12.07	60.00
FORBS			
Achillea millefolium	3.50	6.73	40.00
Equisetum arvensis	0.75	2.38	10.00
Iris missouriensis	24.00	13.19	95.00
GRASSES (and grass-likes)			
Carex microptera	7.75	10.43	30.00
Elymus lanceolatus	1.25	3.11	15.00
Elymus smithii	0.25	1.09	5.00
Elymus trachycaulus	0.50	2.18	5.00
Juncus arcticus	24.00	9.95	100.00
Koeleria nitida	1.50	4.77	10.00
Phleum pratensis	0.50	2.18	5.00
Poa pratensis	7.50	7.66	60.00
Poa secunda	1.25	3.11	15.00

Table 3-29: Coal Hollow Project. Total Cover and Composition (2007)		
Meadow (M) **Proposed Disturbed**		
A. TOTAL COVER	Mean Percent	Standard Deviation
Understory Cover (u)	86.00	7.18
Litter	8.25	4.69
Bareground	4.05	1.96
Rock	1.70	3.05
B. % COMPOSITION (u)		
Shrubs	15.88	15.08
Forbs	32.54	16.94
Grasses	51.58	13.82

Table 3-30: Coal Hollow Project. Woody Species Density (2007).

Meadow **Proposed Disturbed**	
SPECIES	**Individuals Per Acre**
Rosa woodsii	384.06
TOTAL	**384.06**

Table 3-31: Coal Hollow Project. Living Cover and Frequency by Plant Species (2007).			
Meadow (M) Reference Area			
	Mean Percent	Standard Deviation	Percent Frequency
SHRUBS			
Rosa woodsii	9.75	9.68	65.00
FORBS			
Achillea millefolium	0.25	1.09	5.00
Iris missouriensis	32.37	12.50	100.00
GRASSES (and grass-likes)			
Elymus lanceolatus	0.50	1.50	10.00
Juncus arcticus	33.00	13.55	100.00
Poa pratensis	11.00	14.20	60.00
Poa secunda	1.25	3.83	10.00

Table 3-32: Coal Hollow Project. Total Cover and Composition (2007)		
Meadow (M) Reference Area		
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover (u)	88.50	5.94
Litter	7.85	4.98
Bareground	2.65	2.03
Rock	1.00	0.00
B. % COMPOSITION (u)		
Shrubs	11.04	11.01
Forbs	37.38	13.75
Grasses	51.57	13.78

Table 3-33: Coal Hollow Project. Woody Species Density (2007).

Meadow (M) Reference Area	
SPECIES	**Individuals Per Acre**
Rosa woodsii	2225.69
TOTAL	**2225.69**

321.200. Productivity

Productivity measurements were recorded for the plant communities of the permit area during the same sample period as described in section 321.100 above. Production estimates for the communities at that time are shown in Table 3-34.

Table 3-34: ~~Biomass~~ Production of Plant Communities in the Coal Hollow Permit Area
(1) *Estimates* (from soil and approx. vegetation types) - Source: U.S. Department of Agriculture SCS (NRCS). July 1990. Soil Survey of Panguitch area, Utah: Parts of Garfield, Iron, Kane, and Piute Counties
(2) *Actual measurements*. - Source: Cedar Creek Associates (1986) *in* Mine Permit Application. 1987. Utah International, Inc., Alton Coal Project, Alton, Utah.
(*) *Estimates* - Source: Fieldwork during 2007 by Mt. Nebo Scientific, Inc.

MAP SYMBOL (see *Vegetation Map*, Drawing 3-1)	PLANT COMMUNITY	Pounds/Acre (1)	Pounds/Acre (2)
SB	Sagebrush/Grass	750	762
P	Pasture Land (*)	1100	1100
M	Meadow	2000	2121
P-J	Pinyon-Juniper	50	33
OB	Oak Brush [*called Mountain Brush* (2)]	1500	1471
RB/SB	Rabbitbrush/Sagebrush (*)	700	700

NOTE: Expansion of the mine has been proposed to include a new area north of the current operations. Vegetation information including cover, composition, density and production for that area can be found in the VOLUME 12: Supplemental Report section of the MRP in the report called: *Vegetation & Wildlife Habitat of the North Private Lease Area, Coal Hollow Project Kane County, Utah* (November 2014).

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322. **FISH AND WILDLIFE INFORMATION**

322.100. Agency Consultation Studies Conducted and Habitat Improvement

Initial consultations have been made to appropriate state and federal agencies regarding threatened, endangered, and sensitive plant and animal species and their habitats in and adjacent to the Coal Hollow permit area. A summary of this work follows.

• In 2005, a review of the Utah Heritage Program database for sensitive species in the proposed project and adjacent areas was accomplished.

• A spreadsheet has been prepared that shows applicable notes from previous biological surveys of the area.

• Biologists from the USDA Dixie National Forest have been contacted. Life histories and analyses of the species in their forest and in close proximity to the Coal Hollow Project area that have been listed as endangered, threatened, candidate, and management indicator species has been prepared to be used for project planning and agency consultations.

• Files from the offices of *Mt. Nebo Scientific, Inc*. regarding sensitive species have been consulted for the project area.

• A sage-grouse lek had been located in the area by biologists from the Bureau of Land Management (BLM) and the State of Utah, Division of Wildlife Resources (DWR). In the Spring of 2005 biologists from the BLM captured, collared and began monitoring 4 sage-grouse birds to study the lifecycle and migrating patterns of the local birds.

• In June 2005, a field survey for potential habitat of sensitive species within the project and adjacent areas was conducted by N. Duane Atwood, Ph.D. and Patrick D. Collins, Ph.D.

• In April 2006, a biologist, Steven L. Petersen, Ph.D., representing the Coal Hollow Project began independent studies and also began participating with the BLM and DWR in sage-grouse studies in the project area.

• In May 2006, a raptor survey by helicopter was conducted by Talon Resources, Mt. Nebo Scientific, Inc., and DWR of the permit area and adjacent areas.

• In August 2006 sensitive plant species surveys were conducted during quantitative sampling of specific areas proposed disturbed and reference areas for mining year one of the project.

• In 2007 the team has continued studies of the sage-grouse with biologists from DWR, the BLM, Southern Utah University (SUU), and the Coal Hollow Project by capturing, taking blood samples, and placing radio transmitters on several birds from March through May.

• In April 2007, two helicopter flights, arranged by Coal Hollow Project, were conducted to search for satellite leks of the sage-grouse.

• In May 2007, another raptor survey by helicopter was conducted by DWR that included the permit area and adjacent areas.

• In September 2007, sensitive plant species surveys were conducted during quantitative sampling of additional proposed disturbed and reference areas for mining years one through three of the project.

• In September 2007, additional quantitative sampling was conducted in meadow areas outside the permit area to be used as a companion study with other areas.

• In 2007, an excavator was used to remove over 10,000 invading juniper trees from the conservation area to reduce potential perching sites for raptors that can reduce the sage-grouse populations.

• Private land owners from Alton have been working to reestablish a migratory corridor between Hoyts Ranch and Alton by clearing juniper and Gambel oak and reseeding open areas with a seed mix consisting of perennial grasses and forbs. Preliminary monitoring results in 2009 indicate that the sage-grouse are beginning to use this corridor. This project was completed in 2011 consisting of 885 acres. Verification was documented in a letter from Director Baza addressed to Denise A. Dragoo, Esq dated May 16, 2012.

• To date, an ongoing monitoring program for radio-collared sage-grouse has been conducted with collaborations with DWR, the BLM, SUU and ACD.

- In 2012 habitat improvement work for sage-grouse was completed on 146 acres to the east of the property that included lop and scatter of pinyon/juniper and chemical treatment of Rabbitbrush.

- In 2012, two helicopter flights, arranged by Coal Hollow Mine, were conducted to search for satellite leks of the sage-grouse.

- Cronquist's phacelia (*Phacelia cronquistiana*; BLM sensitive) was identified as having potential to occur in the area of the mine. Surveys of potential habitats for this species were conducted in June 2012, and no individuals were found.

- In 2013 habitat improvement work for sage-grouse was strarted on 355 acres adjoining the west boundary of the Coal Hollow mine that included lop and scatter of pinyon/juniper. After assessment of the project in early 2014 by the BLM, it was

decided that additional work needed to be done in the appropriate season of 2014 as per the letter dated 3/3/2014 from Lisa Church in Appendix 3-7.

- In 2014, ACD partnered with the Watershed Restoration Initiative (WRI) to complete habitat improvement work for sage-grouse on 600 acres. ACD contributed funding to complete 300 acres of the Paunsaugunt rabbit-brush removal Phase II (Project Id. 3011) and 300 acres of the UKC Thompson Creek Project (Project Id. 2701).

- In 2014, ACD funded the purchase of and monitoring of two GPS transmitters in coordination with Dr. Frey of USU. These were deployed on two sage-grouse in the Sinkvalley area and will provide four locations of the grouse per day.

- In 2015, expansion of the mine has been proposed to include a new area north of the current operations. Threatened, endangered, and sensitive plant and animal species information for that area can be found in VOLUME 12: Supplemental Report section of the MRP in the report called: *Vegetation & Wildlife Habitat of the North Private Lease Area, Coal Hollow Project Kane County, Utah* (November 2014October 2015).

322.200. Site-Specific Resource Information

A review of the Utah Heritage Program database for sensitive species in the proposed mine site and adjacent areas has been accomplished. Field maps with locations of these species have been prepared and have been used for additional surveys and will continue to be used for future biological studies.

Due to the sensitivity of these species, specific location information is considered confidential and has not been submitted in this application. However, review of this information by the regulatory authorities can be arranged.

322.210. Threatened, Endangered, and Candidate Plant and Animal Species

Table 3-35 shows a list of the plant and animal species that are federally listed as threatened, endangered, or candidates for this designation for Kane County, Utah.

Table 3-35: List of Threatened, Endangered, and Candidate Plant & Animal Species in Kane County, Utah

This list was compiled using known species occurrences and species observations from the Utah Natural Heritage Program's Biodiversity Tracking and Conservation System (BIOTICS); other federally listed species likely occur in Utah Counties. This list includes both current and historic records. The list was accessed on-line June 15, 2015. Its last update was dated January 12, 2012.
Additional species were added to the list as requested by Utah State Division of Oil, Gas & Mining in June 2015 and are designated by an asterisk (*)

ENDANGERED		SITE-SPECIFIC NOTES
Empidonax traillii extimus	Southwestern willow flycatcher	This bird has been observed in Kane, County Utah (see the attached DWR distribution map following this table) . Although it is possible that it could have occurred at some time in the project area as noted from its distribution map, it is most often observed in thick willow riparian habitats. The study area has some willow patches on Kanab Creek, but they are not common on this reach of the stream. The Kanab Creek riparian zone will not be disturbed. It is highly unlikely this species would be impacted by mining in this area. However, after consultations with DOGM & USFWS, it seemed prudent to survey specific areas on Kanab Creek. The surveys have been conducted according to protocols by qualified biologists. A habitat assessment and follow up surveys were conducted as recommended by the USFWS (see Yellow-Billed Cuckoo and Southwestern Willow Flycatcher Habitat Assessment & Southwestern Willow Flycatcher Surveys Along Kanab Creek, Kane County, Utah August 2015 (refer to Appendix A). Between the marginal habitat quality at Kanab Creek and the fact that no southwestern willow flycatchers were detected during the surveys conducted, it was concluded that it is highly unlikely that this species would nest in the study area.
Gila cypha	Humpback chub	Humpback chub in Utah are now confined to a few whitewater areas in the Colorado, Green, and White Rivers. These rivers do not occur in the study area and the confluence of Kanab Creek and the Colorado River is well below the known population of this species. There will be no impact to this species from mining in the study area.
Gila elegans	Bonytail	The bonytail is a very rare minnow originally native to the Colorado River system. The known populations of the bonytail are in the Colorado River System well above the confluence of Kanab Creek and the Colorado River. There will be no impact to this species from mining in the study area.
Lesquerella tumulosa (Physaria rubicudula var tumulosa)	Kodachrome bladderpod	In Utah, this federally listed endangered species is known only in an isolated area in Kane County on semi-barren shale knolls of the Carmel Formation. This geologic formation nor the habitat of this species is found on the study area. Consequently, there will be no impact to this species from mining in the study area.

Table 3-35: List of Threatened, Endangered, and Candidate Plant & Animal Species in Kane County, Utah

This list was compiled using known species occurrences and species observations from the Utah Natural Heritage Program's Biodiversity Tracking and Conservation System (BIOTICS); other federally listed species likely occur in Utah Counties. This list includes both current and historic records. The list was accessed on-line June 15, 2015. Its last update was dated January 12, 2012.
Additional species were added to the list as requested by Utah State Division of Oil, Gas & Mining in June 2015 and are designated by an asterisk (*)

ENDANGERED		**SITE-SPECIFIC NOTES**
Oxyloma kanabense	Kanab ambersnail	Known populations of the gastropod are primarily found in 2 locations along Kanab Creek. The primary and more well-known location is in extreme south Kane County, about 6 miles north of the city of Kanab in an area called Three Lakes. The second, much smaller population, is located about 1.3 miles north of the Three Lakes population in Kanab Creek Canyon. According to DWR, however, this population, is thought to be extirpated. Upper Kanab Creek dissects the project area and will not be disturbed from the proposed mining activities. That was associated Kanab Creek will not be impacted, so the downstream habitats, like that of the Kanab ambersnail, will not be negatively impacted by the proposed mine site.
THREATENED		**SITE-SPECIFIC NOTES**
Asclepias welshii	Welsh's milkweed	In Utah this plant in known to occur only on the Coral Pink sand dunes in Kane County. There are no dune habitats in the project area so this species will not be impacted by it.
*Coccyzus americanus**	Yellow-billed cuckoo	The western yellow-billed cuckoo is listed as a threatened species under the Endangered Species Act. It is an obligate riparian nester, meaning that the species is restricted to more mesic habitat along rivers, streams, and other wetlands. The US historical range of this species is thought to have included all states west of the Rocky Mountains. According to DWR database information, the current range of yellow-billed cuckoo is limited to disjunct fragments of riparian habitat in northern Utah, western Colorado, southwestern Wyoming, southeastern Idaho, southern Nevada and California. That said, the distribution of this bird in Utah is poorly understood (see the attached DWR distribution map following this table), so consultations with DOGM and USFWS have been conducted. A habitat assessment was conducted as recommended by the USFWS (see Yellow-Billed Cuckoo and Southwestern Willow Flycatcher Habitat Assessment & Southwestern Willow Flycatcher Surveys Along Kanab Creek, Kane County, Utah, August 2015 (refer to Appendix A). No designated critical habitat occurs in the study area.
Cycladenia humilis var jonesii	Jones cycladenia	Jones cycladenia grows in gypsiferous, saline soils derived from strata much lower (older) in the geologic column than what is found in the project area such as Summerville (Jurassic), Chinle (Triassic), and Cutler (Permian) formations. The project area soils are derived mostly from Tropic Shale and Dakota formations of Cretaceous age. The geology, soils and habitat do not occur in the project area. There will be no impact to this species from mining in the study area.

Table 3-35: List of Threatened, Endangered, and Candidate Plant & Animal Species in Kane County, Utah

This list was compiled using known species occurrences and species observations from the Utah Natural Heritage Program's Biodiversity Tracking and Conservation System (BIOTICS); other federally listed species likely occur in Utah Counties. This list includes both current and historic records. The list was accessed on-line June 15, 2015. Its last update was dated January 12, 2012.
Additional species were added to the list as requested by Utah State Division of Oil, Gas & Mining in June 2015 and are designated by an asterisk (*)

Cynomys parvidens	Utah prairie-dog	Habitat for this prairie-dog does not exist in the study area. Consequently, there will be no impact to this species as a result of mining in the North Private Lease
Pediocactus sileri	Siler pincushion cactus	In Utah, this small footcactus is known to occur in salt desert shrub communities in Kane and Washington Counties. It tends to be found in gypsiferous, seleniferous and calciferous soils and shales of the Moenkopi formation. The geology, soils and habitat do not occur in the project area. There will be no impact to this species from mining in the study area
Strix occidentalis lucida	Mexican spotted owl	The primary habitats in Utah for this owl are various forest types and steep rocky canyons. DWR distribution maps suggest the project area is out of its range in Kane County. The required habitat and apparent distributional information indicate that the likelihood for impacts to this bird by the proposed mining is remote.
CANDIDATE		**SITE-SPECIFIC NOTES**
Cicindela limbata albissima	Coral Pink Sand Dunes tiger beetle	Like Welsh's milkweed described above, this beetle is known to occur only on the Coral Pink sand dunes of Kane County, Utah. There are no sand dune habitats in the project area so this species will not be impacted by it.
OTHER		**SITE-SPECIFIC NOTES**
*Camissonia exilis**	Meager Camissonia	This is not a federally protected species, however, its conservation status is ranked as "G1" (critically imperiled). This annual plant is a Colorado Plateau endemic found only in gypsiferous strata in Moenkopi and Entrada formations. These formations and habitats are not within the North Private Lease area. Additionally, other gypsiferous substrates have not be found during geologic or soil surveys of the site. There should be no impact to this species from mining in the study area. However, because this species was noted by DWR to occur in the general area, collaborations between cooperating agencies (DWR & USFWS) regarding potential impact are currently in-progress. Results of findings between agencies will be reported to ACD by DOGM.
*Rana pipiens**	Northern Leopard Frog	This frog is not a federally protected species and it is fairly common in Utah. Although some reports suggest numbers may be declining, the conservation status of this amphibian is ranked as "G5" (demonstrably secure). This species occurs in a variety of aquatic habitats some of which occur in the North Private Lease area, but most are in and adjacent to Kanab Creek. This creek will not be mined and a 100 ft protection buffer will be in-place during mining and reclamation periods. Although impacts to the local populations may be possible due to mining activities relatively close to the habitat, they area thought to be relatively minor. However, because this species was noted by DWR to occur in the general area, collaborations between

Table 3-35: List of Threatened, Endangered, and Candidate Plant & Animal Species in Kane County, Utah

This list was compiled using known species occurrences and species observations from the Utah Natural Heritage Program's Biodiversity Tracking and Conservation System (BIOTICS); other federally listed species likely occur in Utah Counties. This list includes both current and historic records. The list was accessed on-line June 15, 2015. Its last update was dated January 12, 2012.

Additional species were added to the list as requested by Utah State Division of Oil, Gas & Mining in June 2015 and are designated by an asterisk (*)

		cooperating agencies (DWR & USFWS) regarding potential impact are currently in-progress. Results of findings between agencies will be reported by DOGM to ACD
Centrocercus urophasianus	Greater sagegrouse	Greater sage-grouse (***Centrocercus urophasianus***) habitat has been documented in the study area. DWR has mapped much of the area to be ***occupied*** and ***brood-rearing*** habitat (Wildlife Map 4). Additionally Utah's Conservation Plan for Greater Sage-grouse (February 14, 2013) shows the Alton area to be "Other Habitat" habitat for the sage-grouse. Other habitat is defined here as sage-grouse habitat but not part of the lek, nesting or wintering areas. Impacts of mining in the North Private Lease have been addressed (see Greater Sage-grouse Management Plans, for the Coal Hollow Mine site).

Table 45 (attachments)

Southwestern Willow Flycatcher

Known Distribution in Utah

Map Source:
Utah Division of Wildlife Resources.
Access Date: 15 June 2015

Yellow-Billed Cuckoo

Utah Gap Analysis

Breeding/Wintering Habitat

In summary, based on the information provided above and studies conducted to-date, no threatened or endangered species have been located in the permit area.

NOTE: Expansion of the mine has been proposed to include a new area north of the current operations. Threatened, endangered and sensitive species information, including an updated table similar to the one above for that area can be found in the VOLUME 12: Supplemental Report section of the MRP in the report called: *Vegetation & Wildlife Habitat of the North Private Lease Area, Coal Hollow Project Kane County, Utah* (October 2015).

322.220. High Value Habitats

The State of Utah, Division of Wildlife Resources (DWR) geographic information system (GIS) database was consulted for high-value habitats. In 2006 DWR updated the habitat value definitions.

Crucial Value was defined as "habitat on which the local population of wildlife species depends for survival because there are not alternative ranges of habitats available. Crucial Value habitat is essential for the life history requirements of a wildlife species".

Substantial Value was defined as "habitat that is used by a wildlife species but is not crucial for population survival. Degradation or unavailability of substantial value habitat will not lead to significant declines in carrying capacity and/or numbers of the wildlife species in question".

The DWR database was revisited by project biologists on August 11, 2009. Of the species maintained on the database, important habitat of four species have been mapped by DWR within or adjacent to the Coal Hollow Project area. These habitats are described below.

First, areas adjacent to the permit area and a portion of it have been designated as black bear (*Ursus americanus*) habitat. This habitat has been listed as having year-long, Substantial Value habitat by DWR (Drawing 3-2).

Next, Rocky Mountain elk (*Cervus canadensis*) habitat was located in the area. Crucial Value summer and calving habitat was mapped throughout the entire area from the town of Alton south into Sink Valley, including the permit area. Additionally, year-long Substantial Value habitat was located in areas southeast of the permit area (Drawing 3-3).

Mule deer (*Odocoileus hemionus*) habitat has also been mapped in the area by DWR biologists. The habitat has been classified as "Crucial" summer and fawning habitat. This designation included the entire permit area as well as those areas adjacent to it (Drawing 3-4).

Finally, sage-grouse (*Centrocercus urophasianus*) habitat has been documented in the project area. DWR biologists have mapped much of the area to be Crucial Value brood habitat (Drawing 3-5). Sage-grouse populations continue to be monitored in the area by biologists from DWR, Bureau of Land Management (BLM), Southern Utah University (SUU), and the Coal Hollow Project. The only lek in the vicinity including those areas around Alton and Sink Valley was located west of the Swapp Ranch. This lek was within the permit area boundary. A site-specific study called reported in "*Alton Sage-Grouse Habitat Assessment and Mitigation Plan*" has been conducted for the Coal Hollow Project and has been included in this document (see **Appendix 3-1**). Follow-up studies of the sage-grouse in the area are described in a report called *"Sage-grouse Distribution and Habitat Improvement in Alton, Utah*" (see **Appendix 3-3**). Finally, for the Coal

Hollow Mine a document called *"Alton Sage-Grouse Habitat Mitigation Plan*" has also been included in the MRP (see **Appendix 3-5**). With the addition of the North Private Lease, a document called "*Greater Sage-grouse Management Plan North Private Lease, Alton, Utah*" has been included in the MRP (see Appendix 3-8).
From 2006 to date, biologists representing the Coal Hollow Project have been involved with a previously assembled team of biologists that have been studying the populations in the area. In 2007, the team captured, drew blood samples for DNA analyses, and placed radio collars on several birds. For more details refer to **Appendix 3-3**.

In addition to studying the sage-grouse birds as described above, techniques to improve habitat for the birds are currently being conducted. A project conducted by the U.S. Department of Interior, Bureau of Land Management (BLM) and the State of Utah, Division of Wildlife Resources (DWR) was completed that removed many of the juniper trees that have encroached the valley by grinding them up by chipping (also called bull-hogging) equipment. These areas can be easily seen on the new *Vegetation Map, Drawing: 3-1.* These areas are delineated as "SB (chipped)" on the map.

Because they provide perching structure for predatory species, single juniper trees scattered throughout sagebrush communities are known to discourage nesting by sage-grouse. To enhance sage-grouse nesting habitat within the permit area, juniper trees that have encroached some of the sagebrush communities in the valleys of the permit area have been removed by a track hoe using a large grapple claw. This equipment can pull the trees out of the ground, including the roots. To date, it has been estimated that over 10,000 juniper trees have been removed by this technique. In doing so, the technique caused relatively minor impacts to the sagebrush component of the community.

There is a substantially larger sage-grouse lek located north or the project area. The lek, known as the Hoyt's Ranch Lek, has also been studied by state, federal and private biologists. It has been hypothesized that connectivity between the two leks, the Alton lek and the Hoyt's Ranch Lek, could greatly increase the chances of survival for the Alton birds. Therefore, intensive efforts have been made to open a corridor of these two leks by removing juniper and oak stands (see **Appendix 3-5**).

In addition to the habitat improvements mentioned above for sage-grouse, seed mixtures formulated to restore pasture lands disturbed by mining include plant species that are used by the birds for food, cover and breeding. Moreover, some areas that are currently dominated by grass species for domestic livestock use, will be seeded with plants that include species known to provide nesting habitat for sage-grouse such as big sagebrush and black sagebrush [for more detailed information see "Habitat Reclamation Plan" (Chapter 3); "Other Wildlife Enhancement Information" (Chapter 3); "Seed Mixtures" (Chapter 3); Drawing 3-7 and 3-11 (Chapter 3); "Postmining Land Use"(Chapter 4)].

NOTE: Expansion of the mine has been proposed to include a new area north of the current operations. Additional wildlife information for that area can be found in the VOLUME 12: Supplemental Report section of the MRP in the report called: *Vegetation & Wildlife Habitat of the North Private Lease Area, Coal Hollow Project Kane County, Utah* (October 2015).

322.230. Other Species or Habitats

As mentioned previously, raptor surveys have been conducted in the area by Coal Hollow project and DWR biologists. The 2006 through 2008 surveys show no golden eagle (*Aquila chrysaetos*) or bald eagle (*Haliaeetus leucocephalus*) nests within ½ mine of the permit area. In fact, the most recent survey indicated that there were *no* raptor nests located within ½ of the permit area (see Confidential File, Drawing 3-6). There was, however, one inactive red-tailed hawk (*Buteo jamaicensis*) nest located over one mile from the permit area, three inactive golden eagle nests, one active peregrine falcon (*Falco peregrinus*) nest and another inactive falcon nest located approximately two miles from the permit area.

To date, no other species or habitats have been identified through agency consultation or field studies that require special protection under state or federal law, however, if they are found through the permitting process, they will be appropriately addressed and monitored.

A vegetation map has been prepared that delineates the plant communities in the permit area. The map also shows adjacent areas including those plant communities that will be impacted by the proposed county road realignment (Drawing: 3-1).

322.300. Fish and Wildlife Service Review

Upon request, the State of Utah, Division of Oil, Gas & Mining (DOGM) will provide the resource information required under R645-301-322 and the protection and enhancement plan required under R645-301-333 to the U.S. Fish and Wildlife Service Regional or Field Office for their review. This information will be provided within 10 days of receipt of the request from the Service.

323. **MAPS AND AERIAL PHOTOGRAPHS**

323.100. Reference Area Maps

Several vegetation maps have been prepared for the Coal Hollow Project. A revised vegetation map has been prepared that includes all vegetation sample areas, plus other updated map information [Vegetation Map, Drawing 3-1, (12/26/07)]. The new map replaces the previous vegetation maps. This new map includes reference areas, or plant communities sampled that are similar to those that have been proposed for disturbance by mining activities. These reference areas will be compared to those areas proposed for disturbance during the initial studies for the mine site and will consequently be used as revegetation success standards at the time of final reclamation of mined areas. reclamation is planned immediately after portions of the land are mined (see Chapter 5).

323.200. Sample Area Maps

Elevations, locations of monitoring stations, proposed disturbed areas, reference areas, and other areas used to gather data for fish and wildlife, and any special habitat features, have been delineated on the aforementioned new vegetation map. Due to the Dame Incidental Boundary Change, the Meadow area reference will be relocated to an area that will have no potential impacts from mining. This relocation will occur during the growing season of 2014 in consultation with DOGM.

323.300. Protection and Enhancement of Fish & Wildlife Maps

Each facility to be used to protect and enhance fish and wildlife and related environmental values have been represented on the new maps.

323.400. Plant Communities Map

An initial vegetation map was prepared that delineated the plant communities that existed within the Coal Hollow Project permit area. This **first** map was prepared by delineating the plant communities from an existing vegetation map to a permit quadrangle map (see Section 321.100 for more details). However, a new flight was conducted in 2006 that provided aerial photography with more detailed information to be used to update many maps of the project area. Consequently, a **second** vegetation map was prepared using the new aerial photography (along with groundtruthing), and submitted along with the first map to DOGM (MRP submittal dated May 25, 2007). Finally, a **third** vegetation map was prepared to reflect information and to show new sample areas within the plant communities of the permit and adjacent areas [see *Vegetation Map, Drawing 3-1*, *(12/26/07)*]. This map **replaced** the first and second maps and was submitted to DOGM (MRP submittal dated January 15, 2008.

NOTE: Expansion of the mine has been proposed to include a new area north of the current operations. Additional vegetation information for that area can be found in the VOLUME 12: Supplemental Report section of the MRP in the report called: *Vegetation & Wildlife Habitat of the North Private Lease Area, Coal Hollow Project Kane County, Utah* (November 2014).

330. **OPERATION PLAN**

331. **MINE PLAN & RECLAMATION TIMING**

In each mined segment, the mine plan includes redistributing subsoil and topsoil followed by seeding this segment with the final seed mix contemporaneously, or at the same time the mining begins in the next segment. The mine plan has been engineered to disturb the smallest practicable area at any one time. With prompt establishment and maintenance of vegetation, immediate stabilization of disturbed areas will minimize surface erosion. Details of the plan have been provide in Chapter 5 of this document.

332. **SUBSIDENCE**

Mining in the Coal Hollow project area will be a combination of surface mining, either open pit or highwall mining and underground mining. Mining in the North Lease will be a combination of surface mining, either open pit or highwall mining. Both the highwall mining and underground mining are designed such that subsidence is not expected to occur or have a negative impact on renewable resource lands. This is further discussed in Section 525 of Chapter 5. As indicated in that Section, no subsidence is projected and no monitoring is planned. As requested by the Division, however, the company will conduct surface observations walkovers of each of the 4 developed panel areas in this proposed plan within 60 days of completion of mining in those areas. If the observations determine that no affects or voids have developed to the surface, it will be documented and forwarded to the Division. If surface cracking, sinkholes or other surface impacts are noted during the walkovers, they will be documented, located on a surface topographic map, reported to the Division, photographed and repaired after approval by the Division.

Also, based on the proposed underground mining plan, and as discussed in Appendix 7-15 (Probable Hydrologic Consequences for Underground Coal Mining at the Alton Coal Development, LLC Coal Hollow Mine) there are no likely adverse effects to the hydrologic regime in the area. However, in the event that diminution of discharge rates from seeps and springs does occur as a consequence of mining activities, any lost water will be replaced according to all applicable Utah State laws and regulations, using the water replacement source specified in R645-301-727. The quantity and quality of replacement water detailed in that Section, will be suitable for the existing premining uses and approved postmining land uses.

However, current elevation of the existing topography may be slightly altered in the mining and reclamation operations with open pit mining. The alternate Highwall mining or underground mining will have only the disturbance associated with the trench for placement of the highwall miner or portals and will have no impact on the surface above the highwall panels

Reclamation has been planned to minimize the impact to the renewable resources identified in this section by promptly reclaiming each mine segment contemporaneously by controlling erosion and re-seeding with a mixture of native plant species that will re-establish the plant communities to vegetative cover that will be diverse, effective, permanent, and consistent with the postmining land use. More details regarding postmining land and topography have been provided in Chapter 4 and Chapter 5 of this document, respectively.

The mine plan is not expected to negatively impact the plants and wildlife in the Coal Hollow Project and North Private Lease areas. Onsite revegetation research and sage-grouse mitigation plans have been designed. Details of this work have been made available to DOGM specialists for their comments and participation in the process.

333. PROCEDURES TO MINIMIZE ADVERSE IMPACTS TO FISH & WILDLIFE

Section Preface

In addition to the language in the main body of the MRP regarding sensitive species, ~~three~~ four appendices (Appendix 3-1, Appendix 3-3 ~~and~~ Appendix 3-5 and Appendix 3-8) were prepared separately and have been included to address the sage-grouse in the Alton area. Each of these appendices was submitted in different submittals to the State of Utah, Division of Oil, Gas & Mining (DOGM). After each submittal, they were reviewed by the DOGM and other agencies, which provided comments. Accordingly, the comments were addressed and the next sage-grouse appendix was then written. In other words, the appendices were written in chronological order and each subsequent appendix was a result of comments from the previous one. Therefore, the last ~~appendix~~ appendes written (Appendix 3-5 and 3-8) explains ACD's final mitigation plan for the sage-grouse in the Alton area. However, the previous Appendices (Appendix 3-1 and 3-3) remain in the MRP because they continue to provide valuable information regarding the natural history, previous work and process of addressing the sage-grouse issues in the Alton area.

Sage-Grouse Work

The Coal Hollow Project will minimize disturbances and adverse impacts to fish and wildlife and related environmental values during coal mining and reclamation operations. The project will comply with the Endangered Species Act of 1973 during coal mining and reclamation operations. The location and operation of haul and access roads and support facilities will be placed to avoid or minimize impacts on important fish and wildlife species or other species protected by state or federal law. The implementation of the highwall miner provides an additional method of recovering the coal resource while minimizing disturbance to the surface and associated wildlife species. Enhancement of such resources will be achieved, where practicable. An example is provided below for sage-grouse habitat.

After consultation with appropriate agencies and biologists regarding habitats and sensitive species, the sage-grouse and its habitat were of greatest concern in the area.

There has been a decreasing trend in the populations of this species since 1964 (see Appendix 3.1 and Appendix 3-3 for more details). There was a general consensus among the biologists and agencies consulted that due to the marginal habitat in the Alton Amphitheater area, the loss of habitat in recent years for nesting and brood-rearing and the relatively low population numbers in the area, that the local population of sage-grouse is vulnerable to elimination, regardless of mining activities proposed by the Coal Hollow Project. Accordingly, the following measures to minimize impacts and enhance habitat for this species have been proposed and are subject to further consideration by the operator and regulatory agencies.

Biologists representing the regulatory agencies, land managers, academia and the coal mine operator, the primary goals for the Alton sage-grouse population includes:

- Enhance current sage-grouse habitat by reducing juniper trees in the area and restoring desirable perennial plant species.
- Create a conservation area for the sage-grouse that will never be mined.
- Provide a corridor between north (Hoyt's Ranch) and south (Alton Sink Valley) populations to promote gene transfer and increase population numbers.
- Use decoys to shift breeding activities to alternate lek sites in Sink Valley.
- Restore the Alton lek site to its original ecological structure and function.
- Monitor sage-grouse distribution patterns at both Alton and Hoyts Ranch.
- Restore sagebrush communities disturbed by mining activities to enhance sage-grouse habitat.
- Control predators through cooperation with official state and/or federal predator control agencies and organizations
- Prior to the implementation of the highwall miner, ACD will measure and record noise level both during active operations and inactivity at the mine. Once the highwall miner is in operation, noise levels will again be measured and recorded in the same locations. The locations will be the area currently being utilized for lekking and two locations within the 85.88-acre Dame Lease.

Sage-Grouse Short-Term Mitigation Plan

The following information was taken directly from the "*Alton Sage-Grouse Habitat Assessment and Mitigation Plan*" (Appendix 3-1) and the follow-up document called "*Alton Sage-Grouse Habitat and Mitigation Plan*" (Appendix 3-5).

In addition to ensuring the protection of nearby grassland and shrubland for alternate breeding and nesting areas, mining activities will be minimized so that the lowest

disturbance will be created during the breeding season at areas adjacent to the original lek. A lek area will be disturbed during mining activities that could potentially displace birds from typical mating activities. To encourage mating behavior during the breeding season, decoys and mating calls will be used to lure birds to nearby alternative sites positioned away from the disturbed area. Research has shown that birds will shift mating activities toward decoys and recorded bird calls. Both silhouette and 3-dimensional decoys (with bright white coloration) will be used to encourage sage-grouse mating activity (see Appendix 3-5).

After mining has been completed, reclamation specialists will return the original grade and valley form to pre-disturbance conditions. Reclamation will include seeding similar plant species with comparable plant composition, structure and function as those of the original plant community. In sites used by sage-grouse for breeding and roosting that had previous livestock grazing, livestock will be used post-reclamation to maintain similar vegetation characteristics as pre-mining conditions.

Intact sagebrush stands will be avoided for storing mined subsoil and topsoil piles when possible. Intact sagebrush sites will be cleared of all young juniper trees with the use of a compact excavator with a grappling claw or hand tools such as chainsaws. Trees will be removed from these stands. Juniper woodlands surrounding intact stands can be cut back to increase patch size and increase the amount of area that has the potential for nest site selection by hens.

Sage-Grouse Long-Term Mitigation Plan

The following information was taken directly from the "*Alton Sage-Grouse Habitat Assessment and Mitigation Plan*" (Appendix 3-1), "*Sage-grouse Distribution and Habitat Improvement in Alton, Utah*" (Appendix 3-3) and "*Alton Sage-Grouse Habitat and Mitigation Plan*" (Appendix 3-5).

Juniper Removal

A significant contribution that mining can provide for enhanced sage-grouse habitat is the removal of juniper from the Alton valley. The removal of trees during mining operations with subsequent reclamation activities will create conditions that promote

grass, forb and eventually sagebrush establishment. Two years after juniper was removed from plots located in eastern Oregon, Bates et al. (2000) recorded a 200-300% increase in percent cover and production of herbaceous vegetation. Increased plant community vigor results from decreased competition with juniper for subsurface resources (water, nutrients) and space. As a result, transpiration rates and soil surface evaporation rates will decrease and higher soil moisture will be available for plant growth and survival. Based on anecdotal, evidence, it is also possible that spring discharge will increase and seeps and spring may emerge that were lost with initial encroachment. This would provide more sites where birds would be able to obtain water during the summer and fall months.

Research continues to emphasize the importance of intact sagebrush habitats in providing the resources sage-grouse require throughout their life cycle. This includes the necessity of sagebrush (*Artemisia* spp.) as the primary source of cover, food, and breeding (Crawford et al. 2004, Connelly et al. 2004, Gregg et al. 1994). Connelly et al. (2004) suggest that productive sage-grouse nesting habitat includes sagebrush that has both horizontal and structural diversity with an understory dominated by native grasses and forbs which provide a food source of insects and forbs as well as concealment from predation (Connelly et al. 2000, Connelly et al. 2004). With an increase in juniper, sagebrush steppe communities rapidly decline (Miller et al. 2000, Connelly 2004). Pinyon – Juniper forests have increased within sage-grouse habitat by as much as 18.9 million acres and continue to expand in the absence of fire (Miller et al. 2000).

In the Alton area, evidence of widespread juniper impacts on the sagebrush – grassland ecosystem can be observed (Figure 6). Cursory assessments of sage-grouse habitat conditions within the valley indicate that the cover, density and biomass of living sagebrush and herbaceous plants occurring in the intercanopy of these juniper woodlands is lower than in open sagebrush stands (Figure 7). Data collected from radio-collared birds confirms that these birds do not rely on juniper encroached sites for nesting and brood rearing (Frey 2008).

Figure 6. Intact sagebrush community being encroached by Utah juniper.

Figure 7. Juniper and pinyon dominated plant communities located 50m west of the country road between Alton and Sink Valley.

Follow up quantitative sampling was conducted in the pinyon-juniper and sagebrush communities of the Alton area (Collins, 2007a; Collins, 2007b). When comparing reference areas of these two communities (reference areas are those areas chosen to represent future revegetation success standards), the total living understory cover of the sagebrush area was 60.50% compared to 27.50% for the pinyon-juniper community. Additionally, the sagebrush understory cover was comprised of 38.51% forbs and

grasses as opposed to only 10.44% in the pinyon-juniper community. Finally, woody species density in the sagebrush community consisted of 8,331 individuals per acre, of which over 90% were sagebrush plants. In the pinyon-juniper community the woody species density was estimated at 4,215 individuals per acre, many of which were pinyon pine and Utah juniper trees.

Within the past few years, sage-grouse habitat was improved within the Alton region by removing juniper and pinyon pine trees using bullhogging technology. Following tree removal, radio collared birds were observed the next year utilizing these stands where they had not been found before (personal communication with Nicki Frey 2007). The primary benefit of this work was a reduction in trees that compete with sagebrush and herbaceous plant species while maintaining trees that could be used for roosting (primarily during hot summer months). Over time, shrub and herbaceous biomass production and plant cover will likely increase compared to pretreatment levels, even though recovery of perennial plants has been slow. To improve nesting habitat, tree removal has been important for returning disturbed communities to sagebrush dominated sites recommended for sage-grouse habitat (Connelly 2004). Juniper provides perching sites for predatorial birds, obstructs the ability to observe predators from a distance, and impairs intercanopy and understory plant community structure. Furthermore, remaining trees provide a seed source for more rapid reinvasion in the intercanopy space which can lead to a more rapid exclusion of sage-grouse habitat in that area.

In southeast Oregon and northwest Nevada, over 1,200 nest sites were located from 1995 to 2003. The majority of sage-grouse nest sites occur in intact sagebrush and bitterbrush/sagebrush stands which lacked juniper trees. Western juniper occurs throughout the region and within 10 km of both leks, however, birds have never been observed nesting within juniper woodlands. In Canada, 90% of all identified nest sites occurred under sagebrush plants (Aldridge and Bingham 2002). In Colorado, birds nested 94% of the time under sagebrush (Petersen 1980). Other plant species that provided nest sites included greasewood, bitterbrush, rabbitbrush, horsebrush, snowberry, shadscale, mountain-mahogany, and basin wildrye. While sage-grouse

nesting under juniper limbs or near juniper has been reported (i.e. Colorado), it is generally agreed that sage-grouse nest away from juniper stands, in particular closed or nearly closed canopy woodlands (Miller 2005). At a recent sage-grouse conference held in Mammoth Lakes, California (July 2008), a group of 4-5 sage-grouse biologists were questioned on their attitude about nesting habitat and juniper. The group unanimously stated that optimal nest site habitat is void of juniper trees. Complete juniper removal from sage-grouse habitat was identified as a primary objective for improving sage-grouse nesting habitat throughout the range of the species. Holloran (2008) also agreed that optimal habitat would include large-scale removal of juniper. In addition to nesting habitat, brood rearing habitat is also impacted as plant structure and forage availability are reduced and the potential for predation is increased with juniper encroachment.

According to Crawford et al. (2004), sage-grouse managers should understand that without purposeful habitat management such as juniper removal, sage-grouse habitat quality may decline. To improve habitat conditions in the Alton area, and to increase connectivity with the neighboring Hoyts Ranch population, large-scale juniper removal is recommended. With aggressive revegetation of native shrub species (e.g. *Artemisia* spp, *Purshia tridentata*), including the use of transplants to increase more rapid sagebrush establishment and establishment of herbaceous species (in particular sage-grouse forage species), habitat conditions can be improved to ensure greater habitat availability for nesting and brood rearing. Tree removal increases resources available for shrub and herbaceous plant establishment and growth. In the Alton area, it is likely that birds will identify adequate sites for roosting following tree removal, using sagebrush plants or juniper trees at the juniper woodland fringe. More significant is the long-term benefit from having greater area for hens to nest and raise their brood. While research is needed to provide further evidence of the impacts of juniper on sage-grouse habitat, an assessment from sage-grouse biologists and wildlife habitat biologists have concluded that juniper impacts are detrimental to sage-grouse nesting and brood rearing habitat.

Any future tree removal treatments will be completed outside the avian nesting season. This does not include any tree removal that will occur during the mining process.

Removing trees from extensive areas creates greater connectivity of suitable habitat. In 2005, the BLM cleared portions of the land to increase sagebrush habitat. This improvement was beneficial for improving relatively small site conditions, however, the amount of land treated was minimal compared to the level needed to sustain the sage-grouse population in the Alton area. In 2007, the Coal Hollow Project removed over 10,000 juniper trees that had encroached the sagebrush open areas. Other than during the mining process itself, any future tree removal treatments within the permit area will be completed outside the area's avian nesting season. Current plans have been designed to provide a corridor for the sage-grouse in the Alton to intermix with the larger population located to the north, called the Heut's Ranch Lek (see below). This landscape-level operation could greatly enhance sagebrush restoration objectives by the BLM that is currently limited by constrained budgets and manpower.

Reestablishing Connectivity Between Alton and Hoyt's Ranch

Over time, juniper encroachment has likely been the primary factor in isolating the Alton sage-grouse population from nearby populations. There is a larger sage-grouse population located approximately 6 miles north of Alton. It is likely that migration once occurred between these populations allowing an exchange of individuals and genes between the two populations. Fragmentation of the landscape by juniper has likely resulted in minimal or no movement of birds between the two populations. Similarly, two populations that once occurred further south (near Kanab) have become locally extinct, likely due to the lack of connectivity with more northern populations. According to Fuhlendorf (2001), small populations of prairie chickens became disconnected from other larger populations with increased croplands and juniper invasion. These small populations became locally extinct due to the lack of migration and gene flow potential. Therefore, by reducing the degree of fragmentation caused by expanding juniper, the potential for migration and population sustainability is increased.

A plan has been made to establish connectivity by removing juniper and scrub oak trees from private land between the Alton and Hoyts Ranch populations. An area that is approximately 1,700 acres has been delineated that, with treatment, could provide connectivity between the two populations (Appendix 3-5). Funds have been earmarked by ACD to work with DWR and/or the landowners (Heaton Brothers, LLC) to provide technical and financial support to establish a migration corridor through the 1,700 acres. It is anticipated that this habitat improvement will create easier access for birds to travel more freely between the two populations.

Although ongoing, much of the corridor development work has been accomplished. A field visit that included a Division biologist, representatives from Heaton Brothers and ACD, and other independent biologists to this area to observe the progress of the project was conducted in late September 2009. Additionally, preliminary field monitoring data from radio-collared sage-grouse suggest that the corridor is beginning to be used by the birds.

Establishment of a Core Sage-Grouse Conservation Area

The east end of the valley maintains one of the few remaining intact sagebrush stands in the valley. This area is located northeast of the lek and provides sites for roosting during the mating season (Drawing 3-1 and Drawing 3-5). This area will not be mined, rather, it will be preserved to create a harbor area for bird breeding, nesting, and brood rearing (Figure 3-1). Within this “Conservation Area”, habitat will be protected for sheltering displaced sage-grouse, especially during the breeding and brood-rearing seasons. Most of the juniper trees that encroached into sagebrush communities within the permit area have been removed. This has been accomplished by felling and removing individual juniper trees while minimizing the impacts to the sagebrush community (see “Juniper Removal” above). In addition to juniper, some Gambel oak (Quercus gambelii) trees have also been removed to expand the sagebrush community and provide greater suitable habitat for sagegrouse.

In addition to juniper and oak removal, sagebrush treatments (mechanical) will be applied to reduce shrub cover and density in small areas (patches) if quantitative sampling in that area suggests that these parameters exceed optimal sage-grouse habitat requirements. Forb species that are known to be important sage-grouse forage will then be seeded to provide an additional food source for hens and chicks, primarily during the brood rearing period. Grasses will also be seeded to provide additional hiding cover and a potential source of insects for chick foraging. These treatments could initially be done in a few, relatively small areas to determine whether forb and grass densities actually do increase and if birds are observed using these areas for foraging. If successful, these treatments can then be used in other areas where benefits are expected. Conversely, if the results from preliminary vegetation sampling, along with the current research literature regarding sage-grouse habitat requirements, indicate that widespread treatments should be made to the existing sagebrush community, then this will be the course of action.

Maintaining optimal shrub cover for nesting, brood rearing, predator avoidance, roosting, and as a source of shelter will remain the highest priority for these sites.

Predator Control Plan

Several species that prey on sage-grouse eggs, chicks and adults live in the Alton region including common ravens (*Corvus corax*), American crows (*Corvus brachyrhynchos*) and coyotes (*Canus latrans*). ACD will coordinate with the appropriate government agency to help implement a predator control program to enhance survival of the sage-grouse in the area. The operator will not conduct the predator control measures but will assist the appropriate agency with developing technical expertise to formulate a plan to implement such a program through the appropriate government agency.

- Restoration of Sagebrush Habitat

After mining has been completed, reclamation specialists will return the original grade and valley form to approximate pre-disturbance conditions. An emphasis will be

placed on restoring sagebrush ecosystems. Reclamation will include seeding similar plant species with comparable plant composition, structure and function as those of the original plant community. Final reclamation seed mixtures have been formulated to include forb species critical for survival of hens and their chicks.

Seed mixes that are used for reclamation will consist of native shrub, grass and forb species that provide cover and food. In order to accelerate shrub re-establishment, bareroot or containerize sagebrush and bitterbrush transplants can be planted (in additional to sage-grouse preferred forb species) to enhance sagebrush ecosystem restoration (see Coal Hollow Project, Mining & Reclamation Plan, Chapter 3, Revegetation Seed Mixtures). Cursory surveys conducted on April 30, 2006 found that there is a low probability that a dominant invasive species (i.e. cheatgrass, medusahead) could establish on reclaimed sites. However, post-reclamation surveys will be conducted for undesirable invasive plants. If a breakout does occur, mechanical and/or chemical treatments will be applied.

Primary brood-rearing habitat in the Alton valley is associated with alfalfa fields near the town of Alton. Birds likely utilize these areas due to the availability of forbs, insects, and water. To reduce the dependency of the birds on these areas, areas that are currently pasture lands will be returned to sagebrush/grass/forb communities. Seed mixtures for final reclamation have been created with this goal in mind.

Seeding and planting will occur in the fall season following the growing season and into dormancy, or in the spring if timing and conditions appear more favorable. During the following growing season, vegetation sampling will be conducted to monitor reclamation success. Measurements will be continued each year until the reclamation goals have been achieved. Additional seeding can be applied during subsequent years if the minimum standards of acceptance have not been achieved. Juniper seedlings found in reclaimed areas will be removed.

- Restoration of Lekking Habitat

The current lek is located in a low-growing pasture in the south end of the proposed mining area. The lek is dominated by perennial grasses and forbs. Following mining, this site will be seeded with similar perennial species occurring at the lek prior to disturbance. Several studies demonstrate the plant structure of greater sage-grouse leks. They are described as occurring in sparsely vegetated areas (surrounded by sagebrush communities) that provide escape and protection from predators (Gill 1965, Connelly et al. 1981, Connelly et al. 2000, Call and Maser 1985, Crawford et al. 2004). After mining, the Alton lek will be restored to resemble pre-disturbance conditions. Plant species will be seeded to most closely represent the original lekking environment. Depending on post-mining soil water conditions and the presence of dominated perennial grass species, vegetation growth of seeded species may exceed the height tolerated by displaying sage-grouse during the lekking period. Additionally, weedy species may occur that grow taller than conditions typical of sage-grouse lekking habitat. With excessive plant growth, sage-grouse may choose not to attend the lek for display.

If needed, the reduction of plant growth may be required to create “sparsely vegetated conditions” (Figure 8) within the lekking area, by reducing both living and decadent plant materials. In cases where grass growth at the restored lek exceeds this maximum height requirement, ACD will work with the DWR prior to any vegetation treatments to identify optimal methods for vegetation management on the lek.

Figure 7. Sage-grouse males displaying on the Sink Valley lek on March 30, 2006.

- Wildlife Awareness Program

A Wildlife Awareness Program will be implemented during the active phases of mining for the Coal Hollow Project. The objectives of the program will be to provide protection of the resident wildlife, decrease collisions by heavy equipment and other vehicles, as well as minimize impact to the wildlife during the mining operations. During this program, qualified biologist will provide employees specific training on sage-grouse identification, seasonal patterns in sage-grouse development and movement, and deer and elk observations and migratory patterns in the Alton area. Annual refresher training for all ACD employees occurs in January, UDWR and UDOGM are invited to participate in the Wildlife Awareness training.

The coal operations will, to the extent possible using the best technology currently available, minimize disturbances and adverse impacts on fish, wildlife, and related environmental values and will achieve enhancement of such resources where practicable. In doing so, the following procedures will be implemented.

- Speed limits of all vehicles will be posted at 25 mph inside the permit area.
- The safety meetings conducted on the mine site to all employees will include information regarding awareness of important wildlife species in the area.
- No coal mining and reclamation operations will be conducted that would likely jeopardize the continued existence of federally listed endangered or threatened or which is likely to result in the destruction or adverse modification of designated critical habitats of such species in violation of the Endangered Species Act of 1973.
- As mentioned above and in following sections, extensive measures for protecting, enhancing and mitigating habitat for the sensitive bird species, sage-grouse, have been conducted. Mitigation plans for this species have also begun and continue through opperations (see Appendix 3-5 and Appendix 3-8).
- The mining operator will promptly report to the State of Utah, Division of Oil, Gas & Mining any state- or federally-listed endangered or threatened species within the permit area of which the operator becomes aware. Upon notification, the

Division will consult with appropriate state and federal fish and wildlife agencies and, after consultation, will identify whether, and under what conditions, the operator may proceed.

- The mining operator keep log records of any road kill of deer, elk, sage-grouse and domestic livestock from coal haul and associated vehicles from the mine site to highway 89.
- The operator will ensure that electric powerlines and other transmission facilities used for, or incidental to, coal mining and reclamation operations on the permit area are designed and constructed to minimize electrocution hazards to raptors, except where the Division determines that such requirements are unnecessary.
- The operator will design fences, overland conveyers, and other potential barriers to permit passage for large mammals, except where the Division determines that such requirements are unnecessary.

340. **RECLAMATION PLAN**

341. **REVEGETATION**

This document contains the revegetation plan for final reclamation of all lands disturbed by coal mining and reclamation operations, except water areas and the surface of roads approved as part of the postmining land use, as required in R645-301-353 *through* R645-301-357. It also shows how the Coal Hollow Project will comply with the biological protection performance standards of the State Program.

341.100. Reclamation Timetable

A detailed schedule and timetable for the completion of each major step in the mine plan has been included in Chapter 5 of the MRP and on Drawing 5-38 ~~or 5-38 A~~and 5-76 ~~for the highwall miner~~. Briefly, the mine will conduct operations in one area (segment) at a time. Initial mine development will involve removal and storage of topsoil from mine infrastructure locations. Facilities for equipment maintenance/warehouse, coal handling, and offices will be constructed. During the development and initial mining period, facilities temporary in nature may be used until permanent facilities can be built. Construction of sedimentation ponds, diversion ditches, and mine roads accessing the initial mining areas will also be ongoing.

Mining will employ typical open pit methods using truck/loader type equipment to remove overburden and recover the coal. Mining will advance across the property in successive cuts approximately 250 ft. in width and 800 to 1,300 ft. long (generally equal to the width of the property less property barriers). Layout of these pits can be viewed on Drawing 5-10 and 5-53. In practice, these overburden lifts are mined in a stairstep fashion ahead of the coal removal operation to provide adequate working room for the equipment and stable advancing slopes. Once mining is complete, excavated overburden (spoil) from a successive cut is used to backfill the excavation. General cross sections of this process can be viewed on Drawings 5-11 and 5-12. For the highwall miner method, mining of the trench will be in successive cuts approximately 150 ft. in width and 550 to 600 ft. long. Layout of these trenchs can be viewed on Drawing 5-10~~A~~ and 5-~~10B~~53. Otherwise, mining and reclamation will proceed as described for the typical open pit method.

Prior to beginning mining, the area will be cleared of vegetation, and the topsoil will be recovered and either stockpiled or live hauled to regraded areas. Overburden will then be removed using large hydraulic excavator(s) or front end loaders and off-road trucks which will haul the spoil and place it in parts of the pit where the coal has been removed, or in the excess spoil area shown on Drawings 5-3, 5-37 and 5-37A for the Coal Hollow Mine and Drawing 5-47 for the North Private Lease. Overburden is removed in successively deeper benches until the coal seam is exposed. Some overburden in lower lifts may be moved by direct dozing into the mined out pit by large bulldozers.

Once the coal is removed, the pit will be backfilled by spoil from adjacent mine pits. Once the pit is backfilled to the planned final surface contour, suitable topsoil and subsoil will be replaced, and the area reseeded. Revegetation work will proceed seasonally as appropriate for planting. The mine plan has been engineered to disturb the smallest practicable area at any one time. The Alternate highwall mining will reduce the practicable area to be reclaimed. With prompt establishment and maintenance of vegetation, immediate stabilization of disturbed areas will minimize surface erosion. Details of the plan has been included in Chapter 5, Section 540 of this document.

341.200. Reclamation Description

The Coal Hollow Projects will be reclaimed and revegetated to meet the appropriate postmining land use. Most areas will be reclaimed to the native plant communities that existed prior to mining conditions. Other areas will be reclaimed to enhance habitat for sage-grouse or other wildlife species. Finally, in those areas where the landowner requests a change in the plant community to increase productivity for domestic livestock, they will be reclaimed accordingly.

341.210. Seed Mixtures

Revegetation seed mixtures for each plant community disturbed by mining activities in the Coal Hollow Project area are given in this section. Table 3-36 shows the plant communities that may eventually be disturbed by mining operations at the Coal Hollow Project area.

Table 3-36: Vegetation Communities of the Coal Hollow Permit Area Proposed for Disturbance

MINE AREA	MAP SYMBOL (see *Vegetation Map,* Drawing 3-1 and Volume 12 Vegetation Map 1)	PLANT COMMUNITY
	S/G	Sagebrush/Grass
	P	Pasture Land
	P-J	Pinyon-Juniper
	M	Meadow
	OB	Oak Brush
	RB/SB	Rabbitbrush/Sagebrush (Disturbed; previously Sagebrush/Grass)
North Private Lease	P	Pasture Land
	P-J	Pinyon-Juniper/Sagebrush
	CU	Channel Uplands
	W	Wetlands

Seed mixtures for each disturbance type are shown on Tables 3-37 *through* 3-~~42~~43. These rates have been based on drill seeding methods described in this document. When broadcast seeding is employed these rates will be doubled.

Table 3-37: Revegetation Seed Mixture for the Sagebrush/Grass Community at the Coal Hollow Project

	Rate** (# PLS/Ac)	Seeds/ft2
SHRUBS		
*Artemisia nova**	0.20	4.16
*Artemisia tridentata**	0.10	5.74
Ceratoides lanata	1.00	1.26
Purshia tridentata	2.00	0.69
Symphoricarpos oreophilus	1.00	1.72
FORBS* **		
Achillea millefolium	0.03	1.91
Hedysarum boreale	1.00	0.77
Linum lewisii	0.70	4.47
Lupinus argenteus	1.00	0.29
Penstemon palmeri	0.30	4.20
Sphaeralcea grossulariifolia	0.40	4.59
Viguiera multiflora	0.20	4.84
GRASSES		
Elymus smithii	1.50	4.34
Elymus trachycaulus	1.50	5.51
Poa pratensis	0.10	5.00
Poa secunda	0.20	4.25
Stipa hymenoides	1.00	4.32
Sterile Triticale - Quick Guard	10.00	4.59
TOTALS	22.23	62.66

* This species could also to be planted by containerized seedlings at a rate of 200 plants per acre to enhance sage-grouse habitat.

** Based on drill seeding methods. The number reflects the pounds of pure live seed (PLS) per acre.

*** Seeds used may be based on commercial availability. Other forb species that would be beneficial for sage-grouse enhancement include: Achillea millefolium, Agoseris glauca, Crepis acuminata, Gayophytum spp., Lomatium spp., Tragopogon dubius, Trifolium spp.

Table 3-38: Revegetation Seed Mixture for the Pasture Lands at the Coal Hollow Project

(Final determination to be made by landowners)	Rate* (# PLS/Ac)	Seeds/ft2
SHRUBS		
FORBS **		
Achillea millefolium var. occidentalis	0.04	2.55
Astragalus cicer	1.5	4.22
Hedysarum boreale	1	0.77
Linum perenne	1	6.39
Medicago sativa	1	5.21
GRASSES		
Bromus inermis	1	2.45
Dactylis glomerata	0.2	0.00
Pascopyrum smithii	1.5	4.34
Elymus lanceolatus ssp. lanceolatus	1.5	5.27
Psathyrostachys juncea	1	0.00
Thinopyrum intermedium	2	0.00
Phleum pretense	0.2	0.00
Poa pratensis	0.1	5.00
Sterile Triticale - Quick Guard	10.00	4.59
TOTALS	22.04	40.78

* Based on drill seeding methods. The number reflects the pounds of pure live seed (PLS) per acre.

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*** Seeds used may be based on commercial availability. Other forb species that would be beneficial for sage-grouse enhancement include: Achillea millefolium, Agoseris glauca, Crepis acuminata, Gayophytum spp., Lomatium spp., Tragopogon dubius, Trifolium spp.

Table 3-39: Revegetation Seed Mixture for the Pinyon-Juniper Community at the Coal Hollow Project

	Rate** (# PLS/Ac)	Seeds/ft2
SHRUBS		
Amelanchier Utahensis	5.00	2.96
Artemisia nova	0.20	4.16
Artemisia tridentata vaseyana	0.07	4.02
Ceratoides lanata	3.00	3.79
Purshia tridentata	12.00	4.13
Symphoricarpos oreophilus	2.50	4.30
FORBS		
Artemisia ludoviciana	0.04	4.13
Eriogonum umbellatum	1.00	4.80
Hedysarum boreale	5.00	3.86
Lupinus argenteus	15.00	4.30
Sphaeralcea coccinea	0.50	5.74
Viguiera multiflora	0.20	4.84
GRASSES		
Elymus spicatus	1.00	3.21
Elymus smithii	1.50	4.34
Elymus trachycaulus	1.50	5.51
Poa pratensis	0.10	5.00
Poa secunda	0.20	4.25
Stipa hymenoides	1.00	4.32
Sterile Triticale - Quick Guard	10.00	4.59
TOTALS	59.81	82.25

* Based on drill seeding methods. The number reflects the pounds of pure live seed (PLS) per acre.

Table 3-40: Revegetation Seed Mixture for the Meadow Community at the Coal Hollow Project

	Rate* (# PLS/Ac)	Seeds/ft2
SHRUBS		
FORBS **		
Iris missouriensis	2	0.96
Achillea millefolium var. occidentalis	0.1	6.37
GRASSES		
Carex microptera	0.2	3.89
Carex nebrascensis	0.5	6.13
Elymus trachycaulus ssp. trachycaulus	2	7.35
Phleum pretense	0.2	5.97
Poa pratensis	0.1	5.00
Poa secunda ssp. sandbergii	0.3	6.38
Schoenoplectus americanus	1	4.13
Sporobolus airoides	0.2	8.03
Sterile Triticale - Quick Guard	10.00	4.59
TOTALS	16.60	58.79

* Based on drill seeding methods. The number reflects the pounds of pure live seed (PLS) per acre.

*** Seeds used may be based on commercial availability. Other forb species that would be beneficial for sage-grouse enhancement include: Achillea millefolium, Agoseris glauca, Crepis acuminata, Gayophytum spp., Lomatium spp., Tragopogon dubius, Trifolium spp.

Table 3-41: Revegetation Seed Mixture for the Oak Brush Community at the Coal Hollow Project

	Rate* (# PLS/Ac)	Seeds/ft2
SHRUBS		
Amelanchier utahensis	1	0.59
Artemisia nova	0.2	4.16
Artemisia tridentate ssp. vaseyana	0.07	4.02
Cercocarpus montanus	1	1.35
Purshia tridentate	2	0.69
Symphoricarpos oreophilus	1	1.72
Ephedra viridis	2	1.15
FORBS		
Artemisia ludoviciana	0.04	4.13
Sphaeralcea coccine	0.2	2.30
Hedysarum boreale	1	0.77
Heliomeris multiflora	0.2	4.84
GRASSES		
Bromus marginatus	2	4.90
Pseudoroegneria spicata ssp. spicata	1.5	4.82
Elymus trachycaulus ssp. trachycaulus	1.5	3.96
Poa pratensis	0.1	5.00
Poa secunda ssp. sandbergii	0.2	4.25
Achnatherum hymenoides	1	4.32
Sterile Triticale - Quick Guard	10.00	4.59
TOTALS	25.01	57.56

* Based on drill seeding methods. The number reflects the pounds of pure live seed (PLS) per acre.

Table 3-42: Revegetation Seed Mixture for the Rabbitbrush/Sagebrush Community (disturbed Sagebrush/Grass Community) at the Coal Hollow Project

	Rate** (# PLS/Ac)	Seeds/ft2
SHRUBS		
*Artemisia nova**	0.2	4.16
*Artemisia tridentate ssp. Tridentate**	0.1	5.74
Krascheninnikovia lanata	1	1.26
Purshia tridentate	2	0.69
Symphoricarpos oreophilus	1	1.72
FORBS * **		
Achillea millefolium var. occidentalis	0.03	1.91
Hedysarum boreale	1	0.77
Linum perenne	0.7	4.47
Lupinus argenteus ssp. rubricaulis	1	0.29
Penstemon palmeri	0.3	4.20
Sphaeralcea grossulariifolia	0.4	4.59
Heliomeris multiflora	0.2	4.84
GRASSES		
Pascopyrum smithii	1.5	4.34
Elymus trachycaulus ssp. trachycaulus	1.5	5.51
Poa pratensis	0.1	5.00
Poa secunda ssp. sandbergii	0.2	4.25
Achnatherum hymenoides	1	4.32
Sterile Triticale - Quick Guard	10.00	4.59
TOTALS	22.23	62.66

* This species could also to be planted by containerized seedlings at a rate of 200 plants per acre to enhance sage-grouse habitat.

** Based on drill seeding methods. The number reflects the pounds of pure live seed (PLS) per acre.

*** Seeds used may be based on commercial availability. Other forb species that would be beneficial for sage-grouse enhancement include: Achillea millefolium, Agoseris glauca, Crepis acuminata, Gayophytum spp., Lomatium spp., Tragopogon dubius, Trifolium spp.

Table 3-43: Revegetation Seed Mixture for the Wetland Community in the North Lease Area of the Coal Hollow Project

	Rate* (# PLS/Ac)	Seeds/ft2
SHRUBS		
Rosa woodsii	5.00	5.20
FORBS ***		
Iris missouriensis	10.00	4.82
GRASSES/GRASS-LIKE		
Agrostis stolonifera	0.05	7.35
Carex microptera	0.40	7.78
Carex nebrascensis	0.50	6.13
Carex pellita	1.00	7.16
Carex utriculata	0.50	5.10
Juncus arcticus	0.05	6.89
Poa pratensis	0.07	3.50
Scipus americanus	2.00	8.26
Triglochin maritima	0.50	5.17
TOTALS	20.07	67.34

* Based on drill seeding methods. The number reflects the pounds of pure live seed (PLS) per acre.

** Seeds used may be based on commercial availability. Other substitute species could include: Carex aquatilis, Carex obnupta, Carex praegracilis, Juncus tenuis, Juncus torrevi

341.220. Planting & Seeding Methods

Seedbed Preparation & Analyses

The final seedbed of the reclaimed areas will be prepared by first replacing the subsoil and topsoil in the same order it existed prior to removal by the mining activities. Next, a basic topsoil (top 8 inches of reclamation profile) sampling regime will be implemented prior to seeding that should identify fertility problems and will provide a basis for determining necessary soil amendments. The parameters analyzed will be:

- Available phosphorus (P)
- Soluble Potassium (K)
- Nitrate-Nitrogen

One composite sample will be collected from approximately every 2 to 5 acres based on soil types and variability. Each composite will be comprised of at least 4 samples.

Pre-testing of the soils has been conducted as part of the soils survey. Results from the pre-testing of topsoil and subsoil can be viewed in Table C-1 of Appendix 2-1 (native topsoil and subsoil) and Table C-2 (samples from core hole/overburden pits) of Appendix 2-1.

If heavy equipment operation results in excessive soil compaction at the surface of the reclaimed areas, they will then be ripped, disked, and harrowed to loosen the seedbed prior to seeding. Excessive compaction that could impact seeding success will be determined by observation and judgment of an environmental professional. In other areas where less compaction has occurred, the areas will be disked and harrowed. The disking and harrowing of all areas will be done parallel with the contour wherever possible to decrease the potential for water erosion downslope. In other areas where compaction is not a problem, dozer tracking can be used to roughen the surface, and to trap seed, fertilizer, mulch, and other amendments as well as decrease erosion by wind and water. In such cases, seeding will be done immediately after this treatment, whereas soil amendments, where required, would be applied over the surface during seedbed preparations. Seeding will mainly occur in the early spring and late fall.

Seeding & Transplanting

Seeding will be accomplished using different methods depending on the area to be seeded. In the more flat areas such as the meadows and existing pasture lands, a typical farmland drill will be used for seeding. In other areas where the surface may be more rough, a modified rangeland drill or “rough terrain seeder” will be used. Finally, in the areas where access is more difficult to reach by heavy equipment due to slope steepness or other limiting factors, broadcast seeding or hydro-seeding will be employed. For a list of plant species to be seeded refer to Tables 3-37 *through* 3-~~42~~43.

Containerized plants can be planted in those areas proposed for sage-grouse habitat enhancement. These plants will be planted from containers at least 10 cubic inches in size and inoculated with appropriate site-specific or commercial mycorrhizal inocula at specified infection rates. The containerized plants will be planted at a rate that totals at least 400 individuals per acre. For a list of the species to be planted, refer to Table 3-37. Containerized plants should be dormant when they arrive at the site in the spring or fall and will be planted as soon after delivery as possible. Plants will be planted in a fashion to simulate a natural habitat. If competing vegetation is present at the time of planting, this vegetation will be removed by scalping the area or herbicide application beforehand that provide a time period ample as to not affect the containerized seedling. A small depression will be created in the seedbed around the seedling at the time of planting to increase survivability by harvesting and holding water. The plants will be "wateredin" when they are planted by adding water to the depression. If possible, the plants will be watered during dry periods for the first growing season.

341.230. Mulching Techniques

Mulch will be placed on the seedbed surface once soil amendments have been incorporated and seeding has been accomplished. Mulching will occur by one of the following methods:

• Certified noxious weed free straw applied at a rate of 1 ton/acre anchored by crimping or a chemical binder.

• Wood fiber hydromulch at a rate of ¾ ton per acre for slopes flatter than 3:1 and 1 ton per acre for slopes at 3:1 which is the steepest slope planned at the project. This hydromulch would be anchored with a chemical binder at the manufacturer's suggested rate.

- Live mulch by use of quick growing sterile nurse crop such as "Quick Guard" with recommended rates of 5-10 lbs. /acre.

The mulch should control erosion by wind and water, decrease evaporation and seed predation, and increase survivability of the seeded species. Since there is only one post mining land use, mulching will follow one of the above described methods for all reclaim areas.

341.240. Irrigation

Irrigation has not been planned for the reclaimed area with the exception of watering the containerized plants as mentioned above.

341.250. Revegetation Monitoring

Vegetation of the reclaimed areas will be monitored regularly to measure the success of plant establishment and to determine if problem areas exist. Qualitative and quantitative data will be recorded at regular intervals. The qualitative data will include: site location, sample date, observers, slope, exposure, acreage, animal disturbance, erosion damage, dominant plant species observed, and other pertinent notes. Quantitative data recorded will include: total cover (living cover, rock, litter, bare ground), cover by species, composition, frequency, and woody species density.

Methods for quantitative monitoring will be as follows. Transect lines will be placed randomly on each of the revegetation sites. Random sample locations will then be placed from these transect lines and the aforementioned data will be recorded. Ocular methods with square meter quadrat will be used to provide cover and frequency data, whereas, point quarter and/or belt transects will be used to estimate woody species densities.

Weed control through chemical means will follow the current Weed Control Handbook (published annually or biannually by the Utah State University Cooperative Extension Service) and herbicide labels.

Weed surveys will also be conducted on the reclaimed areas on a yearly basis or during the revegetation monitoring studies. If undesirable, exotic or “weedy” plant species are present at a density that they could impede revegetation or out-compete desirable plant species, a certified or trained specialist will spray herbacide, kill or remove the weeds mechanically (roguing, grubbing and mowing).

341.300. Mining, Reclamation & Revegetation Research

Mining, reclamation & revegetation research has been planned and is in the process of being submitted to DOGM. Additionally, DOGM may require greenhouse studies, field trials, or equivalent methods of testing proposed or potential revegetation materials and methods to demonstrate that revegetation is feasible pursuant to R645-300-133.710.

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342. **FISH AND WILDLIFE ENHANCEMENT**

This application includes a fish and wildlife plan for the reclamation and postmining phase of the operation consistent with R645-301-330, the performance standards of R645-301-358 and include the following (for details see section 330, OPERATION PLAN).

342.100. Measures for Enhancement of Habitat

Enhancement measures that will be used during the reclamation and postmining phase of the operation to develop aquatic and terrestrial habitat. Such measures may include restoration of streams and other wetlands, retention of ponds and impoundments, establishment of vegetation for wildlife food and cover, and the replacement of perches and nest boxes (see also section 330, **OPERATION PLAN**).

342.200. Reclamation Plants for Enhancement

Where fish and wildlife habitat is to be a postmining land use, the plant species to be used on reclaimed areas have been selected on the basis of the criteria described below.

342.210. Nutritional Values of Plant Species

Among other qualities (e.g. erosion control qualities, establishment capabilities, and seed availability), plant species for revegetation of the Coal Hollow Project have been chosen for their proven nutritional value for wildlife (see Table 3-37 *through* 3-~~42~~43).

342.220. Cover Quality of Plant Species

Among other qualities (e.g. erosion control qualities, establishment capabilities, and seed availability), plant species for revegetation of the Coal Hollow Project have been chosen for their cover qualities for wildlife (see Table 3-37 *through* 3-~~42~~43).

342.230. Habitat Enhancement & Plant Species

Among other qualities, plant species for revegetation of the Coal Hollow Project have been chosen for their proven habitat enhancement qualities for wildlife (see Table 3-37 *through* 3-~~42~~43). The plants have also been chosen for their ability to support and enhance fish or wildlife habitat after the release of performance bonds. At final revegetation, the selected plants will be grouped and distributed in a manner which optimizes edge effect, cover, and other benefits to fish and wildlife.

After consultation with appropriate agencies and biologists regarding habitats and sensitive species, the sage-grouse and its habitat were of greatest concern in the area. There has been a decreasing trend in the populations of this species since 1964 (see **Appendix 3-1** and **Appendix 3-3** for more details). There was a general consensus among the biologists and agencies consulted that due to the: 1) marginal habitat in the Alton Amphitheater area, 2) loss of habitat in recent years for nesting and brood-rearing and 3) relatively low population numbers in the area, that the local population of sage-grouse is vulnerable to elimination, regardless of mining activities proposed by the Coal Hollow Project. Accordingly, the several measures to minimize impacts and enhance habitat for this species have been proposed and are subject to further consideration by the operator and regulatory agencies (see Section 333 above).

342.300. Cropland & Revegetation

Where cropland is to be the postmining land use, where appropriate for wildlife- and crop-management practices, and with approval from the private landowners, the Coal Hollow Project will intersperse the fields with trees, hedges, or fence rows throughout the harvested area to break up large blocks of monoculture and to diversify habitat types for birds and other animals.

342.400. Residential & Industrial Reclamation

Where residential, public service, or industrial uses are to be the postmining land use, and where consistent with the approved postmining land use, the Coal Hollow Project will intersperse reclaimed lands with greenbelts utilizing species of grass, shrubs, and trees useful as food and cover for wildlife. No residential or industrial areas have been planned at this time.

350. **PERFORMANCE STANDARDS**

351. **GENERAL REQUIREMENTS**

All coal mining and reclamation operations will be carried out according to plans provided under R645-301-330 *through* R645-301-340.

352. **CONTEMPORANEOUS RECLAMATION**

Revegetation on all land that is disturbed by coal mining and reclamation operations, will occur as contemporaneously as practicable with mining operations, except when such mining operations are conducted in accordance with a variance for combined Surface and Underground Coal Mining and Reclamation Activities issued under R645-302-280. DOGM may establish schedules that define contemporaneous reclamation.

353. **REVEGETATION: GENERAL REQUIREMENTS**

Operators of the Coal Hollow Project will establish on re-graded areas and on all other disturbed areas, except water areas and surface areas of roads that are approved as part of the postmining land use, a vegetative cover that is in accordance with the mine permit and reclamation plan.

353.100. Vegetative Plant Cover Qualities

353.110. Diverse, Effective, & Permanent

The vegetation cover established at final reclamation will be diverse, effective and permanent.

353.120. Native Plant Species

The cover will be comprised of species native to the area, or of introduced species where desirable and necessary to achieve the approved postmining land use and approved by the DOGM (see Table 3-37 *through* 3-~~42~~43).

353.130. Final Vegetation Cover & Quantities

The final cover will be at least equal in extent of cover to the natural vegetation of the area, or those standards set for final revegetation success.

353.140. Vegetation Cover and Soil Stabilization

The cover will be capable of stabilizing the soil surface from erosion.

353.200. The reestablished plant species will also contain the qualities listed below.

353.210. (a) Be compatible with the approved postmining land use.

353.220. (b) Have the same seasonal characteristics of growth as the original vegetation.

353.230. (c) Be capable of self-regeneration and plant succession.

353.240. (d) Be compatible with the plant and animal species of the area.

353.250. (e) Meet the requirements of applicable Utah and federal seed, poisonous and noxious plant; and introduced species laws or regulations.

353.300. Vegetative Cover Exceptions

DOGM may grant exception to the requirements of R645-301-353.220 and R645-301-353.230 when the species are necessary to achieve a quick-growing, temporary, stabilizing cover, and measures to establish permanent vegetation are included in the approved permit and reclamation plan.

353.400. Cropland Exceptions

When the approved postmining land use is cropland, DOGM may grant exceptions to the requirements of R645-301-353.110, R645-301-353.130, R645-301-353.220 and R645-301-353.230.

354. **TIMING OF REVEGETATION**

Disturbed areas will be planted during the first normal period for favorable planting conditions after replacement of the plant-growth medium. The normal period for favorable planting is that planting time generally accepted locally for the type of plant materials selected (see section 341.100, Reclamation Timetable).

355. MULCHING & OTHER SOIL STABILIZING PRACTICES FOR REVEGETATION

Suitable mulch and other soil stabilizing practices will be used on all areas that have been re-graded and covered by topsoil or topsoil substitutes (see section 340, RECLAMATION PLAN).

356. **STANDARDS FOR REVEGETATION SUCCESS**

356.100. Success Criteria

Success of revegetation will be judged on the effectiveness of the vegetation for the approved postmining land use, the extent of cover compared to the extent of cover of the reference area or other approved success standard, and the general requirements of R645-301-353.

356.110. Vegetation Information Guidelines

Standards for success, statistically valid sampling techniques for measuring success, and approved methods are identified in the DOGM's "Vegetation Information Guidelines, Appendix A." The approved techniques in that document will be used for the Coal Hollow Project. As stated above, the reclaimed plant communities at the site will be diverse, permanent, capable of stabilizing the soil surface for erosion, and will be compatible with the postmining land use. The reclaimed areas will be compared to the reference areas. Methods to be employed to determine that the standards have been met follow:

Cover	Ocular methods by meter square quadrats.
Shrub Density	Point quarter method and/or belt transects
Frequency	Relative number of times that it occurred in the square meter quadrats.
Production	Total annual biomass production will be estimated by clipping, drying and weighing current annual growth. Herbaceous and woody species will be summarized separately. "Double sampling" using four quadrats will be estimated around the clipped plots.
Diversity	Diversity will be measured by several methods. The average number of vascular species per meter square quadrat will be obtained by summing the frequency of all species in an area and dividing by 100. Another diversity measurement will be species richness or simply the total number of species encountered in the quadrats for each area. Finally, total diversity will be measured by using the MacArthur and Wilson's (1967) formula where the proportion of the sum frequency of each species of an area was calculated. The proportion of each species will be squared and the values for all species in the area are to be summed. This index integrates the number of species encountered and the degree to which frequency of occurrence is equitably distributed among those species. The formula is given below:

$$\textit{Total Diversity} = \frac{1}{\sum P_i^2}$$

where,

P_i = the proportion of the sum frequency for a community contributed by the i_{th} species.

356.120. Revegetation Success Standards

Standards for revegetation success will include comparisons of unmined lands (reference areas) with the areas being reclaimed to evaluate the appropriate vegetation parameters of ground cover, production, or stocking. Ground cover, production, or stocking will be considered equal to the approved success standard when they are not less than 90 percent of the success standard. The sampling techniques for measuring success will use a 90-percent statistical confidence interval (i.e., one-sided test with a 0.10 alpha error).

356.200. Postmining Land Use

Standards for success will be applied in accordance with the approved postmining land uses (see Chapter 4).

356.210. Grazing or Pasture Land

Some areas will be reclaimed as pasture and grazing land (see *Vegetation Map, Drawing 3-1and Volume 12, Vegetation Map 1*). For these and other areas determined by the landowners, the ground cover and production of living plants on the revegetated area will be at least equal to that of a reference area or other success standards approved by DOGM.

356.220. Cropland

For areas developed for use as cropland, crop production on the revegetated area will be at least equal to that of a reference area or such other success standards approved by DOGM. The requirements of R645-302-310 through R645-302-317 apply to areas identified as prime farmland (*no areas have been identified as prime farmland in the Coal Hollow Project Area*).

356.221. Wetlands

Portions of the North Private Lease supports wetland communities, some of which could be disturbed by proposed mining in that area. For revegetation success standards of these communities, refer to Volume 12: Supplemental Report section of the MRP in the report called: *Vegetation & Wildlife Habitat of the North Private Lease Area, Coal Hollow Project Kane County, Utah (November 2014).*

356.230. Wildlife Habitat

Several areas will be returned to wildlife habitat. For these areas success of vegetation will be determined on the basis of tree and shrub stocking and vegetative ground cover (see also section 356.100, Success Criteria).

356.231. Consultation & Approval

Minimum stocking and planting arrangements will be specified by DOGM on the basis of local and regional conditions and after consultation with and approval by Utah agencies responsible for the administration of forestry and wildlife programs. Consultation and approval will be on a permit specific basis.

356.232. Woody Species Success Criteria

Trees and shrubs that will be used in determining the success of stocking and the adequacy of plant arrangement will have utility for the approved postmining land use. At the time of bond release, such trees and shrubs will be healthy, and at least 80 percent will have been in place for at least 60 percent of the applicable minimum period of responsibility. No trees and shrubs in place for less than two growing seasons will be counted in determining stocking adequacy.

356.233. General Vegetative Cover

Vegetative ground cover will not be less than that required to achieve the approved postmining land use.

356.240. Industrial, Commercial or Residential Success Criteria

For areas to be developed for industrial, commercial, or residential use less than two years after regrading is completed, the vegetative ground cover will not be less than that required to control erosion. At this time, no areas have been proposed to be reclaimed as industrial, commercial or residential for the Coal Hollow Project.

356.250. Previous Disturbed Areas Success Criteria

For areas previously disturbed by mining that were not reclaimed to the requirements of R645-200 through R645-203 and R645-301 through R645-302 and that are re-mined or otherwise redisturbed by coal mining and reclamation operations, at a minimum, the vegetative ground cover will be not less than the ground cover existing before redisturbance and will be adequate to control erosion. Other than those lands where the native plant communities have been disturbed for rangeland improvements or pasture lands, no areas would be considered “previously disturbed” in the project area.

356.300. Sediment Control Structures

Siltation structures will be maintained until removal is authorized by the DOGM and the disturbed area has been stabilized and revegetated. In no case will the structure be removed sooner than two years after the last augmented seeding.

356.400. Removal of Sediment Control Structures

When a siltation structure is removed, the land on which the siltation structure was located will be revegetated in accordance with the reclamation plan and R645-301-353 *through* R645-301-357.

357. **REVEGETATION RESPONSIBILITY PERIODS**

357.100. Beginning Date

The period of extended responsibility for successful vegetation will begin after the last year of augmented seeding, fertilization, irrigation, or other work, excluding husbandry practices that are approved by DOGM in accordance with paragraph R645-301-357.300.

357.200. Duration

Vegetation parameters identified in R645-301-356.200 will equal or exceed the approved success standard during the growing seasons for the last two years of the responsibility period. The period of extended responsibility will continue for five or ten years based on precipitation data reported pursuant to R645-301-724.411 based on the following conditions.

357.210. (a). In areas of more than 26.0 inches average annual precipitation, the period of responsibility will continue for a period of not less than five full years.

357.220. (b). In areas of 26.0 inches or less average annual precipitation, the period of responsibility will continue for a period of not less than ten full years.

357.300. Husbandry Practices

357.301. Approval Information

DOGM may approve certain selective husbandry practices without lengthening the extended responsibility period. Practices that may be approved are identified in R645-301-357.310 *through* R645-301-357.365. The operator may propose to use additional practices, but they would need to be approved as part of the Utah Program in accordance with 30 CFR 732.17. Any practices used will first be incorporated into the mining and reclamation plan and approved in writing by DOGM. Approved practices are normal conservation practices for unmined lands within the region which have land uses similar to the approved postmining land use of the disturbed area. Approved practices may continue as part of the postmining land use, but discontinuance of the practices after the end of the bond liability period will not jeopardize permanent revegetation success. Augmented seeding, fertilization, or irrigation will not be approved without extending the period of responsibility for revegetation success and bond liability for the areas affected by said activities and in accordance with R645-301-820.330.

357.302. Demonstration of Appropriate Reclamation Techniques

The Coal Hollow Project will demonstrate that husbandry practices proposed for a reclaimed area are not necessitated by inadequate grading practices, adverse soil conditions, or poor reclamation procedures.

357.303. Bonded Area & Husbandry Practices

DOGM will consider the entire area that is bonded within the same increment, as defined in R645-301- 820.110, when calculating the extent of area that may be treated by husbandry practices.

357.304. Separate Responsibility Periods

If it is necessary to seed or plant in excess of the limits set forth under R645-301-357.300, DOGM may allow a separate extended responsibility period for these reseeded or replanted areas in accordance with R645-301-820.330.

357.310. Reestablishing Trees and Shrubs

357.311. Planting Within the Responsibility Period

Trees or shrubs may be replanted or reseeded at a rate of up to a cumulative total of 20% of the required stocking rate through 40% of the extended responsibility period. 357.312. Planting Shrubs in Established Vegetation If shrubs are to be established by seed in areas of established vegetation, small areas will be scalped (see section 341.220, Planting & Seeding Methods). The number of shrubs to be counted toward the tree and shrub density standard for success from each scalped area will be limited to one.

357.320. Weed Control and Associated Revegetation

Weed control through chemical, mechanical, and biological means discussed in R645-301-357.321 *through* R645-301-357.323 may be conducted through the entire extended responsibility period for noxious weeds and through the first 20% of the responsibility period for other weeds.

Any revegetation necessitated by the following weed control methods will be performed according to the seeding and transplanting parameters set forth in R645-301-357.324.

357.321. Chemical Weed Control

Weed control through chemical means will follow the current Weed Control Handbook (published annually or biannually by the Utah State University Cooperative Extension Service) and herbicide labels.

Weed surveys will also be conducted on the reclaimed areas on a yearly basis or during the revegetation monitoring studies. If undesirable, exotic or “weedy” plant species are present at a density that they could impede revegetation or out-compete desirable plant species, a certified or trained specialist will spray herbacide, kill or remove the weeds mechanically (see below).

357.322. Mechanical Weed Control

Mechanical practices that may be approved include hand roguing, grubbing and mowing.

357.323. Biological Weed Control

Selective grazing by domestic livestock may be used by the Coal Hollow Project. Biological control of weeds through disease, insects, or other biological weed control agents is allowed but will be approved on a case-by-case basis by DOGM, and other appropriate agency or agencies which have the authority to regulate the introduction and/or use of biological control agents.

357.324. Weed Control & Desirable Species Damage

Where weed control practices damage desirable vegetation, areas treated to control weeds may be reseeded or replanted according to the following limitations. Up to a cumulative total of 15% of a reclaimed area may be reseeded or replanted during the first 20% of the extended responsibility period without restarting the responsibility period. After the first 20% of the responsibility period, no more than 3% of the reclaimed area may be reseeded in any single year without restarting the responsibility period, and no continuous reseeded area may be larger than one acre. Furthermore, no seeding will be done after the first 60% of the responsibility period or Phase II bond release, whichever comes first. Any seeding outside these parameters will be considered to be "augmentative seeding," and will restart the extended responsibility period.

357.330. Control of Other Pests

357.331. Big Game

Control of big game (deer, elk, moose, antelope) may be used only during the first 60% of the extended responsibility period or until Phase II bond release, whichever comes first. Any methods used will first be approved by DOGM and, as appropriate, the land management agency and the State of Utah Division of Wildlife Resources (DWR). Methods that may be used include fencing and other barriers, repellents, scaring, shooting, and trapping and relocation. Trapping and special hunts or shooting will be approved by DWR. Other control techniques may be allowed but will be considered on a case-bycase basis by the DOGM and by DWR. Appendix C of the DOGM's "Vegetation Information Guidelines" includes a non-exhaustive list of publications containing big game control methods.

357.332. Small Mammal & Insects

Control of small mammals and insects will be approved on a case-by-case basis by DWR and/or the Utah Department of Agriculture. The recommendations of these agencies will also be approved by the appropriate land management agency or agencies. Small mammal control will be allowed only during the first 60% of the extended responsibility period or until Phase II bond release, whichever comes first. Insect control will be allowed through the entire extended responsibility period if it is determined, through consultation with the Utah Department of Agriculture or Cooperative Extension Service, that a specific practice is being performed on adjacent unmined lands.

357.340. Natural Disasters and Illegal Activities Occurring After Phase II Bond Release

Where necessitated by a natural disaster, excluding climatic variation, or illegal activities, such as vandalism, not caused by any lack of planning, design, or implementation of the mining and reclamation plan on the part of the Coal Hollow Project, the seeding and planting of the entire area which is significantly affected by the disaster or illegal activities will be allowed as an accepted husbandry practice and thus will not restart the extended responsibility period. Appendix C of the Division's "Vegetation Information Guidelines" references publications that show methods used to revegetate damaged land. Examples of natural disasters that may necessitate reseeding which will not restart the extended responsibility period include wildfires, earthquakes, and mass movements originating outside the disturbed area.

357.341. Extent of Area

The extent of the area where seeding and planting will be allowed will be determined by the DOGM in cooperation with the Coal Hollow Project.

357.342. Standards of Success

All applicable revegetation success standards will be achieved on areas reseeded following a disaster, including R645-301-356.232 for areas with a designated postmining land use of forestry or wildlife.

357.343. Seeding & Planting in Phase II Areas

Seeding and planting after natural disasters or illegal activities will only be allowed in areas where Phase II bond release has been granted.

357.350. Irrigation

The irrigation of transplanted trees and shrubs, but not of general areas, is allowed by DOGM through the first 20% of the extended responsibility period. Irrigation may be by such methods as, but not limited to, drip irrigation, hand watering, or sprinkling.

357.360. Highly Erodible Area and Rill and Gully Repair

The repair of highly erodible areas and rills and gullies will not be considered an augmentative practice, and will thus not restart the extended responsibility period, if the affected area as defined in R645-301- 357.363 comprises no more than 15% of the disturbed area for the first 20% of the extended responsibility period and if no continuous area to be repaired is larger than one acre.

357.361. Highly Erodible Areas Responsibility Period

After the first 20% of the extended responsibility period but prior to the end of the first 60% of the responsibility period or until Phase II bond release, whichever comes first, highly erodible area and rill and gully repair will be considered augmentative, and will thus restart the responsibility period, if the area to be repaired is greater than 3% of the total disturbed area or if a continuous area is larger than one acre.

357.362. Extent of Area Affected

The extent of the affected area will be determined by the DOGM in cooperation with the Coal Hollow Project.

357.363. Definition of Highly Erodible Areas

The area affected by the repair of highly erodible areas and rills and gullies is defined as any area that is reseeded as a result of the repair. Also included in the affected areas are interspacial areas of thirty feet or less between repaired rills and gullies. Highly erodible areas are those areas which cannot usually be stabilized by ordinary conservation treatments and if left untreated can cause severe erosion or sediment damage.

357.364. Erodible Areas & Sediment Control

The repair and/or treatment of rills and gullies which result from a deficient surface water control or grading plan, as defined by the recurrence of rills and gullies, will be considered an augmentative practice and will thus restart the extended responsibility period.

357.365. Erodible Area Designs & Repairs

The Coal Hollow Project shall demonstrate by specific plans and designs the methods to be used for the treatment of highly erodible areas and rills and gullies. These will be based on a combination of treatments recommended in the Soil Conservation Service Critical Area Planting recommendations, literature recommendations including those found in Appendix C of the Division's "Vegetation Information Guidelines", and other successful practices used at other reclamation sites in the State of Utah. Any treatment practices used will be approved by the Division.

358. **PROTECTION OF FISH, WILDLIFE AND RELATED ENVIRONMENTAL VALUES**

The Coal Hollow Project will, to the extent possible using the best technology currently available, minimize disturbances and adverse impacts on fish, wildlife, and related environmental values and will achieve enhancement of such resources where practicable.

358.100. Threatened & Endangered Species

A review of the Utah Heritage Program database for sensitive species in the proposed mine site and adjacent areas has been accomplished. Field maps with locations of these species have been prepared and have been used for additional surveys and will continue to be used in future biological studies or when disturbance by mining in specific areas is proposed.

Due to the sensitivity of these species, specific location information is considered confidential and has not been submitted in this application. However, review of this information can be arranged by the regulatory authorities (see section 322.200, Site-Specific Resource Information).

No coal mining and reclamation operation will be conducted which is likely to jeopardize the continued existence of endangered or threatened species listed by the Secretary or which is likely to result in the destruction or adverse modification of designated critical habitats of such species in violation of the Endangered Species Act of 1973. The Coal Hollow Project will promptly report to the DOGM any state- or federally-listed endangered or threatened species within the permit area of which the operator becomes aware. Upon notification, DOGM will consult with appropriate state and federal fish and wildlife agencies and, after consultation, will identify whether, and under what conditions, the operator may proceed.

358.200. Eagles

The coal mining and reclamation operations at the Coal Hollow Project will not be conducted in a manner which would result in the unlawful taking of a bald or golden eagle, its nest, or any of its eggs. The operator of the Coal Hollow Project will promptly report to the DOGM any golden or bald eagle nest within the permit area of which the operator becomes aware. Upon notification, the DOGM will consult with the U.S. Fish and Wildlife Service (USFWS) and DWR and, after consultation, will identify whether, and under what conditions, the mining operations may proceed.

358.300. Removal of a Threatened & Endangered Species

No regulations in the R645 Rules authorizes the taking of an endangered or threatened species or a bald or golden eagle, its nest, or any of its eggs in violation of the Endangered Species Act of 1973 or the Bald Eagle Protection Act, as amended, 16 U.S.C. 668 et seq.

358.400. Riparian & Wetland Areas

There are some riparian and wetland areas associated with springs and seeps in the Coal Hollow permit area (including the 85.88-acre Dame Lease IBC area) (see Chapter 7). The habitat in the vicinity of springs SP-8, SP-14, SP-20, SP-22, and SP-40, and wells C4, C2, C3, C5, and Y-61 will be protected through the use of highwall mining techniques in the 85.88-acre Dame Lease IBC. Unlike coal mining using conventional mine pit surface mining techniques (utilized elsewhere at the Coal Hollow Mine), mining using highwall mining techniques does not result in disturbance to the land surface above coal extraction areas (the coal is extracted through a series of excavated horizontal holes, with sufficient coal left in place between holes to fully support the overlying land surface). The highwall mining plan for the 85.88-acre Dame Lease IBC, including the spacing and dimensions of the excavated holes, has been engineered to prevent subsidence of the land surface. The highwall mining will occur in the Smirl coal seam, which is separated from overlying shallow alluvial groundwater systems by a thickness of soft, low-permeability Tropic Shale bedrock. The presence of the Tropic Shale bedrock between the coal seam and the overlying alluvium minimizes the potential for downward migration of alluvial groundwaters into the excavated coal holes. Accordingly, impacts to water quantity in the overlying and adjacent shallow alluvial groundwater systems are not anticipated (Appendix 7-14). Similarly, as no surface disturbance is anticipated over highwall mined areas, impacts to water quality in the overlying alluvial groundwater systems are not anticipated. For these reasons, impacts to ecosystems in and around the monitoring sites mentioned above are not anticipated and the habitat will be protected.

In the event that diminution of discharge rates from seeps and springs does occur as a consequence of mining and reclamation activities, any lost water will be replaced according to all applicable Utah State laws and regulations using the water replacement source specified in R645-301-727. The quantity and quality of replacement water detailed in R645-301-727 will be suitable for the existing premining uses and approved postmining land uses. The methodology for restoring possible diminution of discharge from a spring would include piping from ACD's current water replacement well to the approximate location of the impacted water source. Implementation will occur after consultation with all parties (DOGM, ACD and Richard Dame).

Vegetation will be monitored in the 85.88 acre Dame Lease by monitoring the existing meadow reference transect and one additional random transects within the lease area. Monitoring will begin with the first appropriate season and will continue until the first appropriate season following highwall mining within the Dame lease.

There are also some riparian and wetland areas associated with the North Private Lease (refer to Volumes 10 and 12: Supplemental Report sections of the MRP).

Additionally, the coal mining and reclamation operations at the Coal Hollow Project will avoid disturbances to, enhance where practicable, or restore, habitats of unusually high value for fish and wildlife (see Section 333, Procedures to Minimize Adverse Impacts to Fish & Wildlife in this document).

358.500. Best Technology Available

The Coal Hollow Project will apply the best technology currently available in all disciplines of the coal mining and reclamation activities.

358.510. Powerline & Transmission Facilities

The Coal Hollow Project will ensure that electric powerlines and other transmission facilities used for, or incidental to, coal mining and reclamation operations on the permit area are designed and constructed to minimize electrocution hazards to raptors, except where DOGM determines that such requirements are unnecessary.

358.520. Fences & Conveyers

The Coal Hollow Project will design fences, overland conveyers, and other potential barriers to permit passage for large mammals, except where the DOGM determines that such requirements are unnecessary.

358.530. Toxic-Forming Areas

The Coal Hollow Project has no plans for ponds that contain hazardous concentrations of toxic-forming materials.

Appendix 3-8

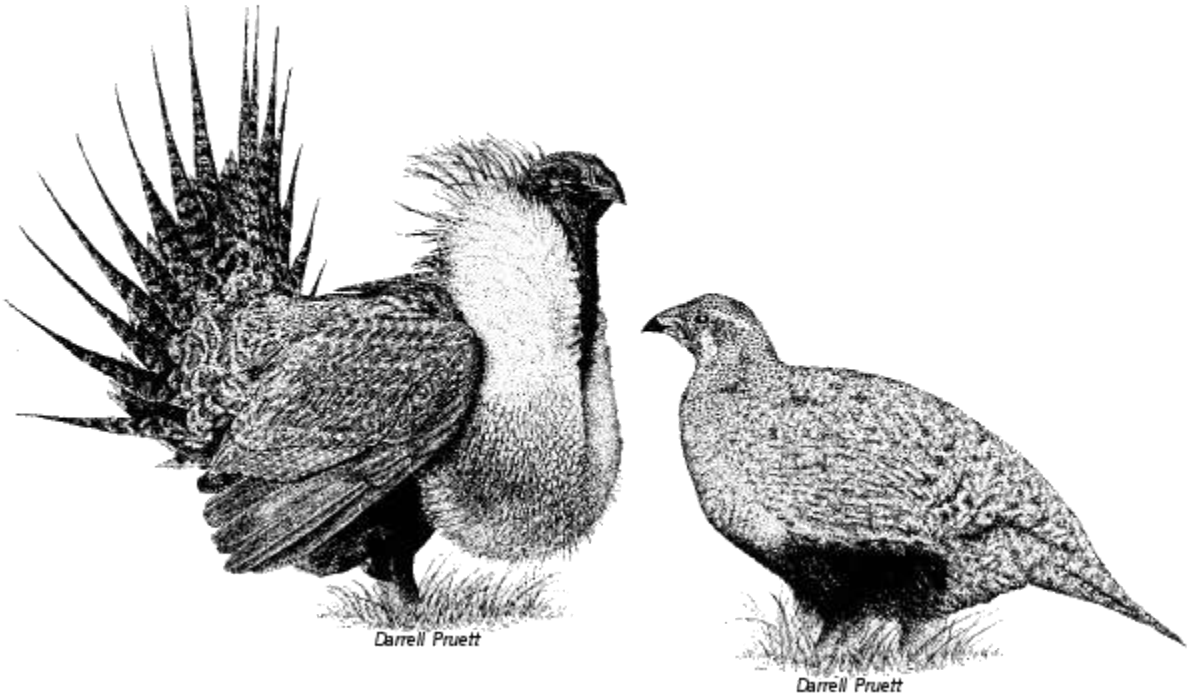
North Private Lease

Management Plan

2015

Greater Sage-grouse Management Plan
North Private Lease, Alton, Utah

Coal Hollow Mine, Alton Coal Development



Drawing provided by USGS (www.npwrc.usgs.gov)

June 14, 2015
Modified October 8, 2015

Prepared by
Steven L. Petersen, Ph.D.
Sage-grouse Population and Habitat Consultant

Greater Sage-grouse Management Plan
North Private Lease, Alton, Utah

The Alton-Sink Valley region of southern Utah is rich in coal deposits that are being extracted to supply energy demands for several western states. In 2014, approximately 650,000 tons of coal were extracted by Alton Coal Development Inc. (ACD) from the Coal Hollow Mine located on private leases in this area. ACD proposes to add 295.60 acres of private lease lands to the Coal Hollow Mine, which will be located some 1.9 miles north of the existing mining operations. Both the existing Coal Hollow Mine and the proposed North Private Lease tract are located within the larger Alton-Sink Valley area. See Figure 1.

Within the Alton-Sink Valley area, greater sage-grouse (*Centrocercus urophasianus*) are found utilizing sagebrush and wet meadow habitats for nesting, brood rearing, and wintering. Greater sage-grouse are a species of significant concern throughout western North America. Impacts that threaten sage-grouse populations include habitat loss, habitat fragmentation, degraded habitat condition, fire, invasive plant species, predation, and disease (Crawford et al. 2004).

Mitigation efforts should focus on reducing impacts to sage-grouse habitat and help maintain stable sage-grouse populations. The purpose of this report is to present strategies that will be implemented by ACD in the North Lease project area to reduce impacts to sage-grouse and improve habitat structure and availability.

ACD has maintained a close working relationship with partners in sage-grouse conservation, in particular the Utah Division of Oil, Gas, and Mining (UDOGM), the Utah Division of Wildlife Resources (UDWR), the Color Country Adaptive Resource Management group (CCARM), and the Bureau of Land Management (BLM). These partnerships will be included throughout the life of the mine to develop and assess strategies for improving rangeland resources and providing the conditions required for a stable sage-grouse population.

The purpose of this report is to present the management strategies designed to sustain sage-grouse populations and maintain suitable sage-grouse habitat in the North Private Lease area near the Town of Alton, Utah.

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North Private Lease Description

The proposed North Private Lease coal mining area is located some 0.8 miles south and east of the Town of Alton, Utah (Alton). This new lease tract will be added to the existing Coal Hollow Mine which is located on private lands some 1.9 miles to the south. The Sink Valley area is located some 2 miles south of the North Private Lease Area to the east of the Coal Hollow Mine. (Figure 1). This area, broadly referred to as the Alton/Sink Valley area is dominated by 1) an association of sagebrush (*Artemisia* L. spp) and perennial grasses, 2) sagebrush and Gambel Oak (*Quercus gambelii* Nutt.) communities, riparian habitats and 3) wet meadow plant communities. In many locations, Utah juniper (*Juniperus osteosperma* Torr.) and pinyon pine (*Pinus edulis* Engelm.) have expanded into critical sagebrush habitats or have infilled over time resulting in the shift from a Phase I to Phase II woodland community, or Phase II to Phase III closed canopy woodland condition. Pinyon – Juniper (PJ) woodlands in phase II or phase III condition typically have low sagebrush and herbaceous plant species densities, low forage availability, high erosion potential, and degraded nesting and brood rearing habitat structure (Nebo Scientific 2013 report, Pierson et al. 2014). Additionally, the Alton / Sink Valley region has supported human populations for many generations and the associated impacts have been expansive. Along with the development of city infrastructure and associated impacts, much of the land surrounding Alton has been converted from rangelands into irrigated crops (e.g. alfalfa) or pasture.

Currently, there are no known leks reported in the North Private Lease Area. Greater sage-grouse have been observed historically within the broader Alton/Sink Valley area, using habitats within the North Private Lease site. During 2006-2010, birds were observed in this region typically within the alfalfa fields, wetland areas, and pasturelands in closer proximity to the North Private Lease tract. Since 2010, bird observations within the North Private Lease area have been substantially lower compared to the higher habitat use recorded prior to this time period. This change in habitat use is likely attributed to habitat improvement projects completed by BLM and private entities in the Sink Valley area (Personal Communication with Frey 2015).

A focus of this management plan is to establish goals and priorities for habitat improvement that promote sustained sage-grouse populations. Since ~~improvements~~ mining will be completed ~~in three phases~~over several years (Figure 2), ~~reclamation of post-mining lands and associated habitat recovery~~habitat mitigation, at the required ratio will occur prior to the next years planned disturbance.~~while subsequent phases are underway~~. The Governor's Conservation Plan for Greater Sage-grouse in Utah (Conservation Plan) and recent comments provided by the Governor's Office and UDWR, have been used to develop the sage-grouse conservation strategies set forth in this document. ACD in consultation with UDWR will conduct a further survey of the North Lease Area to more precisely delineate habitat, non-habitat and

opportunity areas as provided at Section 3.5.2.2 of the Conservation Plan. Once this survey is complete, a formal mitigation agreement may be established between UDWR, UDOGM, and ACD. This agreement may be used to ensure that functional mitigation actions have been clearly identified and that funds have been fully committed for annual implementation. Funds used for mitigation projects and habitat improvement can be channeled through the Watershed Restoration Initiative (WRI) to allow WRI partners an opportunity to review and comment on proposed treatments.

Sage-grouse Population Monitoring

Historic and Current Lek use in Alton/Sink Valley

Greater sage-grouse are long-term residents of the Sink Valley and Alton areas of Kane County, Utah. Birds exhibit breeding and nesting activity in Sink Valley, and winter habitat use in the Sink Valley and the surrounding Alton area. Population densities have fluctuated widely based on data reported by wildlife biologists from UDWR. Since 1991, data suggest that there has been an oscillation in male lek attendance over the past 20 years which would indicate variable sage-grouse presence and habitat use within this area (Figure 3). In contrast to lek use patterns in Sink Valley, there are no known leks reported in the North Private Lease area. Similar to lekking patterns recorded for the Sink Valley region, lek counts have also been recorded for Hoyts Ranch located approximately 15 miles north of the North Private Lease region (Figure 4).

Since mining began in 2010, the sage-grouse population within the region (particularly Sink Valley) has remained relatively constant and stable. Male lek attendance has fluctuated over time, however recent numbers are similar to counts recorded prior to mining (13-15 males; Figure 3). Sage-grouse surveys have also reported a relatively consistent bird population density since mining as compared to pre-mining densities. During fall 2015, 43 sage-grouse were counted near the mine in September and 41 in October. These are counts comparable to pre-mining sage-grouse survey numbers. Most sage-grouse are regularly observed in the sagebrush field south of the active Coal Hollow mine site and the wet meadow, sagebrush grassland area east of the mine (ACD Annual Report 2012, 2013, 2014).

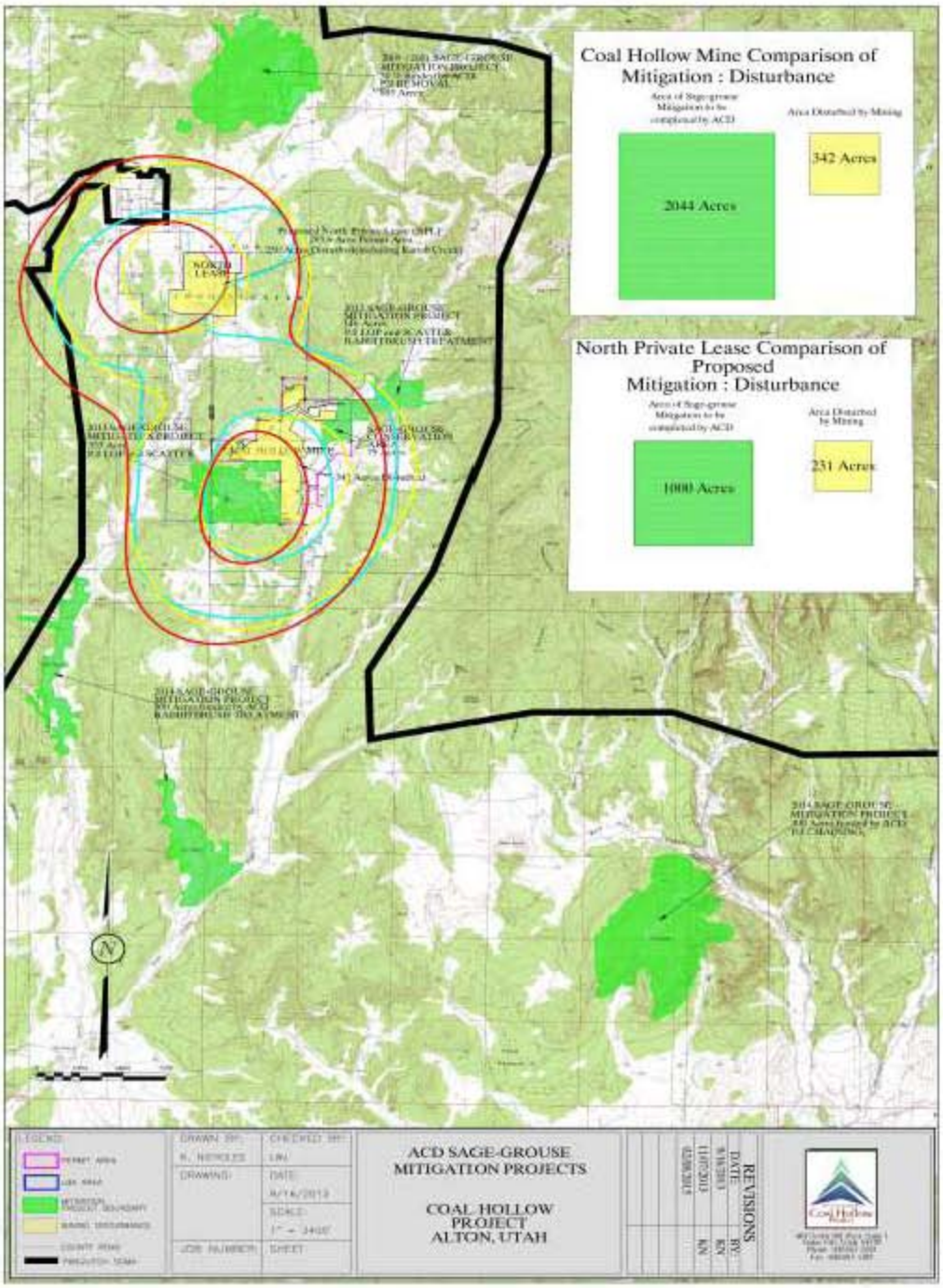

Figure 1. Location of the North Private Lease area, occurring east of Alton, Utah. The rings represent locations of past greater sage-grouse habitat use, data provided by Dr. Nicki Frey of Utah State University.

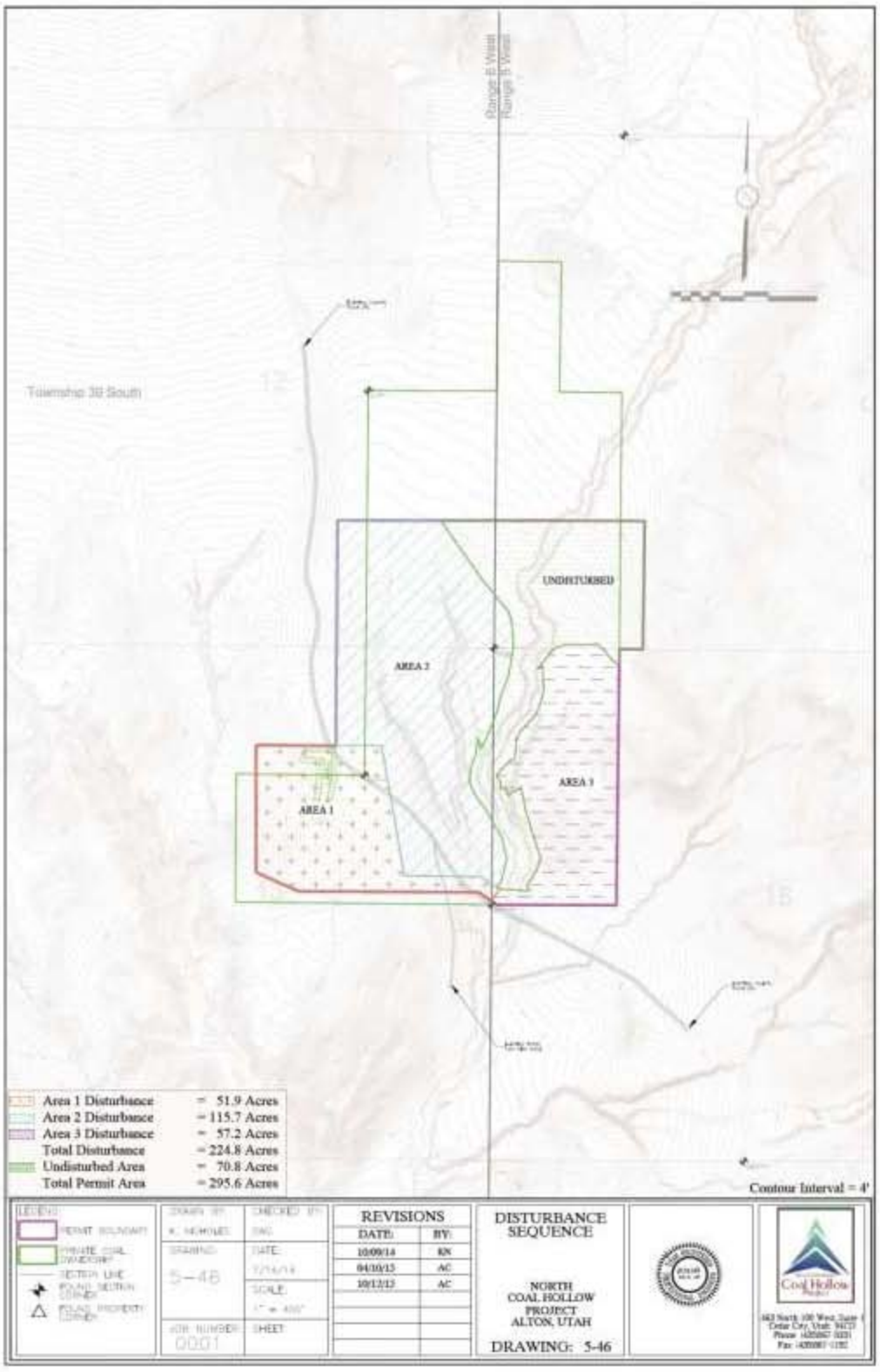

Figure 2. Sequence of mining in the North Private Lease project. Habitat improvement will be based on the completion of each phase, emphasizing habitat improvement for greater sage-grouse and other important wildlife and plant species.

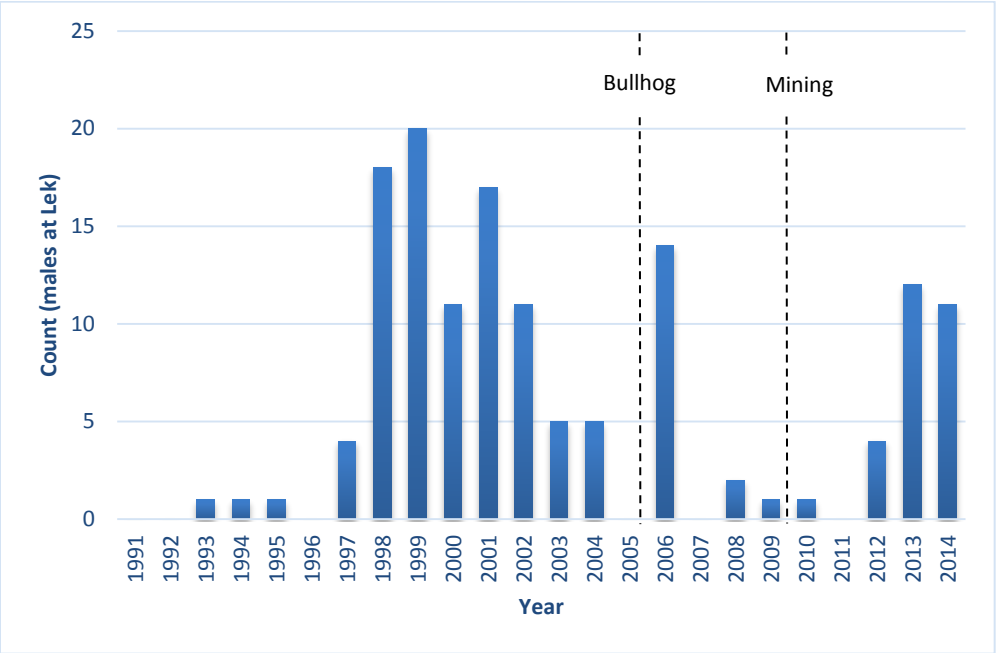

Figure 3. Male bird attendance at the Sink Valley lek, located south of Alton, Utah. Observations were made by Utah DWR employees observing during the spring breeding months (February – April). The 2005 and 2007 data are missing for this graph. Birds recorded from 2012-14 were located on a new lek, located south of the mining operations in Sink Valley.

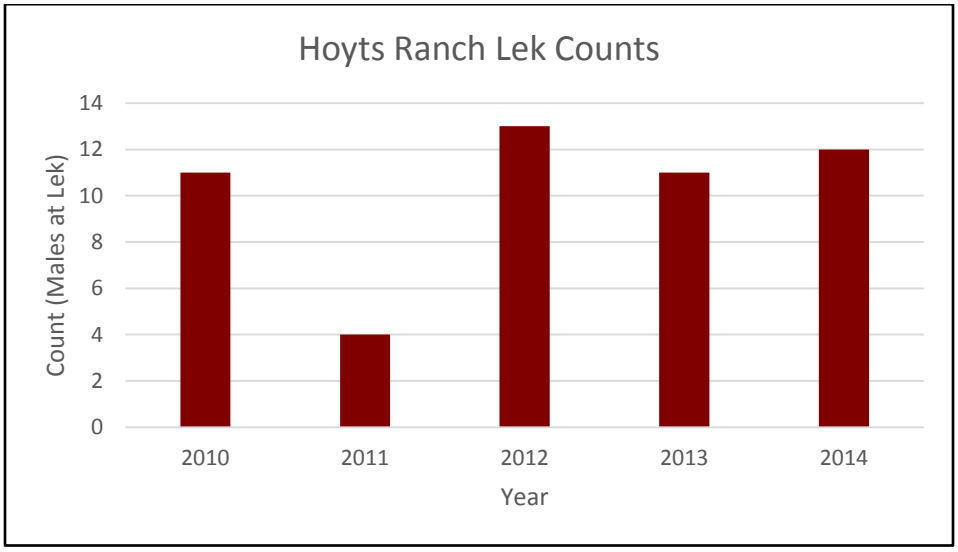

Figure 4. Male bird attendance at the Hoyts Ranch lek, north of Alton. Observations recorded expanded from 2010 to 2014.

Employee Observations and Sage-grouse Population Monitoring

ACD employees have been trained to accurately identify sage-grouse and report any sighting and the location of that sighting whenever observed. These observations are reported directly to Kirk Nicholes (ACD Environmental Manager) who logs each sighting, records the coordinate location of each sighting, and manages this information for use in population monitoring and trend analysis.

Monthly Bird Surveys

During the non-breeding time period, sage-grouse are monitored within the Alton/Sink Valley region monthly using surveys within the primary habitat areas. These surveys consist of walking within each sage-grouse area using visual (sweeping) observation patterns to detect birds, in particular counting flushed birds. Dogs will not be used to locate birds. Each time a bird or group of birds are observed, a coordinate location is collected at the site where they were last observed as well as the time of day the birds were flushed.

GPS Collaring and Monitoring

Dr. Nicki Frey has recorded sage-grouse locations since 2007 using VHF and more recently GPS technology. Over time, birds have been trapped and collared to track movement patterns throughout the region. Since the time that birds have been collared, these data have provided valuable coordinate locations that can be used to determine bird movement patterns and habitat use throughout the year.

Noise Detection and Sound Assessment

The influence of sound (noise pollution) on sage-grouse will be assessed by measuring sound (decibel) at specific areas around the North Private Lease area. Decibels will be recorded at each location where birds are flushed (see *Monthly Bird Surveys* above). Sound levels will be recorded using an Extech 407735 Sound Level Meter or similar sound level recording device.

Habitat Mitigation, Conservation, Protection, and Restoration

The North Private Lease mining operation will result in 230.8 acres of disturbance. A small portion of the 200 ft. buffer of undisturbed habitat located along Kanab Creek will be temporally impacted by mining activities on either side of the creek. Subsequently, approximately 20 acres will be added to the total amount of disturbed area. With approximately 250 acres of planned disturbance and using an offsite mitigation treatment ratio of 4 acres of land treated to every 1 acre disturbed (4:1 mitigation ratio), 1,000 acres will be improved as habitat mitigation. This same approach to mitigation will be implemented each year based on the number of acres planned to be disturbed for each year. The location and type of mitigation project will be determined from input and recommendations provided by

ACD, UDOGM, UDWR, CCARM, and BLM which may be formalized in a mitigation agreement between the parties.

To ensure that useable habitat is available during and after mining, habitat improvement treatments will keep pace ahead of the annual mining disturbance. This work will emphasize the need to restore ~~pre-mining conditions~~nesting/brood rearing habitat throughout the area, particularly riparian areas, wet meadows, and irrigated pasture land where potential for birds use is highest. It should be noted that the majority of sage-grouse are consistently observed near the current Coal Hollow Mine in the sagebrush field south of the mine and wet meadow areas east of the mine (based on GPS and VHF data collected by Dr. Nicki Frey and monthly sage-grouse surveys).

In addition to enhanced sagebrush, grassland, wet meadow and riparian habitats, pinyon and juniper trees will be removed to not exceed 5% canopy cover and existing sagebrush areas will be maintained at a minimum of 10% canopy cover and not over 30% cover. Forb and grass cover will also be maintained at 10% cover seasonally, during nesting and brood rearing periods in the Alton/Sink Valley area. Forbs and the rich diversity of insects that depend on these plants both provide an important food source for young chicks and hens. Where appropriate, green strips may also be created to protect sensitive habitats from fire.

In 2014, ACD made an Incidental Boundary Change (IBC) that added an additional 85.88 acres New Dame Lease with the anticipation of utilizing the newly acquired high-wall miner to remove coal. Coal removal from this location would have occurred (subsurface) within the original Coal Hollow Mine boundary, subsequently, no additional surface disturbance was required or scheduled to occur. Nonetheless, ACD was required to complete the 344 acres of sage-grouse mitigation prior the end of the year (2014) to meet requirements for the New Dame Lease. All 344 acres were completed, but no coal was removed and the land surface within the New Dame Lease remains unaltered. ACD will credit these completed mitigation acres to the proposed North Private Lease. Planned disturbance for the first year of mining is approximately 50 acres, therefore the 344 acres of completed migration will far exceed the needed acreage based on the 4:1 requirement for the first year of mining.

The purpose of habitat mitigation is to improve or replace vegetation structure that can enhance habitat for sage-grouse and other desired plant and animal species. Reclamation efforts will include seeding plant species mixes that include native shrubs and herbaceous species important for sage-grouse (nesting, foraging). These treatments will also improve habitat and forage heterogeneity and availability that benefit other wildlife such as local deer and elk populations. With pinyon-juniper woodland reduction, resources (e.g. water, soil

nutrients, light) are released that can be used to increase total grass, forb and shrub cover and production (Frey et al. 2013, Roundy et al. 2014). Mitigation treatments should focus on restoring critical habitat such as sagebrush, grass, and forb growth and persistence, as well as an increase in mesic habitats (e.g. riparian areas, wet meadows). These areas will be monitored to evaluate birds use patterns and to make sure all treatment in new areas are keeping pace ahead of mining disturbances.

To assess whether mitigation sites are being successfully used by wildlife, in particular sage-grouse ~~and migratory birds~~, treatment areas will be monitored regularly to identify 1) if the proper treatment prescription was used and 2) if sage-grouse are utilizing these areas successfully, particularly for brood rearing. Over the past 8 years, no nesting or early brood rearing activity has been observed in the North Private Lease area. However, all sites will be monitored annually to determine if birds are using this area for these purposes. If nesting or brood rearing behaviors are detected, disturbance in those areas will be minimized and alternate habitat will be enhanced (wet meadows and riparian areas for food and shelter). If nesting or brood rearing activities are detected within the area, ACD will consult with UDWR regarding recommended guidelines for mining activities (sound <10 db over ambient levels, distance to bird habitat use). ACD and ~~UDWQ~~ UDWR will monitor bird activities ~~will be monitored~~ to detect bird response and minimize impacts.

Vegetation Improvements and Monitoring

Improving habitat for sage-grouse is an important objective to land managers for maintaining or increasing sage-grouse populations. Boyd et al. (2011) provide several examples of effective land management practices that have resulted in greater habitat use by sage-grouse. Dahlgren et al. (2006a, 2006b) found that habitat treatment in the Parker Mountains of south-central Utah resulted in higher sage-grouse densities. They mechanically treated sagebrush using a Dixie harrow or herbicide applications of tebuthiron to reduce decadent or high density sagebrush stands as recommended in the sagebrush guidelines (Connelly et al. 2000). By managing sagebrush to create target vegetation densities and increasing plant community diversity (mosaic patterns), sage-grouse habitat is improved.

Vegetation improvements will be completed in areas recommended by ACD, state and federal consulting entities (NRCS, DWR, DOGM, BLM, and FWS) and CCARM. ACD will also provide maintenance toward already treated areas by removing young trees, and lopping and scattering limbs and debris from previous PJ harvests. Sagebrush canopy cover will be managed to create habitat structure suitable for sage-grouse nesting and brood rearing using local cover levels and Connelly et al. (2000) guidelines.

Sites that will be monitored will be based on recommendations and discussions with state and federal consulting entities (NRCS, DWR, DOGM, BLM, and FWS) and CCARM. The data collected will be consistent from previous years, consisting of species composition, percent cover, density, and bird use (noted by feathers, tracks, fecal piles, or bird sightings).

Predator Control Activities

Sage-grouse predators will continue to be removed from the Alton / Sink Valley area using the same procedures as utilized at the Coal Hollow Mine during previous years. Wildlife Services provides raven and mesopredator control throughout this area to increase nest and brood rearing success. Predator control activities will continue for this region as long as the mine is operational.

The types of predators that will be removed are common ravens (*Corvus corax*), American crows (*Corvus brachyrhynchos*), coyotes (*Canis latrans*), and red fox (*Vulpes vulpes*). All predator control activities are conducted by USDA Wildlife Services. Ravens are considered one of the greatest threat to sage-grouse eggs, chicks and adults in the Alton/Sink Valley area. Ravens have been found to increase with a higher availability of resources found near towns (i.e. Alton and its stockyards) and subsequently have a higher impact on sage-grouse populations (Bui et al. 2010). Additionally, Bui et al. (2010) found that resident ravens that exhibit high territorial behavior have a greater impact on nest success than birds only flying though an area. Resident birds in the Alton/Sink Valley are common and are predicted to have a high impact on bird populations.

Small mammalian mesopredators can also have a distinct negative impact on sage-grouse. Little evidence has been provided on the impact of coyotes on sage-grouse, however fox, badger, raccoon, and skunk have been shown to significantly impact nest and brood-rearing success (Mezquida et al. 2006). The removal of coyotes should be carefully monitored to ensure that lagomorph populations do not increase throughout the area. The lack of coyote predation on lagomorphs can result in higher densities that will potentially attract golden eagles (*Aquila chrysaetos*) into the valley. Golden eagles have been considered to be the most significant predator of adult sage-grouse (Mezquida et al. 2006), and have been observed taking adult sage-grouse in the Alton/Sink Valley area (Personal Communication with Frey 2010).

In a study conducted in Pinedale, Wyoming, 51% of monitored sage-grouse nest sites failed, of which 83% were lost to predation by mesopredators. 47% of all broods failed, all attributed to predation (Bui et al. 2010). Fragmentation or reduced density of sagebrush habitats can also increase exposure of nests and young birds to predators, increasing impacts of predators on sage-grouse survival (Lyon and Anderson 2003).

To control ravens, wildlife services specialist Theresa Wright will distribute poisoned eggs through the North Lease area. With a 4:1 egg to kill ratio, more eggs will need to be placed than the number of birds that will be removed. To control mammalian mesopredators, Roger Nauer will set a trap line along the fence near the alfalfa fields south of Alton. In 2014, approximately 20 snares were set along the fence, placed at locations where holes had been dug under the fence by mesopredators. A total of 19 coyotes were killed during the year.

Chicks raised by hens in the valley have been observed at the Coal Hollow Mine near the well. While not monitored from the time since hatched, chicks are found with hens throughout the brood-rearing period. With consistent chick counts, it is likely that chick mortality is low. This is likely due to the reduction in predators in the Alton/Sink Valley area.

Participation and Involvement with Local Working Groups

ACD will maintain a collaborative partnership with UDWR, CCARM, USU Extension, Southern Utah University, the Heaton family, and other organizations and individuals focused on sage-grouse conservation efforts. ACD will contribute $8,000 toward monitoring that is in addition to the regular monthly surveys conducted by the ACD sage-grouse specialist and the ACD employee sighting reports generated whenever birds are observed. The additional monitoring funds can be used to purchase GPS or VHF collars, coordinate aerial surveys with UDWR, or any other recommended monitoring service. ACD will also continue to provide support for trapping and collaring birds upon request as long as the mine is operational.

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We appreciate the contribution of many people who invested time and resources for this project including Kirk Nicholes (ACD), Larry Johnson (ACD), Kevin Heaton (USU Extension), Joe Helfrich (UDOGM), Dustin Schaible (UDWR), Rhett Boswell (UDWR), Teresa Wright (USDA WS), Nicki Frey (SUU/USU Extension), and the entire Color-Country Adaptive Resource Management group. The combined effort of these individuals has resulted in successful sage-grouse conservation and habitat improvement for the Alton / Sink Valley greater sage-grouse population.

Range 6 West
Range 5 West

12

7

P Seed Mixture
Treatments* A, B, C

P Seed Mixture
Treatments* A, B, C

P Seed Mixture
Treatments* A, B, C

Seed P-J Mixture
Treatments* A, B, C

P Seed Mixture
Treatments* A, B, C

13

18

N

0 500 1000 1500

Disturbance
Year 1 = 92.8 acres
Year 2 = 90.8 acres
Year 3 = 47.2 acres
Total Disturbed = 230.8 acres

P: Pasture
(see Table 3-38)

P-J: Pinyon-Juniper
(see Table 3-39)

29

W: Wetlands
(see Table 3-43)

*Reclamation Treatments:
(see Section 341.220)

A. Seedbed Analysis
B. Ripped, disked, harrowed (if compacted)
C. Mulch (0.75T/Ac; 1.0T/Ac on slopes 3:1 or greater)

24

19

Township 39 South

LEGEND:
- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- SECTION LINE
- FOUND SECTION CORNER
- FOUND PROPERTY CORNER

DRAWN BY:	CHECKED BY:
K. NICHOLES	B. LONG
DRAWING: 3–11	DATE: 8/8/14
	SCALE: 1" = 500'
JOB NUMBER: 0001	SHEET

REVISIONS

DATE:	BY:
09/08/14	KN

RECLAMATION TREATMENTS, MONITORING & SAMPLE LOCATIONS

NORTH
COAL HOLLOW
PROJECT
ALTON, UTAH

DRAWING: 3-11

UTAH REGISTERED #154168 DAN W. GUY PROFESSIONAL ENGINEER

Alton Coal Development
Coal Hollow Project

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Phone (435)867-5331
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CHAPTER 4

R645-301-400. LAND USE

410. REGIONAL LAND USE

Land use and agricultural production in the Coal Hollow Project region centers around livestock production. Rangeland use for cattle grazing is the predominant land use in the ~~Region~~area, but~~.~~ the land is also used as watershed, recreational hunting, and wildlife habitat.

The majority of the land in the current Coal Hollow Mine area is classified as unimproved rangeland. Some farming is done within the surrounding lands but crop choice and production levels are severely restricted by climate, soil, and water availability ~~conditions~~. Alton and Sink Valley incur frequent early spring frost conditions as a result of cold air drainage into these low-lying valleys. These conditions and the resultant short growing season restrict crop choice to the more hardy wheat and small grain crops and alfalfa hay. ~~This land is also used as watershed, recreational hunting, and wildlife habitat.~~

The North Private Lease area, located less than a mile from the current Coal Hollow Mine permit, consists mostly of rangelands that have been converted to pasture lands. Although there are differences in the vegetation between pastures due to management practices, seed mixtures planted and soils, the pasture lands are primarily dominated by grass species. Additionally, in the North Private Lease there is also a fair amount of land that has been converted to croplands, most of which lie outside the area to be mined. Although crops can vary from year-to-year due to rotation practices, the most common crops raised are alfalfa, wheat and silage crops. Like the current mine area, there are other areas that support native, relatively undisturbed, plant communities (or undeveloped rangelands). These areas consist of pinyon-juniper, sagebrush and mountain brush communities -- including transitional zones between these types. Finally, there are also drainage channels that dissect the North Private Lease area. Some of these channels support riparian and wetland communities along with native upland plant communities adjacent to them.
~~Within the permit boundaries, all lands and mineral resources are owned privately. These lands are mainly used for grazing, and native wildlife habitat.~~

411. ENVIRONMENTAL DESCRIPTION

The Coal Hollow Project~~permit~~ area ~~is~~ lies within elevations 6,840 feet and 7,000 feet above sea level. It ~~incorporated~~ incorporates valley floors and hills, and is cradled between the Dixie National Forest. Climate is largely determined by local topography and the location of the area relative to the principal sources of moisture, the Pacific Ocean and the Gulf of Mexico. The existence of barriers between southern Utah and these moisture sources produces the dry temperature climate for which this area is renowned. A weather

station was constructed in the summer of 2005 to monitor~~,~~ monthly~~,~~ precipitation, t~~T~~emperature, ~~W~~wind direction and speed~~, and~~; it is shown in Photographs 4-1 and 4-2.

Winter season Pacific storms reaching the Utah area must first cross the Sierra Nevada and Cascade Ranges to the west. Lifting of the air masses during storm passage~~s~~ over these barriers result in the majority of the moisture in the air condensing and falling out as precipitation. Thus, air mass reaching southern Utah from the west is generally dry and the associated precipitation is light. A similar barrier to moisture from the Gulf of Mexico can be found in the Rocky Mountains east of southeast Utah. During the summer, moist air masses do move into the southern part of Utah from the Gulf of California. Precipitation usually falls as thundershowers associated with these air masses. Precipitation for the area generally averages 16 inches per year. Temperature varies from a mean maximum temperature of 92 degrees Fahrenheit during the summer months to a mean minimum temperature of 18 degrees during the winter months. Maximum snow depths average about 12" but usually melt fairly rapidly.

The predominant wind direction of south-central Utah ranges from southwest through west, with secondary peaks from the southeast and northwest. Surface winds near the permit area average about eight miles per hour. Higher wind speeds are usually associated with the passage of frontal systems or thunderstorms, generally during the springtime.

411.100 Premining Land Use Information

The premining use of the land within the permit boundaries is grazing~~,~~ and wildlife habitat.

Rangeland use for cattle grazing is the predominant land use in the Alton ~~Coal~~ area. Together with lands too steep or unproductive for cattle grazing, these two land types~~s~~ account for 90% of land ~~commitments~~uses.

The land within the permit area consists of managed and unmanaged expanses of rolling to steep p~~P~~in~~iy~~on-j~~J~~uniper~~, landscapes,~~ sagebrush~~, and~~ mountain brush, meadows, wetlands, riparian zones and pasture lands. Some horse and cattle grazing occurs within the pasture land, but is limited due to the short growing season.

Agricultural crop production is sustained on some land east of the current permit area. 85% to 90% of this crop is not harvested, but is used for cattle grazing. ~~–~~Crop-lands located north of the permit area and south of the town of Alton (i.e. the North Private Lease) are devoted to hay, wheat and silage production for on-ranch winter cattle feed. Exhibit 4-1 and 4-2 reflect~~s~~ land use within and around the permit areas. Photographs 4-3 and 4-4 show actual layout of ~~Crop~~ cropland and g~~G~~razing land.

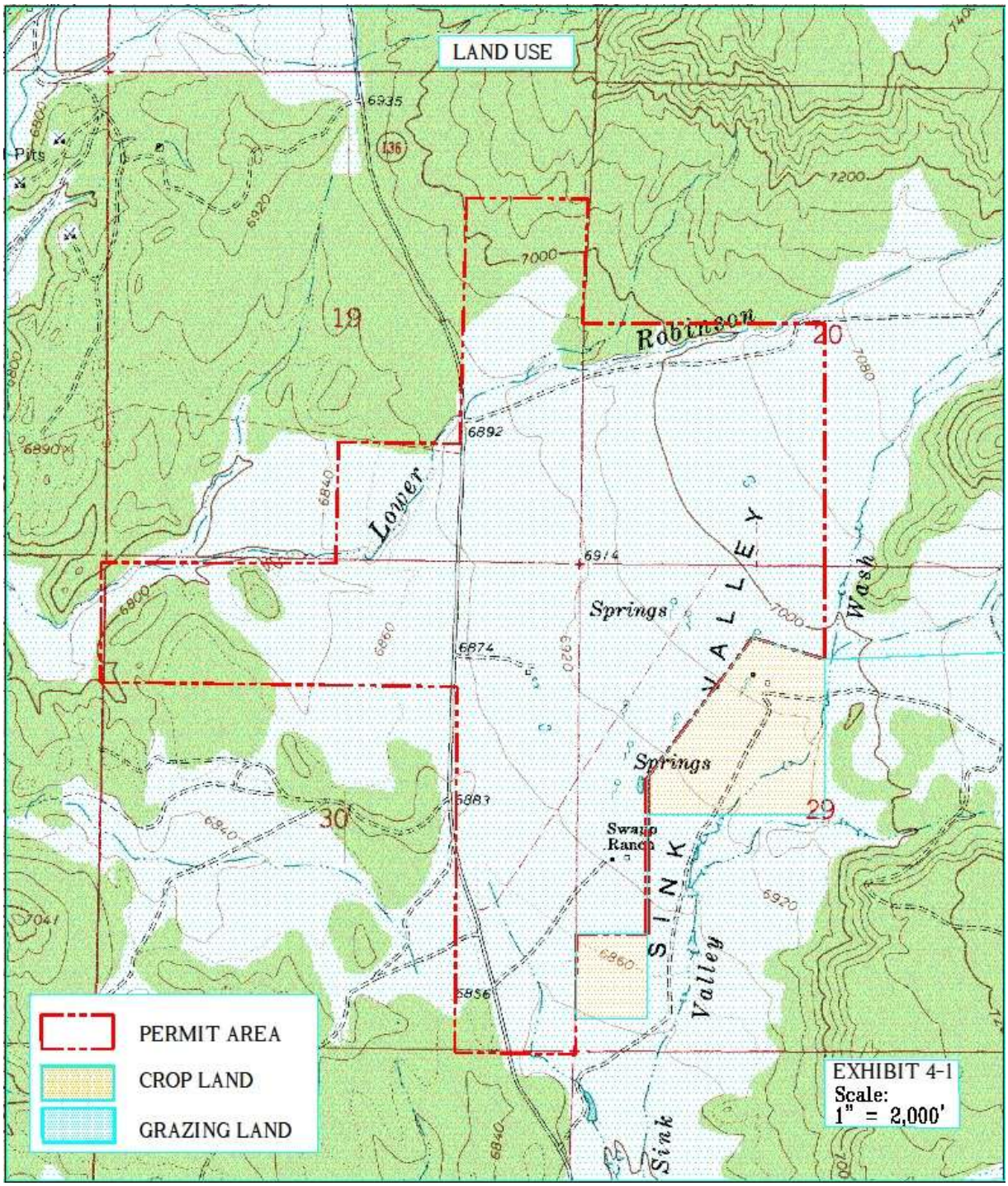
Wildlife habitats within the current mine area are reflected on Drawings 3-2 *through* 3-5. ~~Black Bear, Rocky Mountain Elk, Mule Deer, and Greater Sage Grouse are some wildlife that uses the lands within the Permit area.~~Wildlife habitats for the North Private Lease area are shown on Wildlife Maps 1 *through* 4 in VOLUME 12 (Supplemental Report:

Vegetation & Wildlife Habitat of the North Private Lease Area). Black bear, Rocky Mountain elk, mule deer, and greater sage-grouse are some of the wildlife species that use the lands within the permit area. Land use maps of the current Coal Hollow Mine area and North Private Lease have been provided below.

After reclamation, the mining area will be restored to support uses it was capable of supporting prior to mining. Vegetation will be restored to provide habitat and a food source for wildlife. Access roads, fence lines, and supporting structures will be reconstructed pursuant to the wishes of the surface landowners.

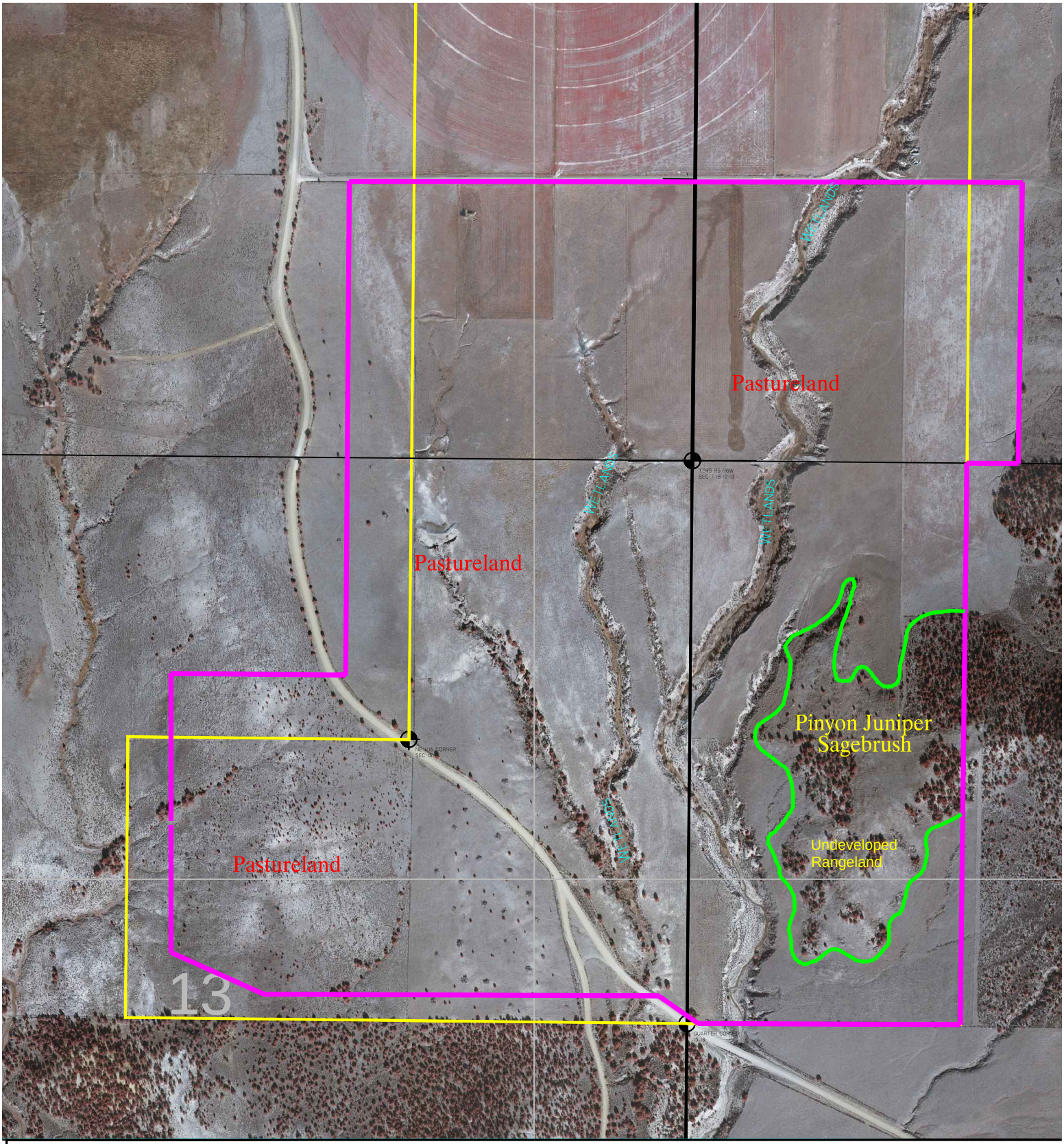
~~Utility corridors and other Right-of-ways~~

~~Kane County maintains a county road, County Road 136, which runs north-south through the western part of the permit area. This is reflected on Drawing 1-1. Alton Coal Development, under the direction and in corporation with Kane County, plans to temporarily relocate county road 136, east while mining operations commence to the west. This is reflected on Drawing 5-1. After mining is completed below the now existing road bed, the county road will be moved back to its original, permanent location and constructed as required by Kane County Road Department.~~



Acreage of crop land under production:

Sorensen: 90 acres (approximate)
Johnson: None currently
Dame: None currently
Pugh: None currently



LEGEND:
- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- SECTION LINE
- FOUND SECTION CORNER
- FOUND PROPERTY CORNER

DRAWN BY:	CHECKED BY:
K. NICHOLES	DWG
DRAWING: EXHIBIT 4–2	DATE: 4/10/15
	SCALE: 1" = 600'
JOB NUMBER: 0001	SHEET

REVISIONS	
DATE:	BY:
XX/XX/XX	XX

LAND USE MAP - VEGETATION TYPES

NORTH COAL HOLLOW PROJECT ALTON, UTAH

EXHIBIT 4-2

Alton Coal Development
Coal Hollow Project
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Utility Corridors and Other Right-of-Ways

Kane County maintains a county road, County Road 136, which runs north-south through the western part of the permit areas. This is reflected on Drawing 1-1. Alton Coal Development, under the direction and in corporation with Kane County, plans to temporarily relocate County Road 136 east while mining operations commence to the west. This is reflected on Drawing 5-1 and 5-45. After mining is completed below the now existing road bed, the county road will be moved to its original location and constructed as required by Kane County Road Department.

411.110 Surface Land Status/Mine Plan Area

Ownership of the surface rights within and contiguous to the mine plan and permit area is shown on Drawing 1-3. The surface within the permit area is privately owned and leased by Alton Coal Development, LLC. The contiguous lands, outside the permit area, are administered by Bureau of Land Management, along with other private owners, as reflected on Drawing 1-3.

Alton Coal Development believes that the mining of the permit area will enhance the post-mining use of the land. Some gullies and rills will be eliminated. Drainages will be enhanced allowing a better use of land. Wildlife habitat will benefit from the planting and reclamation of lands for that purpose. Reclamation will be constructed to the final landform shown on Drawings 5-35 and 5-36 for the current mine area. Reclamation will be constructed to the final landform shown on Drawing 5-74 and 5-75 for the North Private Lease. The alternative highwall mining will reduce surface disturbance. Mining disturbance to the surface will be reduced along with reclamation needs. Surface areas that will not be affected by any mining will remain in the existing pre-mining state.

411.120 Land Capability

The Coal Hollow Project ~~Area~~ area has several land uses ranging from wildlife habitat to pasture land. ~~Current vegetative~~ Vegetative cover and productivity of the plant communities in the current ~~permit~~mine area are shown in Chapter 3 (sections 321.100 *through* 321.200). Vegetative cover and productivity estimates for the North Private Lease are shown in Tables 1 *through* 43 of VOLUME 12 (Supplemental Report: *Vegetation & Wildlife Habitat of the North Private Lease Area*). Soil resources information of the permit area is provided in Chapter 2 (sections 222.100 *through* 222.400). Soils information for the North Private Lease can be found in VOLUME 11 (Supplemental Report: *Order 2 Soil Survey for the Proposed North Private Lease Expansion of the Coal Hollow Mine*). Topography of the area is described in several chapters, but specifically in Chapter 6. Current hydrologic conditions of the permit and adjacent areas to the project are provided in Chapter 7.

411.130 Existing Land Uses/Land Use Classifications

Kane County has zoned the area within the permit boundaries and surrounding area as Agriculture.

411.140 Cultural and Historic Resource Information

CURRENT COAL HOLLOW MINE AREA

The current Coal Hollow Mine Area has seen a number of cultural resource inventories and associated projects over the years that have been completed for coal mining and related exploration activities. The first inventory was completed in 1977 by K.K. Pelli under state project number U77-KA-0258b. The project covered a portion of the current Coal Hollow Mine area with no cultural sites reported (Pierson & Pierson 1977).

Table 4-1. Cultural resource projects completed within the current Coal Hollow Mine area

Project Name	Project Number	Author & Year
Cultural Resource Management Investigations in Kane and Carbon Counties for Proposed Coal Leasing on Federal Lands	U77-KA-0258b	Pierson & Pierson 1977
An Archaeological Survey of Proposed Drill Holes, Access Roads and a Sample Test Pit in the Alton Coal Field	U79-NI-0406b	Dosh 1979
An Archaeological Survey and Evaluation of 7325 Acres in the Alton Leasehold, Kane County, Utah	U81-NI-0254b	Halbirt & Gualtieri 1981
Archaeological Survey of 23 Proposed Drill Holes and Access Roads in the Alton Coal Field, Kane County, Utah	U85-NI-0587b	Keller 1985
Archaeological Investigations, Utah International, San Francisco Alton Coal Field Project, Bureau of Land Management Land, Cedar City District, and Private Land, Kane County, Utah	U86-NI-0297b,p	Weaver 1986a
An Archaeological Survey of Auger Borings and Backhoe Test Pits for Utah International, Inc., Alton Coal Field, Kane County, Utah	U87-NI-0856b	Weaver & Hurley 1987
Cultural Resource Inventory of the Coal Hollow Project Coal Seam Drill Sites in the Alton Amphitheater, Kane County, Utah.	U05-MQ-0346b,p	Thornton & Montgomery 2005
Cultural Resource Inventory of Alton Coal Development's Sink Valley-Alton Amphitheater Project Area, Kane County, Utah.	U05-MQ-1567	Stavish 2006
Cultural Resource Inventory of Alton Coal Development's Project Area, Kane County, Utah	U05-MQ-1568b,p	Stavish 2007a
Data Recovery and Research Design for Sites 42KA2068, 42KA6104, 42KA6105, 42KA6106, 42KA6107, and 42KA6108, Kane County, Utah	N/A	Stavish 2007b
Cultural Resource Inventory of Alton Coal Development's Additional Survey of 440 Acres in the Alton Coal Amphitheater, Kane County, Utah	U08-MQ-0539	Stavish 2008a
Data Recovery Plan and Research Design for Site 42KA2044, Kane County, Utah	N/A	Stavish 2008b
Archaeological Data Recovery at Sites 42KA2042, 42KA2044, 42KA2068, 42KA6104, 42KA6105, 42KA6106, 42KA6107, and 42KA6108, Kane County, Utah	U10-MQ-0504(e)	Stavish 2010
Alton Coal Development's Phase I Cultural Resources Treatment Plan for Data Recovery at 42KA6093 and 42KA6505, and Avoidance at 42KA1313, 42KA2041, 42KA2043, 42KA6109, 42KA6110, and 42KA6126, Kane County, Utah	N/A	Clark & Creer 2010
Alton Coal Development's Coal Hollow Mine Project Phase I: Data Recovery Report for 42KA2060 and 42KA6093, Kane County, Utah	U10-ST-0886p(e)	Clark 2011
Treatment Plan for the Portion of 42KA2041 Located on the Coal Hollow Mine	N/A	Cannon & Fenner 2013
Preliminary Report on the Phase I Testing of a Portion of Site	N/A	Gourley 2013

42KA2041, Kane County, Utah		

In 1979 MNA completed an inventory of 31 exploratory drill holes, 19 access corridors, and a test pit location within the Alton Coal Field under state project number U79-NI-0406. Two of these exploratory sites were located within the current Coal Hollow Mine project area. No cultural sites were reported for those locations (Dosh 1979).

In 1979-1980, MNA completed a survey covering all of the current Coal Hollow Mine project area under state project number U81-NI-0254b. Results of the inventory included documentation of five eligible prehistoric sites (42KA2041-42KA2044 & 42KA2060) and one eligible prehistoric/historic site (42KA2068) within the project area with one additional eligible prehistoric/historic site (42KA2058) recorded immediately adjacent to the mine (Halbirt & Gualtieri 1981).

In 1985, MNA completed a survey of 23 exploratory drill holes and associated access corridors within the Alton Coal Field under state project number U85-NI-0587b. One of these drill holes was within the current Coal Hollow Mine project area. No cultural sites were reported for that location (Keller 1985).

MNA completed another inventory in 1986 for 43 exploratory drill holes and associated access corridors as part of the Alton Coal Project under state project number U86-NI-0297. Six of these exploratory sites were within the current Coal Hollow Mine project area. No cultural sites were reported for those locations (Weaver 1986).

The following year, in 1987, MNA completed another inventory of 22 exploratory auger bores and 27 backhoe test pits within the Alton Coal Field under state project number U87-NI-0856b. Two of these exploratory sites were within the current Coal Hollow Mine project area. No cultural sites were reported for those locations (Weaver & Hurley 1987).

In June and July of 2005, Montgomery Archaeological Consultants, Inc. (MOAC) conducted a~~A~~ cultural resource inventory ~~was conducted by Montgomery Archaeological Consultants Inc. (MOAC) in June 2005~~ for Alton Coal Development, LLC~~. The project area is located in the Sink Valley area in the Alton Amphitheater. This survey~~ that ~~covers~~ covered ~~the entire~~most of the permit area~~,~~ totaling approximately 433 ~~acres, all of which are on~~acres of private property under state project number U05-MQ-1567p. The additional 85.88 acres of surface, Dame Property (plot 9-5-29-2), added as part of this permit will not be impacted by operations and will not be affected by mining (~~.~~ See Drawing 1-3). This inventory resulted in the identification and documentation of seven new eligible prehistoric sites (42KA6104-42KA6109 & 42KA6126) within the current Coal Hollow Mine area, and updating the recording on~~one previously recorded historic/prehistoric site,~~ five eligible previously recorded prehistoric sites (42KA1313, 42KA2041-42KA2044 & 42KA2068)~~, and nine new prehistoric sites~~. One additional new eligible prehistoric site (42KA6110) was documented immediately adjacent to the mine (Stavish 2006).

In August 2005, exploration activities resumed with an inventory of six drill sites within the current Coal Hollow Mine project area by MOAC under state project number U05-MQ-0346b,p. No cultural sites were reported for those locations (Thornton & Montgomery 2005).

Later that same year, MOAC completed yet another inventory in 2005 that covered a portion of the current Coal Hollow Mine project area under state project number U05-MQ-1568b,p. One eligible previously recorded historic/prehistoric site (42KA2058) was present just beyond the mine project area and an updated recording was completed (Stavish 2007a).

In 2008, MOAC completed an inventory that covered a portion of the current Coal Hollow Mine project area under state project number U08-MQ-0539. One eligible previously recorded prehistoric site (42KA2060/42KA6505) was present within the mine project area and an updated recording was completed (Stavish 2008a).

Mitigation of adverse effects has been carried out on 11 of the sites within the current Coal Hollow Mine project area through development of several archaeological treatment plans. ~~Five eligible sites will be affected by mining operations. These five locations will require a data recovery treatment plan.~~The first eight sites (42KA2042, 42KA2044, 42KA2068 & 42KA6104-42KA6108) were mitigated in 2010 under two separate treatment plans developed by MOAC (Stavish 2007b & Stavish 2008b) and reported on in 2010 (Stavish 2010). This was followed by mitigation work on two sites (42KA2060 & 42KA6093) in 2010 under a treatment plan developed by SWCA (Clark & Creer 2010) and reported on in 2011 (Clark 2011). Finally, one additional site (42KA2041) had limited mitigation work carried out on it in 2013 under a treatment plan prepared by SWCA in 2013 (Cannon & Fenner 2013). A preliminary letter report for this site has been produced (Gourley 2013) and a final report is forthcoming. An additional six eligible cultural sites within the current Coal Hollow Mine area and two immediately adjacent to the mine have been avoided. Should mining designs change and adverse effects be necessitated, then development of an appropriate treatment plan will be completed. All new surface disturbances within the mine area have also been monitored per guidelines set forth in the Cultural Resource Management Plan developed by MOAC (Stavish 2008) and the Cultural Resource Discovery Plan developed by SWCA (Bollong & Johnson 2010).

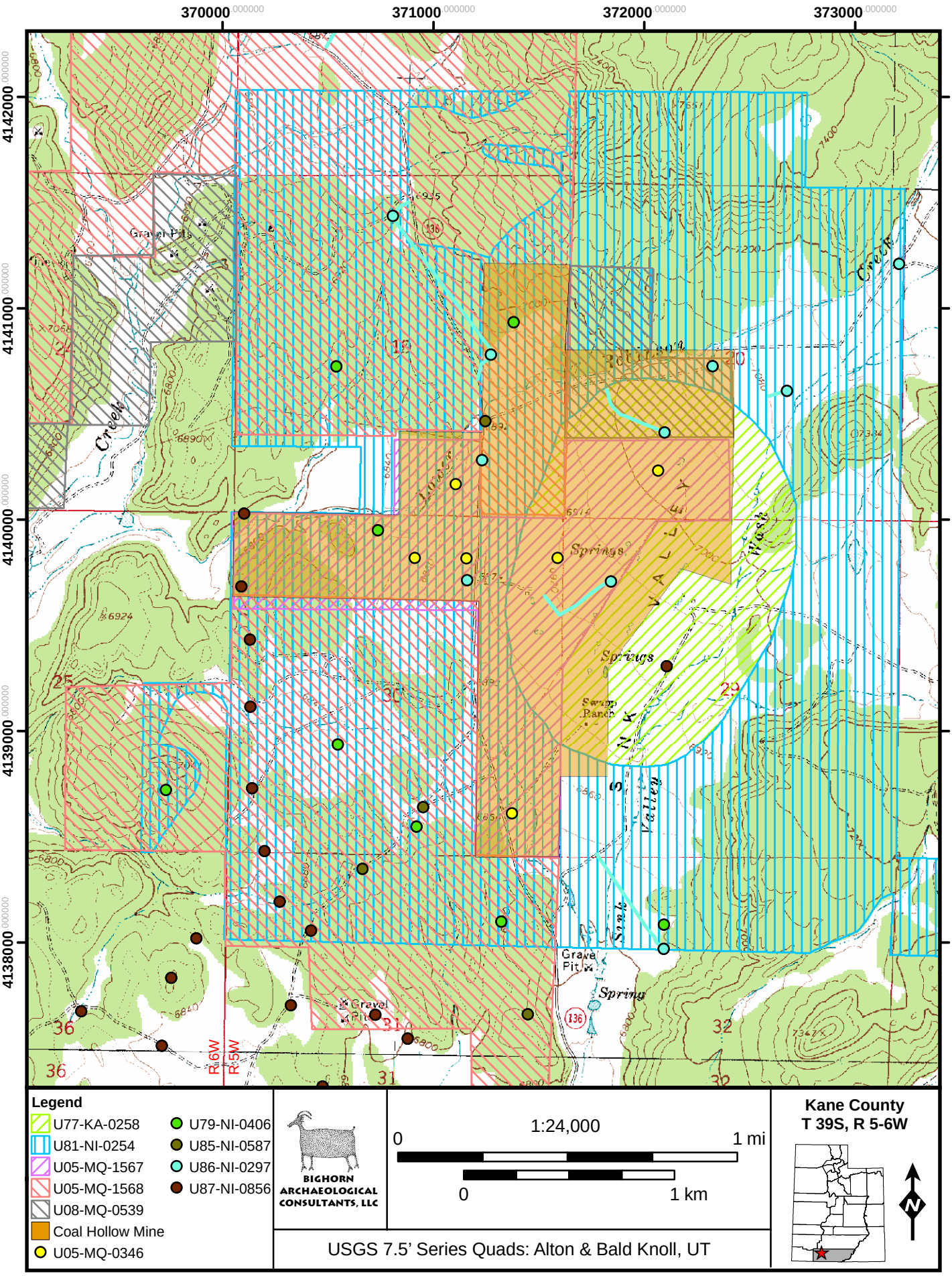

Exhibit 4-3. Cultural inventories complted within the Coal Hollow Mine area

NORTH PRIVATE LEASE AREA

Six cultural resource inventories have been conducted within the North Private Lease area. The first such project was completed in 1985 by MNA for 23 exploratory drill holes and associated access routes within the Alton Coal Field under state project number U85-NI-0587b. One of these drill holes was within the North Private Lease area. No cultural sites were reported for that location (Keller 1985).

Table 4-2. Cultural resource projects completed within the North Private Lease area

Project Name	Project Number	Author & Year
Archaeological Survey of 23 Proposed Drill Holes and Access Roads in the Alton Coal Field, Kane County, Utah	U85-NI-0587b	Keller 1985
Archaeological Investigations, Utah International, San Francisco Alton Coal Field Project, Bureau of Land Management Land, Cedar City District, and Private Land, Kane County, Utah	U86-NI-0297b,p	Weaver 1986
Alton Coal Project Survey	U86-NI-0487b,s	Keller 1987
Survey and Monitoring, Nine Backhoe Test Pits	U86-NI-0864b	Weaver 1986
Cultural Resource Inventory of Alton Coal Development's Project Area, Kane County, Utah.	U05-MQ-1568b,p	Stavish 2007
A Cultural Resource Inventory of the Alton Town Bypass Route, Kane County, Utah	U11-HO-0623p	Gourley 2011

The following year, in 1986, MNA completed another inventory for 43 exploratory drill holes and associated access corridors as part of the Alton Coal Project under state project number U86-NI-0297. One of these exploratory sites was within the North Private Lease area. No cultural sites were reported for this location (Weaver 1986).

Later that same year, in 1986, MNA completed an inventory that covered most of the North Private Lease area as part of the Alton Coal Project Survey under state project number U86-NI-0487b,s. One eligible prehistoric site (42KA3077) and one eligible prehistoric/historic site (42KA3097) were documented within the North Private Lease area (Keller 1987).

An inventory and monitoring of nine backhoe test pits was also completed by MNA in 1986 under state project number U86-NI-0864b. One of these test pits was within the North Private Lease area. No cultural sites were reported for that location (Weaver 1986).

In June and July of 2005, a~~A~~ cultural resource inventory was conducted by MOAC ~~in June and July of 2005~~under state project number ~~(Repor~~t U-05-1568-b,p that covered both~~) for~~ private and BLM lands. The survey covered ~~the private lands within~~all of the North Private Lease and ~~the~~ adjacent LBA. Updated documentation was completed for one eligible previously recorded prehistoric site (42KA3077) and for one eligible prehistoric/historic site (42KA3097). One new eligible prehistoric site (42KA6080) was also recorded along the southern edge of lease area within what was originally an expanded boundary for site 42KA3077 (Stavish 2007). Appendix 4-1, Cultural Resource Inventory of Alton Coal Developments Sink Valley-Alton Amphitheater Project Area, Kane County, Utah, reflects maps, photographs, and results of the inventory.

In August 2011, one final inventory was completed by Bighorn Archaeological Consultants, LLC as part of the proposed Alton bypass road under state project number U11-HO-0623p. This survey covered a small portion of the North Private Lease area. Site 42KA3097 was present within the corridor but no updated site recording was required.

~~The inventory resulted in the documentation of two prehistoric sites. Both sites are~~Based on these previous inventories, planned mining operations within the North Private Lease area will result in an adverse effect to two eligible cultural sites, 42KA3077 and 42KA3097. One additional site, 42KA6080 is present along the southern edge of the lease area and can be avoided. ~~and will be affected by mining operations~~. ~~The~~A draft data recovery treatment plan discussing testing and avoidance/monitoring methods has been prepared for these ~~two~~ three sites (Gourley 2015) and has been included in Appendix 4-~~1~~7. In this plan it is proposed to complete testing and possibly data recovery excavations on the two sites to be adversely effected by the mining operations (42KA3077 and 42KA3097). The third site (42KA6080) that is to be avoided will include avoidance barricading and monitoring to ensure no adverse effect.

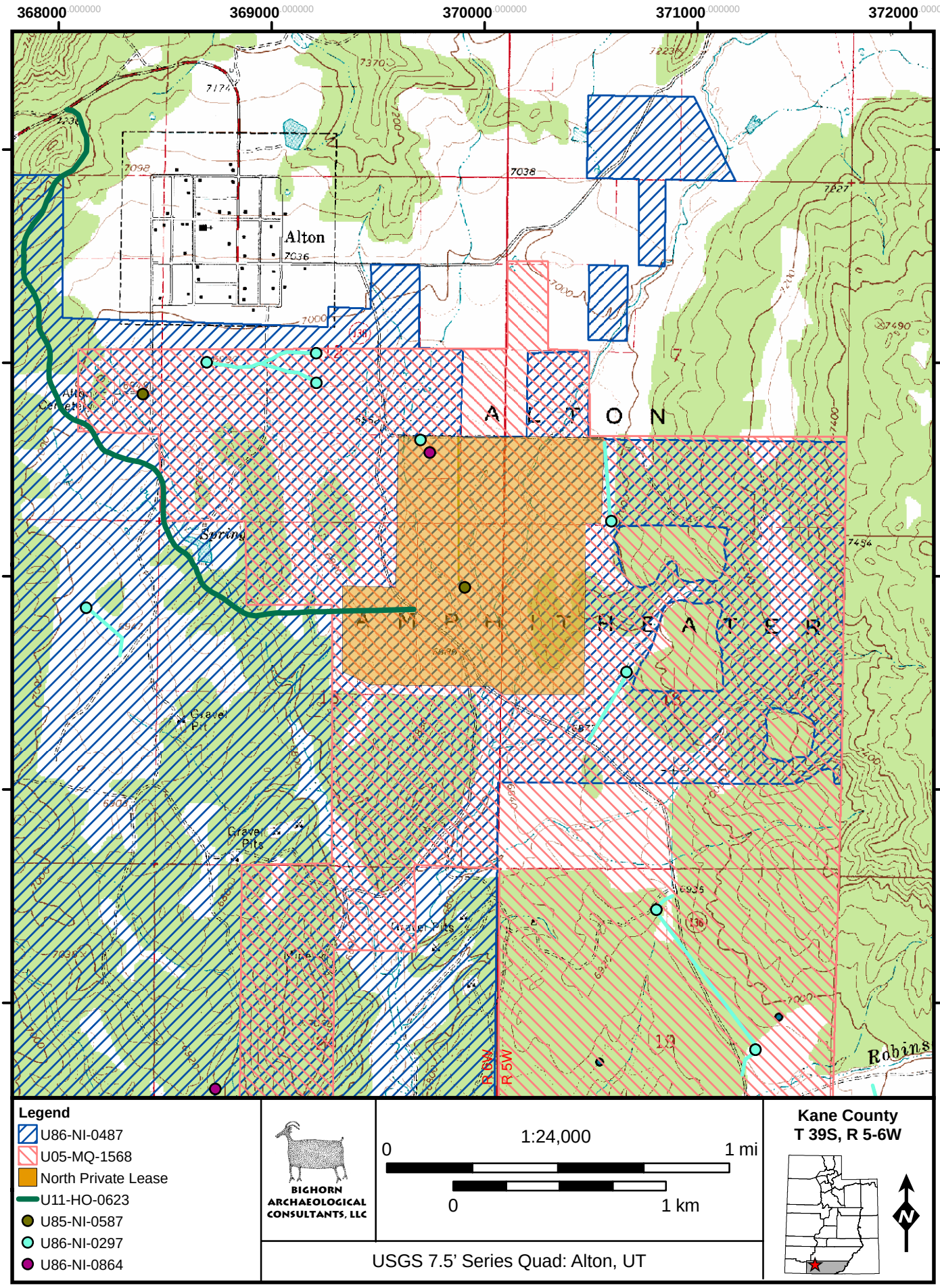

Exhibit 4-4. Cultural inventories completed within the North Private Lease area

~~Appendix 4-1, Cultural Rresource Iinventory of Alton Coal Developments Sink Valley-Alton Amphitheater Project Area, Kane County, Utah, reflects maps, photographs, and results of the inventory.~~

Procedures for ground disturbing ~~activity~~ operations form surface and underground mining activities as described in section 521 and 523 and shown on drawing's 5-10 and 5-53 will follow the "Cultural Resources Discovery Plan for the Alton Coal LLC, Coal Hollow Project in Kane County found in Appendix 4-8.

411.141 Cultural and Historic Resources Maps

Cultural and Historic Resource Maps are included in Appendix 4-1 for the Current Coal Hollow Project and Appendix 4-7 for the North Private Lease expansion.

411.141.1 Boundaries of Public Parks

There are no public parks in the permit area. There are known archeological sites as reflected in the Montgomery survey, Appendix 4-1.

411.141.2 Cemeteries Located within 100 feet

No cemeteries exist within the permit area or within 100 feet of the permit area or within any adjacent area subject to potential impacts.

411.141.3 Trails, Wild and Scenic Rivers System

No trails or wild and scenic rivers or study area rivers exist within the permit area or areas of potential impact.

411.142 Coordination with the State Historic Preservation Officer

Coordination with the State Historic Preservation Officer (SHPO) will take place prior to any mining. Clearances will be obtained through SHPO by means of Phase Testing, a data recovery treatment plan, or other appropriate mitigation processes.

CURRENT COAL HOLLOW MINE AREA

DOGM issued a Notice to Proceed with mining activities on a portion of site 42KA2041 on 4 September 2013. This was provided after completion of formal consultation with PLPCO and SHPO who provided concurrence on such action following Tier I data recovery on the site earlier that year.

NORTH PRIVATE LEASE AREA

DOGM initiated eligibility and effects consultation with SHPO in a letter dated 23 July 2015. On 28 July 2015, SHPO provided their concurrence with DOGM's determination of adverse effects to sites 42KA3077 and 42KA3097 in conjunction with proposed mining activities within the boundaries of the North Private Lease area.

411.142.1 Adverse Impacts on Publicly Owned Parks or Places Listed on the National Register of Historic Places ~~publicly owned parks or places listed on the National Register of Historic Places.~~

The Permit area is not within any publicly owned parks ~~or~~ and there are no places listed on the National Register of Historic Places within either the current Coal Hollow Mine area or the North Private Lease area, however there are a number of eligible cultural sites within each area that are discussed below.

CURRENT COAL HOLLOW MINE AREA

Mitigation of adverse effects has been carried out on 11 of the sites within the current Coal Hollow Mine project area through development of several archaeological treatment plans. Eight sites (42KA2042, 42KA2044, 42KA2068 & 42KA6104-42KA6108) were mitigated in 2010 under two separate treatment plans developed by MOAC (Stavish 2007b & Stavish 2008b) and reported on in 2010 (Stavish 2010). This was followed by mitigation work on two sites (42KA2060 & 42KA6093) in 2010 under a treatment plan developed by SWCA (Clark & Creer 2010) and reported on in 2011 (Clark 2011). Finally, one additional site (42KA2041) had limited mitigation work carried out on it in 2013 under a treatment plan prepared by SWCA in 2013 (Cannon & Fenner 2013). A preliminary letter report for this site has been produced (Gourley 2013) and a final report is forthcoming. An additional six eligible cultural sites within the current Coal Hollow Mine area and two immediately adjacent to the mine have been avoided. Should mining designs change and adverse effects be necessitated, then development of an appropriate treatment plan will be completed. All new surface disturbances within the mine area have also been monitored by a qualified archaeologist per guidelines set forth in the Cultural Resource Management Plan developed by MOAC (Stavish 2008) and the Cultural Resource Discovery Plan developed by SWCA (Bollong & Johnson 2010).

NORTH PRIVATE LEASE AREA

Utilization of the North Private Lease area will result in an adverse effect on two eligible cultural sites (42KA3077 & 42KA3097). The adverse nature of these effects will be lessened to the maximum extent possible through archeological testing and data recovery. A third historic property (42KA6080) lies immediately adjacent to the proposed project area and will require barricading and monitoring to avoid impacts during construction related activities. A draft monitoring and treatment plan addressing these effects and mitigation of such effects has been produced. Work outlined in the plan generally includes excavation of a series of 1 x 1 m test pits and possibly mechanical trenches to determine if subsurface deposits and cultural features or use surfaces exist, followed by excavation of features, use surfaces and other cultural remains to address research issues (Gourley 2015).

411.142.2 Valid Existing Rights / Joint Agency Approval

The Permit area is ~~not within any publicly owned parks or places listed on the National Register of Historic Places~~located on privately owned lands; however one eligible cultural site along the southern edge of the North Private Lease area is located on lands administered by the BLM. This site, 42KA6080, is proposed to be avoided and monitored by a qualified archaeologist during project related activities to ensure no adverse effect (Gourley 2015). No additional coordination with the BLM will be required.

411.143 Mining on Historical Resources

CURRENT COAL HOLLOW MINE AREA

~~Alton Coal Development determines there will be no significant effects of mining on historical resources. Alton Coal Development proposes there will be no impacts on mining on human values, cultural or historical.~~

Inventories of the Current Coal Hollow Mine area have identified 19 eligible cultural resource sites within and immediately adjacent to the project area. Eleven of these sites have seen mitigation efforts to offset adverse effects through development of a number of archaeological treatment plans. The remaining eight sites have been avoided by project activities and monitored to ensure no adverse effect.

NORTH PRIVATE LEASE AREA

Inventories of the North Private Lease area have resulted in the identification of three eligible cultural sites within and immediately adjacent to the proposed project area. Proposed mining activities will result in an adverse effect to two of these sites while the third site can be avoided. A draft treatment plan has been developed to offset these adverse effects (Gourley 2015). Monitoring of the third site is also proposed to insure no adverse effect.

411.143.1 Collection of Additional Information

Alton Coal Development will continue to conduct additional field investigations and mitigation of adverse effects within the current Coal Hollow Mine area ~~when determined needed~~if mining plans should change and necessitate such actions. Archaeological monitoring will continue within this area per the guidelines set forth in the Cultural Resource Management Plan (Stavish 2008) and the Cultural Resource Discovery Plan (Bollong & Johnson 2010). A map showing the survey area already investigated for archeological importance is included in Appendix 4-1.

Alton Coal Development will also complete additional inventory, treatment of adverse effects, and archaeological monitoring of eligible cultural resource sites identified within the North Private Lease area as determined appropriate through consultation with DOGM and SHPO. A draft treatment and monitoring plan for this area has been produced (Gourley 2015) and is attached in Appendix 4-7 along with a

~~A~~ map showing the survey area already investigated for archeological importance ~~is included in Appendix 4-1~~. Archaeological monitoring will be completed within this area as well per the guidelines set forth in the Cultural Resource Management Plan (Stavish 2008) and the Cultural Resource Discovery Plan (Bollong & Johnson 2010).

411.144

Alton Coal Development will continue to follow the process for the development and implementation of appropriate treatment and mitigation plans to address adverse effects within the current Coal Hollow Mine area, should mining plans require such work. Archaeological monitoring will continue within this area per the guidelines set forth in the Cultural Resource Management Plan (Stavish 2008) and the Cultural Resource Discovery Plan (Bollong & Johnson 2010).

A draft treatment plan addressing mitigation efforts for proposed adverse effects to cultural sites within the North Private Lease area has been completed and is attached within Appendix 4-7. Once the plan is approved, Alton Coal Development will implement the mitigation measures to offset the proposed adverse effects to sites 42KA3077 and 42KA3097, as well as avoidance and monitoring measures for site 42KA6080 to ensure no adverse effect.

411.200 Previous Mining

There has been no mining within the permit area.

412 **RECLAMATION PLAN**

412. Reclamation & Land Use

412.100. Postmining Land Use Plan

A description of the proposed land use following reclamation of the mined areas has been provided in this section of the MRP. The discussion includes the utility and capacity of the reclaimed land and the relationship of the proposed uses to existing land use policies and plans, as well as the desires of the current landowners.

412.110. Postmining land use will be achieved by following the detailed reclamation plan included in the MRP. The reclamation plan includes descriptions for structure removal, excess spoil and mine waste disposal, backfilling, compacting, and regrading (Chapter 5); soil handling and stabilization (Chapter 2); revegetation techniques (Chapter 3); measures to control sediments during mining and reclamation activities (Chapter 7).

412.120. Grazing Management Plans

Consultations have been conducted with all surface landowners of the permit area to provide comments in the plan and attain their expectations for the desired postmining land use. According to the landowners, grazing and wildlife habitat would be the desired postmining land use, with emphasis on grazing by domestic livestock in most of the pasture land areas (these areas are shown on Vegetation Map, Drawing 3-l of the MRP and on Vegetation Map 1 in VOLUME 12 (Supplemental Report: *Vegetation & Wildlife Habitat of the North Private Lease Area).* An exception to this plan is that one area in the current mine site that is ~~currently~~ now pasture land will be reseeded appropriately to provide additional habitat for ~~sage~~ sage-grouse, a sensitive species in the area. More about this plan is provided below.

~~The two landowners of the permit area are: Richard Dame and Burton Pugh (see Land Ownership Map,~~A land ownership map of the current Coal Hollow Mine and North Private Lease areas has been provided in the MRP (Drawing 1-3). Descriptions of current management practices as well as future grazing plans for the postmining land use have been provided below.

Property Management Plans ~~for Richard Dame Property~~

A surface ownership map for the current Coal Hollow Mine area as well as the North Private Lease has been provided in the MRP (Drawing 1-3). Management plans for each property owner is provided below.

CURRENT COAL HOLLOW MINE AREA

Richard Dame Property: The portion of land in the permit area owned by Mr. Richard Dame currently provides forage for domestic livestock and some wildlife species. This land is comprised mostly of unirrigated pasture land but also supports some native stands of pinyon--juniper and sagebrush communities (see Vegetation Map 3-l).

Mr. Dame has expressed the desire to return his property to pasture land that focuses on domestic livestock, but also ~~included~~ wants some plant species for wildlife habitat to be seeded. In doing so, the revegetation -seed mix is composed primarily of native and introduced grasses and forbs, with no woody species to be planted (for the seed mixture -refer to Chapter 3, Table 3-~~19~~38).

The livestock currently sustained on Mr. Dame's property are mostly cattle, with some horses. The animals are kept in the pastures from April through November of each year. A management plan to support this same postmining land use has been designed so that the property will adequately support the animals desired by the landowner and will not be over-grazed.

The management plan suggests that 1.125 animals/month/acre could reasonably be sustained on the property. This figure was derived from the *Average Animal Weight Method* (Pratt and Rasmussen) and is based on raising 1 cow weighing 1,000 lbs and her calf on pastures that have an annual biomass productivity of 1,800 lbs/acre. It conservatively estimates that one-half of the production will be consumed ("take half, leave half rationale"). Therefore, the total number of animals allowed on the property in the postmining land use management plan can be calculated by multiplying the estimated number of animals/month/acre by the number of pasture land acres available by the number of months the animals are maintained on a given pasture.

A copy of ~~this~~these management plans signed by the landowners along with their comments are provided in Appendix 4-3 and 4-4 of this chapter of the MRP.

~~Management Plan for Burton Pugh Property~~

Burton Pugh Property: The land in the permit area owned by Mr. Pugh also provides forage for domestic livestock and wildlife habitat. This land is comprised of unirrigated pasture land, meadows, sagebrush/grass, pinyon--juniper, and oak-brush communities (see Vegetation Map 3-l). The livestock currently sustained on Mr. ~~Pughes~~ Pugh's pasture land property are mostly cattle, but sometimes horses are also kept on the property. The animals are supported in the pastures from April through November of the year. A management plan to support a similar postmining land use has been designed so that the property will not be over-grazed, yet support the animals desired by the landowner.

Following mining and reclamation activities, Mr. Pugh has expressed the desire for his land to be returned to its current or better condition for livestock and wildlife habitat. In accomplishing this, the pasture lands will be revegetated to focus on domestic livestock, but the seed mixtures will also include some plant species used by the resident wildlife species. Because it has been postulated that encroachment -of juniper trees into the valley in recent years has had a negative effect on the local sage--grouse populations, the revegetation plan for these areas will also focus on other plant species, or species that could have a positive effect on the birds as well as provide good forage for domestic livestock. The revegetation seed mixes for the Pugh property are shown in Chapter 3 and includ~~inge~~: the sagebrush/grass (Table 3-~~1~~37), meadows (Table 3-~~18~~40), pasture lands (Table 3-~~19~~38), oakbrush (Table 3-~~21~~41), and pinyon-juniper communities (Table 3-~~23~~39).

The management plan for Mr. Pugh suggests that 1.125 animals/month/acre could reasonably be sustained on the property. This figure was derived from the *Average Animal Weight Method* (Pratt and Rasmussen 2001) and is based on raising 1 cow weighing 1,000 lbs and her calf on pastures that have an annual biomass productivity of 1,800 lbs/acre. It conservatively estimates that one-half of the production will be consumed ("take half, leave half rationale"). Therefore, the total number of animals allowed on the property in the postmining land use management plan can be calculated by multiplying the estimated number of animals/monthly acre by the number of pasture land acres available by the number of months the animals are maintained on a given pasture.

There is, however, one area within Mr. ~~Pughes'~~ Pugh's property that currently supports pasture land, but once it is reclaimed, it will be seeded to a mixture that would be conducive to sage--grouse enhancement. This field can easily be located on Drawing 3-l because it is the only pasture land located west of the county road. This land will be seeded with the sagebrush/grass mixture (Chapter 3, Table 3-~~17~~37).

A copy of ~~this~~ these management plans signed by the landowners along with their comments have been provided in the Appendix 4-3 and 4-4 of this chapter of the MRP.

NORTH PRIVATE LEASE AREA

In the North Private Lease area, current plans have restricted mining to the areas located south of what is called "Farm Road". This east-west road can be easily identified on Vegetation Map 1, VOLUME 12 (Supplemental Report: *Vegetation & Wildlife Habitat of the North Private Lease Area*). It is south of the distinctive center-pivot field. Consequently, more specific land use descriptions and reclamation plans in this section will concentrate more on the areas south of Farm Road.

As mentioned previously, the majority of the area in the North Private Lease, especially those areas south of Farm Road, are comprised of rangelands that have been converted to pasture lands. Based on quantitatively sampling results from the vegetation in both areas, these pasture lands are very similar to those described in the current Coal Hollow Mine area. Consequently, the land use, management and reclamation plans are also very similar. There are, however, incised channels that dissect the North Private Lease. More information about these channels has been provided in the specific parcels of land described below.

Following are descriptions of current management practices for the major landowners as well as future grazing plans for the postmining land uses.

Dean R. Heaton Property: This landowner has 3 parcels south of Farm Road for a total of 45 acres (Drawing 1-3). The lands here are developed rangelands and currently support grass species for domestic livestock grazing. Based on previous studies and information gathered from other landowners with similar pasture lands, a management plan suggests that 1.125 animals/month/acre could reasonably be sustained on the property. As explained before, this figure was derived from the *Average Animal Weight Method* (Pratt and Rasmussen) and is based on raising 1 cow weighing 1,000 lbs and her calf on pastures that have an annual biomass productivity of 1,800 lbs/acre. It conservatively estimates that one-half of the production will be consumed ("take half, leave half rationale"). Therefore, the total number of animals allowed on the property in the postmining land use management plan can be calculated by multiplying the estimated number of animals/month/acre by the number of pasture land acres available by the number of months the animals are maintained on a given pasture.

Unless the landowner specifies a change in the revegetation plans in the future, the pasture will be reclaimed with the existing pasture land species mixture (see Table 3-38).

G. Ferril & Dorothy M. Heaton Property: These landowners have approximately 110 acres of land south of Farm Road. Most of this land is pasture land, but Kanab Creek dissects some of it where its deeply incised channel supports riparian and wetland communities along with adjacent uplands. This stream channel is basically undeveloped rangeland and, other than some grazing pressure and the erosional component so common in the area, the riparian and upland communities are relatively

undisturbed. The uplands in the channel are located on the flood plains and stream terraces bordering the riparian zones. The upland communities are primarily dominated by Wyoming big sagebrush and black sagebrush.

Additionally, there was one relatively small area within this property that supported trees and shrubs. The area consists of native, mostly undisturbed, plant communities (or undeveloped rangelands) that are primarily pinyon-juniper and sagebrush. These communities will have little mine-related disturbance to them. However, if the fringes of this area are disturbed, the landowner may likely prefer re-seeding it to increase and blend in with the adjacent pastures and not be restored to trees and shrub-lands. Therefore, the postmining land use will be that of wildlife habitat and domestic livestock grazing. It will most-likely be seeded with the pasture land seed mixture (Table 3-38), but the pinyon-juniper (Table 3-39) mix may also be utilized.

The incised channels of Kanab Creek will not be disturbed by the proposed mining operations and therefore reclamation will not be needed. The current land uses will be continued in the future. The pasture lands within these properties are similar to those described above with respect to current land use and productivity. They will also be reclaimed with the same species list (see Table 3-38).

Heaton Brothers, LLC Property: The Heaton brothers also own a significant portion of the North Private Lease land south of Farm Road, or approximately 150 acres (Drawing 1-3). Like the properties described above, most of this land are pastures. The pasture lands are very similar to those described above, with the same current land uses, reclamation plans and postmining land uses.

The Heaton brothers property also includes some ephemeral drainage channels. They are located west of Kanab Creek. The ephemeral drainages have also been studied extensively and reported in a document called *Wetland & Ordinary High Watermark Idenfications, Private Lease Area* (VOLUME 10, Supplemental Report) and in another study called *Vegetation & Wildlife Habitat of the North Private Lease Area* (VOLUME 12, Supplemental Report).

The channels support some riparian and wetland communities including riparian wet meadows, mixed riparian scrub/shrubs, as well as narrow bands of sagebrush communities on the adjacent upland terraces. The field studies found that the Private North Lease study area supports 9.44 acres of jurisdictional wetlands, most of which were identified in the Kanab Creek drainage. Kanab Creek and the plant communities supported within it will *not* be disturbed by mining activities. The other channels, however, may be disturbed by mining, some of which support wetland and upland communities. ~~The uplands in the channels that will be disturbed will later be reclaimed and seeded with native plants (see Table 3-37). The wetlands will also been reclaimed and seeded with an appropriate seed mixture (see Table 3-43).~~ The landowner has indicated that the erosional features be eliminated, therefore areas of the channels will be reclaimed and seeded to support pasture land.

Postmining land uses of the Heaton Brothers property will be returned to the current land use – that of grazing in the pastures and wildlife habitat in the drainage channels.

Orval & Greta Palmer Property: There is one relatively small parcel of land, about 10 acres, owned by Orval & Great Palmer. This is a pasture with identical current land uses as described above for other pasture lands. It will also be seeded the same at the time of final reclamation and result in the same postmining land use.

412.130. ~~Post-Mining~~ Postmining Land Use Changes

With the exception of improvement of the current pasture lands, and the area mentioned above that will be seeded with plant species that enhances sage-~~-~~grouse habitat, there will be no changes from the pre-mining land use for the postmining land uses.

412.140. Land Use Considerations

Considerations for postmining land uses have been made by consulting with the surface landowners for the pasture lands as well as the native plant communities that will be impacted by the mining activities. The landowners have special concerns regarding plant species for livestock and others for wildlife. Basically, the pasture lands will be planted with grass and forb species good for livestock and wildlife species, and will not include any woody species. At final reclamation, the natural plant communities disturbed by mining will be seeded with native plants, some of which will have special considerations for habitat improvement for the sensitive bird, greater sage-~~-~~grouse.

Additionally, considerations were made to insure compliance with all state and federal regulations for postmining land use and reclamation. For example, all plant communities that will be impacted by mining will be quantitatively sampled beforehand and compared to similar communities that will not be affected. The unaffected communities will remain undisturbed and will be used as "reference areas", or future standard for revegetation success at the time of final reclamation. Nonetheless, reference areas for the pasture lands will also be established for revegetation success standards.

412.200. Land Owner or Surface Manager Comments

The postmining land use plans that have been signed by the landowners and are included in the appendix of this chapter. Also included is a page for "Comments" by the landowners.

412.300. Suitability and Compatibility

The final fills containing excess spoil will be suitable for reclamation and revegetation and are compatible with the natural surroundings and the approved postmining land uses. The final fill slopes will be regraded to a maximum angle of 3h: 1v (33 percent). The slopes will be revegetated and drainage will be established in a manner similar to the original flow patterns. These slopes will be suitable for grazing and wildlife habitat. The design for this excess spoil and the final landform can be viewed on Drawings 5-35 and 5-36. The construction and reclamation practices for the excess spoil are further explained in Chapter 5.

413 **PERFORMANCE STANDARDS**

413.100. Postmining Land Use

All disturbed areas will be restored in a timely manner to conditions that are capable of supporting the uses that were present before any mining occurred. In some cases improvement of the land will be achieved (see Postmining Land Use Plan above).

413.200. Determining Pre-Mining Uses of Land

The pre-mining uses of land in which the postmining land use is compared have been previously described (see Postmining Land Use Plan above).

413.300. Criteria for Alternative Postmining Land Uses

Other than improvements to the existing land described above, the land will be returned to its pre-mining conditions.

420 AIR QUALITY

421 CLEAN AIR ACT

Coal mining and reclamation operations will be conducted in compliance with the requirements for the Clean Air Act and Any other applicable Utah or Federal statutes and regulations containing air quality standards.

422 UTAH BUREAU OF AIR QUALITY

For the Coal Hollow Mine, Alton Coal Development, LLC ~~has~~ retained JBR Environmental Consultants to prepare a Notice of Intent (NOI) for a new source at the Coal Hollow Project. The original NOI was submitted to the Utah Division of Air Quality (UDAQ) on May 8, 2007. This NOI provided an initial assessment of air emissions for the project based on the MRP prior to being determined Administratively Complete. JBR coordinated preparation of the original NOI with Tom Bradley and Jon Black of the UDAQ. In September 2008, JBR began development of a revised NOI to include air dispersion modeling. This air dispersion modeling was coordinated with Dave Prey of UDAQ. A conference call was conducted with representatives of UDAQ, JBR and Alton Coal on December 8th, 2008 to discuss modeling inputs, background emissions and preliminary modeling results. The revised NOI was submitted on April 20, 2009. UDAQ responded to the NOI on June 23, 2009 by asking for additional information. The Fugitive Dust Control Plan is provided as Appendix 4-5. Alton Coal was issued by the Executive Secretary of the Utah Air Quality Board Approval Order DAQE-

AN0140470002-10 for a new source on November 10, 2010. After consultation with Jon Black, an NOI dated August 22, 2013 was submitted to UDAQ, Alton Coal requested addition of a highwall miner to list of mobile equipment in use at the Coal Hollow Mine. On November 12, 2014 prior to beginning underground operations, Jon Black of the UDAQ was consulted with the proposed underground plans. An NOI was sent to UDEQ on November 17, 2014 listing the additional equipment and increase in pollutants anticipated with the operation of the underground mine. The revised Air Approval Order including the underground was received April 21,2015.

For the North Private Lease, Alton Coal development began coordination preparation of the NOI with Jon Black of UDAQ on June 4, 2015. The North Private Lease will be an amendment to the Coal Hollow Mine Approval Order and will require dispersion modeling. Ramboll Environ ~~will~~has completed the dispersion modeling in coordination with UDAQ. The final NOI and dispersion model was submitted to UDAQ on September 9, 2015 with the model being accepted September 24, 2015 and the engineering review approved September 25, 2015. Public Notice was advertised in the Southern Utah News October 1, 2015.

423.100- 200 **AIR POLLUTION CONTROL PLAN**

Production rates at the Coal Hollow Mine are expected to exceed 1,000,000 tons of coal per year. Appendix 4-5 provides a Fugitive Dust Control Plan (FDCP). This plan includes controls and monitoring measures that will be taken to minimize air pollution related specifically to fugitive dust.

Production rates at the North Private Lease of the Coal Hollow Mine are expected to exceed 1,000,000 tons of coal per year. Appendix 4-6 provides a Fugitive Dust Control Plan (FDCP). This plan includes controls and monitoring measures that will be taken to minimize air pollution related specifically to fugitive dust.

424 **PLAN FOR FUGITIVE DUST CONTROL PRACTICES**

Proposed mining will exceed 1,000,000 tons annually. A Fugitive Dust Control Plan is provided as Appendix 4-5 for the Coal Hollow Mine and in Appendix 4-6 for the North Private Lease.

ALTON COAL DEVELOPMENT, LLC

463 NORTH 100 WEST, SUITE 1
(435) 867-5331

Fugitive Dust Control Plan

For

North Private Lease

Located In:

T39S, R5W, Sections 7 & 18 and R6W, Sections 12 & 13, southeast of Alton in Kane County, UT

for questions regarding this plan contact

Kirk Nicholes

at

(435) 867-5331

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Attachment 1 Responsible Parties for Fugitive Dust Control

Attachment 2 Fugitive Dust Management, Acknowledgement and Certification

I. Introduction

Alton Coal Development, LLC (Alton) intends to excavate and process coal from its North Private Lease Site, located south-southeast of Alton, UT. A Notice of Intent has been filed with the Utah Department of Environmental Quality, Division of Air Quality (UDAQ). Typical operations will include excavation, hauling, and stockpiling the coal. The intent of this Fugitive Dust Control Plan (FDCP) is to outline Alton's plan to control fugitive dust during coal mining operations.

II. Regulatory Applicability

Utah Administrative Code R645-301-423 requires that all surface coal mining and reclamation activities with projected production rates exceeding 1,000,000 tons of coal per year must provide an air pollution control plan. The North Private Lease Mine projects a production rate of 2,000,000 tons of coal a year, therefore this code is applicable to the operation. Although the North Private Lease is not subject to the requirements of UAC R307-309, ***Non-attainment and Maintenance Areas for PM10: Fugitive Emissions and Fugitive Dust***, as it is not in a non-attainment area or maintenance area, the mine is subject to R307-205, ***Emission Standards: Fugitive Emissions and Fugitive Dust.*** The purpose of R307-205 is to establish minimum work practices and emission standards for sources of fugitive emissions and fugitive dust located in all areas of the state, except those listed in the state implementation plan or non-attainment areas (UAC R307-205-1). While R307-205 does not require the implementation of a FDCP, Alton has prepared this FDCP to ensure the requirements of R645-301-423, R645-301-244, R645-301-526.220 and R307-205 are met.

The UAC R307-309-2 defines material as "sand, gravel, soil, minerals, and other matter that may create fugitive dust." For this FDCP, material is used and defined in the same way. The following activities of concern to the UDAQ and UDOGM, will take place:

YES	NO	ACTIVITY
✓	☐	Storage, hauling or handling operations of material
✓	☐	Clearing, leveling and reclamation of land one-quarter acre or greater in size
✓	☐	Earthmoving, excavation, or movement of trucks or construction equipment over cleared land one-quarter acre size or greater
✓	☐	Haul road access and activity
☐	✓	Engaging in demolition activities including razing homes, buildings or other structures

Alton recognizes that in some cases, an approval order or temporary relocation permit will be required for the project, especially in cases of equipment use such as crushers or screens. This document in no way releases Alton from the requirements of air quality permits.

III. Source Information

The section supplies the site specific information regarding the project. Although not required by the UAC, the Utah Division of Air Quality (UDAQ) suggests the FDCP contain the following source specific information. Therefore, the information provided in this section is not to be used for determining compliance with any applicable permits, rather to give an overall understanding of the project for fugitive dust applications only.

SOURCE INFORMATION	
Name of Operation:	**Alton Coal Development, LLC – North Private Lease Mine**
Address or Approximate Location:	**T39S, R95W, Sections 19, 20, 29 and 30, South-southeast of Alton in Kane County, UT**
Approximate Length of Project:	**4 years**
Description of Process or Activity:	**Preparing site for mining operations including installation haul roads and sizing/stockpiling equipment. Conducting coal mining operations including clearing topsoil, overburden removal, excavation of coal, and sizing, sorting and stockpiling coal.**
Type of Material Processed or Disturbed:	**Topsoil and vegetation temporarily removed (will be replaced and re-vegetated).** **Vegetation, topsoil, overburden, coal**
Amount of Material Processed or Disturbed:	**Approximately 159.2 acres of land will be cleared of topsoil and overburden to allow for excavation of coal. Approximately 71.6 acres will be cleared of topsoil to allow placement of haul roads, sediment ponds, spoil placement and subsoil/topsoil stockpiles**

In all cases, the responsible parties for fugitive dust control are the owner and/or operator.

Attachment 1 identifies the owner and operators of this project, and the contact information of the individuals responsible for implementation and maintenance of the FDCP.

In addition, all subcontractors who may be active on the project have will be required to enter into an agreement of shared responsibility regarding fugitive dust control. Attachment 2 provides the form which would identify subcontractors and the duration of subcontractor activity on the project. Also included in Attachment 2 is a signed acknowledgement that would be provided for each subcontracting company. Included in that acknowledgement is: awareness of the FDCP, intent to comply with the FDCP, obligation of reporting to the owner and/or operator any problems with fugitive dust control, and shared responsibility of any fines incurred from subcontractor negligence regarding fugitive dust control.

IV. Fugitive Dust Emission Activities

The section fulfills the requirements set for the UAC R307-309-6(1)(a)-(k), by further addressing the specific project activities generating fugitive dust.

ACTIVITY	YES	NO	ACTIVITY DETAILS
MATERIAL STORAGE	✓	☐	*List the type of material, how many storage piles and area used for storage piles.* **Initially, topsoil will be removed from the facility area and stockpiled. Also topsoil and subsoil from the initial coal pits will be salvaged and stored in the east of the mining area. As mining progresses, topsoil and overburden from one pit will be direct hauled to reclamation areas, when practical. Any topsoil piles that exist for at least 1 year will be stabilized by sloping to a 3:1, reseeding and mulching. Piles that exist for less than 1 year will be coated with a tackifier at the manufacturer's suggested rate for dust control applications.**
MATERIAL HANDLING, TRANSFER, HAULING LOADING, OR DUMPING	✓	☐	*List the type of material that will be handled, transferred, loaded, hauled and/or dumped and the equipment that will be used for these activities.* **Topsoil will be handled with scrapers, loaders, dozers, trucks and/or graders.** **Overburden will be handled with loaders, dozers, excavators and trucks.** **Coal will be handled with loaders, excavators, highwall miner, and trucks,.**
HAUL ROADS, ROADWAYS, OR YARD AREAS	✓	☐	*List vehicles, equipment, and frequency of driving on the haul roads, roadways, or yard areas. List approximate lengths of road or areas these items will take up.* **There will be two sets of roads at the site, coal haul roads and overburden haul roads. The majority of the coal haul roads will be mostly long term and centrally located at the site. The maximum length will be approximately 3600'. 80 to 150 ton haul trucks will be the primary vehicles on these roads.**

			Overburden haul roads will be located near the pits and location and length will be constantly changing as mining progresses. 150 to 250 ton haul trucks will be the primary vehicles on the overburden haul roads. **All haul roads will have marked speed limit of 25 mph and either watering or chemical suppressant dust control.**
CLEARING, LEVELING, AND UNVEGETATED RECLAMATION AREAS	✓	☐	*List the acreage of land being cleared or leveled.* **Approximately 3 acres will be cleared for mining and sizing/stockpiling activities. This area will be reclaimed contemporaneously with mining operations in order to restore the lands post mining land use in an efficient and timely manner.**
EARTH MOVING, EXCAVATION	✓	☐	*List the areas of earthmoving, excavation or trenching.* **The coal pit areas, storage piles, roads, ditches and sediment pond locations.**
CONSTRUCTION, DEMOLITION	☐	✓	*List the structures that will be demolished or constructed and the areas associated with those activities.*
DRILLING, BLASTING, PUSHING OPERATIONS	✓	☐	*List frequency of drilling blasting and pushing operations, (hours per day, days per week, weeks per year).* **Operations will occur up to 24 hr/day, 6 days per week, 52 weeks per year**
MATERIAL PROCESSING**	✓	☐	*Will any material be made or altered during the project? For example, crushing, screening, concrete production? Explain any material processing activities that will take place.* **The sizing and sorting operation involves crushing/breaking, screening, conveying, and stockpiling. Material is extracted at the mine using hydraulic excavators, & highwall miner and delivered to the processing plant by Over-the-Road trucks to the Coal Hollow Mine.**
OTHER	✓	☐	**Reclamation areas that have topsoil applied during a season not suitable for seeding will have tackifier applied for dust control measures. During the**

			appropriate season for seeding, all newly reclaimed areas will then be seeded and mulched.

*Material processing may require an approval order or other air permit. If applicable, the appropriate permits are in Attachment 3.

V. Fugitive Dust Controls

There are various aspects of fugitive dust control that must be addressed

- Road Activity – Fugitive Dust Control
- Activity Specific On-Site Fugitive Dust Control
- Off-Site Fugitive Dust Control

i. Road Activity – Fugitive Dust Control

The following are requirements, specific to road use that must be implemented during all projects, as indicated by the UAC. The UAC specifically identify activities that require prompt mitigation for control of fugitive dust. Due to the nature of Alton's business, these activities will always apply to a project; therefore, these techniques will be implemented for duration the project.

UAC R307-309-7. Storage, Hauling, and Handling of Coal and Overburden.
Any person owing, operating or maintaining a new or existing material storage, handling, or hauling operation shall prevent, to the maximum extent possible, material from being deposited onto any paved road other than a designated deposit site. Any such person who deposits materials that may create fugitive dust on a public or private paved road shall clean the road promptly.

UAC R307-309-7. Construction and Demolition Activities.
Any person engaging in clearing or leveling of land with an area of one-quarter acre or more, earthmoving, excavating, construction, demolition, or moving trucks or construction equipment over cleared land or access haul roads, shall prevent, to the maximum extent possible, material from being deposited onto any paved road other than a designated deposit site. Any such person who deposits materials that may create fugitive dust on a public or private paved road shall clean the road promptly.

UAC R307-309-9. Roads.

(1) Any person responsible for construction or maintenance of any existing road or having right-of-way easement or possessing the right to use the same whose activities results in fugitive dust from the road shall minimize fugitive dust to the maximum extent possible. Any such person who deposits material that may create fugitive dust on a public or private paved road shall clean the road promptly.
(2) Unpaved Roads. Any person responsible for construction or maintenance of any new or existing paved road shall prevent, to the maximum extent possible, the deposit of material from the unpaved road onto any intersecting paved road during construction or maintenance. Any person who deposits material that may create fugitive dust on a public or private paved road shall clean the road promptly.

ii. Activity Specific On-Site Fugitive Dust Control

For each activity that was described in ***IV. Fugitive Dust Emission Activities***, a control strategy or strategies are listed. The strategies are listed in a staged approach, meaning that if the first approach of control, Stage 1, is not satisfactory, then the next approach of control, Stage 2 will be attempted. Stage 3 is the final stage. If Stage 3 is unsuccessful in mitigating fugitive dust, this plan requires ceasing operation to control fugitive dust.

It is the owner/operator's responsibility to ensure that each of these control strategies are implemented and maintained on-site and that all subcontractors are aware of their obligation regarding these control strategies. Additional space has intentionally been included to allow the site supervisor to include any additional control strategies at each stage.

ACTIVITY	CONTROL STRATEGY	
MATERIAL STORAGE	Stage 1:	Either seeding and mulch or tackifier application for topsoil and subsoil. Coal: Inherent moisture with water sprays as needed.
	Stage 2:	Topsoil/Subsoil: Increase rate of tackifier application until fugitive dust is controlled. Coal: Increase use of water sprays until fugitive dust is controlled.
	Stage 3:	Topsoil/Subsoil and Coal: Minimize or reduce operations.
MATERIAL HANDLING, TRANSFER, HAULING LOADING, OR DUMPING	Stage 1:	Inherent moisture with water sprays only on an as-needed basis.
	Stage 2:	Increase use of water sprays until fugitive dust is controlled.
	Stage 3:	Minimize or reduce operations.
HAUL ROADS, ROADWAYS, OR YARD AREAS	Stage 1:	Water sprays only on as-needed basis.
	Stage 2:	Increase use of water sprays until fugitive dust is controlled, apply magnesium chloride or gravel as needed.
	Stage 3:	Minimize or reduce travel on these areas.
CLEARING, LEVELING, AND UNVEGETATED RECLAMATION AREAS	Stage 1:	Inherent moisture with water sprays only on an as-needed basis. Reclamation areas that have been graded and topsoiled will either be seeded and mulched, if during the appropriate planting season, or tackifier will be applied to control fugitive dust and erosion until the proper planting season.
	Stage 2:	Increase use of water sprays until fugitive dust is controlled.
	Stage 3:	Minimize and reduce operations.
EARTH MOVING, EXCAVATION	Stage 1:	Inherent moisture with water sprays only on an as-needed basis.
	Stage 2:	Increase use of water sprays until fugitive dust is

		controlled.
	Stage 3:	Minimize or reduce operations.
CONSTRUCTION, DEMOLITION	Stage 1:	Water sprays only on an as-needed basis.
	Stage 2:	Increase use of water sprays until fugitive dust is controlled.
	Stage 3:	Minimize or reduce operations.
DRILLING, BLASTING, PUSHING OPERATIONS	Stage 1:	Perform activity when low or no wind exists, when practicable.
	Stage 2:	Use water sprays on the area where activity will occur.
	Stage 3:	Minimize or reduce operations.
MATERIAL PROCESSING** (includes crushing and screening type operations)	Stage 1:	Inherent moisture with water sprays only on an as-needed basis.
	Stage 2:	Increase use of water sprays until fugitive dust is controlled.
	Stage 3:	Minimize or reduce operations.

** If processing other than crushing or screening occurs, the fugitive dust controls for those operations are addressed in the "OTHER" category.

Alton will also implement an awareness level program to minimize fugitive dust due to mining activities and haul road traffic in the pit areas. The site supervisor, (or authorized representative) will periodically observe the dust throughout each shift to determine the level of control needed to minimize the dust.

The following levels of awareness and control will be used:

Level 0 – No dust present; current dust control measures are adequate.

Level 1 – Weather or production causing dust at 0-5% opacity at the permit boundary; increase dust control measures necessary. Watering frequency and application of magnesium chloride on the Out of Pit haul roads will be increased until Level 0 is reached.

Level 2 - Weather or production causing dust at 5-10% opacity at the permit boundary; increase dust control measures necessary. Watering frequency and application of magnesium chloride on the Out of

Pit haul roads will be increased until Level 0 is reached. Production reduced until evident that these measures are controlling the dust.

Level 3 - Weather or production causing dust > 10% opacity at the permit boundary; increase dust control measures necessary. Production stopped until Level 2 is reached. Level 2 activities conducted until Level 0 is reached.

Watering records will be maintained to show the dust control measures taken. These records will be provided in the Annual Report made available to Utah Division of Oil, Gas and Mining and to the inspectors upon request.

Since this plan provides control strategies based on total project opacity impacts at the property boundary, monitoring at the property boundary will be sufficient to "judge the effectiveness of the fugitive dust control plan". In order to monitor opacity at the property boundary, Alton Coal will utilize standard method 9 methodologies for the highest density "aggregate" plume from all sources within the property thus capturing highest impact of both point and non-point sources. Attachment 3 contains a description of method 9 techniques.

iii. Activity Specific Off-Site Fugitive Dust Control

Alton will control off-site of fugitive dust, which includes track-out, with the following control strategies:

OFF-SITE ACTIVITY	CONTROL STRATEGY	
FUGITIVE DUST ESCAPING FROM TRUCK BEDS	Stage 1:	Inherent moisture in material.
	Stage 2:	Use a synthetic cover for haul trucks.
	Stage 3:	Minimize or reduce operations.
TRACK-OUT	Stage 1:	Course gravel will be placed at the entrances and exits of the construction area to public roads to prevent track-out.
	Stage 2:	Use of a grader to clean the road from track-out.
	Stage 3:	Minimize or reduce operations, or wash tires.

VI. Continuous Improvement

Alton will review this plan and activities associated with controlling the North Private Lease site's fugitive dust at least ONCE A YEAR. Changes to the plan will occur at this time, or sooner, if necessary.

ATTACHMENT 1

Responsible Parties for Fugitive Dust Control

Responsible Parties for Fugitive Dust Control

OPERATOR:	Alton Coal Development, LLC
Contact Name:	Larry Johnson
Position:	Mine Manager
Phone Number:	435-867-5331
OWNER:	Alton Coal Development, LLC
Contact Name:	Robert C. Nead, Jr.
Position:	Managing Member
Phone Number:	(239) 825-2332

ATTACHMENT 2

Fugitive Dust Management, Acknowledgement and Certification

Fugitive Dust Management, Acknowledgement and Certification

Contractor:	
Contact Name:	
Position:	
Phone Number:	
Start Date on Project:	
Finish Date on Project:	

I certify that I have reviewed the Fugitive Dust Control Plan and understand the requirements of this Plan, required under the Utah Administrative Code R307-309, and will instruct all employees of the Contractor on site to follow guidelines set for in the plan to control fugitive dust. The Contractor is equally responsible for fugitive dust maintenance and any fugitive dust violations from the Utah Division of Air Quality that may be directly related to the Contractor or its employees. Any and all subsequent violations due to fugitive dust non-compliance that can be attributed to the Contractor may be monetarily assessed to the Contractor by the owner and/or operator receiving the fine. The Contractor will report any fugitive dust control non-compliance to the owner and/or operator listed in this document.

Contractor

_____
Company Name (Printed)

_____
Name (Printed)

_____ _____
Signature Date

Alton Coal Development, LLC

Larry Johnson
Name (Printed)

_____ _____
Signature Date

ATTACHMENT 3

Method 9 Opacity Methodology and Documentation

APPENDIX 4-7

Management Plans for the
North Private Lease Properties

MANAGEMENT PLAN FOR THE NORTH PRIVATE LEASE PROPERTIES

Property ownership is shown on Drawing 1-3 of the Coal Hollow Mining and Reclamation Plan. Representatives from Alton Coal Development met with the landowners of the North Private Lease area to ascertain current land use information prior to mining in the area. The following information was provided to Larry Johnson by each landowner (personal communications, September 2015). The landowners expect reclamation and revegetation will provide as good as or better than the follow production.

PARCEL: 9-6-13-1, 9-6-12-5
LANDOWNER: Heaton Bros.
ACRES: 120
LIVESTOCK USE: 1.67 animal/acre; 30 days/year (June)
HAY PRODUCTION: None
IRRIGATION: No

PARCELS: 9-6-12-2; 9-5-7-4A; 9-5-18-3
LANDOWNER: Dean Heaton
ACRES: 45
LIVESTOCK USE: 1.33 animals/acre; 60 days/year (September and October)
HAY PRODUCTION: 1 crop/year (9 of 10 years); 2,000 pounds/acre
IRRIGATION: No

PARCELS: 9-5-7-3A, 9-5-18-5, 9-5-18-3A, 9-6-12-1
LANDOWNER: Ferril Heaton
ACRES: 108.34
LIVESTOCK USE: 0.69 animals/acre (with supplemental feed); 60 days/year (September and October)
HAY PRODUCTION: 1 crop/year (9 of 10 years); 2,000 pounds/acre
IRRIGATION: No

PARCEL: 9-6-12-3
LANDOWNER: Orvil Palmer
ACRES: 7
LIVESTOCK USE:1.43 animals/year; 60 days/year (July and August)
HAY PRODUCTION: None
IRRIGATION: No

I, Dean R. Heaton, have leased to Alton Coal Development a parcel of land, including the coal resource, parcel Number 9-6-12-2, in Kane County, Utah, in Section 12, T39S, R6W, SLB&M for the purpose to surface mine coal.

When mining is completed and surface reclamation begins, I require that the surface be put back to approximate original contour and eliminating erosional features and stock ponds within this parcel.

Signed:

Dean R Heaton

9-21-15

Dean R. Heaton

Land Owner.

Heaton Brothers, LLC has leased to Alton Coal Development a parcel of land, including the coal resource, parcel Number 9-6-13-2, in Kane County, Utah, in Section 13, T39S, R6W, SLB&M for the purpose to surface mine coal.

When mining is completed and surface reclamation begins, Heaton Brothers, LLC requires that the surface be put back to approximate original contour and eliminating erosional features and stock ponds within this parcel. Alton Coal, LLC will manage the surface to eliminate any erosion that could be caused by these changes.

Signed: 17th of September, 2015

Ronald W. Heaton

Heaton Brothers, LLC

Land Owner.

APPENDIX 4-8

CULTURAL RESOURCE DISCOVERY PLAN FOR ALTON
COAL LLC, COAL HOLLOW PROJECT IN
KANE COUNTY, UTAH

CULTURAL RESOURCES DISCOVERY PLAN FOR THE ALTON COAL LLC, COAL HOLLOW PROJECT IN KANE COUNTY, UTAH

Prepared for

Alton Coal

Submitted to

Utah Department of Oil Gas and Mining (UDOGM)

Prepared by

Charles Bollong and Tanya Johnson

Under the direction of

Heather Stettler, Ph.D., Principal Investigator

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BLM Permit No. 08UT55126
Public Lands Policy Coordination Office Permit No. 36

SWCA Project No. 16987

November 5, 2010

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1.0 INTRODUCTION

As part of their development of an open pit mining facility, Alton Coal Development, LLC has undertaken cultural resource inventories (Stavish 2008a) in their lease areas south of the town of Alton, in Kane County, Utah. The results of these inventories suggested that the Coal Hollow undertaking would have either direct effects to cultural resources determined eligible to the National Register of Historic Places (NRHP), or potential effects to NRHP eligible sites. In 2007, Montgomery Archaeological Consultants conducted a Class I file search and Class III pedestrian inventory of the project area of potential effect (APE) (Stavish 2006, 2007, 2008b, 2008c, 2010). All sites available for visual inspection are presumed to have been identified or documented. However, since a large number of cultural resources have been identified in the area of the proposed project, there is a high probability of encountering previously unidentified cultural resources during mining operations. Moreover, the proposed project APE is known to impact several sites that are recommended or have been determined eligible for listing on the NRHP. Additionally, the proposed project is located in an area where natural depositional processes or human activities may have caused cultural materials that were at one time present on the ground surface to have become buried or obscured by ground disturbance. Due to the fact that the Utah Division of Oil, Gas and Mining (UDOGM) does not employ a full-time qualified archaeologist, they have designated this role to Mr. Kelly Beck at the Public Lands Policy Coordination Office (PLPCO). Despite there being two agencies involved, for all intents and purposes here forth, UDOGM is the sole lead agency.

Therefore, given the high density of cultural resources in the general area, discoveries of additional cultural resources during mining activities are anticipated. These discoveries are expected to be almost exclusively represented by subsurface finds of cultural materials. This plan documents the procedures to be implemented in the event that cultural resources are discovered by project archaeologists, mine personnel, Environmental Inspectors, or other personnel during mining operations for the Coal Hollow mine (CHM). This plan includes monitoring procedures, definitions of simple versus complex discoveries, procedures for developing treatment plans, notification procedures, and procedures in case of the discovery of human remains.

The research design presented in this Treatment Plan is also intended to address potential unanticipated discoveries during mining activities at CHM. Research objectives include identifying single component occupations, determining the surrounding environment during the time(s) of the occupation, the season(s) of occupation(s), the length of occupation(s), site structure and function, patterns of resource exploitation and mobility patterns. First order research questions regarding site stratigraphy, geomorphological setting, site formation processes, date(s) of occupation, food resources utilized, and technologies (lithic, ceramic, etc.) utilized also apply. This research design provides the basis for assessing discoveries and determining whether they can be adequately documented under limited testing procedures, or whether they require more extensive excavation and notification of state and federal agencies.

2.0 QUALIFICATION AND TRAINING OF ARCHAEOLOGICAL MONITORS AND MINE PERSONNEL

2.1 Archaeological Personnel

All archaeologists will meet minimum Secretary of the Interior standards for archaeology and will be led in the field by (but not necessarily in the direct presence of) a permitted archaeologist who is qualified based on the standards required under the Public Lands Policy Coordination Office guidelines. No additional training will be required.

Archaeological monitors have the authority to halt mining activities and operations in the event of an archaeological discovery and, in some instances as described below, to authorize mining activities and operations to resume.

2.2 Mine Personnel

All mine personnel will meet with Alton Coal representatives and monitoring archaeologists for training and orientation prior to the start of mining operations. The training will be developed by the monitoring archaeologists in cooperation with Alton Coal representatives. New mine personnel added after mining begins will be trained before working on-site. A list of trained personnel will be kept by Alton Coal representatives.

3.0 MONITORING METHODS

This section details the monitoring methods to be used during the current project. It includes the areas to be inspected and methods to be utilized during monitoring of mine activities.

The foundation construction of all buildings and associated below-ground facilities, as well as any soil storage/dumping locations for the CHM project will be subjected to archaeological monitoring. Monitoring will be conducted either while the subsurface disturbance is occurring or once it has been completed. Additionally, within the boundaries of sites recommended or determined eligible for listing on the NRHP, archaeological monitors will inspect the ground surface during any ground-disturbing activity as it occurs in order to identify any cultural remains that may have been exposed by mining activities and the movement of mining equipment. If at any time human remains or physical remains believed to be human are encountered by mine personnel, the appropriate procedures described in Section 6 will be immediately implemented.

For the purposes of this Discovery Plan, ground-disturbing activities are defined as any activities that have moderate to high potential to expose buried cultural resources. A high potential to expose buried cultural resources is defined as any activity that has the potential to disturb more than 1 to 2 inches of sediment over an area more than 3 feet square. Examples of such activities include, but are not limited to, blading, grading, stripping, and trenching or pit excavation activities, as well as the traversing of sites by heavy tracked vehicles, even if no other activities accompany the vehicle movement.

Certain activities within sites will not require monitoring. These consist of actions with low potential to expose cultural resources. Examples of activities with low potential to expose cultural resources include simple traversing of sites by foot traffic, traversing of sites by rubber-tired vehicles within existing road tracks or areas of pre-existing mining disturbance, installation of temporary survey markers, or any traversing of areas that have been previously disturbed (and monitored) by the project or prior to the project.

Archaeological monitors will inspect the overall work area including trench/pit walls and backdirt piles for evidence of artifacts, cultural features, stained occupation surfaces, concentrations of animal bone, or human remains. For safety reasons, examination of trench/pit walls will generally be conducted from the ground surface. Backdirt will not be screened, but collection of artifacts may occur from backdirt piles, as may the collection of charcoal and/or stained sediment for possible radiocarbon dating.

4.0 DISCOVERY DEFINITIONS AND TREATMENT METHODS

Based on the research design, unanticipated discoveries are divided into two categories. The first includes archaeological materials such as artifacts and features, while the second consists of human remains. The discovery of human remains entails specific notification and treatment procedures that differ from the discovery of non-human cultural materials and, therefore, is discussed in Section 6. Discoveries of archaeological materials are further divided into two categories: isolated resources and small, simple sites and features; and large, complex sites and features.

Archaeological discoveries refer to the material remains of human activities that have the potential to yield data that can increase our understanding of the prehistory and history of the area. Prehistoric discoveries include, but are not limited to, hearth features, housepits, storage features, artifact concentrations, activity areas, etc. Historical discoveries include, but are not limited to, historic hearths, trash deposits, structures, old canals, roads, artifact concentrations, activity areas, etc.

Site and isolated occurrence (IO) definitions established by the Bureau of Land Management (BLM) Guidelines will be applied during Monitoring and Discovery procedures. In general, a site is defined as a location of purposeful prehistoric or historic human activity. An activity is considered to have been purposeful if it resulted in a deposit of cultural materials beyond the level of one or a few artifacts. Locations of human activity not classifiable as sites by this definition are considered IOs. BLM definitions are as follow:

> Sites should contain remains of past human activity that are at least 50 years old and should consist of one or more of the following:
>
> 1. At least 10 artifacts of a single class e.g., 10 sherds) within a 10-meter diameter, except when all pieces appear to originate from a single source (e.g., one ceramic pot, one glass bottle, etc.).
>
> 2. At least 15 artifacts that include at least two classes of artifact types (e.g., sherds, nails, glass) within a 10-meter diameter area.
>
> 3. One or more archaeological features in temporal association with any number of artifacts.
>
> 4. Two or more temporally associated archaeological features without artifacts.
>
> In applying Criteria 3 and 4 above, rock piles need be recorded as sites only if there is reason to believe they are aboriginal. Historical rock piles such as mining cairns may be recorded as sites only if they are believed to be of significant importance. Similarly, single hearths, small rock rings, or small rock alignments without any associated cultural material or without potential for yielding dates, faunal or floral samples need not be recorded as sites unless they are believed to be of sufficient importance in the area they are found. Professional judgment should always be exercised in applying the criteria to cases which are questionable (Bureau of Land Management 2002).

4.1 Discovery of Isolated Occurrences or Small, Simple Sites and Features

4.1.1 Isolated Occurrences or Small, Simple Sites and Features – Definitions

Isolated occurrences (IOs) may include, but are not limited to, individual prehistoric or historic artifacts, small assemblages less than 10 artifacts of a single class or less than 15 artifacts of at least two classes that lack associated features. Small, simple sites and features may include, but are not limited to, artifact concentrations of moderate density; a single, simple hearth; stained soil; or fire-cracked rock cluster. IOs

and small, simple sites and features are defined as those having little potential to yield additional data relevant to research questions developed for the region. Since it is not possible to anticipate every type of discovery that may arise, the archaeological monitor will utilize professional judgment in the field to determine if the materials encountered merit further investigation. Although general examples of IOs and small, simple sites and features are provided here, the predominant guideline will be whether the material in question is determined capable of providing information about regional prehistory or history through further investigation, such as might qualify a site for listing on the NRHP.

4.1.2 Isolated Resources or Small, Simple Sites and Features –Documentation Methods

Upon the discovery of an IO, mining activities will cease (if determined necessary by the archaeological monitor) in order to allow the archaeological monitor to safely recover the IO and document the find. Documentation of IOs will consist of: recording Global Positioning System (GPS) data of the location of the discovery, detailed description(s) of the artifact(s), information required for the Utah IO form, and photographs of the discovery. Photographs of IOs will preferably include general overview photographs of the location of the discovery, in situ photographs of the IO, and close-ups of the artifact(s) subsequent to removal. However, if mining activities have moved the artifact out of context, a general overview of the area where the IO was identified will suffice, along with the close-ups.

Small, simple sites and features will be more extensively documented than IOs. Upon the discovery of small, simple sites and features, all recovery procedures of in situ sites and features will require an excavation permit issued through the Public Lands Policy Coordination Office (PLPCO).

Documentation of small, simple sites and features will include: recording GPS data of the location of the discovery, detailed description(s) of the artifact(s), and information required for recording on the Intermountain Antiquities Computer System form. Photographs of small, simple sites and features will preferably include general overview photographs of the location of the discovery, in situ photographs of the discovery, and close-ups of any artifact(s) subsequent to removal. However, if mining activities have moved the artifacts or features out of context, a general overview of the area where the small, simple site or feature was identified will suffice, along with the close-ups. Feature plans and profiles will be drawn and the feature will be photographed in plan and profile views.

Additionally, upon the discovery of in situ small, simple sites and features, the archaeological monitor will excavate a formal test unit to expose the top of the feature. The plan view of the feature will be documented, after which the monitor will either collect the entire feature fill for later study or collect samples from the feature fill, if possible, for determination of age and subsistence practices as appropriate. Uncollected feature fill will be screened using a 0.25-inch mesh. For all discoveries, auger probes, shovel tests, or excavation of a small area or feature may be required to determine the extent and characteristics of the discovery. If, in order to adequately evaluate the discovery, testing and data collection would exceed the limits of what can appropriately be called 'limited testing', the discovery will be treated under the procedures established for large, complex sites and features.

IOs and small, simple sites and features will be documented in field notes, on field forms, and in a daily monitoring log. Additionally, these discoveries will be included in the weekly report submitted to Alton Coal representatives and UDOGM. They will also be documented in the monitoring report produced at the conclusion of the CHM monitoring.

4.1.3 Isolated Resources or Small, Simple Sites and Features – Summary

Upon the discovery of IOs and small, simple sites and features, mining activity will cease (if determined necessary by the archeological monitor) for the length of time required for the archaeological monitor to recover and adequately document the cultural materials. Work will not resume in the area of the discovery until such time as authorized by the archaeological monitor. The notification procedures outlined in Section 5 will not apply to discovery of either IOs or small, simple sites and features. By definition, all IOs and small, simple sites and features will not lead to additional mitigation. In the event of uncertainty regarding whether a discovery is in the category of small, simple features or large, complex sites and features, the procedures defined below for large, complex discoveries will be implemented.

A weekly report of all IOs, simple, and complex discoveries will be provided to Alton Coal representatives and UDOGM by the archaeological monitor. This will include a table and description of all discoveries identified during the week. All IOs, simple, and complex discoveries will also be included in the summary report compiled at the conclusion of CHM monitoring.

4.2 Discovery of Large, Complex Sites and Features

4.2.1 Large, Complex Sites and Features – Definitions

Large, complex sites and features are defined as those with the potential to yield significant additional data relevant to research questions developed for the region. Since it is not possible to anticipate every type of discovery that may arise, the archaeological monitor will utilize their professional judgment in the field to determine if the materials encountered merit further investigation. Although general examples of large, complex sites and features are provided here, the predominant guideline will be whether the material in question is determined capable of providing information about regional prehistory or history through further investigation, such as might qualify a site for listing on the NRHP.

Large, complex sites and features may include, but are not limited to, large or dense concentrations of artifacts; artifact concentrations that exhibit a high diversity in the tool assemblage; complex hearth structures such as large rock-lined roasting pits with internal stratigraphy and associated large artifact collections, floral and faunal material; housepits; concentrations of fire pit features (for example, between 5 and 10 fire pit features in a single 30-meter (m) [approximately 100-foot] length of trench or exposed cutbank), or other types of structures. Large, complex sites and features also include discoveries at which limited testing was conducted to determine the extent and characteristics of the discovery where the results of limited testing indicate that the site may provide further significant archaeological data (in the APE) and, therefore, that additional excavation is necessary.

In all cases of discovery of large, complex sites and features (or in cases where the archaeological monitor is undecided about the type of discovery), mining operations will cease in the vicinity of the discovery and the notification procedures detailed in Section 5 must be implemented. Mine activities will not resume until the appropriate agencies, including UDOGM, have been notified, in consultation with the State Historic Preservation Officer (SHPO), have been able to evaluate the significance of the discovery; and an appropriate course of treatment has been determined.

4.2.2 Large, Complex Sites and Features – Documentation Methods

Upon the discovery of a large, complex site or feature, mining operations will cease for 30 m (approximately 100 feet) on either side of the discovery in order to preserve the discovery and any associated materials, to allow the archaeological monitor to safely document the discovery, and to give the archaeological monitor time to implement the notification and consultation procedures.

Discovery of large and complex sites and features during open trench or cutbank inspection or monitoring at NRHP-eligible sites will be recorded and evaluated following the standards and format used for recording sites during the Class III inventory phase of the project. The initial treatment of any discovery will consist of recording the location of the materials within the construction or mining area and within any previously recorded site boundary; recording summary data concerning the feature(s) and/or other remains (including dimensions, qualitative characteristics, and associated remains); photographing each exposed feature and the overall context of the exposed remains; and profiling trench/pit walls containing cultural features or strata (where safe and prudent).

For all discoveries, auger probes, shovel tests, or excavation of a small area or feature may be required to determine the extent and characteristics of the discovery. If the discovery can be adequately covered by limited testing measures, the discovery will be treated under the procedures established for small, simple sites and features. Collections of fill samples and artifacts may also be made at this time, as appropriate, to prevent data loss.

If the limited testing indicates that the discovery is indeed a large, complex site or feature, consultation between UDOGM and SHPO will determine subsequent actions. If the agencies determine that excavation is merited in order to fully assess the nature and extent of the discovery, a site-specific Treatment Plan will be developed, as described in Section 4.3.

In some cases, a discovery may be clearly of such significance that it will merit data recovery. In such cases, consultation between UDOGM and SHPO will determine subsequent actions. In most such cases, development and implementation of a site-specific Treatment Plan will be necessary in order to address the portion of the discovery within the immediate affected mining area. Once mining has been completed, a full Data Recovery Plan will be developed for such discoveries, with implementation of the Data Recovery Plan to take place the following field season thereby allowing sufficient time for writing the full report and for consultation with appropriate parties.

Large, complex sites and features will be documented in field notes, on field forms, and in a daily monitoring log. Additionally, although consultation with UDOGM and SHPO will be initiated immediately for large, complex discoveries, such discoveries will also be included in the weekly monitoring report submitted to UDOGM. All large, complex sites and features also will be documented in the monitoring report produced at the conclusion of CHM monitoring.

4.2.3 Large, Complex Sites and Features – Summary

Upon the discovery of large, complex sites and features, mining operations will cease within 30 m (approximately 100 feet) on either side of the discovery. Work will not resume in the area of the discovery until such time as authorized by the relevant state agencies. The notification procedures outlined in Section 5 must be carried out upon discovery of large, complex sites and features. In the event of uncertainty after limited testing regarding whether a discovery is in the category of small, simple feature or large, complex feature, the procedures defined above for large, complex sites and features will be implemented.

A weekly report of all discoveries will be provided to UDOGM by the archaeological monitor. This will include a table and description of all discoveries identified during the week. All large, complex discoveries will also be included in the summary report compiled at the conclusion of CHM monitoring.

4.3 Site-Specific Treatment Plans and Data Recovery Plans for Discoveries

As noted above, the significance of discoveries will be evaluated based on the archaeological monitor's professional judgment of their potential to address research questions developed for the region. Small, simple sites and features will not, by definition, require treatment. Large and complex sites and features and/or discoveries within sites that contribute to the significance of the site may require treatment. Most large, complex discoveries will require an immediate site-specific Treatment Plan in order to evaluate the nature and extent of the discovery. In some cases, this will lead to a Data Recovery Plan. Both types of plans are discussed below.

4.3.1 Treatment Plans

For large, complex sites and features, a site-specific Treatment Plan will be produced by Alton Coal and/or their Cultural Resources Consultant within 2 to 5 working days after the discovery (however, this schedule will be dependent on the pace of consultation with agencies and other involved parties) and submitted to UDOGM and Utah SHPO. The Treatment Plan is intended to evaluate the nature and extent of the discovery and any associated activity area(s) or other features, and should describe the appropriate methods for acquiring the necessary data. All Treatment Plans will be limited to a maximum of 25 cubic meters (m3) of deposits over the entire project APE, unless exceptional circumstances necessitate a greater level of work.

The Treatment Plan will include the type and location of the discovery and the data recovery procedures. Data recovery procedures may include, but not be limited to, excavation of controlled units over and around the feature area, the placement of additional test units and/or auger probes, and exploratory mechanical trenching. Where discoveries identified during open trench inspection are deeply buried, the Treatment Plan may include mechanical stripping of overlying deposits in order to efficiently reach the sediments containing cultural materials. Such mechanical stripping would only be allowed after manual test excavations have been conducted, which will allow the archaeologist to ascertain whether components with similar characteristics are present in the overlying deposits.

The Treatment Plan will be submitted to UDOGM and Utah SHPO within one week of the discovery, if permitted by the pace of consultation. All state agencies will have one week to review and comment on the Treatment Plan, if all parties agree upon this schedule. Upon receipt of agency comments, UDOGM will make a final decision regarding treatment and authorize implementation of the Treatment Plan, if appropriate.

The Treatment Plan will include a schedule for excavation in order to enable mining operations to resume within a reasonable time frame. In circumstances where mining operation schedules allow, full excavation of discoveries/features may be possible before mining resumes. In some cases, the discovery/feature may be unavoidable and in the direct path of mining operations. Under these circumstances, excavation will proceed immediately upon approval of the plan by UDOGM and Utah SHPO. Where project mining can occur without immediate impact to the discovery, or where excavation of the portions of the discovery in the path of mining operations has been completed, full implementation of the Treatment Plan for the discovery may be deferred until mining operations in the vicinity has been completed. Subject to mine scheduling and the onset of inclement weather, treatment activities outside the immediate mining activity may be deferred until the following field season.

After the notification procedures have been followed and an appropriate course of action has been determined, UDOGM, in consultation with the SHPO will provide Alton Coal with notification to proceed with treatment. Alton Coal will provide written notification to UDOGM and SHPO upon

completion of treatment. That notification will include a statement of the nature, scope, and outcome of the actions completed. After Alton Coal has successfully fulfilled any such responsibilities, UDGOM and SHPO provide Alton Coal with authorization to proceed with mining activities. Alton Coal will not resume mining activities in the buffer area surrounding the discovery until it has received authorization from the UDGOM and SHPO to proceed. The authorization may include a statement of any stipulations that will apply during or after the resumption of mining activities.

Data recovered from implementation of Treatment Plans will be integrated into the monitoring report compiled after CHM monitoring is completed.

Data Recovery Plans

In some cases, the discovery will be of such complexity and significance that, following implementation of the Treatment Plan, a Data Recovery Plan will also be required. A Data Recovery Plan is necessary in cases where full data recovery investigations are required. Data Recovery Plans typically will be implemented the following field season in order to provide adequate time to be fully developed, which may be included in the monitoring report produced after completion of CHM monitoring. Implementation of a Data Recovery Plan the following field season also allows for consultation with appropriate parties and acquisition of the appropriate permits. Depending on the nature and extent of the discovery, the full Data Recovery Plan may require excavation of more than 25 m3 in order to collect sufficient information to address research questions.

Under no circumstances will completion of a Data Recovery Plan be deferred more than one field season. Alton Coal shall be responsible for protecting the historic and prehistoric properties from mine activity impact and until such time as any deferred Data Recovery Plans have been completed. Data Recovery Plans may include, but are not limited to, excavation, and other measures may also be required. Should data recovery of discoveries/features be deferred past completion of mining, Alton Coal shall set forth written assurances to fund fieldwork, analyses, curation, and publication of results, as well as obtain written permission from landowners for continued access to the sites. Copies of these assurances will be submitted to UDOGM and SHPO as appropriate.

Where discoveries identified during open trench or cutbank inspection are deeply buried, the Data Recovery Plan may include mechanical stripping of overlying deposits in order to efficiently reach the sediments containing cultural materials. Such mechanical stripping would only be allowed after manual test excavations have been conducted, which will allow the archaeologist to ascertain whether components with similar characteristics are present in the overlying deposits.

For any discoveries that require a Data Recovery Plan, notification procedures would have been initiated earlier, when it became evident that a discovery was large and complex and would require a Treatment Plan. Communication with UDOGM and SHPO will be ongoing during development of the Treatment Plan and subsequent decision as to whether a Data Recovery Plan is required. After an appropriate course of action has been determined, such as the requirement of a Data Recovery Plan, UDOGM, in consultation with the SHPO, will provide Alton Coal with notification to proceed with mining operations. Alton Coal will provide written assurance to UDOGM and SHPO that a Data Recovery Plan will be produced and implemented. After Alton Coal has successfully provided such assurance, UDOGM will provide Alton Coal with authorization to proceed with mining activities. Alton Coal will not resume mining activities in the buffer area surrounding the discovery until it has received authorization from UDOGM to proceed. The authorization may include a statement of any stipulations that will apply during or after the resumption of mining operations. Data recovered from implementation of a Data Recovery Plan will be reported in a separate Data Recovery Report produced after data recovery is completed.

4.4 Summary

The decision tree provided in

Figure 1 illustrates the series of decisions and subsequent actions that will be made by the archaeological monitor.

5.0 NOTIFICATION PROCEDURES AND CONTACT INFORMATION FOR REPORTING DISCOVERIES

All large, complex sites and features will require notification of the appropriate federal and state agencies involved in the CHM. Small, simple sites and features will not require notification, but will be documented following the procedures outlined above in Section 4.1 and will be documented in the weekly monitoring report submitted to the agencies documenting all discoveries identified during the week. A summary monitoring report will be produced at the completion of monitoring. For all large, complex discoveries, the archaeological monitor will notify Alton Coal who will notify UDOGM and SHPO. Table 1 lists the contacts to be notified in the event of a large, complex discovery.

Table 1. Contact Information for Large, Complex Discoveries During Coal Hollow Mine Activities.

Name	Title/Agency/Firm	Phone	Fax	Address	E-Mail
Tanya Johnson	Program Director, Cultural Resources SWCA Environmental Consultants	801-322-4307	801-322-4308	257 E. 200 South Ste. 200 Salt Lake City, UT 84111	tjohnson@swca.com
Jamie Clark	Assistant Project Manager, Cultural Resources SWCA Environmental Consultants	801-322-4307	801-322-4308	257 E. 200 South Ste. 200 Salt Lake City, UT 84111	jclark@swca.com
Chris McCourt	Alton Coal Development, LLC	435-867-5331	435-867-1192	463 North 100 West, Cedar City, UT 84721	CMcCourt@altoncoal.com
Kelly Beck	Archaeologist, Office of the Governor, Public Lands Policy Coordination	801-537-9046	801-537-9226	5110 State Office Building, P.O. Box 41107, Salt Lake City Utah, 84114	kellybeck@utah.gov
Lori Hunsaker	Utah Deputy SHPO	801-533-3555		300 Rio Grande Salt Lake City, UT 84101	lhunsaker@blm.gov

After the appropriate course of action has been determined, UDOGM in consultation with SHPO, will provide Alton Coal with notification of its decision, including details of any actions that Alton Coal must complete before authorization to proceed with mining operations is granted. Alton Coal will provide written notification to UDOGM or their designee and SHPO including a statement of the nature, scope, and outcome of the actions completed. After Alton Coal has successfully fulfilled any such responsibilities, UDOGM or their designee will provide Alton Coal with authorization to proceed with mining operations. Alton Coal will not resume mining activities in the buffer area surrounding the discovery until it has received authorization from UDOGM or their designee to proceed. The authorization may include a statement of any stipulations that will apply during or after the resumption of mining operations.

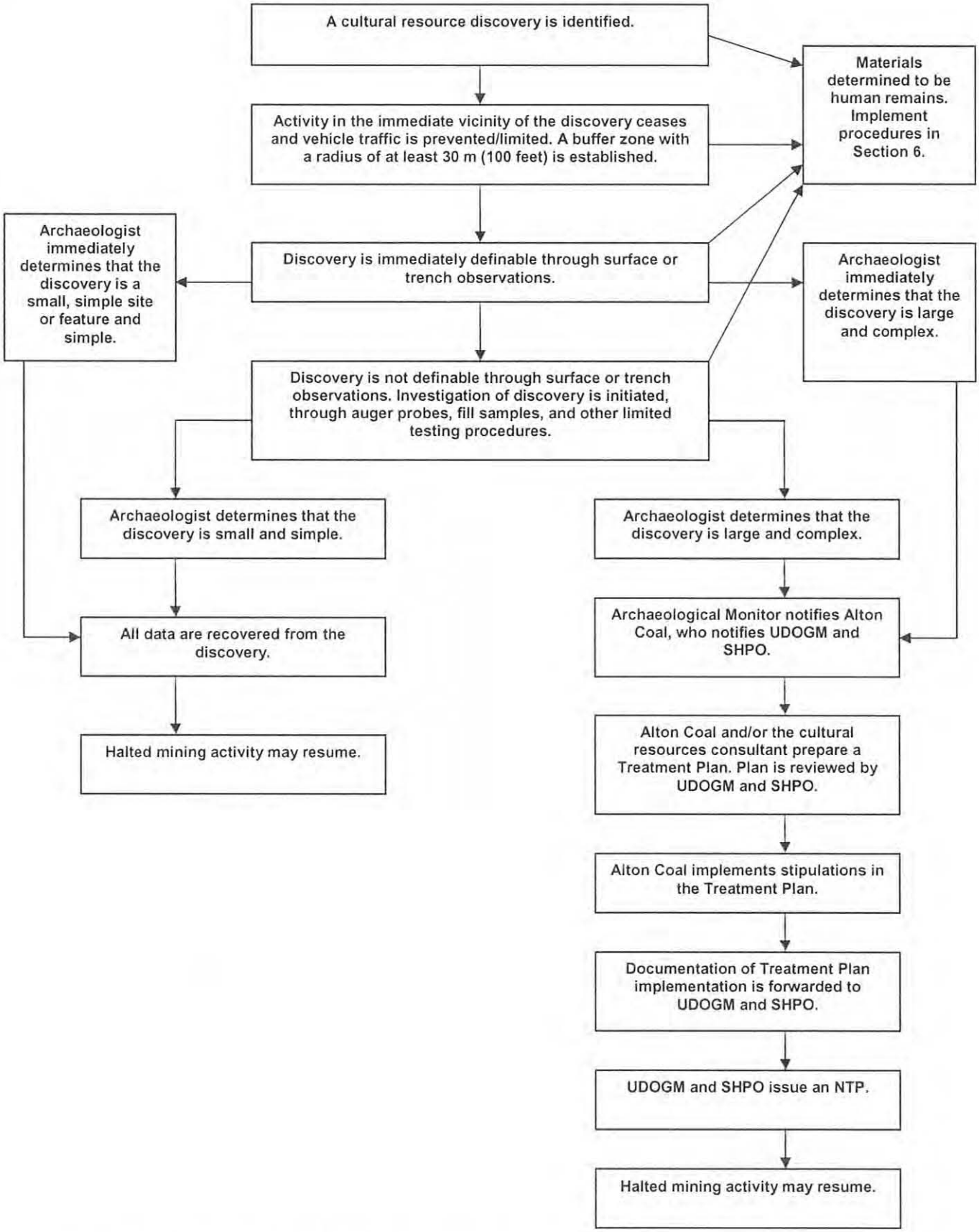

Figure 1. Procedures for archaeological discoveries.

6.0 DISCOVERY OF HUMAN REMAINS

Human remains and associated funereal artifacts may be discovered during mining operations, reclamation, or maintenance. If human remains are discovered under any circumstances, they will be secured and protected until such time as appropriate disposition has been determined, in accordance with applicable local, state, and federal statutes.

If human remains are encountered during mining operations, appropriate measures will be taken to protect the discovery from further disturbance (see Section 6.1 below) until the discovery has been fully evaluated and the appropriate treatment of the discovery has been completed (

Figure 2).

The notification process will be implemented, including contacting UDOGM and SHPO and/or private landowner, if applicable. If human remains are discovered on federal lands and they are determined to be aboriginal, the Native American Graves Protection and Repatriation Act (NAGPRA) and its implementing regulations will apply. In such cases, mining operations activities in the vicinity of the burial will cease for a minimum of 30 days while appropriate consultation processes proceed.

Figure 2 summarizes the procedures for the treatment of the unanticipated discovery of human remains.

6.1 Procedures to Protect Human Remains

If any human remains or remains that may be human are discovered, all mining activity within the immediate vicinity of the discovery will be halted. Cessation of ground-disturbing activity will encompass a sufficient area to protect the discovery and provide a buffer zone for adequate and safe investigation of the discovery and any other associated features or artifacts. A buffer area no smaller than 30 by 30 m (approximately 100 by 100 feet) around the discovery will be established, but this area can be expanded if deemed necessary. Mine personnel will promptly vacate the buffer zone and traffic within the buffer zone will be limited to that necessary to remove vehicles and equipment from it. Care will be taken to prevent any further disturbance of the potential human remains during removal of vehicles and equipment. A qualified archaeologist will be responsible for determining if the remains are human.

Mine personnel involved in such a discovery will immediately notify a supervisor (or designated substitute), who will immediately notify the appropriate UDOGM archaeological contact.

After all mining activity has been halted and while the notification procedure is being implemented, steps will be taken to protect the human remains including:

- ensuring that no ground-disturbing activity resumes within the buffer zone of the discovery;
- preventing vehicle traffic through that portion of the area of the undertaking beyond that necessary to remove vehicles and equipment already within the area; and
- providing protection in the form of tarps, shoring, protection from the elements, and any other procedures necessary to ensure preservation of the remains.

The measures to protect the remains and any associated artifacts will remain in effect until Alton Coal has received notice from UDOGM or SHPO, as appropriate, to proceed with the mining activity in the buffer zone.

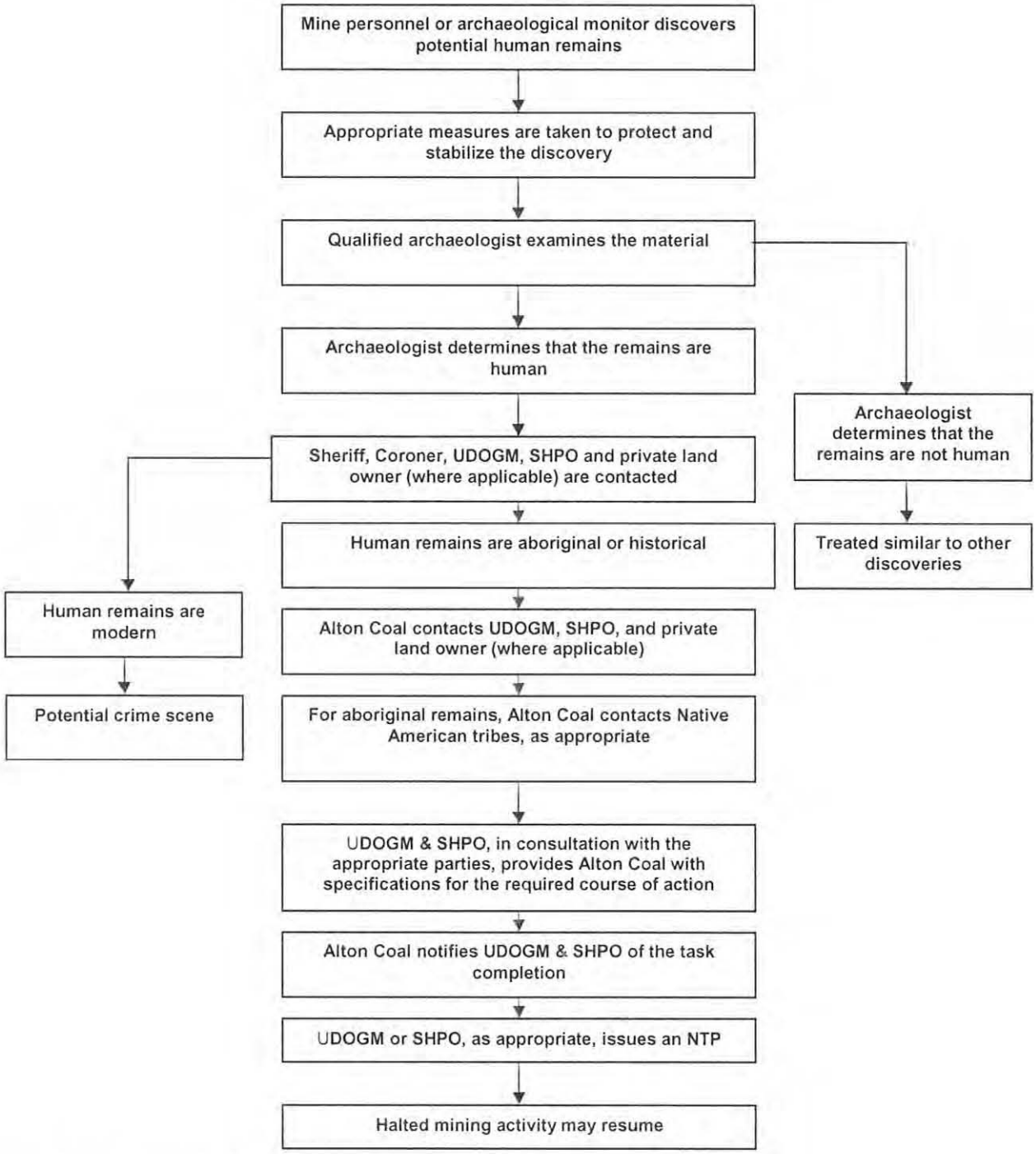

Figure 2. Procedures for the treatment of unanticipated discovery of human remains.

6.2 Contact and Notification Procedures for Discovery of Human Remains

Upon being notified by the investigating archaeologist of the presence of human remains, the respective County Sheriff and County Coroner will be notified by the archaeological monitor, as well as UDOGM, SHPO, Alton Coal, and the private landowner, if applicable (Table 2).

Table 2. Contact Information for Human Remains Discoveries During Mining Operations of the CHM

Name	Title/Agency	Phone	Fax	Address	E-Mail
Tanya Johnson	Program Director, Cultural Resources SWCA Environmental Consultants	801-322-4307	801-322-4308	257 E. 200 South Ste. 200 Salt Lake City, UT 84111	tjohnson@swca.com
Jamie Clark	Assistant Project Manager, Cultural Resources SWCA Environmental Consultants	801-322-4307	801-322-4308	257 E. 200 South Ste. 200 Salt Lake City, UT 84111	jclark@swca.com
Kelly Beck	Archaeologist, Office of the Governor, Public Lands Policy Coordination	801-537-9046	801-537-9226	5110 State Office Building, P.O. Box 41107, Salt Lake City Utah, 84114	kellybeck@utah.gov
Chris McCourt	Alton Coal Development, LLC	435-867-5331	435-867-1192	463 North 100 West, Cedar City, UT 84721	CMcCourt@altoncoal.com
Lori Hunsaker	Utah Deputy SHPO	801-533-3555		300 Rio Grande Salt Lake City, UT 84101	lhunsaker@blm.gov
Kane County Sheriff	Kane County Sheriff's Office	435-644-4916	435-644-2096	76 North Main Street, Kanab, UT 84741	N/A
Mark O. Gower	Sheriff, Iron County Sheriff Department	435-867-7550	435-867-7539	2132 North Main Street, Cedar City, Utah 84721	N/A

The County Sheriff's office and County Coroner have initial jurisdiction with regard to any discovered human remains. The County Sheriff and County Coroner may determine that the remains are not modern, do not reflect a crime scene, and/or may otherwise relinquish their jurisdiction over the remains.

Upon receiving notice that the County Sheriff's office and County Coroner have relinquished jurisdiction over the discovery, Alton Coal will notify UDOGM, SHPO, and private landowner (if applicable) by telephone, followed by written confirmation by fax or certified mail. The notification will include a brief description of the discovery, its location, and an explicit statement that the discovery is situated on federal, state, or private lands (as appropriate). In cases of discoveries of human remains on private land, Alton Coal will advise the landowner that Native American tribe(s) with an identifiable interest in the discovery may request to inspect the burial and make recommendations concerning the disposition of the remains within 48 hours of being notified. The Utah SHPO may offer to mediate consultation with the landowner.

A forensic expert may be required to determine whether the remains are Native American or Euro-American. If the remains are found to be Native American and the discovery is on private or state lands, Alton Coal will consult with UDOGM on how to initiate the notification and consultation process involving the appropriate Tribe(s) and/or private landowner. The Utah SHPO will also determine the appropriate course of action for any non-Native American human remains, and this may include excavation.

After the appropriate course of action has been determined, UDOGM in consultation with the Utah SHPO will provide Alton Coal with notification of its decision, including specific details of any actions that Alton Coal must complete before authorization to proceed with mining operations is granted. Alton Coal will provide written notification to UDOGM and SHPO, including a statement of the nature, scope, and outcome of the actions completed. After Alton Coal has successfully fulfilled any such responsibilities, UDOGM and/or SHPO will provide Alton Coal with authorization to proceed with mining operations. Alton Coal will not resume mining operations in the buffer area surrounding the discovery until it has received authorization to proceed. The authorization may include a statement of any stipulations that will apply during or after the resumption of mining operations.

In all human remains discovery cases in which the County Sheriff and County Coroner have relinquished jurisdiction, the remains will be held temporarily by UDOGM until their final disposition is determined.

7.0 PROCEDURES FOR HANDLING DISCOVERIES IDENTIFIED BY MINE PERSONNEL

7.1 Training of Mine Personnel

This section details the procedures to be used for unanticipated cultural resources discovery by mine personnel outside of the locations designated for CHM monitoring, such as within areas of ground disturbance outside of known sites. Prior to the start of a mining activity, Alton Coal personnel directly involved with the project will be informed of the stipulations provided in this plan. Those instructions will cover:

- the procedures regarding the protection of discoveries until such time as they can be properly evaluated by a qualified professional archaeologist;
- the need to treat all human remains and associated artifacts with dignity and respect;
- the procedure for notification of the appropriate Alton Coal personnel;
- the necessity of reporting discoveries in a timely manner and complying with the other stipulations provided in this plan; and
- the penalties for failure to report discoveries or to comply with the procedures outlined in this plan.

7.2 Steps to Protect the Discovery

Figure 3 summarizes the procedures required for discoveries identified by mine personnel. When a discovery is encountered, the mining activity that resulted in its exposure will be immediately halted, followed as soon as possible by the cessation of all other ground-disturbing activity in the immediate vicinity. All mining activity will cease in the area of the discovery and in a surrounding buffer zone that is large enough to protect the discovery itself, to protect any other associated features or artifacts, and to provide a buffer zone for thorough and safe investigation. A general guideline for a buffer area is approximately 30 m (approximately 100 feet) in all directions around the discovery, but can be enlarged or reduced as long as it provides adequate protection and is not an unnecessary hindrance to mining operations. This buffer area will be fenced.

After all mining activity in the immediate vicinity of the discovery has been halted, the Mine Supervisor (or designated substitute) will be notified. The supervisor or substitute will immediately notify the Mine Inspector or Environmental Inspector, who will then contact an archaeological monitor to determine the nature of the discovery. If the remains are non-cultural, Alton Coal will be notified and mining activity can resume. If the discovery is determined cultural, the procedures outlined for their treatment in Figure 1 and Sections 4.1 and 4.2 will be implemented. During initial investigation and evaluation of the discovery, the archaeologist will have the authority to conduct limited testing within the constraints of the guidelines in the BLM limited testing permit held. Treatment procedures for general archaeological materials have been detailed in Section 4 and procedures for the treatment of human remains are detailed in Section 6.

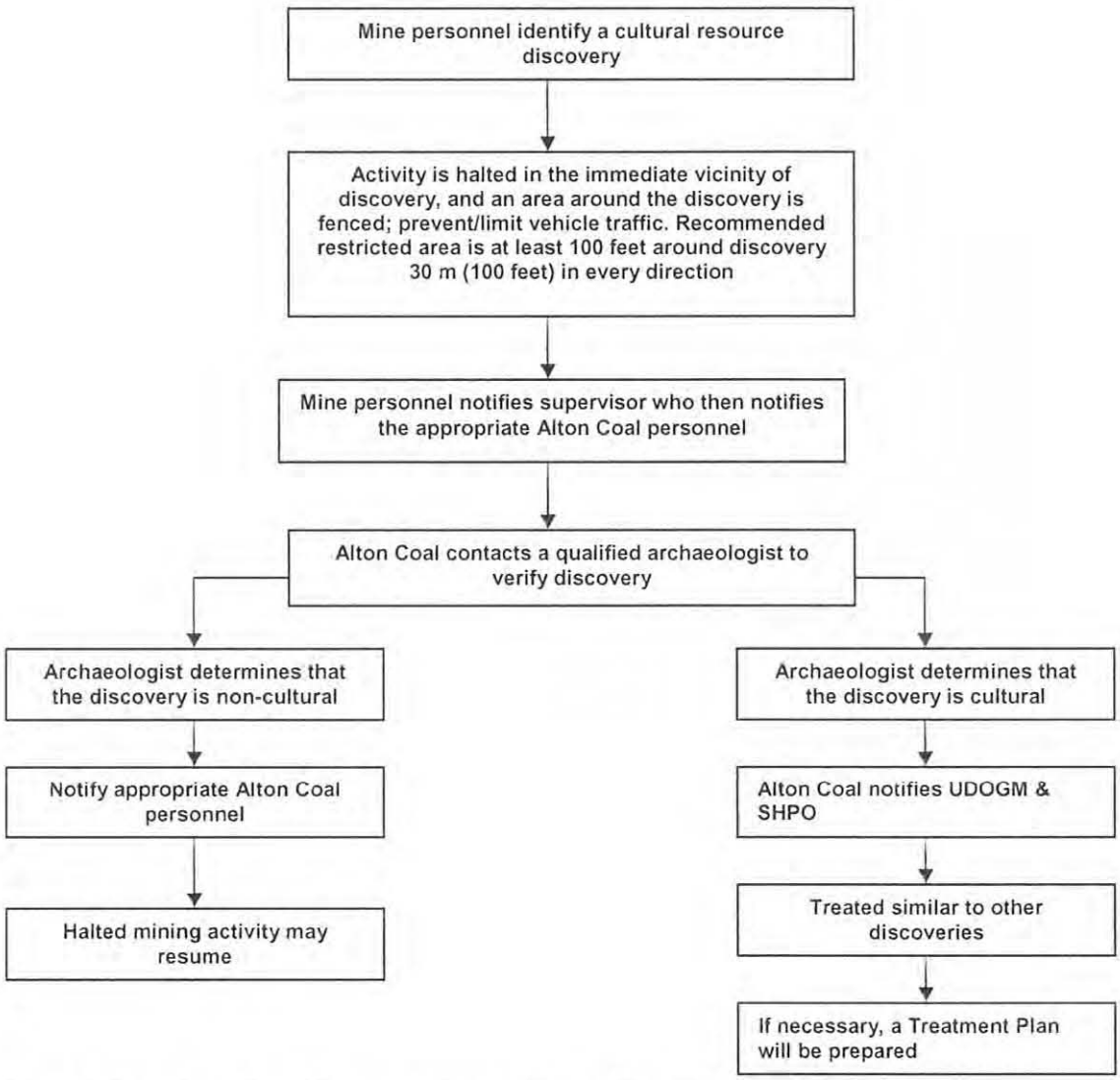

Figure 3. Procedures for addressing cultural resource discoveries by mine personnel

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CHAPTER 5

Comment [ARC31]: This chapter includes 3 sets of pending edits. The most recent are in response to Technical Review deficiencies as provided by DOGM in September 2015

R645-301-500. ENGINEERING

510. INTRODUCTION.

The engineering section of the Mining and Reclamation Plan (MRP) is divided into the operation plan, reclamation plan, design criteria, and performance standards. All of the activities associated with the coal mining and reclamation operations are designed, located, constructed, maintained, and reclaimed in accordance with the operation and reclamation plan.

511. GENERAL REQUIREMENTS

511.100 - 511.300. Contents

The operation and reclamation permit application includes descriptions of the coal mining and reclamation operations with attendant Drawings, plans, and cross sections. and its potential impacts to the environment as well as methods and calculations utilized to achieve compliance with design criteria.

All this information can be viewed in this section, Drawings 5-1 through 5-44 and Appendices 5-1 through 5-~~9~~10 for the existing Coal Hollow Mine and on Drawings 5-45 through 5-78 and Appendices 5-11 through 5-13 for the North Private Lease.

512. CERTIFICATIONS

512.100. Cross Sections and Drawings.

All cross sections and Drawings required under applicable portions of sections 512.100 through 512.150 have been prepared by, or under the direction of, and certified by: a qualified, registered, professional engineer; a professional geologist; or a qualified, registered, professional land surveyor, with assistance from experts in related fields such as hydrology, geology and landscape architecture.

Compliance with this section has been completed and certifications are available on all cross sections and Drawings.

512.200. Plans and Engineering Designs.

All plans for excess spoil, durable rock fills, coal mine waste, impoundments, primary roads and variances from approximate original contour will be certified by a qualified registered professional engineer.

Plans for excess spoil, sediment impoundments, and primary roads , ~~and a variance from approximate original contour~~ have been certified by a qualified registered professional engineer. These certifications can be viewed on Drawings 5-22 through 5-37 for the existing Coal Hollow Mine and on Drawings 5-51A & 5-58 through 5-71 for the North Private Lease. No coal mine waste or durable rock fills are planned.

512.210 Excess Spoil Disposal Areas

A professional engineer experienced in the design and construction of earth and rock fills will certify the design of Excess Spoil Disposal Areas according to 535.100.

A professional engineer with experience in design and construction of earth and rock fills has certified the design of the Excess Spoil Disposal for the existing Coal Hollow Mine and of the Temporary Excess Spoil Pile for the North Private Lease according to 535.100. An expert in the field of slope stability and geotechnical analysis has provided a thorough review of the designs. These~~is~~ analyses~~is~~ can be viewed in Appendix 5-1 for the Coal Hollow Mine and in Appendix 5-11 for the North Private Lease.

512.220 - 230 Durable Rock Fills and Coal Mine Waste Structures

The MRP does not contemplate the construction of any permanent Durable Rock Fills or Coal Mine Waste structures. If such structures become part of the plan, a professional engineer experienced in the design of earth and rock fills and or disposal facilities will certify the design according to R645-301-535.100 - 536.

512.240. Impoundments.

A professional engineer experienced in the design and construction of impoundments will use current, prudent, engineering practices and will certify the design of the impoundment according to R645-301-743.

A professional engineer experienced in the design and construction of impoundments with assistance from a geotechnical expert has used current, prudent, engineering practices to design the proposed impoundments. The plans have been certified and a detailed geotechnical analysis has been provided. The detailed investigation for impoundments 5 through 7 found soils to be representative of the Coal Hollow Mine, thus additional geotechnical analysis, specific stability analysis for the Coal Hollow Mine apply to the impoundments at the North Private Lease. The certifications and drawings can be viewed in Drawings 5-25 through 5-31 and Appendices 5-1 and 5-2 for the existing Coal Hollow Mine and on Drawings 5-65 through 5-71 and Appendix 5-11 and 5-12 for the North Private Lease.

512.250. Primary Roads.

A professional engineer will certify the design and construction or reconstruction of primary roads as meeting the requirements of 742.420.

Designs of primary roads have been certified as meeting the requirements of 742.420.

512.260. Variance From Approximate Original Contour.

In areas of the MRP where a variance from the approximate original contour is required, a professional engineer will certify the design for the proposed variance from the approximate original contour, as described under 270, in conformance with professional standards established to assure the stability, drainage and configuration necessary for the intended use of the site.

~~A variance from the approximate original contour has been certified in conformance with professional standards to assure the stability, drainage and configuration necessary for the intended use of the site~~The MRP does not contemplate any variances from Approximate Original Contour for the Coal Hollow Mine or~~.~~ the North Private Lease.

513. **COMPLIANCE WITH MSHA REGULATIONS AND MSHA APPROVALS.**

513.100. Coal Processing Waste Dams and Embankments

The MRP does not contemplate the construction of any coal processing waste dams and embankments.

513.200. Impoundments and Sedimentation Ponds

Impoundments and sedimentation ponds meeting the size or other qualifying criteria of MSHA, 30 CFR 77.216(a) will comply with the requirements of MSHA, 30 CFR 77.216 (see R645-301-533.600, R645-301-742.222, and R645- 301-742.223).

No impoundments or sedimentation ponds meeting the size or other qualifying criteria of MSHA, 30 CFR 77.216(a) exist or are planned within the proposed Mine Permit Area. Should impoundments and sedimentation ponds meeting the size or other qualifying criteria of MSHA, 30 CFR 77.216(a) become necessary, compliance with the requirements of MSHA, 30 CFR 77.216 will be met.

513.300. Disposal of Underground Development Waste, Coal Processing Waste and Excess Spoil in underground mine workings.

The MRP does not contemplate any underground development waste, coal processing waste, or excess spoil being disposed of in underground mine workings.

513.400. Refuse Piles

The MRP does not contemplate the construction of any refuse piles.

513.500. Capping, Sealing and Backfilling Openings to the Surface from the Underground.

Each shaft, drift, adit, tunnel, exploratory hole, entryway or other opening to the surface from the underground will be capped, sealed, backfilled or otherwise properly managed consistent with MSHA, 30 CFR 75.1711 (see R645-301-551).

~~Each shaft, drift, adit, tunnel, exploratory hole, entryway or other opening to the surface from the underground will be capped, sealed, backfilled or otherwise properly managed consistent with MSHA, 30 CFR 75.1711 and requirements of R645-301-513, R645-301-529 and R645-301-551.~~

Underground mine portals are located in the bottom of ~~-~~the Coal Hollow Pit 10, and will ultimately be reclaimed by the backfilling of the pit to a depth of 100 + when no longer required.

All wells will be managed to comply with R645-301-748 and R645-301-765. Water monitoring wells will be managed on a temporary basis according to R645-301-738.

Wells constructed for monitoring groundwater conditions in the proposed Coal Hollow Mine permit and adjacent area, including exploration holes and boreholes used for water wells or monitoring wells, will be designed to prevent contamination of groundwater and surface-water resources and to protect the hydrologic balance. A diagram depicting typical monitoring well construction methods is shown in Figure 7-11. Monitoring wells will include a protective hydraulic seal immediately above the screened interval, an annular seal plugging the borehole above the hydraulic seal to near the ground surface, and a concrete surface seal extending from the top of the hydraulic seal to the ground surface which is sloped away from the well casing to prevent the entrance of surface flows into the borehole area. Well casings will protrude above the ground surface a sufficient height so as to minimize the potential for the entrance of surface water or other material into the well. A steel surface protector with a locking cover will be installed at monitoring wells to prevent access by unauthorized personnel. Where there is potential for damage to monitoring wells, the wells will be protected through the use of barricades, fences, or other protective devices. These protective devices will be periodically inspected and maintained in good operating conditions. Monitoring wells will be locked in a closed position between uses.

When no longer needed for monitoring or other use approved by the Division upon a finding of no adverse environmental or health and safety effects, or unless approved for transfer as a

water well under R645-301-731.100 through R645-301-731.522 and R645-301-731.800, each well will be capped, sealed, backfilled, or otherwise properly managed, as required by the Division in accordance with R645-301-529.400, R645-301-631.100, and R645-301-748. Permanent closure measures will be designed to prevent access to the mine workings by people, livestock, fish and wildlife, machinery and to keep acid or other toxic drainage from entering ground or surface waters.

If a water well is exposed by coal mining and reclamation operations, it will be permanently closed unless otherwise managed in a manner approved by the Division.

Permanent closure and abandonment of water wells greater than 30 feet in depth will be in accordance with the requirements of "Administrative Rules for Water Well Drillers", State of Utah, Division of Water Rights or other applicable state regulations. Abandonment of wells will be performed by a licensed water well driller. The wells to be abandoned will be completely filled using neat cement grout, sand cement grout, unhydrated bentonite, or bentonite grout, or other materials approved by the Utah State Engineer's office. Alternatively, the well may be abandoned using a different procedure upon approval from the Utah State Engineer's office.

Abandonment materials will be introduced at the bottom of the well or required sealing interval and placed progressively upward to the top of the well. The casing will be severed a minimum of 2 feet below the ground surface. A minimum of 2 feet of compacted native material will be placed above the abandoned well upon completion.

Within 30 days of the completion of well abandonment procedures, a report will be submitted to the State Engineer by the responsible licensed driller giving data related to the abandonment of the well. This shall include the name of the licensed driller or other person(s) performing abandonment procedures, name of well owner at the time of abandonment, the address or location of the well by section, township, and range, abandonment materials and equipment used, water right or file number covering the well, the final disposition of the well, and the date of completion.

Exploration holes and boreholes will be backfilled, plugged, cased, capped, sealed, or otherwise managed to prevent acid or toxic contamination of water resources and to minimize disturbance to the prevailing hydrologic balance. Exploration holes and boreholes will be managed to ensure the safety of people, livestock, fish and wildlife, and machinery.

If a water well is exposed by coal mining and reclamation operations, it will be permanently closed unless otherwise managed in a manner approved by the Division.

If any exploration boreholes are to be used as monitoring wells or water wells, these will meet the provisions of R645-301-731

Boreholes will be backfilled to within 1 foot of the land surface with concrete or other materials approved by the Division as necessary to prevent contamination of groundwater or

surface-water resources or to protect the prevailing hydrologic balance. The upper approximately 1 foot will be backfilled with native materials to facilitate reclamation (see Drawing 6-11). Exploration holes and boreholes that may be uncovered during mining and reclamation activities will be permanently closed unless approved for water monitoring or otherwise managed in a manner approved by the Division.

513.600. Discharges into an underground mine

The MRP does not contemplate discharges into an underground mine.

513.700. Surface Mining Closer than 500 Feet to an Active Underground Mine

The MRP does not contemplate mining within 500 feet of an active underground mine.

513.800. Coal Mine Waste Fires

The MRP does not contemplate the generation of any coal mine waste.

514. **INSPECTIONS**

All engineering inspections, excepting those described under R645-301-514.320, will be conducted by a qualified registered professional engineer or other qualified professional specialist under the direction of the professional engineer.~~All engineering inspections, will be conducted by a qualified registered professional engineer or other qualified professional specialist under the direction of the professional engineer.~~

514.100 Excess Spoil.

The professional engineer or specialist will be experienced in the construction of earth and rock fills and will periodically inspect the fill during construction. Regular inspections will also be conducted during placement and compaction of fill materials.

The construction method for the excess soil specified in 528.310 is expected to meet the 85% compaction standard. As verification, the fill compaction will be periodically field tested using method(s) as directed by the qualified registered professional engineer. A description of the test method and the test results will be provided to the Division as part of the quarterly inspection reports.

514.110. *Such inspections will be made at least quarterly throughout construction and during critical construction periods. Critical construction periods will include at minimum:*

514.111. *Foundation preparation, including the removal of all organic material and topsoil;*

514.112. *Placement of underdrains and protective filter systems.*

No underdrains or protective filter systems are planned as part of the excess spoil.

514.113. *Installation of final surface drain systems; and*

514.114. *The final graded and revegetated fill.*

514.120. *The qualified registered professional engineer will provide a certified report to the Division promptly after each inspection that the fill has been constructed and maintained as designed and in accordance with the approved plan and the R645-301 and R645-302 Rules. The report will include appearances of instability, structural weakness, and other hazardous conditions.*

514.200 - 250. Refuse Piles.

The MRP does not contemplate the construction of any refuse piles.

514.300. Impoundments.

514.310 - 313. Certified Inspection.

A professional engineer or specialist experienced in the construction of impoundments will inspect impoundments. Inspections will be made regularly during construction, upon completion of construction, and at least yearly until removal of the structure or release of the performance bond. The qualified registered professional engineer will promptly, after each inspection, provide to the Division, a certified report that the impoundment has been constructed and maintained as designed and in accordance with the approved plan and the R645 Rules. The report will include discussion of any appearances of instability, structural weakness or other hazardous conditions, depth and elevation of any impounded waters, existing storage capacity, any existing or required monitoring procedures and instrumentation and any other aspects of the structure affecting stability. A copy of the report will be retained at or near the mine site.

514.320. Inspection Standard and Frequency

Impoundments meeting the NRCS Class B or C criteria for dams in TR-60, or the size or other criteria of 30 CFR Sec. 77.216 must be examined in accordance with 30 CFR Sec. 77.216-3. Impoundments not meeting the NRCS Class B or C Criteria for dams in TR-60, or subject to 30 CFR Sec. 77.216, shall be examined at least quarterly. A qualified person designated by the operator shall examine impoundments for the appearance of structural weakness and other hazardous conditions.

The MRP does not contemplate construction of any impoundments meeting the NRCS Class B or C criteria for dams in TR-60, or the size or other criteria of 30 CFR Sec. 77.216. If such impoundments become necessary, they will be examined in accordance with 30 CFR Sec. 77.216-3. Impoundments not meeting the NRCS Class B or C Criteria for dams in TR-60, or subject to 30 CFR Sec. 77.216, will be examined at least quarterly. A qualified person designated by Alton Coal Development LLC will examine impoundments for the appearance of structural weakness and other hazardous conditions.

515. **REPORTING AND EMERGENCY PROCEDURES**

515.100. Slides

Any time a slide occurs which may have a potential adverse effect on public, property, health, safety, or the environment, Alton Coal Development LLC will notify the Division by the fastest available means and comply with any remedial measures required by the Division.

515.200. Impoundment Hazards.

If any examination or inspection of an impoundment discloses that a potential hazard exists, the person who examined the impoundment will promptly inform the Division of the finding and of the emergency procedures formulated for public protection and remedial action. If adequate procedures cannot be formulated or implemented, the Division will be notified immediately.

515.300. Temporary Cessation

515.311

During a temporary cessation of the Underground operations, surface access openings to underground operations and facilities in areas in which there are no current operations, but in which operations are to be resumed under an approved permit will be effectively maintained secured. Portal access will be controlled by security personnel, signage, temporary fencing and/or other means as determined appropriate by the company and MSHA. Portal access will be provided as required. Any facilities or equipment required to protect the underground workings, i.e. fans, pumps, etc., will be maintained and operated during this time. Since the portal area is graded to drain to a collection sump, any surface runoff will be collected there and will be utilized for dust control during operations and temporary cessation.

515.312.

During a temporary cessation, surface facilities in areas in which there are no current operations, but in which operations are to be resumed under an approved permit will be effectively secured.

515.320.

Before temporary cessation of coal mining and reclamation operations for a period of 30 days or more, or as soon as it is known that a temporary cessation will extend beyond 30 days, a notice of intention to cease or abandon operations will be submitted to the division. This notice will include:

- A statement of the exact number of acres which have been affected in the permit area prior to such temporary cessation,

- The extent and kind of reclamation of those areas which has been accomplished, and
- Identification of the backfilling, regrading, revegetation, environmental monitoring, and water treatment activities that will continue during the temporary cessation.

515.321.

Before temporary cessation of coal mining and reclamation operations for a period of 30 days or more, or as soon as it is known that a temporary cessation will extend beyond 30 days, a notice of intention to cease or abandon operations will be submitted to the division. This notice will include:

- A statement of the exact number of acres which have been affected in the permit area prior to such temporary cessation,
- The extent and kind of reclamation of those areas which has been accomplished, and
- Identification of the backfilling, regrading, revegetation, environmental monitoring, and water treatment activities that will continue during the temporary cessation.

516. PREVENTION OF SLIDES

The moderate topography in the area of the planned Coal Hollow Mine will minimize the potential for unplanned slides. A natural barrier will, however, be left undisturbed except as necessary for roads, sedimentation control, temporary topsoil and spoil storage and similar features, beginning at the elevation of the coal seam and extending from the outslope for a distance of at least 50 ft. The barrier will be retained in place to prevent slides and erosion.

520. **OPERATION PLAN.**

521. **GENERAL.**

The plan, with Drawings, cross sections, narrative, descriptions, and calculations indicates how the relevant requirements will be met. The lands subject to coal mining and reclamation operations over the estimated life of the operations are identified and briefly described. All appropriate information for the Coal Hollow Mine is located in the subsequent sections and Drawings 5-1 through 5-44 and Appendices 5-1 through 5-10. Topsoil piles and removal sequencing is shown on Drawing 2-2. All appropriate information for the North Private Lease is located in the subsequent sections and Drawings 5-45 through 5-78 and Appendix 5-11 and 5-13. Topsoil piles and removal sequencing is shown on Drawing 2-4.

The ~~proposed~~ Coal Hollow Mine is located approximately 2.5 miles south of Alton, Utah. The ~~proposed expanded~~ North Private Lease is located approximately 0.8 miles south of Alton, Utah. In order to maximize the use and conservation of the coal resource, coal will be recovered using large hydraulic excavators, front end loaders, off-road trucks, underground continuous miner and a highwall auger miner. Mined coal will be hauled to a central coal area for crushing and placement into a stockpile. Coal from the stockpile will be transferred into a bin and loaded into over-the-road trucks for transport. Section 523 of this chapter provides detailed production, sequence, and timing information. Drawings 5-2 and 5-46 show the disturbance sequence for the Coal Hollow and North Lease permit areas, respectively.

~~The plan, with Drawings, cross sections, narrative, descriptions, and calculations indicates how the relevant requirements will be met. The lands subject to coal mining and reclamation operations over the estimated life of the operations are identified and briefly described. All appropriate information for the Coal Hollow Mine is located in the subsequent sections and Drawings 5-1 through 5-44 and Appendices 5-1 through 5-10. Topsoil piles and removal sequencing is shown on Drawing 2-2. All appropriate information for the North Private Lease is located in the subsequent sections and Drawings 5-45 through 5-74 and Appendix 5-11 through 5-12. Topsoil piles and removal sequencing is shown on Drawing 2-4.~~

521.100. Cross Sections and Drawings.

The application includes cross sections, Drawings and plans showing all the relevant information required by the Division. Appropriate information is provided in Drawings

and cross sections 5-1 through 5-44 for the existing Coal Hollow Mine and on Drawings and cross sections 5-45 through 5-78 for the North Private Lease.

521.110. Previously Mined Areas.

Historically, there has been some underground mining of coal within the Alton Amphitheater. The following underground mines are known to have historically existed within the Amphitheater:

- Seaman Mine
- Smirl Mine
- Alton Mine
- Johnson Mine
- Silver Mine

There are not any known mines that existed or currently exist within the permit areas or the adjacent area as defined in R645-100-200. There is also not any active coal mining operations in the area.

521.120. Existing Surface and Subsurface Facilities and Features**.**

521.121. Buildings

The location of all buildings in and within 1,000 feet of the proposed permit area, with identification of the current use of the buildings is shown on Drawings 1-5 and 1-6 for the Coal Hollow Mine. There are no buildings in or within 1,000 feet of the permit area for the North Private Lease.

521.122. Surface and Subsurface Man-Made Features

The only known surface and subsurface manmade features that exist within the existing and proposed permit areas are:

- County Road 136 (locations shown on Drawing 5-3 and Drawing 5-47)
- Alton Coal Mine Road (location shown on Drawing 5-47)
- Water pipeline to Pond 20-1 (location shown on Drawing 7-7)
- Water pipelines for agricultural uses in the North Private Lease (locations shown on Figure 12 in Appendix 7-16)

521.123. Public Roads

Two Class B public roads, Kane County Road 136 (K3900) and Alton Coal Mine Road (K3100), areis located in or within 100 feet of the ~~proposed~~ permit areas and areis shown on Drawing 5-3 and Drawing 5-47. ~~This road will be temporarily relocated outside the permit area until mining is complete and then reconstructed.~~

In addition, Kane County has recently made a claim on the two-track road located adjacent to Lower Robinson Creek which is also located within the permit boundary. This road has mostly been closed to the public since it crosses private land and ACD has worked with Kane County to develop an access agreement which includes access through the permit area by mine personnel escort only. This agreement is included as Appendix 1-8 in Chapter 1. The County has named this Class D public road K3993.

~~The details for reestablishing road K3900 is shown on Drawings 5-22E, 5-22F and 5-22H. The details related to reestablishing K3993 following mining is shown on Drawing 5-22C.~~

521.124. Existing areas of spoil, waste, coal development waste, and noncoal waste disposal, dams, embankments, other impoundments, and water treatment and air pollution control facilities.

There are three impoundments currently located within the existing Coal Hollow Mine permit area which are Pond 20-1, Pond 29-3 and Pond 29-5 shown on Drawing 7-7. The area of these impoundments are approximately 3,400, 10,500 and 6,963 square feet respectively. There are four impoundments located within the North Private Lease permit area, Ponds 12-1 thru 12-3 and Pond 13-1 shown on Figure 12 in Appendix 7-16. The area of these impoundments are approximately 823, 3,853, 8,319 and 33,525 square feet, respectively.

There are no other areas of existing spoils, waste, coal development waste, and noncoal waste disposal, dams, embankments, other impoundments, and water treatment and air pollution control facilities within the permit area.

521.125. Ponds and Other Impoundments

The MRP does not contemplate construction of any permanent water impoundments; coal processing waste banks and coal processing waste dams or embankments. The planned location of each sedimentation pond is shown on Drawing 5-3 for the Coal Hollow Mine and Drawing 5-47 for the North Private Lease.

521.130. Landowners and Right of Entry and Public Interest Drawings.

All boundaries of lands and the names of present owners of record of both surface and subsurface within the Mine Permit Area are shown on Drawing 1-3 (Surface) and Drawing 1-4 (Subsurface).

521.132. Permit Boundary

The boundaries of land within the proposed permit area are shown on all applicable Drawings.

521.133. Public Roads

No mining or reclamation operations are planned within 100 ft. of an operating public road. However mine vehicles may cross the right-of-way of Kane County Road #136 for a short period early in the operation's life. Appropriate measures, including signage and mine operating practices and training will be implemented to protect the public.

521.133.2 Relocating a Public Road:

The design of any relocated road will be approved by Kane County authorities, or such other authorities as have jurisdiction. Appropriate measures will be taken to prevent entrance into the mining area via the pre-existing road, and appropriate signage and barriers will be installed to protect the public.

County Road 136 (K3900) and Alton Coal Mine Road (K3100) will be temporarily relocated outside the permit areas prior to mining for both the existing Coal Hollow Mine and the North Private Lease until mining is complete and then reconstructed. The relocation of County Road 136 for both the Coal Hollow Mine and the North Private Lease will require construction of temporary bypass roads. The locations of these bypass roads are shown in Drawings 5-3 and 5-45 for the Coal Hollow Mine and North Private Lease respectively. Plans and details for these roads are shown in Appendix 1-7 and 1-11. Each bypass road will be constructed, inspected, certified and available for public use prior to closure of the associated section of impacted County Road 136. The Alton Coal Mine Road (K3100) will not require a significant bypass, but will be accessed via a new intersection with the North Private Lease bypass road approximately 500 ft. south of the current intersection with County Road 136.

Upon completion of mining and reclamation activities in each permit area, the aforementioned pre-mining roads will be reestablished to their pre-mining state or better. The details for reestablishing road K3900 within the Coal Hollow Mine are shown on Drawings 5-22E, 5-22F and 5-22H. The details for reestablishing roads K3900 and K3100 within the North Private Lease are shown on Drawings 5-59 thru 5-61. The details related to reestablishing K3993 following mining are shown on Drawing 5-22C.

It is expected that County Road 136 will be diverted around the Coal Hollow Mine for approximately 5 years, and diverted around the North Private Lease for approximately 5 years.

521.140. Mine Drawings and Permit Area Drawings.

521.141 *The boundaries of all areas proposed to be affected over the estimated total life of the coal mining and reclamation operations, with a description of size, sequence and timing of the mining, the coal mining and reclamation operations to be conducted, the lands to be affected throughout the operation, and changes in facilities or features to be caused by the proposed operations;*

These items are depicted on Drawings 5-1 through 5-44 for the Coal Hollow Mine and on Drawings 5-45 through 5-78 for the North Private Lease.

Current land disturbance for the Coal Hollow Mine is shown on Drawing 5-2, while the expected land disturbance sequence for the North Private Lease is shown on Drawing 5-46. Total disturbance for the Coal Hollow mine is 342 acres, with no current plans to increase. Total disturbance for the North Private Lease is expected to reach a maximum of ~~230.8~~295.6 acres over a three year period, with 92.8 acres in the first year of operations, 90.8 acres in the second year, and 47.2 acres in the third year.

Overburden mining for the Coal Hollow Mine and North Private Lease is depicted on Drawing 5-16 and Drawing 5-57 respectively, according to the methods and schedules detailed in section 523 Mining Methods of this chapter.

Coal mining for the Coal Hollow Mine and North Private Lease is depicted on Drawings 5-9 & 5-10 and Drawings 5-52 & 5-53 respectively, according to the methods and schedules detailed in section 522 Coal Recovery of this chapter.

A layout of facilities, structures, and features for the Coal Hollow Mine and North Private lease is shown on Drawing 5-3 and Drawing 5-47 respectively. Sections 521.160, 521.170, and 521.180 of this chapter describe these features and their construction and use.

~~Two options are provided for f~~Final ~~r~~Reclamation plans of the Coal Hollow Mine permit area~~. The Preferred option is shown on Drawings 5-35 and 5-36. The anticipated time schedule for this option is shown on Drawing 5-38. This option includes mining operations transitioning into the adjacent federal coal reserves. In the case that these reserves are not acquired by ACD, an alternative plan~~ are~~is~~ provided in Drawings 5-37 and 5-37A. ~~which~~This reclamation requires rehandling much of the fill above original contour to fill in the final pits, especially Pit 10 which will remain open until the closure of underground operations. This rehandle will bring all disturbed ground back to Approximate Original Contour (AOC)~~.~~

~~If a circumstance occurs where mining of the permit area is complete and ACD has acquired the federal lease but permit approval has not yet been acquired to continue mining in the federal coal reserves; ACD requests that the Division consider a temporary cessation of operations at that time rather than requiring implementation of the alternate reclamation scenario. This temporary cessation could be granted for a sufficient period of time to allow ACD to acquire approval for transitioning mining operations into the adjacent federal coal reserves. The Division does have the authority to grant such an allowance based on R645-301-515.300. Should the alternative reclamation scenario be implemented prematurely, reclamation along the western side and south end of the permit area will either be excavated to recover coal or these coal reserves beneath and adjacent to the reclamation will be unrecoverable. Also, an additional excess spoil structure will have be constructed for the boxcut for the federal reserves.~~ . All post-mining landforms, drainage, and slopes will be consistent with pre-mining conditions and regional trends. A detailed description of the ~~two~~ reclamation scenario~~s and how each scenario would apply~~ is provided in Section 528.200 Overburden and 553 Backfilling and Grading of this Chapter. The Coal Hollow Mine requires 175.5 acres of Phase 1 reclamation, 342 acres of Phase 2, and 342 acres of Phase 3.

~~If ACD does not acquire the federal coal lease by the time that the final pit is complete, ACD will then immediately transition the reclamation plan to the alternative scenario.~~

Reclamation plans for the North Private Lease area are provided in Drawings 5-74 thru 5-76C.

These plans include restoration of all disturbed ground to AOC with only slight variation in landform, most notably a material void on the east of Kanab Creek which will result in a net increase of land available for agriculture and elimination of the center and western drainages east of Kanab Creek. All post-mining landforms, drainage, and slopes will be consistent with pre-mining conditions and regional trends. A detailed description of the reclamation scenario is provided in Section 528.200 Overburden and 553 Backfilling and Grading of this Chapter. The North Private Lease requires 181.0 acres of Phase 1 reclamation, 230.8 acres of Phase 2, and 230.8 acres of Phase 3.

Underground mining is also ~~proposed~~ permitted for ~~this~~ the Coal Hollow Mine~~site~~. Mine portals will be within an existing pit and coal will be loaded within the pit and hauled in the same manner as with the surface mining. Underground mining plans are shown in Drawings 5-3, 5-3B, 5-9 and 5-10.

521.142

Drawing 5-10 shows the underground workings. All underground coal mining will be first mining only. Subsidence will be prevented by following the recommendations provided in the Norwest Corporation letter report found in Appendix 5-9.

521.143 -The proposed disposal sites for placing excess spoil generated at surface areas affected by surface operations, underground operations and facilities for the purposes COAL MINING and RECLAMATION ACTIVITIES according to:

- *R645-301-211: The applicant will present a description of the premining soil resources as specified under R645-301-221. Topsoil and subsoil to be saved under R645-301-232 will be separately removed and segregated from other material.*

  The soil resources for the ~~proposed~~ excess spoil disposal area in the Coal Hollow Mine are described in Appendix 2-1. A plan has been developed for removal of topsoil and suitable subsoil based on the soil descriptions in this appendix. The handling plan can be viewed on Drawing 2-2. Topsoil and acceptable subsoil will be separately removed and segregated from other material prior to placement of any spoil.

  The soil resources for the North Private Lease temporary excess spoil disposal area are described in Volume 11. A plan has been developed for removal of topsoil and suitable subsoil based on the soil descriptions in this appendix. The handling plan can be viewed on Drawing 2-4. Topsoil and acceptable subsoil will be separately removed and segregated from other material prior to placement of any spoil.

- *R645-301-212: After removal, topsoil will be immediately redistributed in accordance with R645-301-242, stockpiled pending redistribution under R645-301-234, or if demonstrated that an alternative procedure will provide equal or more protection for the topsoil, the Division may, on a case-by case basis, approve an alternative;*

  Excess spoil will have topsoil and subsoil redistributed in an approximately uniform, stable thickness with the approved post mining land use, contours and surface water drainage systems. Material handling practices will prevent excess compaction of these materials. Handling practices will also protect the materials from wind and water erosion before and after seeding and planting.

- *R645-301-412.300: Criteria for Alternative Postmining Land Uses.*

  The MRP does not contemplate alternative postmining land uses.

- *R645-301-512.210: Excess Spoil. The professional engineer experienced in the design of earth and rock fills will certify the design according to R645-301-535.100.*

A professional engineer experienced in the design of earth and rock fills with assistance from a geotechnical expert has certified the design according to R645-301-535.100. These certifications can be viewed on Drawings 5-37, 5-~~-~~37A and 5-17 for the Coal Hollow Mine and Drawing 5-51A for the North Private Lease.

- *R645-301-512.220: Durable Rock Fills*

  No durable rock fills are planned.

- *R645-301-514.100: Excess Spoil. The professional engineer or specialist will be experienced in the construction of earth and rock fills and will periodically inspect the fill during construction. Regular inspections will also be conducted during placement and compaction of fill materials.*

  A professional engineer or specialist that is experienced in the construction of earth and rock fills will inspect the fill during construction and regular inspections will also be conducted during placement and compaction of fill materials.

- *R645-301-528.310: Excess spoil will be placed in designated disposal areas within the permit area, in a controllable manner to ensure mass stability and prevent mass movement during and after construction. Excess spoil will meet the design criteria of R645-301-535. For the purposes of SURFACE COAL MINING AND RECLAMATION ACTIVITIES, the permit application must include a description of the proposed disposal site and the design of the spoil disposal structures according to R645-301-211, R645-301-212, R645-301-412.300, R645-301-512.210, R645-528.310, R645-301-535.100 through R645-301-535.130, R645-301-535.300 through R645-301-535.500, R645-536.300, R645-301-542.720, R645-301-553.240, R645-301-745.100, R645-301-745.100, R645-301-745.300, and R645-301-745.400.*

  Excess spoil will be placed in the area designated on Drawing 5-3 and 5-~~35~~37 for the Coal Hollow Mine and on Drawing 5-47 and 5-51A for the North Private Lease. This fill will be placed in lifts not to exceed 4 feet. The material will be transported from the overburden removal area to the fill by end dump haul trucks and a dozer(s) will spread the spoil to this lift thickness. The fill will meet at minimum 85% compaction as related to the standard Procter. Final slopes will be regraded to a maximum slope of 3h:1v. The top of the fill will be sloped to approximately 2% to prevent pooling of water and to reestablish drainage similar to original flow patterns.

  The excess spoil placed on the non-mined areas of the Coal Hollow Mine is approximately 32 acres and varies in height from 35 to 110 feet. ~~The area of excess fill over mined out areas (variance from approximate original contour) is an extension of the fill placed on the non-mined area and is approximately 55 acres. Combined acreage of the excess fill placed on mined and non-mined areas is 87 acres and varies in height from 60 to 100 feet above original contour. Total~~

~~excess fill is 8.6 million yards.~~ Design of this fill can be viewed in Drawings 5-~~35~~ 37 through 5-~~36~~ 37A and the geotechnical study can be viewed in Appendix 5-1. Due to actual swell factors of overburden material differing from swell factors used in initial planning, the size and configuration of the excess spoils has varied greatly from what was originally analyzed in Appendix 5-1.

The temporary excess spoil placed on the subsequent pit areas of the North Private Lease is approximately 9 acres and varies in height from 23 to 59 feet. Design of this temporary fill can be viewed in Drawing 5-51A and the geotechnical study can be viewed in Appendix 5-11.

- *R645-301-535.100 through R645-301-130: Disposal of Excess Spoil*

A geotechnical analysis of the Coal Hollow Mine long term excess spoil structure design has been completed by an expert in this field. The long term static safety factor for this structure design is estimated at 1.6 to 1.7. Lifts will be placed in thicknesses not to exceed 4 feet. The lifts will meet 85% compaction by the standard Procter. The fill will be graded to allow for drainage similar to original patterns and to prevent excessive infiltration of water. Fill will be covered with subsoil and topsoil as specified in Chapter 2 to provide conditions suitable for revegetation of the area. The geotechnical study can be viewed in Appendix 5-1.

A geotechnical analysis of the North Private Lease temporary excess spoil structure design has also been completed by an expert in this field. The long term static safety factor for this structure design is estimated at 1.6 to 1.7. Lifts will be placed in thicknesses not to exceed 4 feet. The lifts will meet 85% compaction by the standard Procter. The fill will be graded to allow for drainage similar to original patterns and to prevent excessive infiltration of water. As this excess spoil structure will be rehandled to backfill the open pit in a short time frame (less than 6 months), it is not anticipated that this fill will be covered with subsoil and topsoil. The geotechnical study can be viewed in Appendix 5-11.

- *R645-301-535.300 through R645-301-535.500: Disposal of Excess - Spoil Durable Rock Fills.*

No durable rock fills are planned.

- *R645-301-536.300: Disposal of Coal Mine Waste in Excess Spoil*

No coal mine waste is planned in the excess spoil area.

- *R645-301-542.720: Excess spoil will be placed in designated disposal areas within the permit area, in a controlled manner to ensure that the final fill is suitable for reclamation and revegetation compatible with the natural surroundings and the approved postmining land use. Excess spoil that is combustible will be adequately covered with noncombustible material to prevent*

sustained combustion. The reclamation of excess spoil will comply with the design criteria under R645-301-553.240.

The Coal Hollow Mine long term excess spoil as shown in Drawing 5-~~35~~ 37 and 5-~~36~~ 37A will be suitable to the surrounding area and for the postmining land use of primarily grazing. No combustible excess spoil will be placed in the proposed structure. The reclamation of the spoil does not include any terraces and the slopes will not exceed 3h:1v.

The North Private Lease temporary excess spoil will be rehandled and used as backfill in a short time frame (less than 6 months) and will not require any reclamation measures.

- *R645-301-553.240: The final fill configuration of the fill (excess spoil) will be suitable for the approved postmining land use. Terraces may be constructed on the outslope of the fill if required for stability, control of erosion, to conserve soil moisture, or to facilitate the approved postmining land use. The grade of the outslope between terrace benches will not be steeper than 2h:1v (50 percent).*

The Coal Hollow Mine long term excess spoil as shown in Drawings 5-~~35~~ 37 and 5-~~36~~ 37A will be suitable to the surrounding area and for the postmining land use of primarily grazing. The reclamation of the spoil does not include any terraces and the slopes will not exceed 3h:1v. The long term static safety factor for these slopes is estimated to be 1.6 to 1.7.

- The North Private Lease temporary excess spoil will be rehandled and used as backfill in a short time frame (less than 6 months). The spoil will not include any terraces and the slopes will be maintained at no less than an overall 3h:1v. The static safety factor for these temporary slopes is estimated to be 1.6 to 1.7.

- *R645-301-745.100: General Requirements.*

  745.110: Excess Spoil will be placed in designated disposal areas within the permit area, in a controlled manner to:

  745.111: Minimize the adverse effects of leaching and surface water runoff from the fill on surface and underground water;

  Reclamation of the Coal Hollow Mine excess spoil will include topsoil and a subsoil layer. Infiltration through the reclamation is expected to be minimal based on the high clay content of these soils. The North Private Lease temporary excess spoil will be in use for such a short period of time and will be comprised entirely of high-clay tropic shale such that infiltration is also expected to be negligible. In addition, laboratory data for the overburden shows that there is

minimal potential for leaching of pollutants should infiltration rates become higher than expected.

The foundations of both of the excess spoil areas also ~~has~~ have high clay content with minimal potential for infiltration. This will provide an additional, natural barrier to protect ground water present beneath the proposed structures.

745.112: Ensure permanent impoundments are not located on the completed fill. Small depressions may be allowed by the Division if they are needed to retain moisture or minimize erosion, create and enhance wildlife habitat or assist revegetation, and if they are not incompatible with the stability of the fill; and

Permanent impoundments are not planned on either of the excess spoil areas. Small depressions may be constructed as allowed by the Division to retain moisture, minimize erosion, create and enhance wildlife habitat or assist revegetation.

745.113: Adequately cover or treat the excess spoil that is acid- and toxic forming with nonacid nontoxic material to control the impact on the surface and ground water in accordance with R645-301-731.300 and to minimize adverse effects on plant growth and approved postmining land use.

Laboratory data representative of the overburden planned for disposal in the excess spoil areas does not show acid- and toxic forming characteristics.

745.120: Drainage Control. If the disposal area contains springs, natural or manmade water courses, or wet weather seeps, the fill design will include diversions and underdrains as necessary to control erosion, prevent water infiltration into the fill and ensure stability.

A spring and seep survey available in Chapter 7 has identified no springs or wet weather seeps in the proposed excess spoil areas. The final surface of the Coal Hollow Mine excess spoil will be regraded to a contour that will route water from snowmelt and rainfall around the excess spoil as shown on the final contours Drawing 5-~~35~~37. There are no manmade water courses present in the excess spoil areas. No underdrains are planned for the excess spoil structures.

745.121: Diversions will comply with the requirements of R645-301-742.300

No diversions are planned in the excess spoil areas.

745.122 : Underdrains

No underdrains are planned in the excess spoil areas.

745.300: Durable Rock Fills

No durable rock fills are planned in the excess spoil areas.

745.400: Preexisting Benches

Excess spoil will not be disposed of through placement on preexisting benches.

521.150. Land Surface Configuration Drawings.

Surface contours representing the existing land surface configuration of the ~~proposed~~ Coal Hollow Mine permit area are shown on Drawing 5-1 and the post mining land configuration is shown on 5-~~35~~37. Cross sections with both these landforms are shown on Drawing 5-~~36~~37A.

Surface contours representing the existing land surface configuration of the proposed North Private Lease permit area are shown on Drawing 5-45 and the post mining land configuration is shown on 5-74. Cross sections with these landforms are shown on Drawing 5-75.

521.151 Slope Measurements or Surface Contours:

For both the Coal Hollow Mine and the North Private Lease, Drawings 5-1, 5-37 & 5-37A and Drawings 5-45, 5-74 & 5-75 respectively use topographical contours to represent the surface configuration for pre- and –post mining scenarios. The contours for the Coal Hollow Mine drawings occur at 5 ft. elevation intervals, with index contours occurring at 25 ft. elevation intervals. The contours for the North Private Lease drawings occur at 4 ft. elevation intervals, with index contours occurring at 20 ft. elevation intervals. Each Drawing has been certified according to R645-301-512.

521.152 Previously Mined Areas:

Neither the Coal Hollow Mine nor the North Private Lease propose activities on areas that have been previously mined.

521.160. Maps and Cross sections of the Proposed Features for the Proposed Permit Area. These maps and cross sections will clearly show:

521.161 Buildings, utility corridors, and facilities to be used:

These items are shown on Drawings 5-3 through 5-8C for the Coal Hollow Mine and on Drawing 5-47 for the North Private Lease.

521.162 The area of land to be affected within the proposed permit area, according to the sequence of mining and reclamation:

A yearly and overall disturbance sequence for the permit area is provided on Drawing 5-2 for ~~open pit mining and on Drawing 5-2A for the alternative method of highwall mining~~the ~~existing~~Coal Hollow Mine and on Drawing 5-46 for the North Private Lease.

521.163 Each area of land for which a performance bond or other equivalent guarantee will be posted under R645-301-512;

The area of land that will have a performance bond posted in the Coal Hollow Mine is shown on Drawing 5-3. Drawing 5-3 was reconfigured in December of 2014 prior to phased bond release to remove performance bond from areas that are no-longer within the MRP planed disturbance (not disturbed by mining), thus removing the need to include in bond release. The area of land that will have a performance bond posted in the North Private Lease is shown on Drawing 5-47

521.164 Each coal storage, cleaning and loading area. The map will be prepared and certified according to R645-301-512;

These facilities can be viewed on Drawings 5-3 through 5-5 for the Coal Hollow Mine and on Drawing 5-47 through 5-51A for the North Private Lease.

521.165 Each topsoil, spoil, coal preparation waste, underground development waste, and noncoal waste storage area. The maps will be prepared and certified according to R645-301-512;

For the Coal Hollow Mine, ~~Topsoil~~ topsoil storage areas and handling can be viewed on Drawing 2-2. Spoil placement and the excess spoil structure can be viewed on Drawings 5-3, 5-17, ~~5-18, 5-19,~~ 5-~~35~~ 37 and 5-~~36~~37A.

For the North Private Lease, topsoil storage areas and handling can be viewed on Drawing 2-4. Temporary spoils placement can be viewed on Drawing 5-47 through 5-51A.

521.166 Each source of waste and each waste disposal area relating to coal processing or pollution control;

Only sizing of the coal is proposed. This process will not produce any waste.

521.167 Each explosive storage and handling facility;

Need for these facilities are not anticipated at this time. Should these facilities become necessary, appropriate drawings will be provided to the Division.

521.168 For the purposes of SURFACE COAL MINING AND RECLAMATION ACTIVITIES, each air pollution collection and control facility; and

There are no specific air pollution collection or control facilities proposed.

521.169 Each proposed coal processing waste bank, dam or embankment. The map will be prepared and certified according to R645-301-512.

The MRP does not contemplate processing of coal that will produce waste.

521.170. Transportation Facilities Drawings.

Transportation facilities for the Coal Hollow Mine include eight primary roads, a conveyor system, and miscellaneous ancillary/temporary roads. Numerous drawings detail the designs and specifications for each one of the proposed facilities. The following is a description of each facility and a reference for the associated drawings:

- Roads: Two primary mine haul roads are planned within the permit area. The first road extends from the coal unloading area to the first series of pits along the west side of the property. This road will be utilized for access to the pits (pits shown on Drawing 5-10). This road will be approximately 2,800 feet in length and will be utilized throughout mining. There will be three culverts installed along this road all sized for a 100 year, 24 hour storm event. The first culvert will be across a tributary of Lower Robinson Creek and will be a 36 inch corrugated steel pipe. The second culvert is the main crossing over Lower Robinson Creek and is a 96 inch corrugated steel pipe. Both of these culverts have been sized based on analysis of the Lower Robinson Creek watershed. This analysis can be viewed in Appendix A5-3. The third culvert is crossing over a diversion ditch that will route water mainly from disturbed areas along the south side of Lower Robinson Creek to a sediment impoundment. This culvert will be a 24 inch corrugated steel pipe.

  The second road extends from an intersection with the first road, located just south of the Lower Robinson Creek crossing, and proceeds southeast to long term topsoil stockpile 2 and subsoil stockpile pile 1. This road is approximately 1,300 feet in length. There is one culvert crossing along this road to cross a diversion ditch. This culvert will be a 24 inch culvert sized for maximum anticipated flows in the diversion.

  The following specifications apply to these Primary mine haul roads:
  1) Roads will be approximately 80’ in width
  2) Approximately a 2% crown
  3) Approximately one foot deep cut ditches along shoulders for controlling storm water

4) 18" of crushed rock or gravel for road surfacing
5) Cut and fill slopes of 1.5 h:1v
6) Minimum fill over each culvert will be 2 times diameter of culvert
7) Berms placed as necessary along fills

The underground mine portal access and haul road in Pit 10 will also be a primary road. This road is accessed from the main haul road from the coal unloading area. The underground access/haul road will be constructed to the same specifications for the haul roads above, except that the road may be narrowed to a 40 foot width.

The ancillary roads will have similar specifications except surfacing will occur only as needed and may be narrowed to a 40 foot road width. A typical cross section for the ancillary roads can be viewed on Drawing 5-24.

The location and details for Primary Mine Haul roads can be viewed on Drawings 5-3 and 5-22 and 5-23.

In addition to the two roads primary Mine Haul roads, the road located within the facilities area is also classified as a primary road. This road is planned to be 24 feet wide with 24 inches of compacted sub base and 8 inches of compacted 1 inch minus gravel as surfacing. This road is referred to as "Facilities Roadway" and more details are described in 527.200 along with Drawings 5-22A and 5-22B.

In addition to the primary roads that will be present during active mining, four additional roads are planned to exist postmining and are also classified as primary roads for this reason.

Roads that will remain postmining are the following:

- Road to Water Well with details shown on Drawing 5-22D
- Road to east C. Burton Pugh property (K3993) with details shown on Drawing 5-22C. Kane County has claimed this road as County Road K3993.
- County Road 136 (K3900) with details on Drawing 5-22E, 5-22F and 5-22H. This County road will be reconstructed within the permit area by Kane County. This reconstruction will occur concurrently with the final phase of reclamation as scheduled on Drawing 5-38 and is expected to be completed by 2017.
- Road to Swapp Ranch (same specification as the Water Well Road)

The location of these roads is shown on Drawing~~s 5-35 and~~ 5-37 along with the post mining topography.

The ramps, benches and equipment travel paths within the active surface mining area are temporary in nature and will be relocated frequently as mining progresses. These temporary travelways are considered part of the pit due to their short term use, and

are not individually designed nor engineered. They will be built and maintained to facilitate safe and efficient mine and reclamation operations.

- Conveyors: A conveyor system will be used to stockpile coal and to load highway approved haul trucks for transportation to market. The first conveyor is mainly a stacker system for the coal stockpile which will be located at the coal unloading area and will be approximately 451' in length. This conveyor is estimated to be a 48" solid frame system.

  The second conveyor is a coal reclaim belt that will be loaded by an above ground reclaim feeder from the coal stockpile and will convey coal to the loadout chute which will load the highway approved coal haulage trucks. This section will be approximately 290' in length. Similar to the first section, this conveyor is estimated to be a 48" solid frame system.

  An additional stacking conveyor will be installed to transfer coal from the underground conveyor system to stockpile from which trucks will be loaded. The stacking conveyor will be a 48" wide, wheel-mounted system, approximately 125' in length.

  Drawings of these systems can be viewed on Drawings 5-3 through 5-5.

Transportation facilities for the North Private Lease will consist of two primary roads, and miscellaneous ancillary/temporary roads. Drawings detail the designs and specifications for each one of the proposed facilities. The following is a description of each facility and a reference for the associated drawings:

- Roads: A primary haul road shown in Drawings 5-47, 5-58 and 5-59 will extend from the entrance of the permit area to the Western end of Pit 19. This road is approximately 3,540 feet in length. This road is referred as the "Northern Haul Road". A second primary haul road shown in Drawings 5-47 and 5-60, the "Southern Haul Road" extends from the South end of Pit 1 on the West, to the South end of the Highwall Trench on the East. This road is approximately 2,980 feet in length. There are three culvert crossings along this road as shown in Drawing 5-60 including a substantial culvert to cross Kanab Creek. Culvert 1 (C-1) is sized at 24 inches. C-2 is sized at 48 inches to match the current culvert under County Road 136, and C-3 is sized at 172 inches for maximum anticipated flows in Kanab Creek. Final design of this culvert will be in conjunction with approvals and oversight from the Army Corps of Engineers. Culvert sizing calculations can be found in Appendix 5-12.

  The following specifications apply to this Primary mine haul roads:

  1) Roads will be approximately 80' in width
  2) Approximately a 2% crown
  3) Approximately one foot deep cut ditches along shoulders for controlling storm water

4) 18" of crushed rock or gravel for road surfacing
5) Cut and fill slopes of 1.5 h: 1v
6) Berms placed as necessary along fills

The ramps, benches and equipment travel paths within the active surface mining area are temporary in nature and will be relocated frequently as mining progresses. These temporary travelways are considered part of the pit due to their short term use, and are not individually designed nor engineered. They will be built and maintained to facilitate safe and efficient mine and reclamation operations.

521.180. Support facilities.

Description of the support facilities is provided in Section 526.220. Drawings 5-3, 5-3B, 5-4, 5-5, 5-6, 5-7, 5-8, 5-8A, 5-8B, ~~and~~ 5-8C, and 5-47, provide the maps, appropriate cross-sections, design drawings and specifications to demonstrate compliance with R645-301-526.220 through R645-301-526.222 for each facility.

521.200. Signs and Markers Specifications.

Signs and markers will be posted, maintained, and removed by Alton Coal Development LLC. Signs and markers will be a uniform design that can be easily seen and read; made of durable material; conform to local laws and regulations, and be maintained during all activities to which they pertain;

521.240. Mine and Permit Identification Signs.

Identification signs showing the name, business address, and telephone number of Alton Coal Development LLC and the identification number of the permanent program permit authorizing coal mining and reclamation operations will be displayed at each point of access to the permit area from public roads, and will be retained and maintained until after the release of all bonds for the permit area;

521.250. Perimeter Markers.

The perimeter of a permit area will be clearly marked before the beginning of surface mining activities;

521.260. Buffer Zone Markers.

Buffer zones will be marked along their boundaries as required under 731.600

521.270. Topsoil Markers.

Markers will be erected to mark where topsoil or other vegetation - supporting material is physically segregated and stockpiled.

522. **COAL RECOVERY**.

The MRP is designed to maximize recovery of the coal resource within technological, safety and legal limitations. Coal will be recovered from the Smirl Seam which ranges in thickness from ~~13.5~~11.0 to 18.5 feet averaging approximately 16 feet in the planned mining area. The Smirl Seam is the only surface mineable seam in the permit area. Isopach maps of the coal thickness and strip ratio can be viewed on Drawings 5-13 and 5-14 for the Coal Hollow Mine and Drawings 5-54 and 5-55 for the North Private Lease.

Some coal along the boundaries of the mine area will not be recovered in conjunction with the proposed operation. This includes coal underlying the pit highwalls and areas where drainage or sedimentation control structures (diversions, ditches, ponds, etc) are located. The mine is designed to minimize such losses by locating haulage ramps in the spoil rather than on the pit wall, by oversteepening the coal face at the pit edges, and by minimizing the use of out of pit ancillary roads. Coal which is left in place in these areas may be recovered in the future when adjacent property rights are secured. Current plans are for a planned maximum mining depth of approximately 200 ft. and a strip ratio of 10:1; however, the ultimate mining depth will depend on cost related factors.

~~A detailed mine plan has been developed for the proposed permit area and the following table along with Drawing 5-9 summarize the coal extraction for the permit area for open pit mining.~~

A detailed mine plan has been developed for the proposed permit area and the following tables for each area along with Drawing 5-9 for the Coal Hollow Mine and Drawing 5-52 for the North Private lease summarize the coal extraction for the permit area for the open pit mining, highwall mining and underground mining:

Existing Coal Hollow Mine

Description	Extraction Status	Average Coal Thickness (ft)	Average Strip Ratio* (yd^3/Ton)	Quantity (**Ton)
Total Coal within Permit Boundary	N/A	16.3	7.7	12,092,000
High Strip Ratio Area (NE corner of permit area)	Not Mined	16.0	13.5	2,930,000
Coal under highwalls and sedimentation structures	Not Mined	17.2	4.8	2,305,000
Coal under Robinson Creek Diversion	Not Mined	15.5	3.9	172,000
Highwall & Underground	Not Mined	16.0	0	2,662,000
Recoverable Coal (Surface)	Mined	16.3	6.4	3,298,000
Recoverable Coal	Mined	16.0	0	725,000

(Underground)				

*All strip ratios are bank cubic yards of overburden to tons of coal
**All coal tons are based on a 95% recovery factor for open pit mining and 45% for highwall mining and the underground mining.

North Private Lease

Description	Extraction Status	Average Coal Thickness (ft)	Average Strip Ratio* (yd^3/Ton)	Quantity (**Ton)
Total Fee Coal within Permit Boundary	N/A	15.4	4.5:1	7,127,300
Coal under highwalls and sedimentation structures	Not Mined	15.1	10.1:1	1,934,600
Highwall	Not Mined	15.2	0	1,528,100
Highwall	Mined	15.2	0	785,700
Open Pit	Mined	15.6	6.0:1	2,878,900
Total Recoverable Coal (Surface)	Mined	15.5~~6~~	4.6~~5~~:1	3,664,600

*All strip ratios are bank cubic yards of overburden to tons of coal
**All coal tons are based on a 95% recovery factor for open pit mining and 35% for highwall mining.

Once approval is received to progress with mining on the adjacent federal coal reserves, an additional 57% of the coal under the highwalls will be recovered as part of the progression into these adjacent reserves.

With open pit mining, the application of highly flexible, open pit truck/shovel techniques will minimize losses of coal due to pit geometry or spoil support requirements, allowing the maximum possible exposure of the coal resource. The full seam section will be loaded primarily using large hydraulic backhoes. The backhoes, which can work from the top of the seam, provide the ability to efficiently and cleanly excavate the lower part of the coal seam without disturbing the pit floor. This, along with the machine's high degree of bucket horizon control will minimize floor losses. The backhoes can also work safely from the top of the seam to over steepen the loading face along the pit walls, thus recovering the maximum amount of coal.

Where pit geometry or operational factors preclude the use of backhoes for loading, a large rubber tire front end loader will be used. These machines provide similar horizon control, can operate on the floor of the pit or on an intermediate bench, and can recover coal from confined areas such as the ends of the pits.

With the highwall miner, the application of a highwall mining system will be employed to recover coal from the exposed face. In this method of mining, an unmanned cutter module is driven underground and operated in front of the highwall. The highwall

mining machine stands on the pit floor or on a bench, directly in front of the exposed seam and makes long parallel rectangular drives into the coal seam. A remote-operated cutter module is pushed into the seam by a string of push beams (unmanned coal-conveying elements) that transport the mined coal back to the entry of the drive onto a stockpile.

The underground mining will utilize standard extraction methods. These will include a continuous miner, shuttle cars and a conveyor system to the surface. The mine plan calls for first mining only to prevent subsidence. Coal brought to the surface will flow to a stacking conveyor and stockpile as shown on Drawing 5-3B.

The limited extraction, first-mining only and compliance with the recommendations in the Norwest Report (Appendix 5-9) will ensure access in the event the portals should need to remain open for future underground operations.

For the Coal Hollow Mine, ~~R~~rear dump haul trucks, loaded by the backhoes or front end loader, will be used to move the coal from the pit via inpit roads and the primary haulroad to the crusher and stockpile. The trucks will be equipped with "combo" beds suitable for hauling both coal and overburden, and configured to minimize coal spillage. For the North private Lease, over-the-road trucks, loaded by the backhoes or front end loader, will be used to move the coal from the pit via inpit roads and the primary haulroad to the Coal Hollow Mine crushing facility.

A net recovery of 95% (including the effects of in-pit coal losses and out-of-seam dilution) of the coal exposed in the open pit is anticipated. A net recovery of 45% of the coal mined by the highwall system as well as the underground mining is anticipated. Normal coal losses are expected due to cleaning of the top of the seam, loading losses at the seam floor, and coal oxidation near the outcrop.

No coal washing is contemplated at this time, thus there will be no coal processing losses.

Maps and cross sections providing detailed information related to coal recovery activities can be viewed on Drawings 5-9 through 5-14 for the Coal Hollow and on Drawings 5-52 through 5-55.

523. **MINING METHOD(s).**

The Coal Hollow Mine will be a combination coal mining operation, utilizing open pit mining, highwall mining and underground mining methods. Primary mining equipment will include hydraulic excavators, a highwall miner, standard underground mining equipment including a continuous miner, shuttle cars and conveyor system, and end-dump mining trucks. The coal will be crushed at the mine site, and hauled to market in over-the-road coal trucks.

The Coal Hollow ~~n~~Mine is planned to produce approximately ~~3.5~~2.7 million tons of coal over a life of approximately ~~5~~6 years. The estimated production schedule is summarized below:

Production Schedule		
		Tons Produced
Year		(000)
2011~~1~~		~~542~~405
2012~~2~~		~~505~~578
2013~~3~~		~~568~~741
2014~~4~~		~~685~~534
2015 - Projected~~5~~		~~762~~395
~~6~~		~~431~~
Total		~~3,493~~2,653

Initial mine development will involve removal and storage of topsoil from mine infrastructure locations. Facilities for equipment maintenance/warehouse, coal handling, and offices will be constructed. During the development and initial mining period, facilities temporary in nature may be used until permanent facilities can be built. Construction of sedimentation ponds, diversion ditches, and mine roads accessing the initial mining areas will also be ongoing.

Mining will employ typical open pit methods using truck/loader type equipment to remove overburden and recover the coal. Mining will advance across the property in successive cuts approximately 250 ft. in width and 800 to 1,300 ft. long (generally equal to the width of the property less property barriers). Layout of these pits can be viewed on Drawing 5-10. Drawing 5-10 has been modified from the original layout to accommodate modifications to the plan for highwall mining, underground mining and anomalies encountered in the coal (large sand channels), thus the non-sequential numbering of the pits. The overburden will be removed in layers or lifts approximately 20 to 40 feet deep. In practice, these overburden lifts are mined in a stairstep fashion ahead of the coal removal operation to provide adequate working room for the equipment and stable advancing slopes. Once mining is complete, excavated overburden (spoil) from a successive cut is used to backfill the excavation. General cross sections of this process can be viewed on Drawings 5-11 and 5-12.

Prior to beginning mining, the area will be cleared of vegetation, and the topsoil will be recovered and either stockpiled or live hauled to regraded areas. It is not anticipated that blasting of the overburden will be necessary based on drilling data. Should this process become necessary, this is the phase where it would be implemented. Overburden will then be removed using large hydraulic excavator(s) or front end loaders and off-road trucks which will haul the spoil and place it in parts of the pit where the coal has been removed, or in the excess spoil area shown on Drawings 5-3, 5-~~35~~37 and 5-~~36~~37A. Overburden is removed in successively deeper benches until the coal seam is exposed.

Some overburden in lower lifts may be moved by direct dozing into the mined out pit by large bulldozers.

When overburden removal is finished in a particular pit, the top of the coal will be cleaned (removal of any roof rock or other non-coal material on top of the seam) using a motor grader, dozer or front end loader. The material removed will be placed in the adjacent mined out pit. For the open pit mined coal, if necessary, the coal seam will be loosened by drilling and blasting or ripping prior to loading. Drilling and blasting of the coal is not expected to be necessary. The cleaned, exposed coal is then excavated by backhoe or front end loader and placed into off-road rear dump trucks. Coal mined with a highwall miner would not require blasting.

Once the coal is removed, the pit will be backfilled by spoil from adjacent mine pits. Spoil will be placed in lifts and spread with a dozer. Once the pit is backfilled to the planned final surface contour, suitable topsoil and subsoil will be replaced, and the area reseeded. Revegetation work will proceed seasonally as appropriate for planting.

Overburden excavation and coal mining at Coal Hollow will begin near the subcrop of the coal seam at the western end of the permit area in the NW ¼ NE ¼ of Section 30, T39S, R5W. Topsoil will be removed and stored separately in topsoil stockpiles as shown on Map 2-2. Overburden from the initial pits will be hauled to the excess spoil pile east of the mining area. Once the initial pits are established, as much spoil as possible will be placed directly in the pit backfill, allowing reclamation to closely follow mining. This initial phase includes pits 1 through 9 as shown on Drawing 5-10.

From the initial mining area, operations will proceed from the southeast ¼ of Section 30, beginning with pit 28 and proceeding north to pit 22. Pit 9 will not be backfilled at this stage; it has been left open for placement of the highwall miner to recover coal from panels 1-3. In hole 27 of Pit 9 Panel 3, the highwall miner head became lodged. Another head was leased in order to continue highwall mining in pits 22 and 23 while a recover plan was approved to mine Pit 10 and recover the lodged miner head. Pit 21 was then mined along the highwall panels in 21, then Pit10. Pit 10 will remain open for development of the underground portals and remain open until all underground coal is mined. Surface mining will continue with mining of Highwall Trench (HWT) 1 continuing south to HWT 3.~~The proposed method for filling this pit back to approximate original contour will be accomplished by utilizing overburden from the pit(s) in the adjacent federal reserves located east of Pit 6. Alton Coal Development, LLC is currently in the process of an Environmental Impact Study for these reserves with the intent of acquiring the rights to mine. It is expected that these rights will be acquired prior to the completion of the final phase in the proposed Permit Area. Also, if acquired, Pit 10 along with the underground portals will remain open to access underground coal within the LBA. The final landform for the Permit Area is shown on Drawings 5-35 and 5-36.~~

~~In the case that Alton Coal Development, LLC is not successful with acquiring the rights to the adjacent federal coal reserves, spoil will be rehandled from the excess spoil and~~

~~variance from the approximate original contour to fill the remaining pits. The final landform for this alternate scenario is shown on Drawing 5-37 and 5-37A.~~

~~An estimate of the primary mining equipment planned for use at the Coal Hollow Mine is listed below:~~

~~Diesel - Hydraulic Excavators (15 to 38 cu. yd. capacity)~~
~~Highwall Mining System (CAT HW300 or equivalent)~~
~~Rubber Tired Front End Loaders (8 to 20 cu. yd. capacity)~~
~~End Dump Trucks (100 to 240 ton capacity class)~~
~~Track Dozers (Caterpillar D7 through D11 Class)~~
~~Motor Graders (Caterpillar 16H to 24H Class)~~
~~Water Trucks (8,000 to 20,000 Gallon Class)~~
~~Underground miner and associated equipment~~

~~A variety of other equipment will also be used to support the mining operation.~~

~~Proposed engineering techniques for meeting the proposed mining methods will include:~~

- ~~Design support for roads, pits, sediment impoundments etc…~~
- ~~Field staking of designs utilizing high precision GPS survey systems.~~
- ~~Weekly field engineering support to view and provide guidance related to designs and environmental controls.~~
- ~~Ongoing geotechnical support for ensuring highwall stability~~
- ~~As additional information becomes available, update geological models to ensure full recovery of resource.~~
- ~~Weekly mine plans that specify appropriate engineering and environmental specifications.~~

~~There are no known underground mines within 500 feet of the permit boundary. No surface mining or reclamation activities are proposed to take place within 500 feet of the underground mine.~~

The North Private Lease will be a combination coal mining operation, utilizing open pit mining, and highwall mining. Primary mining equipment will include hydraulic excavators, a highwall miner, and end-dump mining trucks. The raw coal will be mined from the open pits and loaded to over-the-road coal trucks and delivered to the Coal Hollow Mine for crushing then hauled to market in over-the-road coal trucks.

The North Private Lease is planned to produce approximately 3.7 million tons of coal over a life of approximately 6 years. The estimated production schedule is summarized below:

Production Schedule		
		Tons Produced
Year		(000)
1		785
2		7554

3		8076
4		721
5		374
6		223
Total		3,6653

Initial mine development will involve removal and storage of topsoil from mine infrastructure locations. Construction of sedimentation ponds, diversion ditches, and mine roads accessing the initial mining areas will also be ongoing.

Mining will employ typical open pit methods using truck/loader type equipment to remove overburden and recover the coal. Mining will advance across the property in successive cuts approximately 200 ft. in width and 500 to 1,300 ft. long. Layout of these pits can be viewed on Drawing 5-52. The overburden will be removed in layers or lifts approximately 20 to 40 feet deep. In practice, these overburden lifts are mined in a stair step fashion ahead of the coal removal operation to provide adequate working room for the equipment and stable advancing slopes. Once mining is complete, excavated overburden (spoil) from a successive cut is used to backfill the excavation. General cross sections of this process can be viewed on Drawings 5-11 and 5-12.

Prior to beginning mining, the area will be cleared of vegetation, and the topsoil will be recovered and either stockpiled or live hauled to regraded areas. It is not anticipated that blasting of the overburden will be necessary based on drilling data. Should this process become necessary, this is the phase where it would be implemented. Overburden will then be removed using large hydraulic excavator(s) or front end loaders and off-road trucks which will haul the spoil and place it in parts of the pit where the coal has been removed, or in the temporary spoil area shown on Drawings 5-47. Overburden is removed in successively deeper benches until the coal seam is exposed. Some overburden may be moved by direct dozing into the mined out pit by large bulldozers.

When overburden removal is finished in a particular pit, the top of the coal will be cleaned (removal of any roof rock or other non-coal material on top of the seam) using a motor grader, trackhoe, dozer or front end loader. The material removed will be placed in the adjacent mined out pit. For the open pit mined coal, if necessary, the coal seam will be loosened by drilling and blasting or ripping prior to loading. Drilling and blasting of the coal is not expected to be necessary. The cleaned, exposed coal is then excavated by backhoe or front end loader and placed into over-the-road trucks. Coal mined with a highwall miner would not require blasting.

Once the coal is removed, the pit will be backfilled by spoil from adjacent mine pits. Spoil will be placed in lifts and spread with a dozer. Once the pit is backfilled to the planned final surface contour, suitable topsoil and subsoil will be replaced, and the area reseeded. Revegetation work will proceed seasonally as appropriate for planting.

Overburden excavation and coal mining at the North Private Lease will begin near the subcrop of the coal seam at the southwestern end of the permit area in the SW ¼ NW ¼

of Section 13, T39S, R5W. Topsoil will be removed and stored separately in topsoil stockpiles as shown on Map 2-2N. Overburden from the initial pit 1 and southern half of 2 will be hauled to the temporary excess spoil pile located on the future pits 3, 4 and 5. Once the initial pit is established, as much spoil as possible will be placed directly in the pit backfill, allowing reclamation to closely follow mining. As mining progresses to Pit 3, material from the temporary excess spoil pile can be rehandled to be placed in the mined out void. As mining proceeds from pit 5 to pit 10 all spoils mined is placed into pit backfill. This initial phase includes pits 1 through 10 as shown on Drawing 5-53.

From the initial mining area, operations will proceed to the North to Pit 21. All spoils are placed in the proceeding void. Once coal is removed from Pit 21, overburden from the development of the highwall trench will be used to backfill the remaining Pit 21.

The final mining area will be developed on the East side of Kanab Creek. Overburden from Highwall Trench 1 will proceed north in the trench with overburden being placed into the previously mined out area. Backfill for the final Highwall Trench will come from the temporary overburden stockpiles.

Alton Coal Development, LLC is currently in the process of an Environmental Impact Study for Federal Reserve's adjacent to the private mining areas known as the LBA. It is expected that these rights will be acquired prior to the completion of the final phase in the proposed Permit Area. Also, if acquired, Pit 10 along with the underground portals will remain open to access underground coal within the LBA. The final landform for Coal Hollow Mine is shown on Drawings 5-37 and 5-37A. The final landform for the North Private Lease is shown on Drawings 5-74 and 5-75.

An estimate of the primary mining equipment planned for use at the Coal Hollow Mine and North Private Lease is listed below:

Diesel - Hydraulic Excavators (15 to 38 cu. yd. capacity)
Highwall Mining System (CAT HW300 or equivalent)
Rubber Tired Front End Loaders (8 to 20 cu. yd. capacity)
End Dump Trucks (100 to 240 ton capacity class)
Track Dozers (Caterpillar D7 through D11 Class)
Motor Graders (Caterpillar 16H to 24H Class)
Water Trucks (8,000 to 20,000 Gallon Class)
Underground miner and associated equipment

A variety of other equipment will also be used to support the mining operation.

Proposed engineering techniques for meeting the proposed mining methods will include:

- Design support for roads, pits, sediment impoundments etc…
- Field staking of designs utilizing high precision GPS survey systems.
- Weekly field engineering support to view and provide guidance related to designs and environmental controls.
- Ongoing geotechnical support for ensuring highwall stability

- As additional information becomes available, update geological models to ensure full recovery of resource.
- Weekly mine plans that specify appropriate engineering and environmental specifications.

There are no known underground mines within 500 feet of the permit boundary. No surface mining or reclamation activities are proposed to take place within 500 feet of the underground mine.

524. BLASTING AND EXPLOSIVES

~~As a result of the 2005 drilling program and overburden characterization, it was~~ initially ~~determined that the soil over the coal seam is void of any solid structure and that the overburden is extremely homogenous consisting of soft clay and soft shale. As results of~~

~~this cursory investigation, it is was anticipated that there would be no need to drill and blast the overburden to facilitate the removal of the spoil above the coal seam. After commencement of mining at the Coal Hollow Mine, the structure of the shale and clay proved to be more solid than anticipated and therefore required blasting to facilitate timely removal of overburden. Also, due to the fact that the coal will have to be mined from on top of the seam due to wet clay zone beneath the coal seam It is was initially anticipated that there would be no need to drill and blast the coal seam to facilitate coal removal, and that has remained to be the case in most circumstances. It is further expected that blasting operations will continue to be required at the North Private Lease.~~

~~As a safeguard or fallback position if mining condition should change, all blasting and explosive criteria will be addressed.~~

~~Though not anticipated, e~~Explosives ~~may~~ will be utilized as necessary at Coal Hollow Mine and the North Private Lease to break the overburden over the coal and may be used to break the coal for loading if necessary. In accordance with the requirements of this section, a blasting plan is provided to the Division in Appendix 5-4. Blasts that use more than five pounds of explosives or blasting agents will be conducted according to the schedule provided in R645-301-524.~~524.400~~.

524.100 Blaster Certification

Alton Coal Development, LLC (ACD) will, prior to conducting any surface blasting operations, ensure that all surface blasting incident to surface mining in Utah is conducted under the direction of a Utah Certified Blaster. ~~Certificates of blaster certification will be carried by the blasters or will be on file at the mine permit area during blasting operations~~Blaster certifications will be carried on the person of the Certified Blaster and copies of the Blasting license(s) will be on file at the mine. A blaster and at least one other person will be present at the firing of a blast.

The Certified Blaster will be responsible~~Persons responsible~~ for blasting operations at the~~a~~ blasting site, ~~will~~ be familiar with the blasting plan and site-specific performance standards, and give on-the-job training to persons who are not certified and who are assigned to the blasting crew or assist in the use of explosives.

524.200 Blast Design

There are no dwellings, public buildings, schools, churches, or community or institutional building within 1,000 feet of the planned blasting area for either the Coal Hollow Mine or the North Private Lease ~~in the initial (year 1) mining period~~. There are also no historic underground mines within 500 feet of either of the permit areas. ~~The anticipated blast design can not be reasonably estimated at this time since ACD is not sure what geologic conditions exist that may require blasting. If conditions are encountered that require blasting, ACD will provide the Division with the designed pattern prior to conducting blasting.~~

Overburden shot size is generally 450x200 ft or 200,000 cubic yards. A typical overburden blast design has a burden and spacing of 18x18ft at a depth of 60ft. Stemming height is typically 13 ft. Shots will be loaded with Ammonium Nitrate Fuel Oil (ANFO) in dry holes, and packaged emulsion on wet holes. Average pounds per hole will be 833 lbs. Powder Factors ~~are typically 1.1 lbs/cyd~~can range from .4 lbs/cyd to 1.25 lbs/cyd depending on geology. Each hole will have at least one booster (0.75 lb or 1 lb) and a 25/500ms nonel cap, as shown in Figure 1 of Appendix 5-4.

Timing will typically be 25 ms between holes with 84 ms between rows, and follow the pattern shown in Figure 2 of Appendix 5-4.

The closest structure to any blast pattern for the Coal Hollow Mine is the Richard Dame (Swapp Ranch) property at 1,585 ft. from the closest blast pattern. For the North Private Lease, the nearest structures are located in the town of Alton, over 2~~500~~686 ft. away. The required scaled distance is 55 for Coal Hollow Mine and 55 for the North Private Lease per 524.640 – 662. Based on these scaled distances, the maximum pounds of explosives per 8 ms delay is 2,066 lbs for the Coal Hollow Mine and North Private Lease respectively.

The above blast design, loading, and timing are general designs for the mine and may be altered due to geology, mine design, production needs, and blast optimization.

Blasts conducted within 1000 ft. of a dwelling, public building, school, church, or community or institutional building will be submitted for Division and MSHA approval, prior to blasting. The blast design and shot report will contain sketches of the drill and delay patterns, decking, type and amount of explosives required per blast, critical dimensions, design factors utilized to protect the public, general location drawings of protected structures, which meet the applicable airblast, flyrock, and ground vibration standards in 524.600.

The blast design and shot report will be prepared and signed by a Utah certified blaster. Records documenting blasting operations will be maintained at the mine site for at least three years and upon request will be made available to the Division upon request. These records will include all information as required in R645-301-524.700. The contractor will also keep blasting records for at least 3 years at the contractors' site office. See Appendix 5-4 Section 4 for a blank shot report and Section 1H for a typical blast design.

524.300 - 350 Preblasting Survey

A preblasting survey will be conducted prior to commencement of blasting operations. As part of the preblasting survey Alton Coal Development LLC will:

- Notify, in writing, all residents or owners of dwellings or other structures located within one-half mile of the permit area how to request a preblasting survey at least 30 days before initiation of blasting.
- Prepare a written report of any preblasting survey. A resident or owner of a dwelling or structure within one-half mile of any part of the permit area may request a preblasting survey. This request will be made, in writing, directly to Alton Coal Development LLC or to the Division, who will promptly notify Alton Coal Development LLC. Alton Coal Development LLC will promptly conduct a preblasting survey of the dwelling or structure and promptly prepare the written report. An updated survey of any additions, modifications, or renovation will be performed by Alton Coal Development LLC if requested by the resident or owner.
- Determine the condition of the dwelling or structure and will document any preblasting damage and other physical factors that could reasonably be affected by the blasting. Structures such as pipelines, cables, transmission lines, and cisterns, wells, and other water systems warrant special attention; however, the assessment of these structures may be limited to surface conditions and other readily available data.
- Require the written report of the survey be signed by the person who conducted the survey. Copies of the report will be promptly provided to the Division and to the person requesting the survey. If the person requesting the survey disagrees with the contents and/or recommendations contained therein, he or she may submit to both Alton Coal Development LLC and the Division a detailed description of the specific areas of disagreement.
- Complete any survey requested more than ten days before the planned initiation of blasting, before blasting occurs.

Preblasting surveys were conducted for the Swapp Ranch and the Darlynn Sorensen residence on August 23, 2011 for the Coal Hollow Mine. There are no residences within ½ mile of the North Private Lease requiring a preblasting survey.

524.400 Blasting Schedule

Blasting will typically take place approximately once every 1.5 weeks, with adjustments made for production, weather, and the mine's or contractor's schedule.

524.410. Unscheduled Blasts

Unscheduled blasts will be conducted only where public or operator health and safety so requires and for emergency blasting actions. When an unscheduled surface blast incidental to coal mining and reclamation operations is conducted, Alton Coal Development LLC, using audible signals (see section 524.500-532 for blasting signals), will notify residents within one-half mile of the blasting site and document the reason on the shot report in accordance with 524.760.

Also, for unscheduled blast in the Coal Hollow Mine, Darlynn Sorensen, and Richard Dame will be notified. Within the North Private Lease there are no residents within a ½ mile radius that require notification.

524.420. Timing of Blasting

All blasting will be conducted between sunrise and sunset unless nighttime blasting is approved by the Division. Alton Coal Development LLC will conduct blasting operations at times approved by the Division and announced in the blasting schedule.

524.450 - 453. Blasting Schedule Publication and Distribution.

Alton Coal Development, LLC will:

- Publish the blasting schedule in a newspaper of general circulation in the locality of the blasting site at least ten days, but not more than 30 days, before beginning a blasting program;
- Distribute copies of the schedule to local governments and public utilities and to each local residence within one-half mile of the proposed blasting site described in the schedule; and
- Republish and redistribute the schedule at least every 12 months and revise and republish the schedule at least ten days, but not more than 30 days, before blasting whenever the area covered by the schedule changes or actual time periods for blasting significantly differ from the prior announcement; and

A copy of the public notice is included in Appendix 5-4 as Exhibit 1

524.460 - 465. Blasting Schedule Contents.

The blasting schedule will contain, at a minimum:

- Name, address, and telephone number of operator;
- Identification of the specific areas in which blasting will take place;
- Dates and time periods when explosives are to be detonated;
- Methods to be used to control access to the blasting area; and
- Type and patterns of audible warning and all-clear signals to be used before and after blasting.

A copy of the public notice is included in Appendix 5-4 as Exhibit 1

524.500 - 532 Blasting and Warning Signs, Access Control

Blasting signs will read **"Blasting Area"** and be conspicuously placed along the edge of any blasting area that comes within 100 feet of any public right-of-way, and at the point

where any other road provides access to the blasting area. At all entrances to the mine permit area from public roads or highways, signs will be conspicuously placed which read **"Warning! Explosives in Use"**, clearly list and describe the meaning of the audible blast warning and all-clear signals in use, and explain the identification of blasting areas where charged holes await firing at the blasting site in the mine permit area.

Warning and all-clear signals of different character or pattern that are audible within a range of one-half mile from the point of the blast will be given. Each person within the permit area and each person who resides or works regularly within one-half mile of the blast site in the mine permit area will be notified of the meaning of the signals in the blasting schedule and notification.

Prior to blasting, all persons will be evacuated from the blasting zone and guards will be posted at the entrance of the blasting area. A typical blast sequence will be the following:

- 30 minute warning – Blast announced over all Coal Hollow Mine or North Private Lease radio channels.
- 15 minute warning – Blast once again announced over all Coal Hollow Mine or North Private Lease radio channels. Guards are placed at the entrance of the blasting area and the pit is cleared.
- 5 minute warning – Guards blocking all access, pit cleared, access to the blasting area blocked, radio silence required and siren activated. Siren will be three prolonged wales.
- 1 minute warning – A series of short siren wales
- Countdown to ignition @ 5,4,3,2,1 – Announced across Coal Hollow Mine or North Private Lease radio channels
- All clear signal – One prolonged siren wale

A post blast inspection will be conducted by the qualified blaster and/or foreman prior to clearing the area. All guards will remain at their assigned positions until the blast area has been cleared by the qualified person.

The post blast inspection will include an examination of faces and/or muck piles associated with the blasting operation.

Access within the blasting areas will be controlled to prevent presence of livestock or unauthorized persons during blasting and until ~~an authorized representative of Alton Coal Development LLC~~the Certified Blaster has reasonably determined that no unusual hazards exist, such as imminent slides or un-detonated charges; and access to and travel within the blasting area can be safely resumed.

524.600 - 610 Adverse Effects Of Blasting

Blasting will be conducted to prevent injury to persons, damage to public or private property outside the mine permit area, and changes in the course, channels, or availability of surface or ground water outside the mine permit area by following industry best practices, limits, and regulations.

524.620 Airblast Limits

Airblast will not exceed the maximum limits listed below at the location of any dwelling, public building, school, church, or community or institutional building outside the mine permit area, except for those structures and facilities owned by Alton Coal Development LLC as approved by the Division. Maximum airblast limits are as follows:

Lower Frequency Limit of Measuring System, HZ (+3dB)		Maximum Level dB
2 Hz or lower – flat response		133 peak

(1) Only when approved by the Division.

524.630. Monitoring:

Periodic monitoring will be conducted once per quarter, unless there are no blasts, to ensure compliance with the airblast standards. Airblast measurements and will be taken as required by the Division at locations specified by the Division. The measuring system used will have an upper-end flat frequency response of at least ~~200~~ 125 Hz.

524.633. Flyrock:

Flyrock traveling in the air or along the ground will not be cast from the blasting site more than one-half the distance to the nearest dwelling or other occupied structure; beyond the area of blasting access control or beyond the mine permit area boundary. Each shot will be recorded to ensure flyrock falls within the limits described above. If flyrock occurs, it will be documented on the shot report in the comments section.

524.640 - 662. Ground Vibration.

In all blasting operations, except as otherwise authorized by the Division, the maximum ground vibration will not exceed the values approved by the Division. The maximum ground vibration for protected structures will be in accordance with ~~either~~ the maximum peak-particle velocity limits~~, the scaled-distance equation, the blasting-level chart, or by the Division~~. All other structures in the vicinity of the blasting area such as water towers, pipelines and other utilities, tunnels, dams, impoundments, and underground mines will be protected from damage by establishment of a maximum allowable limit on the ground vibration. These limits will be submitted by Alton Coal Development LLC and approved by the Division prior to blasting. A seismographic record will be provided for each blast if protected structures are within 2500 ft of the blast. If no protected structures are within the 2500 ft limit, periodic monitoring will be conducted once per quarter, unless there are

no blasts, to ensure compliance with the ground vibration limits. In the event a scaled distance less than 55 or PPV greater than 1.00 in/s, Maximum Peak Particle Velocity Method and Scaled Distance Equation Method will be used to monitor.

Maximum Peak-Particle Velocity Method: The maximum ground vibration will not exceed the following limits at the location of any dwelling, public building, school, church, or community or institutional building outside the mine permit area in accordance with the following:

Distance (D) from Blast Site in feet	Maximum allowable Particle Velocity (Vmax) for ground vibration, in inches/second (1)	Scaled distance factor to be applied without seismic monitoring (Ds) (2)
0 to 300	1.25	50
301 to 5,000	1.00	55
5,001 and beyond	0.75	65

(1) Ground vibration will be measured as the particle velocity. Particle velocity will be recorded in three mutually perpendicular directions. The maximum allowable peak particle velocity will apply to each of the three measurements.
(2) Applicable in the scale-distance equation of 524.651.

~~**Scaled Distance Equation Method:** Alton Coal Development LLC will use the scaled-distance equation, $W=(D/Ds)^2$, to determine the allowable charge weight of explosives to be detonated in any eight-millisecond period, without seismic monitoring: where W = the maximum weight of explosives, in pounds: D = the distance, in feet, from the blasting site to the nearest protected structure: and Ds = the scaled-distance factor, which may initially be approved by the Division using the values for scaled-distance factor listed in 524.642.~~
~~The development of a modified scaled-distance factor may be authorized by the Division on receipt of a written request by Alton Coal Development LLC, supported by seismographic records of blasting at the mine site. The modified scaled-distance factor of the predicted ground vibration will not exceed the prescribed maximum allowable peak particle velocity of 524.642 at a 95% confidence level.~~

~~**Blasting Level Chart**. Alton Coal Development LLC may use the ground vibration limits in Figure 1 (Figure 1, showing maximum allowable ground particle velocity at specified frequencies, is incorporated by reference. Figure 1 may be viewed at 30 CFR 817.67 or at the Division of Oil, Gas and Mining State Office.) to determine the maximum allowable ground vibration. If the Figure 1 limits are used, a seismographic record including both particle velocity and vibration-frequency levels will be provided for each blast. The method for the analysis of the predominant frequency contained in the blasting records will be approved by the Division before application of this alternative blasting criterion.~~

524.690. Standards not Applicable

The maximum airblast and ground-vibration standards of 524.620 through 524.632 and 524.640 through 524.680 will not apply at the following locations: At structures owned by Alton Coal Development LLC and not leased to another person; and at structures owned by Alton Coal Development LLC and leased to another person, if a written waiver by the lessee is submitted to the Division before blasting.

524.700 Records of Blasting Operations**:**

Blasting records will be maintained at the mine site for at least three years and upon request, records will be available for inspection by the Division or the public. A blasting record will contain the name of Alton Coal Development LLC; location, date, and time of the blast; name, signature, and Utah certification number of the blaster conducting the blast. It will also include the identification, direction, and distance, in feet, from the nearest blast hole to the nearest dwelling, public building, school, church, community or institutional building outside the permit area, except those described in 524.690 and weather conditions, including those which may cause possible adverse blasting effects.

The blasting record will include: The type of material blasted; sketches of the blast pattern including number of holes, burden, spacing, decks, and delay pattern; diameter and depth of holes; types of explosives used; total weight of explosives detonated in an eight-millisecond period; initiation system; type and length of stemming; and mats or other protection used.

If ~~required~~protected structures are within 2500 ft of the blast or it is periodic monitoring as outlined in sections 524.620 through 524.690, a record of seismographic and airblast information will include: type of instrument, sensitivity, and calibration signal or certification of annual calibration; exact location of instrument and the date, time, and distance from the blast; name of the person and firm analyzing the seismographic record; and the vibration and/or airblast level recorded; and the reasons and conditions for each unscheduled blast.

See Appendix 5-4 for example shot report.

524.800 Use of Explosives:

Alton Coal Development LLC will comply with all appropriate Utah and federal laws and regulations in the use of explosives.

525. SUBSIDENCE CONTROL PLAN

The proposed underground mining is first-mining only and is planned for limited extraction with no subsidence. Refer to Appendix 5-9 (Norwest Report) for geotechnical and design information. Due to the design and mining method of underground mining in this plan, no subsidence is projected and no monitoring is planned. As requested by the Division, however, the company will conduct surface observation walkovers of each of the 4 developed panel areas in this proposed plan within 60 days of completion of mining in those areas. Two additional observation walkovers will be made at approximately 1 year intervals following the initial walkover. If the observations determine that no affects or voids have developed to the surface, it will be documented and forwarded to the Division. If surface cracking, sinkholes or other surface impacts are noted during the walkovers, they will be documented, located on a surface topographic map, reported to the Division, photographed and repaired after approval by the Division. If the observation indicates no deformation is occurring, no further walkovers are proposed to be conducted on the respective panel areas.

It should be noted that, in addition to the larger pillar sizing near the portals (Appendix 5-9), the portal entries will be lined with arches and/or crossbars in areas of less than 120' of cover, per recommendations in the Norwest Report (Appendix 5-9), to further reduce the possibility of subsidence or failure in that low cover area.

Highwall mining or Auger mining, as defined in the definitions in R645-100-200 is Surface Mining, thus Underground regulations do not apply. Therefore, highwall mining in this plan have been addressed using the regulations contained in R645-302-240, Special Categories of Mining. The alternate highwall option has limited extraction with no subsidence. Refer to Appendix 5-8 (Feasibility of highwall mining the Smirl seam) for geotechnical and design information. Do to the design and mining method of highwall mining in this plan, no subsidence is projected and no monitoring is planned. Appendix 1-2 Right of Entry, Exhibit 5 contains the New Dame Lease. In this document, under Article 7 Section 7.03, provisions have been made if there is material damage as a result of subsidence.

526. **MINE FACILITIES**:

526.110-115 Existing Structures.

There are no existing structures within the permit areas.

526.116. Public Roads:

526.116.1. Operations Within 100 ft. of a Public Road

Initial mining operations at the Coal Hollow Mine will be on the western edge of the property, and will require rerouting Kane County Road #136 (K3900) so that operations do not come within 100 feet of this road. During the initial development phase (topsoil removal, diversion construction, etc.), equipment traffic may cross the county road right-of-way to access the necessary area, see Drawing 5-3. Details related to the road relocation and reestablishment can be viewed on Drawings 5-3, 5-22E, 5-22F, 5-22H and in Appendix 1-7.

In addition, the road adjacent to Lower Robinson Creek (K3993) has been claimed by Kane County as a public road. An agreement has been developed with the County to restrict access on this road to escort by mine personnel only. Details for the reestablishment of this road following mining are provided on Drawing 5-22C.

Initial mining operations at the North Private Lease will be on the western edge of the property, and will require rerouting Kane County Road #136 (K3900) and placing the intersection with the Alton Coal Mine Road (K3100) outside of the mine boundary. Although operations will come within 100 feet of these roads, the installation of a boundary fence with appropriate signage will provide adequate protection to the public. Details related to the road relocation and reestablishment can be viewed on Drawings 5-47, 5-61, 5-62, 5-63 and in Appendix 1-11.

526.116.2 Relocating a Public Road:

For the Coal Hollow Mine, Ffollowing the initial development period, Kane County will temporarily relocate County Road #136 (K3900) to federal lands located west of the permit area which are managed by the BLM. This relocation will bypass the permit area for the duration of mining operations and is shown on Drawing 5-3. Details of agreements and appropriate approvals for this road relocation are located in Appendix 1-7. The relocated road is not within 100 ft. of mining or reclamation operations. The design and route of the relocated road has been approved by Kane County authorities and the BLM. Kane County will continue to have sole jurisdiction and will maintain it as a public road. Following completion of mining operations within the permit area, Kane County will reestablish the road to the approximate original location and will also reclaim the temporary road as required by the BLM. The existing road from the north relocation diversion point to the permit boundary will also continue to be maintained as a public road by Kane County. Once the road intersects the permit boundary, appropriate signs and barricades will be installed to protect the public. This road will be reestablished following mining as provided in the agreements in Appendix 1-7 and shown on Drawings 5-22E, 5-22F and 5-22H.

For the North Private Lease, Kane County will temporarily relocate County Road #136 (K3900) and the intersection with the Alton Coal Mine Road (K3100) to Private lands located west and south of the permit area which are leased by ACD. This relocation will bypass the permit area for the duration of mining operations and is shown on Drawing 5-47. Details of agreements and appropriate approvals for these road relocations are located in Appendix 1-11. The relocated road is within 100 ft. of mining or reclamation operations. The design and route of the relocated road has been approved by Kane County authorities and the property owner. Kane County will continue to have sole jurisdiction and will maintain it as a public road. Following completion of mining operations within the permit area, Kane County will reestablish the road to the approximate original location and will also reclaim the temporary road as required by the BLM. A fence will be installed on the mine boundary between the public road and the active mine. Appropriate signs and barricades will be installed to protect the public. This road will be reestablished following mining as provided in the agreements in Appendix 1-11 and shown on Drawings 5-61, 5-62, 5-63.

526.200 Utility Installation and Support Facilities

526.210 Existing Utilities.

There are no known oil, gas, and water wells; oil, gas, and coal-slurry pipelines, railroads; electric and telephone lines; and water and sewage lines passing over, under, or through the permit areas. Should such facilities be installed, mining and reclamation operations will be conducted in a manner that minimizes damage, destruction, or disruption of services provided by such facilities unless otherwise approved by the owner of those facilities and the Division.

526.220 Support Facilities

The primary mine support facilities will include an office, shop, wash bay, oil containment, fuel containment, coal stacking system, coal loadout system and an equipment parking area These facilities will be constructed on an isolated section of the Coal Hollow Mine permit area that is approximately 34 acres. This area is located immediately north of Lower Robinson Creek, in Township 39 South, Range 5 West, Section 19. A diversion ditch will route water from the upgradient area immediately east of the area around the facilities and into a tributary of Lower Robinson Creek as shown on Drawing 5-3. Storm water and snow melt that occurs within the facilities area will be routed to an impoundment that will contain sediment. This impoundment will have a drop-pipe spillway installed that will allow removal of any oil sheens that may result from parking lots or maintenance activities by using absorbent materials to remove the sheen. In addition to this pond, an additional small impoundment will also be located in the southwest corner of the facilities area to control drainage from the mine access road. Details for these impoundments can be viewed on Drawings 5-28 and 5-28B.

No additional support facilities are proposed for the North Private Lease permit area. Operations occurring within the North Private Lease will continue to utilize the Coal Hollow Mine support facilities as currently constituted.

The following is a detailed description of each proposed facility and a reference to where detailed drawings can be found:

- Office: The office will be located on the northwest corner of the facilities area, immediately adjacent to the facilities access road. This building will be a steel structure with concrete footers. This structure will be 150 feet long by 100 feet wide and will be two stories in height. The office will provide working space for administrative and technical personnel. Details for the office can be viewed of Drawings 5-3 and 5-6.
- Shop: The shop will be located on the northeast side of the facilities area. This building will be a steel structure with concrete floors and foundation. The structure will be approximately 200 feet long by 100 feet wide and 50 feet high. This building will be used for maintenance of equipment, parts storage, tool storage, and office space for maintenance personnel. Details for this building can be viewed on Drawings 5-3 and 5-7.
- Wash Bay: The wash bay will be located immediately east of the shop. This building will be a steel structure with a concrete foundation. The structure will be 50 feet long by 60 feet wide and 50 feet high. Included will be a closed circuit water recycle system. This system will eliminate and store water impurities and reroute water back through the wash bay for cleaning equipment. Details for this structure can be viewed on Drawings 5-3, 5-8, and 5-8A.
- Oil and Fuel Containments: The oil and fuel containments will be concrete structures appropriately sized for containing metal tanks. The oil containment will contain 55 gallon barrels and up to 2,000 gallon totes. This containment will be 80 feet long by 30 feet wide and 3 feet deep. The fuel containment will store 3 fuel tanks. Included

will be a 4,000 gallon unleaded fuel tank and two 12,000 gallon diesel tanks. This structure will 50 feet long by 30 feet wide and 3 feet deep. Details for this structure can be viewed on Drawings 5-3 and 5-8.

- Coal Stacking System: The coal stacking system will be located in the central part of the facilities area. This system will include a coal hopper, coal feeder breaker, feed conveyor, crusher, and an inclined conveyor belt. Trucks will dump coal into the coal hopper which will funnel coal through the feeder breaker onto a short feed conveyor belt. This conveyor belt will transport the coal approximately 195 feet to a crusher that will size the coal appropriately for market. Once the coal is sized through the crusher it will enter an inclined stacker conveyor belt that is angled at approximately 16 degrees and is 186 feet long. This system will be a radial conveyor which will feed a coal stock pile with a live storage of approximately 50,000 tons. This system can be viewed on Drawings 5-3 through 5-5.
- Coal Loadout System: The coal loadout system will be located in the central part of the facilities area. This system will include an above ground reclaim feeder, a coal reclaim conveyor and an inclined conveyor. The reclaim feeder will be loaded by a dozer pushing the coal onto the feeder. One inclined conveyor that is approximately 290 feet in length will convey the coal from the feeder to the loadout hopper. This loadout hopper will load highway approved haul trucks that transport coal to market.
- Minor Facilities: The minor facilities will include a septic vault at the office (Drawing 5-6), a power washing and water recycle system in the Wash Bay (Drawing 5-8A), conduit with electrical lines running from generators to various facilities (Drawing 5-8B), Water System (Drawing 5-8C), an Equipment Hotstart Area (Drawing 5-3, 5-8B) and a Field Hydrant (Drawing 5-4, 5-5, 5-8B).
- Electrical System: The electrical system for the facilities at Coal Hollow will consist of two diesel fuel powered generators. One generator is a 750 KVA unit that will provide electricity to all the buildings. The other generator is a 1200 KVA unit that will be used to supply electricity to the coal conveying, sizing, stockpiling and loading system. The anticipated layout of the electrical system is shown on Drawing 5-8B.
- Dust Control Structures: A water system will be constructed to provide water for non-potable uses at the facilities and also for fugitive dust control measures. This system will consist of a water well, 6" water transport pipe, and two 16,000 gallon water tanks. These two tanks are located at the facilities area to provide a water supply to the facilities for non-potable uses (cleaning equipment, restrooms, etc…) and to load the water truck which will spray water on the active roads for dust control. The pipeline connecting the tanks to the well will be buried (3,578 ft). The tanks are portable units with its own elevated base, no base is required. These tanks supply water to the crusher through a buried pipe (869 ft.) A third tank is located east of the underground portals in Pit 10 and will supply water for dust control underground and other non-potable uses. The pipe line connecting the tank to the well will be above ground (996 ft.). This tank is also a portable unit with its own elevated base, no other base is required. It supplies water to the Underground facilities through a pipeline above ground (413 ft.). Further details related to this water system can be viewed on Drawing 5-8C.

- Underground Mining Facilities: Mine fan, portable generator/power supply, water supply system (described above) and stacking conveyor. The generator and stacker are mobile and considered temporary. The mine fan is a single unit that is mounted, but easily removed. All of these facilities are in an existing pit, and shown on Drawing 5-3B.

During mine development and the initial mining period, some facilities of a temporary nature such as mobile buildings and crusher/stacking conveyors may be utilized.

Support facilities to provide lighting at night will be kept to a minimum but will need to be sufficient enough to provide safe operating conditions in the dark. The following lighting equipment is anticipated to be used to provide safe working conditions:

- Two to three mobile light plants: Each light plant will have up to four 1,000 watt lights.
- Four to six exterior lights at the facilities area for lighting walkways and miscellaneous work areas: Each of these is expected to be 250 watt lights.
- Lights on mobile mining equipment, support vehicles and building lights

The support facilities will be located, maintained, and used in a manner that prevent or control erosion and siltation, water pollution, and damage to public or private property; and to the extent possible use the best technology currently available to minimize damage to fish, wildlife, and related environmental values; and minimize additional contributions of suspended solids to stream flow or runoff outside the mine permit area. Any such contributions will not be in excess of limitations of Utah or Federal law.

The facilities will be fully reclaimed at the end of mining operations with the exception of the water well. The final contour for this area can be viewed on Drawing ~~5-35 and~~ 5-37 and an anticipated timetable is shown on Drawing 5-38.

526.300 Water Pollution Control Facilities:

Water pollution associated with mining and reclamation activities within the permit areas will be controlled by:

- Construction of berms and/or diversion ditches to control runoff from all facilities areas.
- Roads will be constructed with ditches to capture runoff
- Diversion ditches will be constructed as necessary around active mining and reclamation areas to capture runoff from those areas.
- Sedimentation impoundments will be constructed to control discharges
- In areas where impoundments or diversions are not suitable to the surrounding terrain, silt fence or other appropriate structures will be utilized to control sediment discharge from the permit area.

In order to accomplish these objectives for the Coal Hollow Mine, watershed analysis of the permit and adjacent areas has been completed and specific designs are established for each water pollution control structure. Primary control structures include five sediment impoundments, four diversion ditches and miscellaneous berms. The locations of these structures can be viewed on Drawing 5-3. The detailed analysis for these structures and specific designs can be viewed on Drawings 5-25 through 5-34. In addition, a geotechnical analysis of the impoundments to ensure stability can be viewed in Appendix 5-1. The watershed and structure sizing analysis can be viewed in Appendix 5-2. An evaluation of the possible addition of underground mine water pumped to Sediment Pond 3 is included as Appendix 5-13.

In addition to these primary structures, temporary diversions and impoundments may also be implemented, as necessary, in mining areas to further enhance pollution controls.

All these facilities will be reclaimed to approximate original contour. The reclamation sequence and final landform can be viewed on Drawings 5-~~35~~ 37 and 5-38.

In order to accomplish these objectives for the North Private Lease, watershed analysis of the permit and adjacent areas has been completed and specific designs are established for each water pollution control structure. Primary control structures include three sediment impoundments, fourteen diversion ditches and miscellaneous berms. The locations of these structures can be viewed on Drawing 5-65. The detailed analysis for these structures and specific designs can be viewed on Drawings 5-67 through 5-71. In addition, a geotechnical analysis of the impoundments to ensure stability can be viewed in Appendix 5-11. The watershed and structure sizing analysis can be viewed in Appendix 5-12.

In addition to these primary structures, temporary diversions and impoundments may also be implemented, as necessary, in mining areas to further enhance pollution controls.

All these facilities will be reclaimed to approximate original contour. The reclamation sequence and final landform can be viewed on Drawings 5-74 through 5-76.

526.400 Air Pollution Control Facilities:

Air pollution (fugitive dust) emissions from mining and reclamation operations in the permit area will be controlled by a number of means, including:

- Haul roads will be maintained and will have water or other dust suppressants applied as appropriate.
- Road surfaces will be graded to stabilize/remove dust-forming debris as required.
- Areas adjoining primary roads will be stabilized and vegetated as required.
- Mobile equipment speeds will be controlled to minimize dusting conditions.
- Cleared vegetation debris within the mine area will be disposed of by placement in pit backfills.

A water system will be constructed to provide water for non-potable uses at the facilities and also for fugitive dust control measures. This system will consist of a water well, 6" water transport pipe, and ~~two~~ three 16,000 gallon water tanks. ~~The first water tank will be placed near the mining~~Two of these are placed along the coal haul road near the crushing area and will be used specifically to load the water truck which will spray water on the active roads within the permit area to control dust and provide water for dust suppression at the crushing facilities as needed. The ~~second~~ third tank is located ~~at~~ above the underground facilities area to provide a water supply to the facilities for non-potable uses (cleaning equipment, restrooms, etc…). Further details related to this water system can be viewed on Drawing 5-8C.

Due to the close proximity between permit areas, aside from the potential addition (in correlation with the Division of Air Quality) of monitoring stations, proposed activities at the North Private Lease permit area will continue to utilize the air pollution control facilities as currently constituted at the Coal Hollow Mine.

For details related to air pollution control and monitoring, refer to Chapter 4 and Appendix 4-2 and 4-5.

527. TRANSPORTATION FACILITIES

527.100 Classification of Roads

Primary roads are any road that is used to transport coal or spoil and is frequently used for access or other purposes for a period in excess of six months; or is to be retained for an approved postmining land use. The following are the roads that meet the classification of a primary road based on this standard:

Roads used to transport coal or spoil in excess of six months

There are three roads in the Coal Hollow mine that will be used to transport coal or spoil in excess of six months and are referred to as "Year 1 and 2 Mine Haul Road"

and "Year 2 and 3 Mine Haul Road", and the Underground Portal Access/Haul Road. The two main haul roads will be the main accesses for the pits throughout the life of the mine. Details for these roads are provided in Section 527.200 and on Drawings 5-22 and 5-23. In addition to these roads, the road located within the facilities area is also classified as a primary road. This road is referred to as "Facilities Roadway" and details are described in 527.200 along with Drawings 5-22A and 5-22B.

There are two roads in the North Private Lease that will be used to transport coal or spoil in excess of six months and are referred to as "Northern Haul Road" and "Southern Haul Road". Details for these roads are provided in Section 527.200 and on Drawings 5-58, 5-59 and 5-60.

Roads retained for an approved postmining land use

Roads retained for an approved postmining land use include the following: Access to East Pugh Property (K3993), County Road 136 (K3900), Alton Coal Mine Road (K3100), Access to Water Well and Road to Swapp Ranch. Details and locations for these roads are shown on Drawings 5-61, 5-62, 5-63 5-35, 5-37, 5-22A, 5-22B, 5-22C, 5-22D, 5-22E, 5-22F and 5-22H.

All other roads planned for construction within the permit area will be classified as ancillary. These will include temporary ramps, benches and equipment travel paths within the active mining area.

527.200 Description of Roads

Transportation facilities for the Coal Hollow Mine include eight primary roads, 2 stacking conveyors, a conveyor system, and miscellaneous ancillary/temporary roads. Numerous drawings detail the designs and specifications for each one of the proposed facilities. The following is a description of each facility and a reference for the associated drawings:

- Roads: Two primary mine haul roads are planned within the permit area. The first road extends from the coal unloading area to the first series of pits along the west side of the property. This road will be utilized for access to the pits (pits shown on Drawing 5-10). This road will be approximately 2,800 feet in length and will be utilized throughout mining. There will be three culverts installed along this road all sized for a 100 year, 24 hour storm event. The first culvert will be across a tributary of Lower Robinson Creek and will be a 36 inch corrugated steel pipe. The second culvert is the main crossing over Lower Robinson Creek and is a 96 inch corrugated steel pipe. Both of these culverts have been sized based on analysis of the Lower Robinson Creek watershed. This analysis can be viewed in Appendix A5-3. The third culvert is crossing over a diversion ditch that will route water mainly from disturbed

areas along the south side of Lower Robinson Creek to a sediment impoundment. This culvert will be a 24 inch corrugated steel pipe.

The second road extends from an intersection with the first road, located just south of the Lower Robinson Creek crossing, and proceeds southeast to long term topsoil stockpile 2 and subsoil stockpile 1. This road is approximately 1,300 feet in length. There is one culvert crossing along this road to cross a diversion ditch. This culvert will be a 24 inch culvert sized for maximum anticipated flows in the diversion.

The following specifications apply to these Primary mine haul roads:

1) Roads will be approximately 80' in width
2) Approximately a 2% crown
3) Approximately one foot deep cut ditches along shoulders for controlling storm water
4) 18" of crushed rock or gravel for road surfacing
5) Cut and fill slopes of 1.5 h:1v
6) Minimum fill over each culvert will be 2 times diameter of culvert
7) Berms placed as necessary along fills

The underground mine portal access and haul road in Pit 10 will also be a primary road. This road is accessed from the main haul road from the coal unloading area. The underground access road will be approximately 500' in length and will be constructed to the same specifications for the haul roads above, except that the road may be narrowed to a 40 foot width.

The ancillary roads will have similar specifications except surfacing will occur only as needed and may be narrowed to a 40 foot road width. A typical cross section for the ancillary roads can be viewed on Drawing 5-24.

The location and details for Primary Mine Haul roads can be viewed on Drawings 5-3 and 5-22 and 5-23.

In addition to the three roads primary Mine Haul roads, the road located within the facilities area is also classified as a primary road. This road is planned to be 24 feet wide with 24 inches of compacted sub base and 8 inches of compacted 1 inch minus gravel as surfacing. This road is referred to as "Facilities Roadway" and more details are described in 527.200 along with Drawings 5-22A and 5-22B.

In addition to the primary roads that will be present during active mining, four additional roads are planned to exist postmining and are also classified as primary roads for this reason.

Roads that will remain postmining are the following:

- Road to Water Well with details shown on Drawing 5-22D

- Road to east C. Burton Pugh property (K3993) with details shown on Drawing 5-22C
- County Road 136 (K3900) with details on Drawing 5-22E, 5-22F and 5-22G. This County road will be reconstructed within the permit area by Kane County. This reconstruction will occur concurrently with the final stage of reclamation as scheduled on Drawing 5-38 and is expected to be completed by the end of Year 4.
- Road to Swapp Ranch (same specification as the Water Well Road)

The location of these roads is shown on Drawings 5-35 and 5-37 along with the post mining topography.

The ramps, benches and equipment travel paths within the active surface mining area are temporary in nature and will be relocated frequently as mining progresses. These temporary travelways are considered part of the pit due to their short term use, and are not individually designed nor engineered. They will be built and maintained to facilitate safe and efficient mine and reclamation operations.

- Conveyors: A conveyor system will be used to stockpile coal and to load highway approved haul trucks for transportation to market. The first conveyor is mainly a stacker system for the coal stockpile which will be located at the coal unloading area and will be approximately 451' in length. This conveyor is estimated to be a 48" solid frame system.

  The second conveyor is a coal reclaim belt that will be loaded by an above ground reclaim feeder from the coal stockpile and will convey coal to the loadout chute which will load the highway approved coal haulage trucks. This section will be approximately 290' in length. Similar to the first section, this conveyor is estimated to be a 48" solid frame system.

  An additional stacking conveyor will be installed to transfer coal from the underground conveyor system to a stockpile from which trucks will be loaded. The stacking conveyor will be a 48'wide, wheel-mounted system, approximately 250' in length.

  Drawings of these systems can be viewed on Drawings 5-3 through 5-5.

Transportation facilities for the North Private Lease will consist of two primary roads, and miscellaneous ancillary/temporary roads. Drawings detail the designs and specifications for each one of the proposed facilities. The following is a description of each facility and a reference for the associated drawings:

- Roads: A primary haul road shown in Drawings 5-47, 5-58 and 5-59 will extend from the entrance of the permit area to the Western end of Pit 19. This road is approximately 3,540 feet in length. This road is referred as the "Northern Haul Road". A second primary haul road shown in Drawings 5-47 and 5-60, the "Southern

Haul Road" extends from the South end of Pit 1 on the West, to the South end of the Highwall Trench on the East. This road is approximately 2,980 feet in length. There are three culvert crossings along this road as shown in Drawing 5-58 including a substantial culvert to cross Kanab Creek. Culvert 1 (C-1) is sized at 24 inches. C-2 is sized at 48 inches to match the current culvert under County Road 136, and C-3 is sized at 172 inches for maximum anticipated flows in Kanab Creek. Final design of this culvert will be in conjunction with approvals and oversight from the Army Corps of Engineers. Culvert sizing calculations can be found in Appendix 5-12.

The following specifications apply to these Primary mine haul roads:

1) Roads will be approximately 80' in width
2) Approximately a 2% crown
3) Approximately one foot deep cut ditches along shoulders for controlling storm water
4) 18" of crushed rock or gravel for road surfacing
5) Cut and fill slopes of 1.5 h:1v
6) Berms placed as necessary along fills

The ancillary roads will have similar specifications except surfacing will occur only as needed and may be narrowed to a 40 foot road width. A typical cross section for the ancillary roads can be viewed on Drawing 5-24.

The ramps, benches and equipment travel paths within the active surface mining area are temporary in nature and will be relocated frequently as mining progresses. These temporary travelways are considered part of the pit due to their short term use, and are not individually designed nor engineered. They will be built and maintained to facilitate safe and efficient mine and reclamation operations.

527.220 Alteration or Relocation of Natural Drainageways.

As currently planned, no natural drainageways will be altered or relocated due to road construction, though a temporary diversion of Lower Robinson Creek will be constructed to allow for maximum recovery of coal. This temporary diversion of Lower Robinson Creek is not being constructed to facilitate road construction. If any other alterations or relocations are necessary, appropriate measures will be taken to obtain Division approval for such alterations or relocations.

Mine development work will include a temporary diversion of Lower Robinson Creek away from the mining area. This diversion has been designed for a flow capacity of a 100 year, 24 hour storm event. The sides will be graded to a 3h:1v slope and rip-rap will be appropriately placed to minimize erosion of the channel beyond current channel conditions. All specifications required to meet the requirements for such a diversion have been included in this diversion design. Appendix 5-2 details the analysis/specifications for this diversion and Drawings 5-20 and 5-21 show the details of this design.

As part of the reclamation process, Lower Robinson Creek will be reconstructed to its approximate original location. The design for this reconstruction is shown on Drawings 5-20A and 5-21A. This design includes considerable improvements to the channel compared to the channel's current condition. The current condition is such that less than 25% of the channel within the disturbed area has a flood plain present and most of the slopes are near the angle of repose with fair to poor vegetative cover. The reconstructed channel includes stable slope angles that will be revegetated with a flood plain on both sides of the channel for the entire length reconstructed. Sharp corners in the original alignment have been rounded to sinuous curve shapes and rip-rap will be installed in the bottom section of the channel to minimize erosion. The flood plain will seeded and covered with erosion matting to control erosion until a natural vegetative condition can be attained.

527.230 Road Maintenance

All roads will be maintained on an as needed basis using motor graders, water trucks for dust suppression, and other equipment as necessary. Crushed stone and/or gravel will be used as a surface course for primary roads outside the active mining area, and may be used as needed for ramps and travelways within the pit. Should the roads be damaged by a catastrophic event, such as an earthquake or a flood, repairs will be made as soon as possible after the damage has occurred or the road will be closed and reclaimed.

527.250. Geotechnical Analysis

No alternative specifications or steep cut slopes associated with roads are anticipated outside the active mine area. A report of appropriate geotechnical analysis will be provided should such alternative specifications or steep cut slopes where approval of the Division is required, become necessary.

528. HANDLING AND DISPOSAL OF COAL, OVERBURDEN, EXCESS SPOIL, AND COAL MINE WASTE:

528.100. Coal removal, handling, storage, cleaning, and transportation areas and structures;

Coal handling activities are confined to the active pit and underground portal areas, and the coal sizing/loading areas located north of ~~the p~~Pit 10 at the Coal Hollow Mine. All areas and facilities will be designed and constructed, utilized and maintained in conformance with industry standards and all applicable regulations. At the conclusion of mining, the facilities will be removed as part of final mine reclamation activities.

Material from coal stockpile areas, and other areas of potential coal accumulation will be excavated and the excavated material placed in the final mined out pit.

528.200. Overburden;

Overburden will be excavated after the removal of topsoil and subsoil as defined in Chapter 2. The overburden excavation will be accomplished by utilizing hydraulic excavators with end dump haul trucks and dozers. This process will include excavating this material in a stairstep fashion that will include benches approximately every 40 feet in depth. These benches are planned to be approximately 40 feet in width and will create an overall 2h:1v slope for the highwalls to create a stable and safe working area. This is a conservative approach for initial mining and once mining begins, ongoing geotechnical studies and monitoring will be used to further define the proper slope angle to ensure slope stability while maximizing resource recovery.

For the Coal Hollow Mine, b~~B~~ased on the overburden isopach map (Drawing 5-15), the overburden removal has been separated into three major stages. The first stage of overburden removal is the initial mining area, Pits 1-9~~8~~. These pits have a relatively low strip ratio, approximately 4.3~~5~~:1 (refer to Drawing 5-13). In order to efficiently remove overburden for this phase, spoil from the first three pits will be placed in an excess spoil area. This excess spoil structure will hold approximately 2.7 million loose cubic yards (LCY) of material. Once the excess spoil pile is filled, overburden from the next 5 pits can then be used as pit backfill as the mining progresses through Pit 9.

5-75~~From the initial mining area, operations will proceed from the southeast ¼ of Section 30, beginning with pit 28 and proceeding north to pit 20. Pit 9 will not be backfilled at this stage; it has been left open for placement of the highwall miner to recover coal from panels 1-3. In this method of mining, an unmanned cutter module is driven underground and operated in front of the highwall. The highwall mining machine stands on the pit floor or on a bench, directly in front of the exposed seam and makes long parallel rectangular drives into the coal seam. A remote-operated cutter module is pushed into the seam by a string of push beams (unmanned coal conveying elements) that transport the mined coal back to the entry of the drive onto a stockpile. Coal is then removed to the sizing/loading area. The miner is moved along the face making successive pushes into the coal face. Once coal is removed from the Pits/ Highwall Trench, overburden from excavation of the next Highwall Trench is used to backfilled the mined out area continuing with the progression of the trench. In hole 27 of Pit 9 Panel 3, the highwall miner head became lodged. Another head was leased in order to continue highwall mining in pits 22 and 23 while a recover plan was approved to mine Pit 10 and recover the lodged miner head. Pit 21 was then mined along the highwall panels in 21, then Pit10. Pit 10 will remain open for development of the underground portals and remain open until all underground coal is mined. Surface mining will continue with mining of Highwall Trench (HWT) 1 continuing south to HWT 3.Once mining is complete, the proposed plan for backfilling Highwall Trench 3 includes acquiring the right to mine the adjacent federal coal reserves, east of Pit 6. Also, some of the federal coal reserves can be recovered by underground mining which can be accessed through the underground~~

~~portals located in Pit 10. In the case that Alton Coal Development is not successful with acquiring the adjacent federal coal reserves, all the fill above approximate original contour and part of the excess spoil structure will be rehandled and placed back in the remaining backfill areas (Pit 10 and Highwall Trench 3). In this method of mining, an unmanned cutter module is driven underground and operated in front of the highwall. The highwall mining machine stands on the pit floor or on a bench, directly in front of the exposed seam and makes long parallel rectangular drives into the coal seam. A remote-operated cutter module is pushed into the seam by a string of push beams (unmanned coal-conveying elements) that transport the mined coal back to the entry of the drive onto a stockpile. Coal is then removed to the sizing/loading area. The miner is moved along the face making successive pushes into the coal face. Once coal is removed from the Pits/ Highwall Trench, overburden from excavation of the next Highwall Trench is used to backfilled the mined out area continuing with the progression of the trench.~~

As is depicted, each Pit/Highwall Trench consists of Panels, each panel consisting of 10 holes. The spacing between the holes and the spacing between the panels are dictated by the amount of overburden over the panels. ~~The alternate~~ Highwall mining is designed such that subsidence does not occur to the surface with nonyieldable webs and barriers. Specific information concerning these design are found in Appendix 5-8. Highwall mining will have only the disturbance associated with the pit/trench for placement of the highwall miner and will have no impact on the surface above the highwall panels.

~~The following tables show the material balance during the different phases of overburden removal for each scenario:~~

~~Preferred Scenario~~				
~~Phase~~	~~Overburden (LCY)~~	~~Available Backfill (LCY)~~	~~Excess Spoil (LCY)~~	~~Total Excess Spoil (LCY)~~
~~1~~	~~7,936,000~~	~~5,195,000~~	~~2,741,000~~	~~2,741,000~~
~~2~~	~~7,381,000~~	~~7,277,000~~	~~104,000~~	~~2,845,000~~
~~3~~	~~5,257,000~~	~~5,257,000~~	~~0~~	~~2,845,000~~
~~4 (Federal)~~	~~2,545,000~~	~~2,545,000~~	~~0~~	~~2,845,000~~
~~Total~~	~~23,119,000~~	~~20,274,000~~	~~2,845,000~~	~~2,845,000~~

~~*Loose Cubic Yards is estimated based on an overall 22% swell factor (Caterpillar Performance Handbook)~~

~~The Preferred scenario for overburden removal will minimize overall disturbance and maximize resource recovery by providing a transition into the adjacent federal reserves with minimal effect to existing reclamation and backfill in the Permit Area. This scenario will also minimize variances from approximate original contour on the federal lands by eliminating the need for an excess spoil structure from the initial boxcut once operations are transitioned into these reserves.~~

During the course of mining, some additional excavated overburden may be placed temporarily on mined over and backfilled areas due to operational considerations. This

material will be re-excavated and moved to ~~it's~~ a final placement location as operations allow.

The underground mining will be accessed through portals in an existing pit. There will be no additional overburden removal associated with the underground mining; however, cross sections of the portal area are shown on Drawing 5-3B. Cover or overburden depths for the underground mining are described in Section 627.

All maps related to the overburden removal process can be viewed on Drawings 5-15 through 5-17.
The following table summarizes overburden movement for the Coal Hollow Mine.

Coal Hollow Mine Overburden Summary	
2011	3,511,849 CY
2012	2,135,022 CY
2013	3,090,547 CY
2014	3,423,635 CY
2015 - Projected	1,613,023 CY
Total	13,774,076 CY

For the North Private Lease, based on the overburden isopach map (Drawing 5-56), the overburden removal has been separated into three major stages. The initial area of overburden removal is the mining area, Pits 1-10. These pits have a relatively low strip ratio, approximately 4.6:1 (refer to Drawing 5-52). In order to efficiently remove overburden for this phase, spoil from pit 1and pit 2 will be placed in a temporary excess spoil area on the area of pits 5 and 6. This excess spoil structure will hold approximately 505,866 loose cubic yards (LCY) of material. Once the excess spoil pile is filled, overburden from the remaining pits can then be used as pit backfill as the mining progresses through Pit 10, also as pit 4 is completed, material from the temporary spoils pile can be placed in pit backfill.

From the initial mining area, operations will proceed North from pit 11to Pit 21. These pits have a strip ratio increasing from 4.7:1 to 9.6:1. All spoils are placed in the preceding void. Once coal is removed from Pit 21, overburden from the development of the highwall trench in the eastern side of Kanab Creek will be used to backfill the remaining Pit 21.

The final mining area will be developed on the East side of Kanab Creek. Overburden removal from Highwall Trench 1 will proceed north in the trench with overburden being placed into the previously mined out area of Pit 21 until it reaches AOC. After Pit 21 is filled, material mined from the highwall trench will be placed directly as backfill in the same highwall trench, progressing from South to North.

The following table summarizes overburden movement for the North Private Lease.

North Private Lease Overburden Summary	
Year 1	2,485,800 CY
Year 2	2,571,300 CY
Year 3	4,049,000 CY
Year 4	3,354,200 CY
Year 5	3,075,900 CY
Year 6	1,842,000 CY
Total	17,378,100 CY

528.300. Spoil, coal processing waste, mine development waste, and noncoal waste removal, handling, storage, transportation, and disposal areas and structures;

528.310. Excess Spoil. Excess spoil will be placed in designated disposal areas within the permit areas, in a controllable manner to ensure mass stability and prevent mass movement during and after construction. Excess spoil will meet the design criteria of R645-301-535. For the purposes of SURFACE COAL MINING AND RECLAMATION ACTIVITIES, the permit application must include a description of the proposed disposal site and the design of the spoil disposal structures according to R645-301-211, R645-301-212, R645-301-412.300, R645-301-512.210, R645-528.310, R645-301-535.100 through R645-301-535.130, R645-301-535.300 through R645-301-535.500, R645-536.300, R645-301-542.720, R645-301-553.240, R645-301-745.100, R645-301-745.100, R645-301-745.300, and R645-301-745.400.

Excess spoil will be placed in the areas designated on Drawings 5-3 and 5-3735 for the Coal Hollow Mine and on 5-47 & 5-51A for the North Private Lease. This fill will be placed in lifts not to exceed 4 feet in thickness. The material will be transported from the overburden removal area to the fill by end dump haul trucks and a dozer(s) will spread the spoil to this lift thickness. The fill will meet at minimum 85% compaction as related to the standard Procter. Final slopes will be regraded to a maximum slope of 3h:1v. The top of the fill will be sloped to approximately 2% to prevent pooling of water and to reestablish drainage similar to original flow patterns. The excess spoil placed on the non-mined areas at the Coal Hollow Mine is approximately 32 acres and varies in height from 35 to 120 feet. ~~The area of excess fill over mined out areas (variance from approximate original contour) is an extension of the fill placed on the non-mined area and is approximately 35 acres. Combined acreage of the excess fill placed on mined and non-mined areas is 67 acres and varies in height from 60 to 100 feet above original contour. Total excess fill is 5.8 million yards.~~ Design of this long-term fill can be viewed in Drawings 5-~~35~~37 through 5-~~36~~37A and the geotechnical study can be viewed in Appendix 5-1.

- *R645-301-211: The applicant will present a description of the premining soil resources as specified under R645-301-221. Topsoil and subsoil to be saved*

under R645-301-232 will be separately removed and segregated from other material.

The soil resources for the proposed long-term excess spoil disposal area in the Coal Hollow Mine are described in Appendix 2-1. The soil resources for the North Private Lease temporary spoil disposal area are described in Volume 11. A plan has been developed for removal of topsoil and suitable subsoil based on the soil descriptions in theseis appendices. The handling plan can be viewed on Drawings 2-2 and 2-4. Topsoil and acceptable subsoil will be separately removed and segregated from other material prior to placement of any spoil.

- *R645-301-212: After removal, topsoil will be immediately redistributed in accordance with R645-301-242, stockpiled pending redistribution under R645-301-234, or if demonstrated that an alternative procedure will provide equal or more protection for the topsoil, the Division may, on a case-by case basis, approve an alternative;*

  Excess spoil will have topsoil and subsoil redistributed in an approximately uniform, stable thickness with the approved post mining land use, contours and surface water drainage systems. Material handling practices will prevent excess compaction of these materials. Handling practices will also protect the materials from wind and water erosion before and after seeding and planting. These practices include seeding and grading stockpiles that will exist for more than year to stabilize the soil.

- *R645-301-412.300: Criteria for Alternative Postmining Land Uses.*

  The MRP does not contemplate Alternative Postmining Land Uses.

- *R645-301-512.210: Excess Spoil. The professional engineer experienced in the design of earth and rock fills will certify the design according to R645-301-535.100.*

  A professional engineer experienced in the design of earth and rock fills with assistance from a geotechnical expert has certified the design according to R645-301-535.100. These certifications can be viewed on Drawings 5-3537, 5-36 37A and 5-17 through 5-19for the Coal Hollow Mine and on Drawing 5-47 & 5-51A for the North Private Lease.

- *R645-301-512.220: Durable Rock Fills*

  No durable rock fills are planned.

- *R645-301-514.100: Excess Spoil. The professional engineer or specialist will be experienced in the construction of earth and rock fills and will periodically*

inspect the fill during construction. Regular inspections will also be conducted during placement and compaction of fill materials.

A professional engineer or specialist that is experienced in the construction of earth and rock fills will inspect the fill during construction and regular inspections will also be conducted during placement and compaction of fill materials.

- *R645-301-535.100 through R645-301-130: Disposal of Excess Spoil*

A geotechnical analysis of the excess spoil structure designs has been completed by an expert in this field. The long term static safety factor for ~~this~~ these structure designs ~~is~~ are estimated at 1.6 to 1.7. Lifts will be placed in thicknesses not to exceed 4 feet. The lifts will meet 85% compaction by the standard Procter. The fill will be graded to allow for drainage similar to original patterns and to prevent excessive infiltration of water. For the Coal Hollow Mine, ~~F~~fill will be covered with subsoil and topsoil as specified in Chapter 2 to provide conditions suitable for revegetation of the area. The geotechnical studies~~y~~ for both permit areas can be viewed in Appendix ~~A~~5-1for the Coal Hollow Mine and 5-11 for the North Private Lease.

- *R645-301-535.300 through R645-301-535.500: Disposal of Excess - Spoil Durable Rock Fills.*

No durable rock fills are planned.

- *R645-301-536.300: Disposal of Coal Mine Waste in Excess Spoil*

No coal mine waste is planned in the excess spoil area.

- *R645-301-542.720: Excess spoil will be placed in designated disposal areas within the permit area, in a controlled manner to ensure that the final fill is suitable for reclamation and revegetation compatible with the natural surroundings and the approved postmining land use. Excess spoil that is combustible will be adequately covered with noncombustible material to prevent sustained combustion. The reclamation of excess spoil will comply with the design criteria under R645-301-553.240.*

The Coal Hollow Mine long-term excess spoil as shown in Drawing 5-~~35~~ 37 and 5-~~36~~ 37A will be suitable to the surrounding area and for the postmining land use of primarily grazing. No combustible excess spoil will be placed in the proposed structure. The final reclamation of the spoil does not include any terraces and the slopes will not exceed 3h:1v.

The North Private Lease temporary spoil pile will be in place for less than 6 months before being rehandled as pit backfill. Therefore, no postmining land use has been considered.

- *R645-301-553.240: The final fill configuration of the fill (excess spoil) will be suitable for the approved postmining land use. Terraces may be constructed on the outslope of the fill if required for stability, control of erosion, to conserve soil moisture, or to facilitate the approved postmining land use. The grade of the outslope between terrace benches will not be steeper than 2h:1v (50 percent).*

  The Coal Hollow long-term excess spoil as shown in Drawings 5-~~35~~ 37 and 5-~~36~~ 37A will be suitable to the surrounding area and for the postmining land use of primarily grazing. The reclamation of the spoil does not include any terraces and the slopes will not exceed 3h:1v. The long term static safety factor for these slopes is estimated to be 1.6 to 1.7.

- *R645-301-745.100: General Requirements.*

  745.110: Excess Spoil will be placed in designated disposal areas within the permit area, in a controlled manner to:

  745.111: Minimize the adverse effects of leaching and surface water runoff from the fill on surface and underground water;

  Reclamation of the Coal Hollow long-term excess spoil will include a topsoil cover and subsoil layer. Infiltration through the reclamation is expected to be minimal based on the high clay content of these soils. The North Private Lease temporary excess spoil will be in use for such a short period of time and will be comprised entirely of high-clay tropic shale such that infiltration is also expected to be negligible. In addition, laboratory data for the overburden shows that there is minimal potential for leaching of pollutants should infiltration rates become higher than expected.

  The foundations of these excess spoil areas also has high clay content with minimal potential for infiltration. This will provide an additional, natural barrier to protect ground water present beneath the proposed structure.

  745.112: Ensure permanent impoundments are not located on the completed fill. Small depressions may be allowed by the Division if they are needed to retain moisture or minimize erosion, create and enhance wildlife habitat or assist revegetation, and if they are not incompatible with the stability of the fill; and

  Permanent impoundments are not planned on the excess spoil areas. Small depressions may be constructed as allowed by the Division to retain moisture, minimize erosion, create and enhance wildlife habitat or assist revegetation.

  745.113: Adequately cover or treat the excess spoil that is acid- and toxic forming with nonacid nontoxic material to control the impact on the surface and ground water in accordance with R645-301-731.300 and to minimize adverse effects on plant growth and approved postmining land use.

Laboratory data representative of the overburden planned for disposal in the excess spoil areas does not show acid- and toxic forming characteristics.

745.120: Drainage Control. If the disposal area contains springs, natural or manmade water courses, or wet weather seeps, the fill design will include diversions and underdrains as necessary to control erosion, prevent water infiltration into the fill and ensure stability.

A spring and seep survey available in Chapter 7 has identified no springs or wet weather seeps in the proposed excess spoil areas. The final surfaces will be regraded to a contour that will route water from snowmelt and rainfall around the excess spoil as shown on the final contours Drawing 5-~~35~~37 and 5-74. There are no manmade water courses present in the excess spoil area. No underdrains are planned for the excess spoil structure.

745.121: Diversions will comply with the requirements of R645-301-742.300

No diversions are planned in the excess spoil area.

745.122 : Underdrains

No underdrains are planned in the excess spoil area.

745.300: Durable Rock Fills

No durable rock fills are planned.

745.400: Preexisting Benches

The MRP does not contemplate disposal of excess spoil on preexisting benches.

528.320. Coal Mine Waste.

The MRP does not contemplate processing coal that would produce coal mine waste.

528.321 Coal Processing Waste

The MRP does not contemplate processing coal that would produce coal processing waste that would be returned to the Underground workings.

528.322. Refuse Piles.

The MRP does not contemplate the construction of any refuse piles,

528.323. Burning and Burned Waste Utilization.

The MRP does not contemplate processing coal that would produce coal mine waste, eliminating the any potential for coal mine waste fires.

528.330. Noncoal Mine Waste.

Noncoal mine wastes including, but not limited to, grease, lubricants, paints, flammable liquids, garbage, abandoned mining machinery, lumber and other combustible materials generated during mining activities will be temporarily stored in appropriate containers and removed from the permit area and will be properly disposed of according to applicable State and Federal regulations.

528.332.

Final disposal of noncoal mine wastes will be in a State-approved solid waste disposal site not located within the permit area. Exceptions to the removal of all noncoal mine waste from the permit area is perforated piping used in the construction of Alluvial Ground Water Drains will be left in place as mining advances. This perforated piping will be covered in place approximately 20' to 30' below the final reclaimed surface. All other waste materials (ie. metal culvert) associated with the Alluvial Ground Water Drains will be removed and disposed of in a State-approved solid waste disposal site. Also, concrete pads for the generator and fan utilized in the underground operation will remain and will be covered with approximately 120' of overburden.

528.333.

At no time will any noncoal mine waste be deposited in a refuse pile or impounding structure, nor will any excavation for a noncoal mine waste disposal site be located within eight feet of any coal outcrop or coal storage area.

528.334.

Notwithstanding any other provision to the R645 Rules, any noncoal mine waste defined as "hazardous" under 3001 of the Resource Conservation and Recovery Act (RCRA) (Pub. L. 94-580, as amended) and 40 CFR Part 261 will be handled in accordance with the requirements of Subtitle C of RCRA and any implementing regulations.

528.340

As development of the Underground workings originates in the existing Surface mining Pit, development wastes have been stored in the excess spoils pile. Once all mining is complete spoils will be returned to the mined out Pit following the surface mining regulations.

528.350. Acid-Forming and Toxic Materials

If coal, having qualities that make it unmarketable, are to be left in the pit backfill in quantities greater than 5,000 tons: a minimum of 1 composite sample per 5,000 Tons of coal will be analyzed for the parameters list in Table 3 and 7 of the "Soil and Overburden Guidelines". A record of the volume of coal remaining and laboratory analytical results will be kept onsite. Debris, acid-forming, toxic-forming materials and materials constituting a fire hazard will be identified and disposed of in accordance with R645-301-528.330, R645-301-537.200, R645-301-542.740, R645-301-553.100 through R645-301-553.600, R645-301-553.900, and R645-301-747. Appropriate measures will be implemented to preclude sustained combustion of such materials; and

528.400. Dams, embankments and other impoundments.

Plans do not include using dams, embankments or other impoundments for disposal of coal, overburden, excess spoil or coal mine waste

529. **MANAGEMENT OF MINE OPENINGS**.

When no longer required, underground mine openings will be closed in accordance with R645-301-513, R645-301-529, R645-301-551 and MSHA approved requirements and backfilled. Each entry to the Underground mine if temporarily inactive, but having further projected useful service will be secured by barricades or other covering devices and posted with signs, to prevent access into the entry and identify the hazardous nature of the openings.

Highwall mining will produce openings (holes) in the coal at the bottom of trenches specifically constructed for highwall mining. Trench depth to the holes range from 60 feet to 200 feet. After highwall mining is completed in a given trench, that trench will be completely backfilled, burying any openings made by highwall mining.

All wells will be managed to comply with R645-301-748 and R645-301-765. Water monitoring wells will be managed on a temporary basis according to R645-301-738.

Wells constructed for monitoring groundwater conditions in the proposed Coal Hollow Mine permit and adjacent area, including exploration holes and boreholes used for water wells or monitoring wells, will be designed to prevent contamination of groundwater and surface-water resources and to protect the hydrologic balance. A diagram depicting typical monitoring well construction methods is shown in Drawing 7-11. Monitoring wells will include a protective hydraulic seal immediately above the screened interval, an annular seal plugging the borehole above the hydraulic seal to near the ground surface, and a concrete surface seal extending from the top of the hydraulic seal to the ground surface which is sloped away from the well casing to prevent the entrance of surface flows into the borehole area. Well casings will protrude above the ground surface a sufficient

height so as to minimize the potential for the entrance of surface water or other material into the well. A steel surface protector with a locking cover will be installed at monitoring wells to prevent access by unauthorized personnel. Where there is potential for damage to monitoring wells, the wells will be protected through the use of barricades, fences, or other protective devices. These protective devices will be periodically inspected and maintained in good operating conditions. Monitoring wells will be locked in a closed position between uses.

When no longer needed for monitoring or other use approved by the Division upon a finding of no adverse environmental or health and safety effects, or unless approved for transfer as a water well under R645-301-731.100 through R645-301-731.522 and R645-301-731.800, each well will be capped, sealed, backfilled, or otherwise properly managed, as required by the Division in accordance with R645-301-529.400, R645-301-631.100, and R645-301-748. Permanent closure measures will be designed to prevent access to the mine workings by people, livestock, fish and wildlife, machinery and to keep acid or other toxic drainage from entering ground or surface waters.

If a water well is exposed by coal mining and reclamation operations, it will be permanently closed unless otherwise managed in a manner approved by the Division.

Permanent closure and abandonment of water wells greater than 30 feet in depth will be in accordance with the requirements of "Administrative Rules for Water Well Drillers", State of Utah, Division of Water Rights or other applicable state regulations. Abandonment of wells will be performed by a licensed water well driller. The wells to be abandoned will be completely filled using neat cement grout, sand cement grout, unhydrated bentonite, or bentonite grout, or other materials approved by the Utah State Engineer's office. Alternatively, the well may be abandoned using a different procedure upon approval from the Utah State Engineer's office.

Abandonment materials will be introduced at the bottom of the well or required sealing interval and placed progressively upward to the top of the well. The casing will be severed a minimum of 2 feet below the ground surface. A minimum of 2 feet of compacted native material will be placed above the abandoned well upon completion.

Within 30 days of the completion of well abandonment procedures, a report will be submitted to the State Engineer by the responsible licensed driller giving data related to the abandonment of the well. This shall include the name of the licensed driller or other person(s) performing abandonment procedures, name of well owner at the time of abandonment, the address or location of the well by section, township, and range, abandonment materials and equipment used, water right or file number covering the well, the final disposition of the well, and the date of completion.

Exploration holes and boreholes will be backfilled, plugged, cased, capped, sealed, or otherwise managed to prevent acid or toxic contamination of water resources and to minimize disturbance to the prevailing hydrologic balance. Exploration holes and boreholes will be managed to ensure the safety of people, livestock, fish and wildlife, and machinery.

If a water well is exposed by coal mining and reclamation operations, it will be permanently closed unless otherwise managed in a manner approved by the Division.

If any exploration boreholes are to be used as monitoring wells or water wells, these will meet the provisions of R645-301-731

Boreholes will be backfilled to within 1 foot of the land surface with concrete or other materials approved by the Division as necessary to prevent contamination of groundwater or surface-water resources or to protect the prevailing hydrologic balance. The upper approximately 1 foot will be backfilled with native materials to facilitate reclamation (see Drawing 6-11). Exploration holes and boreholes that may be uncovered during mining and reclamation activities will be permanently closed unless approved for water monitoring or otherwise managed in a manner approved by the Division.

530 OPERATIONAL DESIGN CRITERIA AND PLANS:

531 GENERAL:

There are five sediment impoundments ~~proposed~~ for the Coal Hollow Mine permit area and three sediment impoundments for the North Private Lease. These structures will be constructed using a combination of dozers and backhoes. The structures have been designed to contain the required storm events as specified in Appendix 5-2 for the Coal Hollow Mine and Appendix 5-11 for the North Private Lease. The structures will have sediment removed as necessary to ensure the required capacities. Details for these structures can be viewed on Drawings 5-25, 5-26 and 5-28 through 5-32~~.~~ with ~~C~~calculations and supporting text ~~can be viewed~~ in Appendix 5-2~~.~~ for the Coal Hollow Mine. An evaluation of the possible addition of underground mine water pumped to Sediment Pond 3 is included as Appendix 5-13. Details for the North Private Lease sediment impoundments are on drawings 5-67 through 5-71 with calculations and supporting text in Appendix 5-12.

There are no other coal processing waste banks, dams or embankments proposed within the permit areas.

Underground mining has ~~not occurred~~begun within the Coal Hollow Mine permit area~~.~~, but none of the planned underground workings are closer than 900 ft. from the nearest sediment impoundment as shown by comparing Drawing 5-3 to Drawing 5-10. Also, all underground mining has been planned as "first mining" only, which means that underground workings are not expected to cause any surface subsidence.

532 SEDIMENT CONTROL:

Four diversion ditches along with five sediment impoundments are proposed for the ~~permit area~~Coal Hollow Mine. In addition, miscellaneous controls such as silt fence and berms are also proposed for specific areas. The proposed locations for these structures are shown on Drawing 5-3. Details associated with these structures can be viewed on Drawings 5-25 through 5-34 and Appendix 5-2. An evaluation of the possible addition of the underground mine water pumped to Sediment Pond 3 is included as Appendix 5-13. Fourteen diversion ditches along with three sediment impoundments are proposed for the

North Private Lease. In addition, miscellaneous controls such as silt fence and berms are also proposed for specific areas. The proposed locations for these structures are shown on Drawing 5-65. Details associated with these structures can be viewed on Drawings 5-67 through 5-71 and Appendix 5-12.

Mulch will be placed on the seedbed surface once soil amendments have been incorporated and seeding has been accomplished in areas that will be reclaimed to native plant communities. The mulch should control erosion by wind and water, decrease evaporation and seed predation, and increase survivability of the seeded species. Like the seeding methods, mulch will be applied with a variety of techniques and materials depending on the reclaimed area.

532.100 Disturbed Area:

The smallest practicable area, consistent with reasonable and safe mine operational practices will be disturbed at any one time during the mining operation and reclamation phases. This will be accomplished through progressive backfilling, grading, and prompt revegetation of disturbed areas. An estimated reclamation schedule is shown on Drawing 5-38 for the Coal Hollow Mine ~~or~~ and on 5-76 for the North Private Lease.

532.200 Backfill Stabilization:

The backfilled material will be stabilized by grading to promote a reduction of the rate and volume of runoff in accordance with the applicable requirements. The excess spoil and fill above approximate original contour will be graded to a maximum angle 3h:1v slope and revegetated to minimize erosion. This area is designed with concave slopes and slope irregularities that will also assist in minimizing erosion. A geotechnical analysis of this configuration has been completed and the factor of safety is estimated at 1.6 to 1.7. This analysis can be viewed in Appendix 5-1. The remaining backfill will be placed in the mined out pit, and thus confined on all sides. The backfill will be inherently stable.

Mulch will be placed on the seedbed surface once soil amendments have been incorporated and seeding has been accomplished in areas that will be reclaimed to native plant communities. The mulch should control erosion by wind and water, decrease evaporation and seed predation, and increase survivability of the seeded species. Like the seeding methods, mulch will be applied with a variety of techniques and materials depending on the reclaimed area.

533. IMPOUNDMENTS.

533.100.

No impoundments meeting the NRCS Class B or C criteria for dams in TR-60, or the size or other criteria of 30 CFR Sec. 77.216(a) are planned for the Coal Hollow Mine.

533.110

Impoundments not included in 533.100, will be designed and constructed with a minimum static safety factor of 1.3 for a normal pool with steady state seepage saturation conditions or meet the requirements of R645-301-733.210.

The proposed sediment impoundments are expected to impound seasonal water and storms. A geotechnical analysis of these designs has been performed and can be reviewed in Appendix 5-1 for the Coal Hollow Mine and Appendix 5-11 for the North Private Lease. Static safety factors for the proposed designs range from 2.2 to 5.3.

533.200. Foundations.

Foundations for temporary and permanent impoundments will be designed so that

- *Foundations and abutments for the impounding structure are stable during all phases of construction and operation. Such foundations for temporary and permanent impoundments will be designed based on adequate and accurate information on the foundation conditions*

  Refer to Appendices~~x~~ 5-1 and 5-11 for information related to foundations of the proposed impounding structures. No permanent impoundments are proposed.

- *All vegetative and organic materials will be removed and foundations excavated and prepared to resist failure. Cutoff trenches will be installed if necessary to ensure stability.*

  All vegetation, topsoil and subsoil as identified in Chapter 2 will be removed from the impoundment areas prior to construction. Cutoff trenches will not be necessary for stability.

- *Slope protection will be provided to protect against surface erosion at the site and protect against sudden drawdown.*

  Slopes of impoundments will be seeded and sloped to protect against erosion at the site. The high clay content and compaction characteristics of the material present at the impoundments will also assist with minimizing erosion of the slopes.

- *Faces of embankments and surrounding areas will be vegetated except that faces where water is impounded may be riprapped or otherwise stabilized in accordance with accepted design practices.*

Faces of embankments will be vegetated to minimize erosion. Standing water in the ponds is expected to be minimal and therefore these faces will also be seeded for erosion control.

- *The vertical portion of any remaining highwall will be located far enough below the low- water line along the full extent of highwall to provide adequate safety and access for the proposed water users.*

  All highwalls will be fully covered following active use and backfilling of pits.

533.300

A rapid drawdown analysis was completed assuming the spillways are plugged, the basin fills to top of the embankments and then the water is released or pumped down to the base of basins. The soil strengths utilized were based on total stress conditions as determined from the triaxial shear tests completed for this project. It should be noted that rapid drawdown is highly unlikely since spillway and outlet piping will be no more than 4-feet below the top of embankments. The resulting safety factors under these conditions range from 1.2 to 1.9. Based on this analysis, no additional protection measures are needed for the impoundments in relation to rapid drawdown. Details for this analysis on Coal Hollow impoundments are provided in Appendix 5-1, pages 6 through 7 in the main section of the report. Details for this analysis on the North Private Lease also refer to Appendix 5-1, pages 6 and 7, as the geotechnical report provided in Appendix 5-11 lists the soil characteristics present in the North Private Lease to be identical to those in the Coal Hollow Mine.

533.600.

The MRP does not contemplate construction of impoundments that meet the criteria of MSHA, 30 CFR 77.216(a).

533.700 - 714. Plans.

Each detailed design plan for structures not included in 533.610 shall:

- *Be prepared by, or under the direction of, and certified by a qualified, registered, professional engineer, except that all coal processing waste dams and embankments covered by R645-301-536 and R645-301- 746.200 shall be certified by a qualified, registered, professional engineer;*

  Designs for the proposed impoundments have been prepared by a qualified, registered, professional engineer, with assistance from a geotechnical expert. These certifications can be viewed on Drawings 5-28 through 5-31 for the Coal Hollow Mine and on Drawings 5-67 through 5-71 for the North Private Lease.

- *Include any design and construction requirements for the structure, including any required geotechnical information;*

  A geotechnical analysis of the impoundments has been prepared by an expert in this field. This analysis can be viewed in Appendix 5-1 for the Coal Hollow Mine

and Appendix 5-11 for The North Private Lease. Embankments will be constructed in 2 foot lifts as recommended by the analysis.

- *Describe the operation and maintenance requirements for each structure; and*

  The proposed impoundments are designed to temporarily store water from storm events and snow melt. Long term standing water in the impoundments is anticipated to be seasonal and sediment will be removed as necessary to provide the required storage capacities. Emergency spillways have been included in the designs to provide a non-destructive discharge route should the capacities ever be exceeded. Surveys of these impoundments will be regularly conducted to ensure that design capacities are available. An evaluation of the possible addition of underground mine water pumped to Sediment Pond 3 is included as Appendix 5-13.

- *Describe the timetable and plans to remove each structure, if appropriate.*

  All impoundments will be reclaimed at the end of operations. The estimated timeline for removal of these structures are shown on Drawing 5-38 for the Coal Hollow Mine and Drawing 5-76 for the North Private Lease. Expected removal is year seven of the mining and reclamation process for the Coal Hollow Mine and year five for the North Private Lease. In areas where soils are not stabilized following the removal of these sediment impoundments, silt fence will be appropriately installed and maintained to provide sediment control until stable conditions are met.

Detailed designs of impoundments can be viewed on Drawings 5-28 through 5-31 for the Coal Hollow Mine and Drawings 5-67 through 5-71 for the North Private Lease. Locations can be viewed on Drawing 5-3 and 5-25 for the Coal Hollow Mine and Drawings 5-47 and 5-65 for the North Private Lease.

534. **ROADS**

534.100-200 Roads will be located, designed, constructed, reconstructed, used, maintained, and reclaimed so as to:

- *Prevent or control damage to public or private property;*

  All roads will be reclaimed to approximate original contour as shown on Drawings 5-~~35~~37, 5-~~36~~ 37A and 5-38 for the Coal Hollow Mine and Drawings 5-74, 5-75 and 5-76 for the North Private Lease. These roads are designed to control damage to public and private property.

- *Use nonacid - or nontoxic-forming substances in road surfacing; and*

  There will be no acid or toxic forming substances used in road surfacing.

- *Have, at a minimum, a static safety factor of 1.3 for all embankments.*

  All embankments are designed with static safety factors that exceed 1.3.

- *Have a schedule and plan to remove and reclaim each road that would not be retained under an approved postmining land use.*

  All roads not planned to remain postmining will be removed and reclaimed according to Drawings 5-~~35~~ 37 and 5-~~36~~37A for the Coal Hollow Mine and Drawings 5-74, and 5-75 for the North Private Lease. The estimated timetable for removing these roads is shown on Drawing 5-38 and 5-76 respectively.

- *Control or prevent erosion, siltation and the air pollution attendant to erosion by vegetating or otherwise stabilizing all exposed surfaces in accordance with current, prudent engineering practices.*

  Cut ditches will be established on the shoulders of all primary roads to control drainage and erosion. Cut and fill slopes along the primary roads will be minimal and are not expected to cause significant erosion. In locations where there are culvert crossings (i.e. Lower Robinson Creek), the fills slopes will be stabilized by utilizing standard methods such as grass matting or straw wattles. Also, the upper slope of pit 10 is cut into alluvium at 4:1, this slope will be stabilized by planting with the interim seed mix found in Chapter 2 page 2-25.

- *To ensure environmental protection and safety appropriate for their planned duration and use, including consideration of the type and size of equipment used, the design and reconstruction of roads will incorporate appropriate limits for grade, width, surface materials, and any necessary design criteria established by the Division.*

The following specifications apply to the Primary Mine Haul roads:

1) Roads will be approximately 80’ in width
2) Approximately a 2% crown
3) Approximately one foot deep cut ditches along shoulders for controlling storm water
4) 18” of crushed rock or gravel for road surfacing
5) Cut and fill slopes of 1.5 h:1v
6) Minimum fill over each culvert will be 2 times diameter of culvert
7) Berms placed as necessary along fills

The underground mine portal access and haul road in Pit 10 will also be a primary

road. This road is accessed from the main haul road from the coal unloading area. The underground access road will be approximately 500' in length and will be constructed to the same specifications for the haul roads above, except that the road may be narrowed to a 40 foot width.

The ancillary roads will have similar specifications except surfacing will occur only as needed and may be narrowed to a 40 foot road width. A typical cross section for the ancillary roads can be viewed on Drawing 5-24.

The location and details for Primary Mine Haul roads can be viewed on Drawings 5-3, ~~and~~ 5-22 ~~and~~ , 5-23, ~~-~~ 5-47, and 5-58 through 5-60.

For the Coal Hollow Mine, ~~I~~in addition to the two ~~roads~~ primary Mine Haul roads, the road located within the facilities area is also classified as a primary road. This road is planned to be 24 feet wide with 24 inches of compacted sub base and 8 inches of compacted 1 inch minus gravel as surfacing. This road is referred to as "Facilities Roadway" and more details are described in 527.200 along with Drawings 5-22A and 5-22B.

In addition to the primary roads that will be present during active mining, four additional roads are planned to exist postmining and are also classified as primary roads for this reason.

Roads that will remain postmining are the following:

- Road to Water Well with details shown on Drawing 5-22D
- Road to east C. Burton Pugh property (K3993) with details shown on Drawing 5-22C
- County Road 136 (K3900) with details on Drawings 5-22E, 5-22F and 5-22G for the Coal Hollow Mine, and Drawings 5-61 and 5-63 for the North Private Lease. This County road will be reconstructed within the permit area by Kane County. This reconstruction will occur concurrently with the final stage of reclamation as scheduled on Drawings 5-38 and 5-76 and is expected to be completed by the end of Year 5 for the Coal Hollow Mine and Year 7 for the North Private Lease.
- Alton Coal Mine Road (K3100) in the North Private Lease with details on Drawings 5-62 and 5-63. This short section of County Road will also be reconstructed within the permit area by Kane County. The reconstruction will occur concurrently with the final stage of reclamation as scheduled on Drawing 5-76 and will be completed in Year 7.
- Road to Swapp Ranch (same specification as the Water Well Road)

The location of these roads is shown on Drawings ~~5-35 and~~ 5-37 along with the post mining topography.

The ramps, benches and equipment travel paths within the active surface mining area are temporary in nature and will be relocated frequently as mining progresses. These temporary travelways are considered part of the pit due to their short term use, and

are not individually designed nor engineered. They will be built and maintained to facilitate safe and efficient mine and reclamation operations.

534.300-340. Primary Roads.

Primary roads will:

- *Be located, insofar as practical, on the most stable available surfaces;*

  These roads are designed on the most practicable, stable surfaces.

- *Be surfaced with rock, crushed gravel, asphalt, or other material approved by the Division as being sufficiently durable for the anticipated volume of traffic and the weight and speed of vehicles using the road;*

  Primary ~~roads~~ haul roads will be surfaced with approximately 18" of crushed rock or gravel to provide a durable surface for the anticipated volume of traffic and equipment.

- *Be routinely maintained to include repairs to the road surface, blading, filling potholes and adding replacement gravel or asphalt. It will also include revegetation, brush removal, and minor reconstruction of road segments as necessary; and*

  All roads will be maintained on an as needed basis using motor graders, water trucks for dust suppression, and other equipment as necessary. Crushed stone and/or gravel will be used as a surface course for primary roads outside the active mining area, and may be used as needed for ramps and travelways within the pit. Should the roads be damaged by a catastrophic event, such as an earthquake or a flood, repairs will be made as soon as possible after the damage has occurred or the road will be closed and reclaimed. Roads will be reclaimed once they are no longer needed for their intended use.

- *Have culverts that are designed, installed, and maintained to sustain the vertical soil pressure, the passive resistance of the foundation, and the weight of vehicles using the road.*

  Road fill over culverts will be at minimum two times the diameter of the culvert. This is a conservative standard that has been effectively utilized at mining operations with similar equipment and mining practices.

535. **SPOIL**

535.100 -150 Disposal of Excess Spoil.

Excess spoil will be placed in designated disposal areas within the permit area in a controlled manner. The fill and appurtenant structures will be designed using current, prudent engineering practices and will meet any design criteria established by the Division.

- *The fill will be designed to attain a minimum long-term static safety factor of 1.5. The foundation and abutments of the fill must be stable under all conditions of construction.*

  A geotechnical analysis has been completed for both the ~~proposed~~ long term excess spoil structure located at the Coal Hollow Mine and the temporary excess spoil structure located at the North Private Lease. ~~This~~ These analyses~~is~~ estimate~~s~~ the long-term safety factor to be 1.6 to 1.7 based on the proposed designs. Following proper construction practices of building the structures in maximum four foot lifts and meeting 85% compaction based on the standard Procter will ensure that the structures will be stable under all conditions of construction. The following earthwork specifications will be followed:

  1) Areas to receive fill will be stripped of all vegetation, organic material, and debris. Any existing undocumented or non-structural fill/backfill materials and other unsuitable materials will be excavated in their entirety. All areas that are to receive fill will be observed by a professional engineer experienced in the design of earth and rock fills prior to placement of fill.

  2) Fill will be compacted to 85% of the maximum density as compared to ASTM D 698 (standard proctor) for the spoil.

  3) Individual lift thickness will not exceed 4 feet, unless approved by both the Division and the professional engineer based on compaction test results during field verification.

  4) Saturated soils will be placed in an area that will have minimal effect on the performance of slopes.

5) A qualified professional engineer with experience in the design of earth and rock fills will periodically observe the placement of fill and conduct in-place field density tests on the fill to check for adequate moisture and relative compaction. The compaction tests will be conducted as part of the periodic inspections required in R645-301-514.100, 514.311, and R645-301-514.120. These compaction tests will be conducted using nuclear density (ASTM D2292-9) or equivalent method. If less than the specified relative compaction is obtained, additional compactive effort will be applied and the fill moisture-conditioned as necessary until the specified relative compaction is attained.

6) Wherever, in the opinion of the ACD's representatives, an unstable condition is being created, the work will not proceed in that area until an evaluation has been made and the grading operations revised, if necessary.

7) During unfavorable weather conditions, construction of the fill will not proceed without confirmation from the professional engineer experienced in the design of earth and rock fills.

This construction will occur only in the designated excess spoil areas as shown on Drawings 5-3, ~~and~~ 5-37, for the Coal Hollow Mine and Drawing 5-47 for the North Private Lease. The fill will be placed with end dump haul trucks and lifts will be constructed using dozers. High precision GPS systems will be regularly utilized to check grades and appropriate lift thickness. The geotechnical analysis for this structure can be viewed in Appendix 5-1 for the Coal Hollow Mine and in Appendix 5-11 for the North Private Lease.

- *Be located on the most moderately sloping and naturally stable areas available, as approved by the Division, and placed, where possible, upon or above a natural terrace, bench or berm, if such placement provides additional stability and prevents mass movement;*

The excess spoil is planned to be placed in ~~an~~ areas where natural grades range from 0 to 5%. ~~This is one~~These are some of the most moderately sloping locations in the Permit Area. Stability of ~~this~~ these structures is estimated to be 1.6 to 1.7 based on the Appendix 5-1.

- *Be subject of sufficient foundation investigations. Any necessary laboratory testing of foundation material, will be performed in order to determine the design requirements for foundation stability. The analyses of foundation conditions will take into consideration the effect of underground mine workings, if any, upon the stability of the fill and appurtent structures; and*

Geotechnical borings and trench samples were completed in the foundations of the proposed disposal areas. Laboratory analysis of these borings and trench

samples have~~has~~ also been completed. Details of this analysis can be viewed in Appendix 5-1 and Appendix 5-11.

- *Incorporate keyway cuts (excavations to bedrock) or rock buttresses to ensure stability where the slope in the disposal area is in excess of 2.8h:1v (36 percent), or such lesser slope as may be designated by the Division based on local conditions. Where the toe of the spoil rests on a downslope, stability analyses will be performed in accordance with R645-301-535.150 to determine the size of rock toe buttresses and keyway cuts*

  Permanent slopes for the proposed excess spoil will not exceed 3h:1v (33 percent), therefore no keyway cuts have been proposed in the design. Appendix 5-1 and Appendix 5-11 detail~~s~~ the stability ~~analysis~~ analyses for the proposed structures.

- *Excess spoil may be disposed of in underground mine workings,..*

  Excess spoil will not be disposed of in underground mine workings.

- *Placement of Excess Spoil. Excess spoil will be transported and placed in a controlled manner in horizontal lifts not exceeding four feet in thickness; concurrently compacted as necessary to ensure mass stability and to prevent mass movement during and after construction; graded so that surface and subsurface drainage is compatible with the natural surroundings: and covered with topsoil or substitute material in accordance with R645-301-232.100 through R645-301-232.600, R645-301-234, R645-301-242, and R645-301-243. The Division may approve a design which incorporates placement of excess spoil in horizontal lifts other than four feet in thickness when it is demonstrated by the operator and certified by a professional engineer that the design will ensure the stability of the fill and will meet all other applicable requirements.*

  Horizontal lifts will not exceed four feet in thickness unless otherwise approved by the Division. The lifts will be concurrently compacted to meet 85% of the standard Procter. The geotechnical analysis (Appendix 5-1~~)~~ and Appendix 5-11), provides information showing that these construction standards will provide mass stability and will prevent mass movement during and after construction. The excess spoil will be graded to provide drainage similar to original flow patterns. Topsoil and subsoil as designated in Chapter 2 will be removed and separated from other materials prior to placement of spoil.

- *For the purposes of SURFACE COAL MINING AND RECLMATION ACTIVITIES the design of the spoil disposal structures will include the results of geotechnical investigations as follows:*

  1) The Character of the bedrock and any adverse geologic conditions in the disposal area;

Refer to Appendix 5-1 and Appendix 5-11.

2) *A survey identifying all springs, seepage, and ground water flow observed or anticipated during wet periods in the area of the disposal site;*

Spring and seep survey information is provided on Drawing 7-1. There are no springs or seeps identified in the excess spoil area.

3) *A survey of the potential effects of subsidence of the subsurface strata due to past and future mining operations;*

There no historical underground mining operations in the proposed excess spoil area. There are also no future underground operations proposed.

4) *A technical description of the rock material to be utilized in the construction of those disposal structures containing rock chimney cores or underlain by a rock drainage blanket; and*

There are no rock chimneys or drainage blankets proposed.

5) *A stability analysis including, but not limited to, strength parameters, pore pressures and long-term seepage conditions. These data will be accompanied by a description of all engineering design assumptions and calculations and the alternative considered in selecting the specific design specifications and methods.*

The stability analysis and all supporting data are available in Appendix 5-1for Coal Hollow and Appendix 5-11 for the North Private Lease.

- *If for the purposes of SURFACE COAL MINING AND RECLAMATION ACTIVITIES, under R645-301-535.112 and R645-301-535.113, rock-toe buttresses or key-way cuts are required, the will include the following:*

Neither rock-toe buttresses nor key-way cuts are required under R645-301-535.112 or R645-301-535.113.

535.200. Disposal of Excess Spoil: Valley Fills/Head-of-Hollow Fills.

The MRP does not contemplate disposal of excess spoil as valley fill or head-of-hollow fills.

535.300. Disposal of Excess Spoil: Durable Rock Fills.

The MRP does not contemplate disposal of excess spoil as durable rock fill.

535.400. Disposal of Excess Spoil: Preexisting Benches.

The MRP does not contemplate disposal of excess spoil on preexisting benches.

535.500 Disposal of Excess Spoil: At Drift Entries.

The MRP does not comptemplate disposal of spoils resulting from face-up operations at the drift entries. Drift entries will originate from the existing Pit, excess spoil for which are stored in the pit backfill or in the approved Excess Spoils Pile.

536. ~~Coal Mine Waste~~**COAL MINE WASTE:**~~.~~

The MRP does not contemplate processing of coal that would produce coal mine waste.

537 **REGRADED SLOPES**:

537.100 Geotechnical Analysis:

The long-term excess spoil structure and fill above approximate original contour at the Coal Hollow Mine are the only alternative specifications proposed. A geotechnical analysis has been completed for this proposal and can be viewed in Appendix 5-1. ~~-~~All other mined areas within the Coal Hollow Mine and North Private Lease, for surface or underground will be restored to approximate original contour.

537.200 Regrading of Underground Fills/Spoil:

Any spoils produced by underground operations at the Coal Hollow Mine will be placed in the first instance in unused crosscuts or underground voids. If necessary, underground spoils may also be placed in the Pit 10 void, not to exceed approximate original contour. As a last resort, underground spoils may also be placed in the long-term excess spoil structure under the design criteria detailed in Appendix 5-1. No underground spoils are expected from the North Private Lease permit area.

540 **RECLAMATION PLAN**:

541.100 - 400 General

Concurrent with mining operations and ~~W~~when coal mining is complete~~d~~, all pits within each permit area will be backfilled and reclaimed in accordance with the R645 rules and this permit. All equipment, structures, and other facilities, unless approved by the Division as suitable for the postmining land use or environmental monitoring, will be removed and the affected land reclaimed.

Underground mine portals will be closed in accordance with R645-301-513, R645-301-529, R645-301-551 and approved MSHA plans and backfilled.

Since the underground mine portals are located in the bottom of Pit 10 at the Coal Hollow Mine, they will be reclaimed and permanently closed by the backfilling of the pit to a depth of greater than 100' when no longer required.

When no longer needed for monitoring or other use approved by the Division upon a finding of no adverse environmental or health and safety effects, or unless approved for transfer as a water well under R645-301-731.100 through R645-301-731.522 and R645-301-731.800, each well will be capped, sealed, backfilled, or otherwise properly managed, as required by the Division in accordance with R645-301-529.400, R645-301-631.100, and R645-301-748. Permanent closure measures will be designed to prevent access to the mine workings by people, livestock, fish and wildlife, machinery and to keep acid or other toxic drainage from entering ground or surface waters.

If a water well is exposed by coal mining and reclamation operations, it will be permanently closed unless otherwise managed in a manner approved by the Division.

Permanent closure and abandonment of water wells greater than 30 feet in depth will be in accordance with the requirements of "Administrative Rules for Water Well Drillers", State of Utah, Division of Water Rights or other applicable state regulations. Abandonment of wells will be performed by a licensed water well driller. The wells to be abandoned will be completely filled using neat cement grout, sand cement grout, unhydrated bentonite, or bentonite grout, or other materials approved by the Utah State Engineer's office. Alternatively, the well may be abandoned using a different procedure upon approval from the Utah State Engineer's office.

Abandonment materials will be introduced at the bottom of the well or required sealing interval and placed progressively upward to the top of the well. The casing will be severed a minimum of 2 feet below the ground surface. A minimum of 2 feet of compacted native material will be placed above the abandoned well upon completion.

Within 30 days of the completion of well abandonment procedures, a report will be submitted to the State Engineer by the responsible licensed driller giving data related to the abandonment of the well. This shall include the name of the licensed driller or other person(s) performing abandonment procedures, name of well owner at the time of abandonment, the address or location of the well by section, township, and range, abandonment materials and equipment used, water right or file number covering the well, the final disposition of the well, and the date of completion.

Exploration holes and boreholes will be backfilled, plugged, cased, capped, sealed, or otherwise managed to prevent acid or toxic contamination of water resources and to minimize disturbance to the prevailing hydrologic balance. Exploration holes and boreholes will be managed to ensure the safety of people, livestock, fish and wildlife, and machinery.

If an ~~water well~~ exploration borehole is exposed by coal mining and reclamation operations, it will be permanently closed unless otherwise managed in a manner approved by the Division.

If any exploration boreholes are to be used as monitoring wells or water wells, these will meet the provisions of R645-301-731

Boreholes will be backfilled to within 1 foot of the land surface with concrete or other materials approved by the Division as necessary to prevent contamination of groundwater or surface-water resources or to protect the prevailing hydrologic balance. The upper approximately 1 foot will be backfilled with native materials to facilitate reclamation (see Drawing 6-11). Exploration holes and boreholes that may be uncovered during mining and reclamation activities will be permanently closed unless approved for water monitoring or otherwise managed in a manner approved by the Division.

542 **NARRATIVE, DRAWINGS AND PLANS**:

542-100 through 600 Plan and Timetable.

Reclamation at the Coal Hollow Mine and North Private Lease includes both ongoing reclamation and final reclamation activities. Ongoing reclamation will follow mining operations as closely as practicable during the mine production phase. Major steps in the ongoing reclamation process are:

- Backfilling and Grading. The planned backfilling and grading operations are described more fully under section 553 below.

- Topsoil and Subsoil Replacement. Following grading, suitable topsoil and subsoil will be replaced on the regraded area. Topsoil may be direct placed from areas ahead of the mine, or may be taken from available stockpiled material. The planned topsoil operation will have topsoil ahead of the operation dozed into windrows, and loaded into trucks by a front end loader. The trucks will haul the topsoil to the regraded area, or to a temporary topsoil stockpile. Subsoil will be handled similar to topsoil. Once dumped on the regraded area, topsoil and subsoil layers will be dozed to a consistent thickness. Approximately 8 inches of topsoil is expected to be removed ahead of mining and replaced over the regraded area. Subsoil removed and replaced will average 40 inches thick and will be placed between the topsoil layer and run of mine spoil. The total profile thickness of topsoil and subsoil in mined areas will average 48 inches. Once in place, the area will be fine graded to remove small erosion features and depressions.
- Revegetation. Following replacement of topsoil the area will be revegetated by seeding. Mulch will be placed on the seedbed surface once soil amendments have been incorporated and seeding has been accomplished in areas that will be reclaimed to native plant communities. The mulch should control erosion by wind and water, decrease evaporation and seed predation, and increase survivability of the seeded species. Like the seeding methods, mulch will be applied with a variety of techniques and materials depending on the reclaimed area.

Generally, mined areas will be backfilled and graded within approximately 180 days following coal removal, or 1,500 feet of the active coal removal face. One exception to this standard is ~~during mining and backfilling of the Highwall Trench south of Pit 9. During this phase of mining, Pit 9 will be left open for access to the Highwall Trench. Also,~~that a portion of Pit 10 will be left open for access to the underground portals until completion of underground mining.~~. A detailed description of the reason for this variation are fully described in section 528 (Overburden) and the major steps can be viewed on Drawing 5-17.~~ Areas needed for in-pit roads, ramps, drainage controls or areas which must be left open temporarily for operational reasons will be backfilled and graded when they are no longer needed. The rate of backfilling will depend on the availability of mined out pit areas for backfilling, and the rate of production at the mine. Based on anticipated production rates, Drawing 5-38 for the Coal Hollow Mine and Drawing 5-76 for the North Private Lease~~,~~ provide~~s~~ an estimated sequence and timing for reclamation.

Topsoil will be replaced on the graded areas as soon as operationally practicable. This work will depend on weather and soil conditions in the removal and replacement areas, but is generally anticipated to occur within 90 days of completion of regrading.

Revegetation activities will be seasonal in nature. As currently planned, initial seeding will occur at the first planting opportunity following replacement of topsoil. Supplemental seeding may be done subsequently as needed.

At the Coal Hollow Mine, surface mining operations are at a steady state and nearing completion. As such, all material mined goes directly to a backfill or reclaim capacity and is covered by subsoil and topsoil then prepared for mulching and seeding as soon as possible. During this last stage of mining, material from the Highwall Trench is directly backfilled into the remnants of Pits 9, 10 (a portion), 20, 21 and the northern extent of the trench itself. While a majority of Pit 10 will remain open until completion of underground mining, all other pits will be backfilled and reclaimed to approximate original contour. Any shortage of material for final backfill of the Highwall Trench will be made up by rehandle of spoil from the long term excess spoil pile. The long term excess spoil pile will also be the source of material for final backfill of Pit 10 after completion of underground mining activities.

For start-up of the North Private Lease, ~~S~~some delay is unavoidable in reclamation of the initial mining areas due to the time required to establish the initial working pit and backfill area, and to achieve a steady state excavation/backfill operation. -As currently planned, ~~the initial mining areas~~Pits 1 and 2 will be backfilled to the planned post mining contour, graded, and the subsoil and topsoil replaced concurrently with mining of Pits 3, 4, and 5 midway through the ~~by late in the~~ first year ~~or in the first half of the second year~~ of mining. Reclamation activities will proceed at the regular planned rate thereafter. As mining progresses through the second and into the third year (culminating with Pit 21), a backfill void will develop between the mining face and the direct backfill behind it. This void is a product of the interaction between coal being mined (leaving approximately 15 ft. of extra depth to fill) and the placed backfill swelling from in-situ to loose at an average factor of 10.725%, which is insufficient to make up for the coal depth loss. The final void on completion of Pit 21 will be approximately 1,000,000 cubic yards. As mining commences on the eastern side of the permit area in the Highwall Trench, material will be hauled from the trench back across the property to backfill the remaining void. Therefore, the void will in effect be transferred to the eastern side of the permit where a natural topographic ridge rests above the Highwall trench. This ridge will provide adequate material to fill the Pit 21 void while natural landform, post-mining land use, and drainage will be maintained or improved. Proposed final reclamation contours and cross sections can be viewed on ~~Drawings 5-35 and 5-36 for the preferred reclamation scenario and on~~ Drawings 5-~~35~~ 37 and 5-~~35A~~ 37A for the Coal Hollow Mine and on Drawings 5-74 and 5-75 for the North Private Lease.

The sequence and timing of reclamation activities is dependent on the coal production rate. Should that rate differ significantly from the current plan, the reclamation schedule will also vary.

Final reclamation includes the following:

- Backfilling and Grading. Backfilling of all final pits will commence at the conclusion of coal production. All highwalls, spoil piles, and depressions will be removed, except that small depressions may be constructed if they are needed to retain moisture, minimize erosion, create and enhance wildlife habitat, or assist revegetation. No permanent final pit impoundments are currently planned. The

long-term excess spoil structure ~~will~~ may remain at the Coal Hollow Mine, but smaller than designed due to swell factors that varied from initial design. All exposed coal seams, and acidic or toxic-forming strata will be covered with at least five feet of noncombustible material.

- Topsoil and Subsoil Replacement. 8 inches of topsoil underlain by 40 inches of subsoil will be placed on the backfilled pits and excess spoil. Other disturbed areas will have topsoil replaced (including facilities sites, roads etc.).
- Removal of Structures. Before abandoning the permit area or seeking bond release, all structures not needed for the approved post mining land use will be removed and reclaimed. The Lower Robinson Creek diversion is proposed to be temporary. Material from the coal stockpile base area and other areas where coal spillage may accumulate will be excavated and placed in a controlled manner in the final pit and covered with noncombustible material to prevent sustained combustion. The only structure for both permit areas planned to exist postmining is the water well in the Coal Hollow Mine permit area with details shown in Drawing 5-8C and location shown on 5-3, 5-35 and 5-37.
- Removal of Roads. Roads not retained for use under an approved postmining land use will be reclaimed immediately after they are no longer needed for mining and reclamation operations. Roads that are not listed as postmining roads in this section, will be closed to traffic, and all bridges and culverts removed. Prior to reclamation, surface material that is incompatible with the postmining land use and revegetation requirements will be removed from the roads and properly disposed of at the mine site. The main haul road roadbeds will be scarified or ripped to break up the surface. Topsoil will be replaced on the roadbed and the surface revegetated in accordance with the standards set forth in R645. The portal access/haul road is in Pit 10 and will be backfilled when no longer needed.

  Roads that will remain postmining are the following:

  - Road to Water Well with details shown on Drawing 5-22D
  - Road to east C. Burton Pugh property (K3993) with details shown on Drawing~~—~~ 5-22C
  - County Road 136 (K3900) with details on Drawing 5-22E, 5-22F and 5-22G for the Coal Hollow Mine permit area and Drawings 5-61 and 5-63 for the North Private Lease. This County road will be reconstructed within the permit areas by Kane County. This reconstruction will occur concurrently with the final stage of reclamation as scheduled on Drawing 5-38 for the Coal Hollow Mine and Drawing 5-76 for the North Private Lease and is expected to be completed by 2017 and year 5 of operations, respectively.
  - Alton Coal Mine Road (K3100) with details on Drawings 5-62 and 5-63. This County road will also be reconstructed within the permit area by Kane County, and will also be constructed concurrently with the final stage of reclamation as shown on Drawing 5-76. It is expected to be completed by year 5 of operations.
  - Road to Swapp Ranch (same specification as the Water Well Road)

The location of these roads is shown on Drawings ~~5-35 and~~ 5-37 and 5-38 along with the post mining topography for each permit area.

- Removal of Water Control Structures. All sedimentation control structures, including ditches, berms and sedimentation ponds not retained as part of the approved post-mining land use will be removed, the areas regraded, topsoiled, and revegetated. All water control structures will be removed at final reclamation.

Final pit backfilling, removal of buildings, roads and other facilities, along with replacement of topsoil is expected to require approximately 15 months after the last coal is removed. ~~In the alternate reclamation scenario (Drawing 5-37), the bulk of this period will be required to backfill the final pits.~~

542.700. Final Abandonment of Mine Openings and Disposal Areas.

Final abandonment of alternative mined highwall panels will be at the time when completed panels are backfilled as described in Section 529.

Underground mine openings will be closed in accordance with R645-301-513, R645-301-529, R645-301-551 and approved MSHA requirements and backfilled.

When no longer needed for monitoring or other use approved by the Division upon a finding of no adverse environmental or health and safety effects, or unless approved for transfer as a water well under R645-301-731.100 through R645-301-731.522 and R645-301-731.800, each well will be capped, sealed, backfilled, or otherwise properly managed, as required by the Division in accordance with R645-301-529.400, R645-301-631.100, and R645-301-748. Permanent closure measures will be designed to prevent access to the mine workings by people, livestock, fish and wildlife, machinery and to keep acid or other toxic drainage from entering ground or surface waters.

If a water well is exposed by coal mining and reclamation operations, it will be permanently closed unless otherwise managed in a manner approved by the Division.

Permanent closure and abandonment of water wells greater than 30 feet in depth will be in accordance with the requirements of "Administrative Rules for Water Well Drillers", State of Utah, Division of Water Rights or other applicable state regulations. Abandonment of wells will be performed by a licensed water well driller. The wells to be abandoned will be completely filled using neat cement grout, sand cement grout, unhydrated bentonite, or bentonite grout, or other materials approved by the Utah State Engineer's office. Alternatively, the well may be abandoned using a different procedure upon approval from the Utah State Engineer's office.

Abandonment materials will be introduced at the bottom of the well or required sealing interval and placed progressively upward to the top of the well. The casing will be severed a minimum of 2 feet below the ground surface. A minimum of 2 feet of compacted native material will be placed above the abandoned well upon completion.

Within 30 days of the completion of well abandonment procedures, a report will be submitted to the State Engineer by the responsible licensed driller giving data related to the abandonment of the well. This shall include the name of the licensed driller or other person(s) performing abandonment procedures, name of well owner at the time of abandonment, the address or location of the well by section, township, and range, abandonment materials and equipment used, water right or file number covering the well, the final disposition of the well, and the date of completion.

Exploration holes and boreholes will be backfilled, plugged, cased, capped, sealed, or otherwise managed to prevent acid or toxic contamination of water resources and to minimize disturbance to the prevailing hydrologic balance. Exploration holes and boreholes will be managed to ensure the safety of people, livestock, fish and wildlife, and machinery.

If an ~~water well~~ exploration hole is exposed by coal mining and reclamation operations, it will be permanently closed unless otherwise managed in a manner approved by the Division.

If any exploration boreholes are to be used as monitoring wells or water wells, these will meet the provisions of R645-301-731

Boreholes will be backfilled to within 1 foot of the land surface with concrete or other materials approved by the Division as necessary to prevent contamination of groundwater or surface-water resources or to protect the prevailing hydrologic balance. The upper approximately 1 foot will be backfilled with native materials to facilitate reclamation (see Drawing 6-11). Exploration holes and boreholes that may be uncovered during mining and reclamation activities will be permanently closed unless approved for water monitoring or otherwise managed in a manner approved by the Division.

542.720. Disposal of Excess Spoil.

A geotechnical analysis has been completed for the proposed long term and temporary excess spoil structures for each permit area. This analysis estimates the long-term safety factor to be 1.6 to 1.7 based on the proposed design. Following proper construction practices of building the structure in maximum four foot lifts and meeting 85% compaction based on the standard Procter will ensure that the structure will be stable under all conditions of construction. This construction will occur only in the designated excess spoil area as shown on Drawings 5-3 and 5-35 for the Coal Hollow Mine and Drawing 5-47 and 5-51A for the North Private Lease. The fill will be placed with end dump haul trucks and lifts will be constructed using dozers. High precision GPS systems

will be regularly utilized to check grades and appropriate lift thickness. The geotechnical analysis for this structure can be viewed in Appendix 5-1 for the Coal Hollow Mine and Appendix 5-11 for the temporary structure at the North Private Lease.

Excess spoil that is combustible will be adequately covered with noncombustible material to prevent sustained combustion.

542.730. Disposal of Coal Mine Waste.

The MRP does not contemplate processing of coal that would produce coal mine waste.

542.740. Disposal of Noncoal Mine Wastes.

Noncoal mine waste including, but not limited to grease, lubricants, paints, flammable liquids, garbage, abandoned mining machinery, lumber and other combustible materials generated during mining activities will be placed and temporarily stored in a controlled manner in a designated portion of the permit area and hauled offsite to a state approved recycling or solid waste disposal site. Final disposal of noncoal mine waste will not take place within the permit area. With the exception of removal of perforated piping used in the construction of Alluvial Ground Water Drains that will be left in place as mining advances and water line piping. This perforated piping will be covered in place approximately 20' to 30' below the final reclaimed surface. All other waste materials (ie. metal culvert) associated with the Alluvial Ground Water Drains will be removed and disposed of in a State-approved solid waste disposal site. The buried water line from the well to the Coal Yard, all buried water pipe within the Coal Yard and the buried water line from the tank East of Pit 10 will be cut off 4' below the final surface, capped and left in place.

542.800. Reclamation Cost.

The amount of the bond will depend upon the requirements of the ***approved*** permit and reclamation plan (R645-830.120).

A preliminary estimate of reclamation costs is included in Appendix 8-1. This estimate is based upon the proposed plan of open pit, highwall and underground mining. A final bond estimate will be provided by the applicant to the Division upon completion of the approved permit and reclamation plan.

550. RECLAMATION DESIGN CRITERIA AND PLANS

551. SEALING AND CASING OF UNDERGROUND OPENINGS

When no longer required, underground mine openings will be closed in accordance with R645-301-513, R645-301-529, R645-301-551 and MSHA approved requirements and backfilled. When no longer needed for monitoring or other use approved by the Division upon a finding of no adverse environmental or health and safety effects, or unless approved for transfer as a water well under R645-301-731.100 through R645-301-731.522 and R645-301-731.800, each well will be capped, sealed, backfilled, or otherwise properly managed, as required by the Division in accordance with R645-301-529.400, R645-301-631.100, and R645-301-748. Permanent closure measures will be designed to prevent access to the mine workings by people, livestock, fish and wildlife, machinery and to keep acid or other toxic drainage from entering ground or surface waters.

If a water well is exposed by coal mining and reclamation operations, it will be permanently closed unless otherwise managed in a manner approved by the Division.

Permanent closure and abandonment of water wells greater than 30 feet in depth will be in accordance with the requirements of "Administrative Rules for Water Well Drillers", State of Utah, Division of Water Rights or other applicable state regulations. Abandonment of wells will be performed by a licensed water well driller. The wells to be abandoned will be completely filled using neat cement grout, sand cement grout, unhydrated bentonite, or bentonite grout, or other materials approved by the Utah State Engineer's office. Alternatively, the well may be abandoned using a different procedure upon approval from the Utah State Engineer's office.

Abandonment materials will be introduced at the bottom of the well or required sealing interval and placed progressively upward to the top of the well. The casing will be severed a minimum of 2 feet below the ground surface. A minimum of 2 feet of compacted native material will be placed above the abandoned well upon completion.

Within 30 days of the completion of well abandonment procedures, a report will be submitted to the State Engineer by the responsible licensed driller giving data related to the abandonment of the well. This shall include the name of the licensed driller or other person(s) performing abandonment procedures, name of well owner at the time of abandonment, the address or location of the well by section, township, and range, abandonment materials and equipment used, water right or file number covering the well, the final disposition of the well, and the date of completion.

Exploration holes and boreholes will be backfilled, plugged, cased, capped, sealed, or otherwise managed to prevent acid or toxic contamination of water resources and to minimize disturbance to the prevailing hydrologic balance. Exploration holes and boreholes will be managed to ensure the safety of people, livestock, fish and wildlife, and machinery.

If an ~~water well~~ exploration hole is exposed by coal mining and reclamation operations, it will be permanently closed unless otherwise managed in a manner approved by the Division.
If any exploration boreholes are to be used as monitoring wells or water wells, these will meet the provisions of R645-301-731

Boreholes will be backfilled to within 1 foot of the land surface with concrete or other materials approved by the Division as necessary to prevent contamination of groundwater or surface-water resources or to protect the prevailing hydrologic balance. The upper approximately 1 foot will be backfilled with native materials to facilitate reclamation (see Drawing 6-11). Exploration holes and boreholes that may be uncovered during mining and reclamation activities will be permanently closed unless approved for water monitoring or otherwise managed in a manner approved by the Division.

552. **PERMANENT FEATURES**.

552.100

Small depressions may be constructed if they are needed to retain moisture, minimize erosion, create and enhance wildlife habitat, or assist revegetation.

552.200

All impoundments will be reclaimed, no permanent impoundments are proposed.

553 **BACKFILLING AND GRADING:**

Backfilling and Grading of the mined areas will proceed in conjunction with coal recovery operations.

~~The planned mine will recover approximately 3.05 million tons of coal, and remove approximately 16.1 million Bank Cubic Yards (BCY) of overburden.~~ The following is a description of the overburden removal and backfilling process:

For the Coal Hollow Mine, ~~B~~based on the overburden isopach map (Drawing 5-15), the overburden removal and backfilling process has been separated into three major stages. The first stage of this process is for the initial mining area, Pits 1-9. These pits have a relatively low strip ratio, approximately 4:3 (refer to Drawing 5-13). In order to efficiently remove overburden for this phase, spoil from the first three pits will be placed in an excess spoil area located immediately west of Pit 1. This excess spoil structure will hold approximately 2.7 million loose cubic yards (LCY) of material. Once the excess spoil pile is filled, overburden from the next 5~~4~~ pits can then be used as pit backfill as the mining progresses through Pit 9. Pit 9 will not be backfilled at this stage; it has been left open for placement of the highwall miner to recover coal from panels 1-3.

From the initial mining area, operations will proceed from the southeast ¼ of Section 30, beginning with pit 28 and proceeding north to pit 20~~2~~. Material from pit 28 was place in the excess spoil structure with overburden material from successive pits to the north being placed in the mined out pit to the south. These pits were not mined as initially laid out due to the coal being eroded in the eastern half of pit 28 and numerous sand channels replacing much of the coal in the eastern portions of pit 22-27. These pits as mined have a relatively low strip ratio of approximately 5.0:2. While overburden removal was occurring in pit 22, coal recovery was occurring from the pit 9 highwall panels. In this method of mining, an unmanned cutter module is driven underground and operated in front of the highwall. The highwall mining machine stands on the pit floor or on a bench, directly in front of the exposed seam and makes long parallel rectangular drives into the coal seam. A remote-operated cutter module is pushed into the seam by a string of push beams (unmanned coal-conveying elements) that transport the mined coal back to the entry of the drive onto a stockpile. Coal is then removed to the sizing/loading area. The miner is moved along the face making successive pushes into the coal face. Once coal is removed from the Pits/ Highwall Trench, overburden from excavation of the next Highwall Trench is used to backfilled the mined out area continuing with the progression of the trench. In hole 27 of Pit 9 Panel 3, the highwall miner head became lodged. Another head was leased in order to continue highwall mining from pits 22 and 23 while a recover plan was approved to mine Pit 10 and recover the lodged miner head.

In Stage three, Pit 21 was then mined along with the highwall panels in 21, then Pit10. The strip ratio for these two pits was 8.0 and 12.1 respectively. Overburden was placed in

the pits to the south from pit 21 and in pit 9 from pit 10. Pit 10 will remain open for development of the underground portals and remain open until all underground coal is mined. There will be no additional overburden removal associated with the underground mining. Surface mining will continue with mining of Highwall Trench (HWT) 1 continuing south to HWT 3 ~~and pit 20~~. The strip ratio for the highwall trench is 10.3:1. Overburden from HWT 1 will fill the remaining pit 9 with material from HWT 2 and 3 filling the previously mined portions of highwall trench and any remaining void in Pits 9, 20, 21, and 22. ~~The remaining trench provides an open pit near the federal coal reserves for backfilling of overburden so that a smooth transition can be made without developing another excess spoil area.~~

~~The proposed plan (Preferred Scenario) for backfilling the final pits is based on the assumption that Alton Coal Development, LLC will be successful with acquiring the adjacent federal coal reserves, located to the south, west and north of the project area. This Preferred scenario for backfilling will minimize overall disturbance, and maximize resource recovery by providing a transition into the adjacent federal reserves with minimal effect to existing reclamation and backfill in the Permit Area. This scenario will also minimize variances from approximate original contour on the federal lands by eliminating the need for an excess spoil structure from the initial box cut as operations are transitioned into these reserves. In addition, this scenario provides a method for implementing concurrent reclamation during the project by reducing temporary stockpiles of spoil that cannot be reclaimed and have to be placed in backfilled areas at a later time.~~

~~At the time that the transition occurs into the federal reserves, overburden will be removed from the federal reserves and placed in the final pits to approximate original contour. This final landform can be viewed on Drawings 5-35 and 5-36.~~

~~The following is an overburden and backfill balance for this scenario:~~

~~Preferred Scenario (Adjacent Federal Reserves Acquired)~~				
~~Stage~~	~~Overburden (LCY)~~	~~Available Backfill (LCY)~~	~~Excess Spoil (LCY)~~	~~Total Excess Spoil (LCY)~~
~~1~~	~~7,936,000~~	~~5,195,000~~	~~2,741,000~~	~~2,741,000~~
~~2~~	~~7,381,000~~	~~7,277,000~~	~~104,000~~	~~2,845,000~~
~~3~~	~~5,257,000~~	~~5,257,000~~	~~0~~	~~2,845,000~~
~~4 (Federal)~~	~~2,545,000~~	~~2,545,000~~	~~0~~	~~2,845,000~~
~~Total~~	~~23,119,000~~	~~20,274,000~~	~~2,845,000~~	~~2,845,000~~

~~*Loose Cubic Yards is estimated based on an overall 22% swell factor (Caterpillar Performance Handbook)~~

~~In the case that Alton Coal Development is not successful with acquiring the adjacent federal coal reserves, an alternate scenario has been developed. The Alternate scenario requires that all fill above approximate original contour and~~ Any remaining void in the Highwall Trench as well as Pit 10 at the end of underground mining will require part of the excess spoil structure to~~will~~ be rehandled and placed in the remaining backfill area. The final landform for this scenario is shown on Drawing 5-37. This step requires

rehandle of approximately 2.5 million yards of spoil. ~~An additional excess spoil structure would then need to be constructed on the federal lands to place spoil from the initial boxcut. Part of the excess spoil would likely be material removed from the Permit Area to access the coal beneath the Permit Area highwalls and provide the proper layback of the backfill material along the Permit boundary.~~

The following table summarizes the overburden and backfill ~~balance for this scenario~~movement for the Coal Hollow Mine:

Coal Hollow Mine Overburden Summary	
2011	3,511,849 CY
2012	2,135,022 CY
2013	3,090,547 CY
2014	3,423,635 CY
2015 - Projected	1,613,023 CY
Total	13,774,076 CY

~~Alternate Scenario (Adjacent Federal Reserve's Not Acquired)~~				
~~Phase~~	~~Overburden (LCY)~~	~~Available Backfill (LCY)~~	~~Excess Spoil (LCY)~~	~~Total Excess Spoil (LCY)~~
~~1~~	~~7,936,000~~	~~5,195,000~~	~~2,741,000~~	~~2,741,000~~
~~2~~	~~7,381,000~~	~~7,277,000~~	~~104,000~~	~~2,845,000~~
~~3~~	~~5,257,000~~	~~5,257,000~~	~~0~~	~~2,845,000~~
~~4 (Rehandle)~~	~~0~~	~~2,545,000~~	~~-2,545,000~~	~~300,000~~
~~Total~~	~~20,574,000~~	~~20,274,000~~	~~300,000~~	~~300,000~~

~~In both scenarios (Preferred and Alternate),~~ Rough backfilling and grading operations will follow coal removal by not more than 60 days or 1500 linear feet except ~~for~~ that Pit 10 will remain open until removal of underground coal is complete. ~~Once mining is complete, the proposed plan for backfilling Highwall Trench 3 includes acquiring the right to mine the adjacent federal coal reserves, located immediately east of pit 6. Also, some of the federal coal reserves can be accessed through the underground portals located in Pit 10. In the case that Alton Coal Development is not successful with acquiring the adjacent federal coal reserves, all the fill above approximate original contour and part of the excess spoil structure will be rehandled and placed back in the remaining backfill area.~~

For the North Private Lease, based on the overburden isopach map (Drawing 5-56), the overburden removal has been separated into three major stages. The initial area of overburden removal is the mining area, Pits 1-10. These pits have a relatively low strip ratio, approximately 4.6:1 (refer to Drawing 5-54). In order to efficiently remove overburden for this phase, spoil from pit 1and pit 2 will be placed in a temporary excess spoil area on the area of pits 5 and 6. This excess spoil structure will hold approximately 506,000 loose cubic yards (LCY) of material. Once the excess spoil pile is filled,

overburden from the remaining pits can then be used as pit backfill as the mining progresses through Pit 10, also as pit 4 is completed, material from the temporary spoils pile can be placed in pit backfill.

From the initial mining area, operations will proceed North from Pit 11to Pit 21. These pits have a strip ratio increasing from 4.7:1 to 9.6:1. All spoils are placed in the proceeding void. Once coal is removed from Pit 21, overburden from the development of the highwall trench will be used to backfill the remaining Pit 21.

The final mining area will be developed on the East side of Kanab Creek. Overburden removal from Highwall Trench 1 will proceed north in the trench with overburden being placed into the previously mined out area of Pit 21 until it reaches AOC. After Pit 21 is filled, material mined from the highwall trench will be placed directly as backfill in the same highwall trench, progressing from South to North.

For start-up of the North Private Lease, some delay is unavoidable in reclamation of the initial mining areas due to the time required to establish the initial working pit and backfill area, and to achieve a steady state excavation/backfill operation. As currently planned, Pits 1 and 2 will be backfilled to the planned post mining contour, graded, and the subsoil and topsoil replaced concurrently with mining of Pits 3, 4, and 5 midway through the first year of mining. Reclamation activities will proceed at the regular planned rate thereafter. As mining progresses ~~through~~from the second ~~and into~~to the ~~third~~fourth year (culminating with Pit 21), a backfill void will develop between the mining face and the direct backfill behind it. This void is a product of the interaction between coal being mined (leaving approximately 15 ft. of extra depth to fill) and the placed backfill swelling from in-situ to loose at an average factor of 10.725%, which is insufficient to make up for the coal depth loss. The final void on completion of Pit 21 will be approximately 1,000,000 cubic yards. As mining commences on the eastern side of the permit area in the Highwall Trench, material will be hauled from the trench back across the property to backfill the remaining void. Therefore, the void will in effect be transferred to the eastern side of the permit where a natural topographic ridge rests above the Highwall trench. This ridge will provide adequate material to fill the Pit 21 void while natural landform, post-mining land use, and drainage will be maintained or improved.

Of note, erosional scours (center and western drainage) existing prior to mining will be eliminated per the landowner request. This requires coordination with the USACOE for the elimination of wet lands (final landform shown on Drawings 5-74 and 5-75) identified in the Preliminary Jurisdictional Determination SPK-2011-01248 November of 2012 and updated September 2015 (MRP, Volume 10, NPL Wetland Study Report Final). Disturbances within the identified wetlands will not occur until approval of the 404 permit. The 404 permit will allow for take of the wetlands within the center drainage with wetlands being replaced in offsite mitigation under USCOE jurisdiction.

The following table summarizes overburden movement for the North Private Lease.

North Private Lease Overburden Summary	
Year 1	2,485,800 CY
Year 2	2,571,300 CY
Year 3	4,049,000 CY
Year 4	3,354,200 CY
Year 5	3,075,900 CY
Year 6	1,842,000 CY
Total	17,378,100 CY

Major steps in the backfilling and grading process for both permit areas are:

- Backfilling of the Mined Out Pit. Material from active pits will be used to backfill mined out pits as mining progresses. Material will be placed in the in-pit backfill in lifts, until the approximate planned final elevation is reached. Working stability in the backfill will be achieved by placement of the material, and control of the overall spoil face slope at stable angles. The mined out area will be filled to its planned post-mining elevation, which approximates the pre-mining land contour. The backfill will be inherently stable because the exposed surface will have shallow slopes, and the backfill surface will not be significantly higher than the surrounding undisturbed ground ~~with the exception of the variance shown on Drawing 5-3~~.
- Backfilling of Ramps. Ramps and travelways within the active mining will be moved as necessary for safe operation and efficient hauling of overburden and coal. When a particular ramp or travelway is no longer needed, it will be backfilled with excavated overburden from the advancing pit.
- Grading. After backfilling is complete in each mined out area, the area will be graded using dozers and motor graders to achieve the planned post-mining contour, facilitate stable positive drainage patterns, and to blend in with the surrounding topography. Postmining slopes will not exceed either the angle of repose or such lesser slope as is necessary to achieve a minimum long-term static safety factor of 1.3 and prevent slides. A geotechnical analysis has been completed for the excess spoil structure and can be found in Appendix 5-1.

Timing of backfilling and grading operations will depend on the rate of mine advance and the availability of backfill space and material. It is planned that mined areas will be backfilled and graded within approximately 60 days following coal removal, or within 1,500 feet of the active coal removal face. As described in the previous text ~~and shown on Drawing 5-19,~~ there will be a variance from this standard ~~in the final pits~~for Pit 10 of the Coal Hollow Mine as it remains open during underground mining operations. Also, as the North Private Lease progresses toward Pit 21 in the North and accumulates an ever-growing void, the width of the void space never exceeds 400 ft., but the area in the void may take slightly longer to reach AOC than the standard 60 days as the backfill face advances. This will be immediately resolved once mining commences in the Highwall

Trench on the eastern side of the permit area.- Areas needed for in-pit roads, ramps, drainage controls or areas which must be left open temporarily for operational reasons will be backfilled and graded as they become available.

553.110

All areas ~~except for the excess spoil pile and the variance from AOC (approximately 85 acres),~~ will be restored to approximate original contour for the Coal Hollow Mine as shown on Drawing 5-~~35~~37. R645-301-553.800 (Thick Overburden) does apply to this surface mine. ~~In areas where excess spoil and variance from approximate original contour occur, the~~ The slopes will be regraded to a maximum angle of 3h:1v and most slopes are flatter as shown on Drawing 5-~~35~~ 37 and 5-~~36~~37A. A geotechnical analysis has been completed to verify that the spoil material will be stable long term. This analysis can be viewed in Appendix 5-1.

All areas will be restored to approximate original contour for the North Private Lease as shown on Drawings 5-74 and 5-75. R645-301-553.800 (Thick Overburden) does apply to this surface mine. The slopes will be regraded to a maximum angle of 3h:1v and most slopes are flatter as shown on Drawing 5-74 and 5-75. A geotechnical analysis has been completed to verify that the spoil material will be stable long term. This analysis can be viewed in Appendix 5-11.

553.120
All highwalls will be eliminated in the final landform. Small depressions may be constructed as needed to retain moisture, minimize erosion, create and enhance wildlife habitat or assist vegetation. All spoil piles will be eliminated with the exception of the planned Coal Hollow Mine long term excess spoil ~~and variance from original contour~~ as shown on Drawing 5-~~35~~37.

553.130
Postmining slopes for both permit areas will not exceed the angle of repose which is expected to be approximately 1.5h:1v as described in Appendix 5-5. This appendix is an analysis by Dr. Ben Seegmiller addressing the safety factor for the post mining slope with the lowest safety factor outside the excess spoil area. This analysis concludes that a minimum safety factor of these slopes will be 1.7 which exceeds the requirement of 1.3. The excess spoil slopes have been analyzed by Alan Taylor, P.E., an expert in geotechnical engineering. These slopes also significantly exceed the required 1.3 safety factor. Details for this analysis by Mr. Taylor can be viewed in Appendix 5-1.

553.140

Slopes will be regraded and vegetated to minimize erosion and water pollution on and off the site.

553.150

Backfilling and grading will be conducted to support the approved post mining land use.

553.200 Spoil and Waste.

Spoil located in each of the excess spoil areas ~~and the variance from approximate original contour~~ will be compacted to 85% of the standard Procter to provide long term stability of these structures. Remaining backfill in mined out areas will be confined and regraded to approximate original contour and will therefore not require compaction for long term stability. Subsoil will be placed over spoils and waste prior to placement of topsoil. This subsoil layer will provide a covering with minimal infiltration rate to prevent leaching of toxic materials.

553.210

Excess spoil from surface mining activities will be disposed of according to R645-301-211, R645-301-212, R645-301-412.300, R645-301-512.210, R645-528.310, R645-301-535.100 through R645-301-535.130, R645-301-535.300 through R645-301-535.500, R645-536.300, R645-301-542.720, R645-301-553.240, R645-301-745.100, R645-301-745.100, R645-301-745.300, and R645-301-745.400. Detail for meeting these standards can be reviewed in the corresponding sections.

553.220

The MRP does not contemplate placing spoil on areas outside the mined-out surface area for the purposes of restoring the approximate original contour.

553.300. Covering of Exposed Coal Seams, and Acid- and Toxic-Forming Materials.

Exposed coal seams, acid- and toxic-forming materials, and combustible materials exposed, used, or produced during mining will be adequately covered with nontoxic and noncombustible materials, or treated, to control the impact on surface and ground water in accordance with R645-301-731.100 through R645-301-731.522 and R645-301-731.800, to prevent sustained combustion, and to minimize adverse effects on plant growth and on the approved postmining land use.

553.400. Cut and Fill Terraces

The MRP does not contemplate constructing cut and fill terraces.

553.500. Previously Mined Areas (PMA's) and Continuously Mined Areas (CMA's).

The MRP does not contemplate operations associated with PMA's, CMA's, or areas with remaining highwalls.

553.600. Highwall Management

The MRP does not contemplate operations associated with PMA's, CMA's, or areas with remaining highwalls.

553.700. Backfilling and Grading: Thin Overburden.

The Coal Hollow project is expected to have approximately 1.8 million loose cubic yards of excess spoil; therefore R645-301-800 applies rather than R645-301-553.700.

553.800. Backfilling and Grading: Thick Overburden.

553.810

The spoil in each permit area will be placed to attain the lowest practicable grade, and will not exceed the angle of repose for the material. The slopes on the excess spoil areas ~~and variance from the approximate original contour~~ will not exceed 3h:1v or flatter, which will provide a long-term, stable structure. The general design of the tall (60'+ vertically) excess spoil slopes is 5h:1v to 4h:1v to 3h:1v, bottom to top. This design creates a concave shape slope that resembles naturally occurring hills in the area and will minimize erosion. In addition, irregularities (flatter areas) have been added to break up long slopes. The overall shape of the pile is also irregular to be similar to hills in the surrounding area. The final configuration of this excess spoil can be viewed in Drawings 5-~~35~~ 37 and 5-~~36~~37A. The rough grading of the excess spoil outlsopes will follow by not more than 60 days after completed construction. The angle of repose for the spoil material is expected to be 1.5h:1v as provided in Appendix 5-5 in the Introductory Overview (page 1) by Dr. Ben Seegmiller, an expert in the field of rock mechanics and slope stability. The design slopes are significantly flatter than the angle of repose expected for the spoil.

553.820 - 553.830

Backfilling and Grading of thick overburden will meet the following requirements:

- *R645-301-211: The applicant will present a description of the premining soil resources as specified under R645-301-221. Topsoil and subsoil to be saved under R645-301-232 will be separately removed and segregated from other material.*

  The soil resources for the proposed excess spoil disposal areas are described in Appendix 2-1. A plan has been developed for removal of topsoil and suitable subsoil based on the soil descriptions in this appendix~~ces~~. The handling plan can be viewed on Drawings 2-2 and 2-4 for the Coal Hollow Mine and North Private

Lease, respectively. Topsoil and acceptable subsoil will be separately removed and segregated from other material prior to placement of any spoil.

- *R645-301-212: After removal, topsoil will be immediately redistributed in accordance with R645-301-242, stockpiled pending redistribution under R645-301-234, or if demonstrated that an alternative procedure will provide equal or more protection for the topsoil, the Division may, on a case-by case basis, approve an alternative;*

  Excess spoil will have topsoil and subsoil redistributed in an approximately uniform, stable thickness with the approved post mining land use, contours and surface water drainage systems. Material handling practices will prevent excess compaction of these materials. Handling practices will also protect the materials from wind and water erosion before and after seeding and planting.

- *R645-301-412.300: Criteria for Alternative Postmining Land Uses.*

  Not Applicable

- *R645-301-512.210: Excess Spoil. The professional engineer experienced in the design of earth and rock fills will certify the design according to R645-301-535.100.*

  A professional engineer experienced in the design of earth and rock fills with assistance from a geotechnical expert has certified the design according to R645-301-535.100. These certifications can be viewed on Drawings 5-~~35~~37, 5-~~36~~ 37A, 5-47, 5-51A and 5-17 ~~through 5-19~~.

- *R645-301-512.220: Durable Rock Fills*

  No durable rock fills are planned.

- *R645-301-514.100: Excess Spoil. The professional engineer or specialist will be experienced in the construction of earth and rock fills and will periodically inspect the fill during construction. Regular inspections will also be conducted during placement and compaction of fill materials.*

  A professional engineer or specialist that is experienced in the construction of earth and rock fills will inspect the fill during construction and regular inspections will also be conducted during placement and compaction of fill materials.

- *R645-301-528.310: Excess spoil will be placed in designated disposal areas within the permit areas within the permit area, in a controllable manner to ensure mass stability and prevent mass movement during and after construction. Excess spoil will meet the design criteria of R645-301-535. For the purposes of SURFACE COAL MINING AND RECLAMATION ACTIVITIES, the permit*

application must include a description of the proposed disposal site and the design of the spoil disposal structures according to R645-301-211, R645-301-212, R645-301-412.300, R645-301-512.210, R645-528.310, R645-301-535.100 through R645-301-535.130, R645-301-535.300 through R645-301-535.500, R645-536.300, R645-301-542.720, R645-301-553.240, R645-301-745.100, R645-301-745.100, R645-301-745.300, and R645-301-745.400.

Excess spoil will be placed in the areas designated on Drawings 5-3 and 5-~~35~~37 for the Coal Hollow Mine and on 5-47 and 5-51A for the North Private Lease. This fill will be placed in lifts not to exceed 4 feet. The material will be transported from the overburden removal area to the fill by end dump haul trucks and a dozer(s) will spread the spoil to this lift thickness. The fill will meet at minimum 85% compaction as related to the standard Procter. Final slopes will be regraded to a maximum slope of 3h:1v. The top of the fill will be sloped to approximately 2% to prevent pooling of water and to reestablish drainage similar to the original flow patterns. The excess spoil placed on the non-mined areas at the Coal Hollow Mine is approximately 32 acres and varies in height from 35 to 110 feet. ~~The area of excess fill over mined out areas (variance from approximate original contour) is an extension of the fill placed on the non-mined area and is approximately 55 acres. Combined acreage of the excess fill placed on mined and non-mined areas is 87 acres and varies in height from 60 to 100 feet above original contour. Total excess fill is 8.6 million yards.~~ Design of this long term fill can be viewed in Drawings 5-~~35~~ 37 ~~through~~ and5-~~36~~ 37A and the geotechnical study can be viewed in Appendix 5-1.

- *R645-301-535.100 through R645-301-130: Disposal of Excess Spoil*

  A geotechnical analysis of the excess spoil structure designs has been completed by an expert in this field. The long term static safety factor for these~~is~~ structure designs is estimated at 1.6 to 1.7. Lifts will be placed in thicknesses not to exceed 4 feet. The lifts will meet 85% compaction by the standard Procter. The fills will be graded to allow for drainage similar to original patterns and to prevent excessive infiltration of water. For the Coal Hollow Mine, ~~F~~fill will be covered with subsoil and topsoil as specified in Chapter 2 to provide conditions suitable for revegetation of the area. The geotechnical study can be viewed in Appendix 5-1for the Coal Hollow Mine and in Appendix 5-11 for the temporary excess spoil structure at the North Private Lease.

- *R645-301-535.300 through R645-301-535.500: Disposal of Excess - Spoil Durable Rock Fills.*

  Not Applicable

- *R645-301-536.300: Disposal of Coal Mine Waste in Excess Spoil*

  No coal mine waste is planned in the excess spoil area.

- *R645-301-542.720: Excess spoil will be placed in designated disposal areas within the permit area, in a controlled manner to ensure that the final fill is suitable for reclamation and revegetation compatible with the natural surroundings and the approved postmining land use. Excess spoil that is combustible will be adequately covered with noncombustible material to prevent sustained combustion. The reclamation of excess spoil will comply with the design criteria under R645-301-553.240.*

  The Coal Hollow Mine long term excess spoil as shown in Drawing 5-~~35~~ 37 and 5-~~36~~ 37A will be suitable to the surrounding area and for the postmining land use of primarily grazing. No combustible excess spoil will be placed in the proposed structure. The reclamation of the spoil does not include any terraces and the slopes will not exceed 3h:1v.

  The North Private Lease temporary spoil pile will be in place for less than 6 months before being rehandled as pit backfill. Therefore, no postmining land use has been considered.

- *R645-301-553.240: The final fill configuration of the fill (excess spoil) will be suitable for the approved postmining land use. Terraces may be constructed on the outslope of the fill if required for stability, control of erosion, to conserve soil moisture, or to facilitate the approved postmining land use. The grade of the outslope between terrace benches will not be steeper than 2h:1v (50 percent).*

  The Coal Hollow Mine excess spoil as shown in Drawings 5-~~35~~ 37 and 5-~~36~~ 37A will be suitable to the surrounding area and for the postmining land use of primarily grazing. The reclamation of the spoil does not include any terraces and the slopes will not exceed 3h:1v. This slope angle has been utilized at similar mining operations and found to be suitable for erosion control and revegetation of reclaim slopes. The long term static safety factor for these slopes is estimated to be 1.6 to 1.7.

- *R645-301-745.100: General Requirements.*

  745.110: Excess Spoil will be placed in designated disposal areas within the permit area, in a controlled manner to:

  745.111: Minimize the adverse effects of leaching and surface water runoff from the fill on surface and underground water;

  Reclamation of the Coal Hollow long term excess spoil will include a topsoil cover and subsoil layer. Infiltration through the reclamation is expected to be minimal based on the high clay content of these soils. The North Private Lease temporary excess spoil will be in use for such a short period of time and will be comprised entirely of high-clay tropic shale such that infiltration is also expected to be negligible. In addition, laboratory data for the overburden shows that there is

minimal potential for leaching of pollutants should infiltration rates become higher than expected.

The foundations of these excess spoil areas also has high clay content with minimal potential for infiltration. This will provide an additional, natural barrier to protect ground water present beneath the proposed structure.

745.112: Ensure permanent impoundments are not located on the completed fill. Small depressions may be allowed by the Division if they are needed to retain moisture or minimize erosion, create and enhance wildlife habitat or assist revegetation, and if they are not incompatible with the stability of the fill; and

Permanent impoundments are not planned on the excess spoil area. Small depressions are also not planned in the excess spoil and are not viewed as a necessary enhancement to final reclamation based on average annual moisture data and the proposed slope configuration of the pile.

745.113: Adequately cover or treat the excess spoil that is acid- and toxic forming with nonacid nontoxic material to control the impact on the surface and ground water in accordance with R645-301-731.300 and to minimize adverse effects on plant growth and approved postmining land use.

Laboratory data representative of the overburden planned for disposal in the excess spoil area does not show acid- and toxic forming characteristics.

745.120: Drainage Control. If the disposal area contains springs, natural or manmade water courses, or wet weather seeps, the fill design will include diversions and underdrains as necessary to control erosion, prevent water infiltration into the fill and ensure stability.

A spring and seep survey available in Chapter 7 has identified no springs or wet weather seeps in the proposed excess spoil area. The final surfaces will be ~~appropriately~~ regraded to a contour that will route natural water from snowmelt and rainfall around the excess spoil as shown on the final contours Drawing 5-~~35~~37 and 5-74. There are no manmade water courses present in the excess spoil area. No underdrains are planned for the excess spoil structure.

745.121: Diversions will comply with the requirements of R645-301-742.300

No diversions are planned in the excess spoil area.

745.122 : Underdrains

No underdrains are planned in the excess spoil area.

745.300: Durable Rock Fills

No Durable Rock fills are planned.

745.400: Preexisting Benches

The MRP does not contemplate disposal of excess spoil on preexisting benches.

Alton Coal Development, LLC will provide the Division, as part of the annual report for each calendar year, Drawing 5-38 ~~or if the alternate highwall method is selected Drawing 538-A.~~ for the Coal Hollow Mine and Drawing 5-76A and 5-76B for the North Private Lease. The Drawings will provide an as-built of the reclamation sequence, depicting the acres of open pit and /or trench, the acres backfilled, the acres fully reclaimed (topsoiled and seeded) and revisions to the reclamation timetable. This information will be submitted by March 28th of each calendar year with the appropriate C1/C2.

560. Performance Standards

Coal mining and reclamation operations will be conducted in accordance with the approved permit and requirements of R645-301-510 through R645-301-553.

Alton Coal Development, LLC
Coal Hollow Mine
Blasting Plan

1. Introduction and General Information

The intent of this plan is to provide a summary of blasting operations ~~should these operations become necessary~~ at the Coal Hollow Mine and North Private Lease. Based on current knowledge of the geologic formation planned for excavation and the methods for removal of overburden, it is expected that blasting will ~~not~~ be necessary~~.~~ ~~In the case that a geologic anomaly or unexpected conditions are experienced which require blasting;~~ and the following plan will apply:

Blasting operations and use of explosives at the Coal Hollow Mine and North Private Lease will be conducted in accordance with the following:

- MSHA – Parts 56 and 57 Subpart E-Explosives
- Utah Administrative Code – R645-301-524
- Coal Hollow Mine Specifications
- Federal, State and local regulations governing the use of explosives

Blasting operations will be contracted to a competent and qualified organization with expertise in this area. This contractor will be required to have all necessary certifications and must follow this blasting plan along with all safety and environmental regulations that apply to the Coal Hollow Mine and North Private Lease. This organization will be referred to as the "Contractor" for the purposes of this plan.

1.A. Explosives Handling

All explosives will be handled by a competent, qualified blaster and/or blasting foreman. This blaster and/or foreman will have proper certification as specified in Utah Administrative Code R645-301-524 and MSHA. The blasting foreman and the blaster will be knowledgeable of state, federal and local laws pertaining to explosives. In addition, they will be knowledgeable of the project specifications and the above referenced Documents in Section 1. The blaster may allow other persons to handle explosives only under his/her direct supervision. Explosives will be handled in a safe manner. The Contractor will be responsible for this individual(s) as needed for conducting blasting.

1.B. Storage of Explosives

~~Storage of explosives is not expected to occur at the~~ The Coal Hollow Mine and North Private Lease ~~Mine~~ do not currently store explosives onsite. All explosives and the associated products necessary for blasting will be transported to the site by the Contractor on an as needed basis only. These products will be utilized for blasting in a timely manner and will not be stored for later use within the permit area of the Coal Hollow Mine and North Private Lease. The Contractor will be

responsible for removal of all explosives and blasting related products from the premise following each individual blast operation.

Future storage of explosive materials onsite may be required due to increases in production and/or mine design. If these circumstances present themselves, onsite storage will comply with MSHA and ATF storage regulations.

1.C. Transportation of Explosives

Explosives will be transported to the Coal Hollow Mine and North Private Lease by the Contractor. Once at the mine, explosives will then be transported and handled by or under the direct supervision of the competent, qualified blaster and/or blasting foreman employed by the Contractor. Under all circumstances, jobsite transportation will comply with MSHA surface transportation of explosives requirements.

1.D. Use of Explosives

Explosives will be used only by a competent, qualified blaster or helper(s) under the direct supervision of the blaster and/or the blasting foreman. This blaster and/or foreman will have proper certification as specified in Utah Administrative Code R645-301-524 and MSHA.

When explosive materials are at the blast site, the blast site will be attended; barricaded and posted with warning signs, such as "Danger", "Explosives" or "Keep Out" or flagged against unauthorized entry.

Vehicles and equipment shall not be driven over the explosive material or initiating system.

1.D.1 Loading

Once loading begins the only activities permitted within the blasting site will be those activities directly related to the blasting operation and the activities of surveying, stemming, sampling of geology and reopening of holes, provided that reasonable care is exercised.

General specifications for loading of holes will be as follows:
The Blaster ~~in charge~~crew ~~-~~will prime the booster with a delay cap, lower it into the hole, ~~after reaching the bottom, the blaster will then have his assistant pour the explosive~~and load explosives (anticipated to be ammonium nitrate with fuel oil (ANFO) for dry holes and packaged emulsion for any wet holes) ~~in the column~~via bulk truck into each hole to the predetermined height. Next, the laborer will stem the hole to the surface (collar) using gravel or cuttings from the drill hole. Alternative

methods such as pre-splitting and use of emulsions may also be utilized when applicable.

Loading and blasting will be conducted in a manner designed to facilitate a continuous process, with the blast fired as soon as possible following completion of loading.

1.D.2 Firing and Inspection

Prior to blasting, all persons will be evacuated from the blasting zone and guards will be posted at the entrance of the blasting area. A typical blast sequence will be the following:

- 30 minute warning – Blast announced over all Coal Hollow Mine or North Private Lease radio channels.
- 15 minute warning – Blast once again announced over all Coal Hollow Mine or North Private Lease radio channels. Guards are placed at the entrance of the blasting area and the pit is cleared.
- 5 minute warning – Guards blocking all access, pit cleared, access to the blasting area blocked, radio silence required and siren activated. Siren will be three prolonged wales.
- 1 minute warning – A series of short siren wales
- Countdown to ignition @ 5,4,3,2,1 – Announced across Coal Hollow Mine or North Private Lease radio channels
- All clear signal – One prolonged siren wale

A post blast inspection will be conducted by the qualified blaster and/or foreman prior to clearing the area. All guards will remain at their assigned positions until the blast area has been cleared by the qualified person.

The post blast inspection will include an examination of faces and/or muck piles associated with the blasting operation.

Darlynn Sorensen (Sorensen Ranch) and Richard Dame (Swapp Ranch) will be notified directly of this system and the meaning of the audible sirens.

1.D.3 Misfires

If a misfire occurs using electric or non-electric initiation systems, only work necessary to remove the misfire and protect safety of miners engaged in the removal will be permitted in the affected area. If a misfire can not be disposed of safely, each approach to the area affected by the misfire will be posted with a warning sign at a conspicuous location to prohibit entry, and the condition will be reported immediately to mine management.

1.E. Blast Warning Signs

Prior to commencement of blasting operations at the Coal Hollow Mine, signs will be placed at the locations where the currently existing County 136 intersects the permit boundary. For the North Private Lease, signs will be also be placed at the locations where County Road 136 intersects the permit boundary, as well as the Lease entrance. Appropriate barricades will be in place at these ~~two~~ locations and signs will be added stating "Warning! Explosives in Use". These signs will also explain the blast warning signal system described in 1.D.2.

1.F. Blasting Schedule

~~If~~ When required, blasting will be scheduled Monday through Friday, between 1 P.M. and ~~4~~ 6 P.M.. Blasting Operations will not be scheduled on Saturday, Sunday or at night.

At least ten days but not more than 30 days, prior to commencement of blasting operations, the blasting schedule for the Coal Hollow Mine and North Private Lease will be published in the Southern Utah News, which is a newspaper of general circulation for the area.

In addition, copies of the blasting schedule will be provided to the Town of Alton, Kane County, Kanab Field Office BLM, and when blasting at the Coal Hollow Mine only, Darlynn Sorensen (Sorensen Ranch) and Richard Dame (Swapp Ranch). No private residences are less than 2,~~500~~686 feet from any potential blasting operations at the North Private Lease.

This schedule will be republished at least every 12 months and at any time when the schedule changes significantly from previous notifications. In the case of changes to the schedule, this publication will take place at least ten days but not more than 30 days prior to implementing the schedule change.

1G. Additional Precautions

During electrical storms, surface blasting operations will be suspended and persons withdrawn from the blast area to a safe location.

Smoking and use of open flames will not be permitted within 50 feet of explosive material. While working directly with explosives, personnel will not be allowed to have any matches, lighters or ignition sources on their person.

1H. Blast Design

~~The anticipated blast design can not be reasonably estimated at this time since Alton Coal Development, LLC (ACD) is not sure what local geologic conditions exist that may require blasting. If conditions are encountered that require blasting,~~

~~ACD will provide the Division with the designed pattern prior to conducting blasting.~~

Overburden shot size is generally 450x200 ft or 200,000 cubic yards. A typical overburden blast design has a burden and spacing of 18x18ft at a depth of 60ft. Stemming height is typically 13 ft. Shots will be loaded with Ammonium Nitrate Fuel Oil (ANFO) in dry holes, and packaged emulsion on wet holes. Average pounds per hole will be 833 lbs. Powder Factors ~~are~~ typically range from .4 lbs/cyd to 1.25 lbs/cyd depending on geology ~~1.1 lbs/cyd~~. Each hole will have at least one booster (0.75 lb or 1 lb) and a 25/500ms nonel cap, as shown Figure 1 below.

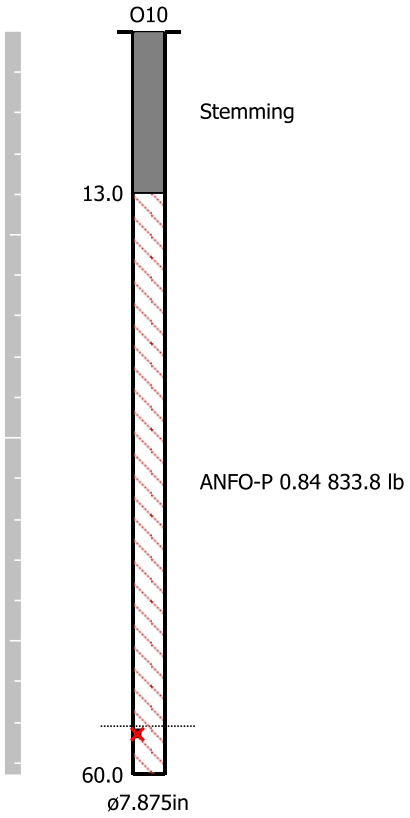

Figure 1: Typical Hole Loading Scheme.

Timing will typically be 25 ms between holes with 84 ms between rows, and follow the pattern shown in Figure 2 below.

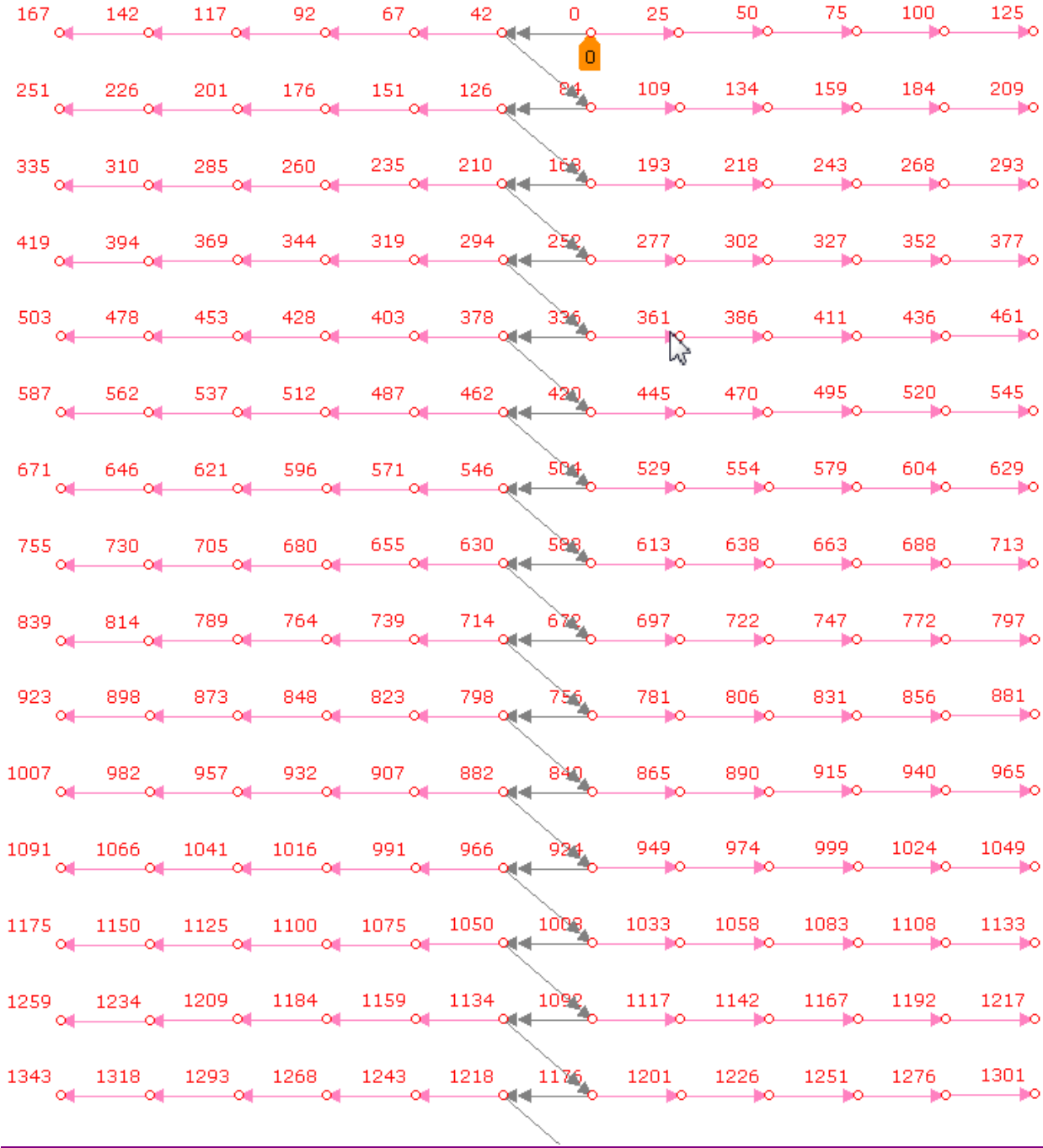

Figure 2: Typical Pattern Tie-in and Timing

The closest structure to any blast pattern for the Coal Hollow Mine is the Richard Dame (Swapp Ranch) property at 1,585 ft. from the closest blast pattern. For the North Private Lease, the nearest structures are located in the town of Alton, ~~over~~at 2~~500~~626 ft. away from the closest mine property boundary. The required scaled distance is 55 for Coal Hollow Mine and 55 for the North Private Lease per 524.640 – 662. Based on these scaled distances, the maximum pounds of explosives per 8 ms delay is 2066 lbs for the Coal Hollow Mine and North Private Lease respectively.

The above blast design, loading, and timing are general designs for the mine and may be altered due to geology, mine design, production needs, and blast optimization.

2. Pre- Blast Survey

Two Ranch properties exist within ½ mile of the proposed mining area that experience part time occupation by the owners. The properties are the Sorensen Ranch and the Swapp Ranches. Pre-blast surveys ~~will~~ have been conducted of all the structures at these properties prior to conducting blasting operations. These structures with a brief description are provided on Drawings 1-5 and 1-6 in the MRP, Chapter 1, Volume 1. An Alton Coal Development, LLC representative ~~will~~ has meet with the owners of these properties and conduct an inspection of each structure in cooperation with the owners. The conditions of each structure ~~will~~ hasl been documented in a report both written and photographically. This report ~~will~~ has been provided ~~immediately~~ to the Division following completion.

There are no other known structures or dwellings within a ½ mile of the planned operations.

3. Ground Vibration, Air Blast and Monitoring

Ground vibration and air blast will be minimized by utilizing proper blast pattern design techniques. By applying appropriate delays, powder factors and blast hole spacing these items can be minimized to comply with the required standards at the dwellings located at the Sorenson and Swapp Ranches. The following standards will be met at the Ranch structure locations:

Air Blast

Lower Frequency Limit of Measuring System, HZ (+3dB)		Maximum Level dB
0.1 Hz or lower – flat response		134 peak
2 Hz or lower – flat response		133 peak
6 Hz or lower – flat response		129 peak

C-weighed – slow response		105 peak dBC

Maximum Peak Particle Velocity (Ground Vibration)

Distance (D) from Blast Site in feet	Maximum allowable Particle Velocity (Vmax) for ground vibration, in inches/second (1)	Scaled distance factor to be applied without seismic monitoring (Ds) (2)
0 to 300	1.25	50
301 to 5,000	1.00	55
5,001 and beyond	0.75	65

(1) Ground Vibration will be measured as the particle velocity. Particle velocity will be recorded in three mutually perpendicular directions. The maximum allowable peak velocity will apply to each of the three measurements.

(2) Applicable in the scaled-diatance equation of Utah Code R645-301.524.651

Monitoring of air blast and ground vibration will be conducted at the Sorenson and Swapp Ranch occupied structures for the first two blasts conducted at the operation and any other blasts that take place within 1,000 feet of either of the occupied dwellings thereafter. This monitoring will be conducted using the following type of instrument and specifications:

- Thomas Instruments, Inc. blast monitoring seismograph VMS-2000 Series or equivalent. Sensitivity level for vibration is 0.02 in/s. Air blast is sensitive down to a trigger level of 100dB. This system records readings for both vibration and air blast once the trigger levels are exceeded. This recording is then loaded into software and reports can then be generated documenting the readings taken during the blast event. This instrument will be setup on the ground near the foundation of the occupied dwellings on the side facing the blast operations. The resulting readings will be provided to the Division following each blast that is monitored.

4. Records of Blasting Operations

Records documenting blasting operations will be maintained at the mine site for at least three years and upon request will be made available to the Division upon request. These records will include all information as required in R645-301-524.700. The contractor will also keep blasting records for at least 3 years at the contractors' site office.

See Exhibit 2 for a blank shot report example

EXHIBIT 1

Public Notice

Public Notice

Alton Coal Development, LLC plan to conduct blasting operations on the Coal Hollow Mine, located 3.9 miles south of Alton, Utah at the address 2060 South Alton Road and the North Private Lease, located 0.25 miles south east of Alton, Utah. As required under the mine and reclamation plan, MRP C/025/0005, the following:

Blasting operations and use of explosives at the Coal Hollow Mine will be conducted in accordance with the following

- MSHA Part 77 – Subpart N – Explosive and Blasting
- Utah Administrative Code – R645-301-524
- Coal Hollow Mine Specifications
- Other Federal, State and Local regulations governing the use of explosives.

I. Name, address, and telephone number of operator;

Alton Coal Development, LLC
463 North 100 West
Cedar City, Utah 84721
435-867-5331

II. Identification of the specific areas in which blasting will take place;

Coal Hollow Mine
The following described lands located in Kane County, Utah within Sec. 19, 20, 29 & 30, T39S, R5W

North Private Lease
The following described lands located in Kane County, Utah within Sec. 12 &13, T39S, R6W and within Sec. 7 &18, T39S, R5W

III. Dates and time periods when explosives are to be detonated;

When required, blasting will be scheduled Monday through Friday, between 1 P.M. and 6 P.M.. Blasting Operations will not be scheduled on Saturday, Sunday or at night.

IV. Methods to be used to control access to the blast area;

Prior to commencement of blasting operations at the Coal Hollow Mine, signs will be placed at the locations where the currently existing County 136 intersects the permit boundary. For the North Private Lease, signs will be also be placed at the locations where County Road 136 intersects the

permit boundary, as well as the Lease entrance. Appropriate barricades will be in place at these locations and signs will be added stating "Warning! Explosives in Use". Type and patterns of audible warnings and all clear signals to be used before and after blasting.

A typical blast sequence will be the following:

- 30 minute warning – Blast announced over all Coal Hollow Mine or North Private Lease radio channels.
- 15 minute warning – Blast once again announced over all Coal Hollow Mine or North Private Lease radio channels. Guards are placed at the entrance of the blasting area and the pit is cleared.
- 5 minute warning – Guards blocking all access, pit cleared, access to the blasting area blocked, radio silence required and siren activated. Siren will be three prolonged wales.
- 1 minute warning – A series of short siren wales
- Countdown to ignition @ 5,4,3,2,1 – Announced across Coal Hollow Mine or North Private Lease radio channels
- All clear signal – One prolonged siren wale

EXHIBIT 2

Example Blast Report

Site Information		Open
Site Name:	OMW Bluffdale	
Address 1:	14860 Pony Express Rd	
Address 2:		
City:	Bluffdale	
State:	UT	
Zip Code:	84065	
State Explosives User Number :		

Customer Information

Customer:	
Operation:	
Address 1:	
Address 2:	
City:	
State:	
Zip:	
County:	
Permitee:	
Permit Number:	
Measurements Format :	

Blast Date

Orica Blast Report Number :	JBEN-A3383A
Blast Time:	
Blast Number:	
Blast Location :	
Rock Geology :	
Rock Density :	1.0000

Weather conditions :	
Temperature:	
Wind From Direction :	
Wind Velocity:	

Blast Type:	

Blast Layout Table

Pattern	Rows	Holes/Row	Diameter	Burden	Spacing	Bench Height	Depth	Sub/Backfill	Volume
			Millimeters	Meters	Meters	Meters	Meters	Meters	Vol Cu M

			Inches	Feet	Feet	Feet	Feet	Feet	Vol Cu Yd

Pattern Hole Loading Detail Table

Pattern	Stemming Length/Hole	Stemming Material Type	Expl. Charges/ Hole	Inert Decks	Avg Inert Deck Length	Inert Deck Length Total/Hole	Inert Deck Material Type
	Meters				Meters	Meters	
	Feet				Feet	Feet	

Calculated Blast Summary

Total Rows:	
Total Holes:	
Total Drill Footage:	
Volume format unknown	
Volume format unknown	

Product	Manufacturer	Size	Quantity/Notes	Weight
				Kilos
				Pounds
				@ERROR

Summary	
Product Weight Total (Kilos):	

Product		Delay	Length	Note	Quantity
			Meters		
			Feet		

Critical Structure:	
Critical Structure Distance (Meters):	
Critical Structure Direction:	
Critical Structure Notes:	
Minimum Delay Interval:	8 ms
Maximum Charges or Decks /Delay:	
Actual - Weight/Delay (Kg):	
Peak Particle Velocity:	*Note: This will not be displayed on the Printed Blast Report Used for reporting only.
Peak Overpressure:	*Note: This will not be displayed on the Printed Blast Report Used for reporting only.

Seismograph Instrument Information

Instrument Location	Name	Model	Serial #	Company	Operator	Calibration Date	Trigger Source	Geophone T. Level	Microphone T. Level
								mm/sec	Pa
								in/sec	dB

Instrument Location Data

Instrument Location	Direction From Blast	Location Note	Distance From Blast
			Meters
			Feet

Instrument Readout Data

Instrument Location	T mm/sec	V mm/sec	L mm/sec	T Hz	V Hz	L Hz	P.P.V	P.O.P

Powder Factor :	
Powder Factor :	
Powder Factor :	
Workplace Inspection :	◯ Yes ◯ No
Safety Meeting :	◯ Yes ◯ No
Persons on Loading Crew :	

Blaster-in-Charge Name :	Jacqueline Berendzen
Blaster License Number :	

General Comments

APPENDIX 5-11

North Area Geotechinical Report

Engineering, Inc.

Geotechnical Investigation (revised)

Alton Coal Mine - North Area

Township 39 South, Range 5 West

Southeast of Alton, Utah

Prepared For:

Alton Coal Development
463 North 100 West
Cedar City, UT 84721

October 14, 2015

Report Number: RG1434

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October 14, 2015

Alton Coal Development
463 North 100 West
Cedar City, UT 84721

Subject: Geotechnical Report - Alton Coal Development Mine - North Area
Southeast of Alton, Utah

Enclosed is our geotechnical investigation report for the subject open pit mine - North Area - Southeast of Alton, Utah.

The report details our field exploration and laboratory testing program and presents our analysis, opinions and recommendations for the proposed project.

Compressiable / loose soils were encountered as outlined in this report.

We appreciate this opportunity to be of service on this phase of the project and look forward to being of service as the project progresses. If you have any questions, please contact this office at your convenience.

Sincerely,
GEM Engineering, Inc.

Joel A. Myers, P.E.
President

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Appendix A

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Appendix B

Taylor Geo-Engineering Report dated December 15, 2008 Project # 307001

Appendix C

Slope Stability Analysis

1.0 INTRODUCTION

1.1 General

This report presents the results of a geotechnical investigation performed for the Alton Coal Development Coal Mine - North Area, Southeast of Alton, Utah. The site is located within Township 39 South, Range 5 West of the Salt Lake Base and Meridian Utah. The study was conducted in accordance with the client's authorization.

The purposes of this investigation were to: (1) evaluate the general nature and engineering properties of the subsurface soils at the site; (2) identify the general site geotechnical conditions and (3) provide recommendations and opinions regarding general site grading and the design and construction of foundations, concrete slabs-on-grade and slope stability. The investigation included a site reconnaissance, subsurface exploration, representative soil sampling, laboratory testing, engineering analyses, review of existing geologic studies performed in the area and preparation of this report. The Taylor Geo-Engineering was relied on for much of the geotechnical data analysis for this site. That report is contained in appendix B. The soils that were tested in the Taylor Geo-Engineering report are essentially the same as in this report.

The recommendations contained in this report are subject to the limitations presented in the "Limitations" section of the report. We recommend that all individuals reading this report read the limitations section of this document.

1.2 Project Description

We understand that an open pit coal mine is to be developed at the north area as shown on Plate 1 of this report. The site will be mined and stockpiles and drainage impoundments will be constructed also as shown on Plate 1 of this report.

The site plan on Plate 1 shows the approximate trench location with respect to the approximate property lines and proposed stockpiles and impoundments.

2.0 FIELD EXPLORATION

The subsurface soil conditions were explored by excavating, with a rubber tired back hoe, 5 exploratory trenches to depths of approximately 10 to 15 feet below the existing site grade. The approximate locations of these explorations are shown on Plate 1. Soils and subsurface conditions encountered in the explorations were classified, logged and recorded at the time of excavation by our field geologists. The results of the explorations are presented on the enclosed Plates 2 through 8. A key to soil symbols and terms is found on Plate 17.

3.0 LABORATORY TESTING

Representative soil samples from the explorations were tested in the laboratory to verify the field classifications and to evaluate other pertinent engineering characteristics. The soil samples were tested for moisture, density, solubility, gradation, consolidation behavior and maximum density. Results are presented on Plate 9.

4.0 GEOLOGIC AND SEISMIC CONDITIONS

4.1 Geologic Setting

The Alton Valley lies near the border of the Basin and Range and the Colorado Plateau physiographic provinces. The area is dominated by normal fault-block structure common to the Basin and Range Province, however, a small area of thrust faults are present in the valley.

The valley fill material consists of alluvial deposits of silt, sand, and clay up to gravel size materials. The thickness of valley fill deposits may be up to 200 feet. The valley fill deposits are generally underlain by the Clarion Formation.

4.2 Geologic Hazards

Although some potential geologic hazards may be identified in this Geotechnical Investigation Report, this is NOT a Geologic Hazards Report and should not be regarded as such.

No evidence of know faults was found within 500 feet of the proposed North Area location.

5.0 SITE CONDITIONS

5.1 Surface Conditions

As stated previously the site is located approximately southeast of Alton, Kane County, Utah. At the time of our investigation the site was vacant undisturbed pasture and range land. The surface generally consisted of sandy and silty clays. Vegetation consisted of grass, brush, native trees and weeds typical of the area. Drainage was pronominally by sheet flow to the southwest.

5.2 Subsurface Conditions

The on site soils encountered in the excavations generally consisted of sandy and silty clays followed by either sandy gravel, sandy silt and clayey soils which extended to the bottom of the holes. Bedrock or refusal was not encountered in any of our explorations.

Numerous factors contribute to fluctuations in groundwater levels and locations. The evaluation of these factors was beyond the scope of this study. However, groundwater was not encountered during the exploration. The soils were in a slightly moist to moist condition throughout the depths explored.

The encountered subsurface conditions are described in detail on the enclosed trench logs, Plates 2 through 8. Due to the nature and depositional characteristics of the native soils, care should be taken in extrapolating subsurface conditions beyond the exploration lactations.

The laboratory tests results indicated that the on-site soils exhibited a relatively low solubility, low plasticity and a low to critical collapse potential.

6.0 ENGINEERING ANALYSIS AND RECOMMENDATIONS

6.1 General

Based on our investigation there are loose, soft and/or collapsible soils located at the site which will require some stabilization and/or overexcavation prior to the placement of structural fill or stockpiles. However, it is our opinion that the subject site is suitable for the proposed construction provided that the recommendations contained in this report are followed.

The following sections of this report present our recommendations to reduce the potential for structural damage. They contain specific opinions and recommendations concerning construction considerations, site preparation and grading, structural fill, foundation design, retaining walls, concrete slabs-on-grade, soil corrosion, moisture protection and structural pavement sections.

One of the most critical recommendations to follow in order to reduce potential for structural damage is to set the finished floor slab elevations high enough to facilitate proper drainage away from the structures.

6.2 Construction Considerations

6.2.1 Support for Structures

After excavation of loose or organic soils and recompaction is completed, the spoil structures and embankments can be supported by the underlying soils as recommended in section 6.3 Earthwork of this report.

6.3 Earthwork

6.3.1 Site Preparation and Grading

Within the areas to be graded which are to recieve structural fill or stockpiles, existing vegetation, loose soils, and debris, should be removed and stockpiled for replacement at the end on the mining operations. Any undocumented fill soils, and soft, loose, collapsible and/or disturbed native soils should be excavated to expose competent, dense or medium dense granular soils.

It is anticipated that competent medium stiff or medium dense granular soils will be encountered at 1 to 2 feet below the ground surface. Usually, direcly beneath the vegitative layer or top soil. A GEM Engineering representative should observe the excavation to verify that competent granular soils have been reached and that no additional overexcavation is required. If additional overexcavation is required the width of overexcavation should extend laterally at least 5 feet beyond the edge of footing on each side or to a distance equal to the depth of overexcavation, whichever is greater. In some circumstances, after review of the excavation, GEM Engineering may approve a width of lateral overexcavation less than 5 feet but in no case shall this width be less than the required depth of overexcavation.

Slabs-on-grade, exterior concrete flatwork, and pavements should be supported by a zone of properly placed and compacted structural fill. If soft or collaspisable soils are encountered after all existing vegetation, loose soils, and debris has been removed than additional overexcavation will be required. Overexcavations, if required, shall extend laterally at least 2 feet beyond exterior flatwork and pavement areas. Excavations may be terminated if competent, medium dense native soils are encountered.

If loose, soft or pumping soils are encountered at the bottom of the overexcavations, stabilization and/or additional overexcavation will be required

prior to the placement of structural fill. Overexcavations may be terminated if competent, medium-dense granular soils are encountered. A GEM Engineering representative should observe excavation and determine if it is acceptable to terminate the excavation or reduce the overexcavation depth.

The majority of on-site soils, free of organics and debris, should be suitable for reuse as structural fill with the exception of the fat clays. If using on-site soils for backfill or structural fill a shrinkage factor of up to 15 percent can be expected.

Following excavation of the unsuitable soils as described above, a representative of this office should observe the excavation bottoms prior to the continuance of grading to verify that unsuitable materials have been removed and that competent soils have been exposed. The native soils exposed after overexcavation should be scarified to a depth of 6 inches, brought to within 2 percent of the optimum moisture content for granular soils and slightly above optimum for fine-grained soils, and compacted to at least 90 percent of the maximum dry density for granular soils and 85 percent of the maximum dry density for fine grained soils as determined by ASTM D-1557. The site should then be brought to the proper grade with structural fill as described in the Structural Fill section.

Subgrade materials supporting slabs-on-grade, exterior concrete flatwork, and pavements should be kept moist and not be allowed to dry out and crack. If the subgrade has been disturbed or dried out prior to placement of aggregate base, the exposed soils should be moisture-conditioned and recompacted as outlined in the Structural Fill section of this report.

We recommend that a GEM Engineering representative be allowed to review the grading plans when prepared to evaluate their compatibility with the recommendations of this report.

6.3.2 Excavations

The majority of the soils encountered in our explorations should be excavatable with conventional earthwork equipment. It is also possible that soft pumping soils may be encountered. Pumping soils will need to be stabilized prior to placing of structural fill. Safety of construction personnel is the responsibility of the Contractor.

6.3.3 Material Volume Changes

There will be shrinkage losses when excavating and compacting the on-site soils from a native state to a compacted structural fill state. An estimated average shrinkage factor of 10 to 15 percent is applicable for the loose to medium-dense/medium stiff near-surface native soils when compacted to 90 percent of ASTM D-1557. A subsidence factor of 0.1 should be used in all areas where the surficial soils are scarified and recompacted to a depth of 6 inches.

The following table illustrates a shrinkage and expansion analysis that was preformed at the site on the different soil types encountered:

SHRINKAGE AND EXPANSION - SUMMARY OF TEST RESULTS

Material Type	Test Type	Average Dry Density	Shrinkage/Expansion
Tropic Shale (CH) Native	Nuclear Density	96.3 pcf	--
Tropic Shale (CH) Loose	Nuclear Density	84.8 pcf	11.9 % - Expansion
Tropic Shale (CH) Compacted	Nuclear Density	107.2 pcf	11.3 % - Shrinkage
Alluvium (SM) Native	Nuclear Density	95.6 pcf	--
Alluvium (SM) Loose	Nuclear Density	88.7 pcf	7.2 % - Expansion
Alluvium (SM) Compacted	Nuclear Density	114.2 pcf	16.3 % - Shrinkage

Based on the above shrinkage and expansion values the bank(native density) to loose expansion factor is calculated to be 10.7 percent for the anticipated 3 to 1 Tropic Shale to Alluvium mixture.

Additionally, when backfilling the pit after the coal column is removed a expansion factor from the bank (native density) to placed in the hole is anticipated

to be 9.5 percent because of the natural consolidation that occurs due to consolidation of the soils that occurs in large fills.

6.3.4 Structural Fill

All fill placed for the support of slabs-on-grade, exterior concrete flatwork, and pavements should be structural fill. Structural fill may consist of approved excavated on-site or imported fill materials. Structural fill should have a swell potential less than 10 percent under a 60 psf surcharge, have a solubility of less than 3 percent, be free of organics, salts, or inert materials larger than 4 inches nominal size, and be similar in gradation to the on-site soils.

Structural fill should be placed in maximum eight-inch loose lifts and compacted on a horizontal plane, unless otherwise approved by the Geotechnical Engineer. Soils in compacted fills should be compacted to at least 90 percent of the maximum dry density as determined by ASTM-D698. The moisture content should be within 2 percent of optimum for granular soils and at least 2 percent above optimum for fine-grained soils. Any imported fill materials should be approved prior to importing. Also, prior to placing any fill, the excavations should be observed by a GEM Engineering representative to observe that unsuitable materials have been removed.

6.4 Slope Stability Analysis

A detailed slope stability analysis was preformed by GEM Engineering. The Factors of safety for the highest slopes range from 2.22 to 5.21 against failure depending on the soil type and cross-sections utilized. A factor of safety of 1.5 is required. The analysis was preformed utilizing STEDwin which is a slope stability software program. The results of the analysis are contained in Appendix C of this report and can be utilized for the subject North Area Stockpiles as long as the 3 to 1 horizontal to vertical slopes are maintained as recommended.

6.5 Excess Spoil Structures and Sediment Impoundments

It is our understanding that a temporary excess spoil structure and Sediment Impoundments will be constructed on the site. We recommend that the maximum slope will be 3:1 (horizontal to vertical) for fill slope slopes and a maximum of 2:1(horizontal to vertical) cut slopes in Sediment Impoundments. It is our understanding that none of the spoil structures are permanent. While ground water was not encountered during our investigation, some dewatering may be necessary at the bottoms of the sediment impoundments if groundwater is encountered. All embankments constructed for the Sediment Impoundments should be constructed with structural fill as recommended in section 6.3.4 of this report and State of Utah R645-Coal Mining Rules.

6.6 Settlement

Based on the anticipated loading of the spoil piles as shown on plate 1 and the consolidation behavior assessed in the laboratory testing in this report, we estimate the settlement of spoil stock piles to be on the order of 1.5 to 2 feet. It should be noted that farming activities can be performed on the reclamated areas but structures should not be placed on the reclamated areas due to the large anticipated settlements.

6.7 Bulking

During mass excavation operation of dense materials, the placement of spoils generally requires more volume of space than that originally occupied by the same soil mass in its native state. Based on dry densities of the CH - Silty Clay materials in their intact state and Standard Proctors preformed, the CH - Silty Clay spoils and testing preformed by our firm in the south area there will be volume increase of approximately 10 to 15 percent. The Alluvium (Lean Clay, Sand and Gravel) materials will have an increase of approximately 5 to 10 percent.

7.0 CLOSURE

7.1 Limitations

The recommendations contained in this report are based on the field exploration, laboratory tests, and our understanding of the proposed construction. The subsurface data used in the preparation of this report were obtained from the exploration made during this investigation. It is possible that variations in the soil and groundwater conditions could exist elsewhere on the site. The nature and extent of variations may not be evident until construction occurs. If any conditions are encountered at the site which are different from those described in this report, GEM Engineering should be immediately notified so that we may make any necessary revisions to recommendations contained in this report. In addition, if the scope of the proposed construction changes from that described in this report, GEM Engineering should likewise be notified.

This report was prepared in accordance with the generally accepted standard of practice at the time the report was written. Although some potential geologic hazards may be indentified in this Geotechnical Investigation Report, this is NOT a Geologic Hazards Report and should not be regarded as such. No warranty, express or implied, is made. It is the Client's responsibility to see that all parties to the project, including the Designer, Contractor, Subcontractors, etc., are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the Contractor's option and risk. GEM Engineering will not accept the responsibility for damage caused by the uncontrolled action of water at the site.

7.2 Additional Services

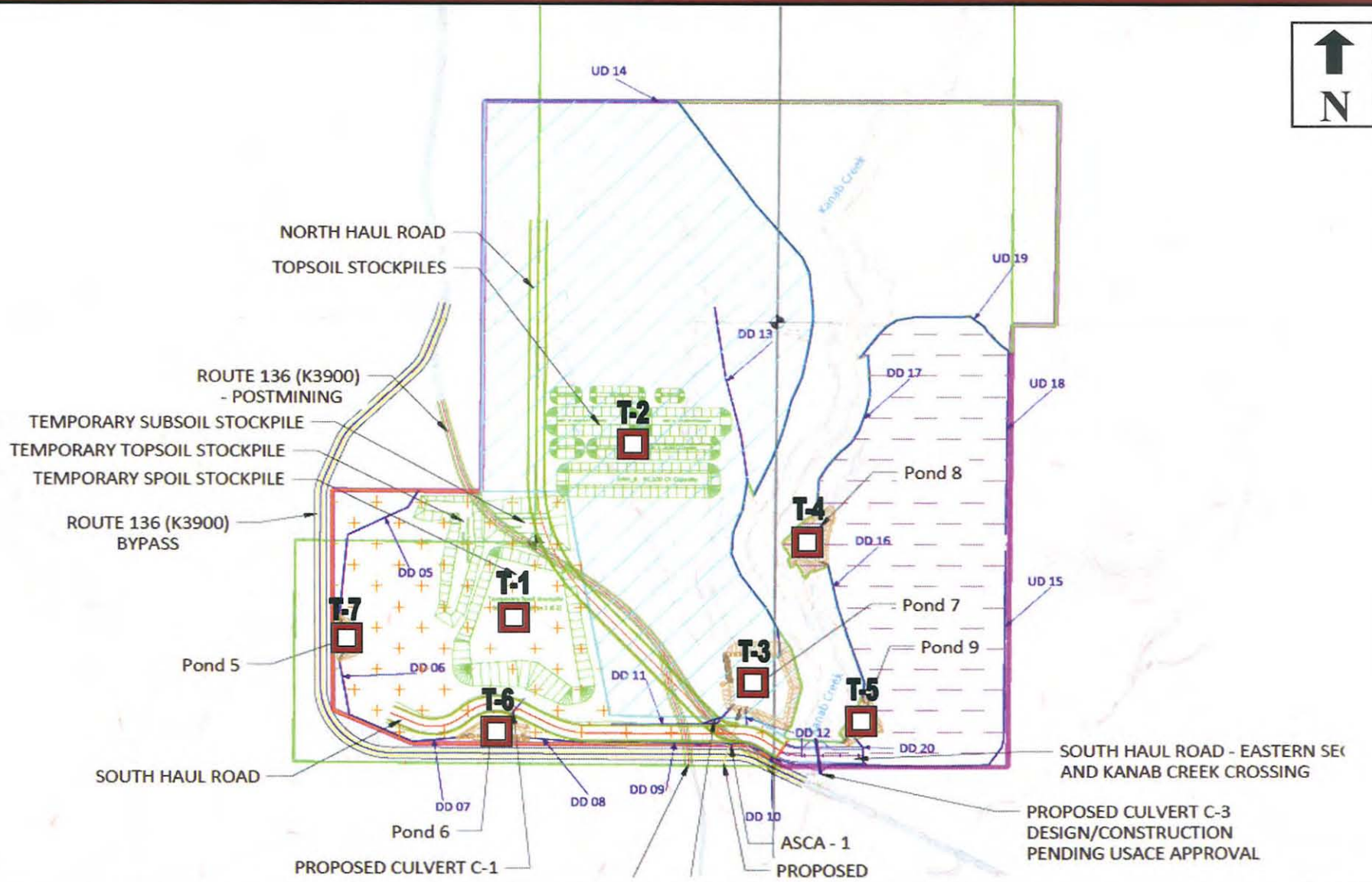
The recommendations made in this report are based on the assumption that an adequate program of tests and observations will be made during the construction to verify compliance with the recommendations. These tests and observations should include, but not necessarily be limited to, the following:

- Observations and testing during site preparation, earthwork and structural fill placement
- Observations of footing excavations
- Consultation as may be required during construction

We also recommend that project plans and specifications be reviewed by us to verify compatibility with our conclusions and recommendations. Additional information concerning the scope and cost of these services can be obtained from our office.

Appendix A

SITE PLAN



Notes:
Key: ☐ Approximate Trench Location
Plan: Not to Scale

PROJECT:	**Alton Coal Development - North Area** **South East of Alton, Utah**
Client:	Alton Coal Development
Report No:	RG1434

GEM ENGINEERING, INC.

Plate: 1

TRENCH LOG Trench No. 1

Sheet 1 of 1

Location: See Site Plan | **Elevation:** Not Measured | **Date Excavated:** 4/14/2015

Depth (ft)	Tests [1]	Sample	USCS Symbol [2]	Soil Description (Additional comments below)	Color	Relative Moisture [3]	Density [4]	Cementation [5]	Max size Particle [6]
0			CH	Silty Clay w/sand	Dark Brown	SM to M	Soft	none	1/4"
							MS		
	AT, M Sol, C								
5						SM	S		
	P, Sol AT, M								
10				Bottom @ 10 Feet					
15									
20									

Sample: Drive Sample | Bag Sample | Bucket Sample

1) At = Atterberg, M = Moisture, Sol = Solubility, E = Expansion, C = Consol, P = Proctor

2) See Plate 12 for explanation of Unified Soil Classification System

3) D = Dry, SM = Slightly Moist, M = Moist, VM = Very Moist, W = Wet

4) Coarse Grain: VL = Very Loose, L = Loose, MD = Medium Dense, D = Dense, VD = Very Dense Fine Grain: VSF = Very Soft, SF = Soft, MS = Medium Stiff, S = Stiff, VS = Very Stiff, H = Hard

5) W = Weak cementation, M = Moderate cementation, S = Strong cementation

6) B=Boulder, C= Cobble, CG=Coarse Gravel (3" - 3/4"), FG=Fine Gravel (3/4" - 1/4"), CS=Coarse Sand (#10-#4), MS=Medium Sand (#40 - #10), FS=Fine Sand (#200 - #40), F=Fines

Notes:
Groundwater:
Not encountered

Caving of side walls:
None noted

PROJECT: Alton Coal Development - North Area
South East of Alton, Utah

Client: Alton Coal Development

Report No: RG1434

GEM ENGINEERING, INC.

Plate: 2

TRENCH LOG Trench No. 2

Location: See Site Plan | **Elevation:** Not Measured | **Date Excavated:** 4/14/2015

Depth (ft)	Tests [1]	Sample	USCS Symbol [2]	Soil Description (Additional comments below)	Color	Relative Moisture [3]	Density [4]	Cementation [5]	Max size Particle [6]
0			CL	Sandy Clay - Top Soil	Dark Brown	SM to M	Soft	None	#4
5	AT, M Sol, C		ML		Tan	M SM	MS	None	3/8"
10	P, Sol AT, M								
15				Botton at 13.5 Feet.					
20									

Sample: Drive Sample | Bag Sample | Bucket Sample

1) At = Atterberg, M = Moisture, Sol = Solubility, E = Expansion, C = Consol, P = Proctor
2) See Plate 12 for explanation of Unified Soil Classification System
3) D = Dry, SM = Slightly Moist, M = Moist, VM = Very Moist, W = Wet
4) Coarse Grain: VL = Very Loose, L = Loose, MD = Medium Dense, D = Dense, VD = Very Dense Fine Grain: VSF = Very Soft, SF = Soft, MS = Medium Stiff, S = Stiff, VS = Very Stiff, H = Hard
5) W = Weak cementation, M = Moderate cementation, S = Strong cementation
6) B=Boulder, C= Cobble, CG=Coarse Gravel (3" - 3/4"), FG=Fine Gravel (3/4" - 1/4"), CS=Coarse Sand (#10-#4), MS=Medium Sand (#40 - #10), FS=Fine Sand (#200 - #40), F=Fines

Notes:
Groundwater:
Not encountered

Caving of side walls:
None noted

PROJECT: Alton Coal Development - North Area
South East of Alton, Utah

Client: Alton Coal Development

Report No: RG1434

GEM ENGINEERING, INC.

Plate: 3

TRENCH LOG Trench No. 3

Sheet 1 of 1

Location: See Site Plan | **Elevation:** Not Measured | **Date Excavated:** 4/14/2015

Depth (ft)	Tests [1]	Sample	USCS Symbol [2]	Soil Description (Additional comments below)	Color	Relative Moisture [3]	Density [4]	Cementation [5]	Max size Particle [6]
0	AT, M Sol, C		CL	Sandy Clay	Red Brown	SM to M	Soft to MS	no	#4
5	P, Sol AT, M		GM	Sandy Gravel - Some Silt	Grey	SM to M	MD	no	5"
10	AT, M Sol		SM	Silty Sand	Yellow Brown	SM to M M	MD to D	no	3/8"
15				Bottom at 14 Feet					
20									

Sample: Drive Sample | Bag Sample | Bucket Sample

1) At = Atterberg, M = Moisture, Sol = Solubility, E = Expansion, C = Consol, P = Proctor

2) See Plate 12 for explanation of Unified Soil Classification System

3) D = Dry, SM = Slightly Moist, M = Moist, VM = Very Moist, W = Wet

4) Coarse Grain: VL = Very Loose, L = Loose, MD = Medium Dense, D = Dense, VD = Very Dense Fine Grain: VSF = Very Soft, SF = Soft, MS = Medium Stiff, S = Stiff, VS = Very Stiff, H = Hard

5) W = Weak cementation, M = Moderate cementation, S = Strong cementation

6) B=Boulder, C= Cobble, CG=Coarse Gravel (3" - 3/4"), FG=Fine Gravel (3/4" - 1/4"), CS=Coarse Sand (#10-#4), MS=Medium Sand (#40 - #10), FS=Fine Sand (#200 - #40), F=Fines

Notes:
Groundwater:
Not encountered

Caving of side walls:
None noted

PROJECT: Alton Coal Development - North Area
South East of Alton, Utah

Client: Alton Coal Development

Report No: RG1434

GEM ENGINEERING, INC.

Plate: 4

TRENCH LOG Trench No. 4

Sheet 1 of 1

Location: See Site Plan | **Elevation:** Not Measured | **Date Excavated:** 4/14/2015

Depth (ft)	Tests [1]	Sample	USCS Symbol [2]	Soil Description (Additional comments below)	Color	Relative Moisture [3]	Density [4]	Cementation [5]	Max size Particle [6]
0			SC	Clayey Sand - Top Soil	Dark Brown	M	L	none	3/8"
5	AT, M Sol P, Sol AT, M		CL	Silty Clay with sand	Orange Brown	SM to M	MS	none	#4
						SM	S		
10							VS		
15				Bottom at 14 feet.					
20									

Sample: Drive Sample | Bag Sample | Bucket Sample

1) At = Atterberg, M = Moisture, Sol = Solubility, E = Expansion, C = Consol, P = Proctor

2) See Plate 12 for explanation of Unified Soil Classification System

3) D = Dry, SM = Slightly Moist, M = Moist, VM = Very Moist, W = Wet

4) Coarse Grain: VL = Very Loose, L = Loose, MD = Medium Dense, D = Dense, VD = Very Dense Fine Grain: VSF = Very Soft, SF = Soft, MS = Medium Stiff, S = Stiff, VS = Very Stiff, H = Hard

5) W = Weak cementation, M = Moderate cementation, S = Strong cementation

6) B=Boulder, C= Cobble, CG=Coarse Gravel (3" - 3/4"), FG=Fine Gravel (3/4" - 1/4"), CS=Coarse Sand (#10-#4), MS=Medium Sand (#40 - #10), FS=Fine Sand (#200 - #40), F=Fines

Notes:
Groundwater:
Not encountered

Caving of side walls:
None noted

PROJECT: Alton Coal Development - North Area
South East of Alton, Utah

Client: Alton Coal Development

Report No: RG1434

GEM ENGINEERING, INC.

Plate: 5

TRENCH LOG Trench No. 5

Location: See Site Plan | **Elevation:** Not Measured | **Date Excavated:** 4/14/2015

Depth (ft)	Tests [1]	Sample	USCS Symbol [2]	Soil Description (Additional comments below)	Color	Relative Moisture [3]	Density [4]	Cementation [5]	Max size Particle [6]
0			CH	Silty Clay - Top Soil in Top foot	Dark Brown	M	Soft	none	#4
							MS		
	AT, M Sol								
5						SM			
	P, Sol AT, M						S		
10			CL	Sandy Clay	Orange Brown	SM	VS	none	#4
15									
20				Bottom at 15 feet.					

Sample: Drive Sample | Bag Sample | Bucket Sample

1) At = Atterberg, M = Moisture, Sol = Solubility, E = Expansion, C = Consol, P = Proctor
2) See Plate 12 for explanation of Unified Soil Classification System
3) D = Dry, SM = Slightly Moist, M = Moist, VM = Very Moist, W = Wet
4) Coarse Grain: VL = Very Loose, L = Loose, MD = Medium Dense, D = Dense, VD = Very Dense Fine Grain: VSF = Very Soft, SF = Soft, MS = Medium Stiff, S = Stiff, VS = Very Stiff, H = Hard
5) W = Weak cementation, M = Moderate cementation, S = Strong cementation
6) B=Boulder, C= Cobble, CG=Coarse Gravel (3" - 3/4"), FG=Fine Gravel (3/4" - 1/4"), CS=Coarse Sand (#10-#4), MS=Medium Sand (#40 - #10), FS=Fine Sand (#200 - #40), F=Fines

Notes:
Groundwater:
Not encountered

Caving of side walls:
None noted

PROJECT: Alton Coal Development - North Area
South East of Alton, Utah

Client: Alton Coal Development

Report No: RG1434

GEM ENGINEERING, INC.

Plate: 6

TRENCH LOG Trench No. 6

Location: See Site Plan | **Elevation:** Not Measured | **Date Excavated:** 4/14/2015

Depth (ft)	Tests [1]	Sample	USCS Symbol [2]	Soil Description (Additional comments below)	Color	Relative Moisture [3]	Density [4]	Cementation [5]	Max size Particle [6]
0			CL	Lean Clay Some Evaporites Roots in top foot	Dark Brown	SM to M	S to VS	--	MS
5	At, M Sol, C								
	At, M Sol, P		CH	Fat Clay	Dark Brown	SM to M	S to VS	--	MS
10									
15				Bottom at 10 feet.					
20									

Sample: Drive Sample | Bag Sample | Bucket Sample

1) At = Atterberg, M = Moisture, Sol = Solubility, E = Expansion, C = Consol, P = Proctor

2) See Plate 12 for explanation of Unified Soil Classification System

3) D = Dry, SM = Slightly Moist, M = Moist, VM = Very Moist, W = Wet

4) Coarse Grain: VL = Very Loose, L = Loose, MD = Medium Dense, D = Dense, VD = Very Dense Fine Grain: VSF = Very Soft, SF = Soft, MS = Medium Stiff, S = Stiff, VS = Very Stiff, H = Hard

5) W = Weak cementation, M = Moderate cementation, S = Strong cementation

6) B=Boulder, C= Cobble, CG=Coarse Gravel (3" - 3/4"), FG=Fine Gravel (3/4" - 1/4"), CS=Coarse Sand (#10-#4), MS=Medium Sand (#40 - #10), FS=Fine Sand (#200 - #40), F=Fines

Notes:
Groundwater:
Not encountered

Caving of side walls:
None noted

PROJECT: Alton Coal Development - North Area
South East of Alton, Utah

Client: Alton Coal Development

Report No: RG1434

GEM ENGINEERING, INC.

Plate: 7

TRENCH LOG Trench No. 7

Sheet 1 of 1

Location: See Site Plan | **Elevation:** Not Measured | **Date Excavated:** 4/14/2015

Depth (ft)	Tests [1]	Sample	USCS Symbol [2]	Soil Description (Additional comments below)	Color	Relative Moisture [3]	Density [4]	Cementation [5]	Max size Particle [6]
0	At, M, C Sol, P		CH	Fat Clay Roots in top 18 inches	Gray White	SM to M	MS to S	--	CS
5	At, M, C Sol, P		CL	Lean Clay Some Evaporites	Brown Gray with Red Streaks	SM to M	VS to H	--	MS
10				Bottom at 10 feet.					
15									
20									

Sample: Drive Sample | Bag Sample | Bucket Sample

1) At = Atterberg, M = Moisture, Sol = Solubility, E = Expansion, C = Consol, P = Proctor

2) See Plate 12 for explanation of Unified Soil Classification System

3) D = Dry, SM = Slightly Moist, M = Moist, VM = Very Moist, W = Wet

4) Coarse Grain: VL = Very Loose, L = Loose, MD = Medium Dense, D = Dense, VD = Very Dense Fine Grain: VSF = Very Soft, SF = Soft, MS = Medium Stiff, S = Stiff, VS = Very Stiff, H = Hard

5) W = Weak cementation, M = Moderate cementation, S = Strong cementation

6) B=Boulder, C= Cobble, CG=Coarse Gravel (3" - 3/4"), FG=Fine Gravel (3/4" - 1/4"), CS=Coarse Sand (#10-#4), MS=Medium Sand (#40 - #10), FS=Fine Sand (#200 - #40), F=Fines

Notes:
Groundwater:
Not encountered

Caving of side walls:
None noted

PROJECT: Alton Coal Development - North Area
South East of Alton, Utah

Client: Alton Coal Development

Report No: RG1434

GEM ENGINEERING, INC.

Plate: 8

LABORATORY TESTS SUMMARY

Trench / Boring No.	Sample Depth (ft)	UCSC Symbol	Soil Description	Field Moisture (%)	Field Dry Density (pcf)	Solubility (%)	Fine Sieve % Passing				Atterberg Limits			Expansion		Net Percent Consolidation		Modified Proctor	
							#4	#10	#40	#200	Liquid Limit	Plastic Limit	Plasticity Index	Load	%	@ 2000 lb	@ H_2O + 2000 lb	Dry Density	Optimum Moisture
T-1	3	CH	Silty Clay w/sand	15.8	100.5	<1	100.0	98.3	96.4	77.5	58	27	31	2000	2.1	5.3	3.2	--	--
T-1	8	CH	Silty Clay w/sand	12.4	--	<1	100.0	98.4	94.6	80.2	60	28	31	--	--	--	--	107.5	16.5
T-2	4	ML	Sandy Silt	6.1	81.2	<1	100.0	82.3	66.4	58.8	9	6	3	--	--	1.2	3.0	--	--
T-2	8	ML	Sandy Silt	7.9	--	<1	100.0	85.7	70.4	55.0	10	7	3	--	--	--	--	94.0	10.5
T-3	1	CL	Sandy Clay	17.3	101.3	<1	95.3	77.3	68.4	52.3	15	4	11	--	--	2.2	2.4	--	--
T-3	4	GM	Sandy Gravel	5.1	--	<1	45.6	34.7	22.9	16.8	NP	NP	NP	--	--	--	--	124.0	8.5
T-3	6	SM	Silty Sand	9.6	105.0	<1	94.3	66.4	42.0	31.3	NP	NP	MP	--	--	1.0	3.8	--	--
T-4	3	CL	Silty Clay w/sand	17.7	84.4	<1	95.4	72.9	68.3	55.3	14	4	10	--	--	--	--	--	--
T-4	4	CL	Silty Clay w/sand	13.4	--	<1	90.6	66.1	62.1	51.6	18	7	11	--	--	--	--	101.5	12.5
T-5	3	CH	Silty Clay	22.4	95.9	<1	100.0	97.4	82.4	79.5	62	30	32	--	--	--	--	--	--
T-5	5	CL	Silty Clay w/sand	12.5	--	<1	100.0	94.3	86.9	80.4	59	22	37	--	--	--	--	105.0	17.0
T-6	5	CL	Clay	11.7	87.9	1.1	100.0	99.9	99.3	96.4	26	16	10	--	--	2.3	9.8	--	--
T-6	7	CH	Clay	12.9	--	<1	100.0	99.7	99.0	96.6	52	20	32	--	--	--	--	99.5	18.5
T-7	2	CH	Clay	18.8	103.0	<1	99.9	99.8	99.2	97.1	62	22	40	2000	0.9	1.7	0.8	101.0	15.5
T-7	6	CL	Clay	11.3	140.0	<1	100.0	100.0	99.9	94.0	41	16	25	2000	0.2	2.0	1.8	109.0	16.5

Notes:

Key: NP = Non Plastic, -- indicates no test performed

Atterberg Limits are for classification of fine-grained and fine-grained fraction of coarse-grained soils

PROJECT: **Alton Coal Development - North Area**
South East of Alton, Utah

Client: Alton Coal Development

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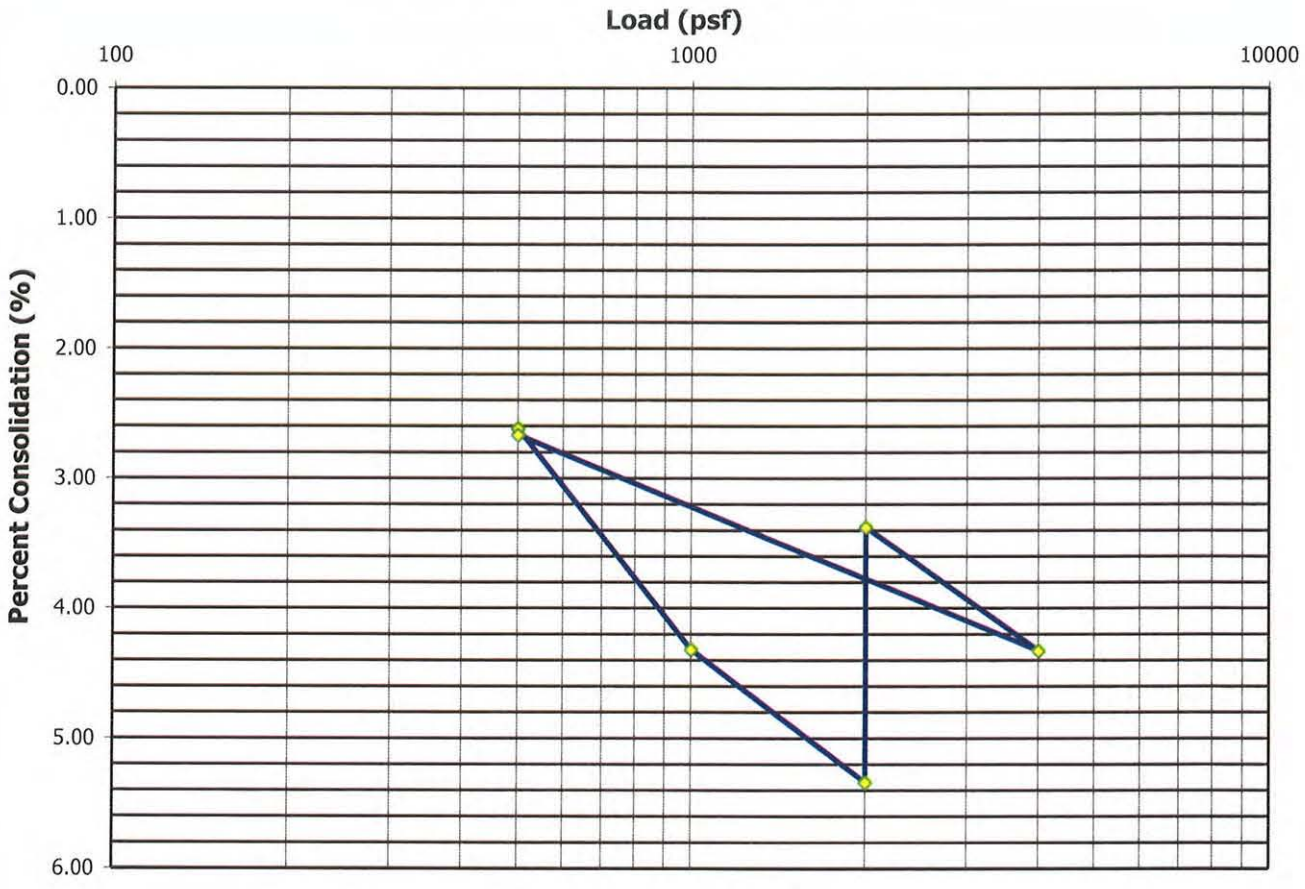
GEM ENGINEERING, INC.

Plate: 9

CONSOLIDATION TEST DATA



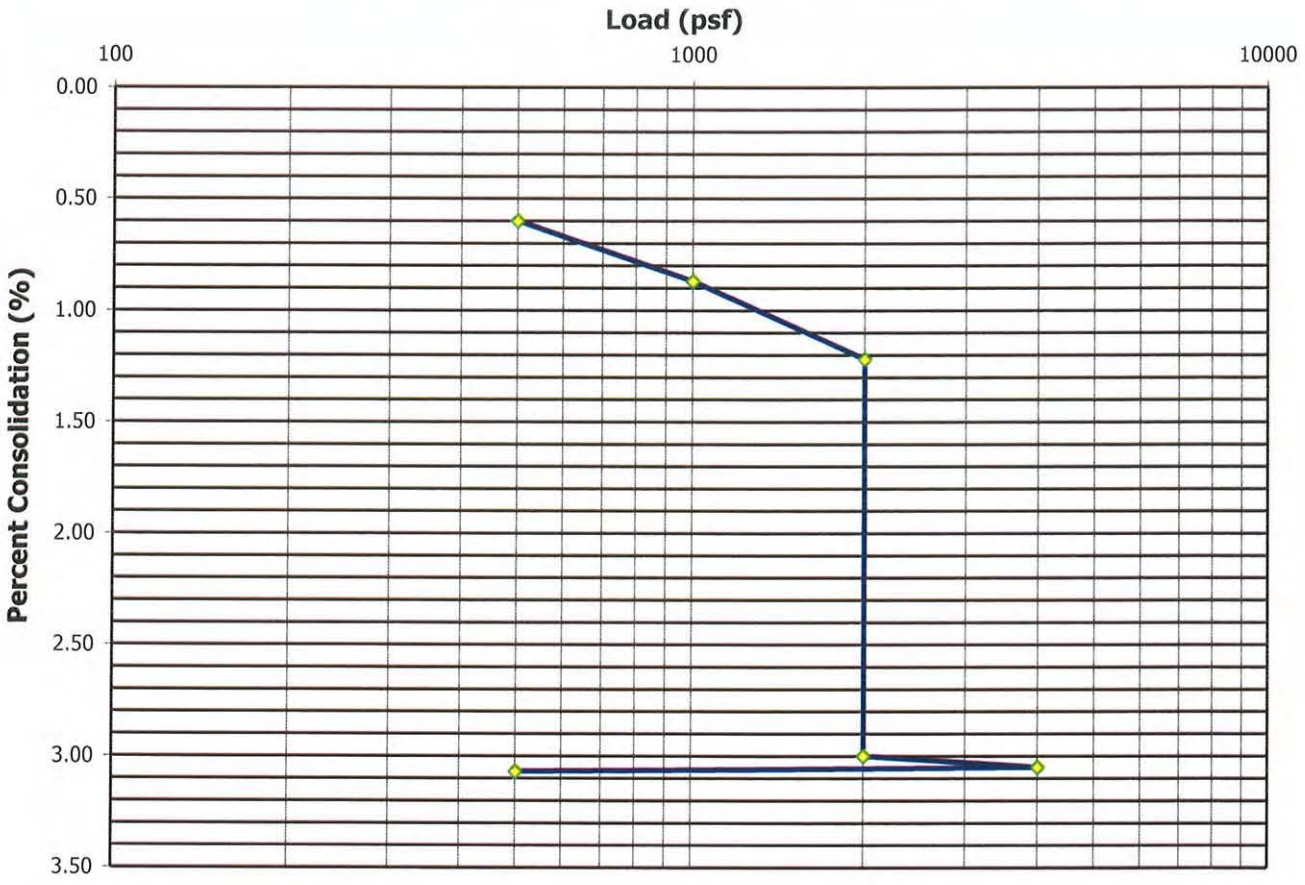
Sample Location - T-1 @ 3'
Water added at 2000 psf

Load (psf)	Percent Consolidation	Net Percent Consolidation *
500	2.62	0.00
1000	4.32	1.70
2000	5.34	2.72
2000 + H20	3.38	0.76
4000	4.33	1.71
500	2.67	0.05

* Net consolidation assumes that existing native pressure on soil is aproximately equal to 500 psf

PROJECT:	**Alton Coal Development - North Area** **South East of Alton, Utah**	GEM ENGINEERING, INC.	**Plate:** **10**
Client:	Alton Coal Development		
Report No:	RG1434		

CONSOLIDATION TEST DATA



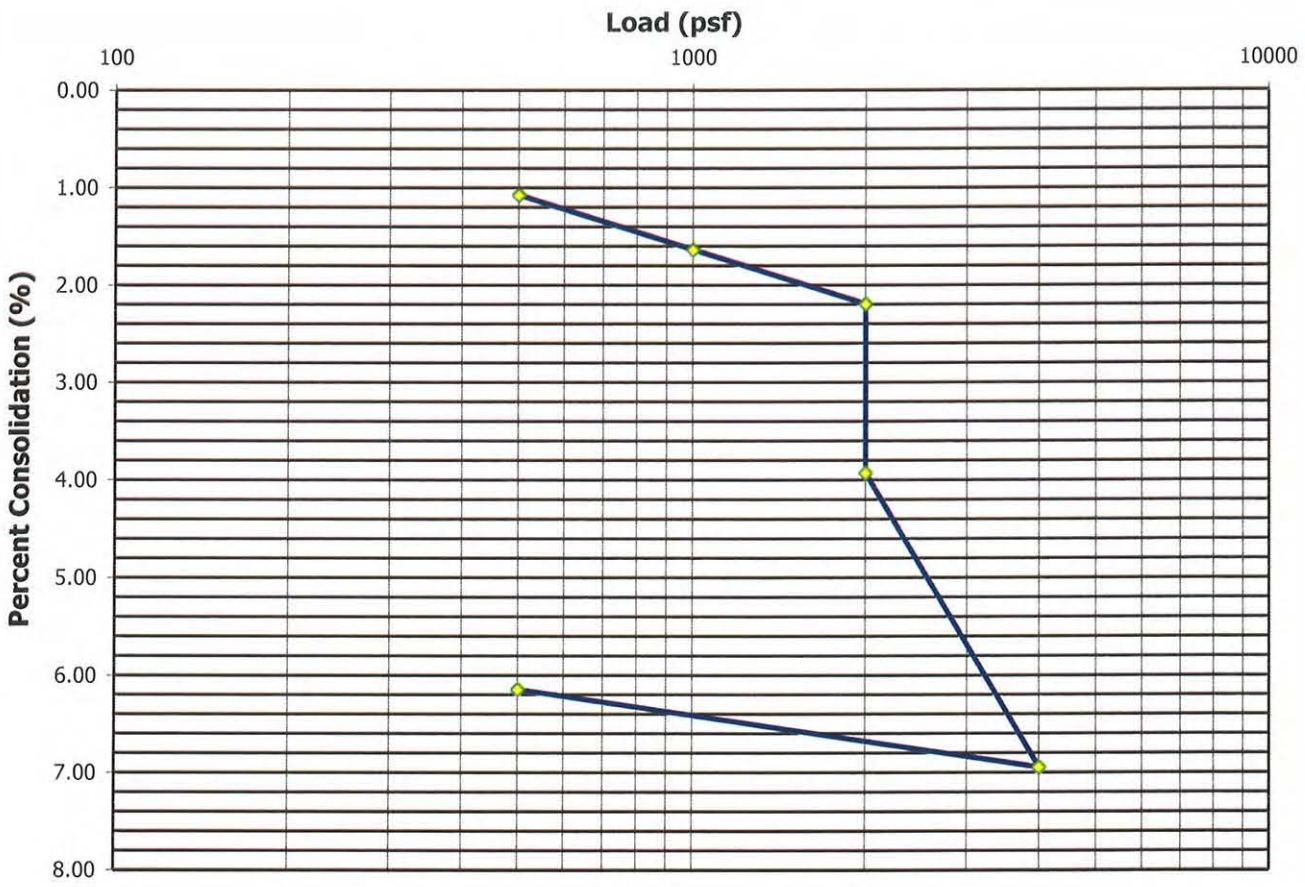
Sample Location - T-2 @ 4'
Water added at 2000 psf

Load (psf)	Percent Consolidation	Net Percent Consolidation *
500	0.60	0.00
1000	0.87	0.27
2000	1.22	0.62
2000 + H20	3.00	2.40
4000	3.05	2.45
500	3.07	2.47

* Net consolidation assumes that existing native pressure on soil is aproximately equal to 500 psf

PROJECT:	**Alton Coal Development - North Area** **South East of Alton, Utah**	GEM ENGINEERING, INC.	**Plate:** 11
Client:	Alton Coal Development		
Report No:	RG1434		

CONSOLIDATION TEST DATA



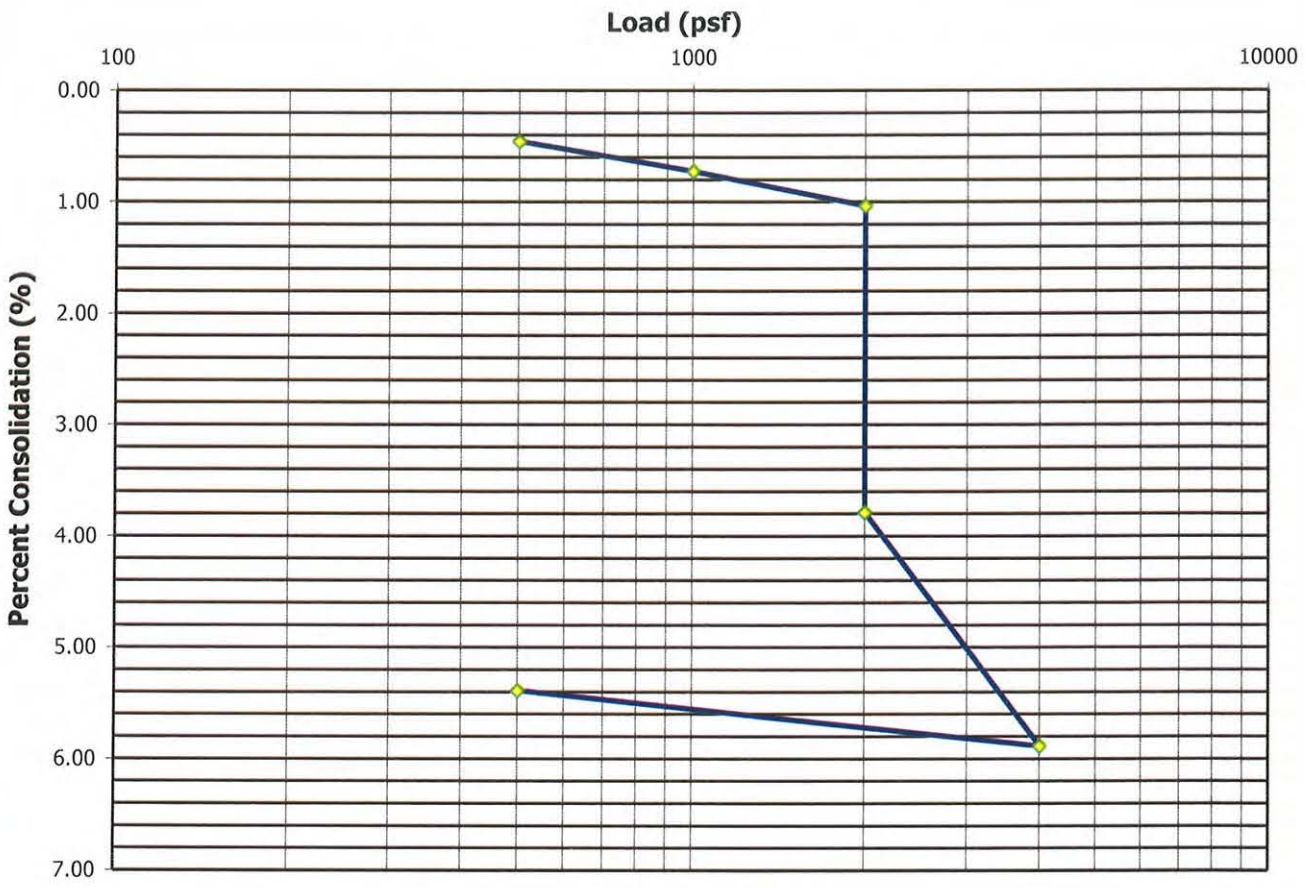
Sample Location - T-3 @ 1'
Water added at 2000 psf

Load (psf)	Percent Consolidation	Net Percent Consolidation *
500	1.08	0.00
1000	1.64	0.56
2000	2.20	1.12
2000 + H20	3.93	2.85
4000	6.95	5.87
500	6.15	5.07

* Net consolidation assumes that existing native pressure on soil is aproximately equal to 500 psf

PROJECT:	**Alton Coal Development - North Area** **South East of Alton, Utah**	GEM ENGINEERING, INC.	**Plate:** **12**
Client:	Alton Coal Development		
Report No:	RG1434		

CONSOLIDATION TEST DATA



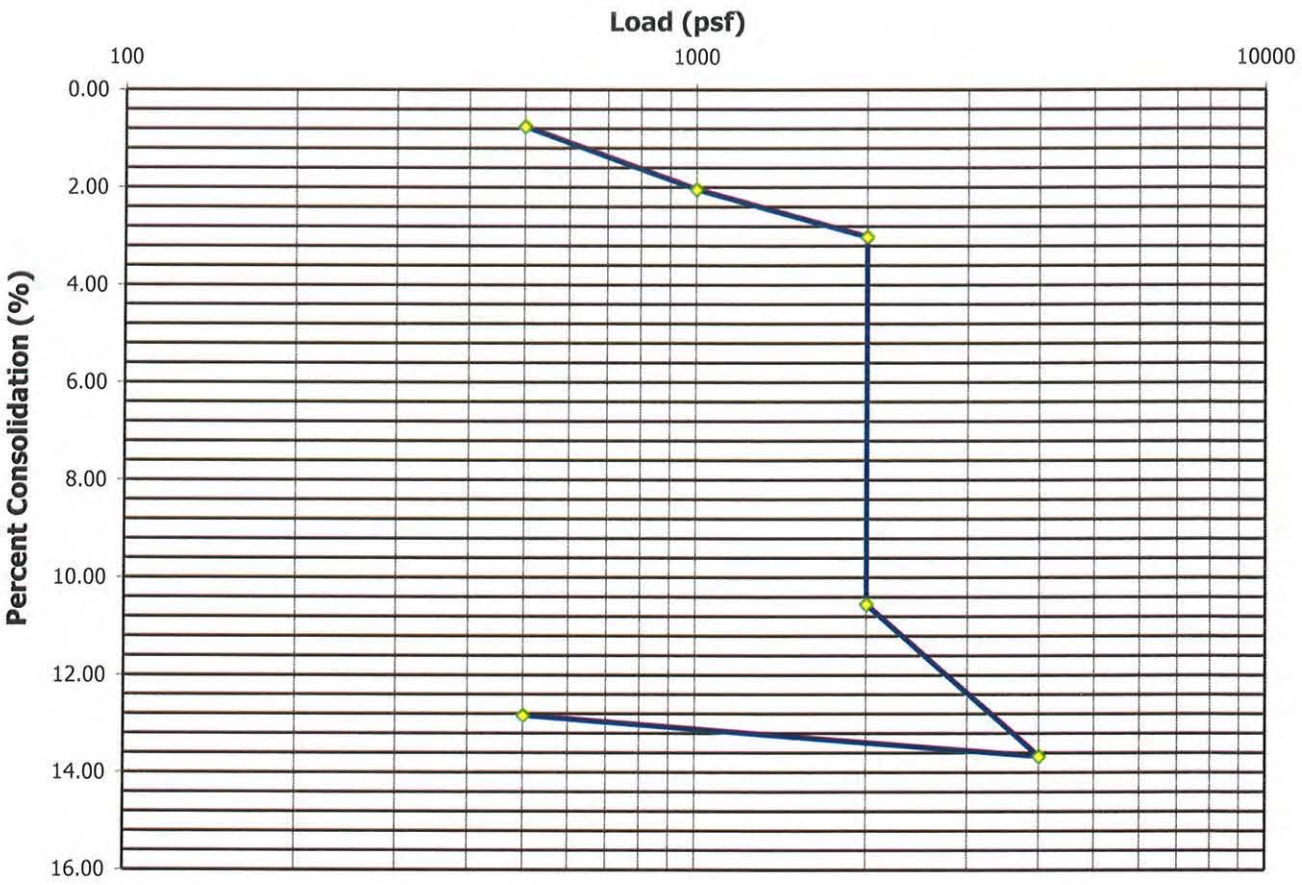
Sample Location - T-3 @ 6'
Water added at 2000 psf

Load (psf)	Percent Consolidation	Net Percent Consolidation *
500	0.46	0.00
1000	0.73	0.27
2000	1.04	0.58
2000 + H20	3.79	3.33
4000	5.89	5.43
500	5.39	4.93

* Net consolidation assumes that existing native pressure on soil is aproximately equal to 500 psf

PROJECT:	**Alton Coal Development - North Area** **South East of Alton, Utah**	GEM ENGINEERING, INC.	**Plate:** **13**
Client:	Alton Coal Development		
Report No:	RG1434		

CONSOLIDATION TEST DATA



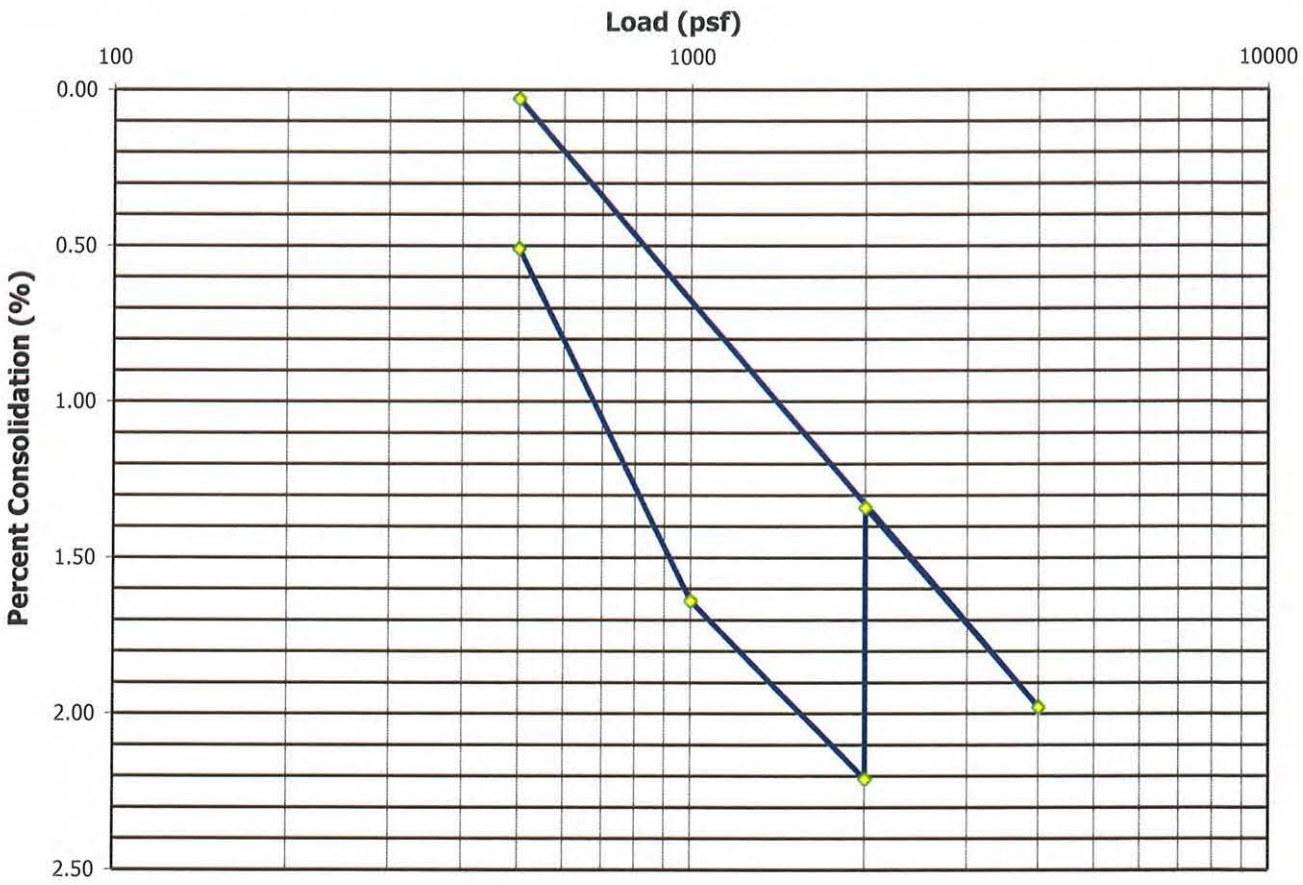
Sample Location - T-6 @ 5'
Water added at 2000 psf

Load (psf)	Percent Consolidation	Net Percent Consolidation *
500	0.76	0.00
1000	2.05	1.29
2000	3.02	2.26
2000 + H20	10.56	9.80
4000	13.68	12.92
500	12.84	12.08

* Net consolidation assumes that existing native pressure on soil is aproximately equal to 500 psf

PROJECT:	**Alton Coal Development - North Area** **South East of Alton, Utah**	GEM ENGINEERING, INC.	**Plate:** **14**
Client:	Alton Coal Development		
Report No:	RG1434		

CONSOLIDATION TEST DATA



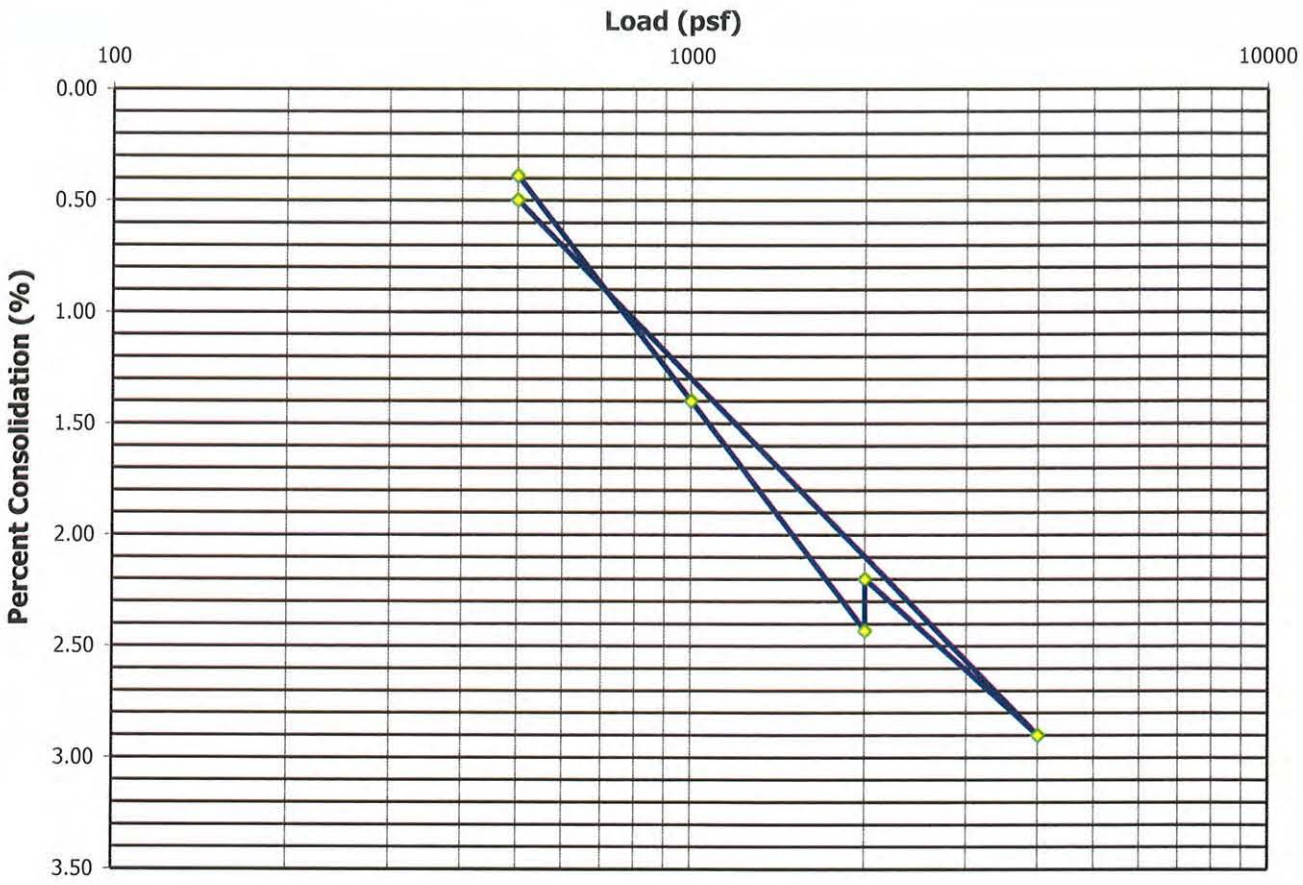
Sample Location - T-7 @ 2'
Water added at 2000 psf

Load (psf)	Percent Consolidation	Net Percent Consolidation *
500	0.51	0.00
1000	1.64	1.13
2000	2.21	1.70
2000 + H20	1.34	0.83
4000	1.98	1.47
500	0.03	-0.48

* Net consolidation assumes that existing native pressure on soil is aproximately equal to 500 psf

PROJECT:	**Alton Coal Development - North Area** **South East of Alton, Utah**	GEM ENGINEERING, INC.	**Plate:** **15**
Client:	Alton Coal Development		
Report No:	RG1434		

CONSOLIDATION TEST DATA



Sample Location - T-7 @ 6'
Water added at 2000 psf

Load (psf)	Percent Consolidation	Net Percent Consolidation *
500	0.39	0.00
1000	1.40	1.01
2000	2.43	2.04
2000 + H20	2.20	1.81
4000	2.90	2.51
500	0.50	0.11

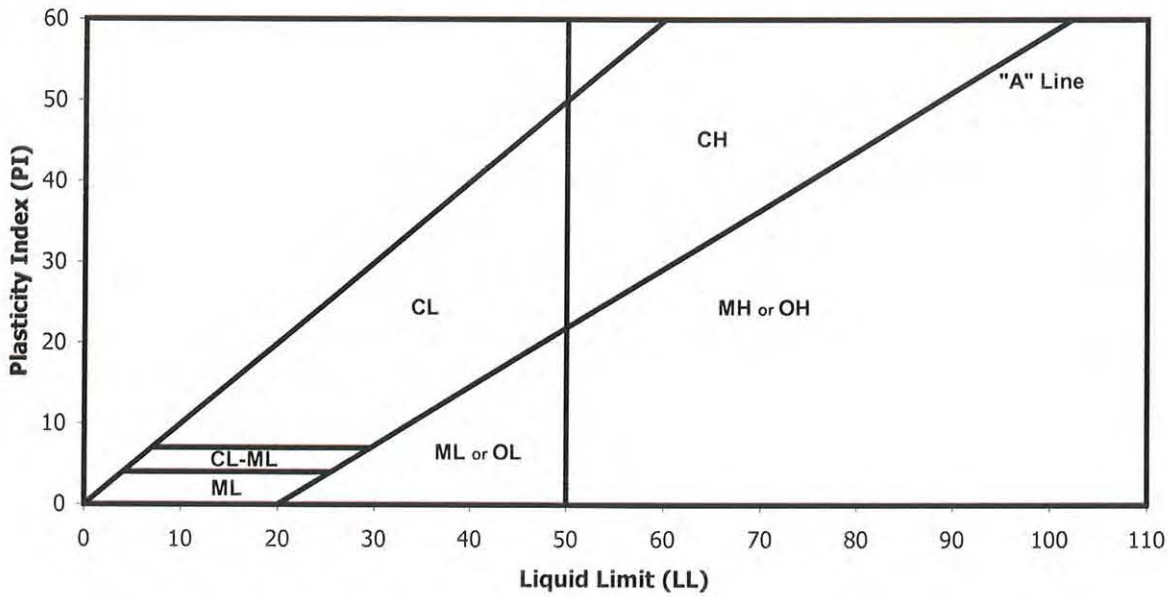
* Net consolidation assumes that existing native pressure on soil is aproximately equal to 500 psf

PROJECT:	**Alton Coal Development - North Area** **South East of Alton, Utah**	GEM ENGINEERING, INC.	**Plate:** **16**
Client:	Alton Coal Development		
Report No:	RG1434		

THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

Major Division			Symbol	Color	Typical Group Names
COARSE GRAINED SOILS 50% or more is retained (larger than) the No. 200 sieve.	**Gravels**	**Clean Gravels**	**GW**		Well graded gravels, gravel sand mixtures, little or no fines
	More than 50 % of coarse part is larger than the No. 4 sieve.	Less than 5% fines	**GP**		Poorly graded gravels/gravel sand mixtures
		Gravels with Fines	**GM**		Silty gravels, gravel-sand-silt mixtures
		More than 12% fines	**GC**		Clayey gravels, gravel-clay-sand mixtures
	Sands	**Clean Sands**	**SW**		Well graded sands, gravely sands, little or no fines
	More than 50 % of coarse part is smaller than the No. 4 sieve.	Less than 5% fines	**SP**		Poorly graded sands or gravely sands, little or no fines
		Sands w/ Fines	**SM**		Silty sands, sand-silt mixtures
		More than 12% fines	**SC**		Clayey sands, sand clay mixtures
FINE GRAINED SOILS 50% or more passes (smaller than) the No. 200 sieve.	**Silts and Clays** Liquid Limit less than 50		**ML**		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with low plasticity
			CL-ML		Inorganic clay-silt mixture and very fine sand, silty or clayey fine sands or clayey silts with low plasticity.
			CL		Inorganic clays of low to medium plasticity, gravely clays, sandy clays, silty clays, lean clays
			OL		Organic silts and organic silty clays of low plasticity
	Silts and Clays Liquid Limit 50 or more		**MH**		Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
			CH		Inorganic clays of high plasticity, fat clays
			OH		Organic clays or medium to high plasticity, organic silts
	Highly Organic Soils		**PT**		Peat and other highly organic silts

PLASTICITY CHART



PROJECT:	**Alton Coal Development - North Area South East of Alton, Utah**
Client:	Alton Coal Development
Report No:	RG1434

GEM ENGINEERING, INC.

Plate: 17

Appendix B

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1.0 INTRODUCTION

This report presents the results of the geotechnical engineering study performed at the subject property. The proposed Alton Coal Mine is located within Township 40 South, Range 5 West Salt Lake Base and Meridian. As shown on Figure 1, Vicinity Map and Figure 2, Site Plan (Appendix A), the area investigated is located on the west side of State Highway 10, approximately 3 miles south of Alton, Utah.

The proposed Coal Hollow Mine will be an open pit coal mine approximately 440 acres in size with the portion addressed in this report comprising 80 acres. It is anticipated that during operation of the mine, approximately 2,000,000 cubic yards of coal will be mined per year with approximately 14,000,000 cubic yards of overburden moved per year. The mining equipment hauling the material is expected to range in weight from 100 tons to 240 tons. They will dump large piles up to 15 feet in height and large dozers (D10 to D11 in size) will spread the material, which will require tracking over the fill material several times during placement to four foot lifts.

For the initial 80 acres of the project, an excess spoil pile and 4 sedimentation ponds will be constructed. The purpose of the study was to verify the stability of the proposed spoil structure and impoundment slopes as designed by Alton Coal Development.

2.0 PREVIOUS STUDIES

Previous investigations have been conducted prior to this study. Several borings were drilled in 2005 by Petersen Hydraulic for a hydraulic study of the proposed mine. Prior to 2005, several test pits and borings were completed as part of an economical geologic study of the area to study overburden thickness and coal stratum thickness.

Test Pits SP-13, SP-15, SP-16 and CH-32, and borings CH-1-05, CH-3-05, CH-5-05 are relevant to this study. The location of the test pits and borings are shown on Figure 2. Borings logs were provided to TGE by Peterson Hydraulic for borings CH-1-05, CH-3-05 and CH-5-05. Logs of the Test Pits were not provided to TGE.

The following samples from the previous subsurface investigations by others were provided by Alton Coal Development to TGE:

ALTON COAL DEVELOPMENT TEST PIT AND BORING NUMBER	DESCRIPTION	SAMPLE DEPTH
SP-13	Sandy Clay (CL)	24"-48"
SP-13	Silty Sand (SM)	72" - 84"
SP-15	Silty Clay (CL-ML)	20" - 37"
SP-15	Silty Sand (SM)	57" - 73"

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SP-16	Clay (CL)	36" - 56"
SP-16	Sandy Silt (ML)	56" - 68"
SP-16	Silt (ML)	68" - 90"
CH-32 (Coal Hollow)	Clay (CL)	31" - 54"
CH-32	Clay (CL)	54" - 72"
CH-1-05 (Rock Core)	Weathered Shale Fat Clay (CH)	40' - 55'
CH-3-05 (Rock Core)	Shale	41' - 44.5'
CH-5-05 (Rock Core)	Shale	48' - 55'
CH-5-05 (Rock Core)	Shale	98' - 108'

Samples SP-13, SP-15, SP-16 and CH 32, were combined to make a sample representative of the upper soil profile which TGE labelled SP-16-13. Samples CH-1-05 and CH-3-05 were hand crushed and combined to create sample CH-1-3. The remaining core samples were hand crushed and labelled CH-5-48 for the 48-55 ft. core and CH-5-98 for the 98-108 ft. core.

3.0 SCOPE OF WORK

This study included the following scope of work.

3.1 Site reconnaissance

A site reconnaissance was conducted by TGE on February 22, 2007. The purpose of the visit was to observe existing site conditions, determine boring locations, and pick up subsurface samples from the previous investigations that have been in storage.

3.2 Subsurface Exploration

Five (5) exploratory borings were drilled on February 28, 2007 and March 1, 2007, at the site to evaluate subsurface conditions. The borings were drilled with a hollow stem auger drill rig, to depths of 5 to 41 feet below the surface. As shown on Figure 2, 3 borings were located within the proposed mining area, one boring was located on the western point of the proposed excess spoil structure, and one boring was located near the proposed Sedimentation Pond #3 embankment.

Subsurface conditions observed in the exploratory boring were carefully documented at the time of drilling by TGE field personnel. Samples of representative soils were obtained from the borings for laboratory testing and visual classification. A description of the field exploration program and the logs of exploratory borings are presented on Figures 3 through 7 in Appendix B, Field Exploration.

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3.3 Laboratory Testing

The representative samples obtained from the TGE field investigation and previous investigations were tested in the laboratory to aid in classification and to determine pertinent engineering properties. These tests included natural dry density and moisture content; Atterberg Limits, grain size analysis and unconfined compression shear tests, hydrometer analysis, and consolidated undrained triaxial shear tests with pore pressure measurement. A description of the laboratory test methods and test results are presented in Appendix C, Laboratory Testing Data Sheets. Results of the laboratory testing are presented on the boring logs, Table 1 and attached data sheets in Appendix C.

3.4 Engineering Analyses and Report

Data obtained from the exploratory borings and the laboratory testing program was evaluated. Geotechnical engineering analyses were performed which included preparation of this report presenting the findings and recommendations developed during the study.

4.0 SITE CONDITIONS

4.1 General

The area investigated consist of open range land vegetated with field grass, sage brush, pinions, and cedar trees. The surface of the area is fairly level with a gentle slope to the west. Relatively large drainage ravines, 1 to15 feet deep, traverse the northern portion of the property. Two small knolls are located on the west side of the property. The knolls appear to be comprised of weathered sandstone and alluvial deposits. A shallow ravine is also located between the knolls and south of Borings GT-4 and GT- 5. Topographic conditions are shown on Figure 2.

Snowmelt was observed seeping into the deep ravine from various locations. Snowmelt was also observed draining into a shallow ravine between the two knolls.

4.2 Subsurface Conditions

Alluvial/colluvial sediments were documented in the exploratory boring to depths of about 5 to 30 feet below existing ground surface. The alluvial/colluvial sediments consist of silty sand (SM), sandy silt (ML) and lean clay (CL). The sediments are underlain by highly weathered shale (fat clay, CH) and slightly to moderately weathered shale, which was documented by others to a maximum depth 41 feet. The shale is underlain by a coal deposits.

Detailed descriptions of subsurface conditions documented at the site are presented on the TGE Boring Logs Figures 3 through 7, and Boring Logs 8 through 10, Peterson Hydraulic logs redrawn with permission by Taylor Geo-Engineering (Appendix B).

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4.3 Subsurface Water

Subsurface water was documented in the borings at a depth of 10± feet (recorded at the time of drilling) in borings GT-1, GT-2 and GT-3. Subsurface water was also observed at a depth of about 15 feet in GT-5. Boring GT-4 terminated at 5 feet below the surface on sandstone bedrock and was free of water.

Flowing sands were documented in the exploratory borings at a depth of 15 to 25 feet±. The flowing sands likely denote a zone of very loose sands that act as a liquid during drilling activities.

The subsurface investigation was performed during a period of high snowmelt which could add to the groundwater table at the time of the investigation. Seasonal fluctuations in groundwater conditions do occur, and groundwater fluctuations of several feet are not unusual. Numerous factors contribute to groundwater fluctuations such as seasonal recharge, regional and local irrigation, and periods of heavy precipitation. The detailed evaluation of these and other factors which may be responsible for groundwater fluctuations is beyond the scope of this study.

4.4 Subsurface Variations

Based on the results of the subsurface exploration and our experience, variations in the continuity and nature of subsurface conditions should be anticipated. Due to the nature and depositional characteristics of soils documented at the site, care should be taken in interpolating or extrapolating subsurface conditions between or beyond the exploratory borings.

5.0 SLOPE STABILITY ANALYSIS

Slope stability analyses were performed for the proposed excess spoil structure, for the interior slopes of the proposed sedimentation Ponds #1 through #4. Stability analyses were performed using GSTABL7 software and safety factors were calculated by the Modified Bishop Method.

Site ground acceleration for the pseudo-static stability analysis was based on the peak ground acceleration with a 2 percent probability of being exceeded in a 50-year period. [1] The peak bedrock ground acceleration (PGA) for the site with a 2 percent probability of being exceeded in 50 years is 0.29g. In accordance with industry standards, the pga was reduced by 50 percent and a value of 0.145g was used in the analyses.

Based on the information provided, TGE understands that the spoil pile will be constructed in thick lifts using large mining equipment; therefore, laboratory testing of the proposed fill materials was completed at 90 percent of the standard Proctor. The engineering characteristics obtained from laboratory testing were utilized in the stability analyses. Since the excess spoil

[1] USGS, 2002, U.S. Geological Survey seismic hazard maps: http://eqhazmap.usgs.gov

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pile will consist of soils from above the coal layer, the strength characteristics of the sandy clay, and fat clay from CH-1-3 and CH-5-48 were averaged to verify the stability of the slopes under static and seismic conditions. The average strength characteristics were reduced 10 percent to account for weakened strengths of materials placed to 85 percent of the standard Proctor.
Slope stability analyses for proposed Sedimentation Ponds #1, #1B, #2, and #4 used strength parameters obtained from sample SP-16-13, since the pond embankments in those areas will be constructed of soils representative of SP-16-13. The analyses considered a maximum slope height of 15 feet, even though not all the ponds will have slopes extending to 15 in height.

The slope stability analysis for the sedimentation Pond #3 embankment was completed using the soil unconfined compression strengths from samples obtained from boring GT-5. Laboratory testing indicated unconfined compressive strength of 9429 psf or a cohesive strength of 4700 psf. For stability purposes a cohesion of 700 psf and a friction angle (ø) of 10 degrees was utilized for static and seismic analyses. The strength values were conservatively reduced to assumed total stress parameters of 300 psf and 8 degrees for the rapid drawdown analysis.

Locations from which the cross-sections for the each of the slope analyses were taken from are shown on Figures 11 through 15, Appendix D. Lines A1-A1, A2-A2, B1-B1 and B2-B2 for the excess spoil pile are shown on Figure 11, Line F-F for the sedimentation ponds is shown on Figure 15, and Line E-E for Pond #3 is shown Figure 14. Profile views with the accompanying output files for each of the static and seismic slope stability analyses are shown on, Figures 16 through 37, in Appendix E, Profile Views and Output Files of Static and Pseudo-static Slope Stability Analyses.

5.1 Excess Spoil Structure

Based on the information provided, TGE understands the excess spoil structure will be a permanent structure after mining operations are complete. The proposed structure has been designed with maximum 3:1 (horizontal: vertical) slopes. As shown on Figure 11, Proposed Embankment Design, embankment height will vary from 75 feet at the east end to 120 feet at the west end.. The top of the embankment will descend to the northwest at a 2.2 percent grade.

The embankment will be comprised of soil deposits that overlie the coal bed to be removed during mining operations. Although the soils will likely consist of a mixture of silt, clay, sand, and shale, the stability analyses considered the materials separately. The analyses assume the materials will be compacted to at least 85 percent of the standard Proctor.

The subsurface information indicates that the subsurface profile varies between the area of GT-2/GT-3 and GT-5. Therefore, four stability analyses were performed representing Line A1-A1, A2-A2. Line B1-B1 and Line B2-B2, Figure 11. Additionally, TGE analyzed the spoil pile having a finished height of 120 feet in the area of the west end of the structure and 100 feet for the central portion of the structure and 75 to 86 feet for the east end of the structure.

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Generally, the subgrade in the area of Lines A1-A1 and A2-A2 will be comprised of all backfill with the depth of backfill decreasing from east to west. The subgrade in the area of Lines B1-B1 and B2-B2 contains loose sand 10-feet to 20-feet in depth underlain by stiff clay then shale. It is anticipated that the groundwater elevation could be different after mining operations. TGE attempted to predict long term groundwater elevations after mining is complete with the depth of water shown on the attached stability profiles Figures 16 through 23.

Representative Factors of Safety of the stability analyses with the respective soil parameters used are tabulated below.

SLOPE SET	PHI,	COHESION	STATIC	PSEUDO-STATIC
A1-A1	19	240	1.6	1.1
A2-A2	19	240	1.6	1.1
B1-B1	19	240	1.7	1.1
B2-B2	19	240	1.6	1.1

SOIL STRENGTHS USED BELOW THE FILL

SAMPLE SET	PHI,	COHESION		
SP-16-13	29.6	94		
CH-1-3	21.6	319		
CH-5-48	20.1	321		
CH-5-98	25.4	216		

5.2 Sediment Impoundments #1, #2 and #4

Sediment Impoundments 1, 1B, 2 and 4 vary in size from 1.7 to 6.28 acre/feet. The proposed basin areas will be derived from digging into the original grades and constructing a portion of the embankments with the spoils. The depth of each sedimentation pond varies but the maximum depth shown on the attached plan sheets is 15 feet, Figures 12, 12B, 13 and 15. The profile obtained for this analysis is based upon Line F-F of Pond #4, Figure 15. The soils associated with the side slopes and dikes for the detention ponds will be similar to sample SP-16-13. The proposed ponds are intended to detain runoff from a major storm event. The slope analyses considered the basis full to spillway level for static and pseudo-static conditions.

A rapid drawdown analysis was completed assuming the spillways are plugged, the basin fills to top of the embankments and then the water is released or pumped down to the base of basins. The soil strengths utilized were based on total stress conditions as determined from the triaxial shear tests completed for this project. It should be noted that rapid drawdown is highly unlikely since spillway and outlet piping will be no more than 4-feet below the top of embankments.

The results of the stability analyses are tabulated below and graphically provided on Figures 24 through 26 in Appendix E.

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LINE F-F

SEDIMENT IMPOUNDMENT	MAXIMUM HEIGHT	HEIGHT OF FREE BOARD	STATIC	PSEUDO-STATIC	RAPID DRAWDOWN
Pond #1, 1B, 2 & 4	15 feet	4 feet	2.2	1.3	1.2

5.3 Sediment Impoundment #3, Valley Pond

Based on the information provided, TGE understands that Valley View Pond will be a sedimentation pond located at the western most point of the mining area and at the base of the tailings embankment between the two knolls spoken of earlier in this report. The base of the pond will be cut 10 feet into the native stiff clay soils and the remainder of the embankment will constructed from soils derived from the excavation of the interior of the pond. The height of the fill for the pond embankment will be approximately 14-feet. The soils associated with the slopes and embankment for the pond will be similar to soils analyzed for samples from GT-5.

A rapid drawdown analysis was completed assuming the spillway is plugged, the basin fills to top of the embankment and then the water is released or pumped down to the base of basin. The soil strengths utilized were based on the stress conditions as previously discussed in section 5.0. It should be noted that rapid drawdown is highly unlikely since the spillway will be no more than 4-feet below the top of embankment.

The results are tabulated below and graphically provided on Figures 27 through 29 in Appendix E.

SEDIMENT IMPOUNDMENT	MAXIMUM HEIGHT	HEIGHT OF FREE BOARD	STATIC	PSEUDO-STATIC	RAPID DRAWDOWN
Pond #3	14 feet	4 feet	5.3	3.2	1.9

For temporary structures, such as Sedimentation Ponds #1, 1B, 2 , and 4, a static Factor of Safety of 1.3, 1.0 and 1.2 for Static, Pseudo-static and Rapid Drawdown conditions is considered adequate. For permanent structures such as the excess spoil structure and the sediment impoundment Pond #3, a static Factor of Safety of 1.5 and 1.0 for Static and Seismic conditions is considered adequate. Long Term rapid drawdown should be at least 1.2.

6.0 SETTLEMENT

The existing subgrade that will not be mined but will be supporting the 100 to 120 feet of spoils will potentially consolidate under the 13,000 psf to 14,000 psf loads associated with the spoil

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pile. Additionally, as the spoil pile is constructed, the spoil materials placed near the base of the spoil pile will consolidate to densities greater than densities at the time of initial placement.

Consolidation of the native materials in the area of GT-3 under the 110 foot embankment could be on the order of 4 to 5 feet. Consolidation of the native materials in the area of GT-4 and GT-5 will be negligible based on the stiffness of the clay soils and the presence of sandstone bedrock.

Consolidation of the spoil materials after placement will be on the order of 0 to 15 percent, depending the depth below finish grade the spoil is located. In all cases, since the spoil pile will be constructed over a period of several years, the effects of the differential settlement across the structure is anticipated to be minimal and should not affect the short term or long term performance of the spoil pile.

7.0 BULKING

During mass excavation operations of dense materials, the placement of spoils generally requires more volume of space during placement than that originally occupied by the same soil mass in its native state. Based on dry densities of the shale materials in their intact state and the standard Proctors conducted for this project, the shale spoils will have a a volume approximately 30 percent higher after mining than prior to mining. The silty sand and clay soils will have minimal bulking with an average of approximately 10 percent. However, as indicated in section **5.0 SETTLEMENT**, the overall apparent bulking may be lower after the fill pile is complete due to post placement consolidation.

8.0 RECOMMENDATIONS

The proposed excess spoil structure and sediment ponds may be constructed as designed by Alton Coal Development. The laboratory shear tests were conducted on materials compacted to at least 90 percent of the standard Proctor. Analysis of the spoil pile was based on reduce strengths to account for lighter compaction. Therefore, fill materials should be placed and compacted to at least 85 percent of the standard Proctor (ASTM test method 698) for the spoil pile and 90 percent for the sedimentation embankments. An engineer from TGE or his representative should be present periodically to verify that the placement of fill materials are being completed properly and that testing inspection is taking place in accordance with Appendix F of this document and the State of Utah R645 – Coal Mining Rules.

It is anticipated that the large mining equipment used to haul and doze the spoil pile material will provide the required loading to achieve 85 percent compaction. The fill used to construct the embankments for the sedimentation ponds may require vibratory compaction during placement to achieve the 90 percent compaction as required.

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Based on the presence of groundwater (see Section 4.3), a dewatering plan will likely need to be implemented during excavation operations. The satiability of the cut walls of the strip mining area will be dependent on temporarily diverting groundwater seepage from the excavation. The design of a dewatering plan was beyond the scope of this study.

If a dewatering plan is properly implemented and the temporary cut slopes are kept dry, TGE recommends that temporary cuts in the stiff clay and shale may be no greater than 1H:1V (horizontal:vertical), and temporary cuts in the lean clay and sand layers my no greater than 2H:1V. If after inspection of the shale formation and additional groundwater observations are made, the cut slopes may be steepened as directed by TGE.

Based on the information provided, TGE's understands that the spoil pile is not intended to be constructed for the future support of structures. The recommendations for fill placement as provided in Appendix F, Recommended Earthwork Specifications, are based on this understanding. Therefore, TGE does not recommend that the excess spoil pile be used in the future for the support of structures since the material is being placed with a moderate level of compaction (at best) and long term differential settlement of the pile will occur.

9.0 CLOSURE

The findings and recommendations of this report were prepared in accordance with generally accepted professional geotechnical engineering principles and practice in this area of Utah at this time. There is no other warranty, either express or implied.

The conclusions and recommendations presented herein are based on the results of limited subsurface exploration and laboratory testing, combined with interpolation and extrapolation of subsurface conditions between and beyond exploration locations. As the project evolves, TGE's continued consultation and construction monitoring should be considered an extension of the services performed to date. Subsurface conditions may differ in some locations from the conditions observed in the explorations, and may require additional analyses and possibly modified recommendations.

This report was written for the exclusive use of Alton Coal Development and only for the proposed project described herein. TGE is not responsible for technical interpretations by others or exploratory information which has not been described or documented in this report. Specific questions or interpretations concerning the findings and conclusions presented herein may require written clarification to avoid possible misunderstandings. The opportunity to be of service is appreciated.

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APPENDIX A

VICINITY MAP AND SITE PLAN

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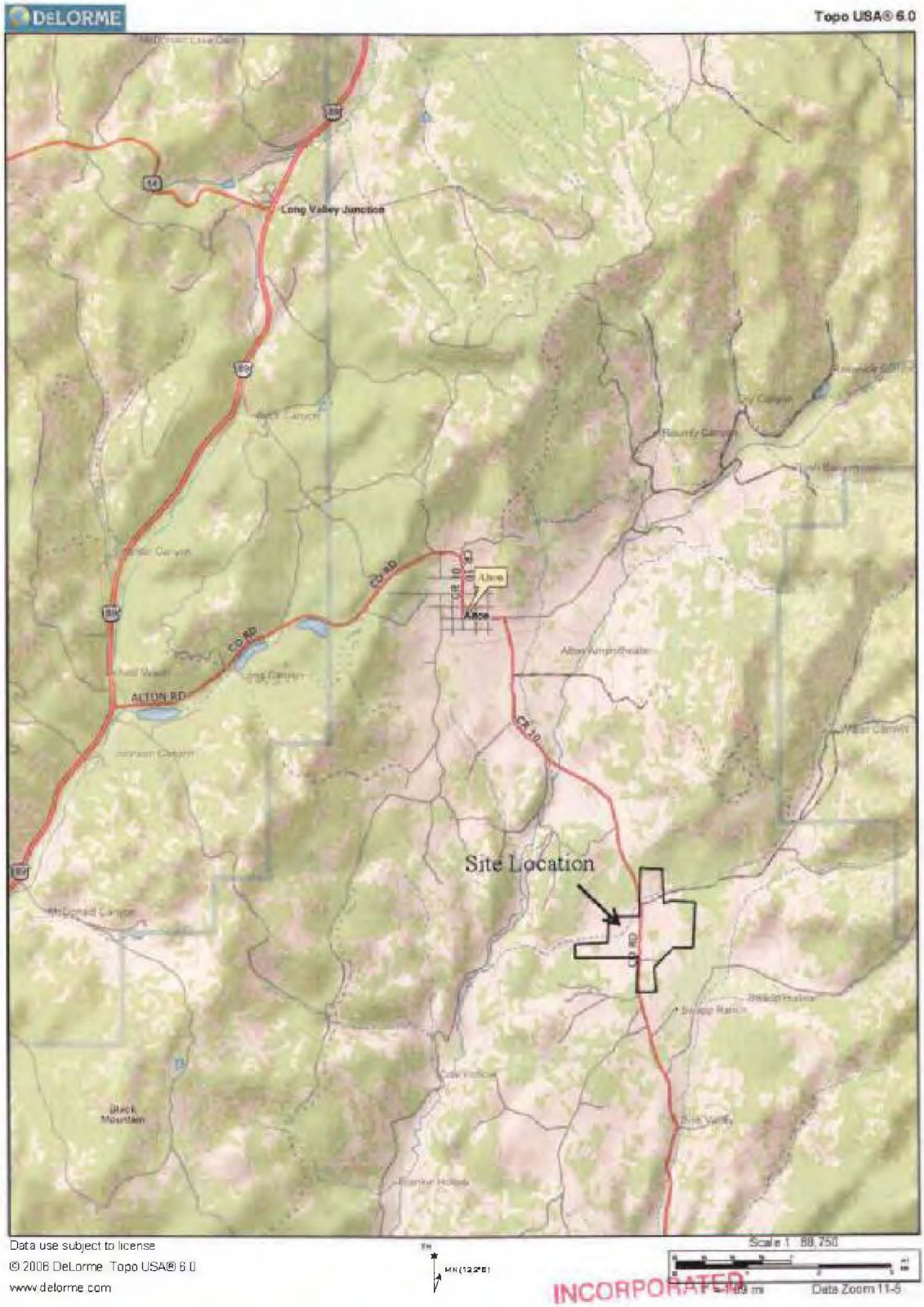
VICINITY MAP



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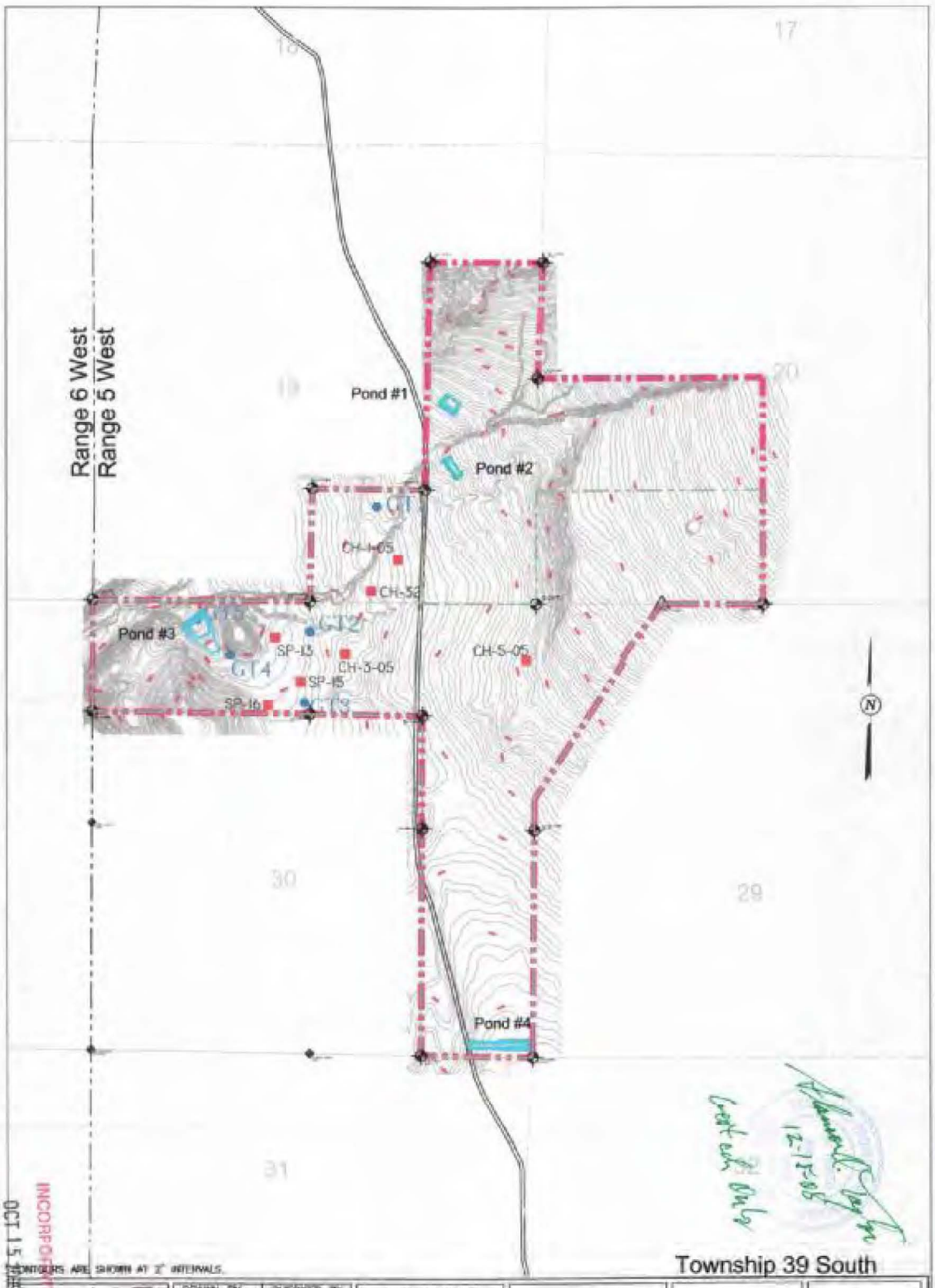
Alton Coal Hollow Mine

Figure No. 1



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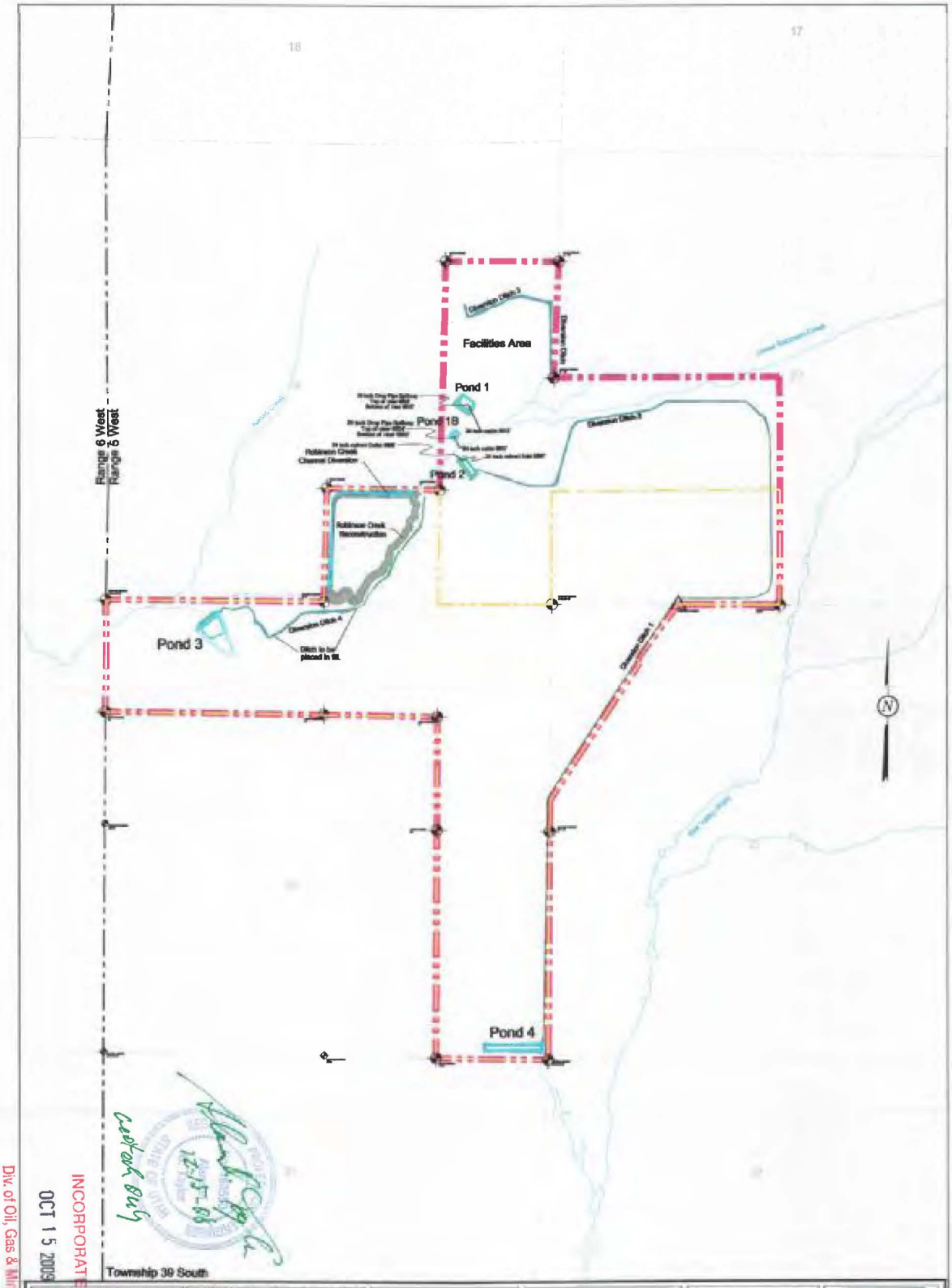

LEGEND

- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- SECTION LINE
- FOUND SECTION CORNER
- FOUND PROPERTY CORNER
- PROPOSED SEDIMENT IMPOUNDS DIVERSION DITCHES
- EXISTING DRAINAGES

DRAWN BY:	CHECKED BY:
J. STANSFIELD	CRM/GG
DRAWING: 5-25	DATE: 4/20/07
	SCALE: 1" = 500'
JOB NUMBER: 1400	SHEET

REVISIONS

DATE:	BY:
12/02/08	CRM

DIVERSION DITCH & SEDIMENT IMPOUND PLAN VIEW

COAL HOLLOW PROJECT ALTON, UTAH

DRAWING: 5-25

Figure No. 2B

Coal Hollow Project
495 North 100 West, Suite 1
Cedar City, Utah 84720
Phone (435)867-5331
Fax (435)867-1192

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APPENDIX B

FIELD EXPLORATION

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APPENDIX B
FIELD EXPLORATION

The program of subsurface exploration consisted of drilling five (5) borings to explore subsurface conditions in the vicinity of the proposed structures and to obtain samples for laboratory testing. Subsurface conditions observed in the borings were carefully documented by experienced TGE field personnel. Subsurface materials were classified in accordance with Unified Soil Classification System (ASTM Method D 2488).

Boring locations are shown on Figure 2, Site Plan (Appendix A). Borings were located by TGE field personnel using surveyed property corners, and information shown on a Figure 2.

Exploratory borings were drilled to depths of about 5 to 41 feet below existing ground surface. The borings were advanced with a truck mounted drill rig using 8-inch outside diameter hollow-stem augers.

Relatively undisturbed and bulk samples of representative soils were obtained from the borings at frequent intervals for laboratory testing and visual classification. Relatively undisturbed samples were obtained using either a 1.4-inch inside diameter (ID) split-spoon sampler (Standard Penetration Test Sampler), a 2-inch ID "Modified California" sampler (lined with 4-inch brass sleeves), or a Shelby Tube sampler.

A sampler was advanced a maximum of 18 inches by successive drops ("blows") from a 140-pound hammer falling 30 inches. The number of blows required to advance the sampler three successive 6-inch increments was recorded. The total number of blows required to advance a sampler the second and third 6-inch increment represents the penetration resistance value (N-value). For the 1.4-inch sampler, this test constitutes the Standard Penetration Test (SPT) as described by ASTM Method D 1586.

A description of soils observed in the borings, the sample types, depths at which the samples were taken, and N-values are shown on the Logs of Exploratory Borings included in this appendix. A legend of boring symbols and the Unified Soil Classification System is also included herein.

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DRILL LOG — TAYLOR GEO-ENGINEERING

Figure No. 3

Boring No. GT-1 — Date of Drilling: February 28, 2007

Project : Alton Hollow Project
Project No.: 307001
Location: Alton, Utah
Elevation: 6900 feet

Drilling Company: GTS
Equipment: Mobile B-80
Logged By: A.T.

GWT: 10 feet

Depth (ft.)	Graphic	USCS	Sample	Description	Laboratory Test Results	Other Data
0						
1				TOPSOIL: Light brown, moist, loose, 6" thick.		
2				LEAN CLAY: Very stiff, moist to wet, greenish brown.		
3						
4						
5						
6			X			2" ID Sampler
7						29, 53, 50/5"
8						
9		CL				
10						2" ID Sampler
11			X		WC = 12.6%	21, 56, 50/3"
12					DD = 111.6 pcf	
13					LL = 47 PI = 31	
14						
15						
16			X			2" ID Sampler
17						20, 37, 50/5"
18						
19						
20						
21			X		WC = 14.4	2" ID Sampler
22						12, 26, 40
23				FAT CLAY: Stiff, moist to wet, probable perched water		
24				between 22 and 25 feet, some pebbles and gravel, gray with		
25				tan specs.		
26			X		WC = 28.6%	2" ID Sampler
27					DD = 95.0 pcf	8, 16, 25
28		CH			LL = 69 PI = 52	
29					UC = 4777 psf	
30			X			2" ID Sampler
31						7, 24, 26
32						
33						
34						
35		SHALE		SHALE: Weathered, hard, moist, brownish gray to gray.		
36			X			2" ID Sampler
37				Boring Terminated at 36 Feet.		17, 50/5"
38						
39						
40						
41						
42						
43						
44						
45						

Notes: 140 lb sampler using drive cable. Low Efficiency.

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DRILL LOG — TAYLOR GEO-ENGINEERING

Figure No. 4

Boring No.: GT-2 — Date of Drilling: March 1, 2007

Project : Alton Hollow Project — Drilling Company: GTS
Project No.: 307001 — Equipment: Mobile B-80
Location: Alton, Utah — Logged By: A.T.
Elevation: 6900 feet

GWT: 10 feet

Depth (ft.)	Graphic	USCS	Sample	Description	Laboratory Test Results	Other Data
0						
1				TOPSOIL: Light brown, moist, loose, 6" thick.		
2		SM		SILTY SAND: Medium dense to loose, moist to wet, gray to tan.		
3						
4						
5						
6			X			Standard Spoon
7						11, 10, 13
8						
9						
10						2" ID Sampler
11			X		WC = 10.6%	5, 8, 7
12					-200 = 33.3%	
13						
14						
15						
16			X	No Recovery Due to GWT and Loose Sand.		2" ID Sampler
17						3, 5, 8
18						
19		SC		CLAYEY SAND: Very loose, wet, tan.		
20						
21			X			2" ID Sampler
22		CL		LEAN CLAY: Some sand, very soft, wet, tannish gray.		2, 3, 5
23						
24						
25						
26			X	Liquified with vibration.	WC = 27.8%	2" ID Sampler
27					LL = 37 PI = 19	2, 6, 9
28						
29						
30			X			2" ID Sampler
31		CH		FAT CLAY: With sand, medium stiff, moist, bluish gray with	WC = 18.5%	3, 6, 8
32				dark gray seams.		
33						
34						
35		SHALE		SHALE: Weathered, hard, moist, light gray to dark gray.		
36			X			2" ID Sampler
37				Boring Terminated at 35.5 Feet.		50/5"
38						
39						
40						
41						
42						
43						
44						
45						

Notes: 140 lb sampler using drive cable. Low Efficiency.

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DRILL LOG — TAYLOR GEO-ENGINEERING

Figure No. 5

Boring No.: GT-3 — Date of Drilling: February 28, 2007

Project : Alton Hollow Project
Project No.: 307001
Location: Alton, Utah
Elevation: 6900 feet

Drilling Company: GTS
Equipment: Mobile B-80
Logged By: A.T.

GWT: 15 feet

Depth (ft.)	Graphic	USCS	Sample	Description	Laboratory Test Results	Other Data
0						
1				TOPSOIL: Light brown, moist, loose, 6" thick.		
2				SILTY SAND: Medium dense to loose, moist to wet, gray to tan.		
3						
4						
5						
6			X			2" ID Sampler
7						12, 20, 16
8						
9						
10						2" ID Sampler
11			X		WC = 11.0%	5, 6, 11
12					-200 = 37.5%	
13						
14		SM				
15						
16			X	No Recovery Due to GWT and Loose Sand.		2" ID Sampler
17						3, 3, 3
18						
19				CLAYEY SAND: Very loose, wet, tan		
20						
21			X			2" ID Sampler
22				LEAN CLAY: Some sand, very soft, wet, tannish gray.		5, 5, 8
23						
24						
25						
26			X	Liquified with vibration.		2" ID Sampler
27						6, 26, 75/5.5"
28						
29				HIGH PLASTICITY SILT: Very Stiff, wet, dark gray to black.	WC = 37.3%	
30		MH	X		DD = 76.6 pcf	2" ID Sampler
31					LL = 74 PI = 38	6, 18, 30
32					UC = 1956 psf	
33				FAT CLAY: Very Stiff, moist, gray. Sampling terminated due to water intrusion into hole from above layers.		
34						
35						
36		CH	X			2" ID Sampler
37						8, 25, -
38						
39						
40		SHALE		SHALE: Weathered, hard, moist, light gray to dark gray.		2" ID Sampler
41			X			13,50/5"
42				Boring Terminated at 41 Feet.		
43						
44						
45						

Notes: 140 lb sampler using drive cable. Low Efficiency.

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DRILL LOG

TAYLOR GEO-ENGINEERING

Figure No. 6

Boring No.: GT-4

Date of Drilling: March 1, 2007

Project : Alton Hollow Project
Project No.: 307001
Location: Alton, Utah
Elevation: 6900 feet

Drilling Company: GTS
Equipment: Mobile B-80
Logged By: A.T.

GWT: NA

Depth (ft.)	Graphic	USCS	Sample	Description	Laboratory Test Results	Other Data
0						
1				TOPSOIL: Light brown, moist, loose, 6" thick.		
2				SILTY SAND: Medium dense, moist, tan.		
3		SM				
4						Standard Spoon
5			X			50/0"
6				Boring Terminated at 5 Feet on sandstone bedrock.		
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						

Notes: 140 lb sampler using drive cable. Low Efficiency.

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DRILL LOG

TAYLOR GEO-ENGINEERING

Figure No. 7

Boring No.: GT-5

Date of Drilling: March 1, 2007

Project : Alton Hollow Project
Project No.: 307001
Location: Alton, Utah
Elevation: 6900 feet

Drilling Company: GTS
Equipment: Mobile B-80
Logged By: A.T.

GWT: 15 feet

Depth (ft.)	Graphic	USCS	Sample	Description	Laboratory Test Results	Other Data
0						
1				TOPSOIL: Light brown, moist, loose, 6" thick.		
2				FAT CLAY: Very Stiff, moist, dark brown with tan specs. Some pebbles at 15 feet and saturated sand layers at 15 feet. Potential perched water.		
3						
4						
5						
6			X		WC = 18.7%	Standard Sampler
7					DD = 108.3 pcf	12, 26, 32
8		CH			LL = 63 PI = 44	
9						
10						2½" ID Sampler
11			X		WC = 17.1%	14, 50, 50/5"
12					DD = 102.0 pcf	
13					LL = 63 PI = 45	
14					UC = 9429 psf	
15						
16			X		WC = 17.2%	2" ID Sampler
17					DD = 120.0 pcf	20, 40, 50/5"
18				Boring Terminated at 16.5 feet.		
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						

Notes: 140 lb sampler using drive cable. Low Efficiency.

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DRILL LOG

PETERSON HYDRAULIC

Figure No. 8

Boring No.: CH-01-05

Date of Drilling: Nov. 9-10, 2005

Project : Alton Hollow Project
Project No.: 307001
Location: Alton, Utah
Elevation: 6900 feet

Drilling Company: DA Smith Drillers
Equipment:
Logged By: Eric Peterson

GWT: Not Indicated

Depth (ft.)	Graphic	USCS	Sample	Description	Laboratory Test Results	Other Data
0						
2				TOPSOIL: Light brown, moist, loose, 6" thick.		
4		CL		0-8 Soil 8-40 Clay, gray (auger drilled)		
6						
8						
10						
12						
14						
16						
18						
20						
22						
24						
26						
28						
30						
32						
34						
36						
38						
40		CH		40-55 Silty clay, gray, dense, and 0.5' bentonite layer, white to orange	ø = 21.6 cohesion = 319 psf OM = 20.5 MDD = 101.9 LL = 53 PI = 32	
42						
44						
46						
48						
50						
52						
54						
56		SHALE		55-56 Silty shale, gray.		
58				56-58 Carbonaceous shale, dark gray.		
60		COAL		58-59.2 Low-grade Coal and organic shale, dark gray to black, some fossiliferous intervals		
62						
64						
66				59.2-73 Coal, black with some brown mottled zones.		
68						
70						
72						
74		SHALE		73-75.8 Siltstone, gray, clayey.		
76				75.8-76.0 Shale, gray; 76-76.3 Siltstone, gray, clayey, laminated; 76.3-76.6 Shale, gray		
78						
80				76.6-80 Organic siltstone/shale, highly laminated, dark gray		
82						
84						
86						
88						
90						

Notes: Auger (0-40 feet), Continous NQ core (40-80 feet)
This boring is close to GT-1

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DRILL LOG

PETERSON HYDRAULIC

Figure No. 9

Boring No.: CH-03-05

Date of Drilling: Nov. 12, 2005

Project : Alton Hollow Project
Project No.: 307001
Location: Alton, Utah
Elevation: 6900 feet

Drilling Company: DA Smith Drillers
Equipment:
Logged By: Eric Peterson

GWT: Not Indicated

Depth (ft.)	Graphic	USCS	Sample	Description	Laboratory Test Results	Other Data
0						
2				TOPSOIL: Light brown, moist, loose, 6" thick.		
4						
6						
8						
10						
12						
14						
16						
18				No Core (Auger hole)		
20						
22						
24						
26						
28						
30						
32						
34						
36						
38						
40						
42		SHALE		41-44.5 Carbonaceous shale, waxy, soft, dark gray to black		
44						
46				44.5-46 Low-grade coal, cabonaceous silty shale		
48				46-61 Coal, black, monor brownish coal, minor pyrite		
50						
52						
54		COAL		46-61 Coal, black, monor brownish coal, minor pyrite		
56						
58						
60				61-61.5 Low-grade coal, carbonaceous shale, some fairly		
62				dissembinted pyrite		
64		SHALE		61.5-63.5 Silty shale, waxy, gray		
66						
68						
70						
72						
74						
76						
78						
80						
82						
84						
86						
88						
90						

Notes: Auger (0-41 feet), Continous NQ core (41-63.5 feet)
This boring is close to GT-2

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DRILL LOG

PETERSON HYDRAULIC

Figure No. 10-A

Boring No.: CH-01-05

Date of Drilling: Nov. 8, 2005

Project : Alton Hollow Project
Project No.: 307001
Location: Alton, Utah
Elevation: 6900 feet

Drilling Company: DA Smith Drillers
Equipment:
Logged By: Eric Peterson

GWT: 15 feet

Depth (ft.)	Graphic	USCS	Sample	Description	Laboratory Test Results	Other Data
0						
2				TOPSOIL: Light brown, moist, loose, 6" thick.		
4		CL		0-5 Soil, Clayey		
6		GM		5-14 Gravel with sand and silt, reddish		
8						
10						
12						
14						
16		CL		14-16.6 Clayey silt, wet 16.5-20 Clay, moist, wet		
18						
20						
22				20-34 Silty clay, dark gray, less dense than above		
24						
26						
28						
30						
32						
34		CH		34-48 Clay, stiff, medium gray		
36						
38						
40						
42						
44						
46						
48						
50		SHALE		48-55 Dark gray silty carbonaceous shale, soft, waxy texture, some minor interbedded shaley siltstone, iron-stained fracture zone at 50-51 feet	ø = 20.1 cohesion = 321 psf OM = 20 MDD = 99.5 LL = 61 PI = 38	
52						
54						
56				55-68 Carbonaceous shale with minor silt, dark gray to black, more competent than above		
58						
60						
62						
64						
66						
68				68-69.5 Fractured/broken carbonaceous shale, dark gray to black		
70						
72				69.5-88.5 Carbonaceous shale, dark gray to black, soft, waxy texture		
74						
76						
78						
80						
82						
84						
86						
88						
90				88.5-89.5 Medium gray siltstone		

Notes: Auger (0-40 feet), Continous NQ core (40-175 feet)

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DRILL LOG

PETERSON HYDRAULIC

Figure No. 10-B

Boring No.: CH-01-05

Date of Drilling: Nov. 8, 2005

Depth (ft.)	Graphic	USCS	Sample	Description	Laboratory Test Results	Other Data
92		CH		89.5-92 Bentonite, medium to dark gray, pure		
94				92-92.5 Siltstone, medium gray		
96				92.5-107 Cabonaceous shale, dark gray to black, soft, waxy texture		
98					ø = 25.4	
100					cohesion = 216 psf	
102				107-109.5 Siltstone and cabonaceous shale, interbedded,	OM = 17.0	
104				thinly laminated, dark gray	MDD = 108.4	
106				109.5-110 Carbonaceous shale, dark gray to black, soft,	LL = 53 PI = 31	
108				waxy texture		
110		SHALE		110-115 Siltstone and cabonaceous shale, interbedded,		
112				thinly laminated, dark gray		
114				115-121.5 Carbonaceous shale, dark gray to black, soft,		
116				waxy texture, (poor core recovery)		
118				121.5-122 Limey claystone, dark gray, fossiliferous, (small,		
120				open fracture in this interval)		
122				122-125 Little or no recovery in this zone		
124				125-127.5 Carbonaceous shale, dark gray to black, soft,		
126				waxy texture		
128		CH		127.5-128 Bentonite, medium to light gray		
130				128-135 Carbonaceous shale, dark gray to black, soft, waxy		
132		SHALE		texture		
134				135-137 Carbonaceousw shale, harder than above		
136				137-138 Bentonite and interbedded carbonaceous shale,		
138		CH		dark and medium gray, thinly laminated		
140				138-143.5 Carbonaceous shale, dark gray to black, soft		
142				143.5-144 Bentonite and interbedded carbonaceous shale,		
144				dark and medium gray, thinly laminated		
146		SHALE		144-146 Carbonaceous shale and thin interbeds of siltstone,		
148				146-152.5 Siltstone with minor thin interbeds of		
150				cabonaceous shale, mottled gray to black		
152						
154				152.5-154.7 Coal, low grade or highly carbonaceous shale, black, abundant white fossils/fossil hash		
156						
158						
160		COAL				
162						
164				154.7-171.5 Coal, black with some brown mottled zones.		
166						
168						
170						
172				171.5-171-7 Coal, low grade, brown and black		
174				171.7-173.5 Carbonaceous shale, dark gray to black		
176				173.5-175 Siltstone, gray, interbedded with minor		
178				carbonaceous shale		
180						
182						
184						
186						
188						
190						
192						

Notes: Auger (0-40 feet), Continous NQ core (40-175 feet)

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APPENDIX C

LABORATORY TESTING DATA

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APPENDIX C
LABORATORY TESTING PROGRAM

Laboratory tests were conducted on representative soil samples obtained from the exploratory borings for the purpose of evaluating specific engineering properties and to aid in classification. Laboratory testing was performed at IGES Geotechnical Laboratory (Murray, Utah). A summary of the various laboratory tests, conducted in accordance with ASTM or other approved procedures follows:

Tests Conducted:	To Determine:
Natural Moisture Content ASTM D 2216	Moisture content representative of field conditions at the time samples were taken.
Natural Dry Density ASTM D 2922	Dry unit weight of samples, representative of in-place conditions at the time samples were taken.
Grain Size Analysis ASTM D 422	Size and distribution of soil particles (i.e. gravel, sand, and the combined percentage of clay and silt) within a soil sample.
Hydrometer ASTM D 422	Size and distribution of soil particles (i.e. gravel, sand, clay, and silt) within a soil sample.
Atterberg Limits ASTM D 423 and D 424	Effect of varying water content on the consistency of fine-grained soils.
Standard Proctor ASTM D 698	Determine the maximum density and optimum moisture for fill compaction effort.
Unconfined Compressive Strength ASTM D 2166	Compressive strength of sample, determined without a confining pressure.
Triaxial Shear Test	Angle of friction and cohesion under a confining pressure.

Results of the laboratory tests are summarized on Table-1, Summary of Laboratory Test Results. Laboratory data sheets are provided in Appendix C-1 and C-2.

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TAYLOR GEO-ENGINEERING, LLC

TABLE 1

Alton Coal Hollow Project

TGE Project No. 307001

Summary of Laboratory Test Results

Sample Location		Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation				Atterberg Limits		Unconfined Compressive Strength (psf)	Standard Proctor		CU Triaxial Test		USCS
Boring No.	Depth (ft.)			Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid Limit (%)	Plasticity Index (%)		Optimum Moisture (%)	Maximum Dry Density (pcf)	Effective (ø)	Effective Cohesion (psf)	
GT-1	10-11.5	12.6	111.6					47.0	31.0						CL
GT-1	20-21.5	14.4													CL
GT-1	25-26.5	28.6	95.0					69.0	52.0	4777.0					CH
GT-2	10-11.5	10.6				33.3									SM
GT-2	25-26.5	27.8						37.0	19.0						CL
GT-2	30-31.5	18.5													CL
GT-3	10-11.5	11.0				37.5									SM
GT-3	30-31.5	37.3	76.6					74.0	38.0	1956.0					MH
GT-5	5-6.5	18.7	108.3					63.0	44.0						CH
GT-5	10-11.5	17.1	102.0					63.0	45.0	9429.0					CH
GT-5	15-16.5	17.2	120.0												CH
SP-16-13	39120.0			0.0	20.5	51.1	28.4	31.0	15.0		17.0	110.4	29.6	94.0	CL
CH-1-3	40 - 44.5			1.1	4.4	57.8	37.8	53.0	32.0		20.5	101.9	21.6	319.0	CH
CH-5-48	48 - 55	5.7	132.9	13.2	40.7	46.1		61.0	38.0		20.0	99.5	20.1	321.0	SC
CH-5-98	98 - 108			7.4	29.7	62.9		53.0	36.0		17.0	108.4	25.4	216.0	CH

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APPENDIX C-1

LABORATORY TESTING DATA for BORINGS GT-1 through GT-5

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Moisture Content and Unit Weight of Soil

(In General Accordance with ASTM D2937 and D2216)

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Project: Taylor Geo-Engineering
No: M00991-002
Location:
Date: 3/9/2007
By: NB

Sample Info.	Boring No.	GT-1	GT-1	GT-2	GT-2	GT-2	GT-3	GT-5	GT-5
	Sample:								
	Depth:	10-11.5'	20.21.5'	10-11.5'	25-26.5'	30-31.5'	10-11.5'	5-6.5'	15-16.5
Unit Weight Info.	Sample height, H (in)	1.110						4.449	2.430
	Sample diameter, D (in)	1.890						1.373	1.824
	Sample volume, V (ft^3)	**0.0018**						**0.0038**	0.0037
	Wt. rings + wet soil (g)	102.87						222.43	234.72
	Wt. rings/tare (g)	0.00						0.00	0.00
	Moist soil, Ws (g)	**102.87**						**222.43**	234.72
	Moist unit wt., γ_m (pcf)	**125.73**						**128.53**	**140.70**
Moisture	Wet soil + tare (g)	292.45	670.40	438.87	295.22	380.60	492.21	283.41	385.29
	Dry soil + tare (g)	276.79	603.47	410.17	264.26	345.01	457.38	262.52	350.82
	Tare (g)	152.92	140.21	140.53	152.70	152.72	139.84	150.75	150.62
Moisture Content, w (%)		**12.6**	**14.4**	**10.6**	**27.8**	**18.5**	**11.0**	**18.7**	**17.2**
Dry Unit Wt., γ_d (pcf)		**111.6**						**108.3**	**120.0**

Entered by:_____
Reviewed:_____

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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

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Project: Taylor Geo-Engineering
No: M00991-002
Location:
Date: 3/13/2007
By: BRR

Boring No.: GT-1
Sample:
Depth: 10-11.5
Description: Not Requested

Preparation method: Air Dry
Liquid limit test method: Multipoint

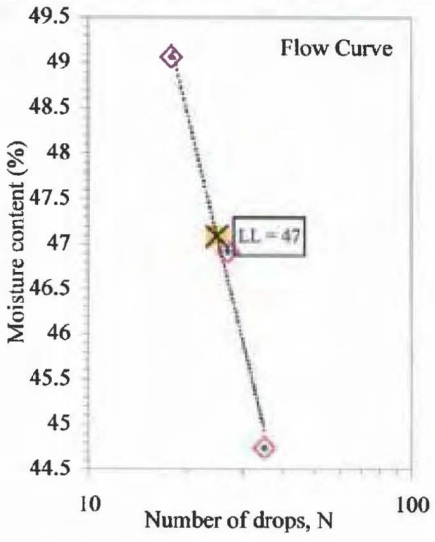
Plastic Limit

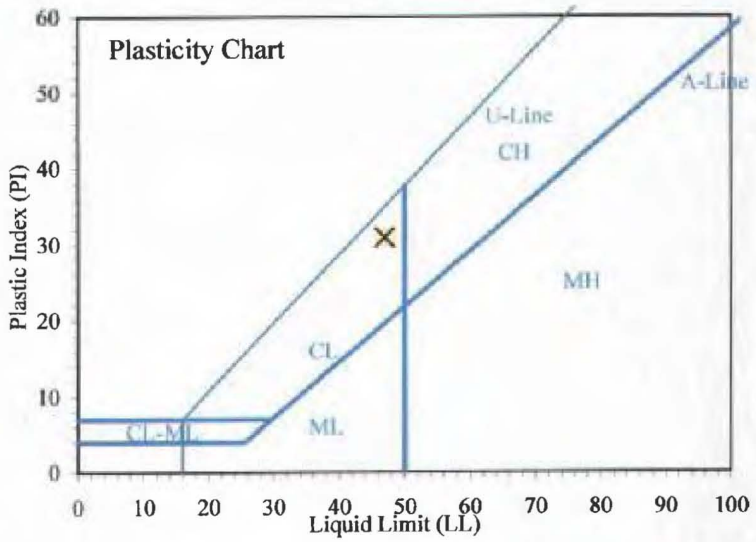
Determination No	1	2				
Wet Soil + Tare (g)	9.48	10.49				
Dry Soil + Tare (g)	8.37	9.24				
Moisture Loss (g)	1.11	1.25				
Tare (g)	1.39	1.39				
Dry Soil (g)	6.98	7.85				
Moisture Content, w (%)	15.90	15.92				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	35	27	18			
Wet Soil + Tare (g)	10.04	11.88	10.87			
Dry Soil + Tare (g)	7.36	8.53	7.75			
Moisture Loss (g)	2.68	3.35	3.12			
Tare (g)	1.37	1.39	1.39			
Dry Soil (g)	5.99	7.14	6.36			
Moisture Content, w (%)	44.74	46.92	49.06			
One-Point LL (%)		47				

Liquid Limit, LL (%)	**47**
Plastic Limit, PL (%)	**16**
Plasticity Index, PI (%)	**31**





Entered by: _____
Reviewed: _____

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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

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Project: Taylor Geo-Engineering
No: M00991-002
Location:
Date: 3/15/2007
By: NB

Boring No.: GT-1
Sample:
Depth: 25-26.5
Description: Not Requested

Preparation method: Air Dry
Liquid limit test method: Multipoint

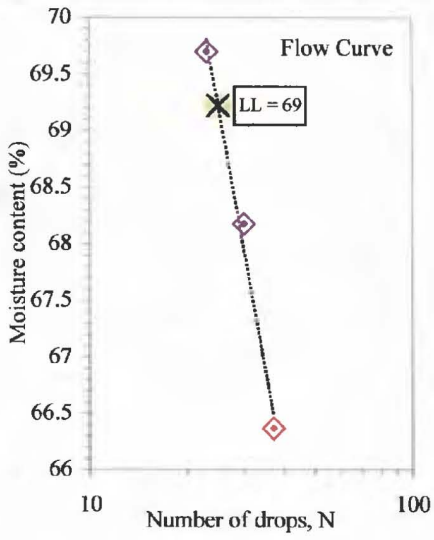
Plastic Limit

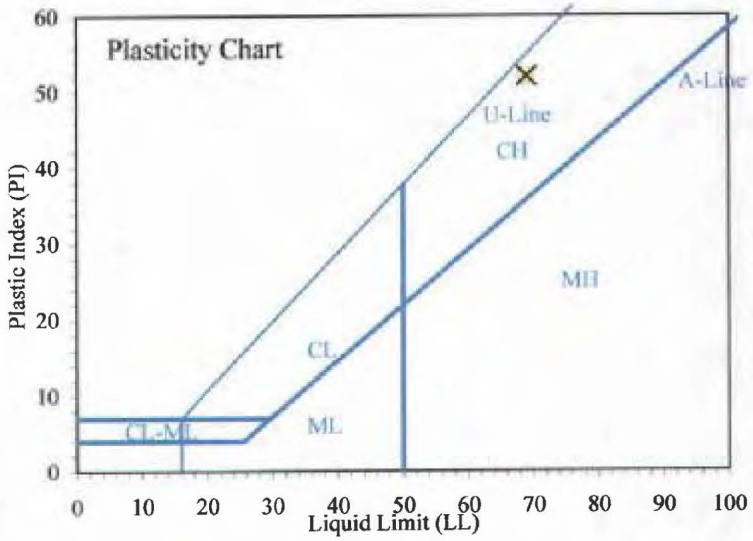
Determination No	1	2				
Wet Soil + Tare (g)	4.1	4.23				
Dry Soil + Tare (g)	3.7	3.81				
Moisture Loss (g)	0.4	0.42				
Tare (g)	1.38	1.38				
Dry Soil (g)	2.32	2.43				
Moisture Content, w (%)	17.24	17.28				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	37	30	23			
Wet Soil + Tare (g)	8.66	7.73	7			
Dry Soil + Tare (g)	5.76	5.16	4.7			
Moisture Loss (g)	2.9	2.57	2.3			
Tare (g)	1.39	1.39	1.4			
Dry Soil (g)	4.37	3.77	3.30			
Moisture Content, w (%)	66.36	68.17	69.70			
One-Point LL (%)		70	69			

Liquid Limit, LL (%)	**69**
Plastic Limit, PL (%)	**17**
Plasticity Index, PI (%)	**52**





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

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Project: Taylor Geo-Engineering
No: M00991-002
Location:
Date: 3/13/2007
By: BRR

Boring No.: GT-2
Sample:
Depth: 25-26.5
Description: Not Requested

Preparation method: Air Dry
Liquid limit test method: Multipoint

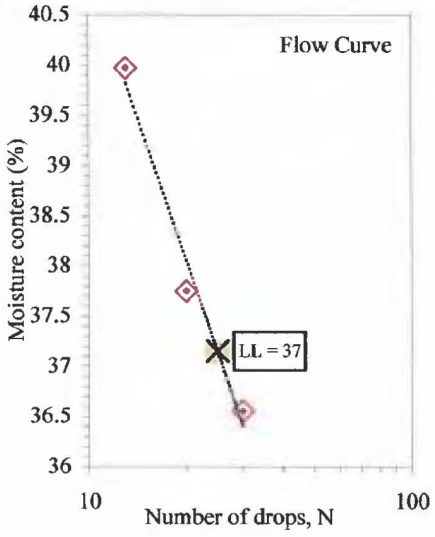
Plastic Limit

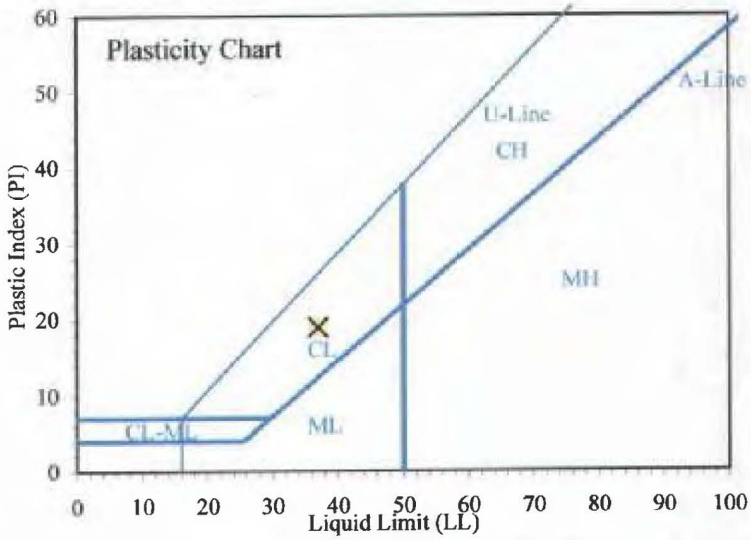
Determination No	1	2				
Wet Soil + Tare (g)	9.63	9.76				
Dry Soil + Tare (g)	8.35	8.47				
Moisture Loss (g)	1.28	1.29				
Tare (g)	1.39	1.4				
Dry Soil (g)	6.96	7.07				
Moisture Content, w (%)	18.39	18.25				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	30	20	13			
Wet Soil + Tare (g)	11	11.9	10.25			
Dry Soil + Tare (g)	8.43	9.02	7.72			
Moisture Loss (g)	2.57	2.88	2.53			
Tare (g)	1.4	1.39	1.39			
Dry Soil (g)	7.03	7.63	6.33			
Moisture Content, w (%)	36.56	37.75	39.97			
One-Point LL (%)	37	37				

Liquid Limit, LL (%)	**37**
Plastic Limit, PL (%)	**18**
Plasticity Index, PI (%)	**19**





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

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Project: Taylor Geo-Engineering
No: M00991-002
Location:
Date: 3/15/2007
By: NB

Boring No.: GT-3
Sample:
Depth: 30-31.5
Description: Not Requested

Preparation method: Air Dry
Liquid limit test method: Multipoint

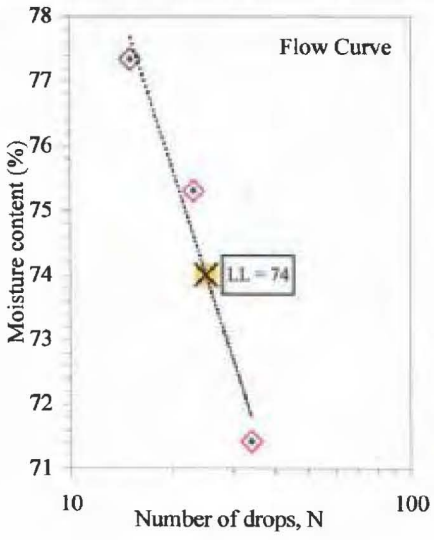
Plastic Limit

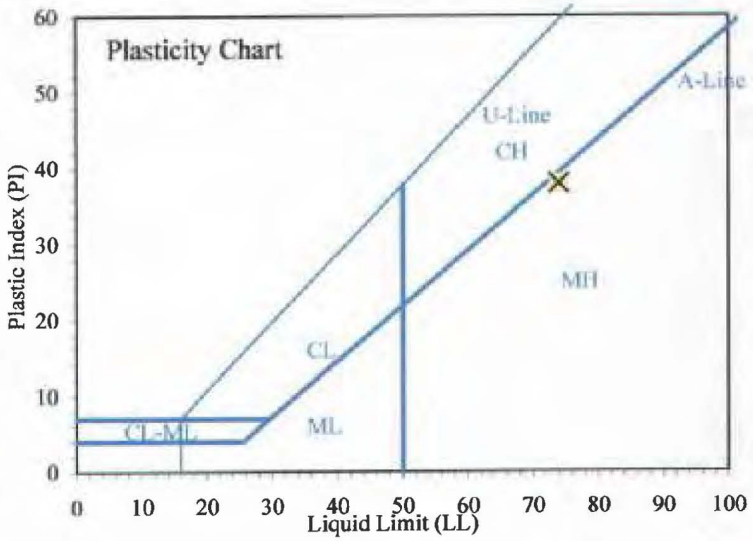
Determination No	1	2				
Wet Soil + Tare (g)	4.54	4.32				
Dry Soil + Tare (g)	3.7	3.55				
Moisture Loss (g)	0.84	0.77				
Tare (g)	1.39	1.39				
Dry Soil (g)	2.31	2.16				
Moisture Content, w (%)	36.36	35.65				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	34	23	15			
Wet Soil + Tare (g)	7.02	8.35	8.2			
Dry Soil + Tare (g)	4.67	5.36	5.23			
Moisture Loss (g)	2.35	2.99	2.97			
Tare (g)	1.38	1.39	1.39			
Dry Soil (g)	3.29	3.97	3.84			
Moisture Content, w (%)	71.43	75.31	77.34			
One-Point LL (%)		75				

Liquid Limit, LL (%)	**74**
Plastic Limit, PL (%)	**36**
Plasticity Index, PI (%)	**38**





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

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Project: Taylor Geo-Engineering
No: M00991-002
Location:
Date: 3/13/2007
By: BRR

Boring No.: GT-5
Sample:
Depth: 5-6.5
Description: Not Requested

Preparation method: Air Dry
Liquid limit test method: Multipoint

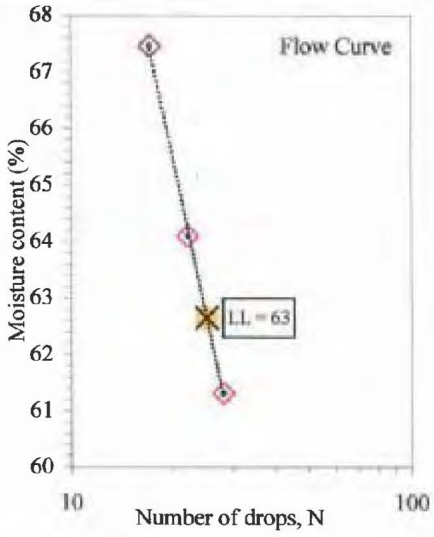
Plastic Limit

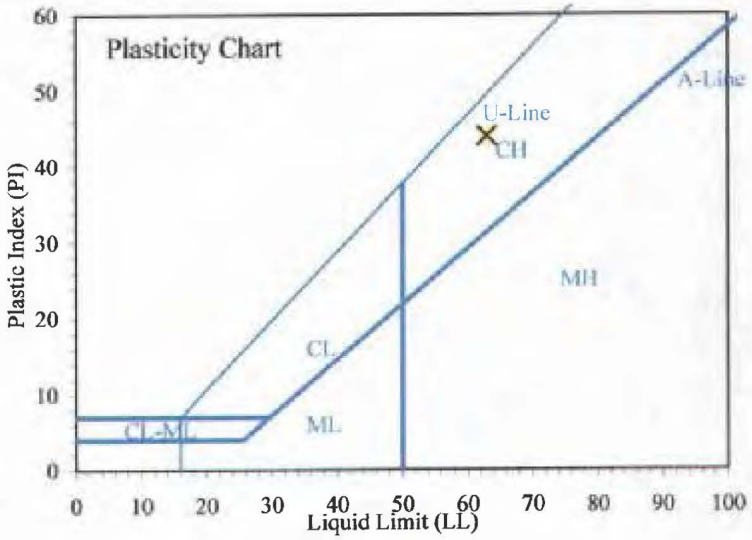
Determination No	1	2				
Wet Soil + Tare (g)	8.32	8.38				
Dry Soil + Tare (g)	7.22	7.28				
Moisture Loss (g)	1.1	1.1				
Tare (g)	1.39	1.38				
Dry Soil (g)	5.83	5.90				
Moisture Content, w (%)	18.87	18.64				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	28	22	17			
Wet Soil + Tare (g)	9.23	8.43	10.49			
Dry Soil + Tare (g)	6.25	5.68	6.82			
Moisture Loss (g)	2.98	2.75	3.67			
Tare (g)	1.39	1.39	1.38			
Dry Soil (g)	4.86	4.29	5.44			
Moisture Content, w (%)	61.32	64.10	67.46			
One-Point LL (%)	62	63				

Liquid Limit, LL (%)	**63**
Plastic Limit, PL (%)	**19**
Plasticity Index, PI (%)	**44**





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

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Project: .
No: M00991-002
Location:
Date: 3/15/2007
By: NB

Boring No.: GT-5
Sample:
Depth: 10-11.5
Description: Not Requested

Preparation method: Air Dry
Liquid limit test method: Multipoint

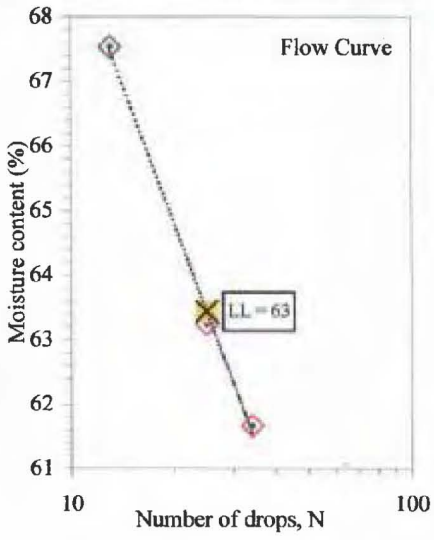
Plastic Limit

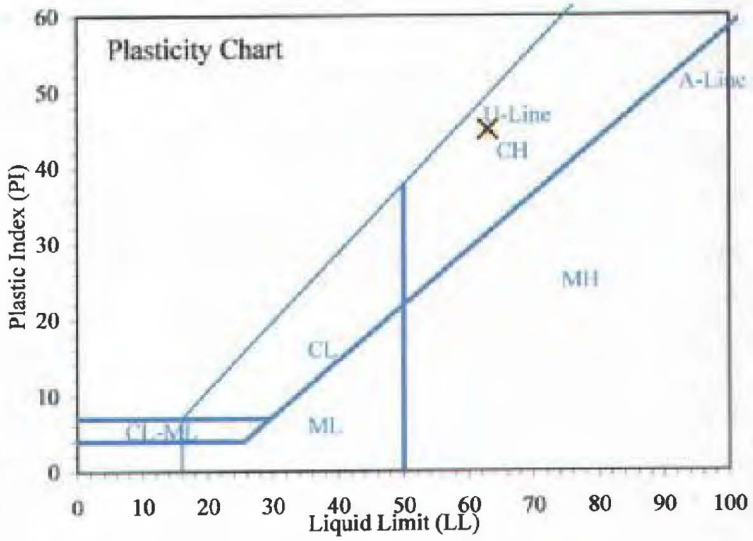
Determination No	1	2				
Wet Soil + Tare (g)	5.3	5.18				
Dry Soil + Tare (g)	4.7	4.61				
Moisture Loss (g)	0.6	0.57				
Tare (g)	1.35	1.35				
Dry Soil (g)	3.35	3.26				
Moisture Content, w (%)	17.91	17.48				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	34	25	13			
Wet Soil + Tare (g)	8.93	8.19	10.32			
Dry Soil + Tare (g)	6.05	5.54	6.72			
Moisture Loss (g)	2.88	2.65	3.6			
Tare (g)	1.38	1.35	1.39			
Dry Soil (g)	4.67	4.19	5.33			
Moisture Content, w (%)	61.67	63.25	67.54			
One-Point LL (%)		63				

Liquid Limit, LL (%)	**63**
Plastic Limit, PL (%)	**18**
Plasticity Index, PI (%)	**45**





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Amount of Material in Soil Finer than the No. 200 (75μm) Sieve

(ASTM D1140)

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Project: Taylor Geo-Engineering
No: M00991-002
Location:
Date: 3/12/2007
By: NB

Sample Info.	Boring No.	GT-2	GT-3						
	Sample								
	Depth	10-11.5	10-11.5						
	Split	No	No						
	Split Sieve*								
Moist total sample wt. (g)		298.34	352.37						
Moist coarse fraction (g)									
Dry split fraction (g)									
No. 200 Dry wt. retained (g)		179.78	198.58						
Split sieve* Dry wt. retained (g)									
Dry total sample wt. (g)		**269.64**	**317.54**						
Coarse Fraction	Moist soil + tare (g)								
	Dry soil + tare (g)								
	Tare (g)								
	Moisture content (%)								
Split Fraction	Moist soil + tare (g)	438.87	492.21						
	Dry soil + tare (g)	410.17	457.38						
	Tare (g)	140.53	139.84						
	Moisture content (%)	**10.64**	10.97						
Percent passing split sieve* (%)									
Percent passing No. 200 sieve (%)		**33.3**	**37.5**						

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Unconfined Compressive Strength of Cohesive Soils

(ASTM D2166)

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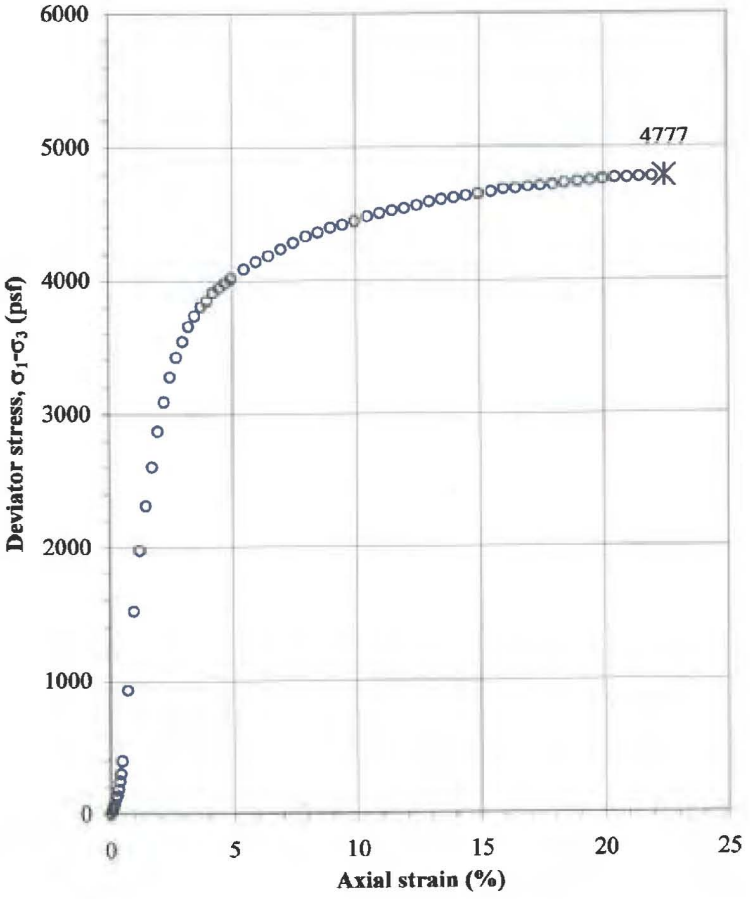
Project: Taylor Geo-Engineering
No: M00991-002
Location:
Date: 3/13/2007
By: DS

Boring No.: GT-1
Sample:
Depth: 25-26.5 feet
Sample Description: Brown clay
Sample type: Undisturbed

Sample height, H (in.)	4.250
Sample diameter, D (in.)	1.930
Sample volume, V (ft^3)	0.0072
Wt. rings + wet soil (g)	398.84
Wt. rings/tare (g)	0.00
Moist soil, Ws (g)	398.84
Moist unit wt., γ_m (pcf)	122.2
Dry unit wt., γ_d (pcf)	**95.0**

Wet soil + tare (g)	58.32
Dry soil + tare (g)	52.02
Tare (g)	30.00
Moisture content, w (%)	**28.6**
Strain rate (%/min)	2.0
Strain at failure, ε_f (%)	22.45
Deviator stress at failure, $(\sigma 1-\sigma 3)_f$ (psf)	4777
Shear stress at failure, $q_f = (\sigma 1_f-\sigma 3_f)/2$ (psf)	2389

Axial Strain (%)	σd σ1-σ3 (psf)	Q 1/2 σd (psf)
0.00	0.0	0.0
0.05	25.8	12.9
0.10	45.1	22.6
0.15	70.9	35.5
0.20	116.0	58.0
0.26	135.3	67.6
0.31	180.3	90.1
0.35	238.2	119.1
0.40	296.0	148.0
0.46	392.4	196.2
0.70	924.5	462.3
0.95	1517.9	759.0
1.20	1974.2	987.1
1.46	2306.7	1153.4
1.70	2599.6	1299.8
1.95	2865.6	1432.8
2.20	3085.8	1542.9
2.45	3273.3	1636.7
2.70	3422.1	1711.1
2.95	3538.6	1769.3
3.20	3654.4	1827.2
3.45	3732.2	1866.1
3.71	3802.9	1901.5
3.95	3849.0	1924.5
4.20	3913.2	1956.6
4.45	3945.9	1973.0
4.70	3984.5	1992.3
4.95	4017.0	2008.5
5.46	4080.6	2040.3
5.95	4137.8	2068.9
6.45	4181.8	2090.9
6.95	4231.2	2115.6
7.46	4279.4	2139.7
7.96	4326.8	2163.4
8.45	4356.5	2178.3
8.96	4390.9	2195.5
9.45	4413.3	2206.7
9.95	4440.9	2220.5
10.45	4473.4	2236.7
10.96	4499.5	2249.8
11.46	4519.5	2259.8
11.95	4533.5	2266.8
12.45	4558.1	2279.1
12.95	4582.0	2291.0
13.45	4600.0	2300.0
13.95	4611.5	2305.8
14.45	4628.5	2314.3
14.95	4644.9	2322.5
15.46	4654.9	2327.5
15.96	4675.7	2337.9
16.45	4680.0	2340.0
16.96	4693.8	2346.9
17.45	4702.7	2351.4
17.95	4710.8	2355.4
18.45	4723.6	2361.8
18.96	4735.4	2367.7
19.45	4742.6	2371.3
19.96	4753.5	2376.8
20.46	4759.2	2379.6
20.96	4759.2	2379.6
21.45	4764.2	2382.1
21.95	4768.7	2384.4
22.45	4777.3	2388.7



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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

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Project: Taylor Geo-Engineering
No: M00991-001
Location: _
Date: 3/8/2007
By: DKS

Boring No.: _
Sample: CH-5-98
Depth: _
Description: Gray Weathered Claystone

Preparation method: Air Dry
Liquid limit test method: Multipoint

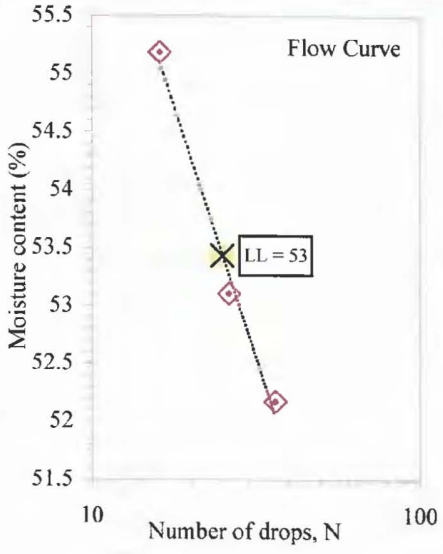
Plastic Limit

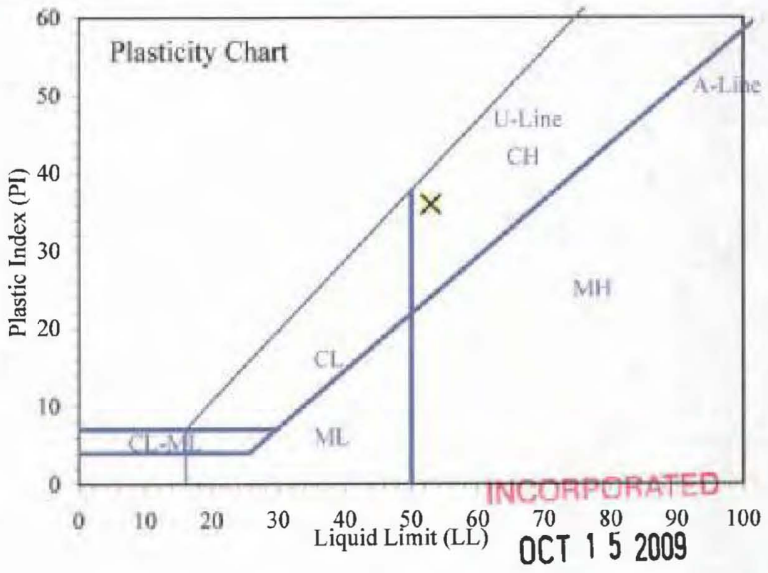
Determination No	1	2				
Wet Soil + Tare (g)	8.38	12.66				
Dry Soil + Tare (g)	7.37	10.99				
Moisture Loss (g)	1.01	1.67				
Tare (g)	1.39	1.38				
Dry Soil (g)	5.98	9.61				
Moisture Content, w (%)	16.89	17.38				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	36	26	16			
Wet Soil + Tare (g)	11.22	12.94	11.57			
Dry Soil + Tare (g)	7.85	8.92	7.95			
Moisture Loss (g)	3.37	4.02	3.62			
Tare (g)	1.39	1.35	1.39			
Dry Soil (g)	6.46	7.57	6.56			
Moisture Content, w (%)	52.17	53.10	55.18			
One-Point LL (%)		53				

Liquid Limit, LL (%)	**53**
Plastic Limit, PL (%)	**17**
Plasticity Index, PI (%)	**36**





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

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Project: Taylor Geo-Engineering
No: M00991-001
Location: _
Date: 3/8/2007
By: BRR

Boring No.: _
Sample: SP-16-13
Depth: _
Description: Not Requested

Preparation method: Air Dry
Liquid limit test method: Multipoint

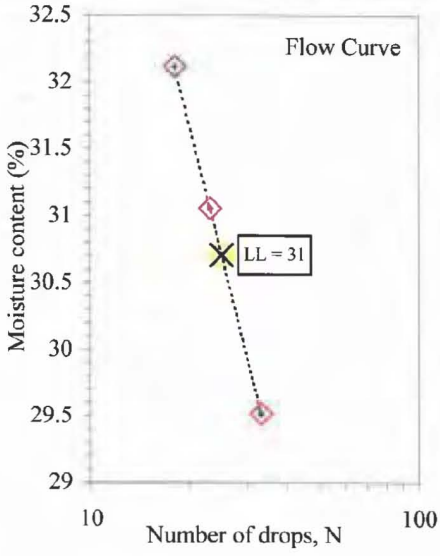
Plastic Limit

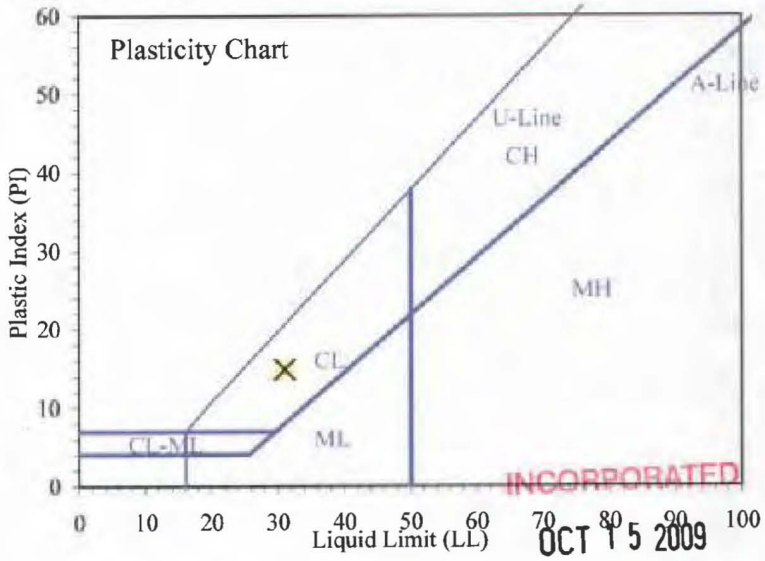
Determination No	1	2				
Wet Soil + Tare (g)	12	12.16				
Dry Soil + Tare (g)	10.53	10.66				
Moisture Loss (g)	1.47	1.5				
Tare (g)	1.4	1.39				
Dry Soil (g)	9.13	9.27				
Moisture Content, w (%)	16.10	16.18				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	33	23	18			
Wet Soil + Tare (g)	9.64	10.95	10.77			
Dry Soil + Tare (g)	7.76	8.68	8.48			
Moisture Loss (g)	1.88	2.27	2.29			
Tare (g)	1.39	1.37	1.35			
Dry Soil (g)	6.37	7.31	7.13			
Moisture Content, w (%)	29.51	31.05	32.12			
One-Point LL (%)		31				

Liquid Limit, LL (%)	**31**
Plastic Limit, PL (%)	**16**
Plasticity Index, PI (%)	**15**





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

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Project: Taylor Geo-Engineering
No: M00991-001
Location:
Date: 3/12/2007
By: NB

Boring No.:
Sample: CH-1-3
Depth:
Description: Not Requested

Preparation method: Air Dry
Liquid limit test method: Multipoint

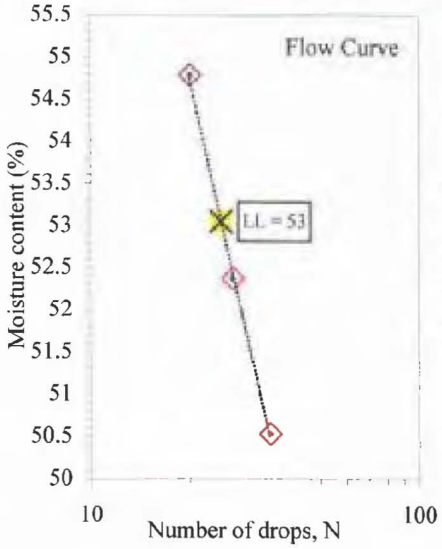
Plastic Limit

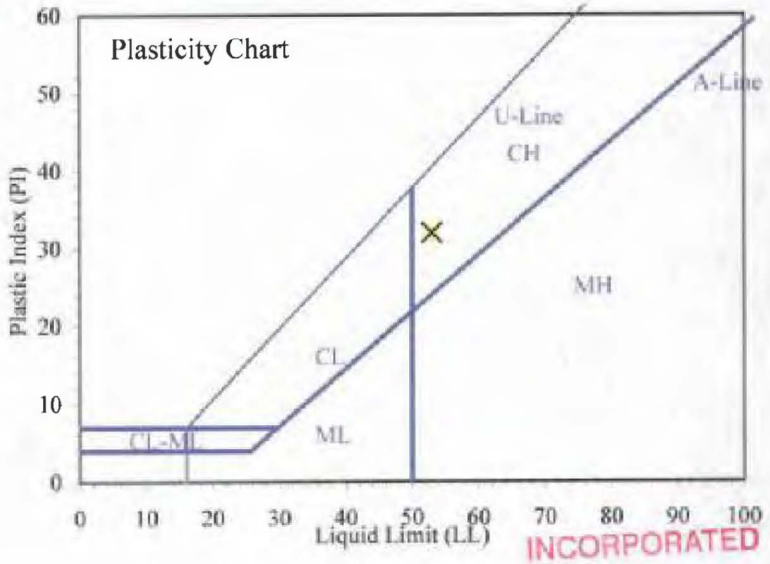
Determination No	1	2				
Wet Soil + Tare (g)	6.44	6.43				
Dry Soil + Tare (g)	5.57	5.57				
Moisture Loss (g)	0.87	0.86				
Tare (g)	1.38	1.39				
Dry Soil (g)	4.19	4.18				
Moisture Content, w (%)	20.76	20.57				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	35	27	20			
Wet Soil + Tare (g)	8.47	8.11	10.61			
Dry Soil + Tare (g)	6.09	5.8	7.35			
Moisture Loss (g)	2.38	2.31	3.26			
Tare (g)	1.38	1.39	1.4			
Dry Soil (g)	4.71	4.41	5.95			
Moisture Content, w (%)	50.53	52.38	54.79			
One-Point LL (%)		53	53			

Liquid Limit, LL (%)	**53**
Plastic Limit, PL (%)	**21**
Plasticity Index, PI (%)	**32**





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Reviewed: _____

Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

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Project: Taylor Geo-Engineering
No: M00991-001
Location:
Date: 3/12/2007
By: NB

Boring No.:
Sample: CH-5-48
Depth:
Description: Not Requested

Preparation method: Air Dry
Liquid limit test method: Multipoint

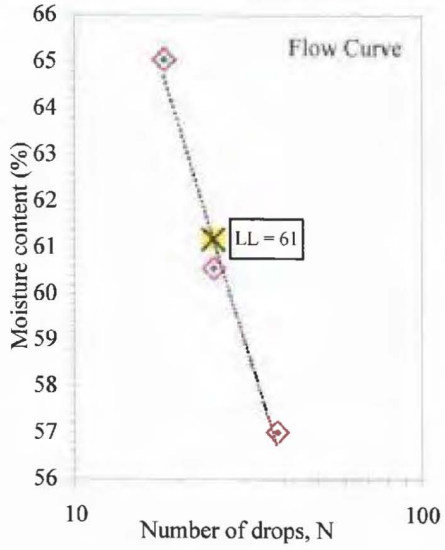
Plastic Limit

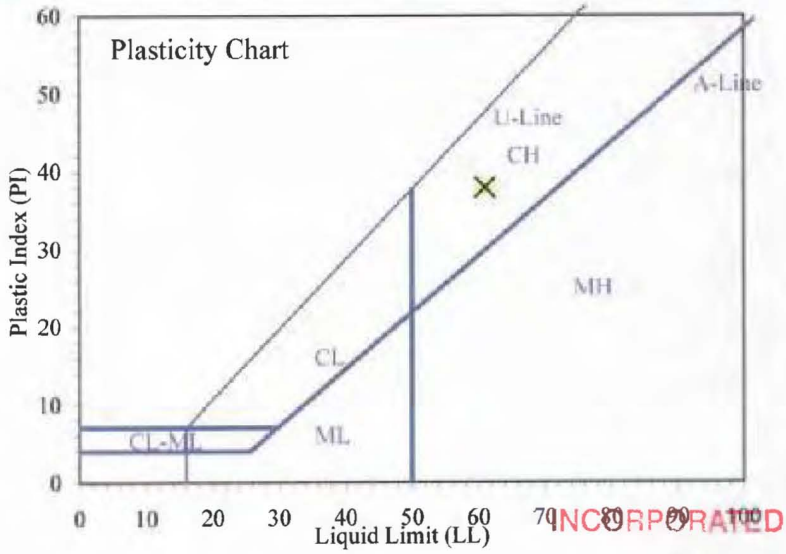
Determination No	1	2				
Wet Soil + Tare (g)	8.58	10.39				
Dry Soil + Tare (g)	7.22	8.71				
Moisture Loss (g)	1.36	1.68				
Tare (g)	1.4	1.39				
Dry Soil (g)	5.82	7.32				
Moisture Content, w (%)	23.37	22.95				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	38	25	18			
Wet Soil + Tare (g)	8.69	9	9.55			
Dry Soil + Tare (g)	6.04	6.13	6.33			
Moisture Loss (g)	2.65	2.87	3.22			
Tare (g)	1.39	1.39	1.38			
Dry Soil (g)	4.65	4.74	4.95			
Moisture Content, w (%)	56.99	60.55	65.05			
One-Point LL (%)		61				

Liquid Limit, LL (%)	**61**
Plastic Limit, PL (%)	**23**
Plasticity Index, PI (%)	**38**





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Particle-Size Analysis of Soils

(ASTM D422)

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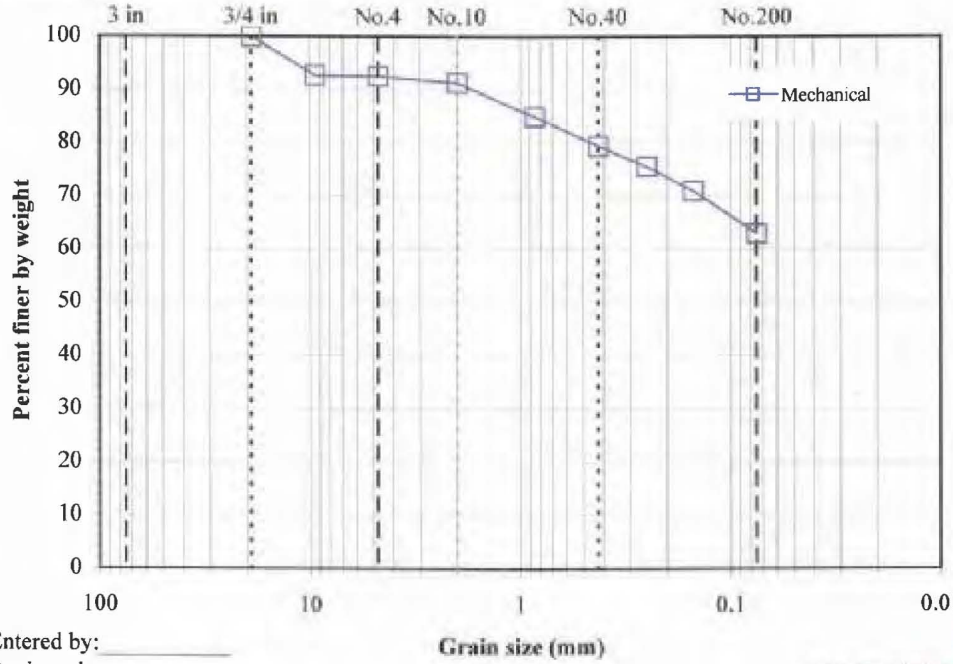
Project: Taylor Geo-Engineering
No: M00991-001
Location: __
Date: 3/6/2007
By: DKS

Boring No.: __
Sample: CH-5-98
Depth: __
Description: Gray Weathered Claystone

Split:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	7142.6	6906.5
+3/8" Coarse fraction (g):	523.1	505.9
-3/8" Split fraction (g):	1270.1	1228.10
Split fraction:	0.927	

Moisture data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	629.80	1661.40
Dry soil + tare (g):	616.32	1619.40
Tare (g):	220.90	391.30
Moisture content (%):	3.4	3.4

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
12"	-	300	-	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	-	
1.5"	-	37.5	-	
3/4"	-	19	100.0	
3/8"	505.90	9.5	92.7	←Split
No.4	1.40	4.75	92.6	
No.10	18.10	2	91.3	
No.20	102.50	0.85	84.9	
No.40	176.30	0.425	79.4	
No.60	227.20	0.25	75.5	
No.100	289.00	0.15	70.9	
No.200	394.40	0.075	62.9	



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Particle-Size Analysis of Soils

(ASTM D422)

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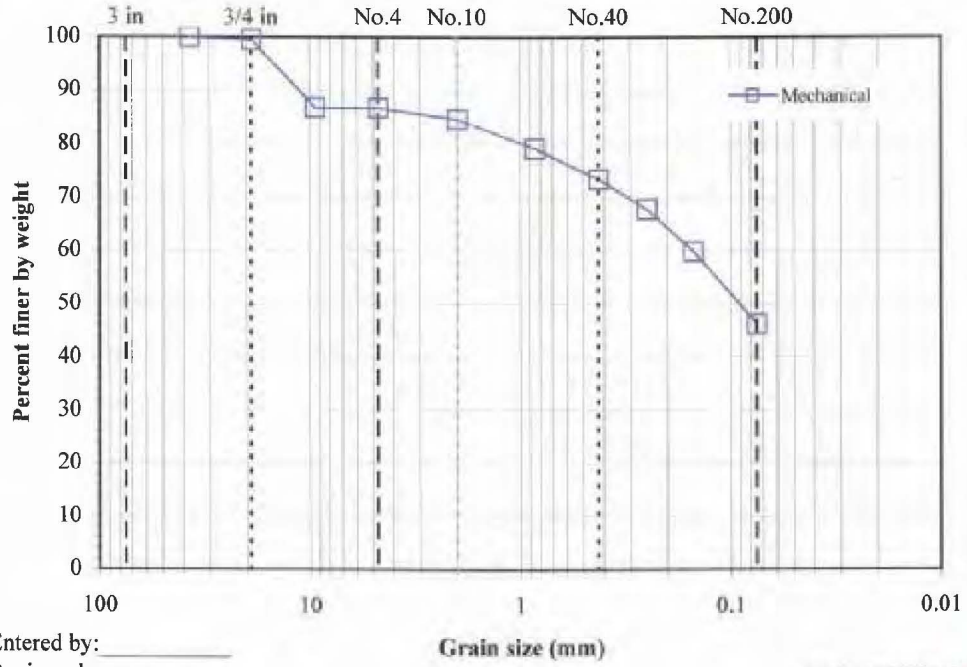
Project: Taylor Geo-Engineering
No: M00991-001
Location: _
Date: 3/6/2007
By: DKS

Boring No.: _
Sample: CH-5-48
Depth: _
Description: Gray Weathered Claystone

	Moist	Dry
Split:	Yes	
Split sieve:	3/8"	
Total sample wt. (g):	5766.1	5455.0
+3/8" Coarse fraction (g):	760.6	719.0
-3/8" Split fraction (g):	464.4	439.40
Split fraction:	0.868	

Moisture data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	440.80	646.60
Dry soil + tare (g):	426.29	621.60
Tare (g):	175.80	182.20
Moisture content (%):	5.8	5.7

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
12"	-	300	-	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	-	
1.5"	-	37.5	100.0	
3/4"	27.60	19	99.5	
3/8"	719.00	9.5	86.8	←Split
No.4	0.20	4.75	86.8	
No.10	11.10	2	84.6	
No.20	38.60	0.85	79.2	
No.40	67.70	0.425	73.4	
No.60	96.10	0.25	67.8	
No.100	136.70	0.15	59.8	
No.200	205.90	0.075	46.1	



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Particle-Size Analysis of Soils *with hydrometer*

(ASTM D422)

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Project: Taylor Geo-Engineering
No: M00991-001
Location:
Date: 3/12/2007
By: BRR

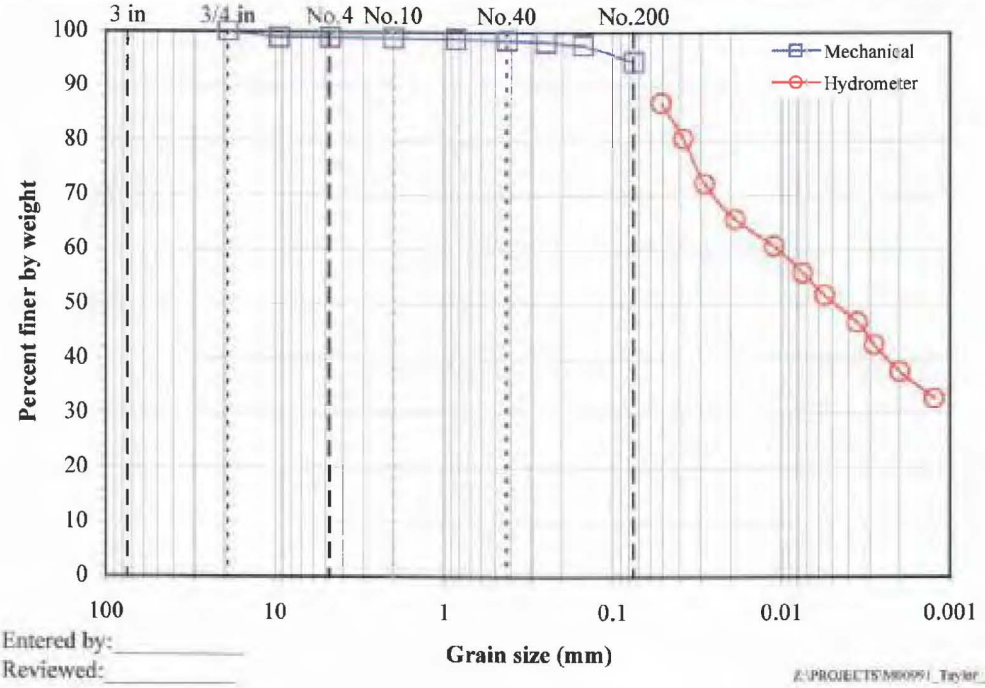
Boring No.:
Sample: CH-1-3
Depth:
Description: Description

Split sieve:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	7774	7397.19
+3/8" Coarse fraction (g):	83.4	79.60
-3/8" Split fraction (g):	356.60	339.30
Hydrometer fraction (g):	62.26	60.20
Split fraction:	0.989	

Moisture data	C.F.(+3/8")	S.F.(-3/8")	Hyd.(-No.10)
Moist soil + tare (g):	224.40	92.06	61.75
Dry soil + tare (g):	220.60	89.05	60.70
Tare (g):	141.00	30.00	30.04
Moisture content (%):	4.77	5.10	3.42

Hydrometer data				
Hyd. split:	No.10		Slope:	-0.164
Gs:	2.65	Assumed	Intercept:	16.3
Composite corr.:	6		α:	1.00
Dispersion period (min):	15		Hyd. fraction:	98.81
			Dispersion device:	Air-jet

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer		Elapsed time (min)	Temp. (°C)	Hydrometer Reading	Grain Size (mm)	% Soil in Suspension
12"	-	300	-		0.5	16.5	59	0.05190	86.99
8"	-	200	-		1	16.5	55	0.03847	80.43
6"	-	150	-		2	16.5	50	0.02870	72.22
4"	-	100	-		5	16.5	46	0.01887	65.65
3"	-	75	-		15	17	43	0.01112	60.73
1.5"	-	37.5	-		34	17.5	40	0.00754	55.81
3/4"	-	19	100.0		64	18	37.5	0.00557	51.70
3/8"	79.60	9.5	98.9	<=Split	160	19	34.5	0.00357	46.78
No.4	-	4.75	98.9		258	20	32	0.00282	42.68
No.10	0.40	2	98.8	<=Split hyd.	521	21.5	29	0.00199	37.75
No.20	0.10	0.85	98.6		1396	21	26	0.00125	32.83
No.40	0.25	0.425	98.4						
No.60	0.40	0.25	98.2						
No.100	0.75	0.15	97.6						
No.200	2.63	0.075	94.5						



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Particle-Size Analysis of Soils *with hydrometer*

(ASTM D422)

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Project: Taylor Geo-Engineering
No: M00991-001
Location:
Date: 3/12/2007
By: BRR

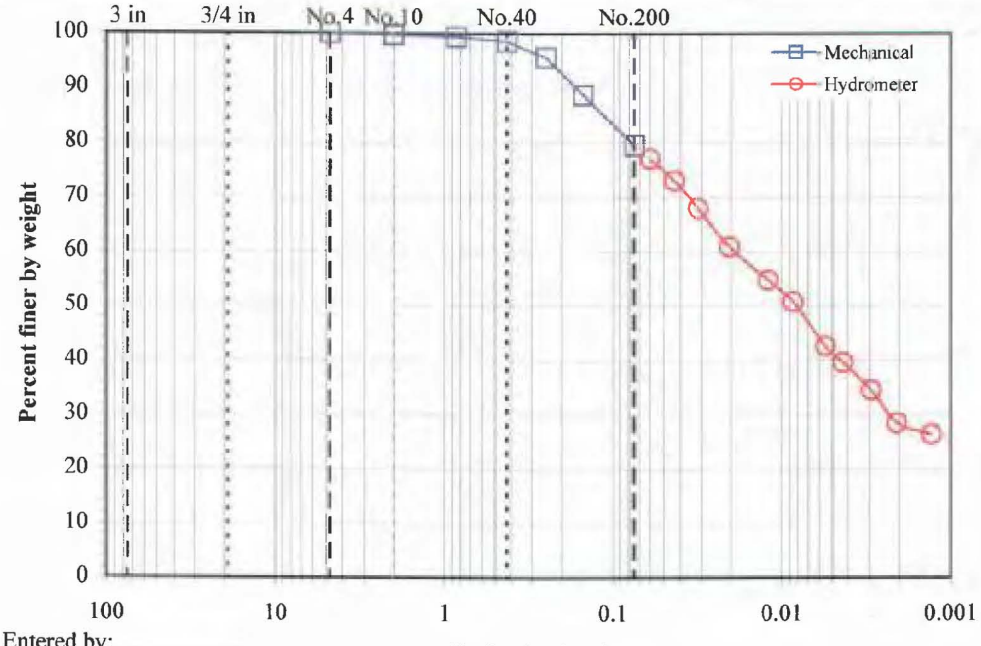
Boring No.:
Sample: SP-16-13
Depth:
Description: Description

Split sieve:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	10597.4	10387.95
+3/8" Coarse fraction (g):		0.00
-3/8" Split fraction (g):	511.30	501.19
Hydrometer fraction (g):	49.63	49.11
Split fraction:	1.000	

Moisture data	C.F.(+3/8")	S.F.(-3/8")	Hyd.(-No.10)
Moist soil + tare (g):	-	680.10	95.73
Dry soil + tare (g):	-	669.71	95.04
Tare (g):	-	154.40	30.00
Moisture content (%):	0.00	2.02	1.06

Hydrometer data				
Hyd. split:	No.10		Slope:	-0.164
Gs:	2.65	Assumed	Intercept:	16.3
Composite corr.:	6		α:	1.00
Dispersion period (min):	15		Hyd. fraction:	99.67
			Dispersion device:	Air-jet

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer		Elapsed time (min)	Temp. (°C)	Hydrometer Reading	Grain Size (mm)	% Soil in Suspension
12"	-	300	-		0.5	17	44	0.06039	77.13
8"	-	200	-		1	17	42	0.04347	73.07
6"	-	150	-		2	17	39.5	0.03140	67.99
4"	-	100	-		5	17	36	0.02043	60.89
3"	-	75	-		15	17	33	0.01207	54.80
1.5"	-	37.5	-		30	17.5	31	0.00861	50.74
3/4"	-	19	-		76	18	27	0.00553	42.62
3/8"	-	9.5	-	<=Split	123	19	25.5	0.00434	39.58
No.4	-	4.75	100.0		266	20	23	0.00296	34.50
No.10	1.63	2	99.7	<=Split hyd.	538	21.5	20	0.00208	28.42
No.20	0.14	0.85	99.4		1413	21	19	0.00130	26.39
No.40	0.55	0.425	98.6						
No.60	1.98	0.25	95.7						
No.100	5.36	0.15	88.8						
No.200	9.94	0.075	79.5						



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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

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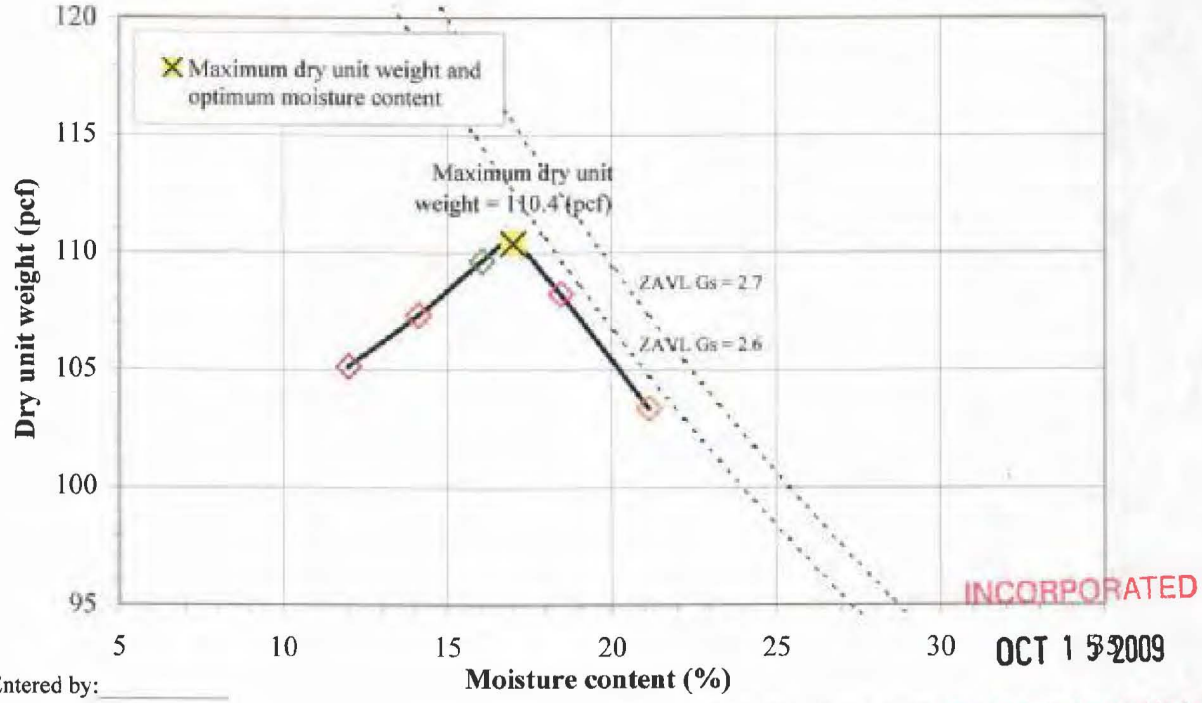
Project: Taylor Geo-Engineering
No: M00991-001
Location:
Date: 3/1/2007
By: NB

Method: ASTM D698 B
Mold volume (ft^3): 0.0333

Boring No.:
Sample: SP-16-13
Depth:
Sample Description:
Engineering Classification: Not requested
As-received moisture content (%): 2.02
Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: No

Optimum moisture content (%): 17
Maximum dry unit weight (pcf): 110.4

Point Number	+10	+12	+14	+16	+18			
Wt. Sample + Mold (g)	5962.0	6033.3	6106.0	6120.3	6075.2			
Wt. of Mold (g)	4181.8	4181.8	4181.8	4181.8	4181.8			
Wet Unit Wt., γ_m (pcf)	117.7	122.5	127.3	128.2	125.2			
Wet Soil + Tare (g)	738.9	593.5	820.4	685.7	719			
Dry Soil + Tare (g)	674.85	538.79	728.12	602.71	620.21			
Tare (g)	140	150.7	153.3	152.4	152.7			
Moisture Content, w (%)	12.0	14.1	16.1	18.4	21.1			
Dry Unit Wt., γ_d (pcf)	105.1	107.3	109.7	108.3	103.4			



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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

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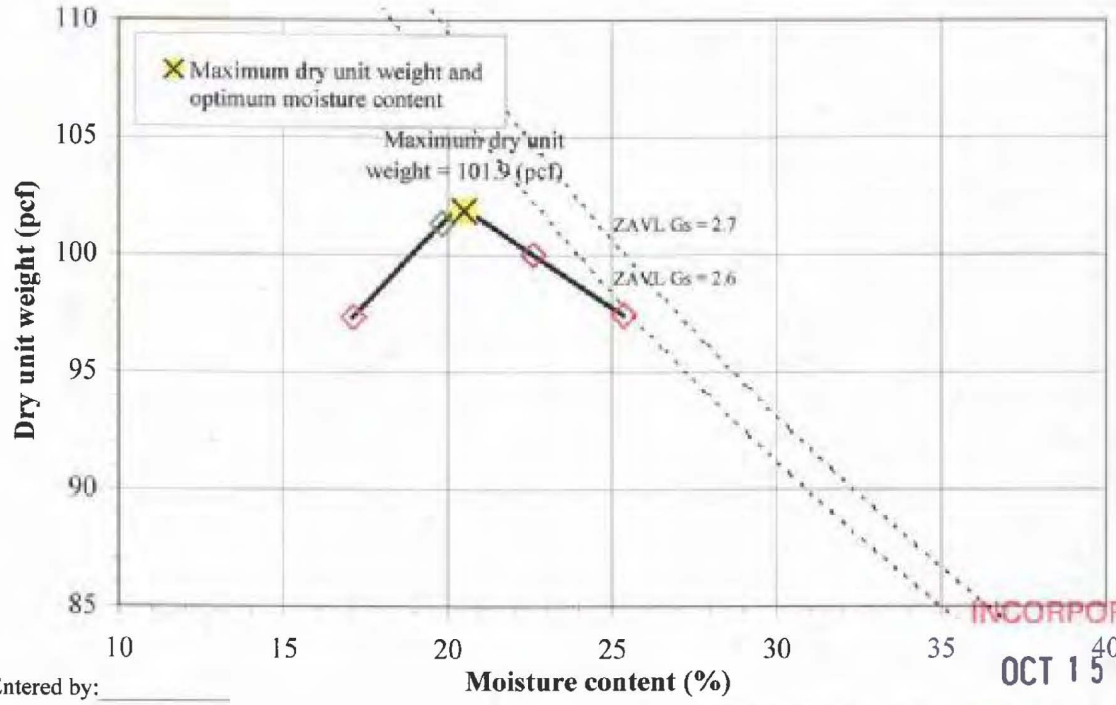
Project: Taylor Geo-Engineering
No: M00991-001
Location:
Date: 3/7/2007
By: DKS

Method: ASTM D698 B
Mold volume (ft^3): 0.0333

Boring No.:
Sample: CH-1-3
Depth:
Sample Description:
Engineering Classification: Not requested
As-received moisture content (%): 5.1
Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: No

Optimum moisture content (%): 20.5
Maximum dry unit weight (pcf): 101.9

Point Number	+18	+20	+15	+12				
Wt. Sample + Mold (g)	6110.0	6102.8	6092.8	5905.3				
Wt. of Mold (g)	4256.2	4256.2	4256.2	4181.7				
Wet Unit Wt., γ_m (pcf)	122.6	122.1	121.5	114.0				
Wet Soil + Tare (g)	518.1	584.4	626.4	659.3				
Dry Soil + Tare (g)	455.42	511.67	559.49	586.02				
Tare (g)	177.9	224.6	222	150.7				
Moisture Content, w (%)	22.6	25.3	19.8	17.1				
Dry Unit Wt., γ_d (pcf)	100.0	97.4	101.4	97.3				



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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

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Project: Taylor Geo-Engineering
No: M00991-001
Location:
Date: 3/7/2007
By: DKS

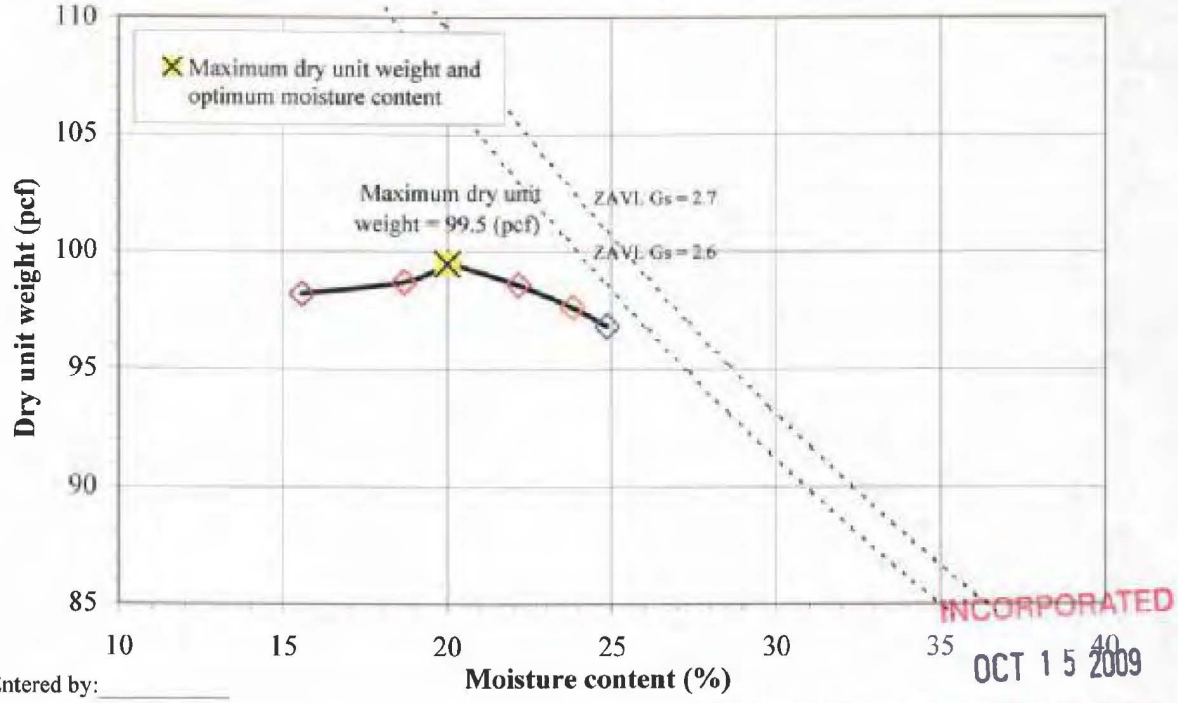
Boring No.:
Sample: CH-5-48
Depth:
Sample Description:
Engineering Classification: Not requested
As-received moisture content (%): 5.7

Method: ASTM D698 B
Mold volume (ft^3): 0.0333

Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: No

Optimum moisture content (%): 20
Maximum dry unit weight (pcf): 99.5

Point Number	+10	+12	+14	+16	+18	+20		
Wt. Sample + Mold (g)	5890.6	5946.0	5981.3	5995.8	6002.4	6002.8		
Wt. of Mold (g)	4174.8	4174.8	4174.8	4174.8	4174.8	4174.8		
Wet Unit Wt., γ_m (pcf)	113.5	117.1	119.5	120.4	120.9	120.9		
Wet Soil + Tare (g)	360.7	316.6	348.1	376.2	414.5	450.5		
Dry Soil + Tare (g)	331.24	288.78	313.48	335.73	364.49	391.25		
Tare (g)	141.8	139.8	140.6	153	154.3	152.8		
Moisture Content, w (%)	15.6	18.7	20.0	22.1	23.8	24.8		
Dry Unit Wt., γ_d (pcf)	98.2	98.7	99.5	98.6	97.6	96.8		



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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

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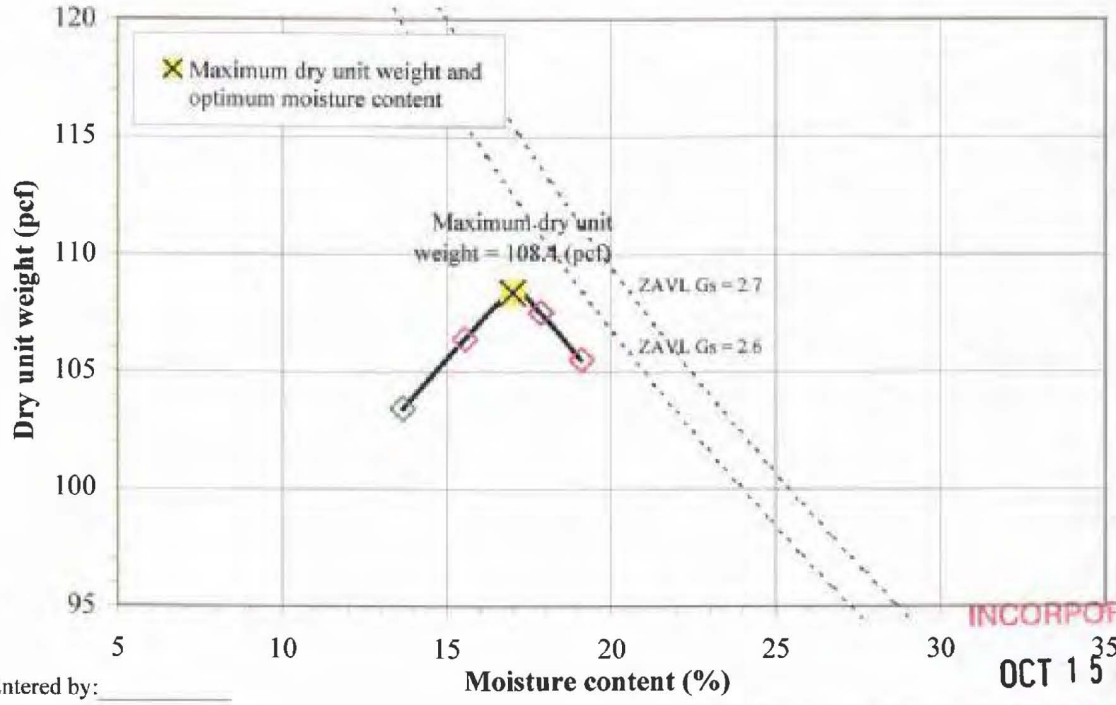
Project: Taylor Geo-Engineering
No: M00991-001
Location:
Date: 3/7/2007
By: DKS

Method: ASTM D698 B
Mold volume (ft^3): 0.0333

Boring No.:
Sample: CH-5-98
Depth:
Sample Description:
Engineering Classification: Not requested
As-received moisture content (%): 3.42
Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: No

Optimum moisture content (%): 17
Maximum dry unit weight (pcf): 108.4

Point Number	+14	+16	+10	+12				
Wt. Sample + Mold (g)	6091.4	6075.0	5952.8	6033.8				
Wt. of Mold (g)	4175.3	4175.3	4175.3	4175.3				
Wet Unit Wt., γ_m (pcf)	126.7	125.6	117.6	122.9				
Wet Soil + Tare (g)	452.1	583.3	536.3	481.8				
Dry Soil + Tare (g)	415.64	525.49	490.64	437.31				
Tare (g)	211.3	222.5	156.2	150.7				
Moisture Content, w (%)	17.8	19.1	13.7	15.5				
Dry Unit Wt., γ_d (pcf)	107.5	105.5	103.4	106.4				



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Isotropically Consolidated Undrained with Pore Pressure (CIU/PP)

Project Name: Taylor Geo-Engineering

Project Number: M00991-001

Sample: CH-1-3

Comments: Samples were compacted to 90% of ASTM D698 at OMC.

Test Number		S1	S2	S3	
Initial	Height, H (in)	5.44	5.85	5.19	
	Diameter, D (in)	2.42	2.42	2.42	
	Moisture Content, w (%)	21.0	21.0	20.2	
	Dry Unit Weight, γd (pcf)	91.0	90.9	91.4	
	Saturation (%)	66.6	66.3	64.7	
	Void Ratio, e	0.85	0.85	0.84	
Before Shear	Moisture Content, w (%)	26.5	25.1	21.2	
	Dry Unit Weight, γd (pcf)	96.4	99.3	105.8	
	Saturation (%)	100.0	100.0	100.0	
	Void Ratio, e	0.72	0.68	0.57	
	B	0.95	0.95	0.95	
	Back pressure (psf)	6193	5161	5474	
	Strain rate (%/min)	0.033	0.033	0.033	
	Time to Failure (min)	606.1	606.1	460.6	
Total Stress	Strain at Failure, εf (%)	20.00	20.00	15.20	
	σ3 (psf)	2878	5760	11518	
	σ1-σ3 (psf)	2393	3460	7111	
	σ1 (psf)	5271	9220	18629	
	q = (σ1-σ3)/2 (psf)	1197	1730	3556	
	p = (σ1+σ3)/2 (psf)	4075	7490	15073	
Effective Stress	u (psf)	1473	3782	6184	
	σ'3 (psf)	1405	1978	5334	
	σ'1-σ'3 (psf)	2393	3460	7111	
	σ'1 (psf)	3798	5438	12445	
	q = (σ'1-σ'3)/2 (psf)	1197	1730	3556	
	p' = (σ'1+σ'3)/2 (psf)	2602	3708	8889	
	σ'1/σ'3	2.70	2.75	2.33	
	A = u/(σ1–σ3)	0.616	1.093	0.870	

Estimated Specific Gravity	2.70
Plastic Limit (%)	21
Liquid Limit (%)	53
Plasticity Index (%)	32

Summary of Strength Paramaters	Total Stress	Effective Stress
c (psf)	223	319
ϕ (deg)	12.6	21.6
tan ϕ	0.224	0.396

* Saturation set to 100% for phase calculations

Tested by: _____

Reviewed: _____

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Isotropically Consolidated Undrained with Pore Pressure (CIU/PP)

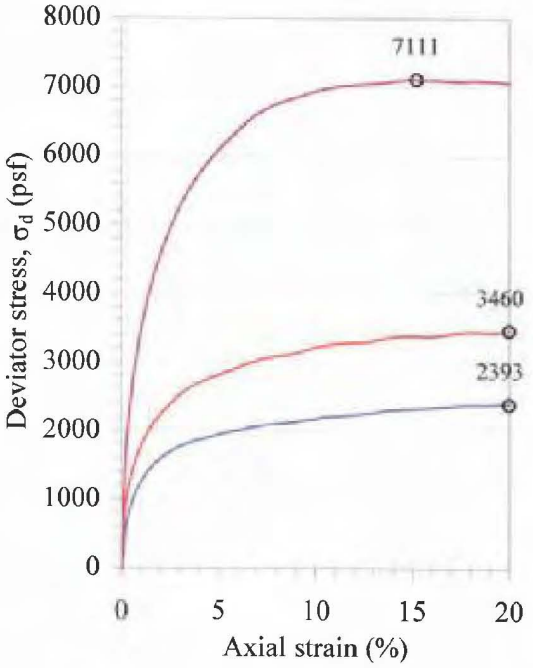
Project Name: Taylor Geo-Engineering

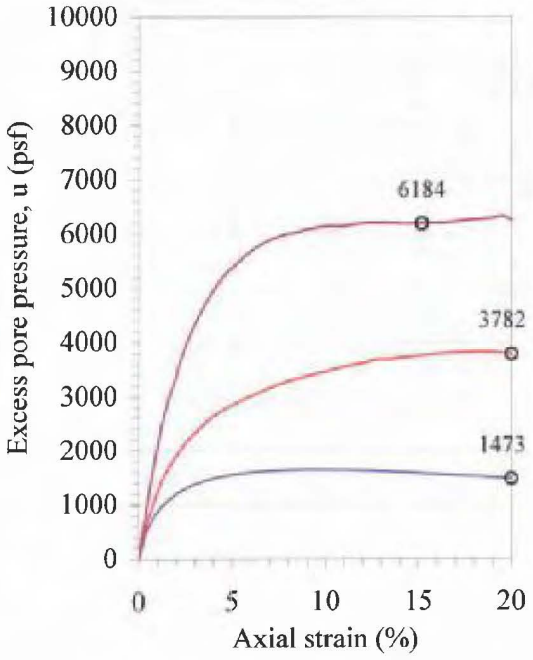
Project Number: M00991-001

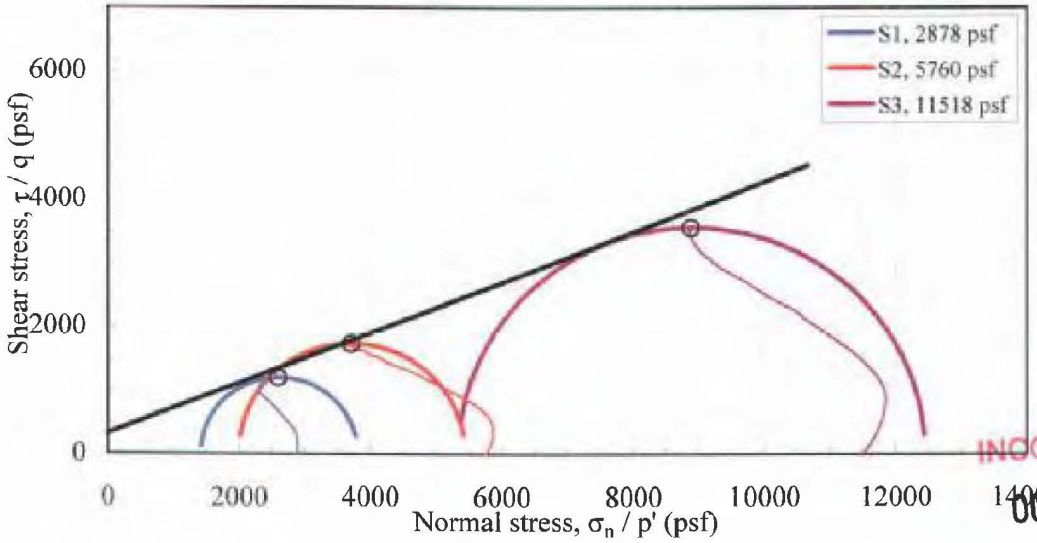
Sample: CH-1-3

Comments:

Summary of Strength Paramaters	Total Stress	Effective Stress
c (psf)	223	319
ϕ (deg)	12.6	21.6
tan ϕ	0.224	0.396







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Project Name: Taylor Geo-Engineering
Project Number: M00991-001
Sample: CH-1-3
Comments: Samples were compacted to 90% of ASTM D698 at
Test Number: S1

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
0.00	-10	0	2878	2868	-5	2873	2873	1.004
0.02	125	56	2822	2947	62	2941	2885	1.044
0.04	133	67	2812	2945	67	2945	2878	1.047
0.06	138	73	2807	2945	69	2948	2876	1.049
0.08	151	78	2800	2950	75	2954	2875	1.054
0.10	259	122	2757	3016	130	3008	2886	1.094
0.20	572	294	2584	3156	286	3164	2870	1.221
0.30	731	409	2470	3201	366	3244	2835	1.296
0.40	843	498	2381	3223	421	3300	2802	1.354
0.50	937	584	2295	3232	468	3348	2764	1.408
0.60	1018	658	2220	3238	509	3387	2729	1.458
0.70	1086	718	2160	3246	543	3421	2703	1.502
0.80	1149	775	2103	3252	574	3453	2678	1.546
0.90	1203	829	2050	3254	602	3481	2652	1.587
1.00	1253	876	2002	3256	627	3505	2629	1.626
1.10	1299	919	1960	3259	650	3529	2610	1.663
1.20	1345	960	1918	3263	672	3551	2590	1.701
1.30	1382	994	1884	3266	691	3569	2575	1.733
1.40	1418	1031	1849	3267	709	3589	2558	1.767
1.50	1451	1062	1816	3267	725	3604	2542	1.799
1.60	1483	1093	1786	3269	742	3620	2527	1.831
1.70	1511	1122	1756	3268	756	3634	2512	1.860
1.80	1539	1148	1731	3270	770	3648	2500	1.889
1.90	1563	1172	1706	3269	782	3660	2488	1.916
2.00	1587	1197	1681	3268	793	3672	2475	1.944
2.10	1610	1218	1660	3271	805	3683	2465	1.970
2.20	1629	1239	1639	3269	815	3693	2454	1.994
2.30	1653	1259	1619	3272	826	3705	2446	2.021
2.40	1672	1279	1601	3273	836	3716	2437	2.045
2.50	1687	1297	1582	3269	843	3722	2425	2.066
2.60	1706	1313	1566	3271	853	3731	2418	2.090
2.70	1725	1329	1549	3274	862	3741	2412	2.113
2.80	1735	1345	1534	3269	868	3746	2402	2.131
2.90	1750	1359	1521	3271	875	3755	2396	2.151
3.00	1765	1373	1506	3271	882	3761	2388	2.172
3.10	1775	1386	1493	3268	888	3766	2380	2.189
3.20	1786	1397	1481	3267	893	3771	2374	2.206
3.30	1800	1409	1469	3270	900	3778	2370	2.225
3.40	1806	1421	1458	3264	903	3782	2361	2.239
3.50	1821	1431	1447	3268	910	3789	2358	2.258
3.60	1831	1442	1437	3268	916	3794	2352	2.275
3.70	1837	1451	1427	3264	919	3797	2346	2.287
3.80	1847	1461	1419	3267	924	3803	2343	2.302
3.90	1858	1469	1410	3267	929	3807	2339	2.318
4.00	1864	1478	1400	3264	932	3810	2332	2.331
4.10	1865	1485	1393	3259	933	3811	2326	2.339
4.20	1880	1494	1384	3264	940	3818	2324	2.358
4.30	1886	1502	1377	3263	943	3821	2320	2.370
4.40	1892	1507	1371	3263	946	3824	2317	2.380
4.50	1898	1514	1365	3263	949	3828	2314	2.390
4.60	1908	1521	1357	3265	954	3832	2311	2.406
4.70	1918	1527	1351	3269	959	3837	2310	2.419
4.80	1919	1533	1345	3265	960	3838	2305	2.427
4.90	1929	1539	1339	3269	965	3843	2304	2.441
5.00	1939	1545	1334	3273	970	3848	2303	2.454
5.10	1945	1550	1329	3274	973	3851	2302	2.464
5.20	1951	1555	1323	3274	976	3854	2299	2.475

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
5.30	1957	1559	1320	3276	978	3857	2298	2.483
5.40	1967	1565	1314	3280	983	3862	2297	2.497
5.50	1972	1569	1309	3281	986	3865	2295	2.507
5.60	1978	1573	1306	3284	989	3867	2295	2.515
5.70	1984	1576	1303	3287	992	3871	2295	2.522
5.80	1990	1580	1298	3288	995	3873	2293	2.532
5.90	1995	1583	1295	3290	998	3876	2293	2.541
6.00	2001	1587	1291	3292	1001	3879	2292	2.549
6.10	2011	1591	1288	3299	1005	3884	2293	2.561
6.20	2012	1593	1286	3298	1006	3884	2292	2.565
6.30	2022	1596	1282	3304	1011	3889	2293	2.577
6.40	2027	1599	1280	3307	1014	3892	2293	2.584
6.50	2037	1602	1276	3313	1019	3897	2295	2.596
6.60	2039	1605	1275	3314	1019	3899	2294	2.599
6.70	2048	1607	1272	3320	1024	3903	2296	2.611
6.80	2050	1609	1269	3319	1025	3903	2294	2.615
6.90	2055	1612	1267	3322	1028	3906	2294	2.622
7.00	2061	1614	1265	3325	1030	3909	2295	2.630
7.10	2062	1616	1262	3324	1031	3909	2293	2.634
7.20	2068	1617	1261	3329	1034	3912	2295	2.640
7.30	2073	1620	1259	3332	1037	3915	2295	2.647
7.40	2074	1621	1257	3332	1037	3916	2295	2.650
7.50	2080	1622	1256	3336	1040	3918	2296	2.656
7.60	2081	1623	1256	3337	1041	3920	2297	2.657
7.70	2087	1624	1254	3341	1043	3922	2297	2.664
7.80	2088	1626	1253	3341	1044	3922	2297	2.667
7.90	2093	1628	1250	3344	1047	3925	2297	2.674
8.00	2095	1628	1252	3346	1047	3927	2299	2.674
8.10	2100	1630	1248	3348	1050	3928	2298	2.683
8.20	2101	1630	1248	3349	1051	3929	2299	2.684
8.30	2107	1630	1248	3355	1053	3932	2301	2.688
8.40	2104	1632	1247	3351	1052	3930	2299	2.687
8.50	2117	1633	1247	3364	1059	3938	2305	2.698
8.60	2118	1634	1245	3363	1059	3938	2304	2.702
8.70	2120	1634	1245	3364	1060	3938	2304	2.703
8.80	2121	1634	1245	3366	1060	3939	2305	2.704
8.90	2130	1634	1245	3375	1065	3943	2310	2.711
9.00	2131	1635	1243	3375	1066	3944	2309	2.714
9.10	2133	1634	1245	3377	1066	3945	2311	2.713
9.20	2138	1634	1245	3382	1069	3947	2313	2.718
9.30	2143	1635	1243	3386	1071	3950	2315	2.723
9.40	2148	1636	1243	3391	1074	3954	2317	2.727
9.50	2157	1635	1243	3400	1079	3957	2322	2.735
9.60	2154	1635	1243	3398	1077	3956	2321	2.733
9.70	2163	1635	1243	3407	1082	3960	2325	2.740
9.80	2164	1634	1245	3409	1082	3961	2327	2.739
9.90	2169	1634	1245	3414	1085	3963	2329	2.743
10.00	2174	1634	1246	3420	1087	3967	2333	2.746
10.10	2179	1634	1246	3425	1090	3969	2336	2.750
10.20	2185	1634	1245	3429	1092	3971	2337	2.755
10.30	2190	1633	1246	3435	1095	3973	2341	2.758
10.40	2195	1633	1246	3440	1097	3976	2343	2.762
10.50	2196	1633	1246	3441	1098	3976	2344	2.762
10.60	2201	1633	1246	3446	1100	3979	2346	2.766
10.70	2205	1632	1248	3454	1103	3982	2351	2.767
10.80	2206	1632	1247	3453	1103	3982	2350	2.770
10.90	2208	1632	1247	3454	1104	3982	2351	2.770
11.00	2209	1630	1248	3457	1104	3983	2352	2.770
11.10	2209	1630	1249	3459	1105	3984	2354	2.769
11.20	2214	1629	1249	3464	1107	3986	2356	2.773
11.30	2215	1628	1250	3466	1108	3986	2358	2.772
11.40	2220	1627	1253	3473	1110	3990	2363	2.771
11.50	2221	1628	1252	3473	1111	3990	2362	2.775
11.60	2230	1627	1253	3483	1115	3995	2368	2.780

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
11.70	2231	1624	1254	3485	1115	3994	2369	2.779
11.80	2228	1623	1256	3484	1114	3994	2370	2.773
11.90	2233	1623	1255	3488	1116	3995	2371	2.779
12.00	2234	1622	1256	3490	1117	3995	2373	2.778
12.10	2238	1621	1257	3496	1119	3998	2377	2.780
12.20	2239	1620	1259	3498	1120	3998	2378	2.779
12.30	2244	1619	1260	3504	1122	4000	2382	2.781
12.40	2245	1617	1261	3506	1122	4001	2383	2.780
12.50	2249	1616	1262	3512	1125	4003	2387	2.782
12.60	2254	1615	1263	3517	1127	4006	2390	2.784
12.70	2259	1614	1266	3524	1129	4009	2395	2.785
12.80	2260	1613	1266	3525	1130	4008	2395	2.785
12.90	2264	1610	1268	3532	1132	4011	2400	2.786
13.00	2273	1609	1269	3542	1136	4015	2405	2.791
13.10	2273	1607	1272	3545	1137	4015	2408	2.788
13.20	2278	1606	1274	3552	1139	4019	2413	2.788
13.30	2282	1605	1274	3556	1141	4020	2415	2.792
13.40	2291	1603	1275	3566	1145	4024	2420	2.797
13.50	2295	1601	1277	3573	1148	4026	2425	2.797
13.60	2296	1600	1279	3575	1148	4026	2427	2.796
13.70	2301	1598	1281	3581	1150	4029	2431	2.796
13.80	2305	1595	1283	3588	1153	4031	2436	2.796
13.90	2306	1594	1284	3590	1153	4031	2437	2.795
14.00	2306	1592	1287	3593	1153	4032	2440	2.792
14.10	2311	1591	1288	3599	1155	4034	2443	2.794
14.20	2315	1588	1290	3606	1158	4036	2448	2.794
14.30	2316	1587	1293	3609	1158	4037	2451	2.792
14.40	2320	1585	1294	3614	1160	4039	2454	2.793
14.50	2321	1582	1296	3617	1161	4039	2457	2.791
14.60	2322	1581	1297	3619	1161	4039	2458	2.790
14.70	2322	1579	1300	3622	1161	4040	2461	2.787
14.80	2323	1576	1302	3625	1161	4040	2463	2.784
14.90	2331	1575	1303	3634	1165	4044	2469	2.789
15.00	2328	1573	1306	3633	1164	4042	2469	2.783
15.10	2328	1572	1307	3635	1164	4043	2471	2.782
15.20	2329	1569	1309	3638	1164	4043	2473	2.779
15.30	2329	1567	1311	3641	1165	4043	2476	2.776
15.40	2334	1566	1313	3646	1167	4045	2479	2.778
15.50	2334	1564	1315	3649	1167	4046	2482	2.775
15.60	2335	1561	1317	3652	1167	4046	2485	2.773
15.70	2335	1559	1320	3655	1168	4046	2487	2.770
15.80	2340	1558	1321	3660	1170	4048	2491	2.771
15.90	2340	1555	1323	3663	1170	4048	2493	2.769
16.00	2341	1553	1327	3667	1170	4050	2497	2.764
16.10	2345	1552	1327	3671	1172	4051	2499	2.768
16.20	2345	1550	1329	3674	1173	4051	2502	2.765
16.30	2349	1548	1330	3679	1175	4053	2505	2.766
16.40	2350	1546	1334	3683	1175	4055	2509	2.762
16.50	2354	1544	1334	3688	1177	4054	2511	2.765
16.60	2358	1542	1337	3695	1179	4059	2516	2.764
16.70	2358	1541	1338	3697	1179	4059	2518	2.762
16.80	2363	1538	1341	3703	1181	4060	2522	2.762
16.90	2367	1535	1343	3710	1183	4062	2526	2.762
17.00	2367	1534	1344	3711	1184	4062	2528	2.761
17.10	2371	1532	1347	3717	1186	4064	2532	2.761
17.20	2371	1530	1349	3720	1186	4064	2535	2.758
17.30	2375	1527	1351	3727	1188	4066	2539	2.758
17.40	2376	1526	1352	3728	1188	4066	2540	2.757
17.50	2376	1524	1355	3731	1188	4066	2543	2.754
17.60	2376	1521	1357	3733	1188	4067	2545	2.751
17.70	2377	1520	1358	3735	1188	4067	2547	2.750
17.80	2381	1518	1361	3741	1190	4069	2551	2.750
17.90	2381	1516	1363	3744	1191	4069	2553	2.747
18.00	2381	1514	1365	3747	1191	4070	2556	2.746

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
18.10	2382	1512	1366	3748	1191	4069	2557	2.743
18.20	2382	1510	1369	3751	1191	4069	2560	2.740
18.30	2382	1507	1371	3753	1191	4070	2562	2.738
18.40	2383	1506	1372	3755	1191	4070	2564	2.736
18.50	2383	1504	1375	3757	1191	4070	2566	2.733
18.60	2387	1502	1377	3764	1193	4072	2570	2.733
18.70	2383	1499	1379	3763	1192	4070	2571	2.728
18.80	2383	1498	1382	3765	1192	4071	2573	2.725
18.90	2384	1496	1383	3767	1192	4070	2575	2.724
19.00	2384	1493	1385	3769	1192	4070	2577	2.721
19.10	2384	1491	1387	3772	1192	4071	2580	2.718
19.20	2384	1490	1389	3773	1192	4071	2581	2.717
19.30	2385	1487	1391	3776	1192	4071	2583	2.714
19.40	2388	1486	1392	3781	1194	4073	2586	2.716
19.50	2389	1484	1395	3783	1194	4073	2589	2.713
19.60	2392	1482	1397	3789	1196	4075	2593	2.713
19.70	2389	1480	1398	3787	1195	4073	2593	2.709
19.80	2393	1478	1400	3793	1196	4075	2597	2.709
19.90	2393	1477	1402	3794	1196	4075	2598	2.707
20.00	2393	1473	1405	3798	1197	4075	2602	2.703

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Project Name: Taylor Geo-Engineering
Project Number: M00991-001
Sample: CH-1-3
Comments: Samples were compacted to 90% of ASTM D698 at
Test Number: S2

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Axial strain, ε (%)	nd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
0.00	-14	0	5760	5746	-7	5753	5753	1.002
0.02	225	59	5701	5927	113	5872	5814	1.040
0.04	391	112	5647	6038	195	5955	5842	1.069
0.06	508	158	5602	6109	254	6014	5855	1.091
0.08	599	200	5559	6158	300	6059	5859	1.108
0.10	677	240	5520	6197	339	6098	5858	1.123
0.20	937	379	5380	6317	468	6228	5848	1.174
0.30	1113	500	5260	6373	557	6316	5816	1.212
0.40	1254	625	5134	6389	627	6387	5761	1.244
0.50	1370	743	5017	6387	685	6444	5702	1.273
0.60	1467	856	4903	6371	734	6493	5637	1.299
0.70	1556	957	4803	6359	778	6538	5581	1.324
0.80	1636	1060	4699	6335	818	6577	5517	1.348
0.90	1707	1158	4602	6310	854	6615	5456	1.371
1.00	1779	1252	4508	6286	889	6649	5397	1.395
1.10	1841	1336	4423	6264	920	6680	5344	1.416
1.20	1895	1417	4342	6237	947	6707	5290	1.436
1.30	1944	1492	4268	6211	972	6731	5239	1.455
1.40	1993	1562	4198	6191	996	6757	5195	1.475
1.50	2042	1630	4129	6171	1021	6781	5150	1.494
1.60	2086	1696	4064	6150	1043	6803	5107	1.513
1.70	2122	1754	4006	6129	1061	6822	5068	1.530
1.80	2158	1808	3951	6110	1079	6839	5030	1.546
1.90	2198	1860	3901	6099	1099	6860	5000	1.564
2.00	2234	1910	3849	6083	1117	6877	4966	1.580
2.10	2270	1959	3800	6070	1135	6894	4935	1.597
2.20	2297	2007	3752	6049	1148	6908	4901	1.612
2.30	2328	2054	3705	6033	1164	6924	4869	1.628
2.40	2363	2100	3661	6024	1182	6942	4843	1.646
2.50	2390	2142	3619	6009	1195	6956	4814	1.661
2.60	2421	2183	3577	5998	1211	6970	4787	1.677
2.70	2448	2221	3539	5987	1224	6984	4763	1.692
2.80	2475	2256	3504	5979	1237	6997	4741	1.706
2.90	2493	2289	3471	5964	1246	7006	4718	1.718
3.00	2519	2325	3435	5954	1260	7019	4695	1.733
3.10	2546	2359	3401	5947	1273	7033	4674	1.749
3.20	2564	2389	3370	5934	1282	7042	4652	1.761
3.30	2582	2423	3338	5919	1291	7052	4629	1.774
3.40	2604	2456	3304	5908	1302	7062	4606	1.788
3.50	2622	2489	3271	5893	1311	7071	4582	1.802
3.60	2640	2522	3239	5879	1320	7081	4559	1.815
3.70	2653	2551	3209	5862	1327	7086	4535	1.827
3.80	2667	2588	3171	5838	1333	7093	4505	1.841
3.90	2685	2612	3149	5834	1342	7103	4491	1.853
4.00	2694	2633	3127	5821	1347	7107	4474	1.862
4.10	2707	2657	3102	5810	1354	7113	4456	1.873
4.20	2717	2680	3080	5797	1358	7118	4438	1.882
4.30	2730	2702	3058	5788	1365	7125	4423	1.893
4.40	2739	2725	3034	5774	1370	7129	4404	1.903
4.50	2757	2745	3014	5771	1378	7138	4393	1.915
4.60	2770	2768	2992	5762	1385	7145	4377	1.926
4.70	2779	2786	2973	5753	1390	7149	4363	1.935
4.80	2788	2799	2960	5749	1394	7154	4355	1.942
4.90	2802	2819	2941	5742	1401	7160	4341	1.953
5.00	2806	2840	2920	5726	1403	7163	4323	1.961
5.10	2820	2858	2902	5722	1410	7169	4312	1.972
5.20	2829	2876	2884	5713	1414	7175	4299	1.981

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
5.30	2842	2894	2866	5707	1421	7180	4286	1.992
5.40	2846	2912	2849	5696	1423	7184	4272	1.999
5.50	2860	2930	2831	5690	1430	7191	4260	2.010
5.60	2873	2947	2813	5686	1436	7196	4249	2.021
5.70	2886	2963	2797	5682	1443	7202	4239	2.032
5.80	2898	2978	2781	5680	1449	7209	4231	2.042
5.90	2911	2995	2765	5676	1456	7215	4221	2.053
6.00	2924	3011	2749	5673	1462	7222	4211	2.064
6.10	2933	3026	2732	5665	1467	7225	4199	2.074
6.20	2946	3043	2718	5664	1473	7234	4191	2.084
6.30	2959	3054	2705	5664	1479	7239	4184	2.094
6.40	2971	3069	2691	5662	1486	7245	4177	2.104
6.50	2980	3080	2679	5659	1490	7250	4169	2.112
6.60	2988	3094	2667	5655	1494	7255	4161	2.121
6.70	3001	3108	2651	5652	1501	7260	4152	2.132
6.80	3010	3122	2638	5648	1505	7266	4143	2.141
6.90	3018	3135	2624	5643	1509	7269	4133	2.150
7.00	3027	3148	2611	5638	1513	7273	4125	2.159
7.10	3035	3162	2597	5633	1518	7277	4115	2.169
7.20	3044	3175	2585	5628	1522	7281	4106	2.178
7.30	3048	3188	2572	5620	1524	7284	4096	2.185
7.40	3052	3201	2560	5612	1526	7287	4086	2.192
7.50	3061	3213	2547	5608	1530	7290	4077	2.202
7.60	3065	3223	2537	5602	1533	7292	4069	2.208
7.70	3069	3235	2525	5594	1535	7294	4060	2.216
7.80	3074	3247	2513	5587	1537	7296	4050	2.223
7.90	3074	3257	2503	5577	1537	7297	4040	2.228
8.00	3082	3270	2490	5572	1541	7301	4031	2.238
8.10	3091	3281	2479	5570	1545	7305	4024	2.247
8.20	3091	3290	2471	5562	1545	7306	4016	2.251
8.30	3099	3300	2459	5558	1550	7309	4009	2.260
8.40	3103	3311	2450	5553	1552	7312	4001	2.267
8.50	3107	3320	2439	5547	1554	7313	3993	2.274
8.60	3111	3330	2431	5543	1556	7317	3987	2.280
8.70	3112	3339	2422	5533	1556	7317	3978	2.285
8.80	3120	3348	2411	5531	1560	7319	3971	2.294
8.90	3128	3358	2403	5531	1564	7325	3967	2.302
9.00	3132	3366	2394	5526	1566	7326	3960	2.308
9.10	3140	3377	2383	5523	1570	7330	3953	2.318
9.20	3148	3386	2374	5522	1574	7334	3948	2.326
9.30	3156	3394	2366	5522	1578	7338	3944	2.334
9.40	3168	3402	2357	5525	1584	7344	3941	2.344
9.50	3176	3412	2348	5524	1588	7347	3936	2.353
9.60	3188	3421	2339	5526	1594	7353	3932	2.363
9.70	3196	3429	2330	5526	1598	7357	3928	2.371
9.80	3199	3437	2323	5523	1600	7360	3923	2.377
9.90	3207	3446	2314	5521	1604	7363	3918	2.386
10.00	3215	3453	2308	5523	1608	7368	3916	2.393
10.10	3219	3463	2296	5515	1610	7369	3906	2.402
10.20	3231	3473	2287	5518	1615	7375	3902	2.413
10.30	3234	3483	2277	5511	1617	7377	3894	2.421
10.40	3238	3490	2270	5508	1619	7379	3889	2.427
10.50	3242	3500	2260	5502	1621	7381	3881	2.434
10.60	3246	3507	2253	5499	1623	7382	3876	2.441
10.70	3250	3516	2244	5493	1625	7384	3868	2.448
10.80	3253	3524	2237	5490	1627	7387	3863	2.454
10.90	3253	3532	2227	5480	1627	7386	3854	2.461
11.00	3257	3539	2220	5477	1628	7388	3849	2.467
11.10	3260	3548	2212	5473	1630	7390	3842	2.474
11.20	3260	3556	2205	5465	1630	7391	3835	2.479
11.30	3264	3564	2196	5460	1632	7392	3828	2.487
11.40	3268	3571	2189	5456	1634	7393	3822	2.493
11.50	3267	3579	2180	5448	1634	7393	3814	2.499
11.60	3271	3586	2175	5446	1636	7396	3810	2.505

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
11.70	3275	3593	2166	5441	1637	7397	3804	2.512
11.80	3274	3600	2159	5434	1637	7397	3797	2.516
11.90	3278	3607	2152	5430	1639	7399	3791	2.523
12.00	3278	3614	2145	5423	1639	7399	3784	2.528
12.10	3274	3621	2138	5412	1637	7396	3775	2.531
12.20	3277	3627	2132	5410	1639	7398	3771	2.537
12.30	3277	3634	2127	5403	1638	7399	3765	2.541
12.40	3284	3647	2114	5398	1642	7403	3756	2.554
12.50	3284	3659	2101	5385	1642	7402	3743	2.563
12.60	3291	3665	2095	5386	1646	7405	3741	2.571
12.70	3295	3671	2089	5384	1647	7407	3736	2.577
12.80	3302	3676	2083	5385	1651	7410	3734	2.585
12.90	3305	3679	2081	5386	1653	7412	3734	2.588
13.00	3312	3679	2082	5394	1656	7417	3738	2.591
13.10	3320	3676	2083	5403	1660	7419	3743	2.593
13.20	3323	3676	2084	5407	1661	7422	3746	2.594
13.30	3330	3676	2084	5414	1665	7426	3749	2.598
13.40	3341	3680	2080	5421	1670	7430	3750	2.606
13.50	3344	3686	2074	5418	1672	7432	3746	2.613
13.60	3347	3688	2072	5419	1674	7433	3745	2.616
13.70	3351	3693	2067	5418	1675	7435	3742	2.621
13.80	3358	3696	2065	5422	1679	7440	3743	2.626
13.90	3361	3701	2059	5420	1681	7440	3739	2.633
14.00	3364	3704	2055	5419	1682	7442	3737	2.637
14.10	3364	3709	2052	5415	1682	7443	3733	2.639
14.20	3367	3714	2047	5414	1683	7444	3730	2.645
14.30	3374	3719	2041	5415	1687	7446	3728	2.653
14.40	3373	3723	2036	5410	1687	7446	3723	2.656
14.50	3376	3728	2032	5408	1688	7448	3720	2.662
14.60	3376	3731	2029	5405	1688	7449	3717	2.663
14.70	3379	3735	2025	5403	1689	7449	3714	2.669
14.80	3378	3738	2021	5399	1689	7449	3710	2.671
14.90	3377	3743	2018	5395	1689	7450	3706	2.674
15.00	3377	3747	2013	5390	1688	7448	3701	2.678
15.10	3380	3749	2011	5391	1690	7450	3701	2.681
15.20	3376	3753	2007	5383	1688	7447	3695	2.682
15.30	3379	3755	2005	5383	1689	7449	3694	2.685
15.40	3374	3760	2000	5374	1687	7447	3687	2.687
15.50	3374	3764	1997	5370	1687	7448	3683	2.690
15.60	3373	3768	1993	5366	1686	7447	3680	2.692
15.70	3372	3772	1988	5361	1686	7447	3674	2.696
15.80	3368	3776	1984	5352	1684	7444	3668	2.698
15.90	3367	3779	1981	5348	1684	7444	3665	2.699
16.00	3374	3783	1978	5352	1687	7448	3665	2.706
16.10	3377	3785	1974	5351	1688	7448	3663	2.710
16.20	3380	3786	1974	5354	1690	7451	3664	2.712
16.30	3382	3790	1971	5353	1691	7452	3662	2.716
16.40	3385	3791	1969	5354	1693	7452	3661	2.720
16.50	3392	3794	1966	5358	1696	7456	3662	2.725
16.60	3395	3796	1964	5358	1697	7457	3661	2.729
16.70	3397	3797	1963	5360	1699	7458	3661	2.731
16.80	3404	3799	1960	5364	1702	7462	3662	2.736
16.90	3407	3801	1959	5366	1703	7463	3662	2.739
17.00	3413	3802	1958	5371	1707	7466	3664	2.743
17.10	3419	3802	1959	5378	1710	7471	3669	2.745
17.20	3426	3804	1956	5381	1713	7472	3668	2.752
17.30	3428	3806	1954	5383	1714	7475	3669	2.754
17.40	3435	3806	1953	5388	1717	7477	3671	2.758
17.50	3437	3806	1953	5391	1719	7478	3672	2.760
17.60	3436	3806	1953	5390	1718	7478	3672	2.759
17.70	3439	3808	1952	5391	1720	7479	3672	2.762
17.80	3442	3808	1952	5394	1721	7480	3673	2.763
17.90	3444	3809	1951	5395	1722	7482	3673	2.765
18.00	3443	3810	1950	5393	1722	7481	3671	2.766

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
18.10	3446	3812	1949	5394	1723	7484	3672	2.768
18.20	3441	3810	1950	5391	1721	7480	3670	2.765
18.30	3440	3811	1949	5389	1720	7480	3669	2.766
18.40	3439	3812	1947	5387	1720	7479	3667	2.766
18.50	3438	3812	1947	5386	1719	7479	3667	2.766
18.60	3441	3813	1946	5387	1720	7480	3667	2.768
18.70	3436	3811	1950	5386	1718	7479	3668	2.762
18.80	3435	3810	1950	5385	1718	7477	3667	2.762
18.90	3431	3808	1952	5383	1715	7475	3667	2.757
19.00	3433	3808	1952	5385	1717	7476	3669	2.759
19.10	3432	3805	1954	5386	1716	7476	3670	2.756
19.20	3434	3804	1956	5390	1717	7477	3673	2.756
19.30	3430	3799	1961	5391	1715	7476	3676	2.749
19.40	3436	3797	1963	5398	1718	7478	3681	2.751
19.50	3442	3795	1966	5408	1721	7482	3687	2.750
19.60	3444	3791	1969	5413	1722	7482	3691	2.750
19.70	3446	3788	1972	5418	1723	7483	3695	2.748
19.80	3449	3785	1974	5423	1724	7484	3699	2.747
19.90	3455	3785	1974	5429	1727	7487	3702	2.750
20.00	3460	3782	1978	5438	1730	7490	3708	2.750

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Project Name: Taylor Geo-Engineering
Project Number: M00991-001
Sample: CH-1-3
Comments: Samples were compacted to 90% of ASTM D698 at
Test Number: S3

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
0.00	-29	0	11518	11488	-15	11503	11503	1.003
0.02	344	61	11457	11801	172	11690	11629	1.030
0.04	614	124	11393	12008	307	11825	11701	1.054
0.06	824	180	11337	12161	412	11929	11749	1.073
0.08	1011	238	11280	12290	505	12023	11785	1.090
0.10	1155	286	11232	12387	577	12095	11809	1.103
0.20	1689	511	11008	12697	845	12364	11853	1.153
0.30	2055	718	10801	12855	1027	12546	11828	1.190
0.40	2350	946	10572	12922	1175	12693	11747	1.222
0.50	2593	1160	10358	12951	1297	12815	11655	1.250
0.60	2808	1369	10149	12957	1404	12922	11553	1.277
0.70	2995	1564	9954	12949	1498	13016	11452	1.301
0.80	3182	1757	9761	12942	1591	13109	11352	1.326
0.90	3344	1940	9578	12923	1672	13190	11250	1.349
1.00	3493	2114	9404	12897	1747	13264	11150	1.371
1.10	3632	2283	9235	12867	1816	13334	11051	1.393
1.20	3762	2441	9078	12840	1881	13400	10959	1.414
1.30	3882	2586	8932	12814	1941	13459	10873	1.435
1.40	4002	2727	8791	12793	2001	13519	10792	1.455
1.50	4108	2860	8658	12766	2054	13572	10712	1.474
1.60	4209	2984	8532	12741	2105	13621	10637	1.493
1.70	4305	3103	8415	12720	2153	13671	10568	1.512
1.80	4401	3184	8333	12734	2201	13718	10534	1.528
1.90	4492	3292	8227	12719	2246	13765	10473	1.546
2.00	4574	3406	8113	12687	2287	13806	10400	1.564
2.10	4661	3536	7982	12643	2330	13848	10312	1.584
2.20	4738	3653	7865	12602	2369	13887	10234	1.602
2.30	4815	3760	7758	12573	2407	13925	10165	1.621
2.40	4891	3858	7660	12551	2446	13963	10105	1.639
2.50	4959	3952	7566	12525	2479	13997	10045	1.655
2.60	5026	4039	7478	12504	2513	14031	9991	1.672
2.70	5097	4123	7396	12494	2549	14068	9945	1.689
2.80	5160	4205	7313	12473	2580	14098	9893	1.706
2.90	5222	4280	7238	12460	2611	14129	9849	1.721
3.00	5275	4350	7168	12443	2638	14155	9806	1.736
3.10	5328	4413	7105	12433	2664	14182	9769	1.750
3.20	5386	4473	7044	12429	2693	14209	9737	1.765
3.30	5438	4545	6972	12410	2719	14237	9691	1.780
3.40	5486	4612	6906	12392	2743	14261	9649	1.794
3.50	5530	4675	6843	12373	2765	14284	9608	1.808
3.60	5578	4739	6779	12357	2789	14306	9568	1.823
3.70	5616	4798	6721	12337	2808	14327	9529	1.836
3.80	5659	4857	6661	12320	2830	14347	9490	1.850
3.90	5698	4912	6606	12304	2849	14367	9455	1.863
4.00	5736	4964	6554	12291	2868	14386	9422	1.875
4.10	5775	5015	6503	12277	2887	14405	9390	1.888
4.20	5818	5065	6452	12270	2909	14426	9361	1.902
4.30	5851	5112	6405	12257	2926	14443	9331	1.913
4.40	5885	5156	6362	12247	2943	14460	9305	1.925
4.50	5918	5198	6320	12238	2959	14477	9279	1.936
4.60	5956	5238	6280	12236	2978	14496	9258	1.948
4.70	5985	5275	6243	12228	2993	14510	9235	1.959
4.80	6023	5308	6210	12233	3012	14529	9221	1.970
4.90	6052	5341	6177	12229	3026	14544	9203	1.980
5.00	6085	5371	6147	12232	3043	14560	9189	1.990
5.10	6109	5400	6117	12226	3055	14572	9172	1.999
5.20	6138	5426	6092	12229	3069	14587	9160	2.008

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
5.30	6166	5464	6054	12220	3083	14601	9137	2.019
5.40	6199	5498	6021	12220	3100	14618	9121	2.030
5.50	6227	5533	5984	12211	3114	14630	9097	2.041
5.60	6256	5569	5949	12204	3128	14645	9076	2.052
5.70	6284	5598	5919	12203	3142	14659	9061	2.062
5.80	6312	5626	5891	12203	3156	14674	9047	2.071
5.90	6340	5653	5864	12204	3170	14688	9034	2.081
6.00	6372	5680	5837	12210	3186	14704	9024	2.092
6.10	6400	5706	5812	12212	3200	14718	9012	2.101
6.20	6419	5732	5786	12205	3210	14727	8995	2.109
6.30	6447	5752	5766	12213	3223	14741	8989	2.118
6.40	6474	5774	5744	12218	3237	14755	8981	2.127
6.50	6498	5795	5723	12220	3249	14767	8972	2.135
6.60	6521	5816	5702	12222	3260	14778	8962	2.144
6.70	6544	5835	5683	12227	3272	14790	8955	2.152
6.80	6567	5850	5668	12235	3284	14801	8951	2.159
6.90	6586	5866	5651	12237	3293	14810	8944	2.165
7.00	6600	5881	5637	12237	3300	14818	8937	2.171
7.10	6614	5895	5624	12238	3307	14826	8931	2.176
7.20	6632	5907	5610	12243	3316	14834	8926	2.182
7.30	6651	5920	5597	12248	3325	14843	8923	2.188
7.40	6665	5932	5586	12250	3332	14850	8918	2.193
7.50	6679	5944	5575	12254	3339	14858	8914	2.198
7.60	6693	5959	5560	12253	3346	14865	8906	2.204
7.70	6707	5968	5549	12256	3353	14871	8903	2.209
7.80	6721	5978	5540	12260	3360	14878	8900	2.213
7.90	6734	5987	5531	12265	3367	14885	8898	2.218
8.00	6748	5998	5520	12268	3374	14892	8894	2.222
8.10	6757	5996	5521	12279	3379	14896	8900	2.224
8.20	6763	5999	5519	12281	3381	14899	8900	2.225
8.30	6772	6002	5515	12287	3386	14904	8901	2.228
8.40	6785	6016	5502	12288	3393	14912	8895	2.233
8.50	6795	6027	5491	12285	3397	14915	8888	2.238
8.60	6804	6039	5479	12283	3402	14920	8881	2.242
8.70	6813	6049	5470	12283	3407	14925	8876	2.246
8.80	6827	6059	5459	12286	3413	14931	8872	2.250
8.90	6831	6068	5450	12281	3416	14933	8865	2.254
9.00	6845	6077	5440	12285	3422	14940	8863	2.258
9.10	6850	6083	5435	12284	3425	14942	8859	2.260
9.20	6854	6090	5428	12282	3427	14945	8855	2.263
9.30	6872	6096	5423	12295	3436	14955	8859	2.267
9.40	6881	6101	5417	12298	3440	14958	8857	2.270
9.50	6890	6108	5411	12301	3445	14964	8856	2.273
9.60	6899	6114	5404	12303	3449	14967	8853	2.277
9.70	6907	6118	5401	12308	3454	14972	8854	2.279
9.80	6912	6122	5396	12308	3456	14974	8852	2.281
9.90	6925	6122	5397	12322	3462	14981	8860	2.283
10.00	6934	6126	5392	12326	3467	14986	8859	2.286
10.10	6947	6129	5389	12335	3473	14991	8862	2.289
10.20	6951	6129	5389	12340	3476	14993	8864	2.290
10.30	6955	6129	5389	12344	3478	14995	8867	2.291
10.40	6968	6131	5387	12355	3484	15002	8871	2.294
10.50	6973	6132	5385	12358	3486	15004	8872	2.295
10.60	6977	6126	5391	12368	3488	15006	8880	2.294
10.70	6985	6125	5392	12378	3493	15010	8885	2.295
10.80	6985	6122	5396	12381	3493	15010	8889	2.295
10.90	6994	6130	5389	12383	3497	15016	8886	2.298
11.00	6998	6136	5383	12381	3499	15018	8882	2.300
11.10	7002	6142	5377	12379	3501	15020	8878	2.302
11.20	7006	6146	5371	12378	3503	15021	8874	2.304
11.30	7011	6155	5363	12374	3505	15023	8868	2.307
11.40	7015	6160	5357	12372	3507	15025	8865	2.309
11.50	7010	6164	5354	12364	3505	15023	8859	2.309
11.60	7015	6171	5347	12361	3507	15025	8854	2.312

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
11.70	7019	6176	5342	12361	3509	15027	8851	2.314
11.80	7023	6178	5341	12363	3511	15030	8852	2.315
11.90	7027	6183	5335	12362	3513	15031	8848	2.317
12.00	7031	6186	5331	12362	3515	15033	8847	2.319
12.10	7030	6189	5330	12361	3515	15034	8845	2.319
12.20	7030	6191	5327	12357	3515	15033	8842	2.320
12.30	7038	6193	5324	12363	3519	15037	8844	2.322
12.40	7034	6197	5321	12355	3517	15035	8838	2.322
12.50	7038	6197	5322	12360	3519	15038	8841	2.322
12.60	7046	6197	5321	12366	3523	15040	8844	2.324
12.70	7045	6197	5321	12366	3523	15040	8844	2.324
12.80	7045	6196	5322	12367	3522	15040	8845	2.324
12.90	7045	6196	5322	12367	3522	15040	8844	2.324
13.00	7048	6196	5322	12370	3524	15042	8846	2.324
13.10	7048	6194	5323	12371	3524	15042	8847	2.324
13.20	7056	6196	5323	12379	3528	15047	8851	2.325
13.30	7059	6193	5324	12384	3530	15047	8854	2.326
13.40	7059	6193	5324	12383	3529	15047	8854	2.326
13.50	7062	6191	5327	12389	3531	15049	8858	2.326
13.60	7070	6190	5328	12398	3535	15053	8863	2.327
13.70	7073	6189	5330	12404	3537	15055	8867	2.327
13.80	7073	6189	5329	12402	3537	15054	8866	2.327
13.90	7080	6187	5330	12411	3540	15058	8871	2.328
14.00	7088	6184	5334	12422	3544	15062	8878	2.329
14.10	7091	6184	5334	12425	3546	15063	8879	2.330
14.20	7091	6183	5336	12427	3545	15064	8881	2.329
14.30	7094	6184	5334	12428	3547	15065	8881	2.330
14.40	7093	6178	5340	12433	3547	15064	8886	2.328
14.50	7101	6179	5339	12439	3550	15068	8889	2.330
14.60	7100	6180	5337	12437	3550	15068	8887	2.330
14.70	7107	6180	5337	12444	3554	15071	8891	2.332
14.80	7106	6183	5335	12441	3553	15071	8888	2.332
14.90	7106	6182	5336	12442	3553	15070	8889	2.332
15.00	7105	6182	5336	12441	3552	15070	8889	2.331
15.10	7104	6182	5336	12440	3552	15070	8888	2.331
15.20	7111	6184	5334	12445	3556	15073	8889	2.333
15.30	7102	6185	5333	12435	3551	15069	8884	2.332
15.40	7094	6183	5335	12429	3547	15064	8882	2.330
15.50	7101	6185	5333	12433	3550	15068	8883	2.332
15.60	7100	6187	5331	12431	3550	15069	8881	2.332
15.70	7103	6189	5329	12432	3551	15069	8880	2.333
15.80	7106	6189	5329	12435	3553	15070	8882	2.333
15.90	7101	6190	5328	12429	3550	15068	8878	2.333
16.00	7100	6192	5326	12425	3550	15068	8876	2.333
16.10	7103	6191	5327	12429	3551	15069	8878	2.333
16.20	7098	6193	5324	12422	3549	15067	8873	2.333
16.30	7097	6196	5322	12419	3548	15066	8871	2.333
16.40	7100	6198	5320	12419	3550	15067	8870	2.335
16.50	7095	6200	5317	12412	3547	15065	8865	2.334
16.60	7094	6204	5314	12407	3547	15064	8861	2.335
16.70	7092	6208	5310	12403	3546	15065	8857	2.336
16.80	7091	6211	5307	12398	3546	15063	8853	2.336
16.90	7086	6216	5302	12389	3543	15061	8845	2.337
17.00	7089	6219	5300	12389	3545	15063	8844	2.338
17.10	7092	6224	5294	12386	3546	15064	8840	2.340
17.20	7091	6230	5288	12379	3545	15063	8833	2.341
17.30	7086	6231	5287	12372	3543	15060	8830	2.340
17.40	7088	6234	5283	12372	3544	15062	8828	2.342
17.50	7087	6238	5281	12368	3543	15062	8825	2.342
17.60	7089	6241	5276	12366	3545	15062	8821	2.344
17.70	7092	6246	5272	12364	3546	15064	8818	2.345
17.80	7087	6247	5271	12357	3543	15061	8814	2.345
17.90	7093	6251	5267	12360	3547	15064	8814	2.347
18.00	7096	6252	5267	12363	3548	15067	8815	2.347

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
18.10	7094	6252	5266	12360	3547	15065	8813	2.347
18.20	7097	6258	5260	12357	3548	15066	8808	2.349
18.30	7095	6261	5257	12352	3548	15065	8804	2.350
18.40	7094	6264	5254	12348	3547	15065	8801	2.350
18.50	7096	6268	5250	12346	3548	15066	8798	2.352
18.60	7091	6266	5252	12343	3546	15063	8797	2.350
18.70	7090	6271	5247	12337	3545	15062	8792	2.351
18.80	7092	6273	5245	12337	3546	15064	8791	2.352
18.90	7094	6276	5242	12336	3547	15066	8789	2.353
19.00	7089	6280	5238	12326	3544	15062	8782	2.353
19.10	7087	6285	5233	12320	3544	15061	8777	2.354
19.20	7082	6287	5232	12314	3541	15060	8773	2.354
19.30	7080	6317	5201	12282	3540	15059	8742	2.361
19.40	7082	6327	5191	12273	3541	15059	8732	2.364
19.50	7081	6322	5197	12277	3540	15059	8737	2.363
19.60	7075	6309	5210	12285	3538	15056	8747	2.358
19.70	7074	6289	5228	12302	3537	15054	8765	2.353
19.80	7064	6272	5247	12312	3532	15051	8779	2.346
19.90	7063	6258	5261	12324	3531	15050	8793	2.342
20.00	7065	6249	5269	12334	3532	15051	8802	2.341

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Isotropically Consolidated Undrained with Pore Pressure (CIU/PP)

Project Name: Taylor Geo-Engineering

Project Number: M00991-001

Sample: CH-5-48

Comments: Samples were compacted to 90% of ASTM D698 at OMC.

	Test Number	S1	S2	S3	
Initial	Height, H (in)	4.21	4.10	4.08	
	Diameter, D (in)	1.93	1.93	1.93	
	Moisture Content, w (%)	19.8	19.8	19.8	
	Dry Unit Weight, γd (pcf)	90.1	89.9	90.1	
	Saturation (%)	66.1	67.1	69.2	
	Void Ratio, e	0.81	0.84	0.81	
Before Shear	Moisture Content, w (%)	27.0	26.5	23.8	
	Dry Unit Weight, γd (pcf)	96.4	97.1	101.4	
	Saturation (%)	100.0	100.0	100.0	
	Void Ratio, e	0.73	0.72	0.64	
	B	0.95	0.95	0.95	
	Back pressure (psf)	17430	4434.1	4751.5	
	Strain rate (%/min)	0.033	0.033	0.033	
	Time to Failure (min)	590.9	509.1	584.8	
Total Stress	Strain at Failure, εf (%)	19.50	16.80	19.30	
	σ3 (psf)	2879	5763	11524	
	σ1-σ3 (psf)	2392	4023	7276	
	σ1 (psf)	5271	9786	18799	
	q = (σ1-σ3)/2 (psf)	1196	2012	3638	
	p = (σ1+σ3)/2 (psf)	4075	7775	15161	
Effective Stress	u (psf)	1332	3013	5413	
	σ'3 (psf)	1547	2750	6110	
	σ'1-σ'3 (psf)	2392	4023	7276	
	σ'1 (psf)	3939	6773	13386	
	q = (σ'1-σ'3)/2 (psf)	1196	2012	3638	
	p' = (σ'1+σ'3)/2 (psf)	2743	4761	9748	
	σ'1/σ'3	2.55	2.46	2.19	
	A = u/(σ1-σ3)	0.557	0.749	0.744	

Estimated Specific Gravity	2.70
Plastic Limit (%)	23
Liquid Limit (%)	61
Plasticity Index (%)	38

Summary of Strength Paramaters	Total Stress	Effective Stress
c (psf)	306	321
ϕ (deg)	12.7	20.1
tan ϕ	0.226	0.367

[a] Saturation set to 100% for phase calculations

Tested by: _____

Reviewed: _____

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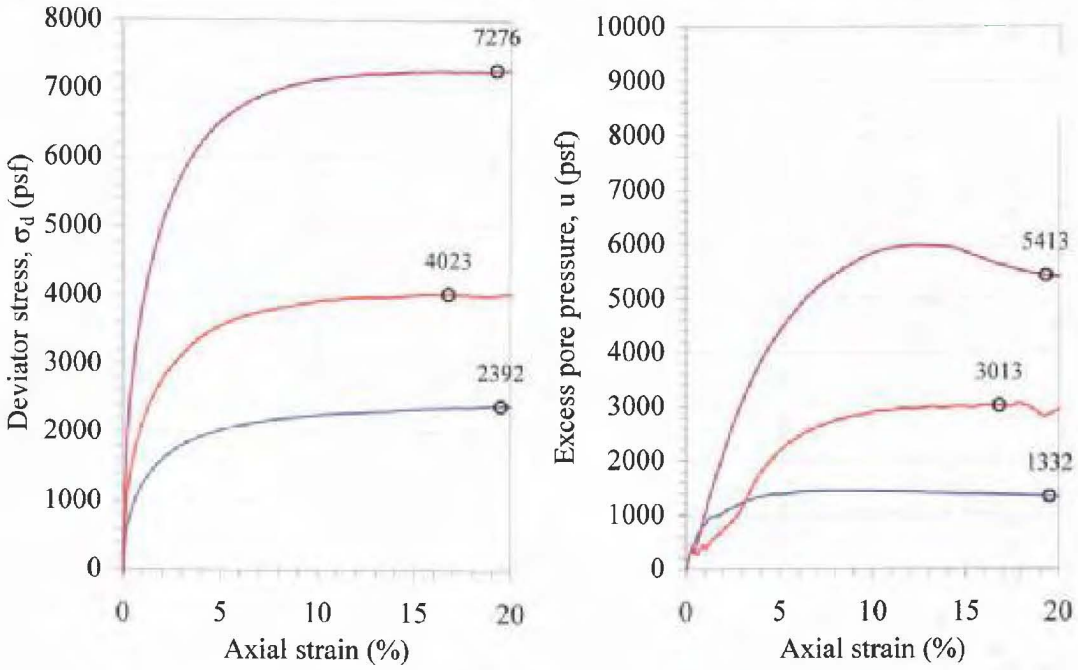
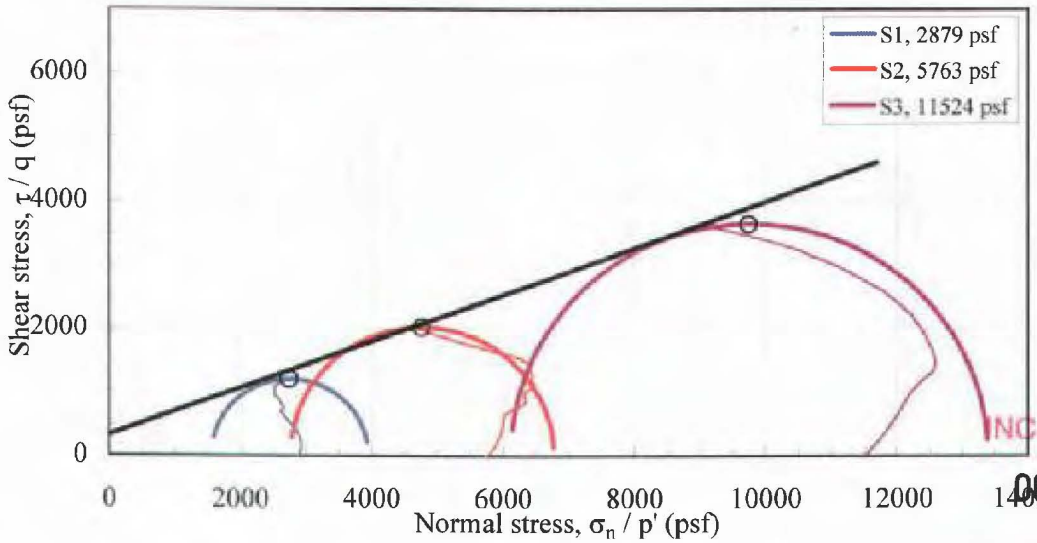
Isotropically Consolidated Undrained with Pore Pressure (CIU/PP)

Project Name: Taylor Geo-Engineering
Project Number: M00991-001
Sample: CH-5-48
Comments:

Summary of Strength Paramaters	Total Stress	Effective Stress
c (psf)	306	321
ϕ (deg)	12.7	20.1
tan ϕ	0.226	0.367





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Project Name: Taylor Geo-Engineering
Project Number: M00991-001
Sample: CH-5-48
Comments: Samples were compacted to 90% of ASTM D698 at
Test Number: S1

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
0.00	-4	0	2879	2875	-2	2877	2877	1.001
0.02	190	56	2823	3013	95	2974	2918	1.067
0.04	267	98	2782	3049	134	3014	2916	1.096
0.06	339	134	2746	3084	169	3048	2915	1.123
0.08	397	165	2714	3111	198	3077	2912	1.146
0.10	448	193	2686	3134	224	3103	2910	1.167
0.20	628	307	2572	3200	314	3193	2886	1.244
0.30	749	399	2480	3229	375	3254	2854	1.302
0.40	851	483	2397	3248	426	3305	2822	1.355
0.50	933	560	2319	3253	467	3346	2786	1.403
0.60	1016	629	2250	3266	508	3387	2758	1.451
0.70	1085	698	2181	3266	542	3421	2723	1.497
0.80	1141	751	2130	3270	570	3451	2700	1.536
0.90	1197	799	2081	3278	598	3479	2680	1.575
1.00	1246	843	2037	3283	623	3503	2660	1.612
1.10	1289	885	1995	3284	645	3525	2639	1.646
1.20	1332	922	1959	3291	666	3546	2625	1.680
1.30	1375	957	1922	3298	688	3567	2610	1.716
1.40	1412	963	1916	3328	706	3585	2622	1.737
1.50	1448	956	1923	3371	724	3603	2647	1.753
1.60	1478	969	1910	3388	739	3618	2649	1.774
1.70	1514	990	1889	3403	757	3636	2646	1.801
1.80	1544	1013	1866	3410	772	3651	2638	1.827
1.90	1573	1035	1844	3417	787	3666	2630	1.853
2.00	1597	1055	1824	3420	798	3677	2622	1.875
2.10	1626	1078	1803	3429	813	3693	2616	1.902
2.20	1649	1097	1783	3432	825	3705	2607	1.925
2.30	1672	1114	1766	3439	836	3716	2603	1.947
2.40	1689	1124	1755	3444	845	3724	2599	1.963
2.50	1712	1133	1745	3458	856	3734	2602	1.981
2.60	1735	1154	1725	3461	868	3747	2593	2.006
2.70	1752	1170	1709	3461	876	3755	2585	2.025
2.80	1768	1191	1689	3457	884	3764	2573	2.047
2.90	1785	1204	1676	3461	892	3773	2569	2.065
3.00	1807	1218	1662	3470	904	3784	2566	2.087
3.10	1818	1232	1647	3465	909	3788	2556	2.104
3.20	1834	1247	1632	3466	917	3796	2549	2.124
3.30	1851	1259	1620	3471	925	3804	2545	2.142
3.40	1861	1272	1607	3468	930	3809	2538	2.158
3.50	1871	1285	1594	3465	935	3814	2530	2.173
3.60	1887	1295	1584	3471	944	3823	2527	2.192
3.70	1897	1305	1574	3471	949	3828	2523	2.205
3.80	1907	1313	1566	3473	954	3833	2520	2.218
3.90	1923	1322	1556	3479	962	3840	2517	2.236
4.00	1933	1329	1550	3483	967	3846	2516	2.247
4.10	1943	1336	1544	3487	971	3852	2515	2.259
4.20	1953	1343	1536	3489	977	3856	2512	2.272
4.30	1963	1350	1530	3493	981	3862	2511	2.283
4.40	1973	1356	1523	3496	986	3865	2509	2.295
4.50	1983	1361	1518	3501	991	3870	2509	2.306
4.60	1992	1366	1513	3506	996	3875	2510	2.316
4.70	2002	1370	1510	3512	1001	3881	2511	2.326
4.80	2012	1372	1508	3519	1006	3885	2514	2.334
4.90	2015	1370	1509	3524	1008	3887	2516	2.336
5.00	2025	1369	1510	3535	1013	3892	2522	2.341
5.10	2035	1375	1505	3540	1017	3898	2523	2.352
5.20	2044	1381	1499	3544	1022	3902	2522	2.363

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
5.30	2048	1386	1495	3542	1024	3904	2519	2.370
5.40	2051	1391	1489	3540	1026	3906	2514	2.378
5.50	2061	1395	1484	3545	1031	3910	2515	2.389
5.60	2064	1401	1478	3543	1032	3911	2511	2.396
5.70	2074	1405	1474	3548	1037	3916	2511	2.407
5.80	2077	1409	1470	3547	1039	3918	2509	2.413
5.90	2081	1414	1467	3547	1040	3921	2507	2.419
6.00	2096	1416	1463	3559	1048	3927	2511	2.433
6.10	2100	1420	1460	3559	1050	3929	2509	2.439
6.20	2109	1423	1456	3565	1055	3934	2511	2.449
6.30	2106	1424	1456	3562	1053	3933	2509	2.447
6.40	2122	1427	1454	3575	1061	3941	2515	2.460
6.50	2125	1429	1450	3575	1063	3942	2513	2.465
6.60	2128	1430	1450	3578	1064	3944	2514	2.468
6.70	2132	1431	1449	3581	1066	3946	2515	2.471
6.80	2135	1431	1449	3584	1067	3948	2516	2.473
6.90	2138	1432	1447	3585	1069	3948	2516	2.478
7.00	2147	1434	1447	3594	1074	3954	2520	2.484
7.10	2151	1434	1446	3596	1075	3954	2521	2.488
7.20	2154	1434	1447	3601	1077	3957	2524	2.489
7.30	2163	1434	1446	3609	1082	3961	2527	2.497
7.40	2166	1434	1446	3612	1083	3962	2529	2.499
7.50	2170	1435	1444	3614	1085	3964	2529	2.502
7.60	2173	1435	1444	3617	1086	3965	2531	2.504
7.70	2176	1435	1444	3620	1088	3967	2532	2.507
7.80	2185	1436	1443	3628	1093	3972	2536	2.514
7.90	2188	1436	1443	3631	1094	3973	2537	2.516
8.00	2185	1437	1442	3627	1093	3972	2535	2.515
8.10	2188	1437	1442	3630	1094	3973	2536	2.518
8.20	2197	1437	1443	3640	1099	3979	2542	2.523
8.30	2200	1437	1442	3642	1100	3979	2542	2.526
8.40	2204	1437	1442	3646	1102	3981	2544	2.528
8.50	2206	1437	1443	3650	1103	3983	2546	2.529
8.60	2210	1436	1443	3653	1105	3984	2548	2.531
8.70	2219	1436	1443	3662	1109	3988	2552	2.537
8.80	2216	1436	1443	3659	1108	3987	2551	2.535
8.90	2219	1436	1444	3663	1109	3990	2554	2.536
9.00	2222	1435	1444	3666	1111	3990	2555	2.538
9.10	2231	1434	1446	3676	1115	3994	2561	2.543
9.20	2228	1434	1446	3673	1114	3993	2559	2.541
9.30	2231	1434	1446	3676	1115	3994	2561	2.543
9.40	2233	1434	1447	3680	1117	3997	2563	2.544
9.50	2236	1432	1447	3683	1118	3997	2565	2.546
9.60	2239	1432	1447	3686	1120	3999	2566	2.548
9.70	2236	1432	1447	3683	1118	3997	2565	2.546
9.80	2245	1432	1448	3693	1123	4003	2570	2.551
9.90	2248	1432	1448	3696	1124	4004	2572	2.553
10.00	2251	1431	1449	3700	1125	4006	2574	2.553
10.10	2254	1430	1450	3704	1127	4007	2577	2.554
10.20	2257	1430	1450	3707	1128	4008	2578	2.556
10.30	2254	1429	1450	3704	1127	4006	2577	2.554
10.40	2262	1430	1450	3712	1131	4011	2581	2.560
10.50	2265	1429	1450	3715	1133	4012	2583	2.562
10.60	2262	1429	1451	3713	1131	4011	2582	2.559
10.70	2265	1429	1451	3716	1132	4013	2584	2.560
10.80	2268	1429	1451	3719	1134	4014	2585	2.562
10.90	2270	1429	1451	3722	1135	4015	2587	2.564
11.00	2273	1428	1451	3725	1137	4016	2588	2.566
11.10	2270	1428	1451	3722	1135	4014	2587	2.564
11.20	2273	1428	1451	3724	1137	4016	2588	2.566
11.30	2276	1428	1451	3727	1138	4017	2589	2.568
11.40	2278	1427	1453	3731	1139	4018	2592	2.569
11.50	2281	1425	1454	3735	1141	4020	2594	2.569
11.60	2284	1425	1454	3738	1142	4021	2596	2.571

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
11.70	2281	1424	1455	3736	1140	4020	2595	2.568
11.80	2284	1424	1455	3738	1142	4021	2597	2.570
11.90	2286	1422	1457	3743	1143	4022	2600	2.569
12.00	2289	1420	1460	3748	1144	4024	2604	2.568
12.10	2286	1417	1462	3748	1143	4022	2605	2.564
12.20	2288	1415	1465	3754	1144	4024	2610	2.562
12.30	2291	1414	1465	3757	1146	4025	2611	2.563
12.40	2294	1415	1464	3758	1147	4026	2611	2.567
12.50	2296	1414	1465	3762	1148	4027	2614	2.567
12.60	2299	1414	1465	3764	1149	4028	2615	2.569
12.70	2296	1411	1468	3764	1148	4027	2616	2.564
12.80	2298	1407	1474	3772	1149	4029	2623	2.560
12.90	2301	1402	1477	3778	1151	4030	2628	2.558
13.00	2303	1402	1477	3781	1152	4031	2629	2.559
13.10	2312	1401	1478	3790	1156	4035	2634	2.564
13.20	2309	1400	1479	3788	1154	4033	2634	2.560
13.30	2305	1400	1481	3786	1153	4033	2633	2.557
13.40	2308	1398	1481	3789	1154	4033	2635	2.559
13.50	2316	1397	1482	3798	1158	4037	2640	2.563
13.60	2319	1397	1482	3800	1159	4038	2641	2.565
13.70	2315	1396	1484	3799	1158	4038	2642	2.560
13.80	2318	1395	1484	3802	1159	4038	2643	2.562
13.90	2320	1395	1484	3805	1160	4039	2644	2.563
14.00	2323	1393	1487	3809	1161	4040	2648	2.563
14.10	2325	1390	1490	3815	1163	4043	2653	2.560
14.20	2328	1390	1489	3816	1164	4043	2653	2.563
14.30	2330	1389	1490	3820	1165	4044	2655	2.564
14.40	2332	1388	1491	3824	1166	4045	2657	2.564
14.50	2329	1387	1494	3823	1165	4045	2658	2.559
14.60	2337	1386	1494	3831	1169	4048	2662	2.565
14.70	2334	1384	1495	3829	1167	4046	2662	2.562
14.80	2342	1383	1496	3838	1171	4050	2667	2.566
14.90	2344	1383	1496	3840	1172	4051	2668	2.567
15.00	2346	1382	1497	3844	1173	4052	2670	2.567
15.10	2349	1382	1498	3847	1174	4055	2673	2.568
15.20	2345	1382	1498	3844	1173	4053	2671	2.566
15.30	2348	1381	1499	3847	1174	4054	2673	2.566
15.40	2350	1381	1498	3848	1175	4054	2673	2.569
15.50	2352	1380	1499	3852	1176	4055	2676	2.569
15.60	2355	1380	1499	3854	1177	4056	2677	2.570
15.70	2351	1379	1501	3852	1176	4055	2676	2.567
15.80	2359	1379	1502	3861	1180	4060	2681	2.571
15.90	2356	1376	1503	3859	1178	4057	2681	2.568
16.00	2358	1375	1504	3862	1179	4058	2683	2.568
16.10	2360	1375	1505	3865	1180	4060	2685	2.568
16.20	2362	1374	1505	3868	1181	4060	2687	2.570
16.30	2365	1374	1506	3871	1182	4063	2689	2.570
16.40	2361	1372	1508	3869	1181	4060	2688	2.566
16.50	2358	1370	1509	3867	1179	4058	2688	2.563
16.60	2360	1369	1510	3870	1180	4059	2690	2.563
16.70	2368	1368	1511	3879	1184	4063	2695	2.567
16.80	2365	1367	1512	3877	1182	4061	2695	2.564
16.90	2372	1364	1515	3887	1186	4065	2701	2.566
17.00	2369	1363	1517	3886	1184	4065	2701	2.561
17.10	2371	1362	1518	3889	1185	4066	2704	2.562
17.20	2367	1361	1519	3887	1184	4064	2703	2.558
17.30	2370	1359	1520	3890	1185	4064	2705	2.559
17.40	2372	1357	1522	3893	1186	4065	2708	2.559
17.50	2368	1356	1524	3892	1184	4064	2708	2.554
17.60	2371	1355	1524	3895	1185	4064	2709	2.556
17.70	2367	1354	1526	3893	1184	4064	2710	2.551
17.80	2369	1352	1528	3897	1185	4064	2712	2.551
17.90	2366	1352	1529	3895	1183	4063	2712	2.548
18.00	2368	1350	1529	3897	1184	4063	2713	2.549

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
18.10	2370	1349	1530	3900	1185	4064	2715	2.549
18.20	2372	1349	1530	3902	1186	4065	2716	2.550
18.30	2379	1348	1531	3910	1190	4069	2721	2.554
18.40	2376	1347	1533	3909	1188	4068	2721	2.549
18.50	2383	1346	1535	3918	1192	4072	2726	2.553
18.60	2385	1345	1536	3921	1192	4073	2728	2.553
18.70	2387	1343	1536	3923	1194	4073	2729	2.554
18.80	2389	1341	1538	3927	1194	4074	2733	2.553
18.90	2385	1340	1540	3926	1193	4073	2733	2.549
19.00	2387	1339	1542	3929	1194	4074	2735	2.549
19.10	2389	1338	1542	3931	1195	4074	2736	2.550
19.20	2391	1336	1543	3934	1196	4075	2738	2.550
19.30	2388	1334	1545	3933	1194	4073	2739	2.545
19.40	2389	1333	1547	3937	1195	4075	2742	2.544
19.50	2392	1332	1547	3939	1196	4075	2743	2.546
19.60	2388	1331	1549	3937	1194	4073	2743	2.542
19.70	2390	1328	1551	3941	1195	4074	2746	2.541
19.80	2392	1326	1554	3946	1196	4076	2750	2.539
19.90	2388	1325	1554	3943	1194	4073	2749	2.537
20.00	2390	1323	1556	3946	1195	4074	2751	2.537

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Project Name: Taylor Geo-Engineering
Project Number: M00991-001
Sample: CH-5-48
Comments: Samples were compacted to 90% of ASTM D698 at
Test Number: S2

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
0.00	-26	0	5761	5735	-13	5748	5748	1.005
0.02	270	45	5717	5987	135	5897	5852	1.047
0.04	450	85	5676	6127	225	5987	5902	1.079
0.06	587	123	5639	6226	294	6055	5933	1.104
0.08	695	155	5607	6303	348	6110	5955	1.124
0.10	782	184	5578	6360	391	6153	5969	1.140
0.20	1090	306	5456	6547	545	6307	6001	1.200
0.30	1298	391	5371	6668	649	6411	6020	1.242
0.40	1476	354	5408	6884	738	6500	6146	1.273
0.50	1618	258	5504	7122	809	6571	6313	1.294
0.60	1745	289	5473	7217	872	6634	6345	1.319
0.70	1857	362	5399	7256	929	6689	6328	1.344
0.80	1955	409	5353	7308	978	6739	6331	1.365
0.90	2053	449	5313	7366	1026	6788	6340	1.386
1.00	2136	341	5421	7557	1068	6830	6489	1.394
1.10	2219	390	5372	7591	1110	6871	6481	1.413
1.20	2295	453	5309	7603	1147	6909	6456	1.432
1.30	2370	512	5251	7621	1185	6948	6436	1.451
1.40	2431	543	5220	7651	1216	6979	6435	1.466
1.50	2493	565	5197	7690	1246	7008	6444	1.480
1.60	2539	597	5165	7704	1270	7032	6434	1.492
1.70	2600	627	5134	7734	1300	7061	6434	1.506
1.80	2660	672	5091	7751	1330	7093	6421	1.523
1.90	2707	703	5059	7766	1354	7115	6413	1.535
2.00	2760	734	5028	7788	1380	7142	6408	1.549
2.10	2799	766	4996	7795	1400	7162	6396	1.560
2.20	2845	801	4961	7806	1423	7185	6384	1.574
2.30	2884	834	4929	7813	1442	7205	6371	1.585
2.40	2923	863	4899	7822	1462	7223	6360	1.597
2.50	2955	898	4864	7819	1477	7239	6341	1.608
2.60	2986	940	4821	7808	1493	7255	6315	1.619
2.70	3018	984	4779	7797	1509	7272	6288	1.631
2.80	3056	1034	4728	7784	1528	7290	6256	1.647
2.90	3088	1092	4670	7758	1544	7306	6214	1.661
3.00	3119	1163	4600	7719	1560	7323	6160	1.678
3.10	3143	1225	4537	7680	1572	7334	6109	1.693
3.20	3175	1287	4475	7649	1587	7349	6062	1.709
3.30	3206	1353	4409	7615	1603	7365	6012	1.727
3.40	3230	1421	4340	7570	1615	7376	5955	1.744
3.50	3261	1494	4268	7528	1630	7392	5898	1.764
3.60	3278	1564	4198	7476	1639	7401	5837	1.781
3.70	3309	1630	4132	7440	1654	7416	5786	1.801
3.80	3332	1691	4071	7403	1666	7428	5737	1.819
3.90	3356	1743	4020	7376	1678	7441	5698	1.835
4.00	3380	1788	3974	7353	1690	7452	5664	1.851
4.10	3397	1826	3936	7333	1698	7460	5634	1.863
4.20	3413	1862	3900	7313	1707	7469	5606	1.875
4.30	3437	1909	3854	7291	1718	7481	5572	1.892
4.40	3446	1952	3811	7257	1723	7486	5534	1.904
4.50	3470	1996	3766	7236	1735	7497	5501	1.921
4.60	3487	2038	3724	7211	1743	7505	5467	1.936
4.70	3496	2074	3688	7184	1748	7510	5436	1.948
4.80	3513	2106	3656	7169	1756	7518	5412	1.961
4.90	3536	2137	3625	7160	1768	7530	5392	1.976
5.00	3545	2169	3593	7138	1773	7535	5366	1.987
5.10	3555	2197	3565	7120	1777	7539	5342	1.997
5.20	3571	2235	3529	7099	1785	7548	5314	2.012

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
5.30	3587	2265	3498	7085	1794	7557	5292	2.025
5.40	3597	2296	3466	7063	1798	7560	5265	2.038
5.50	3613	2323	3439	7052	1806	7568	5246	2.050
5.60	3629	2348	3414	7042	1814	7576	5228	2.063
5.70	3638	2365	3397	7035	1819	7581	5216	2.071
5.80	3647	2386	3376	7023	1824	7586	5200	2.080
5.90	3663	2406	3356	7020	1832	7594	5188	2.091
6.00	3665	2427	3336	7002	1833	7596	5169	2.099
6.10	3675	2451	3312	6986	1837	7600	5149	2.110
6.20	3684	2476	3287	6971	1842	7605	5129	2.121
6.30	3700	2499	3264	6963	1850	7613	5114	2.134
6.40	3702	2520	3243	6945	1851	7614	5094	2.142
6.50	3718	2532	3230	6948	1859	7621	5089	2.151
6.60	3720	2545	3217	6937	1860	7622	5077	2.156
6.70	3722	2557	3205	6928	1861	7623	5066	2.161
6.80	3738	2572	3190	6928	1869	7631	5059	2.172
6.90	3740	2594	3169	6909	1870	7633	5039	2.180
7.00	3749	2613	3150	6899	1874	7638	5025	2.190
7.10	3758	2629	3134	6892	1879	7642	5013	2.199
7.20	3767	2643	3120	6886	1883	7646	5003	2.207
7.30	3769	2655	3107	6876	1884	7646	4991	2.213
7.40	3771	2661	3102	6873	1885	7648	4988	2.216
7.50	3773	2669	3093	6866	1887	7648	4979	2.220
7.60	3782	2680	3082	6864	1891	7653	4973	2.227
7.70	3790	2690	3073	6863	1895	7658	4968	2.233
7.80	3792	2705	3058	6850	1896	7659	4954	2.240
7.90	3801	2722	3041	6842	1901	7664	4942	2.250
8.00	3803	2738	3024	6827	1902	7664	4925	2.258
8.10	3812	2752	3011	6823	1906	7669	4917	2.266
8.20	3814	2756	3006	6820	1907	7669	4913	2.269
8.30	3822	2761	3001	6824	1911	7673	4913	2.274
8.40	3824	2766	2996	6820	1912	7674	4908	2.277
8.50	3833	2773	2989	6821	1916	7678	4905	2.283
8.60	3835	2785	2978	6813	1917	7680	4895	2.288
8.70	3843	2799	2963	6806	1922	7684	4884	2.297
8.80	3851	2806	2957	6808	1926	7689	4883	2.303
8.90	3853	2814	2949	6802	1927	7690	4875	2.307
9.00	3862	2821	2942	6804	1931	7694	4873	2.313
9.10	3864	2828	2934	6797	1932	7694	4865	2.317
9.20	3872	2831	2932	6804	1936	7699	4868	2.320
9.30	3874	2828	2934	6807	1937	7699	4870	2.321
9.40	3889	2833	2929	6818	1944	7706	4873	2.328
9.50	3884	2840	2923	6807	1942	7705	4865	2.329
9.60	3892	2852	2910	6802	1946	7708	4856	2.338
9.70	3894	2866	2896	6790	1947	7709	4843	2.345
9.80	3902	2875	2888	6790	1951	7714	4839	2.351
9.90	3910	2886	2876	6786	1955	7717	4831	2.360
10.00	3912	2894	2869	6781	1956	7719	4825	2.363
10.10	3920	2902	2860	6780	1960	7722	4820	2.371
10.20	3915	2908	2854	6769	1958	7720	4812	2.372
10.30	3930	2914	2849	6779	1965	7728	4814	2.379
10.40	3925	2916	2845	6770	1963	7723	4807	2.380
10.50	3933	2921	2841	6774	1967	7728	4808	2.384
10.60	3935	2915	2847	6781	1967	7729	4814	2.382
10.70	3936	2913	2849	6785	1968	7730	4817	2.381
10.80	3938	2913	2849	6787	1969	7731	4818	2.382
10.90	3939	2921	2842	6781	1970	7733	4812	2.386
11.00	3947	2929	2833	6780	1974	7735	4806	2.393
11.10	3949	2935	2827	6776	1974	7736	4801	2.397
11.20	3943	2940	2823	6767	1972	7735	4795	2.397
11.30	3958	2946	2818	6775	1979	7742	4796	2.405
11.40	3953	2948	2815	6768	1976	7740	4792	2.404
11.50	3961	2953	2809	6770	1980	7742	4790	2.410
11.60	3956	2955	2807	6763	1978	7740	4785	2.409

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
11.70	3964	2954	2808	6772	1982	7744	4790	2.411
11.80	3965	2955	2807	6772	1982	7744	4790	2.413
11.90	3966	2957	2805	6771	1983	7745	4788	2.414
12.00	3968	2962	2800	6768	1984	7746	4784	2.417
12.10	3969	2951	2811	6780	1985	7746	4795	2.412
12.20	3970	2944	2818	6788	1985	7747	4803	2.409
12.30	3971	2942	2821	6793	1986	7749	4807	2.408
12.40	3973	2953	2809	6782	1987	7748	4796	2.414
12.50	3974	2962	2800	6774	1987	7749	4787	2.419
12.60	3976	2965	2797	6772	1988	7750	4784	2.422
12.70	3977	2970	2792	6769	1988	7750	4780	2.424
12.80	3972	2976	2786	6758	1986	7748	4772	2.426
12.90	3973	2980	2784	6756	1986	7750	4770	2.427
13.00	3974	2982	2781	6755	1987	7750	4768	2.429
13.10	3975	2985	2777	6752	1988	7750	4764	2.432
13.20	3977	2985	2777	6753	1988	7750	4765	2.432
13.30	3978	2987	2777	6754	1989	7752	4765	2.433
13.40	3979	2985	2778	6757	1989	7752	4767	2.432
13.50	3974	2978	2784	6758	1987	7749	4771	2.428
13.60	3975	2968	2793	6768	1988	7748	4781	2.423
13.70	3976	2961	2800	6776	1988	7749	4788	2.420
13.80	3977	2970	2792	6769	1989	7751	4781	2.425
13.90	3985	2976	2786	6771	1992	7754	4778	2.430
14.00	3986	2983	2780	6766	1993	7756	4773	2.434
14.10	3987	2985	2778	6765	1993	7756	4771	2.435
14.20	3988	2989	2773	6761	1994	7756	4767	2.438
14.30	3995	2991	2772	6767	1998	7761	4769	2.441
14.40	3990	2994	2768	6758	1995	7757	4763	2.441
14.50	3991	2994	2768	6760	1996	7757	4764	2.442
14.60	3998	2997	2765	6763	1999	7761	4764	2.446
14.70	3999	2998	2764	6763	2000	7762	4763	2.447
14.80	4000	2997	2765	6765	2000	7762	4765	2.447
14.90	4007	2997	2766	6773	2004	7767	4770	2.449
15.00	4008	2996	2766	6774	2004	7766	4770	2.449
15.10	4009	2987	2775	6785	2005	7767	4780	2.445
15.20	4010	2976	2786	6796	2005	7767	4791	2.439
15.30	4017	2974	2788	6806	2009	7771	4797	2.441
15.40	4018	2983	2779	6797	2009	7771	4788	2.446
15.50	4013	2991	2771	6784	2006	7768	4777	2.448
15.60	4020	2997	2765	6785	2010	7772	4775	2.454
15.70	4014	3001	2763	6777	2007	7770	4770	2.453
15.80	4015	3006	2757	6772	2008	7771	4764	2.457
15.90	4022	3010	2752	6774	2011	7773	4763	2.462
16.00	4017	3015	2747	6764	2009	7770	4756	2.462
16.10	4018	3017	2745	6763	2009	7771	4754	2.464
16.20	4019	3018	2744	6763	2009	7771	4753	2.465
16.30	4019	3017	2745	6764	2010	7772	4755	2.464
16.40	4020	3018	2744	6764	2010	7772	4754	2.465
16.50	4021	3019	2743	6764	2011	7772	4753	2.466
16.60	4022	3015	2747	6769	2011	7773	4758	2.464
16.70	4016	3013	2748	6765	2008	7770	4757	2.461
16.80	4023	3013	2750	6773	2012	7775	4761	2.463
16.90	4018	3012	2750	6768	2009	7771	4759	2.461
17.00	4013	3010	2752	6765	2006	7768	4758	2.458
17.10	4019	2999	2763	6782	2010	7772	4772	2.455
17.20	4014	2994	2768	6782	2007	7769	4775	2.450
17.30	4009	2989	2773	6782	2004	7766	4777	2.446
17.40	4009	2996	2766	6775	2005	7767	4771	2.449
17.50	4010	3004	2758	6768	2005	7767	4763	2.454
17.60	4011	3022	2740	6751	2005	7767	4746	2.464
17.70	4011	3045	2718	6729	2006	7769	4724	2.476
17.80	4012	3058	2704	6716	2006	7768	4710	2.484
17.90	4006	3052	2711	6717	2003	7766	4714	2.478
18.00	4001	3046	2716	6717	2001	7762	4716	2.473

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
18.10	3996	3025	2737	6732	1998	7760	4735	2.460
18.20	4002	3012	2750	6752	2001	7763	4751	2.456
18.30	4003	2997	2765	6768	2001	7763	4766	2.448
18.40	4003	2985	2777	6780	2002	7764	4778	2.442
18.50	3998	2956	2806	6804	1999	7761	4805	2.425
18.60	3998	2939	2823	6822	1999	7761	4823	2.416
18.70	3993	2923	2839	6832	1997	7758	4835	2.407
18.80	3999	2912	2850	6850	2000	7762	4850	2.403
18.90	4000	2866	2895	6895	2000	7761	4895	2.382
19.00	3995	2833	2929	6923	1997	7759	4926	2.364
19.10	4001	2817	2944	6945	2001	7761	4945	2.359
19.20	4007	2810	2951	6958	2004	7764	4955	2.358
19.30	4007	2821	2941	6948	2004	7766	4944	2.363
19.40	4008	2834	2929	6937	2004	7767	4933	2.368
19.50	4014	2854	2908	6922	2007	7769	4915	2.381
19.60	4020	2871	2893	6913	2010	7773	4903	2.390
19.70	4021	2889	2873	6893	2010	7772	4883	2.400
19.80	4021	2907	2855	6876	2011	7772	4866	2.408
19.90	4021	2924	2838	6859	2011	7773	4848	2.417
20.00	4022	2943	2819	6840	2011	7773	4830	2.427

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Project Name: Taylor Geo-Engineering
Project Number: M00991-001
Sample: CH-5-48
Comments: Samples were compacted to 90% of ASTM D698 at
Test Number: S3

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Au (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
0.00	-47	0	11524	11477	-23	11500	11500	1.004
0.02	511	43	11480	11992	256	11779	11736	1.045
0.04	829	82	11442	12271	415	11938	11856	1.072
0.06	1054	116	11408	12461	527	12050	11934	1.092
0.08	1247	150	11374	12621	624	12147	11997	1.110
0.10	1394	179	11344	12738	697	12220	12041	1.123
0.20	1949	307	11217	13166	975	12498	12191	1.174
0.30	2333	328	11196	13529	1167	12690	12362	1.208
0.40	2632	288	11235	13867	1316	12839	12551	1.234
0.50	2891	391	11132	14023	1446	12969	12578	1.260
0.60	3119	519	11005	14124	1559	13083	12564	1.283
0.70	3323	650	10875	14198	1662	13186	12536	1.306
0.80	3512	789	10734	14246	1756	13279	12490	1.327
0.90	3684	922	10602	14286	1842	13366	12444	1.348
1.00	3857	1048	10475	14332	1928	13452	12404	1.368
1.10	3998	1168	10356	14354	1999	13523	12355	1.386
1.20	4139	1287	10236	14375	2069	13593	12306	1.404
1.30	4272	1402	10123	14395	2136	13661	12259	1.422
1.40	4405	1505	10019	14423	2202	13726	12221	1.440
1.50	4514	1627	9897	14411	2257	13781	12154	1.456
1.60	4631	1733	9790	14421	2316	13839	12106	1.473
1.70	4733	1846	9678	14410	2366	13890	12044	1.489
1.80	4834	1956	9568	14402	2417	13941	11985	1.505
1.90	4935	2071	9453	14388	2468	13991	11920	1.522
2.00	5021	2169	9355	14375	2510	14034	11865	1.537
2.10	5114	2259	9264	14378	2557	14080	11821	1.552
2.20	5199	2373	9151	14350	2599	14123	11750	1.568
2.30	5276	2478	9045	14322	2638	14161	11683	1.583
2.40	5354	2583	8941	14295	2677	14201	11618	1.599
2.50	5431	2679	8846	14277	2715	14240	11561	1.614
2.60	5493	2771	8753	14245	2746	14270	11499	1.628
2.70	5562	2861	8664	14225	2781	14305	11444	1.642
2.80	5623	2951	8572	14196	2812	14335	11384	1.656
2.90	5677	3035	8490	14167	2839	14364	11329	1.669
3.00	5746	3113	8411	14157	2873	14397	11284	1.683
3.10	5800	3190	8333	14133	2900	14423	11233	1.696
3.20	5846	3269	8255	14101	2923	14447	11178	1.708
3.30	5899	3343	8181	14080	2950	14474	11131	1.721
3.40	5952	3416	8108	14061	2976	14500	11084	1.734
3.50	5991	3493	8031	14022	2995	14519	11026	1.746
3.60	6036	3566	7957	13994	3018	14541	10975	1.759
3.70	6082	3637	7887	13969	3041	14565	10928	1.771
3.80	6127	3706	7818	13945	3064	14587	10881	1.784
3.90	6165	3775	7749	13914	3082	14606	10831	1.796
4.00	6203	3839	7684	13887	3101	14625	10786	1.807
4.10	6240	3902	7621	13861	3120	14643	10741	1.819
4.20	6270	3961	7563	13833	3135	14659	10698	1.829
4.30	6308	4018	7505	13813	3154	14677	10659	1.840
4.40	6345	4078	7447	13791	3172	14697	10619	1.852
4.50	6375	4130	7395	13770	3187	14712	10582	1.862
4.60	6405	4179	7345	13749	3202	14726	10547	1.872
4.70	6442	4233	7291	13733	3221	14745	10512	1.884
4.80	6464	4283	7241	13704	3232	14755	10472	1.893
4.90	6486	4335	7189	13675	3243	14767	10432	1.902
5.00	6523	4384	7140	13663	3261	14785	10401	1.914
5.10	6538	4434	7089	13627	3269	14792	10358	1.922
5.20	6560	4483	7040	13600	3280	14803	10320	1.932

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
5.30	6589	4534	6990	13579	3294	14818	10284	1.943
5.40	6611	4582	6942	13552	3305	14829	10247	1.952
5.50	6625	4627	6897	13522	3313	14837	10210	1.960
5.60	6654	4672	6852	13506	3327	14851	10179	1.971
5.70	6676	4715	6808	13484	3338	14861	10146	1.981
5.80	6690	4755	6769	13459	3345	14869	10114	1.988
5.90	6711	4798	6726	13438	3356	14880	10082	1.998
6.00	6733	4841	6684	13417	3366	14892	10051	2.007
6.10	6747	4882	6643	13390	3374	14899	10017	2.016
6.20	6769	4919	6605	13373	3384	14908	9989	2.025
6.30	6782	4960	6565	13347	3391	14916	9956	2.033
6.40	6797	4997	6526	13323	3398	14922	9924	2.041
6.50	6810	5033	6491	13301	3405	14929	9896	2.049
6.60	6832	5067	6457	13289	3416	14939	9873	2.058
6.70	6845	5098	6427	13272	3423	14947	9849	2.065
6.80	6852	5129	6395	13247	3426	14950	9821	2.071
6.90	6866	5157	6368	13234	3433	14958	9801	2.078
7.00	6879	5187	6338	13217	3440	14964	9777	2.085
7.10	6893	5219	6305	13198	3447	14970	9751	2.093
7.20	6907	5246	6279	13186	3453	14978	9732	2.100
7.30	6920	5273	6251	13171	3460	14984	9711	2.107
7.40	6934	5297	6227	13161	3467	14992	9694	2.113
7.50	6940	5322	6203	13143	3470	14995	9673	2.119
7.60	6947	5345	6178	13125	3473	14997	9652	2.124
7.70	6960	5371	6154	13113	3480	15005	9634	2.131
7.80	6966	5393	6130	13096	3483	15007	9613	2.136
7.90	6987	5421	6103	13090	3493	15018	9597	2.145
8.00	6986	5444	6080	13066	3493	15016	9573	2.149
8.10	6999	5466	6058	13057	3500	15023	9557	2.155
8.20	7005	5491	6033	13038	3503	15026	9536	2.161
8.30	7018	5512	6013	13031	3509	15034	9522	2.167
8.40	7024	5533	5991	13015	3512	15036	9503	2.172
8.50	7037	5554	5970	13007	3519	15042	9488	2.179
8.60	7050	5575	5949	12999	3525	15049	9474	2.185
8.70	7056	5597	5928	12984	3528	15053	9456	2.190
8.80	7055	5618	5905	12960	3528	15051	9433	2.195
8.90	7068	5638	5886	12953	3534	15058	9419	2.201
9.00	7074	5659	5864	12938	3537	15060	9401	2.206
9.10	7073	5680	5843	12916	3536	15060	9380	2.210
9.20	7085	5699	5826	12911	3543	15067	9368	2.216
9.30	7091	5718	5806	12897	3546	15069	9351	2.221
9.40	7097	5736	5787	12884	3548	15072	9336	2.226
9.50	7102	5755	5770	12872	3551	15076	9321	2.231
9.60	7115	5770	5754	12869	3558	15082	9312	2.236
9.70	7114	5787	5737	12850	3557	15080	9294	2.240
9.80	7126	5803	5722	12848	3563	15088	9285	2.245
9.90	7132	5817	5707	12839	3566	15091	9273	2.250
10.00	7130	5829	5696	12826	3565	15090	9261	2.252
10.10	7136	5841	5683	12819	3568	15092	9251	2.256
10.20	7141	5855	5669	12810	3571	15094	9239	2.260
10.30	7140	5865	5659	12799	3570	15095	9229	2.262
10.40	7145	5876	5648	12793	3573	15096	9220	2.265
10.50	7151	5884	5640	12790	3575	15099	9215	2.268
10.60	7156	5895	5629	12785	3578	15102	9207	2.271
10.70	7161	5903	5622	12783	3581	15105	9203	2.274
10.80	7166	5913	5611	12778	3583	15108	9195	2.277
10.90	7172	5920	5604	12776	3586	15111	9190	2.280
11.00	7170	5926	5597	12768	3585	15109	9183	2.281
11.10	7175	5932	5593	12768	3588	15112	9180	2.283
11.20	7174	5938	5586	12759	3587	15110	9173	2.284
11.30	7186	5944	5580	12765	3593	15116	9173	2.288
11.40	7191	5948	5576	12767	3595	15120	9172	2.290
11.50	7189	5954	5569	12758	3595	15118	9164	2.291
11.60	7194	5957	5568	12762	3597	15122	9165	2.292

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
11.70	7192	5961	5562	12755	3596	15120	9158	2.293
11.80	7197	5964	5560	12757	3599	15122	9159	2.295
11.90	7202	5967	5556	12759	3601	15125	9158	2.296
12.00	7207	5968	5555	12763	3604	15127	9159	2.297
12.10	7205	5972	5552	12757	3603	15126	9154	2.298
12.20	7210	5971	5554	12764	3605	15130	9159	2.298
12.30	7215	5971	5553	12768	3608	15131	9160	2.299
12.40	7220	5971	5553	12773	3610	15134	9163	2.300
12.50	7218	5971	5554	12772	3609	15134	9163	2.300
12.60	7223	5970	5555	12778	3611	15136	9167	2.300
12.70	7221	5967	5556	12777	3610	15134	9167	2.300
12.80	7219	5968	5555	12774	3609	15133	9165	2.299
12.90	7224	5967	5556	12780	3612	15135	9168	2.300
13.00	7228	5966	5558	12786	3614	15138	9172	2.301
13.10	7226	5964	5561	12787	3613	15138	9174	2.299
13.20	7217	5963	5561	12778	3609	15132	9170	2.298
13.30	7215	5967	5556	12772	3608	15131	9164	2.299
13.40	7227	5966	5558	12784	3613	15137	9171	2.300
13.50	7224	5963	5561	12785	3612	15136	9173	2.299
13.60	7222	5961	5562	12784	3611	15135	9173	2.298
13.70	7233	5959	5566	12799	3617	15141	9182	2.300
13.80	7231	5957	5567	12798	3616	15139	9183	2.299
13.90	7235	5953	5572	12807	3618	15142	9189	2.299
14.00	7240	5950	5574	12814	3620	15144	9194	2.299
14.10	7238	5945	5580	12817	3619	15144	9199	2.297
14.20	7242	5938	5587	12829	3621	15146	9208	2.296
14.30	7240	5932	5590	12830	3620	15142	9210	2.295
14.40	7237	5924	5601	12838	3619	15143	9220	2.292
14.50	7242	5915	5609	12851	3621	15145	9230	2.291
14.60	7246	5903	5621	12867	3623	15147	9244	2.289
14.70	7250	5891	5634	12884	3625	15150	9259	2.287
14.80	7248	5878	5645	12893	3624	15148	9269	2.284
14.90	7252	5863	5661	12913	3626	15150	9287	2.281
15.00	7263	5849	5675	12938	3632	15155	9306	2.280
15.10	7260	5835	5690	12950	3630	15155	9320	2.276
15.20	7252	5820	5704	12955	3626	15149	9330	2.271
15.30	7255	5807	5718	12973	3628	15152	9346	2.269
15.40	7259	5793	5732	12991	3630	15154	9362	2.266
15.50	7257	5780	5744	13001	3629	15152	9372	2.263
15.60	7255	5767	5757	13011	3627	15151	9384	2.260
15.70	7259	5753	5771	13029	3629	15153	9400	2.258
15.80	7256	5740	5785	13041	3628	15153	9413	2.254
15.90	7260	5727	5798	13057	3630	15155	9428	2.252
16.00	7264	5713	5811	13074	3632	15155	9442	2.250
16.10	7261	5700	5823	13084	3631	15154	9454	2.247
16.20	7259	5687	5836	13095	3629	15153	9466	2.244
16.30	7269	5677	5847	13116	3634	15158	9481	2.243
16.40	7266	5666	5857	13123	3633	15157	9490	2.241
16.50	7263	5653	5870	13134	3632	15155	9502	2.237
16.60	7261	5642	5882	13143	3630	15154	9512	2.234
16.70	7258	5631	5893	13150	3629	15153	9522	2.232
16.80	7262	5623	5901	13162	3631	15154	9532	2.231
16.90	7265	5612	5912	13178	3633	15157	9545	2.229
17.00	7262	5602	5923	13185	3631	15156	9554	2.226
17.10	7253	5590	5934	13187	3627	15150	9560	2.222
17.20	7257	5578	5946	13203	3628	15153	9575	2.220
17.30	7261	5569	5955	13215	3630	15154	9585	2.219
17.40	7264	5558	5965	13229	3632	15156	9597	2.218
17.50	7261	5549	5975	13236	3631	15154	9605	2.215
17.60	7258	5540	5984	13242	3629	15153	9613	2.213
17.70	7262	5535	5989	13250	3631	15154	9619	2.213
17.80	7259	5525	5999	13258	3629	15153	9628	2.210
17.90	7262	5513	6011	13273	3631	15155	9642	2.208
18.00	7259	5503	6021	13280	3630	15154	9648	2.206

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
18.10	7256	5494	6031	13287	3628	15153	9659	2.203
18.20	7260	5485	6040	13300	3630	15154	9670	2.202
18.30	7263	5474	6051	13313	3631	15156	9682	2.200
18.40	7260	5465	6059	13319	3630	15153	9689	2.198
18.50	7263	5458	6066	13329	3632	15155	9697	2.197
18.60	7260	5451	6073	13333	3630	15154	9703	2.196
18.70	7257	5444	6081	13338	3628	15153	9710	2.193
18.80	7260	5439	6086	13346	3630	15155	9716	2.193
18.90	7263	5432	6093	13356	3632	15156	9724	2.192
19.00	7260	5428	6096	13356	3630	15155	9726	2.191
19.10	7270	5425	6099	13368	3635	15158	9733	2.192
19.20	7266	5417	6107	13373	3633	15157	9740	2.190
19.30	7276	5413	6110	13386	3638	15161	9748	2.191
19.40	7266	5409	6115	13381	3633	15157	9748	2.188
19.50	7269	5405	6119	13388	3635	15158	9753	2.188
19.60	7266	5403	6121	13387	3633	15157	9754	2.187
19.70	7269	5402	6122	13391	3634	15158	9757	2.187
19.80	7272	5399	6124	13396	3636	15159	9760	2.187
19.90	7275	5396	6128	13403	3637	15161	9765	2.187
20.00	7271	5393	6130	13402	3636	15159	9766	2.186

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Isotropically Consolidated Undrained with Pore Pressure (CIU/PP)

Project Name: Taylor Geo-Engineering
Project Number: M00991-001
Sample: CH-5-98
Comments: Samples were compacted to 90% of ASTM D698 at OMC.

	Test Number	S1	S2	S3	
Initial	Height, H (in)	4.22	4.22	4.05	
	Diameter, D (in)	1.88	1.88	1.88	
	Moisture Content, w (%)	17.3	17.3	17.3	
	Dry Unit Weight, γd (pcf)	97.9	98.0	97.7	
	Saturation (%)	78.6	77.0	74.0	
	Void Ratio, e	0.59	0.60	0.62	
Before Shear	Moisture Content, w (%)	22.4	20.6	19.8	
	Dry Unit Weight, γd (pcf)	103.8	107.1	114.4	
	Saturation (%)	100.0	100.0	100.0	
	Void Ratio, e	0.61	0.56	0.53	
	B	0.95	0.95	0.97	
	Back pressure (psf)	5431.9	15270	6916	
	Strain rate (%/min)	0.033	0.033	0.033	
	Time to Failure (min)	603.0	606.1	603.0	
Total Stress	Strain at Failure, εf (%)	19.90	20.00	19.90	
	σ3 (psf)	2878	5754	11523	
	σ1-σ3 (psf)	2994	5436	8088	
	σ1 (psf)	5873	11190	19612	
	q = (σ1-σ3)/2 (psf)	1497	2718	4044	
	p = (σ1+σ3)/2 (psf)	4375	8472	15568	
Effective Stress	u (psf)	1353	2564	6606	
	σ'3 (psf)	1526	3190	4918	
	σ'1-σ'3 (psf)	2994	5436	8088	
	σ'1 (psf)	4520	8626	13006	
	q = (σ'1-σ'3)/2 (psf)	1497	2718	4044	
	p' = (σ'1+σ'3)/2 (psf)	3023	5908	8962	
	σ'1/σ'3	2.96	2.70	2.64	
	A = u/(σ1−σ3)	0.452	0.472	0.817	

Estimated Specific Gravity	2.70
Plastic Limit (%)	17
Liquid Limit (%)	53
Plasticity Index (%)	36

Summary of Strength Paramaters	Total Stress	Effective Stress
c (psf)	657	216
ϕ (deg)	12.9	25.4
tan ϕ	0.229	0.475

* Saturation set to 100% for phase calculations

Tested by: _____

Reviewed: _____

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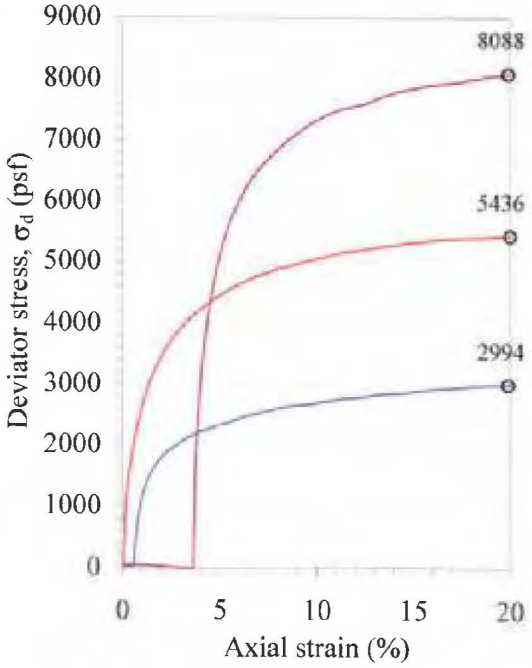
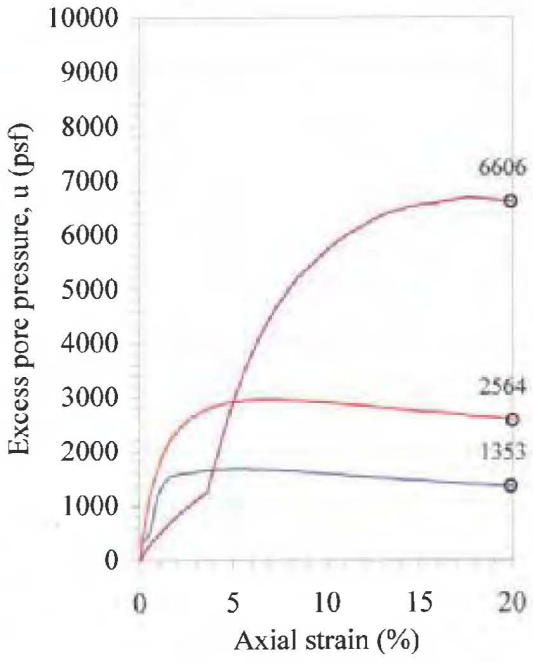
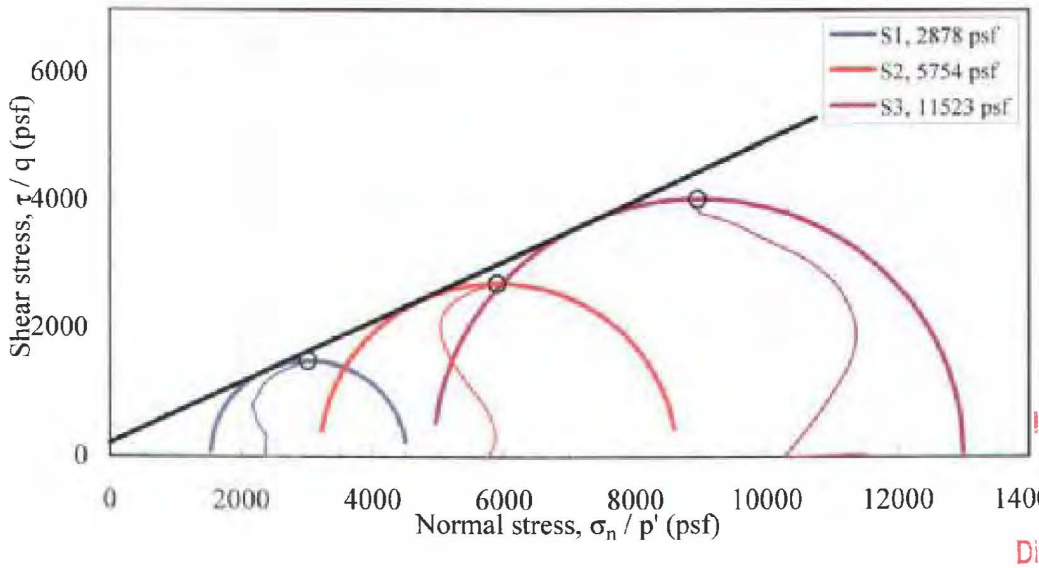
Isotropically Consolidated Undrained with Pore Pressure (CIU/PP)

Project Name: Taylor Geo-Engineering
Project Number: M00991-001
Sample: CH-5-98
Comments:

Summary of Strength Paramaters	Total Stress	Effective Stress
c (psf)	657	216
ϕ (deg)	12.9	25.4
tan ϕ	0.229	0.475







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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
5.30	2352	1677	1201	3553	1176	4054	2377	2.958
5.40	2362	1680	1200	3562	1181	4061	2381	2.968
5.50	2372	1678	1200	3572	1186	4065	2386	2.977
5.60	2389	1678	1200	3590	1195	4073	2395	2.991
5.70	2400	1677	1201	3601	1200	4078	2401	2.998
5.80	2410	1677	1201	3611	1205	4083	2406	3.007
5.90	2420	1674	1205	3625	1210	4089	2415	3.009
6.00	2437	1669	1209	3647	1219	4097	2428	3.015
6.10	2448	1664	1214	3662	1224	4102	2438	3.016
6.20	2458	1669	1209	3667	1229	4107	2438	3.032
6.30	2468	1669	1209	3677	1234	4112	2443	3.041
6.40	2478	1669	1209	3688	1239	4117	2448	3.049
6.50	2495	1668	1212	3707	1247	4127	2459	3.059
6.60	2492	1668	1212	3703	1246	4125	2458	3.056
6.70	2502	1661	1218	3719	1251	4129	2468	3.055
6.80	2505	1656	1221	3726	1253	4130	2474	3.052
6.90	2515	1654	1225	3740	1258	4136	2482	3.054
7.00	2525	1656	1222	3748	1263	4141	2485	3.066
7.10	2529	1655	1223	3752	1264	4143	2488	3.067
7.20	2538	1654	1226	3764	1269	4149	2495	3.071
7.30	2548	1654	1225	3773	1274	4153	2499	3.081
7.40	2552	1650	1228	3780	1276	4154	2504	3.078
7.50	2562	1649	1230	3792	1281	4160	2511	3.082
7.60	2572	1642	1236	3808	1286	4164	2522	3.080
7.70	2581	1637	1241	3822	1291	4169	2532	3.080
7.80	2585	1634	1245	3829	1292	4171	2537	3.077
7.90	2594	1636	1243	3838	1297	4177	2541	3.087
8.00	2598	1637	1241	3839	1299	4177	2540	3.093
8.10	2607	1635	1245	3852	1304	4183	2548	3.095
8.20	2617	1634	1246	3863	1309	4188	2554	3.101
8.30	2620	1630	1248	3868	1310	4188	2558	3.100
8.40	2630	1628	1250	3880	1315	4193	2565	3.103
8.50	2633	1626	1253	3886	1317	4195	2569	3.102
8.60	2636	1623	1256	3892	1318	4198	2574	3.098
8.70	2646	1621	1259	3904	1323	4202	2581	3.102
8.80	2649	1613	1266	3914	1324	4203	2590	3.093
8.90	2652	1608	1270	3922	1326	4204	2596	3.088
9.00	2655	1605	1274	3929	1327	4206	2601	3.084
9.10	2658	1606	1274	3932	1329	4208	2603	3.087
9.20	2654	1605	1274	3928	1327	4206	2601	3.084
9.30	2664	1603	1275	3939	1332	4210	2607	3.089
9.40	2661	1602	1276	3937	1330	4209	2606	3.085
9.50	2663	1600	1279	3942	1332	4210	2610	3.083
9.60	2673	1598	1282	3955	1336	4216	2618	3.085
9.70	2676	1595	1283	3959	1338	4216	2621	3.085
9.80	2685	1592	1287	3972	1343	4221	2629	3.087
9.90	2682	1588	1290	3972	1341	4219	2631	3.079
10.00	2697	1583	1295	3992	1349	4227	2644	3.083
10.10	2700	1578	1301	4001	1350	4229	2651	3.076
10.20	2710	1571	1308	4017	1355	4233	2663	3.072
10.30	2719	1572	1307	4025	1359	4238	2666	3.081
10.40	2715	1571	1309	4024	1358	4237	2667	3.074
10.50	2725	1569	1309	4033	1362	4241	2671	3.082
10.60	2727	1567	1311	4039	1364	4242	2675	3.080
10.70	2736	1565	1314	4050	1368	4247	2682	3.083
10.80	2746	1571	1309	4054	1373	4252	2682	3.098
10.90	2748	1562	1316	4064	1374	4253	2690	3.089
11.00	2751	1558	1321	4072	1376	4254	2696	3.083
11.10	2754	1553	1325	4079	1377	4255	2702	3.078
11.20	2750	1545	1334	4084	1375	4253	2709	3.062
11.30	2766	1538	1341	4106	1383	4261	2723	3.063
11.40	2768	1541	1337	4105	1384	4262	2721	3.070
11.50	2771	1540	1339	4110	1385	4265	2725	3.069
11.60	2774	1538	1341	4114	1387	4265	2727	3.069

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
11.70	2776	1537	1342	4118	1388	4266	2730	3.069
11.80	2779	1533	1346	4125	1389	4269	2736	3.064
11.90	2782	1531	1348	4129	1391	4269	2738	3.064
12.00	2784	1528	1350	4134	1392	4270	2742	3.062
12.10	2787	1525	1353	4140	1393	4272	2747	3.059
12.20	2789	1523	1356	4145	1395	4273	2750	3.057
12.30	2792	1519	1359	4151	1396	4274	2755	3.054
12.40	2801	1517	1362	4162	1400	4279	2762	3.057
12.50	2797	1509	1370	4167	1399	4277	2768	3.042
12.60	2806	1504	1375	4180	1403	4281	2777	3.041
12.70	2808	1500	1378	4186	1404	4282	2782	3.038
12.80	2817	1502	1377	4194	1409	4287	2785	3.046
12.90	2813	1502	1377	4190	1407	4285	2783	3.043
13.00	2822	1500	1378	4200	1411	4289	2789	3.048
13.10	2824	1499	1380	4205	1412	4292	2793	3.046
13.20	2833	1498	1380	4213	1416	4295	2797	3.052
13.30	2835	1496	1384	4219	1418	4297	2802	3.049
13.40	2838	1493	1385	4223	1419	4297	2804	3.049
13.50	2840	1491	1387	4228	1420	4298	2807	3.047
13.60	2843	1489	1390	4232	1421	4300	2811	3.045
13.70	2845	1485	1394	4239	1422	4302	2817	3.040
13.80	2847	1483	1396	4243	1424	4302	2819	3.040
13.90	2850	1479	1399	4249	1425	4303	2824	3.037
14.00	2852	1477	1400	4252	1426	4303	2826	3.037
14.10	2848	1473	1405	4253	1424	4302	2829	3.027
14.20	2856	1470	1409	4265	1428	4307	2837	3.028
14.30	2853	1462	1417	4269	1426	4305	2843	3.014
14.40	2855	1457	1420	4275	1428	4305	2848	3.010
14.50	2857	1455	1424	4281	1429	4307	2852	3.007
14.60	2859	1456	1423	4282	1430	4308	2852	3.010
14.70	2862	1457	1421	4283	1431	4309	2852	3.013
14.80	2870	1456	1424	4294	1435	4315	2859	3.016
14.90	2872	1455	1424	4296	1436	4314	2860	3.017
15.00	2880	1452	1426	4306	1440	4319	2866	3.020
15.10	2883	1451	1427	4310	1441	4320	2869	3.020
15.20	2885	1449	1431	4315	1442	4322	2873	3.016
15.30	2893	1446	1432	4325	1447	4325	2878	3.020
15.40	2895	1449	1430	4325	1448	4326	2877	3.025
15.50	2897	1444	1434	4331	1449	4327	2883	3.020
15.60	2905	1439	1439	4344	1453	4331	2892	3.019
15.70	2907	1437	1442	4350	1454	4333	2896	3.016
15.80	2909	1434	1445	4354	1455	4333	2900	3.014
15.90	2912	1430	1448	4360	1456	4334	2904	3.010
16.00	2914	1428	1451	4364	1457	4335	2907	3.008
16.10	2922	1425	1453	4375	1461	4339	2914	3.011
16.20	2918	1422	1457	4374	1459	4337	2915	3.003
16.30	2926	1420	1459	4384	1463	4341	2922	3.005
16.40	2927	1417	1461	4389	1464	4342	2925	3.004
16.50	2924	1414	1465	4388	1462	4340	2927	2.996
16.60	2926	1410	1468	4394	1463	4341	2931	2.993
16.70	2922	1407	1472	4393	1461	4339	2933	2.985
16.80	2924	1405	1473	4396	1462	4340	2935	2.985
16.90	2931	1402	1476	4408	1466	4344	2942	2.985
17.00	2933	1401	1478	4411	1467	4345	2944	2.985
17.10	2941	1398	1480	4421	1471	4349	2950	2.987
17.20	2943	1395	1483	4426	1472	4350	2955	2.984
17.30	2945	1393	1486	4431	1472	4351	2958	2.982
17.40	2947	1390	1488	4435	1473	4352	2961	2.980
17.50	2948	1388	1490	4439	1474	4353	2965	2.978
17.60	2950	1387	1493	4443	1475	4355	2968	2.976
17.70	2958	1384	1494	4452	1479	4357	2973	2.980
17.80	2966	1382	1496	4462	1483	4361	2979	2.982
17.90	2962	1381	1498	4459	1481	4359	2978	2.978
18.00	2963	1380	1500	4463	1482	4361	2981	2.976

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
18.10	2965	1379	1500	4465	1483	4361	2982	2.977
18.20	2967	1376	1502	4469	1483	4362	2986	2.975
18.30	2974	1375	1503	4478	1487	4366	2991	2.978
18.40	2976	1373	1506	4482	1488	4366	2994	2.977
18.50	2978	1372	1507	4485	1489	4367	2996	2.976
18.60	2974	1370	1508	4482	1487	4365	2995	2.972
18.70	2975	1368	1512	4487	1488	4367	2999	2.968
18.80	2983	1367	1512	4494	1491	4370	3003	2.973
18.90	2979	1364	1514	4493	1489	4368	3003	2.968
19.00	2975	1363	1515	4490	1487	4366	3002	2.963
19.10	2982	1362	1516	4498	1491	4369	3007	2.967
19.20	2978	1361	1517	4495	1489	4367	3006	2.962
19.30	2979	1359	1520	4499	1490	4368	3009	2.960
19.40	2981	1357	1521	4502	1491	4369	3011	2.960
19.50	2977	1354	1524	4501	1488	4367	3013	2.953
19.60	2984	1354	1526	4510	1492	4372	3018	2.956
19.70	2986	1352	1527	4512	1493	4371	3020	2.956
19.80	2981	1350	1529	4511	1491	4370	3020	2.950
19.90	2994	1353	1526	4520	1497	4375	3023	2.963
20.00	2990	1349	1529	4519	1495	4373	3024	2.956

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Project Name: Taylor Geo-Engineering
Project Number: M00991-001
Sample: CH-5-98
Comments: Samples were compacted to 90% of ASTM D698 at
Test Number: S2

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
0.00	-29	0	5754	5725	-14	5740	5740	1.005
0.02	325	76	5678	6002	162	5916	5840	1.057
0.04	533	160	5593	6127	267	6021	5860	1.095
0.06	677	227	5527	6204	339	6093	5865	1.123
0.08	785	288	5466	6251	393	6146	5858	1.144
0.10	893	348	5406	6299	446	6200	5852	1.165
0.20	1265	600	5155	6421	633	6388	5788	1.245
0.30	1537	805	4949	6486	768	6522	5718	1.311
0.40	1757	990	4764	6522	879	6633	5643	1.369
0.50	1949	1156	4598	6547	974	6728	5572	1.424
0.60	2118	1301	4453	6571	1059	6813	5512	1.476
0.70	2259	1428	4327	6586	1129	6884	5457	1.522
0.80	2399	1546	4208	6607	1200	6954	5408	1.570
0.90	2525	1653	4101	6626	1262	7016	5364	1.616
1.00	2650	1757	3997	6647	1325	7079	5322	1.663
1.10	2761	1846	3908	6669	1381	7135	5289	1.707
1.20	2858	1927	3827	6685	1429	7183	5256	1.747
1.30	2954	2003	3752	6706	1477	7232	5229	1.787
1.40	3050	2079	3675	6725	1525	7279	5200	1.830
1.50	3117	2140	3614	6731	1559	7312	5173	1.862
1.60	3199	2196	3558	6757	1599	7353	5157	1.899
1.70	3266	2248	3508	6773	1633	7388	5140	1.931
1.80	3340	2298	3456	6796	1670	7424	5126	1.966
1.90	3399	2344	3412	6811	1700	7455	5111	1.996
2.00	3452	2386	3369	6821	1726	7481	5095	2.024
2.10	3512	2423	3331	6842	1756	7510	5087	2.054
2.20	3564	2457	3297	6861	1782	7536	5079	2.081
2.30	3616	2491	3263	6879	1808	7562	5071	2.108
2.40	3661	2523	3231	6892	1831	7584	5062	2.133
2.50	3713	2553	3201	6914	1857	7610	5057	2.160
2.60	3758	2581	3174	6931	1879	7634	5053	2.184
2.70	3796	2606	3148	6944	1898	7652	5046	2.206
2.80	3833	2629	3125	6958	1917	7671	5041	2.227
2.90	3878	2650	3105	6982	1939	7694	5044	2.249
3.00	3908	2673	3081	6990	1954	7708	5035	2.268
3.10	3953	2695	3059	7012	1976	7730	5035	2.292
3.20	3983	2714	3040	7023	1991	7745	5032	2.310
3.30	4020	2731	3023	7043	2010	7764	5033	2.330
3.40	4050	2748	3008	7058	2025	7780	5033	2.347
3.50	4080	2763	2992	7072	2040	7795	5032	2.364
3.60	4110	2779	2975	7085	2055	7809	5030	2.382
3.70	4140	2793	2962	7102	2070	7825	5032	2.398
3.80	4163	2806	2949	7112	2082	7837	5030	2.412
3.90	4193	2818	2936	7129	2097	7850	5033	2.428
4.00	4216	2828	2926	7141	2108	7862	5033	2.441
4.10	4239	2839	2915	7154	2119	7873	5034	2.454
4.20	4268	2850	2906	7174	2134	7889	5040	2.469
4.30	4291	2858	2896	7187	2145	7899	5042	2.482
4.40	4313	2867	2888	7201	2157	7912	5045	2.494
4.50	4336	2875	2879	7215	2168	7922	5047	2.506
4.60	4365	2882	2872	7237	2183	7937	5054	2.520
4.70	4388	2889	2865	7252	2194	7948	5058	2.532
4.80	4403	2898	2858	7261	2202	7957	5059	2.541
4.90	4432	2905	2849	7282	2216	7970	5066	2.556
5.00	4448	2908	2846	7294	2224	7978	5070	2.563
5.10	4463	2913	2841	7304	2232	7985	5073	2.571
5.20	4485	2916	2838	7323	2243	7997	5080	2.580

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
5.30	4507	2921	2833	7340	2254	8008	5087	2.591
5.40	4522	2924	2831	7353	2261	8016	5092	2.598
5.50	4545	2928	2826	7370	2272	8026	5098	2.608
5.60	4566	2932	2824	7390	2283	8038	5107	2.617
5.70	4581	2934	2820	7402	2291	8045	5111	2.625
5.80	4597	2936	2818	7414	2298	8052	5116	2.631
5.90	4611	2939	2815	7427	2306	8060	5121	2.638
6.00	4626	2941	2814	7440	2313	8068	5127	2.644
6.10	4648	2942	2812	7460	2324	8078	5136	2.653
6.20	4663	2944	2810	7473	2332	8085	5141	2.660
6.30	4671	2946	2810	7480	2335	8090	5145	2.662
6.40	4692	2947	2808	7501	2346	8101	5155	2.671
6.50	4700	2947	2807	7508	2350	8104	5157	2.674
6.60	4722	2947	2808	7530	2361	8116	5169	2.681
6.70	4730	2948	2807	7537	2365	8120	5172	2.685
6.80	4744	2948	2806	7550	2372	8126	5178	2.691
6.90	4759	2949	2806	7565	2379	8134	5185	2.696
7.00	4767	2947	2807	7574	2383	8137	5191	2.698
7.10	4774	2946	2810	7584	2387	8142	5197	2.699
7.20	4789	2947	2807	7596	2395	8148	5202	2.706
7.30	4803	2946	2810	7613	2402	8157	5211	2.710
7.40	4811	2944	2810	7621	2406	8159	5215	2.712
7.50	4819	2943	2811	7629	2409	8163	5220	2.714
7.60	4840	2942	2812	7652	2420	8174	5232	2.721
7.70	4847	2940	2814	7662	2424	8178	5238	2.722
7.80	4855	2940	2814	7669	2427	8181	5242	2.725
7.90	4869	2937	2817	7686	2435	8188	5251	2.729
8.00	4883	2936	2818	7701	2442	8195	5259	2.733
8.10	4891	2935	2819	7710	2445	8199	5264	2.735
8.20	4905	2934	2820	7725	2452	8206	5272	2.739
8.30	4905	2932	2822	7728	2453	8207	5275	2.738
8.40	4919	2930	2824	7743	2460	8214	5283	2.742
8.50	4927	2930	2825	7751	2463	8218	5288	2.744
8.60	4934	2928	2827	7761	2467	8222	5294	2.745
8.70	4941	2926	2828	7770	2471	8225	5299	2.747
8.80	4949	2923	2831	7779	2474	8228	5305	2.748
8.90	4962	2923	2831	7793	2481	8235	5312	2.753
9.00	4969	2920	2835	7805	2485	8240	5320	2.753
9.10	4977	2917	2837	7813	2488	8242	5325	2.755
9.20	4984	2915	2839	7823	2492	8246	5331	2.756
9.30	4998	2913	2841	7839	2499	8253	5340	2.759
9.40	5005	2909	2845	7849	2502	8256	5347	2.759
9.50	5012	2907	2847	7859	2506	8260	5353	2.760
9.60	5018	2905	2851	7869	2509	8264	5360	2.761
9.70	5032	2901	2853	7885	2516	8270	5369	2.764
9.80	5039	2899	2855	7894	2520	8274	5375	2.765
9.90	5040	2895	2859	7898	2520	8274	5379	2.763
10.00	5053	2894	2860	7913	2527	8280	5386	2.767
10.10	5060	2892	2862	7922	2530	8284	5392	2.768
10.20	5067	2888	2866	7932	2533	8287	5399	2.768
10.30	5073	2886	2868	7942	2537	8291	5405	2.769
10.40	5080	2882	2872	7952	2540	8294	5412	2.769
10.50	5087	2879	2875	7962	2544	8297	5419	2.769
10.60	5094	2876	2878	7971	2547	8301	5424	2.770
10.70	5107	2874	2881	7988	2553	8309	5434	2.773
10.80	5113	2871	2885	7998	2557	8312	5441	2.773
10.90	5127	2867	2887	8014	2563	8317	5450	2.776
11.00	5127	2864	2892	8018	2563	8318	5455	2.773
11.10	5140	2860	2894	8034	2570	8324	5464	2.776
11.20	5140	2858	2896	8036	2570	8324	5466	2.775
11.30	5147	2854	2900	8046	2573	8327	5473	2.775
11.40	5153	2851	2903	8056	2577	8331	5480	2.775
11.50	5160	2847	2907	8066	2580	8334	5487	2.774
11.60	5166	2844	2911	8077	2583	8338	5494	2.774

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
11.70	5172	2840	2914	8086	2586	8340	5500	2.775
11.80	5172	2838	2916	8089	2586	8340	5502	2.774
11.90	5179	2834	2920	8098	2589	8343	5509	2.774
12.00	5185	2832	2922	8107	2593	8346	5515	2.775
12.10	5191	2828	2927	8118	2596	8351	5522	2.774
12.20	5191	2825	2929	8120	2596	8350	5525	2.772
12.30	5198	2821	2934	8131	2599	8354	5533	2.772
12.40	5204	2818	2937	8141	2602	8357	5539	2.772
12.50	5210	2816	2940	8150	2605	8360	5545	2.772
12.60	5216	2812	2942	8158	2608	8362	5550	2.773
12.70	5223	2809	2945	8168	2611	8365	5557	2.773
12.80	5222	2805	2949	8171	2611	8365	5560	2.771
12.90	5235	2802	2952	8187	2617	8371	5570	2.773
13.00	5241	2798	2957	8198	2620	8375	5577	2.772
13.10	5241	2794	2959	8200	2620	8374	5580	2.771
13.20	5246	2791	2964	8211	2623	8378	5587	2.770
13.30	5246	2787	2967	8213	2623	8377	5590	2.769
13.40	5252	2784	2970	8222	2626	8380	5596	2.768
13.50	5258	2782	2972	8231	2629	8383	5602	2.769
13.60	5264	2776	2978	8242	2632	8386	5610	2.768
13.70	5270	2773	2981	8251	2635	8389	5616	2.768
13.80	5276	2771	2983	8259	2638	8392	5621	2.769
13.90	5276	2768	2986	8262	2638	8392	5624	2.767
14.00	5275	2764	2990	8265	2638	8392	5628	2.764
14.10	5287	2759	2995	8282	2644	8398	5638	2.766
14.20	5293	2757	2998	8291	2646	8402	5645	2.765
14.30	5299	2752	3002	8300	2649	8403	5651	2.765
14.40	5298	2750	3005	8303	2649	8404	5654	2.763
14.50	5304	2746	3009	8313	2652	8407	5661	2.763
14.60	5310	2743	3011	8321	2655	8409	5666	2.763
14.70	5309	2739	3015	8324	2655	8409	5669	2.761
14.80	5315	2736	3019	8334	2657	8412	5677	2.760
14.90	5314	2731	3023	8337	2657	8411	5680	2.758
15.00	5320	2723	3030	8350	2660	8413	5690	2.756
15.10	5319	2715	3038	8357	2660	8412	5698	2.751
15.20	5331	2714	3040	8371	2665	8419	5706	2.753
15.30	5336	2715	3039	8375	2668	8422	5707	2.756
15.40	5348	2715	3039	8387	2674	8428	5713	2.760
15.50	5341	2715	3040	8381	2670	8426	5711	2.757
15.60	5346	2713	3041	8388	2673	8427	5715	2.758
15.70	5352	2711	3044	8396	2676	8431	5720	2.758
15.80	5357	2710	3044	8401	2679	8433	5722	2.760
15.90	5356	2708	3046	8403	2678	8432	5724	2.758
16.00	5362	2707	3047	8409	2681	8435	5728	2.760
16.10	5361	2704	3050	8411	2681	8434	5730	2.758
16.20	5366	2702	3053	8419	2683	8438	5736	2.758
16.30	5371	2698	3056	8427	2686	8440	5741	2.758
16.40	5377	2696	3058	8435	2688	8442	5746	2.758
16.50	5376	2694	3061	8437	2688	8443	5749	2.756
16.60	5381	2689	3065	8446	2690	8444	5755	2.756
16.70	5386	2686	3068	8454	2693	8447	5761	2.755
16.80	5385	2682	3072	8457	2693	8447	5765	2.753
16.90	5390	2677	3078	8468	2695	8450	5773	2.751
17.00	5389	2674	3080	8469	2695	8449	5775	2.750
17.10	5394	2669	3085	8479	2697	8451	5782	2.749
17.20	5393	2664	3089	8483	2697	8451	5786	2.746
17.30	5392	2660	3094	8487	2696	8450	5790	2.743
17.40	5397	2656	3099	8496	2699	8454	5797	2.742
17.50	5402	2653	3101	8503	2701	8455	5802	2.742
17.60	5395	2643	3111	8506	2698	8452	5808	2.735
17.70	5400	2632	3122	8522	2700	8454	5822	2.730
17.80	5405	2627	3127	8532	2703	8456	5829	2.729
17.90	5404	2632	3123	8527	2702	8457	5825	2.730
18.00	5403	2632	3122	8525	2701	8455	5824	2.730

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
18.10	5408	2632	3122	8530	2704	8458	5826	2.732
18 20	5406	2629	3125	8531	2703	8457	5828	2 730
18 30	5411	2628	3126	8537	2706	8459	5831	2 731
18 40	5404	2625	3129	8533	2702	8456	5831	2 727
18 50	5409	2622	3133	8542	2704	8459	5837	2 726
18 60	5408	2620	3134	8542	2704	8458	5838	2 726
18 70	5412	2618	3136	8549	2706	8460	5842	2 726
18 80	5411	2615	3139	8550	2706	8459	5844	2 724
18 90	5416	2611	3145	8560	2708	8463	5852	2 722
19 00	5420	2607	3148	8568	2710	8465	5858	2 722
19 10	5419	2604	3152	8570	2709	8464	5861	2 719
19 20	5423	2599	3155	8579	2712	8466	5867	2 719
19 30	5428	2594	3160	8588	2714	8468	5874	2 718
19 40	5421	2591	3163	8584	2710	8464	5874	2 714
19 50	5431	2586	3168	8599	2716	8470	5884	2 714
19 60	5424	2580	3174	8598	2712	8466	5886	2 709
19 70	5423	2570	3184	8607	2711	8465	5896	2 703
19 80	5433	2561	3193	8625	2716	8470	5909	2 702
19 90	5431	2564	3190	8622	2716	8470	5906	2 703
20 00	5436	2564	3190	8626	2718	8472	5908	2 704

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Project Name: Taylor Geo-Engineering
Project Number: M00991-001
Sample: CH-5-98
Comments: Samples were compacted to 90% of ASTM D698 at
Test Number: S3

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
0.00	-10	0	11522	11512	-5	11517	11517	1.001
0.02	46	18	11506	11552	23	11547	11529	1.004
0.04	46	30	11493	11539	23	11546	11516	1.004
0.06	54	43	11480	11534	27	11550	11507	1.005
0.08	54	55	11468	11522	27	11550	11495	1.005
0.10	46	67	11457	11502	23	11546	11479	1.004
0.20	45	126	11397	11442	23	11545	11419	1.004
0.30	44	178	11347	11391	22	11547	11369	1.004
0.40	44	224	11300	11343	22	11546	11322	1.004
0.50	51	269	11255	11306	26	11550	11281	1.005
0.60	51	315	11208	11259	25	11549	11234	1.005
0.70	42	357	11166	11208	21	11544	11187	1.004
0.80	41	396	11128	11169	21	11544	11148	1.004
0.90	41	432	11091	11132	20	11543	11111	1.004
1.00	40	470	11054	11094	20	11544	11074	1.004
1.10	39	507	11016	11056	20	11543	11036	1.004
1.20	39	547	10976	11015	19	11543	10996	1.004
1.30	30	587	10937	10967	15	11539	10952	1.003
1.40	29	623	10900	10930	15	11538	10915	1.003
1.50	29	657	10866	10895	14	11538	10881	1.003
1.60	28	691	10832	10861	14	11537	10846	1.003
1.70	27	727	10797	10825	14	11538	10811	1.003
1.80	19	760	10763	10782	10	11533	10773	1.002
1.90	18	792	10733	10751	9	11534	10742	1.002
2.00	18	822	10701	10719	9	11532	10710	1.002
2.10	17	853	10671	10688	9	11532	10679	1.002
2.20	9	883	10640	10649	4	11528	10645	1.001
2.30	16	911	10612	10628	8	11531	10620	1.002
2.40	7	936	10588	10595	4	11527	10591	1.001
2.50	7	967	10556	10563	3	11526	10559	1.001
2.60	6	998	10526	10532	3	11527	10529	1.001
2.70	6	1024	10500	10505	3	11527	10503	1.001
2.80	5	1052	10473	10478	3	11527	10475	1.000
2.90	-3	1078	10446	10443	-2	11522	10444	1.000
3.00	4	1104	10420	10424	2	11526	10422	1.000
3.10	-4	1129	10394	10390	-2	11521	10392	1.000
3.20	-5	1151	10372	10367	-3	11521	10370	1.000
3.30	-6	1176	10347	10342	-3	11521	10345	1.001
3.40	-14	1201	10323	10309	-7	11517	10316	1.001
3.50	-7	1218	10307	10300	-3	11521	10303	1.001
3.60	-7	1240	10283	10276	-4	11519	10279	1.001
3.70	1476	1410	10113	11589	738	12261	10851	1.146
3.80	2203	1545	9979	12182	1102	12625	11080	1.221
3.90	2681	1650	9873	12554	1340	12864	11214	1.272
4.00	3072	1759	9764	12837	1536	13059	11300	1.315
4.10	3401	1884	9639	13040	1701	13224	11340	1.353
4.20	3675	1993	9530	13205	1838	13361	11368	1.386
4.30	3918	2118	9406	13324	1959	13483	11365	1.417
4.40	4145	2245	9278	13423	2072	13596	11351	1.447
4.50	4355	2372	9152	13507	2178	13701	11329	1.476
4.60	4527	2489	9035	13562	2264	13787	11298	1.501
4.70	4691	2605	8919	13610	2346	13869	11264	1.526
4.80	4847	2717	8806	13653	2423	13947	11230	1.550
4.90	4987	2821	8702	13689	2494	14016	11195	1.573
5.00	5111	2921	8602	13714	2556	14079	11158	1.594
5.10	5236	3018	8505	13741	2618	14141	11123	1.616
5.20	5344	3114	8409	13753	2672	14195	11081	1.636

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
5.30	5453	3204	8320	13773	2726	14250	11046	1.655
5.40	5546	3306	8217	13763	2773	14296	10990	1.675
5.50	5638	3400	8123	13762	2819	14343	10943	1.694
5.60	5731	3489	8034	13765	2865	14389	10900	1.713
5.70	5800	3579	7944	13744	2900	14423	10844	1.730
5.80	5885	3664	7860	13744	2942	14466	10802	1.749
5.90	5954	3744	7779	13733	2977	14500	10756	1.765
6.00	6023	3818	7705	13728	3011	14535	10717	1.782
6.10	6084	3894	7629	13713	3042	14565	10671	1.797
6.20	6145	3968	7555	13700	3072	14596	10628	1.813
6.30	6198	4038	7485	13683	3099	14622	10584	1.828
6.40	6251	4105	7418	13670	3126	14649	10544	1.843
6.50	6304	4174	7349	13654	3152	14675	10501	1.858
6.60	6357	4242	7281	13639	3179	14702	10460	1.873
6.70	6395	4305	7218	13613	3198	14721	10416	1.886
6.80	6425	4365	7158	13584	3213	14736	10371	1.898
6.90	6470	4428	7095	13566	3235	14758	10330	1.912
7.00	6508	4490	7033	13541	3254	14777	10287	1.925
7.10	6553	4548	6976	13529	3276	14800	10252	1.939
7.20	6590	4603	6921	13511	3295	14819	10216	1.952
7.30	6620	4658	6867	13487	3310	14835	10177	1.964
7.40	6649	4709	6815	13465	3325	14849	10140	1.976
7.50	6679	4759	6765	13444	3340	14863	10104	1.987
7.60	6716	4801	6723	13439	3358	14882	10081	1.999
7.70	6753	4849	6675	13428	3377	14900	10051	2.012
7.80	6782	4897	6627	13409	3391	14915	10018	2.023
7.90	6811	4951	6573	13384	3406	14929	9979	2.036
8.00	6833	4997	6526	13359	3417	14940	9943	2.047
8.10	6877	5042	6483	13360	3439	14963	9921	2.061
8.20	6906	5086	6437	13343	3453	14976	9890	2.073
8.30	6928	5126	6397	13325	3464	14987	9861	2.083
8.40	6964	5167	6356	13320	3482	15005	9838	2.096
8.50	6993	5206	6319	13311	3496	15021	9815	2.107
8.60	7014	5242	6281	13295	3507	15030	9788	2.117
8.70	7042	5280	6244	13286	3521	15045	9765	2.128
8.80	7064	5317	6206	13270	3532	15055	9738	2.138
8.90	7092	5345	6178	13270	3546	15069	9724	2.148
9.00	7113	5377	6147	13260	3557	15080	9703	2.157
9.10	7141	5414	6109	13250	3571	15094	9680	2.169
9.20	7162	5444	6080	13242	3581	15105	9661	2.178
9.30	7183	5475	6048	13231	3592	15115	9640	2.188
9.40	7204	5508	6015	13219	3602	15125	9617	2.198
9.50	7225	5542	5981	13206	3612	15136	9594	2.208
9.60	7253	5575	5949	13201	3626	15150	9575	2.219
9.70	7266	5601	5923	13189	3633	15156	9556	2.227
9.80	7286	5636	5888	13174	3643	15167	9531	2.238
9.90	7307	5667	5856	13163	3653	15177	9509	2.248
10.00	7313	5698	5826	13138	3656	15180	9482	2.255
10.10	7340	5731	5794	13134	3670	15195	9464	2.267
10.20	7361	5763	5760	13120	3680	15204	9440	2.278
10.30	7373	5794	5730	13103	3687	15210	9416	2.287
10.40	7394	5820	5704	13097	3697	15220	9401	2.296
10.50	7407	5849	5675	13081	3703	15227	9378	2.305
10.60	7419	5876	5648	13067	3710	15233	9357	2.314
10.70	7432	5903	5621	13053	3716	15239	9337	2.322
10.80	7438	5926	5597	13035	3719	15242	9316	2.329
10.90	7457	5951	5573	13030	3729	15252	9301	2.338
11.00	7470	5974	5550	13020	3735	15260	9285	2.346
11.10	7475	5995	5528	13004	3738	15261	9266	2.352
11.20	7495	6016	5507	13002	3748	15271	9255	2.361
11.30	7501	6037	5486	12986	3750	15274	9236	2.367
11.40	7506	6053	5471	12977	3753	15276	9224	2.374
11.50	7518	6070	5453	12971	3759	15283	9212	2.379
11.60	7523	6086	5438	12961	3762	15285	9200	2.384

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
11.70	7536	6107	5417	12953	3768	15291	9185	2.391
11.80	7534	6126	5397	12931	3767	15290	9164	2.396
11.90	7539	6145	5378	12917	3770	15293	9148	2.402
12.00	7551	6164	5359	12911	3776	15299	9135	2.409
12.10	7556	6186	5337	12893	3778	15302	9115	2.416
12.20	7568	6207	5317	12886	3784	15309	9101	2.423
12.30	7580	6230	5294	12874	3790	15314	9084	2.432
12.40	7585	6251	5273	12858	3793	15316	9066	2.439
12.50	7590	6268	5255	12846	3795	15319	9050	2.444
12.60	7609	6287	5237	12846	3805	15328	9041	2.453
12.70	7621	6306	5218	12839	3811	15334	9028	2.461
12.80	7626	6323	5200	12826	3813	15336	9013	2.466
12.90	7645	6341	5183	12827	3822	15346	9005	2.475
13.00	7657	6355	5169	12825	3828	15352	8997	2.481
13.10	7668	6369	5155	12823	3834	15358	8989	2.488
13.20	7687	6382	5142	12829	3844	15367	8985	2.495
13.30	7699	6395	5129	12827	3849	15373	8978	2.501
13.40	7710	6405	5118	12828	3855	15378	8973	2.506
13.50	7722	6416	5108	12829	3861	15384	8968	2.512
13.60	7733	6423	5101	12834	3867	15390	8967	2.516
13.70	7744	6431	5092	12837	3872	15396	8965	2.521
13.80	7749	6438	5085	12834	3875	15398	8960	2.524
13.90	7760	6447	5076	12836	3880	15403	8956	2.529
14.00	7778	6456	5068	12846	3889	15413	8957	2.535
14.10	7783	6465	5058	12841	3891	15415	8950	2.539
14.20	7787	6473	5050	12837	3894	15417	8944	2.542
14.30	7798	6499	5025	12823	3899	15423	8924	2.552
14.40	7802	6514	5010	12813	3901	15426	8912	2.557
14.50	7813	6516	5007	12820	3907	15430	8914	2.561
14.60	7824	6516	5007	12831	3912	15436	8919	2.563
14.70	7829	6518	5006	12834	3914	15438	8920	2.564
14.80	7833	6525	4999	12831	3916	15440	8915	2.567
14.90	7843	6529	4995	12839	3922	15446	8917	2.570
15.00	7847	6536	4987	12834	3924	15447	8911	2.574
15.10	7858	6543	4980	12838	3929	15453	8909	2.578
15.20	7855	6549	4974	12829	3928	15451	8902	2.579
15.30	7873	6556	4967	12840	3936	15460	8904	2.585
15.40	7877	6563	4960	12837	3938	15462	8898	2.588
15.50	7880	6569	4954	12835	3940	15464	8894	2.591
15.60	7884	6560	4964	12848	3942	15466	8906	2.588
15.70	7895	6567	4957	12851	3947	15471	8904	2.593
15.80	7892	6573	4951	12842	3946	15469	8897	2.594
15.90	7895	6574	4950	12845	3948	15471	8897	2.595
16.00	7899	6586	4938	12837	3950	15473	8887	2.600
16.10	7909	6597	4926	12836	3955	15478	8881	2.606
16.20	7906	6606	4918	12824	3953	15477	8871	2.608
16.30	7917	6610	4913	12830	3958	15482	8872	2.611
16.40	7920	6616	4907	12828	3960	15484	8868	2.614
16.50	7924	6622	4902	12825	3962	15485	8863	2.617
16.60	7920	6627	4897	12817	3960	15484	8857	2.617
16.70	7924	6631	4892	12816	3962	15485	8854	2.620
16.80	7927	6638	4885	12812	3964	15487	8849	2.623
16.90	7931	6641	4883	12813	3965	15489	8848	2.624
17.00	7934	6645	4878	12812	3967	15490	8845	2.626
17.10	7944	6652	4871	12815	3972	15495	8843	2.631
17.20	7947	6661	4863	12810	3974	15497	8836	2.634
17.30	7950	6668	4856	12806	3975	15499	8831	2.637
17.40	7960	6670	4854	12814	3980	15504	8834	2.640
17.50	7977	6676	4848	12824	3988	15512	8836	2.645
17.60	7973	6677	4848	12821	3987	15511	8834	2.645
17.70	7976	6679	4844	12820	3988	15512	8832	2.647
17.80	7979	6680	4843	12822	3990	15513	8833	2.648
17.90	7989	6678	4845	12834	3995	15518	8840	2.649
18.00	7999	6677	4847	12845	3999	15523	8846	2.650

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
18.10	8002	6670	4854	12855	4001	15524	8854	2.649
18.20	8005	6665	4858	12863	4002	15526	8861	2.648
18.30	8001	6659	4864	12865	4001	15524	8865	2.645
18.40	8010	6657	4866	12877	4005	15529	8872	2.646
18.50	8020	6651	4872	12892	4010	15533	8882	2.646
18.60	8036	6650	4873	12909	4018	15541	8891	2.649
18.70	8039	6648	4876	12914	4019	15543	8895	2.649
18.80	8041	6644	4879	12921	4021	15544	8900	2.648
18.90	8050	6638	4886	12937	4025	15550	8912	2.648
19.00	8060	6637	4886	12946	4030	15553	8916	2.649
19.10	8049	6635	4889	12938	4025	15548	8913	2.647
19.20	8058	6631	4892	12950	4029	15553	8921	2.647
19.30	8061	6624	4899	12960	4030	15554	8930	2.645
19.40	8070	6621	4902	12971	4035	15557	8937	2.646
19.50	8066	6616	4907	12973	4033	15556	8940	2.644
19.60	8068	6616	4909	12977	4034	15559	8943	2.644
19.70	8077	6610	4913	12990	4039	15562	8952	2.644
19.80	8080	6610	4913	12993	4040	15563	8953	2.644
19.90	8088	6606	4918	13006	4044	15568	8962	2.645
20.00	8084	6594	4930	13014	4042	15566	8972	2.640

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Isotropically Consolidated Undrained with Pore Pressure (CIU/PP)

IGES

Project Name: Taylor Geo-Engineering
Project Number: M00991-001
Sample: SP-16-13
Comments: Samples were compacted to 90% of ASTM D698 at OMC.

Test Number		S1	S2	S3	
Initial	Height, H (in)	5.87	5.82	5.66	
	Diameter, D (in)	2.42	2.42	2.42	
	Moisture Content, w (%)	16.9	16.9	16.9	
	Dry Unit Weight, γd (pcf)	99.9	99.8	99.8	
	Saturation (%)	66.4	66.3	66.2	
	Void Ratio, e	0.69	0.69	0.69	
Before Shear	Moisture Content, w (%)	20.6	19.3	19.0	
	Dry Unit Weight, γd (pcf)	107.1	109.5	110.0	
	Saturation (%)	100.0	100.0	100.0	
	Void Ratio, e	0.56	0.52	0.51	
	B	0.96	0.95	0.96	
	Back pressure (psf)	7343.3	8207.6	4751.5	
	Strain rate (%/min)	0.033	0.033	0.033	
	Time to Failure (min)	606.1	606.1	606.1	
Total Stress	Strain at Failure, εf (%)	20.00	20.00	20.00	
	σ3 (psf)	2880	5759	11524	
	σ1-σ3 (psf)	2443	4466	8909	
	σ1 (psf)	5323	10225	20432	
	q = (σ1-σ3)/2 (psf)	1222	2233	4454	
	p = (σ1+σ3)/2 (psf)	4101	7992	15978	
Effective Stress	u (psf)	1783	3649	7116	
	σ'3 (psf)	1097	2109	4407	
	σ'1-σ'3 (psf)	2443	4466	8909	
	σ'1 (psf)	3541	6576	13316	
	q = (σ'1-σ'3)/2 (psf)	1222	2233	4454	
	p' = (σ'1+σ'3)/2 (psf)	2319	4343	8862	
	σ'1/σ'3	3.23	3.12	3.02	
	A = u/(σ1−σ3)	0.730	0.817	0.799	

Estimated Specific Gravity	2.70
Plastic Limit (%)	16
Liquid Limit (%)	31
Plasticity Index (%)	15

Summary of Strength Paramaters	Total Stress	Effective Stress
c (psf)	84	94
ϕ (deg)	15.9	29.6
tan ϕ	0.284	0.568

* Saturation set to 100% for phase calculations

Tested by: _____

Reviewed: _____

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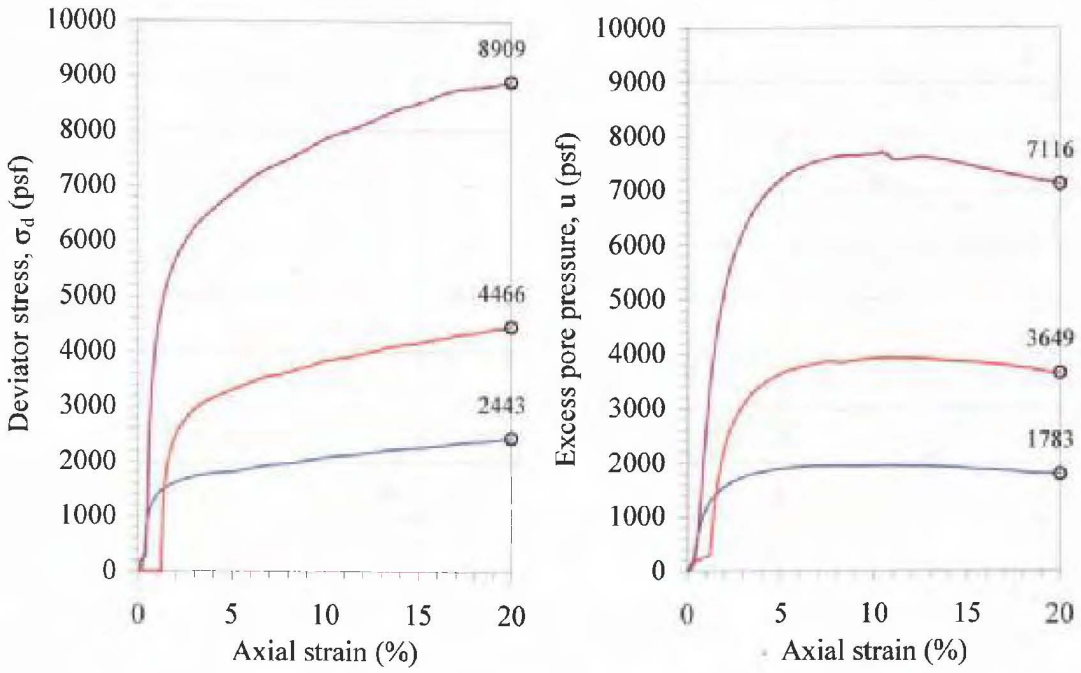
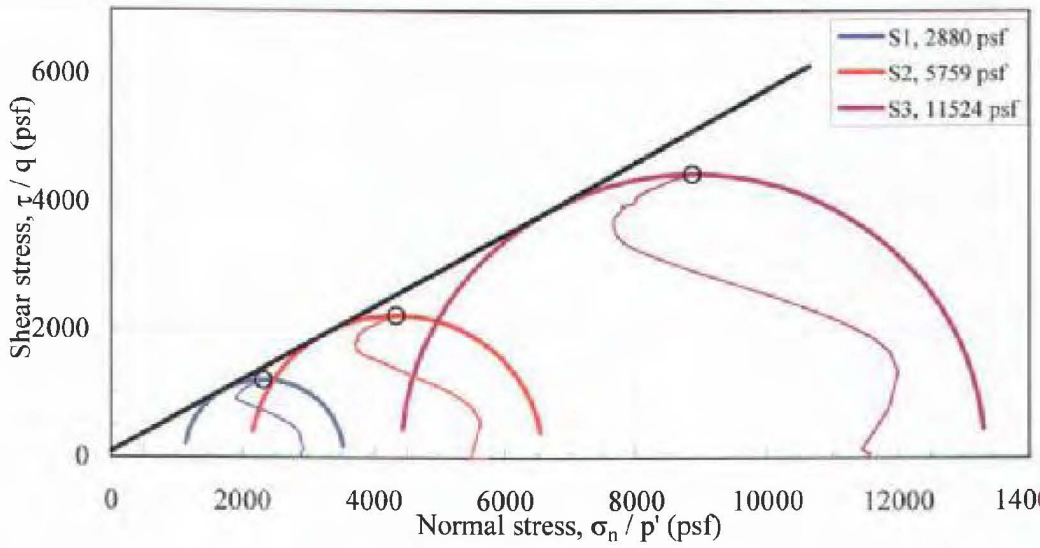
Isotropically Consolidated Undrained with Pore Pressure (CIU/PP)

Project Name: Taylor Geo-Engineering
Project Number: M00991-001
Sample: SP-16-13
Comments:

Summary of Strength Paramaters	Total Stress	Effective Stress
c (psf)	84	94
ϕ (deg)	15.9	29.6
tan ϕ	0.284	0.568





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Project Name: Taylor Geo-Engineering
Project Number: M00991-001
Sample: SP-16-13
Comments: Samples were compacted to 90% of ASTM D698 at
Test Number: S1

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
0.00	-4	0	2879	2874	-2	2877	2877	1.001
0.02	55	21	2857	2912	27	2906	2885	1.019
0.04	55	23	2855	2910	27	2906	2883	1.019
0.06	59	25	2854	2913	29	2908	2883	1.021
0.08	63	27	2853	2916	32	2911	2884	1.022
0.10	63	28	2850	2913	31	2910	2882	1.022
0.20	71	35	2843	2914	35	2914	2879	1.025
0.30	302	116	2761	3064	151	3028	2913	1.109
0.40	811	424	2455	3265	405	3284	2860	1.330
0.50	1003	618	2260	3263	501	3380	2762	1.444
0.60	1123	768	2110	3233	562	3440	2672	1.532
0.70	1206	891	1987	3193	603	3481	2590	1.607
0.80	1279	994	1884	3164	640	3518	2524	1.679
0.90	1336	1079	1800	3136	668	3547	2468	1.742
1.00	1385	1154	1725	3110	692	3571	2417	1.803
1.10	1425	1217	1661	3085	712	3590	2373	1.858
1.20	1456	1273	1605	3062	728	3607	2334	1.907
1.30	1484	1321	1557	3041	742	3620	2299	1.953
1.40	1507	1366	1513	3020	753	3632	2266	1.996
1.50	1534	1405	1473	3007	767	3645	2240	2.041
1.60	1553	1441	1438	2991	776	3655	2214	2.080
1.70	1571	1473	1405	2977	786	3664	2191	2.118
1.80	1586	1505	1374	2960	793	3672	2167	2.155
1.90	1600	1533	1345	2946	800	3679	2146	2.190
2.00	1615	1559	1320	2935	808	3686	2127	2.224
2.10	1629	1581	1297	2927	815	3693	2112	2.256
2.20	1644	1605	1274	2918	822	3701	2096	2.290
2.30	1658	1624	1255	2914	829	3709	2084	2.321
2.40	1669	1643	1235	2904	834	3713	2070	2.351
2.50	1679	1661	1218	2897	839	3718	2057	2.379
2.60	1693	1677	1201	2895	847	3725	2048	2.409
2.70	1699	1694	1185	2884	850	3728	2035	2.434
2.80	1713	1709	1171	2884	857	3737	2028	2.463
2.90	1724	1722	1157	2881	862	3740	2019	2.490
3.00	1730	1735	1144	2874	865	3743	2009	2.512
3.10	1736	1746	1132	2868	868	3746	2000	2.533
3.20	1742	1758	1121	2862	871	3749	1991	2.554
3.30	1748	1767	1112	2860	874	3753	1986	2.571
3.40	1754	1778	1101	2854	877	3755	1977	2.593
3.50	1759	1787	1091	2851	880	3758	1971	2.612
3.60	1765	1797	1082	2847	883	3761	1965	2.632
3.70	1771	1805	1074	2845	886	3764	1959	2.650
3.80	1773	1813	1067	2840	887	3766	1953	2.662
3.90	1779	1820	1060	2839	889	3769	1949	2.679
4.00	1781	1827	1053	2833	890	3770	1943	2.692
4.10	1783	1834	1044	2827	891	3770	1936	2.707
4.20	1788	1839	1040	2828	894	3773	1934	2.720
4.30	1790	1846	1033	2823	895	3774	1928	2.733
4.40	1796	1852	1027	2823	898	3776	1925	2.749
4.50	1802	1858	1021	2823	901	3779	1922	2.765
4.60	1803	1863	1015	2819	902	3780	1917	2.776
4.70	1805	1868	1012	2817	903	3782	1914	2.784
4.80	1811	1874	1006	2817	905	3785	1911	2.800
4.90	1817	1879	1000	2817	908	3787	1908	2.817
5.00	1818	1882	996	2815	909	3788	1906	2.825
5.10	1824	1887	992	2816	912	3791	1904	2.839
5.20	1830	1893	986	2816	915	3793	1901	2.856

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
5.30	1835	1897	982	2818	918	3797	1900	2.868
5.40	1841	1897	981	2822	921	3799	1902	2.876
5.50	1847	1900	979	2826	923	3802	1902	2.887
5.60	1852	1903	975	2828	926	3805	1902	2.899
5.70	1862	1908	971	2833	931	3810	1902	2.918
5.80	1867	1911	968	2836	934	3813	1902	2.929
5.90	1873	1914	965	2838	937	3815	1901	2.941
6.00	1879	1917	962	2841	939	3819	1902	2.952
6.10	1888	1918	960	2848	944	3823	1904	2.967
6.20	1898	1922	958	2855	949	3828	1907	2.981
6.30	1903	1923	955	2859	952	3830	1907	2.992
6.40	1905	1927	952	2857	952	3831	1904	3.001
6.50	1910	1929	951	2861	955	3835	1906	3.009
6.60	1919	1931	947	2867	960	3838	1907	3.026
6.70	1925	1932	946	2871	962	3841	1909	3.035
6.80	1926	1934	945	2871	963	3842	1908	3.039
6.90	1932	1935	944	2876	966	3844	1910	3.047
7.00	1937	1936	943	2880	969	3847	1911	3.055
7.10	1942	1938	941	2884	971	3851	1913	3.063
7.20	1944	1938	940	2884	972	3851	1912	3.068
7.30	1945	1938	940	2886	973	3851	1913	3.069
7.40	1951	1940	939	2890	975	3854	1914	3.077
7.50	1952	1941	938	2890	976	3855	1914	3.081
7.60	1957	1943	937	2894	979	3858	1915	3.090
7.70	1959	1942	937	2896	979	3858	1916	3.091
7.80	1960	1941	938	2898	980	3859	1918	3.090
7.90	1965	1940	939	2905	983	3861	1922	3.093
8.00	1971	1940	939	2910	985	3864	1924	3.099
8.10	1972	1938	940	2912	986	3865	1926	3.097
8.20	1977	1938	940	2918	989	3867	1929	3.103
8.30	1982	1937	941	2924	991	3870	1933	3.106
8.40	1992	1938	940	2932	996	3874	1936	3.118
8.50	1997	1937	941	2938	998	3877	1940	3.121
8.60	2002	1938	940	2942	1001	3879	1941	3.129
8.70	2011	1937	941	2952	1005	3884	1947	3.136
8.80	2012	1937	941	2954	1006	3885	1947	3.137
8.90	2017	1938	940	2957	1009	3887	1949	3.146
9.00	2022	1938	940	2963	1011	3890	1951	3.151
9.10	2027	1940	940	2968	1014	3893	1954	3.156
9.20	2032	1935	944	2976	1016	3895	1960	3.154
9.30	2038	1932	945	2982	1019	3896	1964	3.156
9.40	2046	1930	947	2994	1023	3901	1970	3.160
9.50	2051	1934	945	2996	1026	3904	1971	3.171
9.60	2056	1936	943	2999	1028	3907	1971	3.182
9.70	2065	1937	941	3007	1033	3911	1974	3.194
9.80	2070	1938	940	3010	1035	3914	1975	3.202
9.90	2071	1940	939	3010	1036	3914	1975	3.206
10.00	2080	1941	938	3018	1040	3918	1978	3.218
10.10	2085	1942	937	3022	1042	3921	1979	3.226
10.20	2090	1943	937	3026	1045	3925	1982	3.231
10.30	2091	1943	936	3026	1045	3924	1981	3.235
10.40	2099	1944	934	3034	1050	3928	1984	3.247
10.50	2100	1944	934	3035	1050	3929	1985	3.248
10.60	2105	1944	936	3041	1053	3932	1988	3.250
10.70	2106	1944	936	3042	1053	3933	1989	3.251
10.80	2111	1944	932	3043	1056	3932	1988	3.265
10.90	2112	1943	936	3048	1056	3935	1992	3.258
11.00	2113	1943	936	3049	1057	3935	1992	3.259
11.10	2118	1943	936	3054	1059	3938	1995	3.264
11.20	2119	1942	937	3056	1060	3938	1996	3.262
11.30	2120	1943	937	3057	1060	3940	1997	3.263
11.40	2125	1942	937	3061	1062	3941	1999	3.268
11.50	2129	1941	938	3067	1065	3943	2003	3.270
11.60	2130	1941	938	3068	1065	3944	2003	3.271

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
11.70	2135	1940	940	3075	1068	3947	2008	3.271
11.80	2140	1938	940	3080	1070	3948	2010	3.276
11.90	2144	1938	940	3085	1072	3951	2012	3.281
12.00	2149	1937	941	3090	1074	3953	2016	3.283
12.10	2153	1937	943	3096	1077	3956	2019	3.285
12.20	2158	1936	943	3101	1079	3958	2022	3.290
12.30	2163	1935	944	3106	1081	3960	2025	3.292
12.40	2167	1934	945	3112	1084	3962	2029	3.294
12.50	2172	1932	946	3118	1086	3964	2032	3.296
12.60	2176	1932	946	3122	1088	3967	2034	3.300
12.70	2181	1932	947	3128	1090	3970	2038	3.302
12.80	2182	1929	950	3131	1091	3969	2040	3.297
12.90	2186	1929	950	3136	1093	3972	2043	3.302
13.00	2194	1928	951	3145	1097	3976	2048	3.308
13.10	2199	1925	953	3152	1099	3978	2053	3.307
13.20	2207	1925	954	3161	1103	3983	2058	3.313
13.30	2211	1923	955	3167	1106	3984	2061	3.314
13.40	2216	1922	957	3172	1108	3986	2064	3.316
13.50	2220	1920	959	3179	1110	3989	2069	3.315
13.60	2224	1918	960	3185	1112	3991	2072	3.317
13.70	2229	1917	961	3190	1114	3993	2076	3.318
13.80	2233	1915	964	3197	1117	3995	2080	3.317
13.90	2237	1914	965	3202	1119	3997	2084	3.319
14.00	2242	1911	967	3209	1121	3999	2088	3.318
14.10	2242	1910	968	3211	1121	4000	2090	3.316
14.20	2247	1909	969	3216	1123	4002	2093	3.317
14.30	2247	1907	973	3220	1124	4003	2097	3.310
14.40	2251	1911	968	3220	1126	4006	2094	3.325
14.50	2252	1909	969	3222	1126	4005	2096	3.323
14.60	2256	1907	973	3229	1128	4008	2101	3.319
14.70	2257	1896	982	3239	1129	4007	2111	3.297
14.80	2258	1894	985	3242	1129	4007	2114	3.293
14.90	2254	1892	987	3242	1127	4006	2114	3.284
15.00	2262	1889	989	3252	1131	4010	2121	3.286
15.10	2263	1886	993	3256	1131	4010	2124	3.279
15.20	2263	1884	995	3259	1132	4011	2127	3.274
15.30	2264	1882	996	3260	1132	4011	2128	3.272
15.40	2272	1881	999	3270	1136	4016	2135	3.274
15.50	2276	1879	1000	3276	1138	4016	2138	3.276
15.60	2283	1877	1002	3286	1142	4021	2144	3.278
15.70	2287	1875	1004	3291	1144	4022	2147	3.280
15.80	2291	1874	1005	3296	1146	4024	2150	3.281
15.90	2296	1870	1008	3304	1148	4026	2156	3.277
16.00	2300	1870	1008	3308	1150	4028	2158	3.281
16.10	2300	1868	1012	3312	1150	4030	2162	3.273
16.20	2304	1865	1014	3318	1152	4031	2166	3.272
16.30	2304	1863	1015	3320	1152	4031	2167	3.270
16.40	2308	1862	1016	3325	1154	4033	2171	3.271
16.50	2316	1861	1018	3333	1158	4036	2175	3.276
16.60	2320	1860	1019	3338	1160	4038	2179	3.277
16.70	2324	1859	1021	3345	1162	4042	2183	3.276
16.80	2328	1856	1022	3350	1164	4042	2186	3.277
16.90	2335	1854	1025	3359	1167	4046	2192	3.279
17.00	2342	1852	1028	3370	1171	4051	2199	3.278
17.10	2350	1851	1028	3378	1175	4053	2203	3.285
17.20	2353	1854	1026	3379	1177	4056	2202	3.294
17.30	2357	1851	1028	3385	1179	4057	2207	3.293
17.40	2357	1846	1034	3391	1179	4058	2213	3.280
17.50	2365	1841	1039	3403	1182	4062	2221	3.277
17.60	2365	1836	1042	3407	1183	4061	2225	3.269
17.70	2369	1834	1044	3413	1184	4063	2229	3.268
17.80	2372	1831	1049	3422	1186	4066	2235	3.261
17.90	2373	1826	1053	3425	1186	4065	2239	3.254
18.00	2373	1819	1060	3433	1187	4065	2246	3.239

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
18.10	2380	1814	1064	3444	1190	4069	2254	3.236
18.20	2377	1808	1070	3447	1188	4067	2259	3.221
18.30	2377	1804	1075	3452	1189	4067	2263	3.211
18.40	2381	1802	1076	3457	1190	4069	2266	3.212
18.50	2384	1800	1078	3463	1192	4071	2271	3.211
18.60	2388	1799	1080	3467	1194	4072	2274	3.212
18.70	2395	1797	1082	3477	1197	4076	2279	3.214
18.80	2398	1794	1084	3483	1199	4078	2284	3.212
18.90	2405	1793	1087	3492	1203	4082	2289	3.214
19.00	2406	1793	1085	3491	1203	4081	2288	3.216
19.10	2412	1792	1087	3499	1206	4085	2293	3.220
19.20	2416	1791	1088	3504	1208	4087	2296	3.221
19.30	2419	1788	1090	3510	1210	4088	2300	3.219
19.40	2423	1787	1091	3514	1212	4090	2303	3.220
19.50	2426	1786	1093	3519	1213	4092	2306	3.221
19.60	2426	1784	1095	3521	1213	4092	2308	3.216
19.70	2433	1783	1096	3529	1217	4095	2313	3.220
19.80	2433	1783	1096	3529	1217	4095	2313	3.220
19.90	2437	1786	1093	3529	1218	4097	2311	3.230
20.00	2443	1783	1097	3541	1222	4101	2319	3.227

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Project Name: Taylor Geo-Engineering
Project Number: M00991-001
Sample: SP-16-13
Comments: Samples were compacted to 90% of ASTM D698 at
Test Number: S2

Z:\PROJECTS\M00991 Taylor Geo-Engineering\001\[GTXCU3v1 SP-16-13.xls]s2

Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
0.00	-5	0	5758	5753	-3	5755	5755	1.001
0.02	4	23	5736	5740	2	5762	5738	1.001
0.04	4	39	5720	5724	2	5760	5722	1.001
0.06	-1	52	5707	5706	0	5758	5707	1.000
0.08	3	63	5695	5699	2	5760	5697	1.001
0.10	3	74	5685	5688	2	5760	5687	1.001
0.20	-2	115	5644	5642	-1	5758	5643	1.000
0.30	-2	146	5613	5611	-1	5759	5612	1.000
0.40	-3	169	5591	5589	-1	5759	5590	1.000
0.50	-3	185	5574	5571	-1	5757	5572	1.001
0.60	-3	203	5556	5553	-2	5757	5554	1.001
0.70	-4	218	5541	5537	-2	5757	5539	1.001
0.80	-4	233	5526	5521	-2	5757	5524	1.001
0.90	-5	248	5512	5507	-2	5757	5509	1.001
1.00	-5	261	5499	5494	-3	5757	5496	1.001
1.10	-6	275	5485	5479	-3	5757	5482	1.001
1.20	-2	286	5474	5472	-1	5759	5473	1.000
1.30	1148	702	5057	6205	574	6333	5631	1.227
1.40	1593	1068	4691	6284	797	6555	5487	1.340
1.50	1847	1350	4408	6255	923	6682	5332	1.419
1.60	2030	1593	4166	6196	1015	6774	5181	1.487
1.70	2171	1801	3957	6128	1085	6844	5043	1.548
1.80	2293	1992	3767	6060	1147	6905	4913	1.609
1.90	2390	2154	3605	5995	1195	6954	4800	1.663
2.00	2473	2293	3466	5938	1237	6995	4702	1.714
2.10	2547	2414	3345	5892	1274	7032	4619	1.762
2.20	2613	2524	3236	5849	1307	7066	4543	1.808
2.30	2666	2614	3145	5811	1333	7092	4478	1.848
2.40	2718	2697	3081	5799	1359	7138	4440	1.882
2.50	2767	2776	2983	5750	1383	7142	4366	1.928
2.60	2811	2850	2909	5720	1405	7164	4315	1.966
2.70	2854	2914	2845	5699	1427	7186	4272	2.003
2.80	2890	2974	2785	5675	1445	7203	4230	2.038
2.90	2925	3030	2729	5653	1462	7221	4191	2.072
3.00	2955	3081	2679	5634	1478	7237	4156	2.103
3.10	2982	3125	2634	5616	1491	7250	4125	2.132
3.20	3008	3167	2592	5600	1504	7263	4096	2.161
3.30	3038	3206	2553	5592	1519	7278	4072	2.190
3.40	3056	3249	2510	5566	1528	7287	4038	2.218
3.50	3078	3285	2474	5551	1539	7298	4012	2.244
3.60	3100	3318	2442	5542	1550	7310	3992	2.269
3.70	3113	3351	2408	5521	1557	7315	3964	2.293
3.80	3122	3380	2380	5502	1561	7321	3941	2.312
3.90	3144	3407	2352	5495	1572	7331	3924	2.337
4.00	3153	3428	2331	5483	1576	7335	3907	2.353
4.10	3170	3452	2307	5477	1585	7344	3892	2.374
4.20	3183	3476	2283	5466	1592	7350	3874	2.395
4.30	3196	3500	2259	5456	1598	7357	3857	2.415
4.40	3214	3518	2240	5454	1607	7365	3847	2.434
4.50	3227	3541	2218	5445	1613	7372	3831	2.455
4.60	3244	3560	2199	5443	1622	7382	3821	2.475
4.70	3261	3579	2181	5442	1630	7390	3811	2.495
4.80	3278	3597	2163	5441	1639	7399	3802	2.515
4.90	3287	3615	2143	5430	1643	7402	3787	2.533
5.00	3304	3631	2128	5432	1652	7411	3780	2.552
5.10	3316	3646	2113	5429	1658	7417	3771	2.570
5.20	3329	3656	2102	5431	1665	7423	3767	2.584

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
5.30	3346	3668	2091	5437	1673	7432	3764	2.601
5.40	3355	3685	2074	5429	1677	7436	3751	2.617
5.50	3363	3696	2062	5426	1682	7440	3744	2.631
5.60	3376	3709	2050	5425	1688	7447	3737	2.647
5.70	3392	3721	2038	5430	1696	7455	3734	2.665
5.80	3405	3731	2027	5432	1703	7461	3730	2.680
5.90	3422	3741	2018	5440	1711	7470	3729	2.696
6.00	3434	3750	2009	5443	1717	7476	3726	2.710
6.10	3451	3761	1998	5449	1725	7484	3723	2.727
6.20	3463	3764	1995	5458	1732	7490	3726	2.736
6.30	3480	3771	1988	5467	1740	7499	3727	2.751
6.40	3492	3779	1979	5471	1746	7505	3725	2.764
6.50	3500	3789	1970	5470	1750	7509	3720	2.777
6.60	3512	3798	1962	5474	1756	7516	3718	2.790
6.70	3529	3806	1952	5481	1764	7523	3717	2.807
6.80	3537	3812	1948	5484	1768	7528	3716	2.816
6.90	3545	3819	1939	5484	1773	7531	3712	2.828
7.00	3549	3825	1934	5482	1774	7533	3708	2.835
7.10	3557	3831	1928	5485	1779	7537	3706	2.845
7.20	3565	3843	1916	5481	1783	7541	3699	2.861
7.30	3573	3854	1904	5477	1786	7545	3691	2.876
7.40	3573	3856	1903	5476	1786	7545	3690	2.877
7.50	3581	3858	1901	5481	1790	7549	3691	2.884
7.60	3584	3857	1902	5486	1792	7551	3694	2.885
7.70	3600	3854	1904	5505	1800	7559	3705	2.891
7.80	3604	3854	1904	5509	1802	7561	3706	2.893
7.90	3616	3851	1908	5524	1808	7567	3716	2.895
8.00	3624	3842	1917	5541	1812	7571	3729	2.890
8.10	3640	3834	1924	5564	1820	7579	3744	2.892
8.20	3644	3832	1927	5570	1822	7580	3748	2.891
8.30	3655	3837	1922	5577	1828	7586	3750	2.902
8.40	3667	3842	1917	5584	1834	7592	3751	2.913
8.50	3679	3850	1910	5589	1839	7599	3750	2.926
8.60	3694	3857	1902	5596	1847	7606	3749	2.942
8.70	3706	3863	1896	5602	1853	7612	3749	2.955
8.80	3713	3868	1890	5604	1857	7615	3747	2.965
8.90	3725	3874	1884	5609	1863	7621	3747	2.977
9.00	3729	3879	1880	5608	1864	7623	3744	2.984
9.10	3740	3885	1874	5614	1870	7629	3744	2.996
9.20	3748	3888	1870	5618	1874	7632	3744	3.004
9.30	3759	3893	1866	5625	1880	7638	3745	3.015
9.40	3774	3898	1862	5636	1887	7647	3749	3.027
9.50	3786	3901	1859	5644	1893	7653	3751	3.037
9.60	3797	3905	1854	5651	1899	7657	3752	3.048
9.70	3808	3908	1850	5659	1904	7663	3755	3.058
9.80	3816	3911	1848	5664	1908	7666	3756	3.065
9.90	3831	3913	1847	5678	1915	7675	3762	3.074
10.00	3838	3914	1845	5683	1919	7678	3764	3.081
10.10	3845	3916	1843	5689	1923	7682	3766	3.086
10.20	3852	3918	1841	5693	1926	7685	3767	3.092
10.30	3856	3918	1841	5697	1928	7686	3769	3.094
10.40	3863	3919	1841	5704	1931	7691	3772	3.098
10.50	3870	3921	1839	5708	1935	7695	3774	3.105
10.60	3877	3921	1838	5714	1938	7697	3776	3.110
10.70	3880	3922	1836	5716	1940	7699	3776	3.113
10.80	3883	3922	1836	5719	1942	7700	3778	3.114
10.90	3890	3922	1836	5726	1945	7704	3781	3.118
11.00	3893	3924	1835	5728	1947	7705	3782	3.121
11.10	3892	3922	1838	5730	1946	7706	3784	3.118
11.20	3899	3922	1838	5737	1950	7709	3787	3.122
11.30	3906	3922	1836	5743	1953	7712	3789	3.127
11.40	3921	3922	1836	5757	1960	7719	3797	3.135
11.50	3924	3921	1838	5761	1962	7721	3799	3.135
11.60	3934	3921	1838	5772	1967	7726	3805	3.141

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
11.70	3941	3920	1840	5781	1971	7730	3811	3.142
11.80	3952	3920	1840	5792	1976	7736	3816	3.148
11.90	3959	3919	1840	5799	1979	7738	3819	3.152
12.00	3969	3918	1841	5810	1985	7743	3826	3.156
12.10	3980	3916	1842	5822	1990	7749	3832	3.160
12.20	3990	3915	1843	5834	1995	7754	3839	3.165
12.30	3989	3913	1846	5835	1995	7753	3840	3.161
12.40	4000	3913	1846	5846	2000	7759	3846	3.167
12.50	4010	3911	1849	5859	2005	7765	3854	3.169
12.60	4017	3909	1849	5866	2008	7767	3858	3.172
12.70	4023	3907	1853	5876	2012	7772	3864	3.171
12.80	4030	3905	1855	5885	2015	7775	3870	3.172
12.90	4040	3904	1855	5895	2020	7779	3875	3.178
13.00	4047	3900	1859	5905	2023	7782	3882	3.177
13.10	4061	3899	1860	5920	2030	7789	3890	3.183
13.20	4075	3897	1862	5937	2037	7796	3900	3.188
13.30	4081	3894	1865	5946	2041	7799	3905	3.189
13.40	4084	3891	1868	5952	2042	7801	3910	3.186
13.50	4094	3890	1869	5963	2047	7806	3916	3.190
13.60	4104	3886	1873	5976	2052	7811	3925	3.191
13.70	4106	3885	1874	5980	2053	7812	3927	3.191
13.80	4112	3880	1879	5991	2056	7815	3935	3.189
13.90	4119	3879	1880	5998	2059	7818	3939	3.191
14.00	4121	3875	1883	6004	2061	7819	3944	3.188
14.10	4127	3873	1887	6014	2064	7823	3950	3.187
14.20	4133	3871	1888	6021	2067	7825	3955	3.189
14.30	4136	3868	1890	6026	2068	7827	3958	3.188
14.40	4138	3866	1893	6031	2069	7828	3962	3.186
14.50	4136	3863	1896	6033	2068	7827	3964	3.182
14.60	4143	3860	1898	6041	2071	7830	3970	3.182
14.70	4145	3859	1900	6044	2072	7831	3972	3.182
14.80	4147	3856	1904	6051	2074	7833	3978	3.178
14.90	4157	3852	1907	6063	2078	7837	3985	3.180
15.00	4163	3850	1909	6072	2081	7840	3990	3.181
15.10	4169	3849	1910	6079	2084	7843	3995	3.182
15.20	4178	3846	1914	6092	2089	7849	4003	3.183
15.30	4188	3843	1916	6104	2094	7853	4010	3.186
15.40	4194	3840	1918	6112	2097	7856	4015	3.186
15.50	4203	3838	1921	6124	2102	7860	4022	3.188
15.60	4209	3836	1923	6132	2105	7863	4028	3.189
15.70	4215	3833	1927	6141	2107	7867	4034	3.188
15.80	4217	3830	1929	6146	2108	7867	4037	3.186
15.90	4223	3826	1932	6155	2111	7870	4044	3.185
16.00	4232	3823	1936	6168	2116	7875	4052	3.186
16.10	4238	3820	1938	6176	2119	7877	4057	3.186
16.20	4243	3817	1942	6185	2122	7880	4063	3.185
16.30	4249	3813	1945	6194	2124	7883	4070	3.184
16.40	4251	3810	1949	6200	2125	7884	4074	3.181
16.50	4260	3808	1951	6211	2130	7889	4081	3.183
16.60	4269	3804	1955	6224	2135	7893	4089	3.184
16.70	4275	3799	1959	6234	2137	7896	4097	3.182
16.80	4291	3797	1963	6254	2146	7905	4108	3.186
16.90	4300	3795	1964	6264	2150	7909	4114	3.189
17.00	4306	3791	1968	6273	2153	7911	4120	3.188
17.10	4311	3788	1971	6282	2156	7914	4127	3.187
17.20	4316	3782	1977	6293	2158	7917	4135	3.183
17.30	4322	3778	1980	6302	2161	7920	4141	3.182
17.40	4327	3774	1985	6312	2164	7922	4149	3.180
17.50	4329	3768	1991	6320	2164	7923	4155	3.174
17.60	4334	3763	1996	6330	2167	7926	4163	3.172
17.70	4335	3758	2000	6336	2168	7926	4168	3.167
17.80	4337	3754	2006	6343	2169	7928	4175	3.162
17.90	4342	3750	2009	6351	2171	7930	4180	3.162
18.00	4344	3745	2013	6357	2172	7931	4185	3.160

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
18.10	4353	3740	2019	6372	2176	7935	4195	3.156
18.20	4358	3735	2024	6381	2179	7938	4203	3.153
18.30	4363	3729	2031	6394	2181	7941	4212	3.148
18.40	4375	3738	2021	6396	2188	7947	4209	3.164
18.50	4380	3735	2024	6404	2190	7949	4214	3.164
18.60	4392	3712	2047	6439	2196	7955	4243	3.145
18.70	4394	3699	2061	6455	2197	7957	4258	3.132
18.80	4402	3689	2069	6472	2201	7960	4271	3.127
18.90	4407	3682	2077	6484	2204	7962	4280	3.122
19.00	4412	3678	2081	6493	2206	7965	4287	3.120
19.10	4420	3672	2087	6507	2210	7969	4297	3.118
19.20	4422	3666	2093	6515	2211	7970	4304	3.113
19.30	4426	3660	2099	6525	2213	7972	4312	3.109
19.40	4431	3656	2102	6534	2216	7974	4318	3.108
19.50	4436	3653	2106	6542	2218	7977	4324	3.107
19.60	4441	3648	2110	6551	2220	7979	4331	3.104
19.70	4445	3647	2112	6557	2223	7981	4334	3.105
19.80	4454	3642	2116	6570	2227	7986	4343	3.104
19.90	4462	3654	2106	6568	2231	7991	4337	3.119
20.00	4466	3649	2109	6576	2233	7992	4343	3.118

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Project Name: Taylor Geo-Engineering
Project Number: M00991-001
Sample: SP-16-13
Comments: Samples were compacted to 90% of ASTM D698 at
Test Number: S3

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
0.00	-14	0	11521	11507	-7	11514	11514	1.001
0.02	148	30	11492	11640	74	11596	11566	1.013
0.04	148	46	11477	11624	74	11596	11550	1.013
0.06	156	61	11461	11618	78	11601	11540	1.014
0.08	165	74	11450	11615	83	11606	11532	1.014
0.10	174	87	11436	11610	87	11610	11523	1.015
0.20	205	138	11385	11590	102	11626	11488	1.018
0.30	236	182	11341	11577	118	11641	11459	1.021
0.40	271	219	11303	11574	135	11658	11439	1.024
0.50	1560	450	11073	12632	780	12302	11852	1.141
0.60	2694	881	10642	13335	1347	12869	11988	1.253
0.70	3312	1313	10208	13520	1656	13177	11864	1.324
0.80	3750	1787	9735	13485	1875	13397	11610	1.385
0.90	4075	2255	9269	13344	2038	13562	11307	1.440
1.00	4347	2673	8850	13197	2174	13696	11023	1.491
1.10	4569	3058	8464	13034	2285	13807	10749	1.540
1.20	4764	3407	8115	12880	2382	13905	10498	1.587
1.30	4928	3710	7812	12740	2464	13986	10276	1.631
1.40	5069	3986	7537	12606	2534	14057	10071	1.673
1.50	5196	4226	7297	12493	2598	14120	9895	1.712
1.60	5310	4453	7068	12378	2655	14176	9723	1.751
1.70	5410	4655	6867	12277	2705	14228	9572	1.788
1.80	5502	4848	6675	12176	2751	14273	9426	1.824
1.90	5597	5021	6503	12100	2799	14322	9301	1.861
2.00	5675	5181	6341	12016	2837	14360	9178	1.895
2.10	5748	5331	6191	11939	2874	14396	9065	1.928
2.20	5821	5472	6051	11871	2910	14433	8961	1.962
2.30	5885	5599	5923	11807	2942	14465	8865	1.994
2.40	5940	5718	5805	11744	2970	14492	8774	2.023
2.50	6003	5831	5691	11694	3002	14524	8693	2.055
2.60	6058	5923	5600	11658	3029	14551	8629	2.082
2.70	6108	6014	5508	11617	3054	14577	8563	2.109
2.80	6154	6103	5419	11573	3077	14599	8496	2.136
2.90	6200	6187	5335	11535	3100	14622	8435	2.162
3.00	6245	6272	5251	11496	3123	14645	8373	2.189
3.10	6286	6348	5175	11461	3143	14666	8318	2.215
3.20	6323	6418	5104	11427	3162	14684	8266	2.239
3.30	6360	6484	5039	11398	3180	14702	8219	2.262
3.40	6396	6546	4977	11373	3198	14720	8175	2.285
3.50	6428	6609	4915	11343	3214	14738	8129	2.308
3.60	6460	6656	4867	11327	3230	14752	8097	2.327
3.70	6488	6706	4816	11304	3244	14766	8060	2.347
3.80	6519	6754	4768	11287	3260	14782	8028	2.367
3.90	6551	6802	4720	11271	3276	14798	7996	2.388
4.00	6578	6848	4675	11253	3289	14812	7964	2.407
4.10	6606	6895	4628	11233	3303	14825	7930	2.427
4.20	6633	6933	4589	11222	3316	14839	7905	2.445
4.30	6664	6974	4548	11212	3332	14854	7880	2.465
4.40	6695	7011	4513	11208	3348	14871	7861	2.484
4.50	6727	7047	4475	11202	3363	14886	7839	2.503
4.60	6749	7085	4438	11187	3375	14897	7813	2.521
4.70	6776	7107	4416	11192	3388	14910	7804	2.535
4.80	6807	7135	4388	11195	3404	14926	7791	2.551
4.90	6829	7165	4357	11187	3415	14937	7772	2.567
5.00	6860	7190	4333	11193	3430	14953	7763	2.583
5.10	6887	7220	4302	11189	3443	14966	7745	2.601
5.20	6913	7246	4276	11190	3457	14979	7733	2.617

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
5.30	6940	7272	4231	11190	3470	14992	7720	2.633
5.40	6966	7297	4226	11192	3483	15005	7709	2.648
5.50	6992	7319	4204	11196	3496	15018	7700	2.663
5.60	7018	7340	4184	11202	3509	15033	7693	2.678
5.70	7049	7360	4163	11211	3524	15047	7687	2.693
5.80	7079	7376	4146	11225	3540	15062	7686	2.707
5.90	7105	7390	4132	11237	3552	15075	7685	2.719
6.00	7126	7404	4118	11245	3563	15086	7681	2.731
6.10	7148	7418	4104	11252	3574	15096	7678	2.742
6.20	7174	7436	4087	11260	3587	15109	7673	2.755
6.30	7200	7451	4071	11271	3600	15122	7671	2.768
6.40	7217	7467	4056	11273	3608	15132	7664	2.779
6.50	7234	7482	4041	11275	3617	15139	7658	2.790
6.60	7255	7496	4027	11282	3628	15150	7654	2.802
6.70	7276	7508	4014	11290	3638	15160	7652	2.813
6.80	7293	7519	4003	11297	3647	15169	7650	2.822
6.90	7310	7532	3991	11300	3655	15177	7646	2.832
7.00	7327	7541	3981	11308	3663	15186	7645	2.840
7.10	7344	7547	3975	11319	3672	15194	7647	2.847
7.20	7352	7553	3969	11321	3676	15198	7645	2.852
7.30	7373	7559	3964	11336	3686	15209	7650	2.860
7.40	7381	7569	3954	11335	3691	15214	7645	2.867
7.50	7402	7580	3943	11344	3701	15223	7643	2.877
7.60	7419	7588	3934	11353	3709	15232	7644	2.886
7.70	7431	7596	3926	11357	3715	15238	7642	2.893
7.80	7447	7605	3918	11365	3724	15246	7642	2.901
7.90	7464	7614	3910	11373	3732	15255	7641	2.909
8.00	7480	7619	3904	11384	3740	15262	7644	2.916
8.10	7496	7622	3900	11396	3748	15270	7648	2.922
8.20	7517	7627	3897	11413	3758	15282	7655	2.929
8.30	7533	7633	3891	11424	3766	15290	7657	2.936
8.40	7553	7637	3885	11438	3777	15299	7662	2.944
8.50	7569	7640	3883	11452	3785	15307	7667	2.949
8.60	7589	7643	3879	11468	3795	15317	7674	2.956
8.70	7605	7638	3884	11489	3803	15325	7686	2.958
8.80	7625	7636	3886	11511	3813	15335	7699	2.962
8.90	7645	7637	3885	11530	3823	15345	7708	2.968
9.00	7665	7638	3884	11549	3832	15355	7716	2.973
9.10	7685	7640	3883	11567	3842	15365	7725	2.979
9.20	7708	7642	3880	11589	3854	15377	7735	2.986
9.30	7728	7646	3877	11605	3864	15386	7741	2.993
9.40	7752	7649	3873	11625	3876	15398	7749	3.001
9.50	7767	7649	3873	11641	3884	15406	7757	3.005
9.60	7791	7654	3869	11659	3895	15418	7764	3.014
9.70	7810	7654	3869	11679	3905	15428	7774	3.019
9.80	7825	7656	3866	11692	3913	15435	7779	3.024
9.90	7849	7658	3865	11714	3924	15448	7790	3.031
10.00	7860	7660	3863	11723	3930	15452	7793	3.035
10.10	7875	7660	3864	11739	3938	15461	7802	3.038
10.20	7890	7658	3864	11754	3945	15467	7809	3.042
10.30	7905	7695	3829	11734	3953	15476	7782	3.065
10.40	7916	7708	3815	11731	3958	15480	7773	3.075
10.50	7927	7698	3824	11751	3964	15486	7788	3.073
10.60	7942	7643	3878	11820	3971	15492	7849	3.048
10.70	7957	7669	3855	11811	3978	15502	7833	3.064
10.80	7960	7626	3897	11856	3980	15502	7877	3.043
10.90	7970	7592	3931	11901	3985	15508	7916	3.028
11.00	7981	7574	3947	11928	3991	15512	7938	3.022
11.10	7992	7565	3958	11949	3996	15518	7953	3.019
11.20	8002	7557	3966	11968	4001	15524	7967	3.018
11.30	8013	7562	3960	11973	4006	15529	7966	3.023
11.40	8027	7567	3955	11983	4014	15536	7969	3.029
11.50	8038	7569	3954	11992	4019	15542	7973	3.033
11.60	8044	7576	3946	11990	4022	15544	7968	3.039

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
11.70	8058	7582	3940	11998	4029	15552	7969	3.045
11.80	8073	7587	3935	12008	4036	15559	7972	3.051
11.90	8087	7590	3932	12019	4044	15566	7975	3.057
12.00	8097	7594	3928	12026	4049	15571	7977	3.061
12.10	8115	7597	3925	12040	4058	15580	7983	3.068
12.20	8129	7599	3924	12053	4065	15587	7988	3.072
12.30	8143	7601	3921	12065	4072	15594	7993	3.077
12.40	8161	7605	3919	12080	4081	15604	8000	3.082
12.50	8171	7605	3917	12088	4086	15607	8002	3.086
12.60	8185	7605	3918	12103	4093	15615	8010	3.089
12.70	8207	7605	3918	12125	4103	15626	8021	3.095
12.80	8228	7603	3918	12146	4114	15635	8032	3.100
12.90	8242	7600	3923	12165	4121	15643	8044	3.101
13.00	8256	7596	3926	12182	4128	15650	8054	3.103
13.10	8273	7594	3928	12202	4137	15659	8065	3.106
13.20	8294	7592	3931	12225	4147	15670	8078	3.110
13.30	8308	7586	3937	12245	4154	15676	8091	3.110
13.40	8325	7581	3941	12267	4163	15685	8104	3.112
13.50	8342	7575	3948	12291	4171	15695	8120	3.113
13.60	8360	7571	3952	12312	4180	15702	8132	3.115
13.70	8369	7565	3959	12328	4185	15708	8143	3.114
13.80	8390	7560	3962	12352	4195	15717	8157	3.117
13.90	8399	7554	3968	12368	4200	15722	8168	3.117
14.00	8408	7547	3975	12384	4204	15727	8180	3.115
14.10	8414	7540	3982	12396	4207	15729	8189	3.113
14.20	8431	7533	3989	12420	4215	15738	8205	3.113
14.30	8440	7525	3999	12438	4220	15743	8219	3.111
14.40	8449	7519	4003	12452	4224	15747	8228	3.110
14.50	8454	7512	4010	12464	4227	15749	8237	3.108
14.60	8463	7504	4019	12481	4231	15754	8250	3.106
14.70	8468	7494	4028	12496	4234	15756	8262	3.102
14.80	8477	7485	4037	12514	4238	15761	8276	3.100
14.90	8497	7476	4048	12545	4249	15772	8296	3.099
15.00	8510	7467	4055	12564	4255	15777	8310	3.099
15.10	8518	7462	4062	12580	4259	15783	8321	3.097
15.20	8531	7453	4069	12600	4265	15788	8334	3.097
15.30	8539	7445	4077	12616	4270	15792	8347	3.094
15.40	8548	7438	4084	12632	4274	15796	8358	3.093
15.50	8564	7432	4090	12654	4282	15804	8372	3.094
15.60	8584	7423	4099	12683	4292	15814	8391	3.094
15.70	8600	7414	4109	12709	4300	15822	8409	3.093
15.80	8612	7407	4116	12728	4306	15828	8422	3.092
15.90	8632	7400	4123	12755	4316	15838	8439	3.094
16.00	8648	7391	4131	12779	4324	15846	8455	3.093
16.10	8656	7386	4138	12794	4328	15851	8466	3.092
16.20	8668	7377	4146	12814	4334	15857	8480	3.090
16.30	8683	7369	4155	12838	4342	15865	8496	3.090
16.40	8691	7361	4163	12854	4346	15869	8508	3.088
16.50	8707	7354	4169	12875	4354	15876	8522	3.089
16.60	8715	7346	4177	12892	4358	15880	8534	3.087
16.70	8727	7337	4186	12913	4363	15887	8549	3.085
16.80	8734	7330	4192	12926	4367	15890	8559	3.084
16.90	8742	7325	4198	12940	4371	15894	8569	3.083
17.00	8754	7318	4205	12959	4377	15899	8582	3.082
17.10	8758	7309	4213	12971	4379	15901	8592	3.079
17.20	8758	7302	4220	12978	4379	15901	8599	3.075
17.30	8773	7297	4226	12999	4387	15909	8613	3.076
17.40	8773	7288	4234	13007	4387	15909	8621	3.072
17.50	8773	7280	4244	13017	4387	15910	8630	3.068
17.60	8785	7274	4249	13034	4392	15916	8642	3.067
17.70	8785	7267	4255	13040	4392	15915	8648	3.064
17.80	8781	7259	4263	13044	4391	15913	8654	3.060
17.90	8789	7253	4269	13058	4394	15917	8664	3.059
18.00	8789	7246	4276	13065	4394	15917	8671	3.055

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Axial strain, ε (%)	σd (σ1−σ3) (psf)	Δ pore press., Δu (psf)	Effective σ'3 (psf)	Effective σ'1 (psf)	q (σ1−σ3)/2 (psf)	p (σ1+σ3)/2 (psf)	p' (σ'1+σ'3)/2 (psf)	σ'1/σ'3
18.10	8792	7238	4284	13077	4396	15919	8681	3.052
18.20	8792	7233	4289	13081	4396	15918	8685	3.050
18.30	8799	7226	4296	13096	4400	15922	8696	3.048
18.40	8799	7218	4304	13104	4400	15922	8704	3.044
18.50	8806	7210	4313	13119	4403	15926	8716	3.042
18.60	8810	7204	4318	13128	4405	15927	8723	3.040
18.70	8817	7198	4325	13142	4409	15932	8734	3.038
18.80	8820	7190	4333	13153	4410	15933	8743	3.036
18.90	8827	7185	4338	13166	4414	15937	8752	3.035
19.00	8834	7179	4343	13177	4417	15940	8760	3.034
19.10	8845	7175	4348	13193	4423	15945	8770	3.034
19.20	8852	7168	4356	13208	4426	15949	8782	3.032
19.30	8855	7162	4361	13216	4428	15950	8788	3.031
19.40	8866	7157	4365	13231	4433	15955	8798	3.031
19.50	8872	7150	4374	13246	4436	15960	8810	3.029
19.60	8879	7143	4379	13258	4440	15962	8819	3.027
19.70	8886	7137	4386	13272	4443	15966	8829	3.026
19.80	8889	7129	4393	13282	4444	15967	8838	3.023
19.90	8895	7123	4399	13294	4448	15970	8847	3.022
20.00	8909	7116	4407	13316	4454	15978	8862	3.021

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APPENDIX D

DESIGN AND DETAIL SHEETS

INCORPORATED
OCT 15 2009
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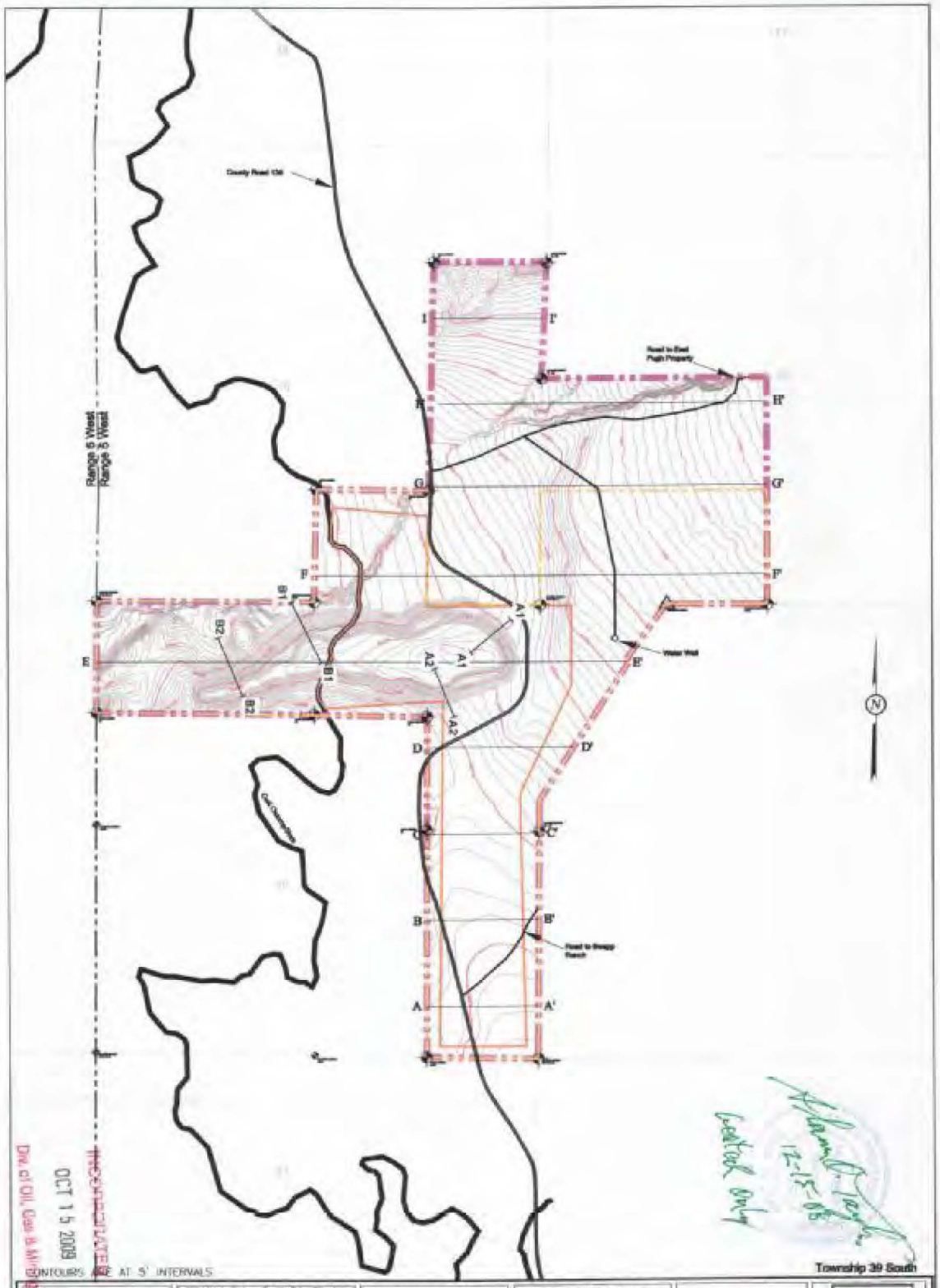


PERMIT BOUNDARY
PRIVATE COAL OWNERSHIP
COAL LINE BOUNDARY
COAL RECOVERY LINE
SECTION LINE
FOUND SECTION CORNER
FOUND PROPERTY CORNER

DRAWN BY:	CHECKED BY:
C. McCOURT	GS
DRAWING: 5-35	DATE: 11/20/08
	SCALE: 1" = 500'
JOB NUMBER: 1400	SHEET

REVISIONS	
DATE:	BY:

POST MINING TOPOGRAPHY

PREFERRED SCENARIO

COAL HOLLOW PROJECT ALTON, UTAH

DRAWING: 5-35

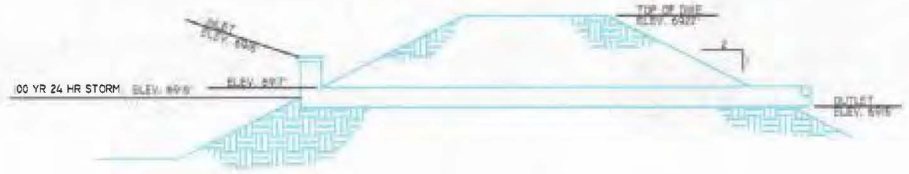
Figure No. 11

Coal Hollow Project

403 North 100 West, Suite
Cedar City, Utah 84720
Phone: (435)867-5351
Fax: (435)867-1385

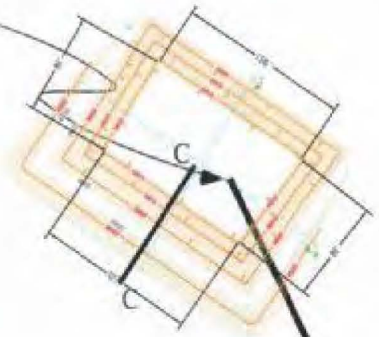
Div. of Oil, Gas & Mining
OCT 15 2009
RECEIVED

12-15-08
Contact Only

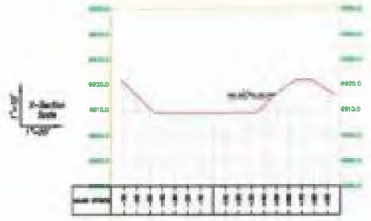


TYPICAL CROSS SECTION
Not to Scale

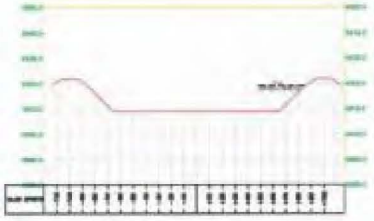
24 inch Drop Pipe Spillway
Top of riser 6918'
Bottom of riser 6915'



24 inch outlet 6915'

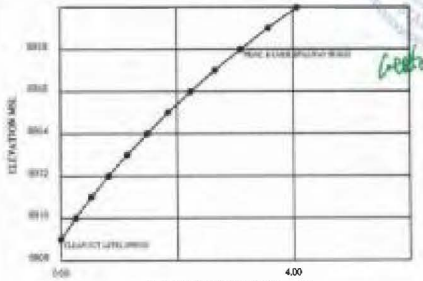


SL-1



SL-2

STAGE STORAGE CURVE
Sediment Control Structure No. 1



STORAGE VOLUME COMPUTATIONS

Sediment Control Structure No. 1

ELEV (ft)	WIDTH (ft)	LENGTH (ft)	AREA (ac)	AVG AREA (ac)	INTERVAL (ft)	STORAGE (ac-ft)	ACC. STORAGE (ac-ft)	STAGE INTERVAL (ft)
6909.00	NA	NA	0.2320					
6910.00	NA	NA	0.2650	0.2485	1.00	0.2485	0.2485	1.00
6911.00	NA	NA	0.2870	0.2760	1.00	0.2760	0.5245	2.00
6912.00	NA	NA	0.3090	0.2980	1.00	0.2980	0.8225	3.00
6913.00	NA	NA	0.3310	0.3200	1.00	0.3200	1.1425	4.00
6914.00	NA	NA	0.3540	0.3425	1.00	0.3425	1.4850	5.00
6915.00	NA	NA	0.3770	0.3655	1.00	0.3655	1.8505	6.00
6916.00	NA	NA	0.4020	0.3895	1.00	0.3895	2.2400	7.00
6917.00	NA	NA	0.4285	0.4153	1.00	0.4153	2.6553	8.00
6918.00	NA	NA	0.4565	0.4440	1.00	0.4440	3.0993	9.00
6919.00	NA	NA	0.4920	0.4755	1.00	0.4755	3.5750	10.00
6920.00	NA	NA	0.5190	0.5055	0.98	0.4954	4.0704	10.98

Pond #1

Required Storage for 100 year, 24 event = 2.57 acre/ft

615 North, 400 East
P.O Box 1230
Huntington, Utah 84528
Phone (435)687-2310
Fax (435)687-5311

275876-2202
CHRIS R. McCOURT

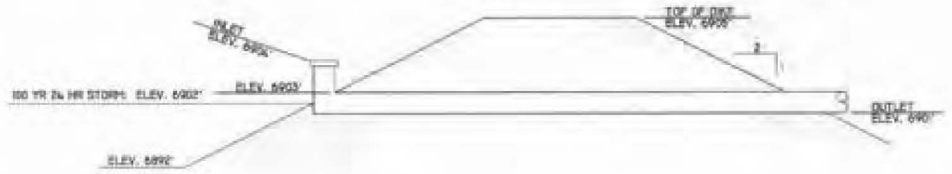
SEDIMENT IMPOUNDMENT 1
DESIGN & DETAILS
COAL HOLLOW PROJECT
ALTON, UTAH
DRAWING: 5-28

REVISIONS
BY:
DATE:

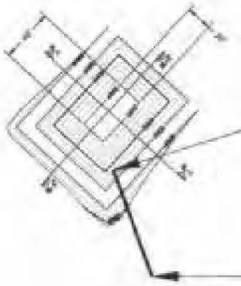
DRAWN BY: C. MCCOURT
CHECKED BY: CM
DRAWING: 5-28
DATE: 04/20/07
SCALE: 1" = 80'
JOB NUMBER: 1400
SHEET

Figure No. 12

INCORPORATED
OCT 15 2009
Div. of Oil, Gas & Mining



TYPICAL CROSS SECTION
Not to Scale

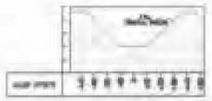


Required Storage for 100 year, 24 event = 0.50 acre/ft

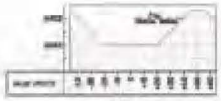
24 inch Drop Pipe Spillway
Top of riser 6904'
Bottom of riser 6902'

24 inch outlet 6901'

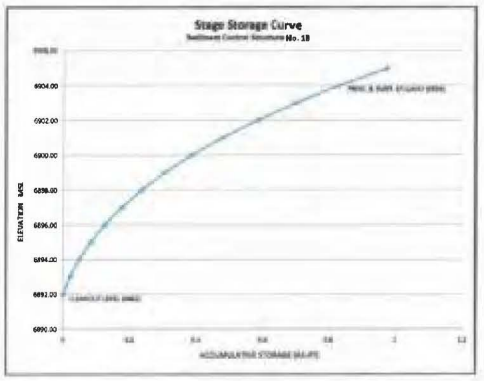
Pond #1B



SL-1



SL-2



6892.00	NA	NA	0.0184					
6893.00	NA	NA	0.0242	0.0213	1.00	0.0213	0.0213	1.00
6894.00	NA	NA	0.0309	0.0276	1.00	0.0276	0.0489	2.00
6895.00	NA	NA	0.0382	0.0346	1.00	0.0346	0.0834	3.00
6896.00	NA	NA	0.0463	0.0423	1.00	0.0423	0.1257	4.00
6897.00	NA	NA	0.0551	0.0507	1.00	0.0507	0.1764	5.00
6898.00	NA	NA	0.0646	0.0599	1.00	0.0599	0.2362	6.00
6899.00	NA	NA	0.0749	0.0698	1.00	0.0698	0.3060	7.00
6900.00	NA	NA	0.0859	0.0804	1.00	0.0804	0.3864	8.00
6901.00	NA	NA	0.0977	0.0918	1.00	0.0918	0.4781	9.00
6902.00	NA	NA	0.1102	0.1040	1.00	0.1040	0.5821	10.00
6903.00	NA	NA	0.1234	0.1168	1.00	0.1168	0.6989	11.00
6904.00	NA	NA	0.1374	0.1304	1.00	0.1304	0.8293	12.00
[illegible]	[illegible]	[illegible]	[illegible]	0.1448	1.00	0.1448	[illegible]	13.00

RECEIVED
OCT 15 2009
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Civil Hollow Engineering
[illegible]

REVISIONS
DATE: BY:

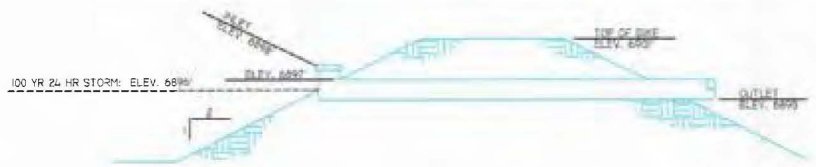
SEDIMENT IMPOUNDMENT 1B DETAILS

COAL HOLLOW PROJECT ALTON, UTAH

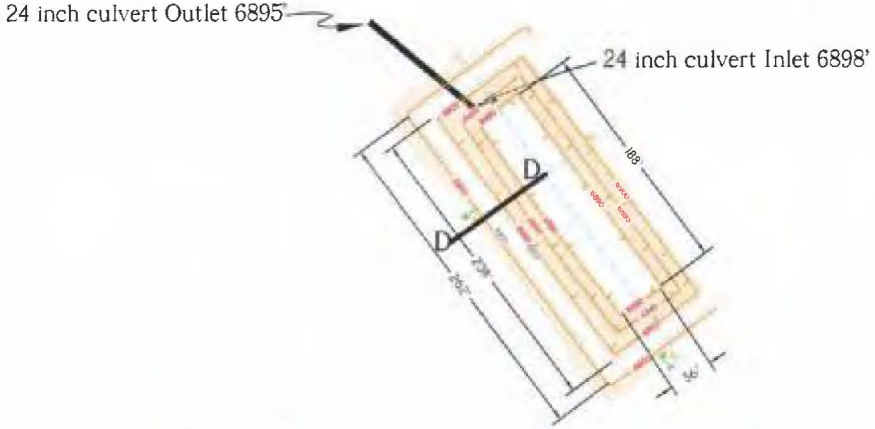
DRAWING: 5-28B

DRAWN BY: G. GROSSMAN
CHECKED BY: CRM/WES
DATE: 11/07/08
SCALE: 1" = 40'
DRAWING: 5-28B
JOB NUMBER: 1400
SHEET

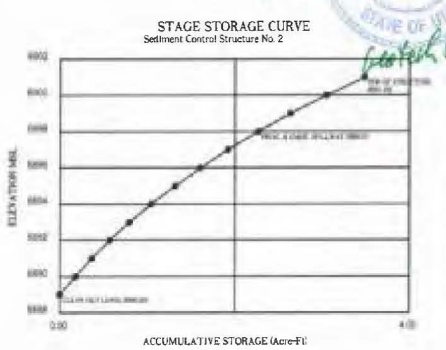
Figure No. 12B



TYPICAL CROSS SECTION
Not to Scale



SL-1 SL-2



STORAGE VOLUME COMPUTATIONS

Sediment Control Structure No. 2

ELEV (ft)	WIDTH (ft)	LENGTH (ft)	AREA (ac)	AVG. AREA (ac)	INTERVAL (ft)	STORAGE (ac-ft)	ACC STORAGE (ac-ft)	STAGE INTERVAL (ft)
6889.00	NA	NA	0.0000					
6890.00	NA	NA	0.1770	0.1770	1.00	0.1770	0.1770	1.00
6891.00	NA	NA	0.1960	0.1865	1.00	0.1865	0.3635	2.00
6892.00	NA	NA	0.2160	0.2060	1.00	0.2060	0.5695	3.00
6893.00	NA	NA	0.2370	0.2265	1.00	0.2265	0.7960	4.00
6894.00	NA	NA	0.2590	0.2475	1.00	0.2475	1.0435	5.00
6895.00	NA	NA	0.2810	0.2685	1.00	0.2685	1.3130	6.00
6896.00	NA	NA	0.3040	0.2925	1.00	0.2925	1.6055	7.00
6897.00	NA	NA	0.3280	0.3160	1.00	0.3160	1.9215	8.00
6898.00	NA	NA	0.3570	0.3425	1.00	0.3425	2.2640	9.00
6899.00	NA	NA	0.3920	0.3745	1.00	0.3745	2.6385	10.00
6900.00	NA	NA	0.4250	0.4085	1.00	0.4085	3.0470	11.00
6901.00	NA	NA	0.4610	0.4430	1.00	0.4430	3.4900	12.00

Pond #2

Required Storage for 100 year, 24 event = 1.71 acre/ft

Figure No. 13

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OCT 15 2009
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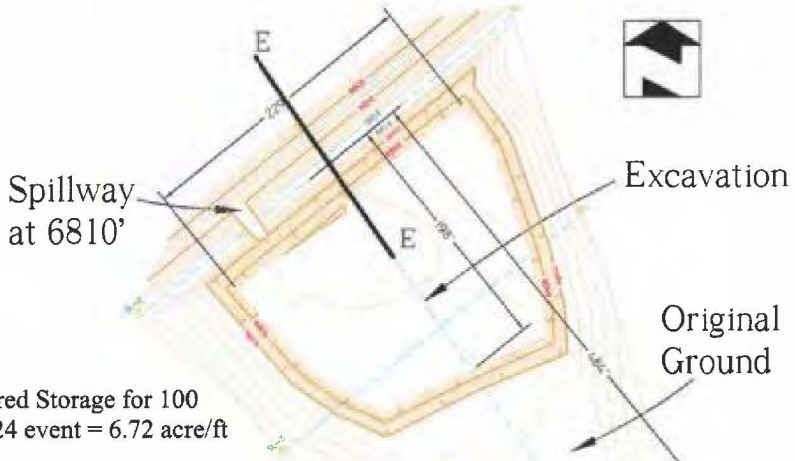
Canyon Fuel Company, LLC
615 North 400 East
P.O. Box 1230
Huntington, Utah 84528
Phone: (435)687-5310
Fax: (435)687-5311

SEDIMENT IMPOUNDMENT 2
DESIGN & DETAILS
COAL HOLLOW PROJECT
ALTON, UTAH
DRAWING: 5-29

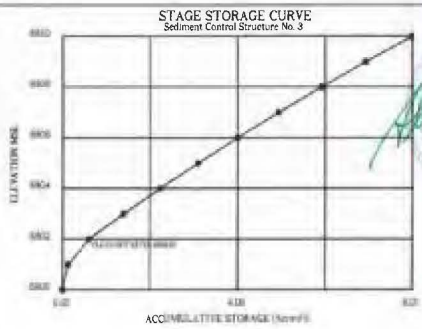
REVISIONS
BY:
DATE:

DRAWN BY: C. MCCOURT
CHECKED BY: GM
DRAWING: 5-29
DATE: 04/20/07
SCALE: 1" = 80'
SHEET
JOB NUMBER: 1400



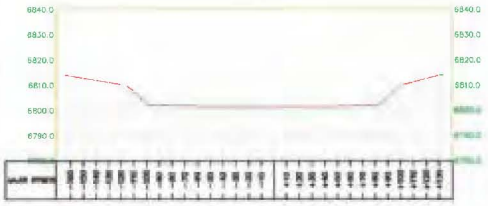
Required Storage for 100 year, 24 event = 6.72 acre/ft

Pond #3
Valley Pond

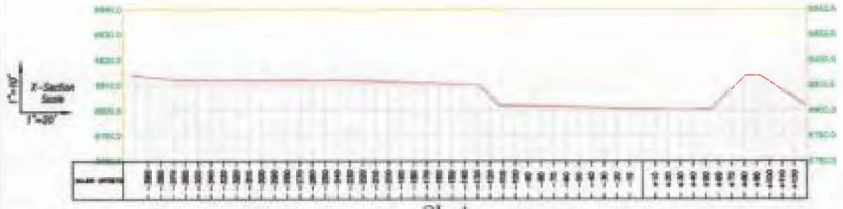


STORAGE VOLUME COMPUTATIONS
Sediment Control Structure No. 3

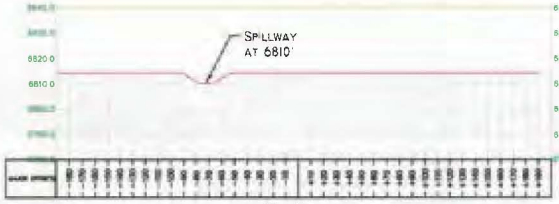
ELEV (ft)	WIDTH (ft)	LENGTH (ft)	AREA (ac)	AVG AREA (ac)	INTERVAL (ft)	STORAGE (ac-ft)	ACC. STORAGE (ac-ft)	STAGE INTERVAL (ft)
6800.00	NA	NA	0.0180					
6801.00	NA	NA	0.2320	0.1250	1.00	0.1250	0.1250	1.00
6802.00	NA	NA	0.7580	0.4950	1.00	0.4950	0.6200	2.00
6803.00	NA	NA	0.8110	0.7845	1.00	0.7845	1.4045	3.00
6804.00	NA	NA	0.8480	0.8295	1.00	0.8295	2.2340	4.00
6805.00	NA	NA	0.8840	0.8660	1.00	0.8660	3.1000	5.00
6806.00	NA	NA	0.9220	0.9030	1.00	0.9030	4.0030	6.00
6807.00	NA	NA	0.9580	0.9400	1.00	0.9400	4.9430	7.00
6808.00	NA	NA	0.9950	0.9765	1.00	0.9765	5.9195	8.00
6809.00	NA	NA	1.0400	1.0175	1.00	1.0175	6.9370	9.00
6810.00	NA	NA	1.0670	1.0535	1.00	1.0430	7.9800	10.00



SL-3



SL-1



SL-2

Civil Hydrology
615 North, 400 East
P.O. Box 1230
Hurricane, Utah 84737
Phone: (435)867-5310
Fax: (435)867-5311

275875-2202
CHRIS R. McCOURT

SEDIMENT IMPOUNDMENT 3
DESIGN & DETAILS
COAL HOLLOW PROJECT
ALTON, UTAH
DRAWING: 5-30

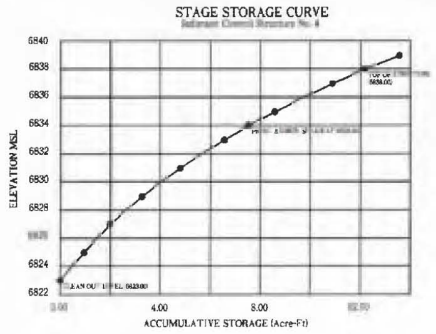
REVISIONS

DATE	BY

DRAWN BY: C. MCCOURT
CHECKED BY: CM
DRAWING: 5-30
DATE: 12/18/06
SCALE: 1" = 80'
JOB NUMBER: 1400
SHEET

Figure No. 14

INCOMPLETE
OCT 15 2008
Div. of Oil, Gas & Mining

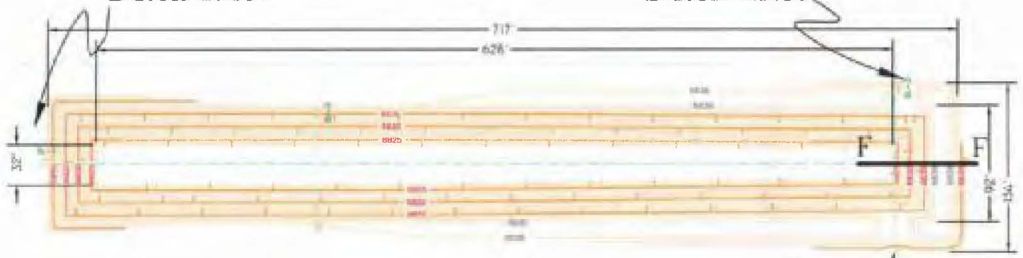


STORAGE FILLING COMPUTATIONS

ELEV (ft)	WIDTH (ft)	LENGTH (ft)	AREA (sq ft)	AVG. AREA (sq ft)	INTERVAL (ft)	STORAGE (ac-ft)	ACC. STORAGE (ac-ft)	OTHER INTERVAL (ft)
6823.00	NA	NA	0.0000					
6825.00	NA	NA	0.4660	0.4650	2.00	0.9320	0.9320	2.00
6827.00	NA	NA	0.5810	0.5235	2.00	1.0470	1.9790	4.00
6829.00	NA	NA	0.6990	0.6400	2.00	1.2800	3.2590	6.00
6831.00	NA	NA	0.8200	0.7595	2.00	1.5190	4.7780	8.00
6833.00	NA	NA	0.9430	0.8815	2.00	1.7630	6.5410	10.00
6834.00	NA	NA	1.0060	0.9745	1.00	0.9760	7.5170	11.00
6835.00	NA	NA	1.0750	1.0420	1.00	1.0420	8.5590	12.00
6837.00	NA	NA	1.2400	1.1575	2.00	2.3150	10.8740	14.00
6838.00	NA	NA	1.3370	1.2885	1.00	1.2885	12.1625	15.00

Ditch Inlet

Ditch Inlet



Required Storage for 100 year, 24 event = 6.28 acre/ft

Pond #4

Spillway at 6836'

SL-2

SL-1

SL-3

INCORPORATED

OCT 1 2009

Div. of Oil, Gas & Mining

615 North, 400 East
P.O. Box 1230
Huntington, Utah 84528
Phone: (435)687-5310
Fax: (435)687-5311

375875-2202
CHRIS R. McCOURT

SEDIMENT IMPOUNDMENT 4
DESIGN & DETAILS
COAL HOLLOW PROJECT
ALTON, UTAH
DRAWING: 5-31

REVISIONS
BY
DATE

DRAWN BY: C. MCCOURT
CHECKED BY: CM
DATE: 04/20/07
SCALE: 1" = 80'
SHEET
DRAWING: 5-31
JOB NUMBER: 1400

Figure No. 15

APPENDIX E

OUPTUT FILES OF STATIC, PSEUDO-STATIC and RAPID DRAWDOWN SLOPE STABILITY ANALYSES

INCORPORATED
OCT 15 2009
Div. of Oil, Gas & Mining

Alton Coal Pile Line A1-A1 - Static

c:\documents and settings\owner\my documents\taylor geo-engineering\alton coal stock pile ch-5-98 seismic revised a1.pl2 Run By: Alan Taylor 12/13/2008 09:44PM

#	FS
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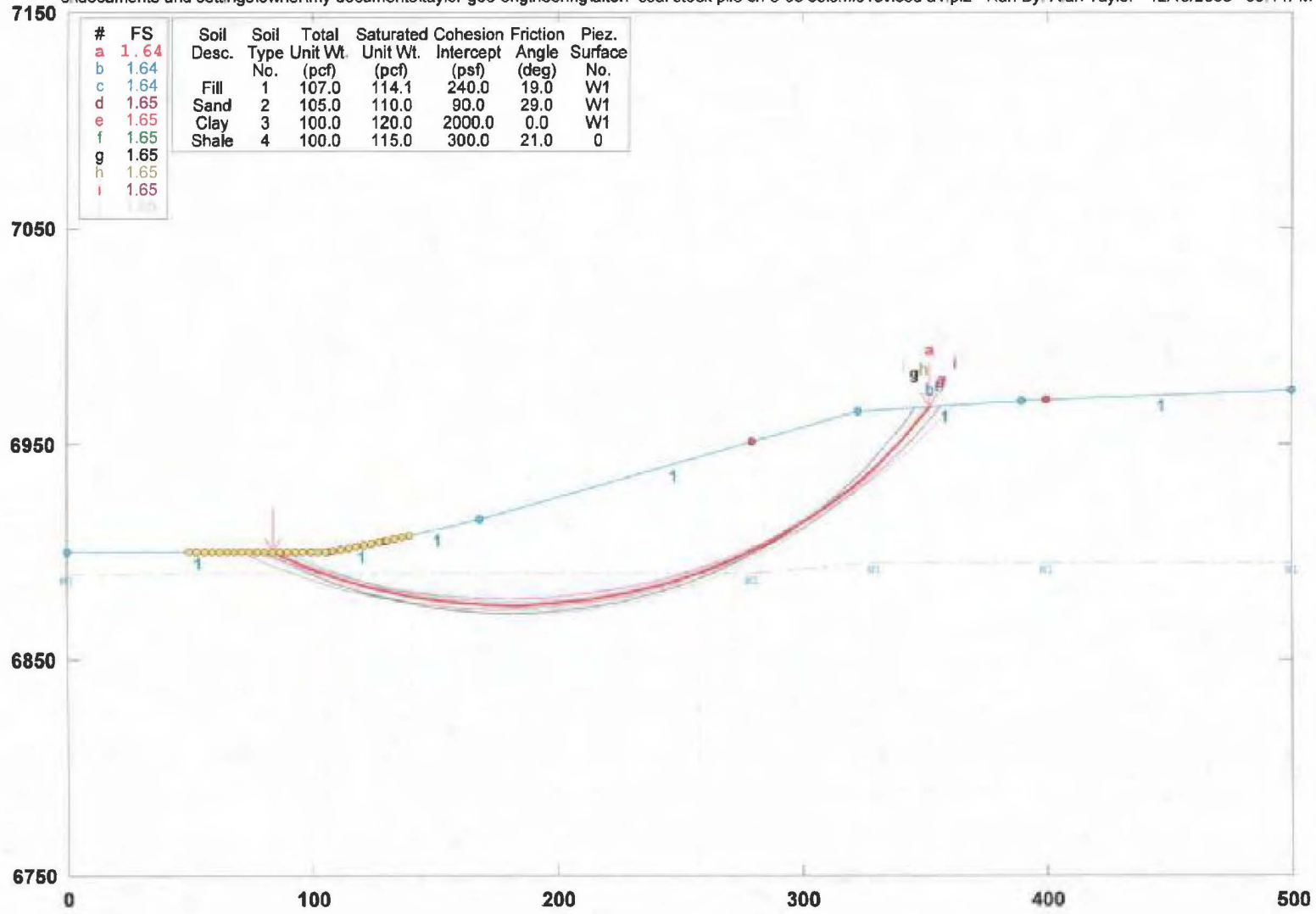
b	1.64
c	1.64
d	1.65
e	1.65
f	1.65
g	1.65
h	1.65
i	1.65

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Fill	1	107.0	114.1	240.0	19.0	W1
Sand	2	105.0	110.0	90.0	29.0	W1
Clay	3	100.0	120.0	2000.0	0.0	W1
Shale	4	100.0	115.0	300.0	21.0	0



GSTABL7 v.2 FSmin=1.64

Safety Factors Are Calculated By The Modified Bishop Method

Figure No. 16

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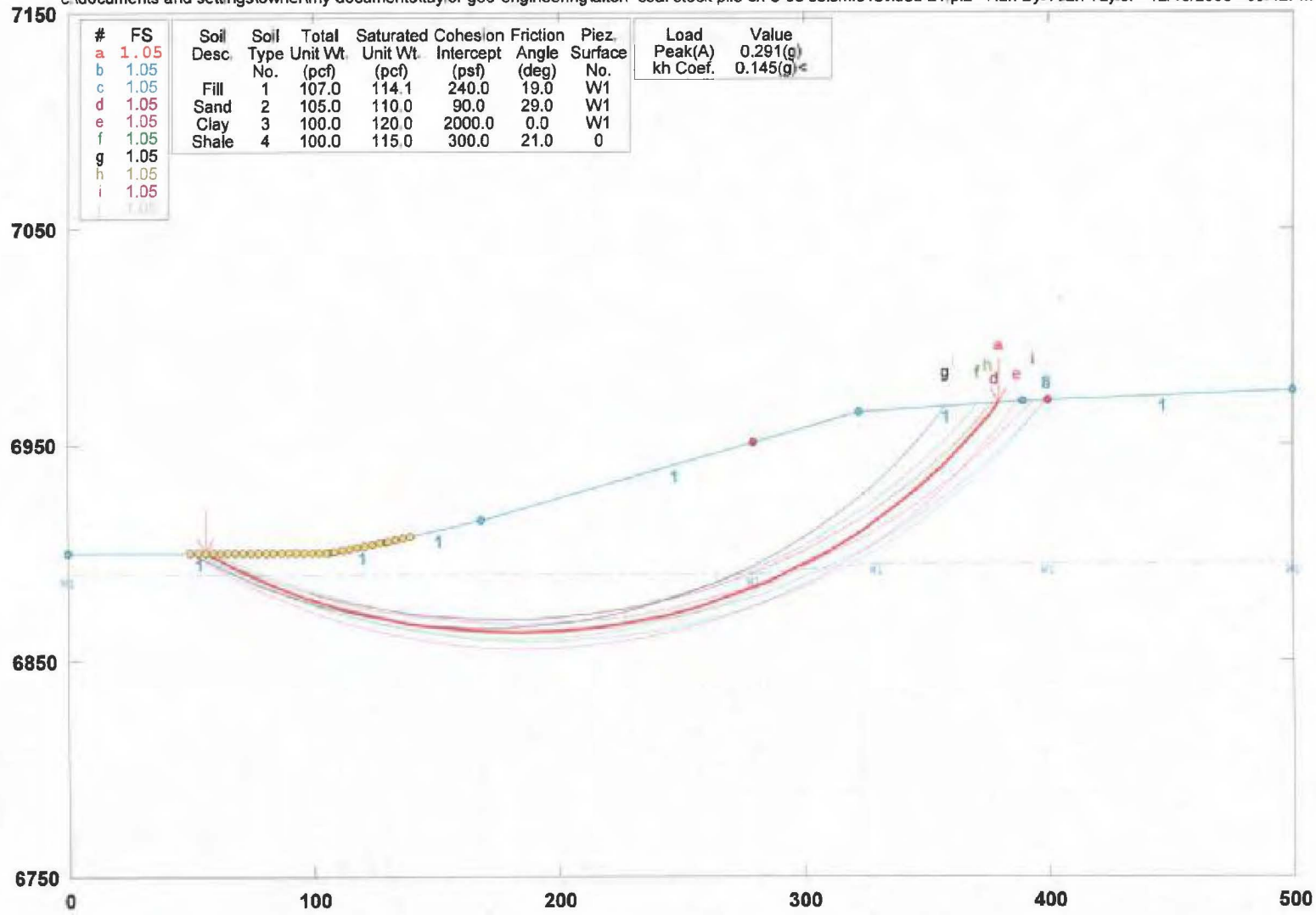
Alton Coal Pile Line A1-A1 - Seismic

c:\documents and settings\owner\my documents\taylor geo-engineering\alton coal stock pile ch-5-98 seismic revised a1.pl2 Run By: Alan Taylor 12/13/2008 09:42PM

#	FS
a	1.05
b	1.05
c	1.05
d	1.05
e	1.05
f	1.05
g	1.05
h	1.05
i	1.05

Soil Desc.	Soil Type No.	Total Unit Wt (pcf)	Saturated Unit Wt (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Fill	1	107.0	114.1	240.0	19.0	W1
Sand	2	105.0	110.0	90.0	29.0	W1
Clay	3	100.0	120.0	2000.0	0.0	W1
Shale	4	100.0	115.0	300.0	21.0	0

Load	Value
Peak(A)	0.291(g)
kh Coef.	0.145(g)<



GSTABL7 v.2 FSmin=1.05

Safety Factors Are Calculated By The Modified Bishop Method

Figure No. 17

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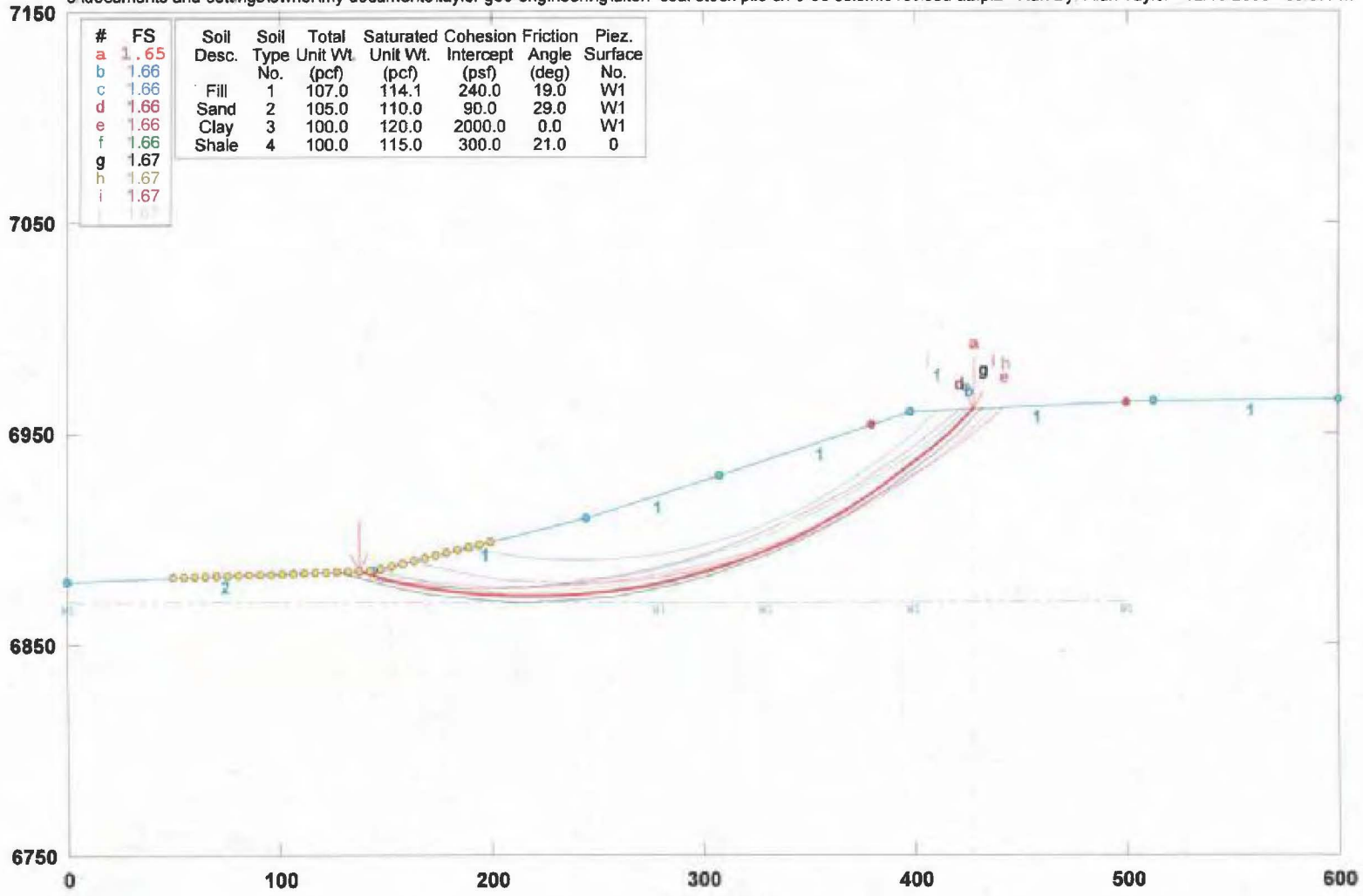
Alton Coal Pile Line A2-A2 - Static

c:\documents and settings\owner\my documents\taylor geo-engineering\alton coal stock pile ch-5-98 seismic revised a2.pl2 Run By: Alan Taylor 12/13/2008 09:37PM

#	FS
a	1.65
b	1.66
c	1.66
d	1.66
e	1.66
f	1.66
g	1.67
h	1.67
i	1.67

Soil Desc.	Soil Type No.	Total Unit Wt (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Fill	1	107.0	114.1	240.0	19.0	W1
Sand	2	105.0	110.0	90.0	29.0	W1
Clay	3	100.0	120.0	2000.0	0.0	W1
Shale	4	100.0	115.0	300.0	21.0	0



GSTABL7 v.2 FSmin=1.65
Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

Figure No. 18

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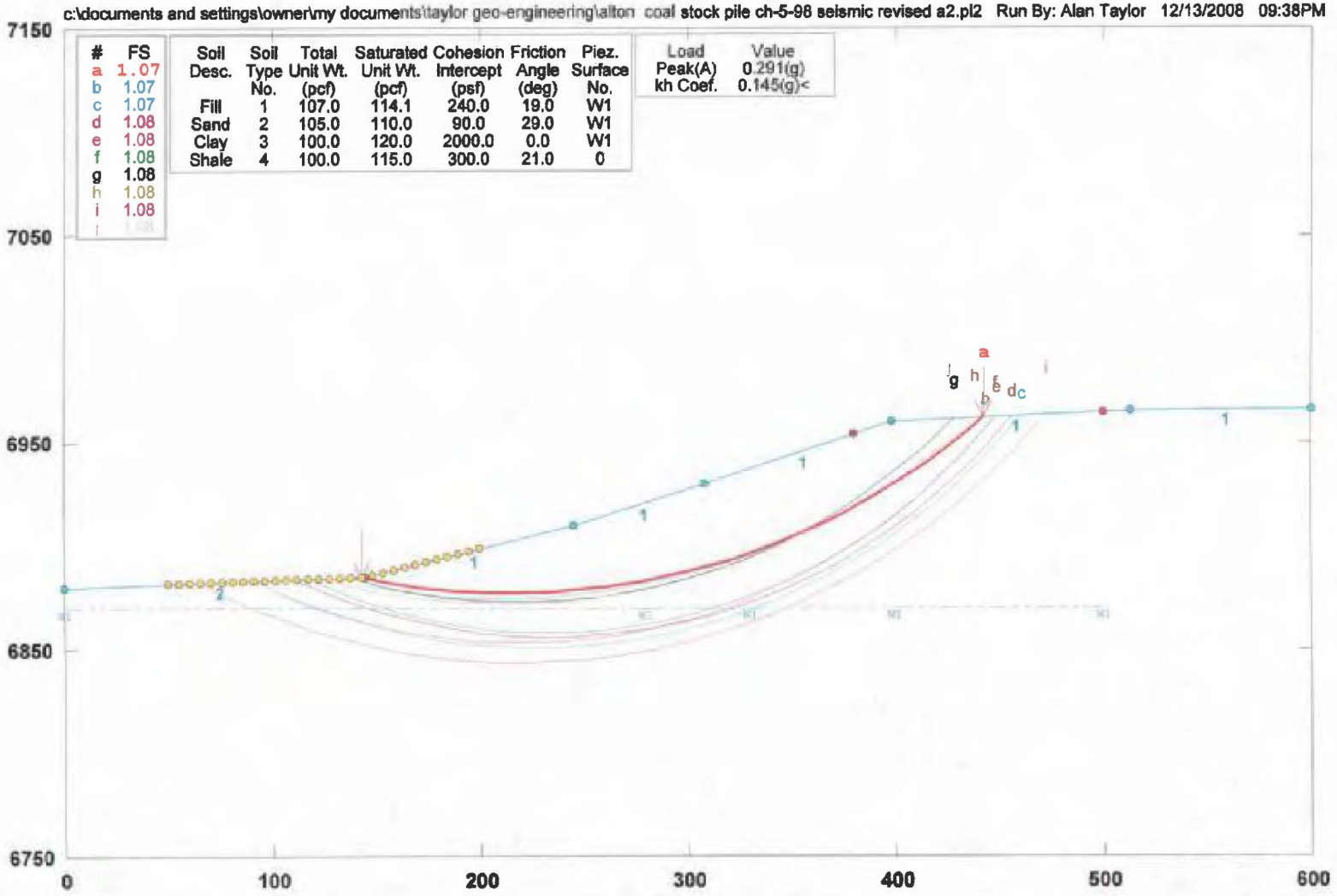
Alton Coal Pile Line A2-A2 - Seismic

c:\documents and settings\owner\my documents\taylor geo-engineering\alton coal stock pile ch-5-98 seismic revised a2.pl2 Run By: Alan Taylor 12/13/2008 09:38PM

#	FS
a	1.07
b	1.07
c	1.07
d	1.08
e	1.08
f	1.08
g	1.08
h	1.08
i	1.08

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Fill	1	107.0	114.1	240.0	19.0	W1
Sand	2	105.0	110.0	90.0	29.0	W1
Clay	3	100.0	120.0	2000.0	0.0	W1
Shale	4	100.0	115.0	300.0	21.0	0

Load	Value
Peak(A)	0.291(g)
kh Coef.	0.145(g)<



GSTABL7 v.2 FSmin=1.07

Safety Factors Are Calculated By The Modified Bishop Method

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Figure No. 19

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Alton Coal Pile Line B1-B1 - Static

c:\documents and settings\owner\my documents\taylor geo-engineering\alton revised\alton coal stock pile ch-5-98 seismic revised b1.pl2 Run By: Alan Taylor 12/13/2008 09:34PM

#	FS
a	1.71
b	1.72
c	1.73
d	1.73
e	1.74
f	1.75
g	1.75
h	1.75
i	1.76
j	1.77

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Fill	1	107.0	114.1	240.0	19.0	W1
Sand	2	105.0	110.0	90.0	29.0	W1
Clay	3	100.0	120.0	2000.0	0.0	W1
Shale	4	100.0	115.0	300.0	21.0	0

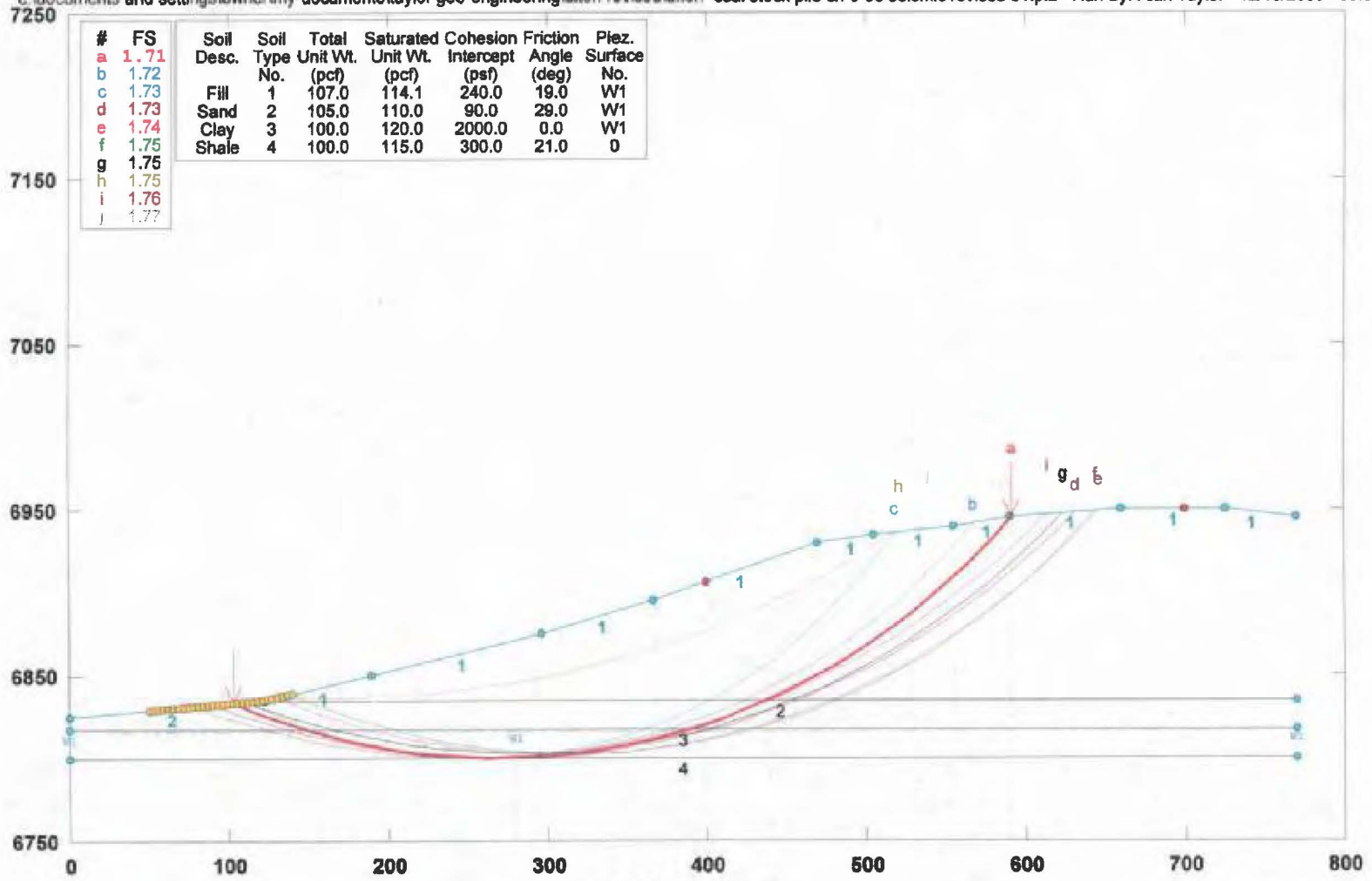

Figure No. 20

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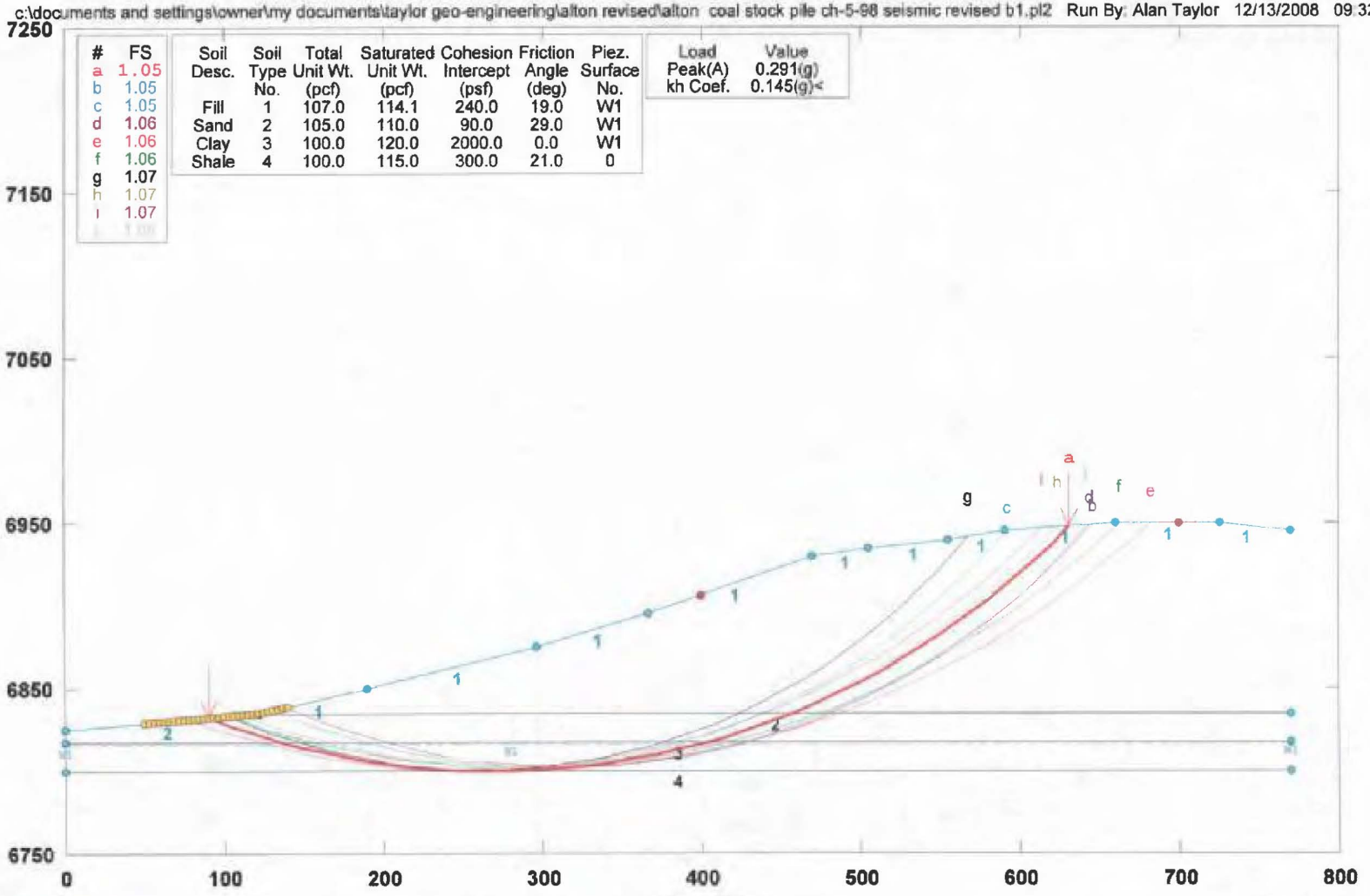
Alton Coal Pile Line B1-B1 - Seismic

c:\documents and settings\owner\my documents\taylor geo-engineering\alton revised\alton coal stock pile ch-5-98 seismic revised b1.pl2 Run By: Alan Taylor 12/13/2008 09:32PM

#	FS
a	1.05
b	1.05
c	1.05
d	1.06
e	1.06
f	1.06
g	1.07
h	1.07
i	1.07

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Fill	1	107.0	114.1	240.0	19.0	W1
Sand	2	105.0	110.0	90.0	29.0	W1
Clay	3	100.0	120.0	2000.0	0.0	W1
Shale	4	100.0	115.0	300.0	21.0	0

Load	Value
Peak(A)	0.291(g)
kh Coef.	0.145(g)<



GSTABL7 v.2 FSmin=1.05
Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

Figure No. 21

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Alton Coal Pile Line B2-B2 - Static

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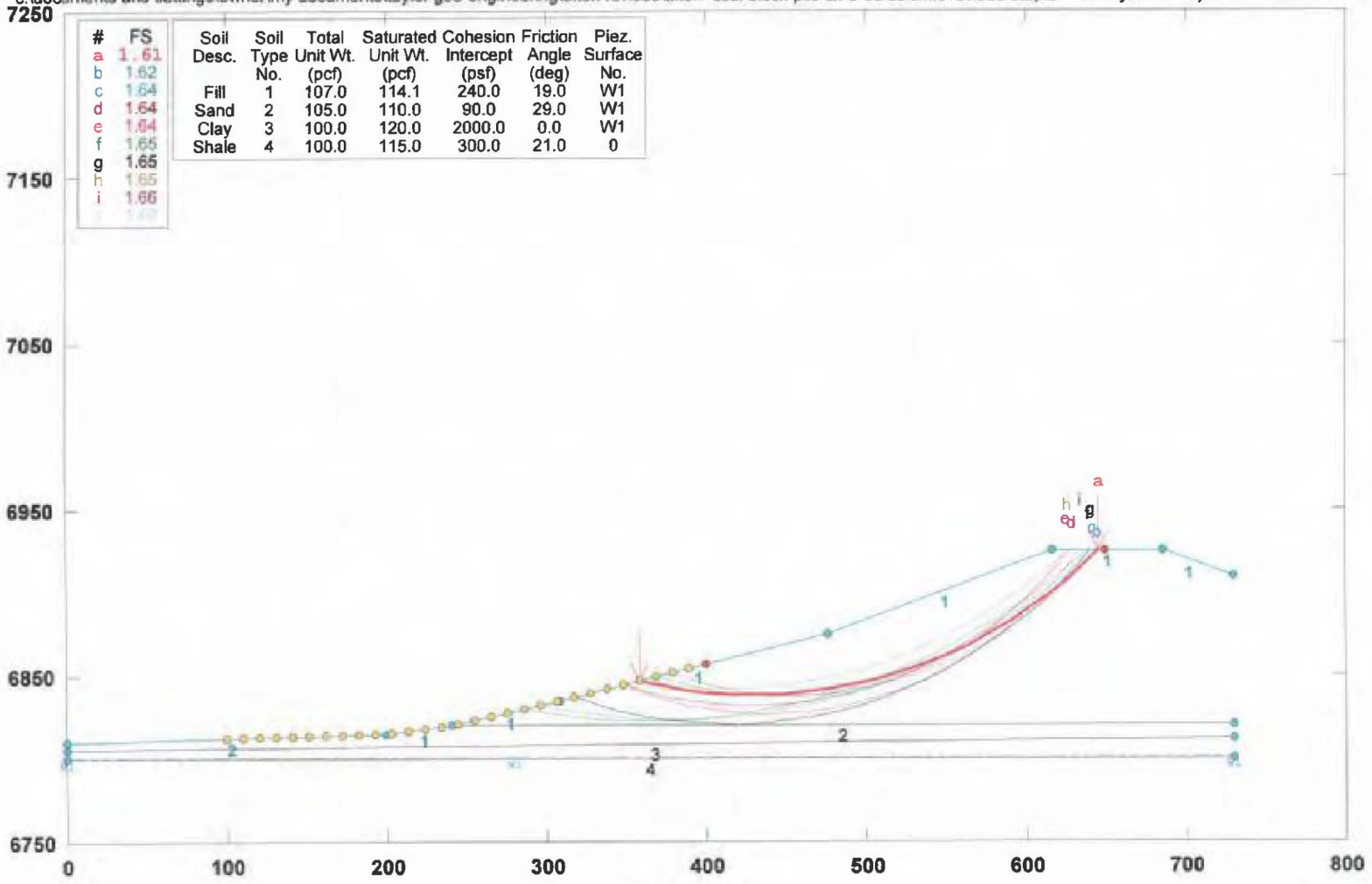
#	FS
a	1.61
b	1.62
c	1.64
d	1.64
e	1.64
f	1.65
g	1.65
h	1.65
i	1.66

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Fill	1	107.0	114.1	240.0	19.0	W1
Sand	2	105.0	110.0	90.0	29.0	W1
Clay	3	100.0	120.0	2000.0	0.0	W1
Shale	4	100.0	115.0	300.0	21.0	0



GSTABL7 v.2 FSmin=1.61
Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

Figure No. 22

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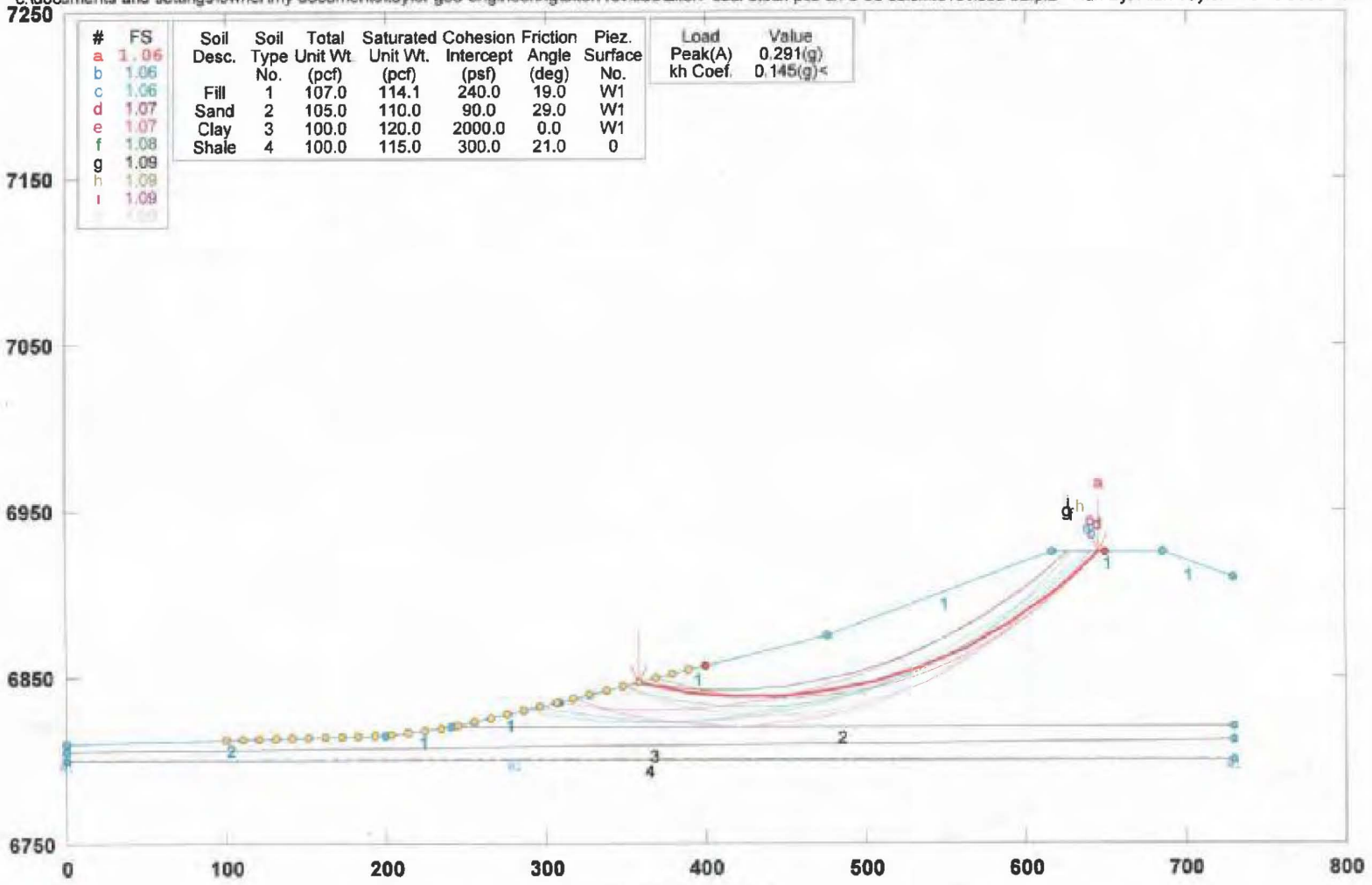
Alton Coal Pile Line B2-B2 - Seismic

c:\documents and settings\owner\my documents\taylor geo-engineering\alton revised\alton coal stock pile ch-5-98 seismic revised b2.pl2 Run By: Alan Taylor 12/13/2008 09:16PM

#	FS
a	1.06
b	1.06
c	1.06
d	1.07
e	1.07
f	1.08
g	1.09
h	1.09
i	1.09

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Fill	1	107.0	114.1	240.0	19.0	W1
Sand	2	105.0	110.0	90.0	29.0	W1
Clay	3	100.0	120.0	2000.0	0.0	W1
Shale	4	100.0	115.0	300.0	21.0	0

Load	Value
Peak(A)	0.291(g)
kh Coef.	0.145(g)<



GSTABL7 v.2 FSmin=1.06

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

Figure No. 23

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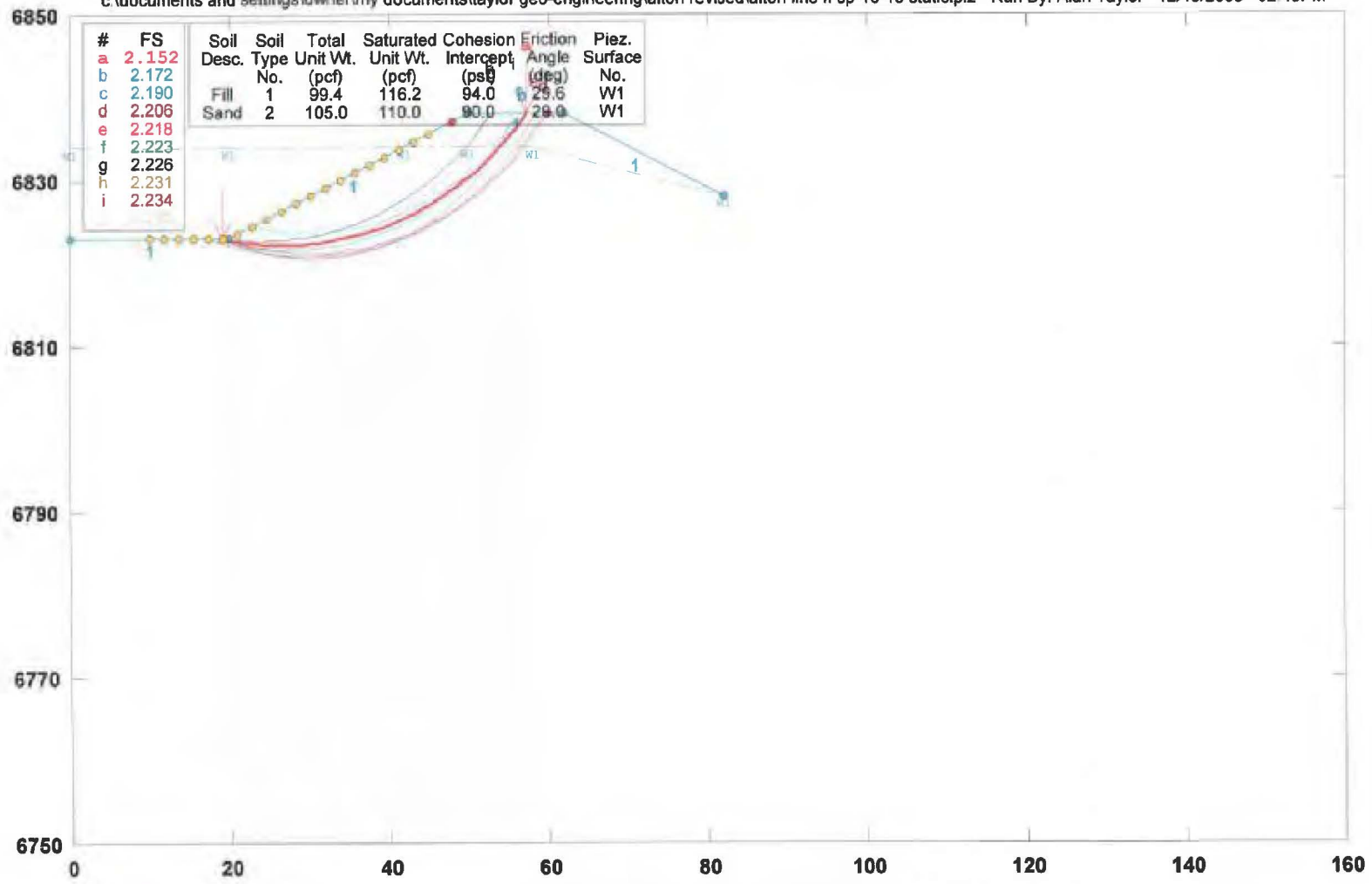
Alton Coal Hollow Sedimentation Pond 4: Line FF, Soil SP-16-13 - Static

c:\documents and settings\owner\my documents\taylor geo-engineering\alton revised\alton line ff sp-16-13 static.pl2 Run By: Alan Taylor 12/15/2008 02:48PM



GSTABL7 v.2 FSmin=2.152

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

Figure No. 24

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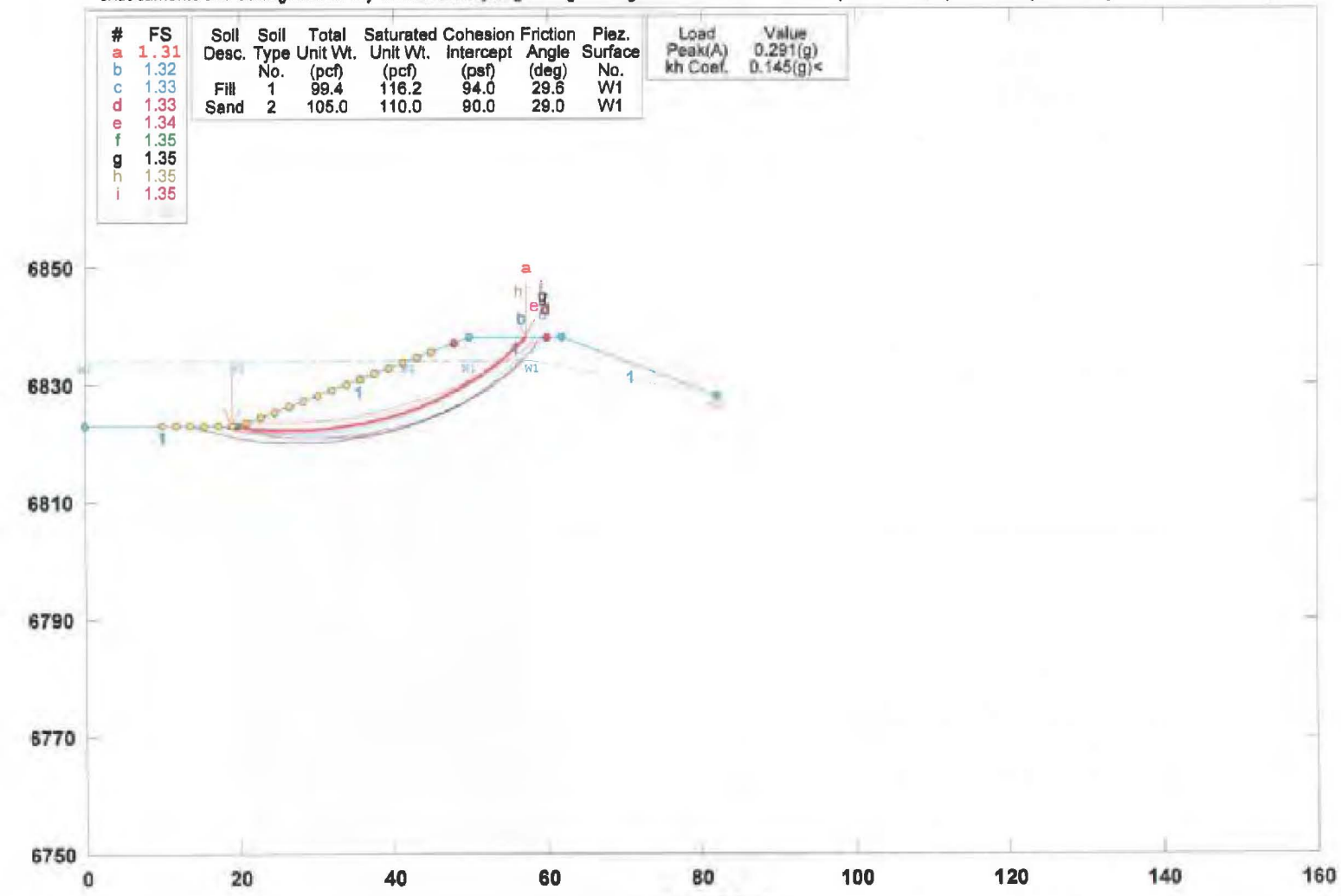
Alton Coal Hollow Sedimentation Pond 4: Line FF, Soil SP-16-13 - Seismic

c:\documents and settings\owner\my documents\taylor geo-engineering\alton revised\alton line ff sp-16-13 static.pl2 Run By: Alan Taylor 12/15/2008 01:40PM

#	FS
a	1.31
b	1.32
c	1.33
d	1.33
e	1.34
f	1.35
g	1.35
h	1.35
i	1.35

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Fill	1	99.4	116.2	94.0	29.6	W1
Sand	2	105.0	110.0	90.0	29.0	W1

Load	Value
Peak(A)	0.291(g)
kh Coef.	0.145(g)<



GSTABL7 v.2 FSmin=1.31
Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

Figure No. 25

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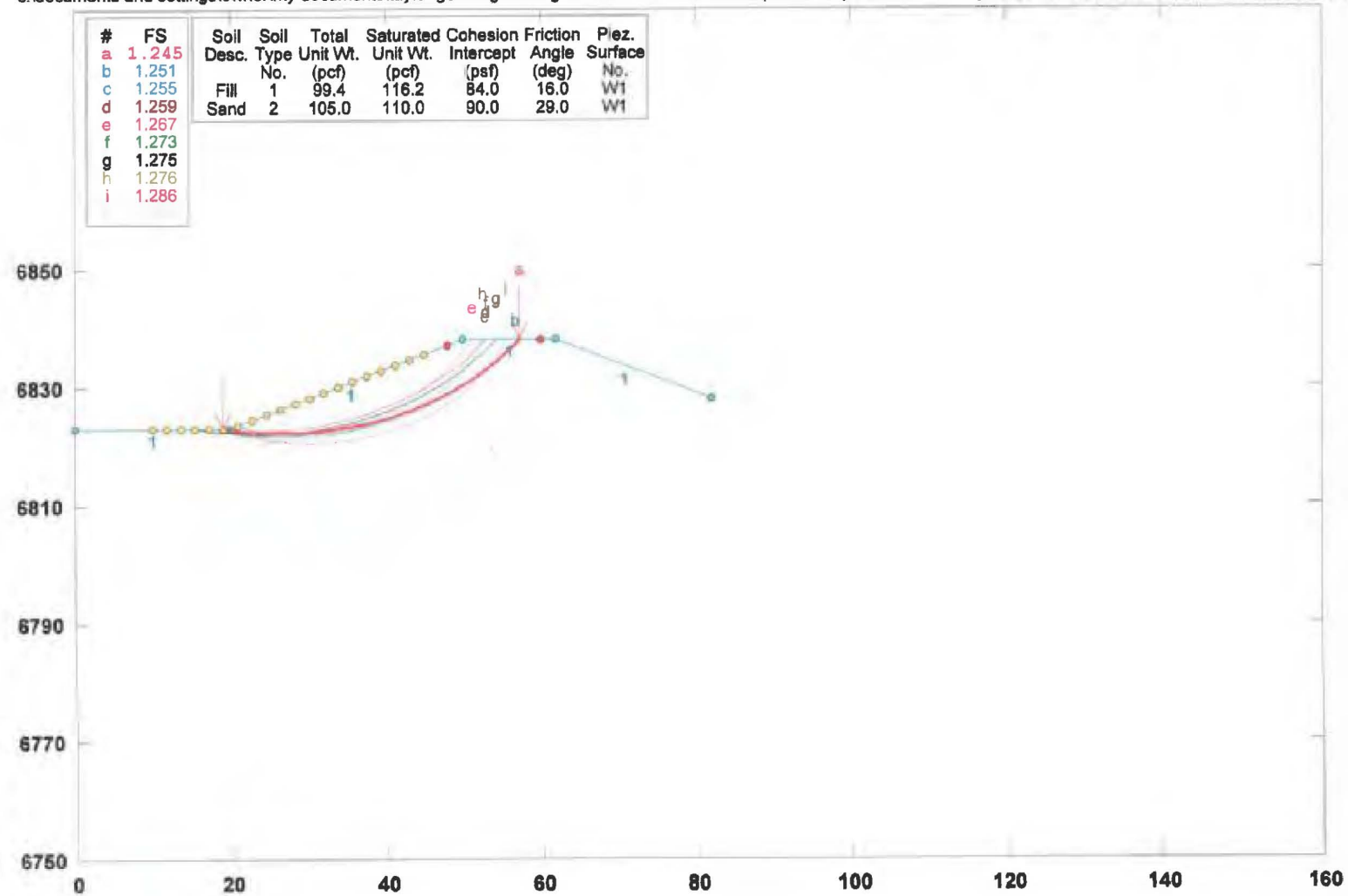
Alton Coal Hollow Sedimentation Pond 4: Line FF, Soil SP-16-13 - Rapid Drawdown

c:\documents and settings\owner\my documents\taylor geo-engineering\alton revised\alton line ff sp-16-13 rapid drawdown stage 1.pl2 Run By: Alan Taylor 12/15/2008 01:31PM



GSTABL7 v.2 FSmin=1.245

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

Figure No. 26

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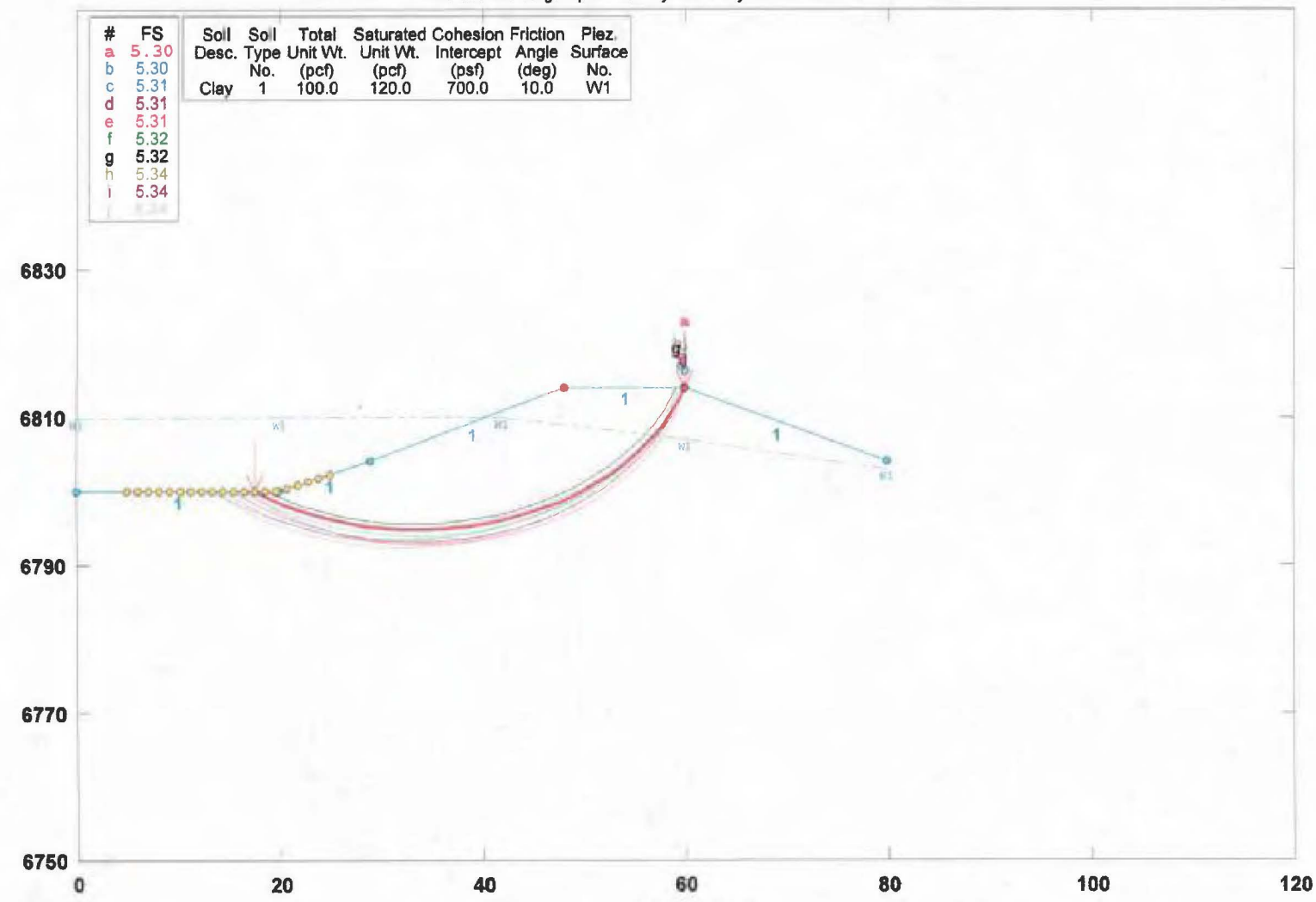
Alton Coal Hollow Sedimentation Pond 3: Line E-E, Soil GT-5 - Static

f:\alton line ee gt-5.pl2 Run By: Alan Taylor 12/15/2008 01:45PM



GSTABL7 v.2 FSmin=5.30

Safety Factors Are Calculated By The Modified Bishop Method

Figure No. 27

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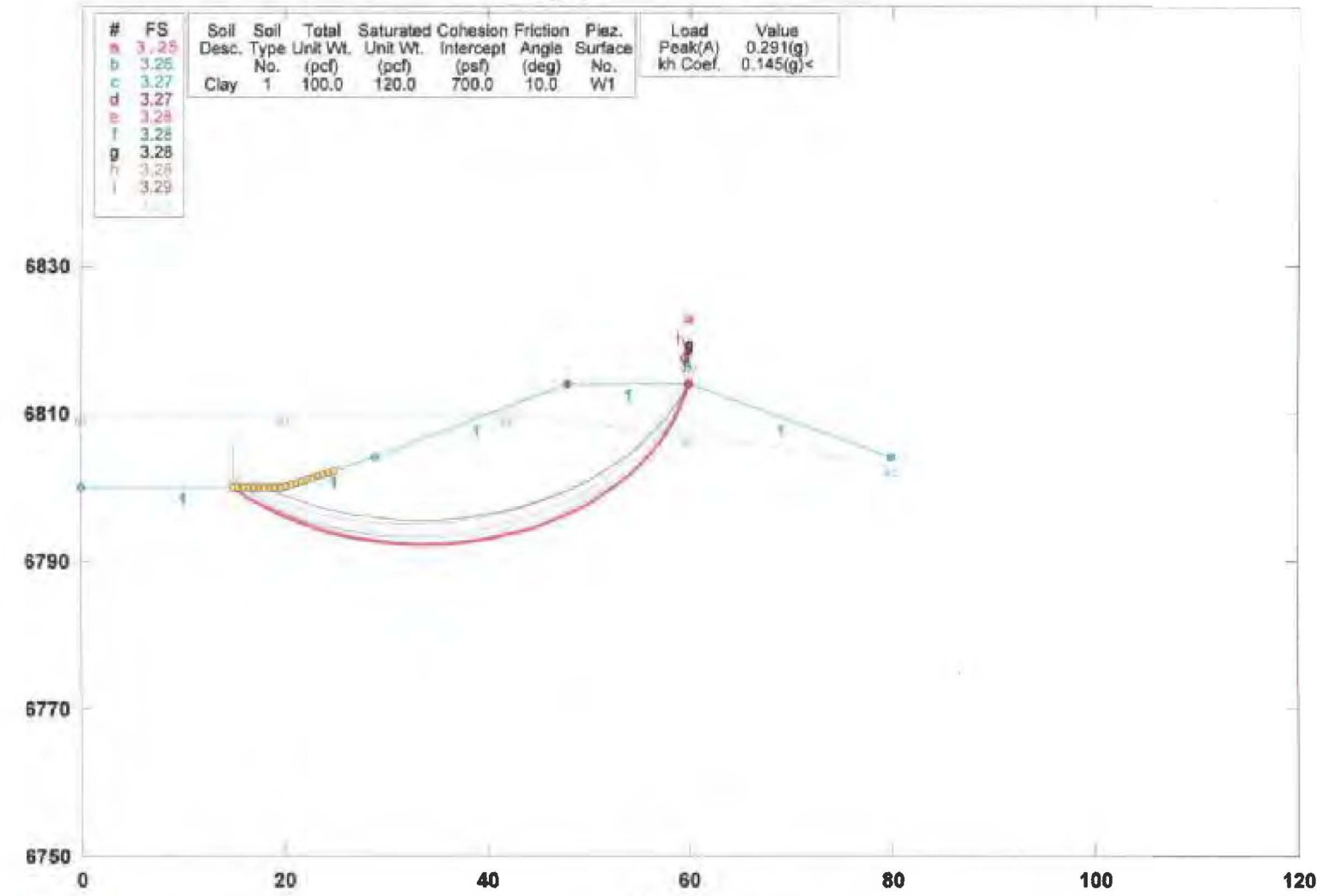
Alton Coal Hollow Sedimentation Pond 3: Line E-E, Soil GT-5 - Seismic

f:\alton line ee gt-5.pl2 Run By: Alan Taylor 12/15/2008 01:50PM



GSTABL7 v.2 FSmin=3.25

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

Figure No. 28

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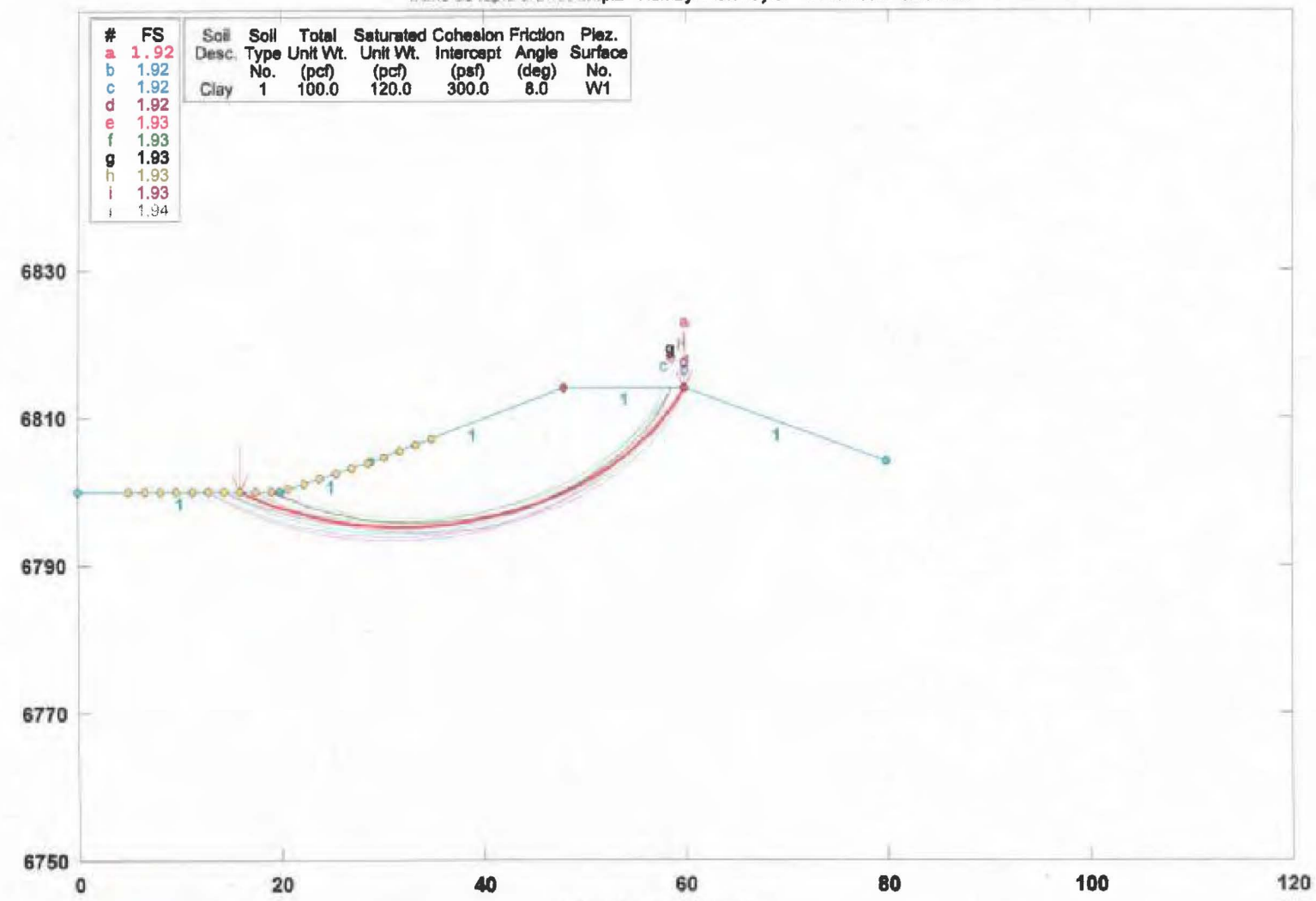
Alton Coal Hollow Sedimentation Pond 3: Line E-E, Soil GT-5 - Rapid Drawdown

f:\line ee rapid drawdown.pl2 Run By: Alan Taylor 12/15/2008 02:01PM



GSTABL7 v.2 FSmin=1.92

Safety Factors Are Calculated By The Modified Bishop Method

Figure No. 29

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APPENDIX E-1

OUPTUT FILES OF STATIC AND PSEUDO-STATIC SLOPE STABILITY ANALYSES

LINE A1-A1

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***** GSTABL7 *****

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **

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****

SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 12/13/2008
Time of Run: 09:44PM
Run By: Alan Taylor
Input Data Filename: C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engineering\alton coal stock pile ch-5-98 seismic revised a1.in
Output Filename: C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engineering\alton coal stock pile ch-5-98 seismic revised a1.OUT
Unit System: English
Plotted Output Filename: C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engineering\alton coal stock pile ch-5-98 seismic revised a1.PLT
PROBLEM DESCRIPTION: Alton Coal Pile Line A1-A1 - Static
BOUNDARY COORDINATES
6 Top Boundaries
6 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	6900.00	107.00	6900.00	1
2	107.00	6900.00	130.00	6905.00	1
3	130.00	6905.00	169.00	6915.00	1
4	169.00	6915.00	323.00	6965.00	1
5	323.00	6965.00	390.00	6970.00	1
6	390.00	6970.00	500.00	6975.00	1

User Specified Y-Origin = 6750.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	107.0	114.1	240.0	19.0	0.00	0.0	1
2	105.0	110.0	90.0	29.0	0.00	0.0	1
3	100.0	120.0	2000.0	0.0	0.00	0.0	1
4	100.0	115.0	300.0	21.0	0.00	0.0	0

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 5 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	6890.00
2	280.00	6890.00
3	330.00	6895.00
4	400.00	6895.00
5	500.00	6895.00

Specified Peak Ground Acceleration Coefficient (A) = 0.291(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.145(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
EARTHQUAKE DATA HAS BEEN SUPPRESSED
A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.
900 Trial Surfaces Have Been Generated.
30 Surface(s) Initiate(s) From Each Of 30 Points Equally Spaced Along The Ground Surface Between X = 50.00(ft)
and X = 140.00(ft)

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Each Surface Terminates Between X = 280.00(ft)
and X = 400.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 6700.00(ft)
15.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 900
Number of Trial Surfaces With Valid FS = 900
Statistical Data On All Valid FS Values:
FS Max = 3.216 FS Min = 1.643 FS Ave = 1.815
Standard Deviation = 0.138 Coefficient of Variation = 7.58 %
Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	84.138	6900.000
2	97.575	6893.333
3	111.464	6887.668
4	125.732	6883.039
5	140.300	6879.467
6	155.092	6876.974
7	170.026	6875.573
8	185.023	6875.271
9	200.002	6876.069
10	214.882	6877.964
11	229.582	6880.945
12	244.025	6884.996
13	258.131	6890.096
14	271.826	6896.216
15	285.035	6903.325
16	297.686	6911.383
17	309.713	6920.347
18	321.050	6930.169
19	331.635	6940.797
20	341.413	6952.172
21	350.330	6964.233
22	352.190	6967.178

Circle Center At X = 181.615 ; Y = 7079.424 ; and Radius = 204.193
Factor of Safety
*** 1.643 ***
Individual data on the 27 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	13.4	4793.4	0.0	0.0	0.	0.	0.0	0.0	0.0
2	8.2	7286.9	0.0	0.0	0.	0.	0.0	0.0	0.0
3	1.3	1377.6	0.0	21.6	0.	0.	0.0	0.0	0.0
4	4.6	5732.4	0.0	427.6	0.	0.	0.0	0.0	0.0
5	14.3	26679.8	0.0	4349.1	0.	0.	0.0	0.0	0.0
6	4.3	10283.9	0.0	2052.4	0.	0.	0.0	0.0	0.0
7	10.3	28882.6	0.0	6134.6	0.	0.	0.0	0.0	0.0
8	14.8	50801.6	0.0	11025.4	0.	0.	0.0	0.0	0.0
9	13.9	56257.3	0.0	11923.1	0.	0.	0.0	0.0	0.0
10	1.0	4446.7	0.0	924.7	0.	0.	0.0	0.0	0.0
11	15.0	69503.3	0.0	13645.1	0.	0.	0.0	0.0	0.0
12	15.0	76794.1	0.0	13412.9	0.	0.	0.0	0.0	0.0
13	14.9	81718.0	0.0	12152.5	0.	0.	0.0	0.0	0.0
14	14.7	84200.0	0.0	9870.9	0.	0.	0.0	0.0	0.0
15	14.4	84237.6	0.0	6579.9	0.	0.	0.0	0.0	0.0
16	13.8	80383.3	0.0	2297.9	0.	0.	0.0	0.0	0.0
17	0.3	1525.4	0.0	0.0	0.	0.	0.0	0.0	0.0
18	13.7	77669.9	0.0	0.0	0.	0.	0.0	0.0	0.0
19	13.2	71738.7	0.0	0.0	0.	0.	0.0	0.0	0.0
20	12.7	64131.7	0.0	0.0	0.	0.	0.0	0.0	0.0
21	12.0	55164.8	0.0	0.0	0.	0.	0.0	0.0	0.0
22	11.3	45207.3	0.0	0.0	0.	0.	0.0	0.0	0.0
23	2.0	6998.7	0.0	0.0	0.	0.	0.0	0.0	0.0

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24	8.6	26666.0	0.0	0.0	0.	0.	0.0	0.0	0.0
25	9.8	20427.5	0.0	0.0	0.	0.	0.0	0.0	0.0
26	8.9	8114.4	0.0	0.0	0.	0.	0.0	0.0	0.0
27	1.9	279.2	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	87.241	6900.000
2	100.783	6893.548
3	114.759	6888.102
4	129.096	6883.690
5	143.716	6880.337
6	158.542	6878.059
7	173.495	6876.869
8	188.495	6876.774
9	203.461	6877.773
10	218.315	6879.863
11	232.977	6883.030
12	247.368	6887.259
13	261.413	6892.527
14	275.035	6898.806
15	288.163	6906.062
16	300.727	6914.258
17	312.659	6923.348
18	323.896	6933.285
19	334.377	6944.015
20	344.048	6955.481
21	352.553	6967.206

Circle Center At X = 182.299 ; Y = 7082.086 ; and Radius = 205.405

Factor of Safety

*** 1.644 ***

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*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
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SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

Analysis Run Date: 12/13/2008
Time of Run: 09:42PM
Run By: Alan Taylor
Input Data Filename: C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engi
neering\alton coal stock pile ch-5-98 seismic revised a1.in
Output Filename: C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engi
neering\alton coal stock pile ch-5-98 seismic revised a1.OUT
Unit System: English
Plotted Output Filename: C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engi
neering\alton coal stock pile ch-5-98 seismic revised a1.PLT
PROBLEM DESCRIPTION: Alton Coal Pile Line A1-A1 - Seismic
BOUNDARY COORDINATES
6 Top Boundaries
6 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	6900.00	107.00	6900.00	1
2	107.00	6900.00	130.00	6905.00	1
3	130.00	6905.00	169.00	6915.00	1
4	169.00	6915.00	323.00	6965.00	1
5	323.00	6965.00	390.00	6970.00	1
6	390.00	6970.00	500.00	6975.00	1

User Specified Y-Origin = 6750.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	107.0	114.1	240.0	19.0	0.00	0.0	1
2	105.0	110.0	90.0	29.0	0.00	0.0	1
3	100.0	120.0	2000.0	0.0	0.00	0.0	1
4	100.0	115.0	300.0	21.0	0.00	0.0	0

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 5 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	6890.00
2	280.00	6890.00
3	330.00	6895.00
4	400.00	6895.00
5	500.00	6895.00

Specified Peak Ground Acceleration Coefficient (A) = 0.291(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.145(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
900 Trial Surfaces Have Been Generated.
30 Surface(s) Initiate(s) From Each Of 30 Points Equally Spaced
Along The Ground Surface Between X = 50.00(ft)
and X = 140.00(ft)
Each Surface Terminates Between X = 280.00(ft)
and X = 400.00(ft)

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Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 6700.00(ft)
15.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 900
Number of Trial Surfaces With Valid FS = 900
Statistical Data On All Valid FS Values:
FS Max = 2.177 FS Min = 1.047 FS Ave = 1.171
Standard Deviation = 0.100 Coefficient of Variation = 8.54 %
Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	56.207	6900.000
2	69.107	6892.346
3	82.468	6885.527
4	96.235	6879.571
5	110.352	6874.501
6	124.763	6870.338
7	139.409	6867.099
8	154.231	6864.797
9	169.170	6863.441
10	184.164	6863.037
11	199.154	6863.585
12	214.079	6865.085
13	228.878	6867.530
14	243.492	6870.911
15	257.862	6875.212
16	271.930	6880.418
17	285.639	6886.507
18	298.933	6893.454
19	311.759	6901.232
20	324.065	6909.809
21	335.801	6919.150
22	346.921	6929.218
23	357.378	6939.972
24	367.131	6951.368
25	376.141	6963.361
26	380.008	6969.254

Circle Center At X = 182.986 ; Y = 7098.840 ; and Radius = 235.818
Factor of Safety
*** 1.047 ***
Individual data on the 32 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	12.9	5282.8	0.0	0.0	0.	0.	766.0	0.0	0.0
2	4.6	4341.7	0.0	0.0	0.	0.	629.5	0.0	0.0
3	8.8	11613.1	0.0	1373.0	0.	0.	1683.9	0.0	0.0
4	13.8	26434.5	0.0	6974.3	0.	0.	3833.0	0.0	0.0
5	10.8	26704.0	0.0	8823.8	0.	0.	3872.1	0.0	0.0
6	3.4	9414.4	0.0	3310.6	0.	0.	1365.1	0.0	0.0
7	14.4	47864.6	0.0	16454.9	0.	0.	6940.4	0.0	0.0
8	5.2	20182.4	0.0	6774.8	0.	0.	2926.5	0.0	0.0
9	9.4	39783.2	0.0	13144.5	0.	0.	5768.6	0.0	0.0
10	14.8	71307.0	0.0	22512.5	0.	0.	10339.5	0.0	0.0
11	14.8	80115.1	0.0	23942.7	0.	0.	11616.7	0.0	0.0
12	0.2	968.1	0.0	282.2	0.	0.	140.4	0.0	0.0
13	15.0	89889.4	0.0	25048.5	0.	0.	13034.0	0.0	0.0
14	15.0	97545.6	0.0	24980.9	0.	0.	14144.1	0.0	0.0
15	14.9	103132.7	0.0	24022.0	0.	0.	14954.2	0.0	0.0
16	14.8	106576.8	0.0	22176.0	0.	0.	15453.6	0.0	0.0
17	14.6	107852.9	0.0	19449.9	0.	0.	15638.7	0.0	0.0
18	14.4	106986.8	0.0	15854.4	0.	0.	15513.1	0.0	0.0
19	14.1	104054.9	0.0	11404.7	0.	0.	15088.0	0.0	0.0
20	8.1	58747.3	0.0	4292.3	0.	0.	8518.4	0.0	0.0
21	5.6	40443.7	0.0	1926.0	0.	0.	5864.3	0.0	0.0

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22	9.6	67333.9	0.0	1364.1	0.	0.	9763.4	0.0	0.0
23	3.7	25331.6	0.0	0.0	0.	0.	3673.1	0.0	0.0
24	12.8	84984.6	0.0	0.0	0.	0.	12322.8	0.0	0.0
25	11.2	69793.7	0.0	0.0	0.	0.	10120.1	0.0	0.0
26	1.1	6336.1	0.0	0.0	0.	0.	918.7	0.0	0.0
27	11.7	64093.3	0.0	0.0	0.	0.	9293.5	0.0	0.0
28	11.1	50192.2	0.0	0.0	0.	0.	7277.9	0.0	0.0
29	10.5	36455.6	0.0	0.0	0.	0.	5286.1	0.0	0.0
30	9.8	23230.0	0.0	0.0	0.	0.	3368.3	0.0	0.0
31	9.0	10859.8	0.0	0.0	0.	0.	1574.7	0.0	0.0
32	3.9	1159.6	0.0	0.0	0.	0.	168.1	0.0	0.0

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	53.103	6900.000
2	66.211	6892.706
3	79.712	6886.171
4	93.564	6880.416
5	107.721	6875.459
6	122.138	6871.317
7	136.768	6868.004
8	151.562	6865.530
9	166.474	6863.902
10	181.454	6863.127
11	196.453	6863.208
12	211.424	6864.142
13	226.318	6865.929
14	241.085	6868.561
15	255.678	6872.031
16	270.050	6876.326
17	284.153	6881.434
18	297.943	6887.336
19	311.374	6894.016
20	324.402	6901.449
21	336.986	6909.613
22	349.084	6918.481
23	360.657	6928.024
24	371.667	6938.211
25	382.079	6949.009
26	391.858	6960.383
27	399.550	6970.434

Circle Center At X = 187.549 ; Y = 7126.167 ; and Radius = 263.110

Factor of Safety

*** 1.048 ***

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APPENDIX E-2

OUPTUT FILES OF STATIC AND PSEUDO-STATIC SLOPE STABILITY ANALYSES

LINE A2-A2

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***** GSTABL7 *****

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **

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SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 12/13/2008
Time of Run: 09:37PM
Run By: Alan Taylor
Input Data Filename: C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engineering\alton coal stock pile ch-5-98 seismic revised a2.in
Output Filename: C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engineering\alton coal stock pile ch-5-98 seismic revised a2.OUT
Unit System: English
Plotted Output Filename: C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engineering\alton coal stock pile ch-5-98 seismic revised a2.PLT
PROBLEM DESCRIPTION: Alton Coal Pile Line A2-A2 - Static
BOUNDARY COORDINATES
6 Top Boundaries
6 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	6880.00	145.00	6885.00	2
2	145.00	6885.00	245.00	6910.00	1
3	245.00	6910.00	308.00	6930.00	1
4	308.00	6930.00	398.00	6960.00	1
5	398.00	6960.00	513.00	6965.00	1
6	513.00	6965.00	600.00	6966.00	1

User Specified Y-Origin = 6750.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	107.0	114.1	240.0	19.0	0.00	0.0	1
2	105.0	110.0	90.0	29.0	0.00	0.0	1
3	100.0	120.0	2000.0	0.0	0.00	0.0	1
4	100.0	115.0	300.0	21.0	0.00	0.0	0

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 5 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	6870.00
2	280.00	6870.00
3	330.00	6870.00
4	400.00	6870.00
5	500.00	6870.00

Specified Peak Ground Acceleration Coefficient (A) = 0.291(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.145(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
EARTHQUAKE DATA HAS BEEN SUPPRESSED
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
900 Trial Surfaces Have Been Generated.
30 Surface(s) Initiate(s) From Each Of 30 Points Equally Spaced
Along The Ground Surface Between X = 50.00(ft)
and X = 200.00(ft)
Each Surface Terminates Between X = 380.00(ft)

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and X = 500.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 6700.00(ft)
15.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 900
Number of Trial Surfaces With Valid FS = 900
Statistical Data On All Valid FS Values:
FS Max = 2.380 FS Min = 1.654 FS Ave = 1.857
Standard Deviation = 0.126 Coefficient of Variation = 6.77 %
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	137.931	6884.756
2	152.420	6880.874
3	167.091	6877.749
4	181.904	6875.388
5	196.819	6873.799
6	211.797	6872.986
7	226.797	6872.951
8	241.779	6873.694
9	256.702	6875.213
10	271.526	6877.504
11	286.211	6880.561
12	300.718	6884.375
13	315.007	6888.937
14	329.041	6894.233
15	342.781	6900.251
16	356.191	6906.973
17	369.233	6914.382
18	381.874	6922.457
19	394.079	6931.177
20	405.815	6940.518
21	417.051	6950.456
22	427.757	6960.962
23	428.074	6961.308

Circle Center At X = 219.974 ; Y = 7161.964 ; and Radius = 289.094
Factor of Safety
*** 1.654 ***
Individual data on the 26 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	7.1	793.3	0.0	0.0	0.	0.	0.0	0.0	0.0
2	7.4	3223.0	0.0	0.0	0.	0.	0.0	0.0	0.0
3	14.7	14720.4	0.0	0.0	0.	0.	0.0	0.0	0.0
4	14.8	25052.8	0.0	0.0	0.	0.	0.0	0.0	0.0
5	14.9	34307.9	0.0	0.0	0.	0.	0.0	0.0	0.0
6	15.0	42365.1	0.0	0.0	0.	0.	0.0	0.0	0.0
7	15.0	49121.6	0.0	0.0	0.	0.	0.0	0.0	0.0
8	15.0	54502.3	0.0	0.0	0.	0.	0.0	0.0	0.0
9	3.2	12318.2	0.0	0.0	0.	0.	0.0	0.0	0.0
10	11.7	46627.8	0.0	0.0	0.	0.	0.0	0.0	0.0
11	14.8	62985.9	0.0	0.0	0.	0.	0.0	0.0	0.0
12	14.7	65555.1	0.0	0.0	0.	0.	0.0	0.0	0.0
13	14.5	66618.9	0.0	0.0	0.	0.	0.0	0.0	0.0
14	7.3	33744.6	0.0	0.0	0.	0.	0.0	0.0	0.0
15	7.0	32503.3	0.0	0.0	0.	0.	0.0	0.0	0.0
16	14.0	64703.9	0.0	0.0	0.	0.	0.0	0.0	0.0
17	13.7	61838.2	0.0	0.0	0.	0.	0.0	0.0	0.0
18	13.4	57702.7	0.0	0.0	0.	0.	0.0	0.0	0.0
19	13.0	52417.1	0.0	0.0	0.	0.	0.0	0.0	0.0
20	12.6	46120.9	0.0	0.0	0.	0.	0.0	0.0	0.0
21	12.2	38971.5	0.0	0.0	0.	0.	0.0	0.0	0.0
22	3.9	11163.5	0.0	0.0	0.	0.	0.0	0.0	0.0
23	7.8	19034.8	0.0	0.0	0.	0.	0.0	0.0	0.0

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24	11.2	18150.5	0.0	0.0	0.	0.	0.0	0.0	0.0
25	10.7	6130.6	0.0	0.0	0.	0.	0.0	0.0	0.0
26	0.3	5.6	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	127.586	6884.399
2	142.305	6881.510
3	157.137	6879.271
4	172.053	6877.685
5	187.024	6876.755
6	202.022	6876.484
7	217.017	6876.873
8	231.980	6877.919
9	246.883	6879.622
10	261.697	6881.977
11	276.393	6884.981
12	290.943	6888.627
13	305.319	6892.910
14	319.493	6897.819
15	333.438	6903.346
16	347.126	6909.480
17	360.532	6916.210
18	373.629	6923.522
19	386.392	6931.402
20	398.797	6939.835
21	410.820	6948.805
22	422.436	6958.294
23	425.695	6961.204

Circle Center At X = 200.688 ; Y = 7217.908 ; and Radius = 341.426

Factor of Safety

*** 1.658 ***

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** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **

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SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 12/13/2008
Time of Run: 09:38PM
Run By: Alan Taylor
Input Data Filename: C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engineering\alton coal stock pile ch-5-98 seismic revised a2.in
Output Filename: C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engineering\alton coal stock pile ch-5-98 seismic revised a2.OUI
Unit System: English
Plotted Output Filename: C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engineering\alton coal stock pile ch-5-98 seismic revised a2.PLT
PROBLEM DESCRIPTION: Alton Coal Pile Line A2-A2 - Seismic
BOUNDARY COORDINATES
6 Top Boundaries
6 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	6880.00	145.00	6885.00	2
2	145.00	6885.00	245.00	6910.00	1
3	245.00	6910.00	308.00	6930.00	1
4	308.00	6930.00	398.00	6960.00	1
5	398.00	6960.00	513.00	6965.00	1
6	513.00	6965.00	600.00	6966.00	1

User Specified Y-Origin = 6750.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	107.0	114.1	240.0	19.0	0.00	0.0	1
2	105.0	110.0	90.0	29.0	0.00	0.0	1
3	100.0	120.0	2000.0	0.0	0.00	0.0	1
4	100.0	115.0	300.0	21.0	0.00	0.0	0

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 5 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	6870.00
2	280.00	6870.00
3	330.00	6870.00
4	400.00	6870.00
5	500.00	6870.00

Specified Peak Ground Acceleration Coefficient (A) = 0.291(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.145(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
900 Trial Surfaces Have Been Generated.
30 Surface(s) Initiate(s) From Each Of 30 Points Equally Spaced
Along The Ground Surface Between X = 50.00(ft)
and X = 200.00(ft)
Each Surface Terminates Between X = 380.00(ft)
and X = 500.00(ft)

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Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 6700.00(ft)
15.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 900
Number of Trial Surfaces With Valid FS = 900
Statistical Data On All Valid FS Values:
FS Max = 1.592 FS Min = 1.073 FS Ave = 1.177
Standard Deviation = 0.084 Coefficient of Variation = 7.10 %
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	143.103	6884.935
2	157.834	6882.103
3	172.673	6879.911
4	187.593	6878.363
5	202.566	6877.463
6	217.564	6877.212
7	232.558	6877.611
8	247.522	6878.658
9	262.426	6880.352
10	277.242	6882.689
11	291.944	6885.666
12	306.503	6889.276
13	320.892	6893.514
14	335.084	6898.370
15	349.053	6903.835
16	362.772	6909.901
17	376.216	6916.555
18	389.359	6923.784
19	402.176	6931.576
20	414.645	6939.915
21	426.740	6948.786
22	438.441	6958.172
23	449.749	6961.946

Circle Center At X = 215.861 ; Y = 7223.639 ; and Radius = 346.431
Factor of Safety
*** 1.073 ***
Individual data on the 26 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.9	42.8	0.0	0.0	0.	0.	6.2	0.0	0.0
2	12.8	4487.1	0.0	0.0	0.	0.	650.6	0.0	0.0
3	14.8	14380.7	0.0	0.0	0.	0.	2085.2	0.0	0.0
4	14.9	23382.2	0.0	0.0	0.	0.	3390.4	0.0	0.0
5	15.0	31411.7	0.0	0.0	0.	0.	4554.7	0.0	0.0
6	15.0	38399.4	0.0	0.0	0.	0.	5567.9	0.0	0.0
7	15.0	44288.0	0.0	0.0	0.	0.	6421.8	0.0	0.0
8	12.4	40468.4	0.0	0.0	0.	0.	5867.9	0.0	0.0
9	2.5	8588.5	0.0	0.0	0.	0.	1245.3	0.0	0.0
10	14.9	53680.5	0.0	0.0	0.	0.	7783.7	0.0	0.0
11	14.8	57649.3	0.0	0.0	0.	0.	8359.1	0.0	0.0
12	14.7	60393.0	0.0	0.0	0.	0.	8757.0	0.0	0.0
13	14.6	61911.7	0.0	0.0	0.	0.	8977.2	0.0	0.0
14	1.5	6449.1	0.0	0.0	0.	0.	935.1	0.0	0.0
15	12.9	55915.0	0.0	0.0	0.	0.	8107.7	0.0	0.0
16	14.2	61837.8	0.0	0.0	0.	0.	8966.5	0.0	0.0
17	14.0	60165.5	0.0	0.0	0.	0.	8724.0	0.0	0.0
18	13.7	57399.8	0.0	0.0	0.	0.	8323.0	0.0	0.0
19	13.4	53612.3	0.0	0.0	0.	0.	7773.8	0.0	0.0
20	13.1	48882.4	0.0	0.0	0.	0.	7087.9	0.0	0.0
21	8.6	29726.0	0.0	0.0	0.	0.	4310.3	0.0	0.0
22	4.2	13309.4	0.0	0.0	0.	0.	1929.9	0.0	0.0
23	12.5	32962.6	0.0	0.0	0.	0.	4779.6	0.0	0.0
24	12.1	21531.9	0.0	0.0	0.	0.	3122.1	0.0	0.0

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25	11.7	10047.3	0.0	0.0	0.	0.	1456.9	0.0	0.0
26	4.3	826.5	0.0	0.0	0.	0.	119.8	0.0	0.0

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	127.586	6884.399
2	142.251	6881.248
3	157.036	6878.717
4	171.915	6876.810
5	186.860	6875.530
6	201.846	6874.881
7	216.846	6874.864
8	231.833	6875.477
9	246.782	6876.721
10	261.664	6878.592
11	276.455	6881.088
12	291.128	6884.205
13	305.656	6887.937
14	320.015	6892.276
15	334.178	6897.216
16	348.121	6902.748
17	361.819	6908.861
18	375.247	6915.545
19	388.382	6922.789
20	401.201	6930.579
21	413.680	6938.902
22	425.798	6947.742
23	437.533	6957.085
24	443.158	6961.963

Circle Center At X = 209.769 ; Y = 7230.776 ; and Radius = 355.992

Factor of Safety

*** 1.074 ***

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APPENDIX E-3

OUPTUT FILES OF STATIC AND PSEUDO-STATIC SLOPE STABILITY ANALYSES

LINE B1-B1

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*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **

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SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 12/13/2008
Time of Run: 09:34PM
Run By: Alan Taylor
Input Data Filename: C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engineering\Alton Revised\alton coal stock pile ch-5-98 seismic revised bl.in
Output Filename: C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engineering\Alton Revised\alton coal stock pile ch-5-98 seismic revised bl.OUT
Unit System: English
Plotted Output Filename: C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engineering\Alton Revised\alton coal stock pile ch-5-98 seismic revised bl.PLT
PROBLEM DESCRIPTION: Alton Coal Pile Line B1-B1 - Static
BOUNDARY COORDINATES
11 Top Boundaries
14 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	6825.00	122.00	6835.00	2
2	122.00	6835.00	190.00	6850.00	1
3	190.00	6850.00	296.00	6875.00	1
4	296.00	6875.00	367.00	6895.00	1
5	367.00	6895.00	470.00	6930.00	1
6	470.00	6930.00	505.00	6935.00	1
7	505.00	6935.00	555.00	6940.00	1
8	555.00	6940.00	591.00	6945.00	1
9	591.00	6945.00	660.00	6950.00	1
10	660.00	6950.00	726.00	6950.00	1
11	726.00	6950.00	770.00	6945.00	1
12	122.00	6835.00	770.00	6835.00	2
13	0.00	6817.00	770.00	6817.00	3
14	0.00	6800.00	770.00	6800.00	4

User Specified Y-Origin = 6750.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	107.0	114.1	240.0	19.0	0.00	0.0	1
2	105.0	110.0	90.0	29.0	0.00	0.0	1
3	100.0	120.0	2000.0	0.0	0.00	0.0	1
4	100.0	115.0	300.0	21.0	0.00	0.0	0

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 3 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	6815.00
2	280.00	6816.00
3	770.00	6816.00

Specified Peak Ground Acceleration Coefficient (A) = 0.291(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.145(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
EARTHQUAKE DATA HAS BEEN SUPPRESSED

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A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
900 Trial Surfaces Have Been Generated.
30 Surface(s) Initiate(s) From Each Of 30 Points Equally Spaced
Along The Ground Surface Between X = 50.00(ft)
and X = 140.00(ft)
Each Surface Terminates Between X = 400.00(ft)
and X = 700.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 6750.00(ft)
15.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 900
Number of Trial Surfaces With Valid FS = 900
Statistical Data On All Valid FS Values:
FS Max = 2.875 FS Min = 1.708 FS Ave = 2.249
Standard Deviation = 0.255 Coefficient of Variation = 11.32 %
Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	102.759	6833.423
2	116.714	6827.923
3	130.851	6822.909
4	145.154	6818.388
5	159.604	6814.364
6	174.185	6810.843
7	188.879	6807.829
8	203.668	6805.325
9	218.536	6803.334
10	233.463	6801.859
11	248.432	6800.902
12	263.426	6800.463
13	278.426	6800.543
14	293.414	6801.143
15	308.372	6802.261
16	323.283	6803.896
17	338.128	6806.045
18	352.890	6808.708
19	367.550	6811.879
20	382.093	6815.557
21	396.499	6819.735
22	410.752	6824.409
23	424.835	6829.574
24	438.731	6835.223
25	452.422	6841.349
26	465.894	6847.946
27	479.129	6855.005
28	492.112	6862.518
29	504.827	6870.475
30	517.259	6878.868
31	529.394	6887.687
32	541.215	6896.919
33	552.710	6906.556
34	563.865	6916.584
35	574.666	6926.993
36	585.100	6937.770
37	591.676	6945.049

Circle Center At X = 268.605 ; Y = 7233.784 ; and Radius = 433.352
Factor of Safety
*** 1.708 ***
Individual data on the 50 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	14.0	4867.4	0.0	0.0	0.	0.	0.0	0.0	0.0
2	5.3	4328.1	0.0	0.0	0.	0.	0.0	0.0	0.0

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3	8.9	10702.9	0.0	0.0	0.	0.	0.0	0.0	0.0
4	14.3	26954.3	0.0	0.0	0.	0.	0.0	0.0	0.0
5	5.0	12073.5	0.0	0.0	0.	0.	0.0	0.0	0.0
6	5.2	13950.7	0.0	0.0	0.	0.	0.0	0.0	0.0
7	4.3	12584.1	0.0	167.0	0.	0.	0.0	0.0	0.0
8	14.6	50291.7	0.0	2801.1	0.	0.	0.0	0.0	0.0
9	14.7	61535.0	0.0	5908.5	0.	0.	0.0	0.0	0.0
10	1.1	5120.8	0.0	563.6	0.	0.	0.0	0.0	0.0
11	13.7	67024.4	0.0	7976.3	0.	0.	0.0	0.0	0.0
12	14.9	82112.4	0.0	10692.7	0.	0.	0.0	0.0	0.0
13	14.9	91175.9	0.0	12365.0	0.	0.	0.0	0.0	0.0
14	15.0	99280.5	0.0	13552.8	0.	0.	0.0	0.0	0.0
15	15.0	106381.7	0.0	14256.6	0.	0.	0.0	0.0	0.0
16	15.0	112441.3	0.0	14474.6	0.	0.	0.0	0.0	0.0
17	1.6	12117.7	0.0	1516.2	0.	0.	0.0	0.0	0.0
18	13.4	105304.8	0.0	12670.4	0.	0.	0.0	0.0	0.0
19	2.6	20712.4	0.0	2388.7	0.	0.	0.0	0.0	0.0
20	12.4	100963.8	0.0	10994.4	0.	0.	0.0	0.0	0.0
21	14.9	125521.0	0.0	12094.9	0.	0.	0.0	0.0	0.0
22	14.8	128255.8	0.0	10323.9	0.	0.	0.0	0.0	0.0
23	14.8	129861.0	0.0	8071.6	0.	0.	0.0	0.0	0.0
24	14.1	125431.3	0.0	5194.5	0.	0.	0.0	0.0	0.0
25	0.6	4911.2	0.0	146.9	0.	0.	0.0	0.0	0.0
26	14.5	130418.9	0.0	2136.2	0.	0.	0.0	0.0	0.0
27	1.5	13778.3	0.0	22.0	0.	0.	0.0	0.0	0.0
28	3.4	31124.9	0.0	0.0	0.	0.	0.0	0.0	0.0
29	9.4	85504.0	0.0	0.0	0.	0.	0.0	0.0	0.0
30	14.3	129833.2	0.0	0.0	0.	0.	0.0	0.0	0.0
31	14.1	128261.4	0.0	0.0	0.	0.	0.0	0.0	0.0
32	13.3	120803.0	0.0	0.0	0.	0.	0.0	0.0	0.0
33	0.5	4932.7	0.0	0.0	0.	0.	0.0	0.0	0.0
34	13.7	122204.0	0.0	0.0	0.	0.	0.0	0.0	0.0
35	13.5	117721.5	0.0	0.0	0.	0.	0.0	0.0	0.0
36	4.1	35262.5	0.0	0.0	0.	0.	0.0	0.0	0.0
37	9.1	76271.3	0.0	0.0	0.	0.	0.0	0.0	0.0
38	13.0	102063.0	0.0	0.0	0.	0.	0.0	0.0	0.0
39	12.7	91931.5	0.0	0.0	0.	0.	0.0	0.0	0.0
40	0.2	1191.7	0.0	0.0	0.	0.	0.0	0.0	0.0
41	12.3	79863.0	0.0	0.0	0.	0.	0.0	0.0	0.0
42	12.1	69534.0	0.0	0.0	0.	0.	0.0	0.0	0.0
43	11.8	57842.1	0.0	0.0	0.	0.	0.0	0.0	0.0
44	11.5	46073.1	0.0	0.0	0.	0.	0.0	0.0	0.0
45	2.3	7913.0	0.0	0.0	0.	0.	0.0	0.0	0.0
46	8.9	26575.3	0.0	0.0	0.	0.	0.0	0.0	0.0
47	10.8	23337.0	0.0	0.0	0.	0.	0.0	0.0	0.0
48	10.4	12364.5	0.0	0.0	0.	0.	0.0	0.0	0.0
49	5.9	2244.5	0.0	0.0	0.	0.	0.0	0.0	0.0
50	0.7	25.3	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	102.759	6833.423
2	116.653	6827.770
3	130.748	6822.638
4	145.023	6818.034
5	159.461	6813.963
6	174.039	6810.433
7	188.739	6807.447
8	203.540	6805.009
9	218.421	6803.124
10	233.362	6801.793
11	248.342	6801.020
12	263.340	6800.803
13	278.336	6801.145
14	293.309	6802.043
15	308.238	6803.499
16	323.103	6805.508
17	337.883	6808.068
18	352.557	6811.177
19	367.106	6814.829

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20	381.509	6819.020
21	395.746	6823.743
22	409.797	6828.992
23	423.644	6834.761
24	437.266	6841.040
25	450.646	6847.822
26	463.764	6855.096
27	476.602	6862.854
28	489.143	6871.083
29	501.370	6879.772
30	513.264	6888.911
31	524.811	6898.486
32	535.994	6908.483
33	546.797	6918.890
34	557.206	6929.690
35	567.206	6940.871
36	567.979	6941.803

Circle Center At X = 261.654 ; Y = 7204.033 ; and Radius = 403.237

Factor of Safety

*** 1.716 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	112.069	6834.186
2	125.621	6827.755
3	139.459	6821.967
4	153.554	6816.834
5	167.873	6812.368
6	182.387	6808.579
7	197.062	6805.474
8	211.866	6803.060
9	226.768	6801.343
10	241.733	6800.327
11	256.730	6800.014
12	271.725	6800.405
13	286.685	6801.498
14	301.577	6803.292
15	316.369	6805.781
16	331.028	6808.962
17	345.522	6812.826
18	359.818	6817.366
19	373.886	6822.571
20	387.695	6828.431
21	401.213	6834.931
22	414.412	6842.058
23	427.262	6849.795
24	439.735	6858.127
25	451.804	6867.035
26	463.441	6876.499
27	474.622	6886.498
28	485.322	6897.010
29	495.518	6908.013
30	505.186	6919.481
31	514.305	6931.391
32	517.691	6936.269

Circle Center At X = 255.886 ; Y = 7119.638 ; and Radius = 319.634

Factor of Safety

*** 1.727 ***

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** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **

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SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

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Analysis Run Date: 12/13/2008
Time of Run: 09:32PM
Run By: Alan Taylor
Input Data Filename: C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engineering\Alton Revised\alton coal stock pile ch-5-98 seismic revised bl.in
Output Filename: C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engineering\Alton Revised\alton coal stock pile ch-5-98 seismic revised bl.OUT
Unit System: English
Plotted Output Filename: C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engineering\Alton Revised\alton coal stock pile ch-5-98 seismic revised bl.PLT
PROBLEM DESCRIPTION: Alton Coal Pile Line B1-B1 - Seismic
BOUNDARY COORDINATES
11 Top Boundaries
14 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	6825.00	122.00	6835.00	2
2	122.00	6835.00	190.00	6850.00	1
3	190.00	6850.00	296.00	6875.00	1
4	296.00	6875.00	367.00	6895.00	1
5	367.00	6895.00	470.00	6930.00	1
6	470.00	6930.00	505.00	6935.00	1
7	505.00	6935.00	555.00	6940.00	1
8	555.00	6940.00	591.00	6945.00	1
9	591.00	6945.00	660.00	6950.00	1
10	660.00	6950.00	726.00	6950.00	1
11	726.00	6950.00	770.00	6945.00	1
12	122.00	6835.00	770.00	6835.00	2
13	0.00	6817.00	770.00	6817.00	3
14	0.00	6800.00	770.00	6800.00	4

User Specified Y-Origin = 6750.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	107.0	114.1	240.0	19.0	0.00	0.0	1
2	105.0	110.0	90.0	29.0	0.00	0.0	1
3	100.0	120.0	2000.0	0.0	0.00	0.0	1
4	100.0	115.0	300.0	21.0	0.00	0.0	0

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 3 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	6815.00
2	280.00	6816.00
3	770.00	6816.00

Specified Peak Ground Acceleration Coefficient (A) = 0.291(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.145(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random

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Technique For Generating Circular Surfaces, Has Been Specified.
900 Trial Surfaces Have Been Generated.
30 Surface(s) Initiate(s) From Each Of 30 Points Equally Spaced
Along The Ground Surface Between X = 50.00(ft)
and X = 140.00(ft)
Each Surface Terminates Between X = 400.00(ft)
and X = 700.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 6750.00(ft)
15.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 900
Number of Trial Surfaces With Valid FS = 900
Statistical Data On All Valid FS Values:
FS Max = 1.741 FS Min = 1.051 FS Ave = 1.397
Standard Deviation = 0.167 Coefficient of Variation = 11.98 %
Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	90.345	6832.405
2	104.479	6827.384
3	118.754	6822.776
4	133.157	6818.585
5	147.675	6814.815
6	162.297	6811.468
7	177.010	6808.547
8	191.801	6806.055
9	206.659	6803.995
10	221.571	6802.367
11	236.523	6801.173
12	251.504	6800.414
13	266.500	6800.091
14	281.500	6800.205
15	296.490	6800.753
16	311.457	6801.738
17	326.390	6803.157
18	341.275	6805.010
19	356.100	6807.294
20	370.853	6810.009
21	385.520	6813.151
22	400.090	6816.718
23	414.549	6820.708
24	428.887	6825.115
25	443.091	6829.938
26	457.148	6835.171
27	471.047	6840.812
28	484.777	6846.853
29	498.325	6853.291
30	511.680	6860.120
31	524.831	6867.334
32	537.767	6874.928
33	550.477	6882.895
34	562.949	6891.228
35	575.174	6899.919
36	587.142	6908.963
37	598.841	6918.350
38	610.263	6928.074
39	621.397	6938.125
40	631.660	6947.946

Circle Center At X = 270.107 ; Y = 7316.028 ; and Radius = 515.951
Factor of Safety
*** 1.051 ***
Individual data on the 53 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)

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1	14.1	4585.8	0.0	0.0	0.	0.	664.9	0.0	0.0
2	14.3	13592.8	0.0	0.0	0.	0.	1970.9	0.0	0.0
3	3.2	4281.6	0.0	0.0	0.	0.	620.8	0.0	0.0
4	11.2	18796.5	0.0	0.0	0.	0.	2725.5	0.0	0.0
5	6.1	13077.4	0.0	0.0	0.	0.	1896.2	0.0	0.0
6	5.7	13919.7	0.0	0.0	0.	0.	2018.4	0.0	0.0
7	2.7	7183.6	0.0	62.1	0.	0.	1041.6	0.0	0.0
8	14.6	45366.4	0.0	2257.7	0.	0.	6578.1	0.0	0.0
9	14.7	56291.5	0.0	5240.3	0.	0.	8162.3	0.0	0.0
10	13.0	57942.9	0.0	6742.7	0.	0.	8401.7	0.0	0.0
11	1.8	8622.2	0.0	1080.0	0.	0.	1250.2	0.0	0.0
12	14.9	76356.4	0.0	10002.6	0.	0.	11071.7	0.0	0.0
13	14.9	85549.3	0.0	11778.6	0.	0.	12404.6	0.0	0.0
14	15.0	93966.5	0.0	13149.2	0.	0.	13625.1	0.0	0.0
15	15.0	101573.8	0.0	14113.1	0.	0.	14728.2	0.0	0.0
16	15.0	108341.7	0.0	14668.9	0.	0.	15709.5	0.0	0.0
17	13.5	102575.7	0.0	13338.7	0.	0.	14873.5	0.0	0.0
18	1.5	11670.5	0.0	1478.9	0.	0.	1692.2	0.0	0.0
19	14.5	115285.3	0.0	14060.9	0.	0.	16716.4	0.0	0.0
20	0.5	3971.1	0.0	466.5	0.	0.	575.8	0.0	0.0
21	15.0	123945.0	0.0	13810.1	0.	0.	17972.0	0.0	0.0
22	14.9	128231.4	0.0	12685.4	0.	0.	18593.6	0.0	0.0
23	14.9	131589.3	0.0	11153.8	0.	0.	19080.5	0.0	0.0
24	14.8	134015.0	0.0	9217.4	0.	0.	19432.2	0.0	0.0
25	10.9	99950.7	0.0	5326.8	0.	0.	14492.9	0.0	0.0
26	3.9	35604.5	0.0	1551.2	0.	0.	5162.7	0.0	0.0
27	14.7	137096.2	0.0	4137.0	0.	0.	19879.0	0.0	0.0
28	11.6	110146.8	0.0	1065.1	0.	0.	15971.3	0.0	0.0
29	2.9	27937.9	0.0	0.0	0.	0.	4051.0	0.0	0.0
30	1.0	9748.2	0.0	0.0	0.	0.	1413.5	0.0	0.0
31	13.4	129009.9	0.0	0.0	0.	0.	18706.4	0.0	0.0
32	14.3	138773.0	0.0	0.0	0.	0.	20122.1	0.0	0.0
33	14.2	137960.8	0.0	0.0	0.	0.	20004.3	0.0	0.0
34	13.6	131884.2	0.0	0.0	0.	0.	19123.2	0.0	0.0
35	0.5	4456.3	0.0	0.0	0.	0.	646.2	0.0	0.0
36	12.9	123816.4	0.0	0.0	0.	0.	17953.4	0.0	0.0
37	1.0	10026.8	0.0	0.0	0.	0.	1453.9	0.0	0.0
38	13.7	128246.1	0.0	0.0	0.	0.	18595.7	0.0	0.0
39	13.5	120329.6	0.0	0.0	0.	0.	17447.8	0.0	0.0
40	6.7	56800.6	0.0	0.0	0.	0.	8236.1	0.0	0.0
41	6.7	54981.1	0.0	0.0	0.	0.	7972.3	0.0	0.0
42	13.2	102157.5	0.0	0.0	0.	0.	14812.8	0.0	0.0
43	12.9	92042.6	0.0	0.0	0.	0.	13346.2	0.0	0.0
44	12.7	81596.3	0.0	0.0	0.	0.	11831.5	0.0	0.0
45	4.5	26798.8	0.0	0.0	0.	0.	3885.8	0.0	0.0
46	7.9	44212.1	0.0	0.0	0.	0.	6410.8	0.0	0.0
47	12.2	60668.5	0.0	0.0	0.	0.	8796.9	0.0	0.0
48	12.0	50185.5	0.0	0.0	0.	0.	7276.9	0.0	0.0
49	3.9	14127.9	0.0	0.0	0.	0.	2048.6	0.0	0.0
50	7.8	25236.6	0.0	0.0	0.	0.	3659.3	0.0	0.0
51	11.4	27827.4	0.0	0.0	0.	0.	4035.0	0.0	0.0
52	11.1	16321.2	0.0	0.0	0.	0.	2366.6	0.0	0.0
53	10.3	4984.7	0.0	0.0	0.	0.	722.8	0.0	0.0

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APPENDIX E-4

OUPTUT FILES OF STATIC AND PSEUDO-STATIC SLOPE STABILITY ANALYSES

LINE B2-B2

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***** GSTABL7 *****

** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
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SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

Analysis Run Date: 12/13/2008
Time of Run: 09:13PM
Run By: Alan Taylor
Input Data Filename: C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engineering\Alton Revised\alton coal stock pile ch-5-98 seismic revised b2.in
Output Filename: C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engineering\Alton Revised\alton coal stock pile ch-5-98 seismic revised b2.OUT
Unit System: English
Plotted Output Filename: C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engineering\Alton Revised\alton coal stock pile ch-5-98 seismic revised b2.PLT
PROBLEM DESCRIPTION: Alton Coal Pile Line B2-B2 - Static
BOUNDARY COORDINATES
7 Top Boundaries
10 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	6810.00	200.00	6815.00	2
2	200.00	6815.00	241.00	6820.00	1
3	241.00	6820.00	308.00	6835.00	1
4	308.00	6835.00	476.00	6875.00	1
5	476.00	6875.00	617.00	6925.00	1
6	617.00	6925.00	686.00	6925.00	1
7	686.00	6925.00	730.00	6910.00	1
8	241.00	6820.00	730.00	6820.00	2
9	0.00	6806.00	730.00	6812.00	3
10	0.00	6800.00	730.00	6800.00	4

User Specified Y-Origin = 6750.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	107.0	114.1	240.0	19.0	0.00	0.0	1
2	105.0	110.0	90.0	29.0	0.00	0.0	1
3	100.0	120.0	2000.0	0.0	0.00	0.0	1
4	100.0	115.0	300.0	21.0	0.00	0.0	0

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 3 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	6801.00
2	280.00	6801.00
3	730.00	6801.00

Specified Peak Ground Acceleration Coefficient (A) = 0.291(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.145(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
EARTHQUAKE DATA HAS BEEN SUPPRESSED
A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.
900 Trial Surfaces Have Been Generated.
30 Surface(s) Initiate(s) From Each Of 30 Points Equally Spaced

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Along The Ground Surface Between X = 100.00(ft)
and X = 400.00(ft)
Each Surface Terminates Between X = 400.00(ft)
and X = 650.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 6750.00(ft)
15.00(ft) Line Segments Define Each Trial Failure Surface.
**** ERROR - RC11 ****
>200 attempts to generate failure surface have failed. Revise limitations
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 3 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	389.66	6854.44
2	400.39	6843.97
3	406.74	6858.51

Factor Of Safety For The Preceding Specified Surface =-12.950
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 900
Number of Trial Surfaces with Misleading FS = 1
Number of Failed Attempts to Generate Trial Surface = 59
Number of Trial Surfaces With Valid FS = 840
Percentage of Trial Surfaces With Non-Valid FS Solutions
of the Total Attempted = 6.7 %
Statistical Data On All Valid FS Values:
FS Max = 10.391 FS Min = 1.611 FS Ave = 2.859
Standard Deviation = 0.835 Coefficient of Variation = 29.20 %
Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	358.621	6847.053
2	373.280	6843.875
3	388.076	6841.411
4	402.975	6839.668
5	417.940	6838.650
6	432.937	6838.359
7	447.931	6838.795
8	462.886	6839.959
9	477.767	6841.847
10	492.538	6844.454
11	507.166	6847.774
12	521.616	6851.801
13	535.853	6856.523
14	549.844	6861.931
15	563.557	6868.011
16	576.958	6874.749
17	590.017	6882.128
18	602.703	6890.133
19	614.985	6898.744
20	626.836	6907.940
21	638.226	6917.701
22	645.952	6925.000

Circle Center At X = 431.437 ; Y = 7147.192 ; and Radius = 308.846
Factor of Safety
*** 1.611 ***
Individual data on the 23 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	14.7	5230.3	0.0	0.0	0.	0.	0.0	0.0	0.0
2	14.8	15296.3	0.0	0.0	0.	0.	0.0	0.0	0.0
3	14.9	24389.9	0.0	0.0	0.	0.	0.0	0.0	0.0
4	15.0	32402.8	0.0	0.0	0.	0.	0.0	0.0	0.0
5	15.0	39246.1	0.0	0.0	0.	0.	0.0	0.0	0.0
6	15.0	44848.1	0.0	0.0	0.	0.	0.0	0.0	0.0

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7	15.0	49156.6	0.0	0.0	0.	0.	0.0	0.0	0.0
8	13.1	45812.3	0.0	0.0	0.	0.	0.0	0.0	0.0
9	1.8	6346.9	0.0	0.0	0.	0.	0.0	0.0	0.0
10	14.8	55470.5	0.0	0.0	0.	0.	0.0	0.0	0.0
11	14.6	58449.6	0.0	0.0	0.	0.	0.0	0.0	0.0
12	14.4	60029.1	0.0	0.0	0.	0.	0.0	0.0	0.0
13	14.2	60231.7	0.0	0.0	0.	0.	0.0	0.0	0.0
14	14.0	59101.7	0.0	0.0	0.	0.	0.0	0.0	0.0
15	13.7	56703.2	0.0	0.0	0.	0.	0.0	0.0	0.0
16	13.4	53121.9	0.0	0.0	0.	0.	0.0	0.0	0.0
17	13.1	48455.5	0.0	0.0	0.	0.	0.0	0.0	0.0
18	12.7	42824.4	0.0	0.0	0.	0.	0.0	0.0	0.0
19	12.3	36363.5	0.0	0.0	0.	0.	0.0	0.0	0.0
20	2.0	5414.5	0.0	0.0	0.	0.	0.0	0.0	0.0
21	9.8	21969.9	0.0	0.0	0.	0.	0.0	0.0	0.0
22	11.4	14843.4	0.0	0.0	0.	0.	0.0	0.0	0.0
23	7.7	3017.3	0.0	0.0	0.	0.	0.0	0.0	0.0

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** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **

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SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 12/13/2008
Time of Run: 09:19PM
Run By: Alan Taylor
Input Data Filename: C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engineering\Alton Revised\alton coal stock pile ch-5-98 seismic revised b2.in
Output Filename: C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engineering\Alton Revised\alton coal stock pile ch-5-98 seismic revised b2.OUT
Unit System: English
Plotted Output Filename: C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engineering\Alton Revised\alton coal stock pile ch-5-98 seismic revised b2.PLT
PROBLEM DESCRIPTION: Alton Coal Pile Line B2-B2 - Seismic

BOUNDARY COORDINATES
7 Top Boundaries
10 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	6810.00	200.00	6815.00	2
2	200.00	6815.00	241.00	6820.00	1
3	241.00	6820.00	308.00	6835.00	1
4	308.00	6835.00	476.00	6875.00	1
5	476.00	6875.00	617.00	6925.00	1
6	617.00	6925.00	686.00	6925.00	1
7	686.00	6925.00	730.00	6910.00	1
8	241.00	6820.00	730.00	6820.00	2
9	0.00	6806.00	730.00	6812.00	3
10	0.00	6800.00	730.00	6800.00	4

User Specified Y-Origin = 6750.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	107.0	114.1	240.0	19.0	0.00	0.0	1
2	105.0	110.0	90.0	29.0	0.00	0.0	1
3	100.0	120.0	2000.0	0.0	0.00	0.0	1
4	100.0	115.0	300.0	21.0	0.00	0.0	0

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 3 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	6801.00
2	280.00	6801.00
3	730.00	6801.00

Specified Peak Ground Acceleration Coefficient (A) = 0.291(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.145(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.
900 Trial Surfaces Have Been Generated.
30 Surface(s) Initiate(s) From Each Of 30 Points Equally Spaced Along The Ground Surface Between X = 100.00(ft)

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and X = 400.00(ft)
Each Surface Terminates Between X = 400.00(ft)
and X = 650.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 6750.00(ft)
20.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 900
Number of Failed Attempts to Generate Trial Surface = 59
Number of Trial Surfaces With Valid FS = 841
Percentage of Trial Surfaces With Non-Valid FS Solutions
of the Total Attempted = 6.6 %
Statistical Data On All Valid FS Values:
FS Max = 6.210 FS Min = 1.059 FS Ave = 1.745
Standard Deviation = 0.440 Coefficient of Variation = 25.23 %
Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	296.552	6832.437
2	316.164	6828.517
3	335.954	6825.629
4	355.869	6823.782
5	375.853	6822.981
6	395.851	6823.228
7	415.809	6824.522
8	435.672	6826.860
9	455.385	6830.236
10	474.895	6834.639
11	494.146	6840.059
12	513.088	6846.479
13	531.667	6853.883
14	549.833	6862.250
15	567.535	6871.557
16	584.726	6881.779
17	601.357	6892.887
18	617.384	6904.852
19	632.762	6917.639
20	640.725	6925.000

Circle Center At X = 381.148 ; Y = 7204.030 ; and Radius = 381.101
Factor of Safety
*** 1.059 ***
Individual data on the 22 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	11.4	2970.9	0.0	C.0	C.	C.	430.8	0.0	0.0
2	8.2	5799.5	0.0	C.0	C.	C.	840.9	0.0	C.0
3	19.8	25891.8	0.0	C.0	C.	C.	3754.3	0.0	C.0
4	19.9	41169.9	0.0	C.0	C.	C.	5969.6	0.0	C.0
5	20.0	54300.7	0.0	C.0	C.	C.	7873.6	0.0	C.0
6	20.0	65118.7	0.0	C.0	C.	C.	9442.2	0.0	C.0
7	20.0	73500.0	0.0	C.0	C.	C.	10657.5	0.0	C.0
8	19.9	79364.6	0.0	C.0	C.	C.	11507.9	0.0	C.0
9	19.7	82679.0	0.0	C.0	C.	C.	11988.5	0.0	C.0
10	19.5	83450.6	0.0	C.0	C.	C.	12100.3	0.0	C.0
11	1.1	4740.1	0.0	C.0	C.	C.	687.3	0.0	C.0
12	18.1	79050.4	0.0	C.0	C.	C.	11462.3	0.0	C.0
13	18.9	84160.1	0.0	C.0	C.	C.	12203.2	0.0	C.0
14	18.6	82033.6	0.0	C.0	C.	C.	11894.9	0.0	C.0
15	18.2	77544.2	0.0	C.0	C.	C.	11243.9	0.0	C.0
16	17.7	70872.9	0.0	C.0	C.	C.	10276.6	0.0	C.0
17	17.2	62244.0	0.0	C.0	C.	C.	9025.4	0.0	C.0
18	16.6	51911.8	0.0	C.0	C.	C.	7527.2	0.0	C.0
19	15.6	39334.7	0.0	C.0	C.	C.	5703.5	0.0	C.0
20	0.4	833.5	0.0	C.0	C.	C.	120.9	0.0	C.0
21	15.4	22632.9	0.0	C.0	C.	C.	3281.8	0.0	C.0

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22 8.0 3136.2 0.0 0.0 0. 0. 454.8 0.0 0.0

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	275.862	6827.805
2	295.582	6824.471
3	315.436	6822.057
4	335.381	6820.568
5	355.373	6820.009
6	375.369	6820.379
7	395.327	6821.679
8	415.203	6823.906
9	434.953	6827.054
10	454.536	6831.117
11	473.909	6836.086
12	493.030	6841.950
13	511.858	6848.697
14	530.351	6856.312
15	548.471	6864.779
16	566.177	6874.079
17	583.432	6884.192
18	600.197	6895.097
19	616.438	6906.769
20	632.119	6919.183
21	638.802	6925.000

Circle Center At X = 357.404 ; Y = 7250.058 ; and Radius = 430.054

Factor of Safety

*** 1.063 ***

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APPENDIX E-5

OUPTUT FILES OF STATIC, PSEUDO-STATIC and RAPID DRAWDOWN SLOPE STABILITY ANALYSES

LINE F-F, Sedimentation Ponds #1, #1B, #2 and #4

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                    *** GSTABL7 ***
              ** GSTABL7 by Garry H. Gregory, P.E. **
   ** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
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 ************************************************************************
                    SLOPE STABILITY ANALYSIS SYSTEM
       Modified Bishop, Simplified Janbu, or GLE Method of Slices.
       (Includes Spencer & Morgenstern-Price Type Analysis)
       Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
       Nonlinear Undrained Shear Strength, Curved Phi Envelope,
       Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
       Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
 ************************************************************************
  Analysis Run Date:        12/15/2008
  Time of Run:              01:37PM
  Run By:                   Alan Taylor
  Input Data Filename:      C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engi
neering\Alton Revised\alton line ff sp-16-13 static.in
  Output Filename:          C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engi
neering\Alton Revised\alton line ff sp-16-13 static.OUT
  Unit System:              English
  Plotted Output Filename:  C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engi
neering\Alton Revised\alton line ff sp-16-13 static.PLT
  PROBLEM DESCRIPTION:  Alton Coal Hollow Sedimentation Pond 4:
                        Line FF, Soil SP-16-13 - Static
  BOUNDARY COORDINATES
      4 Top   Boundaries
      4 Total Boundaries
  Boundary     X-Left      Y-Left     X-Right     Y-Right     Soil Type
     No.        (ft)        (ft)        (ft)        (ft)     Below Bnd
      1          0.00     6823.00       20.00     6823.00        1
      2         20.00     6823.00       50.00     6838.00        1
      3         50.00     6838.00       62.00     6838.00        1
      4         62.00     6838.00       82.00     6828.00        1
  User Specified Y-Origin =      6750.00(ft)
  Default X-Plus Value = 0.00(ft)
  Default Y-Plus Value = 0.00(ft)
 ISOTROPIC SOIL PARAMETERS
  2 Type(s) of Soil
  Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
  Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
   No.  (pcf)    (pcf)     (psf)     (deg)   Param.    (psf)     No.
    1    99.4    116.2      94.0     29.6    0.00       0.0      1
    2   105.0    110.0      90.0     29.0    0.00       0.0      1
  1 PIEZOMETRIC SURFACE(S) SPECIFIED
  Unit Weight of Water =  62.40 (pcf)
  Piezometric Surface No.  1 Specified by  6 Coordinate Points
  Pore Pressure Inclination Factor =  0.50
    Point      X-Water     Y-Water
     No.         (ft)        (ft)
      1          0.00     6834.00
      2         20.00     6834.00
      3         42.00     6834.00
      4         50.00     6834.00
      5         58.00     6834.00
      6         82.00     6828.00
  Specified Peak Ground Acceleration Coefficient (A) =   0.291(g)
  Specified Horizontal Earthquake Coefficient (kh) =   0.145(g)
  Specified Vertical Earthquake Coefficient (kv) =   0.000(g)
  Specified Seismic Pore-Pressure Factor =   0.000
  EARTHQUAKE DATA HAS BEEN SUPPRESSED
  A Critical Failure Surface Searching Method, Using A Random
  Technique For Generating Circular Surfaces, Has Been Specified.
   400 Trial Surfaces Have Been Generated.
    20 Surface(s) Initiate(s) From Each Of    20 Points Equally Spaced
  Along The Ground Surface Between  X =  10.00(ft)
                                and  X =  45.00(ft)
  Each Surface Terminates Between   X =  48.00(ft)
                                and  X =  60.00(ft)
  Unless Further Limitations Were Imposed, The Minimum Elevation
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At Which A Surface Extends Is Y = 6700.00(ft)
1.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 400
Number of Trial Surfaces With Valid FS = 400
Statistical Data On All Valid FS Values:
FS Max = 11.984 FS Min = 2.152 FS Ave = 3.229
Standard Deviation = 1.274 Coefficient of Variation = 39.46 %
Failure Surface Specified By 45 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	19.211	6823.000
2	20.192	6822.808
3	21.178	6822.642
4	22.168	6822.503
5	23.162	6822.391
6	24.158	6822.305
7	25.157	6822.246
8	26.156	6822.213
9	27.156	6822.208
10	28.156	6822.230
11	29.155	6822.279
12	30.152	6822.354
13	31.147	6822.457
14	32.138	6822.585
15	33.126	6822.741
16	34.109	6822.923
17	35.087	6823.132
18	36.059	6823.367
19	37.025	6823.627
20	37.983	6823.914
21	38.933	6824.227
22	39.874	6824.564
23	40.806	6824.927
24	41.728	6825.315
25	42.638	6825.728
26	43.538	6826.165
27	44.425	6826.625
28	45.300	6827.110
29	46.162	6827.618
30	47.009	6828.148
31	47.842	6828.702
32	48.659	6829.278
33	49.461	6829.875
34	50.247	6830.494
35	51.015	6831.134
36	51.766	6831.794
37	52.500	6832.474
38	53.214	6833.174
39	53.909	6833.893
40	54.585	6834.629
41	55.241	6835.384
42	55.876	6836.157
43	56.491	6836.946
44	57.083	6837.751
45	57.257	6838.000

Circle Center At X = 26.846 ; Y = 6859.390 ; and Radius = 37.182
Factor of Safety
*** 2.152 ***
Individual data on the 48 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	0.8	7.1	541.9	556.1	0.	0.	0.0	0.0	0.0
2	0.2	4.9	146.6	136.3	0.	0.	0.0	0.0	0.0
3	1.0	70.7	733.3	703.5	0.	0.	0.0	0.0	0.0

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4	1.0	145.4	702.2	723.1	0.	0.	0.0	0.0	0.0
5	1.0	217.7	670.2	720.9	0.	0.	0.0	0.0	0.0
6	1.0	287.4	637.4	727.1	0.	0.	0.0	0.0	0.0
7	1.0	354.2	603.9	731.6	0.	0.	0.0	0.0	0.0
8	1.0	417.9	569.8	734.5	0.	0.	0.0	0.0	0.0
9	1.0	478.4	535.2	735.6	0.	0.	0.0	0.0	0.0
10	1.0	535.5	500.2	735.2	0.	0.	0.0	0.0	0.0
11	1.0	588.8	464.9	732.9	0.	0.	0.0	0.0	0.0
12	1.0	638.5	429.5	729.1	0.	0.	0.0	0.0	0.0
13	1.0	684.2	393.9	723.5	0.	0.	0.0	0.0	0.0
14	1.0	726.0	358.3	716.3	0.	0.	0.0	0.0	0.0
15	1.0	763.6	322.8	707.4	0.	0.	0.0	0.0	0.0
16	1.0	797.1	287.5	696.9	0.	0.	0.0	0.0	0.0
17	1.0	826.4	252.5	684.7	0.	0.	0.0	0.0	0.0
18	1.0	851.4	217.9	670.9	0.	0.	0.0	0.0	0.0
19	1.0	872.1	183.8	655.4	0.	0.	0.0	0.0	0.0
20	1.0	888.5	150.3	638.3	0.	0.	0.0	0.0	0.0
21	0.9	900.6	117.4	619.7	0.	0.	0.0	0.0	0.0
22	0.9	908.5	85.3	599.4	0.	0.	0.0	0.0	0.0
23	0.9	912.1	54.0	577.4	0.	0.	0.0	0.0	0.0
24	0.9	911.7	23.6	554.0	0.	0.	0.0	0.0	0.0
25	0.3	270.9	1.3	161.0	0.	0.	0.0	0.0	0.0
26	0.6	634.6	0.0	368.1	0.	0.	0.0	0.0	0.0
27	0.9	890.5	0.0	502.6	0.	0.	0.0	0.0	0.0
28	0.9	871.6	0.0	474.6	0.	0.	0.0	0.0	0.0
29	0.9	849.4	0.0	445.0	0.	0.	0.0	0.0	0.0
30	0.9	823.9	0.0	414.1	0.	0.	0.0	0.0	0.0
31	0.8	795.5	0.0	381.7	0.	0.	0.0	0.0	0.0
32	0.8	764.1	0.0	347.9	0.	0.	0.0	0.0	0.0
33	0.8	730.0	0.0	312.6	0.	0.	0.0	0.0	0.0
34	0.8	693.5	0.0	276.0	0.	0.	0.0	0.0	0.0
35	0.5	451.9	0.0	167.4	0.	0.	0.0	0.0	0.0
36	0.2	201.5	0.0	70.6	0.	0.	0.0	0.0	0.0
37	0.8	590.1	0.0	198.8	0.	0.	0.0	0.0	0.0
38	0.8	520.0	0.0	158.3	0.	0.	0.0	0.0	0.0
39	0.7	450.4	0.0	116.5	0.	0.	0.0	0.0	0.0
40	0.7	381.7	0.0	73.4	0.	0.	0.0	0.0	0.0
41	0.7	314.2	0.0	29.1	0.	0.	0.0	0.0	0.0
42	0.1	39.8	0.0	0.5	0.	0.	0.0	0.0	0.0
43	0.6	211.5	0.0	0.0	0.	0.	0.0	0.0	0.0
44	0.7	195.1	0.0	0.0	0.	0.	0.0	0.0	0.0
45	0.6	140.8	0.0	0.0	0.	0.	0.0	0.0	0.0
46	0.6	88.5	0.0	0.0	0.	0.	0.0	0.0	0.0
47	0.6	38.4	0.0	0.0	0.	0.	0.0	0.0	0.0
48	0.2	2.1	0.0	0.0	0.	0.	0.0	0.0	0.0

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   ** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
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 *******************************************************************************
                    SLOPE STABILITY ANALYSIS SYSTEM
       Modified Bishop, Simplified Janbu, or GLE Method of Slices.
       (Includes Spencer & Morgenstern-Price Type Analysis)
       Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
       Nonlinear Undrained Shear Strength, Curved Phi Envelope,
       Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
       Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
 *******************************************************************************
 Analysis Run Date:        12/15/2008
 Time of Run:              01:40PM
 Run By:                   Alan Taylor
 Input Data Filename:      C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engi
neering\Alton Revised\alton line ff sp-16-13 static.in
 Output Filename:          C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engi
neering\Alton Revised\alton line ff sp-16-13 static.OUT
 Unit System:              English
 Plotted Output Filename:  C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engi
neering\Alton Revised\alton line ff sp-16-13 static.PLT
 PROBLEM DESCRIPTION:  Alton Coal Hollow Sedimentation Pond 4:
                       Line FF, Soil SP-16-13 - Seismic
 BOUNDARY COORDINATES
     4 Top   Boundaries
     4 Total Boundaries
 Boundary     X-Left      Y-Left     X-Right     Y-Right     Soil Type
    No.        (ft)        (ft)       (ft)        (ft)     Below Bnd
     1         0.00     6823.00      20.00     6823.00         1
     2        20.00     6823.00      50.00     6838.00         1
     3        50.00     6838.00      62.00     6838.00         1
     4        62.00     6838.00      82.00     6828.00         1
 User Specified Y-Origin =      6750.00(ft)
 Default X-Plus Value = 0.00(ft)
 Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
 2 Type(s) of Soil
 Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
 Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
  No.  (pcf)    (pcf)     (psf)     (deg)   Param.    (psf)     No.
   1    99.4    116.2      94.0     29.6    0.00       0.0      1
   2   105.0    110.0      90.0     29.0    0.00       0.0      1
 1 PIEZOMETRIC SURFACE(S) SPECIFIED
 Unit Weight of Water =  62.40 (pcf)
 Piezometric Surface No.  1 Specified by  6 Coordinate Points
 Pore Pressure Inclination Factor =  0.50
   Point      X-Water     Y-Water
    No.         (ft)        (ft)
     1         0.00     6834.00
     2        20.00     6834.00
     3        42.00     6834.00
     4        50.00     6834.00
     5        58.00     6834.00
     6        82.00     6828.00
 Specified Peak Ground Acceleration Coefficient (A) =   0.291(g)
 Specified Horizontal Earthquake Coefficient (kh) =   0.145(g)
 Specified Vertical Earthquake Coefficient (kv) =   0.000(g)
 Specified Seismic Pore-Pressure Factor =   0.000
 A Critical Failure Surface Searching Method, Using A Random
 Technique For Generating Circular Surfaces, Has Been Specified.
  400 Trial Surfaces Have Been Generated.
   20 Surface(s) Initiate(s) From Each Of    20 Points Equally Spaced
 Along The Ground Surface Between  X =  10.00(ft)
                                 and  X =  45.00(ft)
 Each Surface Terminates Between   X =  48.00(ft)
                                 and   X =  60.00(ft)
 Unless Further Limitations Were Imposed, The Minimum Elevation
 At Which A Surface Extends Is  Y =   6700.00(ft)
```

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1.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 400
Number of Trial Surfaces With Valid FS = 400
Statistical Data On All Valid FS Values:
FS Max = 9.224 FS Min = 1.309 FS Ave = 2.052
Standard Deviation = 0.881 Coefficient of Variation = 42.94 %
Failure Surface Specified By 45 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	19.211	6823.000
2	20.192	6822.808
3	21.178	6822.642
4	22.168	6822.503
5	23.162	6822.391
6	24.158	6822.305
7	25.157	6822.246
8	26.156	6822.213
9	27.156	6822.208
10	28.156	6822.230
11	29.155	6822.279
12	30.152	6822.354
13	31.147	6822.457
14	32.138	6822.585
15	33.126	6822.741
16	34.109	6822.923
17	35.087	6823.132
18	36.059	6823.367
19	37.025	6823.627
20	37.983	6823.914
21	38.933	6824.227
22	39.874	6824.564
23	40.806	6824.927
24	41.728	6825.315
25	42.638	6825.728
26	43.538	6826.165
27	44.425	6826.625
28	45.300	6827.110
29	46.162	6827.618
30	47.009	6828.148
31	47.842	6828.702
32	48.659	6829.278
33	49.461	6829.875
34	50.247	6830.494
35	51.015	6831.134
36	51.766	6831.794
37	52.500	6832.474
38	53.214	6833.174
39	53.909	6833.893
40	54.585	6834.629
41	55.241	6835.384
42	55.876	6836.157
43	56.491	6836.946
44	57.083	6837.751
45	57.257	6838.000

Circle Center At X = 26.846 ; Y = 6859.390 ; and Radius = 37.182
Factor of Safety
*** 1.309 ***
Individual data on the 48 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	0.8	7.1	541.9	556.1	0.	0.	1.0	0.0	0.0
2	0.2	4.9	146.6	136.3	0.	0.	0.7	0.0	0.0
3	1.0	70.7	733.3	703.5	0.	0.	10.3	0.0	0.0
4	1.0	145.4	702.2	713.1	0.	0.	21.1	0.0	0.0

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5	1.0	217.7	670.2	720.9	0.	0.	31.6	0.0	0.0
6	1.0	287.4	637.4	727.1	0.	0.	41.7	0.0	0.0
7	1.0	354.2	603.9	731.6	0.	0.	51.4	0.0	0.0
8	1.0	417.9	569.8	734.5	0.	0.	60.6	0.0	0.0
9	1.0	478.4	535.2	735.6	0.	0.	69.4	0.0	0.0
10	1.0	535.5	500.2	735.2	0.	0.	77.6	0.0	0.0
11	1.0	588.8	464.9	732.9	0.	0.	85.4	0.0	0.0
12	1.0	638.5	429.5	729.1	0.	0.	92.6	0.0	0.0
13	1.0	684.2	393.9	723.5	0.	0.	99.2	0.0	0.0
14	1.0	726.0	358.3	716.3	0.	0.	105.3	0.0	0.0
15	1.0	763.6	322.8	707.4	0.	0.	110.7	0.0	0.0
16	1.0	797.1	287.5	696.9	0.	0.	115.6	0.0	0.0
17	1.0	826.4	252.5	684.7	0.	0.	119.8	0.0	0.0
18	1.0	851.4	217.9	670.9	0.	0.	123.5	0.0	0.0
19	1.0	872.1	183.8	655.4	0.	0.	126.5	0.0	0.0
20	1.0	888.5	150.3	638.3	0.	0.	128.8	0.0	0.0
21	0.9	900.6	117.4	619.7	0.	0.	130.6	0.0	0.0
22	0.9	908.5	85.3	599.4	0.	0.	131.7	0.0	0.0
23	0.9	912.1	54.0	577.4	0.	0.	132.3	0.0	0.0
24	0.9	911.7	23.6	554.0	0.	0.	132.2	0.0	0.0
25	0.3	270.9	1.3	161.0	0.	0.	39.3	0.0	0.0
26	0.6	634.6	0.0	368.1	0.	0.	92.0	0.0	0.0
27	0.9	890.5	0.0	502.6	0.	0.	129.1	0.0	0.0
28	0.9	871.6	0.0	474.6	0.	0.	126.4	0.0	0.0
29	0.9	849.4	0.0	445.0	0.	0.	123.2	0.0	0.0
30	0.9	823.9	0.0	414.1	0.	0.	119.5	0.0	0.0
31	0.8	795.5	0.0	381.7	0.	0.	115.3	0.0	0.0
32	0.8	764.1	0.0	347.9	0.	0.	110.8	0.0	0.0
33	0.8	730.0	0.0	312.6	0.	0.	105.8	0.0	0.0
34	0.8	693.5	0.0	276.0	0.	0.	100.6	0.0	0.0
35	0.5	451.9	0.0	167.4	0.	0.	65.5	0.0	0.0
36	0.2	201.5	0.0	70.6	0.	0.	29.2	0.0	0.0
37	0.8	590.1	0.0	198.8	0.	0.	85.6	0.0	0.0
38	0.8	520.0	0.0	158.3	0.	0.	75.4	0.0	0.0
39	0.7	450.4	0.0	116.5	0.	0.	65.3	0.0	0.0
40	0.7	381.7	0.0	73.4	0.	0.	55.4	0.0	0.0
41	0.7	314.2	0.0	29.1	0.	0.	45.6	0.0	0.0
42	0.1	39.8	0.0	0.5	0.	0.	5.8	0.0	0.0
43	0.6	211.5	0.0	0.0	0.	0.	30.7	0.0	0.0
44	0.7	195.1	0.0	0.0	0.	0.	28.3	0.0	0.0
45	0.6	140.8	0.0	0.0	0.	0.	20.4	0.0	0.0
46	0.6	88.5	0.0	0.0	0.	0.	12.8	0.0	0.0
47	0.6	38.4	0.0	0.0	0.	0.	5.6	0.0	0.0
48	0.2	2.1	0.0	0.0	0.	0.	0.3	0.0	0.0

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              ** GSTABL7 by Garry H. Gregory, P.E. **
    ** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
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 ************************************************************************
                    SLOPE STABILITY ANALYSIS SYSTEM
        Modified Bishop, Simplified Janbu, or GLE Method of Slices.
        (Includes Spencer & Morgenstern-Price Type Analysis)
        Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
        Nonlinear Undrained Shear Strength, Curved Phi Envelope,
        Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
        Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
 ************************************************************************
 Analysis Run Date:        12/15/2008
 Time of Run:              01:31PM
 Run By:                   Alan Taylor
 Input Data Filename:      C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engi
neering\Alton Revised\alton line ff sp-16-13 rapid drawdown stage 1.in
 Output Filename:          C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engi
neering\Alton Revised\alton line ff sp-16-13 rapid drawdown stage 1.OUT
 Unit System:              English
 Plotted Output Filename:  C:\Documents and Settings\Owner\My Documents\Taylor Geo-Engi
neering\Alton Revised\alton line ff sp-16-13 rapid drawdown stage 1.PLT
 PROBLEM DESCRIPTION:  Alton Coal Hollow Sedimentation Pond 4:
                       Line FF, Soil SP-16-13 - Rapid Drawdown
 BOUNDARY COORDINATES
     4 Top   Boundaries
     4 Total Boundaries
 Boundary     X-Left      Y-Left     X-Right     Y-Right     Soil Type
    No.         (ft)        (ft)       (ft)        (ft)     Below Bnd
     1          0.00     6823.00       20.00    6823.00         1
     2         20.00     6823.00       50.00    6838.00         1
     3         50.00     6838.00       62.00    6838.00         1
     4         62.00     6838.00       82.00    6828.00         1
 User Specified Y-Origin =      6750.00(ft)
 Default X-Plus Value = 0.00(ft)
 Default Y-Plus Value = 0.00(ft)
 ISOTROPIC SOIL PARAMETERS
  2 Type(s) of Soil
 Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
 Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
  No.  (pcf)    (pcf)     (psf)     (deg)    Param.   (psf)     No.
   1    99.4    116.2      84.0      16.0    0.00      0.0      1
   2   105.0    110.0      90.0      29.0    0.00      0.0      1
 1 PIEZOMETRIC SURFACE(S) SPECIFIED
 Unit Weight of Water =  62.40 (pcf)
 Piezometric Surface No.  1 Specified by  6 Coordinate Points
 Pore Pressure Inclination Factor =  0.50
   Point      X-Water     Y-Water
    No.         (ft)        (ft)
     1          0.00     6834.00
     2         20.00     6834.00
     3         42.00     6834.00
     4         50.00     6838.00
     5         58.00     6834.00
     6         82.00     6828.00
 WATER SURFACE DATA HAS BEEN SUPPRESSED
 Specified Peak Ground Acceleration Coefficient (A) =   0.291(g)
 Specified Horizontal Earthquake Coefficient (kh) =   0.145(g)
 Specified Vertical Earthquake Coefficient (kv) =   0.000(g)
 Specified Seismic Pore-Pressure Factor =   0.000
 EARTHQUAKE DATA HAS BEEN SUPPRESSED
 A Critical Failure Surface Searching Method, Using A Random
 Technique For Generating Circular Surfaces, Has Been Specified.
  400 Trial Surfaces Have Been Generated.
   20 Surface(s) Initiate(s) From Each Of    20 Points Equally Spaced
 Along The Ground Surface Between  X =  10.00(ft)
                                and  X =  45.00(ft)
 Each Surface Terminates Between   X =  48.00(ft)
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and X = 60.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 6700.00(ft)
1.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 400
Number of Trial Surfaces With Valid FS = 400
Statistical Data On All Valid FS Values:
FS Max = 10.260 FS Min = 1.245 FS Ave = 2.090
Standard Deviation = 1.077 Coefficient of Variation = 51.53 %
Failure Surface Specified By 45 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	19.211	6823.000
2	20.192	6822.808
3	21.178	6822.642
4	22.168	6822.503
5	23.162	6822.391
6	24.158	6822.305
7	25.157	6822.246
8	26.156	6822.213
9	27.156	6822.208
10	28.156	6822.230
11	29.155	6822.279
12	30.152	6822.354
13	31.147	6822.457
14	32.138	6822.585
15	33.126	6822.741
16	34.109	6822.923
17	35.087	6823.132
18	36.059	6823.367
19	37.025	6823.627
20	37.983	6823.914
21	38.933	6824.227
22	39.874	6824.564
23	40.806	6824.927
24	41.728	6825.315
25	42.638	6825.728
26	43.538	6826.165
27	44.425	6826.625
28	45.300	6827.110
29	46.162	6827.618
30	47.009	6828.148
31	47.842	6828.702
32	48.659	6829.278
33	49.461	6829.875
34	50.247	6830.494
35	51.015	6831.134
36	51.766	6831.794
37	52.500	6832.474
38	53.214	6833.174
39	53.909	6833.893
40	54.585	6834.629
41	55.241	6835.384
42	55.876	6836.157
43	56.491	6836.946
44	57.083	6837.751
45	57.257	6838.000

Circle Center At X = 26.846 ; Y = 6859.390 ; and Radius = 37.182
Factor of Safety
*** 1.245 ***
Individual data on the 46 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	C.8	6.7	0.0	0.0	0.	0.	0.0	0.0	0.0

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2	0.2	4.2	0.0	0.0	0.	0.	0.0	0.0	0.0
3	1.0	60.5	0.0	0.0	0.	0.	0.0	0.0	0.0
4	1.0	124.4	0.0	0.0	0.	0.	0.0	0.0	0.0
5	1.0	186.3	0.0	0.0	0.	0.	0.0	0.0	0.0
6	1.0	245.8	0.0	0.0	0.	0.	0.0	0.0	0.0
7	1.0	303.0	0.0	0.0	0.	0.	0.0	0.0	0.0
8	1.0	357.5	0.0	0.0	0.	0.	0.0	0.0	0.0
9	1.0	409.2	0.0	0.0	0.	0.	0.0	0.0	0.0
10	1.0	458.1	0.0	0.0	0.	0.	0.0	0.0	0.0
11	1.0	503.7	0.0	0.0	0.	0.	0.0	0.0	0.0
12	1.0	546.2	0.0	0.0	0.	0.	0.0	0.0	0.0
13	1.0	585.3	0.0	0.0	0.	0.	0.0	0.0	0.0
14	1.0	621.0	0.0	0.0	0.	0.	0.0	0.0	0.0
15	1.0	653.2	0.0	0.0	0.	0.	0.0	0.0	0.0
16	1.0	681.9	0.0	0.0	0.	0.	0.0	0.0	0.0
17	1.0	706.9	0.0	0.0	0.	0.	0.0	0.0	0.0
18	1.0	728.3	0.0	0.0	0.	0.	0.0	0.0	0.0
19	1.0	746.0	0.0	0.0	0.	0.	0.0	0.0	0.0
20	1.0	760.0	0.0	0.0	0.	0.	0.0	0.0	0.0
21	0.9	770.4	0.0	0.0	0.	0.	0.0	0.0	0.0
22	0.9	777.1	0.0	0.0	0.	0.	0.0	0.0	0.0
23	0.9	780.2	0.0	0.0	0.	0.	0.0	0.0	0.0
24	0.9	779.9	0.0	0.0	0.	0.	0.0	0.0	0.0
25	0.9	776.0	0.0	0.0	0.	0.	0.0	0.0	0.0
26	0.9	768.7	0.0	0.0	0.	0.	0.0	0.0	0.0
27	0.9	758.2	0.0	0.0	0.	0.	0.0	0.0	0.0
28	0.9	744.6	0.0	0.0	0.	0.	0.0	0.0	0.0
29	0.9	727.9	0.0	0.0	0.	0.	0.0	0.0	0.0
30	0.8	708.4	0.0	0.0	0.	0.	0.0	0.0	0.0
31	0.8	686.1	0.0	0.0	0.	0.	0.0	0.0	0.0
32	0.8	661.2	0.0	0.0	0.	0.	0.0	0.0	0.0
33	0.8	633.9	0.0	0.0	0.	0.	0.0	0.0	0.0
34	0.5	416.5	0.0	0.0	0.	0.	0.0	0.0	0.0
35	0.2	186.5	0.0	0.0	0.	0.	0.0	0.0	0.0
36	0.8	549.0	0.0	0.0	0.	0.	0.0	0.0	0.0
37	0.8	488.0	0.0	0.0	0.	0.	0.0	0.0	0.0
38	0.7	427.4	0.0	0.0	0.	0.	0.0	0.0	0.0
39	0.7	367.6	0.0	0.0	0.	0.	0.0	0.0	0.0
40	0.7	308.8	0.0	0.0	0.	0.	0.0	0.0	0.0
41	0.7	251.2	0.0	0.0	0.	0.	0.0	0.0	0.0
42	0.7	195.1	0.0	0.0	0.	0.	0.0	0.0	0.0
43	0.6	140.8	0.0	0.0	0.	0.	0.0	0.0	0.0
44	0.6	88.5	0.0	0.0	0.	0.	0.0	0.0	0.0
45	0.6	38.4	0.0	0.0	0.	0.	0.0	0.0	0.0
46	0.2	2.1	0.0	0.0	0.	0.	0.0	0.0	0.0

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APPENDIX E-6

OUPTUT FILES OF STATIC AND PSEUDO-STATIC SLOPE STABILITY ANALYSES

LINE E-E, Sedimentation Pond #3

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** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **

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SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 12/15/2008
Time of Run: 01:45PM
Run By: Alan Taylor
Input Data Filename: f:\alton line ee gt-5.in
Output Filename: f:\alton line ee gt-5.OUT
Unit System: English
Plotted Output Filename: f:\alton line ee gt-5.PLT
PROBLEM DESCRIPTION: Alton Coal Hollow Sedimentation Pond 3:
Line E-E, Soil GT-5 - Static

BOUNDARY COORDINATES
5 Top Boundaries
5 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	6800.00	20.00	6800.00	1
2	20.00	6800.00	29.00	6804.00	1
3	29.00	6804.00	48.00	6814.00	1
4	48.00	6814.00	60.00	6814.00	1
5	60.00	6814.00	80.00	6804.00	1

User Specified Y-Origin = 6750.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
1 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	100.0	120.0	700.0	10.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 5 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	6810.00
2	20.00	6810.00
3	42.00	6810.00
4	60.00	6807.00
5	80.00	6803.00

Specified Peak Ground Acceleration Coefficient (A) = 0.291(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.145(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
EARTHQUAKE DATA HAS BEEN SUPPRESSED
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 5.00(ft)
and X = 25.00(ft)
Each Surface Terminates Between X = 48.00(ft)
and X = 60.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 6700.00(ft)
2.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial

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Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 400
Number of Trial Surfaces With Valid FS = 400
Statistical Data On All Valid FS Values:
FS Max = 19.860 FS Min = 5.298 FS Ave = 6.609
Standard Deviation = 1.849 Coefficient of Variation = 27.98 %
Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	17.632	6800.000
2	19.292	6798.885
3	21.030	6797.895
4	22.834	6797.033
5	24.697	6796.304
6	26.608	6795.713
7	28.556	6795.263
8	30.533	6794.956
9	32.526	6794.792
10	34.526	6794.775
11	36.522	6794.903
12	38.503	6795.176
13	40.459	6795.592
14	42.380	6796.149
15	44.255	6796.845
16	46.075	6797.675
17	47.829	6798.636
18	49.509	6799.721
19	51.105	6800.926
20	52.610	6802.244
21	54.015	6803.667
22	55.312	6805.189
23	56.496	6806.801
24	57.559	6808.496
25	58.496	6810.263
26	59.301	6812.093
27	59.972	6813.978
28	59.978	6814.000

Circle Center At X = 33.766 ; Y = 6822.242 ; and Radius = 27.477
Factor of Safety
*** 5.298 ***
Individual data on the 32 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.7	111.1	1036.2	1317.7	0.	0.	0.0	0.0	0.0
2	0.7	111.8	441.7	575.4	0.	0.	0.0	0.0	0.0
3	1.0	252.2	686.9	873.5	0.	0.	0.0	0.0	0.0
4	1.8	735.2	1126.6	1564.5	0.	0.	0.0	0.0	0.0
5	1.9	1118.8	1059.0	1663.8	0.	0.	0.0	0.0	0.0
6	1.9	1491.1	977.0	1746.1	0.	0.	0.0	0.0	0.0
7	1.9	1842.9	882.3	1811.0	0.	0.	0.0	0.0	0.0
8	0.4	461.8	184.8	413.9	0.	0.	0.0	0.0	0.0
9	1.5	1715.6	604.8	1444.5	0.	0.	0.0	0.0	0.0
10	2.0	2501.4	656.3	1887.7	0.	0.	0.0	0.0	0.0
11	2.0	2783.4	510.3	1899.0	0.	0.	0.0	0.0	0.0
12	2.0	3016.5	361.2	1892.1	0.	0.	0.0	0.0	0.0
13	2.0	3195.7	212.4	1867.1	0.	0.	0.0	0.0	0.0
14	2.0	3317.6	66.7	1824.1	0.	0.	0.0	0.0	0.0
15	1.5	2689.9	0.0	1420.1	0.	0.	0.0	0.0	0.0
16	0.4	668.2	0.0	337.9	0.	0.	0.0	0.0	0.0
17	1.9	3311.3	0.0	1635.4	0.	0.	0.0	0.0	0.0
18	1.8	3212.8	0.0	1503.5	0.	0.	0.0	0.0	0.0
19	1.8	3064.3	0.0	1356.7	0.	0.	0.0	0.0	0.0
20	0.2	295.9	0.0	129.4	0.	0.	0.0	0.0	0.0
21	1.5	2514.9	0.0	1066.0	0.	0.	0.0	0.0	0.0
22	1.6	2444.6	0.0	1020.8	0.	0.	0.0	0.0	0.0
23	1.5	2069.0	0.0	833.8	0.	0.	0.0	0.0	0.0

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24	1.4	1694.6	0.0	635.2	0.	0.	0.0	0.0	0.0
25	1.3	1330.6	0.0	426.2	0.	0.	0.0	0.0	0.0
26	1.2	986.7	0.0	207.7	0.	0.	0.0	0.0	0.0
27	0.4	307.7	0.0	20.1	0.	0.	0.0	0.0	0.0
28	0.6	370.8	0.0	0.0	0.	0.	0.0	0.0	0.0
29	0.9	432.9	0.0	0.0	0.	0.	0.0	0.0	0.0
30	0.8	227.5	0.0	0.0	0.	0.	0.0	0.0	0.0
31	0.7	64.7	0.0	0.0	0.	0.	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	17.632	6800.000
2	19.320	6798.928
3	21.080	6797.979
4	22.904	6797.157
5	24.781	6796.468
6	26.703	6795.915
7	28.660	6795.500
8	30.641	6795.227
9	32.637	6795.095
10	34.637	6795.105
11	36.631	6795.259
12	38.609	6795.554
13	40.561	6795.990
14	42.477	6796.563
15	44.347	6797.272
16	46.162	6798.113
17	47.912	6799.081
18	49.589	6800.171
19	51.183	6801.378
20	52.688	6802.696
21	54.094	6804.118
22	55.396	6805.636
23	56.586	6807.244
24	57.658	6808.932
25	58.607	6810.692
26	59.428	6812.516
27	59.973	6814.000

Circle Center At X = 33.487 ; Y = 6823.099 ; and Radius = 28.017

Factor of Safety

*** 5.302 ***

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***** GSTABL7 *****

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **

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SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 12/15/2008
Time of Run: 01:50PM
Run By: Alan Taylor
Input Data Filename: f:\alton line ee gt-5.in
Output Filename: f:\alton line ee gt-5.OUT
Unit System: English
Plotted Output Filename: f:\alton line ee gt-5.PLT
PROBLEM DESCRIPTION: Alton Coal Hollow Sedimentation Pond 3:
Line E-E, Soil GT-5 - Seismic

BOUNDARY COORDINATES
5 Top Boundaries
5 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	6800.00	20.00	6800.00	1
2	20.00	6800.00	29.00	6804.00	1
3	29.00	6804.00	48.00	6814.00	1
4	48.00	6814.00	60.00	6814.00	1
5	60.00	6814.00	80.00	6804.00	1

User Specified Y-Origin = 6750.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
1 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	100.0	120.0	700.0	10.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 5 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	6810.00
2	20.00	6810.00
3	42.00	6810.00
4	60.00	6807.00
5	80.00	6803.00

Specified Peak Ground Acceleration Coefficient (A) = 0.291(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.145(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 15.00(ft)
and X = 25.00(ft)
Each Surface Terminates Between X = 48.00(ft)
and X = 60.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 6700.00(ft)
2.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are

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Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 400
Number of Trial Surfaces With Valid FS = 400
Statistical Data On All Valid FS Values:
FS Max = 13.678 FS Min = 3.252 FS Ave = 4.176
Standard Deviation = 1.334 Coefficient of Variation = 31.95 %
Failure Surface Specified By 30 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	15.000	6800.000
2	16.469	6798.643
3	18.036	6797.400
4	19.692	6796.278
5	21.427	6795.283
6	23.232	6794.422
7	25.096	6793.698
8	27.010	6793.117
9	28.962	6792.680
10	30.941	6792.391
11	32.936	6792.251
12	34.936	6792.262
13	36.929	6792.422
14	38.905	6792.732
15	40.852	6793.189
16	42.760	6793.791
17	44.617	6794.534
18	46.412	6795.414
19	48.137	6796.427
20	49.781	6797.566
21	51.335	6798.825
22	52.790	6800.197
23	54.138	6801.675
24	55.372	6803.249
25	56.483	6804.912
26	57.467	6806.653
27	58.318	6808.463
28	59.030	6810.332
29	59.600	6812.249
30	59.981	6814.000

Circle Center At X = 33.795 ; Y = 6818.872 ; and Radius = 26.635
Factor of Safety
*** 3.252 ***
Individual data on the 34 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.5	119.7	916.8	1332.7	0.	0.	17.4	0.0	0.0
2	1.6	372.0	977.7	1495.0	0.	0.	53.9	0.0	0.0
3	1.7	628.1	1033.2	1642.6	0.	0.	91.1	0.0	0.0
4	0.3	140.9	192.3	306.1	0.	0.	20.4	0.0	0.0
5	1.4	791.9	943.6	1468.5	0.	0.	114.8	0.0	0.0
6	1.8	1339.1	1104.9	1890.3	0.	0.	194.2	0.0	0.0
7	1.9	1743.0	1037.6	1989.3	0.	0.	252.7	0.0	0.0
8	1.9	2131.5	955.1	2070.6	0.	0.	309.1	0.0	0.0
9	2.0	2494.6	859.7	2134.3	0.	0.	361.7	0.0	0.0
10	0.0	52.0	15.7	41.8	0.	0.	7.5	0.0	0.0
11	1.9	2789.5	751.2	2137.8	0.	0.	404.5	0.0	0.0
12	2.0	3166.3	626.6	2206.3	0.	0.	459.1	0.0	0.0
13	2.0	3441.8	479.8	2214.3	0.	0.	499.1	0.0	0.0
14	2.0	3661.8	330.5	2203.7	0.	0.	531.0	0.0	0.0
15	2.0	3821.3	182.1	2174.4	0.	0.	554.1	0.0	0.0
16	1.9	3917.2	37.7	2126.6	0.	0.	568.0	0.0	0.0
17	1.1	2352.1	0.0	1248.7	0.	0.	341.1	0.0	0.0
18	0.8	1563.6	0.0	797.7	0.	0.	226.7	0.0	0.0
19	1.9	3832.1	0.0	1915.2	0.	0.	555.7	0.0	0.0
20	1.8	3693.5	0.0	1777.8	0.	0.	535.6	0.0	0.0
21	1.6	3225.3	0.0	1501.8	0.	0.	467.7	0.0	0.0
22	0.1	275.9	0.0	123.5	0.	0.	40.0	0.0	0.0

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23	1.6	3179.5	0.0	1458.2	0.	0.	461.0	0.0	0.0
24	1.6	2774.0	0.0	1277.8	0.	0.	402.2	0.0	0.0
25	1.5	2361.1	0.0	1084.8	0.	0.	342.4	0.0	0.0
26	1.3	1951.3	0.0	880.7	0.	0.	282.9	0.0	0.0
27	1.2	1554.8	0.0	666.2	0.	0.	225.4	0.0	0.0
28	1.1	1181.7	0.0	443.0	0.	0.	171.4	0.0	0.0
29	1.0	842.0	0.0	212.0	0.	0.	122.1	0.0	0.0
30	0.3	236.9	0.0	18.7	0.	0.	34.3	0.0	0.0
31	0.5	313.6	0.0	0.0	0.	0.	45.5	0.0	0.0
32	0.7	327.9	0.0	0.0	0.	0.	47.5	0.0	0.0
33	0.6	154.5	0.0	0.0	0.	0.	22.4	0.0	0.0
34	0.4	33.3	0.0	0.0	0.	0.	4.8	0.0	0.0

Failure Surface Specified By 29 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	16.053	6800.000
2	17.577	6798.706
3	19.195	6797.530
4	20.898	6796.480
5	22.675	6795.562
6	24.516	6794.781
7	26.410	6794.141
8	28.348	6793.646
9	30.318	6793.298
10	32.308	6793.101
11	34.307	6793.055
12	36.305	6793.159
13	38.288	6793.415
14	40.247	6793.819
15	42.170	6794.370
16	44.045	6795.065
17	45.862	6795.899
18	47.612	6796.869
19	49.283	6797.968
20	50.866	6799.190
21	52.352	6800.529
22	53.733	6801.976
23	55.001	6803.522
24	56.148	6805.161
25	57.169	6806.881
26	58.056	6808.673
27	58.805	6810.528
28	59.413	6812.434
29	59.784	6814.000

Circle Center At X = 33.922 ; Y = 6819.504 ; and Radius = 26.452

Factor of Safety

*** 3.264 ***

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***** GSTABL7 *****

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **

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SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 12/15/2008
Time of Run: 02:01PM
Run By: Alan Taylor
Input Data Filename: f:\line ee rapid drawdown.in
Output Filename: f:\line ee rapid drawdown.OUT
Unit System: English
Plotted Output Filename: f:\line ee rapid drawdown.PLT
PROBLEM DESCRIPTION: Alton Coal Hollow Sedimentation Pond 3:
Line E-E, Soil GT-5 - Rapid Drawdown

BOUNDARY COORDINATES
5 Top Boundaries
5 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	6800.00	20.00	6800.00	1
2	20.00	6800.00	29.00	6804.00	1
3	29.00	6804.00	48.00	6814.00	1
4	48.00	6814.00	60.00	6814.00	1
5	60.00	6814.00	80.00	6804.00	1

User Specified Y-Origin = 6750.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
1 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	100.0	120.0	300.0	8.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 5 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	6810.00
2	40.00	6810.00
3	48.00	6814.00
4	60.00	6810.00
5	80.00	6803.00

WATER SURFACE DATA HAS BEEN SUPPRESSED
Specified Peak Ground Acceleration Coefficient (A) = 0.291(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.145(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
EARTHQUAKE DATA HAS BEEN SUPPRESSED
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 5.00(ft)
and X = 35.00(ft)
Each Surface Terminates Between X = 48.00(ft)
and X = 60.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 6700.00(ft)
2.00(ft) Line Segments Define Each Trial Failure Surface.

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Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 400
Number of Trial Surfaces With Valid FS = 400
Statistical Data On All Valid FS Values:
FS Max = 7.789 FS Min = 1.916 FS Ave = 2.640
Standard Deviation = 0.930 Coefficient of Variation = 35.22 %
Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	16.053	6800.000
2	17.769	6798.973
3	19.550	6798.063
4	21.388	6797.275
5	23.275	6796.611
6	25.201	6796.075
7	27.160	6795.668
8	29.141	6795.394
9	31.136	6795.253
10	33.136	6795.246
11	35.132	6795.372
12	37.115	6795.631
13	39.076	6796.023
14	41.007	6796.545
15	42.898	6797.195
16	44.742	6797.970
17	46.530	6798.866
18	48.254	6799.880
19	49.906	6801.007
20	51.480	6802.242
21	52.967	6803.580
22	54.361	6805.014
23	55.656	6806.538
24	56.847	6808.145
25	57.927	6809.828
26	58.892	6811.579
27	59.739	6813.391
28	59.975	6814.000

Circle Center At X = 32.244 ; Y = 6825.100 ; and Radius = 29.869
Factor of Safety
*** 1.916 ***
Individual data on the 30 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.7	88.2	0.0	0.0	0.	0.	0.0	0.0	0.0
2	1.8	264.0	0.0	0.0	0.	0.	0.0	0.0	0.0
3	0.4	91.5	0.0	0.0	0.	0.	0.0	0.0	0.0
4	1.4	379.8	0.0	0.0	0.	0.	0.0	0.0	0.0
5	1.9	772.2	0.0	0.0	0.	0.	0.0	0.0	0.0
6	1.9	1067.6	0.0	0.0	0.	0.	0.0	0.0	0.0
7	2.0	1346.4	0.0	0.0	0.	0.	0.0	0.0	0.0
8	1.8	1481.3	0.0	0.0	0.	0.	0.0	0.0	0.0
9	0.1	121.6	0.0	0.0	0.	0.	0.0	0.0	0.0
10	2.0	1850.5	0.0	0.0	0.	0.	0.0	0.0	0.0
11	2.0	2080.3	0.0	0.0	0.	0.	0.0	0.0	0.0
12	2.0	2274.1	0.0	0.0	0.	0.	0.0	0.0	0.0
13	2.0	2428.7	0.0	0.0	0.	0.	0.0	0.0	0.0
14	2.0	2541.8	0.0	0.0	0.	0.	0.0	0.0	0.0
15	1.9	2611.8	0.0	0.0	0.	0.	0.0	0.0	0.0
16	1.9	2638.1	0.0	0.0	0.	0.	0.0	0.0	0.0
17	1.8	2621.6	0.0	0.0	0.	0.	0.0	0.0	0.0
18	1.8	2563.4	0.0	0.0	0.	0.	0.0	0.0	0.0
19	1.5	2104.0	0.0	0.0	0.	0.	0.0	0.0	0.0
20	0.3	360.7	0.0	0.0	0.	0.	0.0	0.0	0.0
21	1.7	2239.8	0.0	0.0	0.	0.	0.0	0.0	0.0
22	1.6	1946.8	0.0	0.0	0.	0.	0.0	0.0	0.0

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23	1.5	1649.0	0.0	0.0	0.	0.	0.0	0.0	0.0
24	1.4	1352.9	0.0	0.0	0.	0.	0.0	0.0	0.0
25	1.3	1065.3	0.0	0.0	0.	0.	0.0	0.0	0.0
26	1.2	792.8	0.0	0.0	0.	0.	0.0	0.0	0.0
27	1.1	541.7	0.0	0.0	0.	0.	0.0	0.0	0.0
28	1.0	318.2	0.0	0.0	0.	0.	0.0	0.0	0.0
29	0.8	128.2	0.0	0.0	0.	0.	0.0	0.0	0.0
30	0.2	7.2	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 30 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	12.895	6800.000
2	14.529	6798.846
3	16.234	6797.802
4	18.005	6796.873
5	19.833	6796.061
6	21.710	6795.371
7	23.628	6794.806
8	25.580	6794.367
9	27.556	6794.058
10	29.548	6793.878
11	31.547	6793.830
12	33.545	6793.913
13	35.534	6794.126
14	37.504	6794.470
15	39.448	6794.942
16	41.356	6795.541
17	43.221	6796.263
18	45.035	6797.106
19	46.789	6798.066
20	48.477	6799.139
21	50.091	6800.321
22	51.623	6801.605
23	53.069	6802.988
24	54.420	6804.462
25	55.672	6806.021
26	56.819	6807.660
27	57.856	6809.370
28	58.779	6811.145
29	59.583	6812.976
30	59.955	6814.000

Circle Center At X = 31.280 ; Y = 6824.292 ; and Radius = 30.465

Factor of Safety

*** 1.919 ***

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APPENDIX F

RECOMMENDED EARTHWORK SPECIFICATIONS

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APPENDIX F
RECOMMENDED EARTHWORK SPECIFICATIONS

1. Areas to receive fill and/or backfill should be stripped of all vegetation, organic material, and debris. Any existing undocumented or non-structural fill/backfill materials and other unsuitable materials should be excavated in their entirety. All areas that are to receive fill should be observed by TGE prior to placement of fill.

2. Fill should be compacted to 85% of the maximum density as compared to ASTM D 698 (standard Proctor) for the spoil pile and 90% for the sedimentation dikes/embankments.

3. Lift thickness for the sedimentation ponds should not exceed 12-inch loose lifts or 8-inch compacted lifts. Since large equipment will be used for the spoil pile, lifts can be as large as 4 feet. The lift thickness may be increased or decreased relative to the results of compaction test results during field verification as approved by TGE.

4. Saturated soils should be placed in an area that will have minimal effect on the performance of the slopes.

5. Native, undisturbed soils to serve as subgrade for the pond embankments should be scarified to a minimum depth of 12 inches, moisture conditioned to, or slightly above, optimum moisture content and re-compacted to at least 90% relative compaction.

6. A qualified geotechnical engineering firm under the direction of TGE, should observe the placement of fill and conduct in-place field density tests on the fill to check for adequate moisture content and relative compaction as outlined herein. If less than the specified relative compaction is obtained, additional compactive effort should be applied and the fill moisture-conditioned as necessary until the specified relative compaction is attained. The Contractor should provide level testing pads on which geotechnical engineering firm may conduct field density tests. The Contractor should provide safe and timely access for engineering personnel throughout the grading site to allow continued monitoring and testing.

7. Wherever, in the opinion of the Owner's representatives, an unstable condition is being created either by cutting or filling, the work should not proceed in that area until an evaluation has been made and the grading operations revised, if found necessary.

8. Fill should not be placed, spread or rolled during unfavorable weather conditions. When the work is interrupted by heavy rain or freezing temperatures, fill operations should not be resumed until field inspections indicate that the moisture content and density of the fill are as previously specified.

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9. Whenever the words "supervision", "inspection", or "control" appear they should mean *observation* of the work and *testing* of the fill placement necessary by TGE or their representative to substantiate compliance with plans, specifications and design concepts.

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APPENDIX 5-2

Sediment Impoundment and
Diversion Structure Analysis

By: Alton Coal Development, LLC
Chris McCourt, P.E.

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Coal Hollow Mine – Sedimentation Structure Sizing

Introduction

Protection of surface water quality at the Coal Hollow Mine is an important part of the mining process. By utilizing sedimentation structures for diversion and sediment impoundment, Alton Coal Development, LLC (ACD) will minimize the sediment that could potentially flow from active disturbance areas into drainages that are in and surrounding the proposed project area. Appropriate sizing of these structures is a necessary step toward ensuring that these controls function properly and serve the purpose of protecting the surrounding environment.

Therefore, ACD has completed a watershed analysis for appropriate sizing of five proposed sedimentation impoundments and four diversion ditches. This report will outline the methods used and results of this analysis.

Sediment Impoundments

Summary

The watersheds for the four proposed sedimentation impoundments have been evaluated mainly using the TR-55 method. This method of analysis was first issued by the Soil Conservation Service (SCS) in 1975. It has since been revised and updated numerous times. This method is applicable for evaluating small watersheds.

To assist with the calculations and mapping, Carlson 2007 Hydrology software has been utilized for this evaluation. A watershed analysis for this project includes: runoff flow paths, watershed boundaries, length and average grade for longest flow lines, runoff curve number classification, time of concentration and peak discharge. Information from this analysis was then used for sedimentation structure sizing. For the specifics associated with each of these parameters refer to the details section of this report.

The sedimentation structures were sized to impound the runoff associated with a 100-year frequency, 24-hour duration storm event. Using the Carlson rainfall map (assembled using TP-40 and TP-47 data), the rainfall intensity associated with this size of event for the Alton area is 3.1 inches. The following table summarizes the final results for each sedimentation structure:

Sedimentation Impoundment Capacities

Structure	Storage Required (ac/ft)	Design Storage* (ac/ft)	Percent of requirement	Additional Storage (ac/ft)
1	2.6	3.1	119	0.5
2	1.7	2.3	135	0.6
3	6.3	7.7	122	1.4
4	5.7	7.5	132	1.8
1B	0.5	0.8	160	0.3

*Design capacities include a minimum of 2 feet free board (spillway to top of embankment)

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The enclosed maps and cross sections detail the design and location for each structure (Drawings 5-25 through 5-34). These drawings also show proposed spillways, diversion ditches and watersheds associated with each structure.

Details

Determining storage capacity requirements using the TR-55 method requires several steps. This section of the report will provide the details and assumptions associated with each step. These steps are: watershed boundaries/flow paths, runoff curve number classification, time of concentration, peak discharge and structure sizing.

- **Watershed Boundaries/Flow Paths**
  The watershed boundaries were determined by first identifying the runoff flow paths for the entire project area. This was completed by creating a three dimensional model of the surface topography. This model was then used to draw flow paths for all the watersheds. Based on these flow paths, boundaries for each watershed are easily determined based on flow direction in combination with proposed control structures (ponds, diversion ditches, etc..).

  Using this process, the project area (in conjunction with diversion ditch locations and berms) was found to be separated into seven distinct watersheds. The natural separations of watersheds in this area are Lower Robinson Creek to the north and Sink Valley Wash at the south end. In addition to these natural separations, the proposed diversion ditches and berms also provide definite boundaries as shown on Drawings 5-26 and 5-27. The following summarizes the watersheds:

Watersheds		
Watershed	**Area (acres)**	**Description**
1	27	North end of project area where facilities are proposed.
2	74	Borders south edge of Lower Robinson Creek.
3	285	Main watershed through the center of permit area
4	256	Southern most watershed bordered by Sink Valley Wash
*5	28	Isolated area between watersheds 3 and 4
*6	19	Area northwest of Lower Robinson Creek Reconstruction
7	5	Southwest end of facilities area, entrance/exit road

*These watersheds will have silt fence or other appropriate control measures installed.

- **Rainfall Amount and Runoff Curve Number Classification**
  First data required to begin estimating runoff for the watersheds is the rainfall amount and the runoff curve number classification. The rainfall amount is the precipitation associated with a 100 year frequency, 24 hour duration storm event. The runoff curve number classification is a classification of the soil and vegetation cover conditions for the watersheds.

  In order to estimate runoff from rainfall, the rainfall amount for a 100 year frequency, 24 hour duration storm event was determined using the Carlson

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rainfall map. This map was assembled by Carlson software based on TP-40 and TP-47 data. The resulting rainfall amount for the Alton area using this map is 3.1 inches.

The runoff curve number was determined by matching the ground cover description and estimated hydrologic soil group for the project area to the descriptions available in Table 2-2d of TR-55. Based on visual observations of the project area and soils the following classifications were estimated:

1. Cover Description: The cover description that best fits watersheds 2, 3 and 4 is "Sagebrush with grass understory". The hydrologic condition for this cover was estimated at "fair" which is defined as 30% to 70% ground cover. This estimation was based off the knowledge of current conditions and future disturbance/reclamation. Plans for this operation include sequenced disturbance combined with concurrent reclamation. This will minimize the area that will be disturbed at any one time. This will be combined with a general vegetation coverage improvement within one to two growing seasons for reclamation compared to current conditions. In addition, a significant amount of runoff from the active mining area for this magnitude of storm event will be temporarily controlled within the active pit area and will not immediately report to the designed impoundments.

   Watersheds 1 and 7 have been classified differently since they include the mine facilities area. These watersheds are classified as "Gravel roads" since most the area will be stripped of vegetation and gravel spread for parking areas and roads. This results in a much higher runoff than the classification for the other three watersheds.

2. Hydrologic Soil Group: This classification was estimated to be Group C for the five watersheds evaluated, as outlined in Appendix A in TR-55. This classification is for soils having low infiltration rates thus producing high amounts of runoff. The soils in this classification typically have infiltration rates of 0.05 to 0.15 inches per hour.

The resulting curve number for watersheds 2, 3 and 4 is 63. Watersheds 1 and 7 were assigned a curve number of 89. These classifications are intended to be conservative estimates (producing higher than expected runoff) to ensure that the sedimentation structures have more than sufficient storage capacity.

These classifications are used in the next step for determining the time of concentration.

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- **Time of Concentration (T_c)**
  T_c is the time for runoff to travel from the furthest point in the watershed to the point that it meets the sedimentation structure. This figure is essential for calculating the peak flow which is used to determine the required size for the sedimentation structure. The SCS method for calculating T_c is used in this analysis. The following table summarizes the inputs for calculating the T_c along with the resulting outputs:

Time of Concentration (T_c)				
Watershed	Curve Number	Flow Length (ft)	Average Slope (%)	T_c (hrs)
1	89	1,087	6.8	0.16
2	63	5,670	3.8	1.7
3	63	7,095	3.5	2.2
4	63	6,831	2.9	2.3
7	89	750	3.6	0.08

The T_c for each watershed is used to calculate the peak discharge which is the final step leading to the structure sizing.

- **Peak Discharge**
  The peak discharge for each watershed was calculated using the Graphical method. The inputs required for this method include: T_c, drainage area, 100 year 24 hour rainfall and the runoff curve number (CN). The following table outlines these inputs and the peak discharge:

Peak Discharge (*Inflow)					
Watershed	CN	Tc (hr)	Rainfall (in)	Drainage Area (ac)	Peak Discharge (cfs)
1	89	0.16	3.1	27	74.7
2	63	1.7	3.1	74	9.9
3	63	2.2	3.1	285	31.8
4	63	2.3	3.1	256	27.8
7	89	0.08	3.1	5	15.6

*The peak discharge from each watershed will also be the peak inflow to the sedimentation structures.

- **Sedimentation Impoundment Sizing**
  The method used for this step is again from the TR-55 program. A sedimentation structure is required for each one of the five watersheds analyzed. Therefore, a size has been evaluated for the five proposed structures. The inputs for this calculation are the following: drainage area, peak inflow, desired outflow, and runoff depth (Q). The desired outflow in this situation is zero since we do not intend any discharge from the structures. The spillways for these structures are proposed for emergency use only and are not intended for regular discharges. The following table summarizes these inputs and the required storage capacity for each watershed:

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Sedimentation Impoundment Sizing				
Structure	Drainage Area (ac)	Inflow (cfs)	Q (in)	Storage Required (ac-ft)
1	27	74.7	2.00	2.6
2	74	9.9	0.48	1.7
3	285	31.8	0.48	6.3
4	256	30.4	0.48	5.7
1B	5	15.6	2.00	0.5

The enclosed maps show the proposed design and locations for each one these structures.

Conclusions

This analysis provides estimates of sufficient storage capacities for each watershed analyzed to impound water from a 100 year frequency, 24 hour duration storm event at the proposed Coal Hollow Mine. In addition to the required storage capacities, a minimum 15% additional storage capacity has been added to each structure design to account for sediment and any standing water that may occur. Spillways have also been included in the structure designs to provide a non destructive route for discharge should these capacities ever be exceeded.

Due to the isolated characteristics and the inability to effectively divert water from Watersheds 5 and 6 , the method of using silt fence or other appropriate control measures for sediment have been chosen and are included on Drawing 5-26.

The structure designs established from this analysis will minimize impacts from sediment to the surrounding environment at the Coal Hollow Mine.

Diversion Ditches

Summary

The channel sizing for the four proposed diversion ditches has been evaluated using the TR-55 method to determine peak flows and the Manning's Equation (ME) to determine appropriate dimensions. The TR-55 method of analysis is the same method used to size impoundments and was utilized in this case to provide a peak flow for each diversion during a 100 year, 24 hour storm event. This peak flow was then input into the ME to determine an appropriate open channel design for minimizing the effects of erosion during peak flows. Similar to the impoundment sizing, the Carlson Software Hydrology module was utilized to perform these calculations. The ditch locations, designs and cross sections can be viewed on Drawings 5-33 and 5-34.

The following table summarizes the inputs and results for each diversion based on flows during a 100 year, 24 hour storm event:

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Diversion Ditch Summary							
Ditch	*Base (ft)	Manning's n	Average Slope (%)	Peak Flow (cfs)	Flow Depth (ft)	Velocity (fps)	Freeboard (ft)
1	3.0	0.020	2.8	14.8	0.5	6.8	0.3
2	2.5	0.020	3.5	6.9	0.4	6.0	0.3
3	4.5	0.020	2.4	16.7	0.5	6.3	0.3
4	5.0	0.020	1.8	19.8	0.6	5.4	0.3

*All side slopes are 2h:1v

Details

- **Watersheds**
  The first step used for evaluating the diversions was to determine the peak flow during a 100 year, 24 hour storm event for each diversion. In order to determine this variable, the TR-55 method of watershed analysis was again utilized. This requires determining the watershed boundaries associated with each diversion. The following table summarizes these watersheds:

Diversion Watersheds		
Ditch	**Area (acres)**	**Description**
1	158	Diverts water outside project area into Pond 4
2	48	Diverts water along Robinson Creek to Pond 2
3	72	Diverts water around facilities area
4	169	Diverts water from project area into Pond 3

- **Rainfall Amount and Runoff Curve Number Classification**
  The rainfall amount for a 100 year, 24 hour storm event was developed utilizing the same method as previously discussed in the impoundments section of this report. This number is 3.1 inches of precipitation.

  The runoff curve number classification for all four watersheds was estimated to be 63. This classification is consistent with the classification and logic used for the impoundment analysis.

- **Time of Concentration (T_c)**
  T_c is the time for runoff to travel from the furthest point in the watershed to the point that it meets the sedimentation structure. This figure is essential for calculating the peak flow which is used to determine the required size for the diversion ditch. The SCS method for calculating T_c is used in this analysis. The following table summarizes the inputs for calculating the T_c along with the resulting outputs:

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Time of Concentration (T_c)				
Ditch	Curve Number	Flow Length (ft)	Average Slope (%)	T_c (hrs)
1	63	8,487	2.9	2.9
2	63	4,187	3.6	1.4
3	63	3,742	13.7	0.7
4	63	5,868	3.9	1.8

The T_c for each watershed is used to calculate the peak flow which is the final step leading to the diversion dimensions.

- **Peak Flow**
  The peak flow for each diversion was calculated using the Graphical method. The inputs required for this method include: T_c, drainage area, 100 year 24 hour rainfall and the runoff curve number (CN). The following table outlines these inputs and the peak flow:

Diversion Peak Flow					
Ditch	CN	Tc (hr)	Rainfall (in)	Drainage Area (ac)	Peak Flow (cfs)
1	63	2.9	3.1	158	14.8
2	63	1.4	3.1	48	6.9
3	63	0.7	3.1	72	16.7
4	63	1.8	3.1	169	19.8

- **Diversion Dimensions**
  The Manning's Equation (ME) equation was used to appropriately size the each diversion. Inputs into this equation are manning's coefficient, average diversion slope, peak flow and side slope angles. Outputs are the depth of flow, and base dimension for a trapezoidal channel design. The following table summarizes the inputs and results:

Diversion Ditch Summary							
Ditch	**Base (ft)	*Manning n	Average Slope (%)	Peak Flow (cfs)	Flow Depth (ft)	Velocity (fps)	Freeboard (ft)
1	3.0	0.020	2.8	14.8	0.5	6.8	0.3
2	2.5	0.020	3.5	6.9	0.4	6.0	0.3
3	4.5	0.020	2.4	16.7	0.5	6.3	0.3
4	5.0	0.020	1.8	19.8	0.6	5.4	0.3

*Manning n of 0.020 is for ordinary firm loam
**All side slopes are 2h:1v

Conclusions

These diversions have been sized in manner that will transport the necessary flows and minimize erosion during a 100 year, 24 hour storm event. These diversions will prevent runoff from up gradient watersheds from entering the active mining areas and will also assist in directing water from disturbed areas to the sediment impoundments.

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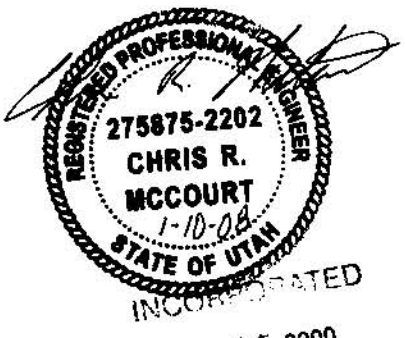
APPENDIX 5-3

Lower Robinson Creek
Culvert and Diversion Analysis

By: Dr. James E. Nelson - Assistant Professor, Civil and Environmental Engineering - Brigham Young University



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Culvert Analysis for Drainages near Lower Robinson Creek

This report summarizes the design and analysis of two culverts proposed to be located on the crossings on Lower Robinson Creek (RCreek) and a small tributary (RCTrib) near Alton Utah.

Figure 1 shows the watersheds above the proposed culvert crossings on the map. The larger drainage **RCreek** has an area of **3.55 sq. mi.** and the smaller drainage **RCTrib** has a drainage area of **0.09 sq. mi**. The average elevation of the watersheds is about 7830 ft. The watersheds were delineated and basin data calculated from the digital elevation model (DEM) of the Alton quadrangle.

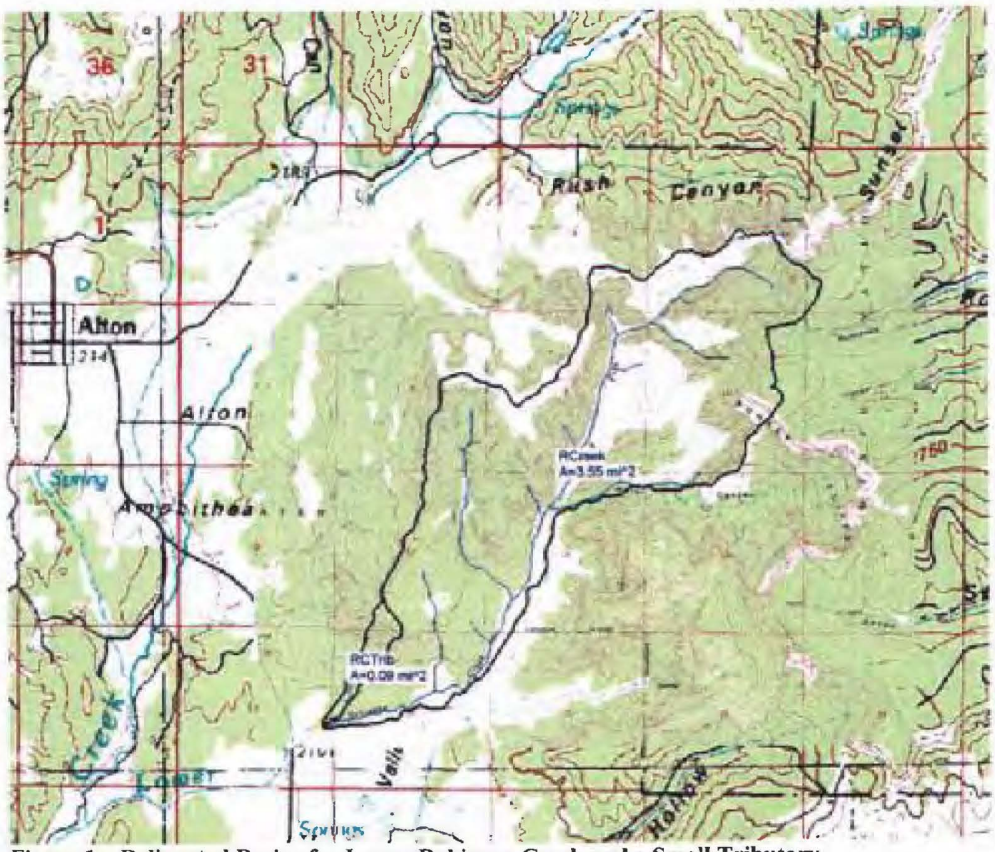

Figure 1 – Delineated Basins for Lower Robinson Creek and a Small Tributary.

The culverts need to be designed such that they can pass a peak flow resulting from the 100-year six hour storm. In order to compute this peak flow the HEC-1 program was used with the 100-year six hour precipitation from NOAA. Losses (initial abstractions and infiltration) are determined using the SCS Curve Number (CN), and excess rainfall transformed to a peak flow and runoff hydrograph using the SCS unit hydrograph method. Land use and hydrologic soil types are required to compute a composite CN. Soil type data were downloaded from the NRCS (formerly SCS) soils data mart. Land use was

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downloaded from the USGS seamless data website and overlaid with the delineated basins as shown in Figure 2.

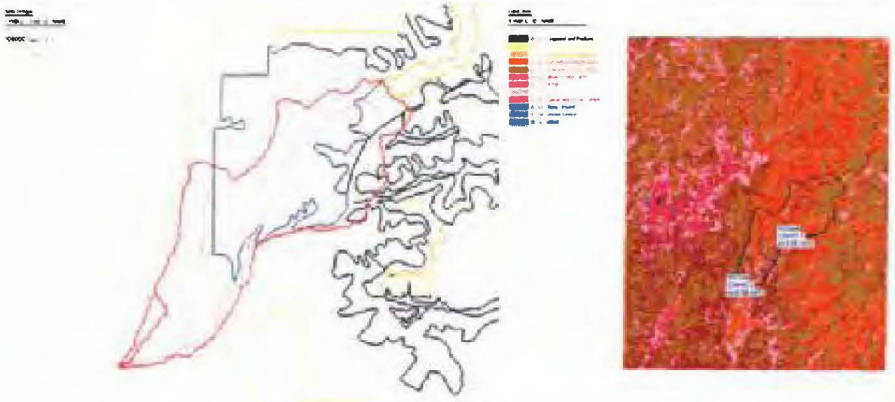

Figure 2 – Digital Land Use and Soils Data Overlaid with Robinson Creek Watersheds.

A CN was computed by averaging the individual CN's determined from the unique land use and soil combinations in conjunction with the table of values prepared for use by the Utah Department of Transportation (UDOT) as shown in Table 1.

Table 1 – CN values for typical USGS land use classifications

ID	Description	CNA	CNB	CNC	CND
-1	"Average Forested Values"	40	60	70	78
11	"Residential"	60	74	82	87
12	"Commercial Services"	89	92	94	95
13	"Industrial"	81	88	91	93
14	"Transportation and Communication"	76	85	89	91
16	"Mixed urban or built up land"	77	85	90	93
17	"Other urban or built up land"	71	82	88	90
21	"Cropland and Pasture"	49	68	78	84
22	"Orchards, Groves, Vineyards, Nurseries"	47	67	77	83
23	"Confined Feeding Operations"	55	63	66	68
24	"Other Agricultural Land"	62	74	82	86
31	"Herbaceous Rangeland"	45	66	77	82
32	"Shrub and Brush Rangeland"	44	64	77	82
33	"Mixed Rangeland"	46	66	77	83
41	"Decideous Forest Land"	31	58	68	75
42	"Evergreen Forest Land"	35	59	73	79
43	"Mixed Forest Land"	39	61	74	80
52	"Lakes"	0	0	0	0
53	"Reservoirs"	0	0	0	0
61	"Forested Wetlands"	44	58	68	75
62	"Nonforested Wetlands"	32	55	68	75
74	"Bare Exposed Rock"	98	98	98	98
75	"Strip Mines"	71	80	85	88
76	"Transitional Areas"	69	78	84	88
81	"Shrub and Shrub Tundra"	60	74	83	87
82	"Herbaceous Tundra"	66	76	83	87
83	"Bare Ground"	74	83	87	90
85	"Mixed Tundra"	50	65	74	80

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The RCreek watershed has a compute average CN of 73, whereas the computed average CN for RCTrib is 61, though in order to be conservative a value of 73 was also used for the small watershed. The higher value was used because the watershed is so small that it did not fit well within the resolution and resulted in almost zero runoff. The watershed is similar in land use and soil to the larger RCreek and therefore the same CN value was used.

Digital rainfall data from NOAA for Utah was downloaded from NOAA and overlaid with the basin in order to determine watershed average values for the 100-year six hour storm. Figure 3 shows the rainfall data and basin (small black area in the south-eastern portion of the state).

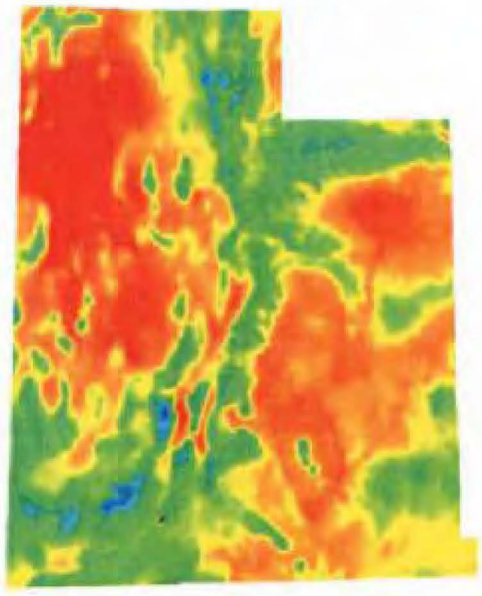

Figure 3 – NOAA Rainfall Data for the 100-Year Six Hour Storm.

Using the NOAA data a rainfall depth of 2.35 inches for RCreek was computed and a depth of 2.27 for RCTrib. These values were spread out over a six hour period using a standard SCS temporal distribution typical for design of hydraulic structures.

The information computed from the digital data and the Watershed Modeling System (WMS) was used to develop the parameters for an HEC-1 model as summarized in Table 2.

Table 2 – Parameter Summaries for HEC-1 Model

Basin	Area (sq. miles)	Precip (inches)	CN	Lag Time (hrs)
RCreek	3.55	2.35	73	.95
RCTrib	.09	2.27	73	.42

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HEC-1 is a computer program developed by the US Army Corps of Engineers to develop rainfall runoff peak flows and hydrographs. The data summarized in Table 2 was formatted by WMS into an input file as shown in Table 3.

Table 3 – HEC-1 Input File

```
IDHEC-1 Analysis using WMS
ID
ID
*DIAGRAM
IT     7 01JAN94        0     200
IO     0
KKRCreek
KO     0        0     0.0        0       22
BA3.5506
PB 2.348
IN     7 01JAN94        0
* SCS-StdEmergencySpillway
PC   0.0    0.008  0.0162  0.0246  0.0333  0.0425  0.0524   0.063  0.0743  0.0863
PC 0.099   0.1124  0.1265   0.142  0.1595    0.18   0.205   0.255   0.345   0.437
PC  0.53    0.603   0.633    0.66   0.684   0.705   0.724   0.742   0.759   0.775
PC  0.79   0.8043   0.818  0.8312  0.8439  0.8561  0.8678   0.879  0.8898  0.9002
PC0.9103   0.9201  0.9297  0.9391  0.9483  0.9573  0.9661  0.9747  0.9832  0.9916
PC   1.0
LS   0.0    73.08     0.0
UD0.9461
KK    4R   CNAME       4C
KO     0        0     0.0        0       22
RN    4R
KKRCTrib
KO     0        0     0.0        0       22
BA0.0935
PB 2.274
IN     7 01JAN94        0
* SCS-StdEmergencySpillway
PC   0.0    0.008  0.0162  0.0246  0.0333  0.0425  0.0524   0.063  0.0743  0.0863
PC 0.099   0.1124  0.1265   0.142  0.1595    0.18   0.205   0.255   0.345   0.437
PC  0.53    0.603   0.633    0.66   0.684   0.705   0.724   0.742   0.759   0.775
PC  0.79   0.8043   0.818  0.8312  0.8439  0.8561  0.8678   0.879  0.8898  0.9002
PC0.9103   0.9201  0.9297  0.9391  0.9483  0.9573  0.9661  0.9747  0.9832  0.9916
PC   1.0
LS   0.0     73.0     0.0
UD0.4207
KK    3R   CNAME       3C
KO     0        0     0.0        0       22
RN    3R
ZZ
```

The results of the HEC-1 model determined the peak flow for RCreek to be 336 cfs (see Figure 4) and for RCTrib the peak flow was computed to be 11 cfs (see Figure 5). Values from the USGS regional regression NFF equations for the same basins were 408 cfs and 117 cfs respectively. It should be noted though that the NFF equations are for a 100-year event, but no durations (i.e. six hour) are specified. The larger basin compared quite well (336 to 408) even considering the differences. However the HEC-1 computed value of 11 cfs would seem low compared to the NFF computed value of 117 cfs. On the other hand the NFF equations were not developed for computing runoff from such small basins and therefore the computed value of 117 (besides not being developed from a six hour storm) is suspect and greater confidence can be given to the HEC-1 computed peak flow.

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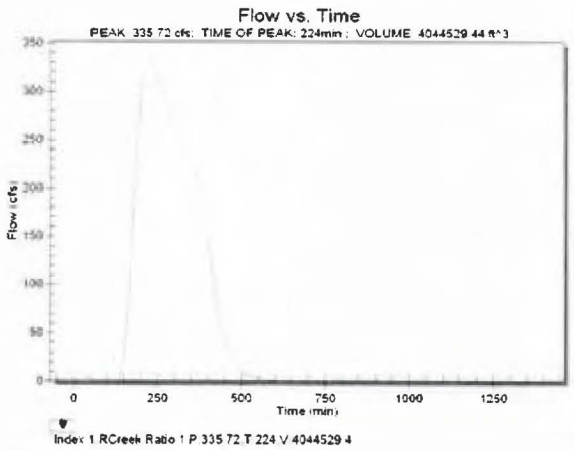

Figure 4 – Computed Runoff Hydrograph for RCreek

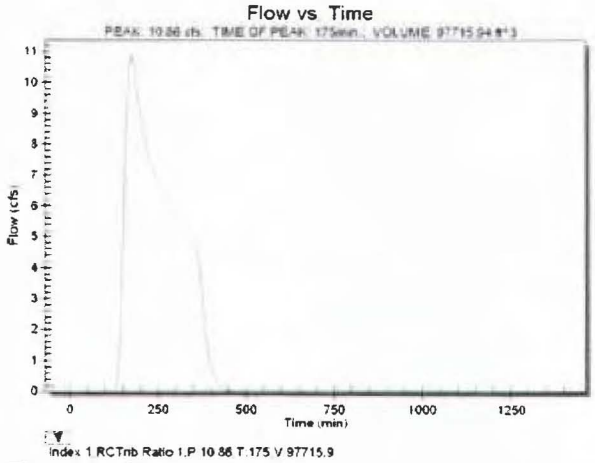

Figure 5 – Computed Runoff Hydrograph for RCTrib

Culvert Analysis

The FHWA HY-8 program for culvert analysis was used with the peak flows of 336 cfs and 11 cfs computed using the HEC-1 analysis described above. Because of the large watershed above RCreek the culvert was analyzed for two different conditions: 1) a smaller sized barrel that is sufficiently large so that overtopping of the roadway (assumed 18 feet above the culvert invert from the provided profile information), but that does surcharge the culvert for the 100-year six hour event, and 2) a larger barrel that carries the design flow with surcharging the culvert.

Culvert Data Summary – 5.5 foot Circular for RCreek

Barrel Shape: Circular

Barrel Diameter: 5.50 ft

Barrel Material: Corrugated Steel

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Table 5 - Summary of Culvert Flows at Crossing: RCreek for 5.5 foot culvert

Headwater Elevation (ft)	Total Discharge (cfs)	Circular Discharge (cfs)	Roadway Discharge (cfs)	Iterations
100.00	0.00	0.00	0.00	1
102.77	40.00	40.00	0.00	1
104.07	80.00	80.00	0.00	1
105.17	120.00	120.00	0.00	1
106.24	160.00	160.00	0.00	1
107.54	200.00	200.00	0.00	1
109.52	240.00	240.00	0.00	1
111.76	280.00	280.00	0.00	1
114.22	320.00	320.00	0.00	1
115.35	336.00	336.00	0.00	1
118.23	400.00	370.29	29.56	7

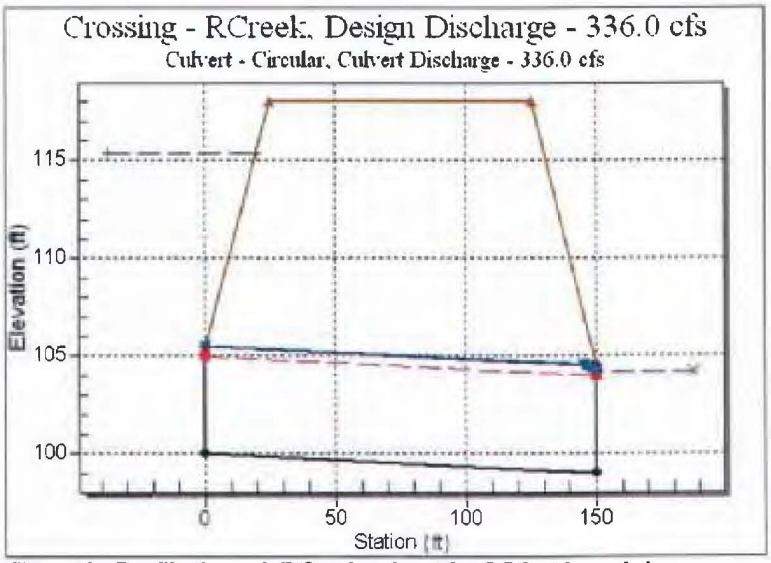

Figure 6 – Profile through RCreek culvert for 5.5 foot barrel size.

Culvert Data Summary – 8.0 foot Circular for RCreek Crossing

Barrel Shape: Circular

Barrel Diameter: 8.00 ft

Barrel Material: Corrugated Steel

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Table 5 - Summary of Culvert Flows at Crossing: RCreek for 8.0 foot culvert

Headwater Elevation (ft)	Total Discharge (cfs)	Circular Discharge (cfs)	Roadway Discharge (cfs)	Iterations
100.00	0.00	0.00	0.00	1
102.46	40.00	40.00	0.00	1
103.57	80.00	80.00	0.00	1
104.43	120.00	120.00	0.00	1
105.19	160.00	160.00	0.00	1
105.88	200.00	200.00	0.00	1
106.52	240.00	240.00	0.00	1
107.13	280.00	280.00	0.00	1
107.73	320.00	320.00	0.00	1
107.96	336.00	336.00	0.00	1
108.91	400.00	400.00	0.00	3

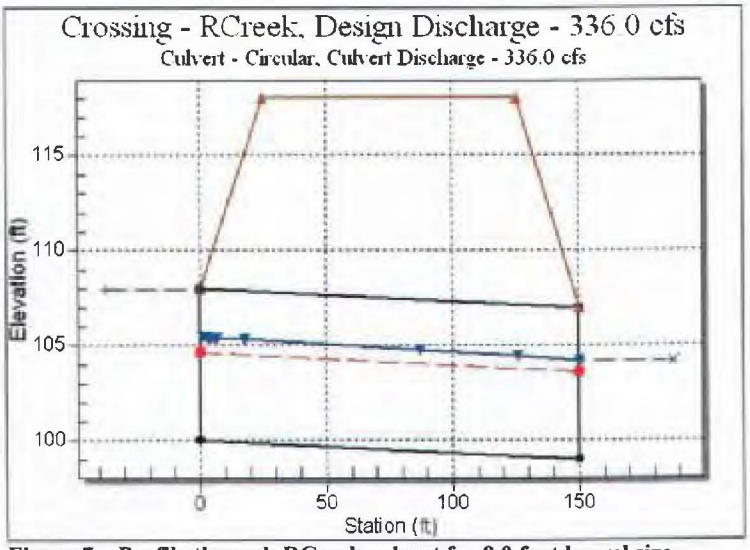

Figure 7 – Profile through RCreek culvert for 8.0 foot barrel size

Culvert Data Summary – 2.5 foot Circular for RCTrib

Barrel Shape: Circular

Barrel Diameter: 2.50 ft

Barrel Material: Corrugated Steel

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Table 6 - Summary of Culvert Flows at Crossing: RCTrib for 2.5 foot culvert

Headwater Elevation (ft)	Total Discharge (cfs)	Circular Discharge (cfs)	Roadway Discharge (cfs)	Iterations
100.00	0.00	0.00	0.00	1
100.82	2.50	2.50	0.00	1
101.19	5.00	5.00	0.00	1
101.49	7.50	7.50	0.00	1
101.75	10.00	10.00	0.00	1
101.85	11.00	11.00	0.00	1
102.23	15.00	15.00	0.00	1
102.48	17.50	17.50	0.00	1
102.74	20.00	20.00	0.00	1
103.11	22.50	22.50	0.00	1
103.70	25.00	25.00	0.00	1

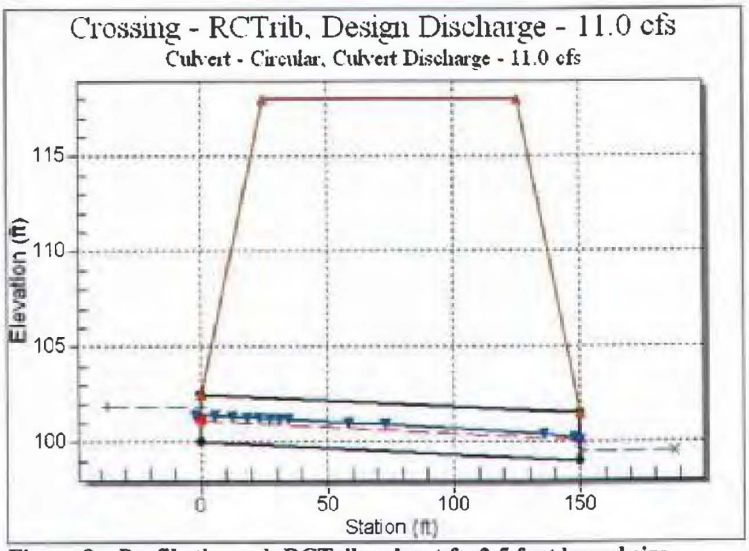

Figure 8 – Profile through RCTrib culvert for2.5 foot barrel size

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Diversion Ditch Analysis for Drainages near Lower Robinson Creek

In a previous study we sized culverts for a 100-year six hour storm. A diversion ditch was also analyzed for a 100-year event, but without lining the ditch in concrete it would be impossible to protect it from the highly erosive super critical flows which occur during larger events primarily because of the relatively steep slopes (.01 to .028). In fact it has been reported that as is the channel appears to be constantly changing due to erosion as a result of larger storms. Even if you were to protect this section with concrete lining of the diversion canal problems above and below are likely to continue and cause additional problems for the stability of the diversion ditch. This report reviews the hydrologic calculations used to determine the 10-year peak flow followed by an analysis of the same ditch designed for the 100-year flow with protection against erosion for the 10-year event. The hydrologic analysis is almost identical to the previous report for culvert design with the exception that the 10-year precipitation is used instead of the 100-year precipitation.

Figure 1 shows the watersheds above the proposed culvert crossings on the map. The larger drainage **RCreek** has an area of **3.55 sq. mi**. and the smaller drainage **RCTrib** has a drainage area of **0.09 sq. mi**. The average elevation of the watersheds is about 7830 ft. The watersheds were delineated and basin data calculated from the digital elevation model (DEM) of the Alton quadrangle.

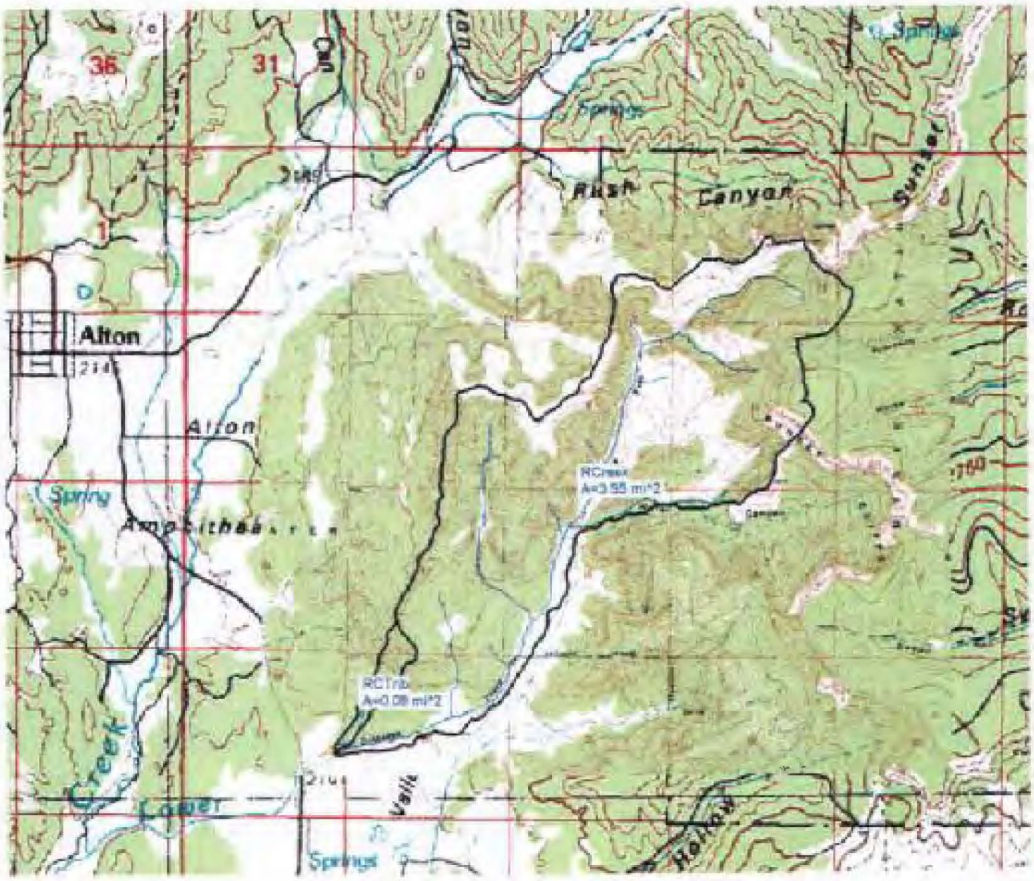

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Figure 1 – Delineated Basins for Lower Robinson Creek and a Small Tributary.

The ditch needs to be designed such that it can convey a peak flow resulting from the 10-year six hour storm. In order to compute this peak flow the HEC-1 program was used with the 10-year six hour precipitation from NOAA. Losses (initial abstractions and infiltration) are determined using the SCS Curve Number (CN), and excess rainfall transformed to a peak flow and runoff hydrograph using the SCS unit hydrograph method. Land use and hydrologic soil types are required to compute a composite CN. Soil type data were downloaded from the NRCS (formerly SCS) soils data mart. Land use was downloaded from the USGS seamless data website and overlaid with the delineated basins as shown in Figure 2.

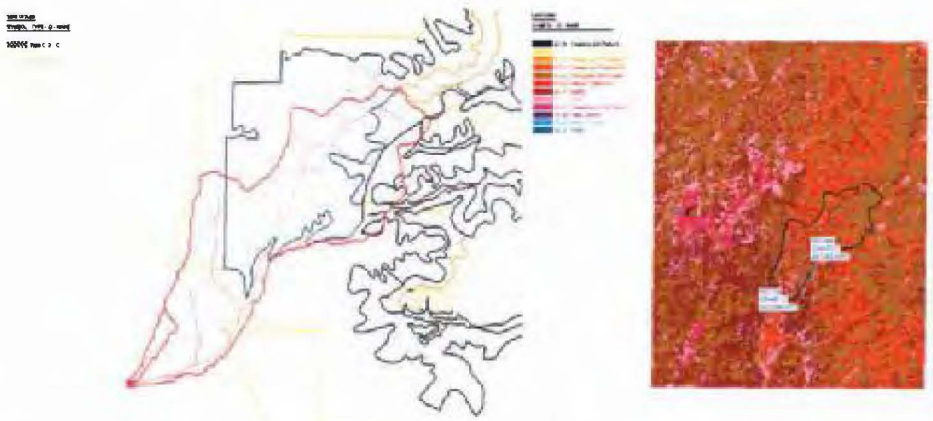

Figure 2 – Digital Land Use and Soils Data Overlaid with Robinson Creek Watersheds.

A CN was computed by averaging the individual CN's determined from the unique land use and soil combinations in conjunction with the table of values prepared for use by the Utah Department of Transportation (UDOT) as shown in Table 1.

Table 1 – CN values for typical USGS land use classifications

ID	Description	CNA	CNB	CNC	CND
-1	"Average Forested Values"	40	60	70	78
11	"Residential"	60	74	82	87
12	"Commercial Services"	89	92	94	95
13	"Industrial"	81	88	91	93
14	"Transportation and Communication"	76	85	89	91
16	"Mixed urban or built up land"	77	85	90	93
17	"Other urban or built up land"	71	82	88	90
21	"Cropland and Pasture"	49	68	78	84
22	"Orchards, Groves, Vineyards, Nurseries"	47	67	77	83
23	"Confined Feeding Operations"	55	63	66	68
24	"Other Agricultural Land"	62	74	82	86
31	"Herbaceous Rangeland"	45	66	77	82
32	"Shrub and Brush Rangeland"	44	64	77	82
33	"Mixed Rangeland"	46	66	77	83
41	"Decideous Forest Land"	31	58	68	75
42	"Evergreen Forest Land"	35	59	73	79
43	"Mixed Forest Land"	39	61	74	80
52	"Lakes"	0	0	0	0
53	"Reservoirs"	0	0	0	0

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```
61, "Forested Wetlands", 44, 58, 68, 75
62, "Nonforested Wetlands", 32, 55, 68, 75
74, "Bare Exposed Rock", 98, 98, 98, 98
75, "Strip Mines", 71, 80, 85, 88
76, "Transitional Areas", 69, 78, 84, 88
81, "Shrub and Shrub Tundra", 60, 74, 83, 87
82, "Herbaceous Tundra", 66, 76, 83, 87
83, "Bare Ground", 74, 83, 87, 90
85, "Mixed Tundra", 50, 65, 74, 80
```

The RCreek watershed has a compute average CN of 73, whereas the computed average CN for RCTrib is 61, though in order to be conservative a value of 73 was also used for the small watershed. The higher value was used because the watershed is so small that it did not fit well within the resolution and resulted in almost zero runoff. The watershed is similar in land use and soil to the larger RCreek and therefore the same CN value was used.

Utah 37.42162 N 112.4207 W 7746 feet
from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4
G M Bonnin, D. Martin, B Lin, T Parzybok, M Yekta, and D Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006

Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.15	0.24	0.29	0.39	0.49	0.56	0.65	0.82	1.14	1.40	1.66	1.99	2.39	2.73	3.61	4.41	5.24	6.23
2	0.20	0.30	0.37	0.50	0.62	0.71	0.81	1.01	1.42	1.74	2.08	2.49	3.00	3.44	4.52	5.53	6.60	7.86
5	0.28	0.42	0.52	0.70	0.86	0.94	1.05	1.27	1.74	2.18	2.61	3.14	3.82	4.41	5.65	6.89	8.32	9.95
10	0.34	0.52	0.65	0.87	1.08	1.16	1.27	1.49	2.02	2.54	3.05	3.68	4.48	5.19	6.56	7.95	9.68	11.58
25	0.46	0.69	0.86	1.16	1.43	1.50	1.60	1.81	2.41	3.04	3.66	4.43	5.40	6.29	7.79	9.36	11.52	13.80
50	0.56	0.85	1.05	1.41	1.75	1.82	1.89	2.08	2.72	3.43	4.14	5.04	6.13	7.16	8.74	10.44	12.96	15.53
100	0.68	1.03	1.28	1.72	2.13	2.21	2.28	2.39	3.04	3.84	4.66	5.68	6.90	8.09	9.72	11.52	14.44	17.31
200	0.82	1.25	1.55	2.08	2.58	2.67	2.75	2.84	3.40	4.26	5.20	6.36	7.70	9.06	10.71	12.61	15.96	19.15
500	1.05	1.60	1.98	2.67	3.30	3.42	3.50	3.59	3.93	4.85	5.94	7.30	8.81	10.43	12.07	14.05	18.05	21.65
1000	1.27	1.93	2.39	3.22	3.98	4.12	4.19	4.28	4.65	5.31	6.54	8.06	9.69	11.52	13.12	15.15	19.68	23.61

Table 2 – NOAA Rainfall Data for the Robinson Creek location.

The rainfall depth for the Robinson Creek location for a 10-year six hour storm is 1.49 inches. This rainfall depth is spread out in HEC-1 over a six hour period using a standard SCS temporal distribution typical for design of hydraulic structures.

The information computed from the digital data and the Watershed Modeling System (WMS) was used to develop the parameters for an HEC-1 model as summarized in Table 2.

Table 3 – Parameter Summaries for HEC-1 Model

Basin	Area	Precip	CN	Lag Time

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	(sq. miles)	(inches)		(hrs)
RCreek	3.55	1.49	73	.95
RCTrib	.09	1.49	73	.42

HEC-1 is a computer program developed by the US Army Corps of Engineers to develop rainfall runoff peak flows and hydrographs. The data summarized in Table 2 was formatted by WMS into an input file as shown in Table 3.

Table 4 – HEC-1 Input File

```
IDHEC-1 Analysis using WMS
ID
ID
*DIAGRAM
IT     7 01JAN94        0     200
IO     0
KKRCreek
KO     0        0     0.0        0       22
BA3.5506
PB 2.348
IN     7 01JAN94        0
* SCS-StdEmergencySpillway
PC   0.0   0.008  0.0162  0.0246  0.0333  0.0425  0.0524   0.063  0.0743  0.0863
PC 0.099  0.1124  0.1265   0.142  0.1595    0.18   0.205   0.255   0.345   0.437
PC  0.53   0.603   0.633    0.66   0.684   0.705   0.724   0.742   0.759   0.775
PC  0.79  0.8043   0.818  0.8312  0.8439  0.8561  0.8678   0.879  0.8898  0.9002
PC0.9103  0.9201  0.9297  0.9391  0.9483  0.9573  0.9661  0.9747  0.9832  0.9916
PC   1.0
LS   0.0   73.08     0.0
UD0.9461
KK    4R   CNAME      4C
KO     C       0     0.0        0       22
RN    4R
KKRCTrib
KO     0        0     0.0        0       22
BA0.0935
PB 2.274
IN     7 01JAN94        0
* SCS-StdEmergencySpillway
PC   0.0   0.008  0.0162  0.0246  0.0333  0.0425  0.0524   0.063  0.0743  0.0863
PC 0.099  0.1124  0.1265   0.142  0.1595    0.18   0.205   0.255   0.345   0.437
PC  0.53   0.603   0.633    0.66   0.684   0.705   0.724   0.742   0.759   0.775
PC  0.79  0.8043   0.818  0.8312  0.8439  0.8561  0.8678   0.879  0.8898  0.9002
PC0.9103  0.9201  0.9297  0.9391  0.9483  0.9573  0.9661  0.9747  0.9832  0.9916
PC   1.0
LS   0.0    73.0     0.0
UD0.4207
KK    3R   CNAME      3C
KO     C       0     0.0        0       22
RN    3R
ZZ
```

The results of the HEC-1 model determined the peak flow for RCreek to be 81.22 cfs (see Figure 4) and for RCTrib the peak flow was computed to be 2.25 cfs (see Figure 5). A value of 83.5 cfs will be used for the stabilization of the diversion ditch.

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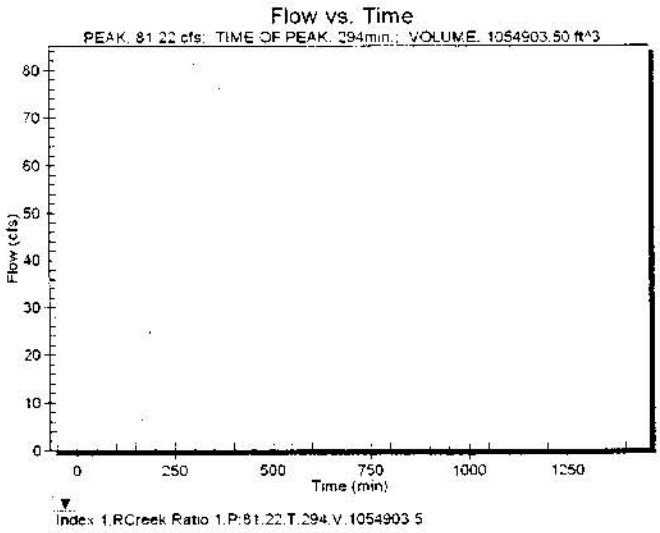

Figure 4 – Computed Runoff Hydrograph for RCreek

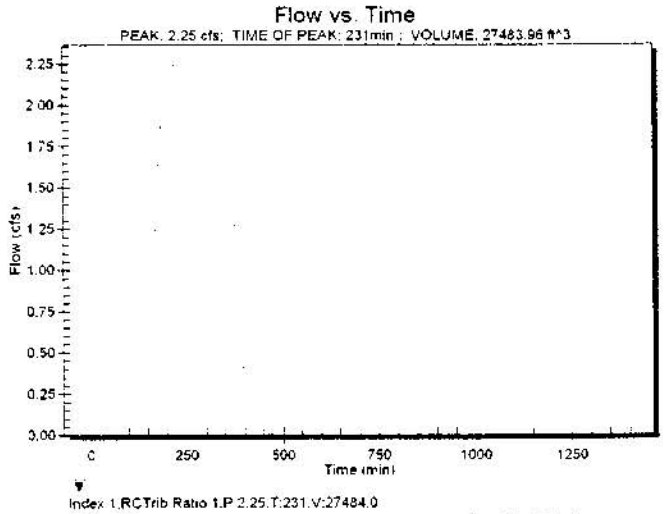

Figure 5 – Computed Runoff Hydrograph for RCTrib

Diversion Ditch Design

In performing the analysis against erosion for the diversion ditch I find the following to be the pertinent issues that need to be considered:

1. I'm assuming the size will remain the same (larger than needed for the 10-year flow) but that we will look at protection against the 10 year flow.
2. Are the in situ soils capable of withstanding the shear stresses induced by the flows corresponding to the 10-year flow.
3. What level of riprap, if any is needed in the channel to protect against bed shear stresses.
4. What level of riprap protection is required at the bends of the diversion ditch, including the point of diversion, the 90° turn in the middle of the diversion ditch and the point where the diversion ditch returns flows to the natural channel.

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In reviewing the channel design I am primarily following the guidelines of the Federal Highways Administration (FHWA) Hydrologic Engineering Circular No. 15 (HEC 15) entitled, "Design of Roadside Channels with Flexible Linings." I will paste the relevant tables where cited, but you can view the entire document at:

[redacted]

Hydraulic Properties and Calculations:

Based on the drawings provided and included with this report I determined the following properties:
Bottom width: 2 feet
Side Slopes: 3:1
Slope station 0+00 to station 11+00 10 feet in 350 or .0286
Slope station 11+00 to station 21+50 10 feet in 1000 or .01
Manning's rougness of .025 as determined for bare soil from Table 2.1 of HEC 15

Table 2.1. Typical Roughness Coefficients for Selected Linings

Lining Category	Lining Type	Manning's n[1]		
		Maximum	Typical	Minimum
Rigid	Concrete	0.015	0.013	0.011
	Grouted Riprap	0.040	0.030	0.028
	Stone Masonry	0.042	0.032	0.030
	Soil Cement	0.025	0.022	0.020
	Asphalt	0.018	0.016	0.016
Unlined	Bare Soil[2]	0.035	0.030	0.016
	Rock Cut (smooth, uniform)	0.045	0.035	0.025
RECP	Open-weave textile	0.028	0.025	0.022
	Erosion control blankets	0.045	0.035	0.028
	Turf reinforcement mat	0.038	0.030	0.024

[1]Based on data from Kouwen, et al. (1980); Cox, et al. (1970); McWhorter, et al. (1968); and Thibodeaux (1965).
[2]Minimum value accounts for grain roughness. Typical and maximum values incorporate varying degrees of form roughness.

Using these parameters and the design flow of 83.5 cfs the following channel hydraulic properties were computed for Stations 0+00 to 11+00

Flow 83.500 cfs
Depth 1.471 ft
Area of Flow 9.438 sq ft
Wetted Perimeter 11.306 ft
Average Velocity 8.847 fps
Top Width (T) 10.829 ft
Froude Number 1.670
Critical Depth 1.868 ft
Critical Velocity 5.880 fps
Critical Slope 0.00938
Critical Top Width 13.206 ft
Calculated Shear Stress 2.571 lb/ft^2
Permissible Shear Stress 4.000 lb/ft^2 (12-inch boulders)
Stability Factor 1.556

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For stations 11+00 to 21+50
Flow 83.500 cfs
Depth 1.842 ft
Area of Flow 13.863 sq ft
Wetted Perimeter 13.650 ft
Average Velocity 6.023 fps
Top Width (T) 13.052 ft
Froude Number 1.030
Critical Depth 1.867 ft
Critical Velocity 5.882 fps
Critical Slope 0.00939
Critical Top Width 13.204 ft
Calculated Shear Stress 1.149 lb/ft^2
Permissible Shear Stress 4.000 lb/ft^2 (12-inch boulders)
Stability Factor 3.480

Channel Sizing

The computed depths of 1.471 and 1.842 in the two segments indicate that the overall size of the channel is larger enough to convey the design flow.

Stability of In Situ Soils and Riprap Protection

The steep slopes along with the high flows creates a condition of super critical flow in both segments (average velocity is greater than critical velocity). However in the second segment where the slope is approximately .01 the velocity is only slightly greater than critical. The calculated shear stresses are still above stable limits for bare soils as identified in Table 2-3 of HEC 15. At the 10-year design flows the channel should be stable with a heavy riprap D_{50}=1.0 ft in order to protect the steeper sloped section and a D_{50}=.5 ft for the more shallow sloped segment (see Table 2-3 below).

Table 2.3. Typical Permissible Shear Stresses for Bare Soil and Stone Linings

Lining Category	Lining Type	Permissible Shear Stress N/m²	Permissible Shear Stress lb/ft²
Bare Soil[1] Cohesive (PI = 10)	Clayey sands	1.6-4.6	0.037-0.095
	Inorganic silts	1.1-4.0	0.027-0.11
	Silty sands	1.1-3.4	0.024-0.072
Bare Soil[1] Cohesive (PI ≥ 20)	Clayey sands	4.5	0.094
	Inorganic silts	4.0	0.083
	Silty sands	3.5	0.072
	Inorganic clays	6.6	0.14
Bare Soil[2] Non-cohesive (PI < 10)	Finer than coarse sand D_{75}<1.3 mm (0.05 in)	1.0	0.02
	Fine gravel D_{75}=7.6 mm (0.3 in)	5.6	0.12
	Gravel D_{75}=15 mm (0.6 in)	11	0.24
Gravel Mulch[3]	Coarse gravel D_{50} = 25 mm (1 in)	19	0.4
	Very coarse gravel D_{50} = 50 mm (2 in)	38	0.8
Rock Riprap[3]	D_{50} = 0.15 m (0.5 ft)	115	2.4
	D_{50} = 0.30 m (1.0 ft)	227	4.8

[1]Based on Equation 4.6 assuming a soil void ratio of 0.5 (USDA, 1987).
[2]Based on Equation 4.5 derived from USDA (1987).
[3]Based on Equation 6.7 with Shield's parameter equal to 0.047

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Protecting Bends in the Channel

The three right angle turns in the diversion channel create additional locations of concern. According to the HEC 15 manual the shear stress on the sides of a channel is a function of the calculated bottom shear stress times a coefficient determined from the radius of curvature to top width. I estimated the radius of curvature of the middle bend to be approximately 150 feet. R_c/T for both segments is approximately equal to 7. From equation 3.7 in HEC 15 the coefficient for the bend (K_b) would be 1.3.

$$K_b = 2.00 \qquad R_C/T \le 2$$

$$K_b = 2.38 - 0.206\left(\frac{R_c}{T}\right) + 0.0073\left(\frac{R_c}{T}\right)^2 \qquad 2 < R_C/T < 10 \qquad (3.7)$$

$$K_b = 1.05 \qquad 10 \le R_C/T$$

where,

R_c = radius of curvature of the bend to the channel centerline, m (ft)

T = channel top (water surface) width, m (ft)

With the computed shear stress of 2.57 lb/ft^2 in the section containing this bend the resulting shear stress on the sides of the channel would be on the order of 3.34 lb/ft^2. 12-inch boulder riprap would still be sufficient to protect the bend.

The beginning and ending points of the diversion channel make almost right angle turns with very small radii of curvature increasing the K_b factor to 2.0 and associated shear stresses would be slightly higher than 5 lb/ft^2 at the point of diversion where the slope is steeper and 2.3 lb/ft^2 along the shallower slope where the diversion channel returns to the natural stream alignment. The 12-inch boulders would not be sufficient at the point of diversion where the slope is steeper. The 6-inch boulders would be sufficient in the lower shallower slope segment where the diversion ditch returns flow to the natural channel, but 12-inch boulders should be adequate.

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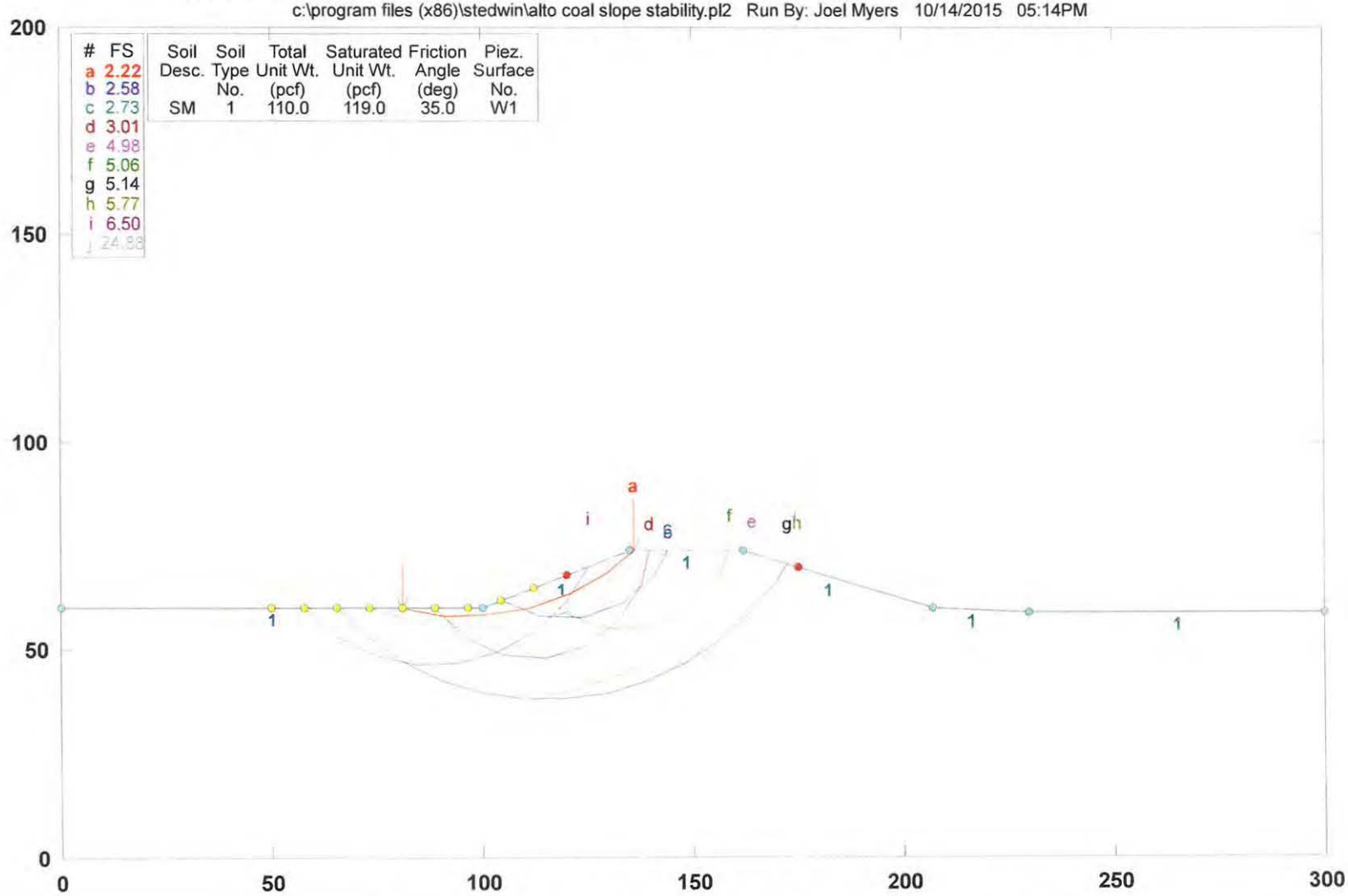
Appendix C

Alton Coal Mine - North Area Stock Pile Static Analysis - Satrurated - Alluvium

c:\program files (x86)\stedwin\alto coal slope stability.pl2 Run By: Joel Myers 10/14/2015 05:14PM



STABL6H FSmin=2.22

Safety Factors Are Calculated By The Modified Janbu Method

** STABL6H **
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 10/14/2015
Time of Run: 05:14PM
Run By: Joel Myers
Input Data Filename: C:alto coal slope stability.in
Output Filename: C:alto coal slope stability.OUT
Plotted Output Filename: C:alto coal slope stability.PLT
PROBLEM DESCRIPTION Alton Coal Mine - North Area Stock Pile
Static Analysis - Satrurated - Alluvium

BOUNDARY COORDINATES
6 Top Boundaries
6 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	60.00	100.00	60.00	1
2	100.00	60.00	135.00	74.00	1
3	135.00	74.00	162.00	74.00	1
4	162.00	74.00	207.00	60.00	1
5	207.00	60.00	230.00	59.00	1
6	230.00	59.00	300.00	59.00	1

ISOTROPIC SOIL PARAMETERS
1 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	110.0	119.0	0.0	35.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 112.30
Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	168.25	71.50
2	300.00	71.50

WATER SURFACE DATA HAS BEEN SUPPRESSED
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
10 Trial Surfaces Have Been Generated.
1 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = 50.00 ft.
and X = 120.00 ft.
Each Surface Terminates Between X = 120.00 ft.
and X = 175.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Janbu Method * *
Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	81.11	60.00
2	90.97	58.31
3	100.97	58.32
4	110.82	60.06
5	120.22	63.45
6	128.91	68.41
7	135.67	74.00

*** 2.224 ***
Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	104.44	61.78
2	113.71	58.02
3	123.71	57.83
4	133.11	61.24
5	140.67	67.78
6	143.99	74.00
***	2.576	***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	73.33	60.00
2	82.85	56.91
3	92.72	55.32
4	102.72	55.24
5	112.61	56.70
6	122.17	59.65
7	131.16	64.02
8	139.38	69.71
9	143.90	74.00
***	2.730	***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	88.89	60.00
2	95.96	52.93
3	105.07	48.81
4	115.05	48.17
5	124.61	51.09
6	132.53	57.20
7	137.78	65.71
8	139.39	74.00
***	3.008	***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	60.00
2	57.33	53.19
3	65.53	47.48
4	74.46	42.97
5	83.93	39.76
6	93.76	37.90
7	103.75	37.44
8	113.70	38.38
9	123.43	40.70
10	132.73	44.36
11	141.43	49.29
12	149.36	55.39
13	156.35	62.54
14	162.28	70.60
15	163.80	73.44
***	4.977	***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	112.22	64.89
2	119.86	58.44
3	129.33	55.22
4	139.32	55.67
5	148.46	59.74
6	155.48	66.86
7	158.55	74.00
***	5.057	***

Failure Surface Specified By 14 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	65.56	60.00
2	72.80	53.10
3	80.98	47.36
4	89.93	42.90
5	99.45	39.83
6	109.32	38.20
7	119.32	38.07
8	129.22	39.43
9	138.82	42.25
10	147.88	46.47
11	156.22	52.00
12	163.64	58.70
13	169.98	66.44
14	172.53	70.72
***	5.140 ***	

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	96.67	60.00
2	104.01	53.22
3	112.62	48.12
4	122.10	44.93
5	132.03	43.80
6	141.98	44.78
7	151.51	47.81
8	160.20	52.77
9	167.65	59.44
10	173.54	67.52
11	174.67	70.06
***	5.773 ***	

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.78	60.00
2	65.31	53.42
3	74.22	48.88
4	83.97	46.64
5	93.96	46.85
6	103.61	49.48
7	112.32	54.39
8	119.58	61.27
9	124.94	69.71
10	125.04	70.02
***	6.497 ***	

Failure Surface Specified By 8 Coordinate Points

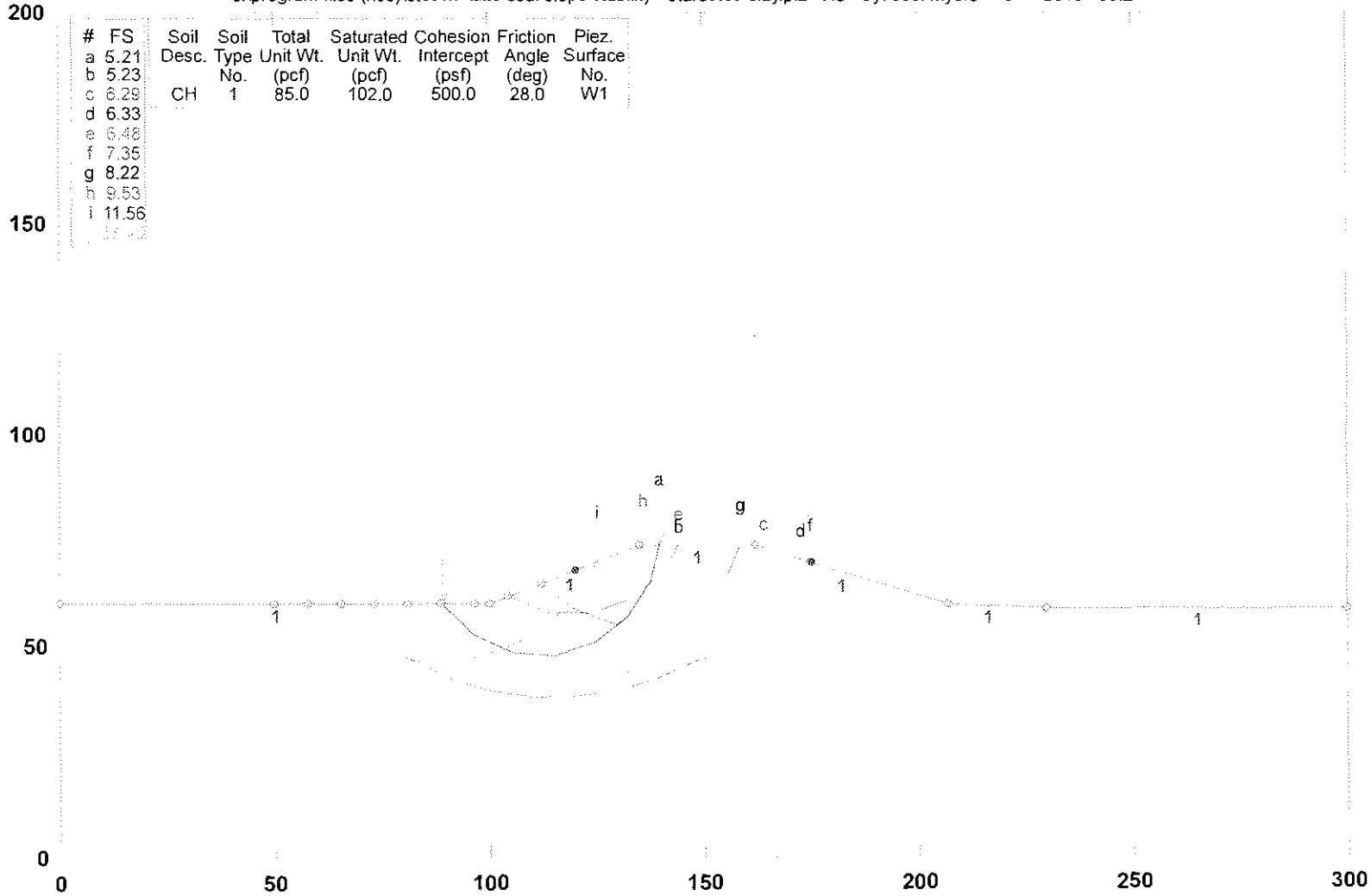
Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	68.00
2	127.89	61.85
3	137.14	58.06
4	147.08	56.91
5	156.95	58.48
6	166.04	62.65
7	173.66	69.12
8	174.36	70.16
***	24.878 ***	

Alton Coal Mine - North Area Stock Pile Static Analysis - Satrurated - Clay

c:\program files (x86)\stedwin\alto coal slope stability - staruated clay.pl2 Run By: Joel Myers 10/14/2015 05:20PM

#	FS
a	5.21
b	5.23
c	6.29
d	6.33
e	6.48
f	7.35
g	8.22
h	9.53
i	11.56

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
CH	1	85.0	102.0	500.0	28.0	W1



STABL6H FSmin=5.21

Safety Factors Are Calculated By The Modified Janbu Method

**** STABL6H ****
by
Purdue University
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 10/14/2015
Time of Run: 05:20PM
Run By: Joel Myers
Input Data Filename: C:alto coal slope stability - staruated Clay.in
Output Filename: C:alto coal slope stability - staruated Clay.OUT
Plotted Output Filename: C:alto coal slope stability - staruated Clay.PLT
PROBLEM DESCRIPTION Alton Coal Mine - North Area Stock Pile
Static Analysis - Satrurated - Clay

BOUNDARY COORDINATES
6 Top Boundaries
6 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	60.00	100.00	60.00	1
2	100.00	60.00	135.00	74.00	1
3	135.00	74.00	162.00	74.00	1
4	162.00	74.00	207.00	60.00	1
5	207.00	60.00	230.00	59.00	1
6	230.00	59.00	300.00	59.00	1

ISOTROPIC SOIL PARAMETERS
1 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	85.0	102.0	500.0	28.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 112.30
Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	168.25	71.50
2	300.00	71.50

WATER SURFACE DATA HAS BEEN SUPPRESSED
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
10 Trial Surfaces Have Been Generated.
1 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = 50.00 ft.
and X = 120.00 ft.
Each Surface Terminates Between X = 120.00 ft.
and X = 175.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00 ft.
10.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Janbu Method * *
Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	88.89	60.00
2	95.96	52.93
3	105.07	48.81
4	115.05	48.17
5	124.61	51.09
6	132.53	57.20
7	137.78	65.71
8	139.39	74.00

*** 5.214 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	104.44	61.78
2	113.71	58.02
3	123.71	57.83
4	133.11	61.24
5	140.67	67.78
6	143.99	74.00
***	5.226	***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	50.00	60.00
2	57.33	53.19
3	65.53	47.48
4	74.46	42.97
5	83.93	39.76
6	93.76	37.90
7	103.75	37.44
8	113.70	38.38
9	123.43	40.70
10	132.73	44.36
11	141.43	49.29
12	149.36	55.39
13	156.35	62.54
14	162.28	70.60
15	163.80	73.44
***	6.287	***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	65.56	60.00
2	72.80	53.10
3	80.98	47.36
4	89.93	42.90
5	99.45	39.83
6	109.32	38.20
7	119.32	38.07
8	129.22	39.43
9	138.82	42.25
10	147.88	46.47
11	156.22	52.00
12	163.64	58.70
13	169.98	66.44
14	172.53	70.72
***	6.334	***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	73.33	60.00
2	82.85	56.91
3	92.72	55.32
4	102.72	55.24
5	112.61	56.70
6	122.17	59.65
7	131.16	64.02
8	139.38	69.71
9	143.90	74.00
***	6.480	***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	96.67	60.00
2	104.01	53.22
3	112.62	48.12

4	122.10	44.93
5	132.03	43.80
6	141.98	44.78
7	151.51	47.81
8	160.20	52.77
9	167.65	59.44
10	173.54	67.52
11	174.67	70.06
***	7.347 ***	

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	112.22	64.89
2	119.86	58.44
3	129.33	55.22
4	139.32	55.67
5	148.46	59.74
6	155.48	66.86
7	158.55	74.00
***	8.221 ***	

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	81.11	60.00
2	90.97	58.31
3	100.97	58.32
4	110.82	60.06
5	120.22	63.45
6	128.91	68.41
7	135.67	74.00
***	9.530 ***	

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.78	60.00
2	65.31	53.42
3	74.22	48.88
4	83.97	46.64
5	93.96	46.85
6	103.61	49.48
7	112.32	54.39
8	119.58	61.27
9	124.94	69.71
10	125.04	70.02
***	11.558 ***	

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	68.00
2	127.89	61.85
3	137.14	58.06
4	147.08	56.91
5	156.95	58.48
6	166.04	62.65
7	173.66	69.12
8	174.36	70.16
***	38.396 ***	

APPENDIX 5-12

HYDROLOGY AND RUNOFF CONTROL

NORTH LEASE AREA

COAL HOLLOW MINE

OCTOBER 2015

Hydrology and Runoff Control

For the

North Lease Area

Coal Hollow Mine

General

This appendix will analyze the watershed characteristics of the North Lease Area of the Coal Hollow Mine and provide sizing and design criteria for adequate runoff and sediment control.

Method

The watersheds for the Undisturbed, Disturbed and Alternate Sediment Control Areas are shown on Drawing 5-65. Watershed areas, hydraulic lengths and elevations were measured directly from this map. Calculations to determine flow characteristics and volumes were performed using the Office of Surface Mining "Storm Program 6.20", by Gary E. McIntosh. This program is based on the SCS TR-55 Method of Peak Flow Determination.

Parameters

The following are the categories analyzed in this appendix, along with the parameters used:

Rainfall – Designs are based on rainfall amounts taken directly from the NOAA Atlas 14, Vol. 1, Version 5, "Point Precipitation Frequency, Alton, Utah". Rainfall amounts used herein are:

2 year – 6 hour precipitation event - 0.96"

10 year - 6 hour precipitation event - 1.41"

25 year - 6 hour precipitation event - 1.72"

10 year - 24 hour precipitation event - 2.39"

Watersheds – Watershed areas, lengths and elevations were measured directly from Drawing 5-65. All undisturbed areas were assigned a runoff curve number (CN) of 63,

mining areas to be reclaimed are assigned a CN of 75, and all remaining disturbed areas have a runoff curve number of 89, as used in the existing approved plan.

Runoff Curve Numbers – As indicated above, 3 separate runoff curve numbers have been used in these calculations. The undisturbed CN of 63 is the same as previously used and approved for the minesite. The CN of 89 is also the same as previously approved, and is applied to those areas that will likely remain disturbed throughout the project. The intermediate runoff curve number of 75 has been used for all other areas to be mined and sequentially reclaimed per the approved mine plan. This number is considered conservative compared to the original approved plan, and is based on the following:

- Surface mining areas will be reclaimed and revegetated within specified approved time frames, which will minimize the area that will be disturbed at any one time;
- Runoff from the active mining area is typically controlled within the pit area, greatly reducing the actual amount reporting to the ponds during an event;
- Only areas which are necessary to the operation or active mining are disturbed. All other areas draining to the ponds are left undisturbed, with a much lower runoff potential, until pit construction is necessary;
- Past experience on the property has shown that revegetation of reclaimed sites has good success in one to two growing seasons, also reducing runoff and sediment loading to the ponds.

Sediment Ponds – Sediment Pond designs are based on regulatory requirements of containment for runoff from a 10 year/24 hour precipitation event of 2.39", plus 3 years of calculated runoff sediment storage. Pond outlets are sized to carry at least the peak flow from a 25 year/6 hour event.

Diversions – All diversions are conservatively sized to control runoff from a 10 year-6 hour event of 1.41". All diversions on the site are considered temporary and will be removed upon completion of operations. Haul road ditch calculations and sizing are also included with the diversion calculations.

Culverts – There are 4 culverts planned for the North Lease Area, along the Southern Haul Road as shown on Drawing 5-47 and 5-60. The culvert C-1 to the west is sized for runoff from a 10 year – 24 hour event of 2.39", since it will be carrying runoff directly to Sediment Pond 6. The culvert designated C-2 will replace the existing county road culvert, and is sized to carry runoff from the undisturbed area above for a 100-year/24-hour event of 3.1". Details on this culvert design are shown on Appendix 5-13. The larger culvert at the Kanab Creek Crossing is to be determined and approved by the U.S. Army Corps of Engineers. Culvert C-4 will be installed prior to construction of the North Haul Road.

ASCA's – There is one ASCA (Alternate Sediment Control Area) proposed for this site. The runoff for this area is based on the 10 year-24 hour event of 2.39". Runoff from the ASCA will be treated by filtering with straw bales and/or silt fences prior to discharge.

General Notes

The west side of the property will be the first to be mined. The first items to be constructed will be culvert C-2 and ASCA-1. The Southern Haul Road will be extended to the west and Sediment Ponds 5 and 6 and contributing ditches will be constructed. Mining, backfilling and reclamation will take place sequentially, and as a result, not all areas shown as disturbed will be disturbed at any given time. As pits are mined out, they will be backfilled and reclaimed in accordance with the approved mine plan. It should be noted that the following tables and calculations in this appendix are based on "worst-case" conditions of entire contributing watersheds draining to ponds, ditches and/or culverts, even though the area will likely be in various stages of disturbance or reclamation at any given time. The east side of the property will not be disturbed until later in the mining cycle, after which time the proposed diversions and sediment ponds will be constructed.

Watersheds

Watershed parameters are summarized on Table 1. Peak flows and volumes are shown on Table 2.

Table 1

Watershed Characteristics

Watershed	Area (ac.)	Hyd. Length (ft.)	Elev. Chg. (ft.)	CN
UA-l	12.6	600	30	63
UA-2	92.1	3250	300	63
UA-3	13.9	2000	200	63
UA-4	254.9	6600	348	63
DA-1	82.3	3250	56	75
DA-2	25.2	3125	56	75
DA-3	28.4	1500	46	75
DA-4	23.6	1250	128	75
DA-5	11.6	1025	40	75
DA-6	24.0	1300	44	75
DA-7	18.8	1250	56	75
DA-8	2.2	700	48	89
ASCA-1	3.1	600	40	89
*SHR	0.6	600	30	89
**NHR	1.4	1500	44	89

* Southern Haul Road – Maximum flow section for road ditch sizing only.

**Northern Haul Road – Maximum flow section for road ditch sizing only.

Table 2

Runoff Calculations

Watershed	Flow (cfs) 10/6	25/6	10/24	Volume (ac. ft.) 10/24	Flows To:
UA-1	0.10	0.27	1.29	0.22	SP-7
UA-2	0.59	1.81	5.04	1.60	UD-18 / UD-19
UA-3	0.10	0.29	1.03	0.24	UD-15
UA-4	1.09	3.95	9.30	4.43	UD-14
DA-1	3.32	6.37	23.75	4.03	DD-13 / SP-7
DA-2	1.03	1.98	7.51	1.23	SP-7
DA-3	1.28	3.42	12.93	1.39	DD-17 / SP-8
DA-4	1.12	3.60	13.46	1.16	DD-16 / SP-9
DA-5	0.51	1.49	5.98	0.57	DD-11 / SP-7
DA-6	1.06	2.85	11.43	1.17	SP-6
DA-7	0.80	2.23	9.17	0.92	2/3 DD-5/1/3 DD-6/SP-5
DA-8	1.15	1.64	2.95	0.25	DD-12/SP-7
ASCA-1	1.60	2.28	4.11	0.35	1/2 DD-9/1/2 DD-10/C-2
SHR	0.29	-	-	-	Road Ditch
NHR	0.49	-	-	-	Road Ditch

Notes:

SP = Sediment Pond

SHR = Southern Haul Road

NHR = Northern Haul Road

Sediment Ponds

There are 5 proposed sediment control ponds on this site. Sediment Ponds 5, 6 and 7 will contain the designated runoff from the west side of the property. Any discharge from this pond will go to the existing channels in accordance with the approved UPDES Permits. Sediment Pond 8 will contain runoff from the northeast side of the property. Overflow from this sediment pond will flow to Sediment Pond 9, which will also contain runoff from the southeast portion of the site. Any discharge from this pond will also flow to the main channel under an approved UPDES Permit.

All sediment ponds are sized to contain the runoff from a 10 year-24 hour precipitation event of 2.39", plus at least 3 years of calculated sediment storage. Each pond will also be equipped with a primary pipe spillway with oil skimmer and an open-channel emergency spillway, capable of passing the flow from a 25 year-6 hour event of 1.72", as required.

All sediment pond inlets and open-channel emergency spillways will be protected with adequately sized rip-rap placed over erosion control fabric. Sizes are shown on Table 3.

Sediment markers will be installed in each pond, showing the 60% cleanout and maximum sediment levels. All ponds are oversized and will be maintained to provide storage capacity for the required 10 year – 24 hour precipitation event, as required.

Sediment pond requirements and sizing is summarized on Table 3. Pond details and designs are shown on Drawings 5-67, 5-68, 5-69, 5-70 and 5-71.

Table 3

Sediment Pond Sizing

Sediment Pond No.	5	6	7	8	9
10yr/24hr Runoff (ac. ft.)	0.92	1.17	6.05	1.39	1.16
+ 3 Yrs. Sediment (ac. ft.)	0.36	0.26	1.06	0.27	1.57
Required Capacity (ac. ft.)	1.28	1.43	7.11	1.66	2.73
Proposed Capacity (ac. ft.)	1.56	3.14	19.26	7.47	3.41
25yr/6hr Peak Flow (cfs)	2.23	2.85	10.11	3.42	3.60
Principle Spillway Pipe	18”	18”	24”	18”	18”
Emergency Spillway Bottom	3’	3’	4’	3’	3’
Velocity (fps)	5.66	6.18	8.93	6.60	6.72
Depth of Flow (ft)	0.12	0.14	0.25	0.16	0.16
Rip-Rap (D50)	6”	6”	9”	6”	6”

Note: Emergency Spillways are based on 3H:1V slope with 2H:1V side slopes.

All rip-rap is underlain with erosion control fabric.

Diversions

All diversions (ditches) are sized to carry the runoff from a 10 year-6 hour precipitation event of 1.41". Diversions are considered temporary and will be removed when no longer required. Undisturbed area diversions are designated by a UD-n label and disturbed area ditches are designated by a DD-n label, as shown on Drawing 5-65.

Estimated flows to the diversions are taken from Table 2, "Runoff Calculations". Average slopes were taken from Drawings 5-72 and 5-73. All ditches are assumed to be constructed in a triangular shape with 2H:1V side slopes, unless otherwise noted; however, actual bottom width and slopes may vary as long as the required cross-sectional area is maintained. Minimum ditch depth and area is determined by the peak flow depth plus a minimum of 6" of freeboard. Proposed ditch depth is based on the expected maximum flow depth plus freeboard, increased to the nearest 1/2 foot. All ditches are assumed to have a Manning's No. (n) of 0.025 for unlined channels.

Haul road ditches are also included with the diversions. The calculations for the haul road runoff are based on the maximum expected flow from a 10 year – 6 hour storm routed through the maximum slope section of the road.

Outlets of all undisturbed diversion ditches will be protected from erosion by placing 6" D-50 rip-rap over erosion control fabric for a distance of at least 20' above the point of discharge. None of the disturbed area diversion ditches show erosive velocities above 5 fps; however, any ditches that exhibit excessive erosion will be repaired and those areas will be equipped with appropriate erosion protection. All sediment pond inlets and outlets will be rip-rapped for protection as shown on the sediment pond drawings 5-67, 5-68, 5-69, 5-70 and 5-71.

Table 4

Diversion Ditches

Diversion	Slope %	Flow cfs	Velocity fps	Flow Depth ft	Proposed Depth ft	Remarks
DD-5	5.21	0.60	3.50	0.29	1.00	2/3 DA-7
DD-6	6.22	0.20	2.85	0.19	1.00	1/3 DA-7
DD-7	4.84	0.28	2.82	0.22	1.00	1/4 DA-6
DD-8	5.16	0.28	2.89	0.22	1.00	1/4 DA-6
DD-9	8.42	0.80	4.51	0.30	1.00	1/2 ASCA-1
DD-10	2.67	0.80	2.93	0.37	1.00	1/2 ASCA-1
DD-11	6.07	0.51	3.56	0.27	1.00	DA-5
DD-12	7.00	1.15	4.61	0.35	1.00	DA-8
DD-13	2.04	3.32	3.78	0.66	1.50	DA-1
UD-14	1.28	1.09	2.40	0.48	1.00	UA-4
UD-15	7.35	0.10	2.55	0.14	1.00	UA-3
DD-16	2.15	4.54	4.17	0.74	1.50	DA-4+SP-8 Overflow
DD-17	2.12	1.28	3.02	0.46	1.00	DA-3
UD-18	12.06	0.20	3.65	0.17	1.00	1/3 UA-2
UD-19	1.99	0.59	2.43	0.35	1.00	UA-2
*SHR	5.00	0.29	3.04	0.31	1.00	Road Ditch
**NHR	2.93	0.49	2.84	0.42	1.00	Road Ditch

* Southern Haul Road – Maximum Road Ditch Flow

**Northern Haul Road – Maximum Road Ditch Flow

Culverts

There are 4 culverts proposed for this site, along the Southern Haul Road as shown on Drawing 5-47 and 5-60. Culvert C-1 to the west has been sized to carry the runoff from a 10- year/24 -hour precipitation event, since it is conveying runoff from the disturbed area directly to Sediment Pond 6.

The culvert designated C-2 is proposed to be a 36" cmp. It will be installed under the realigned county road and extended to the northeast beyond ASCA-1 and drainage area DA-8, where it will continue to carry runoff from the left fork and center drainage until Sediment Pond 7 is constructed. ASCA-1 will drain to culvert C-2 via a 12" culvert drop inlet protected by straw bales surrounding the inlet structure (see Appendix 5-13 for details). After Pond 7 is constructed, the primary and emergency spillways will flow to culvert C-2, along with runoff from ASCA-1. It should be noted that the sizing of culvert C-2 is based on a 100-year/24-hour precipitation event of 3.1" for the entire undisturbed drainage area, since it is passing beneath the county road.

The largest culvert (C-3) will provide a new Kanab Creek Crossing for the mining operation. It is to be located just north of the existing 172" culvert on the county road. The new culvert is also proposed to be 172" (14.33') in diameter; however, the final sizing and approval will be under the direction of the U.S. Army Corps of Engineers.

Culvert C-4 will be placed before construction of the North Haul Road. This culvert will be a 12" cmp and is sized to carry the runoff from a 10-yr. / 6-hr. storm, as required. It will carry the runoff from area DA-5 and will be placed in ditch DD-11 at the North Haul Road crossing.

Culvert sizing is based on the Haestad Methods, Flowmaster I, Version 3.43 Computer Program.

All culverts are considered temporary and will be removed upon final reclamation. The county road will be then be restored to its present location with the existing in-place culverts.

The following table will summarize the culvert sizing and requirements.

Table 5

Culverts

Culvert	Flow cfs	Velocity fps	Required Diam. Ft.	Proposed Diam. Ft.	Remarks
C-1	11.43	5.70	1.60	2.00	Flow from DA-6
C-2	35.14	9.20	2.21	3.00	See Appendix 5-13
C-3	TBD	TBD	TBD	14.33	Pending USACE Approval
C-4	0.51	3.97	0.40	1.00	Flow from DA-5

Notes:

1- Culvert C-1 is calculated with a 2.00% slope and a Manning's n of 0.020.

2- Culvert C-2 is calculated with a 3.39% slope and a Manning's n of 0.020.

3-Culvert C-3 sizing is to be determined by the U.S. Army Corps of Engineers. Final design to be submitted upon approval.

4-Culvert C-4 is calculated with a 6.07% slope and a Manning's n of 0.020.

ASCA's

There is one area in this proposed mining plan that will not drain to the sediment ponds due to topographic restrictions. It is therefore proposed to use alternate sediment control techniques to treat runoff from this area. The ASCA is on the south-central part of the property and is shown on Drawing 5-65. Runoff from this area is based on the 10 year-24 hour precipitation event of 2.39", and will be directed into various diversion ditches as shown on Drawing 5-65 and then into a catch basin and drop inlet structure protected by straw bales as shown in Appendix 5-13. The company will inspect the straw bales at least once per quarter and after every significant precipitation event (0.1" or larger). The bales will be replaced when sediment reaches a depth of one-half of the barrier height (approximately 14" for standard bales).

The Universal Soil Loss Equation (USLE) was used to estimate sediment yield from the ASCA, as well as all areas draining to sediment control structures. The results are shown in the next section entitled Sediment Yield.

The following Table 6 will summarize the ASCA characteristics and expected runoff amounts.

Table 6

Alternate Sediment Control Areas

ASCA	Area ac.	Runoff Volume ac. ft.	Peak Flow cfs	Diversion Ditch
ASCA-1	3.1	0.35	4.11	1/2 DD-9 / 1/2 DD-10

Note: All runoff is treated by filtering through straw bales and/or silt fences.

Sediment Yield

The Universal Soil Loss Equation (USLE) was used to estimate sediment yield from the all disturbed and undisturbed area draining to the sediment ponds and the Alternate Sediment Control Areas (ASCA's). All soil loss from these areas was assumed to be delivered to the respective sediment ponds or ASCA..

Erosion rate (A) in tons/acre/year is determined using the USLE as follows:

A = (R) (K) (LS) (CP) , where:

Variable R is the rainfall factor which can be estimated from R=27 times P to the 2.2 power, where P is the 2 year – 6 hour precipitation value. P for the Alton area is 0.96" ; therefore, the estimated value of R for this area is 24.68.

Variable K is the soil erodibility factor. For disturbed areas, the K value is conservatively estimated to be 0.5, and 0.35 for undisturbed areas.

Variable LS is the length-slope factor. This figure was determined by applying the slope length and percentage for each ASCA drainage area to the chart in Figure 5.15, p. 334, "Applied Hydrology and Sedimentology for Disturbed Areas", Barfield, Warner and Haan, 1983.

Variable CP is the control practice factor, which can be divided into a cover and a practice factor. For purposes of these calculations, the following CP values were used:

- Compacted Areas 1.20
- Mining / Reclaimed Areas 0.80
- Undisturbed Areas 0.38

The sediment volume is based on a density of 100 pounds per cubic foot of sediment.

The following Table is a summary of the sediment yield calculations.

Table 7

Sediment Yield Calculations

Drainage	R	K	Acres	Length	Slope (%)	LS	CP	*A	**Yield
ASCA-1	24.68	0.5	3.1	600’	6.7	1.90	1.20	28.14	0.040
UA-1	24.68	0.35	12.6	600’	5.0	1.30	0.38	4.27	0.025
DA-1	24.68	0.5	82.3	3250’	1.7	0.50	0.80	4.94	0.187
DA-2	24.68	0.5	25.2	3125’	1.8	0.52	0.80	5.13	0.059
DA-3	24.68	0.5	28.4	1500’	3.1	0.70	0.80	6.91	0.090
DA-4	24.68	0.5	23.6	1250’	10.2	4.90	0.80	48.37	0.524
DA-5	24.68	0.5	11.6	1025’	3.9	0.91	0.80	8.98	0.048
DA-6	24.68	0.5	24.0	1300’	3.4	0.80	0.80	7.90	0.087
DA-7	24.68	0.5	18.8	1250’	4.5	1.40	0.80	13.82	0.119
DA-8	24.68	0.5	2.2	700’	6.9	2.20	1.20	32.57	0.033

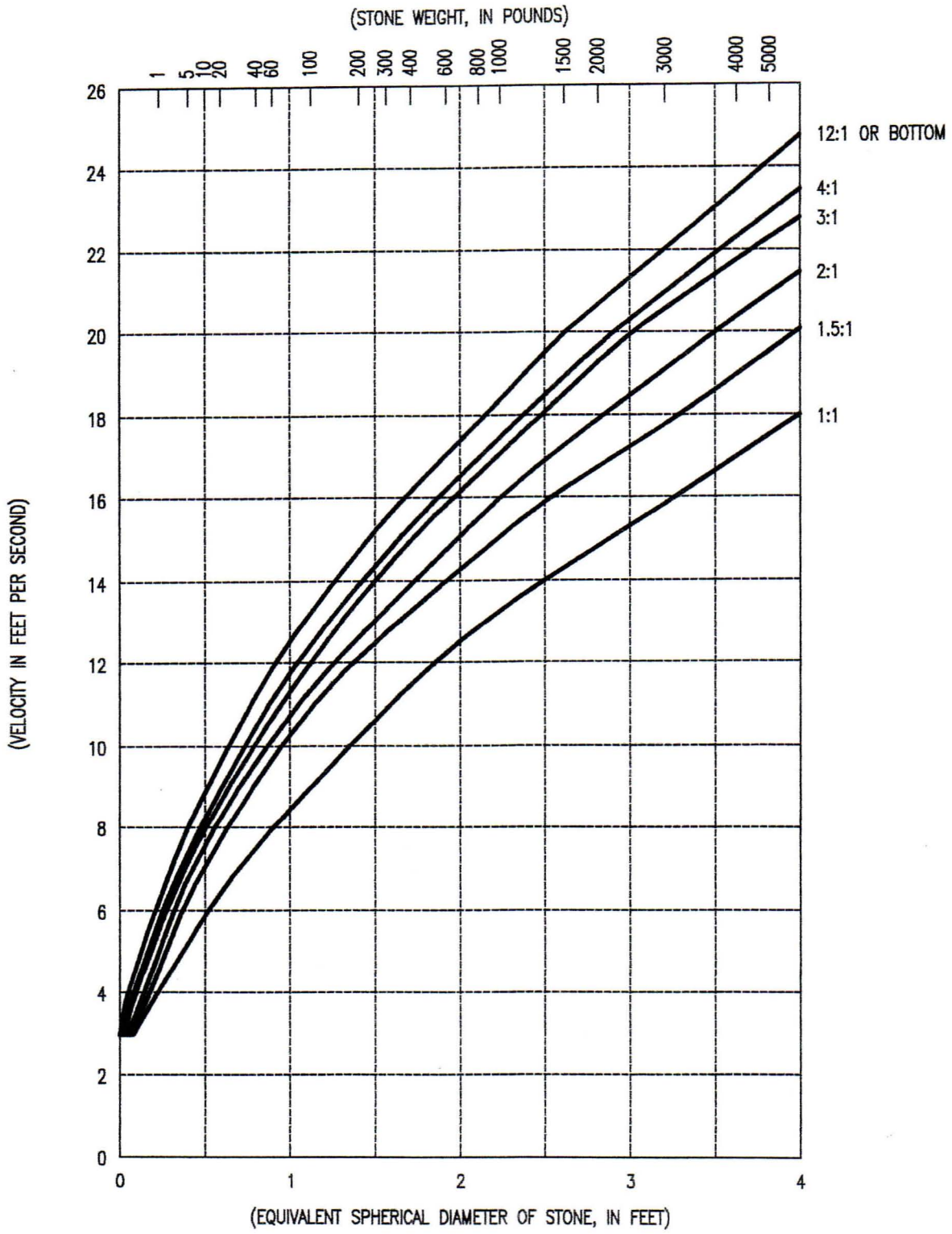
*A=Tons/Acre/Year

**Yield=Acre Ft./Year

Structure	Sediment (1 Year)	Sediment (3 Years)
	Acre Feet	Acre Feet
ASCA-1	0.040	0.120
Pond 5	0.119	0.357
Pond 6	0.087	0.261
Pond 7	0.352	1.056

Pond 8	0.090	0.270
Pond 9	0.524	1.572

RIP-RAP CHART



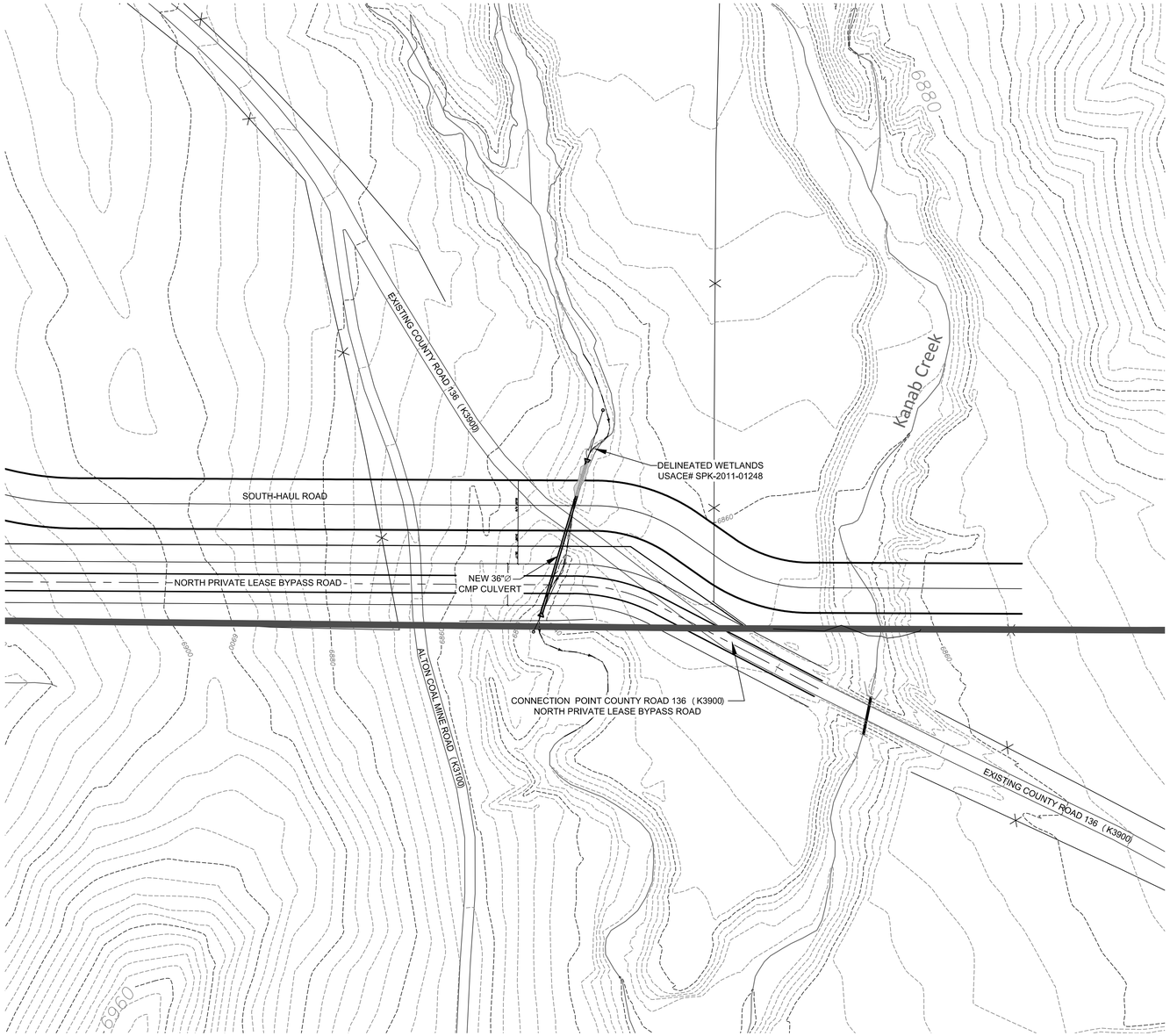
SIZE OF STONE THAT WILL RESIST DISPLACEMENT FOR VARIOUS VELOCITIES AND SIDE SLOPES

NOTE:

ADAPTED FROM REPORT OF SUBCOMMITTE ON SLOPE PROTECTION, AM. SOC. CIVIL ENGINEERS PROC. JUNE 1948.
FOR STONE WEIGHING 165 LBS. PER CUBIC FEET.

APPENDIX 5-13

Culvert Design for C1
North Private Lease



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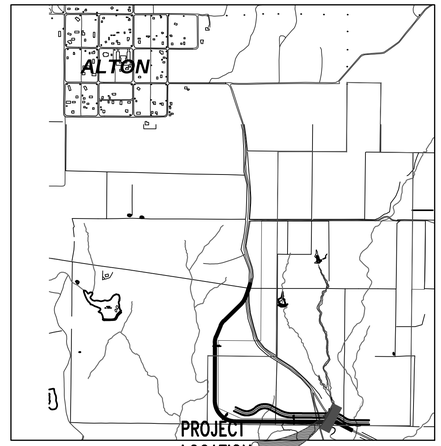
SCALE IN FEET



VICINITY MAP

(NO SCALE)

SHEET INDEX	
C-C1	COVER SHEET
C-P1	DRAINAGE AREA 1 PLAN & PROFILE
C-P2	DETAIL SHEET

ALTON COAL DEVELOPMENT LLC.
NORTH PRIVATE LEASE BYPASS ROAD AND SOUTH HAUL ROAD
CULVERT C-1

LOCATED IN SECTION 13, T 39 S, R 6 W, SLB&M
KANE COUNTY, UTAH
SEPTEMBER 2015

AVOID CUTTING UNDERGROUND UTILITIES. IT'S COSTLY.
Call BEFORE YOU Dig
1-800-662-4111
UNDERGROUND SERVICE (USA)

NOTICE!

THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE LOCATION, PROTECTION, AND RESTORATION OF ALL BURIED OR ABOVE GROUND UTILITIES, SHOWN OR NOT SHOWN ON THE PLANS.

NOTE: ALL WORK AND MATERIALS SHALL BE IN ACCORDANCE WITH CURRENT KANE COUNTY STANDARDS.

REVISIONS

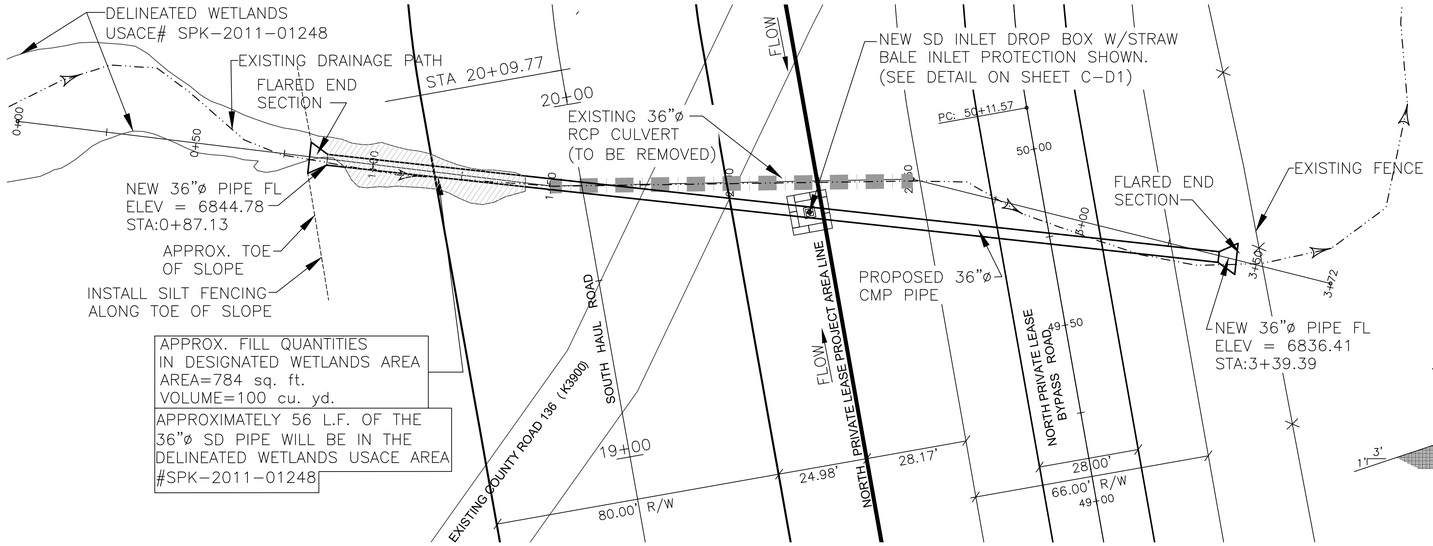
NO.	DESCRIPTION	DATE	BY
1	MOVED ROAD N&W PER A.C.	8/28/15	SWB

BROWN CONSULTING ENGINEERS, P.C.
CIVIL ENGINEERING-LAND SURVEYING-LAND PLANNING
484 WEST 1600 SOUTH, UNIT E-5
ST. GEORGE UTAH 84770
(435) 628-4700 FAX (435) 628-4725

COVER SHEET
FOR
NORTH PRIVATE LEASE BYPASS ROAD AND SOUTH HAUL ROAD
CULVERT C-1
LOCATED IN SEC. 13, T39S, R6W, SL.B. & M.
KANE COUNTY, UTAH

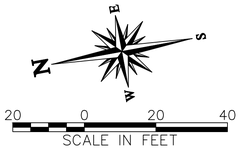
REGISTERED PROFESSIONAL ENGINEER
MARC BROWN
170223
9-18-15
STATE OF UTAH

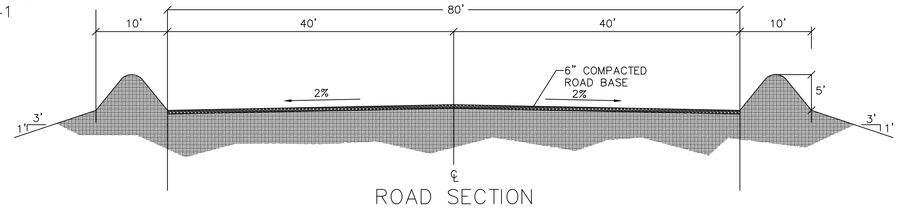
CHECKED BY : MLB
DRAWN BY : SWB
DATE : SEPTEMBER 1
JOB NO. : 15-47
SCALE : 1"=200'
SHEET NO. : C-C1



PLAN

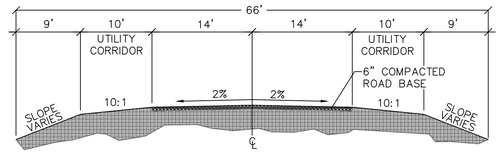
SCALE: 1"= 20'





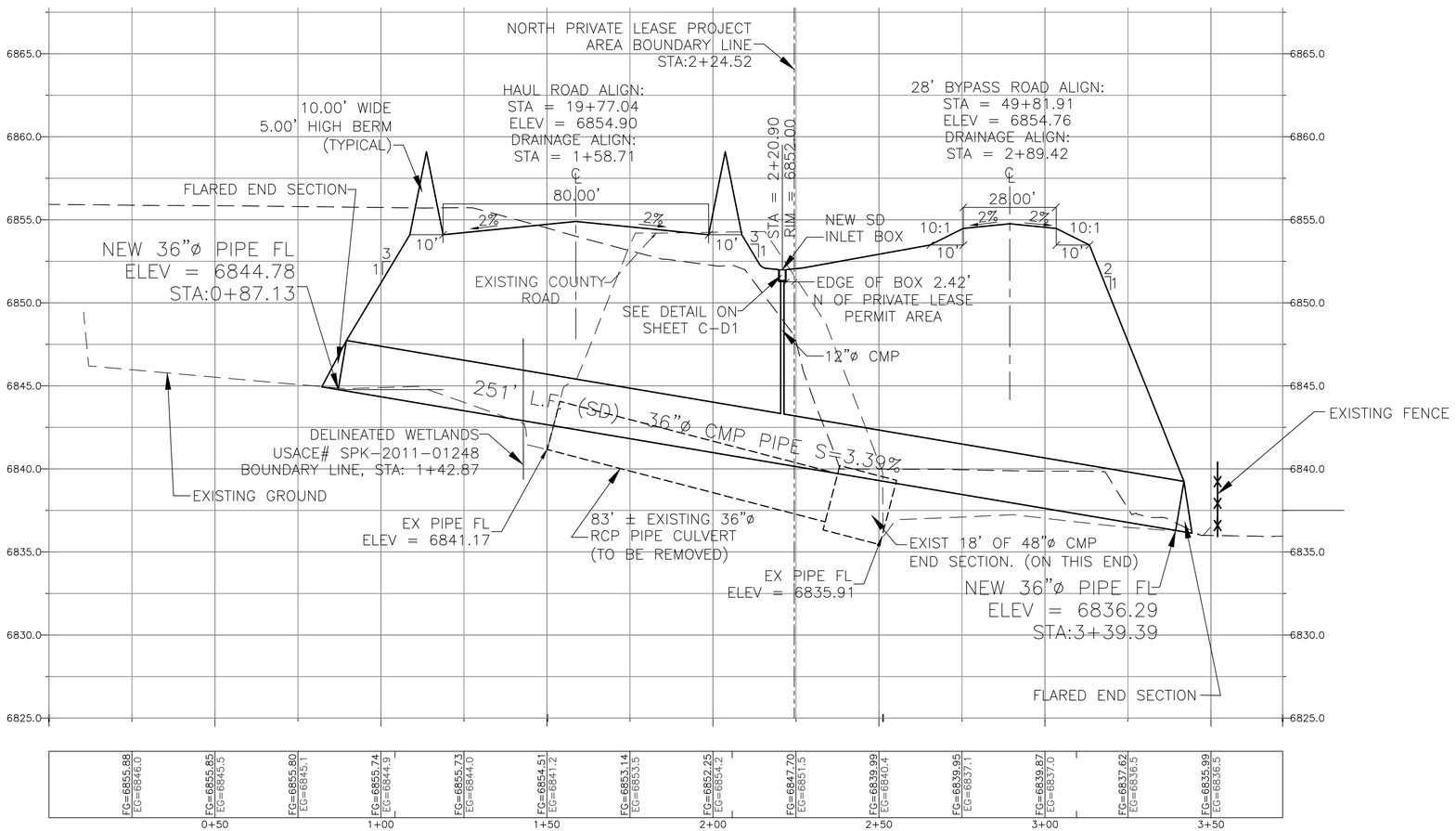
ROAD SECTION
80' HAUL

SCALE: 1"=10'



ROAD SECTION
66' RIGHT-OF-WAY FOR COUNTY ROAD

SCALE: 1"=10'



PROFILE

SCALE: HORZ. 1"= 20'
VERT. 1"= 5'

AVOID CUTTING UNDERGROUND UTILITIES. IT'S COSTLY.
Call BEFORE YOU Dig
1-800-662-4111
UNDERGROUND SERVICE (USA)

NOTICE!

THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE LOCATION, PROTECTION, AND RESTORATION OF ALL BURIED OR ABOVE GROUND UTILITIES, SHOWN OR NOT SHOWN ON THE PLANS.

NOTE: ALL WORK AND MATERIALS SHALL BE IN ACCORDANCE WITH CURRENT KANE COUNTY STANDARDS.

REVISIONS

NO.	DESCRIPTION	DATE	BY

BROWN CONSULTING ENGINEERS, P.C.
CIVIL ENGINEERING-LAND SURVEYING-LAND PLANNING
163 WEST 1600 SOUTH, UNIT 5
ST. GEORGE, UTAH 84770
(435) 628-4700 FAX (435) 628-4725

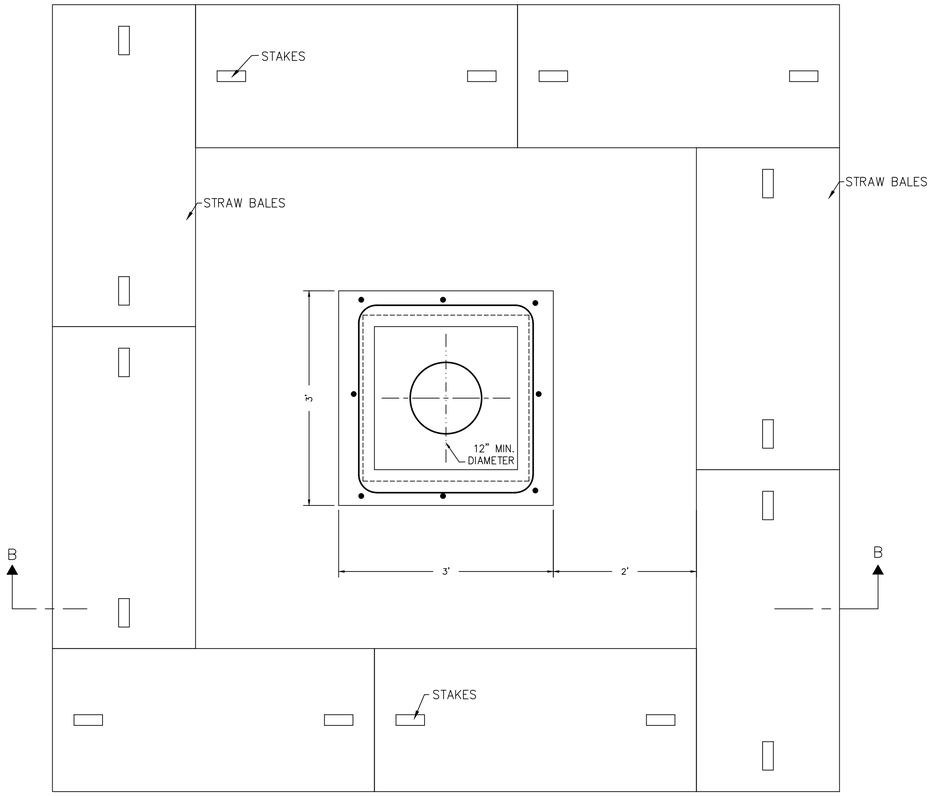
PLAN AND PROFILE
FOR
NORTH PRIVATE LEASE BYPASS ROAD AND SOUTH HAUL ROAD
CULVERT C-1
LOCATED IN SEC. 13, T39S, R6W, S.L.B. M.
KANE COUNTY, UTAH

REGISTERED PROFESSIONAL ENGINEER
MARC L. BROWN
10223
9-18-15
STATE OF UTAH

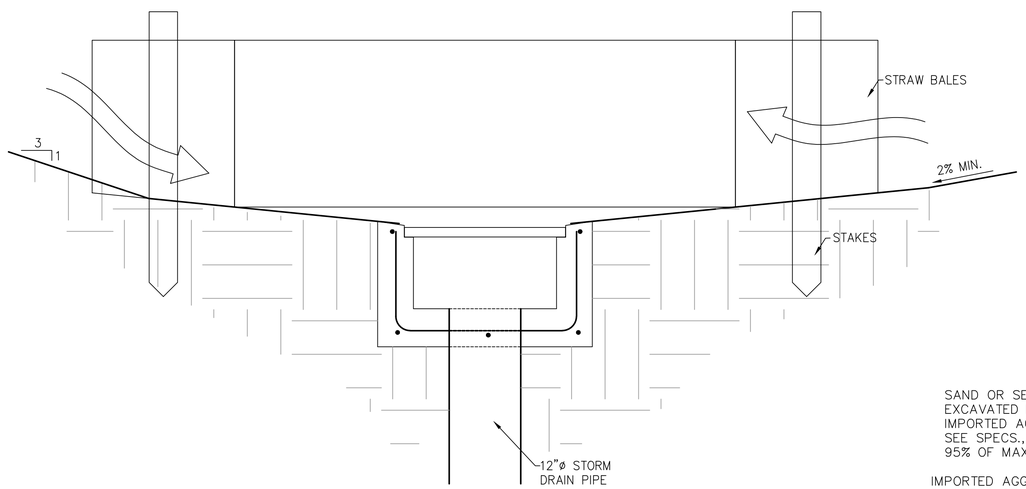
CHECKED BY : MLB
DRAWN BY : SWB
DATE : SEPTEMBER 2015
JOB NO. : 15-47

SCALE : 1"=20'

SHEET NO. : C-P1



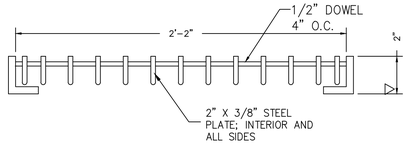
ELEVATION



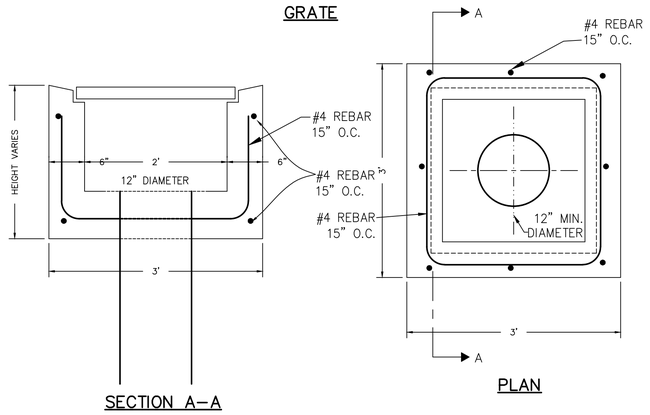
SECTION B–B

STRAW BALE DETAIL

NOT TO SCALE



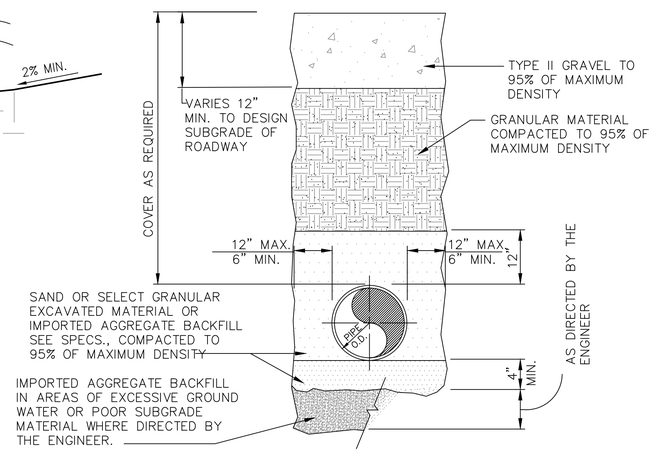
GRATE



SECTION A–A PLAN

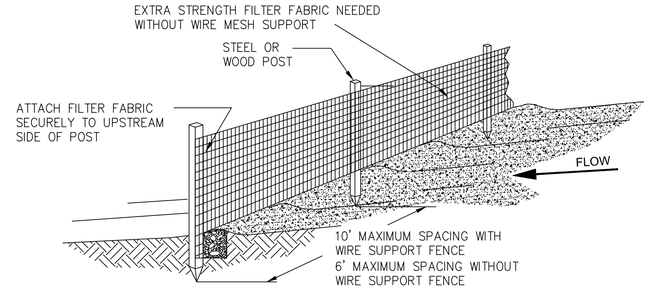
CATCH BASIN

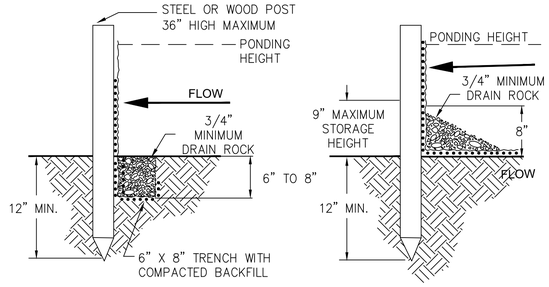
NOT TO SCALE



ROAD CULVERT BACKFILL DETAIL

NOT TO SCALE





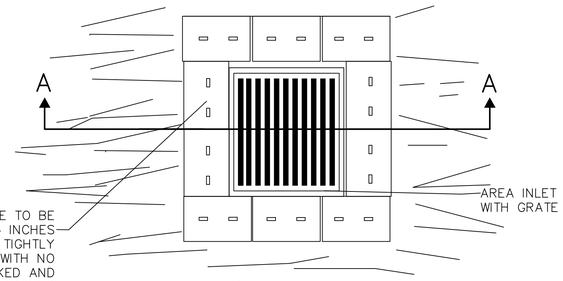
TRENCH DETAIL INSTALLATION WITHOUT TRENCHING

NOTES:

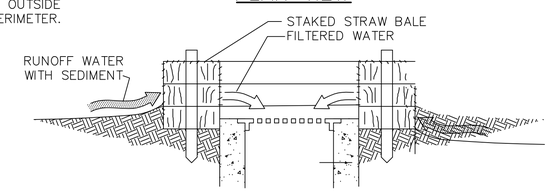
1. MUST BE INSTALLED PROPERLY TO AVOID NOTICE OF VIOLATION.
2. SILT FENCE SHALL BE PLACED ON SLOPE CONTOURS TO MAXIMIZE POUNDING EFFICIENCY.
3. INSPECT AND REPAIR FENCE AFTER EACH STORM EVENT AND REMOVE SEDIMENT WHEN NECESSARY. 9" MAXIMUM RECOMMENDED STORAGE HEIGHT.
4. REMOVED SEDIMENT SHALL BE DEPOSITED TO AN AREA THAT WILL NOT CONTRIBUTE TO SEDIMENT OFF–SITE AND CAN BE PERMANENTLY STABILIZED.

SILT FENCE

N.T.S.



PLAN VIEW



SECTION A–A

STRAW BALE DETAIL

N.T.S.

REVISIONS

NO.	DESCRIPTION	DATE	BY
1	MOVED ROAD N&W PER A.C.	8/28/15	SWB

BROWN CONSULTING ENGINEERS, P.C.
CIVIL ENGINEERING–LAND SURVEYING–LAND PLANNING
163 WEST 1600 SOUTH, UNIT 5
ST. GEORGE, UTAH 84770
(435) 628-4700 FAX (435) 628-4725

DETAIL SHEET
FOR
NORTH PRIVATE LEASE BYPASS ROAD AND SOUTH HAUL ROAD
CULVERT C-1
LOCATED IN SEC. 13, T39S, R6W, SL.B.&M.
KANE COUNTY, UTAH

REGISTERED PROFESSIONAL ENGINEER
MARC L. BROWN
10223
9-18-15
STATE OF UTAH

CHECKED BY : MLB
DRAWN BY : SWB
DATE : SEPTEMBER
JOB NO. : 15-47

SCALE : NONE

SHEET NO. : C-D1

Range 6 West
Range 5 West

Township 39 South

12
7
13
18

Existing County Road 136

County Road 136 Bypass

Existing Alton Coal Mine Road

N

0 500 1000 1500

Elevation Contour Interval = 4'

LEGEND:

- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- SECTION LINE
- FOUND SECTION CORNER
- FOUND PROPERTY CORNER

DRAWN BY:	CHECKED BY:
K. NICHOLES	DWG
DRAWING: 5–45	DATE: 7/14/14
	SCALE: 1" = 400'
JOB NUMBER: 0001	SHEET

REVISIONS

DATE:	BY:
03/11/15	KN
04/10/15	AC
10/15/15	AC

PRE-MINING TOPOGRAPHY

NORTH
COAL HOLLOW
PROJECT
ALTON, UTAH

DRAWING: 5-45

UTAH REGISTERED #154168 DAN W. GUY PROFESSIONAL ENGINEER

Alton Coal Development
Coal Hollow Project

463 North 100 West, Suite 1
Cedar City, Utah 84721
Phone (435)867-5331
Fax (435)867-1192

Range 6 West
Range 5 West

Township 39 South

Existing County Road 136

AREA 1

AREA 2

AREA 3

UNDISTURBED

Existing Alton Coal Mine Road

Existing County Road 136

0 500 1000 1500

N

Area 1 Disturbance	= 51.9 Acres
Area 2 Disturbance	= 115.7 Acres
Area 3 Disturbance	= 57.2 Acres
Total Disturbance	= 224.8 Acres
Undisturbed Area	= 70.8 Acres
Total Permit Area	= 295.6 Acres

Contour Interval = 4'

LEGEND:

- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- SECTION LINE
- FOUND SECTION CORNER
- FOUND PROPERTY CORNER

DRAWN BY: K. NICHOLES	CHECKED BY: DWG
DRAWING: 5–46	DATE: 7/14/14
	SCALE: 1" = 400'
JOB NUMBER: 0001	SHEET

REVISIONS

DATE:	BY:
10/09/14	KN
04/10/15	AC
10/12/15	AC

DISTURBANCE SEQUENCE

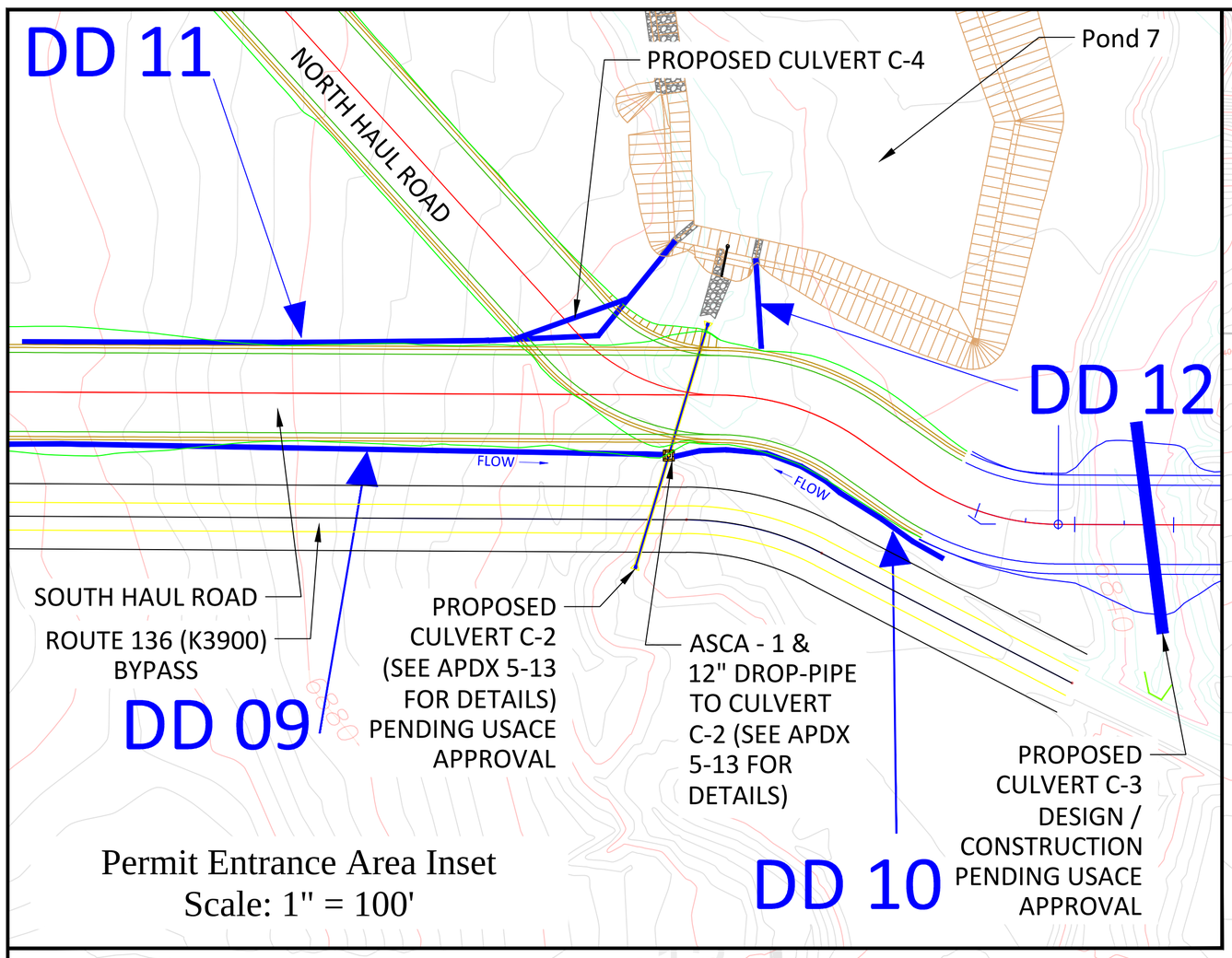
NORTH COAL HOLLOW PROJECT
ALTON, UTAH

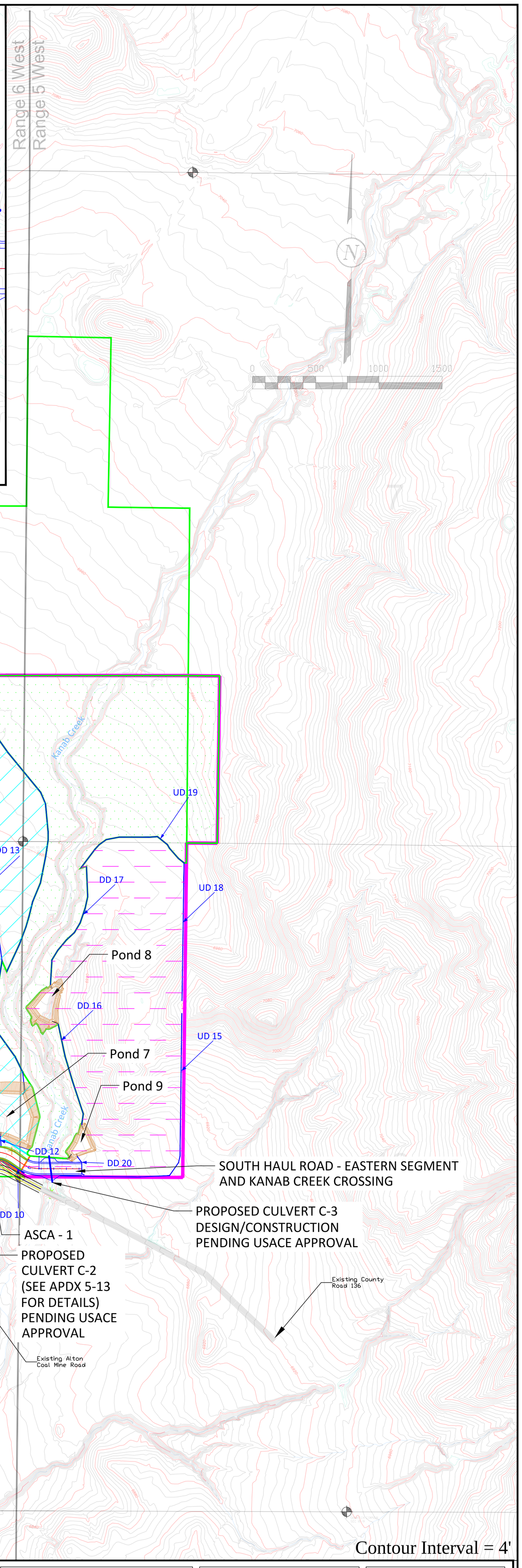
DRAWING: 5-46

UTAH REGISTERED #154168 DAN W. GUY PROFESSIONAL ENGINEER

Alton Coal Development
Coal Hollow Project

463 North 100 West, Suite 1
Cedar City, Utah 84721
Phone (435)867-5331
Fax (435)867-1192





LEGEND:

- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- SECTION LINE
- FOUND SECTION CORNER
- FOUND PROPERTY CORNER

DRAWN BY:	CHECKED BY:
A. CHRISTENSEN	DWG
DRAWING: 5–47	DATE: 4/10/15
	SCALE: 1" = 400'
JOB NUMBER: 0001	SHEET

REVISIONS

DATE:	BY:
10/12/15	ARC

FACILITIES AND STRUCTURES LAYOUT

NORTH COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 5-47

UTAH REGISTERED #154168 DAN W. GUY PROFESSIONAL ENGINEER

Alton Coal Development
Coal Hollow Project

463 North 100 West, Suite 1
Cedar City, Utah 84721
Phone (435)867-5331
Fax (435)867-1192

Temporary Subsoil Stockpile

84,000 C.Y.

Temporary Topsoil Stockpile
60,000 C.Y.

NE 1/16 CORNER
SEC 13

DD 05

Temporary Spoil Stockpile
505,866 C.Y. (Pits 1 & 2)

Pond 8

6880

DD 06

SOUTH HAUL ROAD

PROPOSED CULVERT C-1

Pond 6

PRIOR TO CONSTRUCTION OF POND 7 IN AREA 2, ALL SURFACE RUNOFF FROM WESTERN DOWNHILL SLOPE OF SOUTH HAUL ROAD WILL REPORT TO ASCA-1

ASCA - 1 & 12" DROP-PIPE TO CULVERT C-2 (SEE APDX 5-13 FOR DETAILS)

Kanab Creek

FLOW

FLOW

QUARTER CORNER
13 18

ROUTE 136 (K3900)
BYPASS

DD 07

DD 08

DD 09

DD 10

PROPOSED CULVERT C-2 (SEE APDX 5-13 FOR DETAILS) PENDING USACE APPROVAL

Contour Interval = 4'

Alton Coal Development
Coal Hollow Project
463 North 100 West, Suite 1
Cedar City, Utah 84721
Phone (435)867-5331
Fax (435)867-1192

REGISTERED PROFESSIONAL ENGINEER
#154168
State of Utah

FACILITIES AND STRUCTURES
CONSTRUCTION SEQUENCE - AREA 1

NORTH
COAL HOLLOW
PROJECT
ALTON, UTAH

DRAWING: 5-48

REVISIONS		
DATE:	BY:	
XX/XX/XX	XX	

DRAWN BY: A. CHRISTENSEN	CHECKED BY: DWG		
DRAWING: 5-48	DATE: 10/12/15	SCALE: 1" = 100'	SHEET
			JOB NUMBER: 0001

LEGEND:
- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- SECTION LINE
- FOUND SECTION CORNER
- FOUND PROPERTY CORNER

UD 14

DRH-G-1

OGP-G

GDH-G

OGP-A1

DRH-E-1

OGP-E

DRH-E-2

DRH-A1

GDH-E

DRH-G-2

DRH-D

DD 13

PRIME FARMLAND AND SOILS OF STATEWIDE IMPORTANCE STOCKPILES. CONSTRUCTED FROM DELINEATED POLYGONS FOLLOWING BACKFILL AND REGRADING OF PIT MATERIAL AS SUBGRADE

GDH_B - 37,800 CY Capacity

OGP_B - 37,800 CY Capacity

DRH_A - 24,900 CY Capacity

DRH_B - 93,100 CY Capacity

N

S

DD-13 TO BE CONSTRUCTED IN TWO SEGMENTS. SOUTH SEGMENT CONSTRUCTED PRIOR TO INITIAL SURFACE DISTURBANCE OF AREA 2. NORTH SEGMENT CONSTRUCTED FOLLOWING BACKFILL, REGRADING AND SUB/TOP SOILING OF PIT AREAS PROGRESSING NORTHWARD.

NORTH HAUL ROAD

PONDS 5 AND 6 TO REMAIN UNTIL FINAL PHASE III RECLAMATION

Pond 7

DD 11

DD 12

DURING TRANSITION FROM SOUTH HAUL ROAD TO NORTH HAUL ROAD, SOUTH HAUL ROAD TO BE RECLAIMED. MAINTAIN LIGHT VEHICLE ACCESS TO PONDS.

FOLLOWING CONSTRUCTION OF POND 7 IN AREA 2, WESTERN DOWNHILL SLOPE OF SOUTH HAUL ROAD WILL BE REGRADED & CROWNED SO NORTHERN HALF OF ROAD REPORTS TO DD-11

PROPOSED CULVERT C-4 TO BE CONSTRUCTED DURING TRANSITION FROM SOUTH HAUL ROAD TO NORTH HAUL ROAD

Contour Interval = 4'

LEGEND:

- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- SECTION LINE
- FOUND SECTION CORNER
- FOUND PROPERTY CORNER

DRAWN BY: A. CHRISTENSEN	CHECKED BY: DWG
DRAWING: 5–49	DATE: 10/12/15
	SCALE: 1" = 200'
JOB NUMBER: 0001	SHEET

REVISIONS

DATE:	BY:
XX/XX/XX	XX

FACILITIES AND STRUCTURES CONSTRUCTION SEQUENCE - AREA 2

NORTH
COAL HOLLOW
PROJECT
ALTON, UTAH

DRAWING: 5-49

UTAH REGISTERED #154168 DAN W. GUY PROFESSIONAL ENGINEER

ALTON COAL DEVELOPMENT
COAL HOLLOW PROJECT
463 North 100 West, Suite 1
Cedar City, Utah 84721
Phone (435)867-5331
Fax (435)867-1192

1/16 CORNER
SEC 12

T39S R5 R6W
SEC 7-18-12-13

APPROXIMATELY 1.0 MILLION C.Y. OF BACKFILL TO BE HAULED ALONG NORTH HAUL ROAD FROM AREA 3 TO NORTHERN END OF AREA 2 TO MAKE UP BACKFILL VOID. RECLAMATION OF NORTH HAUL ROAD TO FOLLOW.

NORTH HAUL ROAD

PONDS 5, 6 AND 7 TO REMAIN UNTIL FINAL PHASE III RECLAMATION

LIGHT VEHICLE ACCESS TO PONDS ONLY

POND 8

POND 9

UD 19

DD 17

UD 18

DD 16

UD 15

DD 20

PROPOSED CULVERT C-3
DESIGN/CONSTRUCTION
PENDING USACE APPROVAL

EAST SEGMENT OF
SOUTH HAUL ROAD

Contour Interval = 4'

LEGEND:

- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- SECTION LINE
- FOUND SECTION CORNER
- FOUND PROPERTY CORNER

DRAWN BY:	CHECKED BY:
A. CHRISTENSEN	DWG
DRAWING: 5–50	DATE: 10/12/15
	SCALE: 1" = 200'
JOB NUMBER: 0001	SHEET

REVISIONS

DATE:	BY:
XX/XX/XX	XX

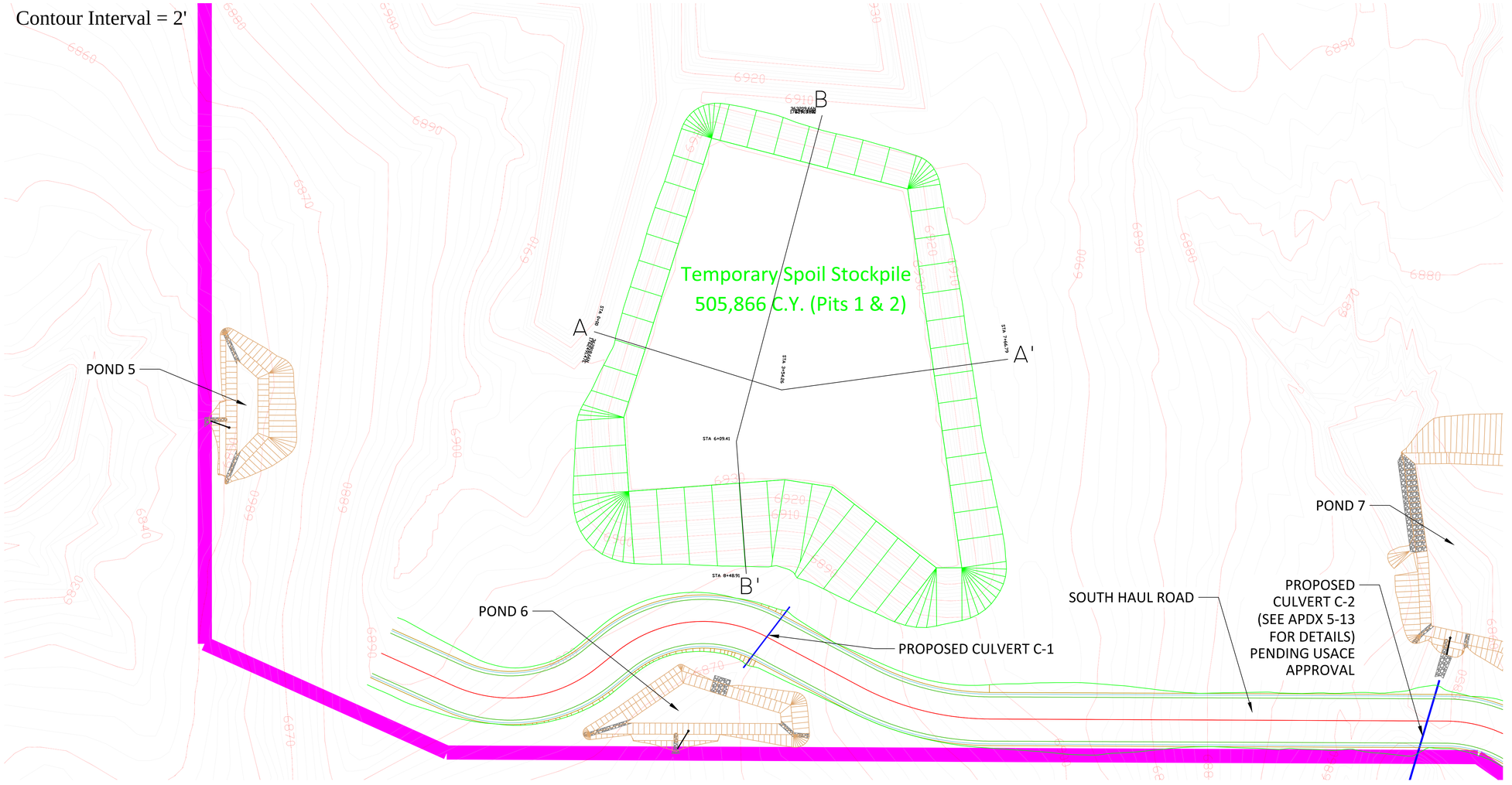
FACILITIES AND STRUCTURES CONSTRUCTION SEQUENCE - AREA 3

NORTH
COAL HOLLOW
PROJECT
ALTON, UTAH

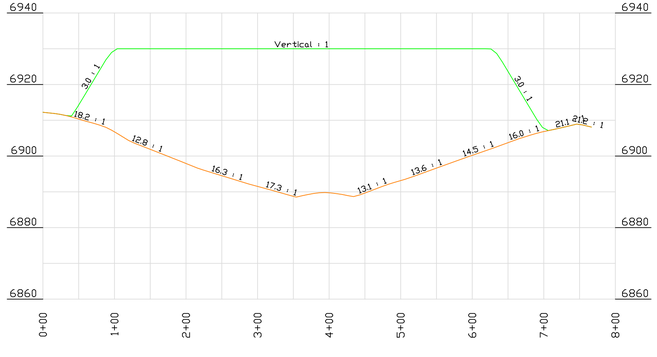
DRAWING: 5-50

UTAH REGISTERED PROFESSIONAL ENGINEER #154168 DAN W. GUY

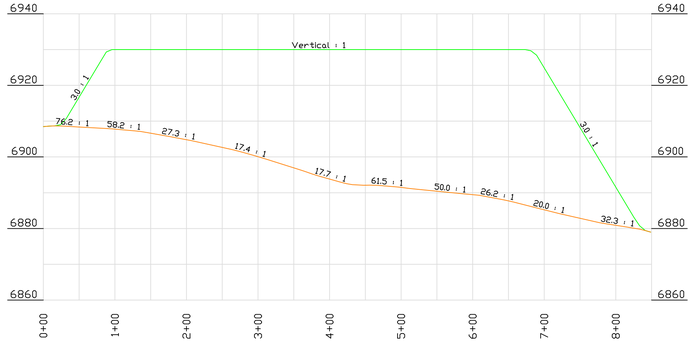
ALTON COAL DEVELOPMENT
COAL HOLLOW PROJECT
463 North 100 West, Suite 1
Cedar City, Utah 84721
Phone (435)867-5331
Fax (435)867-1192



TEMP. SPOIL PILE A-A'



TEMP. SPOIL PILE B-B'



1"=20' X-Section Scale
1"=100'

463 North 100 West, Suite 1
Cedar City, Utah 84720
Phone (435)867-5331
Fax (435)867-1192

TEMPORARY SPOIL STOCKPILE DETAILS

COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 5-51A

REVISIONS		
DATE:	BY:	
XX/XX/XX	XX	

DRAWN BY: A. CHRISTENSEN	CHECKED BY: DG	DATE: 4/10/15	SCALE: 1" = 50'
DRAWING: 5-51A			JOB NUMBER: 1400 SHEET

Contour Interval = 2'

NORTH HAUL ROAD

TEMPORARY SUBSOIL STOCKPILE. TO BE REMOVED PRIOR TO CONSTRUCTION OF NORTH HAUL ROAD

TEMPORARY TOPSOIL STOCKPILE

TEMPORARY SPOIL STOCKPILE. TO BE REMOVED PRIOR TO CONSTRUCTION OF NORTH HAUL ROAD

SILT FENCE / EROSION CONTROL MEASURES DOWN-GRADIENT FROM SOIL STOCKPILES

GDH_B - 37,800 CY Capacity

OGP_B - 37,800 CY Capacity

DRH_A - 24,900 CY Capacity

DRH_B - 93,100 CY Capacity

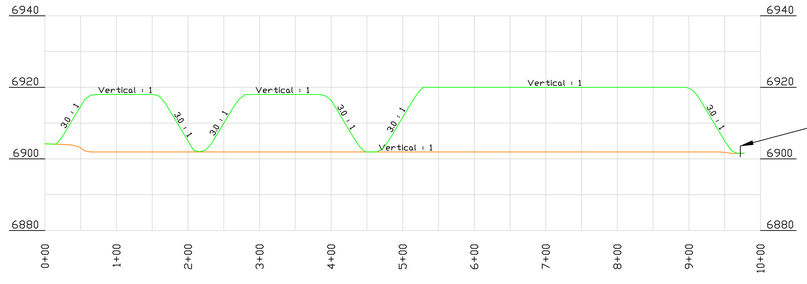
UD-14

PRIME FARMLAND AND SOILS OF STATEWIDE IMPORTANCE STOCKPILES. CONSTRUCTED FROM DELINEATED POLYGONS SHOWN ON DRAWING 2-4 FOLLOWING BACKFILL AND REGRADING OF PIT MATERIAL AS SUBGRADE

POND 7

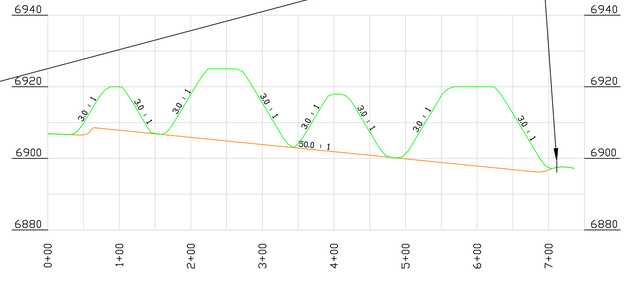
DD-13

TOPSOIL PILES A-A'



TOPSOIL PILES B-B'

SILT FENCE / EROSION CONTROL MEASURES DOWN-GRADIENT FROM SOIL STOCKPILES



X-Section Scale
1"=20'
1"=100'

Alton Coal Development
COAL HOLLOW PROJECT
463 North 100 West, Suite 1
Cedar City, Utah 84720
Phone (435)867-5331
Fax (435)867-1192

REGISTERED PROFESSIONAL ENGINEER
#154168
DANI W. GUY

TOPSOIL STOCKPILES DETAILS

COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 5-51B

REVISIONS	
DATE:	BY:
XX/XX/XX	XX

DRAWN BY: A. CHRISTENSEN	CHECKED BY: DG		
DRAWING: 5-51B	DATE: 4/10/15	SCALE: 1" = 50'	SHEET
			JOB NUMBER: 1400

Range 6 West
Range 5 West

1/16 CORNER
6-7

N

0 500 1000 1500

Existing County Road 136

Township 39 South

12

16 CORNER
SEC 12

7

18

County Road 136 Bypass

Federal Coal Ownership

Highwall Coal to be Mined
Average Coal Thickness 15.2'
Average Cover = 118.1'
Tons at 35% Recovery = 785,700 Tons

Federal Coal Ownership

No Coal/Burn Area

Surface Coal to be Mined
Average Coal Thickness 15.6'
Average Cover = 82.5'
Tons at 95% Recovery = 2,878,900 Tons

Existing Alton Coal Mine Road

Fee Coal Summary

Coal Mined:	
-*By Surface	= 2,878,900 Ton
-**By Highwall Mining	= 785,700 Ton
-Total Coal to be Mined	= 3,664,600 Ton
Coal Not Mined:	
-Misc.	= 1,934,600 Ton
-From Highwall Mining	= 1,528,100 Ton
-Total Coal not Mined	= 3,462,700 Ton
Total Fee Coal	= 7,127,300 Ton

*All tons are at 95% recovery
** All Tons are at 35% recovery

Federal Coal - Not Mined
Coal Mined Surface
Coal Mined Surface/Highwall Miner
Coal not Mined (Under Sloped Highwall, Misc)
No Coal, Burn Area

LEGEND:
- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- SECTION LINE
- FOUND SECTION CORNER
- FOUND PROPERTY CORNER

DRAWN BY:	CHECKED BY:
K. NICHOLES	DWG
DRAWING: 5–52	DATE: 8/8/14
	SCALE: 1" = 400'
JOB NUMBER: 0001	SHEET

REVISIONS

DATE:	BY:
10/08/14	KN
04/10/15	AC
10/12/15	AC

COAL EXTRACTION OVERVIEW

NORTH
COAL HOLLOW
PROJECT
ALTON, UTAH

DRAWING: 5-52

UTAH REGISTERED #154168 DAN W. GUY PROFESSIONAL ENGINEER

Alton Coal Development
Coal Hollow Project

463 North 100 West, Suite 1
Cedar City, Utah 84721
Phone (435)867-5331
Fax (435)867-1192

YEAR 1 – QUARTER 1
YEAR 1 – QUARTER 2
YEAR 1 – QUARTER 3
YEAR 1 – QUARTER 4
YEAR 2 – QUARTER 1
YEAR 2 – QUARTER 2
YEAR 2 – QUARTER 3
YEAR 2 – QUARTER 4
YEAR 3 – QUARTER 1
YEAR 3 – QUARTER 2
YEAR 3 – QUARTER 3
YEAR 3 – QUARTER 4
YEAR 4 – QUARTER 1
YEAR 4 – QUARTER 2
YEAR 4 – QUARTER 3
YEAR 4 – QUARTER 4
YEAR 5 – QUARTER 1
YEAR 5 – QUARTER 2
YEAR 5 – QUARTER 3
YEAR 5 – QUARTER 4
YEAR 6 – QUARTER 1
YEAR 6 – QUARTER 2
YEAR 6 – QUARTER 3

Township 39 South

Range 6 West
Range 5 West

N

0 500 1000 1500

Existing County Road 136

12

7

18

13

Pit 21
Pit 20
Pit 19
Pit 18
Pit 17
Pit 16
Pit 15
Pit 14
Pit 13
Pit 12
Pit 11
Pit 01
Pit 02
Pit 03
Pit 04
Pit 05
Pit 06
Pit 07
Pit 08
Pit 09
Pit 10
HWT 02
HWT 01

County Road 136 Bypass

Existing Alton Coal Mine Road

Coal Sequence Summary by Year:

Year 1:		
Open Pit*	=	785,400 Tons
Highwall**	=	0 Tons
Total		785,400 Tons
Year 2:		
Open Pit	=	684,600 Tons
Highwall	=	69,800 Tons
Total		754,400 Tons
Year 3:		
Open Pit	=	607,100 Tons
Highwall	=	199,400 Tons
Total		806,500 Tons
Year 4:		
Open Pit	=	497,500 Tons
Highwall	=	223,800 Tons
Total		721,300 Tons
Year 5:		
Open Pit	=	193,000 Tons
Highwall	=	181,300 Tons
Total		374,300 Tons
Year 6:		
Open Pit	=	111,400 Tons
Highwall	=	111,400 Tons
Total		222,800 Tons
North Area Total	=	3,664,600 Tons

*All tons are at 95% recovery
** All Tons are at 35% recovery

LEGEND:
- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- SECTION LINE
- FOUND SECTION CORNER
- FOUND PROPERTY CORNER

DRAWN BY:	CHECKED BY:
A. CHRISTENSEN	DWG
DRAWING: 5–53	DATE: 4/10/15
	SCALE: 1" = 400'
JOB NUMBER: 0001	SHEET

REVISIONS

DATE:	BY:
10/12/15	AC

COAL REMOVAL SEQUENCE

NORTH
COAL HOLLOW
PROJECT
ALTON, UTAH

DRAWING: 5-53

UTAH REGISTERED #154168 DAN W. GUY PROFESSIONAL ENGINEER

Alton Coal Development
Coal Hollow Project
463 North 100 West, Suite 1
Cedar City, Utah 84721
Phone (435)867-5331
Fax (435)867-1192

Range 6 West
Range 5 West

Township 39 South

12

7

13

18

County Road 136 Bypass

1/16 CORNER SEC 12

1/16 CORNER SEC 13

1395 R5 R6W SEC 7-18-12-13

QUARTER CORNER SEC 18-19

1/16 CORNER 6-7

N

0 500 1000 1500

Strip Ratio in C.Y. Overburden / Ton Coal

LEGEND:

- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- SECTION LINE
- FOUND SECTION CORNER
- FOUND PROPERTY CORNER

DRAWN BY:	CHECKED BY:
K. NICHOLES	DWG
DRAWING: 5–54	DATE: 7/14/14
	SCALE: 1" = 400'
JOB NUMBER: 0001	SHEET

REVISIONS

DATE:	BY:
03/12/15	KN
04/10/15	AC
10/12/15	AC

STRIP RATIO ISOPACH

NORTH COAL HOLLOW PROJECT ALTON, UTAH

DRAWING: 5-54

UTAH REGISTERED #154168 DAN W. GUY PROFESSIONAL ENGINEER

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Coal Hollow Project
463 North 100 West, Suite 1
Cedar City, Utah 84721
Phone (435)867-5331
Fax (435)867-1192

Range 6 West
Range 5 West

Township 39 South

12

7

18

13

County Road 136 Bypass

1/16 CORNER SEC 12

1/16 CORNER SEC 7

1/16 CORNER SEC 18

QUARTER CORNER SEC 18-19

1395 R5 R6W SEC 7-18-12-13

N

0 500 1000 1500

Thickness Contour Interval = 1'

LEGEND:

- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- SECTION LINE
- FOUND SECTION CORNER
- FOUND PROPERTY CORNER

DRAWN BY: K. NICHOLES	CHECKED BY: DWG
DRAWING: 5–55	DATE: 7/14/14
	SCALE: 1" = 400'
JOB NUMBER: 0001	SHEET

REVISIONS

DATE:	BY:
03/11/15	KN
04/10/15	AC
10/12/15	AC

COAL THICKNESS ISOPACH

NORTH
COAL HOLLOW
PROJECT
ALTON, UTAH

DRAWING: 5-55

UTAH REGISTERED #154168 DAN W. GUY PROFESSIONAL ENGINEER

Alton Coal Development
Coal Hollow Project

463 North 100 West, Suite 1
Cedar City, Utah 84721
Phone (435)867-5331
Fax (435)867-1192

Range 6 West
Range 5 West

Township 39 South

12

7

13

18

N

0 500 1000 1500

County Road 136 Bypass

1/16 CORNER SEC 12

1/16 CORNER SEC 13

QUARTER CORNER 13-18

1/16 CORNER 6-7

S395 R5 R6W SEC 7-18-12-13

QUARTER CORNER SEC 18-19

Thickness Contour Interval = 5'

LEGEND:

- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- SECTION LINE
- FOUND SECTION CORNER
- FOUND PROPERTY CORNER

DRAWN BY: K. NICHOLES	CHECKED BY: DWG
DRAWING: 5–56	DATE: 8/8/14
	SCALE: 1” = 400’
JOB NUMBER: 0001	SHEET

REVISIONS

DATE:	BY:
03/11/15	KN
04/10/15	AC
10/12/15	AC

OVERBURDEN THICKNESS ISOPACH

NORTH COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 5-56

UTAH REGISTERED PROFESSIONAL ENGINEER #154168 DAN W. GUY

Alton Coal Development
Coal Hollow Project
463 North 100 West, Suite 1
Cedar City, Utah 84721
Phone (435)867-5331
Fax (435)867-1192

YEAR 1 – QUARTER 1
YEAR 1 – QUARTER 2
YEAR 1 – QUARTER 3
YEAR 1 – QUARTER 4
YEAR 2 – QUARTER 1
YEAR 2 – QUARTER 2
YEAR 2 – QUARTER 3
YEAR 2 – QUARTER 4
YEAR 3 – QUARTER 1
YEAR 3 – QUARTER 2
YEAR 3 – QUARTER 3
YEAR 3 – QUARTER 4
YEAR 4 – QUARTER 1
YEAR 4 – QUARTER 2
YEAR 4 – QUARTER 3
YEAR 4 – QUARTER 4
YEAR 5 – QUARTER 1
YEAR 5 – QUARTER 2
YEAR 5 – QUARTER 3
YEAR 5 – QUARTER 4
YEAR 6 – QUARTER 1
YEAR 6 – QUARTER 2
YEAR 6 – QUARTER 3

Township 39 South

Range 6 West
Range 5 West

N

0 500 1000 1500

Existing County Road 136

12
7
13
18

Pit 21
Pit 20
Pit 19
Pit 18
Pit 17
Pit 16
Pit 15
Pit 14
Pit 13
Pit 12
Pit 11
Pit 01
Pit 02
Pit 03
Pit 04
Pit 05
Pit 06
Pit 07
Pit 08
Pit 09
Pit 10
HWT 02
HWT 01

County Road 136 Bypass

Existing Alton Coal Mine Road

Existing County Road 136

Overburden Sequence Summary by Year:

Year 1:	2,485,800 CY
Year 2:	2,571,300 CY
Year 3:	4,049,000 CY
Year 4:	3,354,200 CY
Year 5:	3,075,900 CY
Year 6:	1,842,000 CY
North Area Total	17,378,100 CY

LEGEND:
- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- SECTION LINE
- FOUND SECTION CORNER
- FOUND PROPERTY CORNER

DRAWN BY: A. CHRISTENSEN	CHECKED BY: DWG
DRAWING: 5–57	DATE: 4/10/15
	SCALE: 1" = 400'
JOB NUMBER: 0001	SHEET

REVISIONS

DATE:	BY:
10/12/15	AC

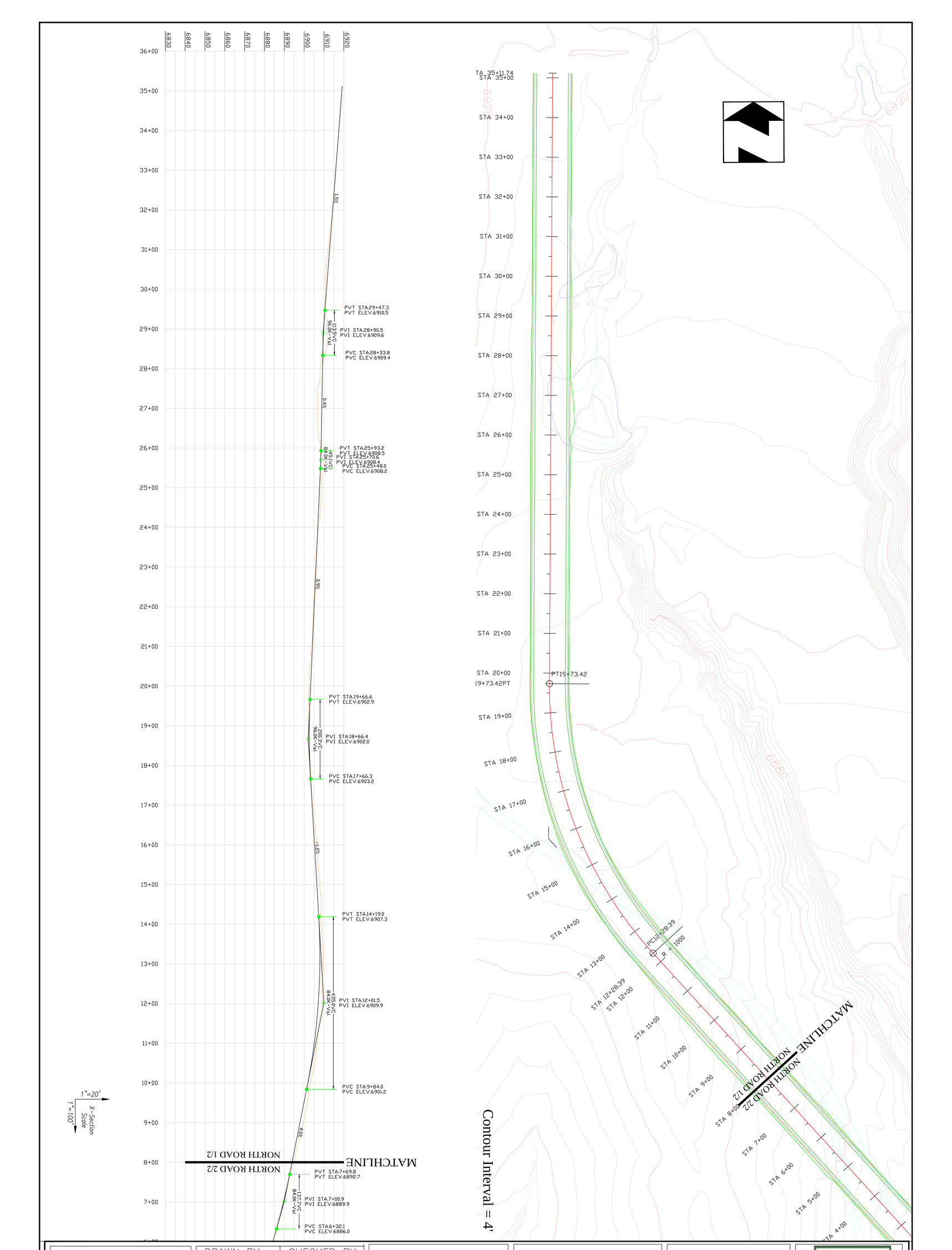
OVERBURDEN REMOVAL SEQUENCE

NORTH
COAL HOLLOW
PROJECT
ALTON, UTAH

DRAWING: 5-57

UTAH REGISTERED #154168 DAN W. GUY PROFESSIONAL ENGINEER

Alton Coal Development
Coal Hollow Project
463 North 100 West, Suite 1
Cedar City, Utah 84721
Phone (435)867-5331
Fax (435)867-1192



DRAWN BY: A. CHRISTENSEN	CHECKED BY: DG	
DRAWING: 5-58	DATE: 4/10/15	
	SCALE: 1" = 100'	
JOB NUMBER: 1400	SHEET	

REVISIONS	
DATE:	BY:
10/12/15	AC

PRIMARY ROADS NORTHERN HAUL ROAD 1/2 PLAN & PROFILE

COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 5-58

UTAH REGISTERED #154168 DAN W. GUY PROFESSIONAL ENGINEER

Alton Coal Development
Coal Hollow Project
463 North 100 West, Suite 1
Cedar City, Utah 84720
Phone (435)867-5331
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Alton Coal Development
COAL HOLLOW PROJECT
463 North 100 West, Suite 1
Cedar City, Utah 84720
Phone (435)867-5331
Fax (435)867-1192

LICENSED PROFESSIONAL ENGINEER
#154168
GLEN W. GOFF

PRIMARY ROADS NORTHERN HAUL ROAD 2/2 PLAN & PROFILE

COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 5-59

REVISIONS	
DATE:	BY:
10/12/15	AC

DRAWN BY: A. CHRISTENSEN	CHECKED BY: DG		
DRAWING: 5-59	DATE: 4/10/15	SCALE: 1" = 100'	SHEET
			JOB NUMBER: 1400

NORTH HAUL ROAD

ROUTE 136 (K3900)
BYPASS

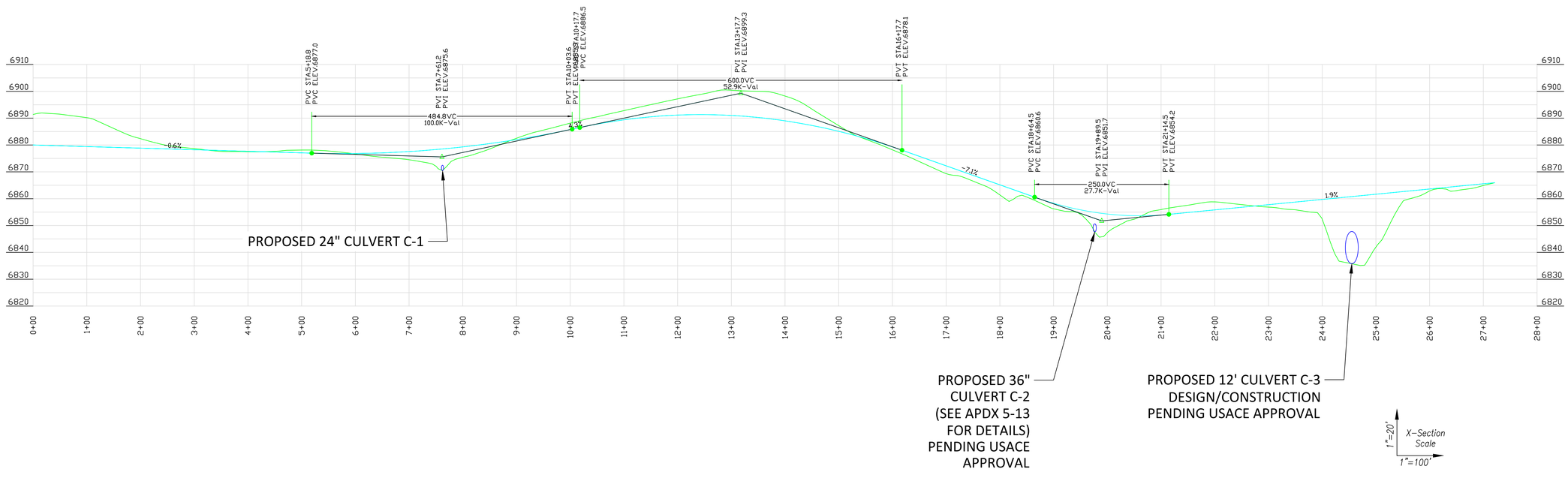
PROPOSED 24" CULVERT C-1

PROPOSED 36"
CULVERT C-2
(SEE APDX 5-13
FOR DETAILS)
PENDING USACE
APPROVAL

PROPOSED 12' CULVERT C-3
DESIGN/CONSTRUCTION
PENDING USACE APPROVAL

Kanab Creek

Contour Interval = 4'



Alton Coal Development
COAL HOLLOW PROJECT
463 North 100 West, Suite 1
Cedar City, Utah 84720
Phone (435)867-5331
Fax (435)867-1192

REGISTERED PROFESSIONAL ENGINEER
#154168
DANIEL W. GOFF

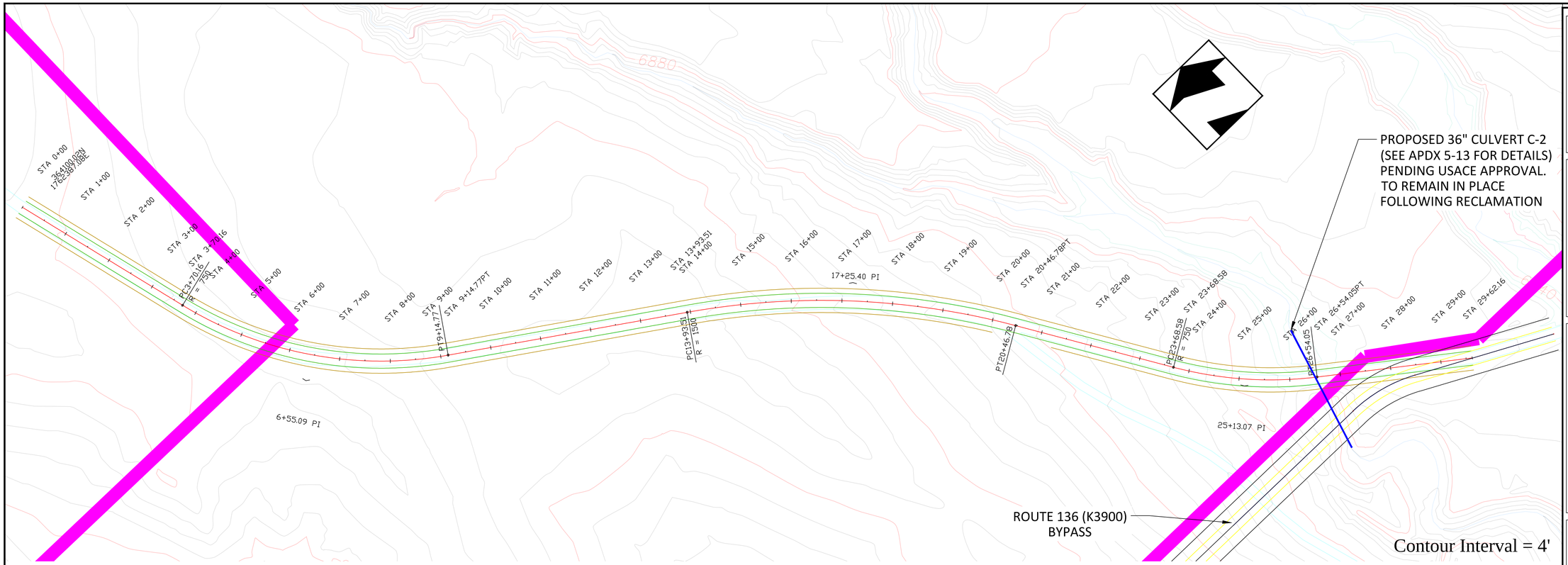
PRIMARY ROADS SOUTHERN HAUL ROAD PLAN & PROFILE

COAL HOLLOW
PROJECT
ALTON, UTAH

DRAWING: 5-60

REVISIONS	
DATE:	BY:
10/12/15	AC

DRAWN BY: A. CHRISTENSEN	CHECKED BY: DG
DRAWING: 5-60	DATE: 4/10/15
	SCALE: 1" = 100'
JOB NUMBER: 1400	SHEET



Alton Coal Development
COAL HOLLOW PROJECT
463 North 100 West, Suite 1
Cedar City, Utah 84720
Phone (435)867-5331
Fax (435)867-1192

REGISTERED PROFESSIONAL ENGINEER #154168 DANIEL W. GUY

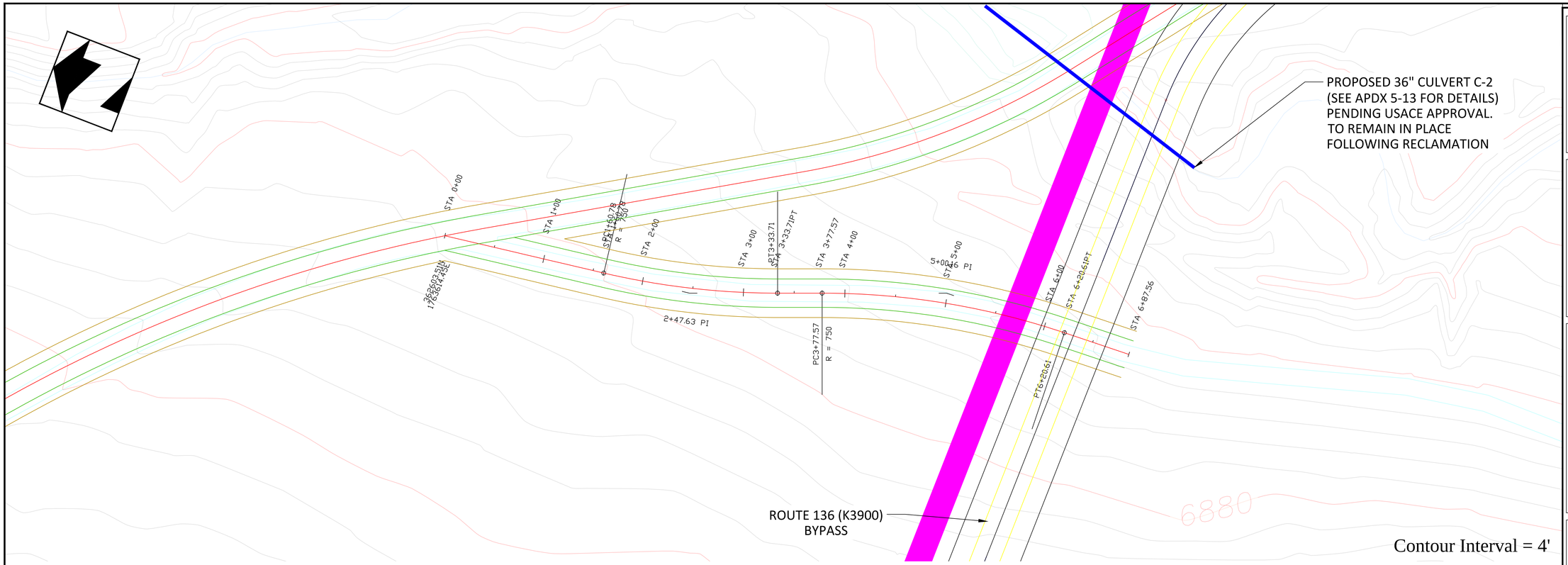
POSTMINING ROADWAYS ROUTE 136 (K3900) PLAN & PROFILE

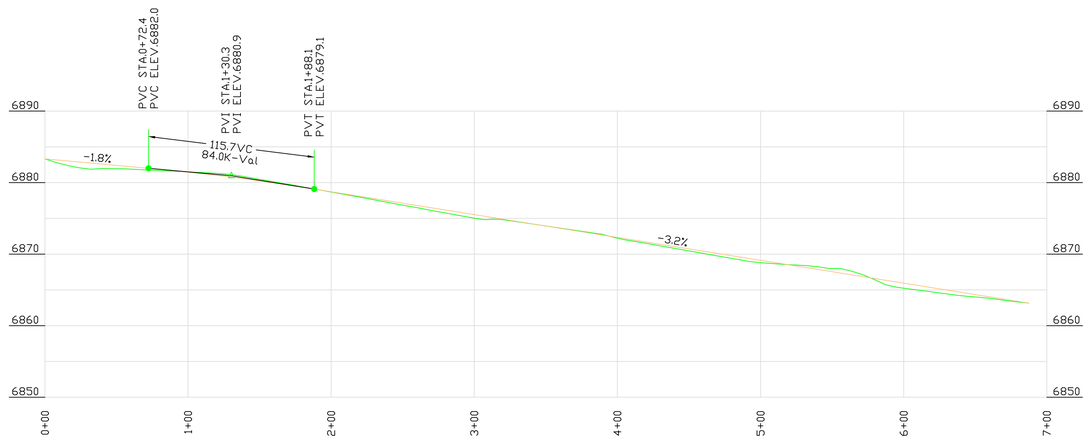
COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 5-61

REVISIONS	
DATE:	BY:
10/12/15	AC

DRAWN BY: A. CHRISTENSEN	CHECKED BY: DG		
DRAWING: 5-61	DATE: 4/10/15	SCALE: 1" = 100'	SHEET
			JOB NUMBER: 1400





1"=10' X-Section Scale 1"=50'

Alton Coal Development
COAL HOLLOW PROJECT
463 North 100 West, Suite 1
Cedar City, Utah 84720
Phone (435)867-5331
Fax (435)867-1192

REGISTERED PROFESSIONAL ENGINEER #154168 DANIEL W. GUY

POSTMINING ROADWAYS ALTON COAL MINE ROAD (K3100) PLAN & PROFILE

COAL HOLLOW PROJECT
ALTON, UTAH

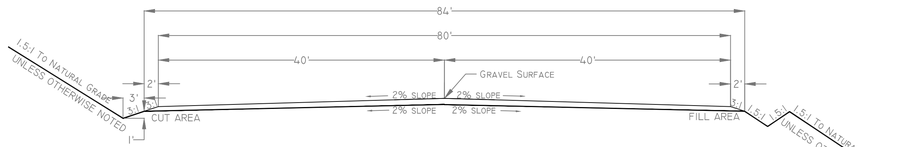
DRAWING: 5-62

REVISIONS

DATE:	BY:
10/12/15	AC

DRAWN BY:	CHECKED BY:	DATE:	SCALE:	SHEET
A. CHRISTENSEN	DG	4/10/15	1" = 50'	
DRAWING: 5-62				JOB NUMBER: 1400

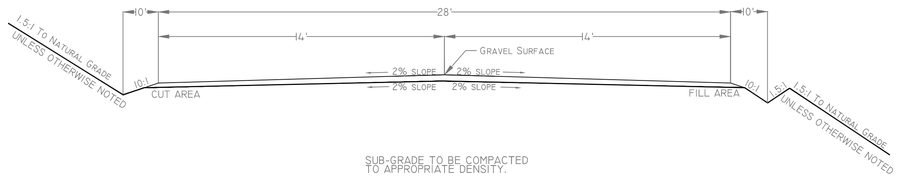
HAUL ROAD TYPICAL CROSS SECTION
NTS



SUB-GRADE TO BE COMPACTED
TO APPROPRIATE DENSITY.

18" OF CRUSHED ROCK OR GRAVEL TO BE PLACED

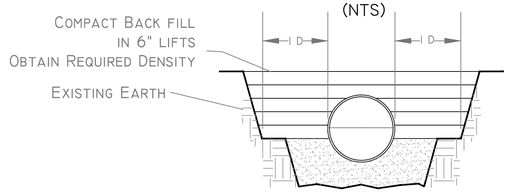
POSTMINING ROAD TYPICAL CROSS SECTION
NTS



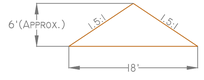
SUB-GRADE TO BE COMPACTED
TO APPROPRIATE DENSITY.

MIN. 6" OF CRUSHED ROCK OR GRAVEL TO BE PLACED

TYPICAL
BACK FILL DETAIL
(NTS)



EARTHEN BERM DETAIL
(NTS)



BERM TO BE PLACED ON ALL ACTIVE
HAUL ROADS AND ACCESS ROADS

Alton Coal Development
COAL HOLLOW PROJECT
463 North 100 West, Suite 1
Cedar City, Utah 84720
Phone (435)867-5331
Fax (435)867-1192

REGISTERED PROFESSIONAL ENGINEER
#154168
DANIEL W. GUY

POSTMINING & PRIMARY ROADWAYS TYP. SECTIONS & DETAILS

COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 5-63

REVISIONS									
DATE:	XX/XX/XX								
BY:	XX								

DRAWN BY: A. CHRISTENSEN	CHECKED BY: DG	DATE: 4/10/15	SCALE: NTS
DRAWING: 5-63			JOB NUMBER: 1400
			SHEET

DD 11

DD 12

DD 09

DD 10

PROPOSED CULVERT C-2 (SEE APDX 5-13 FOR DETAILS) PENDING USACE APPROVAL

ASCA - 1 & 12" DROP-PIPE TO CULVERT C-2 (SEE APDX 5-13 FOR DETAILS)

Permit Entrance Area Inset
Scale: 1" = 100'

Range 6 West
Range 5 West

Township 39 South

UD 14

UD 19

DD 17

UD 18

POND 8

DD 16

UD 15

POND 7

POND 9

POND 5

DD 06

DD 11

DD 12

DD 20

DD 05

DD 07

DD 08

DD 09

DD 10

POND 6

ASCA - 1

Existing County Road 136

Existing Alton Coal Mine Road

Contour Interval = 4'

LEGEND:

- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- SECTION LINE
- FOUND SECTION CORNER
- FOUND PROPERTY CORNER

DRAWN BY:	CHECKED BY:
A. CHRISTENSEN	DWG
DRAWING: 5–65	DATE: 4/10/15
	SCALE: 1" = 400'
JOB NUMBER: 0001	SHEET

REVISIONS

DATE:	BY:
10/12/15	AC

DIVERSION DITCH AND SEDIMENT IMPOUNDMENT PLAN VIEW

NORTH
COAL HOLLOW
PROJECT
ALTON, UTAH

DRAWING: 5-65

UTAH REGISTERED #154168 DAN W. GUY PROFESSIONAL ENGINEER

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Cedar City, Utah 84721
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Fax (435)867-1192

Existing County Road 136

UA-4
254.9 Acres

UD 14

NORTH HAUL ROAD

DA-1
82.3 Acres

UA-1
12.6 Acres

DD 13

Kanab Creek

UD 19

UA-2
92.1 Acres

DD 17

UD 18

DA-3
28.4 Acres

DA-2
25.2 Acres

POND 8

COUNTY ROAD 136 BYPASS

DD 16

DD 05

DA-7
18.8 Acres

UD 15

POND 7

UA-3
13.9 Acres

DA-6
24.0 Acres

DA-5
11.6 Acres

DA-4
23.6 Acres

POND 5

DD 06

DD 11

BERM

POND 9

Kanab Creek

DA-8 2.2 Acres

ASCA-1 3.1 Acres

DD 12

DD 20

SOUTH HAUL ROAD

DD 07

DD 08

DD 09

DD 10

ASCA-1

PROPOSED CULVERT C-3
DESIGN/CONSTRUCTION
PENDING USACE APPROVAL

POND 6

PROPOSED CULVERT C-2
DESIGN/CONSTRUCTION
PENDING USACE APPROVAL

PROPOSED CULVERT C-1

Existing County Road 136

Existing Alton Coal Mine Road

Undisturbed Ground Watersheds
Disturbed Ground Watersheds
Alternate Sediment Control Watersheds

Contour Interval = 4'

LEGEND:

- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- SECTION LINE
- FOUND SECTION CORNER
- FOUND PROPERTY CORNER

DRAWN BY:	CHECKED BY:
A. CHRISTENSEN	DWG
DRAWING: 5—66	DATE: 4/10/15
	SCALE: 1" = 400'
JOB NUMBER: 0001	SHEET

REVISIONS

DATE:	BY:
XX/XX/XX	XX

SEDIMENT CONTROL AREA WATERSHEDS

NORTH
COAL HOLLOW
PROJECT
ALTON, UTAH

DRAWING: 5-66

UTAH REGISTERED #154168 DAN W. GUY PROFESSIONAL ENGINEER

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Coal Hollow Project
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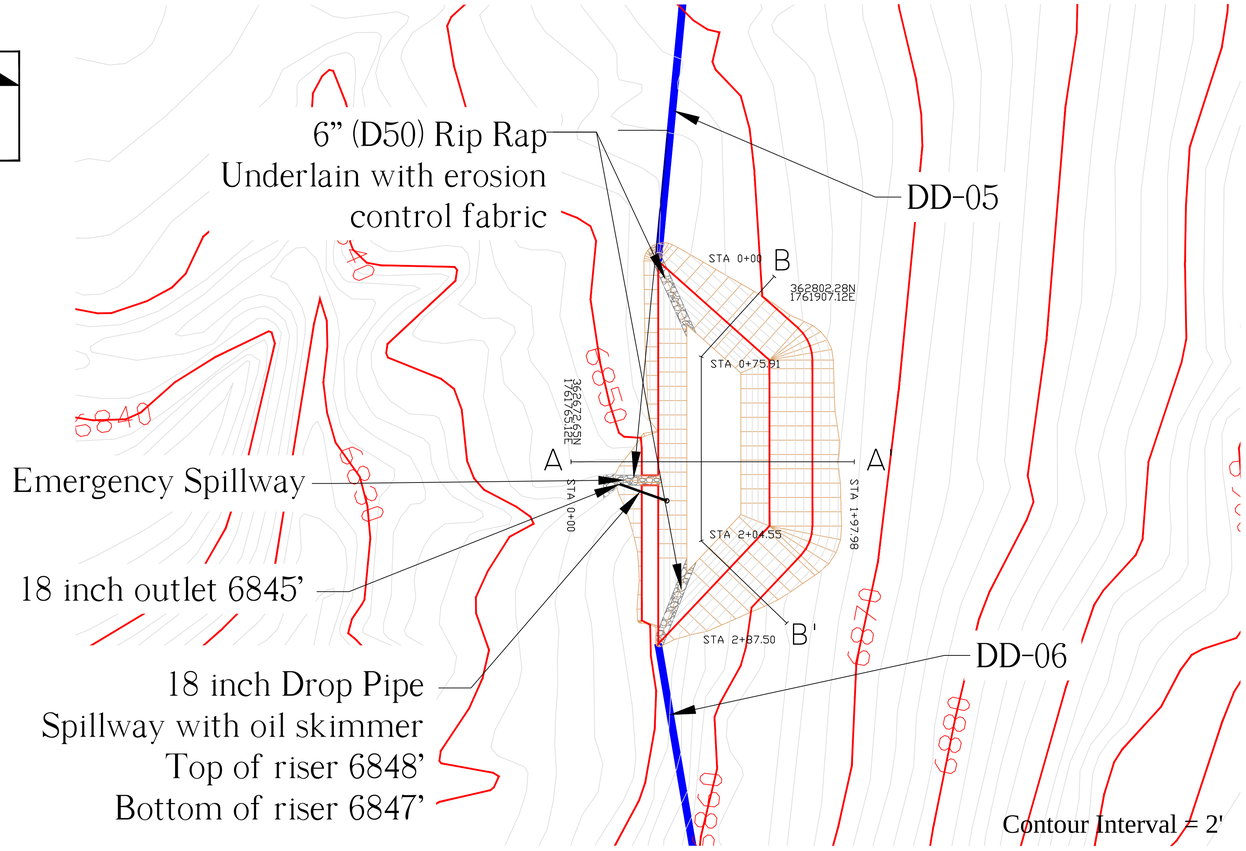
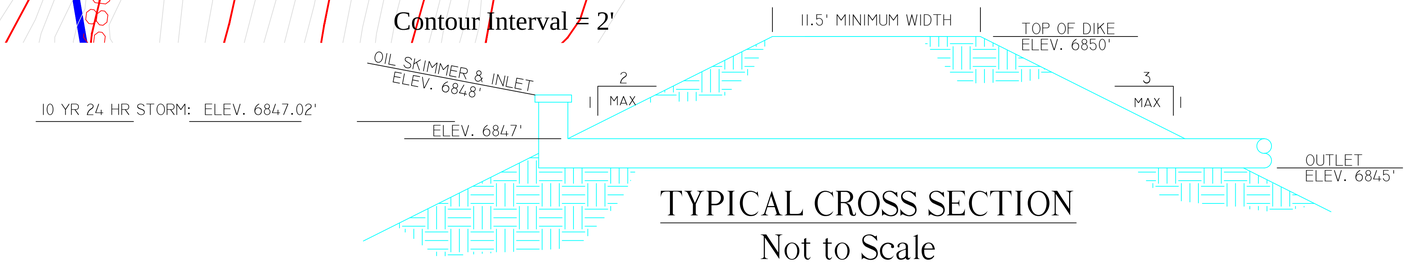
Fax (435)867-1192



Contour Interval = 2'



TYPICAL CROSS SECTION

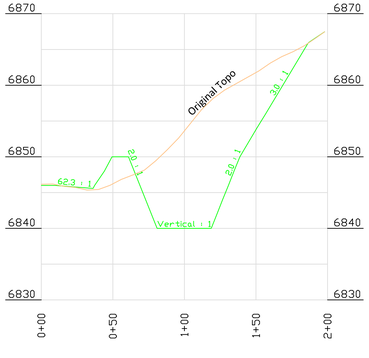
Not to Scale

Pond Storage Volumes

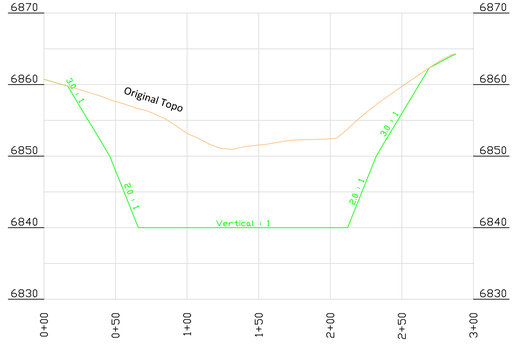
Sediment Control Structure No. 5

Water Elev (ft)	Area (Acres)	Average Area	Volume (Acre-Ft)	Accumulated Volume (Acre-Ft)	Stage
6840.00	0.089	-	-	-	Bottom Pond
6841.00	0.118	0.104	0.104	0.104	
6842.00	0.143	0.131	0.131	0.234	60% Sediment Cleanout
6843.00	0.176	0.160	0.160	0.394	Max Sediment Level
6844.00	0.205	0.191	0.191	0.584	
6845.00	0.216	0.211	0.211	0.795	
6846.00	0.243	0.230	0.230	1.024	
6847.00	0.256	0.250	0.250	1.274	
6848.00	0.299	0.278	0.278	1.551	Principle Spillway
6849.00	0.329	0.314	0.314	1.865	Emergency Spillway
6850.00	0.341	0.335	0.335	2.200	Top of Dike

Pond 5 A - A'



Pond 5 B - B'



Pond #5

Required Storage for 10 year,
24 hr event = 1.28 acre/ft

1" = 10' X-Section Scale 1" = 50'

Alton Coal Development
Coal Hollow Project
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REGISTERED PROFESSIONAL ENGINEER #154168 DAN W. GUY

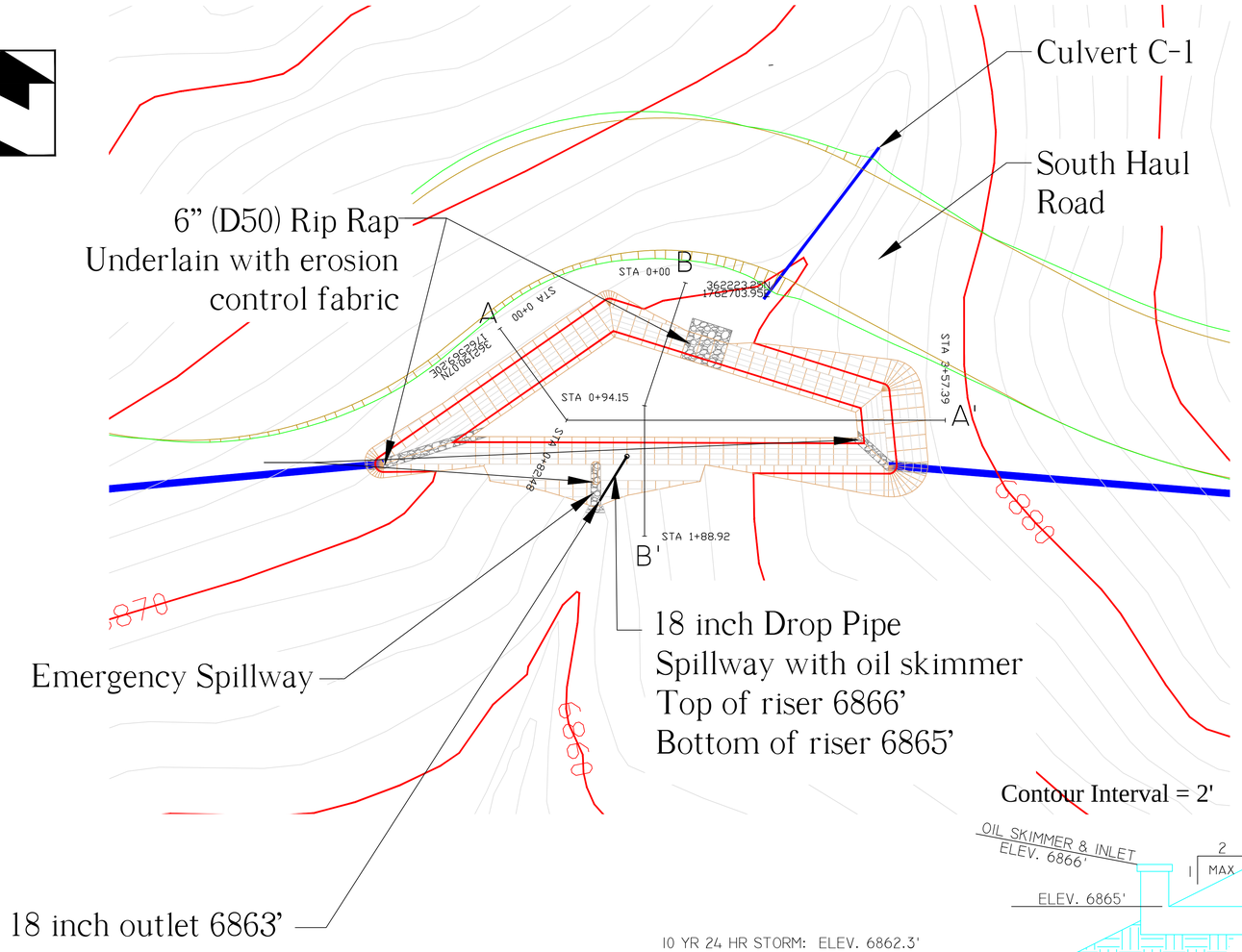
SEDIMENT IMPOUNDMENT 5 DETAILS

COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 5-67

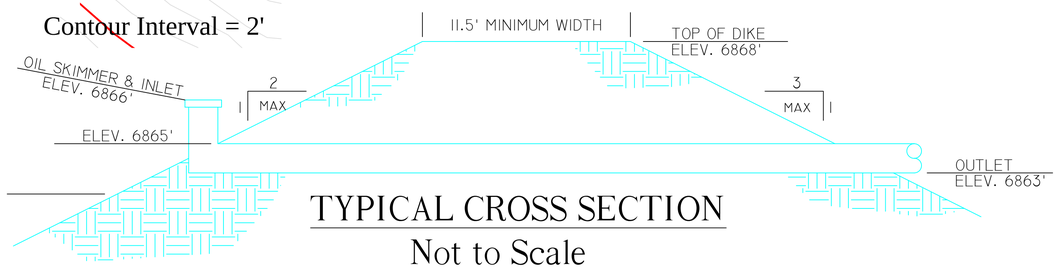
REVISIONS	
DATE:	XX/XX/XX
BY:	XX

DRAWN BY: A. CHRISTENSEN	CHECKED BY: DG	DATE: 10/12/15	SCALE: 1" = 50'
DRAWING: 5-67			SHEET
			JOB NUMBER: 1400



Contour Interval = 2'

10 YR 24 HR STORM: ELEV. 6862.3'



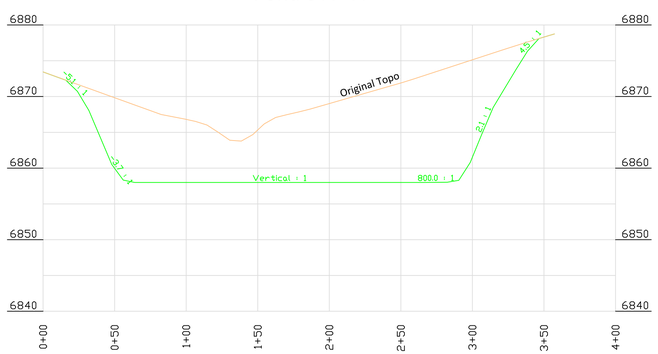
TYPICAL CROSS SECTION
Not to Scale

Pond Storage Volumes

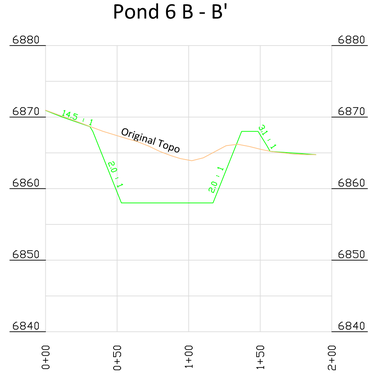
Sediment Control Structure No. 6

Water Elev (ft)	Area (Acres)	Average Area	Volume (Acre-Ft)	Accumulated Volume (Acre-Ft)	Stage
6858.00	0.233	-	-	-	Bottom Pond
6859.00	0.284	0.259	0.259	0.259	
6860.00	0.324	0.304	0.304	0.563	60% Sediment Cleanout
6861.00	0.370	0.347	0.347	0.910	Max Sediment Level
6862.00	0.394	0.382	0.382	1.292	
6863.00	0.429	0.412	0.412	1.703	
6864.00	0.468	0.449	0.449	2.152	
6865.00	0.489	0.479	0.479	2.630	
6866.00	0.549	0.519	0.519	3.149	Principle Spillway
6867.00	0.579	0.564	0.564	3.713	Emergency Spillway
6868.00	0.601	0.590	0.590	4.303	Top of Dike

Pond 6 A - A'



Pond 6 B - B'



Pond #6

Required Storage for 10 year,
24 hr event = 1.43 acre/ft

1"=10' X-Section Scale 1"=50'

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REGISTERED PROFESSIONAL ENGINEER
STATE OF UTAH
#154168
DAN W. GUY

SEDIMENT IMPOUNDMENT 6 DETAILS

COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 5-68

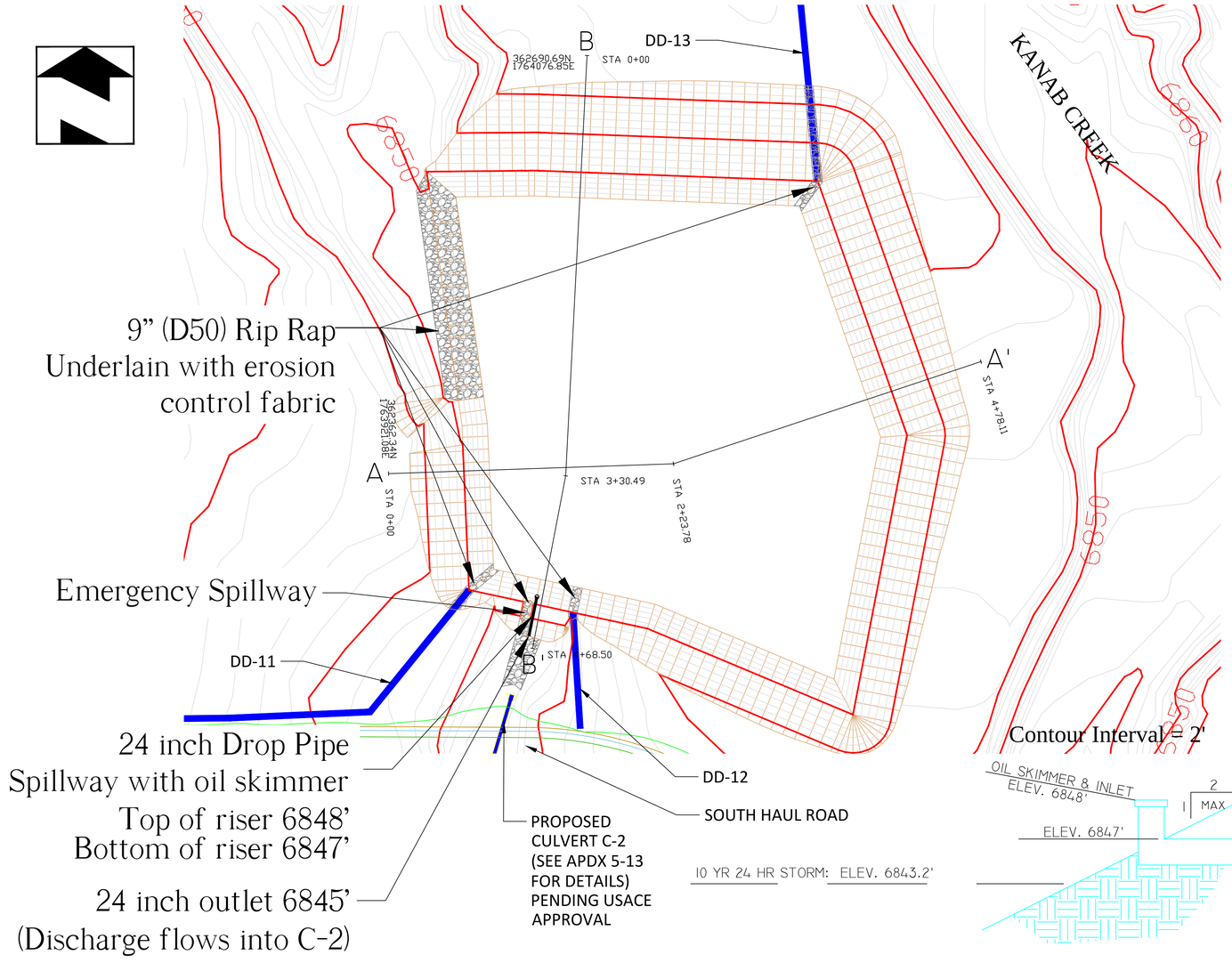
REVISIONS

BY:	DATE:
XX	XX/XX/XX

DRAWN BY:	CHECKED BY:	DATE:	SCALE:	SHEET
A. CHRISTENSEN	DG	10/12/15	1" = 50'	

DRAWING: 5-68

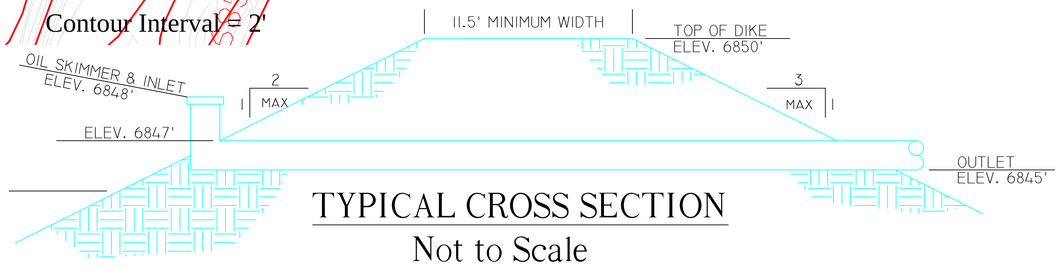
JOB NUMBER: 1400



Pond Storage Volumes

Sediment Control Structure No. 7

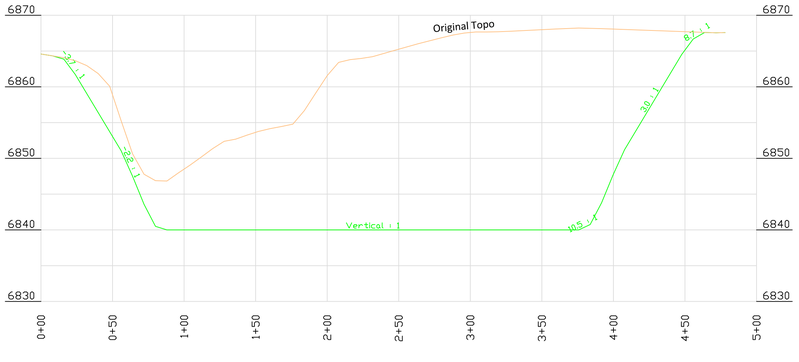
Water Elev (ft)	Area (Acres)	Average Area	Volume (Acre-Ft)	Accumulated Volume (Acre-Ft)	Stage
6840.00	2.071	-	-	-	Bottom Pond
6841.00	2.210	2.141	2.141	2.141	
6842.00	2.284	2.247	2.247	4.388	60% Sediment Cleanout
6843.00	2.356	2.320	2.320	6.708	Max Sediment Level
6844.00	2.414	2.385	2.385	9.093	
6845.00	2.477	2.446	2.446	11.538	
6846.00	2.542	2.510	2.510	14.048	
6847.00	2.598	2.570	2.570	16.618	
6848.00	2.676	2.637	2.637	19.255	Principle Spillway
6849.00	2.746	2.711	2.711	21.966	Emergency Spillway
6850.00	2.776	2.761	2.761	24.727	Top of Dike



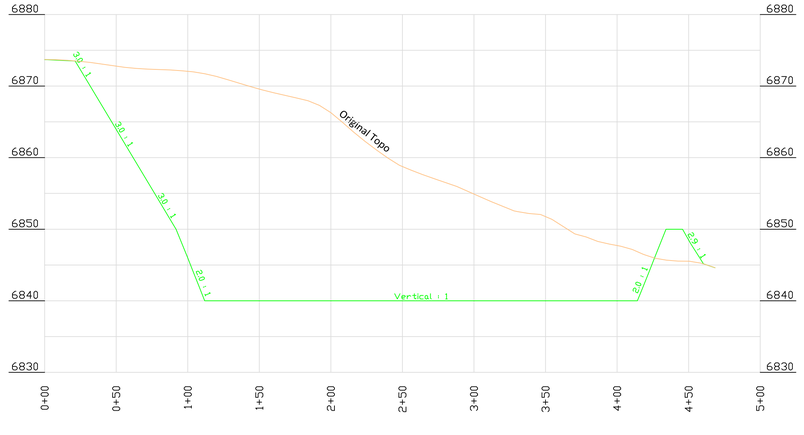
TYPICAL CROSS SECTION

Not to Scale

Pond 7 A - A'



Pond 7 B - B'



Pond #7

Required Storage for 10 year,
24 hr event = 7.11 acre/ft

X-Section Scale
1"=10'
1"=50'

Alton Coal Development
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REGISTERED PROFESSIONAL ENGINEER #154168 DANIEL W. GUY

SEDIMENT IMPOUNDMENT 7 DETAILS

COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 5-69

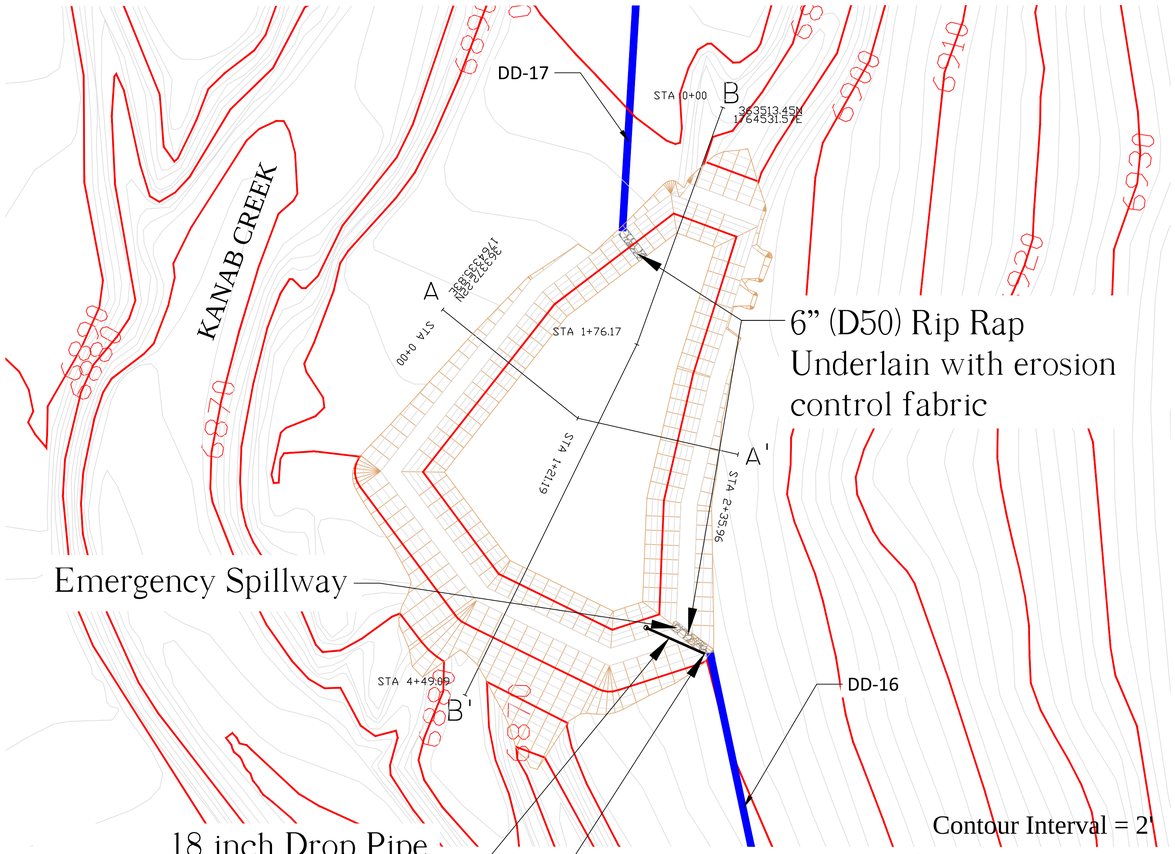
REVISIONS

BY:	DATE:
ARC	10/12/15

DRAWN BY:	CHECKED BY:	DATE:	SCALE:	SHEET
A. CHRISTENSEN	DG	4/10/15	1" = 50'	

DRAWING: 5-69

JOB NUMBER: 1400

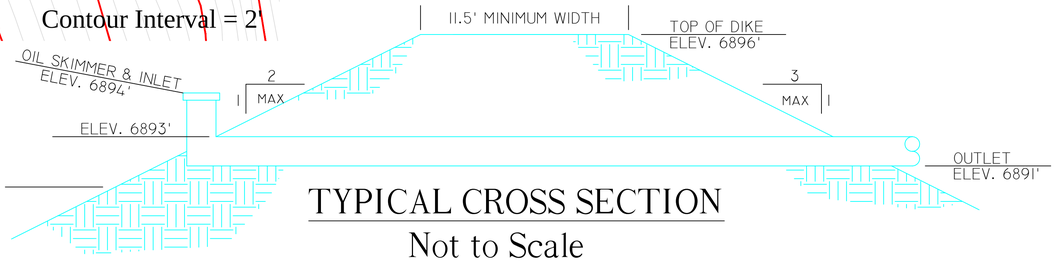


Contour Interval = 2'

Pond Storage Volumes

Sediment Control Structure No. 8

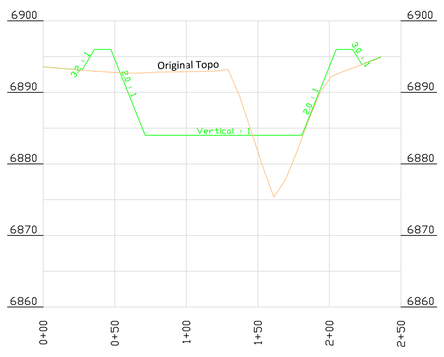
Water Elev (ft)	Area (Acres)	Average Area	Volume (Acre-Ft)	Accumulated Volume (Acre-Ft)	Stage
6884.00	0.519	-	-	-	Bottom Pond
6885.00	0.600	0.560	0.560	0.560	
6886.00	0.644	0.622	0.622	1.182	
6887.00	0.678	0.661	0.661	1.843	
6888.00	0.716	0.697	0.697	2.540	60% Sediment Cleanout
6889.00	0.750	0.733	0.733	3.273	Max Sediment Level
6890.00	0.787	0.769	0.769	4.041	
6891.00	0.823	0.805	0.805	4.846	
6892.00	0.861	0.842	0.842	5.688	
6893.00	0.901	0.881	0.881	6.569	
6894.00	0.949	0.925	0.925	7.494	Principle Spillway
6895.00	1.001	0.975	0.975	8.469	Emergency Spillway
6896.00	1.010	1.006	1.006	9.475	Top of Dike



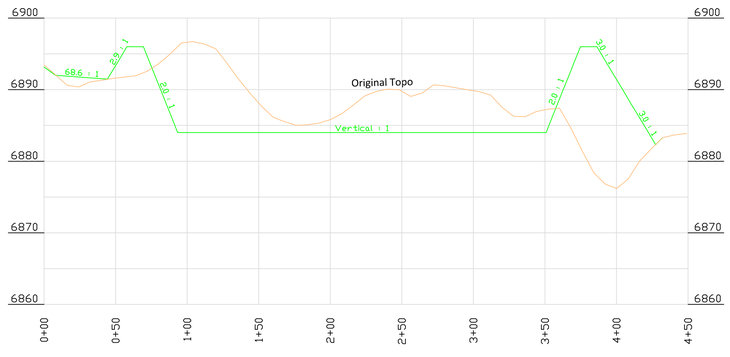
TYPICAL CROSS SECTION

Not to Scale

Pond 8 A - A'



Pond 8 B - B'



Pond #8

Required Storage for 10 year,
24 hr event = 1.66 acre/ft

1"=10' X-Section Scale
1"=50'

Alton Coal Development
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REGISTERED PROFESSIONAL ENGINEER #154168 DAN W. GUY

SEDIMENT IMPOUNDMENT 8 DETAILS

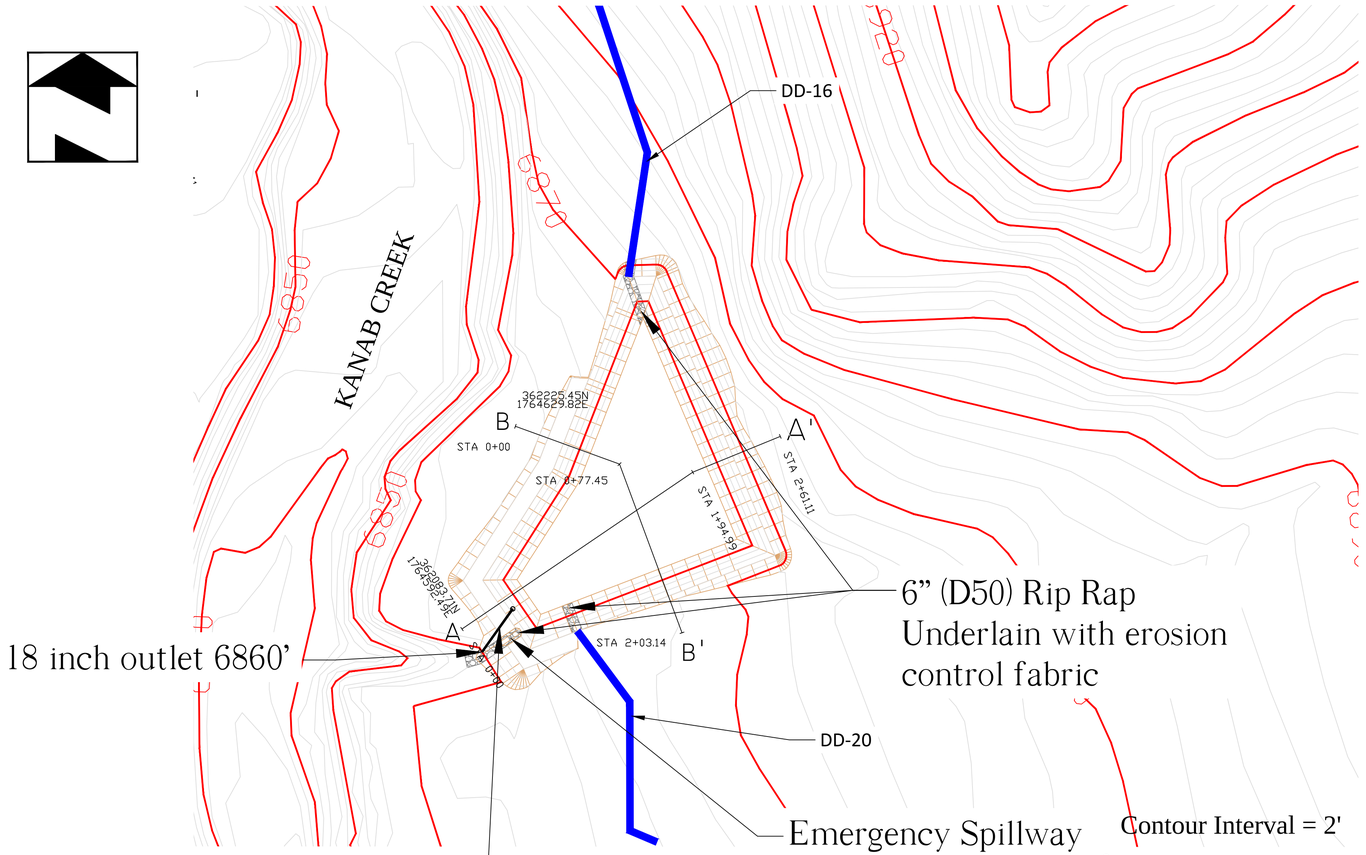
COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 5-70

REVISIONS

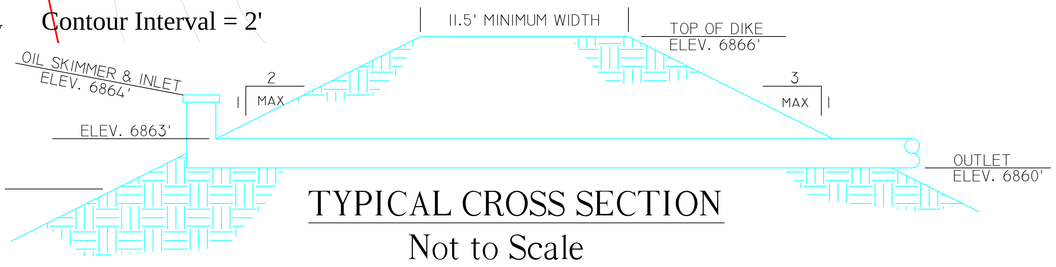
DATE:	BY:
10/12/15	ARC

DRAWN BY: A. CHRISTENSEN	CHECKED BY: DG
DRAWING: 5-70	DATE: 4/10/15
JOB NUMBER: 1400	SCALE: 1" = 50'
	SHEET



Contour Interval = 2'

10 YR 24 HR STORM: ELEV. 6862.7'



TYPICAL CROSS SECTION

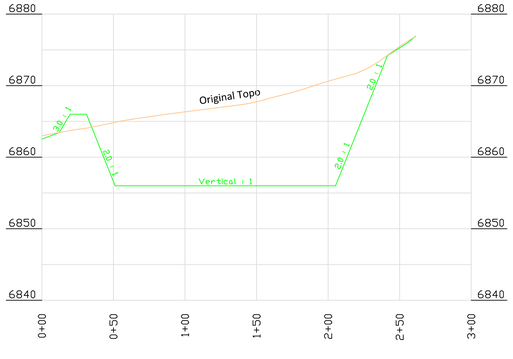
Not to Scale

Pond Storage Volumes

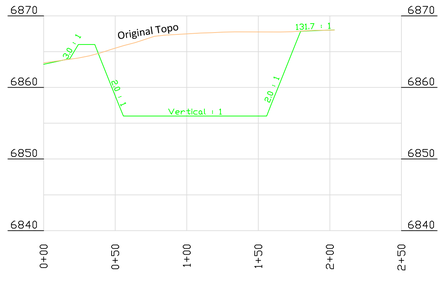
Sediment Control Structure No. 9

Water Elev (ft)	Area (Acres)	Average Area	Volume (Acre-Ft)	Accumulated Volume (Acre-Ft)	Stage
6856	0.273	-	-	-	Bottom Pond
6857	0.334	0.304	0.304	0.304	
6858	0.371	0.353	0.353	0.656	
6859	0.402	0.387	0.387	1.043	60% Sediment Cleanout
6860	0.431	0.417	0.417	1.459	
6860.5	0.446	0.438	0.219	1.678	Max Sediment Level
6861	0.460	0.453	0.226	1.905	
6862	0.489	0.475	0.475	2.379	
6863	0.519	0.504	0.504	2.883	
6864	0.558	0.539	0.539	3.422	Principle Spillway
6865	0.595	0.577	0.577	3.998	Emergency Spillway
6866	0.610	0.603	0.603	4.601	Top of Dike

Pond 9 A - A'



Pond 9 B - B'



Pond #9

Required Storage for 10 year,
24 hr event = 2.73 acre/ft

Alton Coal Development
Coal Hollow Project
463 North 100 West, Suite 1
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REGISTERED ENGINEER #154168 DAN W. GUY UTAH PROFESSIONAL

SEDIMENT IMPOUNDMENT 9 DETAILS

COAL HOLLOW PROJECT
ALTON, UTAH

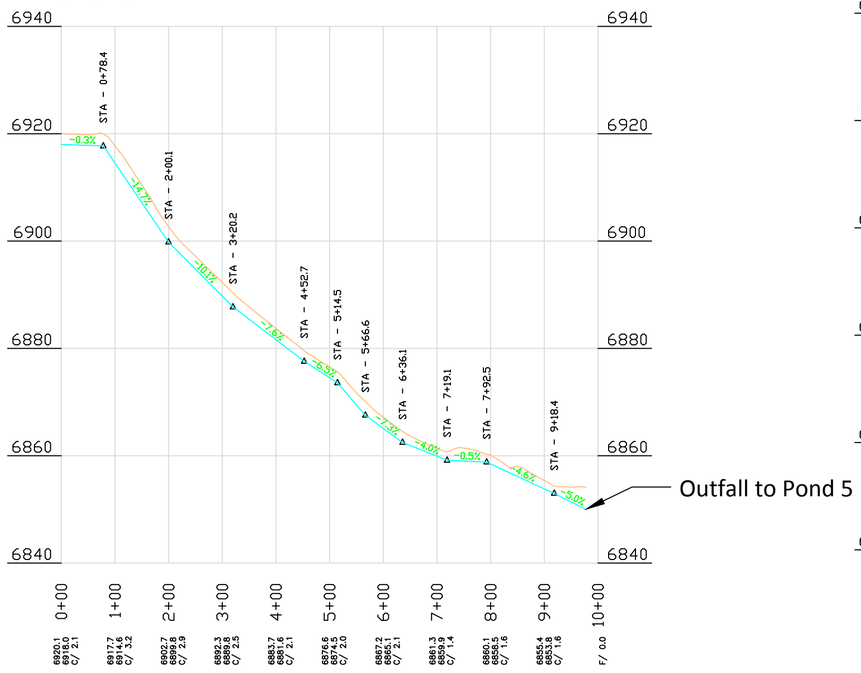
DRAWING: 5-71

REVISIONS

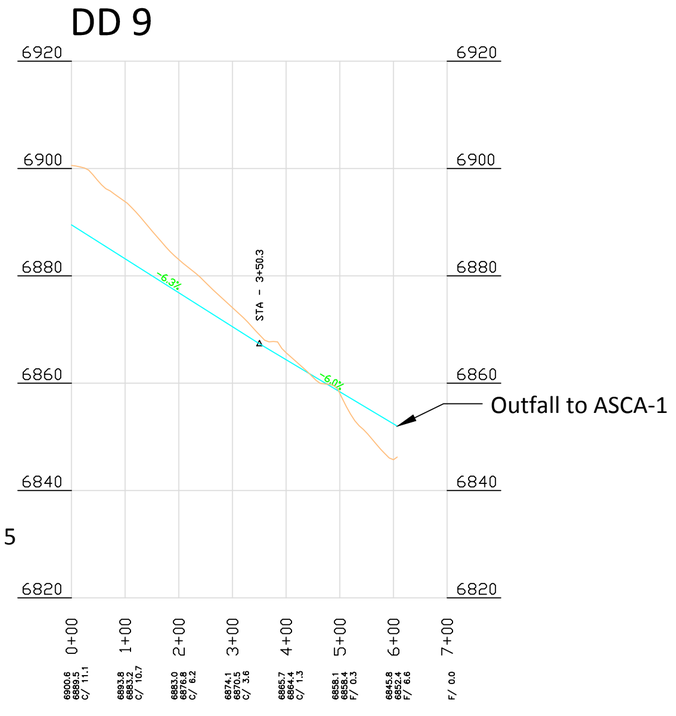
DATE:	BY:
10/12/15	ARC

DRAWN BY:	CHECKED BY:	DATE:	SCALE:	SHEET
A. CHRISTENSEN	DG	4/10/15	1" = 50'	
DRAWING: 5-71				JOB NUMBER: 1400

DD 5

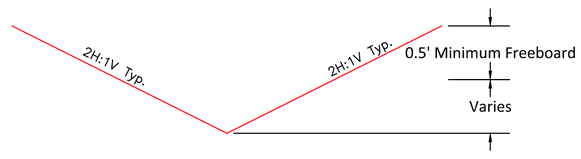


DD 9



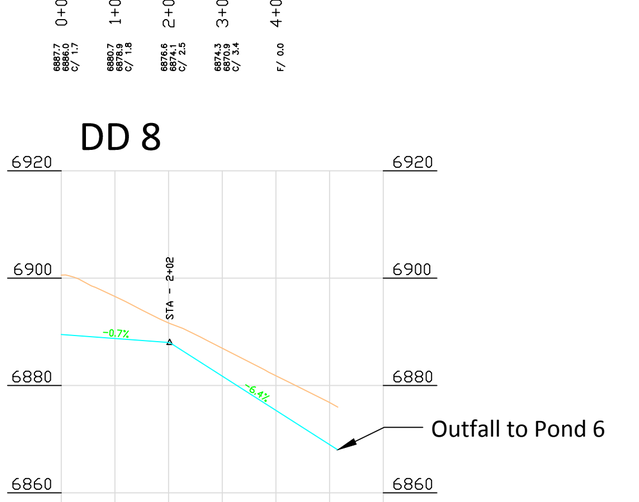
Diversion Ditch Typical Section

(See Appendix 5-12, Table 4)



Triangular Channel
Equal Side Slopes

DD 6



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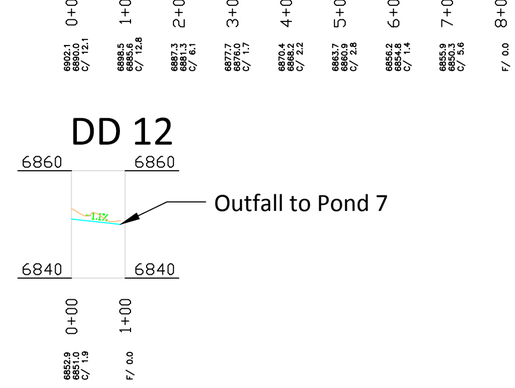

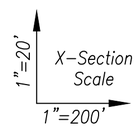

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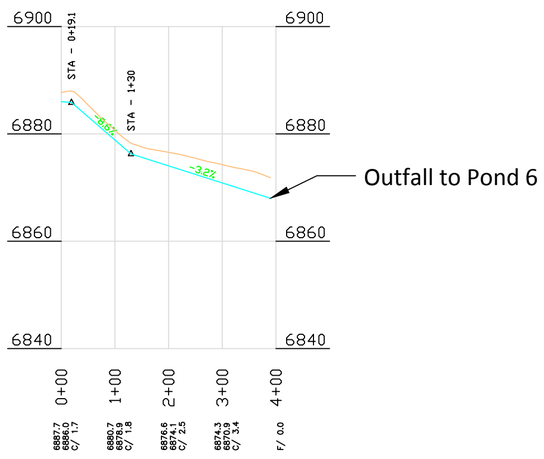
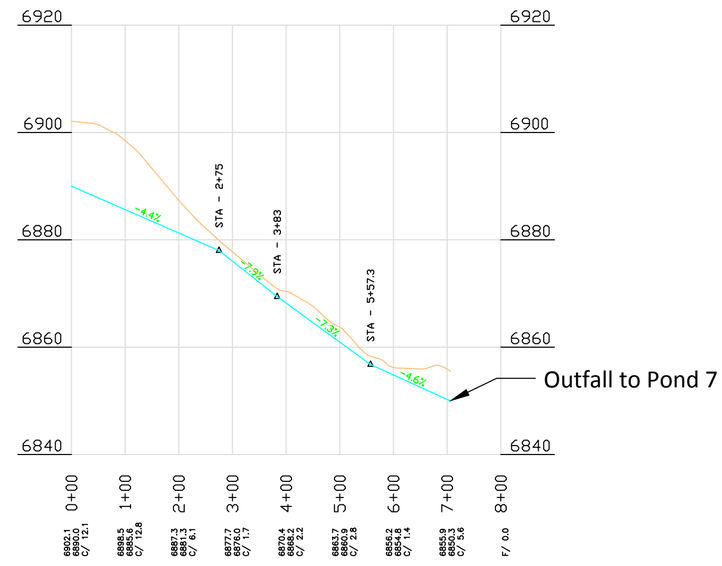


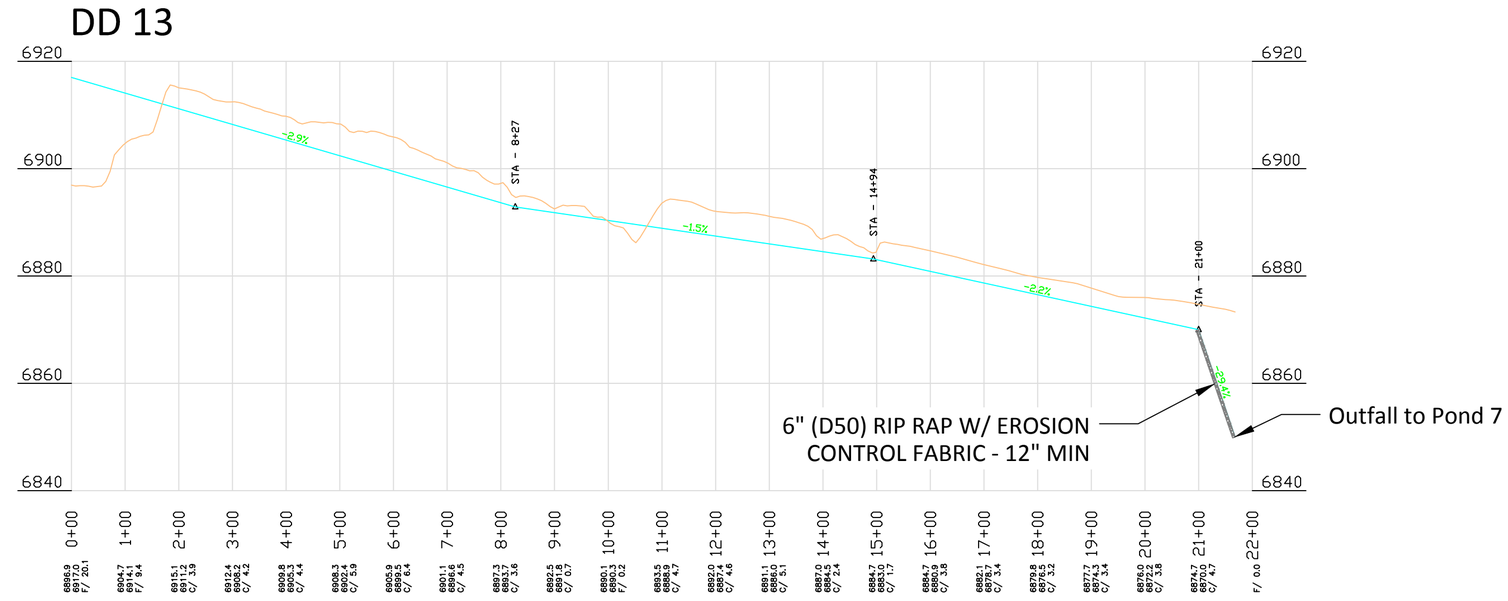
DD 11



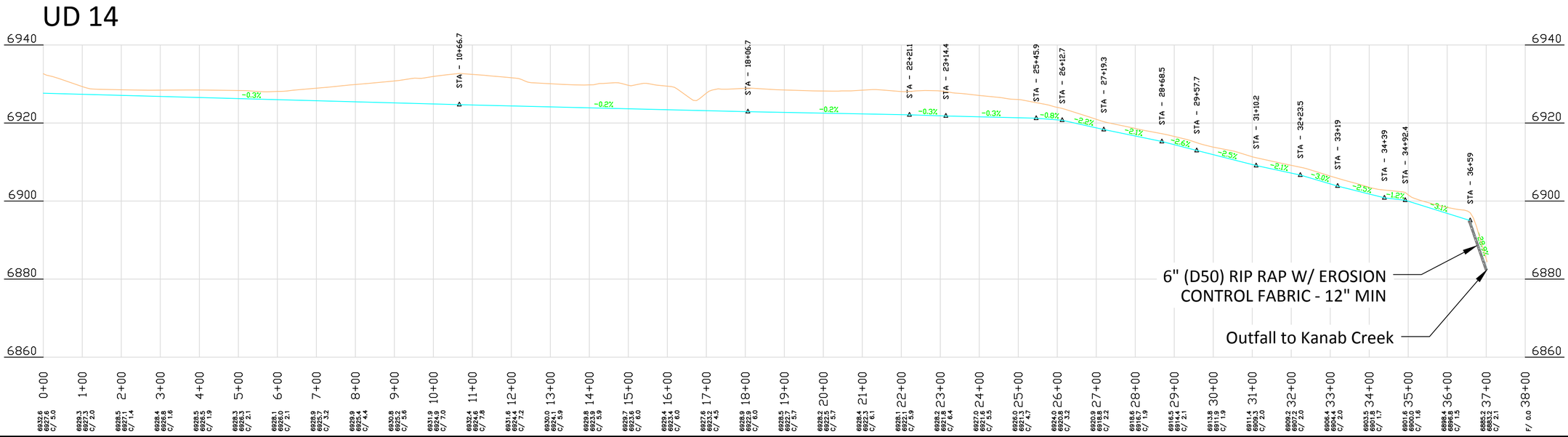
DD 8

DD 12

DD 13



UD 14



LEGEND:

- PROPOSED DITCH
- ORIGINAL TOPOGRAPHY

DRAWN BY:	CHECKED BY:
A. CHRISTENSEN	DWG
DRAWING: 5–72	DATE: 4/10/15
	SCALE: 1" = 200'
JOB NUMBER: 0001	SHEET

REVISIONS

DATE:	BY:
10/12/15	ARC

DIVERSION DITCH DETAILS
DD-5 thru UD-14

NORTH
COAL HOLLOW
PROJECT
ALTON, UTAH

DRAWING: 5-72

UTAH REGISTERED #154168 DAN W. GUY PROFESSIONAL ENGINEER

Alton Coal Development
Coal Hollow Project
463 North 100 West, Suite 1
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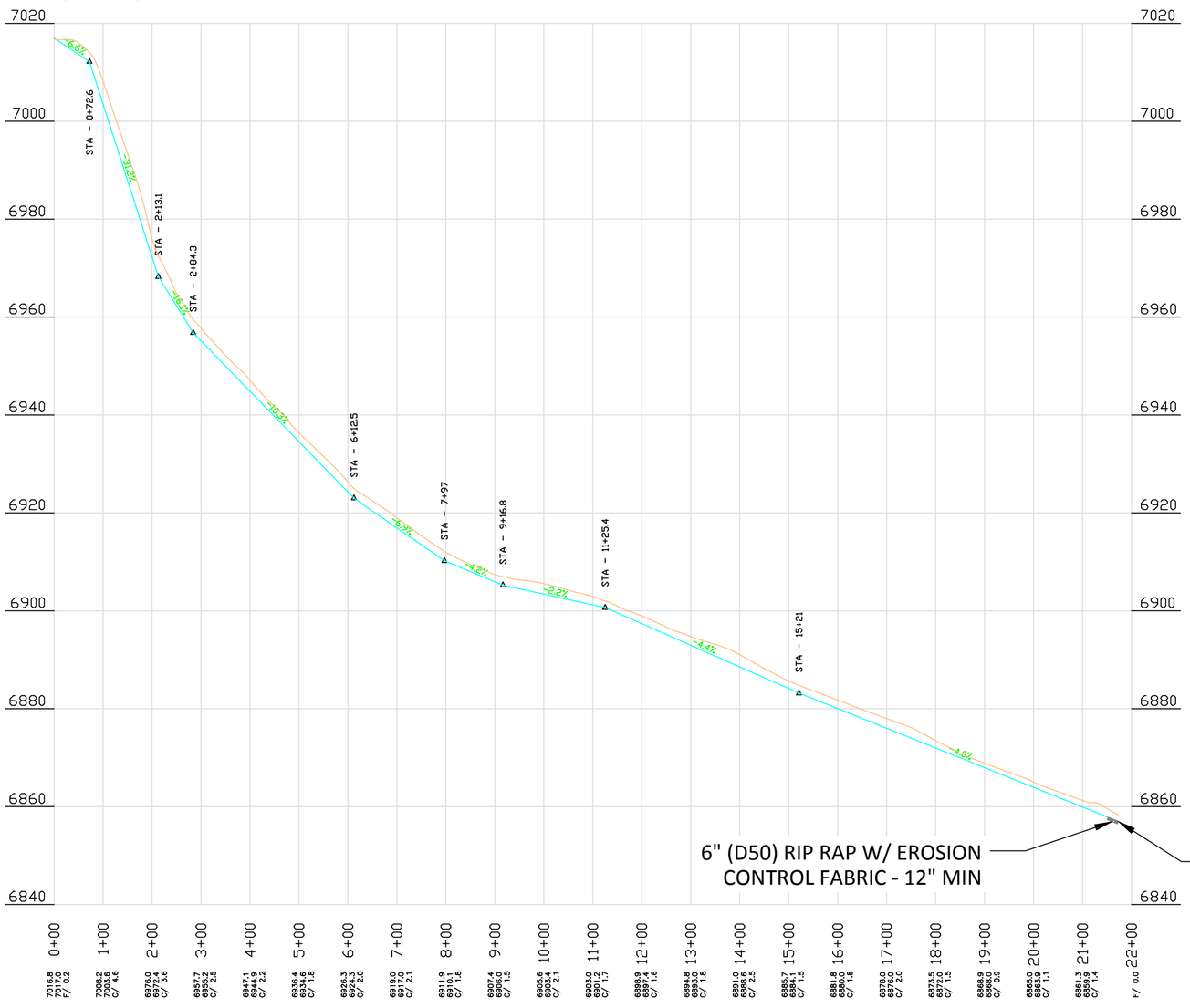
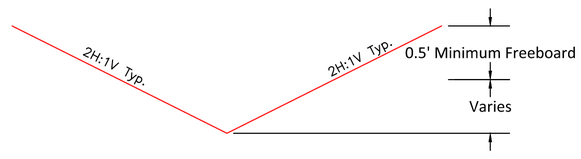
UD 15



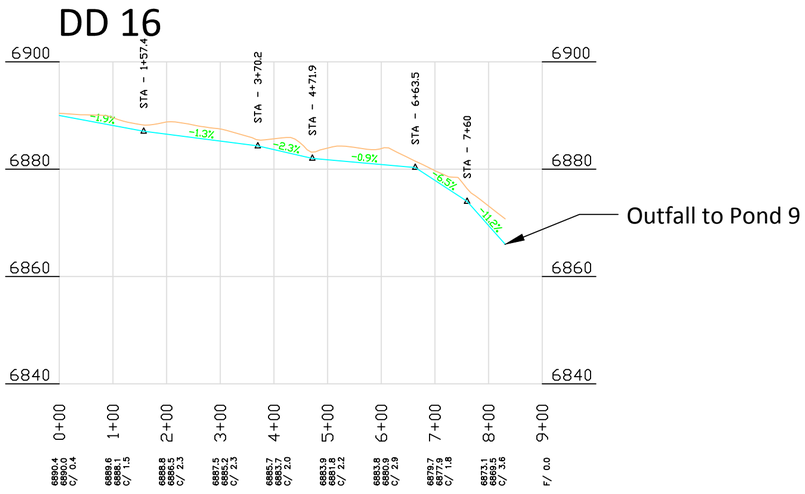
Diversion Ditch Typical Section

(See Appendix 5-12, Table 4)

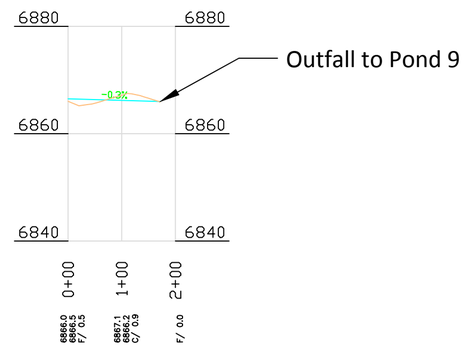


Triangular Channel
Equal Side Slopes

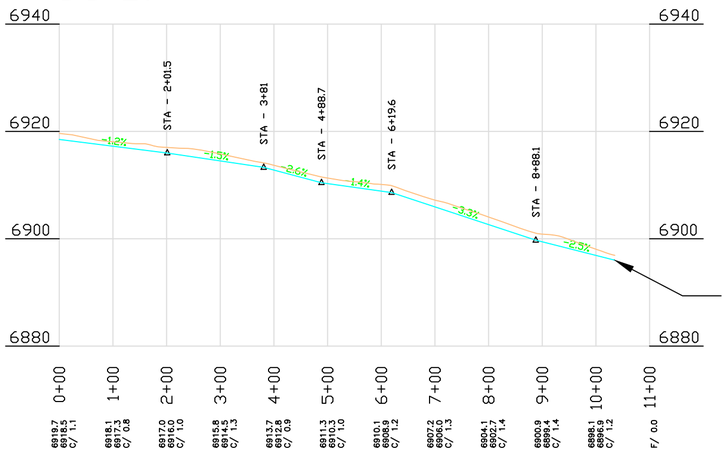
DD 16



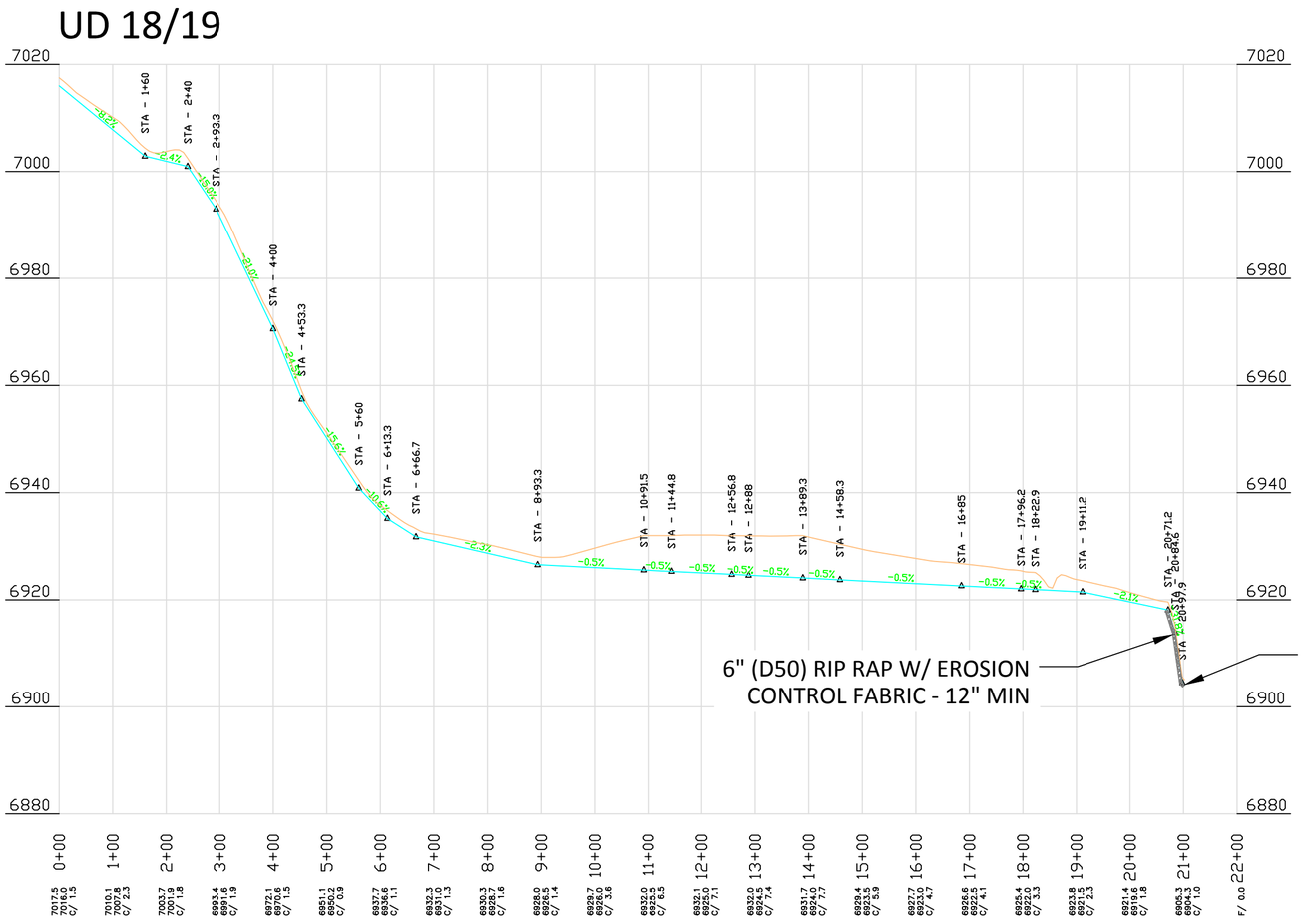
DD 20



DD 17



UD 18/19



1"=20' X-Section Scale
1"=200'

LEGEND:

- PROPOSED DITCH
- ORIGINAL TOPOGRAPHY

DRAWN BY:	CHECKED BY:
A. CHRISTENSEN	DWG
DRAWING: 5-73	DATE: 4/10/15
	SCALE: 1" = 200'
JOB NUMBER: 0001	SHEET

REVISIONS

DATE:	BY:
10/12/15	ARC

DIVERSION DITCH DETAILS DD-15 thru DD-20

NORTH
COAL HOLLOW
PROJECT
ALTON, UTAH

DRAWING: 5-73

UTAH REGISTERED #154168 DAN W. GUY PROFESSIONAL ENGINEER

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Cedar City, Utah 84721
Phone (435)867-5331
Fax (435)867-1192

Range 6 West
Range 5 West

Township 39 South

N

0 500 1000 1500

Existing County Road 136

12

7

18

A
A'
B
B'
C
C'
D
D'
E
E'
F
F'
G
G'

County Road 136 Bypass

Existing County Road 136

Existing Alton Coal Mine Road

Section Lines for Drawing 5-75
Contour Interval = 4'

LEGEND:
- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- SECTION LINE
- FOUND SECTION CORNER
- FOUND PROPERTY CORNER

DRAWN BY:	CHECKED BY:
A. CHRISTENSEN	DWG
DRAWING: 5-74	DATE: 4/10/15
	SCALE: 1" = 400'
JOB NUMBER: 0001	SHEET

REVISIONS

DATE:	BY:
10/12/15	AC

POST MINING TOPOGRAPHY

NORTH COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 5-74

UTAH REGISTERED #154168 DAN W. GUY PROFESSIONAL ENGINEER

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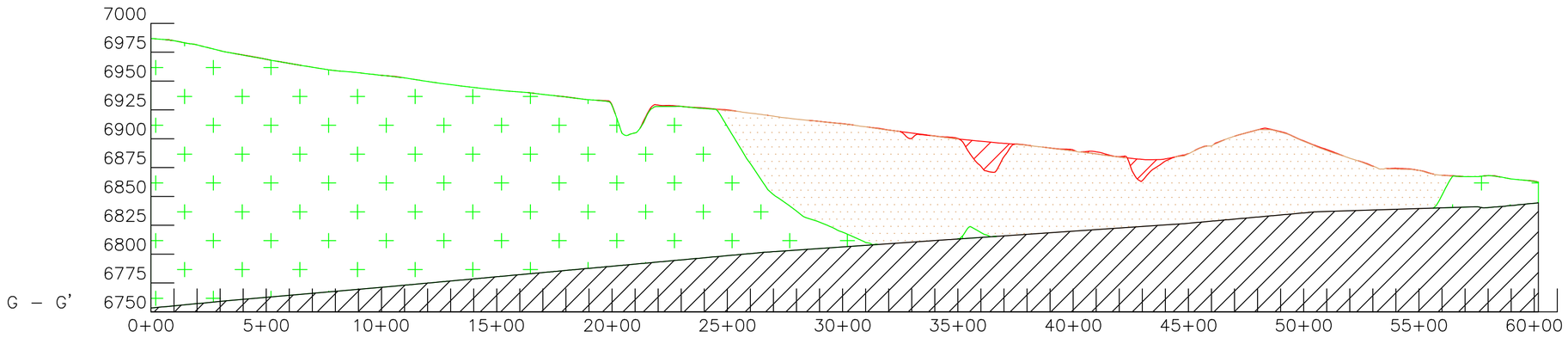
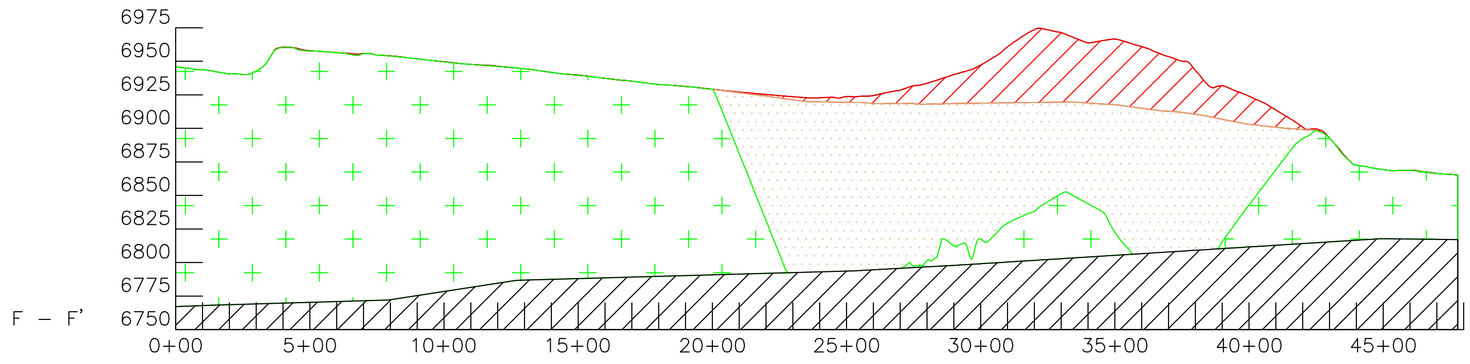
Coal Hollow Project
463 North 100 West, Suite 1
Cedar City, Utah 84721
Phone (435)867-5331
Fax (435)867-1192

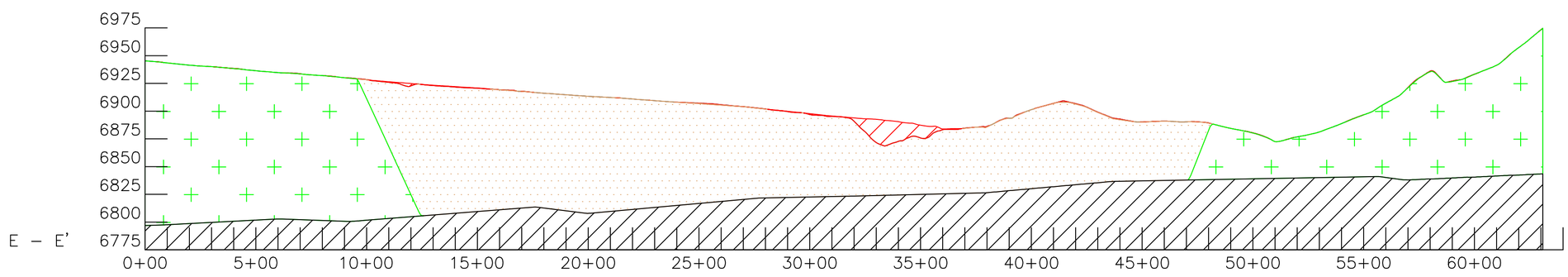
RECLAIM DIFFERENCE

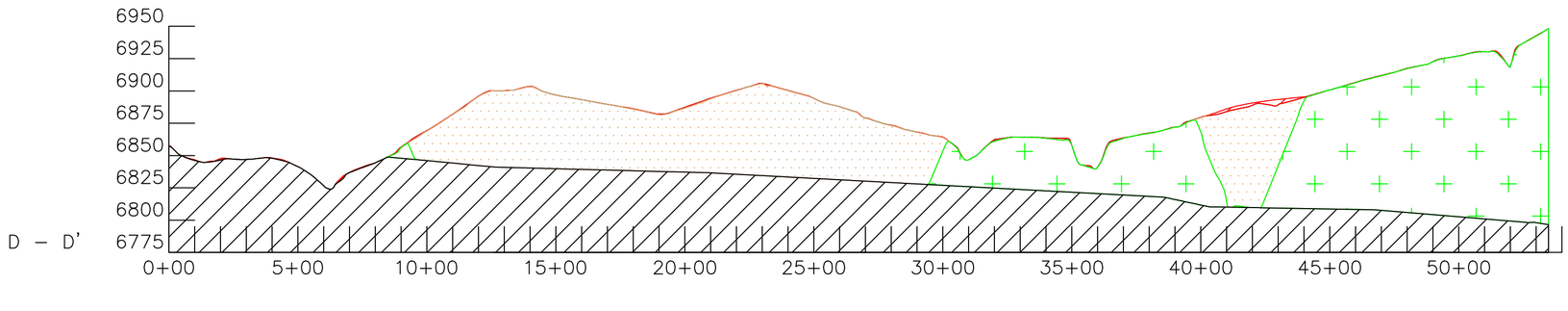
BACKFILL

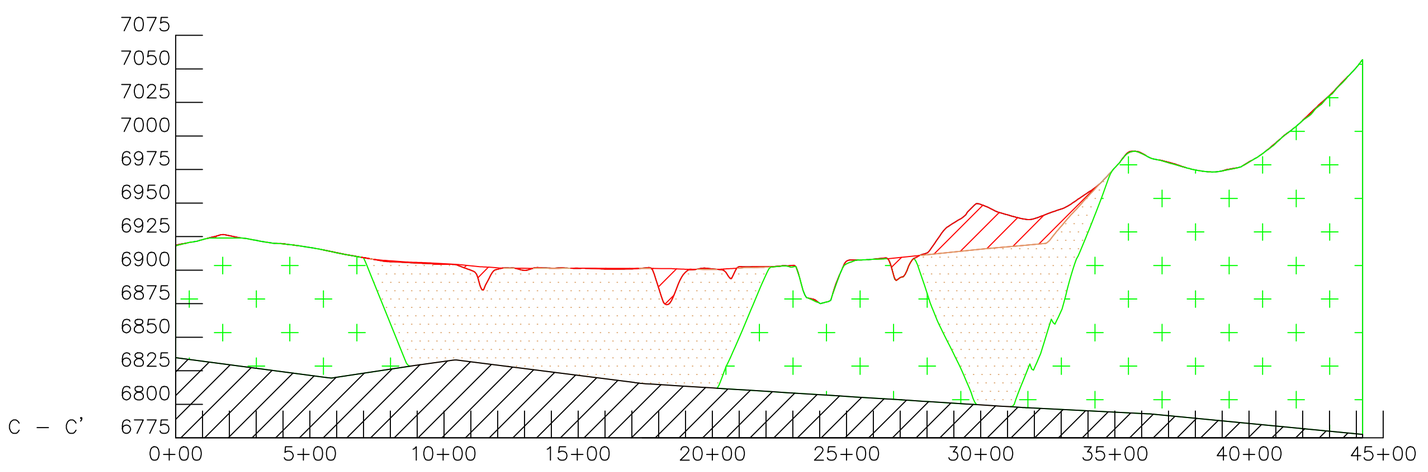
UNMINED

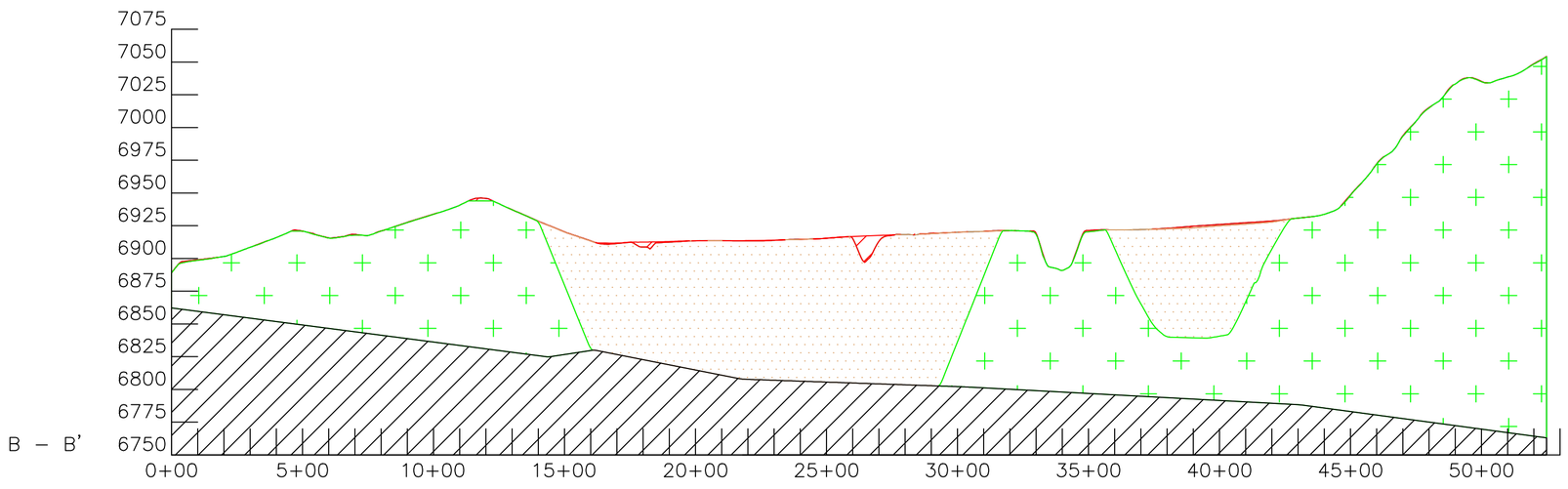






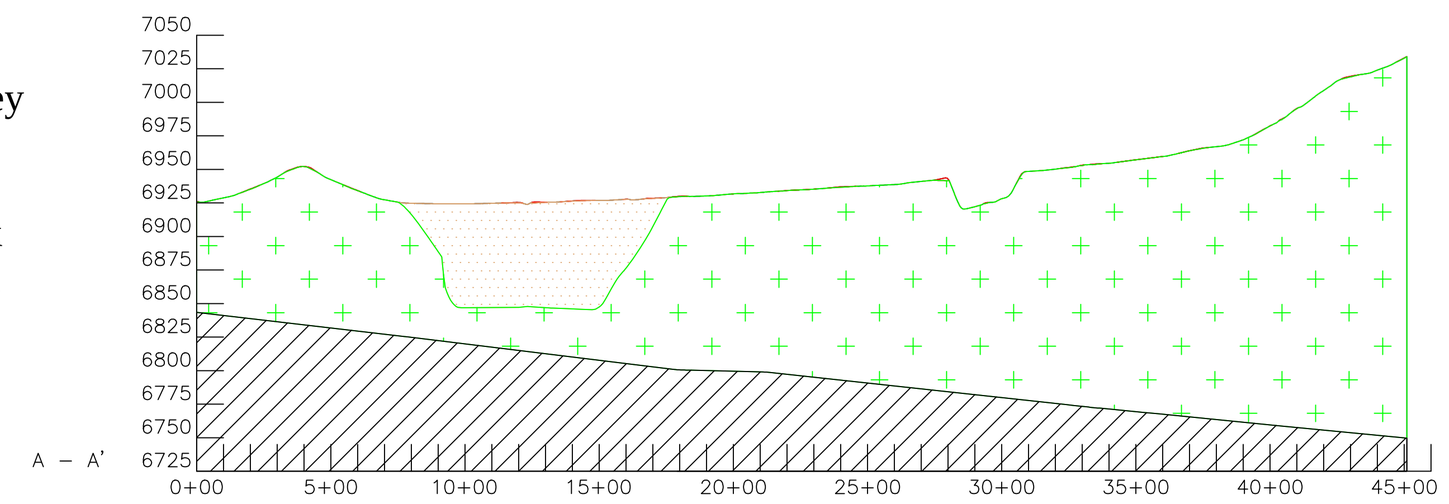






Note:
Reclaim Difference in a valley indicates fill above original contour.
Reclaim Difference in a peak indicates void below original contour.

See Section Lines from Drawing 5-71



LEGEND:
- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- SECTION LINE
- FOUND SECTION CORNER
- FOUND PROPERTY CORNER

DRAWN BY:	CHECKED BY:
A. CHRISTENSEN	DWG
DRAWING: 5–75	DATE: 4/10/15
	SCALE: 1" = 400'
JOB NUMBER: 0001	SHEET

REVISIONS

DATE:	BY:
10/12/15	AC

POST MINING TOPOGRAPHY CROSS SECTIONS

NORTH
COAL HOLLOW
PROJECT
ALTON, UTAH

DRAWING: 5-75

UTAH REGISTERED #154168 DAN W. GUY PROFESSIONAL ENGINEER

Alton Coal Development
Coal Hollow Project
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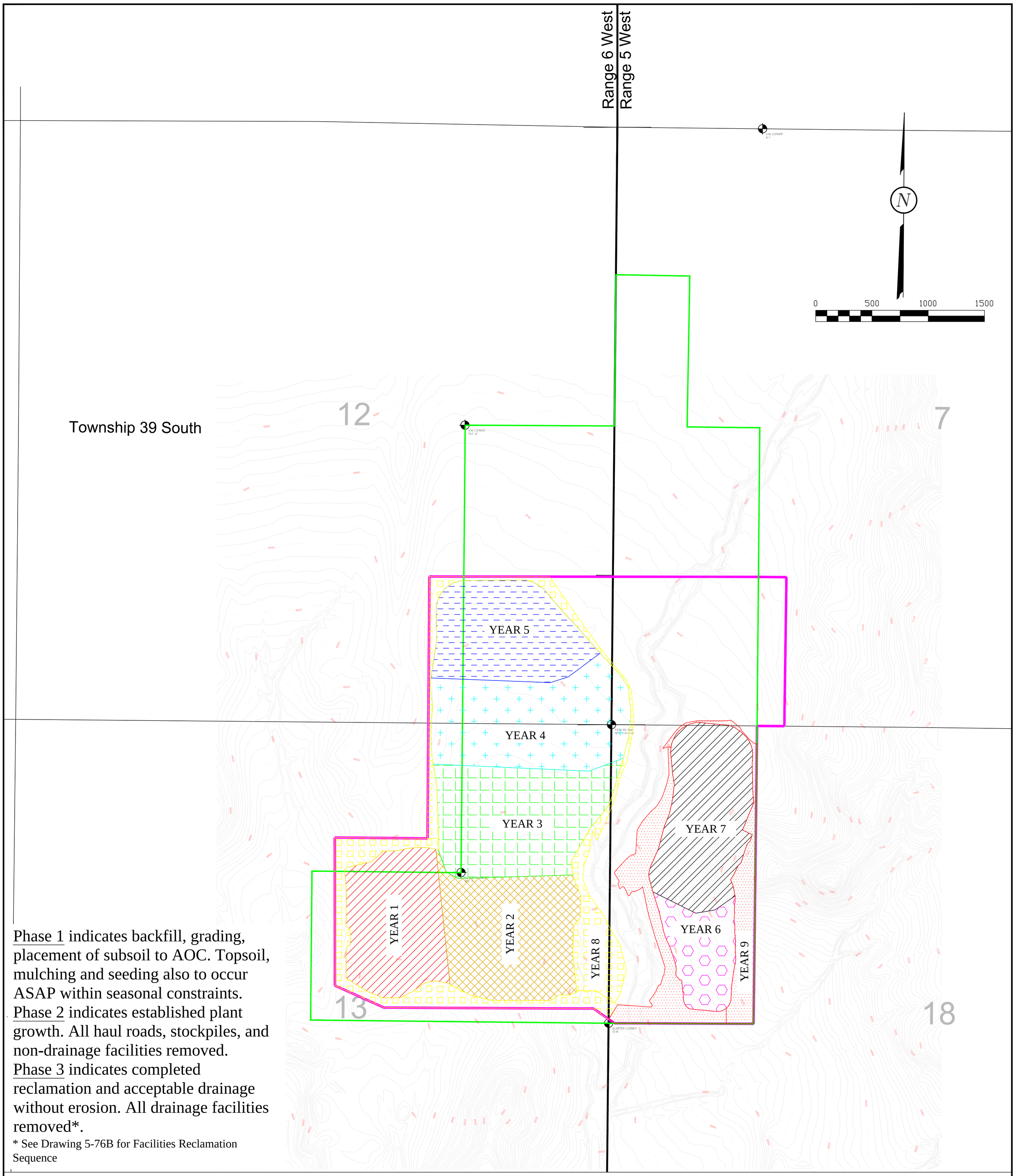
Fax (435)867-1192



Phase 1 indicates backfill, grading, placement of subsoil to AOC. Topsoil, mulching and seeding also to occur ASAP within seasonal constraints.
Phase 2 indicates established plant growth. All haul roads, stockpiles, and non-drainage facilities removed.
Phase 3 indicates completed reclamation and acceptable drainage without erosion. All drainage facilities removed*.

* See Drawing 5-76B for Facilities Reclamation Sequence

Phase 1 Reclamation:

- Year 1 Reclaim = 23.7 Acres
- Year 2 Reclaim = 29.0 Acres
- Year 3 Reclaim = 31.1 Acres
- Year 4 Reclaim = 32.4 Acres
- Year 5 Reclaim = 24.3 Acres
- Year 6 Reclaim = 11.6 Acres
- Year 7 Reclaim = 26.4 Acres
- Year 8 Reclaim = 00.0 Acres
- Year 9 Reclaim = 00.0 Acres

Total Ph. 1 Reclamation = 178.4 Acres

Phase 2/Surface Reclamation:

- Year 1 Reclaim = 00.0 Acres
- Year 2 Reclaim = 00.0 Acres
- Year 3 Reclaim = 00.0 Acres
- Year 4 Reclaim = 00.0 Acres
- Year 5 Reclaim = 00.0 Acres
- Year 6 Reclaim = 00.0 Acres
- Year 7 Reclaim = 00.0 Acres
- Year 8 Reclaim = 167.6 Acres - (Includes yrs. 1-5 Phase 2)
- Year 9 Reclaim = 57.2 Acres - (Includes yrs. 6-7 Phase 2)

Total Ph. 2 Reclamation = 224.9 Acres

Phase 3 Reclamation to be completed and released within the 5-10 year timeframe from Phase 1.

LEGEND:
- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- SECTION LINE
- FOUND SECTION CORNER
- FOUND PROPERTY CORNER

DRAWN BY: A. CHRISTENSEN	CHECKED BY: DWG
DRAWING: 5-76A	DATE: 4/16/15
	SCALE: 1" = 400'
JOB NUMBER: 0001	SHEET

REVISIONS	
DATE:	BY:
10/12/15	AC

EARTHWORKS RECLAMATION SEQUENCE

NORTH COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 5-76A

UTAH REGISTERED #154168 DAN W. GUY PROFESSIONAL ENGINEER

Alton Coal Development
Coal Hollow Project
463 North 100 West, Suite 1
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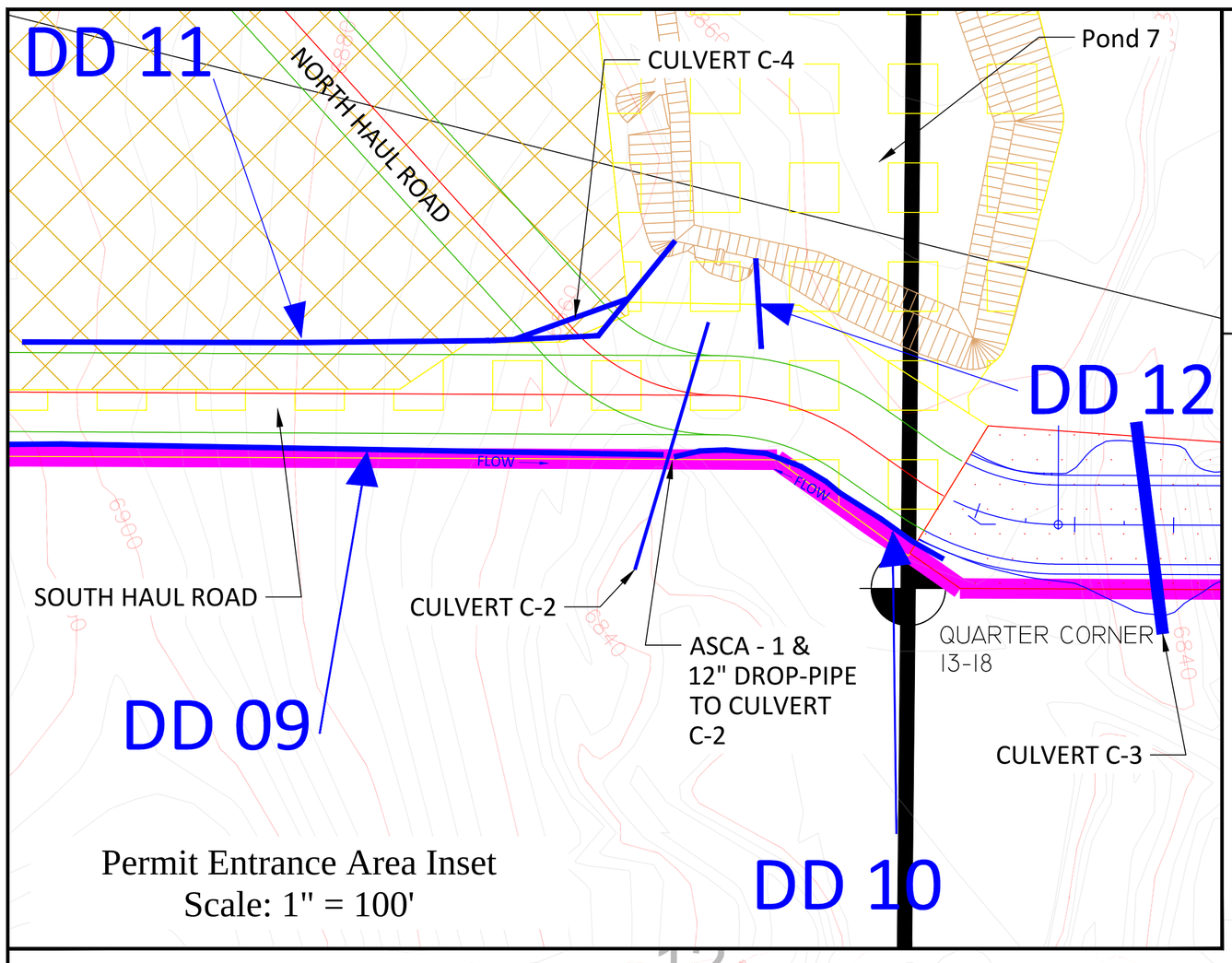
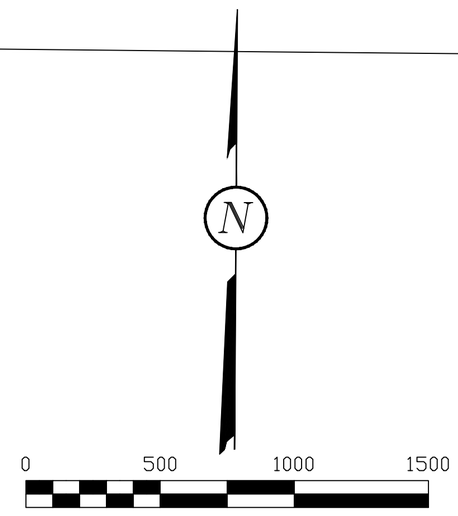
Phone (435)867-5331
Fax (435)867-1192



Permit Entrance Area Inset
Scale: 1" = 100'

Range 6 West
Range 5 West



Township 39 South

12

7

18

13

NORTH HAUL ROAD - Reclaimed after completion of haul from HWT to Pit 20-21 in Year 5.

TOPSOIL STOCKPILES - Rehandled to original ownership during Year 5-6. See Drawing 2-4.

TEMPORARY STOCKPILES - Rehandled to Area 1 within first year of mining.

SOUTH HAUL ROAD - Mined out as pits progress from west to east in Years 1-2. Access to ponds re-established on backfill and reclaimed with ponds.

CULVERT C-1 - Partially mined out in year 1. Reclaimed when ponds are deemed complete in Phase 3 reclamation.

CULVERT C-4 - Removed as part of North Haul Road reclamation in Year 5.

CULVERT C-2 & ASCA-1 - Removed at final closure of North Private Lease in consultation with Kane County.

CULVERT C-3 - Removed at Final Closure of North Private Lease.

UD 14
UD 19
DD 13
DD 17
UD 18
Pond 8
DD 16
UD 15
Pond 9
DD 05
Pond 7
Pond 5
DD 06
DD 11
DD 12
DD 20
DD 07
DD 08
DD 09
DD 10
Pond 6

Phase 1 Reclamation:

- Year 1 Reclaim = 23.7 Acres
- Year 2 Reclaim = 29.0 Acres
- Year 3 Reclaim = 31.1 Acres
- Year 4 Reclaim = 32.4 Acres
- Year 5 Reclaim = 24.3 Acres
- Year 6 Reclaim = 11.6 Acres
- Year 7 Reclaim = 26.4 Acres
- Year 8 Reclaim = 00.0 Acres
- Year 9 Reclaim = 00.0 Acres

Total Ph. 1 Reclamation = 178.4 Acres

Phase 2/Surface Reclamation:

- Year 1 Reclaim = 00.0 Acres
- Year 2 Reclaim = 00.0 Acres
- Year 3 Reclaim = 00.0 Acres
- Year 4 Reclaim = 00.0 Acres
- Year 5 Reclaim = 00.0 Acres
- Year 6 Reclaim = 00.0 Acres
- Year 7 Reclaim = 00.0 Acres
- Year 8 Reclaim = 167.6 Acres - (Includes yrs. 1-5 Phase 2)
- Year 9 Reclaim = 57.2 Acres - (Includes yrs. 6-7 Phase 2)

Total Ph. 2 Reclamation = 224.9 Acres

Phase 3 Reclamation to be completed and released within the 5-10 year timeframe from Phase 1. **Ponds, culverts and ditches** to be assessed and reclaimed as Phase 3 nears completion.

Contour Interval = 4'

LEGEND:

- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- SECTION LINE
- FOUND SECTION CORNER
- FOUND PROPERTY CORNER

DRAWN BY:	CHECKED BY:
A. CHRISTENSEN	DWG
DRAWING: 5-76B	DATE: 10/12/15
	SCALE: 1" = 400'
JOB NUMBER: 0001	SHEET

REVISIONS

DATE:	BY:
xx/xx/xx	xx

FACILITIES RECLAMATION SEQUENCE

NORTH COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 5-76B

UTAH REGISTERED #154168 DAN W. GUY PROFESSIONAL ENGINEER

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Coal Hollow Project
463 North 100 West, Suite 1
Cedar City, Utah 84721
Phone (435)867-5331
Fax (435)867-1192

Range 6 West
Range 5 West

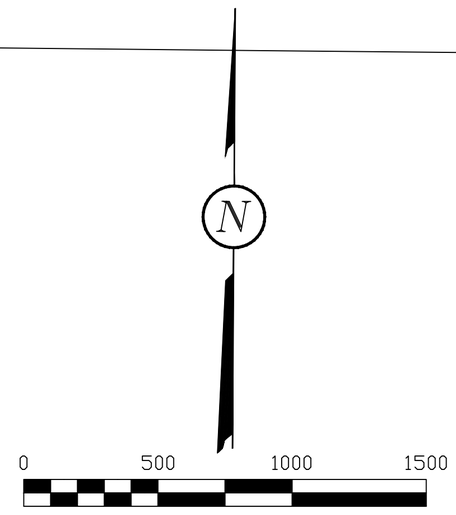
Township 39 South

12

7

13

18



1/16 CORNER
6-7

1/16 CORNER
SEC 12

SURF 2
14.7 Acres

Pit 21
16.9 Acres

Pit 20 7.4 Acres

Pit 19 7.5 Acres

Pit 18 9.1 Acres

Pit 17 8.0 Acres

Pit 16 7.8 Acres

Pit 15 6.9 Acres

Pit 14 7.1 Acres

Pit 13 5.9 Acres

Pit 12 5.9 Acres

Pit 11 5.2 Acres

UNDISTURBED & KANAB CREEK
70.7 Acres

HWT 02
26.4 Acres

SURF 4
8.1 Acres

HWT 01
11.6 Acres

SURF 1
12.5 Acres

Pit 01 2.9 Acres
Pit 02 4.0 Acres
Pit 03 5.3 Acres
Pit 04 5.6 Acres
Pit 05 5.8 Acres
Pit 06 4.8 Acres
Pit 07 4.5 Acres
Pit 08 4.8 Acres
Pit 09 5.9 Acres
Pit 10 8.8 Acres

SURF 2
14.7 Acres

SURF 3
11.1 Acres

1/4 CORNER
SEC 13

QUARTER CORNER
13-18

QUARTER CORNER
SEC 18-19

Undisturbed = 70.7 Acres
Surface Disturbance = 46.5 Acres
Open Pit Disturbance = 178.4 Acres
Total Disturbance = 224.9 Acres

LEGEND:
- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- SECTION LINE
- FOUND SECTION CORNER
- FOUND PROPERTY CORNER

DRAWN BY:	CHECKED BY:
A. CHRISTENSEN	DWG
DRAWING: 5–77	DATE: 4/10/15
	SCALE: 1” = 400’
JOB NUMBER: 0001	SHEET

REVISIONS

DATE:	BY:
10/12/15	AC

BOND POLYGONS

NORTH COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 5-77

UTAH REGISTERED PROFESSIONAL ENGINEER
#154168
DAN W. GUY

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Coal Hollow Project
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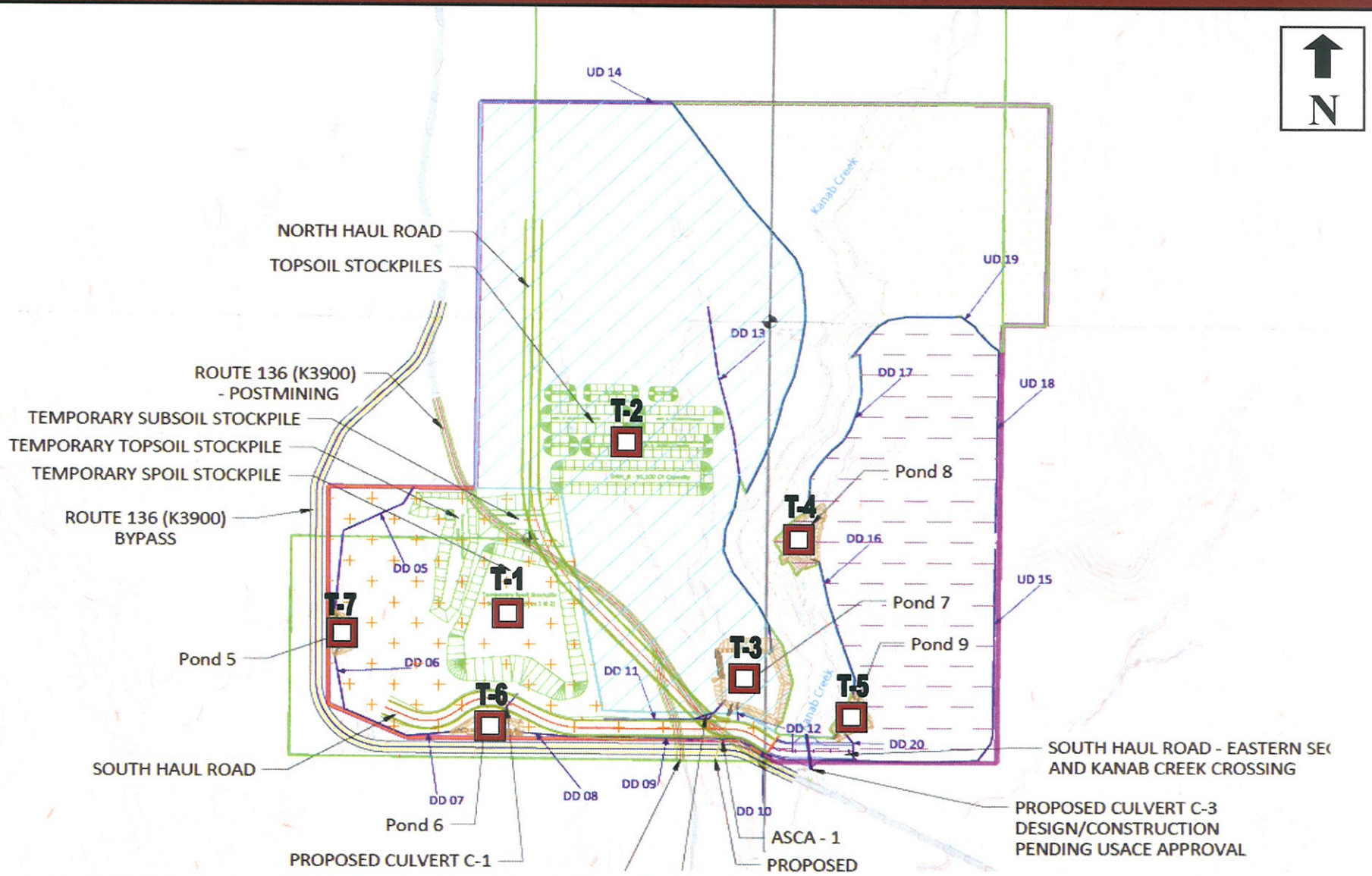
Cedar City, Utah 84721
Phone (435)867-5331
Fax (435)867-1192

SITE PLAN



Notes:
Key: Approximate Trench Location
Plan: Not to Scale

PROJECT:	**Alton Coal Development - North Area South East of Alton, Utah**
Client:	Alton Coal Development
Report No:	RG1434

GEM ENGINEERING, INC.

Drawing 5-78

R645-301-600 GEOLOGY

R645-301-610 INTRODUCTION

This section describes the geologic conditions in the ~~proposed~~ Coal Hollow Mine permit and adjacent areas. This section also describes the geologic conditions in the proposed North Lease area.

611 GENERAL REQUIREMENTS

A characterization of the geology within and adjacent to the ~~proposed~~ Coal Hollow Mine permit area and the proposed North Lease area is given in sections R645-301-621 and R645-301-627. A description of the proposed operating plan for the casing and sealing of exploration holes and boreholes is presented in R645-301-630.

612 CERTIFICATION OF CROSS SECTIONS, MAPS, AND PLANS

All cross sections, maps and plans as required by R645-301-622 have been prepared and certified as described under R645-301-512.100. The cross sections and maps that are included in this permit application and are required to be certified have been prepared by or under the direction of a qualified, registered, professional engineer or a professional geologist, with assistance from experts in related fields such as hydrology, geology and landscape architecture.

R645-301-620 ENVIRONMENTAL DESCRIPTION

R645-301-621 GENERAL REQUIREMENTS

Description of Regional Geology

The coal to be mined at the ~~proposed~~ Coal Hollow Mine permit area and the North Lease area is of Cretaceous age and resides in the Alton Coal Field of southwestern Utah. The Alton Coal Field is a roughly horseshoe-shaped region that is situated between the Kaiparowits Coal Field to the east, and the Kolob Coal Field to the west.

The topography in the Alton Coal Field is marked by bench and slope topography. Topographic relief in the region is approximately 2,800 feet, with elevations ranging from about 9,300 feet on top of the Paunsaugunt Plateau, to about 6,500 feet in the valley bottoms. The economic coal seams are located primarily along the western and southern flanks of the Paunsaugunt Plateau.

The geologic history, geology, stratigraphy, and structure of the Alton Coal Field have been described by Doelling (1972) and Tilton (Appendix 6-3; 2001) and are summarized below. A map of geologic formations exposed at the surface in the proposed Coal Hollow Mine permit area is shown in Drawing 6-1. A cross-section showing the regional geologic conditions in the Alton Coal Field is presented in Drawing 6-2.

Geologic History

During the Jurassic, sediment deposition into a slowly subsiding basin occurred, mostly by fluvial or eolian mechanisms. Later, during the Upper Jurassic, the area was intermittently inundated by a shallow, restrictive sea, with the accompanying deposition of sediments eroded from Mesozoic rocks to the south and west. Subsequently, prior to the end of the Lower Cretaceous, a broad uplift centered west of the Paunsaugunt area occurred, resulting in the erosion of the uplifted areas. Subsequently, to the east, the rock sequence down to the Entrada Formation was eroded away. To the west, the rock sequence down to the Carmel was eroded away. After additional erosion of the region occurred, during the latest Cretaceous or earliest Upper Cretaceous, the land subsided and the region was covered with sediments. The source of these sediments lay mostly to the west and perhaps also to the south. As the Cretaceous Interior Seaway migrated westward, rock deposition occurred in fluvial, paludal, lagoonal and perhaps nearshore marine environments during transgressions and regressions of the seaway. This deposition resulted in the formation of the rocks of the Dakota Formation, which include the economic coal seams of the Alton Coal Field. The two principal coal seams of the Dakota Formation were formed during this period, one near the beginning and the other near the end of Dakota time. After the deposition of the Dakota Formation, the area experienced marine conditions as the Cretaceous Interior Seaway encroached westward toward eastern Iron County, resulting in the deposition of the marine shales of the Tropic Shale. After the subsequent eastward regression of the seaway, nearshore sand deposition occurred, resulting in the deposition of the Straight Cliffs Formation. Deposition of the Wahweap and Formation occurred as floodplains developed and an alternating sequence of sandstones and shales was deposited. Subsidence then ceased for a time and uneven erosion of the region occurred. Subsequent fluvial deposition resulted in the deposition of the Kaiparowits Formation on the erosional surface. Later, in the early Tertiary period, the area subsided and was filled with a lake in which the carbonate sediments of the Claron Formation were deposited. Thereafter, volcanism became active to the west and spread to the margins of the Paunsaugunt. Various agglomerates and volcanic breccias were deposited along the western margin of the plateau. Late in the Tertiary period, the Sevier and Paunsaugunt Fault systems became active. During the Pleistocene, several cinder cones developed which extruded olivine basalts. These include Bald Knoll, Buck Knoll, and others.

Stratigraphy

Stratigraphic units present in the Alton Coal Field area are described in ascending order below. A stratigraphic column showing these geologic formations is shown in Drawing 6-3. A diagrammatic correlation of Cretaceous units in southern and south-central Utah is shown in Drawing 6-4.

Navajo Sandstone (Lower Jurassic)

The Navajo Sandstone is a light gray to tan, locally cross-bedded massive eolian sandstone that underlies the region. Where exposed south of the Alton area, it forms the regionally prominent White Cliffs topographic feature. The Thousand Pockets Tongue of the Navajo Sandstone intertongues with the overlying Carmel Formation. Thickness of the Navajo Sandstone exceeds 1,000 feet in the Paunsaugunt Plateau region. The Navajo Sandstone does not crop out in the ~~proposed~~ Coal Hollow Mine permit area or in the North Lease area. The Nevada Power No. 1 Well, which is located within the North Lease area, reportedly encountered the top of the Navajo Sandstone at a depth of 1,430 feet below ground surface.

Carmel Formation (Upper Jurassic)

The Carmel Formation unconformably overlies the Navajo Sandstone in the region. The Carmel Formation is heterogeneous and consists of limestone, siltstone, sandstone, and gypsum beds. The formation has been subdivided into several members by previous researchers. These include the Wiggler Wash Member, the Winsor Member, the Paria River Member, the Crystal Peak Member, and the Kolob Limestone Member. The thickness of the Carmel Formation ranges from about 650 to 800 feet in the Alton Coal Field area and the formation thickens to the west. The Winsor Member of the Carmel Formation crops out in the bottom of the Kanab Creek drainage about one mile south of the ~~proposed~~ Coal Hollow Mine permit area.

Entrada Sandstone (Upper Jurassic)

The Entrada Sandstone, which may be as thick as 500 feet regionally, is present above the Carmel Formation in the eastern portion of the Alton Coal Field. The formation consists predominantly of siltstone and cross-bedded or fine-grained massive sandstone. The formation is not present in the ~~proposed~~ Coal Hollow Mine permit area.

Dakota Formation (Cretaceous)

The Dakota Formation contains the economic coal seams in the Alton Coal Field. The formation consists of fine- to medium-grained sandstone with interbedded gray shale, carbonaceous shale, and coal. In most locations, shaley strata dominate the formation, comprising about 60 to 75 percent of the formation. The unit characteristically forms ledge and slope topography. In the ~~proposed~~ Coal Hollow Mine permit and adjacent area the Dakota Formation directly overlies the Carmel Formation. Regionally, the outcrop of the Dakota Formation forms the Gray Cliffs topographic feature. The economic coal seams in the Alton Coal Field are present near the base (Bald Knoll coal zone) and near the top of the formation (Smirl coal zone). Local thinner coal seams that are not of economic importance are present in the center of the formation. The thickness in the western portion of the Alton Coal Field is about 450 feet. In the eastern portion of the Alton Coal Field, the Dakota Formation is about 150 feet thick and rests on the Entrada Sandstone.

Tropic Shale (Cretaceous)

The Tropic Shale consists predominantly of gray and carbonaceous silty shale and claystone with a few marine sandstone beds located mostly in its upper part. The formation typically weathers at the surface to a clayey soil that typically forms gentle, vegetated slopes. The Tropic Shale is present (in some locations covered with shallow alluvial or colluvial deposits) at the land surface over most of the ~~proposed~~ Coal Hollow Mine permit area and along the eastern and western margins of the proposed North Lease area. The formation was deposited in an open-marine offshore environment during the maximum westward transgression of the Cretaceous Western Interior Seaway in the Late Cretaceous (Tilton, 2001). Near the top of the formation, more sandy horizons are interbedded with the mudstone units of the formation. These sandy units together with the sandstone at the base of the overlying Straight Cliffs Formation reflect the initial sand influx onto the marine environment of the Tropic Shale. The thickness of the Tropic Shale in the Alton Quadrangle is about 700 feet. In areas planned for mining at the ~~proposed~~ Coal Hollow Mine permit area, only the lower 200 to 250 feet of the Tropic Shale is present. The middle and upper portions of the formation having been removed from proposed mining areas by erosion in Sink Valley.

Information obtained from continuous core drilling in the Tropic Shale in planned mining areas in the ~~proposed~~ Coal Hollow Mine permit area and the proposed North Lease area indicates that the lower 200 to 250 feet of the formation consists of a fairly uniform sequence of soft, dark gray silty shale or thinly bedded claystone with occasional thin lenses of siltstone and occasional layers of bentonite-like clay being present. Strong, competent rock strata that could be of consequence to surface mining operations were not encountered in any of the boreholes. Drilling information obtained from the Tropic Shale during the 2005 drilling program is presented in Appendix 6-4. Drilling information from the 2012 drilling program in the proposed North Lease is also presented in Appendix 7-16~~7-4.~~ Physical and chemical information from the Tropic Shale are presented in Appendix 6-2. The locations of the 2005 boreholes are shown in Appendix 6-4 and also on Drawing 6-5. The locations of the 2012 boreholes are shown in Appendix 6-2~~6-4~~.

Straight Cliffs Formation (Cretaceous)

The Straight Cliffs Formation is approximately 1,200 feet thick in the Alton Quadrangle. The formation is comprised predominantly of calcite-cemented sandstone and mudstone, with sandstone composing about 75 percent of the total composition. The sandstones of the Straight Cliffs Formation make up the lower two-thirds of the ledges radiating out from the southern Paunsaugunt Plateau. Four members of the Straight Cliffs Formation have been identified in the Alton Quadrangle by Tilton (2001). These include the Tibbet Canyon Member (orange-gray weathering fine- to medium grained sandstone), the Smoky Hollow Member (interbedded sandstone, mudstone, and thin coal), the John Henry Member (interbedded mudstone and fluvial sandstone), and Drip Tank Member (light-gray cliff forming sandstone). The Straight Cliffs Formation outcrops on the hillsides east and north of the ~~proposed~~ Coal Hollow Mine permit area and to the east of the proposed North Lease area.

Wahweap and Kaiparowits Formations (Cretaceous)

The Wahweap Formation is composed of alternating sandy shales and thin- to thick-bedded sandstones. The unit contains carbonaceous shale and thin coal beds that are not of economic importance in its lower part. The unit forms step-like topography. Regionally, the Wahweap Formation is separated from the overlying Kaiparowits Formation by an unconformity. Erosion of both the Wahweap and Straight Cliffs Formations prior to the deposition of the Kaiparowits Formation may have locally reduced the thicknesses of these formations in the vicinity of the Paunsaugunt Plateau. The Kaiparowits Formation is composed of irregular beds of arkosic sandstone. The sandstone is weakly cemented by calcite cement. Because of difficulties identifying mappable boundaries between the Wahweap and Kaiparowits Formations in the Alton Quadrangle, the formations were mapped as an undivided unit (Tilton, 2001). The total thickness of the Wahweap and Kaiparowits Formations in the Alton Quadrangle ranges from about 600 to 800 feet.

Claron Formation (Tertiary)

The Claron Formation (also sometimes known as the Wasatch Formation, although the Utah Geological Survey uses the name Claron Formation) forms the cap rock over much of the Paunsaugunt Plateau. The formation is also present west of the Sevier Fault Zone west and north of the town of Alton. The unit is subdivided into a lower pink (also known as red) member and an upper white member, both consisting mostly of massive, fine-grained crystalline limestone of fluvial and lacustrine origin. Resistance to erosion varies both vertically and horizontally in the Claron Formation, resulting in a series of cliffs and steep joints. This condition, together with the presence of closely spaced joints, produces the unique topography associated with the Claron Formation. The Claron Formation is about 800 thick in the Alton Quadrangle. Also mapped together with the Claron Formation in the Alton Quadrangle is the Cretaceous Canaan Peak Formation. The Canaan Peak is a thin, discontinuous formation consisting primarily of conglomerate and conglomeratic sandstone with some mudstone interbeds sometimes present at the base of the Claron Formation. Thickness of the Canaan Peak Formation locally ranges from 0 to 30 feet.

Brian Head Formation (Tertiary)

The Brian Head Formation consists of interbedded pink and purplish-gray very fine-grained sandstone, friable sandstone, conglomerate, siltstone, mudstone, and limey mudstone in its lower part, and gray to white, fine- to medium-grained sandstone and calcarenite, in part with a volcanically derived clay matrix. The formation includes rocks present above the underlying white member of the Claron Formation and the overlying ash-flow tuff of the Needles Range Group. The unit is not resistant to erosion and has been eroded away from the top of the Paunsaugunt Plateau in the Alton Quadrangle. The formation is present in the rugged hills west of the Sevier Fault Zone near the town of Alton. The unit is about 200 feet thick in the Alton Quadrangle.

Quaternary Deposits

Quaternary deposits present in the ~~proposed~~ Coal Hollow Mine permit area and the North Lease area include pediment alluvium, landslide deposits, mass-wasting debris, and alluvial fan deposits. Narrow deposits of stream alluvium are present immediately adjacent to some stream channels.

The pediment alluvium deposits in the region consist of poorly sorted alluvial and colluvial silt, sand, and gravel deposited on broad pediments. After deposition, the pediment surfaces were abandoned as streams have cut down to lower levels.

Landslide deposits in the area are primarily gravity-transported hummocky deposits of mud, sand, and occasional blocks of sandstone. Most of the landslide deposits originated from the lower portion of the Straight Cliffs Formation and slid onto the underlying Tropic Shale, although movement within the Tropic Shale has also occurred. A conspicuous series of progressively built landslide deposits is present east of the Alton Amphitheater as a broad, rolling apron below the lowest cliffs of the Straight Cliffs Formation. The thickness of the landslide deposits locally ranges from a few feet to more than 100 feet.

Alluvium deposits in the region consist of unconsolidated clay, silt, sand, and gravel in and near existing drainages. These deposits exist as stream and fan alluvium and terrace deposits. In the headwaters of the mountain streams, the alluvial material consists predominantly of sand and gravel. In downstream areas, the alluvial material consists mostly of mud derived from the Tropic Shale. Alluvial thickness in the Alton Quadrangle typically ranges from a thin covering to about 10 feet or more.

In the Sink Valley and Lower Robinson Creek drainages near the ~~proposed~~ Coal Hollow Mine permit area, drilling information indicates that alluvial thicknesses are in some locations considerably greater. Alluvial thicknesses measured in the permit and adjacent area range from a thin veneer overlying bedrock formations in many areas to at least 140 feet in thickness along the eastern margins of Sink Valley (see Drawing 6-3). Much of the land surface in the proposed Coal Hollow Mine permit area consists of fan alluvium (mostly composed of clays, silts, and fine-grained sands) derived largely from the highly erodable Tropic Shale in adjacent highland areas east of the proposed permit area. Field investigations suggest that these fan deposits are associated with sheetfloods, debris flows and mud flows. Additional geologic information on alluvial deposition in the ~~proposed~~ Coal Hollow Mine permit and adjacent area is presented in Appendix 7-1.

An igneous dike consisting of black, fine-grained porphyritic olivine basalt is present northeast of Alton near Kanab Creek.

Structure

Rock strata in the region dip gently toward the north and north-east, generally from 1 to 5 degrees. The Alton Coal Field is bounded on the east by the Paunsaugunt Fault and on the west by the Sevier Fault. Regional displacements on these two faults are about 1,000 to 2,000 feet, and 100 to 800

feet, respectively. Additionally, several faults with lesser displacements have been mapped in the region, including the Sand Pass Fault zone (about 400 feet of offset), the Bald Knoll Fault (about 650 feet of offset), and the Sink Valley Fault (likely a few tens of feet of offset). Most local faults in the Alton Quadrangle trend in a northerly or north-westerly direction, are several miles long, and are near vertical. A prominent north- to northwest-trending vertical joint set is present in the Upper Cretaceous sandstone rocks in the region. Stratal dips vary appreciably near the fault zones.

Description of Coal Seam Geology

The coal seams in the Alton Coal Field are located in the Smoky Hollow Member of the Straight Cliffs Formation, and in the Dakota Formation. The coal seam in the Smoky Hollow Member, which occurs within the lower 3 feet of the Member, is only a few inches in thickness and is not of economic importance. Within the Dakota Formation, two regionally important coal zones are present. These include the Smirl coal zone, which is located near the upper formational contact with the Tropic Shale, and the Bald Knoll coal zone, which is located about 200 feet below the Smirl coal zone near the base of the Dakota Formation. Doelling (1972) reported that the Smirl coal zone is 14 to 18 feet thick without splits, while the Bald Knoll coal zone contains several coal seams separated by thin splits, with the thickest seam being 4.8 feet thick. Doelling (1972) reports that coal in the Alton area is a high-volatile Bituminous coal. Additional information on coal quality is presented in Appendix 6-1 (confidential binder).

Within the Alton Quadrangle, five small mines and two prospects have been worked. Production from these mines was small, with a total production from all mines of 35,000 and 50,000 tons from the late 1920s to 1969, when the last mine closed. The last operating mine in the Alton Coal Field was the Smirl Mine, which was located about 1.5 miles south of the town of Alton. In its last year of operation, a total of 1,597 tons of coal was produced. The Smirl Mine portal was sealed by the Utah Division of Oil, Gas and Mining in 1992.

622 **CROSS-SECTIONS, MAPS AND PLANS**

622.100
Elevations of the coal seam to be mined and locations of drill holes are listed in Table 6-1 and shown in Drawing 6-5. Drill hole collar elevations and intervals cored and plugged are shown in Table 6-1.

622.200
The depth and thickness of surrounding strata are shown on geologic cross-sections in Drawing 6-3 and Appendix 7-16~~6-3N~~. Additional information regarding thicknesses of strata in the proposed Coal Hollow Mine permit area and the proposed North Lease permit area from drilling information is given in Appendix 6-4, Appendix 6-2, and Appendix 7-16. Information on the thickness of the Smirl coal zone is listed in Table 6-1. A Smirl coal zone thickness isopach map is presented in Drawing 5-14. Two cross-sections through the proposed Coal Hollow Mine permit area, showing stratigraphic relationships, approximate overburden thickness, and coal seam thickness, together

with a cross-section location map are presented in Drawings 6-6, 6-7, and 6-8. Two additional cross-sections showing stratigraphic relationships and approximate overburden thicknesses are shown in Drawing 6-9. A geologic cross-section depicting regional stratigraphic relationships is shown in Drawing 6-2. An overburden isopach map is provided in Drawing 5-15. A cross-section through the proposed underground mining area is provided in Drawing 6-12. Cross-sections showing stratigraphic relationships and overburden thicknesses in the North Private Lease are shown in Appendix 7-16. ~~Drawing 6-13.~~

Representative drill hole logs depicting the nature, depth and thickness of the coal seam to be mined and rider seams in the overlying strata and the nature of the Dakota Formation strata immediately below the coal seam to be mined are presented in Appendix 6-4 and Appendix 7-16. No rider seams are present in the overburden strata in the proposed coal mining areas.

622.300
The outcrop line of the seam to be mined (Smirl coal zone) is shown on the geologic map in Drawings 6-1 and in Appendix 7-16. The strike and dip of the Smirl coal zone in the permit area is also shown on Drawings 6-1 and 6-6. The strike and dip of the Smirl coal zone in the North Lease area is shown in Appendix 7-16 ~~on Drawing 6-1N~~.

622.400
No oil and gas wells exist within the ~~proposed~~ Coal Hollow Mine permit area or the proposed North Lease permit area.

623 GEOLOGIC INFORMATION

623.100 Acid or Toxic-Forming Strata

No acid-forming or toxic-forming strata are present in strata overlying or in the stratum immediately below the Smirl coal seam in planned mining areas in the ~~proposed~~ Coal Hollow Mine permit area.

Chemical information on the acid- and toxic-forming potential of earth materials naturally present in the Coal Hollow Mine permit area ~~and the proposed North Lease permit area~~ are presented in Appendix 6-2. Chemical information on the low-sulfur Smirl coal zone proposed for mining is presented in Appendix 6-1 (confidential binder). Based on laboratory analytical data, it is apparent that acid-forming and toxic-forming materials that could result in the contamination of surface-water or groundwater supplies in the ~~proposed~~ Coal Hollow Mine permit and adjacent area and in the North Lease permit area are generally not present.

Selenium was not detected in any of the samples from the ~~proposed~~ Coal Hollow Mine permit area. Likewise, concentrations of water-extractable boron were also low, being less than 3 mg/kg in all samples analyzed. The pH of groundwaters in and around the ~~proposed~~ Coal Hollow Mine permit area are moderately alkaline. Data in Appendix 6-2 likewise indicate moderately alkaline conditions in sediments in the proposed permit area. The solubility of dissolved trace metals is limited in waters with alkaline pH conditions. Consequently, high concentrations of these metal constituents in groundwaters and surface waters with elevated pH levels are not anticipated.

The neutralization potential greatly exceeded the acid potential in all samples analyzed, with the neutralization potential commonly exceeding the acid potential by many times, suggesting that acid-mine-drainage will not be a concern at the ~~proposed~~ Coal Hollow Mine. Acid-forming materials in western coal mine environments often consist of sulfide minerals, commonly including pyrite and marcasite, which, when exposed to air and water, are oxidized causing the liberation of H^+ ions (acid) into the water. Oxidation of sulfide minerals may occur in limited amounts in the mine pits where oxygenated water encounters sulfide minerals. However, the acid produced by pyrite oxidation is quickly consumed by dissolution of abundant, naturally occurring carbonate minerals (Appendix 6-2). Dissolved iron is readily precipitated as iron-hydroxide in well aerated waters, and consequently excess iron is not anticipated in mine discharge water.

Other acid-forming materials or toxic-forming materials have not been identified in significant concentrations nor are such suspected to exist in materials to be disturbed by mining.

Because of the overall low-permeability of the rock strata and sediments surrounding the mine workings (primarily the shales and claystones of the lower Tropic Shale), the potential for seepage of mine water into adjacent stratigraphic horizons is low. Additionally, because the floors of the mine pits need to be accessible in order to extract the coal, the mining operations will be carried out in such a manner that the accumulation of large amounts of water in the mine pits will be avoided.

Based on the information in Appendix 6-2 there is no indication that appreciable potential for acid or toxic formation is present.

It is anticipated that coal produced from the ~~proposed~~ Coal Hollow Mine will be shipped as a mine-run product. Thus, no coal processing wastes are anticipated.

623.200 Reclamation Feasibility

Based on the proposed mine plan and the existing geologic and hydrogeologic conditions encountered at the ~~propose~~ Coal Hollow Mine permit and adjacent area, and at the proposed North Lease permit area, it is anticipated that successful reclamation of the site will be feasible. Additional information on the feasibility of reclamation at the ~~proposed~~ Coal Hollow Mine permit area and the North Lease permit area is given in Chapter 2 (soils) and Chapter 3 (biology) of this MRP. There are no special categories or circumstances associated with mining at the ~~proposed~~ Coal Hollow Mine permit area or the proposed North Lease permit area that would render reclamation unfeasible.

Most of the materials that will be handled as part of mining and reclamation activities in the ~~proposed~~ Coal Hollow Mine area and the proposed North Lease permit area are of low hydraulic conductivity (i.e. clays, shales, siltstones, claystones, etc.). Consequently, it is anticipated that groundwater seepage volumes through backfilled and reclaimed land surfaces in reclaimed mine pit areas and excess spoils storage areas will not be large. Additionally, reclaimed areas will be

regraded, sloped, and otherwise managed to minimize the potential for land erosion, to restore approximate surface-water drainage patterns, and also to minimize the potential for ponding of surface waters on reclaimed areas (other than "roughening" or "gouging" of some areas to enhance reclamation). Thus, the potential for interactions between large amounts of disturbed earth materials and groundwaters and surface waters, which could result in leaching of chemical constituents into groundwater and surface-water resources, will be minimized.

Additionally, the mining plan calls for the emplacement of 40 inches of suitable cover material over backfilled areas made up of material types which could negatively impact vegetation (materials with elevated SAR ratios or other physical or chemical characteristics that could cause appreciable adverse impacts on vegetation).

Several investigations involving reclamation of surface disturbed areas in the vicinity have been performed by other entities. These included the use of test plots to measure reclamation feasibility and success. The results of these investigations have been presented in published documents (Ferguson and Frischknecht 1985; USDI 1975). These investigations have demonstrated the feasibility of successful reclamation in the area.

623-300 Subsidence Control Plan

The underground mining has limited extraction with no subsidence. Refer to Appendix 5-9 (Norwest Report) for geotechnical and design information. Due to the design and mining method of underground mining in this plan, no subsidence is projected and no monitoring is planned.

624 **GEOLOGIC DESCRIPTION**

624.100 Regional and Structural Geology

The coal to be mined in the proposed Coal Hollow Mine permit area is of Cretaceous age and resides in the Alton Coal Field of southwestern Utah. The Alton Coal Field is a roughly horseshoe-shaped region that is situated between the Kaiparowits Coal Field to the east, and the Kolob Coal Field to the west.

The topography in the Alton Coal Field is marked by bench and slope topography. Topographic relief in the region is approximately 2,800 feet, with elevations ranging from about 9,300 feet on top of the Paunsaugunt Plateau, to about 6,500 feet in the valley bottoms. The economic coal seams are located primarily along the western and southern flanks of the Paunsaugunt Plateau.

The geologic history, geology, stratigraphy, and structure of the Alton Coal Field have been described by Doelling (1972) and Tilton (Appendix 6-3; 2001) and are summarized below. A map of geologic formations exposed at the surface in the proposed Coal Hollow Mine permit area is shown in Drawing 6-1. Cross-sections showing the regional geologic conditions in the Alton Coal Field are presented in Drawings 6-3 and 6-9.

Stratigraphy

Stratigraphic units present in the Alton Coal Field area are described in ascending order below. A stratigraphic column showing these geologic formations is shown in Drawing 6-3. A diagrammatic correlation of Cretaceous units in southern and south-central Utah is shown in Drawing 6-4.

Navajo Sandstone (Lower Jurassic)

The Navajo Sandstone is a light gray to tan, locally cross-bedded, massive eolian sandstone that underlies the region. Where exposed south of the Alton area, it forms the regionally prominent White Cliffs topographic feature. The Thousand Pockets Tongue of the Navajo Sandstone intertongues with the overlying Carmel Formation. Thickness of the Navajo Sandstone exceeds 1,000 feet in the Paunsaugunt Plateau region. The Navajo Sandstone does not crop out in the ~~proposed~~ Coal Hollow Mine permit area or in the North Lease area. The Nevada Power No. 1 Well, which is located within the North Lease area, reportedly encountered the top of the Navajo Sandstone at a depth of 1,430 feet below ground surface.

Carmel Formation (Upper Jurassic)

The Carmel Formation unconformably overlies the Navajo Sandstone in the region. The Carmel Formation is heterogeneous and consists of limestone, siltstone, sandstone, and gypsum beds. The formation has been subdivided into several members by previous researchers. These include the Wiggler Wash Member, the Winsor Member, the Paria River Member, the Crystal Peak Member, and the Kolob Limestone Member. The thickness of the Carmel Formation ranges from about 650 to 800 feet in the Alton Coal Field area and the formation thickens to the west. The Winsor Member of the Carmel Formation crops out in the bottom of the Kanab Creek drainage about one mile south of the ~~proposed~~ Coal Hollow Mine permit area.

Entrada Sandstone (Upper Jurassic)

The Entrada Sandstone, which may be as thick as 500 feet regionally, is present above the Carmel Formation in the eastern portion of the Alton Coal Field. The formation consists predominantly of siltstone and cross-bedded or fine-grained massive sandstone. The formation is not present in the ~~proposed~~ Coal Hollow Mine permit and adjacent area.

Dakota Formation (Cretaceous)

The Dakota Formation contains the economic coal seams in the Alton Coal Field. The formation consists of fine- to medium-grained sandstone with interbedded gray shale, carbonaceous shale, and coal. In most locations, shaley strata dominate the formation, comprising about 60 to 75 percent of the formation. The unit characteristically forms ledge and slope topography. In the ~~proposed~~ Coal Hollow Mine permit area the Dakota Formation directly overlies the Carmel Formation. Regionally, the outcrop of the Dakota Formation forms the Gray Cliffs topographic feature. The economic coal seams in the Alton Coal Field are present near the base (Bald Knoll coal zone) and near the top of the formation (Smirl coal zone). Local thinner coal seams that are not of economic importance are present in the center of the formation. The thickness in the western portion of the Alton Coal Field is about 450 feet. In the eastern portion of the Alton Coal Field, the Dakota

Formation is about 150 feet thick and rests on the Entrada Sandstone.

Tropic Shale (Cretaceous)

The Tropic Shale consists predominantly of gray and carbonaceous silty shale and claystone with a few marine sandstone beds located mostly in its upper part. The formation typically weathers at the surface to a clayey soil that typically forms gentle, vegetated slopes. The Tropic Shale is present (in some locations covered with shallow alluvial or colluvial deposits) at the land surface over most of the proposed Coal Hollow Mine permit area. The formation was deposited in an open-marine offshore environment during the maximum westward transgression of the Cretaceous Western Interior Seaway in the Late Cretaceous (Tilton, 2001). Near the top of the formation, more sandy horizons are interbedded with the mudstone units of the formation. These sandy units together with the sandstone at the base of the overlying Straight Cliffs Formation reflect the initial sand influx onto the marine environment of the Tropic Shale. The thickness of the Tropic Shale in the Alton Quadrangle is about 700 feet. In areas planned for mining at the proposed Coal Hollow Mine permit area, only the lower 200 to 250 feet of the Tropic Shale is present. The middle and upper portions of the formation having been removed from proposed mining areas by erosion in Sink Valley.

Information obtained from continuous core drilling in the Tropic Shale in planned mining areas in the proposed Coal Hollow Mine permit area indicates that the lower 200 to 250 feet of the formation consists of a fairly uniform sequence of soft, dark gray silty shale or thinly bedded claystone with occasional thin lenses of siltstone and occasional layers of bentonite-like clay being present. Strong, competent rock strata that could be of consequence to surface mining operations were not encountered in any of the boreholes. Drilling information obtained from the Tropic Shale during the 2005 drilling program is presented in Appendix 6-4. Physical and chemical information from the Tropic Shale are presented in Appendix 6-2. The locations of the 2005 boreholes are shown in Appendix 6-4 and also on Drawing 6-5.

Straight Cliffs Formation (Cretaceous)

The Straight Cliffs Formation is approximately 1,200 feet thick in the Alton Quadrangle. The formation is comprised predominantly of calcite-cemented sandstone and mudstone, with sandstone composing about 75 percent of the total composition. The sandstones of the Straight Cliffs Formation make up the lower two-thirds of the ledges radiating out from the southern Paunsaugunt Plateau. Four members of the Straight Cliffs Formation have been identified in the Alton Quadrangle by Tilton (2001). These include the Tibbet Canyon Member (orange-gray weathering fine- to medium grained sandstone), the Smoky Hollow Member (interbedded sandstone, mudstone, and thin coal), the John Henry Member (interbedded mudstone and fluvial sandstone), and Drip Tank Member (light-gray cliff forming sandstone). The Straight Cliffs Formation outcrops on the hillsides east and north of the proposed Coal Hollow Mine permit area.

Wahweap and Kaiparowits Formations (Cretaceous)

The Wahweap Formation is composed of alternating sandy shales and thin- to thick-bedded

sandstones. The unit contains carbonaceous shale and thin coal beds that are not of economic importance in its lower part. The unit forms step-like topography. Regionally, the Wahweap Formation is separated from the overlying Kaiparowits Formation by an unconformity. Erosion of both the Wahweap and Straight Cliffs Formations prior to the deposition of the Kaiparowits Formation may have locally reduced the thicknesses of these formations in the vicinity of the Paunsaugunt Plateau. The Kaiparowits Formation is composed of irregular beds of arkosic sandstone. The sandstone is weakly cemented by calcite cement. Because of difficulties identifying mappable boundaries between the Wahweap and Kaiparowits Formations in the Alton Quadrangle, the formations were mapped as an undivided unit (Tilton, 2001). The total thickness of the Wahweap and Kaiparowits Formations in the Alton Quadrangle ranges from about 600 to 800 feet.

Claron Formation (Tertiary)

The Claron Formation (also sometimes known as the Wasatch Formation, although the Utah Geological Survey uses the name Claron Formation) forms the cap rock over much of the Paunsaugunt Plateau. The formation is also present west of the Sevier Fault Zone west and north of the town of Alton. The unit is subdivided into a lower pink (also known as red) member and an upper white member, both consisting mostly of massive, fine-grained crystalline limestone of fluvial and lacustrine origin. Resistance to erosion varies both vertically and horizontally in the Claron Formation, resulting in a series of cliffs and steep joints. This condition, together with the presence of closely spaced joints, produces the unique topography associated with the Claron Formation. The Claron Formation is about 800 thick in the Alton Quadrangle. Also mapped together with the Claron Formation in the Alton Quadrangle is the Cretaceous Canaan Peak Formation. The Canaan Peak is a thin, discontinuous formation consisting primarily of conglomerate and conglomeratic sandstone with some mudstone interbeds sometimes present at the base of the Claron Formation. Thickness of the Canaan Peak Formation locally ranges from 0 to 30 feet.

Brian Head Formation (Tertiary)

The Brian Head Formation consists of interbedded pink and purplish-gray very fine-grained sandstone, friable sandstone, conglomerate, siltstone, mudstone, and limey mudstone in its lower part, and gray to white, fine- to medium-grained sandstone and calcarenite, in part with a volcanically derived clay matrix. The formation includes rocks present above the underlying white member of the Claron Formation and the overlying ash-flow tuff of the Needles Range Group. The unit is not resistant to erosion and has been eroded away from the top of the Paunsaugunt Plateau in the Alton Quadrangle. The formation is present in the rugged hills west of the Sevier Fault zone near the town of Alton. The unit is about 200 feet thick in the Alton Quadrangle.

Quaternary Deposits

Quaternary deposits present in the area include pediment alluvium, landslide deposits, mass-wasting debris, and alluvium.

The pediment alluvium deposits in the region consist of poorly sorted alluvial and colluvial silt, sand, and gravel deposited on broad pediments. After deposition, the pediment surfaces were abandoned as streams have cut down to lower levels.

Landslide deposits in the area are primarily gravity-transported hummocky deposits of mud, sand, and occasional blocks of sandstone. Most of the landslide deposits originated from the lower portion of the Straight Cliffs Formation and slid onto the underlying Tropic Shale, although movement within the Tropic Shale has also occurred. A conspicuous series of progressively built landslide deposits is present east of the Alton Amphitheater as a broad, rolling apron below the lowest cliffs of the Straight Cliffs Formation. The thickness of the landslide deposits locally ranges from a few feet to more than 100 feet.

Alluvium deposits in the region consist of unconsolidated clay, silt, sand, and gravel in and near existing drainages. These deposits exist as stream and fan alluvium and terrace deposits. In the headwaters of the mountain streams, the alluvial material consists predominantly of sand and gravel. In downstream areas, the alluvial material consists mostly of mud derived from the Tropic Shale. Alluvial thickness in the Alton Quadrangle typically ranges from a thin covering to about 10 feet or more.

In the Sink Valley and Lower Robinson Creek drainages near the proposed Coal Hollow Mine permit area, drilling information indicates that alluvial thicknesses are in some locations considerably greater. Alluvial thicknesses measured in the permit and adjacent area range from a thin veneer overlying bedrock formation in many areas to at least 140 feet in thickness along the eastern margins of Sink Valley (see Drawing 6-3). Much of the land surface in the proposed Coal Hollow Mine permit area consists of fan alluvium (mostly composed of clays, silts, and fine-grained sands) derived largely from the highly erodable Tropic Shale in adjacent highland areas east of the proposed permit area. Field investigations suggest that these fan deposits are associated with sheetfloods, debris flows and mud flows. Additional geologic information on alluvial deposition in the proposed Coal Hollow Mine permit and adjacent area is presented in Appendix 7-1.

An igneous dike consisting of black, fine-grained porphyritic olivine basalt is present northeast of Alton near Kanab Creek.

Structure

Rock strata in the region dip gently toward the north and north-east, generally from 1 to 5 degrees. The Alton Coal Field is bounded on the east by the Paunsaugunt Fault and on the west by the Sevier Fault. Regional displacements on these two faults are about 1,000 to 2,000 feet, and 100 to 800 feet, respectively. Additionally, several faults with lesser displacements have been mapped in the region, including the Sand Pass Fault zone (about 400 feet of offset), the Bald Knoll Fault (about 650 feet of offset), and the Sink Valley Fault (likely a few tens of feet of offset). Most local faults in the Alton Quadrangle trend in a northerly or north-westerly direction, are several miles long, and are near vertical. A prominent north- to northwest-trending vertical joint set is present in the Upper Cretaceous sandstone rocks in the region. Stratal dips vary appreciably near the fault zones.

The Sink Valley Fault extends in a roughly north-south direction through the proposed Coal Hollow Mine permit area from upland areas north of the permit area southward through the central part of the proposed permit area subsequently further south near the eastern edge of the proposed permit area (Drawing 6-1; Appendix 6-3; Drawing 6-2). The fault has down-dropped the strata on the west side of the fault (Appendix 6-3). The offset on the Sink Valley Fault is not known precisely, however based on drilling information from the proposed permit and adjacent area it is apparent that offset on the fault in the vicinity of the proposed Coal Hollow Mine permit area is a few 10s of feet or less.

Description of Coal Seam Geology

The coal seams in the Alton Coal Field are located in the Smoky Hollow Member of the Straight Cliffs Formation, and in the Dakota Formation. The coal seam in the Smoky Hollow Member, which occurs within the lower 3 feet of the Member, is only a few inches in thickness and is not of economic importance. Within the Dakota Formation, two regionally important coal zones are present. These include the Smirl coal zone, which is located near the upper formational contact with the Tropic Shale, and the Bald Knoll coal zone, which is located about 200 feet below the Smirl coal zone near the base of the Dakota Formation. Doelling (1972) reported that the Smirl coal zone is 14 to 18 feet thick without splits, while the Bald Knoll coal zone contains several coal seams separated by thin splits, with the thickest seam being 4.8 feet thick. Doelling (1972) reports that coal in the Alton area is a high-volatile Bituminous coal. Additional information on coal quality is presented in Appendix 6-1 (confidential binder).

Within the Alton Quadrangle, five small mines and two prospects have been worked. Production from these mines was small, with a total production from all mines of 35,000 and 50,000 tons from the late 1920s to 1969, when the last mine closed. The last operating mine in the Alton Coal Field was the Smirl Mine, which was located about 1.5 miles south of the town of Alton. In its last year of operation, a total of 1,597 tons of coal was produced. The Smirl Mine portal was sealed by the Utah Division of Oil, Gas and Mining in 1992.

Groundwater

The depositional history of geologic formations in the proposed permit and adjacent area has resulted in a heterogeneous sequence of rocks that have a profound effect on the movement and availability of groundwater. The stratigraphic package located in the upland regions along the Paunsaugunt Plateau lies well beyond the zone that could potentially be impacted by mining operations in the proposed Coal Hollow Mine permit area. With the exception of the Navajo Sandstone, the rock formations present along the flanks of the Paunsaugunt Plateau area are typically lenticular in nature. Although aquifer-quality rocks may be present in lenses within individual geologic formations, the fact that the lenses are discontinuous in their extent and are typically encased in a surrounding low-permeability matrix, regional type groundwater flow

regimes typically do not form. Additionally, because the geologic formations in the Paunsaugunt Plateau overlying the Tropic Shale are truncated by the plateau escarpment, long, regional type groundwater flow paths typically cannot exist in the proposed permit area. In the immediate vicinity of the proposed Coal Hollow Mine permit and adjacent area, the only bedrock formations that crop out are the Tropic Shale and underlying Dakota Formation. The Windsor Member of the Carmel Formation also crops out at the surface about one mile southwest of the proposed permit area. The water-transmitting properties of the lower portion of the marine Tropic Shale unit that overlies the Smirl coal seam in areas proposed for mining are poor.

Lithologic data collected during continuous core drilling in the Tropic Shale indicate that the rocks of the Tropic Shale in the proposed mining area are composed almost entirely of a fairly uniform sequence of dark gray shale, silty shale, and claystone with high clay content. No appreciable water was encountered during drilling activities in the Tropic Shale in the proposed mining areas and no appreciable spring discharge from formation has been observed. The Tropic Shale in the proposed permit area is underlain by the Dakota Formation, which crops out in the western portion of the proposed permit area and in the bottoms of the Kanab Creek drainage (Drawing 6-1; Appendix 6-3). Vertical recharge to the Dakota Formation through the overlying Tropic Shale is likely negligible due to the poor groundwater transmitting properties of the Tropic Shale discussed above. In addition to the lack of vertical recharge to the Dakota Formation, vertical and horizontal groundwater flow in the formation is impeded because of the abundant presence of low-permeability shaley strata that encase potentially permeable lenticular sandstone strata both vertically and horizontally. Consequently, the potential for the transmission of appreciable quantities of groundwater through the formation is limited (i.e., it is not a good aquifer). Consequently, groundwater discharge from the rocks of the Dakota Formation in the proposed permit area is not appreciable. Because vertical recharge to the Dakota Formation from the Tropic Shale is minimal, the removal of the Tropic Shale from above the Dakota Formation during mining operations followed shortly thereafter by the backfilling and reclamation of mine pits with low-permeability materials would likely not detrimentally impact groundwater systems in the Dakota Formation (i.e., the post-mining conditions will be similar to the pre-mining conditions) .

Shallow groundwater systems have been identified in alluvial sediments in the proposed Coal Hollow Mine permit and adjacent area, most notably in Sink Valley. These shallow alluvial groundwater systems exist in much of Sink Valley and in some locations in the Lower Robinson Creek drainage. The alluvial groundwater systems are likely recharged along the flanks of the Paunsaugunt Plateau through mountain-front-recharge processes. Groundwater flow directions in these alluvial groundwater systems is generally from recharge areas east of the proposed permit area toward lower elevation areas to the west and south. In most locations near the proposed Coal Hollow Mine permit area, the alluvial groundwater systems are directly underlain by the low-permeability Tropic Shale bedrock, which likely prevents appreciable downward migration of the alluvial groundwater into deeper formations. Additional information on groundwater resources in the proposed Coal Hollow Mine permit and adjacent area is provided in Chapter 7 of this MRP and in Appendix 7-1.

624.110 Cross Sections, Maps, Plans.

624.120 Information for this section is found in R645-301-624.200, R645-301-624.300 and R645-301-625.

624.130 Geologic Literature and Practices

The geologic literature utilized in preparing R645-301-600 is listed in the reference list presented at the end of this chapter.

Additional geologic data were collected during field investigations conducted by qualified personnel. Geologic analysis and geologic interpretations were performed by a registered professional geologist in the State of Utah. All practices and procedures for obtaining geologic information have been standard for the industry.

624.200
Samples have been collected and analyzed from test borings in the proposed permit area. The samples were collected from fresh, unweathered, uncontaminated drill cores. The samples were collected and analyzed from the ground surface down to and including the first stratum immediately below the Smirl coal zone to be mined. The laboratory analytical parameters analyzed were comprehensive and as recommended by the Division of Oil, Gas and Mining. Results of the analyses are presented in Appendix 6-2. Additional information regarding the physical and chemical characteristics of the Smirl coal zone to be mined are presented in Appendix 6-1 (confidential binder).

624.210
Geologic logs were prepared that show the lithologic characteristics including physical properties and thickness of each stratum and locations of groundwater where occurring. The well logs are presented in Appendix 6-1. Cross-sections prepared from geologic logs of drillholes in the proposed permit and adjacent area are provided in Drawing 6-3. Additional geologic logs are presented in Appendix 5-1 and Appendix 7-4. Additional lithologic characterization is provided in Appendix 7-1.

624.220
Chemical analyses of strata overlying and immediately below the Smirl coal zone for acid- or toxic-forming materials are presented in Appendix 6-2.

No acid-forming or toxic-forming strata are present in strata overlying or in the stratum immediately below the Smirl coal seam in planned mining areas in the proposed Coal Hollow Mine permit area.

Chemical information on the acid- and toxic-forming potential of earth materials naturally present in the proposed permit area are presented in Appendix 6-2. Chemical information on the low-sulfur Smirl coal zone proposed for mining is presented in Appendix 6-1 (confidential binder). Based on laboratory analytical data, it is apparent that acid-forming and toxic-forming materials that could result in the contamination of surface-water or groundwater supplies in the proposed Coal Hollow Mine permit and adjacent area are generally not present.

Selenium was not detected in any of the samples from the proposed Coal Hollow Mine permit area. Likewise, concentrations of water-extractable boron were also low, being less than 3 mg/kg in all samples analyzed. The pH of groundwaters in and around the proposed Coal Hollow Mine permit area are moderately alkaline. Data in Appendix 6-2 likewise indicate moderately alkaline conditions in sediments in the proposed permit area. The solubility of dissolved trace metals is usually limited in waters with alkaline pH conditions. Consequently, high concentrations of these metal constituents in groundwaters and surface waters with elevated pH levels are not anticipated.

The neutralization potential greatly exceeded the acid potential in all samples analyzed, with the neutralization potential commonly exceeding the acid potential by many times, suggesting that acid-mine-drainage will not be a concern at the proposed Coal Hollow Mine. Acid-forming materials in western coal mine environments often consist of sulfide minerals, commonly including pyrite and marcasite, which, when exposed to air and water, are oxidized causing the liberation of H^+ ions (acid) into the water. Oxidation of sulfide minerals may occur in limited amounts in the mine pits where oxygenated water encounters sulfide minerals. However, the acid produced by pyrite oxidation is quickly consumed by dissolution of abundant, naturally occurring carbonate minerals (Appendix 6-2). Dissolved iron is readily precipitated as iron-hydroxide in well aerated waters, and consequently excess iron is not anticipated in mine discharge water.

Other acid-forming materials or toxic-forming materials have not been identified in significant concentrations nor are such suspected to exist in materials to be disturbed by mining.

Because of the overall low-permeability of the rock strata and sediments surrounding the mine workings (primarily the shales and claystones of the lower Tropic Shale), the potential for seepage of mine water into adjacent stratigraphic horizons is low. Additionally, because the floors of the mine pits need to be accessible in order to extract the coal, the mining operations will be carried out in such a manner that the accumulation of large amounts of water in the mine pits will be avoided.

Based on the information in Appendix 6-2 there is no indication that appreciable potential for acid or toxic formation is present.

It is anticipated that coal produced from the proposed Coal Hollow Mine permit area will be shipped as a mine-run product. Thus, no coal processing wastes are anticipated.

624.230
Chemical analyses of the Smirl coal seam for acid- or toxic-forming materials including total sulfur and pyritic sulfur are presented in Appendix 6-1 (confidential binder).

624.300
Logs of drill holes are presented in Appendix 6-1. Chemical analysis of strata overlying and

immediately below the coal seam are shown in Appendix 6-2. Chemical analysis of the coal seam for acid or toxic forming materials including total sulfur and pyritic sulfur are presented in Appendix 6-1 (Confidential binder).

624.340

Physical properties of the stratum immediately above and below the coal seam are shown in Appendix 6-1 (Confidential Binder)

627 **OVERBURDEN THICKNESS AND LITHOLOGY**

The planned mining in the proposed Coal Hollow Mine permit area does include underground coal mining activities. Overburden thickness and lithology are shown in Appendix 6-1, and Drawing 5-15 and 6-3.

Overburden in planned mining areas in the proposed Coal Hollow Mine permit area consists of the following.

Alluvium

Alluvial sediments are present at the surface in most areas proposed for mining. These sediments consist primarily of clays, silts, and fine-grained sands. The thickness of the alluvium in proposed mining areas ranges from a thin veneer to about 50 feet. The alluvial sediments in most areas are not well sorted and are derived largely from weathering of the Tropic Shale in adjacent upland areas.

Tropic Shale

In all proposed mining areas, the lower portion of the Tropic Shale overlies the Dakota Formation Smirl coal zone to be mined. The thickness of the Tropic Shale overlying the coal seam in proposed mining areas ranges from a few feet up to about 200 feet. The lower Tropic Shale consists predominantly of soft shales, silty shales, and claystones, with occasional thin layers of siltstone and bentonite-like clay layers up to about 1 foot in thickness. Strong, competent rock strata were not encountered in exploration boreholes drilled during 2005 in the proposed Coal Hollow Mine permit area. Well logs graphically depicting this information are presented in Appendix 6-1. Cross-sections prepared from geologic logs of drillholes in the proposed permit and adjacent area are provided in Drawing 6-3. Additional geologic logs are presented in Appendix 5-1 and Appendix 7-4. Additional lithologic characterization is provided in Appendix 7-1.

630 **OPERATION PLAN**

631 **PLAN FOR CASING AND SEALING EXPLORATION HOLES**

Exploration holes and boreholes will be backfilled, plugged, cased, capped, sealed, or otherwise managed to prevent acid or toxic contamination of water resources and to minimize disturbance to the prevailing hydrologic balance. Exploration holes and boreholes will be managed to ensure the safety of people, livestock, fish and wildlife, and machinery.

If any exploration boreholes are to be used as monitoring wells or water wells, these will meet the provisions of R645-301-731

Wells constructed for monitoring groundwater conditions in the proposed Coal Hollow Mine permit and adjacent area, including exploration holes and boreholes used for water wells or monitoring wells, will be designed to prevent contamination of groundwater and surface-water resources and to protect the hydrologic balance. A diagram depicting typical monitoring well construction methods is shown in Drawing 7-11. Monitoring wells will include a protective hydraulic seal immediately above the screened interval, an annular seal plugging the borehole above the hydraulic seal to near the ground surface, and a concrete surface seal extending from the top of the hydraulic seal to the ground surface which is sloped away from the well casing to prevent the entrance of surface flows into the borehole area. Well casings will protrude above the ground surface a sufficient height so as to minimize the potential for the entrance of surface water or other material into the well. A steel surface protector with a locking cover will be installed at monitoring wells to prevent access by unauthorized personnel. Where there is potential for damage to monitoring wells, the wells will be protected through the use of barricades, fences, or other protective devices. These protective devices will be periodically inspected and maintained in good operating conditions. Monitoring wells will be locked in a closed position between uses.

When no longer needed for monitoring or other use approved by the Division upon a finding of no adverse environmental or health and safety effects, or unless approved for transfer as a water well under R645-301-731.100 through R645-301-731.522 and R645-301-731.800, each well will be capped, sealed, backfilled, or otherwise properly managed, as required by the Division in accordance with R645-301-529.400, R645-301-631.100, and R645-301-748. Permanent closure measures will be designed to prevent access to the mine workings by people, livestock, fish and wildlife, machinery and to keep acid or other toxic drainage from entering ground or surface waters.

Permanent closure and abandonment of water wells greater than 30 feet in depth will be in accordance with the requirements of "Administrative Rules for Water Well Drillers", State of Utah, Division of Water Rights or other applicable state regulations. Abandonment of wells will be performed by a licensed water well driller. The wells to be abandoned will be completely filled using neat cement grout, sand cement grout, unhydrated bentonite, or bentonite grout, or other materials approved by the Utah State Engineer's office. Alternatively, the well may be abandoned using a different procedure upon approval from the Utah State Engineer's office.

Abandonment materials will be introduced at the bottom of the well or required sealing interval and

placed progressively upward to the top of the well. The casing will be severed a minimum of 2 feet below the ground surface. A minimum of 2 feet of compacted native material will be placed above the abandoned well upon completion.

Within 30 days of the completion of well abandonment procedures, a report will be submitted to the State Engineer by the responsible licensed driller giving data related to the abandonment of the well. This shall include the name of the licensed driller or other person(s) performing abandonment procedures, name of well owner at the time of abandonment, the address or location of the well by section, township, and range, abandonment materials and equipment used, water right or file number covering the well, the final disposition of the well, and the date of completion.

Exploration holes and boreholes will be backfilled, plugged, cased, capped, sealed, or otherwise managed to prevent acid or toxic contamination of water resources and to minimize disturbance to the prevailing hydrologic balance. Exploration holes and boreholes will be managed to ensure the safety of people, livestock, fish and wildlife, and machinery.

If a water well is exposed by coal mining and reclamation operations, it will be permanently closed unless otherwise managed in a manner approved by the Division.

Boreholes will be backfilled to within 1 foot of the land surface with concrete or other materials approved by the Division as necessary to prevent contamination of groundwater or surface-water resources or to protect the prevailing hydrologic balance. The upper approximately 1 foot will be backfilled with native materials to facilitate reclamation (see Drawing 6-11). Exploration holes and boreholes that may be uncovered during mining and reclamation activities will be permanently closed unless approved for water monitoring or otherwise managed in a manner approved by the Division.

632 **SUBSIDENCE MONITORING**

The underground mining has limited extraction with no subsidence. Refer to Appendix 5-9 (Norwest Report) for geotechnical and design information. Do to the design and mining method of underground mining in this plan, no subsidence is projected and no monitoring is planned.

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640 **PERFORMANCE STANDARDS**

641 **ALL EXPLORATION HOLES AND BOREHOLES**

All exploration holes and boreholes will be permanently cased and sealed according to the requirements of R645-301-631.100 and R645-301-631.200.

Exploration holes and boreholes will be backfilled, plugged, cased, capped, sealed, or otherwise managed to prevent acid or toxic contamination of water resources and to minimize disturbance to the prevailing hydrologic balance. Exploration holes and boreholes will be managed to ensure the

safety of people, livestock, fish and wildlife, and machinery.

If any exploration boreholes are to be used as monitoring wells or water wells, these will meet the provisions of R645-301-731

Wells constructed for monitoring groundwater conditions in the proposed Coal Hollow Mine permit and adjacent area, including exploration holes and boreholes used for water wells or monitoring wells, will be designed to prevent contamination of groundwater and surface-water resources and to protect the hydrologic balance. A diagram depicting typical monitoring well construction methods is shown in Drawing 7-11. Monitoring wells will include a protective hydraulic seal immediately above the screened interval, an annular seal plugging the borehole above the hydraulic seal to near the ground surface, and a concrete surface seal extending from the top of the hydraulic seal to the ground surface which is sloped away from the well casing to prevent the entrance of surface flows into the borehole area. Well casings will protrude above the ground surface a sufficient height so as to minimize the potential for the entrance of surface water or other material into the well. A steel surface protector with a locking cover will be installed at monitoring wells to prevent access by unauthorized personnel. Where there is potential for damage to monitoring wells, the wells will be protected through the use of barricades, fences, or other protective devices. These protective devices will be periodically inspected and maintained in good operating conditions. Monitoring wells will be locked in a closed position between uses.

When no longer needed for monitoring or other use approved by the Division upon a finding of no adverse environmental or health and safety effects, or unless approved for transfer as a water well under R645-301-731.100 through R645-301-731.522 and R645-301-731.800, each well will be capped, sealed, backfilled, or otherwise properly managed, as required by the Division in accordance with R645-301-529.400, R645-301-631.100, and R645-301-748. Permanent closure measures will be designed to prevent access to the mine workings by people, livestock, fish and wildlife, machinery and to keep acid or other toxic drainage from entering ground or surface waters.

Permanent closure and abandonment of water wells greater than 30 feet in depth will be in accordance with the requirements of "Administrative Rules for Water Well Drillers", State of Utah, Division of Water Rights or other applicable state regulations. Abandonment of wells will be performed by a licensed water well driller. The wells to be abandoned will be completely filled using neat cement grout, sand cement grout, unhydrated bentonite, or bentonite grout, or other materials approved by the Utah State Engineer's office. Alternatively, the well may be abandoned using a different procedure upon approval from the Utah State Engineer's office.

Abandonment materials will be introduced at the bottom of the well or required sealing interval and placed progressively upward to the top of the well. The casing will be severed a minimum of 2 feet below the ground surface. A minimum of 2 feet of compacted native material will be placed above the abandoned well upon completion.

Within 30 days of the completion of well abandonment procedures, a report will be submitted to the State Engineer by the responsible licensed driller giving data related to the abandonment of the well. This shall include the name of the licensed driller or other person(s) performing abandonment procedures, name of well owner at the time of abandonment, the address or location of the well by

section, township, and range, abandonment materials and equipment used, water right or file number covering the well, the final disposition of the well, and the date of completion.

Exploration holes and boreholes will be backfilled, plugged, cased, capped, sealed, or otherwise managed to prevent acid or toxic contamination of water resources and to minimize disturbance to the prevailing hydrologic balance. Exploration holes and boreholes will be managed to ensure the safety of people, livestock, fish and wildlife, and machinery.

If a water well is exposed by coal mining and reclamation operations, it will be permanently closed unless otherwise managed in a manner approved by the Division.

Boreholes will be backfilled to within 1 foot of the land surface with concrete or other materials approved by the Division as necessary to prevent contamination of groundwater or surface-water resources or to protect the prevailing hydrologic balance. The upper approximately 1 foot will be backfilled with native materials to facilitate reclamation (see Drawing 6-11). Exploration holes and boreholes that may be uncovered during mining and reclamation activities will be permanently closed unless approved for water monitoring or otherwise managed in a manner approved by the Division.

642 **MONUMENTS AND SURFACE MARKERS**

All monuments and surface markers used as subsidence monitoring points and identified under R645-301-632.200 will be reclaimed in accordance with R645-301-521.210.

REFERENCES

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USDI. 1975. Resource and Potential Reclamation Evaluation, Alton Study Site, Alton Coal Field. U.S. Department of Interior, Bureau of Land Management, Salt Lake City, UT. 130 p.

North Lease Information

(Appendix 6-2)

Suitability Assessment of Overburden

The following assessment of overburden suitability in the North Private lease (NPL) is based on laboratory analysis results interpreted against the suitability criteria set forth in *Guidelines for Management of Topsoil and Overburden* (Utah DOGM 2008). Overburden samples were collected as a mix of all materials within the specified depth. Materials from overlying layers may have also been included in the samples. Samples could not be collected from some depth intervals.

The *Order 2 Soil Survey for the North Private Lease Expansion of the Coal Hollow Mine* (Long 2014) contains a more detailed and depth specific analysis of the topsoil, subsoil, and overburden to depths up to 29 feet.

Overburden with any *Unacceptable* parameters must be buried a minimum of four feet below the surface (Utah DOGM 2008). Soils with extractable selenium concentrations greater than or equal to 0.10 ppm must not be used in surface water impoundments. Soils with extractable selenium concentrations greater than or equal to 0.15 ppm shall not be placed within four feet of the soil surface (rooting zone). These limitations are specified in *Guidelines for Management of Topsoil and Overburden* (Utah DOGM 2008).

Placement of overburden that is in the *Poor* category within the rooting zone (upper four feet) should be minimized or avoided whenever possible.

Limiting Overburden Parameters

The soil parameters that will be limiting, based on materials with concentrations exceeding the *Unacceptable* levels established in the *Guidelines for Management of Topsoil and Overburden* (DOGM 2008), include paste pH, sodium adsorption ratio (SAR), soluble boron, soluble selenium, total organic carbon (TOC), and the acid base potential (ABP). Figure 1 illustrates the location of unsuitable parameters by depth in each drill hole. The location of each drill hole is shown in Figure 2. Results of the overburden laboratory analysis are highlighted in Table 2.

Overburden is defined for the purposes of this assessment as the material above the coal seam.

Paste pH

The paste pH did not exceed the suitability limits of less than 5.5 or greater than 9.0 in any of the overburden above the coal seams. Therefore pH has not been identified as a limiting feature of the overburden above the coal seam.

Paste pH was less than the lower suitability limit of 5.5 in four samples collected from immediately below the coal seam. These samples were:

- Drill Hole #1, 59.0 to 61.0 feet (pH 4.9);
- Drill Hole #2, 56.6 to 59.0 feet (pH 4.6);

- Drill Hole #10, 53.0 to 54.5 feet (pH 4.8) and 54.5 to 57.0 feet (pH 2.6).

Sodium Adsorption Ration

Sodium Adsorption Ratio (SAR) was identified as *Unacceptable* in the overburden in four Drill Holes. The overburden in each case was identified as eitherTropic shale, weathered Tropic shale, or interbeded claystone and siltstone in the drill log or nearby soil survey holes. *Unacceptable* SAR levels were identified at the following locations:

- Hole #1, 0 to 43 feet (SAR 15.6 to 19.7). Soil survey hole 12AS017 identified 3.9 feet of soil above the Tropic shale with SAR levels of 6.60 or less.
- Hole #2, 30 to 40 feet (SAR 16.6). This material is immediately above the coal seam. Soil survey hole 12AS016 identified 3.7 feet of soil above the Tropic shale with SAR levels of 0.09 to 3.53.
- Hole #4, 106 to 112 feet (SAR 14.8) and 130 to 142 feet (SAR 14.3 to 16.0). This material is below the coal seam. Soil survey hole 12AS018 identified 24.0 feet of soil in the upper portion of the overburden with SAR levels of 0.06 to 1.33.
- Hole #5, 92 to 98 feet (SAR 19.7). This material is interbeded claystone and siltstone immediately above the coal seam. Soil survey holes 12AS026 and DP-29 identified 6.6 feet (SAR 0.24 to 0.66) and 12.0 feet (SAR 0.20 to 1.09) of soil in the upper portion of the overburden, respectively.
- Hole #8, 159 to 164 feet (SAR14.6) is in carboniferous material immediately above the coal seam and 179.5 to 193 feet (SAR 21.1 to 22.8) in claystone and siltstone immediately below the coal seam.
- Hole #9, 117 to 121.6 (SAR 15.9) in carboniferous material immediately above the coal seam.

Based on the amount of suitable overburden identified at each of the above Drill Hole locations, SAR will not be a limiting feature of the overburden if Tropic shale is not buried within 4 feet of the final reclamation surface.

Boron

Soluble boron only exceeded the suitability limit of 5.0 ppm in one overburden sample. This sample was the 53.0 to 54.5 depth interval in *Drill Hole #10* (7.32 ppm). This sample was collected from carbonaceous and fossiliferous shale immediately below the bottom of the coal seam. Based on the location of the *Unacceptable* soluble boron, it is not a limiting feature of the overburden.

Selenium

Soluble selenium has two suitability levels depending on the final use of the overburden or substitute topsoil as discussed earlier in this assessment. The selenium zones shown in Figure 1 display both suitability levels together. The majority of the *Unacceptable* zones exceeded the upper limit of 0.15 ppm. These zones were found in: the lower alluvium and the claystone-siltstone zone in *Drill Holes #5 and #8*; and in the weathered Tropic shale in *Drill Hole #9*. Unacceptable soluble selenium levels were also identified beneath the coal seam in most of the *Drill Holes*.

Total Organic Carbon

Total organic carbon (TOC) was identified at *Unacceptable* levels (greater than 10 percent) in the organic, carboniferous, and fossiliferous shales immediately above the coal seam in *Drill Hole #4*. TOC was also identified at *Unacceptable* levels immediately below the coal seam in organic and fossilfereous shales in *Drill Holes #8, #9, and #10*.

Acid Base Potential

The acid base potential (ABP) was identified at *Unacceptable* levels (less than 0.0 tons per 1,000 tons) immediately below the coal seam in *Drill Holes #1 and #10* in the carbonaceous and fossiliferous shale.

Overburden Limitations by Drill Hole

The following drill hole assessments do not include the coal seam.

Hole #1

Overburden in Hole #1 is limited by:

- SAR *is Unacceptable* (15.6 to 19.7) in the upper 43 feet;
- Saturation Percent is *Poor* (82.6 to 236%) in the upper 43 feet due to the clayey soil textures;
- Electrical conductivity is *Poor* (8.70 mmhos/cm) in the 0 to 10 foot depth;
- Soil texture is *Poor* (Silty Clay) in the 40 to 43 foot depth and 59 to 61 foot depth;
- Soil pH (4.6), selenium (0.16 ppm), and acid-base potential (-5.00 ton per 1000 tons) are all in the *Unacceptable* category in the 59 to 61 foot depth;
- The coal seam is in the 43 to 59 foot depth.

Soil survey hole 12AS017 is near the location of *Drill Hole #1*. Tropic shale was identified at 3.9 feet in soil survey hole 12AS017. Paste pH (pH 5.3) was identified as *Unacceptable* in the Tropic shale in soil survey hole 12AS017.

Hole #2

Overburden in Hole #2 is limited by:

- Soil pH is *Unacceptable* (4.6) in the 56.6 to 59 foot depth;
- Saturation percent is *Poor* (103 to 108 percent) in the 0 to 40 foot depth due to the clayey textures;
- SAR is *Unacceptable* (16.6) in the 56.6 to 59 foot depth and *Poor* in the 30 to 40 foot depth;
- Texture is *Poor* (silty clay) in the 15 to 59 foot depth;
- Selenium is *Unacceptable* (0.11 to 0.27 ppm) for use in surface impoundments below 56.6 feet and *Unacceptable* (0.27 ppm) for use in the rooting zone in the 56.6 to 59 foot depth;
- The coal seam is in the 40 to 56.6 foot depth.

Soil survey hole 12AS016 is near the location of *Drill Hole #2*. Tropic shale was identified at 3.7 feet in soil survey hole 12AS016. No *Unacceptable* features were identified in this soil survey hole.

Hole #3

Overburden in Hole #3 is limited by:

- Saturation percent is *Poor* (104 to 161 percent) in the 10 to 41.5 foot depth due to clayey soil textures;
- SAR is *Poor* (12.7 to 13.0) in the 10 to 41.5 foot depth;
- Texture is *Poor* (silty clay) in the 33 to 41.5 foot depth;
- The coal seam is in the 41.5 to 57.7 foot depth.

Soil survey hole 12AS015 is near the location of *Drill Hole #3*. Tropic shale was identified at 3.9 feet in soil survey hole 12AS015. No *Unacceptable* features were identified in this soil survey hole.

Hole #4

Overburden in Hole #4 is limited by:

- Soil pH is *Poor* (8.6) in the 142 to 150 foot depth;
- Saturation percent is *Poor* (80.4 percent) in the 70 80 foot depth;
- Carbonate content is *Poor* (33.1 to 48.2 percent) in the 0 to 30 and 40 to 50 foot depths;
- SAR is *Unacceptable* (14.3 to 16.0) in the 106 to 112 and 130 to 142 foot depths and *Poor* (10.4 to 12.3) in the 70 to 80, 80.3 to 84, 101 to 106, and 142 to 150 foot depths;
- Selenium is *Unacceptable* for use in surface impoundments (0.14 to 0.36 ppm) in the 101 to 136 foot depth and *Unacceptable* for use in the rooting zone (0.16 to 0.36 ppm) in the 101 to 130 foot depth;
- Total Organic Carbon is Unacceptable (12.8 percent) in the 80.3 to 84 foot depth;
- The coal seam is in the 84 to 101 foot depth.

Soil survey hole 12AS018 is near the location of *Drill Hole #4*. Tropic shale was not observed within 24 feet of the surface in soil survey hole 12AS018. No *Unacceptable* features were identified in this soil survey hole.

Hole #5

Overburden in Hole #5 is limited by:

- Saturation percent is *Poor* (24.2 to 24.9 percent) in the 30 to 40 and 50 to 70 foot depths;
- Carbonate content is *Poor* (30.9 to 49.3 percent) in the 0 to 20 foot depth;
- SAR is *Unacceptable* (19.7) in the 92 to 98 foot depth and *Poor* (11.2 to 11.9) in the 98 to 104 and 127 to 133 foot depths;
- Texture is *Poor* (silty clay) in the 0 to 10 and 92 to 98 foot depths;
- Selenium is *Unacceptable* for use in surface impoundments 0.10 to 0.15 ppm) in the 40 to 60 and 127 to 133 foot depths and *Unacceptable* for use in the rooting zone (0.15 ppm) the 40 to 50 foot depth;
- The coal seam is in the 111 to 127 foot depth.

Soil survey holes 12AS026 and DP-29 are near the location of *Drill Hole #5*. Tropic shale was not observed within 6.6 feet at 12AS026 or within 12.0 feet at DP-29. No *Unacceptable* features were identified in either of these soil survey holes.

Hole #8

Overburden in Hole #8 is limited by:

- Saturation percent is *Poor* (22.4 to 24.1 percent) in the 24 to 69 foot depth (sandy loam) and in the 188 to 193 foot depth (87.6 percent in clay);
- Carbonate content is *Poor* (31.7 to 62.7 percent) in the 0 to 94 foot depth;
- SAR is *Unacceptable* (14.6 to 22.8) in the 159 to 164 and 179.5 to 193 foot depths;
- Selenium is *Unacceptable* (0.13 to 0.57) for use in surface impoundments in the 69 to 94 and 179.5 to 188 foot depths and *Unacceptable* for use in the rooting zone in the 179.5 to 188 foot depth;
- Total organic carbon is *Unacceptable* (12.9 percent) in the 159 to 164 foot depth;
- Overburden in the 94 to 159 foot depth was interbeded claystone and siltstone and not analyzed;
- The coal seam is in the 164 to179.5 foot depths.

Soil survey holes 12AS031 and DP-18 are near the location of *Drill Hole #8*. Tropic shale was not observed within 5.6 feet of the surface at 12AS031 or within 20 feet at DP-18. No *Unacceptable* features were identified in either of these soil survey holes.

Hole #9

Overburden in Hole #9 is limited by:

- Saturation percent is *Poor* (58.4 to 68.3 percent) in the 0 to 84, 137.6 to 143, and 158 to 163 foot depths;
- SAR is *Unacceptable* (15.9) in the 117 to 121.6 foot depth and *Poor* (10.6 to 12.9) in the 113 to 117, 137.6 to 148, and 153 to 158 foot depths;
- Texture is *Poor* (silty clay) in the 137.6 to 143 foot depth;
- Selenium is *Unacceptable* for use in surface impoundments (0.12 to 0.15 ppm) in 39 to 59, 137.6 to 148 and 158 to 163 foot depths and *Unacceptable* for use in the rooting zone (0.15 ppm) in the 39 to 49 foot depth;
- Total organic carbon is *Unacceptable* in the 117 to 121.6 foot depth;
- Overburden from the 85 to 113 foot depth was weathered Tropic shale and not analyzed;
- The coal seam is in the 121.6 to 137.6 foot depth.

Soil survey hole 12AS004 is near the location of Drill Hole #9. Tropic sandstone was encountered at 2.6 feet in soil survey hole 12AS004. Tropic sandstone and shale are interbeded in this area. No *Unacceptable* features were identified in this soil survey hole.

Hole #10

Overburden in Hole #10 is limited by:

- Soil pH is *Unacceptable* (2.6 to 4.8) in the 53 to 57 foot depth;
- Boron is *Unacceptable* (7.32 ppm) in the 53 to 54.5 foot depth;
- Selenium is *Unacceptable* for use in surface impoundments in the 53 to 54.5 foot depth;
- Total organic carbon is Unacceptable (33.6 percent) in the 53 to 54.5 foot depth;
- Acid base potential is Unacceptable (-13.4 to -6.9 tons per 1000 tons) in the 53 to 57 foot depth;
- The coal seam is in the 40 to 53 foot depth.

Soil survey holes 13AS05 and 13AS06 are near the location of Drill Hole #10. Tropic shale was not observed within 16.9 feet of the surface at 13AS05 and not within 29.0 feet of the surface at 13AS06. No *Unacceptable* features were identified in either of these soil survey holes.

Overburden Summary

Levels of pH, SAR, selenium, boron, total organic carbon, and acid-base potential (ABP) that are unacceptable for use in the upper four feet below reclaimed land surfaces or for use in surface-water impoundments have been identified in the North Private Lease overburden. The presence of these *Unacceptable* parameters can be correlated to specific geologic materials and locations within the overburden. These generalized correlations are detailed in Table 1 and illustrated in Figure 1.

Alluvium that has been sampled, tested, and identified as not containing any *Unacceptable* parameters may be used as substitute subsoil in areas where the combined topsoil and subsoil depth is less than four feet. Unsuitable Tropic shale, claystone, siltstone, and carboniferous overburden will not be used as topsoil or subsoil substitutes and will not be used for backfill within four feet of the final graded surface.

Based on the depth to limiting overburden features and soil depths identified in the Order 2 Soil Survey of the North Private Lease, it should be possible to place a minimum of four feet of suitable cover over any overburden with *Unacceptable* features. The suitable soil cover may consist of a mixture of topsoil, subsoil, or alluvium. The four feet of suitable cover should *not* include any unsuitable materials, including unsuitable Tropic shale, weathered Tropic shale, claystone, siltstone, carboniferous materials, or coal.

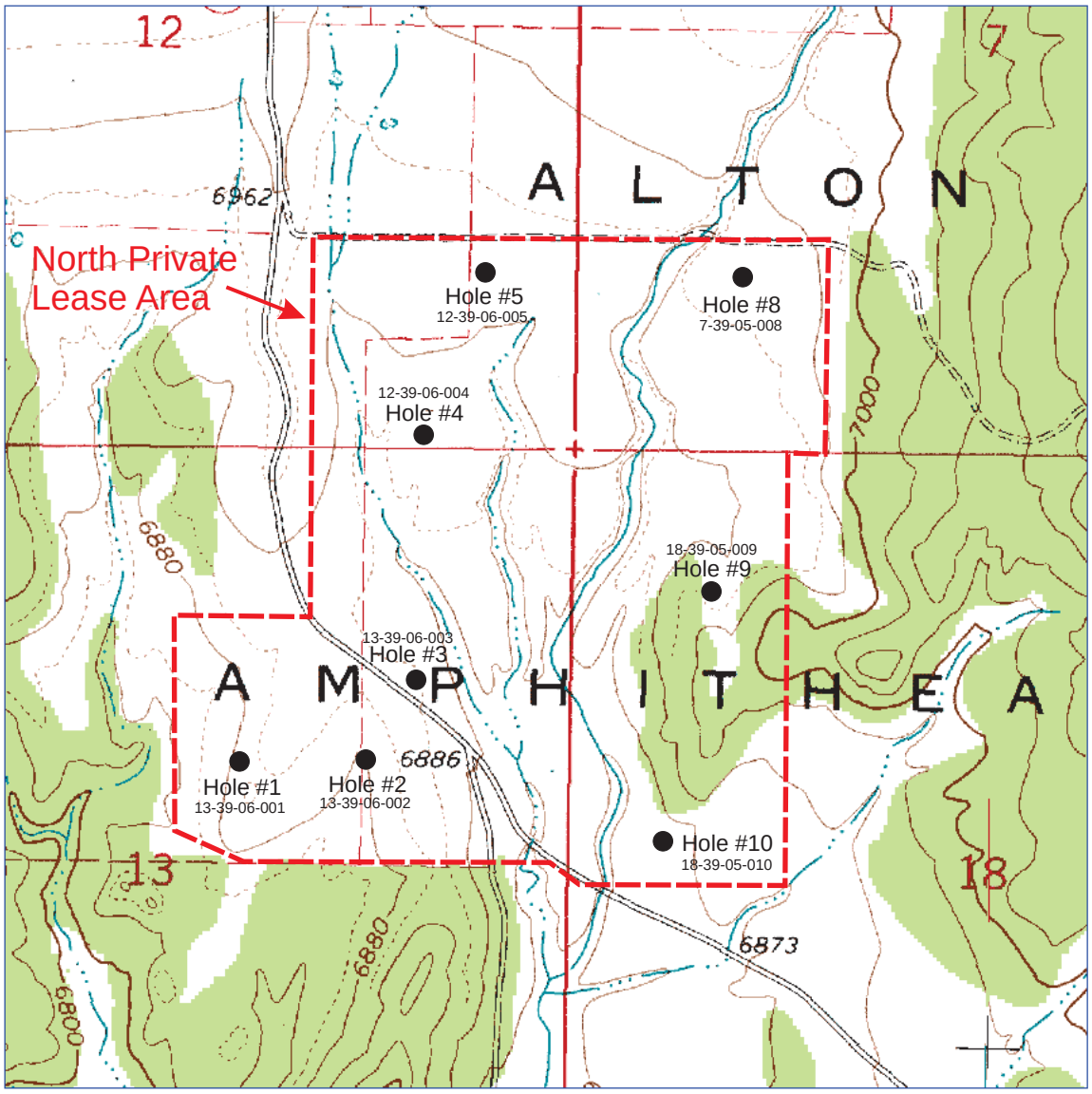
The disturbance of *Unacceptable* materials below the coal seam is not contemplated in the mine plan.

Table 1. General locations of Unacceptable parameters in the overburden.

Unacceptable Overburden Parameter[1]	General Location[2]
pH	Low pH was identified immediately below the coal seam.
Sodium Adsorption Ratio (SAR)	SAR values greater than 14 were identified in weathered Tropic shale and unweathered Tropic shale. *Unacceptable* SAR values were also indentified immediately above and below the coal seam.
Selenium, soluble	Selenium concentrations greater than 0.10 ppm were identified in the weathered Tropic shale, in the claystone/siltstone zone below the alluvium, and in the lower portion of the alluvium immediately above the claystone/siltstone interface (this material may be weathered claystone/siltstone). *Unacceptable* selenium concentrations were also indentified below the coal seam.
Boron, soluble	Boron concentration greater than 5 ppm were identified in the upper portion of the coal seam.
Total Organic Carbon (TOC)	TOC greater than 10 percent were identified in the carboniferous materials immediately above the coal seam.
Acid-Base Potential (ABP)	ABP less than 0 (negative values) was identified immediately below the coal seam.

1. Other *Unacceptable* parameters may also occur within localized areas in the overburden and should be monitored during excavation of the overburden.
2. *Unacceptable* parameter levels may also occur in other materials and at varied depths and should be monitored during excavation of the overburden.

Figure 1. Relative location of Unacceptable overburden parameters. Geologic strata depths taken from drilling field observations (Petersen 2012).



North

0 ¼ ½ Mile

0 1000 2000 Feet

1927 North American Datum; UTM grid zone 12
Generated by BigTopo7 (www.igage.com)
Map compiled from USGS Quads: Alton; UT

Figure 2. General location of Drill Holes.

Literature Cited

Long, R.E. 2014. Order 2 soil survey of the North Private Lease expansion of the Coal Hollow mine.

Petersen, E. 2012. Field notes of geologic strata observations recorded during drilling operations.

Utah Division of Oil, Gas, and Mining (Utah DOGM). 2008. Guidelines for the Management of Topsoil and Overburden.

Appendix 6-2A
Sample identification table for acid and toxic forming laboratory analyses for North Private Lease (Inter-Mountain Laboratory reports)

Sample ID	Lab ID	Sample location and type	Stratigraphic interval of sample	Lithologic description of sample
Hole #1 (13-39-06-001) samples				
Hole #1, 0-10 ft	S1410412-001	Hole #1 cuttings grab sample	33 to 43 feet above base of Tropic Shale	Silt, silty clay, clay, dark gray and brownish gray, moist
Hole #1, 10-20 ft	S1410412-002	Hole #1 cuttings grab sample	23 to 33 feet above base of Tropic Shale	Silt, silty clay, clay, dark gray and brownish gray, moist
Hole #1, 20-30 ft	S1410412-003	Hole #1 cuttings grab sample	13 to 23 feet above base of Tropic Shale	Silt, cilty clay, clay, dark gray and brownish gray, moist
Hole #1, 30-40 ft	S1410412-004	Hole #1 cuttings grab sample	3 to 13 feet above base of Tropic Shale	Silty clay, clay, silt, dark gray to black waxy clay
Hole #1, 40-43 ft	S1410412-005	Hole #1 core composite sample	0 to 3 feet above base of Tropic Shale	Black carbonaceous shale, bony, fossiliferous
Hole #1, 59-61 ft	S1410412-006	Hole #1 core composite sample	0 to 2 feet beneath base of Smirl coal seam	Medium gray waxy claytstone with minor silt
Hole #2 (13-39-06-002) samples				
Hole #2, 0-15 ft	S1410412-007	Hole #2 cuttings grab sample	25 to 40 feet above base of Tropic Shale	Weathered shale, clayey silt
Hole #2, 15-30 ft	S1410412-008	Hole #2 cuttings grab sample	10 to 25 feet above base of Tropic Shale	Silty claystone
Hole #2, 30-40 ft	S1410412-009	Hole #2 cuttings grab sample	0 to 10 feet above base of Tropic Shale	Silty claystone
Hole #2, 56.6-59 ft	S1410412-010	Hole #2 core composite sample	0 to 2.3 feet beneath base of Smirl coal seam	Soft, clayey shale/silt, claystone
Hole #2, 59-65 ft	S1410412-011	Hole #2 core composite sample	2.3 to 8.3 feet beneath base of Smirl coal seam	Silty claystone, clayey siltstone, f.g. sandstone, siltstone
Hole #3 (13-39-06-003) samples				
Hole #3, 0-10 ft	S1410412-012	Hole #3 cuttings grab sample	31.5 to 41.5 feeet above base of Tropic Shale	Silty clayey soil, silty clay, siltstone, brown and light gray, dry
Hole #3, 10-25 ft	S1410412-013	Hole #3 cuttings grab sample	16.5 to 31.5 feet above base of Tropic Shale	Silty clay, brownish gray, moist
Hole #3, 25-33 ft	S1410412-014	Hole #3 cuttings grab sample	8.5 to 16.5 feet above base of Tropic Shale	silty clay, waxy clay, moist, brownish gray and dark greenish gray
Hole #3, 33-41.5 ft	S1410412-015	Hole #3 cuttings grab sample	0 to 8.5 feet above base of Tropic Shale	Dark greenish gray shale, minor silt, moist
Hole #3, 57.7-61 ft	S1410412-016	Hole #3 core composite sample	0 to 3.3 feet beneath base of Smirl coal seam	Shaley siltstone, silty claystone, siltstone, mottled, gray, brown, black, wet
Hole #4 (12-39-06-004) samples				
Hole #4, 0-10 ft	S1410412-017	Hole #4 cuttings grab sample	74 to 84 feet above base of Tropic Shale	Clayey silt, soil, brown and yellowish, dry
Hole #4, 10-20 ft	S1410412-018	Hole #4 cuttings grab sample	64 to 74 feet above base of Tropic Shale	Clayey silt, brown, moist
Hole #4, 20-30 ft	S1410412-019	Hole #4 cuttings grab sample	54 to 64 feet above base of Tropic Shale	Clayey silt, brown, wet
Hole #4, 30-40 ft	S1410412-020	Hole #4 cuttings grab sample	44 to 54 feet above base of Tropic Shale	Clayey silt, brown, wet
Hole #4, 50-40 ft	S1410412-021	Hole #4 cuttings grab sample	34 to 44 feet above base of Tropic Shale	Clayey silt, brown, wet
Hole #4, 50-60 ft	S1410412-022	Hole #4 cuttings grab sample	24 to 34 feet above base of Tropic Shale	Clayey silt, brown, wet
Hole #4, 60-70 ft	S1410412-023	Hole #4 cuttings grab sample	14 to 24 feet above base of Tropic Shale	Clayey silt, brown, wet
Hole #4, 70-80 ft	S1410412-024	Hole #4 cuttings grab sample	4 to 14 feet above base of Tropic Shale	Silty clay, claystone, brown, grayish brown, greenish brown, Tropic Shale
Hole #4, 78-80.3 ft	S1410412-025	Hole #4 core composite sample	3.7 to 6 feet above base of Tropic Shale	Clayey siltstone, medium to dark gray
Hole #4, 80.3-84 ft	S1410412-026	Hole #4 core composite sample	0 to 3.7 feet above base of Tropic Shale	Organic shale, soft, dark gray to black, fossiliferous
Hole #4, 101-106 ft	S1410412-027	Hole #4 core composite sample	0 to 5 feet beneath base of Smirl coal seam	Organic-rich shale/claystone, organic fragments, clayey siltstone, silty claystone
Hole #4, 106-112 ft	S1410412-028	Hole #4 core composite sample	5 to 11 feet beneath base of Smirl coal seam	Siltstone, clayey siltstone, silty claystone/shale, gray
Hole #4, 112-118 ft	S1410412-029	Hole #4 core composite sample	11 to 17 feet beneath base of Smirl coal seam	Silty claystone/shale, fissile, gray, sandstone, f.g., silty claystone, soft, gray
Hole #4, 118-124 ft	S1410412-030	Hole #4 core composite sample	17 to 23 feet beneath base of Smirl coal seam	Clayey siltstone, silty claystone/shale, fissile, siltstone, gray to black organic shale
Hole #4, 124-130 ft	S1410412-031	Hole #4 core composite sample	23 to 29 feet beneath base of Smirl coal seam	Silty claystone, fissile, clayey siltstone, siltstone, gray
Hole #4, 130-136 ft	S1410412-032	Hole #4 core composite sample	29 to 35 feet beneath base of Smirl coal seam	Silty claystone, clayey siltstone, siltstone, gray
Hole #4, 136-142 ft	S1410412-033	Hole #4 core composite sample	35 to 41 feet beneath base of Smirl coal seam	Silty claystone, siltstone, claystone, sandstone
Hole #4, 142-150 ft	S1410412-034	Hole #4 core composite sample	41 to 49 feet beneath base of Smirl coal seam	Sandstone, v.f.g., siltstone, silty claystone, gray
Hole #5 (12-39-06-005) samples				
Hole #5, 0-10 ft	S1410412-035	Hole #5 cuttings composite sample	101 to 111 feet above base of Tropic Shale	Silty Soil, grayish brown, sandy silt, brown, silt, sandy, clayey, gray
Hole #5, 10-20 ft	S1410412-036	Hole #5 cuttings composite sample	91 to 101 feet above base of Tropic Shale	Sandy silt, gray
Hole #5, 20-30 ft	S1410412-037	Hole #5 cuttings composite sample	81 to 91 feet above base of Tropic Shale	Silty sand, v.f.g, yellowish brown
Hole #5, 30-40 ft	S1410412-038	Hole #5 cuttings composite sample	71 to 81 feet above base of Tropic Shale	Silty sand, v.f.g, yellowish brown
Hole #5, 40-50 ft	S1410412-039	Hole #5 cuttings composite sample	61 to 71 feet above base of Tropic Shale	Silty sand, v.f.g, yellowish brown
Hole #5, 50-60 ft	S1410412-040	Hole #5 cuttings composite sample	51 to 61 feet above base of Tropic Shale	Silty sand, v.f.g, yellowish brown, dark gray to black clay
Hole #5, 60-70 ft	S1410412-041	Hole #5 cuttings composite sample	41 to 51 feet above base of Tropic Shale	Silty sand, v.f.g, yellowish brown, dark gray to black clay
Hole #5, 70-80 ft	S1410412-042	Hole #5 cuttings composite sample	31 to 41 feet above base of Tropic Shale	Silty sand, v.f.g, yellowish brown, dark gray to black clay
Hole #5, 80-90 ft	S1410412-043	Hole #5 cuttings composite sample	21 to 31 feet above base of Tropic Shale	Silty sand, v.f.g, yellowish brown, dark gray to black clay
Hole #5, 90-95 ft	S1410412-044	Hole #5 cuttings composite sample	16 to 21 feet abov e base of Tropic Shale	Silty sand, v.f.g, yellowish brown, dark gray to black clay
Hole #5, 92-98 ft	S1410412-045	Hole #5 core composite sample	13 to 16 feet above base of Tropic Shale	Silty claystone, bentonitic claystone grading to bentonite, black, waxy

Sample ID	**Lab ID**	**Sample location and type**	**Stratigraphic interval of sample**	**Lithologic description of sample**
Hole #5, 98-104 ft	S1410412-046	Hole #5 core composite sample	7 to 13 feet above base of Tropic Shale	Silty claystone, siltstone, organic-rich silt, clayey siltstone, dark gray to black
Hole #5, 104-111 ft	S1410412-047	Hole #5 core composite sample	0 to 7 feet above base of Tropic Shale	Silty claystone, siltstone, organic-rich silt, fossiliferous shale, gray to black
Hole #5, 127-133 ft	S1410412-048	Hole #5 core composite sample	0 to 6 feet beneath base of Smirl coal seam	Silty claystone, siltstone, clayey siltstone, gray
Hole #8 (7-39-05-008) samples				
Hole #8, 0-14 ft	S1410412-049	Hole #8 cuttings grab sample	150 to 164 feet above base of Tropic Shale	Silt/soil, sandy silt, minor clay, brown
Hole #8, 14-24 ft	S1410412-050	Hole #8 cuttings grab sample	164 to 154 feet above base of Tropic Shale	Silty clay, sandy silt, medium brown, damp
Hole #8, 24-34 ft	S1410412-051	Hole #8 cuttings grab sample	154 to 144 feet above base of Tropic Shale	Gravel with silt and sand, medium brown, dry
Hole #8, 34-49 ft	S1410412-052	Hole #8 cuttings grab sample	144 to 129 feet above base of Tropic Shale	Silty sand, medium brown, wet to moist
Hole #8, 49-69 ft	S1410412-053	Hole #8 cuttings grab sample	129 to 109 feet above base of Tropic Shale	Silty sand, medium brown, wet to moist
Hole #8, 69-79 ft	S1410412-054	Hole #8 cuttings grab sample	109 to 99 feet above base of Tropic Shale	Silty, clayey sand, greenish brown, clay/claystone, minor silt, wet
Hole #8, 79-94 ft	S1410412-055	Hole #8 cuttings grab sample	99 to 94 feet above base of Tropic Shale	Tropic Shale, claystone/clay, minor silt, greenish gray to black, wet
Hole #8, 159-164 ft	S1410412-056	Hole #8 core composite sample	0 to 5 feet above base of Tropic Shale	Siltstone with interbedded shale, shale, fossiliferous, black
Hole #8, 179.5-184 ft	S1410412-057	Hole #8 core composite sample	0 to 4.5 feet beneath base of Smirl coal seam	Silty claystone, sandy siltstone, silty claystone, gray, soft and hard
Hole #8, 184-188 ft	S1410412-058	Hole #8 core composite sample	4.5 to 8.5 feet beneath base of Smirl coal seam	Siltstone, gray, banded, silty claystone, gray
Hole #8, 188-193 ft	S1410412-059	Hole #8 core composite sample	8.5 to 13.5 feet beneath base of Smirl coal seam	Claytstone, soft, locally silty, gray
Hole #9 (18-39-05-009) samples				
Hole #9, 0-9 ft	S1410412-060	Hole #9 cuttings grab sample	112.6 to 121.6 feet above base of Tropic Shale	Soil, tight clay, dense, no water
Hole #9, 9-19 ft	S1410412-061	Hole #9 cuttings grab sample	102.6 to 112.6 feet above base of Tropic Shale	Silty clay, moist, brownish gray
Hole #9, 19-29 ft	S1410412-062	Hole #9 cuttings grab sample	92.6 to 102.6 feet above base of Tropic Shale	Silty clay, moist, grayish brown
Hole #9, 29-39 ft	S1410412-063	Hole #9 cuttings grab sample	82.6 to 92.6 feet above base of Tropic Shale	Silty clay, moist, grayish brown
Hole #9, 39-49 ft	S1410412-064	Hole #9 cuttings grab sample	72.6 to 82.6 feet above base of Tropic Shale	Clay, tight, dark greenish gray, moist
Hole #9, 49-59 ft	S1410412-065	Hole #9 cuttings grab sample	62.6 to 72.6 feet above base of Tropic Shale	Silty clay, dark greenish gray, moist
Hole #9, 59-69 ft	S1410412-066	Hole #9 cuttings grab sample	52.6 to 62.6 feet above base of Tropic Shale	Silty clay, dark greenish gray, moist
Hole #9, 69-84 ft	S1410412-067	Hole #9 cuttings grab sample	37.6 to 52.6 feet above base of Tropic Shale	Silty clay, dark greenish gray, moist
Hole #9, 113-117 ft	S1410412-068	Hole #9 core composite sample	4.6 to 8.6 feet above base of Tropic Shale	Silty clay, siltstone, mottled gray and black, shale/claystone, fossiliferous, black
Hole #9, 117-121.6 ft	S1410412-069	Hole #9 core composite sample	0 to 4.6 feet above base of Tropic Shale	Shale/claystone, organic shale, fossiliferous, black
Hole #9, 137.6-143 ft	S1410412-070	Hole #9 core composite sample	0 to 5.4 feet beneath base of Smirl coal seam	Clayey siltstone, silty claystone, sandstone, v.f.g, gray
Hole #9, 143-148 ft	S1410412-071	Hole #9 core composite sample	5.4 to 10.4 feet beneath base of Smirl coal seam	Sandstone, fine grained, minor thin shaley partings
Hole #9, 148-153 ft	S1410412-072	Hole #9 core composite sample	10.4 to 15.4 feet beneath base of Smirl coal seam	Sandstone, fine grained, minor thin shaley partings
Hole #9, 153-158 ft	S1410412-073	Hole #9 core composite sample	15.4 to 20.4 feet beneath base of Smirl coal seam	Sandstone, fine grained, minor thin shaley partings
Hole #9, 158-163 ft	S1410412-074	Hole #9 core composite sample	20.4 to 25.4 feet beneath base of Smirl coal seam	Sandstone, v.f.g, thin shaley partings, silty claystone, gray soft
Hole #10 (18-39-05-010) samples				
Hole #10, 0-10 ft	S1410412-075	Hole #10 cuttings grab sample	30 to 40 feet above base of Tropic Shale	Clayey silt, minor sand, grayish brown dry
Hole #10, 10-20 ft	S1410412-076	Hole #10 cuttings grab sample	20 to 30 feet above base of Tropic Shale	Clayey silt, grayish brown, moist
Hole #10, 20-30 ft	S1410412-077	Hole #10 cuttings grab sample	10 to 20 feet above base of Tropic Shale	Clayey silt, grayish brown, moist
Hole #10, 30-40 ft	S1410412-078	Hole #10 core composite sample	0 to 10 feet above base of Tropic Shale	Silty clay, silty shale, brownish gray, dark gray, black
Hole #10, 53-54.4 ft	S1410412-079	Hole #10 core composite sample	0 to 1.5 feet beneath base of Smirl coal seam	Siltstone with minor coal stringers
Hole #10, 54.5-57 ft	S1410412-080	Hole #10 core composite sample	1.5 to 4 feet beneath base of Smirl coal seam	Claystone, light gray, soft, moist

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Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

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Suite 1
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Report ID: S1410412001

Project: North Lease Borings
Date Received: 10/27/2014

Date Reported: 1/5/2015
Work Order: S1410412

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter	CO3
		cm	s.u.	%	dS/m	%	%	%	%	%
S1410412-001	Hole #1	0-10	8.0	82.6	8.70	16.3	40.7	28.8	1.2	8.1
S1410412-002	Hole #1	10-20	8.1	158	7.42	19.9	57.9	51.6	<0.1	4.8
S1410412-003	Hole #1	20-30	8.0	185	7.21	16.5	59.3	48.2	0.1	4.6
S1410412-004	Hole #1	30-40	8.1	236	5.45	23.7	58.2	52.7	1.4	6.1
S1410412-005	Hole #1	40-43	7.8	130	4.80	11.5	44.5	34.3	3.6	8.1
S1410412-006	Hole #1	59-61	4.9	54.8	4.53	8.7	25.3	17.2	1.7	0.4
S1410412-007	Hole #2	0-15	7.9	107	5.48	18.8	53.3	39.8	0.3	5.9
S1410412-008	Hole #2	15-30	7.2	103	5.60	16.8	52.1	39.8	0.7	4.4
S1410412-009	Hole #2	30-40	7.8	108	6.29	16.7	53.7	40.3	0.6	4.7
S1410412-010	Hole #2	56.6-59	4.6	53.9	3.22	4.8	25.9	16.4	2.7	0.7
S1410412-011	Hole #2	59-65	7.6	36.7	2.78	4.5	21.6	8.9	2.8	8.8
S1410412-012	Hole #3	0-10	7.7	56.0	1.58	6.0	30.3	24.0	2.5	28.4
S1410412-013	Hole #3	10-25	7.8	104	6.51	20.9	49.8	42.0	0.4	3.1
S1410412-014	Hole #3	25-33	7.9	161	4.73	16.8	53.8	43.3	1.1	5.5
S1410412-015	Hole #3	33-41.5	8.0	150	3.90	15.4	52.7	40.3	2.2	7.0
S1410412-016	Hole #3	57.7-61	6.2	43.3	3.03	3.2	19.1	12.9	2.5	1.3
S1410412-017	Hole #4	0-10	7.8	47.7	0.46	5.1	27.0	20.0	3.3	48.2
S1410412-018	Hole #4	10-20	7.8	41.2	2.50	13.9	22.8	16.1	2.9	43.3
S1410412-019	Hole #4	20-30	7.7	34.9	3.42	6.4	19.4	12.1	3.1	36.3
S1410412-020	Hole #4	30-40	7.7	40.4	3.25	11.8	19.6	13.4	3.0	29.0

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

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Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter	CO3
		cm	s.u.	%	dS/m	%	%	%	%	%
S1410412-021	Hole #4	40-50	7.8	37.7	3.01	5.7	18.7	12.7	3.1	33.1
S1410412-022	Hole #4	50-60	7.8	37.8	3.34	5.3	21.2	11.0	3.0	28.5
S1410412-023	Hole #4	60-70	7.8	50.4	3.63	20.8	26.1	14.4	2.8	24.3
S1410412-024	Hole #4	70-80	7.9	80.4	5.47	26.0	35.8	24.2	1.3	17.0
S1410412-025	Hole #4	78-80.3	6.9	39.4	4.99	0.7	26.5	6.4	5.8	10.7
S1410412-026	Hole #4	80.3-84	6.8	54.1	5.56	3.2	30.5	13.6	7.8	14.7
S1410412-027	Hole #4	101-106	6.8	66.8	2.67	2.0	27.3	17.6	2.4	1.4
S1410412-028	Hole #4	106-112	8.1	46.7	1.83	1.3	20.8	13.3	3.2	7.2
S1410412-029	Hole #4	112-118	7.8	56.8	1.27	1.5	25.0	16.3	2.4	1.7
S1410412-030	Hole #4	118-124	6.6	45.6	5.23	1.7	24.6	12.9	6.6	9.7
S1410412-031	Hole #4	124-130	8.5	51.7	0.70	1.4	25.0	16.3	3.7	16.2
S1410412-032	Hole #4	130-136	7.6	34.5	2.61	0.8	19.8	10.3	3.3	19.2
S1410412-033	Hole #4	136-142	7.5	41.6	2.21	1.8	21.0	14.1	4.9	23.6
S1410412-034	Hole #4	142-150	8.6	43.2	0.71	1.9	20.6	12.4	3.2	7.0
S1410412-035	Hole #5	0-10	8.0	61.5	1.32	7.0	28.6	21.1	2.8	49.3
S1410412-036	Hole #5	10-20	7.8	40.4	3.33	12.9	18.5	12.0	2.5	30.9
S1410412-037	Hole #5	20-30	7.9	28.9	2.46	21.8	15.1	6.7	2.0	26.9
S1410412-038	Hole #5	30-40	7.8	24.2	2.53	12.6	13.3	5.2	1.8	24.6
S1410412-039	Hole #5	40-50	7.8	26.1	2.11	12.0	13.7	5.5	2.1	24.6
S1410412-040	Hole #5	50-60	7.9	24.7	2.57	11.4	13.6	5.3	1.9	24.6

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Karen Secor, Soil Lab Supervisor

Soil Analysis Report

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Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter	CO3
		cm	s.u.	%	dS/m	%	%	%	%	%
S1410412-041	Hole #5	60-70	7.8	24.9	2.75	13.7	14.6	5.5	1.7	25.4
S1410412-042	Hole #5	70-80	7.7	25.1	2.86	10.4	15.0	5.3	1.9	25.5
S1410412-043	Hole #5	80-90	8.1	51.4	3.35	11.2	24.0	13.6	1.5	18.9
S1410412-044	Hole #5	90-95	8.0	51.3	4.42	12.6	25.9	15.6	2.1	18.1
S1410412-045	Hole #5	92-98	8.2	75.2	2.05	4.5	41.6	30.4	2.8	8.4
S1410412-046	Hole #5	98-104	6.8	41.8	6.91	2.6	30.2	13.3	6.3	5.6
S1410412-047	Hole #5	104-111	7.1	35.9	5.48	1.6	27.0	10.8	6.9	16.6
S1410412-048	Hole #5	127-133	6.8	46.3	3.41	1.6	21.7	14.7	2.7	2.8
S1410412-049	Hole #8	0-14	8.0	36.6	0.53	3.2	21.3	12.4	2.4	37.3
S1410412-050	Hole #8	14-24	8.0	32.1	0.57	7.6	19.4	11.8	2.1	34.3
S1410412-051	Hole #8	24-34	8.5	22.4	0.43	2.8	13.6	5.8	2.0	62.7
S1410412-052	Hole #8	34-49	8.0	24.1	1.86	9.2	15.4	7.2	1.5	35.7
S1410412-053	Hole #8	49-69	8.1	22.8	1.77	8.8	13.6	6.3	1.7	39.7
S1410412-054	Hole #8	69-79	7.5	46.2	2.54	18.4	25.2	14.6	2.6	31.7
S1410412-055	Hole #8	79-94	7.5	50.8	2.38	16.7	26.3	18.5	3.9	31.8
S1410412-056	Hole #8	159-164	7.0	45.2	6.15	2.4	30.7	13.1	7.3	20.5
S1410412-057	Hole #8	179.5-184	8.1	47.3	3.40	1.9	24.0	15.5	2.6	3.7
S1410412-058	Hole #8	184-188	6.9	64.5	3.98	1.7	31.0	21.8	3.6	2.9
S1410412-059	Hole #8	188-193	8.5	87.6	1.64	2.1	34.2	20.6	1.8	1.4
S1410412-060	Hole #9	0-9	8.0	65.1	3.98	5.8	37.6	24.2	2.7	8.4

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Karen Secor, Soil Lab Supervisor

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Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter	CO3
		cm	s.u.	%	dS/m	%	%	%	%	%
S1410412-061	Hole #9	9-19	7.7	71.2	4.59	10.6	38.4	26.8	3.4	20.7
S1410412-062	Hole #9	19-29	7.7	67.9	4.14	13.5	37.5	27.3	2.5	19.1
S1410412-063	Hole #9	29-39	7.5	66.6	4.14	12.7	37.7	29.1	2.2	21.0
S1410412-064	Hole #9	39-49	7.7	68.3	3.92	13.3	37.7	26.9	2.9	21.5
S1410412-065	Hole #9	49-59	7.6	58.2	3.82	9.0	33.4	20.4	2.9	14.5
S1410412-066	Hole #9	59-69	7.7	64.1	3.86	7.5	37.2	24.7	3.2	13.2
S1410412-067	Hole #9	69-84	7.6	65.1	4.16	25.2	34.6	23.8	4.0	12.0
S1410412-068	Hole #9	113-117	7.2	28.6	5.11	1.2	22.0	7.6	7.8	27.5
S1410412-069	Hole #9	117-121.6	7.0	44.4	6.57	2.8	33.4	14.9	9.7	16.0
S1410412-070	Hole #9	137.6-143	6.8	62.2	1.49	1.8	27.3	17.9	2.6	0.8
S1410412-071	Hole #9	143-148	6.7	34.3	3.40	0.3	20.9	8.7	3.9	2.3
S1410412-072	Hole #9	148-153	7.5	31.6	2.72	0.2	23.1	6.7	1.6	5.7
S1410412-073	Hole #9	153-158	7.5	31.0	3.27	0.2	23.2	6.8	1.9	7.3
S1410412-074	Hole #9	158-163	8.4	58.4	1.24	2.0	27.4	18.4	1.9	4.6
S1410412-075	Hole #10	0-10	7.6	62.8	3.36	7.9	38.6	27.8	2.7	19.7
S1410412-076	Hole #10	10-20	7.6	64.7	3.63	11.8	38.0	27.6	2.9	19.2
S1410412-077	Hole #10	20-30	7.7	77.6	4.39	18.2	44.1	33.0	1.2	12.4
S1410412-078	Hole #10	30-40	7.5	66.1	2.89	17.9	36.5	27.0	3.1	8.7
S1410412-079	Hole #10	53-54.5	4.8	51.7	2.83	4.9	29.4	13.1	9.6	1.0
S1410412-080	Hole #10	54.5-57	2.6	43.4	4.92	1.7	21.4	13.5	3.0	<0.1

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Karen Secor, Soil Lab Supervisor

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Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1410412-001	Hole #1	0-10	19.3	26.7	1.00	86.9	18.1
S1410412-002	Hole #1	10-20	16.0	17.6	1.02	81.0	19.7
S1410412-003	Hole #1	20-30	15.2	13.1	1.00	69.6	18.5
S1410412-004	Hole #1	30-40	13.8	8.63	1.04	62.6	18.7
S1410412-005	Hole #1	40-43	14.6	6.58	1.20	50.7	15.6
S1410412-006	Hole #1	59-61	18.4	18.9	1.28	31.4	7.28
S1410412-007	Hole #2	0-15	16.8	18.0	0.75	40.2	9.64
S1410412-008	Hole #2	15-30	15.8	15.1	0.86	47.0	12.0
S1410412-009	Hole #2	30-40	17.4	13.8	1.25	65.4	16.6
S1410412-010	Hole #2	56.6-59	15.4	12.4	1.02	14.1	3.79
S1410412-011	Hole #2	59-65	19.8	12.8	1.13	7.99	1.98
S1410412-012	Hole #3	0-10	7.39	3.00	0.35	8.89	3.90
S1410412-013	Hole #3	10-25	16.2	15.6	0.94	50.9	12.8
S1410412-014	Hole #3	25-33	12.8	7.07	0.99	40.2	12.7
S1410412-015	Hole #3	33-41.5	8.08	5.27	0.85	33.6	13.0
S1410412-016	Hole #3	57.7-61	17.1	15.4	0.85	11.2	2.77
S1410412-017	Hole #4	0-10	2.06	2.24	0.23	0.34	0.23
S1410412-018	Hole #4	10-20	13.7	22.6	0.37	2.74	0.64
S1410412-019	Hole #4	20-30	23.2	25.1	0.41	3.97	0.81
S1410412-020	Hole #4	30-40	21.0	21.9	0.55	4.23	0.91

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Karen Secor, Soil Lab Supervisor

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Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1410412-021	Hole #4	40-50	20.0	20.2	0.47	4.08	0.91
S1410412-022	Hole #4	50-60	21.2	20.6	0.56	6.57	1.44
S1410412-023	Hole #4	60-70	21.7	18.2	0.75	12.7	2.85
S1410412-024	Hole #4	70-80	17.7	12.0	1.03	43.5	11.3
S1410412-025	Hole #4	78-80.3	24.1	16.4	0.86	30.0	6.67
S1410412-026	Hole #4	80.3-84	21.6	10.6	1.07	42.6	10.6
S1410412-027	Hole #4	101-106	4.09	2.43	0.64	22.2	12.3
S1410412-028	Hole #4	106-112	1.40	0.88	0.43	15.8	14.8
S1410412-029	Hole #4	112-118	1.46	1.25	0.38	10.5	9.00
S1410412-030	Hole #4	118-124	20.4	11.2	1.17	39.7	9.98
S1410412-031	Hole #4	124-130	0.85	0.65	0.18	5.51	6.37
S1410412-032	Hole #4	130-136	2.84	1.74	0.54	24.1	16.0
S1410412-033	Hole #4	136-142	3.09	2.06	0.67	22.9	14.3
S1410412-034	Hole #4	142-150	0.72	0.55	0.23	8.31	10.4
S1410412-035	Hole #5	0-10	4.19	6.64	0.22	4.03	1.73
S1410412-036	Hole #5	10-20	19.6	27.6	0.55	3.73	0.77
S1410412-037	Hole #5	20-30	16.8	15.5	0.37	2.55	0.64
S1410412-038	Hole #5	30-40	15.6	17.7	0.43	2.79	0.69
S1410412-039	Hole #5	40-50	13.3	15.6	0.41	3.59	0.95
S1410412-040	Hole #5	50-60	14.7	19.4	0.40	4.02	0.97

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		cm	meq/L	meq/L	meq/L	meq/L	
S1410412-041	Hole #5	60-70	16.4	19.0	0.42	3.58	0.85
S1410412-042	Hole #5	70-80	19.4	19.2	0.42	3.24	0.74
S1410412-043	Hole #5	80-90	4.60	3.03	0.35	15.2	7.79
S1410412-044	Hole #5	90-95	19.1	11.6	0.93	32.4	8.27
S1410412-045	Hole #5	92-98	1.51	0.89	0.32	21.5	19.7
S1410412-046	Hole #5	98-104	20.1	22.0	1.40	54.7	11.9
S1410412-047	Hole #5	104-111	21.6	15.8	1.19	37.0	8.55
S1410412-048	Hole #5	127-133	7.28	4.90	0.89	27.6	11.2
S1410412-049	Hole #8	0-14	2.46	2.18	0.34	0.33	0.22
S1410412-050	Hole #8	14-24	2.29	3.19	0.26	0.54	0.32
S1410412-051	Hole #8	24-34	1.18	2.57	0.26	0.58	0.43
S1410412-052	Hole #8	34-49	11.8	13.3	0.46	1.09	0.31
S1410412-053	Hole #8	49-69	10.2	13.1	0.41	1.46	0.43
S1410412-054	Hole #8	69-79	18.1	16.1	0.68	2.36	0.57
S1410412-055	Hole #8	79-94	15.8	15.2	0.74	2.29	0.58
S1410412-056	Hole #8	159-164	20.9	7.52	1.00	55.2	14.6
S1410412-057	Hole #8	179.5-184	3.26	1.70	0.53	33.3	21.1
S1410412-058	Hole #8	184-188	4.81	2.25	0.57	39.6	21.1
S1410412-059	Hole #8	188-193	0.50	0.40	0.30	15.2	22.8
S1410412-060	Hole #9	0-9	24.0	19.7	0.39	16.4	3.51

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1410412001

Project: North Lease Borings
Date Received: 10/27/2014

Date Reported: 1/5/2015
Work Order: S1410412

Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1410412-061	Hole #9	9-19	21.6	23.0	0.61	20.0	4.23
S1410412-062	Hole #9	19-29	22.7	21.6	0.94	20.1	4.27
S1410412-063	Hole #9	29-39	24.3	18.5	1.13	20.9	4.53
S1410412-064	Hole #9	39-49	22.0	15.4	1.25	21.1	4.88
S1410412-065	Hole #9	49-59	19.0	12.0	1.10	21.2	5.39
S1410412-066	Hole #9	59-69	16.1	10.0	1.05	22.9	6.35
S1410412-067	Hole #9	69-84	16.5	10.9	1.04	21.4	5.79
S1410412-068	Hole #9	113-117	24.3	10.8	1.11	44.5	10.6
S1410412-069	Hole #9	117-121.6	20.8	8.50	1.04	60.7	15.9
S1410412-070	Hole #9	137.6-143	0.36	0.24	0.11	6.38	11.6
S1410412-071	Hole #9	143-148	5.66	3.75	0.58	28.0	12.9
S1410412-072	Hole #9	148-153	8.22	4.62	0.56	19.3	7.60
S1410412-073	Hole #9	153-158	7.62	3.83	0.63	28.9	12.1
S1410412-074	Hole #9	158-163	0.68	0.98	0.43	7.08	7.76
S1410412-075	Hole #10	0-10	19.9	8.38	0.60	14.7	3.91
S1410412-076	Hole #10	10-20	17.8	11.7	0.77	19.6	5.11
S1410412-077	Hole #10	20-30	21.5	17.4	0.94	23.3	5.28
S1410412-078	Hole #10	30-40	14.5	10.3	0.82	11.6	3.29
S1410412-079	Hole #10	53-54.5	14.9	19.8	0.46	6.20	1.49
S1410412-080	Hole #10	54.5-57	15.7	37.2	0.33	3.80	0.74

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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

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Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1410412001

Project: North Lease Borings
Date Received: 10/27/2014

Date Reported: 1/5/2015
Work Order: S1410412

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Boron	Nitrate(as N)	Selenium
		cm	%	%	%		%	ppm	ppm	ppm
S1410412-001	Hole #1	0-10	16.0	23.0	61.0	Clay	8.9	0.85	13.1	<0.02
S1410412-002	Hole #1	10-20	22.0	18.0	60.0	Clay	17.3	0.35	1.7	0.03
S1410412-003	Hole #1	20-30	18.0	38.0	44.0	Clay	14.4	0.42	1.7	0.02
S1410412-004	Hole #1	30-40	22.0	18.0	60.0	Clay	18.0	0.48	3.6	0.03
S1410412-005	Hole #1	40-43	13.0	32.0	55.0	Silty Clay	7.1	0.52	0.2	0.02
S1410412-006	Hole #1	59-61	11.0	43.0	46.0	Silty Clay	6.5	4.09	<0.1	0.16
S1410412-007	Hole #2	0-15	13.0	20.0	67.0	Clay	7.7	1.29	3.7	0.06
S1410412-008	Hole #2	15-30	24.0	17.0	59.0	Silty Clay	20.1	0.44	5.5	0.06
S1410412-009	Hole #2	30-40	26.0	19.0	55.0	Silty Clay	22.0	0.51	2.9	0.05
S1410412-010	Hole #2	56.6-59	9.0	45.0	46.0	Silty Clay	4.3	4.04	<0.1	0.27
S1410412-011	Hole #2	59-65	45.0	33.0	22.0	Loam	13.2	1.33	0.1	0.11
S1410412-012	Hole #3	0-10	33.0	32.0	35.0	Clay Loam	10.0	0.49	0.9	<0.02
S1410412-013	Hole #3	10-25	9.0	23.0	68.0	Clay	1.6	0.67	4.0	0.06
S1410412-014	Hole #3	25-33	9.0	29.0	62.0	Clay	4.9	1.15	0.9	0.07
S1410412-015	Hole #3	33-41.5	22.0	22.0	56.0	Silty Clay	17.8	1.93	2.2	0.04
S1410412-016	Hole #3	57.7-61	21.0	46.0	33.0	Clay Loam	15.6	2.48	0.2	0.06
S1410412-017	Hole #4	0-10	18.0	45.0	37.0	Silty Clay Loam	<0.1	0.31	5.6	<0.02
S1410412-018	Hole #4	10-20	37.0	36.0	27.0	Clay Loam	20.2	0.22	15.0	<0.02
S1410412-019	Hole #4	20-30	37.0	45.0	18.0	Loam	1.1	0.23	3.1	0.04
S1410412-020	Hole #4	30-40	38.0	39.0	23.0	Loam	7.5	0.30	0.9	0.03

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1410412001

Project: North Lease Borings
Date Received: 10/27/2014

Date Reported: 1/5/2015
Work Order: S1410412

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Boron	Nitrate(as N)	Selenium
		cm	%	%	%		%	ppm	ppm	ppm
S1410412-021	Hole #4	40-50	39.0	42.0	19.0	Loam	9.1	0.18	1.2	0.04
S1410412-022	Hole #4	50-60	43.0	36.0	21.0	Loam	8.4	0.20	2.3	0.06
S1410412-023	Hole #4	60-70	41.0	32.0	27.0	Clay Loam	7.2	0.30	3.1	0.06
S1410412-024	Hole #4	70-80	25.0	31.0	44.0	Clay	8.1	0.82	15.4	0.07
S1410412-025	Hole #4	78-80.3	65.0	26.0	9.0	Sandy Loam	11.1	1.29	0.2	<0.02
S1410412-026	Hole #4	80.3-84	33.0	41.0	26.0	Loam	10.9	4.29	0.3	0.04
S1410412-027	Hole #4	101-106	19.0	32.0	49.0	Clay	15.1	3.25	0.2	0.26
S1410412-028	Hole #4	106-112	27.0	39.0	34.0	Clay Loam	5.5	2.23	0.3	0.36
S1410412-029	Hole #4	112-118	22.0	34.0	44.0	Clay	8.0	2.47	0.2	0.16
S1410412-030	Hole #4	118-124	29.0	37.0	34.0	Clay Loam	12.7	3.19	0.1	0.17
S1410412-031	Hole #4	124-130	23.0	40.0	37.0	Clay Loam	8.7	1.51	0.3	0.20
S1410412-032	Hole #4	130-136	31.0	43.0	26.0	Loam	15.2	1.35	0.2	0.14
S1410412-033	Hole #4	136-142	31.0	37.0	32.0	Clay Loam	17.1	1.51	0.2	0.09
S1410412-034	Hole #4	142-150	35.0	38.0	27.0	Clay Loam	14.7	0.94	0.2	0.09
S1410412-035	Hole #5	0-10	7.0	45.0	48.0	Silty Clay	<0.1	0.37	10.0	<0.02
S1410412-036	Hole #5	10-20	41.0	31.0	28.0	Clay Loam	7.4	0.21	7.3	<0.02
S1410412-037	Hole #5	20-30	63.0	24.0	13.0	Sandy Loam	11.0	0.10	1.1	<0.02
S1410412-038	Hole #5	30-40	77.0	13.0	10.0	Sandy Loam	16.8	0.10	0.6	0.06
S1410412-039	Hole #5	40-50	69.0	19.0	12.0	Sandy Loam	6.6	0.11	1.5	0.15
S1410412-040	Hole #5	50-60	71.0	19.0	10.0	Sandy Loam	7.0	0.11	0.7	0.10

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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1410412001

Project: North Lease Borings
Date Received: 10/27/2014

Date Reported: 1/5/2015
Work Order: S1410412

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Boron	Nitrate(as N)	Selenium
		cm	%	%	%		%	ppm	ppm	ppm
S1410412-041	Hole #5	60-70	72.0	18.0	10.0	Sandy Loam	11.8	0.13	0.6	0.03
S1410412-042	Hole #5	70-80	74.0	15.0	11.0	Sandy Loam	10.5	0.13	0.6	0.05
S1410412-043	Hole #5	80-90	55.0	20.0	25.0	Sandy Clay Loam	5.9	0.65	8.9	0.04
S1410412-044	Hole #5	90-95	47.0	24.0	29.0	Sandy Clay Loam	7.4	0.55	0.6	0.02
S1410412-045	Hole #5	92-98	16.0	42.0	42.0	Silty Clay	9.7	1.23	0.4	0.02
S1410412-046	Hole #5	98-104	38.0	37.0	25.0	Loam	21.5	2.17	0.3	0.08
S1410412-047	Hole #5	104-111	54.0	26.0	20.0	Sandy Clay Loam	25.1	2.42	0.3	0.03
S1410412-048	Hole #5	127-133	22.0	40.0	38.0	Clay Loam	12.9	2.27	0.2	0.12
S1410412-049	Hole #8	0-14	39.0	36.0	25.0	Loam	5.7	0.35	8.8	<0.02
S1410412-050	Hole #8	14-24	39.0	37.0	24.0	Loam	3.4	0.22	13.2	<0.02
S1410412-051	Hole #8	24-34	71.0	17.0	12.0	Sandy Loam	5.9	0.14	0.8	<0.02
S1410412-052	Hole #8	34-49	67.0	21.0	12.0	Sandy Loam	5.0	0.21	2.8	0.04
S1410412-053	Hole #8	49-69	73.0	16.0	11.0	Sandy Loam	4.0	0.15	0.7	0.07
S1410412-054	Hole #8	69-79	40.0	30.0	30.0	Clay Loam	<0.1	0.54	1.7	0.13
S1410412-055	Hole #8	79-94	29.0	35.0	36.0	Clay Loam	1.0	0.78	2.5	0.14
S1410412-056	Hole #8	159-164	39.0	37.0	24.0	Loam	14.9	3.90	0.5	0.04
S1410412-057	Hole #8	179.5-184	35.0	29.0	36.0	Clay Loam	12.7	1.94	0.3	0.20
S1410412-058	Hole #8	184-188	11.0	38.0	51.0	Clay	5.5	2.51	0.3	0.57
S1410412-059	Hole #8	188-193	37.0	18.0	45.0	Clay	33.0	1.10	<0.1	0.08
S1410412-060	Hole #9	0-9	17.0	33.0	50.0	Clay	1.7	1.02	2.0	0.05

These results apply only to the samples tested.

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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1410412001

Project: North Lease Borings
Date Received: 10/27/2014

Date Reported: 1/5/2015
Work Order: S1410412

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Boron	Nitrate(as N)	Selenium
		cm	%	%	%		%	ppm	ppm	ppm
S1410412-061	Hole #9	9-19	19.0	19.0	62.0	Clay	12.5	0.74	7.4	0.05
S1410412-062	Hole #9	19-29	9.0	29.0	62.0	Clay	2.6	0.61	6.8	0.03
S1410412-063	Hole #9	29-39	7.0	28.0	65.0	Clay	2.0	1.06	6.4	0.06
S1410412-064	Hole #9	39-49	7.0	31.0	62.0	Clay	1.4	1.19	8.2	0.15
S1410412-065	Hole #9	49-59	27.0	23.0	50.0	Clay	6.8	0.97	6.9	0.14
S1410412-066	Hole #9	59-69	15.0	31.0	54.0	Clay	5.6	1.16	0.8	0.09
S1410412-067	Hole #9	69-84	19.0	33.0	48.0	Clay	9.8	1.34	6.1	0.06
S1410412-068	Hole #9	113-117	69.0	19.0	12.0	Sandy Loam	17.6	1.71	0.2	0.03
S1410412-069	Hole #9	117-121.6	35.0	37.0	28.0	Clay Loam	11.7	4.43	0.3	0.04
S1410412-070	Hole #9	137.6-143	13.0	45.0	42.0	Silty Clay	4.8	3.16	0.3	0.14
S1410412-071	Hole #9	143-148	61.0	23.0	16.0	Sandy Loam	6.4	1.55	0.2	0.13
S1410412-072	Hole #9	148-153	75.0	12.0	13.0	Sandy Loam	10.9	1.29	0.1	0.03
S1410412-073	Hole #9	153-158	73.0	14.0	13.0	Sandy Loam	10.6	1.12	0.2	0.05
S1410412-074	Hole #9	158-163	41.0	20.0	39.0	Clay Loam	21.2	0.91	<0.1	0.12
S1410412-075	Hole #10	0-10	15.0	35.0	50.0	Clay	4.4	0.77	3.1	0.05
S1410412-076	Hole #10	10-20	17.0	30.0	53.0	Clay	7.7	1.32	11.2	0.04
S1410412-077	Hole #10	20-30	11.0	19.0	70.0	Clay	3.4	1.01	6.8	<0.02
S1410412-078	Hole #10	30-40	23.0	25.0	52.0	Clay	11.1	1.12	2.9	0.05
S1410412-079	Hole #10	53-54.5	67.0	17.0	16.0	Sandy Loam	17.1	7.32	0.2	0.13
S1410412-080	Hole #10	54.5-57	25.0	45.0	30.0	Clay Loam	16.8	0.82	<0.1	0.04

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Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

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Suite 1
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Report ID: S1410412001

Project: North Lease Borings
Date Received: 10/27/2014

Date Reported: 1/5/2015
Work Order: S1410412

Lab ID	Sample ID	Depths	Total Carbon	TOC	Total Sulfur	T.S. AB	Neutral. Potential	T.S. ABP	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur
		cm	%	%	%	t/1000t	t/1000t	t/1000t	%	%	%
S1410412-001	Hole #1	0-10	1.1	<0.1	0.85	26.5	80.6	54.1	0.85	<0.01	<0.01
S1410412-002	Hole #1	10-20	0.4	<0.1	0.58	18.2	48.2	29.9	0.57	0.02	<0.01
S1410412-003	Hole #1	20-30	0.4	<0.1	0.61	19.0	45.6	26.6	0.56	0.05	<0.01
S1410412-004	Hole #1	30-40	0.8	<0.1	0.67	20.8	61.1	40.4	0.35	0.31	0.02
S1410412-005	Hole #1	40-43	3.5	2.5	0.86	26.8	80.7	53.9	0.52	0.19	0.16
S1410412-006	Hole #1	59-61	0.9	0.9	0.28	8.76	3.76	-5.00	0.20	0.08	<0.01
S1410412-007	Hole #2	0-15	0.7	<0.1	0.51	15.9	59.2	43.3	0.51	<0.01	<0.01
S1410412-008	Hole #2	15-30	0.5	<0.1	0.40	12.4	44.4	32.0	0.40	<0.01	<0.01
S1410412-009	Hole #2	30-40	0.5	<0.1	0.49	15.2	46.8	31.6	0.44	0.05	<0.01
S1410412-010	Hole #2	56.6-59	1.7	1.6	0.17	5.37	7.25	1.88	0.11	0.06	<0.01
S1410412-011	Hole #2	59-65	1.3	0.2	0.17	5.26	87.7	82.5	0.05	0.12	<0.01
S1410412-012	Hole #3	0-10	4.6	1.1	0.06	1.95	284	282	<0.01	0.06	<0.01
S1410412-013	Hole #3	10-25	0.4	<0.1	0.53	16.7	31.2	14.5	0.53	<0.01	<0.01
S1410412-014	Hole #3	25-33	0.7	<0.1	0.50	15.7	54.8	39.0	0.18	0.32	<0.01
S1410412-015	Hole #3	33-41.5	1.0	0.2	0.53	16.7	69.9	53.2	0.08	0.46	<0.01
S1410412-016	Hole #3	57.7-61	1.0	0.8	0.11	3.56	12.9	9.33	0.09	0.03	<0.01
S1410412-017	Hole #4	0-10	6.8	1.0	0.01	0.36	482	481	0.01	<0.01	<0.01
S1410412-018	Hole #4	10-20	5.7	0.5	0.03	0.90	433	432	0.03	<0.01	<0.01
S1410412-019	Hole #4	20-30	5.0	0.6	0.18	5.71	363	358	0.09	0.10	<0.01
S1410412-020	Hole #4	30-40	3.9	0.5	0.05	1.45	290	289	<0.01	0.04	<0.01

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1410412001

Project: North Lease Borings
Date Received: 10/27/2014

Date Reported: 1/5/2015
Work Order: S1410412

Lab ID	Sample ID	Depths	Total Carbon	TOC	Total Sulfur	T.S. AB	Neutral. Potential	T.S. ABP	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur
		cm	%	%	%	t/1000t	t/1000t	t/1000t	%	%	%
S1410412-021	Hole #4	40-50	4.3	0.3	0.08	2.35	331	329	0.04	0.04	<0.01
S1410412-022	Hole #4	50-60	3.7	0.3	0.09	2.82	285	282	0.07	0.02	<0.01
S1410412-023	Hole #4	60-70	3.0	<0.1	0.14	4.22	243	238	0.12	0.01	<0.01
S1410412-024	Hole #4	70-80	2.0	<0.1	0.37	11.5	170	159	0.26	0.11	<0.01
S1410412-025	Hole #4	78-80.3	4.8	3.5	0.59	18.5	107	88.3	0.24	0.31	0.05
S1410412-026	Hole #4	80.3-84	14.5	12.8	2.11	65.8	147	80.8	0.07	1.42	0.62
S1410412-027	Hole #4	101-106	0.5	0.4	0.16	5.03	13.9	8.83	0.04	0.12	<0.01
S1410412-028	Hole #4	106-112	4.2	3.3	0.11	3.37	72.3	68.9	<0.01	0.11	<0.01
S1410412-029	Hole #4	112-118	0.3	<0.1	0.05	1.71	16.5	14.8	0.03	0.03	<0.01
S1410412-030	Hole #4	118-124	4.8	3.6	0.95	29.6	96.6	66.9	0.12	0.72	0.11
S1410412-031	Hole #4	124-130	1.7	<0.1	0.20	6.25	162	156	<0.01	0.19	<0.01
S1410412-032	Hole #4	130-136	2.5	0.2	0.15	4.78	192	187	0.02	0.11	0.03
S1410412-033	Hole #4	136-142	3.0	0.1	0.26	8.26	236	228	0.13	0.14	<0.01
S1410412-034	Hole #4	142-150	0.9	<0.1	0.07	2.26	70.0	67.7	<0.01	0.07	<0.01
S1410412-035	Hole #5	0-10	5.9	<0.1	0.03	0.97	493	492	0.01	0.02	<0.01
S1410412-036	Hole #5	10-20	4.0	0.3	0.16	4.84	309	304	0.16	<0.01	<0.01
S1410412-037	Hole #5	20-30	3.5	0.3	0.03	1.03	269	268	0.03	<0.01	<0.01
S1410412-038	Hole #5	30-40	3.1	0.2	0.02	0.49	246	246	0.02	<0.01	<0.01
S1410412-039	Hole #5	40-50	3.1	0.1	0.02	0.78	246	245	0.02	<0.01	<0.01
S1410412-040	Hole #5	50-60	3.5	0.5	0.01	0.39	246	246	0.01	<0.01	<0.01

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1410412001

Project: North Lease Borings
Date Received: 10/27/2014

Date Reported: 1/5/2015
Work Order: S1410412

Lab ID	Sample ID	Depths	Total Carbon	TOC	Total Sulfur	T.S. AB	Neutral. Potential	T.S. ABP	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur
		cm	%	%	%	t/1000t	t/1000t	t/1000t	%	%	%
S1410412-041	Hole #5	60-70	3.2	0.2	0.03	0.92	254	253	0.02	<0.01	<0.01
S1410412-042	Hole #5	70-80	3.2	0.1	0.03	1.09	255	254	0.02	0.01	<0.01
S1410412-043	Hole #5	80-90	2.5	0.3	0.12	3.64	189	186	0.04	0.08	<0.01
S1410412-044	Hole #5	90-95	2.0	<0.1	0.15	4.63	181	176	0.01	0.13	<0.01
S1410412-045	Hole #5	92-98	1.4	0.4	0.47	14.7	84.2	69.4	<0.01	0.44	0.03
S1410412-046	Hole #5	98-104	8.4	7.7	1.08	33.7	55.7	22.0	0.45	0.27	0.37
S1410412-047	Hole #5	104-111	8.4	6.4	0.97	30.3	166	136	0.50	0.23	0.24
S1410412-048	Hole #5	127-133	0.7	0.3	0.08	2.60	28.4	25.8	0.03	0.05	<0.01
S1410412-049	Hole #8	0-14	5.6	1.1	<0.01	<0.01	373	373	<0.01	<0.01	<0.01
S1410412-050	Hole #8	14-24	4.8	0.7	<0.01	<0.01	343	343	<0.01	<0.01	<0.01
S1410412-051	Hole #8	24-34	7.9	0.4	<0.01	<0.01	627	627	<0.01	<0.01	<0.01
S1410412-052	Hole #8	34-49	4.6	0.3	<0.01	<0.01	357	357	<0.01	<0.01	<0.01
S1410412-053	Hole #8	49-69	4.8	<0.1	<0.01	<0.01	397	397	<0.01	<0.01	<0.01
S1410412-054	Hole #8	69-79	4.7	0.9	0.12	3.62	317	313	0.12	<0.01	<0.01
S1410412-055	Hole #8	79-94	4.2	0.4	0.17	5.29	318	312	0.13	0.03	0.01
S1410412-056	Hole #8	159-164	15.3	12.9	1.68	52.5	205	153	0.04	1.09	0.55
S1410412-057	Hole #8	179.5-184	1.5	1.0	0.13	4.14	37.3	33.2	0.02	0.10	0.01
S1410412-058	Hole #8	184-188	2.3	2.0	0.38	11.9	29.1	17.3	0.15	0.21	0.02
S1410412-059	Hole #8	188-193	0.2	<0.1	0.09	2.77	14.5	11.7	0.04	0.05	<0.01
S1410412-060	Hole #9	0-9	1.7	0.7	0.11	3.37	84.2	80.8	0.07	<0.01	0.03

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1410412001

Project: North Lease Borings
Date Received: 10/27/2014

Date Reported: 1/5/2015
Work Order: S1410412

Lab ID	Sample ID	Depths	Total Carbon	TOC	Total Sulfur	T.S. AB	Neutral. Potential	T.S. ABP	Sulfate Sulfur	Pyritic Sulfur	Organic Sulfur
		cm	%	%	%	t/1000t	t/1000t	t/1000t	%	%	%
S1410412-061	Hole #9	9-19	2.6	0.1	0.20	6.14	207	201	0.16	<0.01	0.03
S1410412-062	Hole #9	19-29	2.4	<0.1	0.31	9.74	191	182	0.29	<0.01	0.03
S1410412-063	Hole #9	29-39	2.8	0.3	0.21	6.40	210	203	0.14	0.02	0.04
S1410412-064	Hole #9	39-49	3.2	0.7	0.20	6.39	215	209	0.09	0.06	0.05
S1410412-065	Hole #9	49-59	2.4	0.6	0.23	7.02	145	138	0.09	0.10	0.03
S1410412-066	Hole #9	59-69	2.3	0.7	0.33	10.4	132	122	0.09	0.19	0.06
S1410412-067	Hole #9	69-84	2.1	0.7	0.32	9.89	120	110	0.07	0.20	0.05
S1410412-068	Hole #9	113-117	7.8	4.5	1.02	32.0	275	243	0.44	0.46	0.12
S1410412-069	Hole #9	117-121.6	14.2	12.2	2.37	74.2	160	86.3	0.26	1.64	0.48
S1410412-070	Hole #9	137.6-143	2.1	2.0	0.11	3.39	7.57	4.18	<0.01	0.06	0.04
S1410412-071	Hole #9	143-148	0.3	<0.1	0.58	18.1	22.7	4.58	0.11	0.40	0.07
S1410412-072	Hole #9	148-153	0.9	0.2	0.12	3.86	57.0	53.1	0.05	0.04	0.03
S1410412-073	Hole #9	153-158	1.2	0.3	0.08	2.35	73.1	70.8	0.02	0.04	0.02
S1410412-074	Hole #9	158-163	0.8	0.3	0.07	2.13	45.7	43.6	<0.01	0.04	0.02
S1410412-075	Hole #10	0-10	2.8	0.4	0.08	2.41	197	195	0.05	<0.01	0.03
S1410412-076	Hole #10	10-20	2.6	0.3	0.23	7.03	192	185	0.19	0.01	0.03
S1410412-077	Hole #10	20-30	1.6	<0.1	0.49	15.3	124	109	0.46	<0.01	0.03
S1410412-078	Hole #10	30-40	2.0	0.9	0.46	14.4	87.2	72.7	0.21	0.18	0.07
S1410412-079	Hole #10	53-54.5	33.7	33.6	0.53	16.6	9.67	-6.93	0.13	0.07	0.33
S1410412-080	Hole #10	54.5-57	1.2	1.2	0.38	12.0	-1.44	-13.4	0.21	0.11	0.07

These results apply only to the samples tested.

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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1410412001

Project: North Lease Borings
Date Received: 10/27/2014

Date Reported: 1/5/2015
Work Order: S1410412

Lab ID	Sample ID	Depths	Total Arsenic	Total Barium	Total Cadmium	Total Chromium	Total Copper	Total Iron	Total Lead	Total Manganese	Total Molybdenum
		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
S1410412-001	Hole #1	0-10	4.3	49.6	0.16	14.9	11.6	11300	9.3	158	1.2
S1410412-002	Hole #1	10-20	6.4	83.8	0.34	24.7	17.2	17100	17.6	162	2.2
S1410412-003	Hole #1	20-30	4.3	68.8	0.30	27.9	17.8	17200	17.9	140	2.8
S1410412-004	Hole #1	30-40	5.3	79.3	0.32	20.1	13.9	15500	22.8	169	3.9
S1410412-005	Hole #1	40-43	11.8	196	0.25	13.5	12.1	14400	15.0	130	2.2
S1410412-006	Hole #1	59-61	9.2	22.0	0.81	21.0	51.1	8590	24.3	51.0	3.3
S1410412-007	Hole #2	0-15	5.6	101	0.24	24.3	14.5	15500	16.6	146	2.4
S1410412-008	Hole #2	15-30	4.6	65.2	0.27	24.7	15.6	16500	19.9	168	1.6
S1410412-009	Hole #2	30-40	8.8	75.9	0.23	16.5	11.0	14200	20.3	126	2.4
S1410412-010	Hole #2	56.6-59	5.5	22.5	0.25	19.2	50.2	4280	28.7	20.9	2.6
S1410412-011	Hole #2	59-65	6.3	9.37	0.36	10.9	10.6	5720	10.6	93.0	1.9
S1410412-012	Hole #3	0-10	6.3	71.4	0.24	21.2	17.6	14400	11.8	1320	3.2
S1410412-013	Hole #3	10-25	5.1	47.6	0.23	24.5	14.5	15400	17.5	112	2.7
S1410412-014	Hole #3	25-33	6.1	58.4	0.26	18.5	12.1	14100	21.7	151	1.8
S1410412-015	Hole #3	33-41.5	8.7	104	0.24	13.1	10.7	13700	21.4	136	3.4
S1410412-016	Hole #3	57.7-61	4.1	16.5	0.38	15.2	23.8	4350	22.7	37.8	<0.7
S1410412-017	Hole #4	0-10	9.5	486	0.48	21.2	12.9	12700	10.6	290	1.9
S1410412-018	Hole #4	10-20	7.4	203	0.51	19.1	12.7	11100	11.1	276	2.1
S1410412-019	Hole #4	20-30	7.4	133	0.39	13.8	9.59	8880	9.4	226	1.0
S1410412-020	Hole #4	30-40	7.3	122	0.43	14.1	9.22	10400	9.0	231	2.2

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
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Report ID: S1410412001

Project: North Lease Borings
Date Received: 10/27/2014

Date Reported: 1/5/2015
Work Order: S1410412

Lab ID	Sample ID	Depths cm	Total Arsenic mg/Kg	Total Barium mg/Kg	Total Cadmium mg/Kg	Total Chromium mg/Kg	Total Copper mg/Kg	Total Iron mg/Kg	Total Lead mg/Kg	Total Manganese mg/Kg	Total Molybdenum mg/Kg
S1410412-021	Hole #4	40-50	6.7	125	0.37	13.8	7.58	9120	9.2	202	1.5
S1410412-022	Hole #4	50-60	8.47	176	0.574	18.1	11.3	12000	13.9	260	3.34
S1410412-023	Hole #4	60-70	7.7	153	0.46	21.5	12.7	13400	14.7	236	2.5
S1410412-024	Hole #4	70-80	7.4	149	0.42	20.6	12.3	14200	21.0	212	3.6
S1410412-025	Hole #4	78-80.3	9.3	34.4	0.10	7.46	3.78	8580	7.3	110	1.1
S1410412-026	Hole #4	80.3-84	11.6	143	0.59	14.3	17.0	21900	21.0	397	2.9
S1410412-027	Hole #4	101-106	4.7	28.3	0.27	23.6	30.1	6330	28.9	32.8	1.2
S1410412-028	Hole #4	106-112	3.9	47.0	1.09	19.2	26.6	67400	18.6	792	2.7
S1410412-029	Hole #4	112-118	4.6	28.8	0.59	26.6	32.7	9950	31.1	96.6	1.2
S1410412-030	Hole #4	118-124	16.3	32.9	1.23	23.3	33.7	16100	27.9	205	3.8
S1410412-031	Hole #4	124-130	4.0	38.3	1.29	18.0	19.3	57600	16.7	679	1.6
S1410412-032	Hole #4	130-136	5.5	30.6	0.57	22.6	24.5	9210	18.9	209	2.0
S1410412-033	Hole #4	136-142	3.5	35.3	0.77	14.6	12.5	32600	13.9	511	1.6
S1410412-034	Hole #4	142-150	4.5	18.2	0.27	18.3	12.5	6310	18.7	112	1.4
S1410412-035	Hole #5	0-10	17.0	400	0.50	21.8	10.7	19200	10.7	345	2.8
S1410412-036	Hole #5	10-20	8.1	105	0.51	17.2	9.30	11200	8.3	214	3.6
S1410412-037	Hole #5	20-30	7.5	157	0.39	11.1	6.29	8040	7.5	202	1.2
S1410412-038	Hole #5	30-40	5.0	151	0.33	10.3	5.62	6370	8.3	172	0.9
S1410412-039	Hole #5	40-50	4.7	176	0.33	11.3	5.86	6350	6.3	160	1.0
S1410412-040	Hole #5	50-60	5.8	163	0.34	10.4	6.19	6270	6.7	166	0.9

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Report ID: S1410412001

Project: North Lease Borings
Date Received: 10/27/2014

Date Reported: 1/5/2015
Work Order: S1410412

Lab ID	Sample ID	Depths	Total Arsenic	Total Barium	Total Cadmium	Total Chromium	Total Copper	Total Iron	Total Lead	Total Manganese	Total Molybdenum
		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
S1410412-041	Hole #5	60-70	7.2	116	0.52	7.30	5.08	5650	16.9	143	1.7
S1410412-042	Hole #5	70-80	8.6	137	0.62	8.95	5.88	7540	19.1	181	1.0
S1410412-043	Hole #5	80-90	6.6	130	0.37	9.30	7.33	10100	20.5	187	1.4
S1410412-044	Hole #5	90-95	5.9	128	0.77	13.0	8.91	11700	14.6	183	<0.7
S1410412-045	Hole #5	92-98	7.9	76.5	0.26	7.18	7.91	13600	26.7	138	0.8
S1410412-046	Hole #5	98-104	7.6	65.6	0.26	7.55	7.68	11200	27.9	141	<0.7
S1410412-047	Hole #5	104-111	5.2	177	0.48	7.49	6.58	13300	24.8	204	1.2
S1410412-048	Hole #5	127-133	5.35	22.7	0.399	17.8	23.2	6150	31.4	60.9	<0.722
S1410412-049	Hole #8	0-14	6.7	179	0.44	22.3	8.45	10200	19.9	212	1.0
S1410412-050	Hole #8	14-24	9.6	180	0.27	29.7	8.43	11600	10.0	231	2.7
S1410412-051	Hole #8	24-34	5.8	146	0.36	21.9	3.64	7910	12.8	204	2.0
S1410412-052	Hole #8	34-49	6.2	190	0.82	27.5	6.51	7650	10.1	191	1.6
S1410412-053	Hole #8	49-69	8.0	205	0.40	17.5	4.67	10200	10.8	224	1.0
S1410412-054	Hole #8	69-79	7.3	124	0.60	19.8	10.6	13800	12.3	217	2.9
S1410412-055	Hole #8	79-94	5.0	109	0.40	22.2	12.4	13700	13.5	207	3.0
S1410412-056	Hole #8	159-164	7.3	117	0.59	10.1	11.0	17000	17.9	304	1.1
S1410412-057	Hole #8	179.5-184	10.8	24.8	0.464	17.6	21.8	6010	25.9	65.6	4.41
S1410412-058	Hole #8	184-188	8.6	39.6	0.36	20.4	32.7	7670	24.2	44.7	1.8
S1410412-059	Hole #8	188-193	8.0	29.4	0.57	18.8	31.2	8810	24.5	50.5	<0.7
S1410412-060	Hole #9	0-9	8.0	95.1	0.62	24.0	13.5	19200	24.4	298	1.1

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1410412001

Project: North Lease Borings
Date Received: 10/27/2014

Date Reported: 1/5/2015
Work Order: S1410412

Lab ID	Sample ID	Depths	Total Arsenic	Total Barium	Total Cadmium	Total Chromium	Total Copper	Total Iron	Total Lead	Total Manganese	Total Molybdenum
		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
S1410412-061	Hole #9	9-19	5.2	89.1	0.50	18.6	12.3	15300	12.2	166	3.3
S1410412-062	Hole #9	19-29	5.1	102	0.63	22.5	17.8	19800	17.2	263	1.7
S1410412-063	Hole #9	29-39	7.6	109	0.80	23.2	18.6	19800	17.3	238	1.7
S1410412-064	Hole #9	39-49	9.0	117	0.81	24.1	19.1	19800	19.0	242	2.4
S1410412-065	Hole #9	49-59	5.9	66.0	0.55	23.9	13.3	18800	13.8	205	1.2
S1410412-066	Hole #9	59-69	7.8	87.5	0.54	25.3	13.0	16100	13.4	168	1.6
S1410412-067	Hole #9	69-84	7.0	72.6	0.43	27.5	12.3	13100	12.1	151	0.9
S1410412-068	Hole #9	113-117	5.0	69.9	0.12	5.45	3.72	12200	7.6	266	1.6
S1410412-069	Hole #9	117-121.6	9.2	229	0.76	10.4	9.11	22200	16.2	335	2.6
S1410412-070	Hole #9	137.6-143	6.3	34.8	0.73	16.9	25.4	17100	24.1	433	<0.7
S1410412-071	Hole #9	143-148	1.7	11.0	0.49	8.50	7.52	7760	11.1	75.6	<0.7
S1410412-072	Hole #9	148-153	2.4	9.44	0.44	6.93	5.29	5760	8.1	84.3	<0.7
S1410412-073	Hole #9	153-158	0.9	11.4	0.17	8.66	7.27	5370	9.4	195	<0.7
S1410412-074	Hole #9	158-163	5.1	31.2	0.45	15.2	20.1	9340	21.9	233	<0.7
S1410412-075	Hole #10	0-10	1.7	102	0.46	20.8	11.8	17100	15.1	235	1.7
S1410412-076	Hole #10	10-20	4.2	83.7	0.53	18.7	10.4	14900	14.6	192	0.9
S1410412-077	Hole #10	20-30	6.44	105	0.318	14.3	9.04	13300	16.7	179	<0.721
S1410412-078	Hole #10	30-40	9.69	143	0.241	14.6	8.03	12200	16.9	147	<0.718
S1410412-079	Hole #10	53-54.5	2.0	19.9	0.07	6.39	8.88	3020	5.9	20.8	<0.7
S1410412-080	Hole #10	54.5-57	5.7	13.3	0.50	8.55	13.1	6220	17.6	26.5	<0.7

These results apply only to the samples tested.

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1410412001

Project: North Lease Borings
Date Received: 10/27/2014

Date Reported: 1/5/2015
Work Order: S1410412

Lab ID	Sample ID	Depths	Total Selenium	Total Silver	Total Zinc	Total Mercury	Bulk Density
		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	g/cm³
S1410412-001	Hole #1	0-10	<1	<0.5	37.8	<0.2	2.99
S1410412-002	Hole #1	10-20	<1	<0.5	63.0	<0.2	3.23
S1410412-003	Hole #1	20-30	<1	<0.5	62.9	<0.2	3.23
S1410412-004	Hole #1	30-40	<1	<0.5	61.4	<0.2	2.55
S1410412-005	Hole #1	40-43	<1	<0.5	55.2	<0.2	2.83
S1410412-006	Hole #1	59-61	<1	<0.5	128	<0.2	5.34
S1410412-007	Hole #2	0-15	<1	<0.5	57.1	<0.2	3.13
S1410412-008	Hole #2	15-30	<1	<0.5	58.1	<0.2	2.81
S1410412-009	Hole #2	30-40	<1	<0.5	65.8	<0.2	2.39
S1410412-010	Hole #2	56.6-59	<1	<0.5	115	<0.2	1.93
S1410412-011	Hole #2	59-65	<1	<0.5	52.6	<0.2	2.39
S1410412-012	Hole #3	0-10	2	<0.5	42.4	<0.2	3.20
S1410412-013	Hole #3	10-25	<1	<0.5	56.8	<0.2	2.63
S1410412-014	Hole #3	25-33	<1	<0.5	60.6	<0.2	2.59
S1410412-015	Hole #3	33-41.5	<1	<0.5	66.7	<0.2	2.24
S1410412-016	Hole #3	57.7-61	<1	<0.5	85.6	<0.2	2.10
S1410412-017	Hole #4	0-10	<1	<0.5	52.5	<0.2	
S1410412-018	Hole #4	10-20	<1	<0.5	49.4	<0.2	2.80
S1410412-019	Hole #4	20-30	<1	<0.5	41.2	<0.2	2.80
S1410412-020	Hole #4	30-40	<1	<0.5	40.9	<0.2	2.42

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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1410412001

Project: North Lease Borings
Date Received: 10/27/2014

Date Reported: 1/5/2015
Work Order: S1410412

Lab ID	Sample ID	Depths cm	Total Selenium mg/Kg	Total Silver mg/Kg	Total Zinc mg/Kg	Total Mercury mg/Kg	Bulk Density g/cm³
S1410412-021	Hole #4	40-50	2	<0.5	35.7	<0.2	2.34
S1410412-022	Hole #4	50-60	<1.01	<0.506	49.1	<0.2	2.35
S1410412-023	Hole #4	60-70	<1	<0.5	48.6	<0.2	2.16
S1410412-024	Hole #4	70-80	<1	<0.5	61.1	<0.2	2.67
S1410412-025	Hole #4	78-80.3	<1	<0.5	24.5	<0.2	2.28
S1410412-026	Hole #4	80.3-84	2	<0.5	69.1	<0.2	2.55
S1410412-027	Hole #4	101-106	<1	<0.5	121	<0.2	1.96
S1410412-028	Hole #4	106-112	<1	<0.5	75.1	<0.2	1.93
S1410412-029	Hole #4	112-118	<1	<0.5	81.7	<0.2	2.19
S1410412-030	Hole #4	118-124	<1	<0.5	131	<0.2	2.14
S1410412-031	Hole #4	124-130	<1	<0.5	156	<0.2	1.69
S1410412-032	Hole #4	130-136	<1	<0.5	86.3	<0.2	1.91
S1410412-033	Hole #4	136-142	<1	<0.5	55.4	<0.2	1.93
S1410412-034	Hole #4	142-150	<1	<0.5	51.5	<0.2	2.06
S1410412-035	Hole #5	0-10	<1	<0.5	47.6	<0.2	2.43
S1410412-036	Hole #5	10-20	<1	<0.5	44.7	<0.2	
S1410412-037	Hole #5	20-30	<1	<0.5	32.6	<0.2	2.03
S1410412-038	Hole #5	30-40	<1	<0.5	30.0	<0.2	2.30
S1410412-039	Hole #5	40-50	<1	<0.5	32.2	<0.2	
S1410412-040	Hole #5	50-60	<1	<0.5	32.6	<0.2	2.06

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1410412001

Project: North Lease Borings
Date Received: 10/27/2014

Date Reported: 1/5/2015
Work Order: S1410412

Lab ID	Sample ID	Depths	Total Selenium	Total Silver	Total Zinc	Total Mercury	Bulk Density
		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	g/cm³
S1410412-041	Hole #5	60-70	<1	<0.5	21.7	<0.2	2.10
S1410412-042	Hole #5	70-80	<1	1.4	28.4	<0.2	2.40
S1410412-043	Hole #5	80-90	<1	<0.5	38.7	<0.2	2.87
S1410412-044	Hole #5	90-95	<1	<0.5	40.6	<0.2	2.15
S1410412-045	Hole #5	92-98	<1	<0.5	44.6	<0.2	2.08
S1410412-046	Hole #5	98-104	<1	<0.5	41.2	<0.2	2.35
S1410412-047	Hole #5	104-111	<1	<0.5	34.8	<0.2	2.69
S1410412-048	Hole #5	127-133	<1.03	<0.516	140	<0.2	2.14
S1410412-049	Hole #8	0-14	<1	<0.5	40.1	<0.2	
S1410412-050	Hole #8	14-24	<1	<0.5	38.4	<0.2	2.17
S1410412-051	Hole #8	24-34	<1	<0.5	18.3	<0.2	1.90
S1410412-052	Hole #8	34-49	<1	<0.5	27.3	<0.2	2.17
S1410412-053	Hole #8	49-69	<1	<0.5	27.3	<0.2	2.10
S1410412-054	Hole #8	69-79	<1	<0.5	45.5	<0.2	2.11
S1410412-055	Hole #8	79-94	<1	<0.5	51.5	<0.2	2.17
S1410412-056	Hole #8	159-164	2	<0.5	54.1	<0.2	2.36
S1410412-057	Hole #8	179.5-184	<1.02	<0.508	207	<0.2	2.07
S1410412-058	Hole #8	184-188	<1	<0.5	110	<0.2	2.09
S1410412-059	Hole #8	188-193	<1	<0.5	78.1	<0.2	1.88
S1410412-060	Hole #9	0-9	<1	<0.5	68.0	<0.2	2.37

These results apply only to the samples tested.

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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
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Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1410412001

Project: North Lease Borings
Date Received: 10/27/2014

Date Reported: 1/5/2015
Work Order: S1410412

Lab ID	Sample ID	Depths cm	Total Selenium mg/Kg	Total Silver mg/Kg	Total Zinc mg/Kg	Total Mercury mg/Kg	Bulk Density g/cm³
S1410412-061	Hole #9	9-19	<1	<0.5	61.1	<0.2	2.12
S1410412-062	Hole #9	19-29	<1	<0.5	81.5	<0.2	2.26
S1410412-063	Hole #9	29-39	<1	<0.5	90.4	<0.2	2.47
S1410412-064	Hole #9	39-49	<1	0.9	86.8	<0.2	2.10
S1410412-065	Hole #9	49-59	<1	<0.5	70.1	<0.2	2.28
S1410412-066	Hole #9	59-69	<1	<0.5	61.9	<0.2	2.22
S1410412-067	Hole #9	69-84	<1	<0.5	53.1	<0.2	
S1410412-068	Hole #9	113-117	<1	<0.5	31.4	<0.2	2.32
S1410412-069	Hole #9	117-121.6	<1	<0.5	55.5	0.2	2.75
S1410412-070	Hole #9	137.6-143	<1	1.1	75.2	<0.2	1.97
S1410412-071	Hole #9	143-148	<1	0.7	38.6	<0.2	2.11
S1410412-072	Hole #9	148-153	<1	0.8	34.9	<0.2	2.26
S1410412-073	Hole #9	153-158	<1	<0.5	46.4	<0.2	2.36
S1410412-074	Hole #9	158-163	<1	0.7	74.8	<0.2	2.06
S1410412-075	Hole #10	0-10	<1	0.5	67.7	<0.2	2.40
S1410412-076	Hole #10	10-20	<1	<0.5	59.1	<0.2	2.52
S1410412-077	Hole #10	20-30	<1.03	<0.515	54.9	<0.2	2.38
S1410412-078	Hole #10	30-40	1.45	1.23	54.2	<0.2	2.13
S1410412-079	Hole #10	53-54.5	<1	0.6	21.4	<0.2	4.55
S1410412-080	Hole #10	54.5-57	<1	1.0	55.7	<0.2	2.10

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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs, Inc
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Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: North Lease Borings
Date Received: 10/27/2014

Report ID: S1410412001
Date Reported: 1/5/2015
Work Order: S1410412

Lab ID	Sample ID	Organic Matter %	Sand %	Silt %	Clay %	Very Fine Sand %	Texture	K-factor (t.ac.h/100acft.tf.in)	Structure s	Permeability p	M
S1410412-001	Hole #1 (0-10)	1.2	16.0	23.0	61.0	8.9	Clay	0.18	3	6	1244.1
S1410412-002	Hole #1 (10-20)	0.1	22.0	18.0	60.0	17.3	Clay	0.20	3	6	1412.0
S1410412-003	Hole #1 (20-30)	0.1	18.0	38.0	44.0	14.4	Clay	0.33	3	6	2934.4
S1410412-004	Hole #1 (30-40)	1.4	22.0	18.0	60.0	18.0	Clay	0.20	3	6	1440.0
S1410412-005	Hole #1 (40-43)	3.6	13.0	32.0	55.0	7.1	Silty Clay	0.23	4	6	1759.5
S1410412-006	Hole #1 (59-61)	1.7	11.0	43.0	46.0	6.5	Silty Clay	0.31	4	6	2673.0
S1410412-007	Hole #2 (0-15)	0.3	13.0	20.0	67.0	7.7	Clay	0.17	3	6	914.1
S1410412-008	Hole #2 (15-30)	0.7	24.0	17.0	59.0	20.1	Silty Clay	0.21	3	6	1521.1
S1410412-009	Hole #2 (30-40)	0.6	26.0	19.0	55.0	22.0	Silty Clay	0.23	3	6	1845.0
S1410412-010	Hole #2 (56.6-59)	2.7	9.0	45.0	46.0	4.3	Silty Clay	0.30	4	6	2662.2
S1410412-011	Hole #2 (59-65)	2.8	45.0	33.0	22.0	13.2	Loam	0.28	4	3	3603.6
S1410412-012	Hole #3 (0-10)	2.5	33.0	32.0	35.0	10.0	Clay Loam	0.19	2	4	2730.0
S1410412-013	Hole #3 (10-25)	0.4	9.0	23.0	68.0	1.6	Clay	0.16	3	6	787.2
S1410412-014	Hole #3 (25-33)	1.1	9.0	29.0	62.0	4.9	Clay	0.16	2	6	1288.2
S1410412-015	Hole #3 (33-41.5)	2.2	22.0	22.0	56.0	17.8	Silty Clay	0.18	2	6	1751.2
S1410412-016	Hole #3 (57.7-61)	2.5	21.0	46.0	33.0	15.6	Clay Loam	0.35	4	4	4127.2
S1410412-017	Hole #4 (0-10)	3.3	18.0	45.0	37.0	0.1	Silty Clay Loam	0.21	2	5	2841.3
S1410412-018	Hole #4 (10-20)	2.9	37.0	36.0	27.0	20.2	Clay Loam	0.28	2	4	4102.6
S1410412-019	Hole #4 (20-30)	3.1	37.0	45.0	18.0	1.1	Loam	0.26	3	3	3780.2
S1410412-020	Hole #4 (30-40)	3.0	38.0	39.0	23.0	7.5	Loam	0.25	3	3	3580.5
S1410412-021	Hole #4 (40-50)	3.1	39.0	42.0	19.0	9.1	Loam	0.28	3	3	4139.1
S1410412-022	Hole #4 (50-60)	3.0	43.0	36.0	21.0	8.4	Loam	0.21	2	3	3507.6
S1410412-023	Hole #4 (60-70)	2.8	41.0	32.0	27.0	7.2	Clay Loam	0.23	3	4	2861.6
S1410412-024	Hole #4 (70-80)	1.3	25.0	31.0	44.0	8.1	Clay	0.25	3	6	2189.6
S1410412-025	Hole #4 (78-80.3)	5.8	65.0	26.0	9.0	11.1	Sandy Loam	0.18	4	2	3376.1
S1410412-026	Hole #4 (80.3-84)	7.8	33.0	41.0	26.0	10.9	Loam	0.17	4	3	3840.6
S1410412-027	Hole #4 (101-106)	2.4	19.0	32.0	49.0	15.1	Clay	0.28	4	6	2402.1

These Results apply only to the samples tested.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: North Lease Borings
Date Received: 10/27/2014

Report ID: S1410412001
Date Reported: 1/5/2015
Work Order: S1410412

Lab ID	Sample ID	Organic Matter	Sand	Silt	Clay	Very Fine Sand	Texture	K-factor	Structure	Permeability	M
		%	%	%	%	%		(t.ac.h/100acft.tf.in)	s	p	
S1410412-028	Hole #4 (106-112)	3.2	27.0	39.0	34.0	5.5	Clay Loam	0.26	4	4	2937.0
S1410412-029	Hole #4 (112-118)	2.4	22.0	34.0	44.0	8.0	Clay	0.28	4	6	2352.0
S1410412-030	Hole #4 (118-124)	6.6	29.0	37.0	34.0	12.7	Clay Loam	0.21	4	4	3280.2
S1410412-031	Hole #4 (124-130)	3.7	23.0	40.0	37.0	8.7	Clay Loam	0.25	4	4	3068.1
S1410412-032	Hole #4 (130-136)	3.3	31.0	43.0	26.0	15.2	Loam	0.32	4	3	4306.8
S1410412-033	Hole #4 (136-142)	4.9	31.0	37.0	32.0	17.1	Clay Loam	0.26	4	4	3678.8
S1410412-034	Hole #4 (142-150)	3.2	35.0	38.0	27.0	14.7	Clay Loam	0.32	4	4	3847.1
S1410412-035	Hole #5 (0-10)	2.8	7.0	45.0	48.0	0.1	Silty Clay	0.21	2	6	2345.2
S1410412-036	Hole #5 (10-20)	2.5	41.0	31.0	28.0	7.4	Clay Loam	0.19	2	4	2764.8
S1410412-037	Hole #5 (20-30)	2.0	63.0	24.0	13.0	11.0	Sandy Loam	0.17	2	2	3045.0
S1410412-038	Hole #5 (30-40)	1.8	77.0	13.0	10.0	16.8	Sandy Loam	0.15	2	2	2682.0
S1410412-039	Hole #5 (40-50)	2.1	69.0	19.0	12.0	6.6	Sandy Loam	0.11	2	2	2252.8
S1410412-040	Hole #5 (50-60)	1.9	71.0	19.0	10.0	7.0	Sandy Loam	0.12	2	2	2340.0
S1410412-041	Hole #5 (60-70)	1.7	72.0	18.0	10.0	11.8	Sandy Loam	0.15	2	2	2682.0
S1410412-042	Hole #5 (70-80)	1.9	74.0	15.0	11.0	10.5	Sandy Loam	0.12	2	2	2269.5
S1410412-043	Hole #5 (80-90)	1.5	55.0	20.0	25.0	5.9	Sandy Clay Loam	0.15	2	4	1942.5
S1410412-044	Hole #5 (90-95)	2.1	47.0	24.0	29.0	7.4	Sandy Clay Loam	0.16	2	4	2229.4
S1410412-045	Hole #5 (92-98)	2.8	16.0	42.0	42.0	9.7	Silty Clay	0.32	4	6	2998.6
S1410412-046	Hole #5 (98-104)	6.3	38.0	37.0	25.0	21.5	Loam	0.23	4	3	4387.5
S1410412-047	Hole #5 (104-111)	6.9	54.0	26.0	20.0	25.1	Sandy Clay Loam	0.23	4	4	4088.0
S1410412-048	Hole #5 (127-133)	2.7	22.0	40.0	38.0	12.9	Clay Loam	0.29	4	4	3279.8
S1410412-049	Hole #8 (0-14)	2.4	39.0	36.0	25.0	5.7	Loam	0.16	1	3	3127.5
S1410412-050	Hole #8 (14-24)	2.1	39.0	37.0	24.0	3.4	Loam	0.16	1	3	3070.4
S1410412-051	Hole #8 (24-34)	2.0	71.0	17.0	12.0	5.9	Sandy Loam	0.07	1	2	2015.2
S1410412-052	Hole #8 (34-49)	1.5	67.0	21.0	12.0	5.0	Sandy Loam	0.12	2	2	2288.0
S1410412-053	Hole #8 (49-69)	1.7	73.0	16.0	11.0	4.0	Sandy Loam	0.08	2	2	1780.0

These Results apply only to the samples tested.

Reviewed by: Karen Secor

Karen Secor, Soil Lab Supervisor

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Alton Coal Development
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Project ID: North Lease Borings
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Lab ID	Sample ID	Organic Matter	Sand	Silt	Clay	Very Fine Sand	Texture	K-factor	Structure	Permeability	M
		%	%	%	%	%		(t.ac.h/100acft.tf.in)	s	p	
S1410412-054	Hole #8 (69-79)	2.6	40.0	30.0	30.0	0.1	Clay Loam	0.18	3	4	2107.0
S1410412-055	Hole #8 (79-84)	3.9	29.0	35.0	36.0	1.0	Clay Loam	0.17	3	4	2304.0
S1410412-056	Hole #8 (159-164)	7.3	39.0	37.0	24.0	14.9	Loam	0.19	4	3	3944.4
S1410412-057	Hole #8 (179.5-184)	2.6	35.0	29.0	36.0	12.7	Clay Loam	0.25	4	4	2668.8
S1410412-058	Hole #8 (184-188)	3.6	11.0	38.0	51.0	5.5	Clay	0.25	4	6	2131.5
S1410412-059	Hole #8 (188-193)	1.8	37.0	18.0	45.0	33.0	Clay	0.32	4	6	2805.0
S1410412-060	Hole #9 (0-9)	2.7	17.0	33.0	50.0	1.7	Clay	0.20	3	6	1735.0
S1410412-061	Hole #9 (9-19)	3.4	19.0	19.0	62.0	12.5	Clay	0.13	2	6	1197.0
S1410412-062	Hole #9 (19-29)	2.5	9.0	29.0	62.0	2.6	Clay	0.17	3	6	1200.8
S1410412-063	Hole #9 (29-39)	2.2	7.0	28.0	65.0	2.0	Clay	0.16	3	6	1050.0
S1410412-064	Hole #9 (39-49)	2.9	7.0	31.0	62.0	1.4	Clay	0.17	3	6	1231.2
S1410412-065	Hole #9 (49-59)	2.9	27.0	23.0	50.0	6.8	Clay	0.19	3	6	1490.0
S1410412-066	Hole #9 (59-69)	3.2	15.0	31.0	54.0	5.6	Clay	0.20	3	6	1683.6
S1410412-067	Hole #9 (69-84)	4.0	19.0	33.0	48.0	9.8	Clay	0.22	3	6	2225.6
S1410412-068	Hole #9 (113-117)	7.8	69.0	19.0	12.0	17.6	Sandy Loam	0.13	4	2	3220.8
S1410412-069	Hole #9 (117-121.6)	9.7	35.0	37.0	28.0	11.7	Clay Loam	0.14	4	4	3506.4
S1410412-070	Hole #9 (137.6-143)	2.6	13.0	45.0	42.0	4.8	Silty Clay	0.31	4	6	2888.4
S1410412-071	Hole #9 (143-148)	3.9	61.0	23.0	16.0	6.4	Sandy Loam	0.17	4	2	2469.6
S1410412-072	Hole #9 (148-153)	1.6	75.0	12.0	13.0	10.9	Sandy Loam	0.17	4	2	1992.3
S1410412-073	Hole #9 (153-158)	1.9	73.0	14.0	13.0	10.6	Sandy Loam	0.17	4	2	2140.2
S1410412-074	Hole #9 (158-163)	1.9	41.0	20.0	39.0	21.2	Clay Loam	0.25	4	4	2513.2
S1410412-075	Hole #10 (0-10)	2.7	15.0	35.0	50.0	4.4	Clay	0.19	2	6	1970.0
S1410412-076	Hole #10 (10-20)	2.9	17.0	30.0	53.0	7.7	Clay	0.17	2	6	1771.9
S1410412-077	Hole #10 (20-30)	1.2	11.0	19.0	70.0	3.4	Clay	0.11	2	6	672.0
S1410412-078	Hole #10 (30-40)	3.1	23.0	25.0	52.0	11.1	Clay	0.20	3	6	1732.8
S1410412-079	Hole #10 (53-54.5)	9.6	67.0	17.0	16.0	17.1	Sandy Loam	0.08	4	2	2864.4
S1410412-080	Hole #10 (54.5-57)	3.0	25.0	45.0	30.0	16.8	Clay Loam	0.35	4	4	4326.0

These Results apply only to the samples tested.

Reviewed by: Karen Secor

Karen Secor, Soil Lab Supervisor

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CHAPTER 7

R645-301-700. HYDROLOGY

711. GENERAL REQUIREMENTS

711.100 – 711.500 Contents

This chapter provides a description of the hydrology and hydrogeology of the Coal Hollow Mine permit and adjacent area (including the 85.88-acre Dame Lease IBC area and the proposed North Private Lease area). Specifically, this permit section includes descriptions of existing hydrologic resources according to R645-301-720, proposed operations and potential impacts to the hydrologic balance according to R645-301-730, methods and calculations utilized to achieve compliance with the hydrologic design criteria and plans according to R645-301-740, applicable hydrologic performance standards according to R645-301-750, and reclamation activities according to R645-301-760.

This information is presented in subsequent sections of this chapter and in Appendix 7-1. Appendix 7-1 includes a comprehensive characterization of groundwater and surface-water systems in the Coal Hollow permit and adjacent areas (including the 85.88-acre Dame Lease IBC), recommendations for groundwater and surface-water monitoring, and the results of a field investigation regarding the potential for alluvial valley floors in the Coal Hollow Mine permit and adjacent area. It should be noted that Appendix 7-1 may be updated periodically in the future as additional hydrologic and hydrogeologic data become available. A characterization of groundwater and surface-water systems in the proposed North Private Lease area is presented in Appendix 7-16 (Petersen Hydrologic, 2015). Appendix 7-16 also includes recommendations for groundwater and surface-water monitoring in the proposed North Private Lease area.

712 CERTIFICATION

All cross sections, maps, and plans have been prepared per R645-301-512. Compliance with this section has been completed and certifications are available on all Drawings. The cross sections and maps that are included in this permit application and are required to be certified have been prepared by or under the direction of a qualified, registered, professional engineer or a professional geologist, with assistance from experts in related fields such as hydrology, geology and landscape architecture.

713 INSPECTION

Impoundments will be inspected as described under R645-301-514.300. Designs for proposed impoundments in the Coal Hollow permit area are shown in Drawings 5-25 through 5-31 and Appendices A5-1 and A5-2. Designs for proposed impoundments in the Coal Hollow permit area are shown in Drawings 5-67 through 5-71. No impoundments or sedimentation ponds meeting the size or other qualifying criteria of MSHA, 30 CFR 77.216(a) exist or are planned within the Coal Hollow Mine pPermit aArea including the proposed North Private Lease area.

A professional engineer or specialist experienced in the construction of impoundments will inspect impoundments. Inspections will be made regularly during construction, upon completion of construction, and at least yearly until removal of the structure or release of the performance bond. The qualified registered professional engineer will promptly, after each inspection, provide to the Division, a certified report that the impoundment has been constructed and maintained as designed and in accordance with the approved plan and the R645 Rules. The report will include discussion of any appearances of instability, structural weakness or other hazardous conditions, depth and elevation of any impounded waters, existing storage capacity, any existing or required monitoring procedures and instrumentation and any other aspects of the structure affecting stability. A copy of the report will be retained at or near the mine site.

720 ENVIRONMENTAL DESCRIPTION

721 GENERAL REQUIREMENTS

The existing, pre-mining hydrologic resources within the permit and adjacent areas that may be affected by coal mining and reclamation operations (including the 85.88-acre Dame Lease IBC and the proposed new North Private Lease area) are described in Appendix 7-1 and Appendix 7-16 and are summarized below.

Groundwater Resources

A spring and seep survey of the Coal Hollow Mine permit and surrounding area (that includes the 85.88-acre Dame Lease IBC) has been conducted by Petersen Hydrologic, LLC (see sub-appendix B of Appendix 7-1). The locations of springs and seeps in the permit and adjacent area are shown on Drawing 7-1. The results of a spring and seep survey conducted by Petersen Hydrologic in the new North Private Lease area are presented in Appendix 7-16. Seasonal discharge and field water quality measurements for springs and seeps in the Coal Hollow Mine permit and adjacent area have been submitted electronically to the Utah Division of Oil, Gas and Mining Utah Coal Mining Water Quality Database (UDOGM, 2007). Baseline discharge and water quality data for

groundwater resources in the Coal Hollow Mine permit and adjacent area are have also been submitted electronically to the Utah Division of Oil, Gas and Mining, Utah Coal Mining Water Quality Database (UDOGM, 2007). Locations of baseline monitoring stations are shown on Drawing 7-2. Locations of water rights in and adjacent to the Coal Hollow Mine permit area (including the 85.88-acre Dame Lease IBC area) are shown on Drawing 7-3. Locations of water rights in the North Private Lease and adjacent area are shown on Drawing 7-3N. Water rights data from the Coal Hollow Mine permit and adjacent area are detailed in Appendix 7-3. Water rights data from the proposed North Private Lease and adjacent area are shown in Appendix 7-3N. A plot showing potentiometric levels in alluvial groundwater systems in the Coal Hollow Mine permit and adjacent area (including the 85.88-acre Dame Lease IBC) is presented in Drawing 7-13. Potentiometric levels and the direction of shallow groundwater flow in the alluvial groundwater systems in the proposed North Private Lease area are presented in Appendix 7-16.

There are no domestic water supply springs or wells in the mine disturbance area. However, springs that provide water for domestic and livestock use are located on and adjacent to the permit area (See Drawing 7-2 and Appendix 7-3). Spring SP-23 (Spring House Spring) is located on the eastern boundary of the Coal Hollow Mine permit area. Spring SP-23 is a groundwater seepage area with both discrete and diffuse flow with a total discharge that is usually about one gallon per minute or less. Historically, this seepage area was used as a domestic water source for the Pugh property (personal communication, Burton Pugh, 2008). However, water from SP-23, which is not developed, has not been used for this purpose for many years.

Spring SP-35 is located along the eastern boundary of the Coal Hollow Mine permit area. Discharge from SP-35 averages less than 0.25 gallons per minute and is occasionally used for drinking water during camping trips or visits to the Pugh property (personal communication, Burton Pugh, 2008). However, there is apparently no associated domestic water right associated with this spring.

Two additional springs, which are located more distant from the proposed mining areas are also used for domestic water supply sources. These include SP-40, which is located at the Sorensen property, and SP-33, which is located at the Johnson property. Springs with stockwatering rights are listed in Appendix 7-3.

As described in Appendix 7-16, only one spring has been identified within the proposed North Private Lease permit area. This spring (Coyote Seep) discharges from the alluvial groundwater system at less than one gallon per minute. There is no water right associated with this spring. There are no Utah state appropriated groundwater rights within the North Private Lease area.

Some lands east of and adjacent to the Coal Hollow Mine permit area have historically been irrigated using water from alluvial springs. However, irrigation from these springs was apparently limited to home gardens and a few fruit trees. No irrigation of these lands (other than some yard watering at the Swapp Ranch house) is currently occurring nor has

it occurred in at least the past 10 years (Personal communication, Burton Pugh, 2008; Richard Dames, 2007). Additionally, limited irrigation of lands occurs east of the Coal Hollow permit area using surface waters derived from runoff from the adjacent Paunsaugunt Plateau area. Irrigation of these lands is largely limited to years with appreciable precipitation and stream runoff (Personal communication, Darlynn Sorensen, 2008).

Groundwater discharge occurs from springs and seeps in the upland areas of the Paunsaugunt Plateau east of the permit area (Tilton, 2001; Appendix 6-3). However, these springs discharge from rock strata that are topographically and stratigraphically up-gradient of and considerable distances from the Coal Hollow Mine permit area and the North Private Lease area. Consequently, groundwater systems in these areas will not be impacted by mining activities and these are not considered further here.

Groundwater resources in the Tropic Shale and underlying Dakota Formation in the permit and adjacent area and the North Private Lease area are not appreciable. During drilling activities in the Coal Hollow Mine permit and adjacent area, appreciable groundwater inflows were not encountered in the Tropic Shale. Other than a single seep (SP-37; Drawing 7-1) which discharges at a rate of less than 0.05 gpm from an apparent fracture system in a sandy horizon along the eastern margin of lower Sink Valley, no springs or seeps with measurable discharge have been identified in the Tropic Shale. The lack of appreciable groundwater discharge in the Tropic Shale is a result of the poor water transmitting properties of the marine shale unit. While sandstone units occur stratigraphically higher in the Tropic Shale in the surrounding area, in areas proposed for surface mining, the unit present consists of a fairly uniform sequence of soft shale, silty shale, and claystone with minor siltstone horizons. Competent sandstone strata in the Tropic Shale overlying proposed mining areas wereas not observed during drilling. The Tropic Shale acts as a barrier- impeding downward migration of groundwater in the Coal Hollow Mine permit and adjacent area where it is present. The unit also forms a basal confining layer for alluvial groundwater systems in the ~~proposed~~ permit area. Similar hydrogeologic properties in the Tropic Shale were noted during drilling activities in the proposed North Private Lease area.

Groundwater discharge from the Dakota Sandstone in the permit and adjacent area is also meager. The Dakota Formation consists of shaley strata interbedded with lenticular, fine- to medium-grained sandstone and coal. Because of the pervasiveness of interbedded low-permeability horizons in the formation and the vertical and lateral discontinuity of sandstone horizons, the potential for vertical and horizontal movement of groundwater is limited. While no springs discharge from the Dakota Formation in the permit area, a spring with a discharge of about 1 gpm and displaying little seasonal variability in discharge (SP-4; Drawing 7-1) discharges from an apparent fault zone in the Dakota Formation approximately 1.1 miles south of the existing Coal Hollow permit area. Additionally, two seeps with discharges of less than 0.05 gpm (SP-27 and SP-34; Drawing 7-1) seep from the Dakota Formation in lower Sink Valley more than ½ mile south of the Coal Hollow Mine permit area. The results of slug testing performed on wells screened in the Smirl coal seam indicate relatively low values of hydraulic

conductivity for the coal seam (Table 7-8). In much of the mining area, the coal seam is dry (UDOGM, 2007). Thus, appreciable migration of groundwater through the Smirl coal seam is not anticipated.

In the proposed North Private Lease area, there are no springs or seeps discharging from the Dakota Formation (Appendix 7-16). The lack of springs in the Dakota Formation is likely attributable to 1) the presence of Tropic Shale bedrock overlying the formation, which limits the potential for vertical recharge to the formation, 2) the limited surface exposure of the formation, and 3) the overall poor water transmitting potential of the Dakota Formation (Appendix 7-1).

It should be noted that there are springs that discharge below irrigated fields near the town of Alton, Utah west of the proposed North Private Lease mining areas (Appendix 7-16). These springs, which are isolated from the proposed mining areas by upland areas of low-permeability Tropic Shale bedrock, discharge at locations that are stratigraphically near the Tropic Shale/Dakota Formation contact. The bedrock in these areas has apparently been altered as a result of near-surface burning of the Smirl coal seam, which can alter the water bearing and water transmitting characteristics of the bedrock relative to the unaltered bedrock petrology. Appreciable faulting associated with the Sevier Fault Zone has also been mapped in the area to the west of the spring discharge locations (Tilton, 2001).

No water wells are known to exist in the Tropic Shale or Dakota Formation in the Coal Hollow Mine permit and adjacent area (including the 85.88-acre Dame Lease IBC area and the proposed North Private Lease area), demonstrating the inability of these formations to transmit useful quantities of water to wells. Groundwaters from the Tropic Shale and Dakota Formation do not contribute measurable baseflow to streams in the Coal Hollow Mine permit and adjacent area and the North Private Lease area (at least at the surface in stream channels).

Groundwater discharging from springs below the town of Alton, Utah do contribute to the baseflow discharge in the Simpson Hollow tributary to Kanab Creek (Appendix 7-16) west of the proposed North Private Lease area.

Natural groundwater discharge in the existing Coal Hollow Mine permit and adjacent area occurs primarily from alluvial sediments. Alluvial discharge occurs both as discrete springs and seeps (Drawing 7-1) and also locally as diffuse seepage to the surface. Groundwater discharge areas in the ~~proposed~~ Coal Hollow Mine permit and adjacent area are shown on Drawing 7-4 (see also photograph section). The area of most appreciable alluvial groundwater discharge occurs in central Sink Valley in the northwest quarter of Section 29, T39S, R5W (see Drawing 7-4; groundwater discharge area A). The alluvial groundwater system in this area exists under artesian conditions, resulting from the presence of a considerable thickness of sloping, low permeability clayey sediments overlying coarser, water-bearing alluvial sediments at depth (See Drawing 6-3). The artesian alluvial groundwater system in Sink Valley is likely recharged via mountain-front-recharge along the flanks of the Paunsaugunt Plateau to the east and north of the

~~proposed~~ Coal Hollow Mine permit area. This artesian alluvial groundwater system that exists along the eastern margins of Sink Valley is likely continuous from near mountain-front recharge areas southward along the eastern margins of Sink Valley to the lower portion of Sink Valley. Discharge from the alluvial groundwater systems in and adjacent to the Coal Hollow Mine permit area occurs primarily in two areas (Drawing 7-4). In the northwest quarter of Section 29, T39S, R5W, considerable natural discharge from the alluvial groundwater system occurs through springs and seeps (Drawing 7-4; groundwater discharge area A). Minor discharge from several flowing artesian wells also occurs in this area. The artesian alluvial groundwater system in eastern Sink Valley also likely provides recharge to the clayey alluvial sediments in the southwestern portion of the valley in the Coal Hollow Mine permit area. Discharge from the alluvial groundwater system in groundwater discharge area A area results in decreases to the amount of water in storage in the alluvial groundwater system and also decreases in artesian hydraulic pressure in the aquifer.

Appreciable discharge from the alluvial groundwater system also occurs in lower Sink Valley in the northwest quarter of Section 32, T39S, R5W (see Drawing 7-4; groundwater discharge area B). Sink Valley constricts markedly in this area, which forces shallow alluvial groundwaters flowing down the valley to discharge at the land surface as springs, seeps, and diffuse discharge to the surface (i.e., there is a significant decrease in the cross-sectional area of the alluvial sediments). Groundwater discharge in this area occurs from diffuse seepage to the surface and also as discharges to two springs and several small seeps (Drawing 7-1).

Much of the alluvial groundwater in Sink Valley likely ultimately leaves the valley via evapotranspiration. This conclusion is based on the observation that there is very rarely any discharge of surface water (at least at the surface in the channel) in Sink Valley Wash below Sink Valley (See site SW-9; Drawing 7-2; UDOGM, 2007). The clayey, low-permeability sediments present at the surface over most of Sink Valley also impede appreciable infiltration of precipitation and snowmelt waters into the deeper subsurface. Hence, groundwater recharge to the lower half of the Sink Valley sediments (including the Coal Hollow Mine permit area) likely occurs primarily via horizontal migration of alluvial groundwaters from up-gradient areas.

Flowing artesian groundwater conditions are also observed in monitoring wells screened near the base of the alluvial sediments in the northwest corner of Section 32 T39S, R5W. It is probable that the artesian alluvial groundwater system in Section 29, T39S, R5W is continuous with that in the northwest corner of Section 32. It should be noted that within the Coal Hollow permit area, artesian conditions were not observed in monitoring wells. While the thickness of the alluvial sediments in the artesian groundwater system east of the Coal Hollow permit area range up to 150 feet thick, the thickness of alluvium overlying areas with mineable coal in the Coal Hollow permit area generally does not exceed about 50 feet and in many locations it is considerably thinner.

Natural discharge of alluvial groundwater in the Robinson Creek drainage area is meager. This condition is largely due to the presence of the elevated ridge of impermeable Tropic

Shale bedrock associated with the Sink Valley Fault that dissects and effectively isolates the alluvium east of the fault from that west of the fault (See Drawing 6-1). Because of the low permeability of the Tropic Shale, this condition apparently forces alluvial groundwater east of the Tropic Shale ridge to flow to the south toward Sink Valley that would otherwise report to the Robinson Creek drainage. During high flow conditions in the alluvial groundwater system east of the Tropic Shale ridge, minor amounts of groundwater "overtop" the bedrock ridge and drain via surface flow over the Tropic Shale bedrock, where it either recharges shallow alluvial sediments to the west of the fault or is lost to evapotranspiration. The influence of the Tropic Shale ridge is readily evident in field observations, with marked differences in vegetation and soil moisture being apparent on opposite sides of the ridge. During low-flow conditions, discharge from the overtopping of the bedrock ridge has generally not been observed. Isolated areas of soil wetness and shallow perched alluvial groundwater systems that exist west of the bedrock ridge in the northeast corner of Section 30 and the southeast corner of Section 19, T39S, R5W are likely sourced via this mechanism.

Seepage of alluvial groundwater into the deeply incised lower Robinson Creek stream channel occurs near the contact with the underlying Dakota Formation in the southeast quarter of Section 19, T39S, R5W. This water is likely related to saturated alluvial deposits underlying the Robinson Creek stream channel. The alluvial groundwater emerges near where the stream channel intersects the alluvial groundwater system. It is noteworthy that the location of the emergence of alluvial water in the channel has varied somewhat over time. The bank seepage water is likely alluvial groundwater that seeps to the surface where the incised stream channel intersects the potentiometric surface of the alluvial groundwater system. Typically, this is near the contact with the underlying Dakota Formation bedrock in the bottom of the stream channel. Because of the seasonal changes in the elevation of the potentiometric head in the alluvial groundwater system, the location of the bank seepage is variable over time (i.e. the variability in the bank seepage locations are likely controlled primarily by temporal variability in potentiometric levels in the alluvial groundwater system rather than by fixed, permeability-controlled groundwater preferential pathways in the aquifer skeleton). Consequently, the bank seepage locations are not well-defined point sources, but rather dynamic seepage fronts along this general reach of the stream.

The Robinson Creek stream channel above this location is almost always dry (except for in direct response to torrential precipitation events or during the springtime runoff season during wet years. This seepage of alluvial water in the Lower Robinson Creek channel is typically about 5 to 10 gpm or less and is routinely monitored at monitoring station SW-5 (Drawing 7-2).

Information on water quality for groundwaters and surface-waters has been uploaded into the Utah Division of Oil, Gas and Mining, Utah Coal Mining Water Quality Database (UDOGM, 2007) and is summarized and described in Appendix 7-1.

Appreciable spatial variability exists in water quality in groundwaters and surface waters in the Coal Hollow permit and adjacent area. Stiff diagrams depicting solute

compositions and overall water quality for groundwaters and surface waters in the Coal Hollow Mine permit and adjacent area are shown in Appendix 7-1. Important water quality characteristics for groundwaters are summarized below.

Groundwater Source	Chemical type	TDS (mg/L)
Alluvial groundwaters, coarse-grained system east of permit area	Calcium-magnesium-bicarbonate	380 mg/L to 500 mg/L typically, Little seasonal variability
Alluvial groundwaters in south sink valley	Variable, magnesium-bicarbonate sulfate, calcium-magnesium-bicarbonate	450 mg/L to 3,600 typically, Highly variable based on season and climate for shallow systems, less variability in deeper system
Dakota Formation, fault groundwater system south of ~~proposed~~ permit area	Sodium-bicarbonate	500 mg/L to 600 mg/L typically, Little seasonal variability

Water quality characteristics for groundwaters in the proposed North Private Lease area are summarized in Appendix 7-16.

It is apparent that the overall water quality of alluvial groundwater degrades from the mountain-front recharge water to the artesian groundwater system east of the Coal Hollow permit area to the non-artesian shallow alluvial groundwater systems located in the more distal portions of Sink Valley. These changes are due to groundwater interaction with soluble minerals in the primarily Tropic Shale-derived sediments that make up the shallow alluvial materials in the ~~proposed~~ permit area.

This down-gradient degradation in water quality is shown graphically on Drawing 7-5. In Drawing 7-5, the average specific conductance values in µS/cm for representative springs and seeps in the Sink Valley drainage are plotted on the map as circles with the circle areas being proportional to the specific conductance average for the spring or seep. The specific conductance information used in generating Drawing 7-5 has been submitted electronically to the Division's hydrology database (UDOGM, 2007). It is readily apparent from Drawing 7-5 that the specific conductance (which is a reflection of the dissolved solids concentration) is degraded from the mountain-front recharge water (represented by stream SW-8) to the artesian alluvial groundwater system in the northwest quarter of Section 29, T5W, R39S, to the alluvial groundwaters in the southern portion of Sink Valley below the Coal Hollow Mine permit area.

Specific conductance values were used for plotting in Drawing 7-5 because specific conductance values are available for all springs and seeps, while laboratory chemical analyses are available for only some of the springs and seeps. Stiff (1951) diagrams for selected springs along this geochemical evolutionary pathway are shown on Figure 14 of

Appendix 7-1. It is apparent from the Stiff diagrams and from geochemical information submitted to the Division (UDOGM, 2007) that the mountain-front recharge water (represented by monitoring site SW-8 in upper Swapp Hollow) is of the calcium-magnesium-bicarbonate chemical type with an average TDS concentration of 333 mg/L. Groundwater downgradient of the mountain-front recharge areas in the artesian alluvial groundwater system in Section 29, T5W, R39S, is also of the calcium-magnesium-bicarbonate chemical type, with an average TDS concentration at artesian well Y-61 of 400 mg/L. Further downgradient in the artesian alluvial groundwater system in Section 29, the geochemical composition at SP-8 is of the calcium-magnesium-bicarbonate chemical type with a somewhat increased TDS concentration of 425 mg/L. In the lower portions of Sink Valley in Section 32, T5W, R39S, the chemical quality of the alluvial groundwater is appreciably degraded relative to that in the upper portions of the groundwater system. At spring SP-6, the composition of the alluvial groundwater is seasonally variable and is of the magnesium-bicarbonate-sulfate, or calcium-magnesium-bicarbonate-sulfate chemical type. The TDS concentrations at SP-6 average 970 mg/L. The chemical composition of alluvial groundwater at SP-33 is of a geochemical type similar to that at SP-6, although TDS concentrations are somewhat lower, averaging 795 mg/L. The spatial variability apparent in the TDS concentrations in the alluvial groundwater in Section 32 is likely related to flushing effects resulting from higher groundwater fluxes through zones of increased permeability in the alluvium. It is noteworthy that groundwater in the gravelly zones in the deeper alluvi um~~al~~ east of the permit area in Section 32 monitored at the 85-foot deep well LS-85 is considerably lower in TDS concentration with an average of 457 mg/L. The lower TDS concentrations of artesian alluvial groundwater in the deeper, coarser-grained portions of the alluvium are likely attributable to the isolation of these groundwaters from the shallow, clayey, Tropic Shale derived alluvial sediment in the near-surface alluvial groundwaters.

The appreciable temporal variability in the solute geochemical compositions of the shallow alluvial groundwaters in Section 32 is likely attributable to seasonal and climatic variability in the groundwater flux rate through these systems and corresponding variability in rock/water ratios and residence time in the evaporate mineral rich Tropic Shale derived shallow alluvial sediments present in this portion of Sink Valley. Alluvial groundwaters in the deeper portions of Sink Valley to the east in Section 32 are part of a larger, more continuous groundwater system that is hydraulically isolated from overlying shallow recharge sources, and consequently have not exhibited similar temporal variability in solute geochemical composition.

Surface Water Resources

Surface--water resources in the ~~proposed~~ Coal Hollow Mine permit and adjacent area (including the 85.88-acre Dame Lease IBC) are described in Appendix 7-1 and are summarized below. Surface-water resources in the proposed North Private Lease area are described in Appendix 7-16.

Surface waters in the Coal Hollow Mine permit and adjacent area and the proposed North Private Lease area are tributary to Kanab Creek. Surface waters in the northern portion of the existing permit and adjacent area drain into the Robinson Creek and upper Kanab Creek drainages. Surface waters in the southern portion of the permit and adjacent area drain into the Sink Valley Wash drainage which is tributary to Kanab Creek about 6 miles below the Coal Hollow Mine permit area. Surface--water drainages in the permit and surrounding areas are shown in Appendix 7-1. Surface-water drainages in the proposed North Private Lease area are shown in Appendix 7-16. Surface--water baseline monitoring stations are shown on Drawing 7-2.– Locations of surface-water water rights in and adjacent to the Coal Hollow Mine permit and adjacent area are shown on Drawing 7-3. Locations of surface-water rights in and adjacent to the proposed North Private Lease are shown on Appendix 7-3N. Water rights data from the Coal Hollow Mine permit and adjacent area are detailed in Appendix 7-3. Water rights data from the proposed North Private Lease and adjacent area are detailed in Appendix 7-3N.

Information on water quality for groundwaters and surface-waters has been uploaded into the Utah Division of Oil, Gas and Mining, Utah Coal Mining Water Quality Database (UDOGM, 2007) and is summarized and described in Appendix 7-1 and Appendix 7-16.

Surface waters in Kanab Creek are used for stock watering and crop irrigation in the irrigable lands adjacent to Kanab Creek west of the Coal Hollow Mine permit area. Discharge in Kanab Creek measured near the town of Alton (SW-1) is seasonally dependent and largely influenced by upstream water use. Discharge in Kanab Creek monitored at SW-1 typically ranges from 10 cfs or less during the springtime runoff period to 1 cfs or less during the summertime.

Discharge in Lower Robinson Creek drainage is meager. Other than during the springtime runoff event in wet years or during torrential precipitation events, flow has not been observed at monitoring stations SW-4 and SW-101 (Drawing 7-2). Discharge at the lower monitoring site on Lower Robinson Creek (SW-5; Drawing 7-2) is meager. The small discharge occasionally present at SW-5 is derived from the seepage of alluvial groundwater into the Lower Robinson Creek stream channel between monitoring sites SW-101 and SW-5.

Tributaries to the Sink Valley Wash drainage in the Coal Hollow Mine permit and adjacent areas include (from north to south) Water Canyon, an unnamed drainage south of Water Canyon in Section 21 T39S, R5W, and Swapp Hollow. Discharge rates in these drainages are highly seasonally dependent (UDOGM, 2007; Appendix 7-1). Discharges in the Water Canyon and Swapp Hollow drainages are intermittent or perennial in nature with discharge peaks occurring during the springtime runoff season and much lower

flows occurring during the late summer and fall months. Discharge in the unnamed drainage in Section 21 T39S, R5W is ephemeral.

The water quality and discharge characteristics of surface waters in the Coal Hollow Mine permit and adjacent area are presented in UDOGM (2007) and described in Appendix 7-1. The water quality and discharge characteristics of surface waters in the proposed North Private Lease area are described in Appendix 7-16. Solute compositions of stream waters are also depicted graphically as Stiff diagrams in Appendix 7-1 and Appendix 7-16. The solute compositions of surface waters in the Coal Hollow Mine permit and adjacent area are summarized below. Solute compositions of surface waters in the proposed North Private Lease and adjacent areas are summarized in Appendix 7-16.

Source	Chemical type	TDS (mg/L)
Robinson Creek/Dry Fork	Calcium-magnesium-bicarbonate	300 mg/L typical
Lower Robinson Creek	Variable, magnesium-sulfate-bicarbonate	300 – 3,500 mg/L typical, dependent on discharge
Swapp Hollow	Calcium-magnesium-bicarbonate	250-350 mg/L typical
Kanab Creek	Magnesium-calcium-bicarbonate-sulfate during high flow, variable during low-flow, variability likely due largely to interaction with Tropic Shale soils and irrigation return flows	500-1,300 mg/L typical, Variable dependent on season and irrigation use
Sink Valley Wash	Magnesium-calcium-bicarbonate	600 -1,500 mg/L typical, variable dependent on discharge

Considerable seasonal variability exists in the solute compositions of stream waters in Kanab Creek in the Coal Hollow Mine permit and adjacent area (UDOGM, 2007; Appendix 7-1). During low-flow conditions, interactions between stream waters and Tropic Shale or Tropic Shale-derived alluvial sediments likely result in increased TDS concentrations. Return flow from irrigated fields and interactions with soils rich in soluble minerals also likely contribute to increased TDS concentrations in the summertime. During the spring runoff season, high surface-water flows that originate from the adjacent upland areas dominate the flow in the channel. The TDS concentrations of Kanab Creek waters during high-flow conditions are thus lower than during the low-flow season. Much less seasonal variability in solute content in surface water flows from the mountain stream in Swapp Hollow (UDOGM, 2007; Appendix 7-1). This condition is likely attributable to the fact that the stream in Swapp Hollow, which originates on geologic formations overlying the Tropic Shale, has considerably less contact with the Tropic Shale than does Kanab Creek. Additionally, there are no known irrigation diversions or returns above the stream monitoring point (SW-8; Drawing 7-2) in Swapp Hollow.

722 CROSS SECTIONS AND MAPS

722.100 A map showing the locations of springs and seeps in the ~~proposed~~ Coal Hollow Mine permit and adjacent area (including the 85.88-acre Dame Lease IBC area) is presented in Drawing 7-1. A map showing the locations of springs and seeps in the North Private Lease area is provided in Appendix 7-16. A map showing potentiometric levels in alluvial groundwater systems in the ~~proposed~~ Coal Hollow and adjacent areas (including the 85.88-acre Dame Lease IBC) is presented in Drawing 7-13. A Map showing potentiometric levels in the North Private Lease area is provided in Appendix 7-16. It is important to note that the alluvial groundwater potentiometric contours depicted in Drawing 7-13 are not representative of a laterally or vertically continuous groundwater system. Within the Coal Hollow Mine permit and adjacent area, appreciable portions of the alluvial sediments are not saturated. Additionally, perched groundwater conditions are present in many locations in the alluvium in the area. In other words, the alluvial groundwater systems in the Coal Hollow Mine permit and adjacent area are not a single, interconnected aquifer. Rather, there exist several areas of saturated alluvium, which may or may not be in good hydraulic communication with adjacent areas. Consequently, it is not possible or meaningful to construct a true potentiometric contour map in the strict sense. Consequently, it is not appropriate to evaluate regional potentiometric trends over large distances or to infer precise groundwater flow directions or hydraulic gradients in the alluvial groundwater system based on Drawing 7-13. The alluvial groundwater system potentiometric map presented in Drawing 7-13 is useful for evaluating approximate local potentiometric conditions and general saturation trends.

722.200 Location of surface water bodies

Within the ~~proposed~~ Coal Hollow Mine permit and adjacent area, no significant natural ponds or lakes occur. The locations of springs and streams are shown in Drawing 7-1. The locations of springs and streams in the North Private Lease area are shown in Appendix 7-16. Many small earthen impoundments and ponds have been created to store surface-water runoff and spring discharge water for stock watering and irrigation use. Some of these impoundments were created by constructing straight or semi-circular berms across ephemeral surface water drainages to impound surface runoff. Because of the character of the alluvial sediments, some of the ponds have become filled with sediment over time and the holding capacities have diminished. The

locations of ponds and associated conveyance ditches are shown on Drawing 7-7.

722.300 Baseline monitoring stations

Baseline monitoring stations are shown on Drawing 7- 2. A map showing the locations of monitoring wells in the ~~proposed~~ Coal Hollow permit and adjacent area is presented in Drawing 7-12 and on Figure 12 of Appendix 7-1. The locations and completion details of monitoring wells in the North Private Lease area are provided in Appendix 7-16. Drawing 7-12 also shows monitoring stations from which baseline hydrologic data were collected in previous studies. Monitoring station locations, elevations, and other details are presented in Table 7-1 and Appendix 7-16

722.400 Location of water wells

Water well locations are shown in Drawing 7-2 and Drawing 7-12. Well construction details and locations are presented in Table 7-2. Locations and construction details of water wells in the North Private Lease area are shown in Appendix 7-16.

722.500 Contour map(s) of disturbed area(s)

Surface contours representing the existing land surface configuration of the Coal Hollow permit area (including potentially disturbed areas) are shown on Drawing 5-1 and the post mining land configuration is shown on 5-35. Cross sections with both these landforms are shown on Drawing 5-~~36~~37A. Surface contours representing the existing land surface configuration of the North Private Lease permit area (including potentially disturbed areas) are shown on Drawing 5-45 and the post mining land configuration is shown on 5-74. Cross sections with both these landforms are shown on Drawing 5-75. The premining landform, with exception of the Facilities area and Lower Robinson Creek, are from an aerial flight that was limited to a five foot contour interval. Therefore, contours have been interpolated down to a 2 foot level using the available aerial flight information. This interpolation provides accuracy for the Division to make the necessary determinations. The Facilities area and portions of Lower Robinson Creek are actual survey data to the accuracy of 2-foot contours.

723 SAMPLING AND ANALYSIS

Water quality sampling and analyses have been and will be conducted according to the "Standard Methods for the Examination of Water and Wastewater" or EPA methods listed in 40 CFR Parts 136 and 434. Information regarding laboratory analytical methods utilized in performing water quality analyses at the analytical laboratories has been submitted to the Utah Division of Oil, Gas and Mining, Utah Coal Mining Water Quality Database (UDOGM, 2007).

724 BASELINE INFORMATION

Baseline groundwater, surface-water, geologic, and climatologic data (including information for the 85.88-acre Dame Lease IBC area) are described in Appendix 7-1 and summarized below. Baseline information for the North Private Lease area are provided in Appendix 7-16.

724.100 Groundwater Information

The location of wells and springs in the ~~proposed~~ Coal Hollow Mine permit and adjacent area (including the 85.88-acre Dame Lease IBC) are shown on Drawings 7-1 (Spring and seep survey map), 7-2 (Baseline monitoring locations), and 7-12 (Monitoring well location map). Groundwater rights in and around the ~~proposed~~ Coal Hollow Mine permit area are shown on Drawing 7-3 and tabulated in Appendix 7-3. Groundwater rights information for the North Private Lease area are provided in Appendix 7-3N and shown on Drawing 7-3N.

Seasonal quality and quantity of groundwater and usage is presented in Appendix 7-1 and UDOGM (2007). Baseline discharge and water quality data have been submitted electronically to the Utah Division of Oil, Gas and Mining, Utah Coal Mining Water Quality (UDOGM, 2007).

Baseline monitoring of groundwater resources in and around the ~~proposed~~ Coal Hollow permit area have been carried out by several entities. Previous hydrologic studies of the region have been made in the Alton Coal Field area by Goode (1964, 1966), Sandberg (1979), Cordova (1981), and Plantz (1983). Selected hydrologic data collected in conjunction with these studies have been incorporated into the hydrologic analysis and baseline data included in this permit application.

During the 1980's, extensive monitoring of groundwater resources in the ~~proposed~~ permit and surrounding areas was performed by Utah International, Inc. Utah International Inc.'s groundwater monitoring activities included the construction of numerous groundwater monitoring wells, aquifer testing activities, and the performance of discharge, water level, and field and laboratory water quality monitoring of springs,

seeps, and wells. These baseline monitoring activities were performed as part of a proposed coal mine permitting action in the Alton Coal Field. Ultimately, the proposed coal mining action did not proceed. Relevant monitoring information from the Utah International, Inc. baseline monitoring activities have been included as supplemental baseline data included in this permit application.

Commencing in the 2nd quarter of 2005, regular quarterly baseline monitoring of groundwater resources has been commissioned by Alton Coal Development, LLC. Baseline monitoring of springs, seeps, and groundwater wells in and around the ~~proposed~~ Coal Hollow Mine permit area have been routinely performed. Data collected in the baseline monitoring activities have been submitted electronically to the Utah Division of Oil, Gas and Mining, Utah Coal Mining Water Quality Database (UDOGM, 2007).

Baseline potentiometric information from wells has been input into the DOGM database. For non-flowing-artesian wells, this information has been input in a depth-to-water-relative-to-the-top-of-the-well-casing format using units of feet. For wells experiencing flowing artesian conditions, the potentiometric data are reported to the database in feet as a height-of-the-potentiometric-surface-above-the-top-of-the-well-casing format expressed as a negative number (which makes the flowing-artesian and non-flowing-artesian potentiometric measurements directly comparable). For both conditions, the reported measurements can be directly converted to an absolute water elevation by subtracting the reported value from the elevation of the top of the well casing.

The potentiometric head in monitoring wells experiencing flowing-artesian conditions is measured either 1) by temporarily extending the height of the well casing and allowing the water level to stabilize and the performing a height of the water column measurement (where the artesian pressure is small), or 2) by using a pressure gauge to measure the shut-in artesian pressure in the well and then converting that number to an equivalent height in feet.

During December 2006 and January 2007 an extensive drilling and monitoring well construction program was implemented. This hydrogeologic program included the installation of 30 groundwater monitoring wells in and adjacent to the ~~proposed~~ Coal Hollow Mine permit area. The focus of the drilling program was to characterize the stratigraphy and hydrogeologic properties of alluvial groundwater systems in and adjacent to ~~proposed~~ mining areas. Aquifer characterization of the alluvial groundwater system was also performed using pump testing and slug testing techniques. Investigative methods utilized and the results of the analysis of the data are described in Appendix 7-1.

Descriptions of alluvial groundwater systems in the mine permit and surrounding areas, including information on quantity and quality of alluvial groundwaters, are presented in Appendix 7-1. Estimated rates of alluvial groundwater inflow into the mine are presented in Table 7-9. Additional information on alluvial groundwater inflows is provided in Section 728.333.

As indicated in the Alluvial Groundwater Management Plan for the Coal Hollow Mine (See Appendix 7-9), the land surface overlying proposed alluvial groundwater interceptor drains will be contoured to match the existing surrounding topography. Accordingly, alterations of existing surface-water drainage patterns should not occur.

Water monitoring information provided to the Division demonstrates that water levels in shallow alluvial groundwater systems in the Coal Hollow Mine area do respond to seasonal and climatic variability. However, as described in Appendix 7-1, the shallow alluvial sediments in the Coal Hollow Mine area are dominated by silts, clays, and fine-grained sands which generally do not have appreciable hydraulic conductivity. Because of the overall pervasiveness of silts, clays, and fine-grained sands in the alluvial system in the mine permit area, rates of alluvial groundwater migration are generally not rapid (See information provided in Table 7-9). (It should be emphasized that alluvial groundwater flow velocities in the coarser-grained alluvial systems in areas adjacent to proposed mining areas generally to the east and south are known to be appreciably greater). In cross-sectional exposures of saturated alluvial deposits in the up-gradient highwalls at the Coal Hollow Mine, only modest quantities of groundwater discharge have been observed. Although the alluvial sediments are largely saturated, where the saturated alluvial sediments have been exposed, sustained discharges of alluvial groundwater of more than a few gallons per minute are generally not observed. While discharges on the magnitude of a few gallons per minute have been observed in a fluvial channel system intercepted by the mine (which deposits contained sands, silts, and gravels), the much more pervasive fine-grained alluvial sediments where exposed were observed to weep only very minor, un-measurable quantities of water through the highwall. During a site visit on June 2, 2011, Petersen Hydrologic (2011) estimated that the total flow from the 600-foot-long exposure of clayey, silty alluvium in the mine highwall was less than 1 gpm. The total discharge from the exposed fluvial channel system was measured at 5.5 gpm. The total flow from a recently constructed, 870-foot-long up-gradient alluvial groundwater intercept trench was only 13.4 gpm. What this demonstrates is that, while the alluvial sediments adjacent to the mine openings are largely saturated, the presence of low permeability sediments in the alluvium limits the potential for the alluvial groundwaters to rapidly flow into the mine pit areas.

It should be emphasized here, however, that although highly permeable, saturated, coarse-grained alluvial sediments have not been intersected at the Coal Hollow Mine to date, the potential for intercepting such sediments is always present in heterogeneous mountain-front alluvial deposits. Appreciably greater inflow volumes are possible from such sediments were they to be encountered unexpectedly at the Coal Hollow Mine.

The overall low hydraulic conductivity of most of the alluvial sediments in proposed mining areas generally precludes the effective dewatering of saturated alluvial deposits adjacent to proposed mining areas through the use of vertical dewatering wells. For this reason, as described in the proposed alluvial groundwater management plan for the Coal Hollow Mine, horizontal drain systems (with large, long horizontal "screened" intervals in targeted strata to collect intercepted alluvial groundwater) are proposed for use in dewatering the alluvial sediments adjacent to proposed mining areas.

724.200 Surface Water Information

The locations of streams, stock watering ponds, and conveyance ditches in the ~~proposed~~ Coal Hollow Mine permit and adjacent area (including the 85.88-acre Dame Lease IBC area) are shown on Drawing 7-7. Surface-water information for the North Private Lease area are provided in Appendix 7-16. Surface-water rights in and adjacent to the ~~proposed~~ Coal Hollow Mine permit area are shown on Drawing 7-3 and tabulated in Appendix 7-3. Surface-water rights information for the North Private Lease area are provided in Appendix 7-3N and shown on Drawing 7-3N. Surface-water discharge rates and water quality data have been submitted electronically to the Utah Division of Oil, Gas and Mining, Utah Coal Mining Water Quality Database (UDOGM, 2007). Additional surface-water information is provided in Appendix 7-1.

It is not anticipated currently that discharge from the ~~proposed~~ Coal Hollow Mine will be necessary. Where necessary, alluvial groundwater that may be intercepted by mining will be placed in drains and diverted away from disturbed areas and discharged (i.e., as groundwater dewatering). However, a Utah UPDES discharge permit will be obtained so that if discharge of mine water becomes necessary, it can be discharged in accordance with the UPDES discharge permit. The exact locations of mine water discharge points will be established upon issuance of the UPDES discharge permit. Any mine discharge water will be placed in either the Lower Robinson Creek drainage or the Sink Valley Wash drainage. Both of these drainages are tributary to Kanab Creek.

As described in R645-301-728.320, acid drainage is not expected from the proposed mining operation (including the proposed operations in the North Private Lease area). This is due to the pervasiveness of carbonate minerals in the mine environment that will neutralize any acid produced.

Seasonal quality and quantity of groundwater and usage is described herein and in Appendix 7-1 and Appendix 7-16. Baseline discharge and water quality data have been submitted electronically to the Utah Division of Oil, Gas and Mining, Utah Coal Mining Water Quality (UDOGM, 2007).

Baseline monitoring of surface-water resources in and around the ~~proposed~~ Coal Hollow permit area have been carried out by several entities. Previous hydrologic studies of the have been made in the Alton Coal Field area by Goode (1964, 1966), Sandberg (1979), Cordova (1981), and Plantz (1983). Selected hydrologic data collected in conjunction with these studies have been incorporated into the baseline data as part of this permit application.

During the 1980's, extensive monitoring of surface water resources in the ~~proposed~~ permit and surrounding areas was performed by Utah International, Inc. Utah International Inc.'s groundwater monitoring activities included the operation of continuous recording stations on selected streams, and the performance of routine

surface-water discharge measurements and field and laboratory water quality analyses. These baseline monitoring activities were performed as part of a proposed coal mine permitting action in the Alton Coal Field. Ultimately, the proposed coal mining action did not proceed. Relevant monitoring information from the Utah International, Inc. baseline monitoring activities have been included as supplemental baseline data as part of this permit application. Commencing in the 2nd quarter of 2005, regular quarterly baseline monitoring of surface-water resources has been commissioned by Alton Coal Development, LLC. Baseline monitoring of surface-waters in and around the ~~proposed~~ Coal Hollow permit area, including surface-water discharge measurements and field and laboratory water quality analyses, have been routinely performed.

All surface waters in the Coal Hollow Mine permit (including the proposed North Private Lease area) and adjacent area are tributary to the Kanab Creek drainage. Surface-water monitoring stations from which baseline data have been collected are shown on Drawing 7-2 and include the following:

Sink Valley Wash drainage

SW-8 (Swapp Hollow above proposed mining areas), SW-7 (unnamed drainage in Section 21, T39S, R5W), RID-1 (irrigation diversion of water from Water Canyon drainage above proposed mining areas), SW-6 (headwaters of unnamed tributary to lower Sink Valley Wash), SW-9 (Sink Valley Wash below proposed mining areas), SW-10 (unnamed tributary to Sink Valley Wash approximately 1.7 miles south of proposed mining areas), SVWOBS-1 (Sink Valley Wash above proposed mining areas, and SVWOBS-2 (Sink Valley Wash east of proposed mining areas).

Lower Robinson Creek drainage

SW-4 (Robinson Creek above proposed mining areas), SW-101 (Lower Robinson Creek near proposed mining areas), BLM-1 (Lower Robinson Creek adjacent to proposed mining areas) and SW-5 (Lower Robinson Creek below proposed mining areas).

Kanab Creek drainage

SW-1 (Kanab Creek near Alton, Utah; above proposed mining areas), SW-3 (Kanab Creek above proposed mining areas), and SW-2 (Kanab Creek below Lower Robinson Creek and below proposed mining areas). Additionally baseline hydrologic data from Lamb Canal, which is an irrigation ditch that conveys water from a diversion in Kanab Creek to irrigated lands adjacent to Kanab Creek west of proposed mining areas, is also collected.

724.300 Geologic Information

Geologic information in sufficient detail to determine the probable hydrologic consequences of mining and determine whether reclamation as required by R645 can be accomplished is given in Chapter 6 of this permit application package and in Appendix 7-1 and Appendix 7-16.

724.400 Climatological Information

Climatological information, including temperature and precipitation data, have been routinely measured and recorded at the Alton, Utah weather station (420086) since 1928. The station is located in the town of Alton, approximately two miles north of the ~~proposed~~ Coal Hollow Mine permit area. Climatological data collected at the Alton station for the 77 year period from 1928 to 2005 are summarized in Table 7-3. Climatological data from the ~~proposed~~ Coal Hollow Mine permit and adjacent area are plotted in Drawing 7-8.

An automated weather station was installed in the ~~proposed~~ Coal Hollow Mine permit area in December 2005. The station is configured to continuously monitor and record temperature, wind velocity, and wind direction data. The station is also configured to continuously measure and record precipitation, although the tipping rain-gauge is not operative during winter months. Climate data from the ~~proposed~~ Coal Hollow Mine and adjacent area are also presented in Appendix 7-6.

724.411 Seasonal precipitation

Precipitation data from the Alton, Utah weather station indicates average annual precipitation of 16.38 inches per year. Doelling (1972) reports average annual precipitation in the Alton Coal Field area ranging from 9 to 20 inches annually with slightly higher increments likely in the higher parts of the plateau (Doelling, 1972). There are generally two annual wet periods in the region. During the wintertime, cyclonic storms bring precipitation (mainly snowfall) to the region. During the summertime, storms originating from convection of air from the Gulf of Mexico or the Pacific Ocean bring rains to the region. Of the two annual wet cycles, the summer rainfall is most reliable. Average monthly precipitation at the Alton station ranges from a low of 0.57 inches in June to a maximum of 1.80 inches in February. Daily temperature and precipitation data recorded at the Coal Hollow Project weather station during 2006 and early 2007 are presented in Appendix 7-6.

The Palmer Hydrologic Drought Index (PHDI; NCDC, 1997) indicates long-term climatic trends for the region. The PHDI is a monthly value generated by the National Climatic Data Center (NCDC) that indicates the severity of a wet or dry spell. The PHDI is computed from climatic and hydrologic parameters such as temperature, precipitation, evapotranspiration, soil water recharge, soil water loss, and runoff. Because the PHDI takes into account parameters that affect the balance between moisture supply and moisture demand, the index is a useful for evaluating the long-term relationship between climate and groundwater recharge and discharge. A plot of the PHDI for Utah Region 4 (which includes the Coal Hollow Mine permit and surrounding area) is shown in Drawing 7-9. It is apparent in Drawing 7-9 that the region has experienced cyclical periods of drought and wetness since 1980. Baseline hydrologic monitoring performed by Utah International, Inc in 1987 and 1988 occurred during a period of near normal wetness. Recent baseline hydrologic monitoring conducted in 2005 and 2006 occurred during a period of moderate to severe wetness, with 2005 being wetter than 2006.

724.412 Wind direction and velocity

Wind data have been collected at the Coal Hollow Project weather station since December 2005. Monthly wind data from the Coal Hollow Project weather station are available from January 2006 through March 2006, and from November 2006 through May 2007. Monthly wind data are plotted as wind rose diagrams, which depict the average direction and velocity of prevailing winds, in Appendix 7-1. Based on recent data from the Coal Hollow Project weather station, it is apparent that the predominant wind direction in the ~~proposed~~ Coal Hollow Mine permit area (during the months for which data are available) are from the northeast, with secondary peaks from the north and south-southwest (Appendix 7-~~1~~6). Surface winds recorded at the Coal Hollow Project weather station averaged about 6.4 miles per hour. Tabulated hourly wind data from the Coal Hollow Project weather station are maintained on file at Alton Coal Development, LLC.

Wind data have also been collected historically at nearby locations by governmental and other entities. The regionally predominant direction of winds in the region is southwest through west. Secondary peaks are from southeast and northwest. Surface winds in the area average approximately 8 miles per hour. Higher wind speeds are associated with fronts and storms and generally occur during the springtime.

724.413 Seasonal temperature ranges

Temperature data from the region are summarized in Table 7-3. Temperatures in the permit area vary greatly. Temperature data from the Alton station (1928-2005) indicate that monthly average low temperatures are below freezing for the 6-month period from November to April. Monthly average minimum temperatures range from a low of 15.1 °F during January to a high of 49.8 °F in July. Monthly average maximum temperatures range from a low of 39.5 °F in January to a high of 82.6 °F in July. Daily maximum and minimum temperature data collected at the Coal Hollow Project weather station during 2006 ~~and the first quarter of 2007~~through August 2015 are presented in Appendix 7-6. The maximum temperature recorded during this period was ~~93.3~~94.1 °F in ~~July 2006~~June 2013. The minimum temperature recorded during this period was ~~-7.3~~8.4 °F in January ~~2007~~2011.

724.500 Supplemental Information

Other than the possible short-term diminution in discharge rates from alluvial groundwater systems, including the potential short-term diminution of discharge rates from some springs and seeps in Sink Valley, adverse impacts to the hydrologic balance, either on or off the permit area are not expected to occur. Significant adverse impacts to the hydrologic balance in the North Private Lease are likewise not anticipated, although one seep that discharges at less than 1 gpm is planned to be intercepted by the mine workings. It is not anticipated that acid- and toxic-forming materials will cause significant contamination of groundwater or surface-water supplies in either the existing

mine area or at the proposed North Private Lease. Any discharges of mine waters to surface-water systems will be regulated under and meet the criteria of a UPDES discharge permit. The mining and reclamation plan for the existing mine area and the proposed North Private Lease has been designed to minimize the potential for disturbance or disruption of the hydrologic balance and to protect groundwater and surface-water resources in the area.

If substantial alluvial groundwater inflows into mining areas occur as mining progresses in close proximity to alluvial springs and seeps in the eastern ¼ of Section 30, T39S, R5W and the northwest ¼ of Section 29, T39S, R5W or in close proximity to coarse-grained alluvial sediments in the artesian groundwater system along the eastern side of Sink Valley, Alton Coal Development, LLC will evaluate hydrogeologic conditions at the time such may occur. It should be noted that very large discharges into mine workings are not anticipated based on the results of recent drilling and aquifer testing performed in these areas (see Appendix 7-1). Based on the hydrogeologic conditions encountered, where necessary Alton Coal Development, LLC will use a suitable technique to minimize groundwater inflow rates into the mine, which may include the use of bentonite or natural clay filled cutoff walls or other means where appropriate to protect groundwater resources up-gradient of mining activities. The potential for success of such protective measures in minimizing drainage of alluvial deposits up-gradient of proposed mining areas is believed to be good, given that the thickness of the alluvium in these areas is generally on the order of about 20 to 50 feet and these sediments are directly underlain by essentially impermeable Tropic Shale in proposed mining areas. It is important to note that while temporary impacts to groundwater discharge rates from alluvial springs and seeps could possibly occur, these impacts will likely be short-lived. This conclusion is based on the fact that individual mine pits in most instances will remain open for no more than about 60 to 120 days (measured from the time the mining of the pit is completed to the time the pit is backfilled). The variability in the time individual pits remain open is related to the thickness of overburden at the pit and the state of the overall spoil balance. It should be noted that these times could be somewhat greater if the mining production rate is less than the currently anticipated rate (in the event that contracts for the full 2 million tons of coal per year are not in place). However, the backfilling and rough grading requirements of R645-301.553 will be met (except where a variance to this regulation has been requested to assist with the transition to the adjacent federal coal reserves in the south pits area). After mine pits are backfilled and reclaimed, the potential for appreciable continued drainage of up-gradient alluvial groundwater through the backfilled pits in that area is low. When mining is complete in an area, seasonal recharge to alluvial groundwater systems will gradually replenish groundwater to the alluvial groundwater system. Large-scale dewatering of the alluvial groundwater system, such that appreciable compaction of the aquifer skeleton could occur, is not anticipated (see Appendix 7-1).

If diminution of discharge rates from seeps and springs does occur as a consequence of mining and reclamation activities in either the existing mining area or the proposed North Private Lease, any lost water will be replaced according to all applicable Utah State laws and regulations using the water replacement source specified in R645-301-727. The

quantity and quality of replacement water detailed in R645-301-727 will be suitable for the existing premining uses and approved postmining land uses.

It should be noted that the ~~proposed~~ Coal Hollow Mine plan calls for the temporary diversion of a reach of the Lower Robinson Creek stream channel approximately 2,000 feet in length in the southeast ¼ of Section 19, T39S, R5W. Details of the proposed diversion are given in Chapter 5, Section 527.220 of this MRP. If this action results in diminution of groundwater or surface-water resources, where required a suitable mitigation for this potential impact will be designed and implemented in consultation with the Division of Oil, Gas and Mining.

If excess groundwater were to be encountered during mining operations in the existing permit area or in the proposed North Private Lease such that it could not be adequately managed or discharged in compliance with the Utah UPDES discharge permit (which is considered unlikely), Alton Coal Development, LLC may when necessary and with the approval of the Utah Division of Oil, Gas and Mining construct supplemental containment and settlement ponds in which mine discharge waters may be held for treatment (where necessary) and subsequent discharge through UPDES discharge points in compliance with the UPDES discharge permit.

Mining in the Coal Hollow project area will be a combination of surface mining, either open pit or highwall mining, and underground mining. Both the highwall mining and underground mining are designed such that subsidence is not expected to occur or have a negative impact on renewable resources lands.

724.700 Alluvial Valley Floor Determination

A field investigation has been performed in the Coal Hollow Mine permit and adjacent area to provide to the Division the information required to make an evaluation regarding the existence of a probable alluvial valley floor in the Coal Hollow Mine permit and adjacent area. The results of this field investigation and related information is provided in Appendix 7-1. Additional information regarding potential alluvial valley floors in the area is provided in Appendix 7-7.

A report detailing the findings of a previous field investigation performed by Water Engineering & Technology, Inc., entitled "Geomorphological and sedimentological characteristics of Sink Valley, Kane County, Utah" is included as Appendix 7-4.

A field investigation has been performed in the North Private Lease Area and adjacent area to provide to the Division the information required to make an evaluation regarding the existence of a probable alluvial valley floor in the North Private Lease permit and adjacent area. The results of this field investigation and related information is provided in Appendix 7-17.

725 BASELINE CUMULATIVE IMPACT AREA INFORMATION

Appendix 7-1 contains the results of a comprehensive investigation of groundwater and surface-water systems in the ~~proposed~~ Coal Hollow Mine permit and adjacent area (including the 85.88-acre Dame Lease IBC area and the proposed North Private Lease area). Appendix 7-1 also includes information regarding the probable hydrologic consequences of coal mining in the ~~proposed~~ Coal Hollow Mine permit area and recommendations for hydrologic monitoring. Appendix 7-1 also includes the results of a field investigation performed in the ~~proposed~~ Coal Hollow Mine permit and adjacent area to provide to the Division of Oil, Gas and Mining the information required to make an evaluation regarding the existence of a probable alluvial valley floor in the ~~proposed~~ Coal Hollow Mine permit and adjacent area. This Information together with the information submitted herein can be used to assess the probable cumulative hydrologic impacts of coal mining and reclamation operations in the ~~proposed~~ Coal Hollow Mine permit and adjacent area (including the 85.88-acre Dame Lease IBC area) as required by R645-301-729. The results of a field investigation regarding potential alluvial valley floors in the proposed North Private Lease area was previously provided to the Division and is included in the MRP as Appendix 7-17. The AVF report includes baseline information for the North Private Lease area including groundwater and surface-water quality information . The report also includes geologic information including maps of geology and geomorphology of the North Private Lease and Adjacent area.

Information on groundwater and surface-water systems in the North Private Lease area at the North Private Lease area is provided in Appendix 7-16 (Petersen Hydrologic, 2015). Appendix 7-16 includes a map showing hydrologic baseline monitoring locations as well as a map showing spring and seep locations in the North Private Lease and adjacent areas. A plot of the Palmer Hydrologic Drought Index and a geologic map of the North Private Lease and adjacent area are provided in Appendix 7-16. Appendix 7-16 also provides a series of hydrogeologic cross-sections through the North Private Lease and adjacent area that show water levels under seasonal conditions. Discharge hydrographs for springs and streams and water level hydrographs for wells are provided in Appendix 7-16. Baseline water quantity and water quality data for springs, streams, and wells in the North Private Lease and surrounding areas are tabulated in Appendix 7-16. A map showing Stiff diagrams that depict solute geochemical compositions for groundwaters and surface waters in the North Private Lease and surrounding areas is provided in Appendix 7-16. A map showing the locations of ponds and ditches is also provided. Plots of TDS concentrations in Kanab Creek during high flow and low flow conditions are provided in Appendix 7-16, as is a graph of discharge rates plotted versus TDS in the creek. A water table map is also provided in Appendix 7-16. Monitoring well details for wells in the North Private Lease area are also provided in Appendix 7-16. A map showing the proposed hydrologic monitoring locations associated with the North Private Lease area is also provided in Appendix 7-16.

R645-301-726 Modeling

No numerical models have been created for the permit area nor are any planned.

727 ALTERNATIVE WATER SOURCE INFORMATION

This section provides information on the alternative water source that will be used to replace water from groundwaters or surface waters should they be impacted by mining and reclamation activities in the ~~proposed~~ Coal Hollow Mine permit and adjacent area (including the 85.88-acre Dame Lease IBC area and the North Private Lease area).

The alternative water source is a water production well that was constructed ~~planned for construction~~ on private land leased by Alton Coal Development, LLC in the northwest quarter of Section 29, Township 39 South, Range 5 West. The ~~planned~~ location for the well, which is situated within the ~~proposed~~ Coal Hollow Mine permit area, is shown on Drawing 5-8C. The well ~~will~~ produces water from the alluvial groundwater system in Sink Valley in locations up-gradient of proposed mining operations. Based on aquifer testing performed in the alluvial groundwater system near the proposed water well (using the existing well Y-61 as a pump testing well), it is believed that adequate water can be produced from the new well to satisfy the potential water replacement needs of the mine. Details of the aquifer testing and information on the hydrogeologic characteristics of the Sink Valley alluvial groundwater system are presented in Appendix 7-1.

Water quality data from the Sink Valley alluvial groundwater system near the location of the ~~proposed~~ new water well have been collected from well Y-102 and have been submitted electronically to the Utah Division of Oil, Gas and Mining Utah Coal Mining Water Quality Database (UDOGM, 2007). ~~It is anticipated that t~~The quantity and quality of water produced from the new water production well has been~~will be~~ suitable for the existing premining uses and approved postmining land uses. Well testing performed on the new water well indicated a yield of 150 gpm (see well driller's report for well ID 434305 and water right 85-774 on file at the Utah Division of Water Rights and at waterrights.utah.gov).

It should be noted that the ~~proposed~~ water replacement well source ~~will~~ produces water from the coarse-grained alluvial groundwater system in Sink Valley. Nearby springs that could potentially be impacted by mining and reclamation activities are supported by the same alluvial groundwater system. However, while modest decreases in the artesian hydraulic pressures in the alluvial groundwater system could potentially result in diminution of spring flows, the planned new water well will likely be approximately 100 feet deep and will be equipped with an electric well pump giving it the capacity to produce groundwater from the alluvial system even if the hydraulic head in the area were to be diminished such that artesian flow conditions temporarily ceased to exist.

An analysis of the total average discharge of state appropriated groundwaters from the permit and adjacent area has been performed to determine whether the quantity of water that could likely be produced from the new water replacement well will be adequate for potential replacement needs. Based on baseline spring discharge data submitted to the

Division (UDOGM, 2007), it is determined that the average discharge of all state appropriated groundwater from groundwater discharge area A (Drawing 7-3, Drawing 7-4) is approximately 35 gpm. The state appropriated waters in groundwater discharge Area A include most of the significant springs in the area and essentially all of the largest springs in the area (Drawing 7-3; Appendix 7-3). The average discharge of all state appropriated groundwater from groundwater discharge area B (Drawing 7-4) is approximately 17 gpm. Using an unlikely worst-case scenario and assuming that all springs with state appropriated waters in both Areas A and B were to cease flowing, a total replacement of approximately 52 gpm would be required. The proposed new water well located in Section 29, Township 39 South, Range 5 West will be designed to produce water at that quantity and, therefore, should be able to provide adequate replacement water in even this worst-case scenario (which is not considered likely). Aquifer analysis described in Appendix 7-1 suggests that the yield of the alluvial groundwater system in which the new water well will be constructed should be capable of sustaining discharges of the required magnitude and for the lengths of time that the need for replacement water would be likely. It should be noted that if the need arises to provide replacement water for impacted state appropriated waters, the duration of the need will likely be of a relatively short duration (see Section 728 below).

Alton Coal Development, LLC has entered into a written agreement with the town of Alton, Utah to transfer the point of diversion for 50 acre-feet of water for use at the Coal Hollow Mine. A copy of this agreement is included in Appendix 7-8 (in confidential binder). This water ~~will be~~ available for all uses at the mine including potential use for water replacement. The ~~planned~~ new water well ~~will be~~ has been constructed on lands currently leased by Alton Coal Development, LLC. Consequently, no new landowner access agreement will be required for the drilling of the well.

728 PROBABLE HYDROLOGIC CONSEQUENCES (PHC) DETERMINATION

This section describes the probable hydrologic consequences of surface coal mining in the ~~proposed~~ Coal Hollow Mine permit area. This determination is based on data presented herein and on information provided in Appendix 7-1. The probable hydrologic consequences associated with proposed highwall mining activities within the 85.88-acre Dame Lease IBC area are presented in Appendix 7-4. The probable hydrologic consequences associated with the proposed underground mining activities at the Coal Hollow Mine are presented in Appendix 7-15. The probable hydrologic consequences of proposed coal mining and reclamation activities in the North Private Lease area are presented in Appendix 7-16 This mining and reclamation plan has been designed to minimize potential adverse impacts to the hydrologic balance. It should be noted that this PHC and also Appendix 7-1 may be updated periodically as required as additional hydrogeologic information and mining data become available in the future.

728.310 Potential adverse impacts to the hydrologic balance

Other than the possible short-term diminution in discharge rates from alluvial groundwater systems, including the potential short-term diminution of discharge rates from some springs and seeps in Sink Valley, appreciable adverse impacts to the hydrologic balance, either on or off the permit area are not expected to occur. The basis for this determination is discussed below.

As discussed in Section 721 above, minimal groundwater resources exist in the Tropic Shale, which directly overlies the coal reserves in proposed mining areas. Groundwater in the Tropic Shale does not provide measurable baseflow discharge to streams in the area. The lack of appreciable groundwater flow in the Tropic Shale is a result of the poor water transmitting properties of the marine shale unit. Consequently, it is anticipated that little groundwater will be encountered in the Tropic Shale in mining areas. Thus, the potential for adverse impacts to the hydrologic balance resulting from mining through the Tropic Shale in the ~~proposed~~ Coal Hollow Mine permit area is minimal.

Similarly, as described in Section 722 above, groundwater resources in the Dakota Formation underlying the coal seam to be mined are not appreciable. This condition is fundamentally a result of the heterogeneity of the rock strata in the Dakota Formation which impedes the ability of the formation to transmit groundwaters significant distances vertically or horizontally. The presence of the essentially impermeable Tropic Shale on top of the Dakota Formation also minimizes the potential for vertical recharge to the Dakota Formation. Mining operations will remove the overlying Tropic Shale rock strata from the Dakota Formation in addition to the Smirl coal seam deposit at the top of the Dakota Formation in mined areas. However, because the pre-mining hydraulic communication between the Tropic Shale and the underlying Dakota Formation in planned mining areas is believed to be minimal, the removal of the Tropic Shale overburden and Smirl coal seam from the Dakota Formation, followed by the rapid

backfilling of pit areas with low-permeability fill materials should not result in adverse impacts to the hydrologic balance in the Dakota Formation (i.e., the post-mining degree of hydraulic communication between the Dakota Formation and the overlying low-permeability backfill material will be similar to that of the pre-mined condition).

It should be noted that the first water-bearing strata underlying the coal seam to be mined in the ~~proposed~~ Coal Hollow Mine permit area from which appreciable quantities of groundwater can be produced is the Navajo Sandstone. The Navajo Sandstone aquifer is of regional significance in that it provides groundwater of good quality to domestic, agricultural, and municipal wells regionally and provides baseflow to springs and streams. The Navajo Sandstone does not crop out in the ~~proposed~~ Coal Hollow Mine permit and adjacent area. The formation is effectively isolated from proposed mining areas by more than 1,000 feet of rock strata of the Dakota and Carmel Formations (which includes large thicknesses of low-permeability shales and siltstones). The Navajo Sandstone aquifer will not be impacted by proposed mining operations. It should be noted that some previously proposed mining operations in the Alton Coal Field have proposed drilling and pumping of large amounts of groundwater from high-capacity production wells in the Navajo Sandstone aquifer for operational use. No such wells are planned in the ~~proposed~~ Coal Hollow Mine permit and adjacent area.

Of primary importance to the hydrologic balance in the ~~proposed~~ Coal Hollow Mine permit and adjacent area are alluvial groundwater systems. As discussed in Section 722 and in Appendix 7-1, alluvial groundwater systems in the area support springs, seeps, diffuse groundwater discharge, and a limited number of wells. The bulk of the alluvial groundwater flux through the area occurs in alluvial sediments that include coarse-grained and finer-grained sediments near the eastern margins of Sink Valley, east of the ~~proposed~~ Coal Hollow Mine permit area. Lesser quantities of alluvial groundwater migrate through finer-grained alluvial sediments (predominantly clays, silts, and sands) in the western portions of Sink Valley and in the Lower Robinson Creek drainage within the ~~proposed~~ Coal Hollow Mine permit area. Discharges from alluvial groundwater systems in Sink Valley do not contribute measurable quantities of baseflow to streams (at least at the surface in the stream channel). Alluvial groundwater systems in the Lower Robinson Creek area are much less extensive than the alluvial groundwater systems in Sink Valley. Other than the emergence of small quantities of alluvial groundwater from the stream banks where the stream channel intersects the alluvial groundwater system, discharge from the alluvial groundwater system as springs or seeps in Lower Robinson Creek is generally not observed. Perched groundwater conditions exist locally in the alluvial groundwater system in the Lower Robinson Creek drainage.

In the general sense, surface coal mining activities in the ~~proposed~~ Coal Hollow Mine permit area have the potential to impact groundwater systems primarily through three mechanisms:

1) Where water-bearing strata in proposed mining areas are mined through, groundwater systems within these strata will obviously be directly intercepted,

2) Where groundwater flow paths through mine openings are interrupted, groundwater flow in down-gradient areas could be diminished, and
3) Where mine openings intercept permeable strata, groundwater resources in up-gradient areas could potentially be diminished if appreciable quantities of groundwater were to be drained from up-gradient areas.

The potential for the occurrence of each of these potential impacts are described in the following.

Direct Interception of Groundwater Resources

As discussed above, groundwater resources in the relatively impermeable Tropic Shale in the proposed permit area are meager. Consequently, it is improbable that direct interception of appreciable groundwater in the Tropic Shale will occur. Additionally, because Tropic Shale groundwater systems generally do not support discharges to springs or provide baseflow to streams, the potential interception of limited quantities of groundwater in the Tropic Shale will not adversely impact the hydrologic balance. Similarly, groundwater resources in the Dakota Formation (including within the Smirl coal seam) are meager. While the Smirl coal seam will be extracted through mining operations, the underlying strata of the Dakota Formation will not be disturbed. Consequently, adverse impacts to groundwater systems in the Dakota Formation through direct interception of groundwater resources are not anticipated.

Alluvial groundwater systems in planned mining areas in the ~~proposed~~ Coal Hollow Mine permit area will be directly intercepted by the mine openings. It is not anticipated that the direct interception of shallow alluvial groundwater will adversely impact the overall hydrologic balance in the region. This is because no substantial springs, seeps or other important groundwater resources have been identified in proposed mine pit areas (Drawing 7-1). In the pre-mining condition, any diffuse groundwater discharge to the ground surface that occurs is primarily lost to evapotranspiration and does not contribute appreciably to the overall hydrologic balance in the area.

Because of the prevailing low-permeabilities of the alluvial sediments within the proposed mine disturbance area, it is unlikely that the direct mining of the alluvial groundwater system within these areas could cause impacts to subirrigation and soil moisture contents in up-gradient areas.

It is considered likely that the average hydraulic conductivity of the placed run-of-mine backfill material will be low. This is because of the pervasiveness of low-permeability, clay-rich materials in the mine overburden and the anisotropic nature of the placed fill material. Consequently, the potential for the migration of appreciable quantities of groundwater through the fill is considered low. Accordingly, the potential for impacts to subirrigation and soil moisture in the lands up-gradient of mining areas will be minimized by the placement of the low-permeability backfill.

An engineered low-permeability barrier previously planned for the eastern edge of pit 15 will no longer be necessary and will not be constructed. The original purpose of the

proposed engineered barrier was to minimize the potential for long-term impacts to the alluvial groundwater system in Sink Valley up-gradient of mining areas that could occur as a result of the long-term draining of alluvial groundwater into the pit backfill area. Because surface (pit) mining in those areas adjacent to the Sink Valley alluvial groundwater systems (pits13, 14, and 15) is no longer planned, such a barrier will not be necessary.

The potential for short-term impacts to subirrigation and soil moisture in the lands up-gradient of proposed mining areas will be minimized through the implementation of the hydrology resource contingency plan described in Appendix 7-9.

Diminution of down-gradient groundwater resources

Where groundwater flow paths that convey groundwater to down-gradient areas exist in areas that will be mined, there is the potential that diminution of down-gradient groundwater resources could occur. In the ~~proposed~~ Coal Hollow Mine permit area, it is considered unlikely that appreciable diminution of down-gradient resources will occur as a result of mining and reclamation activities. The basis of this conclusion is presented below.

Groundwater resources in the Tropic Shale are meager and groundwater flow rates are very slow through the marine shale unit. Groundwater systems in the Tropic Shale do not support appreciable spring or seep discharge nor do they provide measurable baseflow to streams down-gradient of mining areas. Consequently, the potential for adverse impacts to the hydrologic balance as a result of mining through Tropic Shale is considered minimal.

Similarly, groundwater resources in the Dakota Formation are meager. The potential for lateral and vertical migration of groundwater through the formation is limited by the pervasiveness of low-permeability shaley strata in the formation and the lateral discontinuity of permeable strata. Groundwater systems in the Dakota Formation do not support appreciable spring or seep discharge nor do they provide measurable baseflow to streams down gradient of mining areas. Additionally, with the exception of the relatively low-permeability Smirl coal seam located at the top of the formation, groundwater systems in Dakota Formation rock strata below the coal seam will not be disturbed by mining and reclamation activities. Consequently, the potential for adverse impacts to the hydrologic balance as a result of mining through Dakota Formation strata is considered minimal. It should be noted that spring SP-4 discharges at about 1 gpm approximately 1.1 miles south of the ~~proposed~~ Coal Hollow Mine permit area from an apparent fault/fracture system in the Dakota Formation that may be related to the Sink Valley Fault. It is unlikely that appreciable migration of groundwater through the Sink Valley Fault system in the relatively impermeable Tropic Shale or shallow alluvium in the ~~proposed~~ Coal Hollow Mine permit area occurs. Consequently, it is considered unlikely that mining and reclamation activities in the ~~proposed~~ Coal Hollow Mine permit area will cause a diminution of discharge from spring SP-4.

Alluvial groundwater systems in proposed mining areas area supported primarily by clays, silts, and fine-grained sands. In proposed mining areas in Sink Valley, appreciable coarse-grained alluvial sediments were not encountered in drill holes or back-hoe excavations. Significant layers of clean coarse alluvium, which could rapidly convey significant amounts of groundwater, were likewise not observed. The results of slug testing performed on wells in and adjacent to proposed mining areas likewise suggest that the potential for rapid migration of groundwaters through alluvial sediments in proposed mining areas is low (Tables 7-8 and 7-9). These data and observations suggest that the flux of groundwater migrating through the alluvial sediments in proposed mining areas in Sink Valley (that could support down-gradient groundwater systems) is not large. Much of the groundwater migrating through the alluvial sediments in proposed mining areas (in the East ¼ of Section 30, T39S, R5W) likely leaves the groundwater system through diffuse discharge to the land surface and is lost evapotranspiration and does not contribute to the overall hydrologic balance in the area. In Sink Valley, a preferential pathway for alluvial groundwaters through deep coarse-grained alluvial sediments likely exists along the east side of Sink Valley. While the thickness of the alluvium in proposed mining areas in Sink Valley generally does not exceed 50 feet (and in many locations is much less), the alluvial sediments along the eastern side of Sink Valley adjacent to proposed mining areas range from about 120 to 140 feet. Of the total flux of groundwater through the alluvial groundwater systems in Sink Valley, most of the flux is likely through this coarse-grained portion of the system. The percentage of the total flux that migrates through clayey and silty alluvial sediments in proposed mining areas along the western flanks of Sink Valley is likely much less.

It should be noted that highly permeable strata were encountered from about 60 to 75 feet depth just above the bedrock interface at the SS well cluster (monitoring well SS-75; Table 7-2). This well is screened in an area of burned or eroded coal (the coal is absent) and consequently, mining will not occur at this location. The coal seam is present at the nearby C9 cluster area. Were mining operations to intercept this highly permeable zone, substantial groundwater inflows into the mine openings could occur. Consequently, prior to surface mining in this area, the boundary between the competent coal seam and the area of burned or eroded coal will be more precisely defined by drilling or other suitable techniques such that mine openings can be designed to avoid these areas of potentially large groundwater inflows.

As discussed in Section 722 above, alluvial groundwater from Sink Valley discharges to several springs and seeps and as diffuse discharge to the ground surface in the northwest ¼ of Section 32, T39S, R5W (see Drawing 7-4; groundwater discharge area B). This groundwater discharge is likely a result of the constriction in Sink Valley in this area and the corresponding decrease in the cross-sectional area of the alluvial sediments in the valley, which forces groundwater to discharge at the surface. Most of the groundwater discharge in this area is likely derived from the up-gradient alluvial groundwater systems in the eastern portion of the valley (i.e., the coarse-grained portion of the alluvial groundwater system), which is situated east of the ~~proposed~~ Coal Hollow Mine permit area. This conclusion is based on 1) the substantially larger cross-sectional area of the alluvium in the deeper eastern portion of the valley relative to that in proposed mining

areas near the western margins of the valley, 2) the higher hydraulic conductivity of the sediments in the coarse-grained part of the alluvial system, and 3) the lack of other apparent discharge mechanisms for the coarse-grained system further downstream in Sink Valley Wash (i.e., there are no significant alluvial springs or seeps further downstream in Sink Valley Wash and the system apparently does not contribute measurable baseflow to Sink Valley Wash further downstream (at least at the surface in the stream channel, as evidenced by the lack of baseflow in the wash monitored at SW-9).

Because most of the alluvial groundwater discharge supporting springs and seeps in this area is likely not derived from groundwater systems that underlie planned mining areas in the ~~proposed~~ Coal Hollow Mine permit area, it is considered unlikely that discharges from the springs and seeps in northwest ¼ of Section 32 T39S, R5W will be appreciably diminished as a result of the proposed mining and reclamation activities. While considered unlikely, some temporary impacts to discharge rates from springs and seeps in this area are possible. In particular, it should be noted that mining in the southernmost portions of the ~~proposed~~ Coal Hollow Mine permit area has a somewhat greater potential to decrease groundwater discharge rates at spring SP-6, which is located about 600 feet below the southernmost proposed mining areas (Drawing 7-2). SP-6 is an alluvial seep which has been impounded with an earthen dam from which measurable discharge is generally not present.

It is critical to note that individual mine pits in this area will remain open for short lengths of time, generally no more than about 60 to 120 days (measured from the time the mining of the pit is completed to the time the pit is backfilled). Mining operations in the vicinity near the alluvial groundwater discharge area in the northwest ¼ of Section 32 T39S, R5W are planned to be completed in about 1 year. Thus, any potential impacts to discharge rates from down-gradient groundwater systems will be short-lived. Following the backfilling and reclamation of mine openings, the potential for interception or re-routing of alluvial groundwater away from the groundwater discharge area in northwest ¼ of Section 32 T39S, R5W will be negligible. As stated above, most of the flux through the Sink Valley alluvial groundwater system that supports springs and seeps in the area occurs in the eastern portion of the valley, which will not be impacted by mining and reclamation activities. Consequently, long-term impacts to discharge rates from springs and seeps in this area are not anticipated. It should also be noted that if increased quantities of groundwater were to be encountered in mine workings in lower Sink Valley such that the water would need to be discharged to surface drainages, the mine water will ultimately be discharged to the Sink Valley Wash drainage (i.e., the water will remain in its drainage basin).

Alluvial groundwater systems in the Lower Robinson Creek area are much less extensive than the alluvial groundwater system in Sink Valley. Perched groundwater conditions exist locally in the alluvial groundwater system in the Lower Robinson Creek drainage. Other than the re-emergence of alluvial groundwater flowing beneath the Lower Robinson Creek stream channel where the stream channel exists directly on bedrock substrate, discharges from the alluvial groundwater system as springs or seeps in Lower Robinson Creek are not observed. Consequently, mining operations in the Lower

Robinson Creek drainage will likely not result in diminution of down-gradient groundwater resources.

It should be noted that the ~~proposed~~ Coal Hollow Mine plan calls for the temporary diversion of a reach of the Lower Robinson Creek stream channel approximately 2,000 feet in length in the southeast ¼ of Section 19, T39S, R5W. Details of the ~~proposed~~ diversion are given in Chapter 5, Section 527.220 of this MRP. If this action results in diminution of groundwater or surface-water resources, where required a suitable mitigation for this potential impact will be designed and implemented in consultation with the Division of Oil, Gas and Mining.

If any Utah State appropriated water rights are impacted by mining and reclamation operations in the ~~proposed~~ Coal Hollow Mine, these will be replaced according to all applicable Utah State laws and regulations using the designated water replacement source described in Section 727 above.

Draining of up-gradient groundwater resources

Where surface mining occurs adjacent to up-gradient groundwater systems, there is a potential that draining of groundwater from the up-gradient groundwater system into the mine voids could occur. This condition could occur if a sufficiently large and permeable stratum were to be intercepted that is in good hydraulic communication with the up-gradient groundwater system through which appreciable quantities of water could be transmitted.

To more fully evaluate the potential for draining of up-gradient groundwater resources, a field investigation was performed during the winter of 2006-2007 that was designed to facilitate the characterization of the alluvial groundwater system in the ~~proposed~~ Coal Hollow Mine permit and adjacent area. Specifically, this program was designed 1) to better define the vertical and lateral extent of permeable, coarse-grained sediments in the alluvial groundwater system, 2) to characterize the water bearing and water transmitting properties of alluvial sediments, and 3) to evaluate the degree of hydraulic communication between the coarse-grained portion of the alluvial system in Sink Valley and the clayey alluvial sediments in proposed mining areas.

This field investigation included 1) the drilling and installation of 30 monitoring wells, 2) the performance of a 28-hour pumping and recovery test on the alluvial testing production well Y-61 (which is a 6.625-inch well constructed in 1980 as part of a previous coal mining application for groundwater pumping for alluvial aquifer testing) with contemporaneous measuring of water levels in the monitoring well network and contemporaneous measuring of spring discharge rates at three alluvial springs, and 3) the slug testing of 20 monitoring wells to determine approximate values of hydraulic conductivity. The results of the field investigation including analysis of the data collected in the investigation are presented in Appendix 7-1 and are summarized below.

Other than occasional pebbles or small rocks, coarse-grained sediments (i.e., gravels and coarse sands) were not encountered in the drilling of wells along the eastern margins of proposed mining areas in Sink Valley (C1, C2, C3, and C4 well clusters). (It should be noted that the C2 well cluster is located west of the eastern limit of the mine disturbance. The mine openings will intercept the C2 well cluster and the area to the east to locations west of well Y-102). Rather, the sediments encountered in the drilling of these wells were dominated by clays and silts with subordinate amounts of fine-grained sand. Similarly, coarse-grained deposits were not encountered in well clusters C6, C7, C8, and C9. There was no indication during drilling of any appreciable thickness of highly permeable strata through which groundwater could rapidly be transmitted (although it should be noted that the presence of thin sand layers are difficult to identify in wet auger drilling returns). Similarly, appreciable amounts of high-permeability coarse-grained alluvial sediments were not noted in alluvial sediments investigated in backhoe excavated pits and erosional escarpments in Sink Valley.

The hydraulic heads measured in alluvial monitoring wells near proposed mining areas in Sink Valley (C2, C3, C4, C7, C8, and C9) did not indicate artesian pressures. Rather, marked upward or downward vertical hydraulic gradients were not observed in any of these areas and water levels were consistently within several feet of the ground surface.

The results of pump testing in the alluvial groundwater system demonstrate that the springs in the northwest ¼ of Section 29, T39S, R5W are in direct hydraulic communication with the coarse-grained alluvial groundwater system in which the pumping well Y-61 is screened. Discharge rates (or water levels at Sorensen Spring) measured at each of the four springs (SP-8, SP-14, SP-20, and Sorensen spring) monitored during the 28-hour pumping test responded to pumping at the well. Monitoring wells at clusters C2, C3, and C4 near the easternmost proposed mining areas also showed small, muted responses, with declines measured in water levels during the 28-hour test ranging from about 0.05 to 0.10 feet. Other monitoring wells in proposed mining areas did not respond measurably to pumping at Y-61. It should be noted that after the pumping well was turned off at the end of the 28-hour pumping test, spring discharge rates and water levels in alluvial monitoring wells recovered to approximate pre-testing levels.

The results of slug testing of wells in the ~~proposed~~ Coal Hollow Mine and adjacent area are presented in Table 7-8. Using these hydraulic conductivity values together with measured thicknesses of saturated alluvial sediments determined during drilling, and hydraulic gradient values determined from water levels measured in monitoring wells, rates of estimated groundwater inflows to mine openings have been calculated using Darcy's Law (Table 7-9).

Darcy's Law may be expressed as.

$$Q = KIA$$

Where Q = groundwater discharge rate

K	=	hydraulic conductivity
I	=	hydraulic gradient
A	=	cross-sectional area

The values listed in Table 7-9 are reported as inflow rates per 100 lineal feet of mine openings oriented perpendicular to the groundwater flow direction. Calculations at individual locations are adjusted for the thickness of the saturated alluvium at that location. For all calculations in Table 7-9, a gradient of 0.10 has been used, which is considered a conservative estimate for the alluvial groundwater system in the vicinity of the planned Coal Hollow Mine workings. It is important to note that while values for saturated aquifer thickness and local hydraulic gradient in the alluvial groundwater system can be determined relatively precisely, hydraulic conductivity values determined from slug testing methods are generally considered as order-of-magnitude estimates. Consequently, the information from Table 7-9 should be used for general purposes only. The estimated groundwater inflow rates presented in Table 7-9 suggest that copious, unmanageable amounts of alluvial groundwater will likely not be encountered. It should be noted, however, that alluvial sediments located east of the C2 well cluster may contain coarser grained sediments similar to those intercepted in well Y-102. Special mining protocols will be employed (See Appendix 7-9) when mining in this area (pit15; see Section 728.333) to minimize the potential for interception of large groundwater inflows.

As described in Appendix 7-11, Table 7-9 has been updated to reflect the current pit mine-inflow conditions in the Pit #2 and adjacent areas.

As surface mining operations advance toward the alluvial groundwater discharge area in the northwest ¼ of Section 29, T39S, R5W (See Drawing 7-4; groundwater discharge area A), the information in Table 7-9 suggests that groundwater inflow rates in this area will be modest, generally on the order of a few tens of gallons per minute or less per 100 lineal feet of mine opening. However, it should be noted that, as discussed above, if mine openings in this area were to intersect a substantial thickness of coarse-grained alluvial material that was in good hydraulic communication with the coarse-grained alluvial system located along the eastern margins of Sink Valley, substantially greater rates of groundwater inflow could occur. Based on the information in Tables 7-8 and 7-9, this is not considered likely.

As mining operations advance toward the alluvial groundwater discharge area in the northwest ¼ of Section 29, T39S, R5W (See Drawing 7-4; groundwater discharge area A) and groundwater discharge from up-gradient alluvial groundwater systems occurs, there is the potential that discharge rates from alluvial springs in this area could be diminished. The magnitude of this potential impact will be largely dependent on the drainage rate and volume of groundwater that may be drained from the up-gradient alluvial groundwater system.

The potential for diminution of discharge from alluvial springs near proposed mining areas near the northwest ¼ of Section 29, T39S, R5W will be minimized because:

1) As mining progresses toward the groundwater discharge area in the northwest ¼ of Section 29, T39S, R5W (see Drawing 7-4, groundwater discharge area A), groundwater inflows into mine openings and discharge rates from the nearby alluvial springs will be closely monitored. If groundwater inflow rates into mine openings are excessive, where necessary Alton Coal Development, LLC will use a suitable technique to minimize groundwater inflow rates into the mine. These techniques may include the use of bentonite or natural clay filled cutoff walls or other means where appropriate to isolate and protect groundwater resources up-gradient of mining activities, and

2) Individual mine pits in the ~~proposed~~ Coal Hollow Mine will remain open for short lengths of time, generally no more than about 60 to 120 days (measured from the time the mining of the pit is completed to the time the pit is backfilled). Consequently, any potential impacts to spring discharge rates in the alluvial groundwater system in this area will likely be short-lived. Because the alluvial groundwater recharge areas are located well up-gradient of proposed mining areas (mountain-front recharge) and will not be impacted, recharge to the alluvial system should continue uninterrupted, it is anticipated that water levels in the artesian groundwater system should recover from any mining-related declines in hydraulic head subsequent to the completion of mining in the area.

Groundwater discharge from the springs in the northwest ¼ of Section 29, T39S, R5W (See Drawing 7-4; groundwater discharge area A) do not contribute any measurable baseflow discharge to streams in the area. This conclusion is based on the lack of any baseflow discharge in streams down-gradient of this area in Sink Valley (see monitoring data for SW-6 and SW-9). Rather, most of this discharge is likely ultimately lost to evapotranspiration as the water migrates across the low-permeability, near-surface clayey sediments in Sink Valley. Consequently, the potential temporary diminution of discharge from alluvial springs in the northwest ¼ of Section 29, T39S, R5W would not result in appreciable adverse impacts to the surrounding hydrologic balance.

It is considered likely that the average hydraulic conductivity of the placed run-of-mine backfill material will be low. This is because of the pervasiveness of low-permeability, clay-rich materials in the mine overburden and the anisotropic nature of the placed fill material. Consequently, the potential for the migration of appreciable quantities of groundwater through the fill is considered low. Accordingly, the potential for impacts to subirrigation and soil moisture in the lands up-gradient of mining areas will be minimized by the placement of the low-permeability backfill.

The potential for short-term impacts to subirrigation and soil moisture in the lands up-gradient of proposed mining areas will be minimized through the implementation of the hydrology resource contingency plan described in Appendix 7-9.

The Coal Hollow Mine has designed a plan to divert upgradient alluvial groundwater through an alluvial groundwater interceptor drain system. This plan is designed to minimize the potential for the interception of alluvial groundwater in the mine pit areas

and to protect alluvial groundwater quality. The details of this plan are described in the Coal Hollow Mine Alluvial Groundwater Management Plan, which is presented in Appendix 7-9.

If any Utah State appropriated water rights are impacted by mining and reclamation operations in the ~~proposed~~ Coal Hollow Mine, these will be replaced according to all applicable Utah State laws and regulations using the designated water replacement source described in Section 727 above.

728.320 Presence of acid-forming or toxic-forming materials

Chemical information on the acid- and toxic-forming potential of earth materials naturally present in the proposed permit area are presented in Appendix 6-2. Chemical information on the low-sulfur Smirl coal seam proposed for mining is presented in Appendix 6-1 (confidential binder). Based on laboratory analytical data, it is apparent that acid-forming and toxic-forming materials that could result in the contamination of surface-water or groundwater supplies in the ~~proposed~~ Coal Hollow Mine permit and adjacent area are generally not present.

Total selenium (with a 5 mg/kg laboratory lower detection limit) was not detected in any of the samples from the ~~proposed~~ Coal Hollow Mine permit area. Water-extractable selenium concentrations were also generally low (see Section 728.332 below). Likewise, concentrations of water-extractable boron were also low, being less than 3 mg/kg in all samples analyzed. The pH of groundwaters in and around the ~~proposed~~ Coal Hollow Mine permit area are moderately alkaline (UDOGM, 2007). Data in Appendix 6-2 likewise indicate moderately alkaline conditions in sediments in the ~~proposed~~ permit area. The solubility of dissolved trace metals is usually limited in waters with alkaline pH conditions. Consequently, high concentrations of these metal constituents in groundwaters and surface waters with elevated pH levels are not anticipated. Additionally, most of the materials that will be handled as part of mining and reclamation activities in the ~~proposed~~ Coal Hollow Mine area are of low hydraulic conductivity (i.e. clays, silts, shales, siltstones, claystones, etc.). Consequently, it is anticipated that groundwater seepage volumes through low-permeability backfill and reclaimed land surfaces in reclaimed mine pit areas and excess spoils storage areas will not be large. Additionally, reclaimed areas will be regraded, sloped, and otherwise managed to minimize the potential for land erosion, to restore approximate surface-water drainage patterns, and also to minimize the potential for ponding of surface waters on reclaimed areas (other than "roughening" or "gouging" of some areas to enhance reclamation). Thus, the potential for interactions between large amounts of disturbed earth materials and groundwaters and surface waters, which could result in leaching of chemical constituents into groundwater and surface-water resources, will be minimized.

Additionally, the mining plan calls for the emplacement of 40 inches of suitable cover material over backfilled areas made up of material types which could appreciably impact vegetation (materials with elevated SAR ratios or other physical or chemical characteristics that could adversely impact vegetation).

The neutralization potential greatly exceeded the acid potential in all overburden and underburden samples analyzed, with the neutralization potential commonly exceeding the acid potential by many times, suggesting that acid-mine-drainage will not be a concern at the ~~proposed~~ Coal Hollow Mine (see Section 728.332 below for a further discussion) Acid-forming materials in western coal mine environments often consist of sulfide minerals, commonly including pyrite and marcasite, which, when exposed to air and water, are oxidized causing the liberation of H^+ ions (acid) into the water. Oxidation of sulfide minerals may occur in limited amounts in the mine pits where oxygenated water encounters sulfide minerals. However, the acid produced by pyrite oxidation is quickly consumed by dissolution of abundant, naturally occurring carbonate minerals (Appendix 6-2). Dissolved iron is readily precipitated as iron-hydroxide in well aerated waters, and consequently excess iron is not anticipated in mine discharge water.

Other acid-forming materials or toxic-forming materials have not been identified in significant concentrations nor are such suspected to exist in materials to be disturbed by mining.

Because of the overall low-permeability of the rock strata and sediments surrounding the mine workings (primarily the shales and claystones of the lower Tropic Shale), the potential for seepage of mine water outward into adjacent stratigraphic horizons is low. Additionally, because the floors of the mine pits need to be accessible in order to extract the coal, the mining operations will be carried out in such a manner that the accumulation of large amounts of water in the mine pits will be avoided.

728.331 Sediment yield from the disturbed area.

Erosion from disturbed areas will be minimized through the use of silt fences and other sediment control devices. Surface runoff occurring on disturbed areas will be collected and treated as necessary to remove suspended matter. Four diversion ditches along with four sediment impoundments are proposed for the permit area. In addition, miscellaneous controls such as silt fence and berms are also proposed for specific areas. The proposed locations for these structures are shown on Drawing 5-3. Details associated with these structures can be viewed on Drawings 5-25 through 5-34 and Appendix 5-2.

The smallest practicable area, consistent with reasonable and safe mine operational practices will be disturbed at any one time during the mining operation and reclamation phases. This will be accomplished through progressive backfilling, grading, and prompt revegetation of disturbed areas. The backfilled material will be stabilized by grading to promote a reduction of the rate and volume of runoff in accordance with the applicable requirements. The excess spoil and fill above approximate original contour will be graded to a maximum 3h:1v slope and revegetated to minimize erosion.

Cut ditches will be established on the shoulders of all primary roads to control drainage and erosion. Cut and fill slopes along the primary roads will be minimal and are not

expected to cause significant erosion. In locations where there are culvert crossings (i.e. Lower Robinson Creek), the fills slopes will be stabilized by utilizing standard methods such as grass matting or straw wattles. The location and details for roads can be viewed on Drawings 5-3 and 5-22 through 5-24.

Through the implementation of these sediment control measures, it is anticipated that sediment yield from disturbed areas in the ~~proposed~~ Coal Hollow Mine permit area will be minimized.

728.332 Impacts to important water quality parameters

As discussed above, appreciable quantities of groundwater are not anticipated to be intercepted in the Tropic Shale overlying proposed mining areas. Consequently, discharge of Tropic Shale groundwaters from mining areas is not anticipated. Because of the very low hydraulic conductivity of the marine Tropic Shale unit which immediately overlies the coal in proposed mining areas, the lateral migration of appreciable amounts of groundwater outward from proposed mine pit areas is not anticipated. Therefore, no impacts to important water quality parameters in surrounding groundwater and surface-water resources that could result from the interception of Tropic Shale groundwaters are anticipated.

Similarly, appreciable quantities of groundwater are not expected to emanate from the Dakota Formation in the mine floor into the mine openings. This conclusion is based on the fact that 1) vertical and horizontal groundwater flow in the Dakota Formation is impeded by the presence of low-permeability shales that encase the interbedded lenticular sandstone strata in the formation (i.e., the formation is not a good aquifer), 2) appreciable natural discharge from the Dakota Formation in the surrounding area to springs or streams is not observed, supporting the conclusion that the natural flux of groundwater through the formation is meager, and 3) mining will commence near the truncated up-dip end of the formation, minimizing the potential for elevated hydraulic head in the Dakota Formation. The results of slug testing performed on wells screened in the Smirl coal seam indicate relatively low values of hydraulic conductivity for the coal seam (Table 7-8). In much of the proposed mining area, the coal seam is dry. Thus, large inflows of groundwater from the coal seam into mine workings are not anticipated. Likewise, the potential for seepage out of mine pits through the coal seam is minimal. Consequently, impacts to important water-quality parameters in the Dakota Formation potentially resulting from mining operations are not anticipated, nor are impacts to important water-quality parameters in surrounding groundwater and surface-water systems anticipated as a result of interactions with intercepted Dakota Formation groundwater.

The water quality of groundwaters in the alluvial groundwater system up-gradient of mining operations will likely not be impacted by mining and reclamation activities in the ~~proposed~~ Coal Hollow Mine. Were alluvial groundwaters intercepted by mine openings allowed to flow into the mine pits, there would be the potential for substantially increased TDS concentrations as the water interacts with the marine Tropic Shale and the Smirl coal seam. This occurrence will be avoided.

As groundwater naturally migrates through the shallow, fine-grained alluvial sediments in the ~~proposed~~ Coal Hollow Mine permit and adjacent area (most evident in Sink Valley), the quality of the water is naturally degraded (see Appendix 7-1). In the distal portions of Sink Valley, most notably concentrations of magnesium, sulfate, and bicarbonate are elevated in the alluvial groundwater.

The potential for TDS increases associated with interaction of waters with the Tropic Shale can be minimized by avoiding contact where practical between water sources and earth materials containing soluble minerals. Where possible, in the existing mine area and in the proposed North Private Lease, groundwater that will be encountered in alluvial sediments along the margins of mine pit areas will be routed through pipes, ditches or other conveyance methods away from mining areas via gravity drainage so as to prevent or minimize the potential for interaction with sediments disturbed by mining operations (including contact with the mined coal seam). If diverted alluvial groundwater were allowed to interact extensively with the Tropic Shale bedrock or Tropic Shale-derived alluvial sediments, similar increases in magnesium, sulfate, bicarbonate, and TDS concentrations would be anticipated. Consequently, where intercepted groundwaters will be routed around disturbed areas through pipes or well-constructed and maintained ditches, it is anticipated that detrimental impacts to important water quality parameters in these waters will be minimal.

The pumping and discharging of mine water from mine pits at the ~~proposed~~ Coal Hollow Mine permit area is not anticipated. The impoundment of substantial quantities of water within the mine pits would likely result in degradation of groundwater quality and is also not compatible with the proposed surface mining technique (the coal extraction operations occur at the bottom of the mine pit and thus they cannot be performed in flooded mine pits). As discussed above, the only likely foreseeable source of appreciable quantities of groundwater is from the alluvial groundwater systems overlying the low-permeability Tropic Shale in proposed mining areas. Where this alluvial groundwater is encountered in mining areas, it will be diverted away from mine workings prior to significant interaction with sediments in disturbed areas. Any discharge from the mine pits that does occur will be regulated under a Utah UPDES discharge permit.

Acid mine drainage is not anticipated at the ~~proposed~~ Coal Hollow Mine permit area. This is due primarily to the relatively low sulfur content of the coal (see Appendix 6-1; confidential binder) and rock strata in the permit and adjacent area, and to the pervasiveness of carbonate minerals in the soil and rock strata which neutralize the acidity of the water if it occurs. If sulfide mineral oxidation and subsequent acid neutralization via carbonate dissolution were to occur, increases in TDS, calcium, magnesium, sulfate, and bicarbonate concentrations (and possibly also sodium concentrations via ion-exchange with calcium or magnesium on exchangeable clays) would be anticipated.

An analysis of the acid/base potential of samples collected from the overburden and underburden in the proposed mining area indicates that acid mine drainage will be

unlikely to occur at the Coal Hollow Mine. The results of laboratory analysis of the acid/base potential of samples collected from the overburden, underburden, and Smirl coal zone are presented in Appendix 6-2. None of the overburden or underburden samples were acid forming, as each of the intervals sampled showed excess neutralization potential. Taken as a whole, the un-weighted composite average acid/base potential of the 57 overburden and underburden samples indicates a net neutralization potential of 174 tons per kiloton. The neutralization potential of the composite overburden/underburden (180 tons per kiloton) exceeds the acid potential (5.5 tons per kiloton) by more than 32 times. A general consensus opinion mentioned by the National Mine Land Reclamation Center (OSM, 1998) is that if the net acid/base potential exceeds 30 tons per kiloton, and the ratio of neutralization potential to acid potential exceeds two, then *alkaline* water will be generated and acid mine drainage will not occur. The acid/base characteristics of composite overburden and underburden in the Coal Hollow Mine area greatly exceed both of these two criteria, suggesting the strong likelihood that acid mine drainage will not be an issue at the Coal Hollow Mine.

Because of the net neutralization potential of the composite overburden/underburden in the Coal Hollow Mine area described above, the pH values of groundwater in fill areas will likely be neutral to alkaline. Accordingly, the solubility of dissolved trace metal species in the alkaline water will likely be low. Consequently, the potential for the mobilization and transport of trace metals in groundwater in the fill will likely also be low. Concentrations of total selenium, water extractable selenium, water extractable boron and other important chemical species in the overburden samples from the Coal Hollow Mine area are generally low. Water extractable selenium concentrations in the analyzed Dakota Formation underburden samples range from 0.05 to 0.2 mg/kg (see Appendix 6-2). Water extractable boron concentrations in the Dakota Formation underburden in a single location (CH-08; 6.5 mg/kg) marginally exceed the Division standard of 5 mg/kg. The limited quantities of material containing water extractable selenium and boron in these concentration ranges in backfill materials are not anticipated to result in appreciably elevated selenium or boron concentrations in groundwater or surface water supplies. Because the hydraulic conductivity of the composite run-of-mine backfill material (which will be rich with clays, silts, and shale) is expected to be low, the flux of groundwater that might migrate through the backfilled pit areas is likely to be low. Additionally, the reclaimed land surface will be graded to promote runoff of surface waters overlying backfilled areas, thus minimizing the potential for infiltration of surface waters into backfilled areas. Consequently, the potential for acid mine drainage or toxic drainage from backfilled areas to surrounding groundwater and surface-water supplies will be minimized.

As outlined in the topsoil and subsoil sampling plan in Chapter 2 of this MRP, materials with poor quality SAR, elevated selenium or boron concentrations, or poor pH as defined by Division guidelines will not be placed in the upper four feet of the reclaimed surface. These materials will also not be placed in the backfill within the top four feet of ephemeral drainages with 100 year flood plains, or in the top four feet in surface water impoundments, or in the top four feet in intermittent or perennial drainages including 100 year flood plains as outlined in the Division guidelines. Materials placed in the top four

feet will be sampled to ensure that only suitable materials are placed in the top four feet of the reclaimed surface.

It is noteworthy that in the neighboring state of Wyoming, a water extractable selenium standard of 0.3 mg/kg is considered suitable for topsoil and topsoil substitutes, with concentrations ranging from 0.3 to 0.8 mg/kg being considered marginally suitable for topsoil and topsoil substitute.

As is typical with coal seams regionally, laboratory analyses of coal samples from the Coal Hollow Mine area indicates that there is a net acid forming potential in the coals of the Smirl coal zone (see Appendix 6-2). However, the mining plans call for the mining and removal of 95% of the total coal seam thickness from mining areas, leaving only minor amounts of coal in backfilled areas. Consequently, the potential contribution to the overall acid/base potential of the composite backfill material would be small. Assuming a worst-case-scenario – that all the coal would be retained in the backfill material – the calculated acid/base potential of the composite backfill material is still well within the limits suggested by OSM (1998) to indicate that alkaline discharge without acid mine drainage would be likely.

As described in Chapter 5, Section 532, surface runoff that occurs on disturbed areas will be treated through sedimentation ponds or other sediment-control devices and particulate matter will be allowed to settle prior to the discharging of the water to the receiving water, thus controlling suspended solids concentrations.

At any mining operation there is the potential for contamination of soils, surface-water and groundwater resources resulting from the spillage of hydrocarbons. Diesel fuels, oils, greases, and other hydrocarbons products will be stored and used at the mine site for a variety of purposes. A spill Prevention Control and Countermeasure Plan will be implemented that will help minimize any potential detrimental impacts to the environments.

Spill control kits will be provided on all mining equipment and personnel will be trained to properly control spills and dispose of any contaminated soils in an appropriate manner.

Based on these findings, it is concluded that the potential for mining and reclamation activities in the ~~proposed~~ Coal Hollow Mine permit area to cause detrimental impacts to important water quality parameters is minimal.

728.333 Flooding or streamflow alteration

As described above, appreciable groundwater inflow from the Tropic Shale and Dakota Formation into mine pits at the ~~proposed~~ Coal Hollow Mine are not anticipated. Appreciable groundwater inflows are anticipated only from the relatively thin, overlying alluvial groundwater systems. The thicknesses of the alluvium adjacent to mine openings in the proposed mining areas is generally less than 40 to 50 feet. The hydraulic conductivities of the predominantly clayey and silty alluvial sediments are low, and

consequently, very large or sudden groundwater inflows into mine openings are not anticipated. Where appreciable alluvial groundwater is encountered adjacent to mine openings, it will be routed away from mining areas through ditches or other conveyance mechanisms. Details of the Coal Hollow Mine Alluvial Groundwater Management Plan are provided in Appendix 7-9. Consequently, discharge of mine water from the mine pits is not anticipated. The rates of alluvial groundwater drainage that could occur will likely not be of a magnitude that could potentially cause flooding or streamflow alteration in either the Sink Valley Wash or Lower Robinson Creek drainages.

If excess groundwater were to be encountered during mining operations at the existing mine area or in the proposed North Private Lease such that it could not be adequately managed or discharged in compliance with the Utah UPDES discharge permit (which is considered unlikely), Alton Coal Development, LLC may when necessary construct supplemental containment and settlement ponds in which mine discharge waters may be held for treatment (where necessary) and subsequent discharge through UPDES discharge points in compliance with the UPDES discharge permit, minimizing the potential for flooding or streamflow alteration in areas adjacent to mining.

When coal mining near the eastern edge of the Coal Hollow Mine permit area occurs (mine pits 13-15), special measures will be taken to minimize the potential for the interception by the mine openings of large quantities of groundwater from artesian groundwater system in the northwest ¼ of Section 29, T5W, R39S, and to adequately deal with groundwater inflows if such occur. Details of the contingency plan for this occurrence are provided in Appendix 7-9.

When mining operations advance toward the eastern edge of the permit boundary in pit 15, material excavating in the alluvial sediments will be performed incrementally and with caution. As excavation proceeds, if coarse, water-bearing alluvial sediments (gravels) are encountered, overburden removal in that area will be stopped. The excavation equipment operator will recover the exposed gravel zone with local impermeable sediments (abundant in the alluvium in the area) to halt groundwater inflow if possible. The hydrogeologist will be called to the site to access the hydrogeologic conditions. An investigation of the situation will be performed and a suitable work plan will be developed prior to the resumption of overburden removal in that area. The work plan will be designed to minimize the potential for intercepting unacceptably large inflows of groundwater into the mine pits. The work plan will most likely involve trenching in the alluvium in zones up-gradient of the mine pit area and the emplacement of a low-permeability cut-off wall. The cut-off wall would be emplaced in the excavated trench using acceptable native low-permeability materials. The cut-off wall would be designed to isolate the mine openings from the coarse-grained alluvial groundwater system sufficient to decrease mine inflows to acceptable levels (i.e. so as to minimize the potential for detrimental impacts to the hydrologic balance and to minimize the potential for flooding of mine pits or causing flooding or stream alteration).

As a temporary measure to manage any potential large groundwater inflows that may occur in these areas prior to the installation of a suitable up-gradient hydraulic barrier, the

intercepted alluvial groundwaters would be routed along mine benches that "daylight" to the natural land surface in areas to the south. The water would be diverted into pond 4 which has an appreciable storage capacity and discharge structure.

It should be noted that the interception of moderate amounts of groundwater from shallow alluvial groundwater systems in these areas is considered likely. Modest inflows of shallow groundwater intercepted by the mine workings in these areas would be manageable and not of significant concern. The objective of the work plan would be to ensure that strong hydrodynamic communication between the coarse-grained artesian alluvial groundwater systems in the eastern portion of Sink Valley with the Coal Hollow Mine workings is not established.

The rate at which alluvial groundwater will be intercepted by the ~~proposed~~ Coal Hollow Mine will be variable by location and time in permit area. Because of the heterogeneity inherent in most alluvial deposits, the quantifying of precise aquifer parameters in the various mining areas is not straightforward. Additionally, the geometry of the mine openings including the horizontal lengths and heights of mine pit faces adjacent to saturated groundwater systems that are exposed at any point in time are dynamic variables in the surface mining environment. Consequently, precise quantifications of mine groundwater interception rates are not readily obtainable. However, using the estimated mine pit groundwater inflow rates presented as discharge per linear foot of open pit in Table 7-9, it is considered likely that mine interception will be on the order of a few tens of gallons per minute in dry areas and at times when open pit sizes are small, to several hundred gallons per minute in wetter areas and at times when the open pit size is large. It is important to note that inflows into individual pit areas will be short lived, as the individual pits will commonly remain open for a few weeks to a few months.

The reasonably foreseeable maximum quantity of water that could be intercepted by the Coal Hollow Mine is largely a function of the manner in which coal mining operations are conducted in areas where the potential for encountering appreciable groundwater inflows is greatest. If large areas of water-bearing coarse-grained sediments were to be rapidly exposed in mine pit areas, large quantities of water would be anticipated (likely several thousands of gallons per minute). However, as described above, mining operations will be carried out in these areas using the special mining protocols described above. Consequently, large cross-sectional exposures of water-bearing coarse-grained alluvial sediments will not be allowed to be exposed to the mine pits and large inflows of groundwater on that magnitude are not anticipated.

In the unanticipated event that excessive quantities of water were to flow into the mine pits by any mechanism, the water would be pumped from the pits using a suitable pump and piping equipment that will be located on-site at the Coal Hollow Mine for such a contingency. Such water would be managed appropriately as required by all applicable State and Federal regulations. It should be noted that it is not in the mine's interest to allow excessive water to flow into the mine pits. All reasonable efforts will be taken to minimize the potential for flooding of the mine pits (an event that is not considered reasonably foreseeable or probable to occur).

Through the implementation of the above described mining protocols in areas where potentially large groundwater inflows could reasonably be anticipated to occur, the potential for the interception of large quantities of water by the mine is minimized. Consequently, the potential for flooding or streamflow alteration that could occur as a result of intercepting and discharging large quantities of water will be minimized and is considered unlikely.

The principal surface-water drainages in and adjacent to the ~~proposed~~ Coal Hollow Mine permit area are in many locations not stable in their current configurations (see photograph section). Currently, these stream drainages are actively eroding their channels during precipitation events, resulting in down-cutting and entrenchment of stream channels, the formation of unstable near-vertical erosional escarpments adjacent to stream channels (which occasionally spall off into the stream channel), aggressive headward erosion of stream channels and side tributaries, and the transport of large quantities of sediment associated with torrential precipitation events. These processes are currently actively ongoing in the proposed permit and adjacent area and the upper extents of these erosional processes are in many locations migrating upward in stream channels, resulting in increasing lengths of unstable stream channels.

Hereford (2002) suggests that the valley fill alluviation in the southern Colorado Plateau occurred during a long-term decrease in the frequency of large, destructive floods, which ended in about 1880 with the beginning of the historic arroyo cutting. Hereford (2002) further suggests that the shift from deposition to valley entrenchment coincided with the beginning of an episode of the largest floods in the preceding 400-500 years, which was probably caused by an increased recurrence and intensity of flood-producing El Nino Southern Oscillation events beginning at ca. A.D. 1870.

The exact causes of the entrenchment of stream channels and the creation of the numerous arroyos currently in existence in the southwestern United States are not completely understood. Vogt (2008) suggests that three primary factors resulted in the arroyo formation. These factors included 1) changes in climate that produced heavy rainfall, 2) land-use practices such as livestock grazing, and 3) natural cycles of erosion and deposition caused by internal adjustments to the channel system. The temporal coincidence of the causes may have magnified the effect of each factor.

Each of these factors likely contributed to the formation of the entrenched stream drainages and arroyos in the Coal Hollow Project area. Gregory (1917) states that historical evidence indicates that the cutting of Kanab Creek began when a large storm occurred on 29 July 1883, and that unusually large amounts of precipitation were received in 1884-85. In this period the Kanab Creek channel was down-cut by 60 feet and widened by 70 feet for a distance of about 15 miles. The lowering of Kanab Creek may have resulted in a lowering of the local base level and consequent incision of both Sink Valley Wash and Lower Robinson Creek. As suggested by Vogt (2008), other factors, such as the heavy livestock grazing in the local area, which was occurring

contemporaneously with the heavy thunderstorm events, likely also contributed to the overall conditions that brought about the stream down-cutting episode in the late 1800s.

While the precise sequence of events and conditions that triggered the arroyo formation and stream entrenchment in the principle surface drainages in and adjacent to the Coal Hollow Project area is not known, it is readily apparent that the principle surface water drainages are not currently in a condition of equilibrium. Stream head-cutting (headward erosion), bank erosion, and spalling of the steep stream channel walls are ongoing processes in the Coal Hollow Project area.

The mining and reclamation plan for the Coal Hollow Mines has been designed to minimize the potential for sediment yield and erosion in the mine permit areas. Accordingly, the mining and reclamation plan minimizes the potential for stream channel erosion and instability within the permit area. No mining-related activities are planned that would likely result in a worsening of the current instability of the surface water drainages in the permit and adjacent area.

The Coal Hollow Mine mining and reclamation plan calls for reclamation activities concurrent with mining progression, which results in the smallest disturbed area footprint and minimizes the length of time that the land surface is susceptible to erosion. The plan also calls for soil tackifiers to be used as a temporary soil stabilizer on reclamation areas prior to seeding. Seeded areas will be mulched. Vegetation established in final reclamation areas will minimize the potential for sediment yield and stream erosion in the long term.

The potential for erosion on the planned excess spoils pile will likewise be minimized. The design plans for the excess spoils pile call for the side slopes exceeding 60 feet in height to be constructed with concave slopes to promote slope stability and to minimize the erosion potential. The excess spoils pile will also be revegetated to minimize the erosion potential.

The Lower Robinson Creek reconstruction will likewise be constructed to promote stability and resistance to erosion. Details of the Lower Robinson Creek reconstruction are shown on Drawings 5-20A and 5-21A. The construction of the channel will include riprap of the channel bottom and the inclusion of an inner flood plane to minimize erosion during flooding events. The stream channel will be revegetated to minimize erosion potential. The Lower Robinson Creek reconstruction is designed to leave the drainage in a condition at final bond release that is at least as stable as the current pre-mining condition.

Following reclamation, stream channels will be returned to a stable state to the extent possible given the currently unstable state of natural drainage channels in the area. Stream channels will be designed to withstand anticipated storm events, thus minimizing the potential of flooding in the reclaimed areas.

The overall condition of the land surface and the surface-water drainages within the permit area at final bond release will likely meet or exceed the current pre-mining conditions. However, it should be noted that Alton Coal Development, LLC will have no control over the land management practices and landowner activities that may be implemented on the privately owned lands of the reclaimed Coal Hollow Mine area after final bond release. Accordingly, the degree of erosional stability and overall conditions in the reclaimed lands and stream drainages in the post bond-release period is not in the control of Alton Coal Development, LLC.

The existing principle surface-water drainages adjacent to the ~~proposed~~ Coal Hollow Mine permit area have large discharge capacities (lower Sink Valley Wash below the County Road 136 crossing, Lower Robinson Creek, and Kanab Creek). These drainages periodically convey large amounts of precipitation runoff water associated with torrential precipitation events. The anticipated discharge rates from alluvial groundwater drainage and the maximum reasonably foreseeable amount of mine discharge water that could potentially be required to be discharged from mine pits is much less than that periodically occurring during major torrential precipitation events. The addition of modest amounts of sediment-free water into these stream channels has the potential to cause minor increases in channel erosion. However, the magnitude of this potential impact will likely be small relative to that occurring during torrential precipitation events.

Most precipitation waters falling on disturbed areas will be contained in diversion ditches and routed to sediment impoundments that are designed to impound seasonal water and storms. Sediment control facilities will be designed and constructed to be geotechnically stable. This will minimize the potential for breaches of sediment control structures, which if they occur could result in down-stream flooding and increases in stream erosion and sediment yield. Emergency spillways will be part of the impoundment structures to provide a non-destructive discharge route should capacities ever be exceeded.

Details associated with these structures at the existing Coal Hollow can be viewed on Drawings 5-25 through 5-34 and Appendix 5-2, the structures at the North Private Lease can be viewed on Drawing 5-67 through 5-71 and Appendix 5-12.

It should be noted that during the startup and construction phase of the mine operation, while the ditches and sediment control ponds are being constructed, temporary silt control measures will be utilized. These measures may include the use of silt fences or other appropriate sediment control measures as necessary.

As shown on Drawing 5-26 for the Coal Hollow Mine, there are two sediment impound watershed areas within the mine permit area (Watershed 5 and Watershed 6) from which precipitation runoff water will not be routed through sediment ponds.

Watershed 5 area includes 28 acres near the Sink Valley Wash/Lower Robinson Creek drainage divide. The land surface in Watershed 5 is relatively flat, sloping at about a one percent grade. Because of the flatness of the land surface in Watershed 5, it is not practical to construct ditches to convey water from this area to a sediment pond.

Consequently, control of sediment in runoff water from Watershed 5 will be accomplished through the use of a silt fence or other appropriate sediment control measure placed along the western permit boundary adjacent to Watershed 5 (see Drawing 5-26). Precipitation water falling on Watershed 5 will be retained as soil moisture, retained in the lowest portions of the watershed and allowed to evaporate or infiltrate or, after treatment with silt fences or other appropriate sediment control measures, allowed to flow down gradient onto lower lying adjacent areas.

Watershed 6 includes 19 acres located within the permit boundary east of the proposed Lower Robinson Creek reconstruction (see Drawing 5-26). The land surface in this area slopes gently toward the west at an approximately three to four percent grade. The Watershed 6 area will be isolated from a sediment pond by the reconstructed Lower Robinson Creek stream channel. Control of sediment in Watershed 6 will be accomplished through the installation of a silt fence or other appropriate sediment control measure along the margin of the watershed as shown on Drawing 5-26. The soils on the post-mining land surface in Watershed 6 will initially be stabilized with the use of tackifiers. Subsequent revegetation of the land surface in Watershed 6 will minimize the potential for erosion. After treatment with silt fences or other appropriate sediment control measures, precipitation water falling on Watershed 6 will be allowed to flow down-gradient toward adjacent lands or toward the Lower Robinson Creek stream channel.

The potential for flooding or streamflow alteration resulting from mining and reclamation activities at the ~~proposed~~ Coal Hollow Mine permit area is considered minimal.

728.334 Groundwater and surface water availability

Groundwater use in the ~~proposed~~ Coal Hollow Mine permit and adjacent area is generally limited to stock watering and domestic use in Sink Valley. Some limited use of spring discharge water for irrigation has occurred in Sink Valley, although such irrigation is not occurring presently nor has it occurred in at least the past 10 years. The areas of groundwater use in the ~~proposed~~ Coal Hollow Mine permit and adjacent area are located in the northwest ¼ of Section 29, T39S, R5W (see Drawing 7-4; groundwater discharge area A), and in the northwest ¼ of Section 32, T39S, R5W (see Drawing 7-4; groundwater discharge area B). The likely future availability of groundwater in each of these areas is discussed below.

Groundwater discharge area A (Northwest ¼, Section 29, T39S, R5W)

Groundwater use in area A occurs from several alluvial springs and seeps that are used for stock watering and limited domestic use. As described in Section 728.311 above, short-term diminution in discharge rates from springs in northwest ¼ of Section 29, T39S, R5W are possible as mining operations advance toward these springs. This potential impact is associated with the possible drainage of up-gradient alluvial groundwater into mine openings as mining advances toward groundwater discharge area A. Because individual mine pits will typically remain open for less than about 60 to 120

days (measured from the time the mining of the pit is completed to the time the pit is backfilled) before subsequently being backfilled and reclaimed, the potential for long-term drainage of alluvial groundwater into the mine voids is negligible, and thus any potential decreases in alluvial discharge in groundwater discharge area A is anticipated to be short-lived.

If groundwater inflow rates into mine openings in this area are excessive, such that appreciable impacts to the springs and seeps in groundwater discharge area A are likely, where necessary Alton Coal Development, LLC will use a suitable technique to minimize groundwater inflow rates into the mine voids. These techniques may include the use of bentonite or natural clay filled cutoff walls or other means where appropriate to isolate and protect groundwater resources up-gradient of mining activities. Consequently, the potential that groundwater could become unavailable in this area is minimal. Additionally, if alluvial groundwater resources were to become unavailable in this area due to mining and reclamation activities in the ~~proposed~~ Coal Hollow Mine permit area, groundwater will be replaced according to all applicable State laws and regulations using the replacement water source described in Section 727 above. Details of the contingency plan for this occurrence are provided in Appendix 7-9.

It should be noted that the proposed water replacement source is a new well that will produce groundwater from the coarse-grained alluvial groundwater system in Sink Valley. Nearby springs that could potentially be impacted by mining and reclamation activities are supported by the same alluvial groundwater system. However, while modest decreases in the artesian hydraulic pressures in the alluvial groundwater system could potentially result in diminution of spring flows, the new well will be equipped with an electric well pump providing the capability to produce groundwater from the alluvial system even if the hydraulic head in the alluvial groundwater system were to be diminished such that artesian flow conditions temporarily ceased to exist.

Groundwater discharge area B (Northwest ¼, Section 32, T39S, R5W)

Groundwater use in groundwater discharge area B occurs at alluvial springs and seeps located southeast of the ~~proposed~~ Coal Hollow Mine permit area that are used for stock watering and limited domestic use. As described in Section 728.311 above, although some temporary and short-lived diminution in discharge rates from springs in northwest ¼ of Section 29, T39S, R5W is possible, this potential impact is not considered likely.

In the event that alluvial groundwater resources were to become unavailable in this area due to mining and reclamation activities in the ~~proposed~~ Coal Hollow Mine permit area, groundwater will be replaced according to all applicable State laws and regulations using the replacement water source described in Section 727 above.

Surface-water availability

Surface-water use in the ~~proposed~~ Coal Hollow Mine permit and adjacent area occurs in the Sink Valley Wash drainage and in Lower Robinson Creek. Surface waters in the Sink

Valley Wash drainage (primarily from Water Canyon via an irrigation diversion and from Swapp Hollow; appreciable discharge in Sink Valley Wash below Section 29 T39S, R5W is usually absent) are utilized for both stock watering and limited irrigation use. Stream water in the Sink Valley Wash drainage is derived from runoff from the adjacent Paunsaugunt Plateau area. Because the surface water in the drainage originates from areas up-gradient areas located large distances from proposed mining areas, and because the stream channel is entirely outside the permit area and will not be impacted by mining and reclamation activities, there is essentially no probability that surface water availability in the Sink Valley Wash drainage could become unavailable as a result of mining and reclamation activities.

Discharge in Lower Robinson Creek immediately above the ~~proposed~~ Coal Hollow Mine permit area typically occurs only in direct response to significant precipitation or snowmelt events. Thus, surface-water availability is currently limited in this drainage prior to any mining activities.

Seepage of alluvial groundwater into the deeply incised lower Robinson Creek stream channel occurs near the contact with the underlying Dakota Formation in the southeast quarter of Section 19, T39S, R5W. This water is likely related to saturated alluvial deposits directly underlying the Robinson Creek stream channel and emerges near where the stream channel intersects the alluvial groundwater system. This seepage of alluvial water is usually about 5 - 10 gpm or less and is routinely monitored at monitoring station SW-5 (Drawing 7-2).

It should be noted that the ~~proposed~~ Coal Hollow Mine plan calls for the ~~permanent~~ temporary diversion of a reach of the Lower Robinson Creek stream channel approximately 2,000 feet in length in the southeast ¼ of Section 19, T39S, R5W. Details of the proposed diversion are given in Chapter 5, Section 527.220 of this MRP. If this action results in diminution of the meager discharge of surface water in the drainage below the planned diversion, where required a suitable mitigation for this potential impact will be designed and implemented in consultation with the Division of Oil, Gas and Mining.

The information presented above suggests that the potential for significant impacts to groundwater and surface-water availability resulting from mining and reclamation activities in the ~~proposed~~ Coal Hollow Mine permit and adjacent systems in the region is low.

728.340 Whether mining and reclamation activity will result in contamination, diminution or interruption of State-appropriated waters

State appropriated water rights in the ~~proposed~~ Coal Hollow Mine permit and adjacent area are shown on Drawing 7-3 and tabulated in Appendix 7-3.

Appropriated groundwaters include alluvial springs and seeps in the northwest ¼ of Section 29, T39S, R5W (groundwater discharge area A), springs and seeps in the northwest ¼ of Section 32, T39S, R5W (groundwater discharge area B). State appropriated surface waters include reaches of Sink Valley Wash east of the ~~proposed~~ Coal Hollow Mine permit area, and reaches of Lower Robinson Creek.

The potential for mining and reclamation activities at the ~~proposed~~ Coal Hollow Mine permit area to result in contamination, diminution or interruption of State-appropriated water in the ~~proposed~~ Coal Hollow Permit and adjacent area are described in detail in Sections 728.310, 728.320, 728.332, and 728.334.

With the possible exception of short-term diminution in discharge rates from springs and seeps in the northwest ¼ of Section 29, T39S, R5W, Contamination, diminution, or interruption of State-appropriated waters in the ~~proposed~~ Coal Hollow Mine permit and adjacent area are not anticipated. It should be noted that if groundwater inflow rates into mine openings in this area are excessive, such that appreciable impacts to the springs and seeps in groundwater discharge area A are likely, where necessary Alton Coal Development, LLC will use a suitable technique to minimize groundwater inflow rates into the mine voids. These techniques may include the use of bentonite or natural clay filled cutoff walls or other means where appropriate to isolate and protect groundwater resources up-gradient of mining activities, minimizing the potential for diminution of discharge rates from these springs.

Additionally, it should be noted that the ~~proposed~~ Coal Hollow Mine plan calls for the temporary diversion of a reach of the Lower Robinson Creek stream channel approximately 2,000 feet in length in the southeast ¼ of Section 19, T39S, R5W. Details of the proposed diversion are given in Chapter 5, Section 527.220 of this MRP. If this action results in diminution of the meager discharge of surface water in the drainage below the planned diversion, where required a suitable mitigation for this potential impact will be designed and implemented in consultation with the Division of Oil, Gas and Mining.

In the event that any State appropriated waters were to be contaminated, diminished, or interrupted due to mining and reclamation activities in the ~~proposed~~ Coal Hollow Mine permit area, groundwater will be replaced according to all applicable State laws and regulations using the replacement water source described in Section 727 above.

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730 OPERATION PLAN

Coal mining in the ~~proposed~~ Coal Hollow Mine permit area will occur using surface and underground mining techniques. Planned coal mining operations in the North Private Lease area will be conducted using conventional pit surface mining and highwall mining techniques. All coal mining and reclamation operations will be conducted to minimize disturbance to the hydrologic balance within the permit and adjacent areas, to prevent material damage to the hydrologic balance outside the permit area and support approved postmining land uses in accordance with the terms and conditions of the approved permit and the performance standards of R645-301 and R645-302. Operations will be conducted to assure the protection or replacement of water rights in accordance with the terms and conditions of the approved permit and the performance standards of R645-301 and R645-302.

In order to maximize the use and conservation of the coal resource, coal will be recovered using a combination of large hydraulic backhoes or front end loaders and off-road trucks, highwall mining and underground mining equipment. Mined coal will be hauled to a central coal processing area for crushing and placement into a stockpile. Coal from the stockpile will be transferred into a bin and loaded into over the road trucks for transport.

The plan, with Drawings, cross sections, narrative, descriptions, and calculations indicates how the relevant requirements will be met. The lands subject to coal mining and reclamation operations over the estimated life of the operations are identified and briefly described. All appropriate information is located in the subsequent sections and Drawings 5-1 through 5-39 and Appendices A5-1 through A5-3.

731 GENERAL REQUIREMENTS

Operations will be conducted to assure protection or replacement of water rights in accordance with the terms and conditions of the approved permit and the performance standards of R645-301 and R645-302.

Groundwater and Surface-Water Protection

To protect the hydrologic balance, coal mining and reclamation operations will be conducted to handle earth materials and runoff in a manner that minimizes acid, toxic, or other harmful infiltration to the groundwater system. Additionally, excavations, and disturbances will be managed to prevent or control discharges of pollutants to the groundwater.

Products including chemicals, fuels, and oils used in the mining process will be stored and used in a manner that minimizes the potential for these products entering groundwater systems. Concrete oil and fuel containments will be constructed as shown on Drawings 5-3 and 5-8.

A facilities spill plan for the Coal Hollow Mine is provided in Appendix 7-5. When operations begin, there will be an EPA SPCC plan available on site for inspection.

The wash bay sump sludge will be removed as necessary and transported off site to an approved hazardous waste disposal facility.

The wash bay at the mine site will include a closed circuit water recycle system. This system will eliminate and store water impurities and reroute water back through the wash bay for cleaning equipment, thus minimizing water consumption the potential for contamination of groundwater resources. Details for this structure can be viewed on Drawings 5-3, and 5-8.

As mining operations approach springs and seeps in the northwest ¼ of Section 29, T39S, R5W (See Drawing 7-4; groundwater discharge area A), there is the potential for drainage of up-gradient into mine openings to cause short-lived diminution of discharge from these springs. If groundwater inflow rates into mine openings in this area are excessive, such that appreciable impacts to the springs and seeps in groundwater discharge area A are likely, where necessary Alton Coal Development, LLC will use a suitable technique to minimize groundwater inflow rates into the mine voids. These techniques may include the use of bentonite or natural clay filled cutoff walls or other means where appropriate to isolate and protect groundwater resources up-gradient of mining activities, minimizing the potential for diminution of discharge rates from these springs. Details of the contingency plan for this occurrence are provided in Appendix 7-9.

The mine will replace loss of water identified for protection in this MRP that are impacted by mining and reclamation operations.

To protect the hydrologic balance, coal mining and reclamation operations will be conducted to handle earth materials and runoff in a manner that minimizes acidic or toxic drainage, prevents to the extent possible, additional contributions of suspended solids to streamflow outside the permit area and otherwise prevents water pollution. Runoff and sediment control measures are described in detail in Chapter 5 of this MRP. The mine will maintain adequate runoff- and sediment-control facilities to protect local surface waters.

Discharge of mine water that has been disturbed by coal mining and reclamation operations is not anticipated. However, any discharges of water from areas disturbed by coal mining and reclamation operations that do occur will be made in compliance with all Utah and federal water quality laws and regulations and with effluent limitations for coal mining promulgated by the U.S. Environmental Protection Agency set forth in 40 CFR part 434. Discharge of mine waters will be regulated by a Utah UPDES discharge permit.

Water pollution associated with mining and reclamation activities within the permit areas will be controlled by:

- Construction of berms and/or diversion ditches to control runoff from all facilities areas.
- Roads will be constructed with ditches to capture runoff
- Diversion ditches will be constructed as necessary around active mining and reclamation areas to capture runoff from those areas.
- Sedimentation impoundments will be constructed to control discharges
- In areas where impoundments or diversions are not suitable to the surrounding terrain, silt fence or straw bales will be utilized to control sediment discharge from the permit area.

In order to accomplish these objectives for the Coal Hollow Mine, watershed analysis of the permit and adjacent areas has been completed and specific designs are established for each water pollution control structure. Primary control structures include five sediment impoundments, four diversion ditches and miscellaneous berms. The locations of these structures can be viewed on Drawing 5-3. The detailed analysis for these structures and specific designs can be viewed on Drawings 5-25 through 5-34. In addition, a geotechnical analysis of the impoundments to ensure stability can be viewed in Appendix 5-1. The watershed and structure sizing analysis can be viewed in Appendix 5-2. In addition to these primary structures, temporary diversions and impoundments may also be implemented, as necessary, in mining areas to further enhance pollution controls.

Sediment control measures will be located, maintained, constructed and reclaimed according to plans and designs given under R645-301-732, R645-301-742 and R645-301-760. Siltation structures and diversions will be located, maintained, constructed and reclaimed according to plans and designs given under R645-301-732, R645-301-742 and R645-301-763. Storm water and snow melt that occurs within the facilities area will be routed to an impoundment that will contain sediment. This impoundment will have a drop-pipe spillway installed that will allow removal of any oil sheens that may result from parking lots or maintenance activities by using absorbent materials to remove the sheen. Details for this impoundment can be viewed on Drawings 5-28.

There are five sediment impoundments proposed for the permit area. These structures will be constructed using a combination of dozers and backhoes. The structures have been designed to contain the required storm events as specified in Appendix 5-2. The structures will have sediment removed as necessary to ensure the required capacities. Details for these structures can be viewed on Drawings 5-25, 5-26 and 5-28 through 5-32. Calculations and supporting text can be viewed in Appendix 5-2.

Four diversion ditches along with five sediment impoundments are proposed for the permit area. In addition, miscellaneous controls such as silt fence and berms are also proposed for specific areas. The proposed locations for these structures are shown on Drawing 5-3. Details associated with these structures can be viewed on Drawings 5-25 through 5-34 and Appendix 5-2.

In order to accomplish these objectives for the North Private Lease, watershed analysis of the permit and adjacent areas has been completed and specific designs are established for each water pollution control structure. Primary control structures include ~~three~~five sediment impoundments, fifteen diversion ditches. The locations of these structures can be viewed on Drawing 5-65. The detailed analysis for these structures and specific designs can be viewed on Drawings 5-67 through 5-71. In addition, a geotechnical analysis of the impoundments to ensure stability can be viewed in Appendix 5-11. The watershed and structure sizing analysis can be viewed in Appendix 5-12. In addition to these primary structures, temporary diversions and impoundments may also be implemented, as necessary, in mining areas to further enhance pollution controls.

Sediment control measures will be located, maintained, constructed and reclaimed according to plans and designs given under R645-301-732, R645-301-742 and R645-301-760. Siltation structures and diversions will be located, maintained, constructed and reclaimed according to plans and designs given under R645-301-732, R645-301-742 and R645-301-763.

Fifteen diversion ditches along with five sediment impoundments proposed for the permit area. These structures will be constructed using a combination of dozers and backhoes. The structures have been designed to contain the required storm events as specified in Appendix 5-12. The structures will have sediment removed as necessary to ensure the required capacities. Details for these structures can be viewed on Drawings 5-65 through 5-71. Calculations and supporting text can be viewed in Appendix 5-12.

As shown on Drawing 5-64 for the North Private Lease, there is one watershed areas within the mine permit area (ASCA-1) from which precipitation runoff water will not be routed through sediment ponds.

ASCA-1 area includes 3.1acres of access road to the North Private Lease that will not flow to a sediment impoundment. Consequently, control of sediment in runoff water from ASCA-1 will be accomplished by routing runoff from the road to a row of straw bales for treatment. These straw bales surround a drop box to a culvert flowing under the road (see Appendix 5-13).

The smallest practicable area, consistent with reasonable and safe mine operational practices will be disturbed at any one time during the mining operation and reclamation phases. This will be accomplished through progressive backfilling, grading, and prompt revegetation of disturbed areas.

There are no other coal processing waste banks, dams or embankments proposed within the permit area.

Diesel fuels, oils, greases, and other hydrocarbons products will be stored and used at the mine site for a variety of purposes. A spill Prevention Control and Countermeasure Plan will be implemented that will help minimize any potential detrimental impacts to the environments.

Products including potentially hazardous chemicals, fuels, and oils used in the mining process will be stored and used in a manner that minimizes the potential for these products to contaminate surface-water resources. Concrete oil and fuel containments will be constructed as shown on Drawings 5-3 and 5-8.

The wash bay at the mine site will include a closed circuit water recycle system. This system will eliminate and store water impurities and reroute water back through the wash bay for cleaning equipment, thus minimizing water consumption the potential for contamination of surface-water resources. Details for this structure can be viewed on Drawings 5-3, 5-8, and Appendix 5-4. .

Roads will be located, designed, constructed, reconstructed, used, maintained and reclaimed according to R645-301-732.400, R645-301-742.400 and R645-301-762. The specific plan for road locations and design are presented in R645-301-534. The location and details for roads can be viewed on Drawings 5-3 and 5-22 through 5-24 for the Coal Hollow Mine and on Drawings 5-47 and 5-58 through 5-64 for the North Private Lease.

Roads will be located, designed, constructed, reconstructed, used, maintained and reclaimed to control or prevent additional contributions of suspended solids to stream flow or runoff outside the permit area; Neither cause nor contribute to, directly or indirectly, the violation of effluent standards given under R645-301-751; minimize the diminution to or degradation of the quality or quantity of surface- and ground-water systems; and refrain from significantly altering the normal flow of water in streambeds or drainage channels. No acid- or toxic-forming substances will be used in road surfacing.

All roads for the Coal Hollow Mine will be removed and reclaimed according to Drawings 5-~~35~~ 37 and 5-~~36~~37A. The estimated timetable for removing these roads is shown on Drawing 5-38. All roads for the North Private Lease will be removed and reclaimed according to Drawings 5-74 and 5-75. The estimated timetable for removing these roads is shown on Drawing 5-76. Cut ditches will be established on the shoulders of all primary roads to control drainage and erosion. Cut and fill slopes along the primary roads will be minimal and are not expected to cause significant erosion. In locations where there are culvert crossings (i.e. Lower Robinson Creek), the fills slopes will be stabilized by utilizing standard methods such as grass matting or straw wattles.

All wells will be managed to comply with R645-301-748 and R645-301-765. Water monitoring wells will be managed on a temporary basis according to R645-301-738.

Wells constructed for monitoring groundwater conditions in the ~~proposed~~ Coal Hollow Mine permit and adjacent area, including exploration holes and boreholes used for water wells or monitoring wells, will be designed to prevent contamination of groundwater and surface-water resources and to protect the hydrologic balance. A diagram depicting typical monitoring well construction methods is shown in Drawing 7-11. Monitoring wells will include a protective hydraulic seal immediately above the screened interval, an annular seal plugging the borehole above the hydraulic seal to near the ground surface, and a concrete surface seal extending from the top of the hydraulic seal to the ground surface which is sloped away from the well casing to prevent the entrance of surface

flows into the borehole area. Well casings will protrude above the ground surface a sufficient height so as to minimize the potential for the entrance of surface water or other material into the well. A steel surface protector with a locking cover will be installed at monitoring wells to prevent access by unauthorized personnel. Where there is potential for damage to monitoring wells, the wells will be protected through the use of barricades, fences, or other protective devices. These protective devices will be periodically inspected and maintained in good operating conditions. Monitoring wells will be locked in a closed position between uses.

When no longer needed for monitoring or other use approved by the Division upon a finding of no adverse environmental or health and safety effects, or unless approved for transfer as a water well under R645-301-731.100 through R645-301-731.522 and R645-301-731.800, each well will be capped, sealed, backfilled, or otherwise properly managed, as required by the Division in accordance with R645-301-529.400, R645-301-631.100, and R645-301-748. Permanent closure measures will be designed to prevent access to the mine workings by people, livestock, fish and wildlife, machinery and to keep acid or other toxic drainage from entering ground or surface waters.

If a water well is exposed by coal mining and reclamation operations, it will be permanently closed unless otherwise managed in a manner approved by the Division.

Permanent closure and abandonment of water wells greater than 30 feet in depth will be in accordance with the requirements of "Administrative Rules for Water Well Drillers", State of Utah, Division of Water Rights or other applicable state regulations. Abandonment of wells will be performed by a licensed water well driller. The wells to be abandoned will be completely filled using neat cement grout, sand cement grout, unhydrated bentonite, or bentonite grout, or other materials approved by the Utah State Engineer's office. Alternatively, the well may be abandoned using a different procedure upon approval from the Utah State Engineer's office.

Abandonment materials will be introduced at the bottom of the well or required sealing interval and placed progressively upward to the top of the well. The casing will be severed a minimum of 2 feet below the ground surface. A minimum of 2 feet of compacted native material will be placed above the abandoned well upon completion.

The locations of wells that are planned to be removed by intercepting mining operations in the North Private Lease are shown on Figure 20 of Appendix 7-16. Monitoring wells to be removed by mining operations in the North Private Lease that are deeper than the depths of the advancing mine working will be plugged and abandoned prior to their interception by the mining operations. Shallow monitoring wells that will be completely excavated by mine disturbance will not be plugged/abandoned because the entire well/borehole length will be removed by mining operations and thus plugging and abandoning these wells serves no purpose.

The six monitoring wells that are planned to be removed by mining operations are not planned to be replaced. Monitoring of the alluvial groundwater system within the North

Private Lease after mining is completed will be accomplished using the monitoring wells that are not planned to be intercepted by mining (see Figure 20 of Appendix 7-16) and also using additional monitoring wells proposed for construction in the North Private Lease. As directed by the Division, ACD has proposed the construction of up to 30 additional alluvial monitoring wells in locations within and adjacent to the North Private Lease that are to remain after mining is complete. Monitoring of alluvial groundwater quantity and quality can be accomplished using these wells.

Within 30 days of the completion of well abandonment procedures, a report will be submitted to the State Engineer by the responsible licensed driller giving data related to the abandonment of the well. This shall include the name of the licensed driller or other person(s) performing abandonment procedures, name of well owner at the time of abandonment, the address or location of the well by section, township, and range, abandonment materials and equipment used, water right or file number covering the well, the final disposition of the well, and the date of completion.

Water wells less than thirty feet deep are not regulated by the Utah Division of Water Rights. The permanent closure and abandonment of water wells less than 30 feet deep will be accomplished by filling the well casing with neat cement grout, sand cement grout, unhydrated bentonite, or bentonite grout, or other appropriate materials. The well casing will then be cut off below the ground surface and native materials placed over the abandoned well site.

Exploration holes and boreholes will be backfilled, plugged, cased, capped, sealed, or otherwise managed to prevent acid or toxic contamination of water resources and to minimize disturbance to the prevailing hydrologic balance. Exploration holes and boreholes will be managed to ensure the safety of people, livestock, fish and wildlife, and machinery.

If a water well is exposed by coal mining and reclamation operations, it will be permanently closed unless otherwise managed in a manner approved by the Division.

If any exploration boreholes are to be used as monitoring wells or water wells, these will meet the provisions of R645-301-731 and be managed according to the following.

Boreholes will be backfilled to within 1 foot of the land surface with concrete or other materials approved by the Division as necessary to prevent contamination of groundwater or surface-water resources or to protect the prevailing hydrologic balance. The upper approximately 1 foot will be backfilled with native materials to facilitate reclamation (see Drawing 6-11). Exploration holes and boreholes that may be uncovered during mining and reclamation activities will be permanently closed unless approved for water monitoring or otherwise managed in a manner approved by the Division.

If mining and reclamation activities result in the contamination, diminution, or interruption of State appropriated groundwater or surface-water sources, replacement water will be provided using the alternate water source described in R645-301-727.

Seasonal baseline water monitoring information for all water rights that could be affected by mining in the permit and adjacent area have been submitted electronically to the Division's on-line hydrology database.

731.200 Water Monitoring

This section describes the hydrologic monitoring plan (including that for the 85.88-acre Dame Lease IBC). The hydrologic monitoring plans for groundwaters and surface waters in the proposed North Private Lease area are provided in Appendix 7-16. Locations of surface-water and groundwater monitoring sites are indicated on Drawing 7-10. Hydrologic monitoring protocols, sampling frequencies, and sampling sites are described in Table 7-4. Groundwater and surface-water monitoring locations are listed in Table 7-5. Operational field and laboratory hydrologic monitoring parameters for surface water are listed in Table 7-6, and for groundwater in Table 7-7. The hydrologic monitoring plan during reclamation will be the same as during the operational phase. The hydrologic monitoring parameters have been selected in consultation with the Division's directive Tech-006, *Water Monitoring Programs for Coal Mines.*

The groundwater and surface-water monitoring plan is extensive and includes more than 503 ~~3~~ monitoring sites. The monitoring plan is designed to monitor groundwater and surface-water resources for any potential impacts that could potentially occur as a result of mining and reclamation activities in the ~~proposed~~ Coal Hollow Mine permit and adjacent area. Each of the sampling locations and their monitoring purpose are described below.

Streams

Kanab Creek will be monitored at sites SW-3 (above the permit area), and SW-2 (below the permit area). Lower Robinson Creek will be monitored at sites SW-4 (above the permit area), SW-101 (within the permit area), and SW-5 (below the permit area above the confluence with Kanab Creek). The irrigation water near SW-4 will also be monitored at site RID-1. Swapp Hollow creek will be monitored above the permit area at site SW-8. Sink Valley Wash will be monitored at SW-6 (a small tributary to the wash immediately below the permit area) and at SW-9, located in the main drainage below the permit area. All of these locations, with the exception of RID-1) will be monitored for discharge and water quality parameters specified in Table 7-6 quarterly, when reasonably accessible. Additionally, Lower Robinson Creek will be monitored at site BLM-1, which is near the location of alluvial groundwater emergence in the bottom of the stream

channel. RID-1 will be monitored for discharge and field water quality parameters. BLM-1 will be monitored for discharge and water quality parameters specified in Table 7-6 quarterly. Monitoring sites BLM-1, SW-5, SW-6, and SW-9 will also be monitored for total and dissolved selenium quarterly.

Springs

Eight springs from alluvial groundwater area A will be monitored including SP-8, SP-14, SP-16, SP-19, SP-20, SP-22, SP-24 and Sorensen Spring. Spring SP-8 is a developed spring in area A that provides culinary water for the Swapp Ranch house. SP-8 will be monitored for discharge and operational laboratory water quality measurements quarterly when reasonably accessible. Springs SP-14, SP-16, SP-19, SP-20, SP-22, SP-24 and Sorensen Spring springs will be monitored for discharge and field water quality measurements quarterly when reasonably accessible.

Springs SP-4 and SP-6, and SP-33, which are located in Sink Valley below the proposed mining area, will also be monitored. SP-6 is an area of diffuse seepage above an earthen impoundment in the wash immediately below the permit area. Spring SP-33 is a developed spring that discharges into a pond below the permit area and provides culinary water to two adjacent cabins. Each of these Springs SP-6 and SP-33 will be monitored for discharge and operational laboratory water quality measurements quarterly when reasonably accessible. SP-4 discharges from a fault/fracture system in the Dakota Formation near the canyon margin in Sink Valley Wash below the permit area. Spring SP-4 will be monitored for discharge and field water quality measurements quarterly when reasonably accessible. Spring SP-3 discharges from pediment alluvium in the upland area above Sink Valley Wash more than a mile from the permit area. It is extremely unlikely that discharge rates or water quality at this spring could be impacted as a result of mining-related activities in the mine permit area. However, this spring will be monitored for discharge and field water quality measurements quarterly, primarily to provide background data from springs in the region.

Wells

Wells Y-98 (Robinson Creek alluvium above the permit area), Y-45 (coal seam well in Swapp Hollow above permit area), Y-102 (flowing alluvial well in alluvial groundwater discharge area A), Y-36 (coal seam well in Sink Valley above the permit area), Y-38 (coal seam well in Sink Valley permit area), Y-61 (alluvial well at the Sorenson Ranch), and C5-130 (new monitoring well in alluvial groundwater discharge A) will be monitored quarterly when reasonable accessible. Well Y-61 will be monitored for groundwater operational laboratory water quality parameters to monitor groundwater quality in

alluvial groundwater discharge area A. The other wells will be monitored for water level only.

Additionally, 19 newly constructed monitoring wells constructed in the Sink Valley alluvial groundwater system will be monitored quarterly. These include C2-15, C2-28, C2-40, C3-15, C3-30, C3-40, C4-15, C4-30, C4-50, C7-20, C9-15, C9-25, C9-40, LS-28, LS-60, LS-85, SS-15, SS-30, and SS-75. All of these wells will be monitored quarterly for water level. Additionally, wells LS-85 and SS-30 will be monitored for groundwater operational laboratory water quality measurements.

Additionally two wells in the Lower Robinson Creek alluvium will be monitored for water level and groundwater operational laboratory chemistry. These include UR-70 located above proposed mining locations in the Lower Robinson Creek drainage, and LR-45, located below proposed mining areas adjacent to Lower Robinson Creek. It should be noted that LR-45 is located near a proposed sediment pond impoundment. Consequently, if this well becomes unsuitable for monitoring, an alternate location will be used to monitor the Lower Robinson alluvial groundwater system in this area.

Wells C0-18 and C0-54 are located near the initial proposed mining areas in the Lower Robinson Creek drainage. These will be monitored for water level quarterly.

It should be noted that many of the wells specified for monitoring in this monitoring plan will at some point be destroyed or rendered inoperable as the mine workings precede through the area. These wells will be monitored until such a time as they are destroyed or become inoperable.

The possible need for an additional monitoring well located along the east-west permit boundary in Section 30, T39S, R4W has been evaluated. As described in Section 728.332, based on the laboratory analyses of acid and toxic forming materials in the overburden, coal seam, and underburden, it has been determined that discharges from the mine areas will likely be alkaline in character and acid mine drainage will likely not occur. Similarly, the potential for toxic drainage is not anticipated (see Section 728.332). Additionally, given the general east to northeasterly direction of the bedrock dip in the mine area, groundwater migrating through the pit backfill areas after mining will likely migrate down slope in those same directions (to the east). Because the lower portions of the highwalls surrounding the mine pit areas consist of relatively impermeable Tropic Shale bedrock, the potential for migration of appreciable quantities of groundwater from the mine pit fill areas into surrounding unmined areas is low (see Section 728.320). Shallow alluvial groundwater that could potentially migrate to the west is monitored for laboratory water quality parameters at well LR-45. Surface runoff from these areas is monitored for laboratory water quality parameters at site SW-5, which is located in Lower Robinson Creek below the proposed mining areas. For these reasons, the installation and monitoring of an additional monitoring well is not deemed necessary at this time.

Groundwater and surface-water monitoring will continue through the post-mining periods until bond release. The monitoring requirements, including monitoring sites, analytical parameters and the sampling frequency may be modified in the future in consultation with the Division if the data demonstrate that such a modification is warranted.

85.88-acre Dame Lease IBC

In conjunction with highwall mining activities within the 85.88-acre Dame Lease IBC, supplemental water monitoring activities will be performed at selected nearby springs and wells. This will include weekly monitoring of spring discharge rates at sites SP-8, SP-14, SP-20, SP-22, and SP-40, and weekly measurements of water levels in monitoring wells C4, C2, C3, C5, and Y-61. The weekly monitoring at these sites will begin one month prior to the commencement of highwall mining in the 85.88-acre Dame Lease IBC and will continue until one month after highwall mining in the IBC is concluded. Following the period of weekly monitoring, the above specified stations will be monitored monthly for a period of six months. The flow and water level data generated during this period of accelerated monitoring will be sent to the Division of Oil, Gas and Mining as a spreadsheet via e-mail at the end of each month.

In accordance with R645-302.245.230 all holes discharging water will be sealed within 72 hours after completion with impervious and noncombustible material. However, in the approved Ground Control Plan for CHM, MSHA requires the adjacent hole remain open for monitoring of the web. Thus, if an adjacent hole is discharging water and needs to be kept open for web monitoring then the discharge will be tested to determine if it contains acid or toxic-forming material and approvael to keep this hole open for web monitoring will be requested from the Division in accordance with R645-302.245.230.

In order to verify that the highwall mining holes excavated into the 85.88-acre Dame Lease IBC do not cause depletion of the overlying shallow alluvial groundwater systems, the groundwater discharge rate (if any) that occurs from the mouths of the holes within the Dame Lease IBC will be monitored daily. The daily monitoring will commence upon completion of the hole excavation and continue until the hole is sealed. Where it is reasonably possible to do so, the discharge rate measurements will be performed using an appropriate field flow measurement technique (i.e. pipe and a calibrated container, flume, weir, etc.). In areas where the performance of a field discharge measurement is not reasonably possible (i.e. under diffuse seepage conditions or where unconcentrated dispersed flow conditions exist) the discharge rate will be estimated. Discharge rate measurements from the highwall holes will not be performed in areas where such measurements cannot be performed safely. In those areas where the discharge rates cannot safely be measured, this will be noted in the flow record and, where possible, a visual estimate of the discharge rate will be made. Upon approval from the Division, at times when no discharge is occurring from any of the open highwall mining holes in the Dame Lease IBC, discharge measurements will be performed daily on those days that the mine is operating (generally Monday through Friday). Under conditions where

measurable flows are present at any open highwall mining hole in the 85.88-acre Dame Lease IBC, the flow measurements will be performed on a continuous daily basis (7 days a week) until the hole is sealed. The flow data for each hole will be sent to the Division as a spreadsheet via e-mail at the end of each month.

The details of the hydrologic monitoring plan for the North Private Lease area are provided in Appendix 7-16 and are summarized in Tables 7-4, 7-5, 7-6 and 7-7. The locations of surface-water and groundwater monitoring sites in the North Private Lease are shown in Appendix 7-16.

Instruction for the use of the groundwater and surface-water monitoring plans
The hydrologic monitoring plans for groundwaters and surface-waters at the Coal Hollow Mine (including the North Private Lease area) may be used to detect potential impacts to groundwater and surface-water systems that could occur as a result of the proposed operations. Prior to the performance of coal mining and reclamation activities at the mine, baseline monitoring of groundwater and surface-water resources was performed. This has included monitoring water quantity (stream and spring discharge rates and water levels in wells), and water quality (both field and laboratory water quality measurements). The monitoring data may be used by comparing the water quantity and water quality characteristics of groundwaters and surface-waters measured during the operational mining and post-mining periods with that measured during the baseline monitoring period for any parameter of interest to evaluate the nature and magnitude of of any potential impacts (i.e. changes would be indicated by differences between the baseline data and the operational or reclamation phase data). In evaluating potential impacts, it is important that all potential factors which could potentially cause variability in water quantity and/or water quality characteristics be considered. These factors could include short-term or long-term variability in climatic conditions (which may conveniently be evaluated using the Palmer Hydrologic Drought Index as described in Appendix 7-1), changes in land use practices over time, or several other factors. A convenient way to evaluate the water quality characteristics and detect potential impacts to water quality of groundwaters and surface waters is through the use of Stiff diagrams (see Appendix 7-1 for further explanation). Information is also provided by the Utah Division of Oil, Gas and Mining regarding the use of Stiff diagrams (Utah.gov).

731.300. Acid- and Toxic-Forming Materials.

At the existing Coal Hollow Mine and the proposed North Private lease area, drainage from acid- and toxic-forming materials and underground development waste into surface water and ground water will be avoided by identifying and burying and/or treating, when necessary, materials which may adversely affect water quality, or be detrimental to vegetation or to public health and safety if not buried and/or treated.

Materials will be stored in a manner that will protect surface water and ground water by preventing erosion, the formation of polluted runoff and the infiltration of polluted water. Storage will be limited to the period until burial and/or treatment first become feasible, and so long as storage will not result in any risk of water pollution or other environmental damage.

Storage, burial or treatment practices will be consistent with other material handling and disposal provisions of R645 Rules.

During the period of operation of the Coal Hollow Mine, the observed pH of the water that has infrequently been discharged through the UPDES discharge points has consistently been alkaline in nature (UDOGM, 2015). No acid mine discharge has been observed at the Coal Hollow Mine. Measured concentrations of selenium and manganese in the mine discharge water have consistently been low (near the lower laboratory detection limits). Similarly, concentrations of total iron have also usually been low, although on a few occasions slightly elevated concentration of total iron (<1.61 mg/L) in the mine discharge water has been measured. These total iron concentrations are generally associated with suspended solids associated with storm water runoff or snowmelt events.

Based on the overall similarities in the geologic environments at the existing Coal Hollow Mine permit area and the proposed North Private lease area, it is considered likely that mine discharge waters that could potentially be discharged from the North Private Lease would have similar water quality characteristics (i.e. no acid mine drainage and no appreciable toxicity).

731.400. Transfer of Wells

Before final release of bond, exploratory or monitoring wells will be sealed in a safe and environmentally sound manner in accordance with R645-301-631, R645-301-738, and R645-301-765. With the prior approval of the Division, wells may be transferred to another party for further use. However, at a minimum, the conditions of such transfer will comply with Utah and local laws and the permittee will remain responsible for the proper management of the well until bond release in accordance with R645-301-529, R645-301-551, R645-301-631, R645-301-738, and R645-301-765.

731.530 State-appropriated water supply

A water supply well was constructed in the Sink Valley Alluvial groundwater system in October of 2010. The water well is being used as a water supply source for the mine and can also be used for water replacement if needed (also for use if needed as a replacement water source for mining in the 85.88-acre Dame Lease IBC).

731.600 Stream Buffer Zones

Any perennial or intermittent streams in the mine area will be protected by 100 foot stream buffer zones on either side of these streams. Coal mining and reclamation operations will not cause or contribute to the violation of applicable Utah or federal water standards and will not adversely affect the water quality and quantity or other environmental resources of the stream.

Temporary or permanent stream channel diversion will comply with R645-301-742-300. It should be noted that the ~~proposed~~ Coal Hollow Mine plan calls for the temporary diversion of a reach of the Lower Robinson Creek stream channel approximately 2,000 feet in length in the southeast ¼ of Section 19, T39S, R5W. Details of the proposed diversion are given in Chapter 5, Section 527.220 of this MRP. If this action results in diminution of the meager discharge of surface water in the drainage below the planned diversion, where required a suitable mitigation for this potential impact will be designed and implemented in consultation with the Division of Oil, Gas and Mining.

The areas surrounding the streams that are not to be disturbed will be designated as buffer zones, and will be marked as specified in R645-301-521.260.

731.700 Cross sections and Maps

The locations of springs and seeps identified in the ~~proposed~~ Coal Hollow Mine permit and adjacent area are shown in Drawing 7-1. The locations of springs and seeps in the North Private Lease area are shown in Appendix 7-16. The locations of baseline hydrologic monitoring locations (including those for the North Private Lease) are shown on Drawing 7-2. The locations of water rights in the ~~proposed~~ Coal Hollow permit and adjacent area are provided on Drawing 7-3. Water rights in the North Private Lease area are shown on Drawing 7-3N. Cross-sections depicting the stratigraphy and hydrostratigraphy of the ~~proposed~~ Coal Hollow Mine permit and adjacent area are presented in Chapter 6, Drawing 6-2 and in Appendix 7-16. Designs for ~~proposed~~ impoundments in the ~~proposed~~ Coal Hollow permit area are shown in Drawings 5-25 through 5-31 and impoundments in the North Private Lease area are shown in Drawings 5-65 through 5-67.

731.800 Water Rights and Replacement

Alton Coal Development, LLC commits to replace the water supply of an owner of interest in real property who obtains all or part of his or her supply of water for domestic, agricultural, industrial, or other legitimate use from the underground or surface source, where the water supply has been adversely impacted by contamination, diminution, or interruption proximately resulting from the surface mining activities. Baseline hydrologic information required in R645-301-624.100 through R645-301-624.200, R645-301-625, R645-301-626, R645-301-723 through R645-301-724.300, R645-301-724.500, R645-301-725 through R645-301-731, and R645-301-731.210 through R645-301-731.223 will be used to determine the extent of the impact of mining upon ground water and surface water.

Sorensen Spring (SP-40) is the current domestic water supply for the Sorensen Ranch (Personal communication, Darlynn Sorensen, 2008). There is currently no development at the spring that would convey water to the ranch house. Rather, water from the spring is obtained directly from the spring for use at the ranch. Monitoring of discharge rate and water quality is included in the proposed water monitoring plan for the Coal Hollow Mine. The operational and reclamation phase water monitoring protocols for this spring are listed in Tables 7-5 and 7-7A. Should the water source be interrupted, diminished, or contaminated, replacement water will be provided from the new water well that will be constructed prior to the beginning of overburden removal for pits 13, 14, and 15 (see description in section R645-301-727 above, and Drawing 5-8C) or other suitable water replacement source as approved by the Division.

There are no state-appropriated groundwater rights in the North Private Lease area.

As specified in R645-301-112, groundwater quantity will be protected by handling earth materials and runoff in a manner that will restore approximate premining recharge capacity of the reclaimed area as a whole, excluding coal mine waste disposal areas and fills, so as to allow the movement of water to the groundwater system.

732 Sediment Control Measures

Sediment control measures have been designed, constructed and maintained to prevent additional contributions of sediment to streamflow or to runoff outside the permit area.

732.100 Siltation Structures

Siltation structures within the permit area are described in Section 732.200

732.200 Sedimentation Ponds

Four diversion ditches along with five sediment impoundments are proposed for the Coal Hollow permit area. In addition, miscellaneous controls such as silt fence and berms are also proposed for specific areas. The proposed locations for these structures are shown on Drawing 5-3. Details associated with these structures can be viewed on Drawings 5-25 through 5-34 and Appendix 5-2.

Fifteen diversion ditches along with five sediment impoundments are proposed for the North Private Lease permit area. In addition, miscellaneous controls such as berms are also proposed for specific areas. The proposed locations for these structures are shown on Drawing 5-47. Details associated with these structures can be viewed on Drawings 5-67 through 5-71 and Appendix 5-12.

Sedimentation ponds have been designed in compliance with the requirements of R645-301-356.300, R645-301-356.400, R645-301-513.200, R645-301-742.200 through R645-301-742.240, and R645-301-763.

No sedimentation ponds or earthen structures that will remain open are planned.

The sedimentation plan has been designed to comply with the MSHA requirements given under R645-301-513.100 and R645-301-513.200.

732.300 Diversions

The runoff control plan is designed to isolate, to the maximum degree possible, runoff from disturbed areas from that of undisturbed areas. Where possible, this has been accomplished by allowing up-stream runoff to bypass the disturbed area, and routing any runoff from undisturbed areas that enter the disturbed area into a sediment control system.

Four diversion ditches along with five sediment impoundments are proposed for the Coal Hollow permit area. In addition, miscellaneous controls such as silt fence, berms and temporary diversion ditches are also proposed for specific areas. The proposed locations for these structures are shown on Drawing 5-3. Details associated with these structures can be viewed on Drawings 5-25 through 5-34 and Appendix 5-2. All temporary ditches will meet the design requirements of Diversion Ditch 4 (designed for the 100-year, 24 hour storm) and will be adjusted within the permitted active mining area in relation to the active pit, currant spoils pile configuration and reclamation.

Fifteen diversion ditches along with ~~three~~five sediment impoundments are proposed for the North Private Lease permit area. In addition, miscellaneous controls such as silt fences, berms and temporary diversion ditches are also proposed for specific areas. The proposed locations for these structures are shown on Drawing 5-63. Details associated with these structures can be viewed on Drawings 5-67 through 5-71 and Appendix 5-12.

732.400 Road Drainage

All roads will be constructed, maintained and reconstructed to comply with R645-301-742.400. Road drainage facilities include diversion ditches, culverts, containment berms, and/or water bars. Specific plans for road drainage, road construction, and road maintenance are presented in Chapter 5, Section 534 of this MRP.

A description of measures to be taken to obtain division approval for alteration or relocation of a natural drainage way will be presented to the Division when necessary.

A description of measures to be taken to protect the inlet end of a ditch relief culvert will be submitted to the Division when necessary.

All road drainage diversions will be maintained and repaired to operational condition following the occurrence of a large storm event. Culvert inlets and outlets will be kept clear of sediment and other debris.

733 IMPOUNDMENTS

733.100 General Plans

A professional engineer experienced in the design and construction of impoundments with assistance from a geotechnical expert has used current, prudent, engineering practices to design the proposed impoundments.

The plans for the Coal Hollow Mine have been certified and a detailed geotechnical analysis has been provided in Appendix 5-1. The certifications, drawings and cross sections can be viewed in Drawings 5-25 through 5-31 and Appendices 5-1 and 5-2. The plans for the North Private Lease have been certified and a detailed geotechnical analysis has been provided in Appendix 5-11. The certifications, drawings and cross sections can be viewed in Drawings 5-67 through 5-71 and Appendices 5-12.

As requested by the Division, the design criteria of the mine site sediment ponds have been reevaluated in light of groundwater that is being encountered at the site (see Appendix 7-11). It was the determination of this reevaluation that the sediment ponds currently in place meet or exceed the minimum requirements of the Utah Coal Mining Rules and that the construction of additional ponds or the redesigning of existing ponds is not required at this time. Accordingly, the small ephemeral channel tributary to Lower Robinson Creek near the toe of the spoils pile mentioned in the Division Deficiency List (Task No. 3799) has been evaluated as a potential sediment pond site, but the construction of a sediment pond in that location is not required at the current time.

As indicated in Section 728.332, where appreciable alluvial groundwater inflows into the mine pit areas occur and where deemed necessary and possible, alluvial groundwater inflows into the mine pit areas will be diverted away from the mine pit areas through pipes, ditches, or other conveyance methods, minimizing the need for the pumping of mine discharge waters to the sediment ponds. Groundwater that interacts with the Tropic Shale and the Smirl coal seam in the mine pits is considered as mine water and accordingly it will be either routed to Pond #3 or Pond #4 in the Coal Hollow Permit and

Pond #7 in the North Private Lease and subsequently discharged under the approved Coal Hollow Mine UPDES discharge permit, or it will be contained and managed within the pit areas and not discharged.

Depending on prevailing climatic conditions and on the nature and quantity of encountered mine waters, at times it may periodically be necessary to discharge water from the Coal Hollow Mine sediment ponds. The discharges from the ponds will occur in compliance with the approved Coal Hollow Mine UPDES permit (see Appendix 7-12).

Five impoundments are proposed to control storm water runoff and sediment from disturbed areas of the Coal Hollow Mine. Each impoundment is designed to contain the run off from a 100 year, 24 hour duration storm event. The locations of the impoundments and the associated watersheds can be viewed on Drawing 5-26. The following table summarizes the final capacity results for each impoundment:

Coal Hollow Mine Sedimentation Impoundment Capacities

Structure	Storage Required (ac/ft)	Design Storage* (ac/ft)	Percent of requirement	Additional Storage (ac/ft)
1	2.6	3.0	115	0.4
2	1.7	2.3	135	0.6
3	6.3	10.9	173	4.6
4	2.1	5.5	261	3.4
1B	0.5	0.8	160	0.3

Structure 1 is a rectangular impoundment approximately 125.6 feet long by 75.6 feet wide and 9 feet in depth. This impoundment will control storm water run off from the facilities area. The impoundment will be constructed with a 24" drop pipe spillway in order to prevent any oil sheens that may occur from discharging. This impoundment will be incised into the existing ground. Part of the excavated material will be utilized to construct an embankment on the down grade side to provide a minimum of 3 feet freeboard. This pond will control storm water from a watershed of approximately 27 acres. The cleanout and spillway elevation are 6911' and 6920', respectively. The top of the embankment is at elevation 6924'. Details for the design can be viewed on Drawing 5-28.

Structure 1B is a small rectangular impoundment that is approximately 40 feet long by 20 feet wide. This impoundment will control storm water run off from the facilities access road system. The impoundment will be constructed with a 24" drop pipe spillway in order to prevent any oil sheens that may occur from discharging. This impoundment will be incised into the existing ground. Part of the excavated material will be utilized to construct an embankment on the down grade side to provide a minimum of 2 feet freeboard. This pond will control storm water from a watershed of approximately 5 acres. The cleanout and spillway elevation are 6894' and 6906', respectively. The top of the embankment is at elevation 6908'. Details for the design can be viewed on Drawing 5-28B.

Structure 2 is a rectangular impoundment approximately 188 feet long by 36 feet wide and 9 feet in depth. This impoundment will control storm water runoff from the disturbed areas immediately south of Lower Robinson Creek. The impoundment will be constructed with a 24" drop pipe spillway. Part of the excavated material will be utilized to construct an embankment on the down grade side to provide a minimum 3 feet freeboard. This pond will control storm water runoff from a watershed of approximately 74 acres. The cleanout and spillway elevation are 6891' and 6900', respectively. Top of the embankment is at elevation 6903'. Details for the design can be viewed on Drawing 5-29.

Structure 3 is a valley fill impoundment that will impound an area approximately 472 feet long by 229 feet wide and 9 feet deep. The fill for the impoundment will be constructed from an excavation 378 feet wide by 229 feet long and 8 feet deep. The embankment will be constructed in 2 foot lifts utilizing a dozer. The top of the embankment will be a minimum 12 feet wide. This pond will have a decant pipe install at the 6808' elevation that allows for the pond level to be managed and to still be able to contain the 100 year 24 hour event. Also, this pond has a secondary open channel spillway that will have rip-rap min. 6". This pond will control storm water runoff from a watershed of approximately 300 acres, it will also be capable of receiving ground water from the underground in the event it cannot be managed at the underground operation (not considered likely). The cleanout and spillway elevation are 6801' and 6811', respectively. Top of the embankment is at 6813'. Details for the design can be viewed on Drawing 5-30.

Structure 4 is a rectangular pond located at the south end of the permit area that is approximately 90 feet wide by 582 feet long and 12 feet deep. This impoundment will be incised into the existing ground. Part of the excavation will be used to construct a 12 foot wide embankment. The spillway will be an open channel that will have rip-rap min. 6". This pond will control storm water runoff from a watershed of approximately 96 acres. The cleanout and spillway elevation are 6822' and 6834', respectively. Top of the embankment is at elevation 6838'. Details for the design can be viewed on Drawing 5-31.

Open channel spillway details for impoundments 3 and 4 are provided in Drawing 5-32. These spillways are designed for emergencies and are not expected to be used during normal operations.

Five impoundments are proposed to control storm water runoff and sediment from disturbed areas of the North Private Lease. Each impoundment is designed to contain the run off from a 10 year, 24 hour duration storm event. The locations of the impoundments and the associated watersheds can be viewed on Drawing 5-65. The following table summarizes the final capacity results for each impoundment:

North Private Lease Sedimentation Impoundment Capacities				
Structure	Storage Required	Design Storage*	Percent of	Additional

	(ac/ft)	(ac/ft)	requirement	Storage (ac/ft)
5	1.28	1.55	122	0.28
6	1.43	3.15	220	1.71
7	7.11	19.26	271	12.15
8	1.66	7.49	450	5.81
9	2.73	3.42	125	0.68

Structure 5 is a trapezoid impoundment 8 feet in depth. This impoundment will control storm water runoff from the western side of the permit area were mining will begin. The impoundment will be constructed with an 18" primary spillway with an oil skimmer and an open channel secondary spillway that will have 6" D50 rip-rap. This impoundment will be incised into the existing ground. Part of the excavated material will be utilized to construct an embankment on the down grade side to provide a minimum of 2" feet freeboard. This pond will control storm water from a watershed of approximately 18.8 acres. The cleanout and spillway elevation are 6840' and 6848' respectively. The top of the embankment is at elevation 6850'. Details for the design can be viewed on Drawing 5-67.

Structure 6 is a trapezoid impoundment 8 feet in depth. This impoundment will control storm water runoff from the western side of the permit area were mining will begin. The impoundment will be constructed with an 18" primary spillway with an oil skimmer and an open channel secondary spillway that will have 6" D50 rip-rap. This impoundment will be incised into the existing ground. Part of the excavated material will be utilized to construct an embankment on the down grade side to provide a minimum of 2" feet freeboard. This pond will control storm water from a watershed of approximately 24.0 acres. The cleanout and spillway elevation are 6858' and 6866' respectively. The top of the embankment is at elevation 6868'. Details for the design can be viewed on Drawing 5-68.

Structure 7 is a square impoundment 8 feet in depth. This impoundment will control storm water runoff from the western side of the permit area were mining will begin. The impoundment will be constructed with a 24" primary spillway with an oil skimmer and an open channel secondary spillway that will have 9" D50 rip-rap. This impoundment will be incised into the existing ground. Part of the excavated material will be utilized to construct an embankment on the down grade side to provide a minimum of 2" feet freeboard. This pond will control storm water from a watershed of approximately 133.9 acres. The cleanout and spillway elevation are 6840' and 6848' respectively. The top of the embankment is at elevation 6850'. Details for the design can be viewed on Drawing 5-69.

Structure 8 is a triangle impoundment 10 feet in depth. This impoundment will control storm water runoff from the western side of the permit area were mining will begin. The impoundment will be constructed with an 18" primary spillway with an oil skimmer and an open channel secondary spillway that will have 6" D50 rip-rap. This impoundment will be incised into the existing ground. Part of the excavated material will be utilized to construct an embankment on the down grade side to provide a minimum of 2" feet

freeboard. This pond will control storm water from a watershed of approximately 28.4 acres. The cleanout and spillway elevation are 6884' and 6894' respectively. The top of the embankment is at elevation 6896'. Details for the design can be viewed on Drawing 5-70.

Structure 9 is a triangle impoundment 8 feet in depth. This impoundment will control storm water runoff from the western side of the permit area were mining will begin. The impoundment will be constructed with an 18" primary spillway with an oil skimmer and an open channel secondary spillway that will have 6" D50 rip-rap. This impoundment will be incised into the existing ground. Part of the excavated material will be utilized to construct an embankment on the down grade side to provide a minimum of 2" feet freeboard. This pond will control storm water from a watershed of approximately 23.6 acres. The cleanout and spillway elevation are 6856' and 6864' respectively. The top of the embankment is at elevation 6866'. Details for the design can be viewed on Drawing 5-71.

The outer slopes of the impoundments will be sloped to a maximum grade of 3h:1v. Inside slopes will be graded to a maximum 2h:1v. The slopes will be graded and revegetated for erosion control.

No underground mine workings exist near or under the impoundment structures; therefore subsidence surveys are not provided.

Geologic data for the area where impoundments will be located consists of mainly fine grained alluvium with high clay content. Seepage from the impoundments is expected to be minimal based on the high clay content of the existing materials. Characterization of the soils is contained in Chapter 2. Acid and Toxic analysis of the soils indicates that water seeping through the alluvium layer will not result in reducing water quality. The acid and toxic analysis for the alluvium can be viewed in Appendix 6-2.

Hydrologic data for the permit area is provided in Appendix 7-1. This data indicates that there will be some seepage through the subsurface that may travel to adjacent drainages. The quantities for this seepage are expected to be minimal and will have minimal impact to the overall hydrologic balance. Even though seepage may occur, analysis of the soils indicates that water quality will not be diminished.

The above information provides a summary of all the impoundment structures that are ~~proposed~~ for the Coal Hollow Project and North Private Lease. Detailed designs and calculations are provided in this section, Drawings 5-26 through 5-32 and Appendix 5-2. No other impoundments are anticipated.

At some times it may be necessary to discharge water from the sediment ponds. The approved Coal Hollow UPDES permit (Appendix 7-12) allows for discharges.

733.200 Permanent and Temporary Impoundments

All impoundments have been designed and constructed using current, prudent engineering practices and have been designed to comply with the requirements of R645-301-512.240, R645-301-514.300, R645-301-515.200, R645-301-533.100 through R645-301-533.600, R645-301-733.220 through R645-301-733.226, R645-301-743.240, and R645-301-743.

No impoundments or sedimentation ponds meeting the size or other qualifying criteria of MSHA, 30 CFR 77.216(a) exist or are planned within the ~~proposed~~ Mine Permit Area. Should impoundments and sedimentation ponds meeting the size or other qualifying criteria of MSHA, 30 CFR 77.216(a) become necessary, compliance with the requirements of MSHA, 30 CFR 77.216 will be met.

All ten planned impoundments have been evaluated by a professional engineer to ensure stability of each structure. The stability analysis performed resulted in a static safety factor of at least 2.2 for each structure. The details for this analysis can be viewed in Appendix 5-1 for the Coal Hollow Mine and Appendix 5-12 for the North Private Lease.

No permanent impoundments are planned in the project area.

If any examination or inspection discloses that a potential hazard exists, the person who examined the impoundment will promptly inform the Division according R645-301-515.200.

734 Discharge Structures

Discharge structures will be constructed and maintained to comply with R645-301-744.

The proposed impoundments are designed to temporarily store water from storm events and snow melt. Long term standing water in the impoundments is anticipated to be seasonal and sediment will be removed as necessary to provide the required storage capacities. Emergency spillways have been included in the designs to provide a non-destructive discharge route should the capacities ever be exceeded. Surveys of these impoundments will be regularly conducted to ensure that the required design capacities are available.

Impoundments 3 and 4 will be constructed with open channel spillways. These spillways are designed to discharge a 6 hour duration, 100 year storm event even though they are not expected to be used. They will have rip-rap min 6” to minimize erosion and spillway slopes will not exceed 3h:1v. Drawing 5-32 provides the details for the open channel spillways. Also, impoundment 3 will have a decant installed at the 6808 elevation that will allow for the pond level to be managed and to still be able to contain the 100 year 24 hour event.

Impoundments 1, 1B, 2, 5, 6, 7, 8 and 9 will be constructed with a drop pipe spillway system. Storm water and snow melt that occurs within the associated watersheds will be routed to these impoundments to contain sediment. These impoundments will have the drop-pipe spillways installed which will allow removal of any oil sheens that may result from parking lots, primary roads or maintenance activities by using absorbent materials to remove the sheen. The drop-pipe spillways are 24" diameter pipes that are vertical in the impoundment. These pipes have a metal cover over the end. This cover is recessed over the pipe by at least an inch, with a gap between the cover and the pipe. This leaves a route for water to discharge once the impoundment is full but prevents debris or pollutants located on the water surface from discharging. This system was chosen for these three impoundments based on their locations in relation to the facilities and primary roads. This discharge system will be constructed for precautionary measures only since pollutants are not expected in the impoundments during normal operations.

Disposal of Excess Spoil

Areas designated for the disposal of excess spoil and excess spoil structures will be constructed and maintained to comply with R645-301-745.

Details of proposed excess spoil disposal plans are presented in Chapter 5, Section 535 of this MRP and are summarized below.

A geotechnical analysis has been completed for the proposed excess spoil structure. This analysis estimates the long-term safety factor to be 1.6 to 1.7 based on the proposed design. Following proper construction practices of building the structure in maximum four foot lifts and meeting 85% compaction based on the standard Procter will ensure that the structure will be stable under all conditions of construction. This construction will occur only in the designated excess spoil area as shown on Drawing 5-3 and 5-35. The fill will be placed with end dump haul trucks and lifts will be constructed using dozers. High precision GPS systems will be regularly utilized to check grades and appropriate lift thickness. The geotechnical analysis for this structure can be viewed in Appendix 5-1.

The excess spoil is planned to be placed in an area where natural grades range from 0 to 5%. This is one of the most moderately sloping locations in the Permit Area. Stability of this structure is estimated to be 1.6 to 1.7 based on the Appendix 5-1.

Geotechnical borings were completed in the foundation of the proposed disposal area. Laboratory analysis of these borings has also been completed. Details of this analysis can be viewed in Appendix 5-1.

Permanent slopes for the proposed excess spoil will not exceed 3h:1v (33 percent), therefore no keyway cuts have been proposed in the design. Appendix 5-1 details the stability analysis for the proposed structure.

Excess spoil will not be disposed of in underground mine workings.

Horizontal lifts will not exceed four feet in thickness unless otherwise approved by the Division. The lifts will be concurrently compacted to meet 85% of the standard Procter.

The geotechnical analysis (Appendix 5-1), provides information showing that these construction standards will provide mass stability and will prevent mass movement during and after construction. The excess spoil will be graded to provide drainage similar to original flow patterns. Topsoil and subsoil as designated in Chapter 2 will be removed and separated from other materials prior to placement of spoil.

A description of the character of the bedrock and any adverse geologic conditions in presented in Appendix 5-1.

Spring and seep survey information is provided on Drawing 7-1. There are no springs or seeps identified in the excess spoil area.

There are no historical underground mining operations in the proposed excess spoil area. There are future underground operations proposed.

There are no rock chimneys or drainage blankets proposed.

A stability analysis including strength parameters, pore pressures and long-term seepage conditions is presented together with all supporting data in Appendix 5-1.

Neither rock-toe buttresses nor key-way cuts are required under R645-301-535.112 or R645-301-535.113.

No valley fills or head-of-hollow fills are proposed.

No durable rock fills are proposed.

No disposal of waste on preexisting benches is planned

The excess spoil structure and fill above approximate original contour are the only alternative specifications proposed. A geotechnical analysis has been completed for this proposal and can be viewed in Appendix 5-1. All other mined areas will be restored to approximate original contour.

735 Coal Mine Waste

Areas designated for disposal of coal mine waste and coal mine waste structures will be constructed and maintained to comply with R645-301-746.

No structures for the disposal of coal mine waste are planned.

736 Noncoal Mine Waste

Noncoal mine waste will be stored and final disposal of noncoal mine waste will comply with R645-301-747

Noncoal mine waste, including but not limited to grease, lubricants, paints, flammable liquids, garbage, machinery, lumber and other combustible materials generated during coal mining and reclamation operations will be temporarily stored in a controlled manner. Final disposal of noncoal mine wastes will consist of removal from the project area and transportation to a State-approved solid waste disposal area.

Only sizing of the coal is proposed. This process will not produce any waste.

At no time will any noncoal mine waste be deposited in a refuse pile or impounding structure, nor will any excavation for a noncoal mine waste disposal site be located within eight feet of any coal outcrop or coal storage area.

Notwithstanding any other provision to the R645 Rules, any noncoal mine waste defined as "hazardous" under 3001 of the Resource Conservation and Recovery Act (RCRA) (Pub. L. 94-580, as amended) and 40 CFR Part 261 will be handled in accordance with the requirements of Subtitle C of RCRA and any implementing regulations.

Debris, acid-forming, toxic-forming materials and materials constituting a fire hazard will be identified and disposed of in accordance with R645-301-528.330, R645-301-537.200, R645-301-542.740, R645-301-553.100 through R645-301-553.600, R645-301-553.900, and R645-301-747. Appropriate measures will be implemented to preclude sustained combustion of such materials.

Plans do not include using dams, embankments or other impoundments for disposal of coal, overburden, excess spoil or coal mine waste.

738 Temporary Casing and Sealing of Wells

Wells constructed for monitoring groundwater conditions in the ~~proposed~~ Coal Hollow Mine permit and adjacent area, including exploration holes and boreholes used for water wells or monitoring wells, will be designed to prevent contamination of groundwater and surface-water resources and to protect the hydrologic balance. A diagram depicting typical monitoring well construction methods is shown in Drawing 7-11. Monitoring wells will include a protective hydraulic seal immediately above the screened interval, an annular seal plugging the borehole above the hydraulic seal to near the ground surface, and a concrete surface seal extending from the top of the hydraulic seal to the ground surface which is sloped away from the well casing to prevent the entrance of surface flows into the borehole area. Well casings will protrude above the ground surface a sufficient height so as to minimize the potential for the entrance of surface water or other material into the well. A steel surface protector with a locking cover will be installed at monitoring wells to prevent access by unauthorized personnel. Where there is potential for damage to monitoring wells, the wells will be protected through the use of barricades, fences, or other protective devices. These protective devices will be periodically

inspected and maintained in good operating conditions. Monitoring wells will be locked in a closed position between uses.

When no longer needed for monitoring or other use approved by the Division upon a finding of no adverse environmental or health and safety effects, or unless approved for transfer as a water well under R645-301-731.100 through R645-301-731.522 and R645-301-731.800, each well will be capped, sealed, backfilled, or otherwise properly managed, as required by the Division in accordance with R645-301-529.400, R645-301-631.100, and R645-301-748. Permanent closure measures will be designed to prevent access to the mine workings by people, livestock, fish and wildlife, machinery and to keep acid or other toxic drainage from entering ground or surface waters.

If a water well is exposed by coal mining and reclamation operations, it will be permanently closed unless otherwise managed in a manner approved by the Division.

Permanent closure and abandonment of water wells greater than 30 feet in depth will be in accordance with the requirements of "Administrative Rules for Water Well Drillers", State of Utah, Division of Water Rights or other applicable state regulations. Abandonment of wells will be performed by a licensed water well driller. The wells to be abandoned will be completely filled using neat cement grout, sand cement grout, unhydrated bentonite, or bentonite grout, or other materials approved by the Utah State Engineer's office. Alternatively, the well may be abandoned using a different procedure upon approval from the Utah State Engineer's office.

Abandonment materials will be introduced at the bottom of the well or required sealing interval and placed progressively upward to the top of the well. The casing will be severed a minimum of 2 feet below the ground surface. A minimum of 2 feet of compacted native material will be placed above the abandoned well upon completion.

Within 30 days of the completion of well abandonment procedures, a report will be submitted to the State Engineer by the responsible licensed driller giving data related to the abandonment of the well. This shall include the name of the licensed driller or other person(s) performing abandonment procedures, name of well owner at the time of abandonment, the address or location of the well by section, township, and range, abandonment materials and equipment used, water right or file number covering the well, the final disposition of the well, and the date of completion.

Exploration holes and boreholes will be backfilled, plugged, cased, capped, sealed, or otherwise managed to prevent acid or toxic contamination of water resources and to minimize disturbance to the prevailing hydrologic balance. Exploration holes and boreholes will be managed to ensure the safety of people, livestock, fish and wildlife, and machinery.

If any exploration boreholes are to be used as monitoring wells or water wells, these will meet the provisions of R645-301-731

Boreholes will be backfilled to within 1 foot of the land surface with concrete or other materials approved by the Division as necessary to prevent contamination of groundwater or surface-water resources or to protect the prevailing hydrologic balance. The upper approximately 1 foot will be backfilled with native materials to facilitate reclamation (see Drawing 6-11). Exploration holes and boreholes that may be uncovered during mining and reclamation activities will be permanently closed unless approved for water monitoring or otherwise managed in a manner approved by the Division.

740 DESIGN CRITERIA AND PLANS

741 GENERAL REQUIREMENTS

742 SEDIMENT CONTROL MEASURES

742.100 General Requirements

742.110 Design

Appropriate sediment control measures will be designed, constructed and maintained using best technology currently available to prevent to the extent possible, contributions of sediment to stream flow or to runoff outside the permit area; meet the effluent limitations under R645-301-751; and minimize erosion to the extent possible.

Four diversion ditches along with five sediment impoundments are proposed for the Coal Hollow permit area. In addition, miscellaneous controls such as silt fence and berms are also proposed for specific areas. The proposed locations for these structures are shown on Drawing 5-3. Details associated with these structures can be viewed on Drawings 5-25 through 5-34 and Appendix 5-2. These impoundments in combination with the ditches will be the primary method that will be used to control sediment resulting from disturbed areas. In addition to the drawings and Appendix 5-2 , the following is a description of the structures:

A professional engineer experienced in the design and construction of impoundments with assistance from a geotechnical expert has used current, prudent, engineering practices to design the proposed impoundments.

The plans have been certified and a detailed geotechnical analysis has been provided in Appendix 5-1. The certifications, drawings and cross sections can be viewed in Drawings 5-25 through 5-31 and Appendices 5-1 and 5-2.

Five impoundments are proposed to control storm water runoff and sediment from disturbed areas. Each impoundment is designed to contain the run off from a 100 year, 24 hour duration storm event. The locations of the impoundments and the associated watersheds can be viewed on Drawing 5-26. The following table summarizes the final capacity results for each impoundment:

Coal Hollow Mine Sedimentation Impoundment Capacities				
Structure	Storage Required (ac/ft)	Design Storage* (ac/ft)	Percent of requirement	Additional Storage (ac/ft)
1	2.6	3.0	115	0.4
2	1.7	2.3	135	0.6
3	6.3	10.9	173	4.6
4	2.1	5.5	261	3.4
1B	0.5	0.8	160	0.3

Structure 1 is a rectangular impoundment approximately 125.6 feet long by 75.6 feet wide and 9 feet in depth. This impoundment will control storm water run off from the facilities area. The impoundment will be constructed with a 24" drop pipe spillway in order to prevent any oil sheens that may occur from discharging. This impoundment will be incised into the existing ground. Part of the excavated material will be utilized to construct an embankment on the down grade side to provide a minimum of 4 feet freeboard. This pond will control storm water from a watershed of approximately 27 acres. The cleanout and spillway elevation are 6911' and 6920', respectively. The top of the embankment is at elevation 6924'. Details for the design can be viewed on Drawing 5-28.

Structure 1B is a small rectangular impoundment that is approximately 40 feet long by 20 feet wide. This impoundment will control storm water run off from the facilities access road system. The impoundment will be constructed with a 24" drop pipe spillway in order to prevent any oil sheens that may occur from discharging. This impoundment will be incised into the existing ground. Part of the excavated material will be utilized to construct an embankment on the down grade side to provide a minimum of 2 feet freeboard. This pond will control storm water from a watershed of approximately 5 acres. The cleanout and spillway elevation are 6894' and 6906', respectively. The top of the embankment is at elevation 6908'. Details for the design can be viewed on Drawing 5-28B.

Structure 2 is a rectangular impoundment approximately 188 feet long by 36 feet wide and 9 feet in depth. This impoundment will control storm water runoff from the disturbed areas immediately south of Lower Robinson Creek. The impoundment will be constructed with a 24" drop pipe spillway. Part of the excavated material will be utilized to construct an embankment on the down grade side to provide a minimum 3 feet freeboard. This pond will control storm water runoff from a watershed of approximately 74 acres. The cleanout and spillway elevation are 6891' and 6900', respectively. Top of the embankment is at elevation 6903'. Details for the design can be viewed on Drawing 5-29.

Structure 3 is a valley fill impoundment that will impound an area approximately 484 feet long by 229 feet wide and 9 feet deep. The fill for the impoundment will be constructed from an excavation 198 feet wide by 229 feet long and 8 feet deep. The embankment will be constructed in 2 foot lifts utilizing a dozer. The top of the embankment will be a minimum 12 feet wide. This pond will have a decant pipe install at the 6808' elevation

that allows for the pond level to be managed and to still be able to contain the 100 year 24 hour event. Also, this pond has a secondary open channel spillway that will have rip-rap min. 6. This pond will control storm water runoff from a watershed of approximately 300 acres, it will also be capable of receiving ground water from the underground in the event it cannot be managed at the underground operation (not considered likely). The cleanout and spillway elevation are 6801' and 6810', respectively. Top of the embankment is at 6814'. Details for the design can be viewed on Drawing 5-30.

Structure 4 is a rectangular pond located at the south end of the permit area that is approximately 90 feet wide by 582 feet long and 12 feet deep. This impoundment will be incised into the existing ground. Part of the excavation will be used to construct a 12 foot wide embankment. The spillway will be an open channel that will have rip-rap min. 6. This pond will control storm water runoff from a watershed of approximately 96 acres. The cleanout and spillway elevation are 6822' and 6834', respectively. Top of the embankment is at elevation 6838'. Details for the design can be viewed on Drawing 5-31.

Open channel spillway details for impoundments 3 and 4 are provided in Drawing 5-32. These spillways are designed for emergencies and are not expected to be used during normal operations.

Five impoundments are proposed to control storm water runoff and sediment from disturbed areas of the North Private Lease. Each impoundment is designed to contain the run off from a 10 year, 24 hour duration storm event. The locations of the impoundments and the associated watersheds can be viewed on Drawing 5-65. The following table summarizes the final capacity results for each impoundment:

North Private Lease Sedimentation Impoundment Capacities

Structure	Storage Required (ac/ft)	Design Storage* (ac/ft)	Percent of requirement	Additional Storage (ac/ft)
5	1.28	1.55	122	0.28
6	1.43	3.15	220	1.71
7	7.11	19.26	271	12.15
8	1.66	7.49	450	5.81
9	2.73	3.42	125	0.68

Structure 5 is a trapezoid impoundment 8 feet in depth. This impoundment will control storm water runoff from the western side of the permit area were mining will begin. The impoundment will be constructed with an 18" primary spillway with an oil skimmer and an open channel secondary spillway that will have 6" D50 rip-rap. This impoundment will be incised into the existing ground. Part of the excavated material will be utilized to construct an embankment on the down grade side to provide a minimum of 2" feet freeboard. This pond will control storm water from a watershed of approximately 18.8 acres. The cleanout and spillway elevation are 6840' and 6848' respectively. The top of

the embankment is at elevation 6850'. Details for the design can be viewed on Drawing 5-67.

Structure 6 is a trapezoid impoundment 8 feet in depth. This impoundment will control storm water runoff from the western side of the permit area were mining will begin. The impoundment will be constructed with an 18" primary spillway with an oil skimmer and an open channel secondary spillway that will have 6" D50 rip-rap. This impoundment will be incised into the existing ground. Part of the excavated material will be utilized to construct an embankment on the down grade side to provide a minimum of 2" feet freeboard. This pond will control storm water from a watershed of approximately 24.0 acres. The cleanout and spillway elevation are 6858' and 6866' respectively. The top of the embankment is at elevation 6868'. Details for the design can be viewed on Drawing 5-68.

Structure 7 is a square impoundment 8 feet in depth. This impoundment will control storm water runoff from the western side of the permit area were mining will begin. The impoundment will be constructed with a 24" primary spillway with an oil skimmer and an open channel secondary spillway that will have 9" D50 rip-rap. This impoundment will be incised into the existing ground. Part of the excavated material will be utilized to construct an embankment on the down grade side to provide a minimum of 2" feet freeboard. This pond will control storm water from a watershed of approximately 133.9 acres. The cleanout and spillway elevation are 6840' and 6848' respectively. The top of the embankment is at elevation 6850'. Details for the design can be viewed on Drawing 5-69.

Structure 8 is a triangle impoundment 10 feet in depth. This impoundment will control storm water runoff from the western side of the permit area were mining will begin. The impoundment will be constructed with an 18" primary spillway with an oil skimmer and an open channel secondary spillway that will have 6" D50 rip-rap. This impoundment will be incised into the existing ground. Part of the excavated material will be utilized to construct an embankment on the down grade side to provide a minimum of 2" feet freeboard. This pond will control storm water from a watershed of approximately 28.4 acres. The cleanout and spillway elevation are 6884' and 6894' respectively. The top of the embankment is at elevation 6896'. Details for the design can be viewed on Drawing 5-70.

Structure 9 is a triangle impoundment 8 feet in depth. This impoundment will control storm water runoff from the western side of the permit area were mining will begin. The impoundment will be constructed with an 18" primary spillway with an oil skimmer and an open channel secondary spillway that will have 6" D50 rip-rap. This impoundment will be incised into the existing ground. Part of the excavated material will be utilized to construct an embankment on the down grade side to provide a minimum of 2" feet freeboard. This pond will control storm water from a watershed of approximately 23.6 acres. The cleanout and spillway elevation are 6856' and 6864' respectively. The top of the embankment is at elevation 6866'. Details for the design can be viewed on Drawing 5-71.

The outer slopes of the impoundments will be sloped to a maximum grade of 3h:1v. Inside slopes will be graded to a maximum 2h:1v. The slopes will be graded and revegetated for erosion control.

No underground mine workings exist near or under the impoundment structures; therefore subsidence surveys are not provided.

Geologic data for the area where impoundments will be located consists of mainly fine grained alluvium with high clay content. Seepage from the impoundments is expected to be minimal based on the high clay content of the existing materials. Characterization of the soils is contained in Chapter 2. Acid and Toxic analysis of the soils indicates that water seeping through the alluvium layer will not result in reducing water quality. The acid and toxic analysis for the alluvium can be viewed in Appendix 6-2.

Hydrologic data for the permit area is provided in Appendix 7-1. This data indicates that there will be some seepage through the subsurface that may travel to adjacent drainages. The quantities for this seepage are expected to be minimal and will have minimal impact to the overall hydrologic balance. Even though seepage may occur, analysis of the soils indicates that water quality will not be diminished.

Sedimentation ponds have been designed in compliance with the requirements of R645-301-356.300, R645-301-356.400, R645-301-513.200, R645-301-742.200 through R645-301-742.240, and R645-301-763.

No sedimentation ponds or earthen structures that will remain open are planned.

The sedimentation plan has been designed to comply with the MSHA requirements given under R645-301-513.100 and R645-301-513.200.

The diversions ditches for the Coal Hollow Mine will be utilized to direct runoff from disturbed areas to the sediment impoundments. The channel sizing for the four ~~proposed~~ diversion ditches has been evaluated using the TR-55 method to determine peak flows and the Manning's Equation (ME) to determine appropriate dimensions. The TR-55 method of analysis is the same method used to size impoundments and was utilized in this case to provide a peak flow for each diversion during a 100 year, 24 hour storm event. This peak flow was then input into the ME to determine an appropriate open channel design for minimizing the effects of erosion during peak flows. Similar to the impoundment sizing, the Carlson Software Hydrology module was utilized to perform these calculations. The ditch locations, designs and cross sections can be viewed on Drawings 5-33 and 5-34.

The following table summarizes the inputs and results for each diversion based on flows during a 100 year, 24 hour storm event:

Coal Hollow Mine Diversion Ditch Summary							
Ditch	*Base	Manning's	Average	Peak Flow	Flow	Velocity	Freeboard

	(ft)	n	Slope (%)	(cfs)	Depth (ft)	(fps)	(ft)
1	3.0	0.020	2.8	14.8	0.5	6.8	0.3
2	2.5	0.020	3.5	6.9	0.4	6.0	0.3
3	4.5	0.020	2.4	16.7	0.5	6.3	0.3
4	5.0	0.020	1.8	19.8	0.6	5.4	0.3

*All side slopes are 2h:1v

The diversions ditches for the North Private Lease will be utilized to direct runoff from disturbed areas to the sediment impoundments. The channel sizing for the fifteen diversion ditches has been evaluated using the TR-55 method to determine peak flows and the Manning's Equation (ME) to determine appropriate dimensions. The TR-55 method of analysis is the same method used to size impoundments and was utilized in this case to provide a peak flow for each diversion during a 10 year, 6 hour storm event. This peak flow was then input into the ME to determine an appropriate open channel design for minimizing the effects of erosion during peak flows. The ditch locations, designs and cross sections can be viewed on Drawings 5-65, 5-72 and 5-73.

The following table summarizes the inputs and results for each diversion based on flows during a 10 year, 6 hour storm event:

North Private Lease Diversion Ditch Summary							
Ditch	*Base (ft)	Manning's n	Average Slope (%)	Peak Flow (cfs)	Flow Depth (ft)	Velocity (fps)	Freeboard (ft)
DD-5	0.0	0.025	5.21	0.60	0.29	3.50	0.71
DD-6	0.0	0.025	6.22	0.20	0.19	2.85	0.81
DD-7	0.0	0.025	4.84	0.28	0.22	2.82	0.78
DD-8	0.0	0.025	5.16	0.28	0.22	2.89	0.78
DD-9	0.0	0.025	8.42	0.80	0.30	4.51	0.70
DD-10	0.0	0.025	2.67	0.80	0.37	2.93	0.63
DD-11	0.0	0.025	6.07	0.51	0.27	3.56	0.83
DD-12	0.0	0.025	7.00	1.15	0.35	4.61	0.65
DD-13	0.0	0.025	2.04	3.32	0.66	3.78	0.84
UD-14	0.0	0.025	1.28	1.09	0.48	2.40	0.32
UD-15	0.0	0.025	7.35	0.10	0.14	2.55	0.86
DD-16	0.0	0.025	2.15	4.54	0.74	4.17	0.76
DD-17	0.0	0.025	2.12	1.28	0.46	3.02	0.34
UD-18	0.0	0.025	12.06	0.20	0.17	3.65	0.83
UD-19	0.0	0.025	1.99	0.59	.035	2.43	0.65

*All side slopes are 2h:1v

The sedimentation plan has been designed to comply with the MSHA requirements given under R645-301-513.100 and R645-301-513.200.

These structures will retain sediment within the disturbed area. The diversion ditches are designed in manner that will minimize erosion of the channels and will divert runoff from

disturbed areas to the impoundments. These sediment control measures are designed to meet the effluent limitations under R645-301-751.

742.126

Water encountered underground will be stored and treated as needed in underground sumps. It is anticipated most or all of such water would be utilized in the underground mining operation. Excess water would only be discharged after meeting applicable UPDES standards.

742.200 Siltation Structures

Siltation structures have been designed in compliance with the requirements of R645-301-742.

Miscellaneous controls such as silt fence and berms are proposed for specific areas. The proposed locations for these structures are shown on Drawing 5-26. Details associated with these structures can be viewed on Drawings 5-25 through 5-34 and Appendix 5-2 for the Coal Hollow Mine. The proposed locations for these structures are shown on Drawing 5-47. Details associated with these structures can be viewed in Appendix 5-13 for the North Private Lease.

742.210 General Requirements

Additional contributions of suspended solids and sediment to streamflow or runoff outside the permit area will be prevented to the extent possible using the best technology currently available. Siltation structures for an area will be constructed before beginning any coal mining and reclamation operations in that area and, upon construction, will be certified by a qualified registered professional engineer to be constructed as designed and as approved in the reclamation plan. Any siltation structures which impounds water will be designed, constructed and maintained in accordance with R645-301-512.240, R645-301-514.300, R645-301-515.200, R645-301-533.100 through R645-301-533.600, R645-301-733.220 through R645-301-733.224, and R645-301-743.

The primary controls for limiting suspended solids and sediment to stream flow and runoff outside the permit area is sediment impoundments and diversions ditches. The proposed system described in section 742.110 is designed to control storm water/runoff discharges from the disturbed areas. Discharges from this system are expected to be minimal and infrequent. Discharges that may occur will comply with R645-301-751.

The impoundment and ditch system will be inspected regularly and discharges will be sampled for water quality purposes.

742.214

Water encountered underground will be stored and treated as needed in underground sumps. It is anticipated most or all of such water would be utilized in the underground

mining operation. Excess water would only be discharged after meeting applicable UPDES standards.

742.220 Sedimentation Ponds.

742.221.1 The proposed sediment ponds are designed to be used individually

742.221.2 The locations for the sediment ponds were selected to be as near as possible to the disturbed areas and are not located in perennial streams

742.221.3 The ponds are designed and will be constructed and maintained to:

742.221.31 The ponds for the Coal Hollow Mine have been designed with excess capacity by at least 15% to allow for adequate sediment storage volume. The following table provides the design capacities in relation to a 24 hour duration, 100 year storm event:

Coal Hollow Mine Sedimentation Impoundment Capacities				
Structure	Storage Required (ac/ft)	Design Storage* (ac/ft)	Percent of requirement	Additional Storage (ac/ft)
1	2.6	3.0	115	0.4
2	1.7	2.3	135	0.6
3	6.3	10.9	173	4.6
4	2.1	5.5	261	3.4
1B	0.5	0.8	160	0.3

The ponds for the North Private Lease have been designed with excess capacity to allow for 3 years of sediment storage volume. The following table provides the design capacities in relation to a 24 hour duration, 10 year storm event:

North Private Lease Sedimentation Impoundment Capacities				
Structure	Storage Required (ac/ft)	Design Storage* (ac/ft)	Percent of requirement	Additional Storage (ac/ft)
5	1.28	1.55	122	0.28
6	1.43	3.15	220	1.71
7	7.11	19.26	271	12.15
8	1.66	7.49	450	5.81
9	2.73	3.42	125	0.68

These sedimentation ponds will be surveyed at least annually to ensure that sufficient sediment storage is available in the impoundment. Sediment will be removed from the ponds as required based on results from the surveys. Calculations related to these design capacities can be viewed in Appendix 5-2 for the Coal Hollow Mine and in Appendix 5-12 for the North Private Lease. Stage-

Storage curves for each pond can be viewed on Drawings 5-28 through 5-31 and 5-65 through 5-67.

742.221.32 The sedimentation ponds in the Coal Hollow Mine are designed to provide detention for a 100 year, 24 hour duration storm event. Calculations for this design can be viewed in Appendix 5-2. The sedimentation ponds in the North Private Lease are designed to provide detention for a 10 year, 24 hour duration storm event. Calculations for this design can be viewed in Appendix 5-12. This design standard is expected to keep discharges from the structure at a minimum and allow adequate settlement time to meet Utah and federal effluent limitations. In the event it becomes necessary to decant water to satisfy the required storage volumes, ACD will use a 4" gasoline driven pump to decant excess water. Water will be required to remain in the pond for a minimum of 24 hours prior to the beginning of decant operations and be discharged through the discharge point approved under UPEDES permit No. UTG04027 following all applicable monitoring protocol under this permit.

742.221.33 The sedimentation ponds at the Coal Hollow Mine are designed for a 100 year, 24 hour storm event which significantly exceeds a 10 year, 24 hour precipitation event. The 100 year, 24 hour event in the Alton area is 3.1 inches of precipitation. The sedimentation ponds at the North Private Lease are designed for a 10 year, 24 hour storm event. The 10 year, 24 hour precipitation event in this same location is approximately 2.0 inches of precipitation. The design standard used for the Coal Hollow project is 155% of the precipitation for the required "design event".

742.221.34 Each pond will be constructed with an emergency spillway, should the capacities of the ponds ever be exceeded. These spillways will provide a nondestructive route for storm water discharge, though the capacities of the ponds are not expected to be exceeded. The design capacities of the ponds are expected to contain each storm event and therefore will provide sufficient detention time to meet Utah and federal effluent limitations. The following is a description of each spillway:

Impoundments 3 and 4 will be constructed with open channel spillways. These spillways are designed to discharge a 24 hour duration, 100 year storm event even though they are not expected to be used during normal operations. They will have rip-rap min. 6" to minimize erosion and spillway slopes will not exceed 3h:1v. Drawing 5-32 provides the details for the open channel spillways.

Impoundments 1, 1B, and 2 will be constructed with a drop pipe spillway system. Storm water and snow melt that occurs within the associated watersheds will be routed to these impoundments to

contain sediment. These impoundments will have the drop-pipe spillways installed which will allow removal of any oil sheens that may result from parking lots, primary roads or maintenance activities by using absorbent materials to remove the sheen. The drop-pipe spillways are 24" diameter pipes that are vertical in the impoundment. These pipes have a metal cover over the end. This cover is recessed over the pipe by at least an inch, with a gap between the cover and the pipe. This leaves a route for water to discharge once the impoundment is full but prevents debris or pollutants located on the water surface from discharging. This system was chosen for these two impoundments based on their locations in relation to the facilities and primary roads. This discharge system will be constructed for precautionary measures only since pollutants are not expected in the impoundments during normal operations.

Impoundments 5, 6, 7, 8 and 9 will be constructed with a drop pipe primary spillway and an open channel emergency spillways system. Storm water and snow melt that occurs within the associated watersheds will be routed to these impoundments to contain sediment. The drop-pipe spillways are 18" diameter pipes for impoundments 5, 6, 8 and 9 and a 24" diameter pipe for impoundment 7 that are vertical in the impoundment. These pipes have a metal cover over the end. This cover is recessed over the pipe by at least an inch, with a gap between the cover and the pipe. This leaves a route for water to discharge once the impoundment is full but prevents debris or pollutants located on the water surface from discharging. The open channel emergency spillways are designed to discharge a 6 hour duration, 25 year storm event even though they are not expected to be used during normal operations. Impoundments 5, 6, 8 and 9 will have 6" rip-rap (D-50) and impoundment 7 will have 9" rip-rap (D-50) with erosion control fabric beneath to minimize erosion and spillway slopes will not exceed 3h:1v

742.221.35 Regular inspections of the sediment pond system during construction and operations will identify any deficiencies that could cause short circuiting. Design standards for the system will ensure proper functioning during extreme storm events which makes it highly unlikely that issues related to short circuiting could occur during normal operations.

742.221.36 Surveys of the pond system will be conducted at least annually. These surveys will be compared against the required "design event" capacity for each pond. Sediment removal will occur as needed to maintain the required capacity.

742.221.37 Geologic conditions in the areas where sediment ponds will be constructed are suitable to the proposed use. Excessive settling of the ponds is not expected based on the high clay content of the soils. Embankments will be constructed in maximum two foot lifts to promote compaction during the construction process, reducing settling during operations. Supporting data for compaction can be viewed in Appendix 5-1.

742.221.38 Any sod, large roots, and/or frozen soil will be removed from sedimentation ponds. No coal processing will be conducted as part of the Coal Hollow Project; therefore wastes from this type of process will not be present.

742.221.39 Embankments will be constructed in maximum two foot lifts to promote compaction during the construction process, reducing settling during operations. Supporting data for this compaction method can be viewed in Appendix 5-1.

742.222 Sedimentation ponds for the Coal Hollow ~~Project~~ Mine or the North Private Lease do not meet the size or other qualifying standard for MSHA, 30 CFR 77.216(a).

742.223 Each sedimentation pond at the Coal Hollow Mine will be constructed with a spillway that will function as both the emergency and principle spillway. Each of these spillways will safely discharge a 25 year, 6 hour precipitation event. The following table summarizes the spillway discharge designs in relation to the 25 year, 6 hour precipitation event:

Sediment Impoundment – Spillway Flow Capacities		
Impoundment	Required Spillway Discharge (cfs)	Designed Spillway Discharge (cfs)
1	30.4	37.4
2	0.8	30.5
3	2.8	11.5
4	2.4	11.5
1B	6.06	23.9

The drop pipe spillways for impoundments 1, 1B, and 2 will be of nonerodible construction. The open channel spillways for impoundments 3 and 4 will be rip-rap min. 6" and are designed to carry short-term, infrequent flows at non erosive velocities where sustained flows are not expected.

742.224 Each sedimentation pond at the North Private Lease will be constructed with a principle spillway and an emergency spillway. Each of these spillways will safely discharge a 25 year, 6 hour precipitation event. The

following table summarizes the spillway discharge designs in relation to the 25 year, 6 hour precipitation event:

Sediment Impoundment – Primary Spillway Flow Capacities		
Impoundment	Required Spillway Discharge (cfs)	Designed Spillway Discharge (cfs)
5	2.23	9.66
6	2.85	9.66
7	10.11	20.80
8	3.42	9.66
9	3.60	9.66

The drop pipe spillways for all impoundments will be of nonerodible construction. The open channel spillways for impoundments 5, 6, 8 and 9 will be rip-rap (D50) 6" underlain with erosion fabric and are designed to carry sustained flows. The open channel spillways for impoundment 7 will be rip-rap (D50) 9" underlain with erosion fabric and is designed to carry sustained flows.

~~742.224~~742.225 Either the requirements of 742.223.1 or 742.223.2 will be met for each sediment impoundment.

~~742.225~~742.226 No exceptions to the sediment pond location guidance are requested

742.230 Other Treatment Facilities

If other treatment facilities become necessary, they will be designed to treat the 10-year, 24-hour precipitation event unless a lesser design event is approved by the Division based on terrain, climate, other site-specific conditions and a demonstration by the operator that the effluent limitations of R645-301-751 will be met.

No other treatment facilities are planned for the Coal Hollow Project.

742.240 Exemptions

Not Applicable

742.300 Diversions

742.310 General Requirements

742.311 There are no flows from mined areas that have been abandoned prior to May 3, 1978 at the Coal Hollow Project. Diversions at the Coal Hollow Project are planned to minimize water from disturbed areas from directly discharging into drainages without first being treated and to also prevent

water from upland, adjacent areas from entering the project area. Four temporary diversion ditches are planned and one temporary diversion of Lower Robinson Creek. Two diversions will be primarily used to route water from upland, undisturbed areas away from the planned disturbed areas. Diversion ditch 2 has been split to minimize the amount of water from upland routed to Pond 2 (see drawing 5-34), 2B will route water from upland to Lower Robinson Creek and 2A will route water from disturbed area to Pond 2. Diversion ditch 4 is planned to direct water from disturbed areas into sediment impoundment Pond 4. The temporary diversion of Lower Robinson Creek is for maximum recovery of coal and will route flows around the mining area. Each temporary diversion has been designed to only carry runoff from areas that will or potentially could be affected by the mining operations, except Lower Robinson Creek diversion which will carry intermittent flows from the upstream watershed. Diversion locations were selected to generally carry runoff to the drainage paths that the precipitation would originally follow. These parameters were followed in the designs to minimize impacts to the overall hydrological balance within the permit and adjacent areas. Diversions will not be used to route water into underground mines. Specific design parameters are discussed in the following sections (R645-301-742.312.1 to 742.314). There are no flows from mined areas that have been abandoned prior to May 3, 1978 at the North Private Lease. Diversions at the North Private Lease are planned to minimize water from disturbed areas from directly discharging into drainages without first being treated and to also prevent water from upland, adjacent areas from entering the project area. Fifteen temporary diversion ditches are planned. Four diversions will be primarily used to route water from upland, undisturbed areas away from the planned disturbed areas. Each temporary diversion has been designed to only carry runoff from areas that will or potentially could be affected by the mining operations. Diversion locations were selected to generally carry runoff to the drainage paths that the precipitation would originally follow. These parameters were followed in the designs to minimize impacts to the overall hydrological balance within the permit and adjacent areas. Diversions will not be used to route water into underground mines. Specific design parameters are discussed in the following sections (R645-301-742.312.1 to 742.314).

742.312

The construction of and the operational activities at the proposed alluvial groundwater interceptor trench systems will be performed according to good engineering practices and in compliance with all applicable State and Federal rules. To ensure the safety of construction personnel during construction of the drain systems, work will be performed primarily by the equipment operators from within the operator compartments of the

employed equipment. Equipment operators will be adequately trained on the hazards associated with the excavation work at the drain sites. Construction personnel will not be allowed to enter excavated trench areas during the drain construction operations other than as allowed by applicable State and Federal laws and regulations. Where necessary, work outside of equipment operator compartments will be performed in a prudent and safe manner. The excavated drain areas will be promptly backfilled after the drain construction materials have been emplaced.

A physical barrier will be constructed and maintained at alluvial groundwater interceptor drain discharge structures to prevent mine personnel from falling into the discharge structure.

742.312 Each diversion in the Coal Hollow Mine was designed to ensure stability and to minimize erosion. In order to accomplish this standard, the diversions were each designed for peak flows during a 100 year, 24 hour storm event. The following summarizes the steps used:

The channel sizing for the four proposed temporary diversion ditches has been evaluated using the TR-55 method to determine peak flows and the Manning's Equation (ME) to determine appropriate dimensions. The TR-55 method of analysis is the same method used to size impoundments and was utilized in this case to provide a peak flow for each diversion during a 100 year, 24 hour storm event. This peak flow was then input into the ME to determine an appropriate open channel design for minimizing the effects of erosion during peak flows. Similar to the impoundment sizing, the Carlson Software Hydrology module was utilized to perform these calculations. The ditch locations, designs and cross sections can be viewed on Drawings 5-33 and 5-34.

The following table summarizes the inputs and results for each diversion based on flows during a 100 year, 24 hour storm event:

Diversion Ditch Summary							
Ditch	*Base (ft)	Manning's n	Average Slope (%)	Peak Flow (cfs)	Flow Depth (ft)	Velocity (fps)	Freeboard (ft)
1	3.0	0.020	2.8	14.8	0.5	6.8	0.3
2	2.5	0.020	3.5	6.9	0.4	6.0	0.3
3	4.5	0.020	2.4	16.7	0.5	6.3	0.3
4	5.0	0.020	1.8	19.8	0.6	5.4	0.3

*All side slopes are 2h:1v

The diversions ditches for the North Private Lease will be utilized to direct runoff from disturbed areas to the sediment impoundments. The channel sizing for the fifteen diversion ditches has been evaluated using the TR-55 method to determine peak flows

and the Manning's Equation (ME) to determine appropriate dimensions. The TR-55 method of analysis is the same method used to size impoundments and was utilized in this case to provide a peak flow for each diversion during a 10 year, 6 hour storm event. This peak flow was then input into the ME to determine an appropriate open channel design for minimizing the effects of erosion during peak flows. The ditch locations, designs and cross sections can be viewed on Drawings 5-65, 5-72 and 5-73.

The following table summarizes the inputs and results for each diversion based on flows during a 10 year, 6 hour storm event:

North Private Lease Diversion Ditch Summary							
Ditch	*Base (ft)	Manning's n	Average Slope (%)	Peak Flow (cfs)	Flow Depth (ft)	Velocity (fps)	Freeboard (ft)
DD-5	0.0	0.025	5.21	0.60	0.29	3.50	0.71
DD-6	0.0	0.025	6.22	0.20	0.19	2.85	0.81
DD-7	0.0	0.025	4.84	0.28	0.22	2.82	0.78
DD-8	0.0	0.025	5.16	0.28	0.22	2.89	0.78
DD-9	0.0	0.025	8.42	0.80	0.30	4.51	0.70
DD-10	0.0	0.025	2.67	0.80	0.37	2.93	0.63
DD-11	0.0	0.025	6.07	0.51	0.27	3.56	0.83
DD-12	0.0	0.025	7.00	1.15	0.35	4.61	0.65
DD-13	0.0	0.025	2.04	3.32	0.66	3.78	0.84
UD-14	0.0	0.025	1.28	1.09	0.48	2.40	0.32
UD-15	0.0	0.025	7.35	0.10	0.14	2.55	0.86
DD-16	0.0	0.025	2.15	4.54	0.74	4.17	0.76
DD-17	0.0	0.025	2.12	1.28	0.46	3.02	0.34
UD-18	0.0	0.025	12.06	0.20	0.17	3.65	0.83
UD-19	0.0	0.025	1.99	0.59	.035	2.43	0.65

*All side slopes are 2h:1v

As shown in the above tables, flow depths will be shallow, flow velocity will be manageable for temporary flow conditions and sufficient freeboard will be present during a flood event. These conditions will provide diversion stability, protection against flooding and prevent to the extent possible additional contributions of suspended solids to streamflow outside the permit area. These diversions are designed to comply with all applicable local, Utah and federal laws and regulations. Further details related to the temporary diversion designs can be viewed in Appendix 5-2 and Appendix 5-12.

Based on the size of the watershed for Lower Robinson Creek, a different method of analysis was used than the method used for the other diversions. The HEC-1 program was used for this analysis and extra erosion protection has been included as part of the design. The channel was designed to safely handle the flows from a 100 year, 6 hour storm

event. This diversion will be further discussed in section 742.320 Diversion of Perennial and Intermittent Streams.

742.313 The four temporary diversions at the Coal Hollow Mine will be reclaimed when they are no longer necessary. This will occur once final reclamation is determined to be sufficient within the project area and the sediment impoundments are no longer needed. This is anticipated to occur in the fourth year of operations.

The Lower Robinson Creek temporary diversion will be constructed in a responsible manner. This diversion will experience some erosion during flood events but erosion rates are expected to be generally less than those in the original channel above and below the diversion. The detailed design for this diversion can be viewed in Drawings 5-20 and 21. Calculations related to this diversion design can be viewed in Appendix 5-3.

The fifteen temporary diversions at the North Private Lease will be reclaimed when they are no longer necessary. This will occur once final reclamation is determined to be sufficient within the project area and the sediment impoundments are no longer needed. This is anticipated to occur in the sixth year of operations.

742.320 Diversion of Perennial and Intermittent Streams.

742.321 Temporary diversion of one intermittent stream is planned for the Coal Hollow Project. The planned diversion is in a length of the stream that appreciable flows only occur during storm events and snow melt periods. This diversion is necessary to recover coal located in the northwest corner of the project area. The diversion would provide mining in an area that is 22 acres and contains approximately 400,000 tons of recoverable coal. Without this diversion, most of this area could not be mined.

742.322 The original unmodified channel immediately upstream and downstream from the Lower Robinson Creek diversion has excessive erosion and is not in stable condition. The channel has incised deeply and has developed into a channel that has a capacity significantly greater than any anticipated storm events. Since these conditions are not desirable for the area, the diversion design instead has dimensions that are suitable to pass a 100 year, 6 hour storm event in compliance with R645-301-742.323.

742.323 The temporary Lower Robinson Creek diversion has been designed to safely pass a 100 year, 6 hour storm event. The watershed for this drainage is 3.64 square miles and has a peak flow of 83.5 cubic feet per second during a 100 year, 6 hour event. Minimum dimensions for

carrying this flow was found to be a channel that has the following dimensions:

Bottom width: 2 feet
Side slopes: 3h:1v
Minimum slope height: 3 feet (1 foot freeboard added)

Details related to the design calculations are provided in Appendix 5-3. Rip-rap will be appropriately placed to minimize erosion of the channel.

Cross sections of the channel design are shown in Drawing 5-21. As shown in the drawing, all sections of the diversions exceed the minimum design standard. A plan view of the diversion design can be viewed in Drawing 5-20.

742.324 Design of the Lower Robinson Creek Diversion has been certified by a qualified registered professional engineer.

742.330 Diversion of Miscellaneous Flows.

742.323

As part of the reclamation process, Lower Robinson Creek will be reconstructed to its approximate original location. The design for this reconstruction is shown on Drawings 5-20A and 5-21A. This design includes considerable improvements to the channel compared to the channel's current condition. The current condition is such that less than 25% of the channel within the disturbed area has a flood plain present and most of the slopes are near the angle of repose with fair to poor vegetative cover. The reconstructed sides of the channel for the entire length reconstructed. Sharp corners in the original alignment have been rounded to sinuous curve shapes and rip-rap will be installed in the bottom section of the channel to minimize erosion. The flood plain will be seeded and covered with erosion matting to control erosion until natural vegetative condition can be attained.

742.331 Diversion of miscellaneous flows at the Coal Hollow Mine is planned using four diversion ditches. Two diversions will be primarily used to route runoff from upland, undisturbed areas away from the planned disturbed areas. Diversion ditch 2 has been split to minimize the amount of water from upland routed to Pond 2 (see drawing 5-34), 2B will route water from upland to Lower Robinson Creek and 2A will route water from disturbed area to Pond 2. Diversion ditch 4 is planned to direct water from disturbed areas into sediment impoundment Pond 3. The locations of these diversions along with the associated watersheds can be viewed on Drawings 5-27, 5-33 and 5-34. Calculations related to the diversions can be viewed in Appendix 5-2.

Diversion of miscellaneous flows at the North Private Lease is planned using fifteen diversion ditches. Four diversions will be primarily used to route runoff from upland, undisturbed areas away from the planned disturbed areas. The locations of these diversions along with the associated watersheds can be viewed on Drawings 5-63, and 5-64. Calculations related to the diversions can be viewed in Appendix 5-12.

742.332 Each diversion at the Coal Hollow Mine was designed for stability and to minimize erosion. In order to accomplish this standard, the diversions were each designed for peak flows during a 100 year, 24 hour storm event. The following summarizes the steps used:

The channel sizing for the four proposed temporary diversion ditches has been evaluated using the TR-55 method to determine peak flows and the Manning's Equation (ME) to determine appropriate dimensions. The TR-55 method of analysis is the same method used to size impoundments and was utilized in this case to provide a peak flow for each diversion during a 100 year, 24 hour storm event. This peak flow was then input into the ME to determine an appropriate open channel design for minimizing the effects of erosion during peak flows. Similar to the impoundment sizing, the Carlson Software Hydrology module was utilized to perform these calculations. The ditch locations, designs and cross sections can be viewed on Drawings 5-33 and 5-34.

The following table summarizes the inputs and results for each diversion based on peak flows during a 100 year, 24 hour storm event:

Diversion Ditch Summary							
Ditch	*Base (ft)	Manning's n	Average Slope (%)	Peak Flow (cfs)	Flow Depth (ft)	Velocity (fps)	Freeboard (ft)
1	3.0	0.020	2.8	14.8	0.5	6.8	0.3
2	2.5	0.020	3.5	6.9	0.4	6.0	0.3
3	4.5	0.020	2.4	16.7	0.5	6.3	0.3
4	5.0	0.020	1.8	19.8	0.6	5.4	0.3

*All side slopes are 2h:1v

The diversions ditches for the North Private Lease will be utilized to direct runoff from disturbed areas to the sediment impoundments. The channel sizing for the fifteen diversion ditches has been evaluated using the TR-55 method to determine peak flows and the Manning's Equation (ME) to determine appropriate dimensions. The TR-55 method of analysis is the same method used to size impoundments and was utilized in this case to provide a peak flow for each diversion during a 10 year, 6 hour storm event. This peak flow was then input into the ME to determine an appropriate open channel design for minimizing the effects of erosion during peak flows. The ditch locations, designs and cross sections can be viewed on Drawings 5-65, 5-72 and 5-73.

The following table summarizes the inputs and results for each diversion based on flows during a 10 year, 6 hour storm event:

North Private Lease Diversion Ditch Summary							
Ditch	*Base (ft)	Manning's n	Average Slope (%)	Peak Flow (cfs)	Flow Depth (ft)	Velocity (fps)	Freeboard (ft)
DD-5	0.0	0.025	5.21	4.77	0.64	5.89	0.36
DD-6	0.0	0.025	6.22	2.34	0.47	5.27	0.53
DD-7	0.0	0.025	4.84	5.34	0.67	5.89	0.83
DD-8	0.0	0.025	5.16	5.33	0.66	6.03	0.84
DD-9	0.0	0.025	8.42	0.70	0.28	4.36	0.72
DD-10	0.0	0.025	0.43	0.70	0.49	1.43	0.51
DD-11	0.0	0.025	6.07	5.22	0.64	6.38	0.86
DD-12	0.0	0.025	0.50	8.36	1.22	2.81	0.78
DD-13	0.0	0.025	2.04	22.80	1.36	6.13	0.64
DD-14	0.0	0.025	1.28	0.55	0.37	2.03	0.63
DD-15	0.0	0.025	7.35	0.10	0.14	2.55	0.86
DD-16	0.0	0.025	2.15	11.89	1.06	5.31	0.94
DD-17	0.0	0.025	2.12	11.38	1.04	5.22	0.96
DD-18	0.0	0.025	12.06	0.20	0.17	3.65	0.83
DD-19	0.0	0.025	1.99	0.59	.035	2.43	0.65

*All side slopes are 2h:1v

As shown in the above tables, flow depths will be shallow, flow velocity will be manageable for temporary flow conditions and sufficient freeboard will be present during a flood event. These conditions will provide diversion stability, protection against flooding and prevent to the extent possible additional contributions of suspended solids to stream flow outside the permit area. These diversions are designed to comply with all applicable local, Utah and federal laws and regulations. Further details related to the temporary diversion designs can be viewed in Appendix 5-2 for the Coal Hollow Mine and Appendix 5-12 for the North Private Lease.

742.333 All four miscellaneous flow diversions planned for the ~~project~~ Coal Hollow Mine are temporary and will be reclaimed when no longer necessary for sediment and storm water control. Therefore, the channels must safely pass the peak runoff from a 2 year, 6 hour event. As previously described, these diversions have been designed to pass a 100 year, 24 hour storm event which significantly exceeds this required design standard. Precipitation from a 100 year, 24 hour storm event for this area is 3.1 inches while precipitation for the 2 year, 6 hour event is less than 1 inch.

All fifteen miscellaneous flow diversions planned for the North Private Lease are temporary and will be reclaimed when no longer necessary for

sediment and storm water control. Therefore, the channels must safely pass the peak runoff from a 2 year, 6 hour event. As previously described, these diversions have been designed to pass a 10 year, 24 hour storm event which significantly exceeds this required design standard. Precipitation from a 10 year, 24 hour storm event for this area is 2.39 inches while precipitation for the 2 year, 6 hour event is less than 1 inch.

742.400 Road Drainage

742.410 All Roads

742.411 To ensure environmental protection and safety appropriate for the planned duration and use, limits have been incorporated in the road designs for the Coal Hollow Project and the North Private Lease. These limits are applied to drainage control and culvert placement/sizing. These limits take into consideration the type and size of equipment planned for the operation. The following is a description of roads along with the design limits and standards that will be incorporated into construction:

Two primary Mine Haul roads at the Coal Hollow Mine are planned within the permit area. The first road extends from the coal unloading area to the first series of pits along the west side of the property. This road will be utilized for access to pits 1 through 15 (pits shown on Drawing 5-10). This road will be approximately 2,600 feet in length and will be utilized mainly during the first two years of mining. There will be three culverts installed along this road all sized for a 100 year, 6 hour storm event. The first culvert will be across a tributary of Lower Robinson Creek and will be a 36 inch corrugated steel pipe. The second culvert is the main crossing over Lower Robinson Creek and is a 96 inch corrugated steel pipe. Both of these culverts have been sized based on analysis of the Lower Robinson Creek watershed. This analysis can be viewed in Appendix 5-3. The third culvert is a crossing over a diversion ditch that will route water mainly from disturbed areas along the south side of Lower Robinson Creek to a sediment impoundment. This culvert will be a 24 inch corrugated steel pipe.

The second road extends from an intersection with the first road, located just south of the Lower Robinson Creek crossing, and proceeds south to approximately pit 25. This road is approximately 2,500 feet in length and will be used for the south pits 16 through 30. There is one culvert crossing along this road to cross a diversion ditch. This culvert will be a 24 inch culvert.

The following specifications apply to these two Primary Mine Haul roads:

1) Roads will be approximately 80’ in width
2) Approximately a 2% crown
3) Approximately one foot deep cut ditches along shoulders for controlling storm water
4) 18” of crushed rock or gravel for road surfacing
5) Cut and fill slopes of 1.5h:1v
6) Minimum fill over each culvert will be 2 times diameter of culvert
7) Berms placed as necessary along fills

The underground mine portal access and haul road in Pit 10 will also be a primary road. This road is accessed from the main haul road from the coal unloading area. The underground access/haul road will be constructed to the same specifications for the haul roads above, except that the road may be narrowed to a 40 foot width.

The ancillary roads will have similar specifications except surfacing will occur only as needed and may be narrowed to a 40 foot road width.

The location and details for all these roads can be viewed on Drawings 5-3 and 5-22 through 5-24.

In addition to the two primary Mine Haul roads, the road located within the facilities area is also classified as a primary road. This road is planned to be 24 feet wide with 24 inches of compacted sub base and 8 inches of compacted 1 inch minus gravel as surfacing. This road system will have six culverts and selectively located berms to appropriately route water to the two sediment impoundments for the facilities area. The location of these culverts and berms is shown on Drawing 5-3. This road is referred to as “Facilities Roadway” and more details are described in 527.200 along with Drawings 5-22A and 5-22B.

The ramps, benches and equipment travel paths within the active surface mining area are temporary in nature and will be relocated frequently as mining progresses. These temporary travelways are considered part of the pit due to their short term use, and are not individually designed nor engineered. They will be built and maintained to facilitate safe and efficient mine and reclamation operations.

All roads will be maintained on an as needed basis using motor graders, water trucks for dust suppression, and other equipment as necessary. Crushed stone and/or gravel will be used as a surface course for primary roads outside the active mining area, and may be used as needed for ramps and travelways within the pit. Should the roads be damaged by a

catastrophic event, such as an earthquake or a flood, repairs will be made as soon as possible after the damage has occurred or the road will be closed and reclaimed.

Cut and fill slopes along the primary roads will be minimal and are not expected to cause significant erosion. The water from roads in the project area will not directly discharge to drainages outside the project area without first being treated by flowing through a sediment impoundment. In locations where there are culvert crossings (i.e. Lower Robinson Creek), the fills slopes will be stabilized by utilizing standard methods such as grass matting or straw wattles.

Transportation facilities for the North Private Lease will consist of two primary road, and miscellaneous ancillary/temporary roads. Drawings detail the designs and specifications for each one of the proposed facilities. The following is a description of each facility and a reference for the associated drawings:

- Roads: A primary haul road will extend from the entrance to the permit area to the North end of Pit 6. This road is approximately 1755 feet in length. This road is referred as the "North Pits Haul Road". The second primary haul road "Kanab Creek Crossing" extends from an intersection with the North Pits Haul Road and cross to the East side of Kanab Creek. This road is approximately 700 feet in length. There is one culvert crossing along this road to cross Kanab Creek. This culvert will be a 172 inch culvert sized for maximum anticipated flows in Kanab Creek.

The following specifications apply to these Primary mine haul roads:

1) Roads will be approximately 80' in width
2) Approximately a 2% crown
3) Approximately one foot deep cut ditches along shoulders for controlling storm water
4) 18" of crushed rock or gravel for road surfacing
5) Cut and fill slopes of 1.5 h:1v
6) Berms placed as necessary along fills

The ancillary roads will have similar specifications except surfacing will occur only as needed and may be narrowed to a 40 foot road width. A typical cross section for the ancillary roads can be viewed on Drawing 5-24.

The location and details for the Primary Mine Haul road can be viewed on Drawings 5-58, through 5-64.

The ramps, benches and equipment travel paths within the active surface mining area are temporary in nature and will be relocated frequently as mining progresses. These temporary travel ways are considered part of the pit due to their short term use, and are not individually designed nor engineered. They will be built and maintained to facilitate safe and efficient mine and reclamation operations.

742.412 No roads will be located in the channel of an intermittent or perennial stream.

742.413 Primary roads constructed utilized during mining operations have been designed and located to route runoff from the roads to the sediment impoundment system. By routing the runoff to this system, sedimentation and flooding downstream resulting from the roads will be minimized. All other roads located within the active mining area will also follow this standard and runoff from the roads will not be directly discharged to drainages outside the permit area.

742.420 Primary Roads

742.421 To minimize erosion, primary roads will be constructed with a rock surface with minimal cut and fill slopes. These roads are located in the most practicable, stable areas within the permit boundary and mostly outside of the designed pits. These locations can be reviewed on Drawing 5-22 through 5-22G. Further descriptions of these roads can be viewed in Section 742.423.1 and 742.111.

742.422 There are no stream fords by primary roads at the Coal Hollow Project.

742.423 Drainage Control

- 742.423.1 Two primary Mine Haul roads are planned within the permit area. The first road extends from the coal unloading area to the first series of pits along the west side of the property. This road will be utilized for access to pits 1 through 15 (pits shown on Drawing 5-10). This road will be approximately 2,600 feet in length and will be utilized mainly during the first two years of mining. There will be three culverts installed along this road all sized for a 100 year, 24 hour storm event. The first culvert will be across a tributary of Lower Robinson Creek and will be a 36 inch corrugated steel pipe. The second culvert is the main crossing over Lower Robinson Creek and is a 96 inch corrugated steel pipe. Both of these culverts have been sized based on analysis of the Lower Robinson Creek watershed. This analysis can be viewed in Appendix A5-3. The third culvert is crossing over a diversion ditch that will route water mainly from disturbed areas along the south side of Lower Robinson Creek to a sediment impoundment. This culvert will be a 24 inch corrugated steel pipe.

The second road extends from an intersection with the first road, located just south of the Lower Robinson Creek crossing, and proceeds south to approximately pit 25. This road is approximately 2,500 feet in length and will be used for the south pits 16 through 30. There is one culvert crossing along this road to cross a diversion ditch. This culvert will be a 24 inch culvert sized for maximum anticipated flows in the diversion.

The following specifications apply to these Primary mine haul roads:

1) Roads will be approximately 80' in width
2) Approximately a 2% crown
3) Approximately one foot deep cut ditches along shoulders for controlling storm water
4) 18" of crushed rock or gravel for road surfacing
5) Cut and fill slopes of 1.5 h:1v
6) Minimum fill over each culvert will be 2 times diameter of culvert
7) Berms placed as necessary along fills

The location and details for Primary Mine Haul roads can be viewed on Drawings 5-3 and 5-22 and 5-23.

In addition to the two roads primary Mine Haul roads, the road located within the facilities area is also classified as a primary road. This road is planned to be 24 feet wide with 24 inches of compacted sub base and 8 inches of compacted 1 inch minus gravel as surfacing. This road system will have four culverts and selectively located berms appropriately placed to route water to the two sediment impoundments for the facilities area. The location of these culverts and berms is shown on Drawing 5-3. This road is referred to as "Facilities Roadway" and more details are described in 527.200 along with Drawings 5-22A and 5-22B.

In addition to the primary roads that will be present during active mining, four additional roads are planned to exist postmining and are also classified as primary roads for this reason.

Roads that will remain postmining are the following:

- Road to Water Well with details shown on Drawing 5-22D
- Road to east C. Burton Pugh property with details shown on Drawing 5-22C
- County Road 136 (K3900) with details on Drawing 5-22E, 5-22F and 5-22G. This County road will be reconstructed within the permit area by Kane County. This reconstruction will occur concurrently with the final stage of reclamation as scheduled on Drawing 5-38 and is expected to be completed by the end of Year 4.
- Road to Swapp Ranch (same specification as the Water Well Road)

The location of these roads is shown on Drawings ~~5-35 and~~ 5-37 along with the post mining topography. With the exception of the County Road, each road will be graded

to complement the surrounding topography and drainages. Details for these roads are provided in the above referenced drawings.

County Road 136 will have a cut ditch on the up gradient side of the road as appropriate. The culvert located at the crossing of Lower Robinson Creek will remain. One culvert will be added at Station 21+66 as shown on Drawing 5-22E. For further details related to reestablishment of County Road 136, refer Drawings 5-22 through 5-22G and 5-35.

Transportation facilities for the North Private Lease will consist of two primary road, and miscellaneous ancillary/temporary roads. Drawings detail the designs and specifications for each one of the proposed facilities. The following is a description of each facility and a reference for the associated drawings:

- Roads: A primary haul road will extend from the entrance to the permit area to the North end of Pit 6. This road is approximately 1755 feet in length. This road is referred as the "North Pits Haul Road". The second primary haul road "Kanab Creek Crossing" extends from an intersection with the North Pits Haul Road and cross to the East side of Kanab Creek. This road is approximately 700 feet in length. There is one culvert crossing along this road to cross Kanab Creek. This culvert will be a 172 inch culvert sized for maximum anticipated flows in Kanab Creek.

  The following specifications apply to this Primary mine haul roads:

  1) Roads will be approximately 80' in width
  2) Approximately a 2% crown
  3) Approximately one foot deep cut ditches along shoulders for controlling storm water
  4) 18" of crushed rock or gravel for road surfacing
  5) Cut and fill slopes of 1.5 h: 1v
  6) Berms placed as necessary along fills

  The location and details for the Primary Mine Haul road can be viewed on Drawings 5-56 thru 5-58.
  The ramps, benches and equipment travel paths within the active surface mining area are temporary in nature and will be relocated frequently as mining progresses. These temporary travelways are considered part of the pit due to their short term use, and are not individually designed nor engineered. They will be built and maintained to facilitate safe and efficient mine and reclamation operations.

  In addition to the primary roads that will be present during active mining, two roads are planned to exist postmining and are also classified as primary roads for this reason.

  Roads that will remain postmining are the following:

- County Road 136 (K3900) with details on Drawing 5-61. This County road will be reconstructed within the permit area by Kane County. This reconstruction will occur concurrently with the final stage of reclamation as scheduled on Drawing 5-76 and is expected to be completed by the end of Year 6.
- McDonalds Road (same specification as the County Road 136) with details on Drawing 5-62. This reconstruction will occur concurrently with the final stage of reclamation as scheduled on Drawing 5-76 and is expected to be completed by the end of Year 6.

The location of these roads is shown on Drawings 5-74 along with the post mining topography. With the exception of the County Road, each road will be graded to complement the surrounding topography and drainages. Details for these roads are provided in the above referenced drawings.

742.423.2 Drainage pipes and culverts will be constructed on a minimum 2% grade to avoid plugging. Minimum fill over culverts will be 2 times the diameter of the culvert itself to avoid collapsing. Grades going in and out of each culvert will be similar to the grade of the culvert itself to avoid erosion at the inlet and outlet.

742.423.3 Drainage ditches have been designed to pass a 100 year 24 hour storm event which will prevent uncontrolled drainage over the road surface and embankment. The watersheds associated with drainage in the project area are each relatively small (less than 400 acres) and are not expected to sustain flows that would carry significant debris through the project area. Therefore, trash racks and debris basins are not expected to be necessary at the Coal Hollow Project.

742.423.4 One natural intermittent stream channel is planned to be diverted. This channel is referred to as Lower Robinson Creek and this diversion will be temporary. A section of this stream runs across an area that is planned for mining.

The Lower Robinson Creek diversion has been designed to safely pass a 100 year, 6 hour storm event. The watershed for this drainage is 3.64 square miles and has a peak flow of 83.5 cubic feet per second during a 100 year, 6 hour event. Minimum dimensions for carrying this flow were found to be a channel that has the following dimensions:

Bottom width: 2 feet
Side slopes: 3h:1v
Minimum slope height: 3 feet (1 foot freeboard added)

Details related for the design calculations are provided in Appendix 5-3. Rip-rap will be appropriately placed to minimize erosion of the channel.

Cross sections of the channel design are shown in Drawing 5-21. As shown in the drawing, all sections of the diversions exceed the minimum design standard. A plan view of the diversion design can be viewed in Drawing 5-20. This diversion design is in accordance with R645-301-731.100 through R645-301-731.522, R645-301.600, R645-301-731.800, R645-301-742.300, and R645-301-751.

Design of the Lower Robinson Creek Diversion has been certified by a qualified registered professional engineer.

742.423.5 All stream crossings are planned to be culverts designed to pass the 100 year, 6 hour storm event. There are no plans to use fords as stream crossings. Calculations for culvert sizing can be found in Appendix 5-3 for the Coal Hollow Mine and in Appendix 5-12 for the North Private Lease.

743 IMPOUNDMENTS

743.100 General Requirements

Five temporary impoundments are planned at the Coal Hollow Project and five temporary impoundments for the North Private Lease. Design for these structures are shown in Drawings 5-28 through 5-32 and 5-65 thru 5-67. These impoundments do not meet the criteria for Class B or C dams as specified in the U.S. Department of Agriculture, Natural Resources Conservation Service Technical Release 60.

743.110 None of the impoundments meet the criteria of MSHA, 30 CFR 77.216(a).

743.120 A professional engineer experienced in the design and construction of impoundments with assistance from a geotechnical expert has used current, prudent, engineering practices to design the proposed impoundments.

The plans have been certified and a detailed geotechnical analysis has been provided in Appendix 5-1 for the Coal Hollow Mine and Appendix 5-11 for the North Private Lease. The certifications, drawings and cross sections can be viewed in Drawings 5-25 through 5-31for the Coal Hollow Mine and Drawings 5-67 through 5-71 and Appendices 5-1, ~~and~~ 5-2, 5-11 and 5-12 for each area.

Each impoundment is designed with a minimum freeboard of 2 feet. Based on the size of the impoundments and the relatively small size of the associated watersheds, this amount of freeboard will be sufficient to prevent overtopping from waves and/or storm events. These impoundments do no meet the criteria for Class B or C dams.

743.130

Each impoundment will be constructed with a spillway that will function as both the emergency and principle spillway. Each of these spillways will safely discharge a 25 year, 6 hour precipitation event. The following table summarizes the spillway discharge designs in relation to the 25 year, 6 hour precipitation event:

Sediment Impoundment – Spillway Flow Capacities		
Impoundment	Required Spillway Discharge (cfs)	Designed Spillway Discharge (cfs)
1	30.4	37.4
2	0.8	30.5
3	2.8	11.5
4	2.4	11.5
1B	6.06	23.9
5	2.23	9.66
6	2.85	9.66
7	10.11	20.80
8	3.42	9.66
9	3.60	9.66

The drop pipe spillways for impoundments 1, 1B, ~~and~~ 2, 5, 6 and 7 will be of nonerodible construction. The open channel spillways for impoundments 3 and 4 will be 6" minimum Rip Rap lined and are designed to carry short-term, infrequent flows at non erosive velocities where sustained flows are not expected.

The impoundments at the Coal Hollow project do not meet the criteria for either Class B or C dams or MSHA CFR 77.216 (a).

743.140

A professional engineer or specialist experienced in the construction of impoundments will inspect impoundments. Inspections will be made regularly during construction, upon completion of construction, and at least yearly until removal of the structure or release of the performance bond. The qualified registered professional engineer will promptly, after each inspection, provide to the Division, a certified report that the impoundment has been constructed and maintained as designed and in accordance with the approved plan and the R645 Rules. The report will include discussion of any appearances of instability, structural weakness or other hazardous conditions, depth and elevation of any impounded waters, existing storage capacity, any existing or required monitoring procedures and instrumentation and any other aspects of the structure affecting stability. A copy of the report will be retained at or near the mine site.

The MRP does not contemplate construction of any impoundments meeting the NRCS Class B or C criteria for dams in TR-60, or the size or other criteria of 30 CFR Sec. 77.216.

743.200

No permanent impoundments are planned.

743.300

Design capacities for spillways exceed the 25 year, 6 hour event. The design capacities are provided in the table located in section R645-301-743.130.

744 DISCHARGE STRUCTURES

744.100

Each pond will be constructed with an emergency spillway, should the capacities of the ponds ever be exceeded. These spillways will provide a nondestructive route for storm water discharge, though the capacities of the ponds are not expected to be exceeded. The design capacities of the ponds are expected to contain each storm event and therefore will provide sufficient detention time to meet Utah and federal effluent limitations. The following is a description of each spillway:

Impoundments 3 and 4 will be constructed with open channel spillways. These spillways are designed to discharge a 24 hour duration, 100 year storm event even though they are not expected to be used during normal operations. They will have rip-rap min. 6" to minimize erosion and spillway slopes will not exceed 3h:1v. Drawing 5-32 provides the details for the open channel spillways.

Impoundments 1, 1B, ~~and~~ 2, 5, 6, 7, 8 and 9 will be constructed with a drop pipe spillway system. Storm water and snow melt that occurs within the associated watersheds will be routed to these impoundments to contain sediment. These impoundments will have the drop-pipe spillways installed which will allow removal of any oil sheens that may result from parking lots, primary roads or maintenance activities by using absorbent materials to remove the sheen. The drop-pipe spillways are 24" diameter ~~pipes~~ pipes for impoundments 1,1B, 2 & 7 and 18" for impoundments 5, 6, 8 and 9 that are vertical in the impoundment. These pipes have a metal cover over the end. This cover is recessed over the pipe by at least an inch, with a gap between the cover and the pipe. This leaves a route for water to discharge once the impoundment is full but prevents debris or pollutants located on the water surface from discharging. This system was chosen for these two impoundments based on their locations in relation to the facilities and primary roads. This discharge system will be constructed for precautionary measures only since pollutants are not expected in the impoundments during normal operations.

The drop pipe spillways for impoundments 1, 1B, ~~and~~ 2, 5, 6, 7, 8 and 9 will be of nonerodible construction. The open channel spillways for impoundments 3 and 4 will be rip-rap min. 6" and are designed to carry short-term, infrequent flows at non erosive velocities where sustained flows are not expected. The open channel spillways for impoundments 5, 6, 8 and 9 will be rip-rap (D50) 6", impoundment 7 will be rip-rap (D50) 9" and are designed to carry short-term, infrequent flows at non erosive velocities

where sustained flows are not expected. These designs will minimize erosion and disturbance to the hydrologic balance.

Details related to these designs can be viewed in Drawings 5-28 through 5-32 for the Coal Hollow and Drawings 5-67 through 5-71 for the North Private Lease.

744.200

Standard engineering design procedures have been used in the design of the discharge structures along with standard mining industry best management practices that are commonly used at surface mining operations.

745 Disposal of Excess Spoil

745.100 General Requirements

Excess spoil will be placed in designated disposal areas within the permit area, in a controlled manner to minimize the adverse effects of leachate and surface water runoff from the fill on surface and ground waters; ensure permanent impoundments are not located on the completed fill. Small depressions may be created if approved by the Division if they are needed to retain moisture or minimize erosion, create and enhance wildlife habitat or assist revegetation, and if they are not incompatible with the stability of the fill; and adequately cover or treat excess spoil that is acid- and toxic-forming with nonacid nontoxic material to control the impact on surface and ground water is accordance with R645-301-731.300 and to minimize adverse effects on plant growth and the approved postmining land use.

If the disposal area contains springs, natural or manmade water courses or wet weather seeps, the fill design will include diversions and underdrains as necessary to control erosion, prevent water infiltration into the fill and ensure stability.

Details of proposed excess spoil disposal plans are presented in Chapter 5, Section 535 of this MRP and are summarized below.

A geotechnical analysis has been completed for the proposed excess spoil structure. This analysis estimates the long-term safety factor to be 1.6 to 1.7 based on the proposed design. Following proper construction practices of building the structure in maximum four foot lifts and meeting 85% compaction based on the standard Procter will ensure that the structure will be stable under all conditions of construction. This construction will occur only in the designated excess spoil area as shown on Drawing 5-3 and 5-35. The fill will be placed with end dump haul trucks and lifts will be constructed using dozers. High precision GPS systems will be regularly utilized to check grades and appropriate lift thickness. The geotechnical analysis for this structure can be viewed in Appendix 5-1.

The excess spoil is planned to be placed in an area where natural grades range from 0 to 5%. This is one of the most moderately sloping locations in the Permit Area. Stability of this structure is estimated to be 1.6 to 1.7 based on the Appendix 5-1.

Geotechnical borings were completed in the foundation of the proposed disposal area. Laboratory analysis of these borings has also been completed. Details of this analysis can be viewed in Appendix 5-1 for the Coal Hollow Mine and in Appendix 5-11 for the North Private Lease.

Permanent slopes for the proposed excess spoil will not exceed 3h:1v (33 percent), therefore no keyway cuts have been proposed in the design. Appendix 5-1 details the stability analysis for the proposed structure.

Excess spoil will not be disposed of in underground mine workings.

Horizontal lifts will not exceed four feet in thickness unless otherwise approved by the Division. The lifts will be concurrently compacted to meet 85% of the standard Procter. The geotechnical analysis (Appendix 5-1), provides information showing that these construction standards will provide mass stability and will prevent mass movement during and after construction. The excess spoil will be graded to provide drainage similar to original flow patterns. Topsoil and subsoil as designated in Chapter 2 will be removed and separated from other materials prior to placement of spoil.

A description of the character of the bedrock and any adverse geologic conditions in presented in Appendix 5-1.

Spring and seep survey information is provided on Drawing 7-1. There are no springs or seeps identified in the excess spoil area.

There are no historical underground mining operations in the proposed excess spoil area. There are also no future underground operations proposed.

There are no rock chimneys or drainage blankets proposed.

A stability analysis including strength parameters, pore pressures and long-term seepage conditions is presented together with all supporting data in Appendix 5-1.

Neither rock-toe buttresses nor key-way cuts are required under R645-301-535.112 or R645-301-535.113.

No valley fills or head-of-hollow fills are proposed.

No durable rock fills are proposed.

No disposal of waste on preexisting benches is planned

The excess spoil structure and fill above approximate original contour are the only alternative specifications proposed. A geotechnical analysis has been completed for this proposal and can be viewed in Appendix 5-1. All other mined areas will be restored to approximate original contour.

745.200 Valley Fills and Head-of-Hollow Fills

Valley fills and head-of-hollow fills are not anticipated in the Coal Hollow Mine permit area.

745.300. Durable Rock Fills.

Durable rock fills are not anticipated in the ~~proposed~~ Coal Hollow Mine permit area.

745.400. Preexisting Benches.

The disposal of excess spoil through placement on preexisting benches is not anticipated in the ~~proposed~~ Coal Hollow Mine permit area.

746. COAL MINE WASTE

746.100. General Requirements.

No coal mine waste is anticipated.

746.200. Refuse Piles.

No refuse piles associated with coal mine waste are anticipated.

746.300. Impounding structures.

No impounding structures associated with coal mine waste are anticipated.

746.330. Drainage control.

No coal mine waste and associated drainage control is anticipated.

746.400. Return of Coal Processing Waste to Abandoned Underground Workings.

No coal mine processing waste is anticipated to be placed in underground workings.

747. DISPOSAL OF NONCOAL WASTE

747.100

Noncoal mine waste, including but not limited to grease, lubricants, paints, flammable liquids, garbage, machinery, lumber and other non combustible materials generated during coal mining and reclamation operations will be temporarily placed in covered dumpsters. This waste will be regularly removed from the project area and disposed of at a state approved solid waste disposal site outside the project area.

747.200

Noncoal mine waste will be stored in a metal, covered dumpster which will prevent storm precipitation or runoff from coming in contact with the waste.

747.300

No noncoal mine waste will be disposed of within the permit area with the exception perforated piping used in the construction of Alluvial Ground Water Drains . This will be left in place as mining advances. This perforated piping will be covered in place approximately 20' to 30' below the final reclaimed surface. All other waste materials (ie. metal culvert) associated with the Alluvial Ground Water Drains will be removed and disposed of in a State-approved solid waste disposal site. Also, concrete pads for the generator and fan utilized in the underground operation will remain and will be covered with approximately 120' of overburden.

748. Casing and Sealing of Wells.

Wells constructed for monitoring groundwater conditions in the ~~proposed~~ Coal Hollow Mine permit and adjacent area, including exploration holes and boreholes used for water wells or monitoring wells, will be designed to prevent contamination of groundwater and surface-water resources and to protect the hydrologic balance. A diagram depicting typical monitoring well construction methods is shown in Drawing 7-11. Monitoring wells will include a protective hydraulic seal immediately above the screened interval, an annular seal plugging the borehole above the hydraulic seal to near the ground surface, and a concrete surface seal extending from the top of the hydraulic seal to the ground surface which is sloped away from the well casing to prevent the entrance of surface flows into the borehole area. Well casings will protrude above the ground surface a sufficient height so as to minimize the potential for the entrance of surface water or other material into the well. A steel surface protector with a locking cover will be installed at monitoring wells to prevent access by unauthorized personnel. Where there is potential for damage to monitoring wells, the wells will be protected through the use of barricades, fences, or other protective devices. These protective devices will be periodically

inspected and maintained in good operating conditions. Monitoring wells will be locked in a closed position between uses.

When no longer needed for monitoring or other use approved by the Division upon a finding of no adverse environmental or health and safety effects, or unless approved for transfer as a water well under R645-301-731.100 through R645-301-731.522 and R645-301-731.800, each well will be capped, sealed, backfilled, or otherwise properly managed, as required by the Division in accordance with R645-301-529.400, R645-301-631.100, and R645-301-748. Permanent closure measures will be designed to prevent access to the mine workings by people, livestock, fish and wildlife, machinery and to keep acid or other toxic drainage from entering ground or surface waters.

If a water well is exposed by coal mining and reclamation operations, it will be permanently closed unless otherwise managed in a manner approved by the Division.

Permanent closure and abandonment of water wells greater than 30 feet in depth will be in accordance with the requirements of "Administrative Rules for Water Well Drillers", State of Utah, Division of Water Rights or other applicable state regulations. Abandonment of wells will be performed by a licensed water well driller. The wells to be abandoned will be completely filled using neat cement grout, sand cement grout, unhydrated bentonite, or bentonite grout, or other materials approved by the Utah State Engineer's office. Alternatively, the well may be abandoned using a different procedure upon approval from the Utah State Engineer's office.

Abandonment materials will be introduced at the bottom of the well or required sealing interval and placed progressively upward to the top of the well. The casing will be severed a minimum of 2 feet below the ground surface. A minimum of 2 feet of compacted native material will be placed above the abandoned well upon completion.

Within 30 days of the completion of well abandonment procedures, a report will be submitted to the State Engineer by the responsible licensed driller giving data related to the abandonment of the well. This shall include the name of the licensed driller or other person(s) performing abandonment procedures, name of well owner at the time of abandonment, the address or location of the well by section, township, and range, abandonment materials and equipment used, water right or file number covering the well, the final disposition of the well, and the date of completion.

Exploration holes and boreholes will be backfilled, plugged, cased, capped, sealed, or otherwise managed to prevent acid or toxic contamination of water resources and to minimize disturbance to the prevailing hydrologic balance. Exploration holes and boreholes will be managed to ensure the safety of people, livestock, fish and wildlife, and machinery.

If a water well is exposed by coal mining and reclamation operations, it will be permanently closed unless otherwise managed in a manner approved by the Division.

If any exploration boreholes are to be used as monitoring wells or water wells, these will meet the provisions of R645-301-731

Boreholes will be backfilled to within 1 foot of the land surface with concrete or other materials approved by the Division as necessary to prevent contamination of groundwater or surface-water resources or to protect the prevailing hydrologic balance. The upper approximately 1 foot will be backfilled with native materials to facilitate reclamation (see Drawing 6-11). Exploration holes and boreholes that may be uncovered during mining and reclamation activities will be permanently closed unless approved for water monitoring or otherwise managed in a manner approved by the Division.

750 PERFORMANCE STANDARDS

All coal mining and reclamation operations will be conducted to minimize disturbance to the hydrologic balance within the permit and adjacent areas, to prevent material damage to the hydrologic balance outside the permit area and support approved postmining land uses in accordance with the terms and conditions of the approved permit and the performance standards of R645-301 and R645-302. Mining operations will be conducted to assure the protection or replacement of water rights in accordance with the terms and conditions of the approved permit and the performance standards of R645-301 and R645-302.

751. Water Quality Standards and Effluent Limitations.

Discharges of water from areas disturbed by coal mining and reclamation operations will be made in compliance with all Utah and federal water quality laws and regulations and with effluent limitations for coal mining promulgated by the U.S. Environmental Protection Agency set forth in 40 CFR Part 434.

Discharges from the Coal Hollow project are expected to be minimal based on the storm water and runoff controls that are described in R645-301-740. These structures are designed to contain large storm events without discharging runoff. Any runoff that does discharge will be treated through the sediment pond system.

Discharges from the proposed alluvial groundwater interceptor drain systems will be made in compliance with all applicable Utah and federal water quality laws and regulations. The proposed drain systems have been designed to intercept and discharge natural, un-contaminated up-gradient alluvial groundwater. The water from the alluvial groundwater intercept drain system will be collected in a gravel-packed underground drainage collection system and conveyed through pipes to a steel/concrete discharge structure from which the water will be discharged via pumping through a discharge hose to the discharge location. By managing the water in this matter, the potential for contamination of the water will be minimized. Prior to the initial discharge of water from newly constructed alluvial groundwater interceptor trench systems to receiving waters, the system will be adequately developed/pumped to remove residual fine-grained sediments that might be present in the

system prior to discharge to receiving waters. Only suitable, uncontaminated groundwater will be discharged to the outfall location. The water quality and discharge rates from the alluvial groundwater intercept system will be monitored as per the requirements of the UPDES permit.

752. Sediment Control Measures

Sediment control measures will be located, maintained, constructed and reclaimed according to the plans and designs given under sections R645-301-732, R645-301-742 and R645-301-760. Plans and designs are described in these sections.

752.100
Siltation structures and diversions will be located, maintained, constructed and reclaimed according to plans and designs given under R645-301-732, R645-301-742 and R645-301-763. Plans and designs are described in these sections.

752.200. Road Drainage

Roads will be located, designed, constructed, reconstructed, used, maintained and reclaimed according to R645-301-732.400, R645-301-742.400 and R645-301-762 and to achieve the following:

Control or prevent erosion, siltation and the air pollution attendant to erosion by vegetating or otherwise stabilizing all exposed surfaces in accordance with current, prudent engineering practices;

Control or prevent additional contributions of suspended solids to stream flow or runoff outside the permit area;

Neither cause nor contribute to, directly or indirectly, the violation of effluent standards given under R645-301-751;

Minimize the diminution to or degradation of the quality or quantity of surface- and ground-water systems; and

Refrain from significantly altering the normal flow of water in streambeds or drainage channels.

All plans and designs to meet these standards are described in the above referenced sections and on Drawings 5-22 through 5-24.

753**.** Impoundments and Discharge Structures

Impoundments and discharge structures will be located, maintained, constructed and reclaimed to comply with R645-301-733, R645-301-734, R645-301-743, R645-301-745 and R645-301-760. Plans and designs are described in these sections.

754. Disposal of Excess Spoil, Coal Mine Waste and Noncoal MineWaste.

Disposal areas for excess spoil, coal mine waste and noncoal mine waste will be located, maintained, constructed and reclaimed to comply with R645-301-735, R645-301-736, R645-301-745, R645-301-746, R645-301-747 and R645-301-760. Plans and designs are described in these sections.

755. Casing and Sealing of Wells

All wells will be managed to comply with R645-301-748 and R645-301-765. Water monitoring wells will be managed on a temporary basis according to R645-301-738.

Wells constructed for monitoring groundwater conditions in the ~~proposed~~ Coal Hollow Mine permit and adjacent area, including exploration holes and boreholes used for water wells or monitoring wells, will be designed to prevent contamination of groundwater and surface-water resources and to protect the hydrologic balance. A diagram depicting typical monitoring well construction methods is shown in Drawing 7-11. Monitoring wells will include a protective hydraulic seal immediately above the screened interval, an annular seal plugging the borehole above the hydraulic seal to near the ground surface, and a concrete surface seal extending from the top of the hydraulic seal to the ground surface which is sloped away from the well casing to prevent the entrance of surface flows into the borehole area. Well casings will protrude above the ground surface a sufficient height so as to minimize the potential for the entrance of surface water or other material into the well. A steel surface protector with a locking cover will be installed at monitoring wells to prevent access by unauthorized personnel. Where there is potential for damage to monitoring wells, the wells will be protected through the use of barricades, fences, or other protective devices. These protective devices will be periodically inspected and maintained in good operating conditions. Monitoring wells will be locked in a closed position between uses.

When no longer needed for monitoring or other use approved by the Division upon a finding of no adverse environmental or health and safety effects, or unless approved for transfer as a water well under R645-301-731.100 through R645-301-731.522 and R645-301-731.800, each well will be capped, sealed, backfilled, or otherwise properly managed, as required by the Division in accordance with R645-301-529.400, R645-301-631.100, and R645-301-748. Permanent closure measures will be designed to prevent access to the mine workings by people, livestock, fish and wildlife, machinery and to keep acid or other toxic drainage from entering ground or surface waters.
Water wells less than thirty feet deep are not regulated by the Utah Division of Water Rights. The permanent closure and abandonment of water wells less than 30 feet deep will

be accomplished by filling the well casing with neat cement grout, sand cement grout, unhydrated bentonite, or bentonite grout, or other appropriate materials. The well casing will then be cut off below the ground surface and native materials placed over the abandoned well site.

If a water well is exposed by coal mining and reclamation operations, it will be permanently closed unless otherwise managed in a manner approved by the Division.

Permanent closure and abandonment of water wells greater than 30 feet in depth will be in accordance with the requirements of "Administrative Rules for Water Well Drillers", State of Utah, Division of Water Rights or other applicable state regulations. Abandonment of wells will be performed by a licensed water well driller. The wells to be abandoned will be completely filled using neat cement grout, sand cement grout, unhydrated bentonite, or bentonite grout, or other materials approved by the Utah State Engineer's office. Alternatively, the well may be abandoned using a different procedure upon approval from the Utah State Engineer's office.

Abandonment materials will be introduced at the bottom of the well or required sealing interval and placed progressively upward to the top of the well. The casing will be severed a minimum of 2 feet below the ground surface. A minimum of 2 feet of compacted native material will be placed above the abandoned well upon completion.

Within 30 days of the completion of well abandonment procedures, a report will be submitted to the State Engineer by the responsible licensed driller giving data related to the abandonment of the well. This shall include the name of the licensed driller or other person(s) performing abandonment procedures, name of well owner at the time of abandonment, the address or location of the well by section, township, and range, abandonment materials and equipment used, water right or file number covering the well, the final disposition of the well, and the date of completion.

Exploration holes and boreholes will be backfilled, plugged, cased, capped, sealed, or otherwise managed to prevent acid or toxic contamination of water resources and to minimize disturbance to the prevailing hydrologic balance. Exploration holes and boreholes will be managed to ensure the safety of people, livestock, fish and wildlife, and machinery.

If a water well is exposed by coal mining and reclamation operations, it will be permanently closed unless otherwise managed in a manner approved by the Division.

If any exploration boreholes are to be used as monitoring wells or water wells, these will meet the provisions of R645-301-731

Boreholes will be backfilled to within 1 foot of the land surface with concrete or other materials approved by the Division as necessary to prevent contamination of groundwater or surface-water resources or to protect the prevailing hydrologic balance. The upper approximately 1 foot will be backfilled with native materials to facilitate reclamation (see Drawing 6-11). Exploration holes and boreholes that may be uncovered during mining and

reclamation activities will be permanently closed unless approved for water monitoring or otherwise managed in a manner approved by the Division.

760. RECLAMATION

761. GENERAL REQUIREMENTS

Before abandoning a permit area or seeking bond release, the mine will ensure that all temporary structures are removed and reclaimed, and that all permanent sedimentation ponds, diversions, impoundments and treatment facilities meet the requirements of R645-301 and R645-302 for permanent structures, have been maintained properly and meet the requirements of the approved reclamation plan for permanent structures and impoundments. The mine will renovate such structures if necessary to meet the requirements of R645-301 and R645-302 and to conform to the approved reclamation plan.

762. ROADS

A road not to be retained for use under an approved postmining land use will be reclaimed immediately after it is no longer needed for coal mining and reclamation operations, including restoring the natural drainage patterns, and reshaping all cut and fill slopes to be compatible with the postmining land use and to complement the drainage pattern of the surrounding terrain.

The post mining land configuration is shown on 5-~~35~~ 37 for the Coal Hollow Mine and 5-74 along with postmining road locations. Cuts and fills for the reclaimed roads will be minimal which allows for minor construction to grade roads to the approximate landform that existed prior to disturbance.

763. SILTATION STRUCTURES

763.100.

Siltation structures will be maintained until removal is authorized by the Division and the disturbed area has been stabilized and revegetated. In no case will the structure be removed sooner than two years after the last augmented seeding.

All impoundments will be reclaimed at the end of operations. The estimated timeline for removal of these structures are shown on Drawing 5-38 for the Coal Hollow Mine and 5-76 for the North Private Lease. Expected removal is year ~~four~~ seven for the Coal Hollow and year six at the North Private Lease, of the mining and reclamation process. In areas where soils are not stabilized following the removal of these sediment impoundments, silt fence will be appropriately installed and maintained to provide sediment control until stable conditions are met.

763.200.

When the siltation structure is removed, the land on which the siltation structure was located will be regraded and revegetated in accordance with the reclamation plan and R645-301-358, R645-301-356, and R645-301-357.

No permanent sedimentation impoundments are planned.

764. STRUCTURE REMOVAL

The application will include the timetable and plans to remove each structure, if appropriate.

All impoundments will be reclaimed at the end of operations. The estimated timeline for removal of these structures are shown on Drawing 5-38 for the Coal Hollow and Drawing 5-76 for the North Private Lease. ~~Expected removal is year four of the mining and reclamation process.~~ In areas where soils are not stabilized following the removal of these sediment impoundments, silt fence will be appropriately installed and maintained to provide sediment control until stable conditions are met.

The facilities will be fully reclaimed at the end of mining operations with the exception of the water well shown on Drawing 5- 8B. The final contour for this area can be viewed on Drawing 5-~~35~~37 for the Coal Hollow and Drawing 5-74 for the North Private Lease.

765. PERMANENT CASING AND SEALING OF WELLS

Wells constructed for monitoring groundwater conditions in the ~~proposed~~ Coal Hollow Mine permit and adjacent area, including exploration holes and boreholes used for water wells or monitoring wells, will be designed to prevent contamination of groundwater and surface-water resources and to protect the hydrologic balance. A diagram depicting typical monitoring well construction methods is shown in Drawing 7-11. Monitoring wells will include a protective hydraulic seal immediately above the screened interval, an annular seal plugging the borehole above the hydraulic seal to near the ground surface, and a concrete surface seal extending from the top of the hydraulic seal to the ground surface which is sloped away from the well casing to prevent the entrance of surface flows into the borehole area. Well casings will protrude above the ground surface a sufficient height so as to minimize the potential for the entrance of surface water or other material into the well. A steel surface protector with a locking cover will be installed at monitoring wells to prevent access by unauthorized personnel. Where there is potential for damage to monitoring wells, the wells will be protected through the use of barricades, fences, or other protective devices. These protective devices will be periodically inspected and maintained in good operating conditions. Monitoring wells will be locked in a closed position between uses.

When no longer needed for monitoring or other use approved by the Division upon a finding of no adverse environmental or health and safety effects, or unless approved for transfer as a water well under R645-301-731.100 through R645-301-731.522 and R645-301-731.800,

each well will be capped, sealed, backfilled, or otherwise properly managed, as required by the Division in accordance with R645-301-529.400, R645-301-631.100, and R645-301-748. Permanent closure measures will be designed to prevent access to the mine workings by people, livestock, fish and wildlife, machinery and to keep acid or other toxic drainage from entering ground or surface waters.

Water wells less than thirty feet deep are not regulated by the Utah Division of Water Rights. The permanent closure and abandonment of water wells less than 30 feet deep will be accomplished by filling the well casing with neat cement grout, sand cement grout, unhydrated bentonite, or bentonite grout, or other appropriate materials. The well casing will then be cut off below the ground surface and native materials placed over the abandoned well site.

If a water well is exposed by coal mining and reclamation operations, it will be permanently closed unless otherwise managed in a manner approved by the Division.

Permanent closure and abandonment of water wells greater than 30 feet in depth will be in accordance with the requirements of "Administrative Rules for Water Well Drillers", State of Utah, Division of Water Rights or other applicable state regulations. Abandonment of wells will be performed by a licensed water well driller. The wells to be abandoned will be completely filled using neat cement grout, sand cement grout, unhydrated bentonite, or bentonite grout, or other materials approved by the Utah State Engineer's office. Alternatively, the well may be abandoned using a different procedure upon approval from the Utah State Engineer's office.

Abandonment materials will be introduced at the bottom of the well or required sealing interval and placed progressively upward to the top of the well. The casing will be severed a minimum of 2 feet below the ground surface. A minimum of 2 feet of compacted native material will be placed above the abandoned well upon completion.

Within 30 days of the completion of well abandonment procedures, a report will be submitted to the State Engineer by the responsible licensed driller giving data related to the abandonment of the well. This shall include the name of the licensed driller or other person(s) performing abandonment procedures, name of well owner at the time of abandonment, the address or location of the well by section, township, and range, abandonment materials and equipment used, water right or file number covering the well, the final disposition of the well, and the date of completion.

Exploration holes and boreholes will be backfilled, plugged, cased, capped, sealed, or otherwise managed to prevent acid or toxic contamination of water resources and to minimize disturbance to the prevailing hydrologic balance. Exploration holes and boreholes will be managed to ensure the safety of people, livestock, fish and wildlife, and machinery.

If a water well is exposed by coal mining and reclamation operations, it will be permanently closed unless otherwise managed in a manner approved by the Division.

If any exploration boreholes are to be used as monitoring wells or water wells, these will meet the provisions of R645-301-731

Boreholes will be backfilled to within 1 foot of the land surface with concrete or other materials approved by the Division as necessary to prevent contamination of groundwater or surface-water resources or to protect the prevailing hydrologic balance. The upper approximately 1 foot will be backfilled with native materials to facilitate reclamation (see Drawing 6-11). Exploration holes and boreholes that may be uncovered during mining and reclamation activities will be permanently closed unless approved for water monitoring or otherwise managed in a manner approved by the Division.

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Table 7-4 Hydrologic monitoring protocols.

Discharge and water level measurements

Protocol	Applies to	Parameter	Frequency
A	Streams	Discharge	Quarterly
B	Springs	Discharge	Quarterly
C	Monitoring wells	Water elevation	Quarterly
D	Springs	Discharge	Weekly measurements beginning one month prior to highwall mining and continuing until one month after highwall mining in the area, followed by monthly measurements for a period of six months
E	Monitoring wells	Water elevation	Weekly measurements beginning one month prior to highwall mining and continuing until one month after highwall mining in the area, followed by monthly measurements for a period of six months

Water quality

Protocol	Applies to	Parameters	Table	Frequency
1	Streams	Operational field and laboratory water quality measurements	7-6A*	Quarterly
2	Streams	Field water quality measurements only	7-6A*	Quarterly
3	Springs	Operational field and laboratory water quality measurements	7-7A*	Quarterly
4	Springs	Field water quality measurements only	7-7A*	Quarterly
5	Monitoring wells	Operational field and laboratory water quality measurements	7-7A*	Quarterly
6	Monitoring wells	Field water quality measurements only	7-7A*	Quarterly
7	Monitoring wells	Laboratory acidity measurements for a period of two years	---	Quarterly
8	Streams	Laboratory total and dissolved selenium measurements	---	Quarterly

*Note: Every 5 years for the third or fourth quarter monitoring event, laboratory analysis will be performed according to the baseline parameter lists specified in Tables 7-6B and 7-7B for surface waters and groundwaters, respectively. This will first be performed in the year 2015, continuing on a schedule of every five years thereafter.

Table 7-5 Hydrologic monitoring locations and protocols for operational and reclamation phase monitoring.

Site	Protocols	Comments
Streams		
BLM-1	A, 1, 8	Lower Robinson Creek adjacent to mined areas
RID-1	A, 2	Irrigation ditch in Lower Robinson Creek
SW-2	A, 1	Kanab Creek below Lower Robinson Creek
SW-3	A, 1	Kanab Creek above permit area
SW-4	A, 1	Lower Robinson Creek above permit area
SW-5	A, 1, 8	Lower Robinson Creek above Kanab Creek
SW-6	A, 1, 8	Sink Valley Wash at permit boundary
SW-8	A, 1	Swapp Hollow Creek above permit area
SW-9	A, 1, 8	Sink Valley Wash below permit area
SW-101	A, 2	Lower Robinson Creek in permit area
SW-1A	A, 2	Kanab Creek above North Private Lease permit area
SW-1	A, 1	Kanab Creek at upper North Private Lease permit boundary
SW-1M	A, 1	Kanab Creek within North Private Lease permit area
Kanab @ C.R	A, 1	Kanab Creek at lower North Private Lease permit boundary
SW-3	A, 1	Kanab Creek below North Private Lease area (existing monitoring site)
RSD-1	A, 2	Ephemeral wash above North Private Lease permit area
SW-11	A, 1	Intermittent drainage at lower North Private Lease permit boundary
April Creek	A, 1	E. Fork Simpson Hollow adjacent to North Private Lease permit boundary
Priscilla Creek	A, 2	Headwaters East Fork Simpson Hollow creek west of North Private Lease permit area
SW-15	A, 1	Simpson Hollow below North Private Lease mining area at Kanab Creek confluence
EW-1	A, 2	Ephemeral tributary to Kanab Creek
Springs		
Sorensen Spring (SP-40)	B,4, D	Developed alluvial spring in Sink Valley at Sorensen ranch
SP-3	B, 4	Spring in upland pediment alluvium south of permit area (developed and piped down canyon in Sink Valley Wash – now monitored at transfer box at mouth of canyon)
SP-4	B, 3	Developed spring in Sink Valley Wash 1 mile below permit area
SP-6	B, 3	Seep in Sink Valley below permit area, seeps directly into excavated pond
SP-8	B, 3, D	Developed alluvial spring in Sink Valley at Dames ranch
SP-14	B, 3, D	Alluvial spring in Sink Valley
SP-16	B, 4	Alluvial spring in Sink Valley

Site	Protocols	Comments
SP-20	B, 3, D	Alluvial spring in Sink Valley
SP-22	B, 4, D	Alluvial spring in Sink Valley, seeps directly into small excavated pool.
SP-23	B, 4	Alluvial spring in Sink Valley
SP-33	B, 3	Developed spring in lower Sink Valley alluvium
Pond Spring	B, 3	Spring below Alton Town, flows to adjacent pond
Hill Spring	B, 4	Spring below Alton Town
Coyote Seep	B, 3	Alluvial seep in North Private Lease area
Alkali Seep	B, 4	Dakota Formation seep below North Lease permit area
Dakota Seep	B, 4	Dakota Formation seep below permit area (usually dry)
Seep Z	B, 4	Dakota Formation seep adjacent to North Lease area
Wells		
Y-36	C	Coal well in Sink Valley above permit area
Y-38*	C	Coal well in Sink Valley in permit area
Y-45	C	Coal seam well in Swapp Hollow above permit area
Y-61	C, 5, E	Water well in Sink Valley artesian alluvial groundwater system above permit area
Y-63	C	Monitoring well in lower Sink Valley Alluvium below mining areas
Y-98	C	Alluvial well in Robinson Creek above permit area
Y-102	C	Alluvial well in upper Sink Valley in permit area
C0-18*	C	Alluvial monitoring well in Lower Robinson Creek drainage
C0-54*	C	Monitoring well in Lower Robinson Creek drainage near coal seam
C1-24	C	Alluvial monitoring well in Lower Robinson Creek drainage
C2-15	C, E	Monitoring well in Sink Valley alluvium
C2-28	C, E	Monitoring well in Sink Valley alluvium
C2-40	C, E	Monitoring well in Sink Valley alluvium
C3-15	C, E	Monitoring well in Sink Valley alluvium
C3-30	C, E	Monitoring well in Sink Valley alluvium
C3-40	C, E	Monitoring well in Sink Valley alluvium
C4-15	C, E	Monitoring well in Sink Valley alluvium
C4-30	C, E	Monitoring well in Sink Valley alluvium
C4-50	C, E	Monitoring well in Sink Valley alluvium
C5-130	C, E	Monitoring well in Sink Valley artesian alluvial groundwater system above permit area
C7-20*	C	Monitoring well in Sink Valley alluvium
C9-15*	C	Monitoring well in Sink Valley alluvium
C9-25*	C	Monitoring well in Sink Valley alluvium
C9-40*	C	Monitoring well in Sink Valley alluvium
LR-45	C, 5	Monitoring well in Lower Robinson Creek alluvium below mine area
LS-28	C, 5	Monitoring well in Sink Valley Alluvium below mining areas
LS-60	C	Monitoring well in Sink Valley Alluvium below mining areas

Site	Protocols	Comments
LS-85	C, 5	Monitoring well in artesian Sink Valley Alluvium below mining areas
SS-15	C	Monitoring well in Sink Valley Alluvium below mining areas
SS-30	C, 5	Monitoring well in Sink Valley Alluvium below mining areas
SS-75	C	Monitoring well in burned coal area material
UR-70	C, 5	Monitoring well in Lower Robinson Creek alluvium above mine area
Y-100	C	Monitoring well in alluvium above underground mining area
Y-101	C	Monitoring well in alluvium above underground mining area
Y-103	C, 5	Alluvial well in North Private Lease area
Y-53	C	Smirl coal seam well southeast of North Private Lease
Y-55	C	Smirl coal seam well west of North Private Lease area
Y-69	C	Smirl coal seam well west of North Private Lease area
Y-70^{+}	C	Smirl coal seam well in North Private Lease area
NLP-1^{+}	C	Alluvial monitoring well in North Private Lease area
NLP-2^{+}	C	Alluvial monitoring well in North Private Lease area
NLP-3^{+}	C	Alluvial monitoring well in North Private Lease area
NLP-4	C, 5	Alluvial monitoring well in North Private Lease area
NLP-5	C, 5	Alluvial monitoring well in North Private Lease area
NLP-6	C	Alluvial monitoring well above North Private Lease area
NLP-7	C	Alluvial monitoring well above North Private Lease area
NLP-8	C	Alluvial monitoring well above North Private Lease area
NLP-9	C	Alluvial monitoring well above North Private Lease area
NLP-10^{+}	C	Alluvial monitoring well in North Private Lease area
NLP-11	C	Alluvial monitoring well in North Private Lease area
NLP-12^{+}	C, 5	Alluvial monitoring well below mining area
NLP-13	C, 5	Dakota Formation/alluvial well below mining area

* Wells in mine pit areas that have been mined through and are no longer operative.
$^{+}$ Wells in proposed mine pit areas that will be mined through in the future

Table 7-6A Surface water operational and reclamation phase water quality monitoring.

FIELD MEASUREMENTS	REPORTED AS
pH	pH units
Specific Conductance	µS/cm @ 25°C
Dissolved Oxygen	mg/L
Temperature	°C
LABORATORY MEASUREMENTS	
Total Dissolved Solids	mg/L
Total Suspended Solids	mg/L
Bicarbonate	mg/L
Carbonate	mg/L
Calcium (dissolved)	mg/L
Chloride	mg/L
Iron (total)	mg/L
Iron (dissolved)	mg/L
Magnesium (dissolved)	mg/L
Manganese (total)	mg/L
Manganese (dissolved)	mg/L
Potassium (dissolved)	mg/L
Sodium (dissolved)	mg/L
Sulfate	mg/L
Oil and grease	mg/L
Cations	meq/l
Anions	meq/l
Cation/Anion Balance	%

Table 7-6B Surface water baseline water quality monitoring

FIELD MEASUREMENTS	REPORTED AS
pH	pH units
Specific Conductance	µS/cm @ 25°C
Dissolved Oxygen	mg/L
Temperature	°C
LABORATORY MEASUREMENTS	
Total Dissolved Solids	mg/L
Total Suspended Solids	mg/L
Total Alkalinity	mg/L
Total Hardness ($CaCO_3$)	mg/L
Acidity	mg/L
Aluminum (dissolved)	mg/L
Arsenic (dissolved)	mg/L
Bicarbonate	mg/L
Boron (dissolved)	mg/L
Cadmium (dissolved)	mg/L
Carbonate	mg/L
Calcium (dissolved)	mg/L
Chloride	mg/L
Copper (dissolved)	mg/L
Iron (total)	mg/L
Iron (dissolved)	mg/L
Lead (dissolved)	mg/L
Magnesium (dissolved)	mg/L
Manganese (total)	mg/L
Manganese (dissolved)	mg/L
Molybdenum (dissolved)	mg/L
Ammonia	mg/L
Nitrate+Nitrite	mg/L
Phosphorous (total)	mg/L
Potassium (dissolved)	mg/L
Selenium (dissolved)	mg/L
Sodium (dissolved)	mg/L
Sulfate	mg/L
Zinc (dissolved)	mg/L
Oil and grease	mg/L
Cations	meq/l
Anions	meq/l
Cation/Anion Balance	%

Table 7-7A Groundwater operational and reclamation phase water quality monitoring.

FIELD MEASUREMENTS	REPORTED AS
pH	pH units
Specific Conductance	µS/cm @ 25°C
Temperature	°C
LABORATORY MEASUREMENTS	
Total Dissolved Solids	mg/L
Carbonate	mg/L
Bicarbonate	mg/L
Calcium (dissolved)	mg/L
Chloride	mg/L
Iron (total)	mg/L
Iron (dissolved)	mg/L
Magnesium (dissolved)	mg/L
Manganese (total)	mg/L
Manganese (dissolved)	mg/L
Potassium (dissolved)	mg/L
Sodium (dissolved)	mg/L
Sulfate	mg/L
Cations	meq/L
Anions	meq/L
Cation/Anion Balance	%

Table 7-7B Groundwater baseline water quality monitoring.

FIELD MEASUREMENTS	REPORTED AS
pH	pH units
Specific Conductance	µS/cm @ 25°C
Temperature	°C
LABORATORY MEASUREMENTS	
Total Dissolved Solids	mg/L
Total Alkalinity	mg/L
Total Hardness ($CaCO_3$)	mg/L
Acidity	mg/L
Aluminum (dissolved)	mg/L
Arsenic (dissolved)	mg/L
Bicarbonate	mg/L
Boron (dissolved)	mg/L
Cadmium (dissolved)	mg/L
Carbonate	mg/L
Calcium (dissolved)	mg/L
Chloride	mg/L
Copper (dissolved)	mg/L
Iron (total)	mg/L
Iron (dissolved)	mg/L
Lead (dissolved)	mg/L
Magnesium (dissolved)	mg/L
Manganese (total)	mg/L
Manganese (dissolved)	mg/L
Molybdenum (dissolved)	mg/L
Ammonia	mg/L
Nitrate+Nitrite	mg/L
Phosphorous (total)	mg/L
Potassium (dissolved)	mg/L
Selenium (dissolved)	mg/L
Sodium (dissolved)	mg/L
Sulfate	mg/L
Zinc (dissolved)	mg/L
Cations	meq/l
Anions	meq/l
Cation/Anion Balance	%

Simpson Hollow Creek, Kanab Creek Sub-Drainage

Kanab Creek Drainage

North Private Lease permit boundary

Simpson Hollow Creek Kanab Creek Sub-Drainage

Kanab Creek Drainage

Coal Hollow Mine permit boundary

Coal Hollow Mine permit boundary

Alton

Amphitheater

Robinson Creek

Lower Kanab Creek

Sink Valley Wash

Swamp Ranch

Broad Hollow

Dry Creek

Swapp

Alton Cemetery

Gravel Pits

Gravel Pit

Mine

Spring

Springs

Hill Spring

Car Seep

Priscilla Seep

Priscilla Creek

Pond Spring

Coyote Seep

April Seep

April Creek

Seep

Alkali Seep

Dakota Seep

Kanab Mid

Kanab CR

LAMB CANAL

Knob Spring

SP7-1

ESD-1

SW-1A

NLP-8

NLP-9

NLP-7

NLP-6

NLP-5

NLP-1

NLP-2

NLP-3

NLP-4

NLP-10

NLP-11

NLP-12

NLP-13

SW-1

SW-1M

SW-1I

EW-1

EW-2

EW-3

SW-3

EW-2A

SW-15

SW-101

BLM-1

LR-45

LR-29

SW-5

SW-2

SW-18

SW-4

RID 1

SW-7

SW-8

SW-6

SW-9

SW-10

SP-5

SP-4

SP-3

SP-33

SP-14

SP-16

SP-40

SP-22

SP-23

SP-20

SP-19

SP-6

Y-99

Y-100

Y-101P

Y-102

Y-36

Y-61

Y-45

Y-59

Y-38

Y-63

Y-98

Y-103 (A6)

Y-70 (PDH7)

Y-56

Y-55

Y-69 (PDH6)

C0

C1

C2

C3

C4

C5

C6

C7

C8

C9

UR

SS

LS

SVT-01

SVT-02

SVT-03

SVT-04

SVT-05

SVT-06

Gravel Pits

Gravel Pit

JEEP TRAIL

T 39 S

T 40 S

N

0 1000 2000 3000

LEGEND:

- COAL LINE
- PERMIT BOUNDARY
- COUNTY ROAD
- ▲ SVT ALLUVIAL TRENCH
- ● SP SPRING
- ▲ SW SURFACE WATER
- ■ Y MONITORING WELL

DRAWN BY:	CHECKED BY:
C. McCOURT	ECP
DRAWING: 7–2	DATE: 8/26/09
	SCALE: 1" = 1000'
JOB NUMBER: 0001	SHEET

REVISIONS

DATE:	BY:
10/23/13	KN
11/06/14	KN
03/18/15	KN
10/05/15	KN

BASELINE MONITORING LOCATIONS

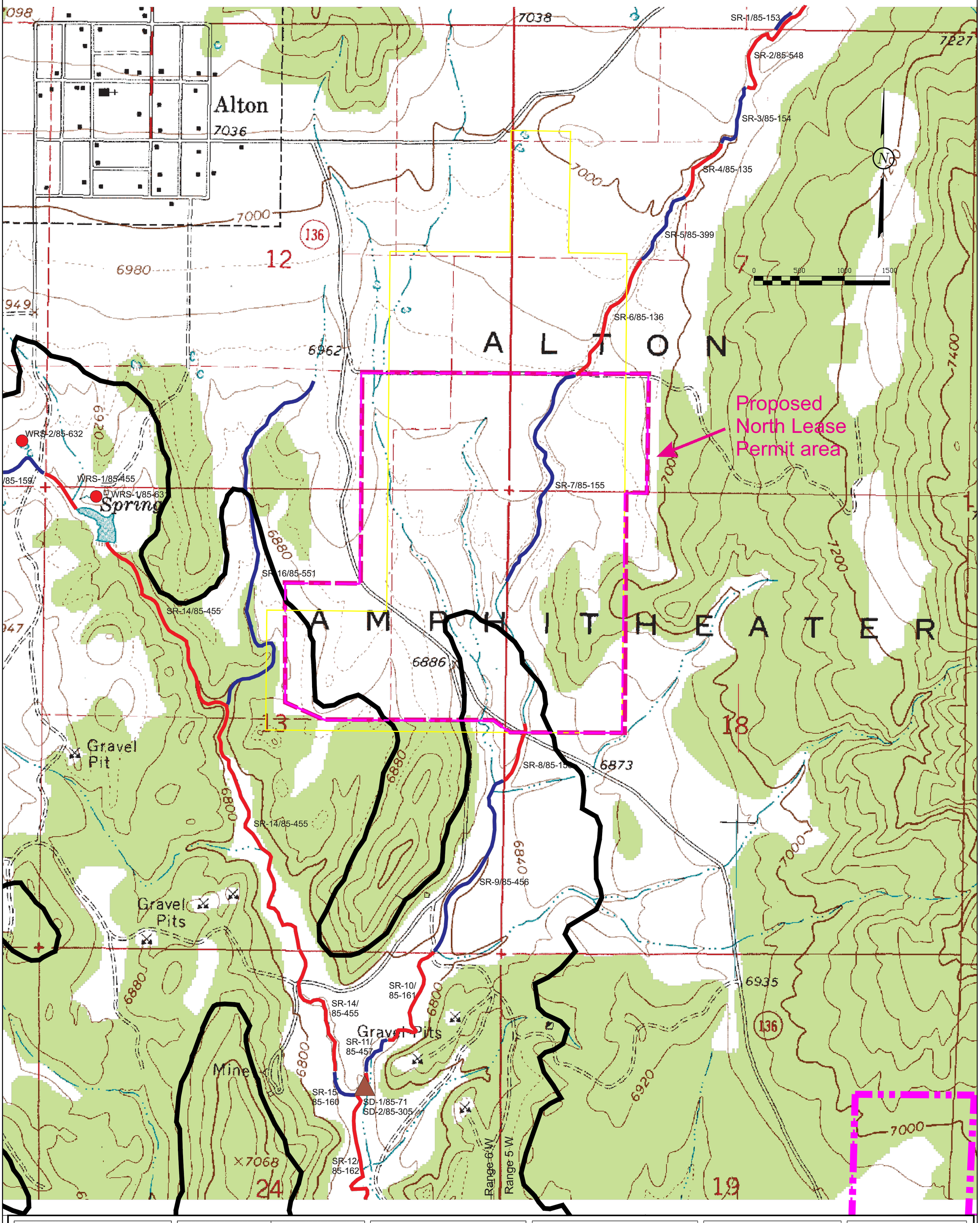
COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 7-2

ERIK CARL PETERSEN
Registered Professional Geologist
5373615–2250
State of Utah

Alton Coal Development
Coal Hollow Project
463 North 100 West, Suite 1
Cedar City, Utah 84721
Phone (435)867-5331
Fax (435)867-1192

R 6 W R 5 W



LEGEND:

- PERMIT BOUNDARY
- COAL LINE BOUNDARY
- COUNTY ROAD
- WRS SPRING
- SD SURFACE DIVERSION
- SR SURFACE REACH

DRAWN BY:	CHECKED BY:
K. NICHOLES	E. PETERSEN
DRAWING: 7–3N	DATE: 03/17/15
	SCALE: 1" = 500'
JOB NUMBER: 0001	SHEET

REVISIONS

DATE:	BY:

PROJECT AREA WATER RIGHTS

COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 7-3N

ERIK CARL PETERSEN
5373615–2250
Registered Professional Engineer
State of Utah

Alton Coal Development
Coal Hollow Project
463 North 100 West, Suite 1
Cedar City, Utah 84721
Phone (435)867-5331
Fax (435)867-1192

North Private Lease permit boundary

Coal Hollow Mine permit boundary

ALTON AMPHITHEATER

R 6 W R 5 W

T 39 S
T 40 S

NATIONAL FOREST

LEGEND:	
COAL LINE	
PERMIT BOUNDARY	
COUNTY ROAD	
SPRING MONITORING STATION	
SURFACE WATER STATION	
WELL MONITORING STATION	

DRAWN BY: C. McCOURT	CHECKED BY: ECP
DRAWING: 7–10	DATE: 8/26/09
	SCALE: 1" = 1000'
JOB NUMBER: 1400	SHEET

REVISIONS

DATE:	BY:
11/14/12	KN
10/25/13	KN
11/06/14	KN
10/05/15	KN

BASELINE MONITORING LOCATIONS

COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 7-10

ERIK CARL PETERSEN
5373615–2250
State of Utah
Registered Professional Geologist

Alton Coal Development
Coal Hollow Project
463 North 100 West, Suite 1
Cedar City, Utah 84721
Phone (435)867-5331
Fax (435)867-1192

APPENDIX 7-3N

EXHIBIT 7-1N

Stream Reaches

(North Lease)

STREAM REACHES

REF#	WR#	OWNER	SOURCE
1	85-153	Ray J. Palmer	Kanab Creek
2	85-548	Lloyd W. & Ross E. & Gail P. & Vard H. Heaton	Kanab Creek
3	85-154	Ray J. Palmer	Kanab Creek
4	85-135	C. Leonard & Edna R. Heaton	Kanab Creek
5	85-399	Orval Palmer	Kanab Creek
6	85-136	C. Leonard & Edna R. Heaton	Kanab Creek
7	85-155	Ray J. & Melba Palmer	Kanab Creek
8	85-156	Ray J. and Melba Palmer	Kanab Creek
9	85-456	Kanab District USA Bureau of Land Management	Kanab Creek
10	85-161	Twin Eagles Ranch, LLC	Kanab Creek
11	85-457	Kanab District USA Bureau of Land Management	Kanab Creek
12	85-162	Twin Eagles Ranch, LLC	Kanab Creek
13	85-159	Twin Eagles Ranch, LLC	Kanab Creek
14	85-455	Kanab District USA Bureau of Land Management	Simpson Hollow Creek
15	85-160	Twin Eagles Ranch, LLC	Simpson Hollow Stream
16	85-551	Lloyd W. & Ross E. & Gail P. & Vard H. Heaton	East Fork Simpson Hollow Creek

STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 85-153

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 12/08/2014 Page 1

WATER RIGHT: 85-153 APPLICATION/CLAIM NO.: CERT. NO.:

==========
OWNERSHIP**********
==========

NAME: Ray J. Palmer
ADDR: Alton UT 84710

==========
DATES, ETC.**********
==========

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: 07/22/1969|PRIORITY: / /1864|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: 07/22/1969|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]

PD BOOK: [85-1]|MAP: [2d]|PUB DATE:

Type of Right: Diligence Claim Source of Info: Proposed Determination Status:

==========
LOCATION OF WATER RIGHT**********
==========

FLOW:

SOURCE: Kanab Creek

COUNTY: Kane COMMON DESCRIPTION:

POINT OF DIVERSION -- POINT TO POINT:
(1)Stockwatering directly on stream from a point at N 660 ft. E 660 ft. from S4 corner, Sec 06, T39S, R5W, SLBM,
to a point at N 660 ft. E 660 ft. from S4 corner, Sec 06, T39S, R5W, SLBM.
COMMENT: Administratively updated by State Engineer.

==========
USES OF WATER RIGHT******** ELU -- Equivalent Livestock Unit (cow, horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family
(The Beneficial Use Amount is the quantity of Use that this Water Right contributes to the Group Total.)
==========
SUPPLEMENTAL GROUP NO. 612235. Water Rights Appurtenant to the following use(s):
85-152(DIL),153(DIL),154(DIL)
....
STOCKWATER: Beneficial Use Amt: UNEVALUATED ELUs Group Total: 150.00 PERIOD OF USE: 04/01 TO 12/31

==========
PLACE OF USE for STOCKWATERING**********
==========

	NORTH-WEST≈ NW NE SW SE	NORTH-EAST≈ NW NE SW SE	SOUTH-WEST≈ NW NE SW SE	SOUTH-EAST≈ NW NE SW SE
Sec 06 T 39S R 5W SLBM	* : : : *	* : : : *	* : : : *	* : : : X: *

****
**********E N D O F D A T A**********
****

STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 85-548

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 10/28/2014 Page 1

WATER RIGHT: 85-548 APPLICATION/CLAIM NO.: CERT. NO.:

OWNERSHIP

NAME: Lloyd W. & Ross E. & Gail P. & Vard H. Heaton
ADDR: Alton UT 84710

DATES, ETC.

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: 04/14/1970|PRIORITY: / /1864|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: 04/14/1970|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]

PD BOOK: [85-1]|MAP: [2d]|PUB DATE:

Type of Right: Diligence Claim Source of Info: Proposed Determination Status:

LOCATION OF WATER RIGHT

FLOW:

SOURCE: Kanab Creek

COUNTY: Kane COMMON DESCRIPTION:

POINT OF DIVERSION -- POINT TO POINT:
(1)Stockwatering directly on stream from a point at S 660 ft. W 660 ft. from E4 corner, Sec 06, T39S, R5W, SLBM,
to a point at S 660 ft. E 660 ft. from N4 corner, Sec 07, T39S, R5W, SLBM.
COMMENT: Administratively updated by State Engineer.

USES OF WATER RIGHT******** ELU -- Equivalent Livestock Unit (cow, horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family
(The Beneficial Use Amount is the quantity of Use that this Water Right contributes to the Group Total.)

SUPPLEMENTAL GROUP NO. 612515. Water Rights Appurtenant to the following use(s):
85-412(DIL),413(DIL),414(DIL),415(DIL),543(DIL),544(DIL),545(DIL),546(DIL),547(DIL),548(DIL),549(DIL),550(DIL),551(DIL),552(DIL)
553(DIL),554(DIL),555(DIL),556(DIL),557(DIL),558(DIL),559(DIL),608(DIL),631(DIL),632(DIL),713(DIL),731(DIL),733(DIL)

STOCKWATER: Beneficial Use Amt: UNEVALUATED ELUs Group Total: 1600.0 PERIOD OF USE: 04/01 TO 12/31

PLACE OF USE for STOCKWATERING

	NORTH-WEST≈ NW NE SW SE	NORTH-EAST≈ NW NE SW SE	SOUTH-WEST≈ NW NE SW SE	SOUTH-EAST≈ NW NE SW SE
Sec 06 T 39S R 5W SLBM	* : : : *	* : : : *	* : : : *	* : X: : *
Sec 07 T 39S R 5W SLBM	* : : : *	* X: : : *	* : : : *	* : : : *

**********E N D O F D A T A**********

STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 85-154

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 10/28/2014 Page 1

WATER RIGHT: 85-154 APPLICATION/CLAIM NO.: CERT. NO.:

OWNERSHIP

NAME: Ray J. Palmer
ADDR: Alton UT 84710

DATES, ETC.

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: 07/22/1969|PRIORITY: / /1864|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: 07/22/1969|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]

PD BOOK: [85-1]|MAP: [2d]|PUB DATE:

Type of Right: Diligence Claim Source of Info: Proposed Determination Status:

LOCATION OF WATER RIGHT

FLOW:

SOURCE: Kanab Creek

COUNTY: Kane COMMON DESCRIPTION:

POINT OF DIVERSION -- POINT TO POINT:
(1)Stockwatering directly on stream from a point at S 660 ft. W 660 ft. from N4 corner, Sec 07, T39S, R5W, SLBM,
to a point at S 660 ft. W 660 ft. from N4 corner, Sec 07, T39S, R5W, SLBM.
COMMENT: Administratively updated by State Engineer.

USES OF WATER RIGHT******** ELU -- Equivalent Livestock Unit (cow, horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family
(The Beneficial Use Amount is the quantity of Use that this Water Right contributes to the Group Total.)

SUPPLEMENTAL GROUP NO. 612235. Water Rights Appurtenant to the following use(s):
85-152(DIL),153(DIL),154(DIL)

STOCKWATER: Beneficial Use Amt: UNEVALUATED ELUs Group Total: 150.00 PERIOD OF USE: 04/01 TO 12/31

PLACE OF USE for STOCKWATERING

	NORTH-WEST≈ NW NE SW SE	NORTH-EAST≈ NW NE SW SE	SOUTH-WEST≈ NW NE SW SE	SOUTH-EAST≈ NW NE SW SE
Sec 07 T 39S R 5W SLBM	* : X: : *	* : : : *	* : : : *	* : : : *

**********E N D O F D A T A**********

STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 85-135

WATER RIGHT: 85-135 APPLICATION/CLAIM NO.: CERT. NO.:

OWNERSHIP**********

NAME: C. Leonard & Edna R. Heaton
ADDR: Moccasin AZ 86002

DATES, ETC.**********

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: 07/21/1969|PRIORITY: / /1864|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: 07/21/1969|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]

PD BOOK: [85-1]|MAP: [2d]|PUB DATE:

Type of Right: Diligence Claim Source of Info: Proposed Determination Status:

LOCATION OF WATER RIGHT**********

FLOW:

SOURCE: Kanab Creek

COUNTY: Kane COMMON DESCRIPTION:

POINT OF DIVERSION -- POINT TO POINT:
(1)Stockwatering directly on stream from a point at N 660 ft. E 1980 ft. from W4 corner, Sec 07, T39S, R5W, SLBM,
to a point at N 660 ft. E 1980 ft. from W4 corner, Sec 07, T39S, R5W, SLBM.
COMMENT: Administratively updated by State Engineer.

USES OF WATER RIGHT******** ELU -- Equivalent Livestock Unit (cow, horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family
(The Beneficial Use Amount is the quantity of Use that this Water Right contributes to the Group Total.)

SUPPLEMENTAL GROUP NO. 612229. Water Rights Appurtenant to the following use(s):
85-135(DIL),136(DIL)

STOCKWATER: Beneficial Use Amt: UNEVALUATED ELUs Group Total: 20.000 PERIOD OF USE: 04/01 TO 12/31

PLACE OF USE for STOCKWATERING**********

	NORTH-WEST≈ NW NE SW SE	NORTH-EAST≈ NW NE SW SE	SOUTH-WEST≈ NW NE SW SE	SOUTH-EAST≈ NW NE SW SE
Sec 07 T 39S R 5W SLBM	* : : : X*	* : : : *	* : : : *	* : : : *

**********E N D O F D A T A**********

STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 85-399

WATER RIGHT: 85-399 APPLICATION/CLAIM NO.: CERT. NO.:

OWNERSHIP**********

NAME: Orval Palmer
ADDR: Alton UT 84710

DATES, ETC.**********

LAND OWNED BY APPLICANT? COUNTY TAX ID#:

FILED: 03/12/1970	PRIORITY: / /1864	PUB BEGAN:	PUB ENDED:	NEWSPAPER:	
ProtestEnd:	PROTESTED: [No]	HEARNG HLD:	SE ACTION: [ ]	ActionDate:	PROOF DUE:
EXTENSION:	ELEC/PROOF:[ ]	ELEC/PROOF:	CERT/WUC: 03/12/1970	LAP, ETC:	LAPS LETTER:
RUSH LETTR:	RENOVATE:	RECON REQ:	TYPE: [ ]		

PD BOOK: [85-1] MAP: [2d] PUB DATE:

Type of Right: Diligence Claim Source of Info: Proposed Determination Status:

LOCATION OF WATER RIGHT**********

FLOW:

SOURCE: Kanab Creek

COUNTY: Kane COMMON DESCRIPTION:

POINT OF DIVERSION -- POINT TO POINT:
(1)Stockwatering directly on stream from a point at N 660 ft. E 1980 ft. from W4 corner, Sec 07, T39S, R5W, SLBM,
to a point at N 660 ft. E 1980 ft. from W4 corner, Sec 07, T39S, R5W, SLBM.
COMMENT: Administratively updated by State Engineer.

USES OF WATER RIGHT******** ELU -- Equivalent Livestock Unit (cow, horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family
(The Beneficial Use Amount is the quantity of Use that this Water Right contributes to the Group Total.)

SUPPLEMENTAL GROUP NO. 612390.

STOCKWATER: 54.0000 Stock Units PERIOD OF USE: 01/01 TO 12/31

PLACE OF USE for STOCKWATERING**********

	NORTH-WEST≈ NW NE SW SE	NORTH-EAST≈ NW NE SW SE	SOUTH-WEST≈ NW NE SW SE	SOUTH-EAST≈ NW NE SW SE
Sec 07 T 39S R 5W SLBM	* : : : X*	* : : : *	* : : : *	* : : : *

**********E N D O F D A T A**********

STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 85-136

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 10/28/2014 Page 1

WATER RIGHT: 85-136 APPLICATION/CLAIM NO.: CERT. NO.:

OWNERSHIP

NAME: C. Leonard & Edna R. Heaton
ADDR: Moccasin AZ 86022
INTEREST: 100%

DATES, ETC.

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: 07/21/1969|PRIORITY: / /1864|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: 07/21/1969|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]

PD BOOK: [85-1]|MAP: [2d]|PUB DATE:

Type of Right: Diligence Claim Source of Info: Proposed Determination Status:

LOCATION OF WATER RIGHT

FLOW:

SOURCE: Kanab Creek

COUNTY: Kane COMMON DESCRIPTION:

POINT OF DIVERSION -- POINT TO POINT:
(1)Stockwatering directly on stream from a point at S 660 ft. E 1980 ft. from W4 corner, Sec 07, T39S, R5W, SLBM,
to a point at S 660 ft. E 660 ft. from W4 corner, Sec 07, T39S, R5W, SLBM.
COMMENT: Administratively updated by State Engineer.

USES OF WATER RIGHT******** ELU -- Equivalent Livestock Unit (cow, horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family
(The Beneficial Use Amount is the quantity of Use that this Water Right contributes to the Group Total.)

SUPPLEMENTAL GROUP NO. 612229. Water Rights Appurtenant to the following use(s):
85-135(DIL),136(DIL)

STOCKWATER: Beneficial Use Amt: UNEVALUATED ELUs Group Total: 20.000 PERIOD OF USE: 04/01 TO 12/31

PLACE OF USE for STOCKWATERING

	NORTH-WEST≈ NW NE SW SE	NORTH-EAST≈ NW NE SW SE	SOUTH-WEST≈ NW NE SW SE	SOUTH-EAST≈ NW NE SW SE
Sec 07 T 39S R 5W SLBM	* : : : *	* : : : *	* X: X: : *	* : : : *

**********E N D O F D A T A**********

STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 85-155

WATER RIGHT: 85-155 APPLICATION/CLAIM NO.: CERT. NO.:

OWNERSHIP**********

NAME: Ray J. & Melba Palmer
ADDR: Alton UT 84710
INTEREST: 100%

DATES, ETC.**********

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: 07/22/1969|PRIORITY: / /1864|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: 07/22/1969|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]

PD BOOK: [85-1]|MAP: [2d]|PUB DATE:

Type of Right: Diligence Claim Source of Info: Proposed Determination Status:

LOCATION OF WATER RIGHT**********

FLOW:

SOURCE: Kanab Creek

COUNTY: Kane COMMON DESCRIPTION:

POINT OF DIVERSION -- POINT TO POINT:
(1)Stockwatering directly on stream from a point at N 660 ft. E 660 ft. from SW corner, Sec 07, T39S, R5W, SLBM,
to a point at S 660 ft. E 660 ft. from NW corner, Sec 18, T39S, R5W, SLBM.
COMMENT: Administratively updated by State Engineer.

USES OF WATER RIGHT******** ELU -- Equivalent Livestock Unit (cow, horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family
(The Beneficial Use Amount is the quantity of Use that this Water Right contributes to the Group Total.)

SUPPLEMENTAL GROUP NO. 612236. Water Rights Appurtenant to the following use(s):
85-155(DIL),156(DIL)

STOCKWATER: Beneficial Use Amt: UNEVALUATED ELUs Group Total: 150.00 PERIOD OF USE: 04/01 TO 12/31

PLACE OF USE for STOCKWATERING**********

	NORTH-WEST≈ NW NE SW SE	NORTH-EAST≈ NW NE SW SE	SOUTH-WEST≈ NW NE SW SE	SOUTH-EAST≈ NW NE SW SE
Sec 07 T 39S R 5W SLBM	* : : : *	* : : : *	* : : X: *	* : : : *
Sec 18 T 39S R 5W SLBM	* X: : : *	* : : : *	* : : : *	* : : : *

**********E N D O F D A T A**********

STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 85-156

WATER RIGHT: 85-156 APPLICATION/CLAIM NO.: CERT. NO.:

OWNERSHIP

NAME: Ray J. and Melba Palmer
ADDR: Alton UT 84710

DATES, ETC.

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: 07/22/1969|PRIORITY: / /1864|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: 07/22/1969|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]

PD BOOK: [85-1]|MAP: [4a]|PUB DATE:

Type of Right: Diligence Claim Source of Info: Proposed Determination Status:

LOCATION OF WATER RIGHT

FLOW:

SOURCE: Kanab Creek

COUNTY: Kane COMMON DESCRIPTION:

POINT OF DIVERSION -- POINT TO POINT:
(1)Stockwatering directly on stream from a point at S 660 ft. E 660 ft. from W4 corner, Sec 18, T39S, R5W, SLBM,
to a point at S 660 ft. E 660 ft. from W4 corner, Sec 18, T39S, R5W, SLBM.
COMMENT: Administratively updated by State Engineer.

USES OF WATER RIGHT******** ELU -- Equivalent Livestock Unit (cow, horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family
(The Beneficial Use Amount is the quantity of Use that this Water Right contributes to the Group Total.)

SUPPLEMENTAL GROUP NO. 612236. Water Rights Appurtenant to the following use(s):
85-155(DIL),156(DIL)

STOCKWATER: Beneficial Use Amt: UNEVALUATED ELUs Group Total: 150.00 PERIOD OF USE: 04/01 TO 12/31

PLACE OF USE for STOCKWATERING

	NORTH-WEST≈ NW NE SW SE	NORTH-EAST≈ NW NE SW SE	SOUTH-WEST≈ NW NE SW SE	SOUTH-EAST≈ NW NE SW SE
Sec 18 T 39S R 5W SLBM	* : : : *	* : : : *	* X: : : *	* : : : *

**********E N D O F D A T A**********

STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 85-456

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 12/05/2014 Page 1

WATER RIGHT: 85-456 APPLICATION/CLAIM NO.: CERT. NO.:

OWNERSHIP

NAME: Kanab District USA Bureau of Land Management
ADDR: 669 S. Highway 89 A
Kanab Utah 84741

DATES, ETC.

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: |PRIORITY: / /1864|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: |LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]

PD BOOK: [85-1]|MAP: [4a]|PUB DATE:

Type of Right: Diligence Claim Source of Info: Proposed Determination Status:

LOCATION OF WATER RIGHT

FLOW:

SOURCE: Kanab Creek

COUNTY: Kane COMMON DESCRIPTION:

POINT OF DIVERSION -- POINT TO POINT:
(1)Stockwatering directly on stream from a point at S 660 ft. W 660 ft. from E4 corner, Sec 13, T39S, R6W, SLBM,
to a point at N 660 ft. W 660 ft. from SE corner, Sec 13, T39S, R6W, SLBM.
COMMENT: Administratively updated by State Engineer.

USES OF WATER RIGHT******** ELU -- Equivalent Livestock Unit (cow, horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family
(The Beneficial Use Amount is the quantity of Use that this Water Right contributes to the Group Total.)

SUPPLEMENTAL GROUP NO. 612416. Water Rights Appurtenant to the following use(s):
85-455(DIL),456(DIL),457(DIL)

STOCKWATER: Beneficial Use Amt: UNEVALUATED ELUs Group Total: 5.0000 PERIOD OF USE: 01/01 TO 12/31
Garn Swapp Allotment No. 40.

PLACE OF USE for STOCKWATERING

	NORTH-WEST≈ NW NE SW SE	NORTH-EAST≈ NW NE SW SE	SOUTH-WEST≈ NW NE SW SE	SOUTH-EAST≈ NW NE SW SE
Sec 13 T 39S R 6W SLBM	* : : : *	* : : : *	* : : : *	* : X: : X*

**********E N D O F D A T A**********

STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 85-161

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 12/08/2014 Page 1

WATER RIGHT: 85-161 APPLICATION/CLAIM NO.: CERT. NO.:

CHANGES: a38554 Approved

OWNERSHIP

NAME: Twin Eagles Ranch, LLC
ADDR: 1375 West 3150 South
Hurricane UT 84737
INTEREST: 100%

DATES, ETC.

LAND OWNED BY APPLICANT? COUNTY TAX ID#:

FILED: 08/01/1969	PRIORITY: / /1864	PUB BEGAN:	PUB ENDED:	NEWSPAPER:	
ProtestEnd:	PROTESTED: [No]	HEARNG HLD:	SE ACTION: [ ]	ActionDate:	PROOF DUE:
EXTENSION:	ELEC/PROOF:[ ]	ELEC/PROOF:	CERT/WUC: 08/01/1969	LAP, ETC:	LAPS LETTER:
RUSH LETTR:	RENOVATE:	RECON REQ:	TYPE: [ ]		

PD BOOK: [85-1] MAP: [4a] PUB DATE:

Type of Right: Diligence Claim Source of Info: Proposed Determination Status:

LOCATION OF WATER RIGHT

FLOW:

SOURCE: Kanab Creek

COUNTY: Kane COMMON DESCRIPTION:

POINT OF DIVERSION -- POINT TO POINT:
(1)Stockwatering directly on stream from a point at S 660 ft. W 660 ft. from NE corner, Sec 24, T39S, R6W, SLBM,
to a point at S 660 ft. W 660 ft. from NE corner, Sec 24, T39S, R6W, SLBM.
COMMENT: Administratively updated by State Engineer.

USES OF WATER RIGHT******** ELU -- Equivalent Livestock Unit (cow, horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family
(The Beneficial Use Amount is the quantity of Use that this Water Right contributes to the Group Total.)

SUPPLEMENTAL GROUP NO. 612239. Water Rights Appurtenant to the following use(s):
85-159(DIL),160(DIL),161(DIL),162(DIL),163(DIL)

STOCKWATER: Beneficial Use Amt: UNEVALUATED ELUs Group Total: 400.00 PERIOD OF USE: 04/01 TO 12/31

PLACE OF USE for STOCKWATERING

	NORTH-WEST≈ NW NE SW SE	NORTH-EAST≈ NW NE SW SE	SOUTH-WEST≈ NW NE SW SE	SOUTH-EAST≈ NW NE SW SE
Sec 24 T 39S R 6W SLBM	* : : : *	* : X: : *	* : : : *	* : : : *

E N D O F D A T A

STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 85-457

WATER RIGHT: 85-457 APPLICATION/CLAIM NO.: CERT. NO.:

OWNERSHIP**********

NAME: Kanab District USA Bureau of Land Management
ADDR: 669 S. Highway 89 A
Kanab Utah 84741

DATES, ETC.**********

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: |PRIORITY: / /1864|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: |LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]

PD BOOK: [85-1]|MAP: [4a]|PUB DATE:

Type of Right: Diligence Claim Source of Info: Proposed Determination Status:

LOCATION OF WATER RIGHT**********

FLOW:

SOURCE: Kanab Creek

COUNTY: Kane COMMON DESCRIPTION:

POINT OF DIVERSION -- POINT TO POINT:
(1)Stockwatering directly on stream from a point at S 660 ft. E 660 ft. from N4 corner, Sec 24, T39S, R6W, SLBM,
to a point at S 660 ft. E 660 ft. from N4 corner, Sec 24, T39S, R6W, SLBM.
COMMENT: Administratively updated by State Engineer.

USES OF WATER RIGHT******** ELU -- Equivalent Livestock Unit (cow, horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family
(The Beneficial Use Amount is the quantity of Use that this Water Right contributes to the Group Total.)

SUPPLEMENTAL GROUP NO. 612416. Water Rights Appurtenant to the following use(s):
85-455(DIL),456(DIL),457(DIL)

STOCKWATER: Beneficial Use Amt: UNEVALUATED ELUs Group Total: 5.0000 PERIOD OF USE: 01/01 TO 12/31
Garn Swapp Allotment No. 40.

PLACE OF USE for STOCKWATERING**********

	NORTH-WEST≈ NW NE SW SE	NORTH-EAST≈ NW NE SW SE	SOUTH-WEST≈ NW NE SW SE	SOUTH-EAST≈ NW NE SW SE
Sec 24 T 39S R 6W SLBM	* : : : *	* X: : : *	* : : : *	* : : : *

**********E N D O F D A T A**********

STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 85-162

WATER RIGHT: 85-162 APPLICATION/CLAIM NO.: CERT. NO.:

CHANGES: a38554 Approved

OWNERSHIP

NAME: Twin Eagles Ranch, LLC
ADDR: 1375 West 3150 South
Hurricane UT 84737

DATES, ETC.

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: 08/01/1969|PRIORITY: / /1864|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: 08/01/1969|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]

PD BOOK: [85-1]|MAP: [4a]|PUB DATE:

Type of Right: Diligence Claim Source of Info: Proposed Determination Status:

LOCATION OF WATER RIGHT

FLOW:

SOURCE: Kanab Creek

COUNTY: Kane COMMON DESCRIPTION:

POINT OF DIVERSION -- POINT TO POINT:
(1)Stockwatering directly on stream from a point at S 1980 ft. E 660 ft. from N4 corner, Sec 24, T39S, R6W, SLBM,
to a point at S 660 ft. W 1980 ft. from E4 corner, Sec 24, T39S, R6W, SLBM.
COMMENT: Administratively updated by State Engineer.

USES OF WATER RIGHT******** ELU -- Equivalent Livestock Unit (cow, horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family
(The Beneficial Use Amount is the quantity of Use that this Water Right contributes to the Group Total.)

SUPPLEMENTAL GROUP NO. 612239. Water Rights Appurtenant to the following use(s):
85-159(DIL),160(DIL),161(DIL),162(DIL),163(DIL)

STOCKWATER: Beneficial Use Amt: UNEVALUATED ELUs Group Total: 400.00 PERIOD OF USE: 04/01 TO 12/31

PLACE OF USE for STOCKWATERING

	NORTH-WEST≈ NW NE SW SE	NORTH-EAST≈ NW NE SW SE	SOUTH-WEST≈ NW NE SW SE	SOUTH-EAST≈ NW NE SW SE
Sec 24 T 39S R 6W SLBM	* : : : *	* : : X: *	* : : : *	* X: : : *

**********E N D O F D A T A**********

STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 85-159

WATER RIGHT: 85-159 APPLICATION/CLAIM NO.: CERT. NO.:

CHANGES: a38554 Approved

OWNERSHIP

NAME: Twin Eagles Ranch, LLC
ADDR: 1375 West 3150 South
Hurricane UT 84737

DATES, ETC.

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: 08/01/1969|PRIORITY: / /1864|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: 08/01/1969|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]

PD BOOK: [85-1]|MAP: [2d]|PUB DATE:

Type of Right: Diligence Claim Source of Info: Proposed Determination Status:

LOCATION OF WATER RIGHT

FLOW:

SOURCE: West Fork Simpson Hollow Creek

COUNTY: Kane COMMON DESCRIPTION:

POINT OF DIVERSION -- POINT TO POINT:
(1)Stockwatering directly on stream from a point at N 660 ft. E 660 ft. from S4 corner, Sec 11, T39S, R6W, SLBM,
to a point at N 660 ft. W 660 ft. from SE corner, Sec 11, T39S, R6W, SLBM.
COMMENT: Administratively updated by State Engineer.

USES OF WATER RIGHT******** ELU -- Equivalent Livestock Unit (cow, horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family
(The Beneficial Use Amount is the quantity of Use that this Water Right contributes to the Group Total.)

SUPPLEMENTAL GROUP NO. 612239. Water Rights Appurtenant to the following use(s):
85-159(DIL),160(DIL),161(DIL),162(DIL),163(DIL)

STOCKWATER: Beneficial Use Amt: UNEVALUATED ELUs Group Total: 400.00 PERIOD OF USE: 04/01 TO 12/31

PLACE OF USE for STOCKWATERING

	NORTH-WEST≈ NW NE SW SE	NORTH-EAST≈ NW NE SW SE	SOUTH-WEST≈ NW NE SW SE	SOUTH-EAST≈ NW NE SW SE
Sec 11 T 39S R 6W SLBM	* : : : *	* : : : *	* : : : *	* : : : X: X*

E N D O F D A T A

STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 85-455

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 12/05/2014 Page 1

WATER RIGHT: 85-455 APPLICATION/CLAIM NO.: CERT. NO.:

OWNERSHIP

NAME: Kanab District USA Bureau of Land Management
ADDR: 669 S. Highway 89 A
Kanab Utah 84741

DATES, ETC.

LAND OWNED BY APPLICANT? COUNTY TAX ID#:

FILED:	|PRIORITY: / /1864	|PUB BEGAN:	|PUB ENDED: |NEWSPAPER:
ProtestEnd:	|PROTESTED: [No]	|HEARNG HLD:	|SE ACTION: [ ] |ActionDate: |PROOF DUE:
EXTENSION:	|ELEC/PROOF:[ ]	|ELEC/PROOF:	|CERT/WUC: |LAP, ETC: |LAPS LETTER:
RUSH LETTR:	|RENOVATE:	|RECON REQ:	|TYPE: [ ]

PD BOOK: [85-1]|MAP: [4a]|PUB DATE:

Type of Right: Diligence Claim Source of Info: Proposed Determination Status:

LOCATION OF WATER RIGHT

FLOW:

SOURCE: Simpson Hollow Creek

COUNTY: Kane COMMON DESCRIPTION:

POINT OF DIVERSION -- POINT TO POINT:
(1)Stockwatering directly on stream from a point at S 660 ft. E 1980 ft. from W4 corner, Sec 13, T39S, R6W, SLBM,
to a point at S 660 ft. E 660 ft. from N4 corner, Sec 13, T39S, R6W, SLBM.
COMMENT: Administratively updated by State Engineer.

USES OF WATER RIGHT******** ELU -- Equivalent Livestock Unit (cow, horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family
(The Beneficial Use Amount is the quantity of Use that this Water Right contributes to the Group Total.)

SUPPLEMENTAL GROUP NO. 612416. Water Rights Appurtenant to the following use(s):
85-455(DIL),456(DIL),457(DIL)

STOCKWATER: Beneficial Use Amt: UNEVALUATED ELUs Group Total: 5.0000 PERIOD OF USE: 01/01 TO 12/31
Garn Swapp Allotment No. 40.

PLACE OF USE for STOCKWATERING

	NORTH-WEST≈ NW NE SW SE	NORTH-EAST≈ NW NE SW SE	SOUTH-WEST≈ NW NE SW SE	SOUTH-EAST≈ NW NE SW SE
Sec 13 T 39S R 6W SLBM	* : : : *	* X: : : *	* : X: : *	* : : : *

**********E N D O F D A T A**********

STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 85-160

WATER RIGHT: 85-160 APPLICATION/CLAIM NO.: CERT. NO.:

CHANGES: a38554 Approved

OWNERSHIP

NAME: Twin Eagles Ranch, LLC
ADDR: 1375 West 3150 South
Hurricane UT 84737

DATES, ETC.

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: 08/01/1969|PRIORITY: / /1864|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: 08/01/1969|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]

PD BOOK: [85-1]|MAP: [4a]|PUB DATE:

Type of Right: Diligence Claim Source of Info: Proposed Determination Status:

LOCATION OF WATER RIGHT

FLOW:

SOURCE: Simpson Hollow Stream

COUNTY: Kane COMMON DESCRIPTION:

POINT OF DIVERSION -- POINT TO POINT:
(1)Stockwatering directly on stream from a point at S 1980 ft. E 660 ft. from N4 corner, Sec 24, T39S, R6W, SLBM,
to a point at S 1980 ft. E 660 ft. from N4 corner, Sec 24, T39S, R6W, SLBM.
COMMENT: Administratively updated by State Engineer.

USES OF WATER RIGHT******** ELU -- Equivalent Livestock Unit (cow, horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family
(The Beneficial Use Amount is the quantity of Use that this Water Right contributes to the Group Total.)

SUPPLEMENTAL GROUP NO. 612239. Water Rights Appurtenant to the following use(s):
85-159(DIL),160(DIL),161(DIL),162(DIL),163(DIL)

STOCKWATER: Beneficial Use Amt: UNEVALUATED ELUs Group Total: 400.00 PERIOD OF USE: 04/01 TO 12/31

PLACE OF USE for STOCKWATERING

	NORTH-WEST≈ NW NE SW SE	NORTH-EAST≈ NW NE SW SE	SOUTH-WEST≈ NW NE SW SE	SOUTH-EAST≈ NW NE SW SE
Sec 24 T 39S R 6W SLBM	* : : : *	* : : X: *	* : : : *	* : : : *

**********E N D O F D A T A**********

STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 85-551

WATER RIGHT: 85-551 APPLICATION/CLAIM NO.: CERT. NO.:

OWNERSHIP

NAME: Lloyd W. & Ross E. & Gail P. & Vard H. Heaton
ADDR: Alton UT 84710

DATES, ETC.

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: 04/14/1970|PRIORITY: / /1864|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: 04/14/1970|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]

PD BOOK: [85-1]|MAP: [2d]|PUB DATE:

Type of Right: Diligence Claim Source of Info: Proposed Determination Status:

LOCATION OF WATER RIGHT

FLOW:

SOURCE: East Fork Simpson Hollow Creek

COUNTY: Kane COMMON DESCRIPTION:

POINT OF DIVERSION -- POINT TO POINT:
(1)Stockwatering directly on stream from a point at N 660 ft. E 660 ft. from S4 corner, Sec 12, T39S, R6W, SLBM,
to a point at N 660 ft. E 1980 ft. from W4 corner, Sec 13, T39S, R6W, SLBM.
COMMENT: Administratively updated by State Engineer.

USES OF WATER RIGHT******** ELU -- Equivalent Livestock Unit (cow, horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family
(The Beneficial Use Amount is the quantity of Use that this Water Right contributes to the Group Total.)

SUPPLEMENTAL GROUP NO. 612515. Water Rights Appurtenant to the following use(s):
85-412(DIL),413(DIL),414(DIL),415(DIL),543(DIL),544(DIL),545(DIL),546(DIL),547(DIL),548(DIL),549(DIL),550(DIL),551(DIL),552(DIL)
553(DIL),554(DIL),555(DIL),556(DIL),557(DIL),558(DIL),559(DIL),608(DIL),631(DIL),632(DIL),713(DIL),731(DIL),733(DIL)

STOCKWATER: Beneficial Use Amt: UNEVALUATED ELUs Group Total: 1600.0 PERIOD OF USE: 04/01 TO 12/31

PLACE OF USE for STOCKWATERING

	NORTH-WEST≈ NW NE SW SE	NORTH-EAST≈ NW NE SW SE	SOUTH-WEST≈ NW NE SW SE	SOUTH-EAST≈ NW NE SW SE
Sec 12 T 39S R 6W SLBM	* : : : *	* : : : *	* : : : *	* : : X: *
Sec 13 T 39S R 6W SLBM	* : : : X*	* : : : *	* : : : *	* : : : *

**********E N D O F D A T A**********

APPENDIX 7-3N

EXHIBIT 7-2N

Surface Diversions

(North Lease)

SURFACE DIVERSIONS

REF#	WR#	OWNER	SOURCE
1	85-71	Sharon C. and Lorene C. Lamb	Kanab Creek
2	85-305	Clark & Florene S. Lamb	Kanab Creek

STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 85-71(D17)

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 12/08/2014 Page 1

WATER RIGHT: 85-71 APPLICATION/CLAIM NO.: D17 CERT. NO.:

OWNERSHIP**********

NAME: Sharon C. and Lorene C. Lamb
ADDR: Orderville UT 84758

DATES, ETC.**********

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: 08/08/1950|PRIORITY: / /1892|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: 09/03/1969|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]

PD BOOK: [85-1]|MAP: [4a]|PUB DATE:

Type of Right: Diligence Claim Source of Info: Proposed Determination Status:

LOCATION OF WATER RIGHT**********

FLOW: 2.55 cfs

SOURCE: Kanab Creek

COUNTY: Kane COMMON DESCRIPTION:

POINT OF DIVERSION -- SURFACE:
(1) S 1630 ft W 1625 ft from NE cor, Sec 24, T 39S, R 6W, SLBM
Diverting Works: Source:

Stream Alt Required?: No

USES OF WATER RIGHT******** ELU -- Equivalent Livestock Unit (cow, horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family
(The Beneficial Use Amount is the quantity of Use that this Water Right contributes to the Group Total.)

SUPPLEMENTAL GROUP NO. 612500.

IRRIGATION: 51.5 acres PERIOD OF USE: 04/01 TO 10/31

###PLACE OF USE:	NORTH WEST QUARTER NW	NORTH WEST QUARTER NE	NORTH WEST QUARTER SW	NORTH WEST QUARTER SE	NORTH EAST QUARTER NW	NORTH EAST QUARTER NE	NORTH EAST QUARTER SW	NORTH EAST QUARTER SE	SOUTH WEST QUARTER NW	SOUTH WEST QUARTER NE	SOUTH WEST QUARTER SW	SOUTH WEST QUARTER SE	SOUTH EAST QUARTER NW	SOUTH EAST QUARTER NE	SOUTH EAST QUARTER SW	SOUTH EAST QUARTER SE	Section Totals
Sec 24 T 39S R 6W SLBM												0.7000			13.8000		14.5000
Sec 25 T 39S R 6W SLBM		20.0000		10.0000	7.0000												37.0000
																GROUP ACREAGE TOTAL:	51.5000

**********E N D O F D A T A**********

STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 85-305

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 12/08/2014 Page 1

WATER RIGHT: 85-305 APPLICATION/CLAIM NO.: CERT. NO.:

OWNERSHIP

NAME: Clark & Florene S. Lamb
ADDR: Mt. Carmel UT 84758
INTEREST: 66.7%

NAME: Sharon C. and Lorene C. Lamb
ADDR: Orderville UT
INTEREST: 33.3%
REMARKS: husband & wife

DATES, ETC.

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: 08/28/1969|PRIORITY: / /1864|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: 08/28/1969|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]

PD BOOK: [85-1]|MAP: [4a]|PUB DATE:

Type of Right: Diligence Claim Source of Info: Proposed Determination Status:

LOCATION OF WATER RIGHT

FLOW: 2.55 cfs

SOURCE: Kanab Creek

COUNTY: Kane COMMON DESCRIPTION:

POINT OF DIVERSION -- SURFACE:
(1) S 1630 ft W 1625 ft from NE cor, Sec 24, T 39S, R 6W, SLBM
Diverting Works: Source:

Stream Alt Required?: No

USES OF WATER RIGHT******** ELU -- Equivalent Livestock Unit (cow, horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family
(The Beneficial Use Amount is the quantity of Use that this Water Right contributes to the Group Total.)

SUPPLEMENTAL GROUP NO. 612337.

IRRIGATION: 41.5 acres PERIOD OF USE: 04/01 TO 10/31

###PLACE OF USE:	NORTH WEST QUARTER				NORTH EAST QUARTER				SOUTH WEST QUARTER				SOUTH EAST QUARTER				Section
	NW	NE	SW	SE	NW	NE	SW	SE	NW	NE	SW	SE	NW	NE	SW	SE	Totals
Sec 25 T 39S R 6W SLBM			0.6000						10.8000		19.3000						30.7000
Sec 26 T 39S R 6W SLBM																7.4000	7.4000
Sec 35 T 39S R 6W SLBM						3.4000											3.4000
																GROUP ACREAGE TOTAL:	41.5000

**********E N D O F D A T A**********

APPENDIX 7-3N

EXHIBIT 7-3N

Springs

(North Lease)

SPRINGS

REF#	WR#	OWNER	SOURCE
1	85-631	Lloyd W. & Ross E. & Gail P. & Vard H. Heaton	Shed Spring
2	85-632	lloyd W. & Ross E. & Gail P. & Vard H. Heaton	Slope Spring Area

STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 85-631

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 12/05/2014 Page 1

WATER RIGHT: 85-631 APPLICATION/CLAIM NO.: CERT. NO.:

OWNERSHIP**********

NAME: Lloyd W. & Ross E. & Gail P. & Vard H. Heaton
ADDR: Alton UT 84710

DATES, ETC.**********

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: 04/14/1970|PRIORITY: / /1864|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: 04/14/1970|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]

PD BOOK: [85-1]|MAP: [2d]|PUB DATE:

Type of Right: Diligence Claim Source of Info: Proposed Determination Status:

LOCATION OF WATER RIGHT**********

FLOW: 0.111 cfs

SOURCE: Shed Spring

COUNTY: Kane COMMON DESCRIPTION:

POINT OF DIVERSION:
(1)Stockwatering directly on spring located at N 660 ft. E 660 ft. from SW corner, Sec 12, T39S, R6W, SLBM.
COMMENT: Administratively updated by State Engineer.

USES OF WATER RIGHT******** ELU -- Equivalent Livestock Unit (cow, horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family
(The Beneficial Use Amount is the quantity of Use that this Water Right contributes to the Group Total.)

SUPPLEMENTAL GROUP NO. 612515. Water Rights Appurtenant to the following use(s):
85-412(DIL),413(DIL),414(DIL),415(DIL),543(DIL),544(DIL),545(DIL),546(DIL),547(DIL),548(DIL),549(DIL),550(DIL),551(DIL),552(DIL)
553(DIL),554(DIL),555(DIL),556(DIL),557(DIL),558(DIL),559(DIL),608(DIL),631(DIL),632(DIL),713(DIL),731(DIL),733(DIL)

STOCKWATER: Beneficial Use Amt: UNEVALUATED ELUs Group Total: 1600.0 PERIOD OF USE: 04/01 TO 12/31

PLACE OF USE for STOCKWATERING**********

	NORTH-WEST≈ NW NE SW SE	NORTH-EAST≈ NW NE SW SE	SOUTH-WEST≈ NW NE SW SE	SOUTH-EAST≈ NW NE SW SE
Sec 12 T 39S R 6W SLBM	* : : : *	* : : : *	* : : X: *	* : : : *

**********E N D O F D A T A**********

STATE OF UTAH -- DIVISION OF WATER RIGHTS -- DATA PRINT OUT for 85-632

WATER RIGHT: 85-632 APPLICATION/CLAIM NO.: CERT. NO.:

OWNERSHIP**********

NAME: Lloyd W. & Ross E. & Gail P. & Vard H. Heaton
ADDR: Alton UT 84710

DATES, ETC.**********

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: 04/14/1970|PRIORITY: / /1864|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: 04/14/1970|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]

PD BOOK: [85-1]|MAP: [2d]|PUB DATE:

Type of Right: Diligence Claim Source of Info: Proposed Determination Status:

LOCATION OF WATER RIGHT**********

FLOW: 0.045 cfs

SOURCE: Slope Spring Area

COUNTY: Kane COMMON DESCRIPTION:

POINT OF DIVERSION:
(1)Stockwatering directly on spring located at N 660 ft. W 660 ft. from SE corner, Sec 11, T39S, R6W, SLBM.
COMMENT: Administratively updated by State Engineer.

USES OF WATER RIGHT******** ELU -- Equivalent Livestock Unit (cow, horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family
(The Beneficial Use Amount is the quantity of Use that this Water Right contributes to the Group Total.)

SUPPLEMENTAL GROUP NO. 612515. Water Rights Appurtenant to the following use(s):
85-412(DIL),413(DIL),414(DIL),415(DIL),543(DIL),544(DIL),545(DIL),546(DIL),547(DIL),548(DIL),549(DIL),550(DIL),551(DIL),552(DIL)
553(DIL),554(DIL),555(DIL),556(DIL),557(DIL),558(DIL),559(DIL),608(DIL),631(DIL),632(DIL),713(DIL),731(DIL),733(DIL)

STOCKWATER: Beneficial Use Amt: UNEVALUATED ELUs Group Total: 1600.0 PERIOD OF USE: 04/01 TO 12/31

PLACE OF USE for STOCKWATERING**********

	NORTH-WEST≈ NW NE SW SE	NORTH-EAST≈ NW NE SW SE	SOUTH-WEST≈ NW NE SW SE	SOUTH-EAST≈ NW NE SW SE
Sec 11 T 39S R 6W SLBM	* : : : *	* : : : *	* : : : *	* : : : X*

**********E N D O F D A T A**********

Appendix 7-6

Climate Data

Appendix 7-6 Climate data for Coal Hollow Weather Station, 2006

Date	Measured Precipitation* (inches)	Maximum Temperature (^{o}F)	Minimum Temperature (^{o}F)
1/1/2006	NA	38.1	18.5
1/2/2006	NA	41.9	29.7
1/3/2006	NA	38.4	27.2
1/4/2006	NA	44.6	22.6
1/5/2006	NA	51.6	25.5
1/6/2006	NA	55.9	30.6
1/7/2006	NA	48.0	26.1
1/8/2006	NA	44.0	25.0
1/9/2006	NA	39.1	15.2
1/10/2006	NA	47.1	21.8
1/11/2006	NA	47.0	29.0
1/12/2006	NA	42.2	24.0
1/13/2006	NA	48.7	22.0
1/14/2006	NA	47.4	29.5
1/15/2006	NA	37.0	18.1
1/16/2006	NA	28.1	13.2
1/17/2006	NA	46.7	11.7
1/18/2006	NA	39.8	24.4
1/19/2006	NA	30.3	20.4
1/20/2006	NA	35.3	12.8
1/21/2006	NA	39.5	15.6
1/22/2006	NA	34.5	15.7
1/23/2006	NA	41.9	16.7
1/24/2006	NA	47.3	15.2
1/25/2006	NA	41.9	26.7
1/26/2006	NA	37.2	19.2
1/27/2006	NA	28.6	17.0
1/28/2006	NA	34.0	10.9
1/29/2006	NA	44.6	21.8
1/30/2006	NA	49.4	26.8
1/31/2006	NA	42.6	28.6
Month	--	55.9	10.9
2/1/2006	NA	51.8	26.0
2/2/2006	NA	49.6	29.9
2/3/2006	NA	47.0	25.8
2/4/2006	NA	49.1	26.9
2/5/2006	NA	38.0	21.5
2/6/2006	NA	49.9	14.4
2/7/2006	NA	55.1	23.6
2/8/2006	NA	56.2	26.0

2/9/2006	NA	56.3	25.2
2/10/2006	NA	44.6	25.4
2/11/2006	NA	47.9	21.2
2/12/2006	NA	51.9	19.3
2/13/2006	NA	50.9	23.6
2/14/2006	NA	48.9	29.6
2/15/2006	NA	42.2	18.5
2/16/2006	NA	31.2	4.6
2/17/2006	NA	39.0	21.1
2/18/2006	NA	32.5	16.5
2/19/2006	NA	27.9	14.2
2/20/2006	NA	32.3	13.3
2/21/2006	NA	37.6	4.6
2/22/2006	NA	45.4	22.7
2/23/2006	NA	50.9	18.1
2/24/2006	NA	52.3	24.9
2/25/2006	NA	53.7	27.3
2/26/2006	NA	55.1	30.9
2/27/2006	NA	55.3	31.7
2/28/2006	NA	43.5	34.7
Month	--	56.3	4.6
3/1/2006	NA	46.3	30.5
3/2/2006	NA	49.5	26.2
3/3/2006	NA	50.3	32.6
3/4/2006	NA	44.7	30.2
3/5/2006	NA	53.4	27.3
3/6/2006	NA	48.5	31.9
3/7/2006	NA	42.4	28.0
3/8/2006	NA	36.0	20.2
3/9/2006	NA	39.9	20.2
3/10/2006	NA	30.5	15.0
3/11/2006	NA	25.0	17.2
3/12/2006	NA	23.2	15.4
3/13/2006	NA	30.2	11.0
3/14/2006	NA	38.4	12.5
3/15/2006	NA	41.8	26.2
3/16/2006	NA	42.8	24.0
3/17/2006	NA	41.8	28.8
3/18/2006	NA	35.1	21.5
3/19/2006	NA	33.5	22.9
3/20/2006	NA	33.4	8.9
3/21/2006	NA	32.0	22.9
3/22/2006	NA	42.0	23.6
3/23/2006	NA	47.6	20.7
3/24/2006	NA	53.2	30.4

3/25/2006	NA	51.3	33.9
3/26/2006	NA	50.4	29.6
3/27/2006	NA	52.8	25.3
3/28/2006	NA	42.4	37.5
3/29/2006	NA	39.5	26.5
3/30/2006	NA	45.6	19.8
3/31/2006	NA	47.1	32.6
Month	--	53.4	8.9
4/1/2006	0.14	44.6	32.1
4/2/2006	0.00	53.2	29.3
4/3/2006	0.00	60.6	40.2
4/4/2006	0.00	56.5	44.4
4/5/2006	0.18	49.6	26.9
4/6/2006	0.10	45.9	26.7
4/7/2006	0.00	55.8	26.9
4/8/2006	0.00	60.5	37.1
4/9/2006	0.00	62.8	34.7
4/10/2006	0.00	53.7	36.9
4/11/2006	0.00	53.0	27.8
4/12/2006	0.00	63.9	35.4
4/13/2006	0.00	65.2	37.0
4/14/2006	0.28	58.9	35.6
4/15/2006	0.12	50.3	33.2
4/16/2006	0.01	59.5	32.4
4/17/2006	0.00	45.8	28.2
4/18/2006	0.00	48.5	24.1
4/19/2006	0.00	55.0	25.6
4/20/2006	0.00	64.0	25.4
4/21/2006	0.00	64.7	40.7
4/22/2006	0.00	66.5	42.5
4/23/2006	0.00	55.0	31.4
4/24/2006	0.00	52.8	27.9
4/25/2006	0.00	60.2	32.4
4/26/2006	0.00	64.6	36.0
4/27/2006	0.00	66.9	41.7
4/28/2006	0.00	65.9	46.2
4/29/2006	0.00	67.1	36.6
4/30/2006	0.00	69.2	43.7
Month	0.83	69.2	24.1
5/1/2006	0.06	65.9	40.8
5/2/2006	0.00	70.1	45.8
5/3/2006	0.00	67.8	40.6
5/4/2006	0.00	62.7	41.2
5/5/2006	0.04	55.7	40.2

5/6/2006	0.00	62.1	33.9
5/7/2006	0.00	70.0	40.4
5/8/2006	0.00	68.6	45.9
5/9/2006	0.00	65.0	37.4
5/10/2006	0.00	67.7	31.0
5/11/2006	0.00	69.5	37.0
5/12/2006	0.00	75.2	46.9
5/13/2006	0.00	76.5	54.1
5/14/2006	0.00	76.4	51.2
5/15/2006	0.00	73.4	45.8
5/16/2006	0.16	71.5	50.6
5/17/2006	0.00	78.5	49.6
5/18/2006	0.00	77.3	52.6
5/19/2006	0.00	75.7	54.2
5/20/2006	0.00	73.9	50.7
5/21/2006	0.00	73.5	49.5
5/22/2006	0.00	60.7	43.3
5/23/2006	0.00	67.7	37.2
5/24/2006	0.00	76.8	45.7
5/25/2006	0.00	78.4	49.5
5/26/2006	0.00	74.0	50.1
5/27/2006	0.00	64.1	44.9
5/28/2006	0.00	52.6	30.6
5/29/2006	0.00	63.2	29.9
5/30/2006	0.00	70.1	38.6
5/31/2006	0.00	75.8	43.7
Month	0.26	78.5	29.9
6/1/2006	0.00	80.4	42.0
6/2/2006	0.50	81.8	54.2
6/3/2006	0.00	80.4	56.3
6/4/2006	0.00	81.9	56.2
6/5/2006	0.00	84.2	59.3
6/6/2006	0.00	87.0	58.0
6/7/2006	0.00	74.1	54.6
6/8/2006	0.00	66.1	48.7
6/9/2006	0.00	74.7	47.6
6/10/2006	0.00	76.2	49.6
6/11/2006	0.00	78.5	49.7
6/12/2006	0.00	77.0	49.4
6/13/2006	0.00	76.3	45.9
6/14/2006	0.00	68.5	47.1
6/15/2006	0.01	61.0	47.1
6/16/2006	0.00	71.5	43.7
6/17/2006	0.00	80.5	40.3
6/18/2006	0.00	83.4	56.6

6/19/2006	0.00	82.5	54.3
6/20/2006	0.00	80.5	56.4
6/21/2006	0.00	80.8	55.8
6/22/2006	0.00	83.7	54.3
6/23/2006	0.00	89.4	48.5
6/24/2006	0.00	86.0	53.3
6/25/2006	0.00	87.6	57.9
6/26/2006	0.00	84.3	56.9
6/27/2006	0.00	76.7	57.6
6/28/2006	0.00	80.7	52.5
6/29/2006	0.00	79.8	54.5
6/30/2006	0.16	82.1	58.6
Month	0.67	89.4	40.3
7/1/2006	0.00	80.0	56.4
7/2/2006	0.16	81.7	56.5
7/3/2006	0.07	81.3	56.2
7/4/2006	0.00	74.0	57.9
7/5/2006	0.00	75.3	56.7
7/6/2006	0.72	73.9	54.6
7/7/2006	0.02	76.0	51.4
7/8/2006	0.00	74.4	56.1
7/9/2006	0.01	75.9	53.7
7/10/2006	0.03	75.4	51.3
7/11/2006	0.01	79.6	56.5
7/12/2006	0.00	81.6	55.5
7/13/2006	0.00	83.9	56.8
7/14/2006	0.00	87.1	60.7
7/15/2006	0.00	91.2	62.4
7/16/2006	0.03	88.5	65.7
7/17/2006	0.00	87.6	65.7
7/18/2006	0.00	84.4	65.3
7/19/2006	0.00	81.2	61.5
7/20/2006	0.00	81.1	59.5
7/21/2006	0.57	86.6	57.7
7/22/2006	0.02	84.3	62.6
7/23/2006	0.00	86.1	62.5
7/24/2006	0.07	88.6	61.8
7/25/2006	0.04	83.7	61.8
7/26/2006	0.00	84.2	63.0
7/27/2006	0.00	89.2	58.3
7/28/2006	0.10	85.0	61.6
7/29/2006	0.08	81.2	55.6
7/30/2006	0.27	75.3	59.1
7/31/2006	0.45	75.5	55.2
Month	2.65	91.2	51.3

8/1/2006	0.00	74.7	55.1
8/2/2006	0.00	73.8	54.9
8/3/2006	0.00	78.0	55.7
8/4/2006	0.17	68.8	57.2
8/5/2006	0.00	76.5	53.2
8/6/2006	0.00	80.6	55.4
8/7/2006	0.00	80.0	63.4
8/8/2006	0.00	81.7	56.0
8/9/2006	0.01	76.4	60.4
8/10/2006	0.00	81.6	58.4
8/11/2006	0.00	77.9	58.7
8/12/2006	0.00	77.8	54.0
8/13/2006	0.00	78.7	55.7
8/14/2006	0.00	79.6	57.0
8/15/2006	0.00	78.2	57.9
8/16/2006	0.00	76.5	53.5
8/17/2006	0.00	76.8	54.0
8/18/2006	0.00	77.5	54.3
8/19/2006	0.00	81.4	51.5
8/20/2006	0.00	81.7	55.4
8/21/2006	0.00	83.8	57.5
8/22/2006	0.00	82.7	59.0
8/23/2006	0.00	81.1	57.4
8/24/2006	0.00	82.1	57.3
8/25/2006	0.00	76.5	55.8
8/26/2006	0.00	76.1	51.6
8/27/2006	0.00	78.8	47.8
8/28/2006	0.00	80.4	47.1
8/29/2006	0.00	81.8	53.9
8/30/2006	0.00	79.0	55.6
8/31/2006	0.00	80.6	57.1
Month	0.18	83.8	47.1
9/1/2006	0.15	77.9	53.7
9/2/2006	0.00	76.7	51.3
9/3/2006	0.00	75.3	49.5
9/4/2006	0.00	79.3	53.6
9/5/2006	0.00	52.6	30.6
9/6/2006	0.06	63.2	29.9
9/7/2006	0.22	60.4	50.1
9/8/2006	0.50	66.5	45.5
9/9/2006	0.02	68.8	47.1
9/10/2006	0.05	68.0	47.2
9/11/2006	0.00	74.5	45.8
9/12/2006	0.00	77.4	52.9

9/13/2006	0.00	77.8	53.2
9/14/2006	0.40	62.4	51.2
9/15/2006	0.00	65.6	50.5
9/16/2006	0.00	57.8	38.4
9/17/2006	0.00	60.5	26.9
9/18/2006	0.00	66.3	26.6
9/19/2006	0.00	69.7	40.7
9/20/2006	0.00	55.7	39.3
9/21/2006	0.00	61.1	32.8
9/22/2006	0.00	51.0	37.3
9/23/2006	0.00	57.5	28.8
9/24/2006	0.00	62.3	32.0
9/25/2006	0.00	69.3	33.8
9/26/2006	0.00	73.8	45.4
9/27/2006	0.00	73.7	44.7
9/28/2006	0.00	76.4	44.1
9/29/2006	0.00	77.1	44.3
9/30/2006	0.00	74.3	45.7
Month	1.40	79.3	26.6
10/1/2006	0.00	71.3	50.6
10/2/2006	0.00	68.2	51.4
10/3/2006	0.10	67.3	45.6
10/4/2006	0.00	66.3	51.5
10/5/2006	0.27	61.9	48.9
10/6/2006	0.37	58.6	46.0
10/7/2006	0.00	58.6	34.4
10/8/2006	0.00	60.4	38.3
10/9/2006	0.02	52.9	37.3
10/10/2006	0.31	53.9	36.9
10/11/2006	0.00	61.2	34.5
10/12/2006	0.01	65.0	29.0
10/13/2006	0.00	65.5	39.6
10/14/2006	1.61	48.5	35.3
10/15/2006	0.00	56.9	32.6
10/16/2006	0.00	55.4	37.9
10/17/2006	0.42	45.4	32.6
10/18/2006	0.00	45.4	31.0
10/19/2006	0.00	57.3	26.1
10/20/2006	0.00	59.9	33.1
10/21/2006	0.00	53.3	29.7
10/22/2006	0.00	58.6	26.9
10/23/2006	0.00	61.2	34.4
10/24/2006	0.15	53.0	40.5
10/25/2006	0.09	44.9	30.4
10/26/2006	0.01	48.6	28.8

10/27/2006	0.00	61.9	29.0
10/28/2006	0.00	63.3	33.9
10/29/2006	0.00	58.9	36.7
10/30/2006	0.00	56.1	34.7
10/31/2006	0.00	53.9	33.8
Month	3.36	71.3	26.1
11/1/2006	0.00	55.3	29.3
11/2/2006	0.00	56.7	35.1
11/3/2006	0.00	57.5	34.7
11/4/2006	0.00	56.9	34.1
11/5/2006	0.00	57.9	29.1
11/6/2006	0.00	63.8	31.9
11/7/2006	0.00	69.4	38.3
11/8/2006	0.00	65.5	43.8
11/9/2006	0.00	55.3	34.2
11/10/2006	0.00	48.2	20.8
11/11/2006	0.00	43.8	30.6
11/12/2006	0.03	41.2	25.7
11/13/2006	0.00	48.4	27.3
11/14/2006	0.00	46.1	29.5
11/15/2006	0.00	49.9	22.3
11/16/2006	0.00	58.4	32.3
11/17/2006	0.00	62.0	34.1
11/18/2006	0.00	60.7	33.4
11/19/2006	0.00	57.5	27.4
11/20/2006	0.00	59.6	31.2
11/21/2006	0.00	58.8	32.4
11/22/2006	0.00	52.0	34.4
11/23/2006	0.00	52.3	33.8
11/24/2006	0.00	52.5	22.6
11/25/2006	0.00	45.5	29.1
11/26/2006	0.00	43.7	25.5
11/27/2006	0.01	35.0	26.3
11/28/2006	0.20	32.8	15.5
11/29/2006	0.01	15.3	8.0
11/30/2006	0.00	37.5	3.5
Month	0.25	69.4	3.5
12/1/2006	0.00	44.1	17.3
12/2/2006	0.00	27.2	12.0
12/3/2006	0.00	38.2	5.6
12/4/2006	0.00	49.0	19.6
12/5/2006	0.00	53.3	25.8
12/6/2006	0.00	53.0	21.6
12/7/2006	0.00	52.5	23.8

12/8/2006	0.00	48.5	24.2
12/9/2006	0.00	45.6	25.6
12/10/2006	0.00	35.0	20.5
12/11/2006	0.17	35.9	15.2
12/12/2006	0.00	42.7	14.2
12/13/2006	0.00	45.7	27.4
12/14/2006	0.00	48.8	30.8
12/15/2006	0.00	47.8	34.4
12/16/2006	0.00	39.5	27.0
12/17/2006	0.00	36.6	22.6
12/18/2006	0.00	0.0	0.0
12/19/2006	0.00	32.2	13.2
12/20/2006	0.00	0.0	0.0
12/21/2006	0.00	0.0	0.0
12/22/2006	0.00	0.0	0.0
12/23/2006	0.00	0.0	0.0
12/24/2006	0.00	0.0	0.0
12/25/2006	0.00	0.0	0.0
12/26/2006	0.00	0.0	0.0
12/27/2006	0.00	0.0	0.0
12/28/2006	0.00	0.0	0.0
12/29/2006	0.00	0.0	0.0
12/30/2006	0.00	0.0	0.0
12/31/2006	0.00	0.0	0.0
Month	0.17	53.3	0.0

Appendix 7-6 Climate data for Coal Hollow Weather Station, 2007

Date	Measured Precipitation* (inches)	Maximum Temperature (^{o}F)	Minimum Temperature (^{o}F)
1/1/2007	0.00	36.9	19.7
1/2/2007	0.00	46.0	17.9
1/3/2007	0.00	47.1	24.7
1/4/2007	0.00	40.7	25.9
1/5/2007	0.00	32.4	12.0
1/6/2007	0.13	36.4	0.2
1/7/2007	0.00	39.0	17.4
1/8/2007	0.00	48.9	15.3
1/9/2007	0.00	49.1	22.0
1/10/2007	0.00	43.3	31.6
1/11/2007	0.00	38.0	25.6
1/12/2007	0.03	33.3	11.1
1/13/2007	0.00	16.0	-4.8
1/14/2007	0.00	21.4	0.7
1/15/2007	0.00	24.1	-4.3
1/16/2007	0.00	30.2	1.4
1/17/2007	0.00	31.3	6.0
1/18/2007	0.00	38.7	7.1
1/19/2007	0.00	40.8	6.9
1/20/2007	0.00	38.9	12.6
1/21/2007	0.00	23.5	12.8
1/22/2007	0.00	34.0	8.0
1/23/2007	0.00	47.8	19.3
1/24/2007	0.00	50.4	21.4
1/25/2007	0.00	50.2	26.9
1/26/2007	0.00	47.7	24.1
1/27/2007	0.00	42.1	23.9
1/28/2007	0.00	42.8	22.7
1/29/2007	0.00	45.1	20.6
1/30/2007	0.00	41.4	19.0
1/31/2007	0.00	33.9	17.4
Month	0.16	50.4	-4.8
2/1/2007	0.00	30.2	9.1
2/2/2007	0.00	35.3	5.6
2/3/2007	0.00	49.4	11.4
2/4/2007	0.00	53.7	28.7
2/5/2007	0.00	58.1	30.7
2/6/2007	0.00	55.8	32.6
2/7/2007	0.00	53.7	34.8
2/8/2007	0.00	50.9	31.8
2/9/2007	0.00	51.5	33.7

2/10/2007	0.00	51.4	37.3
2/11/2007	0.32	42.1	32.9
2/12/2007	0.02	44.9	26.2
2/13/2007	0.03	40.1	27.9
2/14/2007	0.00	33.6	24.2
2/15/2007	0.00	43.6	18.4
2/16/2007	0.00	50.6	25.0
2/17/2007	0.00	53.9	28.2
2/18/2007	0.00	50.8	29.6
2/19/2007	0.03	39.9	24.2
2/20/2007	0.00	42.5	13.0
2/21/2007	0.00	49.8	23.1
2/22/2007	0.00	54.0	29.6
2/23/2007	0.20	39.5	18.8
2/24/2007	0.00	34.4	14.1
2/25/2007	0.00	37.4	19.8
2/26/2007	0.00	44.0	28.0
2/27/2007	0.08	33.5	24.6
2/28/2007	0.23	27.6	10.8
Month	0.91	58.1	5.6
3/1/2007	0.00	31.9	7.9
3/2/2007	0.00	31.7	11.4
3/3/2007	0.00	39.1	8.3
3/4/2007	0.00	51.4	16.6
3/5/2007	0.00	56.9	30.2
3/6/2007	0.00	54.9	34.7
3/7/2007	0.00	55.3	33.0
3/8/2007	0.00	56.4	34.5
3/9/2007	0.00	58.3	34.1
3/10/2007	0.00	54.5	35.0
3/11/2007	0.00	63.1	25.2
3/12/2007	0.00	67.9	34.3
3/13/2007	0.00	70.2	35.9
3/14/2007	0.00	67.7	42.7
3/15/2007	0.00	65.8	39.1
3/16/2007	0.00	71.2	35.3
3/17/2007	0.00	71.4	42.5
3/18/2007	0.00	68.8	44.0
3/19/2007	0.00	65.4	40.3
3/20/2007	0.00	61.1	37.7
3/21/2007	0.34	47.1	34.4
3/22/2007	0.00	53.8	31.8
3/23/2007	0.10	47.5	37.3
3/24/2007	0.00	51.6	36.0
3/25/2007	0.00	59.6	34.4

3/26/2007	0.00	60.1	38.3
3/27/2007	0.00	48.4	22.9
3/28/2007	0.02	32.7	18.9
3/29/2007	0.00	36.5	24.1
3/30/2007	0.00	48.4	19.6
3/31/2007	0.00	61.4	26.0
Month	0.46	71.4	7.9
4/1/2007	0.00	63.8	37.0
4/2/2007	0.00	63.3	38.1
4/3/2007	0.00	66.6	40.4
4/4/2007	1.25	69.5	41.7
4/5/2007	0.00	67.3	40.7
4/6/2007	0.00	66.8	44.0
4/7/2007	0.00	65.1	43.7
4/8/2007	0.05	62.0	36.6
4/9/2007	0.01	61.4	29.3
4/10/2007	0.00	50.0	31.6
4/11/2007	0.00	48.9	29.5
4/12/2007	0.00	47.0	24.6
4/13/2007	0.12	50.4	29.6
4/14/2007	0.00	58.8	28.5
4/15/2007	0.00	51.7	32.5
4/16/2007	0.00	52.5	26.6
4/17/2007	0.00	61.2	29.5
4/18/2007	0.00	47.4	21.5
4/19/2007	0.00	51.4	16.1
4/20/2007	0.00	46.3	29.2
4/21/2007	0.00	51.6	27.0
4/22/2007	0.34	38.9	31.5
4/23/2007	0.52	42.7	28.4
4/24/2007	0.03	53.5	31.5
4/25/2007	0.00	62.6	33.2
4/26/2007	0.00	63.0	38.3
4/27/2007	0.00	71.1	39.3
4/28/2007	0.00	73.7	40.2
4/29/2007	0.00	75.7	48.1
4/30/2007	0.00	73.2	49.2
Month	2.32	75.7	16.1
5/1/2007	0.00	67.5	45.7
5/2/2007	0.00	67.8	41.2
5/3/2007	0.00	53.4	39.7
5/4/2007	0.00	53.3	32.7
5/5/2007	0.02	43.7	27.8
5/6/2007	0.00	51.3	32.9

5/7/2007	0.00	63.1	28.4
5/8/2007	0.00	67.3	38.1
5/9/2007	0.00	72.2	44.1
5/10/2007	0.00	75.5	49.4
5/11/2007	0.00	77.3	50.6
5/12/2007	0.00	78.1	52.5
5/13/2007	0.00	74.8	50.2
5/14/2007	0.00	73.2	46.7
5/15/2007	0.00	75.0	38.9
5/16/2007	0.00	75.0	44.8
5/17/2007	0.00	72.2	48.8
5/18/2007	0.00	72.7	49.6
5/19/2007	0.00	75.1	50.6
5/20/2007	0.00	74.2	47.9
5/21/2007	0.02	68.6	42.8
5/22/2007	0.10	59.1	40.1
5/23/2007	0.03	56.2	34.5
5/24/2007	0.00	63.0	32.0
5/25/2007	0.00	72.4	42.2
5/26/2007	0.00	72.4	49.6
5/27/2007	0.00	75.0	49.5
5/28/2007	0.00	73.8	47.6
5/29/2007	0.00	73.1	46.1
5/30/2007	0.00	75.1	36.7
5/31/2007	0.00	77.1	48.5
Month	0.17	78.1	27.8
6/1/2007	0.00	79.4	47.2
6/2/2007	0.00	77.3	51.7
6/3/2007	0.00	77.2	45.3
6/4/2007	0.00	80.7	55.3
6/5/2007	0.00	75.7	54.9
6/6/2007	0.20	55.9	37.0
6/7/2007	0.00	61.5	35.7
6/8/2007	0.00	69.6	29.6
6/9/2007	0.00	74.7	40.4
6/10/2007	0.00	76.3	49.2
6/11/2007	0.00	72.4	47.8
6/12/2007	0.00	73.6	46.5
6/13/2007	0.00	79.9	52.1
6/14/2007	0.00	82.2	57.0
6/15/2007	0.00	84.5	59.3
6/16/2007	0.00	83.9	59.1
6/17/2007	0.00	81.7	55.5
6/18/2007	0.00	81.8	51.9
6/19/2007	0.00	82.9	54.4

6/20/2007	0.00	83.0	56.6
6/21/2007	0.00	83.3	55.7
6/22/2007	0.00	88.7	53.6
6/23/2007	0.00	85.9	58.9
6/24/2007	0.00	82.6	54.8
6/25/2007	0.00	83.3	54.5
6/26/2007	0.00	83.8	55.7
6/27/2007	0.00	82.6	55.6
6/28/2007	0.00	83.7	55.7
6/29/2007	0.00	84.7	57.5
6/30/2007	0.00	85.1	57.7
Month	0.20	88.7	29.6
7/1/2007	0.00	89.5	58.9
7/2/2007	0.00	88.2	60.0
7/3/2007	0.00	92.0	60.2
7/4/2007	0.00	94.3	69.7
7/5/2007	0.00	87.7	63.6
7/6/2007	0.00	86.1	61.7
7/7/2007	0.00	89.6	61.3
7/8/2007	0.00	89.7	61.9
7/9/2007	0.00	91.0	61.7
7/10/2007	0.00	89.7	59.8
7/11/2007	0.00	78.2	59.8
7/12/2007	0.00	86.5	56.7
7/13/2007	0.00	87.7	58.1
7/14/2007	0.00	89.6	62.3
7/15/2007	0.00	88.5	64.7
7/16/2007	0.00	87.4	66.0
7/17/2007	0.06	85.1	60.9
7/18/2007	0.00	84.8	59.6
7/19/2007	0.00	86.5	61.4
7/20/2007	0.00	84.1	61.3
7/21/2007	0.00	86.2	63.9
7/22/2007	0.00	79.6	60.4
7/23/2007	0.00	78.5	58.4
7/24/2007	0.69	76.9	58.1
7/25/2007	0.01	75.9	57.9
7/26/2007	0.00	78.5	59.3
7/27/2007	0.00	83.0	55.3
7/28/2007	0.00	81.4	54.7
7/29/2007	0.00	82.0	58.9
7/30/2007	0.00	80.5	57.4
7/31/2007	0.00	81.5	54.4
Month	0.76	94.3	54.4

8/1/2007	0.52	79.6	55.3
8/2/2007	0.16	73.9	56.1
8/3/2007	0.00	79.1	57.1
8/4/2007	0.00	83.6	59.9
8/5/2007	0.00	79.8	59.7
8/6/2007	0.00	77.0	56.1
8/7/2007	0.00	77.7	51.9
8/8/2007	0.00	79.9	53.1
8/9/2007	0.00	80.1	57.2
8/10/2007	0.00	80.5	56.1
8/11/2007	0.00	82.6	57.5
8/12/2007	0.00	84.1	60.6
8/13/2007	0.00	85.8	64.0
8/14/2007	0.02	83.2	60.9
8/15/2007	0.00	83.5	60.4
8/16/2007	0.35	78.4	59.8
8/17/2007	0.02	77.9	59.0
8/18/2007	0.00	80.9	57.0
8/19/2007	0.00	80.3	57.9
8/20/2007	0.00	81.0	56.3
8/21/2007	0.00	86.4	56.9
8/22/2007	0.00	84.0	60.1
8/23/2007	0.00	82.1	57.8
8/24/2007	0.00	84.6	57.8
8/25/2007	0.00	85.4	60.5
8/26/2007	0.00	81.0	57.8
8/27/2007	0.65	70.8	54.2
8/28/2007	0.00	76.9	52.4
8/29/2007	0.00	83.0	54.4
8/30/2007	0.00	83.6	59.0
8/31/2007	0.00	82.8	59.4
Month	1.72	86.4	51.9
9/1/2007	0.00	81.8	59.8
9/2/2007	0.00	84.0	58.4
9/3/2007	0.03	80.9	60.5
9/4/2007	0.00	79.9	58.6
9/5/2007	0.07	73.8	47.6
9/6/2007	0.00	73.1	46.1
9/7/2007	0.00	79.8	48.8
9/8/2007	0.00	81.5	55.7
9/9/2007	0.11	76.9	55.2
9/10/2007	0.00	73.4	51.0
9/11/2007	0.00	78.0	48.3
9/12/2007	0.00	79.1	54.1
9/13/2007	0.00	78.1	55.6

9/14/2007	0.00	77.7	53.5
9/15/2007	0.00	77.1	51.8
9/16/2007	0.34	70.8	50.1
9/17/2007	0.00	68.1	44.2
9/18/2007	0.00	69.6	44.3
9/19/2007	0.00	69.5	45.6
9/20/2007	0.00	70.8	49.9
9/21/2007	0.00	73.6	46.5
9/22/2007	1.54	62.2	47.3
9/23/2007	0.00	55.2	37.6
9/24/2007	0.00	55.8	31.6
9/25/2007	0.00	62.3	28.2
9/26/2007	0.00	69.3	34.2
9/27/2007	0.00	69.1	40.0
9/28/2007	0.00	67.5	47.2
9/29/2007	0.00	55.1	28.7
9/30/2007	0.00	63.2	23.8
Month	2.09	84.0	23.8
10/1/2007	0.05	62.1	44.6
10/2/2007	0.00	66.0	38.8
10/3/2007	0.00	67.7	43.4
10/4/2007	0.03	67.7	50.7
10/5/2007	0.24	57.0	34.4
10/6/2007	0.08	42.4	25.8
10/7/2007	0.01	53.7	27.6
10/8/2007	0.00	62.1	29.4
10/9/2007	0.00	66.4	37.7
10/10/2007	0.00	68.0	45.6
10/11/2007	0.00	68.1	41.6
10/12/2007	0.00	58.3	41.2
10/13/2007	0.00	55.4	37.0
10/14/2007	0.00	60.9	38.7
10/15/2007	0.00	62.2	36.1
10/16/2007	0.00	54.2	36.2
10/17/2007	0.00	52.0	31.4
10/18/2007	0.00	59.1	30.0
10/19/2007	0.00	66.3	39.2
10/20/2007	0.00	61.5	29.3
10/21/2007	0.00	42.8	21.8
10/22/2007	0.00	56.2	21.5
10/23/2007	0.00	69.2	36.3
10/24/2007	0.00	68.3	36.4
10/25/2007	0.00	70.0	45.0
10/26/2007	0.00	66.4	45.1
10/27/2007	0.00	65.1	43.3

10/28/2007	0.00	67.2	43.9
10/29/2007	0.00	65.6	43.8
10/30/2007	0.00	61.0	41.1
10/31/2007	0.00	60.1	36.1
Month	0.41	70.0	21.5
11/1/2007	0.00	61.1	33.3
11/2/2007	0.00	58.1	37.0
11/3/2007	0.00	63.4	23.9
11/4/2007	0.00	66.4	33.2
11/5/2007	0.00	67.0	37.2
11/6/2007	0.00	66.4	40.3
11/7/2007	0.00	67.9	40.7
11/8/2007	0.00	65.3	44.2
11/9/2007	0.00	63.1	42.9
11/10/2007	0.00	61.5	38.4
11/11/2007	0.00	54.7	35.3
11/12/2007	0.15	55.4	36.3
11/13/2007	0.00	61.0	37.4
11/14/2007	0.00	58.4	29.6
11/15/2007	0.00	61.2	29.6
11/16/2007	0.00	62.5	39.8
11/17/2007	0.00	64.3	39.5
11/18/2007	0.00	64.1	41.4
11/19/2007	0.00	63.1	39.4
11/20/2007	0.00	56.8	27.9
11/21/2007	0.00	41.5	14.3
11/22/2007	0.00	42.1	12.8
11/23/2007	0.00	35.7	21.7
11/24/2007	0.00	48.3	18.4
11/25/2007	0.00	51.5	20.9
11/26/2007	0.00	49.1	25.3
11/27/2007	0.00	48.7	24.9
11/28/2007	0.00	38.3	16.0
11/29/2007	0.00	50.8	21.0
11/30/2007	0.88	39.8	32.4
Month	1.03	67.9	12.8
12/1/2007	0.71	33.4	22.5
12/2/2007	0.42	36.2	15.4
12/3/2007	0.00	47.4	21.2
12/4/2007	0.00	61.8	33.9
12/5/2007	0.00	55.9	37.2
12/6/2007	0.00	40.5	33.7
12/7/2007	1.33	36.8	29.8
12/8/2007	0.35	33.1	22.4

12/9/2007	0.29	33.1	16.0
12/10/2007	0.00	32.9	12.2
12/11/2007	0.00	30.3	9.1
12/12/2007	0.00	35.8	6.5
12/13/2007	0.00	31.3	12.7
12/14/2007	0.00	22.9	4.0
12/15/2007	0.00	37.0	2.7
12/16/2007	0.00	37.8	14.7
12/17/2007	0.00	37.2	18.2
12/18/2007	0.00	33.7	23.0
12/19/2007	0.00	30.2	1.4
12/20/2007	0.00	32.6	25.2
12/21/2007	0.00	23.0	12.5
12/22/2007	0.14	34.3	10.7
12/23/2007	0.00	40.2	11.3
12/24/2007	0.00	46.1	21.1
12/25/2007	0.00	23.5	9.2
12/26/2007	0.00	27.9	9.0
12/27/2007	0.00	18.1	4.8
12/28/2007	0.00	24.5	1.3
12/29/2007	0.00	27.2	12.9
12/30/2007	0.00	37.3	14.7
12/31/2007	0.00	25.2	9.9
Month	3.24	61.8	1.3

Appendix 7-6 Climate data for Coal Hollow Weather Station, 2008

Date	Measured Precipitation* (inches)	Maximum Temperature (^{o}F)		Minimum Temperature (^{o}F)
1/1/2008	0.00	36.7		3.2
1/2/2008	0.00	37.2		16.4
1/3/2008	0.00	42.1		20.3
1/4/2008	0.00	38.9		31.8
1/5/2008	0.75	34.2		32.3
1/6/2008	0.03	33.1		26.8
1/7/2008	0.45	31.5		17.5
1/8/2008	0.57	31.5		13.5
1/9/2008	0.54	32.1		18.3
1/10/2008	0.00	24 .1	1	2.7
1/11/2008	0.00	43.0		20.5
1/12/2008	0.00	40.4		14.5
1/13/2008	0.00	32.5		21.0
1/14/2008	0.00	42.2		15.6
1/15/2008	0.00	40.9		22.5
1/16/2008	0.00	20.4		3.2
1/17/2008	0.00	22.5		2.1
1/18/2008	0.00	29.3		7.8
1/19/2008	0.00	42.9		8.2
1/20/2008	0.00	35.7		17.9
1/21/2008	0.01	29.2		22.9
1/22/2008	0.01	32.8		19.7
1/23/2008	0.00	34.3		8.1
1/24/2008	0.00	29.3		21.7
1/25/2008	0.15	31.2		19.1
1/26/2008	0.01	38.4		18.9
1/27/2008	0.28	33.9		20.4
1/28/2008	0.00	31.7		13.6
1/29/2008	0.30	23.1		0.0
1/30/2008	0.01	21.2		5.2
1/31/2008	0.00	28.5		-0.7
Month	3.11	24.1	-0.7	
2/1/2008	0.00	30.0		12.1
2/2/2008	0.06	30.2		19.4
2/3/2008	0.00	28.5		18.7
2/4/2008	0.05	23.8		9.1
2/5/2008	0.00	24.6		10.0
2/6/2008	0.08	34.4		5.8
2/7/2008	0.13	40.7		13.4
2/8/2008	0.00	45.0		17.3
2/9/2008	0.00	47.8		18.8

2/10/2008	0.00	49.0	26.2
2/11/2008	0.00	44.1	24.0
2/12/2008	0.00	48.4	26.3
2/13/2008	0.00	43.8	29.1
2/14/2008	0.04	26.2	8.1
2/15/2008	0.00	36.0	12.3
2/16/2008	0.00	43.7	11.3
2/17/2008	0.00	37.7	18.2
2/18/2008	0.00	46.3	17.2
2/19/2008	0.00	44.7	25.2
2/20/2008	0.04	36.4	28.0
2/21/2008	0.40	36.4	19.3
2/22/2008	0.49	32.3	28.3
2/23/2008	0.12	34.4	27.4
2/24/2008	0.24	35.2	29.2
2/25/2008	0.07	42.1	22.2
2/26/2008	0.00	45.8	18.5
2/27/2008	0.00	56.1	24.8
2/28/2008	0.00	53.0	30.6
Month	1.72	56.1	5.8
3/1/2008	0.00	52.0	27.9
3/2/2008	0.00	48.3	34.8
3/3/2008	0.00	39.7	18.9
3/4/2008	0.00	39.4	9.8
3/5/2008	0.00	41.9	22.8
3/6/2008	0.00	30.6	17.9
3/7/2008	0.00	37.3	19.3
3/8/2008	0.00	48.2	20.3
3/9/2008	0.00	45.9	28.2
3/10/2008	0.00	40.9	28.0
3/11/2008	0.00	48.6	22.7
3/12/2008	0.00	57.7	27.9
3/13/2008	0.00	50.4	33.7
3/14/2008	0.00	50.3	32.8
3/15/2008	0.00	40.6	29.8
3/16/2008	0.00	38.4	21.2
3/17/2008	0.03	26.7	23.0
3/18/2008	0.13	36.7	21.5
3/19/2008	0.00	46.7	20.5
3/20/2008	0.00	48.8	25.8
3/21/2008	0.00	49.7	31.9
3/22/2008	0.00	52.5	28.5
3/23/2008	0.00	48.4	32.7
3/24/2008	0.00	53.5	20.9
3/25/2008	0.00	57.4	32.8

3/26/2008	0.00	57.7	34.3
3/27/2008	0.00	58.5	35.8
3/28/2008	0.00	54.4	35.4
3/29/2008	0.00	56.3	27.7
3/30/2008	0.00	57.4	35.4
3/31/2008	0.16	48.5	31.6
Month	0.32	58.5	9.8
4/1/2008	0.10	43.9	26.0
4/2/2008	0.00	52.9	19.4
4/3/2008	0.00	53.6	32.0
4/4/2008	0.00	51.2	30.2
4/5/2008	0.00	53.6	24.8
4/6/2008	0.00	54.6	34.5
4/7/2008	0.00	58.3	31.1
4/8/2008	0.00	51.1	32.9
4/9/2008	0.00	53.0	23.6
4/10/2008	0.01	42.5	29.0
4/11/2008	0.00	40.9	22.9
4/12/2008	0.00	47.4	27.0
4/13/2008	0.00	60.5	23.3
4/14/2008	0.00	64.6	30.9
4/15/2008	0.00	69.4	38.1
4/16/2008	0.00	63.4	41.8
4/17/2008	0.00	39.5	26.6
4/18/2008	0.00	54.7	24.0
4/19/2008	0.00	63.5	28.7
4/20/2008	0.00	62.9	33.1
4/21/2008	0.00	54.3	33.9
4/22/2008	0.00	54.8	28.3
4/23/2008	0.00	62.2	32.0
4/24/2008	0.00	59.2	36.4
4/25/2008	0.00	53.7	34.4
4/26/2008	0.00	60.2	18.9
4/27/2008	0.00	57.6	37.4
4/28/2008	0.00	61.4	24.7
4/29/2008	0.00	68.3	38.4
4/30/2008	0.00	69.3	42.7
Month	0.11	69.4	18.9
5/1/2008	0.00	57.9	35.1
5/2/2008	0.00	43.1	22.8
5/3/2008	0.00	55.7	18.7
5/4/2008	0.00	59.3	30.2
5/5/2008	0.00	60.3	41.2
5/6/2008	0.00	63.1	37.2

5/7/2008	0.00	63.8	41.2
5/8/2008	0.10	65.2	39.2
5/9/2008	0.09	61.0	39.2
5/10/2008	0.00	63.7	40.0
5/11/2008	0.00	64.7	38.7
5/12/2008	0.00	69.0	42.4
5/13/2008	0.00	57.9	38.0
5/14/2008	0.00	55.4	32.2
5/15/2008	0.00	63.1	33.4
5/16/2008	0.00	60.0	42.9
5/17/2008	0.00	71.0	35.5
5/18/2008	0.00	77.3	42.6
5/19/2008	0.00	80.1	49.7
5/20/2008	0.00	83.5	56.0
5/21/2008	0.00	80.4	56.8
5/22/2008	0.04	62.6	38.0
5/23/2008	0.00	49.7	32.1
5/24/2008	0.08	45.8	29.7
5/25/2008	0.09	47.5	33.1
5/26/2008	0.05	56.2	36.5
5/27/2008	0.00	53.9	36.0
5/28/2008	0.00	63.7	33.3
5/29/2008	0.00	64.5	38.5
5/30/2008	0.00	64.0	37.0
5/31/2008	0.00	68.2	39.0
Month	0.45	83.5	18.7
6/1/2008	0.00	73.0	44.6
6/2/2008	0.00	75.2	47.2
6/3/2008	0.00	73.4	48.4
6/4/2008	0.00	71.9	47.9
6/5/2008	0.15	62.9	33.7
6/6/2008	0.07	58.2	34.7
6/7/2008	0.00	72.4	41.2
6/8/2008	0.00	67.5	44.0
6/9/2008	0.00	69.0	44.9
6/10/2008	0.00	74.2	36.3
6/11/2008	0.00	77.0	50.1
6/12/2008	0.00	65.0	41.0
6/13/2008	0.00	68.9	39.0
6/14/2008	0.00	75.0	34.4
6/15/2008	0.00	79.7	50.6
6/16/2008	0.00	81.7	55.0
6/17/2008	0.00	81.7	54.8
6/18/2008	0.00	80.7	57.9
6/19/2008	0.00	82.0	57.1

6/20/2008	0.00	81.0	53.4
6/21/2008	0.00	82.4	45.7
6/22/2008	0.00	83.8	53.4
6/23/2008	0.00	82.4	58.9
6/24/2008	0.00	81.7	57.1
6/25/2008	0.00	81.1	55.5
6/26/2008	0.00	79.5	55.5
6/27/2008	0.00	78.5	54.3
6/28/2008	0.00	80.4	55.2
6/29/2008	0.00	83.7	54.3
6/30/2008	0.00	84.6	53.5
Month	0.22	84.6	33.7
7/1/2008	0.00	82.5	55.8
7/2/2008	0.00	85.0	60.7
7/3/2008	0.00	85.0	59.8
7/4/2008	0.00	85.1	58.9
7/5/2008	0.00	84.8	62.5
7/6/2008	0.00	75.3	59.5
7/7/2008	0.06	78.5	55.0
7/8/2008	0.00	82.1	46.0
7/9/2008	0.00	85.5	53.8
7/10/2008	0.00	87.8	57.4
7/11/2008	0.00	87.2	58.1
7/12/2008	0.00	80.0	57.9
7/13/2008	0.38	78.2	56.0
7/14/2008	0.00	78.1	55.0
7/15/2008	0.24	75.0	57.4
7/16/2008	0.08	79.4	53.2
7/17/2008	0.00	78.5	57.5
7/18/2008	0.13	78.6	58.1
7/19/2008	0.00	82.9	57.1
7/20/2008	0.00	85.6	62.3
7/21/2008	0.17	78.2	60.6
7/22/2008	0.05	77.1	58.1
7/23/2008	0.00	80.6	58.9
7/24/2008	0.00	82.7	58.6
7/25/2008	0.00	84.0	59.8
7/26/2008	0.00	83.8	61.5
7/27/2008	0.07	77.0	59.5
7/28/2008	0.13	77.7	56.8
7/29/2008	0.00	79.0	52.7
7/30/2008	0.00	84.0	58.1
7/31/2008	0.00	83.4	57.6
Month	1.31	87.8	46.0

8/1/2008	0.00	85.2	58.0
8/2/2008	0.00	86.7	61.5
8/3/2008	0.00	81.8	66.8
8/4/2008	0.00	83.1	60.9
8/5/2008	0.06	80.9	59.2
8/6/2008	0.00	79.5	57.1
8/7/2008	0.49	75.7	56.4
8/8/2008	0.00	76.0	57.2
8/9/2008	0.00	74.4	57.0
8/10/2008	0.30	77.5	56.7
8/11/2008	0.00	79.5	56.4
8/12/2008	0.00	82.7	56.5
8/13/2008	0.00	84.1	51.5
8/14/2008	0.00	83.5	58.4
8/15/2008	0.00	86.4	59.4
8/16/2008	0.00	83.5	55.0
8/17/2008	0.01	79.8	54.0
8/18/2008	0.00	80.1	50.5
8/19/2008	0.06	76.4	56.1
8/20/2008	0.00	79.5	54.6
8/21/2008	0.00	79.2	54.2
8/22/2008	0.00	80.6	54.6
8/23/2008	0.00	82.8	56.4
8/24/2008	0.00	83.3	58.2
8/25/2008	0.00	85.0	60.5
8/26/2008	0.00	78.5	59.8
8/27/2008	0.06	81.4	55.4
8/28/2008	0.00	84.6	54.7
8/29/2008	0.00	86.7	50.5
8/30/2008	0.00	86.2	56.9
8/31/2008	0.00	80.7	57.3
Month	0.98	86.7	50.5
9/1/2008	0.53	63.8	54.5
9/2/2008	0.11	68.8	56.4
9/3/2008	0.00	71.3	36.2
9/4/2008	0.00	76.3	47.2
9/5/2008	0.00	63.7	33.3
9/6/2008	0.00	64.5	38.5
9/7/2008	0.00	81.3	46.1
9/8/2008	0.00	79.3	54.6
9/9/2008	0.00	79.4	53.7
9/10/2008	0.01	68.5	51.2
9/11/2008	0.00	69.4	46.3
9/12/2008	0.00	70.3	46.3
9/13/2008	0.00	73.2	40.3

9/14/2008	0.00	76.3	44.5
9/15/2008	0.00	78.7	45.4
9/16/2008	0.00	76.3	45.8
9/17/2008	0.00	73.0	50.1
9/18/2008	0.00	71.7	49.4
9/19/2008	0.06	69.6	49.9
9/20/2008	0.01	72.9	51.6
9/21/2008	0.09	70.2	49.2
9/22/2008	0.00	71.4	45.7
9/23/2008	0.00	69.3	50.5
9/24/2008	0.00	72.3	40.7
9/25/2008	0.00	75.7	44.0
9/26/2008	0.00	76.9	53.9
9/27/2008	0.00	74.0	53.6
9/28/2008	0.00	75.0	48.6
9/29/2008	0.00	73.9	52.1
9/30/2008	0.00	75.0	45.8
Month	0.81	81.3	33.3
10/1/2008	0.00	72.5	48.5
10/2/2008	0.00	74.3	46.8
10/3/2008	0.00	72.3	50.6
10/4/2008	0.00	67.0	49.8
10/5/2008	0.87	55.5	42.4
10/6/2008	0.22	55.5	39.0
10/7/2008	0.00	62.9	32.3
10/8/2008	0.00	67.2	38.7
10/9/2008	0.00	70.2	45.5
10/10/2008	0.00	67.9	42.1
10/11/2008	0.00	60.1	34.9
10/12/2008	0.00	48.9	24.9
10/13/2008	0.04	40.6	15.3
10/14/2008	0.00	44.2	23.9
10/15/2008	0.00	58.7	28.4
10/16/2008	0.00	63.6	31.9
10/17/2008	0.00	67.8	39.2
10/18/2008	0.00	68.8	33.1
10/19/2008	0.00	67.3	41.8
10/20/2008	0.00	65.2	46.2
10/21/2008	0.00	64.2	42.4
10/22/2008	0.00	67.7	41.8
10/23/2008	0.00	56.2	34.2
10/24/2008	0.00	66.4	24.7
10/25/2008	0.00	65.7	36.8
10/26/2008	0.00	73.1	36.0
10/27/2008	0.00	70.1	42.7

10/28/2008	0.00	71.5	39.3
10/29/2008	0.00	73.3	45.0
10/30/2008	0.00	70.5	47.8
10/31/2008	0.00	69.0	45.9
Month	1.13	74.3	15.3
11/1/2008	0.00	64.1	43.5
11/2/2008	0.00	64.9	43.7
11/3/2008	0.24	57.1	39.3
11/4/2008	0.00	56.2	32.9
11/5/2008	0.00	43.7	29.4
11/6/2008	0.04	34.3	17.3
11/7/2008	0.00	44.0	16.9
11/8/2008	0.00	54.3	31.5
11/9/2008	0.00	57.1	29.4
11/10/2008	0.00	44.2	31.5
11/11/2008	0.03	38.9	18.2
11/12/2008	0.00	46.3	23.4
11/13/2008	0.00	56.0	31.1
11/14/2008	0.00	63.9	28.8
11/15/2008	0.00	51.0	37.2
11/16/2008	0.00	60.2	35.2
11/17/2008	0.00	65.9	31.9
11/18/2008	0.00	67.9	36.0
11/19/2008	0.00	64.1	36.0
11/20/2008	0.00	63.7	37.8
11/21/2008	0.00	58.1	36.9
11/22/2008	0.00	59.2	34.9
11/23/2008	0.00	55.5	32.5
11/24/2008	0.00	56.5	32.5
11/25/2008	0.00	52.3	24.8
11/26/2008	0.00	55.3	32.8
11/27/2008	0.43	46.1	32.3
11/28/2008	0.64	35.3	29.8
11/29/2008	0.18	39.9	31.4
11/30/2008	0.00	44.7	33.4
Month	1.56	67.9	16.9
12/1/2008	0.00	51.8	35.5
12/2/2008	0.00	60.5	29.9
12/3/2008	0.00	52.3	37.7
12/4/2008	0.00	50.1	27.2
12/5/2008	0.00	42.3	26.7
12/6/2008	0.00	48.7	15.4
12/7/2008	0.00	56.5	24.0
12/8/2008	0.00	46.5	33.9

12/9/2008	0.11	38.6	23.5
12/10/2008	0.00	35.3	20.7
12/11/2008	0.00	56.9	21.4
12/12/2008	0.00	54.3	26.4
12/13/2008	0.00	46.6	28.8
12/14/2008	0.00	36.8	18.7
12/15/2008	0.01	24.2	1.8
12/16/2008	0.00	21.9	6.4
12/17/2008	0.00	23.9	16.6
12/18/2008	0.03	26.4	12.4
12/19/2008	0.04	40.9	7.8
12/20/2008	0.08	29.9	20.8
12/21/2008	0.09	31.5	10.9
12/22/2008	0.12	38.0	16.8
12/23/2008	0.08	30.7	20.2
12/24/2008	0.15	27.9	10.8
12/25/2008	0.09	27.9	9.0
12/26/2008	0.01	30.9	23.2
12/27/2008	0.00	27.7	7.7
12/28/2008	0.01	21.6	-1.8
12/29/2008	0.30	37.6	11.2
12/30/2008	0.00	42.2	20.1
12/31/2008	0.00	49.1	32.2
Month	1.12	60.5	-1.8

Appendix 7-6 Climate data for Coal Hollow Weather Station, 2009

Date	Measured Precipitation* (inches)	Maximum Temperature (^{o}F)	Minimum Temperature (^{o}F)
1/1/2009	0.00	45.3	25.8
1/2/2009	0.00	44.9	30.2
1/3/2009	0.05	34.6	15.6
1/4/2009	0.00	23.0	-1.2
1/5/2009	0.00	23.8	2.4
1/6/2009	0.04	33.8	11.1
1/7/2009	0.00	43.6	19.8
1/8/2009	0.00	49.9	30.6
1/9/2009	0.00	37.0	21.4
1/10/2009	0.00	38.7	14.2
1/11/2009	0.00	44.5	17.8
1/12/2009	0.00	40.5	18.7
1/13/2009	0.00	48.7	30.9
1/14/2009	0.00	48.2	26.9
1/15/2009	0.00	45.7	25.3
1/16/2009	0.00	48.3	17.9
1/17/2009	0.00	45.8	22.5
1/18/2009	0.00	51.8	19.2
1/19/2009	0.00	52.4	20.0
1/20/2009	0.00	50.6	26.8
1/21/2009	0.00	50.7	30.1
1/22/2009	0.00	48.8	38.3
1/23/2009	0.04	42.3	35.9
1/24/2009	0.42	41.1	35.5
1/25/2009	0.12	35.4	27.6
1/26/2009	0.21	27.9	18.6
1/27/2009	0.01	26.0	12.9
1/28/2009	0.01	38.9	9.4
1/29/2009	0.00	39.4	16.8
1/30/2009	0.00	49.5	25.0
1/31/2009	0.00	49.7	26.6
Month	0.90	52.4	-1.2
2/1/2009	0.00	40.3	21.6
2/2/2009	0.00	49.4	17.5
2/3/2009	0.00	53.1	24.8
2/4/2009	0.00	48.2	24.1
2/5/2009	0.00	46.9	31.0
2/6/2009	0.06	38.4	30.5
2/7/2009	0.00	40.2	31.5
2/8/2009	0.45	38.1	26.6
2/9/2009	0.01	27.7	17.3

2/10/2009	0.09	30.5	8.3
2/11/2009	0.11	30.3	12.9
2/12/2009	0.07	26.8	16.1
2/13/2009	0.06	27.5	4.4
2/14/2009	0.06	30.1	15.2
2/15/2009	0.00	33.8	14.0
2/16/2009	0.00	38.2	22.8
2/17/2009	0.21	30.4	22.4
2/18/2009	0.00	36.3	12.8
2/19/2009	0.00	45.1	10.2
2/20/2009	0.00	48.3	21.0
2/21/2009	0.00	47.1	24.7
2/22/2009	0.00	47.1	27.2
2/23/2009	0.24	41.1	37.8
2/24/2009	0.00	51.9	32.5
2/25/2009	0.00	48.4	28.7
2/26/2009	0.00	48.2	30.1
2/27/2009	0.00	42.0	25.9
2/28/2009	0.00	47.4	14.3
Month	1.36	53.1	4.4
3/1/2009	0.00	56.7	31.4
3/2/2009	0.00	57.9	32.4
3/3/2009	0.00	55.2	38.1
3/4/2009	0.00	50.6	35.3
3/5/2009	0.00	45.2	27.5
3/6/2009	0.00	39.4	21.0
3/7/2009	0.06	37.6	20.3
3/8/2009	0.00	44.2	21.0
3/9/2009	0.00	42.8	27.3
3/10/2009	0.20	43.8	6.1
3/11/2009	0.00	50.4	21.9
3/12/2009	0.00	49.6	30.9
3/13/2009	0.00	49.7	29.9
3/14/2009	0.00	52.6	22.7
3/15/2009	0.00	52.0	29.4
3/16/2009	0.00	58.5	31.0
3/17/2009	0.00	61.8	36.8
3/18/2009	0.00	65.2	30.2
3/19/2009	0.00	64.7	33.9
3/20/2009	0.00	63.9	39.9
3/21/2009	0.00	59.5	38.9
3/22/2009	0.00	47.5	26.2
3/23/2009	0.02	39.2	17.5
3/24/2009	0.00	46.4	23.7
3/25/2009	0.00	50.7	20.8

3/26/2009	0.03	38.9	22.1
3/27/2009	0.00	43.0	18.2
3/28/2009	0.00	59.1	28.5
3/29/2009	0.00	54.6	20.7
3/30/2009	0.01	37.2	16.4
3/31/2009	0.00	49.8	13.9
Month	0.32	65.2	6.1
4/1/2009	0.00	40.3	27.6
4/2/2009	0.00	54.7	22.1
4/3/2009	0.12	43.2	26.1
4/4/2009	0.00	37.0	18.6
4/5/2009	0.00	51.2	19.4
4/6/2009	0.00	56.0	21.6
4/7/2009	0.00	64.0	30.8
4/8/2009	0.00	51.4	30.1
4/9/2009	0.00	54.9	24.0
4/10/2009	0.00	51.6	35.0
4/11/2009	0.37	43.7	27.5
4/12/2009	0.01	54.4	32.9
4/13/2009	0.00	61.7	30.8
4/14/2009	0.03	50.7	39.0
4/15/2009	0.03	39.7	23.3
4/16/2009	0.38	33.0	21.8
4/17/2009	0.02	44.9	26.3
4/18/2009	0.00	58.4	36.1
4/19/2009	0.00	66.9	32.6
4/20/2009	0.00	70.4	36.5
4/21/2009	0.00	71.2	39.4
4/22/2009	0.00	72.4	45.4
4/23/2009	0.00	68.8	44.4
4/24/2009	0.00	63.4	38.2
4/25/2009	0.00	51.7	34.7
4/26/2009	0.00	49.6	21.7
4/27/2009	0.00	58.6	22.7
4/28/2009	0.00	61.8	36.9
4/29/2009	0.00	64.9	34.7
4/30/2009	0.00	66.1	38.1
Month	0.96	72.4	18.6
5/1/2009	0.00	67.9	42.7
5/2/2009	0.06	60.2	45.1
5/3/2009	0.00	66.3	44.5
5/4/2009	0.00	65.3	42.6
5/5/2009	0.00	70.7	44.6
5/6/2009	0.00	74.8	45.5

5/7/2009	0.00	75.1	50.4
5/8/2009	0.00	71.9	45.5
5/9/2009	0.00	72.4	35.3
5/10/2009	0.00	73.7	47.1
5/11/2009	0.00	74.5	47.9
5/12/2009	0.00	72.6	47.6
5/13/2009	0.00	70.2	47.6
5/14/2009	0.00	71.0	37.4
5/15/2009	0.00	73.7	45.2
5/16/2009	0.00	75.9	36.7
5/17/2009	0.00	79.1	41.5
5/18/2009	0.00	81.4	48.7
5/19/2009	0.00	72.5	56.0
5/20/2009	0.00	73.5	49.3
5/21/2009	0.01	67.8	49.8
5/22/2009	0.19	64.1	48.5
5/23/2009	0.38	57.2	47.2
5/24/2009	0.01	66.0	42.2
5/25/2009	0.00	66.1	44.8
5/26/2009	0.00	64.5	38.6
5/27/2009	0.00	71.5	42.7
5/28/2009	0.13	66.5	44.3
5/29/2009	0.00	68.6	45.6
5/30/2009	0.00	69.6	41.6
5/31/2009	0.00	67.0	42.7
Month	0.78	81.4	35.3
6/1/2009	0.01	66.9	45.2
6/2/2009	0.00	71.0	47.2
6/3/2009	0.00	71.2	49.0
6/4/2009	0.00	72.6	48.3
6/5/2009	0.00	62.5	37.3
6/6/2009	0.00	61.1	36.6
6/7/2009	0.03	62.9	37.5
6/8/2009	0.00	65.4	42.7
6/9/2009	0.04	58.2	44.2
6/10/2009	0.01	62.9	44.1
6/11/2009	0.00	65.0	42.6
6/12/2009	0.00	66.9	43.8
6/13/2009	0.02	61.1	48.7
6/14/2009	0.00	67.3	45.4
6/15/2009	0.00	69.1	42.1
6/16/2009	0.01	58.0	48.5
6/17/2009	0.07	60.5	44.7
6/18/2009	0.45	66.6	44.5
6/19/2009	0.00	73.1	41.9

6/20/2009	0.02	67.7	48.1
6/21/2009	0.00	71.9	47.2
6/22/2009	0.00	76.0	45.0
6/23/2009	0.00	80.4	48.3
6/24/2009	0.00	81.8	54.9
6/25/2009	0.03	80.0	54.7
6/26/2009	0.05	67.9	50.3
6/27/2009	0.00	79.4	44.7
6/28/2009	0.00	83.3	53.5
6/29/2009	0.00	84.1	56.3
6/30/2009	0.00	86.3	57.5
Month	0.74	86.3	36.6
7/1/2009	0.00	83.9	59.6
7/2/2009	0.15	72.2	53.4
7/3/2009	0.15	80.1	51.4
7/4/2009	0.00	79.2	54.2
7/5/2009	0.00	82.5	48.0
7/6/2009	0.00	82.6	55.2
7/7/2009	0.00	80.8	53.6
7/8/2009	0.00	81.5	54.4
7/9/2009	0.00	82.0	51.4
7/10/2009	0.00	81.4	54.9
7/11/2009	0.02	81.5	60.9
7/12/2009	0.00	83.4	61.2
7/13/2009	0.00	84.1	61.0
7/14/2009	0.00	84.1	56.6
7/15/2009	0.00	85.4	60.1
7/16/2009	0.00	87.4	60.6
7/17/2009	0.00	90.4	61.3
7/18/2009	0.00	88.2	63.2
7/19/2009	0.14	87.7	59.8
7/20/2009	0.05	82.0	60.0
7/21/2009	0.03	73.7	57.8
7/22/2009	0.00	84.8	54.5
7/23/2009	0.00	85.6	57.4
7/24/2009	0.00	82.0	61.6
7/25/2009	0.00	79.7	61.5
7/26/2009	0.03	84.5	58.1
7/27/2009	0.17	81.9	61.8
7/28/2009	0.00	84.8	62.4
7/29/2009	0.01	82.5	57.3
7/30/2009	0.01	74.7	53.8
7/31/2009	0.00	83.5	52.5
Month	0.76	90.4	48.0

8/1/2009	0.00	85.2		54.6
8/2/2009	0.00	84.1		56.6
8/3/2009	0.00	83.7		60.0
8/4/2009	0.00	84.7		60.6
8/5/2009	0.03	79.9		61.2
8/6/2009	0.13	79.7		56.9
8/7/2009	0.00	70.6		45.5
8/8/2009	0.00	72.2		46.1
8/9/2009	0.00	77.4		43.3
8/10/2009	0.00	80.7		48.1
8/11/2009	0.00	83.1		52.0
8/12/2009	0.00	73.1		58.2
8/13/2009	0.00	79.1		57.4
8/14/2009	0.00	75.9		52.4
8/15/2009	0.00	76.1		47.9
8/16/2009	0.00	77.7		49.6
8/17/2009	0.00	79.7		48.1
8/18/2009	0.00	81.3		52.3
8/19/2009	0.00	85.4		51.4
8/20/2009	0.00	88.4		55.9
8/21/2009	0.00	89.2		58.8
8/22/2009	0.04	82.6		58.3
8/23/2009	0.52	74.6		56.3
8/24/2009	0.00	NA	49.6	
8/25/2009	0.00	78.2		52.4
8/26/2009	0.00	82.9		55.4
8/27/2009	0.00	85.9		51.7
8/28/2009	0.00	86.2		57.2
8/29/2009	0.00	84.9		62.1
8/30/2009	0.00	83.8		60.4
8/31/2009	0.00	81.0		57.4
Month	0.72	89.2		43.3
9/1/2009	0.00	76.8		56.2
9/2/2009	0.00	82.5		56.2
9/3/2009	0.00	77.2		55.0
9/4/2009	0.00	80.4		51.4
9/5/2009	0.34	66.5		44.3
9/6/2009	0.00	68.6		45.6
9/7/2009	0.00	75.2		50.4
9/8/2009	0.00	77.1		51.6
9/9/2009	0.22	78.5		52.1
9/10/2009	0.41	70.8		51.6
9/11/2009	0.00	79.1		51.5
9/12/2009	0.01	78.4		54.8
9/13/2009	0.00	74.0		52.3

9/14/2009	0.04	71.9	52.9
9/15/2009	0.00	67.0	42.7
9/16/2009	0.00	68.4	37.4
9/17/2009	0.00	70.9	46.9
9/18/2009	0.67	65.4	50.5
9/19/2009	0.00	72.4	48.3
9/20/2009	0.00	75.8	54.5
9/21/2009	0.00	67.5	49.2
9/22/2009	0.00	69.0	32.9
9/23/2009	0.00	71.7	40.6
9/24/2009	0.00	73.9	46.5
9/25/2009	0.00	78.1	48.0
9/26/2009	0.00	80.7	46.1
9/27/2009	0.00	82.8	47.0
9/28/2009	0.00	79.3	50.5
9/29/2009	0.00	74.2	47.9
9/30/2009	0.00	63.1	38.6
Month	1.69	82.8	32.9
10/1/2009	0.00	59.0	27.7
10/2/2009	0.00	65.0	28.3
10/3/2009	0.00	60.7	37.9
10/4/2009	0.00	56.7	42.6
10/5/2009	0.00	50.7	28.2
10/6/2009	0.00	55.2	27.1
10/7/2009	0.00	53.8	28.9
10/8/2009	0.00	60.2	31.3
10/9/2009	0.00	64.0	34.6
10/10/2009	0.00	64.9	39.0
10/11/2009	0.00	61.5	36.8
10/12/2009	0.00	57.4	35.3
10/13/2009	0.00	55.5	40.7
10/14/2009	0.00	53.2	43.1
10/15/2009	0.00	70.5	32.2
10/16/2009	0.00	71.9	36.6
10/17/2009	0.00	70.7	37.8
10/18/2009	0.00	71.9	47.7
10/19/2009	0.00	66.7	41.5
10/20/2009	0.09	50.7	37.7
10/21/2009	0.00	54.3	36.6
10/22/2009	0.00	55.5	29.5
10/23/2009	0.00	64.2	40.7
10/24/2009	0.00	64.8	36.0
10/25/2009	0.00	54.8	32.7
10/26/2009	0.00	55.8	23.2
10/27/2009	0.00	44.1	24.5

10/28/2009	0.00	30.4	19.6
10/29/2009	0.00	34.5	20.4
10/30/2009	0.00	49.3	15.5
10/31/2009	0.00	61.5	28.0
Month	0.09	71.9	15.5
11/1/2009	0.00	67.4	35.6
11/2/2009	0.00	69.5	42.9
11/3/2009	0.00	70.6	33.8
11/4/2009	0.00	66.9	41.8
11/5/2009	0.00	65.9	35.9
11/6/2009	0.00	64.0	37.9
11/7/2009	0.00	60.9	39.7
11/8/2009	0.00	57.1	33.3
11/9/2009	0.00	57.1	29.6
11/10/2009	0.00	62.0	32.1
11/11/2009	0.00	58.2	36.9
11/12/2009	0.00	53.5	41.9
11/13/2009	0.41	44.6	29.8
11/14/2009	0.01	38.9	20.9
11/15/2009	0.00	36.7	15.4
11/16/2009	0.00	48.9	17.2
11/17/2009	0.00	53.6	24.6
11/18/2009	0.00	53.3	24.1
11/19/2009	0.00	52.8	26.2
11/20/2009	0.00	52.7	25.5
11/21/2009	0.00	46.3	26.9
11/22/2009	0.00	47.8	20.1
11/23/2009	0.00	40.8	24.2
11/24/2009	0.00	48.7	11.7
11/25/2009	0.00	54.2	17.8
11/26/2009	0.00	57.6	22.2
11/27/2009	0.00	52.3	30.0
11/28/2009	0.00	43.6	30.0
11/29/2009	0.10	42.6	26.3
11/30/2009	0.00	51.4	25.0
Month	0.52	70.6	11.7
12/1/2009	0.00	52.6	18.7
12/2/2009	0.00	43.3	22.3
12/3/2009	0.00	28.6	8.8
12/4/2009	0.00	38.2	0.1
12/5/2009	0.00	35.0	19.8
12/6/2009	0.00	29.7	2.5
12/7/2009	0.00	27.6	24.4
12/8/2009	0.22	27.3	6.3

12/9/2009	0.27	23.7	0.8
12/10/2009	0.00	31.5	1.3
12/11/2009	0.00	29.4	13.1
12/12/2009	0.16	32.6	24.7
12/13/2009	0.57	32.6	26.3
12/14/2009	0.01	35.2	18.9
12/15/2009	0.00	37.3	17.0
12/16/2009	0.00	47.3	21.8
12/17/2009	0.00	47.8	24.5
12/18/2009	0.00	43.0	20.3
12/19/2009	0.00	45.7	17.9
12/20/2009	0.00	44.0	25.9
12/21/2009	0.00	40.3	27.1
12/22/2009	0.07	31.5	20.1
12/23/2009	0.06	28.5	17.5
12/24/2009	0.01	30.6	15.7
12/25/2009	0.00	27.7	13.3
12/26/2009	0.03	30.8	6.2
12/27/2009	0.04	31.1	12.4
12/28/2009	0.00	31.0	9.3
12/29/2009	0.01	32.9	19.4
12/30/2009	0.09	25.9	15.2
12/31/2009	0.08	32.2	13.3
Month	1.62	52.6	0.1

Appendix 7-6 Climate data for Coal Hollow Weather Station, 2010

Date	Measured Precipitation* (inches)	Maximum Temperature (^{o}F)	Minimum Temperature (^{o}F)
1/1/2010	0.00	42.5	16.0
1/2/2010	0.00	44.0	21.6
1/3/2010	0.00	42.4	12.5
1/4/2010	0.00	42.3	16.3
1/5/2010	0.00	47.2	22.0
1/6/2010	0.00	48.4	23.0
1/7/2010	0.00	39.9	19.9
1/8/2010	0.00	43.7	5.9
1/9/2010	0.00	47.7	21.0
1/10/2010	0.00	42.1	24.8
1/11/2010	0.00	44.9	18.5
1/12/2010	0.00	43.6	23.4
1/13/2010	0.00	40.4	25.9
1/14/2010	0.00	36.4	26.3
1/15/2010	0.00	47.3	11.3
1/16/2010	0.00	41.8	29.0
1/17/2010	0.00	40.4	25.0
1/18/2010	0.24	33.0	28.1
1/19/2010	0.40	32.7	28.1
1/20/2010	0.29	29.1	23.8
1/21/2010	0.03	30.9	26.1
1/22/2010	0.08	30.1	23.8
1/23/2010	0.40	30.3	14.0
1/24/2010	0.00	28.3	6.9
1/25/2010	0.00	36.2	13.1
1/26/2010	0.00	41.7	18.4
1/27/2010	0.24	32.1	23.6
1/28/2010	0.02	34.6	18.3
1/29/2010	0.03	41.6	12.0
1/30/2010	0.00	35.0	18.2
1/31/2010	0.00	37.1	17.8
Month	1.73	48.4	5.9
2/1/2010	0.00	42.1	15.0
2/2/2010	0.00	37.6	18.5
2/3/2010	0.00	42.9	20.0
2/4/2010	0.00	41.2	18.8
2/5/2010	0.01	35.7	26.6
2/6/2010	0.34	37.6	29.7
2/7/2010	0.51	33.6	24.4
2/8/2010	0.02	34.1	18.8
2/9/2010	0.01	33.5	16.5

2/10/2010	0.03	41.4	17.3
2/11/2010	0.00	36.5	12.1
2/12/2010	0.00	43.1	19.4
2/13/2010	0.00	44.2	18.1
2/14/2010	0.00	43.0	24.9
2/15/2010	0.00	48.5	26.6
2/16/2010	0.00	45.6	23.7
2/17/2010	0.00	49.0	21.7
2/18/2010	0.00	42.0	25.6
2/19/2010	0.00	39.2	28.5
2/20/2010	0.09	34.6	28.0
2/21/2010	0.35	30.0	23.0
2/22/2010	0.00	25.8	16.2
2/23/2010	0.17	42.3	9.6
2/24/2010	0.03	31.7	22.5
2/25/2010	0.14	35.0	11.8
2/26/2010	0.00	37.7	15.1
2/27/2010	0.00	36.8	24.9
2/28/2010	0.08	36.4	23.1
Month	1.78	49.0	9.6
3/1/2010	0.00	47.3	24.7
3/2/2010	0.00	41.4	25.8
3/3/2010	0.03	41.3	30.3
3/4/2010	0.05	37.1	24.3
3/5/2010	0.00	45.4	18.0
3/6/2010	0.00	42.3	24.1
3/7/2010	0.53	38.2	30.5
3/8/2010	0.32	37.3	27.7
3/9/2010	0.30	31.6	26.4
3/10/2010	0.10	28.3	17.2
3/11/2010	0.24	36.6	18.4
3/12/2010	0.00	50.2	13.0
3/13/2010	0.00	37.7	18.9
3/14/2010	0.05	34.2	20.4
3/15/2010	0.00	52.6	26.0
3/16/2010	0.00	54.3	28.2
3/17/2010	0.00	56.5	29.3
3/18/2010	0.00	53.0	35.6
3/19/2010	0.00	37.0	28.0
3/20/2010	0.00	45.6	17.9
3/21/2010	0.00	52.9	24.9
3/22/2010	0.00	48.8	31.3
3/23/2010	0.00	38.1	27.8
3/24/2010	0.00	49.7	20.6
3/25/2010	0.00	44.5	28.7

3/26/2010	0.00	37.6	29.0
3/27/2010	0.00	40.7	23.2
3/28/2010	0.00	53.1	21.9
3/29/2010	0.00	53.2	34.9
3/30/2010	0.00	55.3	36.4
3/31/2010	0.00	43.6	31.5
Month	1.62	56.5	13.0
4/1/2010	0.13	35.8	19.6
4/2/2010	0.00	39.2	17.5
4/3/2010	0.00	46.5	25.8
4/4/2010	0.00	47.2	27.3
4/5/2010	0.02	41.3	23.6
4/6/2010	0.13	37.0	13.8
4/7/2010	0.00	45.8	22.3
4/8/2010	0.00	57.2	24.0
4/9/2010	0.00	58.6	34.4
4/10/2010	0.00	58.7	34.8
4/11/2010	0.00	63.5	36.8
4/12/2010	0.01	52.4	27.4
4/13/2010	0.24	46.1	28.6
4/14/2010	0.00	56.4	21.8
4/15/2010	0.00	64.7	35.5
4/16/2010	0.00	63.8	41.3
4/17/2010	0.00	67.0	33.3
4/18/2010	0.00	67.4	41.6
4/19/2010	0.00	66.3	42.7
4/20/2010	0.00	64.0	42.7
4/21/2010	0.32	51.1	27.2
4/22/2010	0.14	37.6	22.1
4/23/2010	0.03	42.5	21.4
4/24/2010	0.00	60.7	35.4
4/25/2010	0.00	64.2	35.9
4/26/2010	0.00	65.5	38.8
4/27/2010	0.00	63.8	39.1
4/28/2010	0.00	59.7	40.5
4/29/2010	0.00	42.6	26.3
4/30/2010	0.00	43.5	23.3
Month	1.02	67.4	13.8
5/1/2010	0.00	48.9	30.8
5/2/2010	0.02	42.4	26.5
5/3/2010	0.00	61.7	30.3
5/4/2010	0.00	66.2	39.0
5/5/2010	0.00	67.7	43.0
5/6/2010	0.00	57.8	38.3

5/7/2010	0.00	59.5	28.3
5/8/2010	0.00	65.6	35.1
5/9/2010	0.00	66.0	39.4
5/10/2010	0.00	56.8	29.3
5/11/2010	0.10	44.9	30.6
5/12/2010	0.00	49.5	22.8
5/13/2010	0.00	55.1	28.2
5/14/2010	0.04	56.8	35.6
5/15/2010	0.00	66.1	32.1
5/16/2010	0.00	68.1	37.8
5/17/2010	0.00	66.9	46.9
5/18/2010	0.04	56.0	41.6
5/19/2010	0.00	66.3	34.4
5/20/2010	0.00	70.2	39.6
5/21/2010	0.00	71.5	47.9
5/22/2010	0.00	58.1	36.8
5/23/2010	0.00	56.7	31.6
5/24/2010	0.17	50.3	27.9
5/25/2010	0.00	63.0	31.8
5/26/2010	0.00	68.1	39.6
5/27/2010	0.00	70.4	48.7
5/28/2010	0.00	68.9	44.7
5/29/2010	0.00	64.3	38.3
5/30/2010	0.00	69.1	38.2
5/31/2010	0.00	71.8	43.4
Month	0.37	71.8	22.8
6/1/2010	0.00	68.6	47.8
6/2/2010	0.00	73.2	47.0
6/3/2010	0.00	74.5	50.8
6/4/2010	0.00	78.8	52.8
6/5/2010	0.00	83.8	56.7
6/6/2010	0.00	85.1	60.1
6/7/2010	0.00	81.3	59.1
6/8/2010	0.00	79.4	54.0
6/9/2010	0.00	79.1	51.5
6/10/2010	0.00	74.2	49.3
6/11/2010	0.02	64.9	46.0
6/12/2010	0.19	59.4	40.0
6/13/2010	0.18	55.6	33.4
6/14/2010	0.00	69.1	36.0
6/15/2010	0.00	73.2	44.6
6/16/2010	0.00	72.8	49.0
6/17/2010	0.00	72.8	39.5
6/18/2010	0.00	75.4	46.8
6/19/2010	0.00	74.5	47.4

6/20/2010	0.00	73.9	43.9
6/21/2010	0.00	73.7	46.0
6/22/2010	0.00	74.8	47.9
6/23/2010	0.00	80.5	46.5
6/24/2010	0.00	82.1	54.4
6/25/2010	0.00	79.6	56.9
6/26/2010	0.00	78.9	52.9
6/27/2010	0.00	83.5	55.3
6/28/2010	0.00	84.1	53.5
6/29/2010	0.00	79.5	60.1
6/30/2010	0.00	77.1	58.4
Month	0.39	85.1	33.4
7/1/2010	0.00	79.6	56.8
7/2/2010	0.00	80.5	56.2
7/3/2010	0.00	78.0	50.6
7/4/2010	0.00	74.2	51.2
7/5/2010	0.00	77.9	42.3
7/6/2010	0.00	80.1	53.9
7/7/2010	0.00	80.3	52.1
7/8/2010	0.00	80.3	56.4
7/9/2010	0.12	79.1	62.1
7/10/2010	0.00	79.8	57.5
7/11/2010	0.02	82.2	58.2
7/12/2010	0.00	83.7	59.2
7/13/2010	0.00	81.3	60.6
7/14/2010	0.00	85.2	58.9
7/15/2010	0.00	88.3	59.4
7/16/2010	0.00	88.9	60.0
7/17/2010	0.00	87.8	63.0
7/18/2010	0.02	88.4	61.6
7/19/2010	0.00	87.8	65.2
7/20/2010	0.01	83.7	61.0
7/21/2010	0.00	82.9	59.3
7/22/2010	0.00	82.6	59.8
7/23/2010	0.00	84.5	57.9
7/24/2010	0.00	85.2	60.5
7/25/2010	0.00	82.6	58.4
7/26/2010	0.00	80.2	58.8
7/27/2010	0.10	79.1	56.3
7/28/2010	0.29	78.3	59.6
7/29/2010	0.14	77.8	59.8
7/30/2010	0.05	80.2	54.8
7/31/2010	0.01	74.8	58.9
Month	0.76	88.9	42.3

8/1/2010	0.00	71.7	58.8
8/2/2010	0.19	80.1	55.0
8/3/2010	0.00	80.1	56.7
8/4/2010	0.00	81.1	59.2
8/5/2010	0.08	76.6	56.1
8/6/2010	0.00	80.3	54.6
8/7/2010	0.12	66.7	54.6
8/8/2010	0.15	68.5	47.8
8/9/2010	0.04	73.9	46.5
8/10/2010	0.00	77.1	52.3
8/11/2010	0.00	78.8	51.9
8/12/2010	0.00	79.2	49.8
8/13/2010	0.00	81.7	53.0
8/14/2010	0.00	83.0	54.9
8/15/2010	0.00	85.4	57.6
8/16/2010	0.00	84.1	62.0
8/17/2010	0.00	84.7	58.9
8/18/2010	0.00	73.6	59.4
8/19/2010	0.52	77.0	55.3
8/20/2010	0.00	79.5	52.6
8/21/2010	0.00	83.4	58.0
8/22/2010	0.00	79.1	57.1
8/23/2010	0.00	80.8	57.3
8/24/2010	0.00	82.7	51.2
8/25/2010	0.10	82.0	54.4
8/26/2010	0.00	82.9	57.7
8/27/2010	0.10	75.6	57.1
8/28/2010	0.00	73.8	53.0
8/29/2010	0.00	70.7	54.1
8/30/2010	0.00	68.3	39.5
8/31/2010	0.00	72.4	46.0
Month	1.30	85.4	39.5
9/1/2010	0.00	77.9	45.7
9/2/2010	0.00	82.9	51.5
9/3/2010	0.00	84.8	49.3
9/4/2010	0.00	83.3	57.9
9/5/2010	0.00	68.9	44.7
9/6/2010	0.00	64.3	38.3
9/7/2010	0.16	67.4	47.9
9/8/2010	0.01	71.5	46.9
9/9/2010	0.00	64.8	46.7
9/10/2010	0.00	68.7	38.1
9/11/2010	0.00	74.7	34.3
9/12/2010	0.00	76.7	45.6
9/13/2010	0.00	76.6	51.2

9/14/2010	0.00	76.7	50.5
9/15/2010	0.00	76.5	51.8
9/16/2010	0.00	78.7	52.6
9/17/2010	0.00	79.1	53.9
9/18/2010	0.00	80.6	53.2
9/19/2010	0.00	82.3	50.6
9/20/2010	0.00	78.2	51.0
9/21/2010	0.00	77.0	48.9
9/22/2010	0.00	69.0	48.4
9/23/2010	0.00	73.2	39.8
9/24/2010	0.00	76.7	42.7
9/25/2010	0.00	80.7	42.9
9/26/2010	0.00	82.2	51.1
9/27/2010	0.00	84.8	46.8
9/28/2010	0.00	86.0	53.2
9/29/2010	0.00	83.2	47.7
9/30/2010	0.00	82.1	52.2
Month	0.17	86.0	34.3
10/1/2010	0.00	81.5	54.7
10/2/2010	0.01	79.0	54.5
10/3/2010	0.00	70.4	51.1
10/4/2010	0.62	57.3	44.5
10/5/2010	2.67	49.1	43.8
10/6/2010	0.63	48.6	43.6
10/7/2010	0.01	57.5	38.3
10/8/2010	0.00	60.3	34.8
10/9/2010	0.00	62.3	31.3
10/10/2010	0.00	64.1	44.0
10/11/2010	0.00	68.5	38.5
10/12/2010	0.00	67.0	48.6
10/13/2010	0.00	68.3	35.7
10/14/2010	0.00	70.0	42.1
10/15/2010	0.00	68.8	42.8
10/16/2010	0.00	68.2	44.7
10/17/2010	0.13	63.8	46.9
10/18/2010	0.52	57.6	40.9
10/19/2010	0.01	62.4	34.7
10/20/2010	0.00	60.6	37.2
10/21/2010	0.01	56.0	35.5
10/22/2010	0.19	44.5	36.6
10/23/2010	0.12	46.4	35.3
10/24/2010	0.00	47.8	37.9
10/25/2010	0.11	45.8	27.4
10/26/2010	0.00	47.6	25.6
10/27/2010	0.00	47.8	19.6

10/28/2010	0.00	56.7	22.4
10/29/2010	0.00	59.1	35.6
10/30/2010	0.00	55.7	33.3
10/31/2010	0.00	57.7	27.8
Month	5.03	81.5	19.6
11/1/2010	0.00	59.5	29.3
11/2/2010	0.00	69.2	32.7
11/3/2010	0.00	69.8	38.3
11/4/2010	0.00	68.1	43.9
11/5/2010	0.00	67.3	42.7
11/6/2010	0.00	58.4	40.5
11/7/2010	0.00	56.2	36.4
11/8/2010	0.00	44.9	27.4
11/9/2010	0.01	37.7	20.0
11/10/2010	0.00	39.6	19.1
11/11/2010	0.00	36.0	26.6
11/12/2010	0.00	49.0	18.5
11/13/2010	0.00	46.5	28.3
11/14/2010	0.00	44.4	28.6
11/15/2010	0.00	45.7	30.0
11/16/2010	0.00	50.6	26.8
11/17/2010	0.00	51.7	22.3
11/18/2010	0.00	52.7	27.3
11/19/2010	0.00	48.5	27.9
11/20/2010	0.11	43.7	33.0
11/21/2010	0.19	33.1	22.7
11/22/2010	0.21	28.9	16.2
11/23/2010	0.07	27.7	15.1
11/24/2010	0.06	26.1	4.1
11/25/2010	0.16	27.4	4.8
11/26/2010	0.00	38.8	5.4
11/27/2010	0.00	38.9	14.4
11/28/2010	0.21	32.3	16.1
11/29/2010	0.00	23.6	11.9
11/30/2010	0.00	42.1	2.5
Month	1.02	69.8	2.5
12/1/2010	0.00	50.2	24.6
12/2/2010	0.00	51.1	30.9
12/3/2010	0.00	50.6	36.1
12/4/2010	0.00	50.6	31.1
12/5/2010	0.00	50.6	31.8
12/6/2010	0.19	45.3	30.9
12/7/2010	0.01	48.2	25.0
12/8/2010	0.00	48.1	27.3

12/9/2010	0.00	48.6	32.0
12/10/2010	0.00	52.8	28.7
12/11/2010	0.00	48.3	32.5
12/12/2010	0.00	57.9	30.7
12/13/2010	0.00	60.5	38.0
12/14/2010	0.00	52.6	35.0
12/15/2010	0.00	43.6	31.3
12/16/2010	0.05	33.6	28.3
12/17/2010	0.03	32.9	23.9
12/18/2010	0.62	35.9	29.8
12/19/2010	2.07	47.3	29.0
12/20/2010	2.91	40.0	36.4
12/21/2010	2.75	39.1	32.9
12/22/2010	1.20	38.8	33.4
12/23/2010	0.33	41.0	31.0
12/24/2010	0.01	43.5	22.6
12/25/2010	0.00	44.0	23.2
12/26/2010	0.11	36.4	24.3
12/27/2010	0.01	37.6	20.7
12/28/2010	0.00	39.8	16.0
12/29/2010	0.00	31.0	26.3
12/30/2010	0.00	28.0	0.1
12/31/2010	0.00	12.7	-5.4
Month	10.29	60.5	-5.4

Appendix 7-6 Climate data for Coal Hollow Weather Station, 2011

Date	Measured Precipitation* (inches)	Maximum Temperature (^{o}F)	Minimum Temperature (^{o}F)
1/1/2011	0.25	22.0	-8.4
1/2/2011	0.01	30.2	3.8
1/3/2011	0.01	29.6	11.5
1/4/2011	0.01	31.2	6.5
1/5/2011	0.00	44.1	7.5
1/6/2011	0.00	43.1	15.3
1/7/2011	0.00	44.3	16.6
1/8/2011	0.00	42.9	19.0
1/9/2011	0.00	33.7	20.7
1/10/2011	0.00	21.0	3.2
1/11/2011	0.00	26.2	4.7
1/12/2011	0.00	42.5	13.5
1/13/2011	0.00	47.2	23.7
1/14/2011	0.00	43.6	30.8
1/15/2011	0.00	49.8	29.4
1/16/2011	0.00	51.5	27.1
1/17/2011	0.00	56.4	32.4
1/18/2011	0.00	50.6	28.3
1/19/2011	0.00	45.3	24.5
1/20/2011	0.00	40.6	16.4
1/21/2011	0.00	47.2	20.8
1/22/2011	0.00	46.2	27.8
1/23/2011	0.00	43.3	20.1
1/24/2011	0.00	40.9	17.6
1/25/2011	0.00	46.1	16.2
1/26/2011	0.00	40.5	25.1
1/27/2011	0.00	50.5	22.4
1/28/2011	0.00	54.2	26.7
1/29/2011	0.00	50.4	26.5
1/30/2011	0.00	41.5	26.8
1/31/2011	0.00	32.8	21.6
Month	0.28	56.4	-8.4
2/1/2011	0.00	21.5	3.3
2/2/2011	0.00	16.5	-3.1
2/3/2011	0.00	35.8	1.1
2/4/2011	0.00	43.9	26.8
2/5/2011	0.00	44.8	27.5
2/6/2011	0.00	38.4	28.4
2/7/2011	0.00	46.7	24.8
2/8/2011	0.00	30.0	18.2
2/9/2011	0.00	32.9	11.8

2/10/2011	0.00	41.5	8.0
2/11/2011	0.00	47.5	12.8
2/12/2011	0.00	53.0	20.3
2/13/2011	0.00	57.4	29.3
2/14/2011	0.00	51.5	22.7
2/15/2011	0.00	50.6	29.1
2/16/2011	0.02	46.4	31.1
2/17/2011	0.33	39.8	22.5
2/18/2011	0.02	42.3	22.7
2/19/2011	0.17	38.1	22.4
2/20/2011	0.60	37.5	13.6
2/21/2011	0.06	38.9	7.9
2/22/2011	0.00	34.0	13.7
2/23/2011	0.00	37.6	16.3
2/24/2011	0.00	34.2	21.1
2/25/2011	0.00	33.9	25.6
2/26/2011	0.37	31.4	25.4
2/27/2011	0.41	28.8	16.4
2/28/2011	0.00	37.6	9.2
Month	1.98	57.4	-3.1
3/1/2011	0.00	48.2	21.4
3/2/2011	0.00	45.4	28.4
3/3/2011	0.00	44.6	32.5
3/4/2011	0.00	40.4	27.3
3/5/2011	0.00	48.1	24.6
3/6/2011	0.00	43.0	30.8
3/7/2011	0.46	36.4	28.3
3/8/2011	0.00	38.1	20.5
3/9/2011	0.00	51.5	18.9
3/10/2011	0.00	51.3	31.0
3/11/2011	0.00	54.2	34.3
3/12/2011	0.00	53.2	34.0
3/13/2011	0.00	55.0	27.4
3/14/2011	0.00	55.5	33.6
3/15/2011	0.00	57.0	35.2
3/16/2011	0.00	55.1	36.8
3/17/2011	0.00	45.5	31.5
3/18/2011	0.03	55.0	23.7
3/19/2011	0.00	43.3	35.5
3/20/2011	0.00	45.3	30.1
3/21/2011	0.20	42.1	24.6
3/22/2011	0.13	36.5	18.4
3/23/2011	0.01	44.9	20.7
3/24/2011	0.17	39.4	25.4
3/25/2011	0.07	36.7	25.1

3/26/2011	0.30	34.9	23.7
3/27/2011	0.00	47.7	31.7
3/28/2011	0.01	53.9	31.7
3/29/2011	0.00	52.0	24.7
3/30/2011	0.00	56.6	30.7
3/31/2011	0.00	64.7	33.1
Month	1.38	64.7	18.4
4/1/2011	0.00	71.6	38.0
4/2/2011	0.00	67.6	43.5
4/3/2011	0.01	54.4	26.2
4/4/2011	0.00	51.6	15.9
4/5/2011	0.00	63.5	35.1
4/6/2011	0.00	46.8	32.7
4/7/2011	0.01	45.6	32.2
4/8/2011	0.57	32.7	24.9
4/9/2011	0.22	29.7	22.7
4/10/2011	0.01	38.7	15.1
4/11/2011	0.00	52.4	23.3
4/12/2011	0.00	54.7	29.3
4/13/2011	0.00	54.5	33.1
4/14/2011	0.00	47.7	27.9
4/15/2011	0.00	59.1	27.7
4/16/2011	0.00	65.7	38.1
4/17/2011	0.00	67.0	42.1
4/18/2011	0.00	57.5	41.2
4/19/2011	0.07	59.9	34.2
4/20/2011	0.00	62.8	38.5
4/21/2011	0.04	58.6	37.2
4/22/2011	0.00	58.7	36.0
4/23/2011	0.10	54.0	34.4
4/24/2011	0.28	51.6	36.3
4/25/2011	0.01	55.1	28.2
4/26/2011	0.00	47.1	31.7
4/27/2011	0.00	55.7	20.8
4/28/2011	0.00	62.6	30.0
4/29/2011	0.00	52.3	29.1
4/30/2011	0.00	43.2	22.3
Month	1.32	71.6	15.1
5/1/2011	0.00	46.4	26.7
5/2/2011	0.00	58.7	25.6
5/3/2011	0.00	63.6	34.8
5/4/2011	0.00	66.7	37.3
5/5/2011	0.00	69.7	28.4
5/6/2011	0.00	71.7	45.2

5/7/2011	0.00	71.1	44.4
5/8/2011	0.10	64.8	40.5
5/9/2011	1.13	43.7	32.3
5/10/2011	0.18	44.2	26.3
5/11/2011	0.01	53.5	30.7
5/12/2011	0.00	65.5	34.7
5/13/2011	0.00	67.4	41.7
5/14/2011	0.00	65.7	41.9
5/15/2011	0.00	64.9	44.3
5/16/2011	0.00	55.6	34.5
5/17/2011	0.01	49.4	33.4
5/18/2011	0.57	43.4	32.4
5/19/2011	0.10	42.0	32.5
5/20/2011	0.00	54.0	33.5
5/21/2011	0.00	62.2	32.8
5/22/2011	0.00	62.6	44.9
5/23/2011	0.00	61.1	43.6
5/24/2011	0.00	55.8	32.6
5/25/2011	0.00	69.2	30.7
5/26/2011	0.00	66.0	47.6
5/27/2011	0.00	70.6	44.6
5/28/2011	0.00	68.1	46.7
5/29/2011	0.00	56.1	32.8
5/30/2011	0.00	55.4	26.8
5/31/2011	0.00	68.7	33.9
Month	2.10	71.7	25.6
6/1/2011	0.00	67.0	41.9
6/2/2011	0.00	59.4	38.1
6/3/2011	0.00	66.5	33.6
6/4/2011	0.00	72.6	39.6
6/5/2011	0.00	76.1	46.1
6/6/2011	0.00	66.2	43.4
6/7/2011	0.00	68.9	40.0
6/8/2011	0.00	67.2	43.9
6/9/2011	0.00	70.4	42.5
6/10/2011	0.00	74.4	40.3
6/11/2011	0.00	71.9	47.4
6/12/2011	0.00	71.4	42.5
6/13/2011	0.00	71.5	47.4
6/14/2011	0.00	78.1	49.3
6/15/2011	0.00	79.6	52.5
6/16/2011	0.00	76.8	52.4
6/17/2011	0.00	69.0	49.2
6/18/2011	0.00	73.9	48.5
6/19/2011	0.00	57.1	45.3

6/20/2011	0.00	72.4	38.2
6/21/2011	0.00	79.8	41.3
6/22/2011	0.00	83.2	42.2
6/23/2011	0.00	82.4	57.1
6/24/2011	0.00	80.2	53.2
6/25/2011	0.00	79.2	53.1
6/26/2011	0.00	79.3	51.5
6/27/2011	0.00	82.4	53.4
6/28/2011	0.00	81.6	54.8
6/29/2011	0.00	80.2	61.7
6/30/2011	0.00	73.6	51.1
Month	0.00	83.2	33.6
7/1/2011	0.00	81.6	50.6
7/2/2011	0.00	87.9	51.6
7/3/2011	0.00	86.5	61.7
7/4/2011	0.00	80.7	61.1
7/5/2011	0.00	79.3	57.8
7/6/2011	0.46	79.7	58.1
7/7/2011	0.00	78.9	55.1
7/8/2011	0.18	74.3	57.0
7/9/2011	0.08	77.0	53.8
7/10/2011	0.00	75.2	55.8
7/11/2011	0.00	71.0	55.6
7/12/2011	0.00	73.7	54.8
7/13/2011	0.00	75.9	54.1
7/14/2011	0.00	76.3	49.3
7/15/2011	0.00	75.6	49.0
7/16/2011	0.00	79.3	50.3
7/17/2011	0.00	83.8	55.4
7/18/2011	0.00	79.5	62.7
7/19/2011	0.00	81.4	57.7
7/20/2011	0.00	82.8	58.4
7/21/2011	0.00	82.8	55.5
7/22/2011	0.00	81.6	53.9
7/23/2011	0.00	82.3	54.4
7/24/2011	0.00	86.0	56.3
7/25/2011	0.00	85.2	61.8
7/26/2011	0.35	68.4	55.7
7/27/2011	0.00	78.4	54.0
7/28/2011	0.00	81.4	51.2
7/29/2011	0.00	84.2	56.9
7/30/2011	0.00	81.1	61.3
7/31/2011	0.05	74.6	60.0
Month	1.12	87.9	49.0

8/1/2011	0.02	78.3	53.5
8/2/2011	0.00	82.4	55.1
8/3/2011	0.00	80.5	58.4
8/4/2011	0.02	82.1	51.6
8/5/2011	0.00	82.1	55.5
8/6/2011	0.00	81.5	54.0
8/7/2011	0.00	81.5	48.2
8/8/2011	0.00	83.5	53.9
8/9/2011	0.00	82.9	54.6
8/10/2011	0.00	82.2	58.2
8/11/2011	0.00	82.2	57.5
8/12/2011	0.00	85.7	54.6
8/13/2011	0.00	84.5	53.0
8/14/2011	0.01	79.8	56.2
8/15/2011	0.00	82.6	55.7
8/16/2011	0.00	84.1	56.9
8/17/2011	0.00	86.7	60.1
8/18/2011	0.00	86.1	62.1
8/19/2011	0.00	82.1	56.3
8/20/2011	0.00	82.6	58.8
8/21/2011	0.00	83.7	55.4
8/22/2011	0.00	85.4	56.9
8/23/2011	0.00	88.8	61.0
8/24/2011	0.00	88.3	63.2
8/25/2011	0.20	84.8	60.9
8/26/2011	0.00	84.6	59.8
8/27/2011	0.00	83.5	57.7
8/28/2011	0.28	80.6	58.7
8/29/2011	0.03	80.9	56.7
8/30/2011	0.00	81.9	55.4
8/31/2011	0.00	82.8	54.1
Month	0.56	88.8	48.2
9/1/2011	0.00	79.6	52.9
9/2/2011	0.00	80.7	55.8
9/3/2011	0.00	82.8	49.4
9/4/2011	0.00	84.1	51.8
9/5/2011	0.33	68.1	46.7
9/6/2011	0.00	56.1	32.8
9/7/2011	0.00	77.7	45.8
9/8/2011	0.00	76.3	49.7
9/9/2011	0.26	71.2	46.3
9/10/2011	0.00	66.6	46.9
9/11/2011	0.25	60.6	47.7
9/12/2011	0.28	66.7	43.1
9/13/2011	0.51	68.1	44.2

9/14/2011	0.24	58.5	47.0
9/15/2011	0.01	62.2	42.0
9/16/2011	0.00	66.6	46.6
9/17/2011	0.02	69.0	43.4
9/18/2011	0.00	72.4	48.1
9/19/2011	0.00	73.7	48.5
9/20/2011	0.00	77.9	51.9
9/21/2011	0.00	76.0	47.1
9/22/2011	0.00	77.2	39.4
9/23/2011	0.00	78.3	37.4
9/24/2011	0.00	78.3	48.9
9/25/2011	0.00	75.8	51.7
9/26/2011	0.00	75.8	51.0
9/27/2011	0.00	77.7	47.6
9/28/2011	0.00	80.0	47.1
9/29/2011	0.00	81.7	52.4
9/30/2011	0.06	78.6	49.6
Month	1.96	84.1	32.8
10/1/2011	0.00	70.7	49.1
10/2/2011	0.00	72.4	48.7
10/3/2011	0.14	70.2	47.5
10/4/2011	0.03	64.1	43.9
10/5/2011	1.07	46.3	40.9
10/6/2011	0.78	40.6	27.8
10/7/2011	0.01	44.8	22.3
10/8/2011	0.00	48.2	32.4
10/9/2011	0.00	54.7	27.2
10/10/2011	0.00	58.8	32.7
10/11/2011	0.00	65.9	37.9
10/12/2011	0.00	68.5	34.4
10/13/2011	0.00	73.2	35.0
10/14/2011	0.00	74.5	48.9
10/15/2011	0.00	75.2	50.4
10/16/2011	0.00	70.5	47.2
10/17/2011	0.00	63.5	46.2
10/18/2011	0.00	69.0	33.7
10/19/2011	0.00	67.5	38.2
10/20/2011	0.00	67.7	38.7
10/21/2011	0.00	66.5	42.0
10/22/2011	0.00	68.8	43.4
10/23/2011	0.00	69.3	32.3
10/24/2011	0.00	65.0	43.1
10/25/2011	0.01	62.5	45.2
10/26/2011	0.04	41.4	27.3
10/27/2011	0.00	54.1	21.6

10/28/2011	0.00	54.6	21.4
10/29/2011	0.00	64.3	32.5
10/30/2011	0.00	64.1	32.0
10/31/2011	0.00	65.2	40.1
Month	2.08	75.2	21.4
11/1/2011	0.00	58.5	27.8
11/2/2011	0.00	45.7	21.6
11/3/2011	0.00	50.0	20.7
11/4/2011	0.01	53.9	36.3
11/5/2011	0.01	36.0	21.7
11/6/2011	0.00	30.5	21.7
11/7/2011	0.20	30.9	23.2
11/8/2011	0.00	39.2	17.0
11/9/2011	0.00	46.4	13.3
11/10/2011	0.00	48.8	25.6
11/11/2011	0.00	44.2	26.5
11/12/2011	0.00	47.1	31.0
11/13/2011	0.00	43.5	29.9
11/14/2011	0.00	48.5	27.2
11/15/2011	0.00	50.5	26.8
11/16/2011	0.01	48.8	22.4
11/17/2011	0.00	52.5	29.7
11/18/2011	0.00	49.6	28.3
11/19/2011	0.00	47.0	31.0
11/20/2011	0.05	44.1	33.7
11/21/2011	0.04	39.8	28.4
11/22/2011	0.01	51.4	24.2
11/23/2011	0.00	54.9	26.4
11/24/2011	0.00	48.3	27.5
11/25/2011	0.00	51.3	21.1
11/26/2011	0.00	50.1	28.0
11/27/2011	0.00	59.0	24.8
11/28/2011	0.00	59.6	34.2
11/29/2011	0.00	59.5	27.4
11/30/2011	0.00	54.6	31.1
Month	0.33	59.6	13.3
12/1/2011	0.01	33.1	26.0
12/2/2011	0.16	35.0	24.7
12/3/2011	0.07	27.1	18.3
12/4/2011	0.01	30.2	9.9
12/5/2011	0.00	23.3	11.9
12/6/2011	0.00	35.8	0.5
12/7/2011	0.00	42.9	9.9
12/8/2011	0.00	44.7	19.1

12/9/2011	0.00	48.9	13.7
12/10/2011	0.00	46.0	18.4
12/11/2011	0.00	41.5	20.0
12/12/2011	0.05	31.7	23.5
12/13/2011	0.19	32.7	20.0
12/14/2011	0.00	33.9	13.4
12/15/2011	0.00	34.1	14.1
12/16/2011	0.00	40.3	13.2
12/17/2011	0.00	48.8	12.0
12/18/2011	0.05	40.0	26.8
12/19/2011	0.00	49.9	27.1
12/20/2011	0.00	39.8	28.6
12/21/2011	0.00	42.8	13.6
12/22/2011	0.00	22.9	13.9
12/23/2011	0.00	37.0	15.8
12/24/2011	0.00	42.9	28.1
12/25/2011	0.00	52.0	15.7
12/26/2011	0.00	51.0	16.5
12/27/2011	0.00	52.3	23.6
12/28/2011	0.00	56.0	23.5
12/29/2011	0.00	60.0	34.6
12/30/2011	0.00	55.8	34.3
12/31/2011	0.00	45.1	24.2
Month	0.54	60.0	0.5

Appendix 7-6 Climate data for Coal Hollow Weather Station, 20012

Date	Measured Precipitation* (inches)	Maximum Temperature (^{o}F)	Minimum Temperature (^{o}F)
1/1/2012	0.00	54.0	21.0
1/2/2012	0.00	55.6	26.6
1/3/2012	0.00	58.2	30.9
1/4/2012	0.00	57.3	29.0
1/5/2012	0.00	56.3	31.8
1/6/2012	0.00	55.7	29.3
1/7/2012	0.00	41.1	23.9
1/8/2012	0.00	38.9	20.3
1/9/2012	0.00	54.9	18.0
1/10/2012	0.00	53.0	25.3
1/11/2012	0.62	39.1	24.8
1/12/2012	0.00	43.5	13.9
1/13/2012	0.00	51.4	13.8
1/14/2012	0.00	53.6	25.9
1/15/2012	0.00	45.7	27.5
1/16/2012	0.00	35.6	13.6
1/17/2012	0.00	39.4	7.1
1/18/2012	0.00	44.9	20.9
1/19/2012	0.00	54.1	23.8
1/20/2012	0.00	51.3	26.9
1/21/2012	0.05	36.0	25.2
1/22/2012	0.66	32.9	16.8
1/23/2012	0.12	28.4	20.8
1/24/2012	0.11	31.9	16.3
1/25/2012	0.05	47.9	15.6
1/26/2012	0.00	47.3	26.9
1/27/2012	0.00	37.5	24.8
1/28/2012	0.00	43.0	11.2
1/29/2012	0.00	50.0	18.4
1/30/2012	0.00	47.3	29.0
1/31/2012	0.00	48.1	27.7
Month	1.61	58.2	7.1
2/1/2012	0.00	44.8	26.7
2/2/2012	0.00	34.9	25.2
2/3/2012	0.00	36.7	22.1
2/4/2012	0.00	36.8	21.0
2/5/2012	0.00	36.5	14.5
2/6/2012	0.02	37.0	11.5
2/7/2012	0.00	38.5	11.8
2/8/2012	0.00	48.2	25.4
2/9/2012	0.00	48.9	21.5

2/10/2012	0.00	53.7	27.6
2/11/2012	0.00	50.8	31.6
2/12/2012	0.22	36.8	22.3
2/13/2012	0.30	33.2	20.7
2/14/2012	0.41	32.5	16.6
2/15/2012	0.06	28.7	14.3
2/16/2012	0.00	39.1	15.0
2/17/2012	0.00	42.1	12.1
2/18/2012	0.00	42.6	16.2
2/19/2012	0.36	30.8	5.3
2/20/2012	0.00	38.4	2.6
2/21/2012	0.00	46.2	19.9
2/22/2012	0.00	51.9	29.6
2/23/2012	0.00	39.3	24.2
2/24/2012	0.00	46.1	21.8
2/25/2012	0.00	48.7	24.9
2/26/2012	0.00	41.3	23.6
2/27/2012	0.00	42.2	28.0
2/28/2012	0.33	29.2	24.3
2/29/2012	0.04	33.9	21.9
Month	1.74	53.7	2.6
3/1/2012	0.10	33.8	23.6
3/2/2012	0.02	27.6	13.7
3/3/2012	0.00	42.9	14.5
3/4/2012	0.00	59.2	26.8
3/5/2012	0.00	59.4	31.8
3/6/2012	0.00	51.8	30.6
3/7/2012	0.00	31.8	19.1
3/8/2012	0.00	48.1	24.0
3/9/2012	0.00	56.8	21.7
3/10/2012	0.00	55.5	27.2
3/11/2012	0.00	52.8	31.8
3/12/2012	0.00	54.4	30.8
3/13/2012	0.00	57.3	32.8
3/14/2012	0.00	57.9	31.5
3/15/2012	0.00	60.3	34.6
3/16/2012	0.00	60.7	34.7
3/17/2012	0.00	50.3	37.4
3/18/2012	0.21	34.5	21.2
3/19/2012	0.47	30.0	13.6
3/20/2012	0.00	40.7	6.9
3/21/2012	0.01	56.1	22.1
3/22/2012	0.00	64.0	29.9
3/23/2012	0.00	61.0	35.0
3/24/2012	0.00	62.6	36.8

3/25/2012	0.00	58.6	43.4
3/26/2012	0.03	46.0	27.4
3/27/2012	0.00	57.8	29.8
3/28/2012	0.00	59.3	30.7
3/29/2012	0.00	57.8	34.2
3/30/2012	0.00	66.2	36.5
3/31/2012	0.00	67.3	38.5
Month	0.84	67.3	6.9
4/1/2012	0.00	49.5	29.3
4/2/2012	0.00	42.2	24.0
4/3/2012	0.00	60.5	27.3
4/4/2012	0.00	61.5	35.1
4/5/2012	0.00	58.1	35.2
4/6/2012	0.00	47.7	24.3
4/7/2012	0.00	58.3	17.5
4/8/2012	0.00	66.7	29.5
4/9/2012	0.00	69.3	41.9
4/10/2012	0.00	68.5	42.3
4/11/2012	0.03	53.8	33.3
4/12/2012	0.49	44.2	30.3
4/13/2012	0.02	42.0	29.4
4/14/2012	0.43	33.8	24.4
4/15/2012	0.03	50.1	18.9
4/16/2012	0.00	57.9	29.2
4/17/2012	0.00	61.0	35.4
4/18/2012	0.00	64.3	40.7
4/19/2012	0.00	67.0	39.3
4/20/2012	0.00	72.0	35.9
4/21/2012	0.00	74.9	40.3
4/22/2012	0.00	75.0	48.1
4/23/2012	0.00	77.1	48.7
4/24/2012	0.00	72.4	47.9
4/25/2012	0.00	60.4	47.2
4/26/2012	0.01	56.2	41.5
4/27/2012	0.02	60.9	38.7
4/28/2012	0.00	60.6	39.4
4/29/2012	0.00	64.2	27.1
4/30/2012	0.00	67.3	38.3
Month	1.03	77.1	17.5
5/1/2012	0.00	68.0	43.3
5/2/2012	0.00	67.3	41.7
5/3/2012	0.00	67.0	39.5
5/4/2012	0.00	68.0	43.2
5/5/2012	0.00	65.8	39.5

5/6/2012	0.00	64.9	39.2
5/7/2012	0.00	54.7	39.3
5/8/2012	0.00	66.3	45.6
5/9/2012	0.00	71.4	40.1
5/10/2012	0.00	74.2	47.2
5/11/2012	0.00	71.8	41.9
5/12/2012	0.00	73.0	40.4
5/13/2012	0.00	70.0	44.6
5/14/2012	0.00	74.4	43.9
5/15/2012	0.00	75.8	56.2
5/16/2012	0.00	73.3	43.5
5/17/2012	0.00	77.6	50.8
5/18/2012	0.00	66.2	46.7
5/19/2012	0.00	68.9	33.1
5/20/2012	0.00	76.5	41.0
5/21/2012	0.00	80.6	47.6
5/22/2012	0.00	79.2	53.9
5/23/2012	0.00	71.6	49.5
5/24/2012	0.00	68.1	43.5
5/25/2012	0.00	69.6	49.9
5/26/2012	0.00	52.1	32.4
5/27/2012	0.00	60.5	32.9
5/28/2012	0.00	69.1	35.1
5/29/2012	0.00	72.7	43.7
5/30/2012	0.00	78.5	47.2
5/31/2012	0.00	81.1	58.5
Month	0.00	81.1	32.4
6/1/2012	0.00	84.3	52.3
6/2/2012	0.00	82.1	54.8
6/3/2012	0.00	83.3	54.5
6/4/2012	0.00	79.1	51.2
6/5/2012	0.00	73.3	44.9
6/6/2012	0.00	71.1	36.6
6/7/2012	0.00	76.1	45.3
6/8/2012	0.00	78.2	49.7
6/9/2012	0.00	75.9	48.7
6/10/2012	0.00	71.3	42.1
6/11/2012	0.00	76.4	41.5
6/12/2012	0.00	79.7	50.5
6/13/2012	0.00	81.5	52.8
6/14/2012	0.00	80.9	54.2
6/15/2012	0.00	80.3	51.8
6/16/2012	0.00	83.1	55.4
6/17/2012	0.00	82.8	54.6
6/18/2012	0.00	82.4	56.6

6/19/2012	0.00	83.0	53.3
6/20/2012	0.00	84.8	55.5
6/21/2012	0.00	87.9	51.4
6/22/2012	0.00	83.6	52.4
6/23/2012	0.00	84.2	45.7
6/24/2012	0.00	84.7	52.2
6/25/2012	0.00	82.3	57.5
6/26/2012	0.00	82.7	52.0
6/27/2012	0.00	83.5	56.0
6/28/2012	0.00	84.7	58.8
6/29/2012	0.00	85.0	58.6
6/30/2012	0.00	87.3	57.4
Month	0.00	87.9	36.6
7/1/2012	0.00	86.1	59.7
7/2/2012	0.00	85.0	59.3
7/3/2012	0.00	84.1	58.6
7/4/2012	0.00	80.1	57.4
7/5/2012	0.04	77.1	55.2
7/6/2012	0.00	78.5	52.6
7/7/2012	0.00	81.6	63.1
7/8/2012	0.13	82.1	58.0
7/9/2012	0.00	86.9	56.6
7/10/2012	0.00	87.4	60.6
7/11/2012	0.01	89.3	60.1
7/12/2012	0.01	88.2	56.2
7/13/2012	0.09	77.6	55.9
7/14/2012	0.29	70.3	55.5
7/15/2012	0.03	75.8	54.5
7/16/2012	0.14	73.3	49.8
7/17/2012	0.03	76.2	51.7
7/18/2012	0.00	81.2	53.2
7/19/2012	0.00	78.9	57.8
7/20/2012	0.00	81.6	57.2
7/21/2012	0.00	81.1	58.5
7/22/2012	0.16	81.4	57.8
7/23/2012	0.00	80.8	58.9
7/24/2012	0.09	74.8	53.1
7/25/2012	0.14	80.6	58.0
7/26/2012	0.00	84.2	54.3
7/27/2012	0.02	79.0	60.7
7/28/2012	0.00	81.1	53.4
7/29/2012	0.50	76.8	56.2
7/30/2012	0.17	71.3	57.3
7/31/2012	0.01	74.4	51.4
Month	1.86	89.3	49.8

8/1/2012	0.15	76.3	55.1
8/2/2012	0.09	81.8	54.7
8/3/2012	0.00	82.6	58.0
8/4/2012	0.00	83.2	57.0
8/5/2012	0.00	79.3	57.2
8/6/2012	0.02	80.8	57.4
8/7/2012	0.01	81.2	56.3
8/8/2012	0.00	86.1	59.6
8/9/2012	0.23	84.5	59.6
8/10/2012	0.00	84.4	59.9
8/11/2012	0.00	83.9	56.1
8/12/2012	0.00	84.8	62.6
8/13/2012	0.00	81.5	59.0
8/14/2012	0.00	81.8	58.7
8/15/2012	0.00	81.6	60.1
8/16/2012	0.05	85.0	58.7
8/17/2012	0.01	82.3	57.2
8/18/2012	0.14	82.5	52.3
8/19/2012	0.01	84.0	57.2
8/20/2012	0.03	83.1	54.8
8/21/2012	0.00	82.2	55.6
8/22/2012	0.47	72.3	55.1
8/23/2012	0.01	67.9	52.1
8/24/2012	0.01	76.3	51.4
8/25/2012	0.00	79.5	53.3
8/26/2012	0.00	80.8	55.6
8/27/2012	0.00	80.3	58.5
8/28/2012	0.00	82.3	58.9
8/29/2012	0.00	83.8	60.7
8/30/2012	0.03	81.6	56.6
8/31/2012	0.19	75.3	53.4
Month	1.45	86.1	51.4
9/1/2012	0.01	75.9	54.8
9/2/2012	0.00	78.1	54.1
9/3/2012	0.00	80.4	55.4
9/4/2012	0.01	60.5	32.9
9/5/2012	0.00	69.1	35.1
9/6/2012	0.00	79.3	53.4
9/7/2012	0.00	77.8	53.7
9/8/2012	0.00	80.1	51.8
9/9/2012	0.00	78.8	48.8
9/10/2012	0.00	74.6	52.9
9/11/2012	1.48	60.6	53.5
9/12/2012	0.00	71.0	50.7

9/13/2012	0.00	75.2	45.0
9/14/2012	0.00	74.2	46.9
9/15/2012	0.00	77.7	49.7
9/16/2012	0.00	75.1	44.5
9/17/2012	0.00	75.1	48.7
9/18/2012	0.00	77.4	39.6
9/19/2012	0.00	78.2	46.2
9/20/2012	0.00	78.6	49.9
9/21/2012	0.00	78.9	42.1
9/22/2012	0.00	76.8	50.9
9/23/2012	0.00	73.5	56.1
9/24/2012	0.13	68.5	47.5
9/25/2012	0.20	66.6	46.0
9/26/2012	0.00	65.9	40.9
9/27/2012	0.00	69.2	42.2
9/28/2012	0.00	69.8	44.8
9/29/2012	0.00	73.8	46.4
9/30/2012	0.00	75.2	41.0
Month	1.83	80.4	32.9
10/1/2012	0.00	77.8	42.6
10/2/2012	0.00	78.9	37.0
10/3/2012	0.00	77.0	51.9
10/4/2012	0.00	72.8	50.0
10/5/2012	0.00	70.9	45.0
10/6/2012	0.00	68.8	39.5
10/7/2012	0.00	68.7	43.3
10/8/2012	0.00	66.6	43.3
10/9/2012	0.00	69.0	43.9
10/10/2012	0.00	67.5	47.8
10/11/2012	0.04	55.6	44.0
10/12/2012	0.56	51.0	33.7
10/13/2012	0.04	60.9	35.0
10/14/2012	0.00	65.1	34.6
10/15/2012	0.00	68.3	40.8
10/16/2012	0.00	75.7	40.7
10/17/2012	0.00	64.1	45.3
10/18/2012	0.00	70.9	31.9
10/19/2012	0.00	72.0	35.2
10/20/2012	0.00	67.2	44.1
10/21/2012	0.00	61.3	38.8
10/22/2012	0.00	59.1	45.7
10/23/2012	0.00	59.1	35.2
10/24/2012	0.00	49.3	29.1
10/25/2012	0.00	50.1	23.2
10/26/2012	0.00	49.2	20.8

10/27/2012	0.00	62.5	28.3
10/28/2012	0.00	65.3	35.2
10/29/2012	0.00	66.5	41.0
10/30/2012	0.00	67.9	39.0
10/31/2012	0.00	67.8	39.1
Month	0.64	78.9	20.8
11/1/2012	0.00	58.9	37.0
11/2/2012	0.00	62.6	37.0
11/3/2012	0.00	63.4	35.7
11/4/2012	0.00	66.2	30.5
11/5/2012	0.00	68.7	39.4
11/6/2012	0.00	70.3	34.1
11/7/2012	0.00	66.1	43.2
11/8/2012	0.02	59.3	37.3
11/9/2012	0.38	43.7	27.8
11/10/2012	0.21	27.1	12.5
11/11/2012	0.01	30.0	4.4
11/12/2012	0.01	44.6	12.3
11/13/2012	0.00	51.0	21.9
11/14/2012	0.00	55.5	28.8
11/15/2012	0.00	55.5	30.8
11/16/2012	0.00	48.1	36.1
11/17/2012	0.00	49.3	36.8
11/18/2012	0.00	50.0	34.5
11/19/2012	0.00	52.4	30.4
11/20/2012	0.00	57.1	31.3
11/21/2012	0.00	56.6	31.1
11/22/2012	0.00	59.6	24.9
11/23/2012	0.00	59.8	22.4
11/24/2012	0.00	61.4	35.2
11/25/2012	0.00	57.9	35.7
11/26/2012	0.00	58.0	25.5
11/27/2012	0.00	57.8	31.8
11/28/2012	0.00	57.1	28.8
11/29/2012	0.00	49.1	31.9
11/30/2012	0.00	46.9	39.2
Month	0.63	70.3	4.4
12/1/2012	0.00	47.1	35.3
12/2/2012	0.00	47.1	36.8
12/3/2012	0.00	50.9	29.8
12/4/2012	0.00	55.8	32.6
12/5/2012	0.00	55.9	32.9
12/6/2012	0.00	53.6	33.2
12/7/2012	0.00	48.8	28.8

12/8/2012	0.00	51.4	24.2
12/9/2012	0.00	32.2	17.7
12/10/2012	0.00	44.4	15.3
12/11/2012	0.00	43.8	24.0
12/12/2012	0.00	43.9	22.0
12/13/2012	0.01	41.3	34.3
12/14/2012	0.31	37.9	24.4
12/15/2012	0.30	31.2	21.3
12/16/2012	0.22	29.9	17.5
12/17/2012	0.03	32.6	20.5
12/18/2012	0.22	45.2	28.1
12/19/2012	0.05	32.3	22.0
12/20/2012	0.33	29.9	7.0
12/21/2012	0.00	36.5	10.5
12/22/2012	0.00	38.9	14.2
12/23/2012	0.00	39.5	23.9
12/24/2012	0.18	34.0	17.6
12/25/2012	0.00	31.2	12.9
12/26/2012	0.08	25.1	17.6
12/27/2012	0.02	26.7	13.9
12/28/2012	0.00	32.0	11.7
12/29/2012	0.00	27.9	10.3
12/30/2012	0.00	29.5	8.7
12/31/2012	0.00		
Month	1.75	55.9	7.0

Appendix 7-6 Climate data for Coal Hollow Weather Station, 2013

Date	Measured Precipitation* (inches)	Maximum Temperature (^{o}F)	Minimum Temperature (^{o}F)
1/1/2013	0.00	25.6	6.7
1/2/2013	0.00	36.5	8.0
1/3/2013	0.00	34.5	6.9
1/4/2013	0.00	39.6	7.6
1/5/2013	0.00	43.1	9.3
1/6/2013	0.00	37.3	14.6
1/7/2013	0.00	42.1	18.7
1/8/2013	0.00	40.2	26.4
1/9/2013	0.00	44.8	20.4
1/10/2013	0.00	36.7	19.2
1/11/2013	0.09	18.0	0.7
1/12/2013	0.00	17.3	-5.5
1/13/2013	0.00	12.6	-4.0
1/14/2013	0.00	11.6	-4.8
1/15/2013	0.00	26.1	3.4
1/16/2013	0.00	41.8	17.2
1/17/2013	0.00	44.1	15.6
1/18/2013	0.00	45.2	17.5
1/19/2013	0.00	49.3	17.3
1/20/2013	0.00	49.7	19.5
1/21/2013	0.00	52.8	16.3
1/22/2013	0.00	54.0	25.5
1/23/2013	0.00	49.4	32.4
1/24/2013	0.07	43.5	33.9
1/25/2013	0.01	41.9	34.0
1/26/2013	0.42	38.7	32.7
1/27/2013	0.14	40.1	27.7
1/28/2013	0.13	27.7	12.5
1/29/2013	0.09	26.3	2.5
1/30/2013	0.16	38.8	20.4
1/31/2013	0.00	47.8	21.1
Month	1.11	54.0	-5.5
2/1/2013	0.00	50.1	22.2
2/2/2013	0.00	49.0	19.6
2/3/2013	0.00	45.9	25.4
2/4/2013	0.00	53.1	19.2
2/5/2013	0.00	54.0	23.9
2/6/2013	0.00	48.8	29.7
2/7/2013	0.00	46.3	21.0
2/8/2013	0.00	36.3	20.5
2/9/2013	0.02	30.8	18.9

2/10/2013	0.09	27.2	15.1
2/11/2013	0.00	29.1	12.7
2/12/2013	0.00	36.4	12.5
2/13/2013	0.00	43.4	23.2
2/14/2013	0.00	40.3	25.1
2/15/2013	0.00	48.3	24.6
2/16/2013	0.00	57.4	21.2
2/17/2013	0.00	49.3	28.5
2/18/2013	0.00	45.1	12.2
2/19/2013	0.00	45.5	22.5
2/20/2013	0.12	37.4	20.6
2/21/2013	0.01	33.8	18.4
2/22/2013	0.00	33.8	16.5
2/23/2013	0.00	37.9	16.1
2/24/2013	0.00	27.3	14.5
2/25/2013	0.00	43.8	13.1
2/26/2013	0.01	30.5	16.8
2/27/2013	0.00	38.7	7.2
2/28/2013	0.00	47.1	13.0
Month	0.25	57.4	7.2
3/1/2013	0.00	53.7	27.2
3/2/2013	0.00	60.4	25.2
3/3/2013	0.00	55.4	35.0
3/4/2013	0.00	47.4	27.2
3/5/2013	0.00	54.2	21.2
3/6/2013	0.00	53.6	32.8
3/7/2013	0.00	52.7	29.0
3/8/2013	0.60	35.1	25.7
3/9/2013	0.44	33.0	23.0
3/10/2013	0.00	43.3	15.7
3/11/2013	0.00	50.1	19.1
3/12/2013	0.00	58.0	28.7
3/13/2013	0.00	64.0	26.4
3/14/2013	0.00	70.1	36.3
3/15/2013	0.00	67.4	44.4
3/16/2013	0.00	60.7	40.9
3/17/2013	0.00	55.7	32.4
3/18/2013	0.00	57.3	28.5
3/19/2013	0.00	54.4	34.8
3/20/2013	0.00	56.6	33.7
3/21/2013	0.00	52.4	31.8
3/22/2013	0.00	50.8	26.8
3/23/2013	0.00	37.6	15.7
3/24/2013	0.00	47.3	16.1
3/25/2013	0.00	55.0	20.2

3/26/2013	0.00	56.2	27.9
3/27/2013	0.00	60.2	35.0
3/28/2013	0.00	60.9	34.9
3/29/2013	0.00	64.1	35.6
3/30/2013	0.00	61.8	36.7
3/31/2013	0.01	62.5	31.9
Month	1.05	70.1	15.7
4/1/2013	0.00	55.3	31.3
4/2/2013	0.00	50.1	28.5
4/3/2013	0.00	62.9	27.3
4/4/2013	0.00	64.0	34.9
4/5/2013	0.00	64.2	39.0
4/6/2013	0.00	63.1	38.8
4/7/2013	0.00	62.6	36.8
4/8/2013	0.07	47.9	30.6
4/9/2013	0.07	34.2	25.1
4/10/2013	0.00	48.1	23.9
4/11/2013	0.00	54.7	29.7
4/12/2013	0.00	62.2	25.4
4/13/2013	0.00	62.2	37.8
4/14/2013	0.00	61.2	40.5
4/15/2013	0.00	56.8	44.0
4/16/2013	0.04	45.2	26.7
4/17/2013	0.00	36.9	23.4
4/18/2013	0.00	44.6	18.2
4/19/2013	0.00	57.2	18.2
4/20/2013	0.00	56.7	31.1
4/21/2013	0.00	65.0	32.7
4/22/2013	0.00	68.2	38.9
4/23/2013	0.00	54.4	29.8
4/24/2013	0.00	61.5	27.1
4/25/2013	0.00	63.8	27.5
4/26/2013	0.00	66.0	34.5
4/27/2013	0.00	70.0	31.7
4/28/2013	0.00	74.9	35.3
4/29/2013	0.00	76.2	45.1
4/30/2013	0.00	72.1	47.6
Month	0.18	76.2	18.2
5/1/2013	0.00	53.2	32.8
5/2/2013	0.00	60.2	25.4
5/3/2013	0.00	67.2	31.3
5/4/2013	0.00	68.3	41.5
5/5/2013	0.00	62.4	42.5
5/6/2013	0.05	56.2	36.8

5/7/2013	0.17	53.0	33.3
5/8/2013	0.04	54.4	32.0
5/9/2013	0.23	51.1	37.0
5/10/2013	0.01	63.2	33.9
5/11/2013	0.04	67.4	44.9
5/12/2013	0.00	76.0	46.3
5/13/2013	0.00	79.1	48.2
5/14/2013	0.00	79.1	53.4
5/15/2013	0.00	71.1	49.9
5/16/2013	0.00	72.2	47.9
5/17/2013	0.00	62.3	44.8
5/18/2013	0.00	61.9	38.3
5/19/2013	0.00	58.8	36.6
5/20/2013	0.00	61.8	39.9
5/21/2013	0.00	68.9	32.7
5/22/2013	0.00	73.3	42.7
5/23/2013	0.00	71.6	47.2
5/24/2013	0.00	71.3	41.6
5/25/2013	0.00	71.8	42.1
5/26/2013	0.00	71.9	41.6
5/27/2013	0.00	72.6	45.2
5/28/2013	0.00	67.2	44.8
5/29/2013	0.00	65.0	34.0
5/30/2013	0.00	72.2	38.0
5/31/2013	0.00	72.7	49.8
Month	0.54	79.1	25.4
6/1/2013	0.00	75.0	40.4
6/2/2013	0.00	80.5	45.4
6/3/2013	0.00	79.6	53.8
6/4/2013	0.00	80.7	52.9
6/5/2013	0.00	80.0	46.9
6/6/2013	0.00	82.7	49.5
6/7/2013	0.00	84.9	51.1
6/8/2013	0.00	86.9	54.3
6/9/2013	0.00	88.9	51.5
6/10/2013	0.00	82.6	57.2
6/11/2013	0.00	80.3	47.5
6/12/2013	0.00	82.8	55.4
6/13/2013	0.00	80.7	56.5
6/14/2013	0.00	80.1	51.5
6/15/2013	0.00	79.8	53.3
6/16/2013	0.00	79.6	52.2
6/17/2013	0.00	81.0	52.8
6/18/2013	0.00	80.6	51.9
6/19/2013	0.00	75.6	51.9

6/20/2013	0.00	77.5	45.9
6/21/2013	0.00	78.1	47.2
6/22/2013	0.00	78.0	50.6
6/23/2013	0.00	79.0	52.9
6/24/2013	0.00	72.1	46.5
6/25/2013	0.00	79.2	48.8
6/26/2013	0.00	84.3	55.2
6/27/2013	0.00	90.2	59.6
6/28/2013	0.00	94.1	58.9
6/29/2013	0.00	91.7	60.0
6/30/2013	0.00	89.6	64.4
Month	0.00	94.1	40.4
7/1/2013	0.30	89.0	62.1
7/2/2013	0.00	91.3	61.8
7/3/2013	0.00	89.3	60.6
7/4/2013	0.06	88.0	63.9
7/5/2013	0.00	85.3	59.3
7/6/2013	0.00	83.1	55.1
7/7/2013	0.34	80.6	56.7
7/8/2013	0.00	84.8	54.4
7/9/2013	0.00	86.4	60.3
7/10/2013	0.00	90.4	61.9
7/11/2013	1.18	78.3	55.3
7/12/2013	0.22	75.3	55.1
7/13/2013	0.00	80.0	55.2
7/14/2013	0.48	79.2	56.8
7/15/2013	0.06	83.4	58.6
7/16/2013	0.30	75.5	55.3
7/17/2013	0.00	79.4	57.7
7/18/2013	0.22	79.4	59.5
7/19/2013	0.18	80.7	59.1
7/20/2013	0.26	80.9	56.4
7/21/2013	0.00	84.2	57.2
7/22/2013	0.00	82.3	58.3
7/23/2013	0.00	79.5	57.0
7/24/2013	0.00	81.4	54.2
7/25/2013	0.16	82.7	59.4
7/26/2013	0.06	86.3	59.5
7/27/2013	0.06	72.8	56.7
7/28/2013	2.06	70.0	54.2
7/29/2013	0.12	77.0	48.4
7/30/2013	0.00	80.5	55.5
7/31/2013	0.00	82.6	58.1
Month	6.06	91.3	48.4

8/1/2013	0.14	79.5	60.1
8/2/2013	0.00	80.5	57.4
8/3/2013	0.00	81.4	56.4
8/4/2013	0.00	81.4	58.9
8/5/2013	0.00	81.1	58.4
8/6/2013	0.00	80.2	58.3
8/7/2013	0.02	75.3	55.7
8/8/2013	0.00	78.9	48.1
8/9/2013	0.00	79.1	53.0
8/10/2013	0.00	75.6	54.8
8/11/2013	0.00	78.0	55.3
8/12/2013	0.00	79.3	52.1
8/13/2013	0.00	82.4	54.7
8/14/2013	0.00	84.7	55.1
8/15/2013	0.00	84.9	57.4
8/16/2013	0.00	86.3	61.0
8/17/2013	0.00	84.2	60.2
8/18/2013	0.34	83.3	55.9
8/19/2013	0.00	83.2	54.2
8/20/2013	0.00	84.4	59.8
8/21/2013	0.50	83.2	55.8
8/22/2013	0.00	76.9	55.1
8/23/2013	0.48	70.6	56.0
8/24/2013	0.70	72.2	50.3
8/25/2013	0.62	67.4	49.0
8/26/2013	1.28	68.7	54.0
8/27/2013	0.38	64.1	54.8
8/28/2013	0.00	77.8	54.7
8/29/2013	0.48	82.9	57.3
8/30/2013	2.18	80.9	56.4
8/31/2013	0.00	72.2	55.8
Month	7.12	86.3	48.1
9/1/2013	0.48	72.4	57.5
9/2/2013	0.56	75.4	56.5
9/3/2013	0.00	78.4	55.6
9/4/2013	0.98	80.6	56.0
9/5/2013	0.00	67.2	44.8
9/6/2013	0.00	65.0	34.0
9/7/2013	0.36	78.1	53.5
9/8/2013	0.60	64.7	53.8
9/9/2013	1.12	64.9	52.2
9/10/2013	1.06	63.1	51.7
9/11/2013	0.46	61.2	51.7
9/12/2013	0.06	65.0	50.1
9/13/2013	0.00	70.0	50.2

9/14/2013	0.18	68.7	48.1
9/15/2013	0.82	69.4	48.9
9/16/2013	0.00	74.6	51.4
9/17/2013	0.00	73.6	56.8
9/18/2013	0.00	72.6	50.0
9/19/2013	0.00	73.8	43.8
9/20/2013	0.00	75.0	41.3
9/21/2013	0.06	69.9	52.2
9/22/2013	0.00	57.9	40.1
9/23/2013	0.00	69.9	38.2
9/24/2013	0.00	70.7	41.6
9/25/2013	0.00	67.7	43.1
9/26/2013	0.00	59.0	31.5
9/27/2013	0.00	52.7	30.7
9/28/2013	0.00	62.6	24.6
9/29/2013	0.00	68.6	41.2
9/30/2013	0.00	69.8	45.0
Month	6.74	80.6	24.6
10/1/2013	0.00	68.8	45.8
10/2/2013	0.00	67.9	42.6
10/3/2013	0.00	62.0	33.4
10/4/2013	0.00	46.3	28.2
10/5/2013	0.00	58.9	28.5
10/6/2013	0.00	69.3	30.3
10/7/2013	0.00	67.5	40.1
10/8/2013	0.00	64.1	35.6
10/9/2013	0.04	89.0	45.8
10/10/2013	0.71	91.3	61.8
10/11/2013	0.00	89.3	60.6
10/12/2013	0.00	88.0	63.9
10/13/2013	0.04	85.3	59.3
10/14/2013	0.00	83.1	55.1
10/15/2013	0.00	80.6	56.7
10/16/2013	0.00	84.8	54.4
10/17/2013	0.00	86.4	60.3
10/18/2013	0.00	90.4	61.9
10/19/2013	0.00	78.3	55.3
10/20/2013	0.00	75.3	55.1
10/21/2013	0.00	80.0	55.2
10/22/2013	0.00	79.2	56.8
10/23/2013	0.00	83.4	58.6
10/24/2013	0.00	75.5	55.3
10/25/2013	0.01	79.4	57.7
10/26/2013	0.00	79.4	59.5
10/27/2013	0.00	80.7	59.1

10/28/2013	0.35	80.9	56.4
10/29/2013	0.63	84.2	57.2
10/30/2013	0.63	82.3	58.3
10/31/2013	0.00	79.5	57.0
Month	2.41	91.3	28.2
11/1/2013	0.00	81.4	54.2
11/2/2013	0.00	82.7	59.4
11/3/2013	0.00	86.3	59.5
11/4/2013	0.04	72.8	56.7
11/5/2013	0.00	70.0	54.2
11/6/2013	0.00	77.0	48.4
11/7/2013	0.00	80.5	55.5
11/8/2013	0.00	82.6	58.1
11/9/2013	0.00	79.5	60.1
11/10/2013	0.50	80.5	57.4
11/11/2013	0.00	81.4	56.4
11/12/2013	0.00	81.4	58.9
11/13/2013	0.00	81.1	58.4
11/14/2013	0.00	80.2	58.3
11/15/2013	0.00	75.3	55.7
11/16/2013	0.00	78.9	48.1
11/17/2013	0.00	79.1	53.0
11/18/2013	0.00	75.6	54.8
11/19/2013	0.00	78.0	55.3
11/20/2013	0.50	79.3	52.1
11/21/2013	0.60	82.4	54.7
11/22/2013	0.03	84.7	55.1
11/23/2013	0.19	84.9	57.4
11/24/2013	0.14	86.3	61.0
11/25/2013	0.00	84.2	60.2
11/26/2013	0.00	83.3	55.9
11/27/2013	0.00	83.2	54.2
11/28/2013	0.00	84.4	59.8
11/29/2013	0.00	83.2	55.8
11/30/2013	0.00	76.9	55.1
Month	2.00	86.3	48.1
12/1/2013	0.00	70.6	56.0
12/2/2013	0.00	72.2	50.3
12/3/2013	0.02	67.4	49.0
12/4/2013	0.00	68.7	54.0
12/5/2013	0.15	64.1	54.8
12/6/2013	0.03	77.8	54.7
12/7/2013	0.00	82.9	57.3
12/8/2013	0.08	80.9	56.4

12/9/2013	0.02	72.2	55.8
12/10/2013	0.19	72.4	57.5
12/11/2013	0.00	75.4	56.5
12/12/2013	0.00	78.4	55.6
12/13/2013	0.00	80.6	56.0
12/14/2013	0.00	79.8	56.7
12/15/2013	0.00	77.6	58.4
12/16/2013	0.00	78.1	53.5
12/17/2013	0.00	64.7	53.8
12/18/2013	0.00	64.9	52.2
12/19/2013	0.00	40.4	17.2
12/20/2013	0.00	63.1	51.7
12/21/2013	0.00	65.0	50.1
12/22/2013	0.00	70.0	50.2
12/23/2013	0.00	68.7	48.1
12/24/2013	0.00	69.4	48.9
12/25/2013	0.00	74.6	51.4
12/26/2013	0.00	73.6	56.8
12/27/2013	0.00	72.6	50.0
12/28/2013	0.00	73.8	43.8
12/29/2013	0.00	75.0	41.3
12/30/2013	0.00	69.9	52.2
12/31/2013	0.00	57.9	40.1
Month	0.49	82.9	17.2

Appendix 7-6 Climate data for Coal Hollow Weather Station, 2014

Date	Measured Precipitation* (inches)	Maximum Temperature (^{o}F)	Minimum Temperature (^{o}F)
1/1/2014	0.00	49.2	25.9
1/2/2014	0.00	55.2	25.2
1/3/2014	0.00	51.5	29.0
1/4/2014	0.00	40.7	20.8
1/5/2014	0.00	33.6	20.0
1/6/2014	0.00	48.7	14.5
1/7/2014	0.00	48.3	24.2
1/8/2014	0.00	47.6	26.8
1/9/2014	0.00	44.4	22.7
1/10/2014	0.00	48.7	21.8
1/11/2014	0.00	52.5	27.5
1/12/2014	0.00	38.6	28.4
1/13/2014	0.00	47.6	19.5
1/14/2014	0.00	48.1	24.3
1/15/2014	0.00	53.4	27.7
1/16/2014	0.00	50.3	33.9
1/17/2014	0.00	55.9	19.8
1/18/2014	0.00	57.0	30.0
1/19/2014	0.00	57.4	29.4
1/20/2014	0.00	57.3	21.5
1/21/2014	0.00	56.4	22.4
1/22/2014	0.00	52.7	25.0
1/23/2014	0.00	45.6	24.4
1/24/2014	0.00	50.1	15.2
1/25/2014	0.00	53.3	25.8
1/26/2014	0.00	54.6	22.4
1/27/2014	0.00	52.4	21.2
1/28/2014	0.00	49.5	26.7
1/29/2014	0.00	51.5	22.6
1/30/2014	0.06	45.6	32.2
1/31/2014	0.54	35.4	24.3
Month	0.60	57.4	14.5
2/1/2014	0.02	27.4	14.6
2/2/2014	0.00	32.3	6.6
2/3/2014	0.06	32.3	17.7
2/4/2014	0.02	29.1	14.0
2/5/2014	0.00	33.5	13.6
2/6/2014	0.00	34.5	16.9
2/7/2014	0.08	34.4	26.6
2/8/2014	0.00	41.0	30.1
2/9/2014	0.00	47.7	30.8

2/10/2014	0.00	47.4	31.0
2/11/2014	0.00	47.5	22.8
2/12/2014	0.00	52.3	26.6
2/13/2014	0.00	60.2	33.3
2/14/2014	0.00	60.8	33.5
2/15/2014	0.00	55.9	39.5
2/16/2014	0.00	56.7	33.4
2/17/2014	0.00	57.6	29.7
2/18/2014	0.00	56.7	31.5
2/19/2014	0.00	51.3	26.7
2/20/2014	0.00	43.7	19.6
2/21/2014	0.00	51.7	NA
2/22/2014	0.00	54.8	29.2
2/23/2014	0.00	55.7	27.0
2/24/2014	0.00	58.7	29.6
2/25/2014	0.00	57.8	33.4
2/26/2014	0.00	57.6	31.4
2/27/2014	0.33	40.5	29.7
2/28/2014	0.50	41.3	29.3
Month	2.15	60.8	6.6
3/1/2014	0.43	42.9	28.5
3/2/2014	0.01	48.4	25.2
3/3/2014	0.00	54.3	25.1
3/4/2014	0.00	50.4	33.3
3/5/2014	0.00	54.0	25.6
3/6/2014	0.00	56.4	34.9
3/7/2014	0.00	45.7	31.6
3/8/2014	0.00	52.9	26.2
3/9/2014	0.00	61.0	25.6
3/10/2014	0.00	58.2	36.5
3/11/2014	0.00	42.2	25.8
3/12/2014	0.00	46.9	23.0
3/13/2014	0.00	50.0	27.3
3/14/2014	0.00	58.9	32.3
3/15/2014	0.00	51.2	31.1
3/16/2014	0.00	65.1	33.3
3/17/2014	0.00	59.2	26.9
3/18/2014	0.00	44.6	20.0
3/19/2014	0.00	53.5	17.8
3/20/2014	0.00	56.1	28.9
3/21/2014	0.00	57.9	33.1
3/22/2014	0.00	52.5	33.7
3/23/2014	0.00	58.0	23.2
3/24/2014	0.00	63.0	22.4
3/25/2014	0.00	64.4	29.2

3/26/2014	0.05	50.6	24.5
3/27/2014	0.13	44.7	25.4
3/28/2014	0.00	52.7	25.1
3/29/2014	0.00	57.1	30.9
3/30/2014	0.27	45.0	25.6
3/31/2014	0.00	50.1	23.2
Month	0.89	65.1	17.8
4/1/2014	0.01	44.8	32.5
4/2/2014	0.11	37.3	21.8
4/3/2014	0.06	46.8	16.9
4/4/2014	0.00	47.1	26.9
4/5/2014	0.00	47.4	29.4
4/6/2014	0.00	53.2	31.5
4/7/2014	0.00	64.8	36.1
4/8/2014	0.00	70.2	27.7
4/9/2014	0.00	66.7	42.7
4/10/2014	0.00	71.3	41.8
4/11/2014	0.00	69.5	44.2
4/12/2014	0.00	64.9	42.7
4/13/2014	0.00	52.3	34.6
4/14/2014	0.00	57.9	29.0
4/15/2014	0.00	63.7	30.7
4/16/2014	0.00	59.8	34.6
4/17/2014	0.00	69.0	34.5
4/18/2014	0.00	64.5	41.1
4/19/2014	0.38	57.5	37.3
4/20/2014	0.09	67.0	41.0
4/21/2014	0.00	69.0	42.5
4/22/2014	0.00	62.7	46.6
4/23/2014	0.00	56.2	31.6
4/24/2014	0.00	64.4	27.6
4/25/2014	0.00	62.3	36.0
4/26/2014	0.63	48.7	32.2
4/27/2014	0.01	50.8	25.7
4/28/2014	0.00	48.4	33.5
4/29/2014	0.00	52.0	23.7
4/30/2014	0.00	55.5	27.8
Month	1.29	71.3	16.9
5/1/2014	0.00	65.8	29.9
5/2/2014	0.00	73.5	34.5
5/3/2014	0.00	73.4	46.7
5/4/2014	0.00	71.4	40.7
5/5/2014	0.00	69.1	40.8
5/6/2014	0.01	59.6	37.5

5/7/2014	0.17	43.2	31.6
5/8/2014	0.14	56.4	26.2
5/9/2014	0.00	63.1	36.8
5/10/2014	0.14	65.3	36.9
5/11/2014	0.11	42.5	30.4
5/12/2014	0.00	51.7	29.4
5/13/2014	0.00	57.5	23.7
5/14/2014	0.00	65.5	30.8
5/15/2014	0.00	74.4	42.1
5/16/2014	0.00	74.3	50.4
5/17/2014	0.00	76.8	50.0
5/18/2014	0.00	74.4	50.2
5/19/2014	0.00	70.3	40.3
5/20/2014	0.00	65.3	42.8
5/21/2014	0.00	65.6	37.8
5/22/2014	0.00	67.0	36.8
5/23/2014	0.05	54.6	36.9
5/24/2014	0.00	60.6	34.7
5/25/2014	0.00	72.2	33.5
5/26/2014	0.00	80.8	44.1
5/27/2014	0.00	81.9	52.9
5/28/2014	0.00	79.0	55.3
5/29/2014	0.00	72.6	54.3
5/30/2014	0.00	77.3	48.5
5/31/2014	0.00	77.6	49.2
Month	0.62	81.9	23.7
6/1/2014	0.00	77.0	47.9
6/2/2014	0.00	80.1	47.5
6/3/2014	0.00	77.0	43.2
6/4/2014	0.00	79.0	49.6
6/5/2014	0.00	81.9	38.2
6/6/2014	0.00	82.6	40.4
6/7/2014	0.00	79.9	48.3
6/8/2014	0.00	77.4	50.9
6/9/2014	0.00	80.8	45.6
6/10/2014	0.00	83.0	54.3
6/11/2014	0.00	79.4	49.1
6/12/2014	0.00	81.1	53.2
6/13/2014	0.00	77.1	47.2
6/14/2014	0.00	72.1	45.7
6/15/2014	0.00	75.6	46.1
6/16/2014	0.00	72.4	50.9
6/17/2014	0.00	72.5	43.3
6/18/2014	0.00	69.1	40.9
6/19/2014	0.00	77.3	33.8

6/20/2014	0.00	80.5	50.4
6/21/2014	0.00	79.4	54.8
6/22/2014	0.00	81.4	53.1
6/23/2014	0.00	83.0	53.9
6/24/2014	0.00	82.6	55.6
6/25/2014	0.00	82.7	53.8
6/26/2014	0.00	73.8	50.6
6/27/2014	0.00	77.4	47.5
6/28/2014	0.00	82.7	48.3
6/29/2014	0.00	86.6	58.7
6/30/2014	0.00	89.5	60.0
Month	0.00	89.5	33.8
7/1/2014	0.00	87.4	59.1
7/2/2014	0.00	83.8	60.6
7/3/2014	0.00	86.3	58.6
7/4/2014	0.09	83.3	57.0
7/5/2014	0.00	81.2	55.7
7/6/2014	0.00	83.0	58.3
7/7/2014	0.01	86.3	55.7
7/8/2014	0.14	84.4	57.4
7/9/2014	0.23	81.1	52.7
7/10/2014	0.37	74.6	56.8
7/11/2014	0.00	80.9	50.8
7/12/2014	0.00	88.1	55.5
7/13/2014	0.12	86.6	63.2
7/14/2014	0.00	85.8	59.8
7/15/2014	0.00	81.0	60.0
7/16/2014	0.00	85.0	56.7
7/17/2014	0.00	83.8	55.4
7/18/2014	0.01	83.4	60.1
7/19/2014	0.00	85.6	57.0
7/20/2014	0.00	83.0	58.0
7/21/2014	0.00	82.6	53.8
7/22/2014	0.00	89.2	58.4
7/23/2014	0.00	91.0	63.9
7/24/2014	0.00	87.1	63.1
7/25/2014	0.00	83.6	62.2
7/26/2014	0.00	80.0	59.1
7/27/2014	0.00	86.3	58.0
7/28/2014	0.04	77.9	57.9
7/29/2014	0.00	79.4	56.5
7/30/2014	0.74	80.0	54.9
7/31/2014	0.02	79.7	55.6
Month	1.77	91.0	50.8

8/1/2014	0.44	77.5	53.2
8/2/2014	0.02	79.6	55.7
8/3/2014	0.52	65.8	54.8
8/4/2014	0.63	71.8	53.3
8/5/2014	0.00	75.2	54.8
8/6/2014	0.00	78.3	54.2
8/7/2014	0.00	79.2	53.7
8/8/2014	0.00	80.2	52.4
8/9/2014	0.00	82.4	54.2
8/10/2014	0.00	82.1	53.8
8/11/2014	0.00	81.6	58.0
8/12/2014	0.43	69.3	55.6
8/13/2014	0.31	65.1	55.0
8/14/2014	0.00	75.3	54.6
8/15/2014	0.00	79.5	56.1
8/16/2014	0.00	83.0	55.9
8/17/2014	0.00	84.5	58.1
8/18/2014	0.00	83.8	58.9
8/19/2014	0.64	62.4	51.1
8/20/2014	0.00	71.8	49.4
8/21/2014	0.97	73.1	52.0
8/22/2014	0.00	71.9	48.0
8/23/2014	0.00	72.0	50.2
8/24/2014	0.00	74.8	51.2
8/25/2014	0.00	73.3	48.8
8/26/2014	0.97	65.1	47.2
8/27/2014	0.27	71.2	44.8
8/28/2014	0.00	77.8	46.8
8/29/2014	0.00	81.3	51.9
8/30/2014	0.00	78.4	56.5
8/31/2014	0.00	78.8	53.8
Month	5.20	84.5	44.8
9/1/2014	0.00	80.7	54.9
9/2/2014	0.00	81.4	57.3
9/3/2014	0.00	79.8	53.9
9/4/2014	0.00	74.2	54.1
9/5/2014	0.00	79.0	55.3
9/6/2014	0.00	72.6	54.3
9/7/2014	0.00	79.1	55.6
9/8/2014	1.05	73.5	54.8
9/9/2014	1.60	66.2	47.8
9/10/2014	0.00	73.1	40.9
9/11/2014	0.00	75.7	49.9
9/12/2014	0.00	78.2	46.5
9/13/2014	0.00	78.9	48.2

9/14/2014	0.00	78.4	55.7
9/15/2014	0.00	81.4	54.5
9/16/2014	0.00	80.7	54.5
9/17/2014	0.00	77.1	56.8
9/18/2014	0.00	78.4	54.1
9/19/2014	0.00	80.7	55.7
9/20/2014	0.00	79.4	54.6
9/21/2014	0.65	72.2	51.3
9/22/2014	0.00	72.0	50.4
9/23/2014	0.00	75.8	47.3
9/24/2014	0.00	79.0	51.7
9/25/2014	0.00	76.4	53.1
9/26/2014	0.00	75.0	51.4
9/27/2014	1.58	61.2	39.7
9/28/2014	0.03	56.8	39.4
9/29/2014	0.07	57.9	38.8
9/30/2014	0.00	65.2	40.1
Month	4.98	81.4	38.8
10/1/2014	0.00	58.1	39.5
10/2/2014	0.00	64.6	29.0
10/3/2014	0.00	71.8	33.9
10/4/2014	0.00	73.1	35.2
10/5/2014	0.00	71.5	35.1
10/6/2014	0.00	74.6	38.6
10/7/2014	0.00	67.1	41.0
10/8/2014	0.00	64.9	49.8
10/9/2014	0.00	68.1	43.8
10/10/2014	0.00	69.9	39.3
10/11/2014	0.00	69.0	43.0
10/12/2014	0.00	55.3	36.0
10/13/2014	0.00	64.1	30.4
10/14/2014	0.00	68.0	36.6
10/15/2014	0.00	68.1	45.0
10/16/2014	0.00	67.3	42.4
10/17/2014	0.00	66.5	41.5
10/18/2014	0.00	67.8	45.5
10/19/2014	0.00	70.5	35.4
10/20/2014	0.00	66.1	43.2
10/21/2014	0.00	64.8	44.1
10/22/2014	0.00	65.3	41.8
10/23/2014	0.00	69.1	38.6
10/24/2014	0.00	73.0	46.3
10/25/2014	0.00	67.2	43.3
10/26/2014	0.00	62.2	40.6
10/27/2014	0.00	59.1	35.4

10/28/2014	0.00	64.5	30.6
10/29/2014	0.00	69.0	34.8
10/30/2014	0.00	66.6	38.6
10/31/2014	0.00	67.0	48.7
Month	0.00	74.6	29.0
11/1/2014	0.03	55.9	38.2
11/2/2014	0.06	44.7	30.2
11/3/2014	0.00	41.4	26.6
11/4/2014	0.00	57.2	22.0
11/5/2014	0.00	62.3	28.0
11/6/2014	0.00	65.4	28.5
11/7/2014	0.00	68.2	33.6
11/8/2014	0.00	64.5	33.2
11/9/2014	0.00	65.0	37.1
11/10/2014	0.00	59.7	30.3
11/11/2014	1.27	57.9	28.2
11/12/2014	0.00	54.2	28.7
11/13/2014	0.00	50.3	33.4
11/14/2014	0.09	48.2	33.9
11/15/2014	0.01	48.9	27.2
11/16/2014	0.00	31.6	13.1
11/17/2014	0.00	46.1	10.5
11/18/2014	0.00	52.7	14.1
11/19/2014	0.00	52.5	29.3
11/20/2014	0.00	52.2	30.3
11/21/2014	0.00	52.3	29.8
11/22/2014	0.00	49.4	30.9
11/23/2014	0.00	38.4	25.0
11/24/2014	0.00	38.1	12.7
11/25/2014	0.00	48.4	14.2
11/26/2014	0.00	60.5	26.8
11/27/2014	0.00	65.2	34.5
11/28/2014	0.00	59.8	36.4
11/29/2014	0.00	54.0	31.9
11/30/2014	0.00	49.6	30.0
Month	1.46	68.2	10.5
12/1/2014	0.00	52.8	28.7
12/2/2014	0.01	51.9	31.3
12/3/2014	0.16	42.5	32.2
12/4/2014	0.35	45.1	33.3
12/5/2014	0.01	46.8	31.7
12/6/2014	0.00	48.8	33.9
12/7/2014	0.00	52.6	28.7
12/8/2014	0.00	50.5	30.8

12/9/2014	0.00	54.8	28.7
12/10/2014	0.00	53.7	29.5
12/11/2014	0.00	48.9	27.8
12/12/2014	0.27	46.6	28.2
12/13/2014	0.56	34.8	24.4
12/14/2014	0.03	32.0	15.6
12/15/2014	0.00	35.6	13.6
12/16/2014	0.01	40.0	25.6
12/17/2014	0.20	32.7	24.7
12/18/2014	0.09	37.4	18.7
12/19/2014	0.00	52.3	33.9
12/20/2014	0.00	40.0	19.4
12/21/2014	0.00	45.9	22.2
12/22/2014	0.02	49.7	29.3
12/23/2014	0.00	36.6	23.1
12/24/2014	0.00	40.1	17.0
12/25/2014	0.10	31.2	18.4
12/26/2014	0.01	25.0	14.9
12/27/2014	0.00	30.9	11.9
12/28/2014	0.00	36.4	12.2
12/29/2014	0.00	31.2	9.6
12/30/2014	0.00	24.1	8.5
12/31/2014	0.00	25.1	10.2
Month	1.82	54.8	8.5

Appendix 7-6 Climate data for Coal Hollow Weather Station, 2015

Date	Measured Precipitation* (inches)	Maximum Temperature (^{o}F)	Minimum Temperature (^{o}F)
1/1/2015	0.06	29.7	7.7
1/2/2015	0.01	36.8	5.1
1/3/2015	0.00	44.8	16.0
1/4/2015	0.00	47.0	15.7
1/5/2015	0.00	55.9	25.3
1/6/2015	0.00	58.1	29.3
1/7/2015	0.00	62.3	32.9
1/8/2015	0.00	57.8	32.7
1/9/2015	0.00	53.9	30.5
1/10/2015	0.13	46.4	31.6
1/11/2015	0.10	44.6	33.1
1/12/2015	0.09	36.9	31.2
1/13/2015	0.17	32.9	25.9
1/14/2015	0.00	43.0	20.7
1/15/2015	0.00	50.9	16.6
1/16/2015	0.00	50.2	26.2
1/17/2015	0.00	51.0	26.3
1/18/2015	0.00	58.3	29.5
1/19/2015	0.00	51.1	27.1
1/20/2015	0.00	46.1	26.0
1/21/2015	0.00	39.0	23.7
1/22/2015	0.00	41.5	13.8
1/23/2015	0.00	43.8	18.6
1/24/2015	0.00	53.6	27.9
1/25/2015	0.00	57.6	32.1
1/26/2015	0.00	56.8	29.4
1/27/2015	0.14	47.6	32.3
1/28/2015	0.00	50.4	29.1
1/29/2015	0.00	46.8	31.1
1/30/2015	0.27	36.9	31.7
1/31/2015	0.23	41.2	29.8
Month	1.20	62.3	5.1
2/1/2015	0.00	51.8	24.2
2/2/2015	0.00	56.0	31.7
2/3/2015	0.00	55.4	33.7
2/4/2015	0.00	57.6	33.7
2/5/2015	0.00	61.0	35.4
2/6/2015	0.00	60.6	34.5
2/7/2015	0.00	58.2	32.1
2/8/2015	0.00	59.6	34.5
2/9/2015	0.00	59.3	36.2

2/10/2015	0.00	51.6	30.7
2/11/2015	0.00	55.0	26.5
2/12/2015	0.00	60.9	27.3
2/13/2015	0.00	64.2	33.1
2/14/2015	0.00	65.6	34.7
2/15/2015	0.00	56.8	24.0
2/16/2015	0.00	50.1	18.5
2/17/2015	0.00	52.1	18.2
2/18/2015	0.00	63.8	20.4
2/19/2015	0.00	61.6	31.1
2/20/2015	0.00	58.1	31.9
2/21/2015	0.00	45.6	19.8
2/22/2015	0.43	31.6	24.9
2/23/2015	0.51	35.0	17.8
2/24/2015	0.01	35.2	16.9
2/25/2015	0.00	43.7	19.8
2/26/2015	0.00	43.5	25.2
2/27/2015	0.00	36.9	20.7
2/28/2015	0.43	35.1	26.2
Month	1.38	65.6	16.9
3/1/2015	0.36	34.3	24.8
3/2/2015	0.78	33.5	26.0
3/3/2015	0.40	32.8	17.2
3/4/2015	0.05	31.0	15.4
3/5/2015	0.00	48.2	11.0
3/6/2015	0.00	50.7	18.8
3/7/2015	0.00	54.8	23.2
3/8/2015	0.00	52.3	28.1
3/9/2015	0.00	50.2	25.7
3/10/2015	0.00	59.2	22.7
3/11/2015	0.00	53.7	34.7
3/12/2015	0.00	49.4	36.0
3/13/2015	0.00	56.2	36.3
3/14/2015	0.00	60.8	32.6
3/15/2015	0.00	65.1	37.7
3/16/2015	0.00	65.8	36.4
3/17/2015	0.00	64.5	40.6
3/18/2015	1.28	57.1	40.9
3/19/2015	0.00	58.1	33.5
3/20/2015	0.00	64.3	29.5
3/21/2015	0.00	63.4	36.2
3/22/2015	0.00	60.5	37.9
3/23/2015	0.00	58.5	32.1
3/24/2015	0.00	59.8	32.9
3/25/2015	0.00	52.8	34.2

3/26/2015	0.00	64.8	36.1
3/27/2015	0.00	70.2	31.4
3/28/2015	0.00	70.4	41.8
3/29/2015	0.00	69.8	36.3
3/30/2015	0.00	70.2	41.7
3/31/2015	0.00	67.0	43.5
Month	2.87	70.4	11.0
4/1/2015	0.00	61.6	34.8
4/2/2015	0.00	50.8	19.7
4/3/2015	0.00	54.2	15.1
4/4/2015	0.00	61.8	26.1
4/5/2015	0.00	61.5	32.1
4/6/2015	0.00	58.2	31.6
4/7/2015	0.00	55.4	30.0
4/8/2015	0.07	41.6	25.9
4/9/2015	0.00	55.1	21.0
4/10/2015	0.00	61.4	28.4
4/11/2015	0.00	61.2	34.9
4/12/2015	0.00	63.4	33.4
4/13/2015	0.00	69.0	28.4
4/14/2015	0.00	64.1	27.5
4/15/2015	0.00	36.4	19.5
4/16/2015	0.00	41.5	22.2
4/17/2015	0.08	48.4	19.5
4/18/2015	0.00	63.9	31.1
4/19/2015	0.00	64.3	37.2
4/20/2015	0.00	64.2	40.6
4/21/2015	0.00	66.7	41.0
4/22/2015	0.00	62.8	40.7
4/23/2015	0.00	58.2	36.3
4/24/2015	0.26	54.6	31.7
4/25/2015	0.59	43.8	30.6
4/26/2015	0.01	46.0	28.7
4/27/2015	0.00	61.4	35.6
4/28/2015	0.00	68.1	37.4
4/29/2015	0.00	70.5	41.6
4/30/2015	0.00	71.7	46.0
Month	1.01	71.7	15.1
5/1/2015	0.00	71.6	43.5
5/2/2015	0.00	70.1	47.4
5/3/2015	0.18	67.0	42.6
5/4/2015	0.09	60.1	41.5
5/5/2015	0.26	54.8	40.7
5/6/2015	0.02	59.1	41.4

5/7/2015	0.00	59.5	38.5
5/8/2015	0.16	48.2	31.9
5/9/2015	0.18	43.1	30.6
5/10/2015	0.00	58.3	31.2
5/11/2015	0.00	63.3	33.9
5/12/2015	0.00	64.8	41.0
5/13/2015	0.00	62.0	37.5
5/14/2015	0.22	55.5	37.4
5/15/2015	0.52	42.2	32.6
5/16/2015	0.01	50.3	28.2
5/17/2015	0.00	60.7	34.7
5/18/2015	0.11	54.6	35.3
5/19/2015	0.01	57.4	33.9
5/20/2015	0.00	61.7	38.8
5/21/2015	0.00	62.7	41.3
5/22/2015	0.21	57.5	36.3
5/23/2015	0.50	44.7	32.5
5/24/2015	0.16	56.0	36.0
5/25/2015	0.00	62.2	38.7
5/26/2015	0.00	65.2	44.3
5/27/2015	0.00	69.8	42.7
5/28/2015	0.00	69.2	42.6
5/29/2015	0.00	67.1	47.0
5/30/2015	0.00	74.8	47.3
5/31/2015	0.00	78.5	53.5
Month	2.63	78.5	28.2
6/1/2015	0.00	76.5	46.8
6/2/2015	0.00	74.9	44.8
6/3/2015	1.33	72.7	46.2
6/4/2015	0.00	73.0	43.9
6/5/2015	0.11	63.6	45.0
6/6/2015	0.00	63.3	42.9
6/7/2015	0.14	65.6	39.5
6/8/2015	0.00	75.7	41.3
6/9/2015	0.02	74.1	49.8
6/10/2015	0.16	69.7	51.9
6/11/2015	0.19	62.7	48.1
6/12/2015	0.01	70.1	46.0
6/13/2015	0.00	74.8	51.8
6/14/2015	0.05	78.0	52.9
6/15/2015	0.00	80.8	52.9
6/16/2015	0.00	82.2	56.5
6/17/2015	0.00	83.1	55.2
6/18/2015	0.00	84.5	57.2
6/19/2015	0.00	85.0	56.6

6/20/2015	0.00	88.0	58.5
6/21/2015	0.00	85.7	58.1
6/22/2015	0.00	85.0	55.8
6/23/2015	0.00	84.6	59.3
6/24/2015	0.00	86.1	58.1
6/25/2015	0.00	87.4	60.0
6/26/2015	0.00	90.4	60.9
6/27/2015	0.00	88.1	55.3
6/28/2015	0.00	88.8	61.1
6/29/2015	0.00	88.3	59.5
6/30/2015	0.00	88.0	58.7
Month	2.01	90.4	39.5
7/1/2015	0.12	91.3	62.5
7/2/2015	0.16	82.5	57.4
7/3/2015	0.00	81.3	55.0
7/4/2015	0.00	76.6	60.9
7/5/2015	0.01	80.9	57.9
7/6/2015	0.02	74.0	53.0
7/7/2015	0.00	73.0	51.5
7/8/2015	0.28	70.3	47.6
7/9/2015	0.00	73.8	46.3
7/10/2015	0.00	71.8	50.5
7/11/2015	0.06	74.0	51.4
7/12/2015	0.00	80.5	48.6
7/13/2015	0.00	81.1	54.8
7/14/2015	0.00	79.8	55.1
7/15/2015	0.00	81.0	59.6
7/16/2015	0.00	80.8	55.7
7/17/2015	0.00	82.1	56.9
7/18/2015	0.54	72.8	49.4
7/19/2015	0.00	72.3	46.5
7/20/2015	0.15	66.2	52.6
7/21/2015	0.00	74.3	53.4
7/22/2015	0.00	78.3	53.6
7/23/2015	0.00	78.0	53.5
7/24/2015	0.00	78.9	54.0
7/25/2015	0.00	81.5	53.2
7/26/2015	0.00	82.7	57.3
7/27/2015	0.00	80.0	51.5
7/28/2015	0.00	82.4	53.4
7/29/2015	0.00	85.0	53.3
7/30/2015	0.00	84.2	56.7
7/31/2015	0.00	83.3	62.8
Month	1.34	91.3	46.3

8/1/2015	0.00	73.3	59.1
8/2/2015	0.01	74.6	54.0
8/3/2015	0.00	82.4	55.6
8/4/2015	0.00	84.0	56.9
8/5/2015	0.00	83.4	55.7
8/6/2015	0.00	83.6	59.5
8/7/2015	0.90	60.9	50.1
8/8/2015	0.07	74.3	51.9
8/9/2015	0.00	78.0	52.2
8/10/2015	0.00	78.2	55.6
8/11/2015	0.62	68.1	55.2
8/12/2015	0.06	70.1	56.5
8/13/2015	0.00	80.4	55.6
8/14/2015	0.00	84.2	59.2
8/15/2015	0.00	85.3	61.4
8/16/2015	0.00	86.1	62.2
8/17/2015	0.00	87.5	64.5
8/18/2015	0.00	85.3	52.1
8/19/2015	0.00	84.4	50.0
8/20/2015	0.00	83.9	60.8
8/21/2015	0.00	81.0	56.4
8/22/2015	0.01	82.7	57.0
8/23/2015	0.00	84.0	59.3
8/24/2015	0.00	87.0	59.8
8/25/2015	0.07	82.2	57.6
8/26/2015	1.17	70.0	55.2
8/27/2015	0.02	76.3	32.0
Month	2.93	87.5	32.0
9/1/2015	0.01	76.4	52.3
9/2/2015	0.00	76.0	54.1
9/3/2015	0.00	75.5	50.8
9/4/2015	0.00	70.7	50.9
9/5/2015	0.00	69.2	42.6
9/6/2015	0.00	67.1	47.0
9/7/2015	0.06	75.3	52.7
9/8/2015	0.00	78.9	53.3
9/9/2015	0.00	81.6	51.7
9/10/2015	0.00	84.5	51.9
9/11/2015	0.00	85.4	49.1
9/12/2015	0.00	85.2	55.7
9/13/2015	0.11	79.1	53.0
9/14/2015	0.87	65.0	46.9
9/15/2015	1.02	58.5	50.8
9/16/2015	0.05	66.0	47.7
9/17/2015	0.00	67.5	47.4

9/18/2015	0.00	72.0	41.0
9/19/2015	0.00	74.8	42.6
9/20/2015	0.00	78.2	44.8
9/21/2015	0.00	76.7	50.0
9/22/2015	0.00	73.4	51.1
9/23/2015	0.58	75.9	45.5
9/24/2015	0.00	79.8	51.5
9/25/2015	0.00	79.1	51.8
9/26/2015	0.00	75.8	52.5
9/27/2015	0.00	76.1	53.1
9/28/2015	0.00	76.4	55.6
9/29/2015	0.00	77.6	53.9
9/30/2015	0.00	76.7	56.4
Month	2.70	85.4	41.0

ALTON, UTAH (420086)

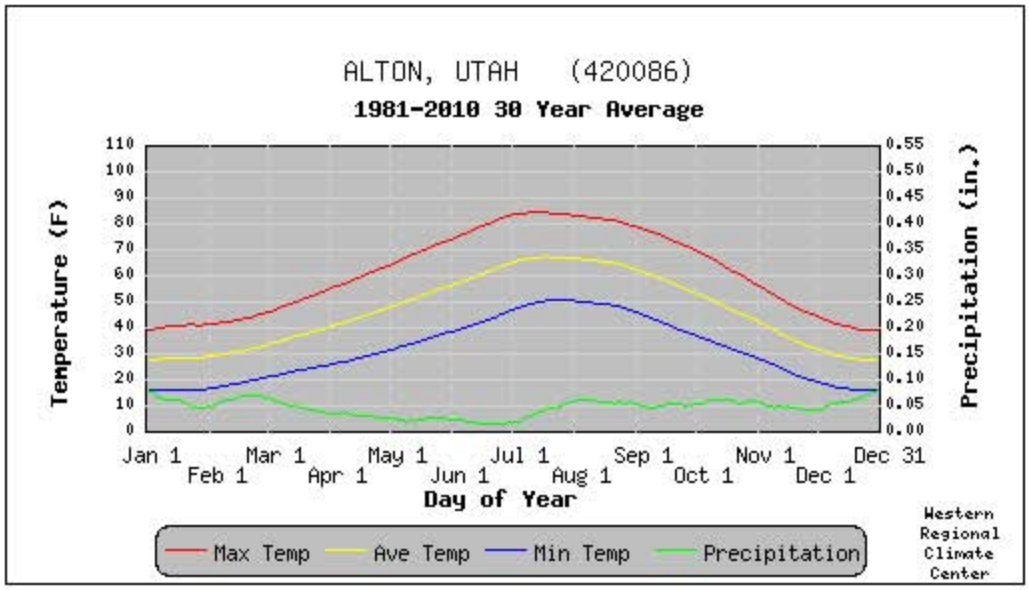
Period of Record Monthly Climate Summary

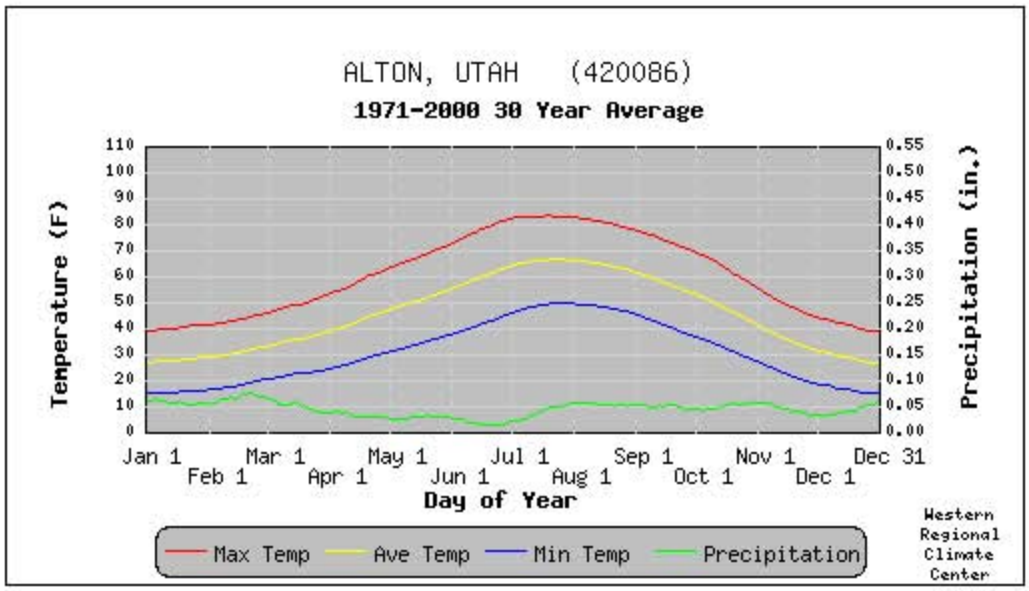
Period of Record : 05/01/1915 to 12/31/2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	39.4	42.1	47.8	57.5	67.1	76.8	82.3	80.0	73.5	62.6	50.0	41.5	60.0
Average Min. Temperature (F)	15.1	17.6	21.9	28.0	34.9	42.2	50.1	48.9	41.8	32.9	23.1	16.8	31.1
Average Total Precipitation (in.)	1.84	1.81	1.60	1.06	0.82	0.53	1.43	1.73	1.47	1.49	1.26	1.68	16.71
Average Total SnowFall (in.)	20.7	19.5	13.8	4.8	0.6	0.1	0.0	0.0	0.0	1.2	6.4	16.4	83.6
Average Snow Depth (in.)	7	8	5	1	0	0	0	0	0	0	1	3	2

Percent of possible observations for period of record.
Max. Temp.: 99.1% Min. Temp.: 99.1% Precipitation: 99.6% Snowfall: 97.7% Snow Depth: 92.4%
Check Station Metadata or Metadata graphics for more detail about data completeness.

Western Regional Climate Center, wrcc@dri.edu


ALTON, UTAH (420086)
1981-2010 30 Year Average
Temperature (F)
Precipitation (in.)
Jan 1
Feb 1
Mar 1
Apr 1
May 1
Jun 1
Jul 1
Aug 1
Sep 1
Oct 1
Nov 1
Dec 1
Dec 31
Day of Year
Max Temp
Ave Temp
Min Temp
Precipitation
Western Regional Climate Center


ALTON, UTAH (420086)
1971-2000 30 Year Average
Temperature (F)
Precipitation (in.)
Jan 1
Feb 1
Mar 1
Apr 1
May 1
Jun 1
Jul 1
Aug 1
Sep 1
Oct 1
Nov 1
Dec 1
Dec 31
Day of Year
Max Temp
Ave Temp
Min Temp
Precipitation
Western Regional Climate Center

ALTON, UTAH

30 Year Daily Temperature and Precipitation Summary

STATION 420086 AVERAGES FROM AVAILABLE YEARS IN PERIOD 1981 TO 2010 .

DOY	MON	DY	TMAX	#YRS	TMIN	#YRS	PRECIP	#YRS	SD MAX	SD MIN
1	1	1	39.6	30.	15.9	30.	0.079	29.	8.961	9.094
2	1	2	39.6	30.	15.9	30.	0.076	29.	9.019	9.120
3	1	3	39.5	29.	15.8	29.	0.076	30.	9.034	9.192
4	1	4	39.6	30.	15.8	30.	0.075	30.	9.047	9.193
5	1	5	39.7	29.	15.9	28.	0.070	27.	9.061	9.054
6	1	6	39.9	29.	15.9	29.	0.067	29.	9.089	8.944
7	1	7	40.0	29.	16.0	29.	0.065	29.	9.045	8.841
8	1	8	40.1	29.	16.1	29.	0.066	29.	9.011	8.712
9	1	9	40.2	29.	16.1	29.	0.063	29.	8.949	8.712
10	1	10	40.4	29.	16.3	29.	0.062	29.	8.885	8.672
11	1	11	40.5	29.	16.4	29.	0.062	29.	8.863	8.576
12	1	12	40.7	29.	16.4	29.	0.062	29.	8.832	8.591
13	1	13	40.8	29.	16.5	29.	0.061	29.	8.816	8.500
14	1	14	40.8	29.	16.5	29.	0.060	29.	8.771	8.456
15	1	15	40.8	29.	16.5	29.	0.061	29.	8.720	8.386
16	1	16	40.9	29.	16.5	29.	0.060	29.	8.836	8.391
17	1	17	40.9	29.	16.5	29.	0.060	29.	8.963	8.426
18	1	18	40.9	30.	16.4	30.	0.058	30.	8.977	8.421
19	1	19	41.0	29.	16.4	29.	0.056	29.	8.934	8.386
20	1	20	41.1	29.	16.3	29.	0.053	29.	8.907	8.349
21	1	21	41.2	29.	16.3	29.	0.053	29.	8.882	8.394
22	1	22	41.2	29.	16.4	29.	0.050	29.	8.856	8.381
23	1	23	41.2	29.	16.3	29.	0.047	29.	8.907	8.428
24	1	24	41.2	29.	16.3	29.	0.048	29.	8.889	8.496
25	1	25	41.1	29.	16.3	29.	0.049	29.	8.937	8.599
26	1	26	41.0	29.	16.3	29.	0.046	29.	8.966	8.684
27	1	27	41.1	28.	16.3	29.	0.045	29.	8.891	8.696
28	1	28	41.1	29.	16.3	29.	0.046	29.	8.798	8.692
29	1	29	41.2	28.	16.4	28.	0.045	29.	8.727	8.696
30	1	30	41.2	29.	16.5	29.	0.047	29.	8.715	8.716
31	1	31	41.4	29.	16.7	29.	0.049	29.	8.655	8.746
32	2	1	41.5	30.	16.7	30.	0.049	28.	8.660	8.762
33	2	2	41.7	30.	16.8	30.	0.048	30.	8.618	8.732
34	2	3	41.7	30.	16.9	30.	0.050	30.	8.569	8.696
35	2	4	41.8	30.	17.1	30.	0.052	30.	8.502	8.660
36	2	5	41.9	30.	17.3	30.	0.054	30.	8.468	8.647
37	2	6	42.0	30.	17.5	30.	0.058	30.	8.460	8.663
38	2	7	42.1	30.	17.7	30.	0.059	30.	8.446	8.595
39	2	8	42.1	30.	17.8	30.	0.061	30.	8.537	8.567
40	2	9	42.2	30.	17.8	29.	0.060	30.	8.599	8.566
41	2	10	42.4	30.	18.0	30.	0.060	30.	8.666	8.477
42	2	11	42.5	30.	18.1	30.	0.061	30.	8.721	8.503
43	2	12	42.6	30.	18.2	30.	0.061	30.	8.782	8.486
44	2	13	42.8	30.	18.4	30.	0.063	30.	8.844	8.523
45	2	14	42.9	30.	18.5	30.	0.067	30.	8.840	8.496
46	2	15	43.1	30.	18.5	30.	0.066	30.	8.834	8.572
47	2	16	43.3	30.	18.7	30.	0.068	30.	8.830	8.518

48	2	17	43.4	30.	18.9	30.	0.070	30.	8.815	8.491
49	2	18	43.5	30.	19.0	30.	0.071	30.	8.778	8.516
50	2	19	43.6	30.	19.2	30.	0.069	30.	8.769	8.483
51	2	20	43.8	30.	19.4	30.	0.070	30.	8.680	8.438
52	2	21	44.0	30.	19.7	30.	0.072	30.	8.577	8.267
53	2	22	44.2	30.	19.8	30.	0.070	30.	8.486	8.167
54	2	23	44.4	30.	20.0	30.	0.068	30.	8.407	8.057
55	2	24	44.7	30.	20.1	30.	0.068	30.	8.350	7.994
56	2	25	45.0	30.	20.3	30.	0.069	30.	8.368	7.984
57	2	26	45.2	30.	20.6	30.	0.069	30.	8.479	7.908
58	2	27	45.4	30.	20.7	30.	0.068	30.	8.576	7.871
59	2	28	45.7	30.	20.9	30.	0.066	30.	8.616	7.811
60	2	29	45.9	7.	21.0	7.	0.065	7.	8.707	7.770
61	3	1	46.1	29.	21.3	29.	0.064	28.	8.702	7.636
62	3	2	46.3	29.	21.4	29.	0.064	29.	8.744	7.548
63	3	3	46.5	29.	21.5	29.	0.063	29.	8.801	7.518
64	3	4	46.8	29.	21.7	29.	0.062	29.	8.878	7.440
65	3	5	47.1	29.	21.8	29.	0.059	29.	8.957	7.385
66	3	6	47.5	29.	21.9	29.	0.057	29.	9.056	7.384
67	3	7	47.8	29.	22.1	29.	0.057	29.	9.198	7.412
68	3	8	48.1	29.	22.2	29.	0.055	29.	9.253	7.368
69	3	9	48.4	29.	22.4	29.	0.054	29.	9.269	7.289
70	3	10	48.7	29.	22.6	29.	0.054	29.	9.243	7.272
71	3	11	49.0	29.	22.7	29.	0.051	29.	9.220	7.187
72	3	12	49.3	29.	22.9	29.	0.051	29.	9.185	7.148
73	3	13	49.6	29.	23.1	29.	0.051	29.	9.190	7.037
74	3	14	49.8	29.	23.3	29.	0.050	29.	9.179	6.990
75	3	15	49.9	29.	23.5	29.	0.052	29.	9.185	6.821
76	3	16	50.2	29.	23.6	29.	0.050	29.	9.183	6.795
77	3	17	50.5	29.	23.7	29.	0.048	29.	9.248	6.734
78	3	18	50.8	29.	23.9	29.	0.046	29.	9.286	6.648
79	3	19	51.2	29.	24.0	29.	0.047	29.	9.334	6.629
80	3	20	51.5	29.	24.2	29.	0.046	29.	9.422	6.519
81	3	21	51.8	29.	24.3	29.	0.044	29.	9.519	6.531
82	3	22	52.1	29.	24.5	29.	0.044	29.	9.668	6.502
83	3	23	52.4	29.	24.6	29.	0.043	29.	9.775	6.497
84	3	24	52.6	29.	24.8	29.	0.042	29.	9.881	6.464
85	3	25	53.0	29.	24.9	29.	0.041	29.	9.912	6.449
86	3	26	53.3	29.	25.0	29.	0.040	29.	9.877	6.411
87	3	27	53.6	29.	25.1	29.	0.039	28.	9.830	6.345
88	3	28	53.8	29.	25.3	29.	0.039	28.	9.817	6.289
89	3	29	54.1	29.	25.4	29.	0.038	29.	9.822	6.238
90	3	30	54.5	29.	25.5	29.	0.037	29.	9.831	6.256
91	3	31	54.9	29.	25.7	29.	0.036	29.	9.794	6.267
92	4	1	55.3	30.	25.9	30.	0.036	30.	9.737	6.326
93	4	2	55.6	30.	26.0	30.	0.036	30.	9.724	6.328
94	4	3	55.9	30.	26.2	30.	0.037	30.	9.705	6.334
95	4	4	56.1	30.	26.5	30.	0.036	30.	9.652	6.281
96	4	5	56.3	30.	26.6	30.	0.036	30.	9.543	6.216
97	4	6	56.5	30.	26.7	30.	0.036	30.	9.512	6.219
98	4	7	56.6	30.	26.9	30.	0.037	30.	9.526	6.231
99	4	8	56.9	30.	27.0	30.	0.036	30.	9.549	6.195
100	4	9	57.1	30.	27.2	30.	0.038	30.	9.575	6.159
101	4	10	57.4	30.	27.3	30.	0.038	30.	9.571	6.134
102	4	11	57.8	30.	27.5	30.	0.036	30.	9.533	6.140
103	4	12	58.1	30.	27.7	30.	0.033	30.	9.537	6.135
104	4	13	58.6	30.	27.9	30.	0.032	30.	9.518	6.140

105	4	14	59.0	30.	28.2	30.	0.032	30.	9.526	6.117
106	4	15	59.3	30.	28.4	30.	0.031	30.	9.472	6.132
107	4	16	59.6	30.	28.6	30.	0.031	30.	9.523	6.148
108	4	17	60.0	30.	28.8	30.	0.030	30.	9.509	6.098
109	4	18	60.3	30.	29.0	30.	0.029	30.	9.443	6.144
110	4	19	60.7	30.	29.2	30.	0.030	30.	9.332	6.119
111	4	20	61.1	30.	29.4	30.	0.030	30.	9.219	6.070
112	4	21	61.3	30.	29.6	30.	0.030	30.	9.157	6.015
113	4	22	61.6	30.	29.8	30.	0.029	30.	9.091	5.999
114	4	23	61.8	30.	29.9	29.	0.029	30.	9.085	5.951
115	4	24	62.1	30.	30.2	30.	0.028	30.	9.040	5.959
116	4	25	62.4	30.	30.3	30.	0.028	30.	8.964	5.972
117	4	26	62.8	30.	30.5	30.	0.028	30.	8.871	5.944
118	4	27	63.1	30.	30.7	30.	0.027	30.	8.833	5.939
119	4	28	63.4	30.	30.9	30.	0.027	30.	8.822	5.899
120	4	29	63.6	30.	31.1	30.	0.026	30.	8.830	5.896
121	4	30	63.9	30.	31.2	30.	0.027	30.	8.808	5.797
122	5	1	64.2	30.	31.5	30.	0.027	30.	8.728	5.779
123	5	2	64.5	30.	31.7	30.	0.026	30.	8.699	5.758
124	5	3	64.8	30.	31.9	30.	0.026	30.	8.642	5.777
125	5	4	65.3	30.	32.2	30.	0.024	30.	8.557	5.741
126	5	5	65.7	30.	32.5	30.	0.024	30.	8.458	5.716
127	5	6	66.1	30.	32.7	30.	0.023	30.	8.356	5.703
128	5	7	66.5	30.	32.9	30.	0.023	30.	8.247	5.695
129	5	8	66.8	30.	33.1	30.	0.022	30.	8.157	5.752
130	5	9	67.2	30.	33.3	30.	0.019	30.	8.171	5.785
131	5	10	67.5	30.	33.6	30.	0.021	30.	8.200	5.747
132	5	11	67.8	30.	33.8	30.	0.022	30.	8.141	5.741
133	5	12	68.1	30.	34.0	30.	0.022	30.	8.095	5.647
134	5	13	68.4	30.	34.2	30.	0.021	30.	8.024	5.637
135	5	14	68.7	30.	34.5	30.	0.023	30.	8.037	5.632
136	5	15	69.0	30.	34.7	30.	0.023	30.	7.982	5.588
137	5	16	69.4	30.	34.9	30.	0.023	30.	7.949	5.594
138	5	17	69.7	29.	35.2	29.	0.024	30.	7.962	5.601
139	5	18	70.0	30.	35.4	30.	0.024	30.	7.971	5.584
140	5	19	70.3	30.	35.6	30.	0.025	30.	7.947	5.592
141	5	20	70.7	30.	35.9	30.	0.025	30.	7.906	5.574
142	5	21	71.1	30.	36.1	30.	0.025	30.	7.873	5.558
143	5	22	71.4	30.	36.5	30.	0.025	30.	7.881	5.575
144	5	23	71.8	30.	36.7	30.	0.025	30.	7.903	5.580
145	5	24	72.0	30.	36.9	30.	0.025	30.	7.970	5.578
146	5	25	72.3	30.	37.2	30.	0.025	30.	8.050	5.605
147	5	26	72.6	30.	37.5	30.	0.025	30.	7.993	5.615
148	5	27	72.8	30.	37.7	30.	0.026	30.	7.890	5.590
149	5	28	73.1	30.	37.9	30.	0.026	30.	7.777	5.539
150	5	29	73.4	30.	38.1	29.	0.025	30.	7.689	5.548
151	5	30	73.6	30.	38.2	30.	0.024	30.	7.669	5.537
152	5	31	73.9	30.	38.4	30.	0.024	30.	7.619	5.588
153	6	1	74.2	30.	38.5	30.	0.022	30.	7.607	5.559
154	6	2	74.5	30.	38.8	30.	0.023	30.	7.615	5.590
155	6	3	74.8	30.	39.0	30.	0.023	30.	7.635	5.590
156	6	4	75.1	30.	39.2	30.	0.023	30.	7.610	5.576
157	6	5	75.4	30.	39.4	30.	0.022	30.	7.544	5.573
158	6	6	75.8	30.	39.7	30.	0.022	30.	7.421	5.527
159	6	7	76.2	30.	40.0	30.	0.022	30.	7.282	5.483
160	6	8	76.5	30.	40.2	30.	0.020	30.	7.146	5.467
161	6	9	76.9	30.	40.5	30.	0.019	30.	7.034	5.438

162	6	10	77.3	30.	40.7	30.	0.019	30.	6.919	5.439
163	6	11	77.6	30.	41.0	30.	0.019	30.	6.878	5.410
164	6	12	77.8	30.	41.2	30.	0.018	30.	6.790	5.388
165	6	13	78.2	30.	41.4	30.	0.018	30.	6.667	5.362
166	6	14	78.5	30.	41.7	30.	0.017	30.	6.551	5.317
167	6	15	78.9	30.	42.0	30.	0.016	30.	6.432	5.226
168	6	16	79.2	30.	42.3	30.	0.016	30.	6.352	5.221
169	6	17	79.5	30.	42.6	30.	0.015	30.	6.323	5.287
170	6	18	79.8	30.	42.8	30.	0.014	30.	6.256	5.315
171	6	19	80.0	30.	43.1	30.	0.015	30.	6.166	5.350
172	6	20	80.3	30.	43.3	30.	0.014	30.	6.066	5.317
173	6	21	80.7	30.	43.6	30.	0.014	30.	5.984	5.303
174	6	22	81.0	30.	43.9	30.	0.015	30.	5.868	5.253
175	6	23	81.4	30.	44.2	30.	0.014	30.	5.753	5.195
176	6	24	81.7	30.	44.6	30.	0.015	30.	5.747	5.155
177	6	25	82.0	30.	45.0	30.	0.016	30.	5.733	5.161
178	6	26	82.2	30.	45.3	30.	0.016	30.	5.705	5.131
179	6	27	82.5	30.	45.6	30.	0.016	30.	5.691	5.137
180	6	28	82.8	30.	46.0	30.	0.017	30.	5.654	5.111
181	6	29	83.0	30.	46.3	30.	0.018	30.	5.628	5.033
182	6	30	83.2	30.	46.7	29.	0.019	30.	5.592	5.005
183	7	1	83.5	30.	47.0	30.	0.020	30.	5.551	4.997
184	7	2	83.7	30.	47.2	30.	0.021	30.	5.517	5.004
185	7	3	83.8	30.	47.5	30.	0.020	30.	5.501	5.024
186	7	4	83.9	30.	47.8	30.	0.020	30.	5.532	5.030
187	7	5	84.1	29.	48.0	29.	0.021	29.	5.585	5.073
188	7	6	84.2	29.	48.3	29.	0.024	29.	5.623	5.100
189	7	7	84.2	29.	48.6	29.	0.027	29.	5.693	5.109
190	7	8	84.2	29.	48.8	29.	0.028	30.	5.775	5.120
191	7	9	84.3	29.	49.0	29.	0.029	30.	5.792	5.128
192	7	10	84.3	29.	49.2	29.	0.030	30.	5.772	5.075
193	7	11	84.4	29.	49.4	29.	0.031	30.	5.697	5.036
194	7	12	84.4	29.	49.6	29.	0.033	30.	5.680	5.014
195	7	13	84.4	29.	49.8	29.	0.036	30.	5.646	5.006
196	7	14	84.4	30.	49.9	30.	0.038	30.	5.675	5.015
197	7	15	84.4	30.	50.1	30.	0.039	30.	5.677	4.981
198	7	16	84.3	30.	50.2	30.	0.040	30.	5.668	4.843
199	7	17	84.3	30.	50.3	30.	0.042	30.	5.633	4.781
200	7	18	84.3	30.	50.4	30.	0.043	30.	5.606	4.738
201	7	19	84.3	30.	50.5	30.	0.045	30.	5.544	4.672
202	7	20	84.1	30.	50.6	30.	0.048	30.	5.481	4.593
203	7	21	84.0	30.	50.6	30.	0.047	30.	5.436	4.571
204	7	22	84.0	30.	50.6	29.	0.047	30.	5.385	4.568
205	7	23	83.9	30.	50.6	30.	0.048	30.	5.295	4.520
206	7	24	83.9	30.	50.6	30.	0.048	30.	5.225	4.507
207	7	25	83.9	30.	50.6	30.	0.049	30.	5.218	4.547
208	7	26	83.9	30.	50.5	30.	0.051	30.	5.173	4.506
209	7	27	83.8	30.	50.5	30.	0.054	30.	5.172	4.500
210	7	28	83.7	30.	50.5	30.	0.055	30.	5.207	4.492
211	7	29	83.6	30.	50.5	30.	0.056	30.	5.213	4.477
212	7	30	83.5	30.	50.4	30.	0.057	30.	5.226	4.450
213	7	31	83.4	30.	50.4	30.	0.057	30.	5.191	4.404
214	8	1	83.3	30.	50.4	30.	0.058	30.	5.197	4.344
215	8	2	83.2	30.	50.3	30.	0.060	30.	5.207	4.332
216	8	3	83.1	30.	50.2	30.	0.061	30.	5.170	4.284
217	8	4	82.9	30.	50.2	30.	0.060	30.	5.151	4.241
218	8	5	82.9	30.	50.1	30.	0.060	30.	5.109	4.181

219	8	6	82.8	30.	50.0	30.	0.061	30.	5.049	4.118
220	8	7	82.7	30.	50.0	30.	0.061	30.	5.047	4.080
221	8	8	82.6	30.	49.9	30.	0.061	30.	5.028	4.073
222	8	9	82.5	29.	49.8	29.	0.062	30.	5.079	4.077
223	8	10	82.4	29.	49.7	29.	0.062	30.	5.128	4.097
224	8	11	82.3	29.	49.6	29.	0.060	30.	5.172	4.114
225	8	12	82.2	29.	49.6	29.	0.058	30.	5.159	4.141
226	8	13	82.1	29.	49.5	29.	0.058	30.	5.148	4.195
227	8	14	82.1	29.	49.4	29.	0.058	30.	5.110	4.234
228	8	15	82.0	29.	49.3	29.	0.056	30.	5.127	4.214
229	8	16	81.9	29.	49.2	29.	0.057	30.	5.190	4.217
230	8	17	81.8	29.	49.1	29.	0.058	30.	5.266	4.233
231	8	18	81.7	29.	49.0	29.	0.055	30.	5.308	4.300
232	8	19	81.6	29.	48.9	29.	0.056	30.	5.318	4.337
233	8	20	81.5	29.	48.7	29.	0.056	30.	5.336	4.357
234	8	21	81.4	29.	48.6	29.	0.055	30.	5.379	4.386
235	8	22	81.2	29.	48.5	29.	0.055	30.	5.402	4.406
236	8	23	81.0	29.	48.3	29.	0.056	30.	5.431	4.401
237	8	24	80.7	29.	48.2	29.	0.058	30.	5.529	4.423
238	8	25	80.5	29.	48.0	29.	0.056	30.	5.530	4.435
239	8	26	80.3	29.	47.8	29.	0.055	30.	5.462	4.456
240	8	27	80.1	29.	47.6	29.	0.055	30.	5.430	4.463
241	8	28	79.8	29.	47.3	29.	0.056	30.	5.464	4.483
242	8	29	79.5	29.	47.0	29.	0.056	30.	5.515	4.499
243	8	30	79.3	29.	46.7	29.	0.056	30.	5.535	4.585
244	8	31	79.1	29.	46.4	29.	0.054	30.	5.540	4.659
245	9	1	78.9	29.	46.1	29.	0.055	30.	5.587	4.699
246	9	2	78.7	29.	45.8	29.	0.054	30.	5.611	4.704
247	9	3	78.5	29.	45.6	29.	0.051	30.	5.618	4.790
248	9	4	78.2	29.	45.3	29.	0.049	30.	5.626	4.844
249	9	5	77.9	29.	44.9	29.	0.050	30.	5.611	4.944
250	9	6	77.7	29.	44.6	29.	0.049	30.	5.667	4.976
251	9	7	77.4	29.	44.3	29.	0.046	30.	5.704	4.984
252	9	8	77.2	29.	44.0	29.	0.046	30.	5.704	4.993
253	9	9	76.9	29.	43.7	29.	0.048	30.	5.726	4.977
254	9	10	76.6	29.	43.4	29.	0.048	30.	5.822	5.008
255	9	11	76.4	29.	43.1	29.	0.048	30.	5.932	5.036
256	9	12	76.1	29.	42.8	29.	0.049	30.	6.021	5.084
257	9	13	75.8	29.	42.5	29.	0.051	30.	6.135	5.129
258	9	14	75.5	29.	42.2	30.	0.050	30.	6.231	5.122
259	9	15	75.2	30.	41.9	30.	0.050	30.	6.292	5.198
260	9	16	74.9	29.	41.5	30.	0.052	30.	6.374	5.200
261	9	17	74.5	29.	41.2	29.	0.052	30.	6.486	5.229
262	9	18	74.2	29.	41.0	29.	0.054	30.	6.600	5.247
263	9	19	73.8	29.	40.6	29.	0.054	30.	6.694	5.253
264	9	20	73.4	29.	40.3	29.	0.054	30.	6.772	5.243
265	9	21	73.1	29.	40.0	29.	0.055	30.	6.857	5.282
266	9	22	72.7	29.	39.6	29.	0.054	30.	6.876	5.357
267	9	23	72.4	30.	39.3	29.	0.053	30.	6.911	5.373
268	9	24	72.0	30.	39.0	30.	0.053	30.	6.952	5.403
269	9	25	71.8	30.	38.7	30.	0.051	30.	7.024	5.450
270	9	26	71.5	30.	38.4	30.	0.050	30.	7.065	5.438
271	9	27	71.2	30.	38.1	30.	0.051	30.	7.117	5.444
272	9	28	70.8	30.	37.9	30.	0.052	30.	7.248	5.448
273	9	29	70.4	30.	37.6	30.	0.051	30.	7.326	5.406
274	9	30	70.0	30.	37.4	30.	0.053	30.	7.374	5.423
275	10	1	69.7	30.	37.0	30.	0.052	30.	7.464	5.445

276	10	2	69.3	30.	36.7	30.	0.054	30.	7.605	5.444
277	10	3	69.0	30.	36.4	30.	0.053	30.	7.720	5.407
278	10	4	68.6	30.	36.2	30.	0.054	30.	7.864	5.374
279	10	5	68.3	30.	35.9	30.	0.055	30.	7.913	5.388
280	10	6	67.9	30.	35.6	30.	0.057	30.	7.996	5.428
281	10	7	67.5	30.	35.3	30.	0.061	29.	8.128	5.437
282	10	8	67.1	30.	35.0	30.	0.061	29.	8.214	5.480
283	10	9	66.7	30.	34.8	30.	0.061	29.	8.244	5.483
284	10	10	66.3	30.	34.5	30.	0.061	28.	8.232	5.474
285	10	11	65.8	30.	34.2	30.	0.061	29.	8.308	5.426
286	10	12	65.3	30.	33.9	30.	0.059	30.	8.372	5.465
287	10	13	64.8	30.	33.6	30.	0.062	30.	8.400	5.492
288	10	14	64.4	30.	33.3	30.	0.062	30.	8.514	5.513
289	10	15	63.9	30.	33.1	30.	0.060	30.	8.670	5.563
290	10	16	63.3	30.	32.8	30.	0.062	30.	8.758	5.621
291	10	17	62.8	30.	32.4	30.	0.060	30.	8.792	5.656
292	10	18	62.3	30.	32.1	30.	0.060	30.	8.802	5.707
293	10	19	61.9	30.	31.8	30.	0.063	29.	8.856	5.732
294	10	20	61.5	30.	31.5	30.	0.059	29.	8.967	5.786
295	10	21	61.2	30.	31.2	30.	0.056	30.	9.027	5.794
296	10	22	60.9	30.	30.9	30.	0.055	30.	9.058	5.836
297	10	23	60.6	30.	30.7	30.	0.055	30.	9.157	5.873
298	10	24	60.1	30.	30.4	30.	0.055	30.	9.205	5.904
299	10	25	59.7	30.	30.2	30.	0.059	30.	9.208	5.941
300	10	26	59.2	30.	29.9	30.	0.059	30.	9.230	5.994
301	10	27	58.8	30.	29.7	30.	0.059	30.	9.208	6.022
302	10	28	58.3	30.	29.5	30.	0.060	30.	9.287	6.041
303	10	29	57.8	30.	29.2	30.	0.059	30.	9.383	6.057
304	10	30	57.3	30.	29.0	30.	0.060	30.	9.415	6.157
305	10	31	56.8	30.	28.7	30.	0.059	30.	9.398	6.211
306	11	1	56.3	29.	28.3	28.	0.059	29.	9.439	6.312
307	11	2	55.9	29.	28.0	29.	0.056	29.	9.453	6.350
308	11	3	55.4	29.	27.7	29.	0.055	29.	9.510	6.431
309	11	4	55.0	29.	27.4	29.	0.055	29.	9.535	6.416
310	11	5	54.5	29.	27.1	29.	0.051	29.	9.560	6.455
311	11	6	54.2	29.	26.8	29.	0.049	29.	9.558	6.491
312	11	7	53.7	29.	26.5	29.	0.050	29.	9.579	6.501
313	11	8	53.3	29.	26.2	29.	0.050	29.	9.616	6.576
314	11	9	52.8	29.	25.8	29.	0.048	29.	9.621	6.720
315	11	10	52.4	29.	25.4	29.	0.051	29.	9.593	6.707
316	11	11	51.9	29.	25.1	29.	0.050	29.	9.611	6.789
317	11	12	51.4	29.	24.7	29.	0.049	29.	9.538	6.845
318	11	13	50.9	29.	24.3	29.	0.049	29.	9.450	6.860
319	11	14	50.4	29.	23.8	29.	0.048	29.	9.387	6.848
320	11	15	50.0	29.	23.5	29.	0.047	29.	9.471	6.887
321	11	16	49.5	29.	23.2	29.	0.049	28.	9.477	6.968
322	11	17	49.2	29.	22.8	29.	0.048	29.	9.488	7.002
323	11	18	48.8	29.	22.5	29.	0.048	29.	9.380	6.976
324	11	19	48.3	29.	22.2	29.	0.048	29.	9.310	6.957
325	11	20	47.9	29.	21.9	29.	0.048	29.	9.313	6.971
326	11	21	47.6	29.	21.6	29.	0.048	29.	9.328	7.019
327	11	22	47.2	29.	21.3	29.	0.048	29.	9.309	7.088
328	11	23	46.9	29.	21.1	29.	0.044	29.	9.324	7.084
329	11	24	46.5	29.	20.9	29.	0.044	28.	9.271	7.069
330	11	25	46.2	29.	20.5	29.	0.043	28.	9.246	7.106
331	11	26	45.9	29.	20.3	29.	0.043	28.	9.245	7.157
332	11	27	45.6	29.	20.1	29.	0.042	29.	9.224	7.231

333	11	28	45.2	29.	19.9	29.	0.042	29.	9.187	7.285
334	11	29	45.0	29.	19.7	29.	0.044	29.	9.166	7.295
335	11	30	44.7	29.	19.4	29.	0.044	29.	9.087	7.288
336	12	1	44.4	29.	19.2	29.	0.044	29.	9.058	7.393
337	12	2	44.0	29.	19.0	29.	0.045	29.	8.983	7.369
338	12	3	43.7	29.	18.8	29.	0.044	29.	8.947	7.434
339	12	4	43.4	29.	18.6	29.	0.047	29.	8.840	7.437
340	12	5	43.0	29.	18.4	29.	0.049	29.	8.855	7.468
341	12	6	42.7	29.	18.2	29.	0.049	29.	8.848	7.568
342	12	7	42.4	29.	18.0	29.	0.052	29.	8.875	7.685
343	12	8	42.1	29.	17.8	29.	0.056	29.	8.875	7.804
344	12	9	41.7	29.	17.5	29.	0.055	29.	8.905	7.975
345	12	10	41.4	29.	17.2	29.	0.053	29.	8.867	8.076
346	12	11	41.3	29.	17.0	29.	0.055	29.	8.886	8.083
347	12	12	41.2	29.	16.9	29.	0.056	29.	8.824	8.161
348	12	13	41.0	29.	16.9	29.	0.057	29.	8.790	8.281
349	12	14	40.9	29.	16.8	29.	0.059	29.	8.704	8.333
350	12	15	40.8	29.	16.7	29.	0.058	29.	8.708	8.365
351	12	16	40.6	29.	16.7	29.	0.059	29.	8.717	8.418
352	12	17	40.4	29.	16.5	29.	0.058	29.	8.753	8.539
353	12	18	40.2	29.	16.5	29.	0.060	28.	8.760	8.620
354	12	19	40.0	29.	16.4	29.	0.060	29.	8.732	8.704
355	12	20	39.8	29.	16.4	29.	0.063	29.	8.705	8.778
356	12	21	39.6	29.	16.3	29.	0.064	28.	8.738	8.819
357	12	22	39.5	29.	16.2	29.	0.067	29.	8.774	8.958
358	12	23	39.4	29.	16.1	29.	0.067	29.	8.842	9.005
359	12	24	39.3	29.	16.0	28.	0.070	29.	8.890	9.059
360	12	25	39.3	29.	15.9	29.	0.071	29.	8.845	9.116
361	12	26	39.4	29.	15.8	29.	0.072	29.	8.836	9.108
362	12	27	39.4	29.	15.9	29.	0.073	29.	8.812	9.047
363	12	28	39.5	29.	15.9	29.	0.076	29.	8.778	8.993
364	12	29	39.5	29.	16.0	29.	0.077	29.	8.827	9.024
365	12	30	39.5	29.	15.9	29.	0.078	29.	8.851	9.001
366	12	31	39.5	29.	15.9	29.	0.079	29.	8.943	9.059

ALTON, UTAH

NCDC 1981-2010 Monthly Normals

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Max. Temperature (F)	40.9	43.1	50.1	59.6	69.5	79.2	84.4	82.0	75.0	63.4	50.2	40.7	61.6
Highest Mean Max. Temperature (F)													
Year Highest Occurred													
Lowest Mean Max. Temperature (F)													
Year Lowest Occurred													
Mean Temperature (F)	28.6	30.8	36.7	44.0	52.2	60.7	67.2	65.6	58.4	48.1	36.8	28.7	46.6
Highest Mean Temperature (F)													
Year Highest Occurred													
Lowest Mean Temperature (F)													
Year Lowest Occurred													
Mean Min. Temperature (F)	16.4	18.5	23.3	28.4	34.9	42.1	50.1	49.3	41.7	32.8	23.4	16.7	31.5
Highest Mean Min. Temperature (F)													
Year Highest Occurred													
Lowest Mean Min. Temperature (F)													
Year Lowest Occurred													
Mean Precipitation (in.)	1.87	1.98	1.52	0.94	0.72	0.49	1.23	1.75	1.54	1.86	1.41	1.80	17.11
Highest Precipitation (in.)													
Year Highest Occurred													

Lowest Precipitation (in.)													
Year Lowest Occurred													
Heating Degree Days (F)	1127.	958.	877.	630.	398.	151.	26.	40.	205.	524.	846.	1125.	6907.
Cooling Degree Days (F)	0.	0.	0.	0.	1.	20.	96.	60.	5.	0.	0.	0.	183.

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ALTON, UTAH

NCDC 1971-2000 Monthly Normals

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Monthly
Mean Max. Temperature (F)	40.0	42.9	48.6	58.1	68.0	78.6	84.0	81.7	74.9	64.2	50.2	42.1	61.1
Highest Mean Max. Temperature (F)	49.4	50.8	60.0	67.2	75.5	85.0	89.0	85.9	80.1	71.6	59.3	51.7	89.0
Year Highest Occurred	1986	1995	1972	1989	1984	1974	1972	1994	1979	1988	1995	1980	1972
Lowest Mean Max. Temperature (F)	30.8	36.2	41.2	48.1	60.7	72.1	79.5	78.1	69.7	56.9	41.3	32.6	30.8
Year Lowest Occurred	1979	1998	1973	1983	1977	1993	1993	1983	1986	1972	1994	1992	1979
Mean Temperature (F)	27.9	30.5	35.6	43.0	51.2	60.3	66.6	65.1	58.2	48.4	36.4	29.5	46.1
Highest Mean Temperature (F)	36.0	37.1	43.2	49.8	56.6	65.0	69.9	68.7	62.0	54.7	42.7	37.8	69.9
Year Highest Occurred	1986	1995	1972	1992	1984	1974	1996	1994	1979	1988	1995	1980	1996
Lowest Mean Temperature (F)	20.0	25.0	29.7	35.2	46.3	55.0	60.8	62.2	53.4	43.2	29.3	21.0	20.0
Year Lowest Occurred	1979	1993	1980	1975	1977	1993	1993	1976	1986	1984	1994	1990	1979
Mean Min. Temperature (F)	15.7	18.1	22.6	27.8	34.4	41.9	49.2	48.4	41.4	32.6	22.6	16.8	31.0
Highest Mean Min. Temperature (F)	22.5	23.5	28.2	33.2	38.4	45.2	53.3	51.9	46.3	37.7	26.3	23.9	53.3
Year Highest Occurred	1986	1991	1986	1992	1992	1994	1996	2000	1997	1988	1996	1980	1996
Lowest Mean Min. Temperature (F)	8.9	11.3	16.8	21.4	30.8	36.8	42.1	44.2	37.2	28.3	17.2	6.9	6.9
Year Lowest Occurred	1973	1979	1977	1975	1975	1998	1993	1976	1986	1982	1994	1990	1990
Mean Precipitation (in.)	1.76	1.90	1.75	0.95	0.97	0.51	1.34	1.62	1.53	1.59	1.40	1.19	16.51

Highest Precipitation (in.)	7.32	5.88	4.38	3.90	2.96	1.61	3.18	3.59	5.21	4.93	5.72	4.85	7.32
Year Highest Occurred	1993	1993	1978	1988	1992	1972	1999	1987	1997	2000	1978	1971	1993
Lowest Precipitation (in.)	0.00	0.00	0.00	0.02	0.02	0.00	0.00	0.00	0.03	0.00	0.11	0.00	0.00
Year Lowest Occurred	1976	1972	1997	1993	1972	1979	1993	1985	1989	1999	1980	1989	1976
Heating Degree Days (F)	1152.	966.	911.	661.	429.	174.	45.	60.	211.	516.	858.	1103.	7086.
Cooling Degree Days (F)	0.	0.	0.	0.	1.	31.	93.	60.	5.	0.	0.	0.	190.

Western Regional Climate Center, wrcc@dri.edu

ALTON, UTAH (420086)

1981-2010 Monthly Climate Summary

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	40.6	43.3	50.4	59.5	69.3	78.9	84.0	81.6	74.8	63.5	48.5	40.9	61.5
Average Min. Temperature (F)	16.3	18.7	23.5	28.5	35.0	42.3	49.6	48.9	41.7	32.8	22.8	16.9	31.5
Average Total Precipitation (in.)	1.82	1.83	1.52	0.96	0.74	0.54	1.20	1.79	1.53	1.81	1.45	1.87	17.07

Unofficial values based on averages/sums of smoothed daily data. Information is computed from available daily data during the 1981-2010 period. Smoothing, missing data and observation-time changes may cause these 1981-2010 values to differ from official NCDC values. This table is presented for use at locations that don't have official NCDC data. No adjustments are made for missing data or time of observation. Check NCDC normals table for official data.

Western Regional Climate Center, wrcc@dri.edu

ALTON, UTAH (420086)

1971-2000 Monthly Climate Summary

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	40.5	43.7	49.6	58.3	67.9	78.0	83.3	80.9	74.1	63.2	48.0	41.5	60.9
Average Min. Temperature (F)	15.9	18.4	22.6	27.8	34.5	41.8	48.8	48.2	41.4	32.4	22.1	16.7	31.0
Average Total Precipitation (in.)	1.81	1.97	1.59	1.01	0.93	0.59	1.25	1.69	1.51	1.60	1.37	1.32	16.62

Unofficial values based on averages/sums of smoothed daily data. Information is computed from available daily data during the 1971-2000 period. Smoothing, missing data and observation-time changes may cause these 1971-2000 values to differ from official NCDC values. This table is presented for use at locations that don't have official NCDC data. No adjustments are made for missing data or time of observation. Check NCDC normals table for official data.

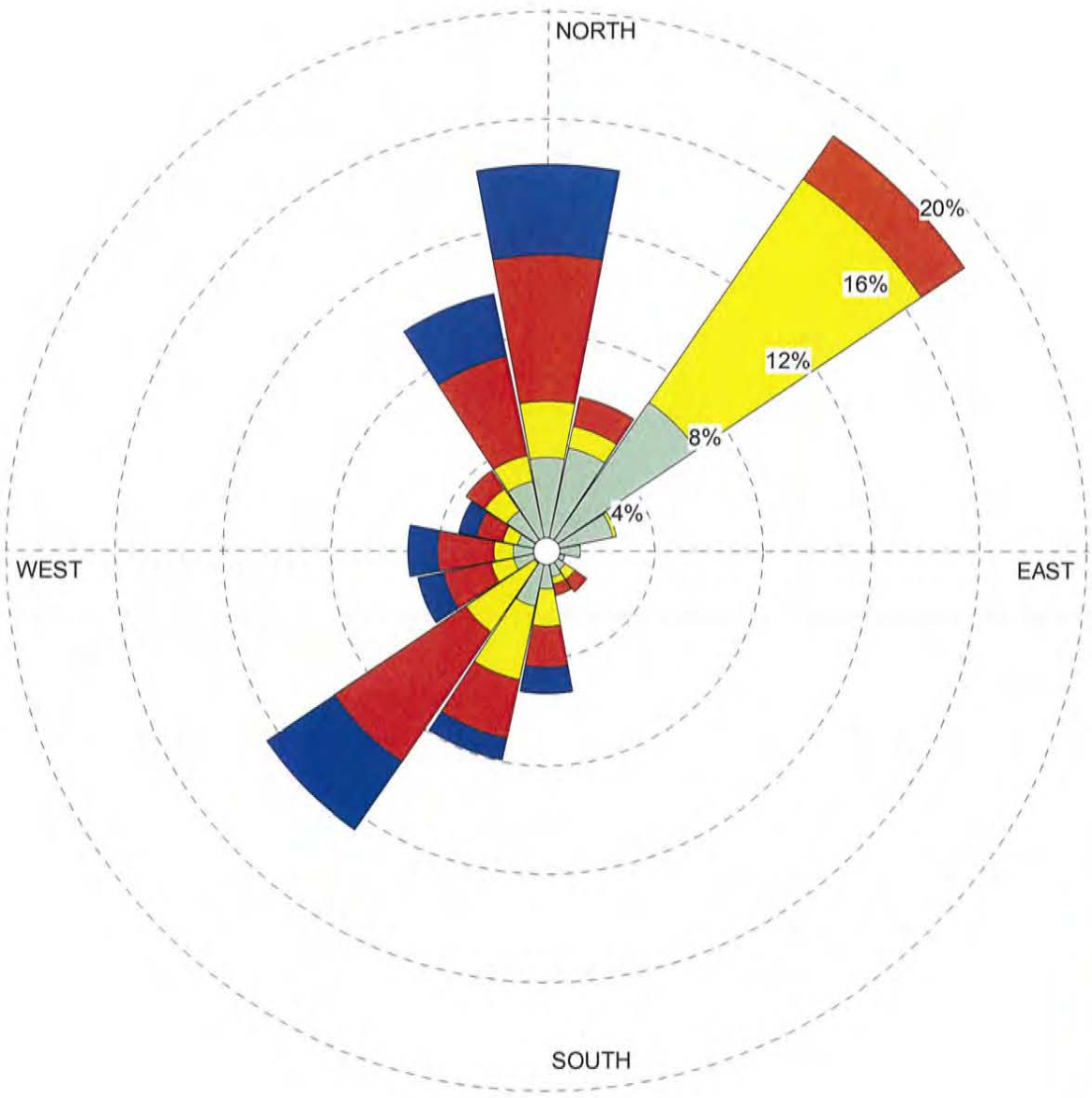
Western Regional Climate Center, wrcc@dri.edu

Wind Rose Plots

Coal Hollow Mine

WIND ROSE PLOT:

Alton Coal Development, Alton, Utah
April 2011



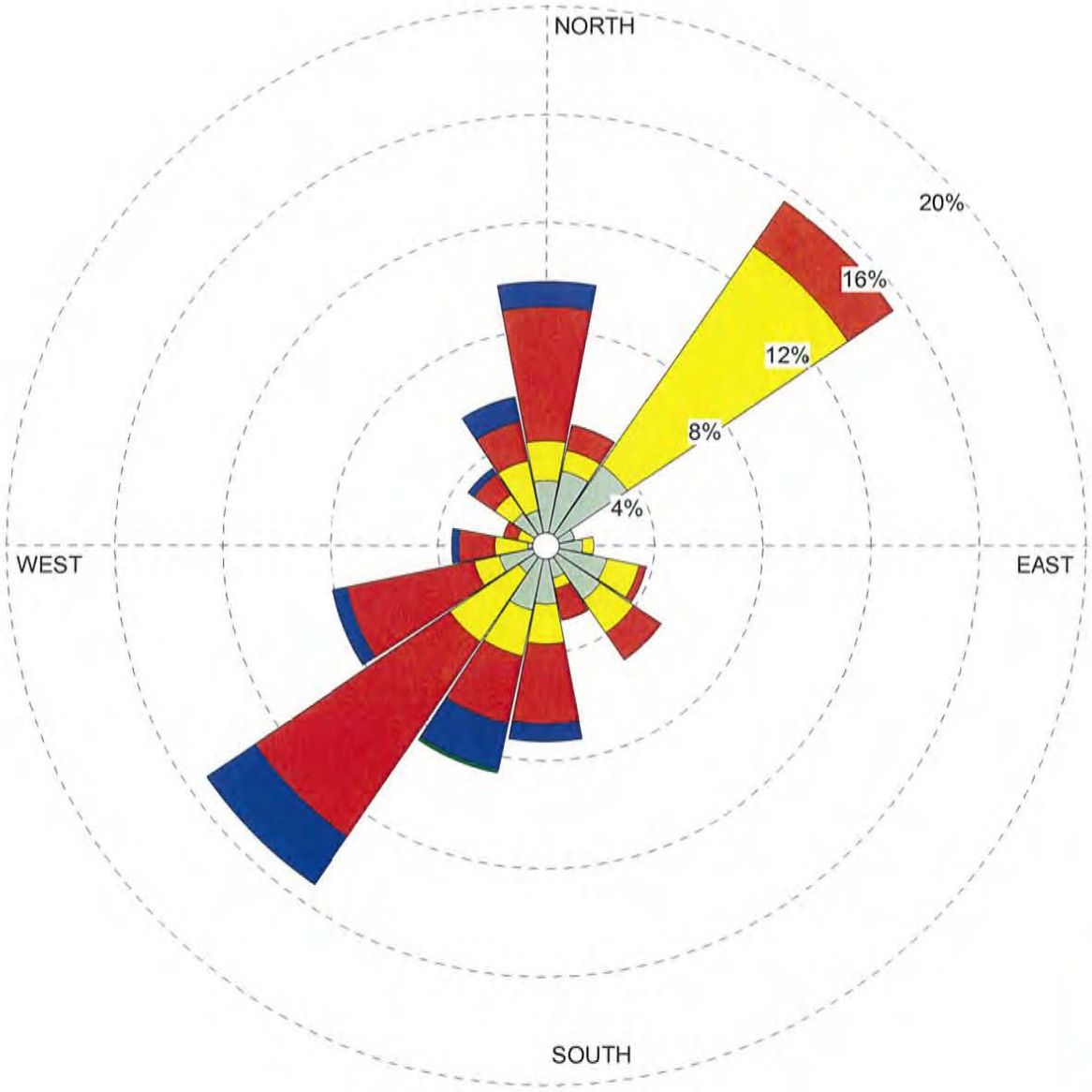
WIND SPEED
(m/s)

- >= 11.1
- 8.8 - 11.1
- 5.7 - 8.8
- 3.6 - 5.7
- 2.1 - 3.6
- 0.5 - 2.1

Calms: 0.83%

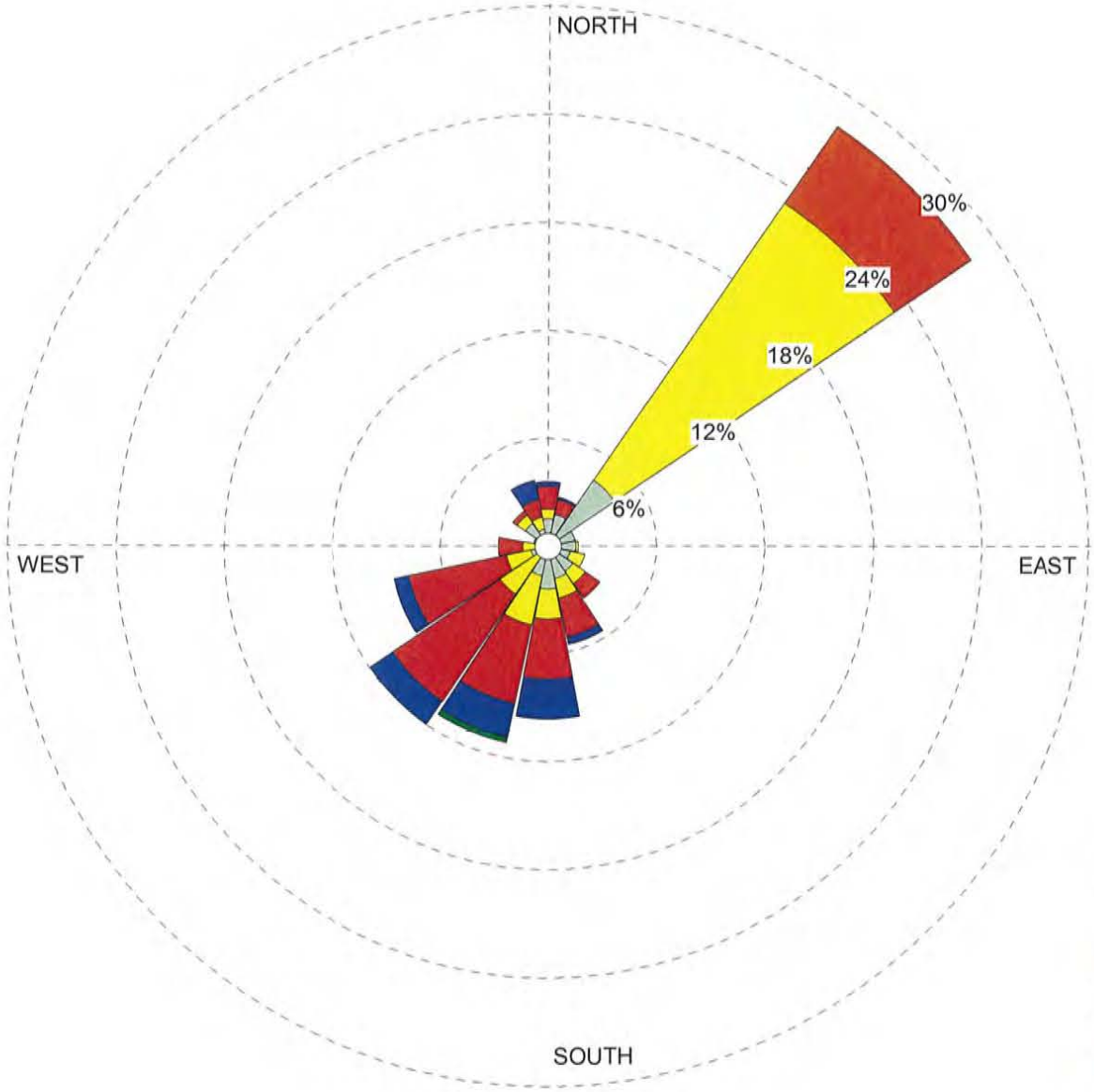
WIND ROSE PLOT:

Alton Coal Development, Alton, Utah
May 2011



WIND ROSE PLOT:

Alton Coal Development, Alton, Utah
June 2011

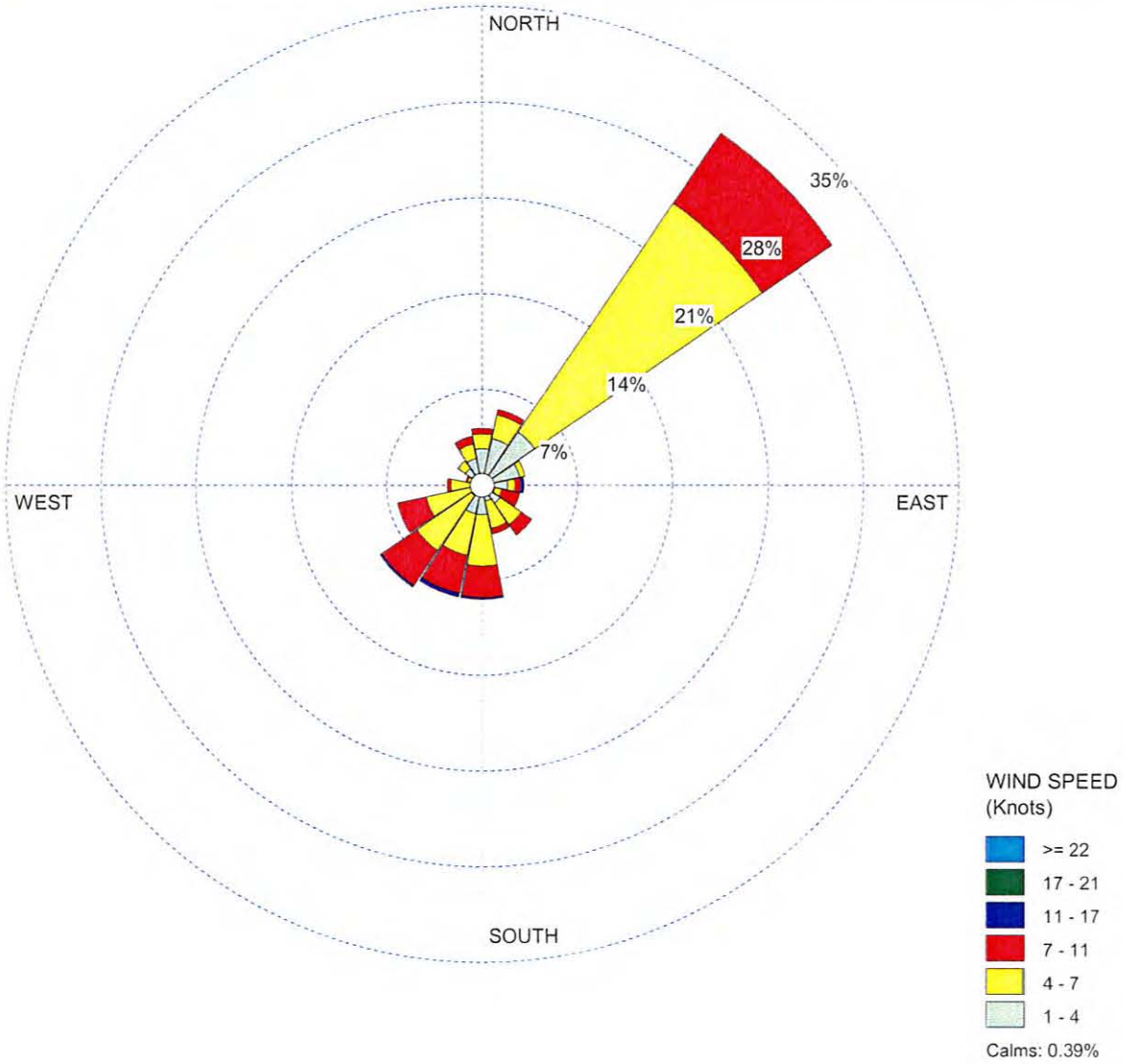


WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
July 2011

DISPLAY:

Wind Speed
Direction (blowing from)



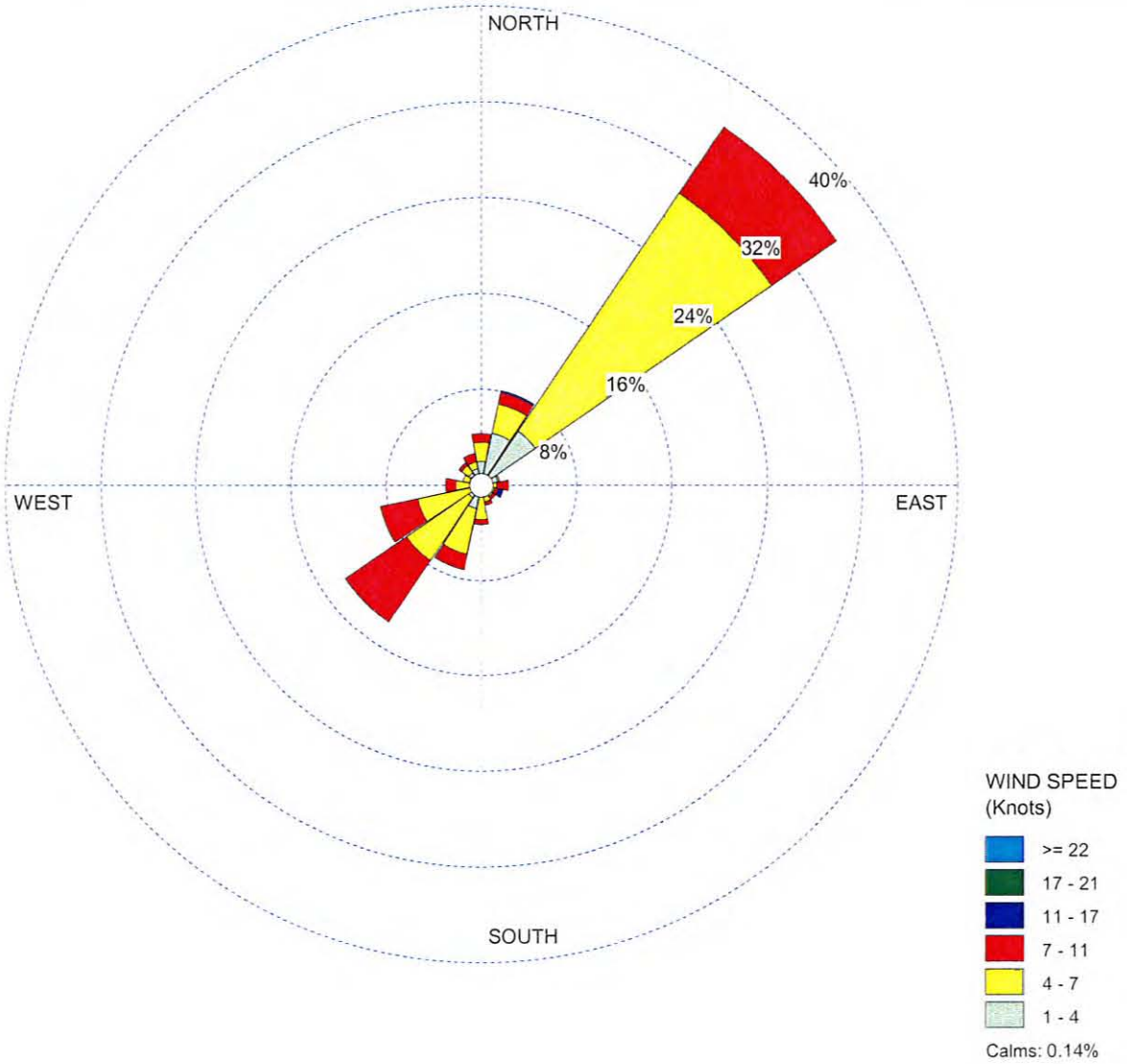
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 7/1/2011 - 00:00 End Date: 7/31/2011 - 23:00	Coal Hollow Mine	
		MODELER: K. Nicholes	
	CALM WINDS: 0.39%	TOTAL COUNT: 744 hrs.	
	AVG. WIND SPEED: 5.22 Knots	DATE: 10/10/2011	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
August 2011

DISPLAY:

Wind Speed
Direction (blowing from)



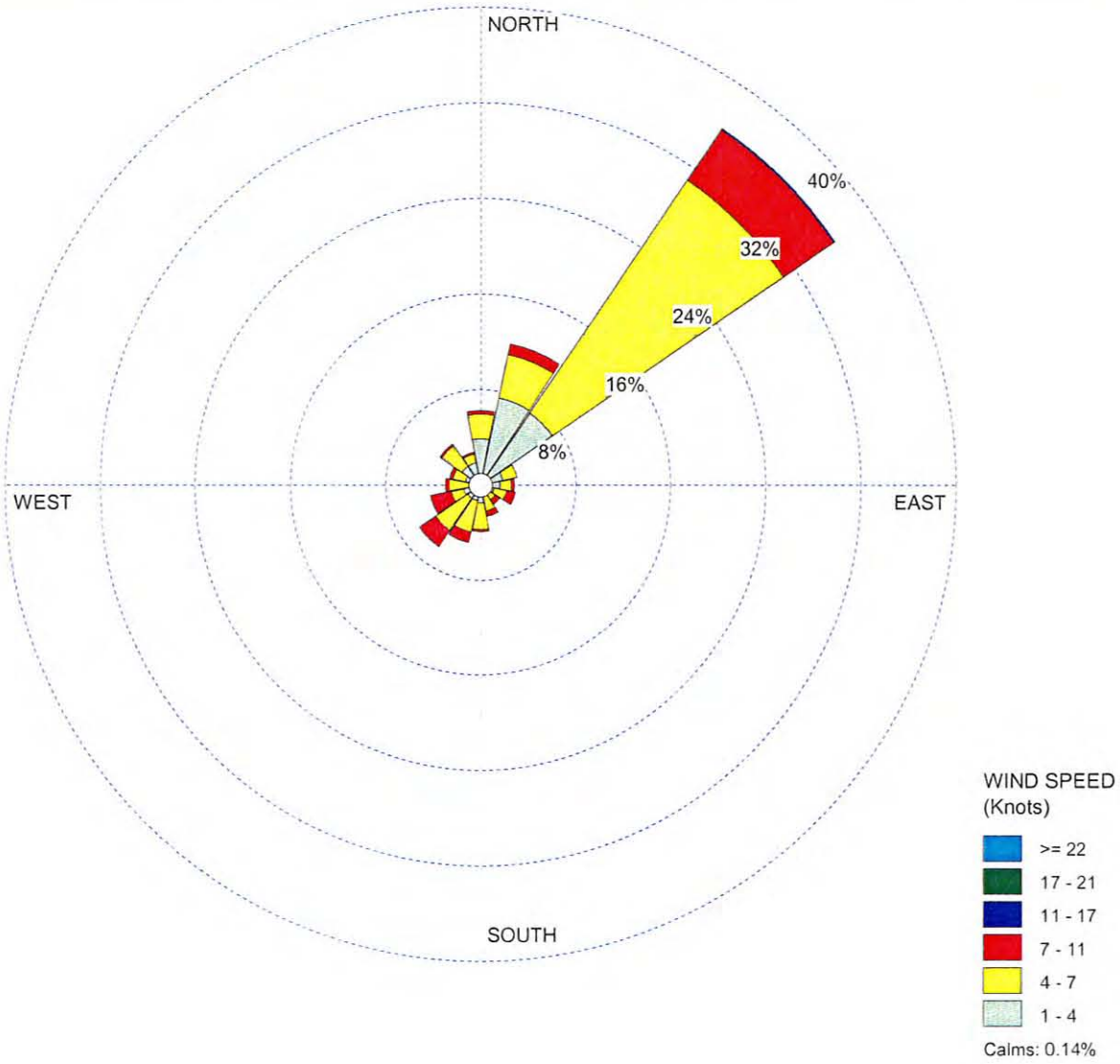
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 8/1/2011 - 00:00 End Date: 8/29/2011 - 23:00	Coal Hollow Mine	
		MODELER: K. Nicholes	
	CALM WINDS: 0.14%	TOTAL COUNT: 696 hrs.	
	AVG. WIND SPEED: 5.54 Knots	DATE: 10/10/2011	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
September 2011

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 9/1/2011 - 00:00 **End Date: 9/30/2011 - 23:00**	**Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **0.14%**	TOTAL COUNT: **672 hrs.**	
	AVG. WIND SPEED: **4.85 Knots**	DATE: **10/10/2011**	PROJECT NO.:

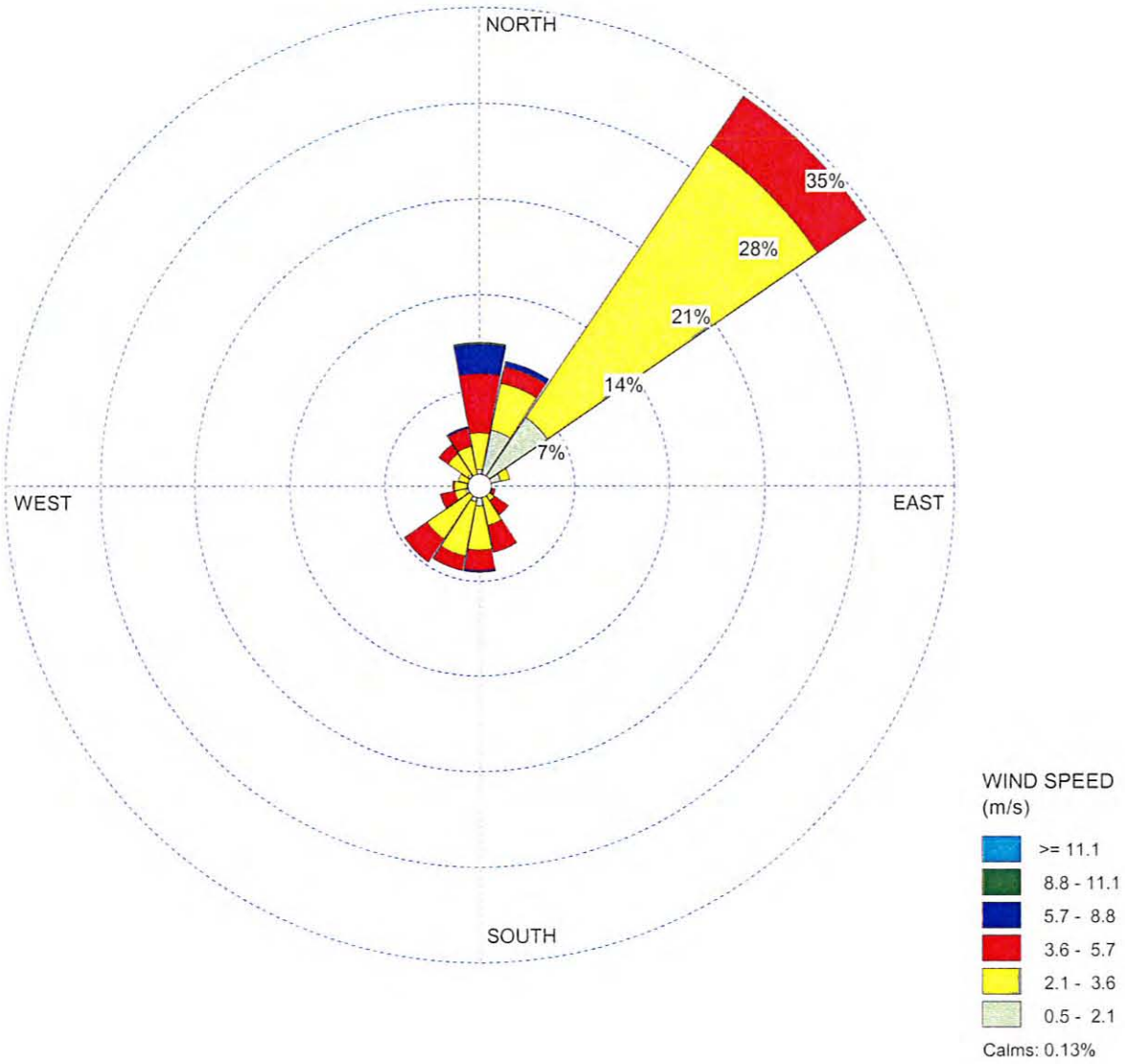
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2011 October

DISPLAY:

Wind Speed
Direction (blowing from)



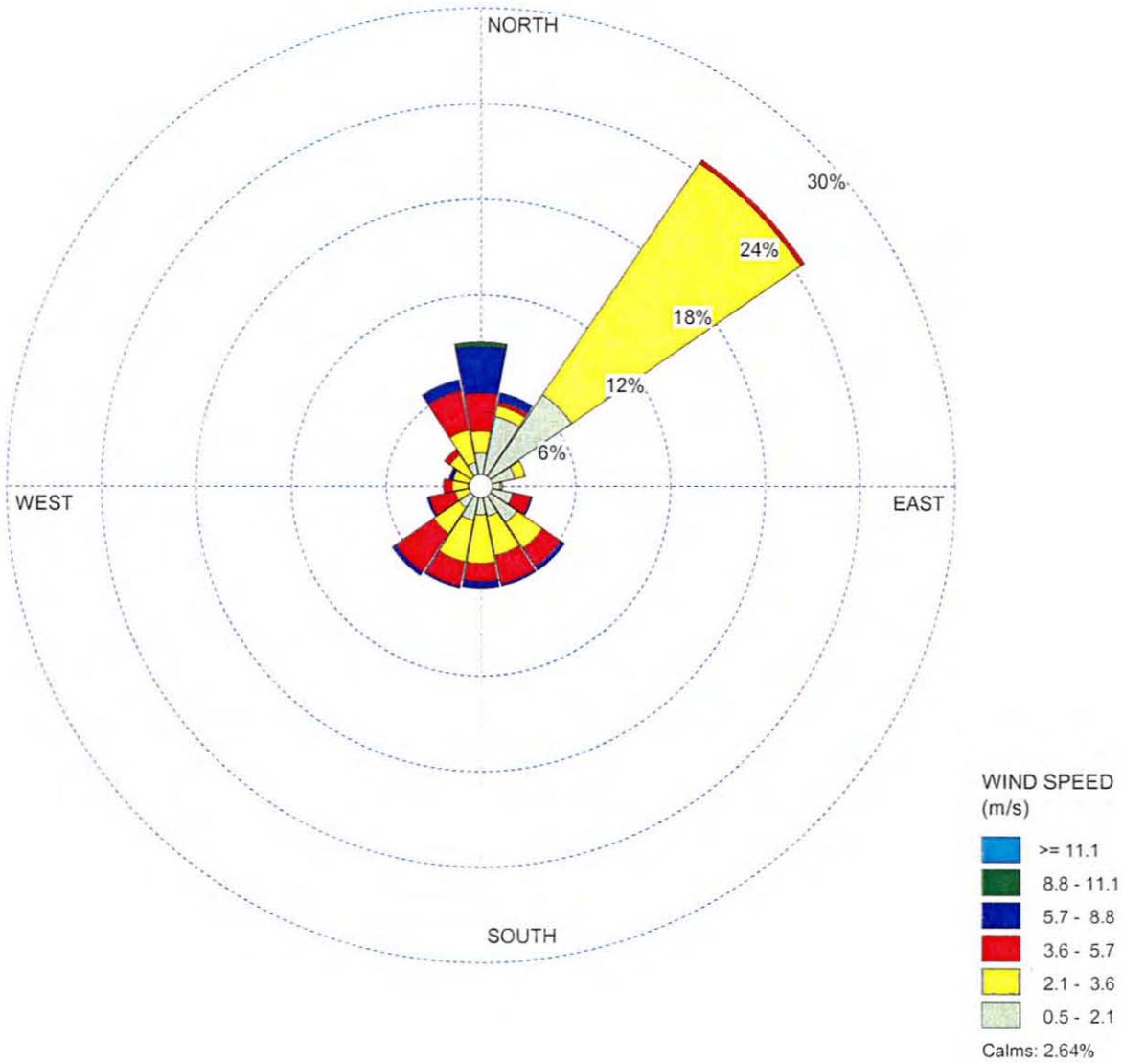
COMMENTS:	DATA PERIOD: Start Date: 10/1/2011 - 01:00 End Date: 10/31/2011 - 23:00	COMPANY NAME: Coal Hollow Mine	
		MODELER: K. Nicholes	
	CALM WINDS: 0.13%	TOTAL COUNT: 744 hrs.	
	AVG. WIND SPEED: 2.92 m/s	DATE: 1/13/2012	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2011 November

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: Start Date: 11/1/2011 - 00:00 End Date: 11/30/2011 - 23:00	COMPANY NAME: Coal Hollow Mine	
		MODELER: K. Nicholes	
	CALM WINDS: 2.64%	TOTAL COUNT: 720 hrs.	
	AVG. WIND SPEED: 2.81 m/s	DATE: 1/13/2012	PROJECT NO.:

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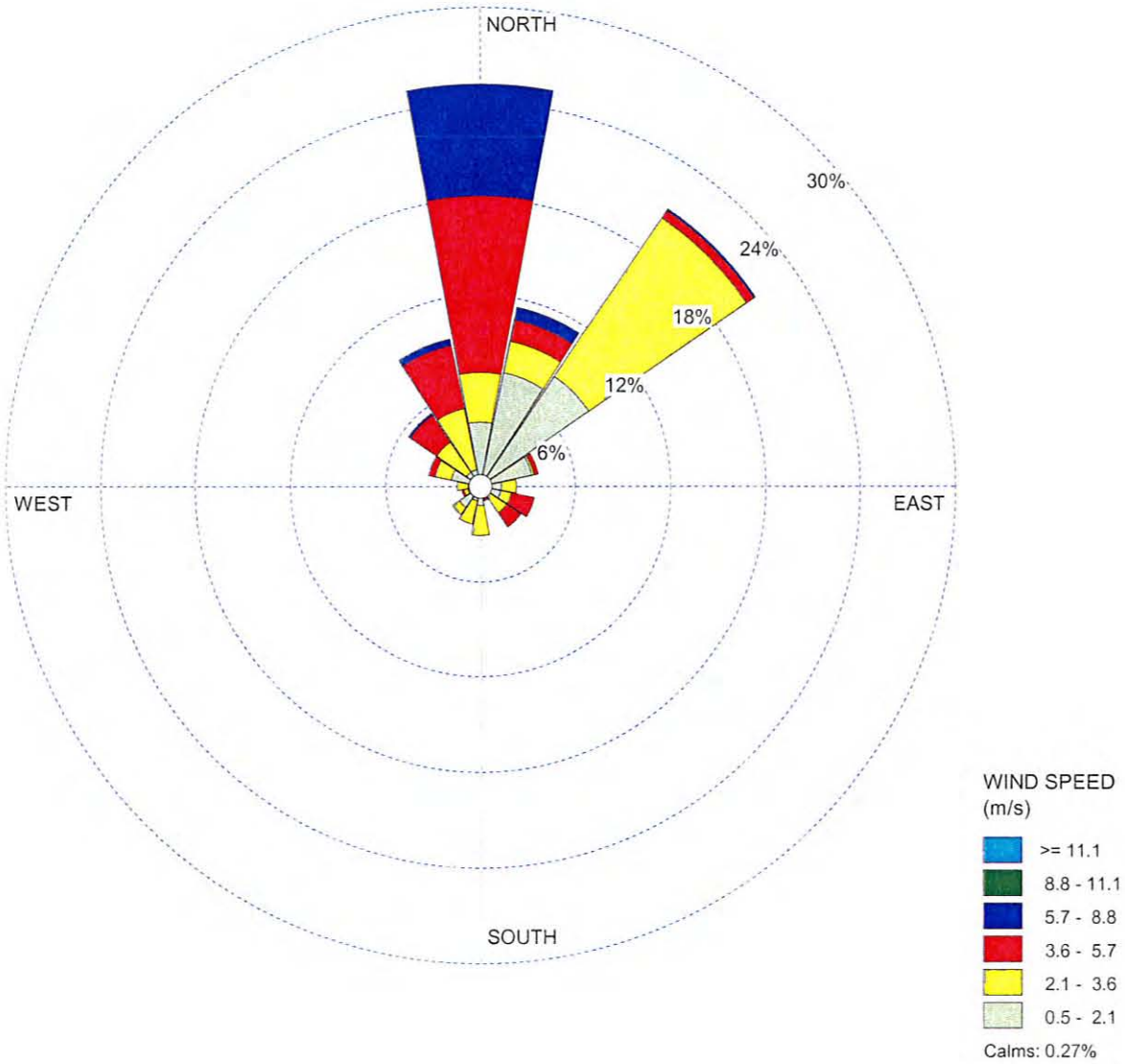
WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2011 December

DISPLAY:

Wind Speed
Direction (blowing from)



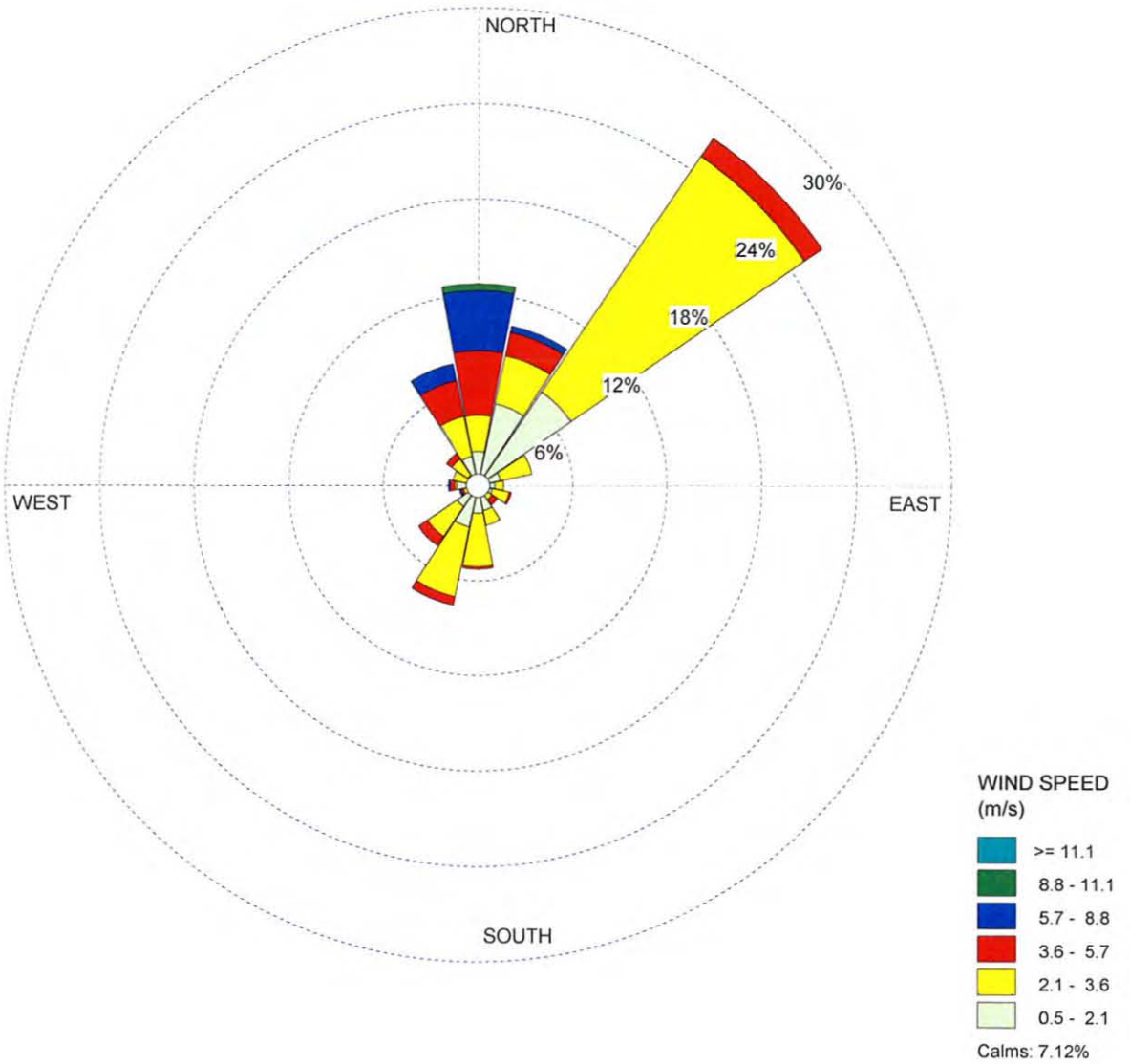
COMMENTS:	DATA PERIOD: **Start Date: 12/1/2011 - 00:00** **End Date: 12/31/2011 - 23:00**	COMPANY NAME: **Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **0.27%**	TOTAL COUNT: **744 hrs.**	
	AVG. WIND SPEED: **3.01 m/s**	DATE: **1/13/2012**	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2012 January

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 1/1/2012 - 00:00** **End Date: 1/31/2012 - 23:00**	COMPANY NAME: **Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **7.12%**	TOTAL COUNT: **744 hrs.**	
	AVG. WIND SPEED: **2.61 m/s**	DATE: **4/25/2012**	PROJECT NO.:

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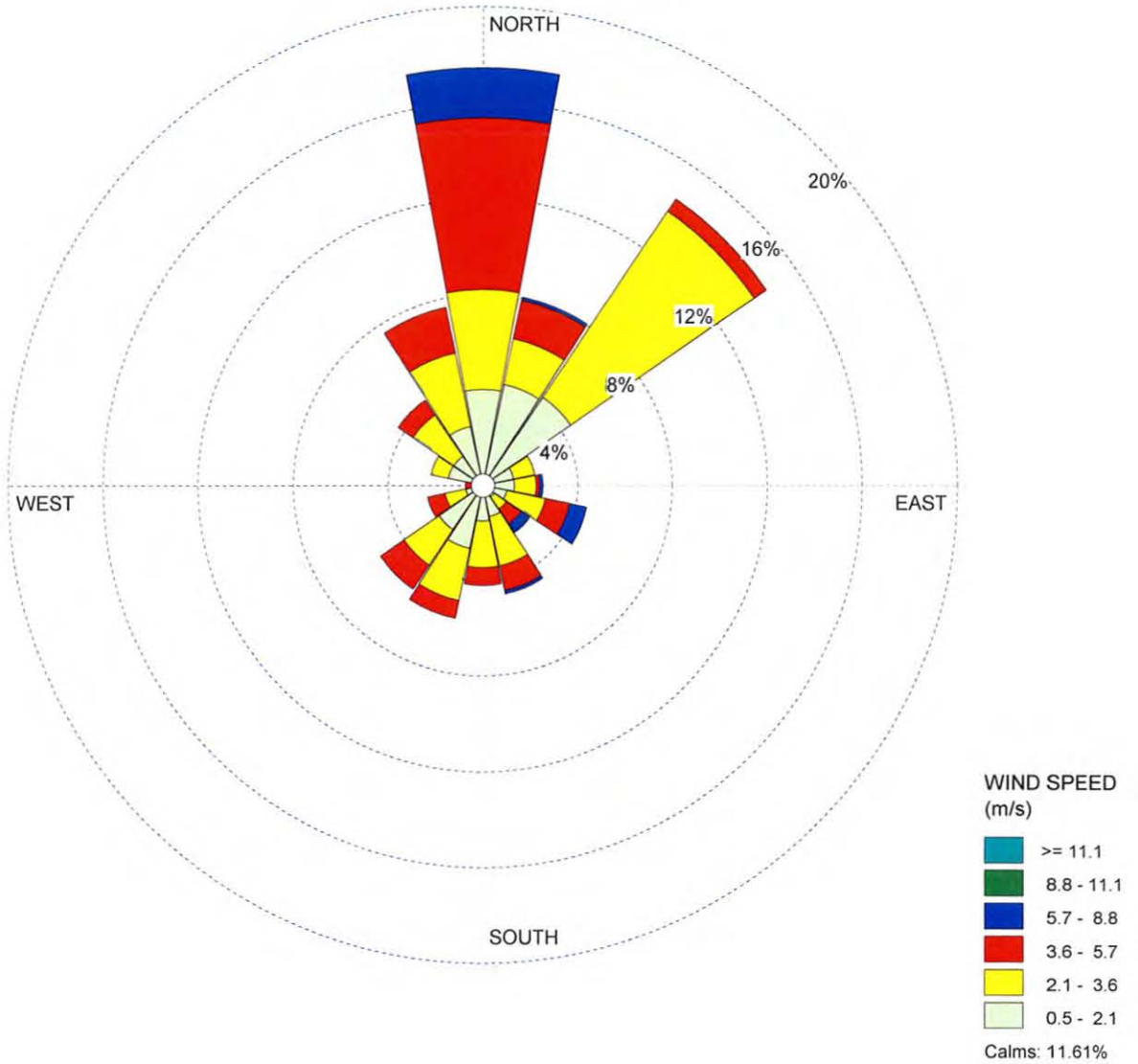
WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2012 February

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 2/1/2012 - 00:00** **End Date: 2/28/2012 - 23:00**	COMPANY NAME: **Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **11.61%**	TOTAL COUNT: **672 hrs.**	
	AVG. WIND SPEED: **2.50 m/s**	DATE: **4/25/2012**	PROJECT NO.:

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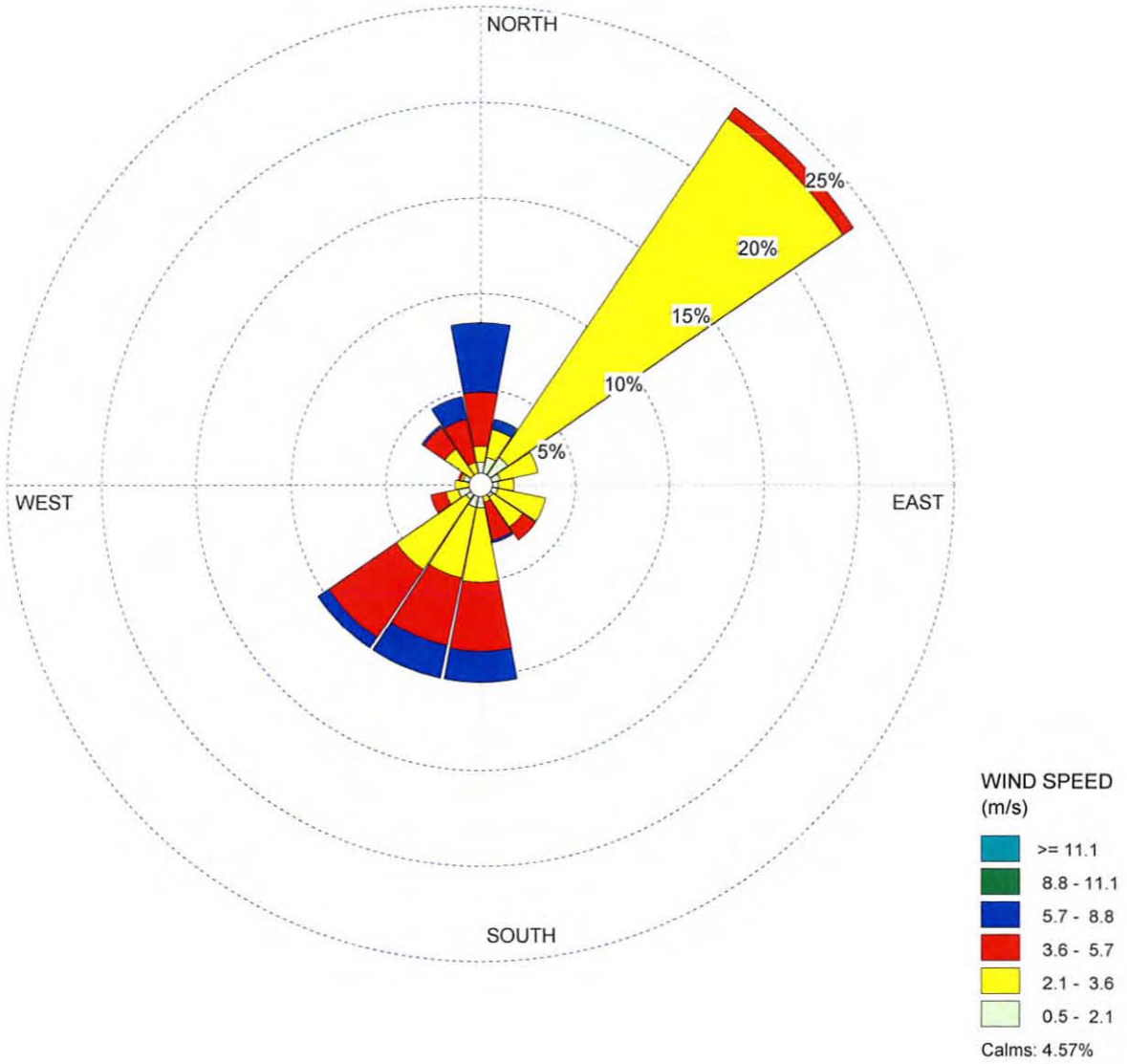
WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2012 March

DISPLAY:

Wind Speed
Direction (blowing from)



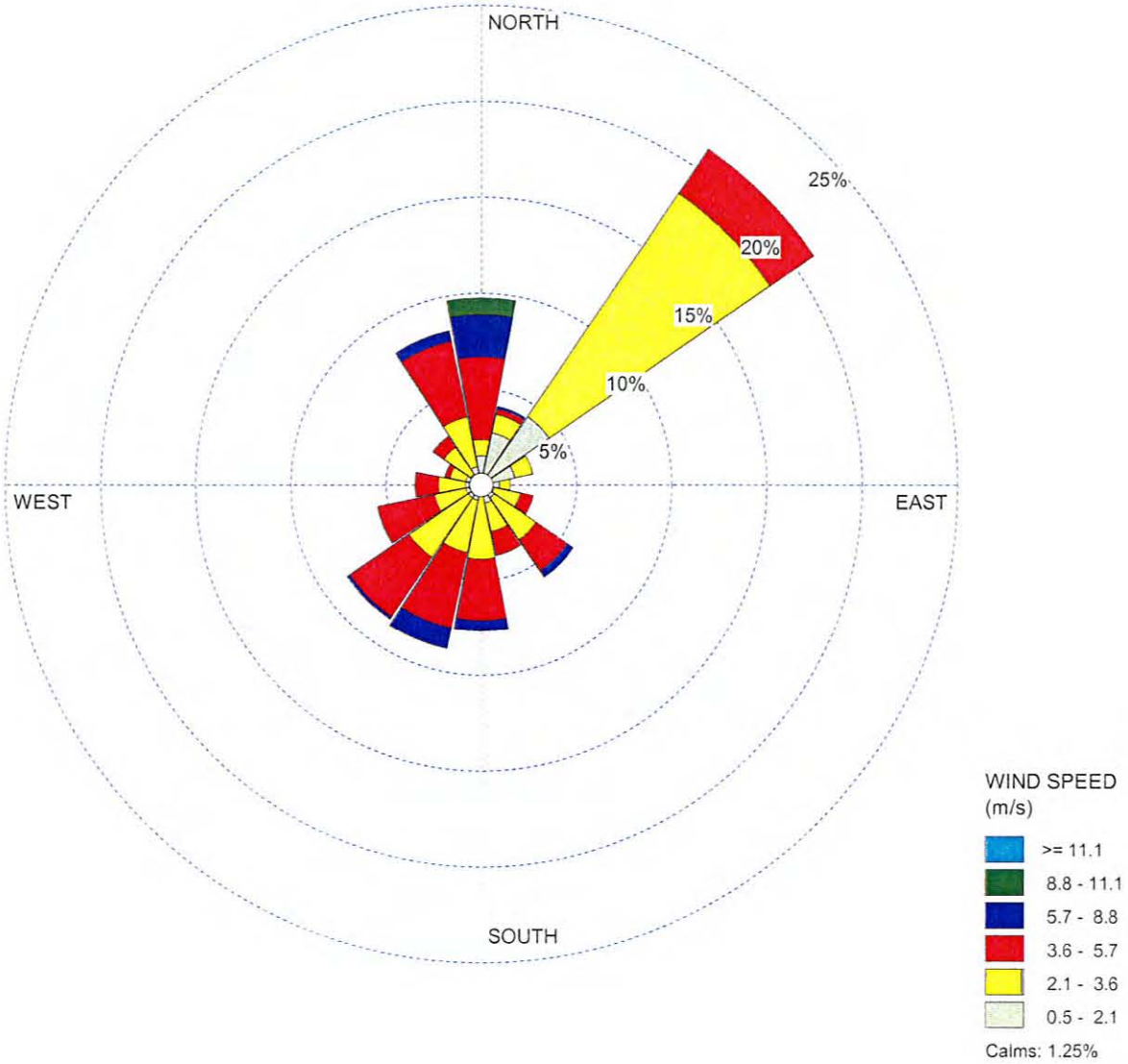
COMMENTS:	DATA PERIOD: **Start Date: 3/1/2012 - 00:00** **End Date: 3/31/2012 - 23:00**	COMPANY NAME: **Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **4.57%**	TOTAL COUNT: **744 hrs.**	
	AVG. WIND SPEED: **3.21 m/s**	DATE: **4/25/2012**	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2012 April

DISPLAY:

Wind Speed
Direction (blowing from)



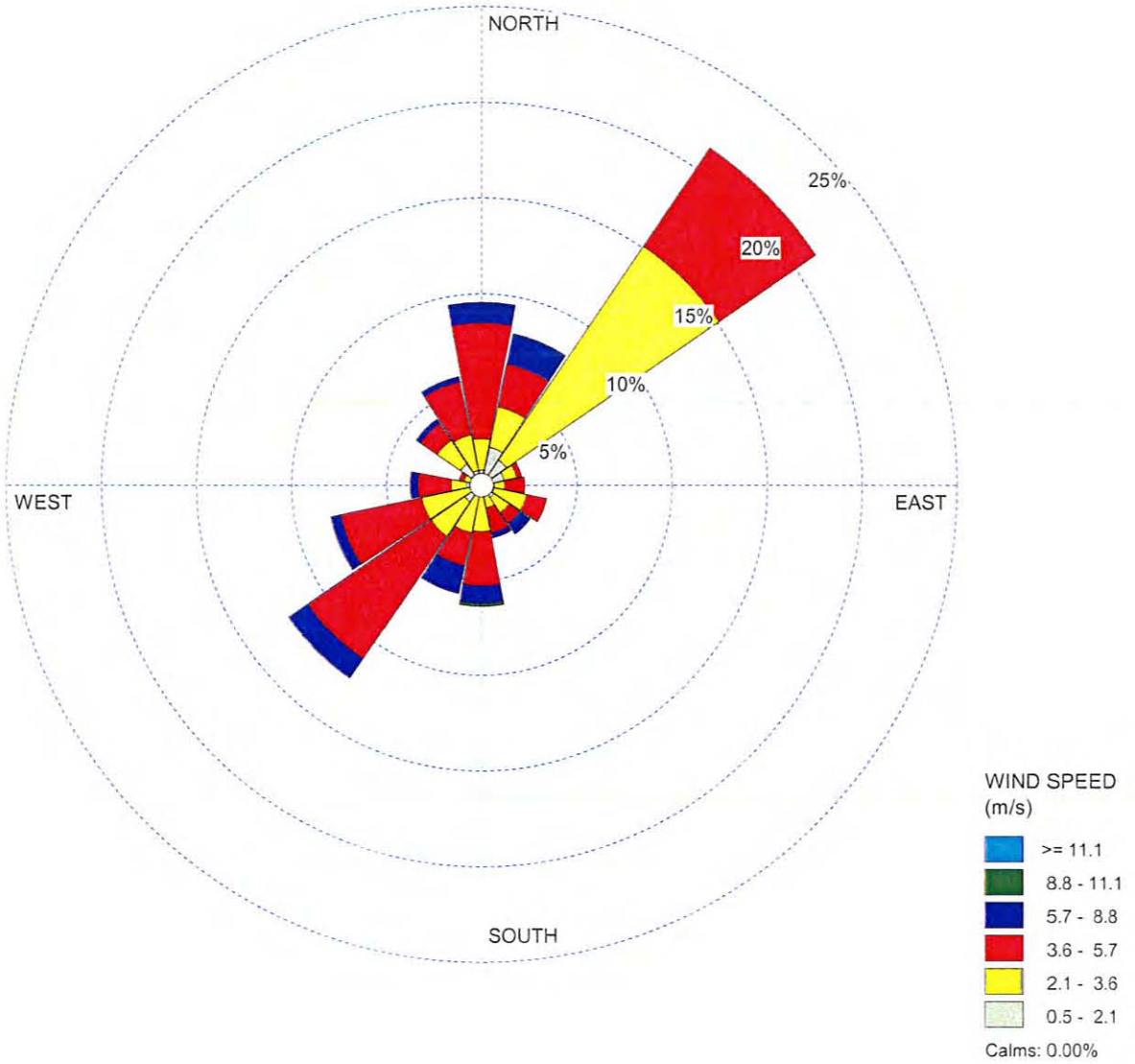
COMMENTS:	DATA PERIOD: Start Date: 4/1/2012 - 00:00 End Date: 4/30/2012 - 23:00	COMPANY NAME: Coal Hollow Mine	
		MODELER: K. Nicholes	
	CALM WINDS: 1.25%	TOTAL COUNT: 720 hrs.	
	AVG. WIND SPEED: 3.30 m/s	DATE: 7/6/2012	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2012 May

DISPLAY:

Wind Speed
Direction (blowing from)



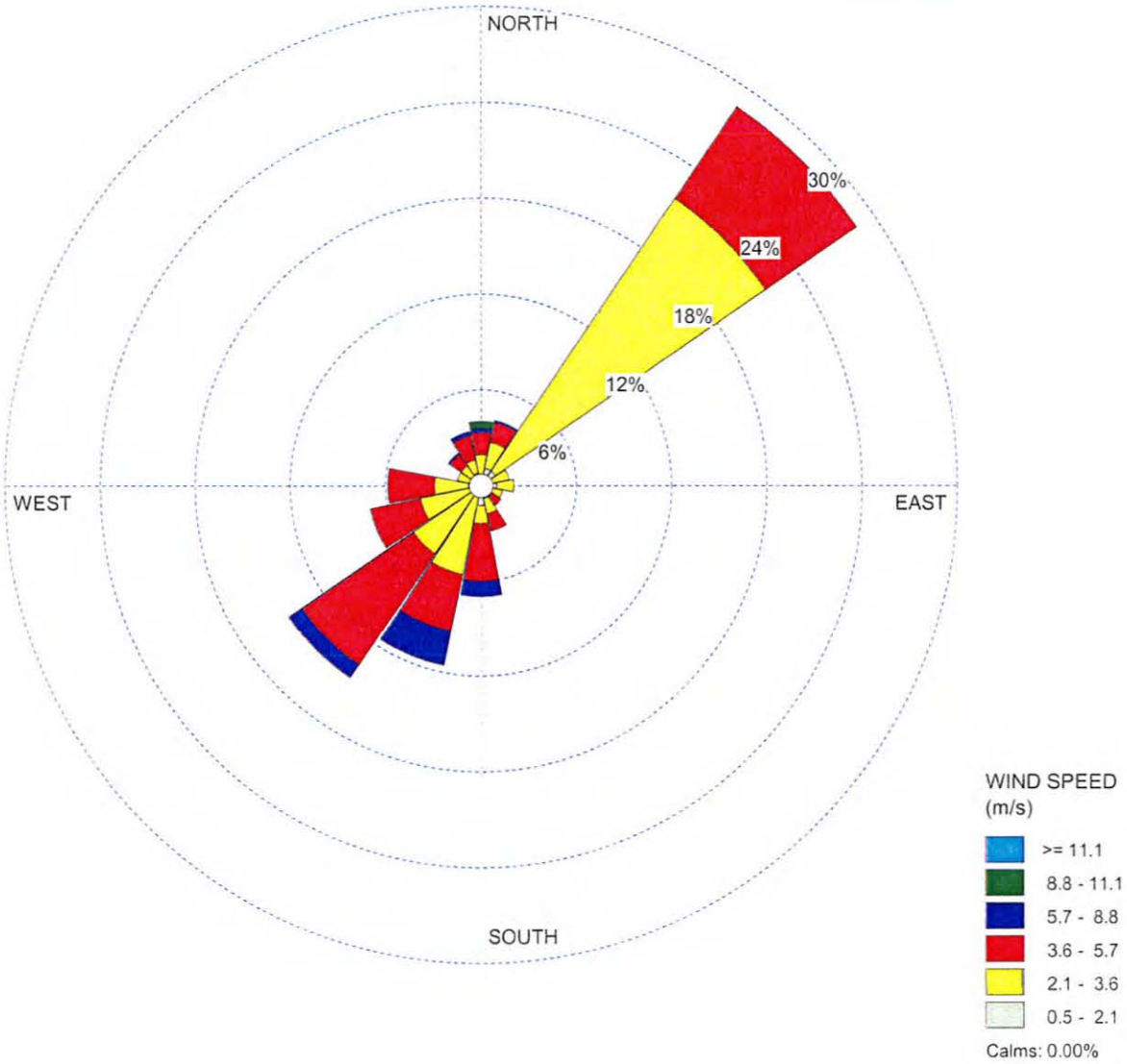
COMMENTS:	DATA PERIOD: **Start Date: 5/1/2012 - 00:00** **End Date: 5/31/2012 - 23:00**	COMPANY NAME: **Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **0.00%**	TOTAL COUNT: **744 hrs.**	
	AVG. WIND SPEED: **3.66 m/s**	DATE: **7/6/2012**	PROJECT NO.

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2012 June

DISPLAY:

Wind Speed
Direction (blowing from)



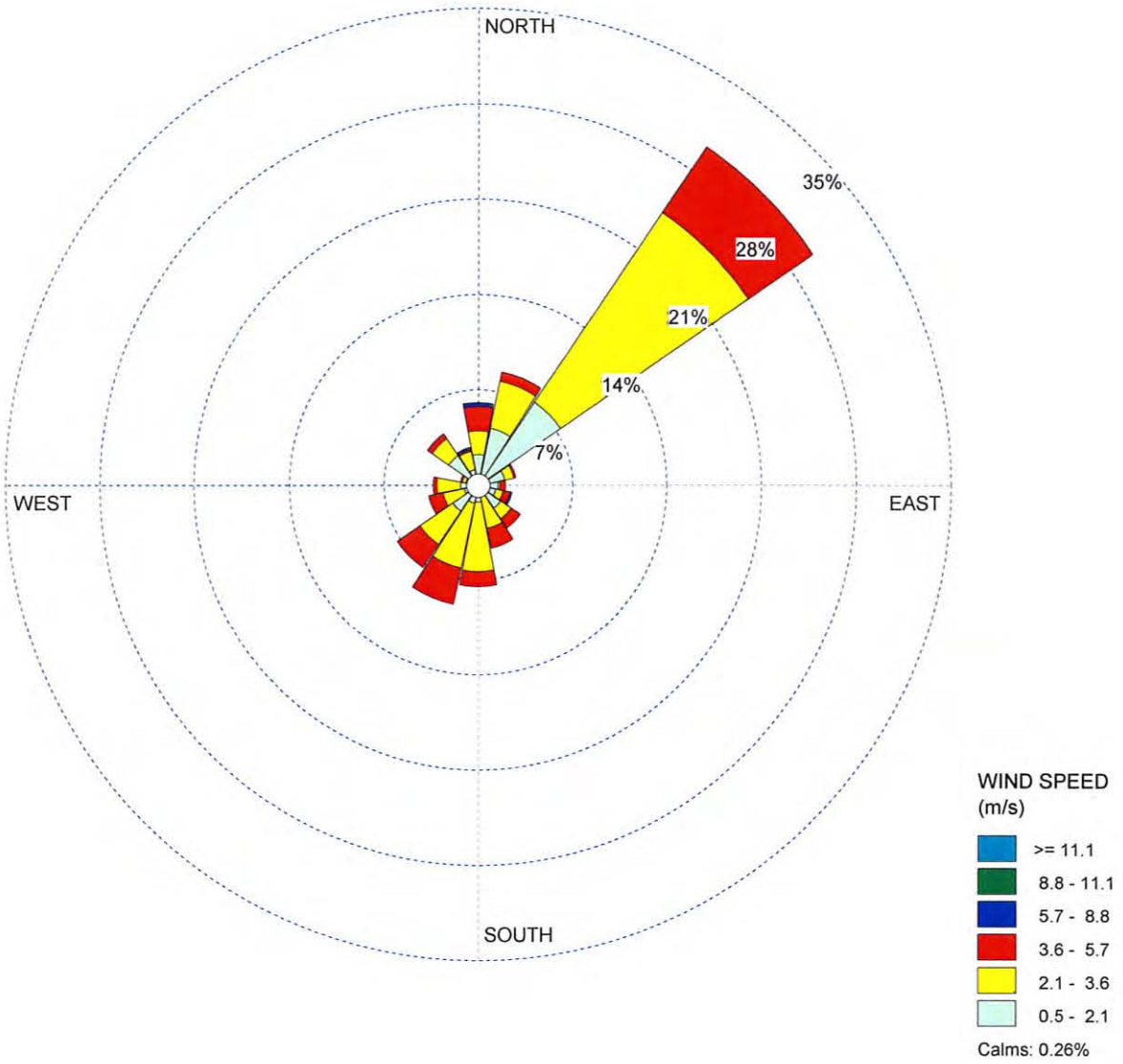
COMMENTS:	DATA PERIOD: Start Date: 6/1/2012 - 00:00 End Date: 6/30/2012 - 23:00	COMPANY NAME: Coal Hollow Mine	
		MODELER: K. Nicholes	
	CALM WINDS: 0.00%	TOTAL COUNT: 720 hrs.	
	AVG. WIND SPEED: 3.46 m/s	DATE: 7/6/2012	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2012 July

DISPLAY:

Wind Speed
Direction (blowing from)



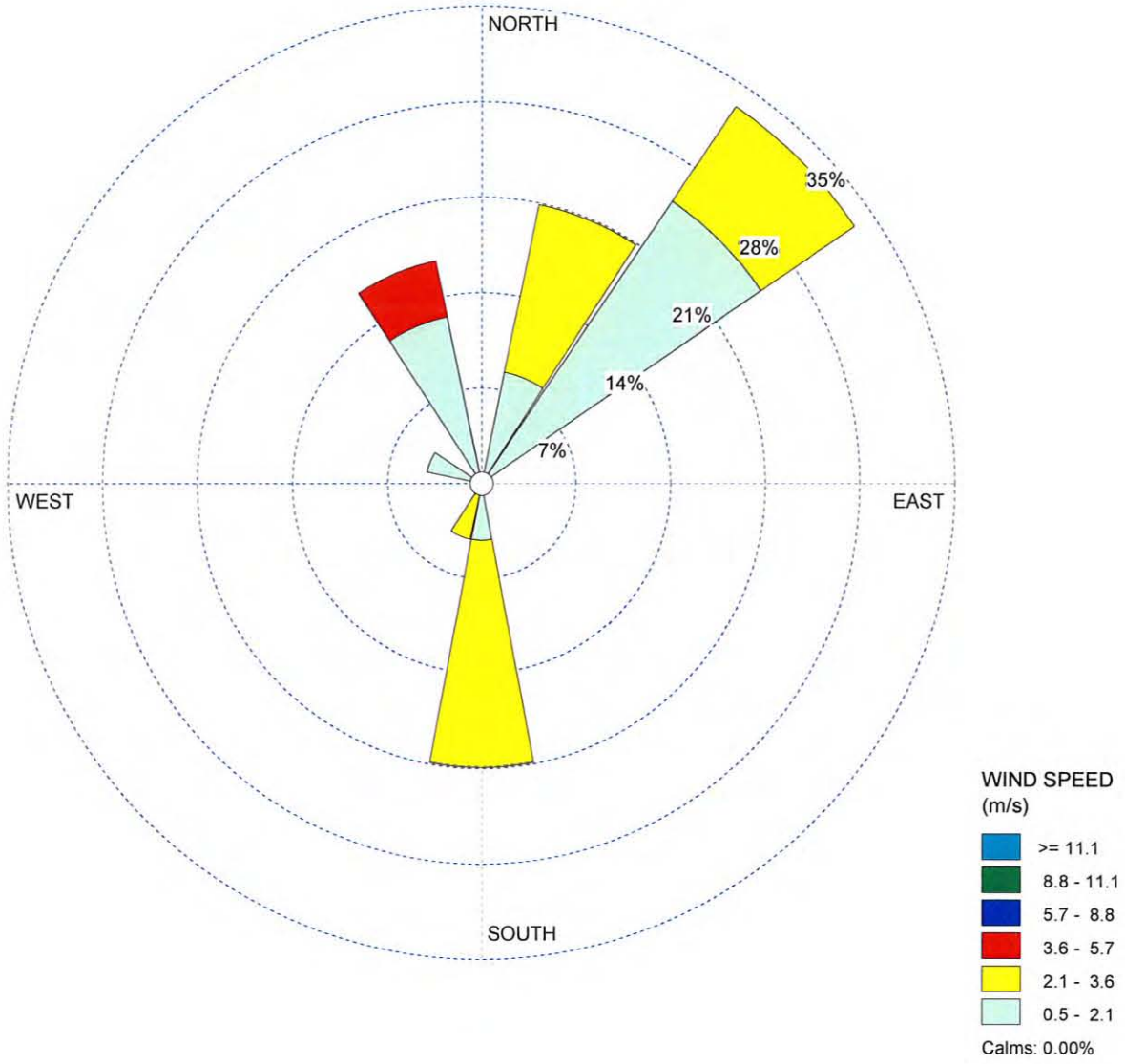
COMMENTS:	DATA PERIOD: **Start Date: 7/1/2012 - 00:00** **End Date: 7/31/2012 - 23:00**	COMPANY NAME: **Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **0.26%**	TOTAL COUNT: **744 hrs.**	
	AVG. WIND SPEED: **2.63 m/s**	DATE: **10/2/2012**	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2012 August

DISPLAY:

Wind Speed
Direction (blowing from)



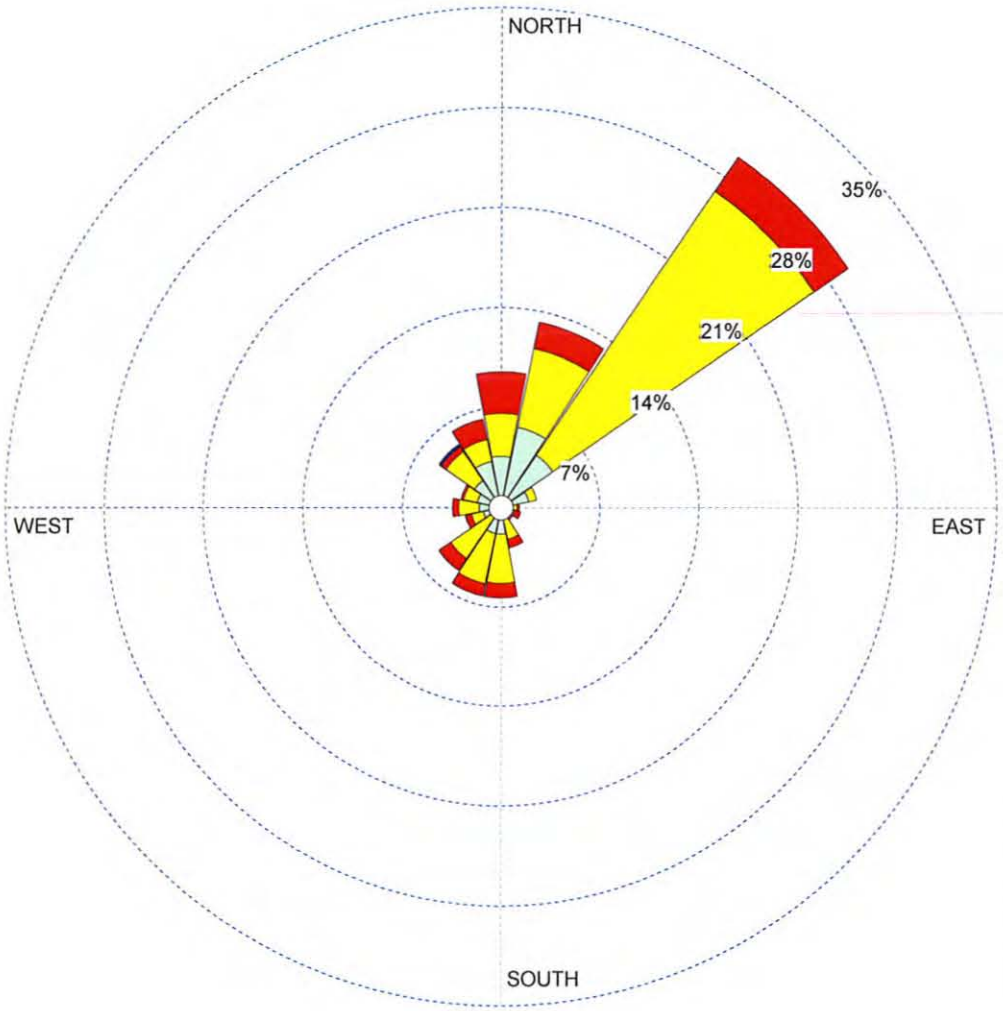
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 8/1/2012 - 00:00 **End Date: 8/1/2012 - 23:00**	**Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **0.00%**	TOTAL COUNT: **24 hrs.**	
	AVG. WIND SPEED: **2.06 m/s**	DATE: **10/2/2012**	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2012 September

DISPLAY:

Wind Speed
Direction (blowing from)



WIND SPEED
(m/s)

- >= 11.1
- 8.8 - 11.1
- 5.7 - 8.8
- 3.6 - 5.7
- 2.1 - 3.6
- 0.5 - 2.1

Calms: 0.00%

COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 9/2/2012 - 00:00 **End Date: 9/30/2012 - 23:00**	**Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **0.00%**	TOTAL COUNT: **696 hrs.**	
	AVG. WIND SPEED: **2.58 m/s**	DATE: **10/2/2012**	PROJECT NO.:

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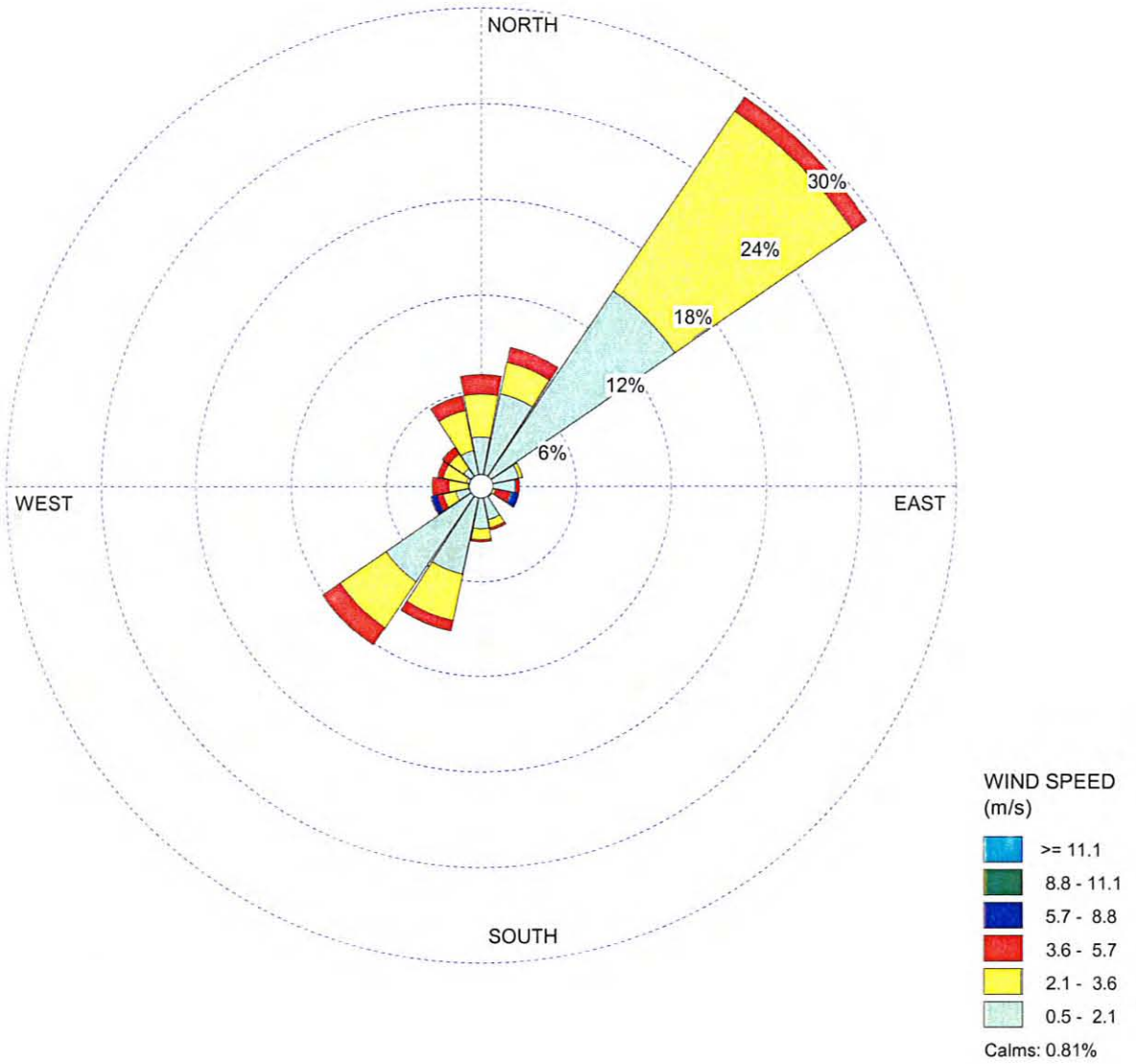
WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2012 October

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 10/1/2012 - 00:00** **End Date: 10/31/2012 - 23:00**	COMPANY NAME: **Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **0.81%**	TOTAL COUNT: **744 hrs.**	
	AVG. WIND SPEED: **2.11 m/s**	DATE: **1/15/2013**	PROJECT NO.:

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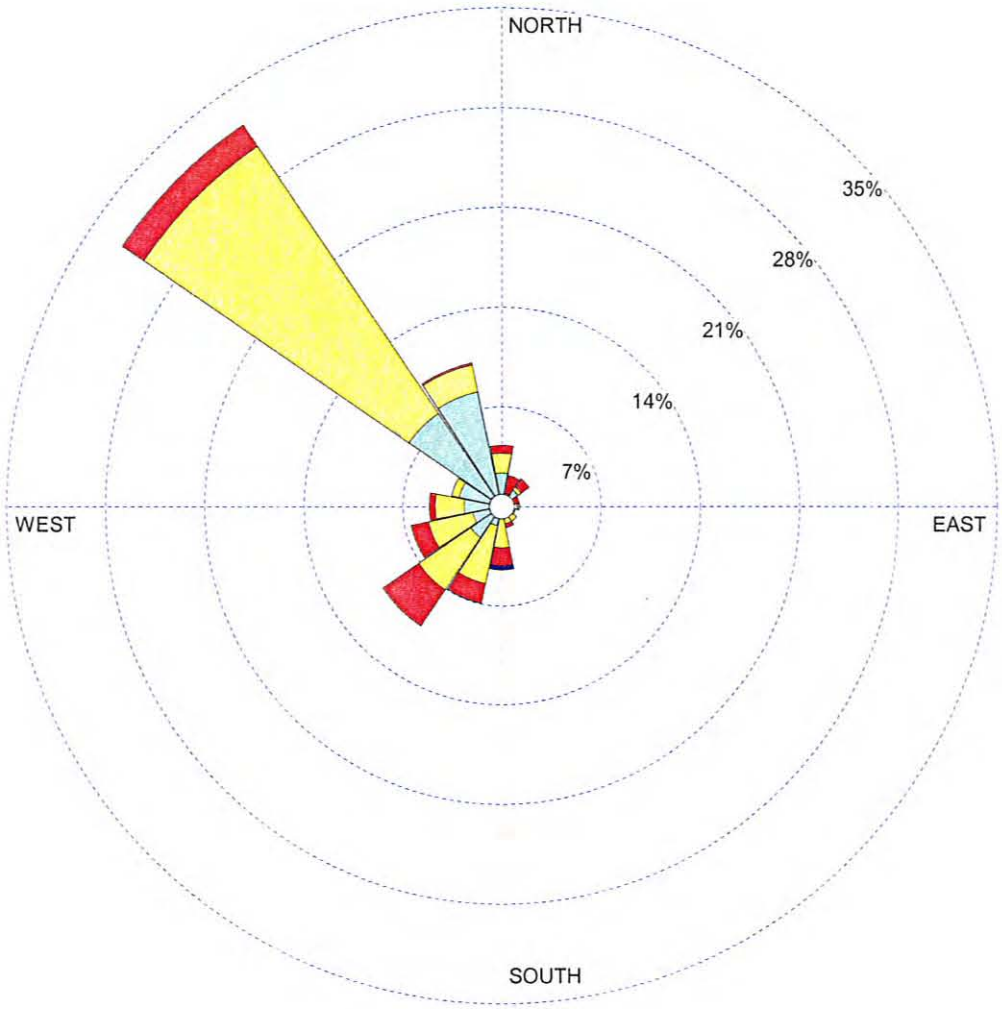
WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2012 November

DISPLAY:

Wind Speed
Direction (blowing from)



WIND SPEED
(m/s)

- >= 11.1
- 8.8 - 11.1
- 5.7 - 8.8
- 3.6 - 5.7
- 2.1 - 3.6
- 0.5 - 2.1

Calms: 5.42%

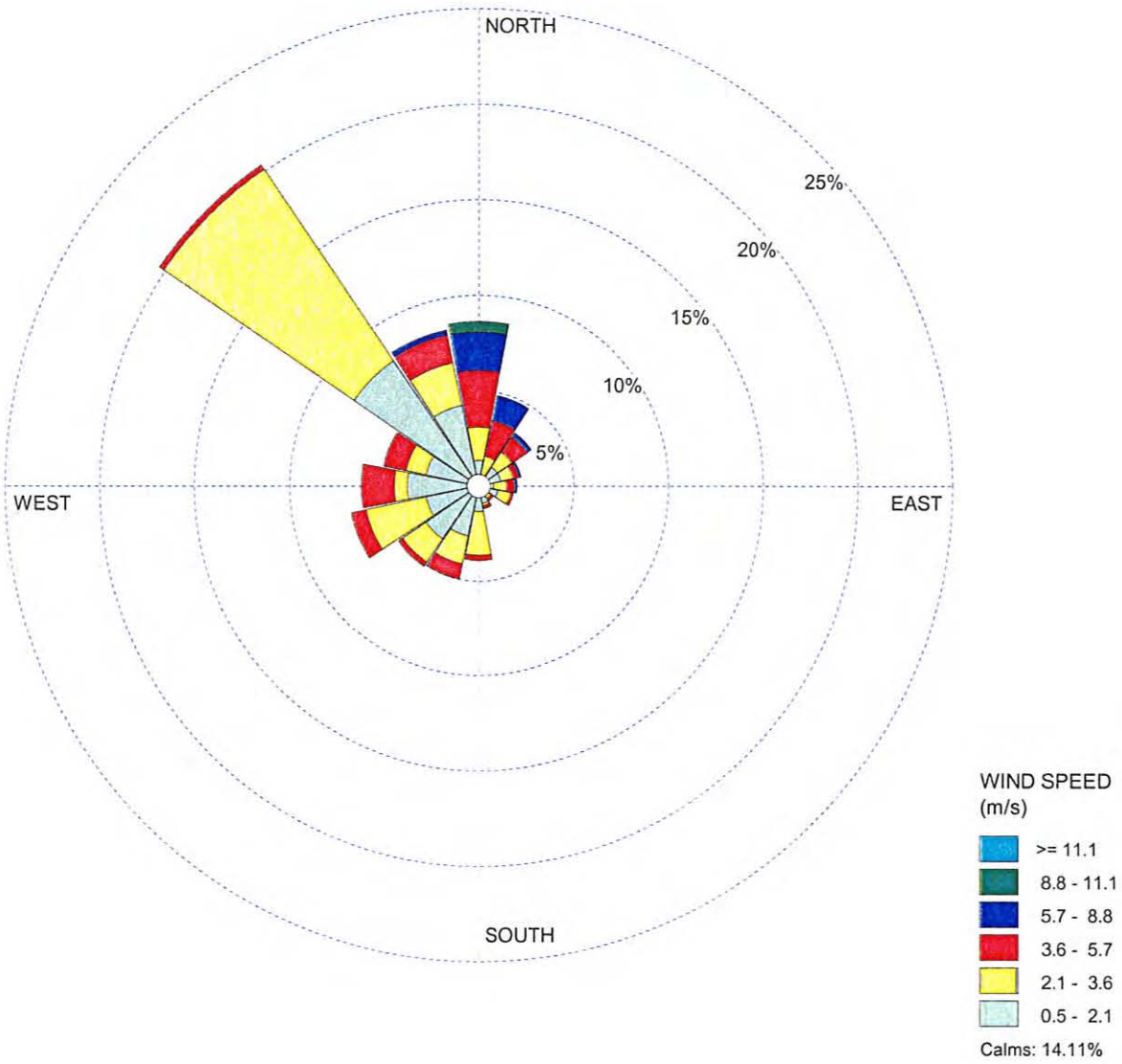
COMMENTS:	DATA PERIOD: **Start Date: 11/1/2012 - 00:00** **End Date: 11/30/2012 - 23:00**	COMPANY NAME: **Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **5.42%**	TOTAL COUNT: **720 hrs.**	
	AVG. WIND SPEED: **2.36 m/s**	DATE: **1/15/2013**	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2012 December

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 12/1/2012 - 00:00 **End Date: 12/31/2012 - 23:00**	**Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **14.11%**	TOTAL COUNT: **744 hrs.**	
	AVG. WIND SPEED: **2.26 m/s**	DATE: **1/15/2013**	PROJECT NO.:

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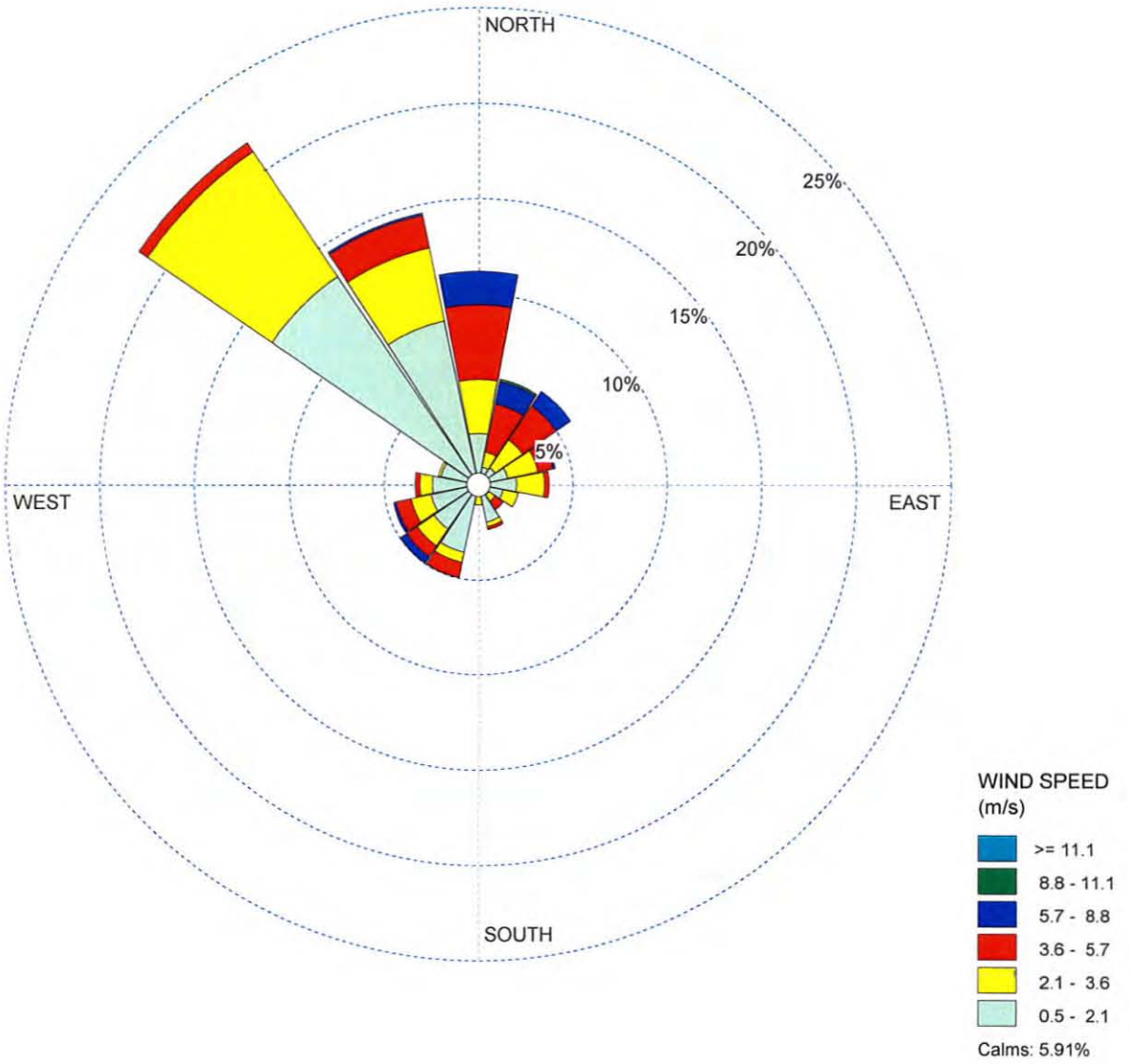
WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2013 Januarary

DISPLAY:

Wind Speed
Direction (blowing from)



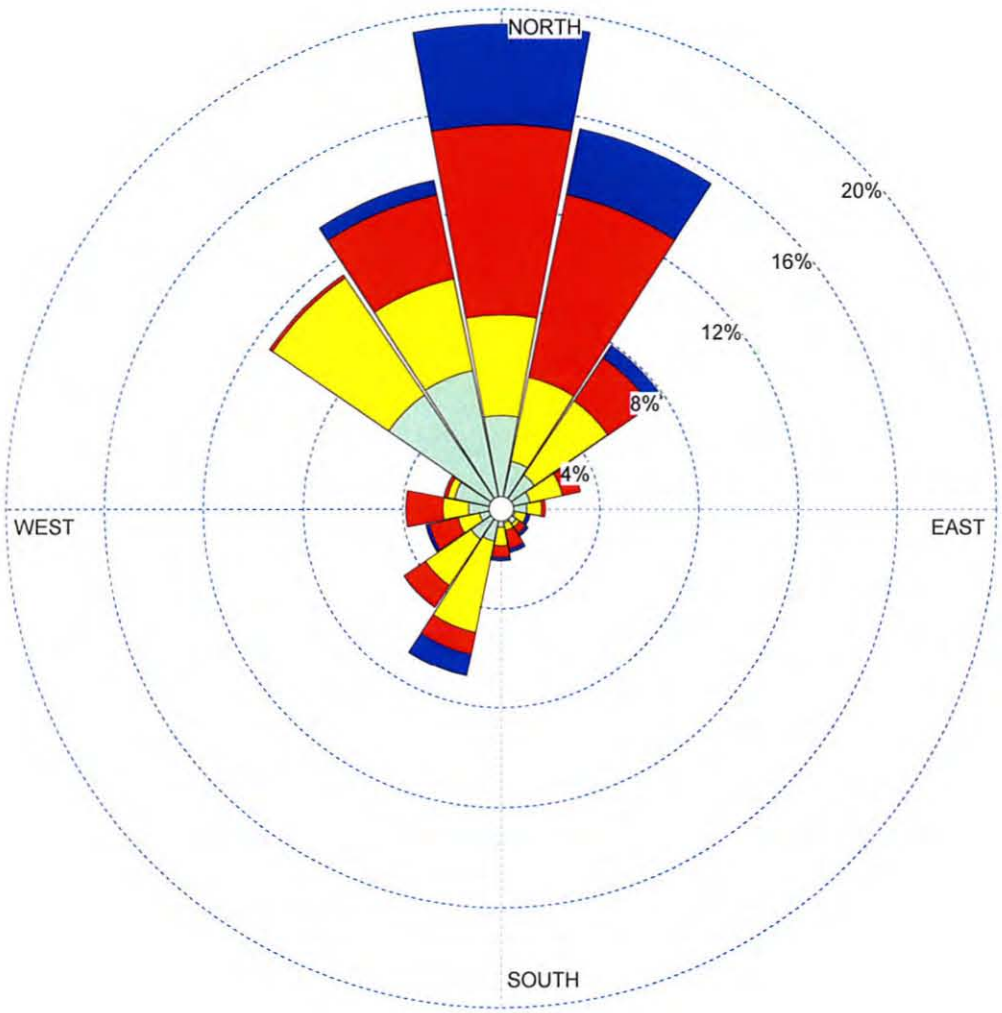
COMMENTS:	DATA PERIOD: **Start Date: 1/1/2013 - 00:00** **End Date: 1/31/2013 - 23:00**	COMPANY NAME: **Alton Coal Development, LLC - Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **5.91%**	TOTAL COUNT: **744 hrs.**	
	AVG. WIND SPEED: **2.39 m/s**	DATE: **4/12/2013**	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2013 February

DISPLAY:

Wind Speed
Direction (blowing from)



WIND SPEED
(m/s)

- >= 11.1
- 8.8 - 11.1
- 5.7 - 8.8
- 3.6 - 5.7
- 2.1 - 3.6
- 0.5 - 2.1

Calms: 0.15%

COMMENTS:	DATA PERIOD: **Start Date: 2/1/2013 - 00:00** **End Date: 2/28/2013 - 23:00**	COMPANY NAME: **Alton Coal Development, LLC - Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **0.15%**	TOTAL COUNT: **672 hrs.**	
	AVG. WIND SPEED: **3.22 m/s**	DATE: **4/12/2013**	PROJECT NO.:

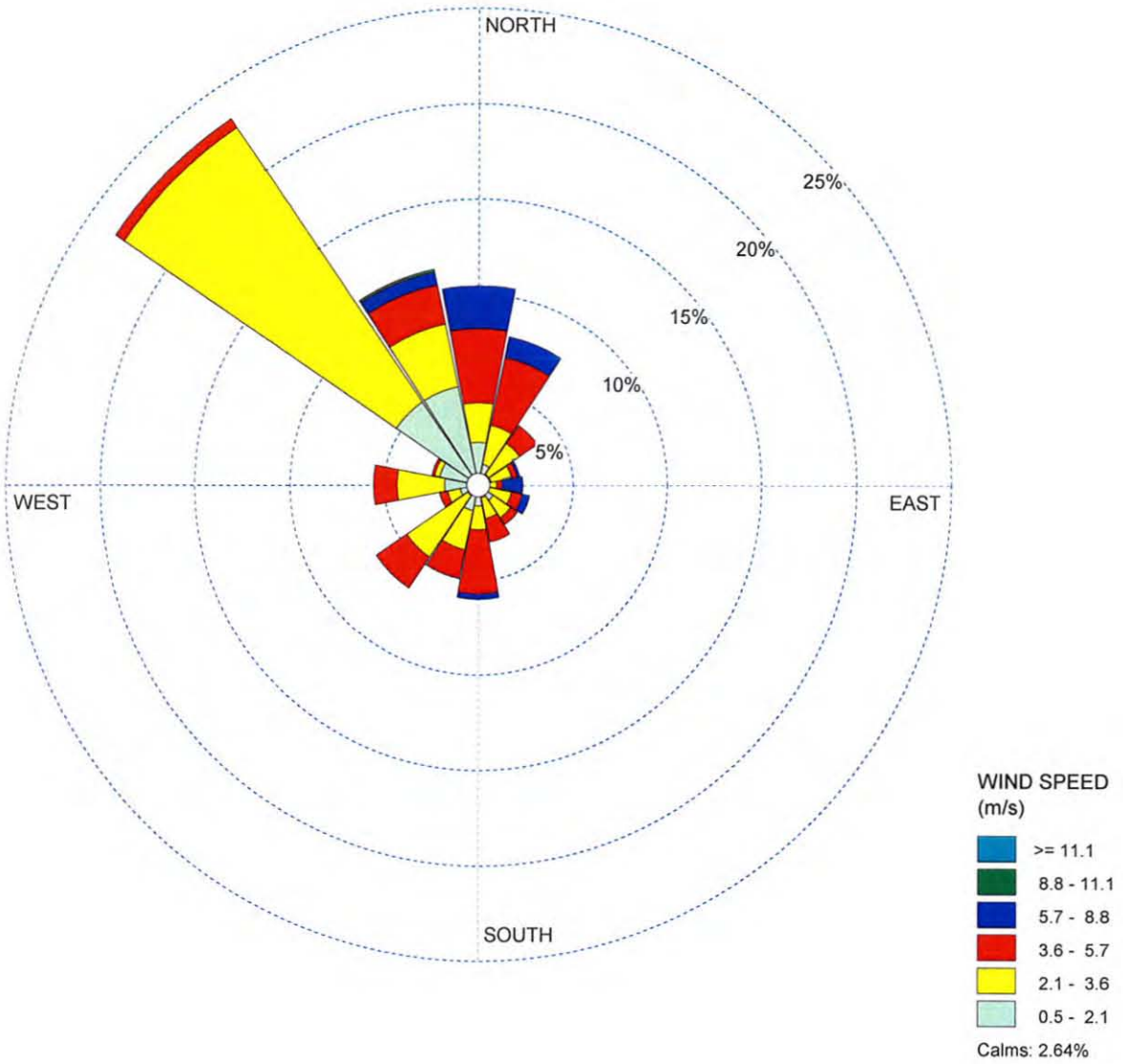
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2013 March

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 3/1/2013 - 00:00** **End Date: 3/30/2013 - 23:00**	COMPANY NAME: **Alton Coal Development, LLC - Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **2.64%**	TOTAL COUNT: **720 hrs.**	
	AVG. WIND SPEED: **2.98 m/s**	DATE: **4/12/2013**	PROJECT NO.:

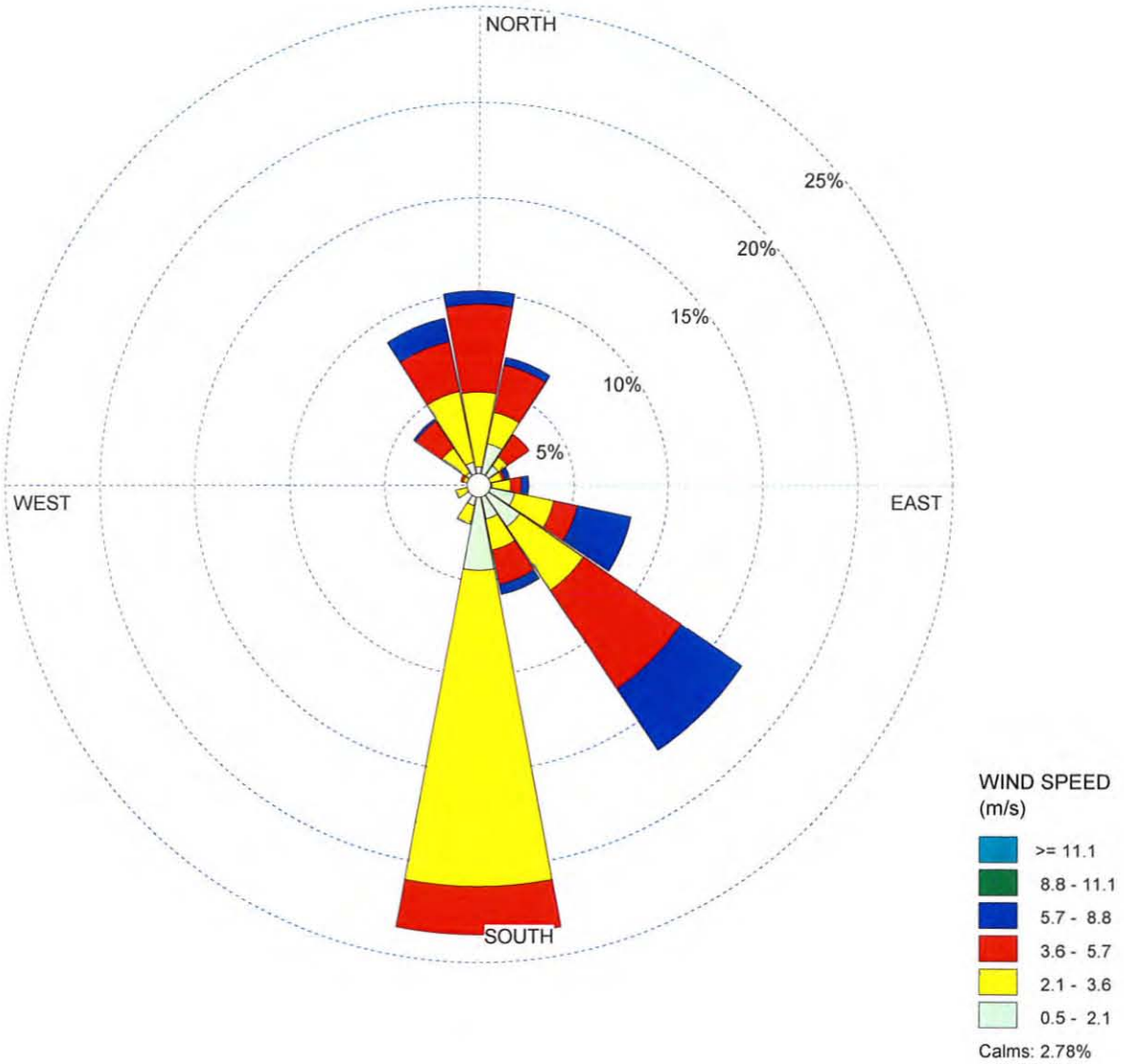
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2014 April

DISPLAY:

Wind Speed
Direction (blowing from)



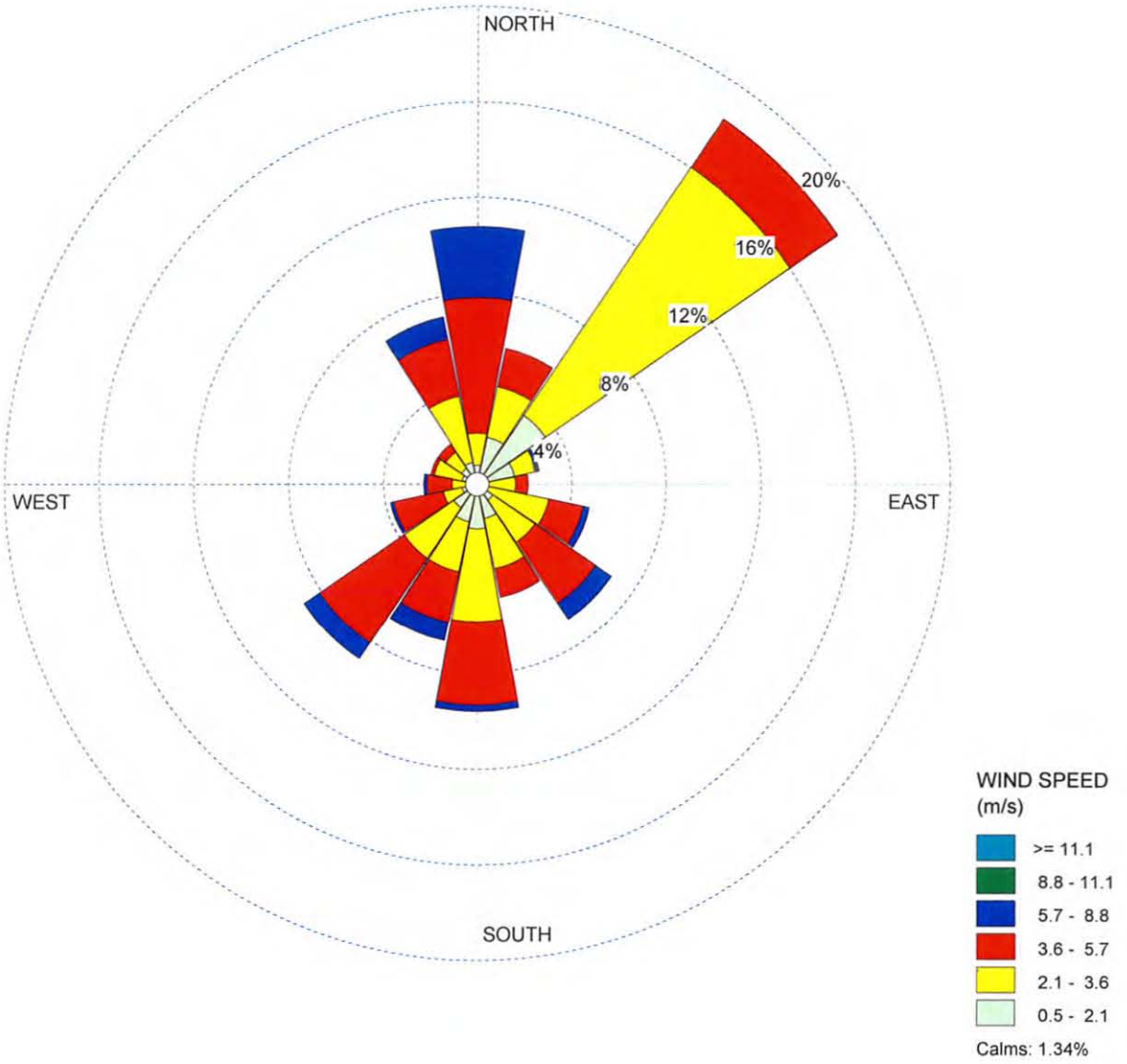
COMMENTS:	DATA PERIOD: **Start Date: 4/1/2014 - 00:00** **End Date: 4/30/2014 - 23:00**	COMPANY NAME: **Alton Coal Development, LLC - Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **2.78%**	TOTAL COUNT: **720 hrs.**	
	AVG. WIND SPEED: **3.23 m/s**	DATE: **7/11/2014**	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2014 May

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 5/1/2014 - 00:00** **End Date: 5/31/2014 - 23:00**	COMPANY NAME: **Alton Coal Development, LLC - Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **1.34%**	TOTAL COUNT: **744 hrs.**	
	AVG. WIND SPEED: **3.31 m/s**	DATE: **7/11/2014**	PROJECT NO.:

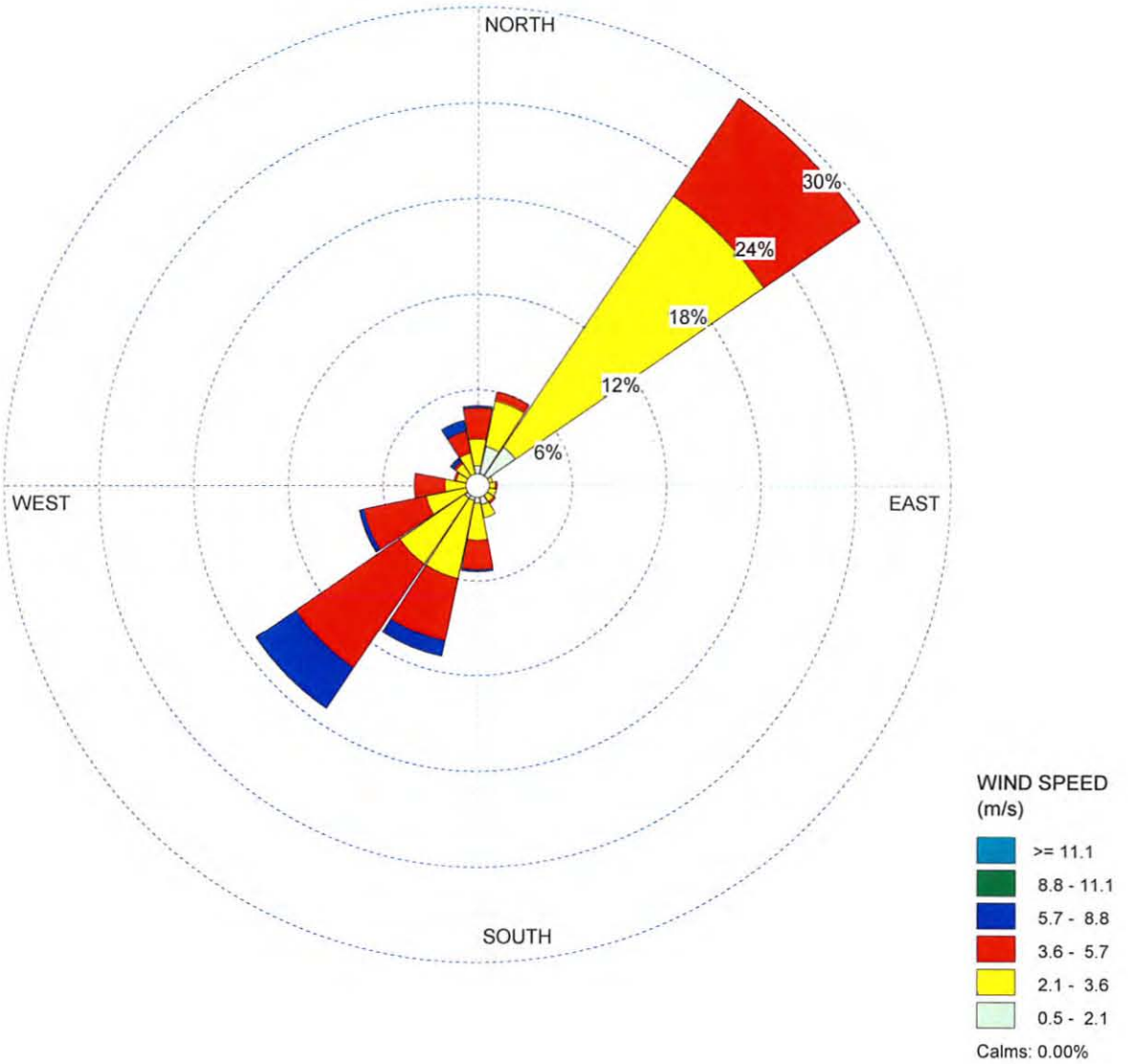
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2014 June

DISPLAY:

Wind Speed
Direction (blowing from)



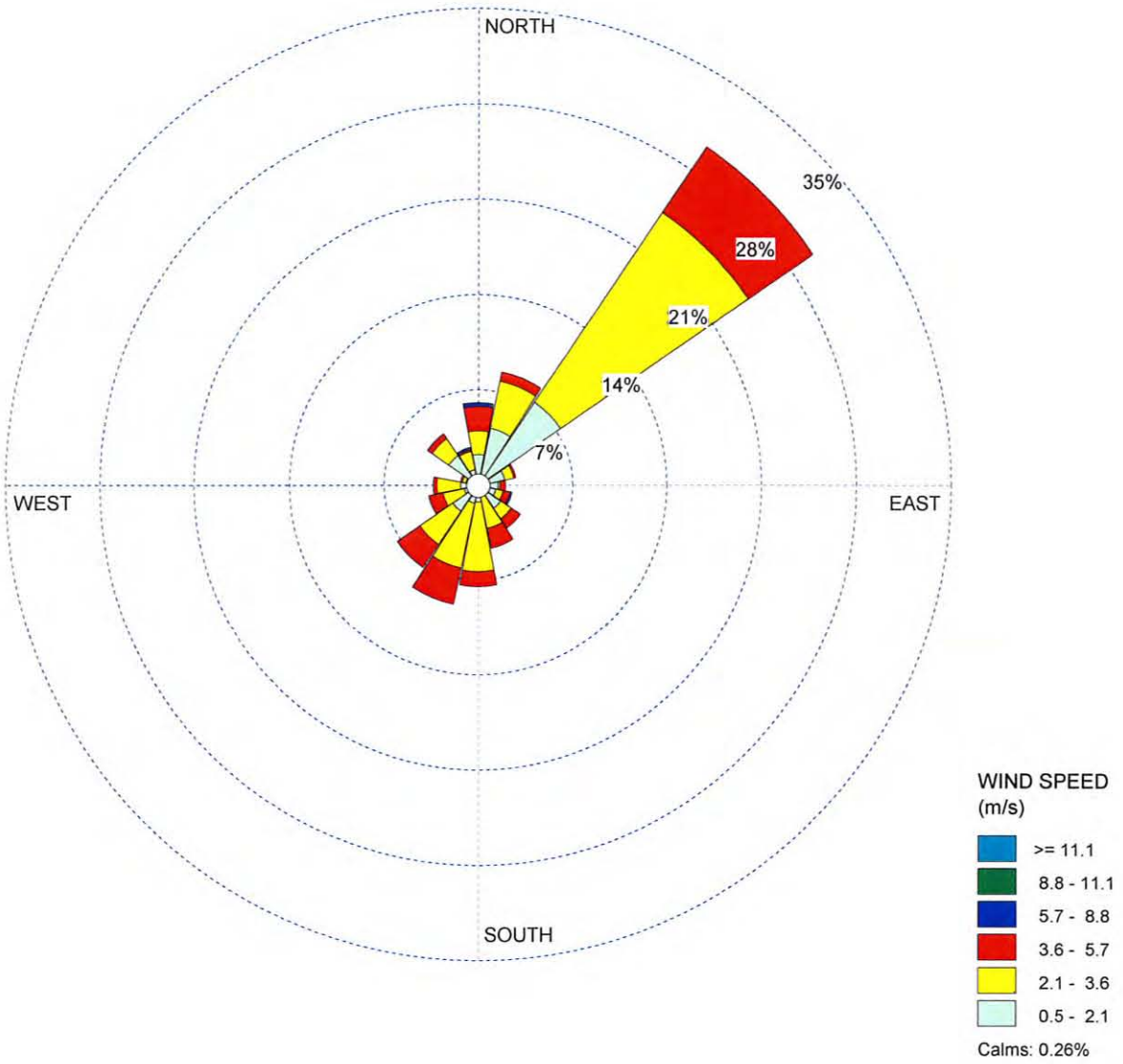
COMMENTS:	DATA PERIOD: **Start Date: 6/1/2014 - 00:00** **End Date: 6/30/2014 - 23:00**	COMPANY NAME: **Alton Coal Development, LLC - Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **0.00%**	TOTAL COUNT: **720 hrs.**	
	AVG. WIND SPEED: **3.26 m/s**	DATE: **7/11/2014**	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2012 July

DISPLAY:

Wind Speed
Direction (blowing from)



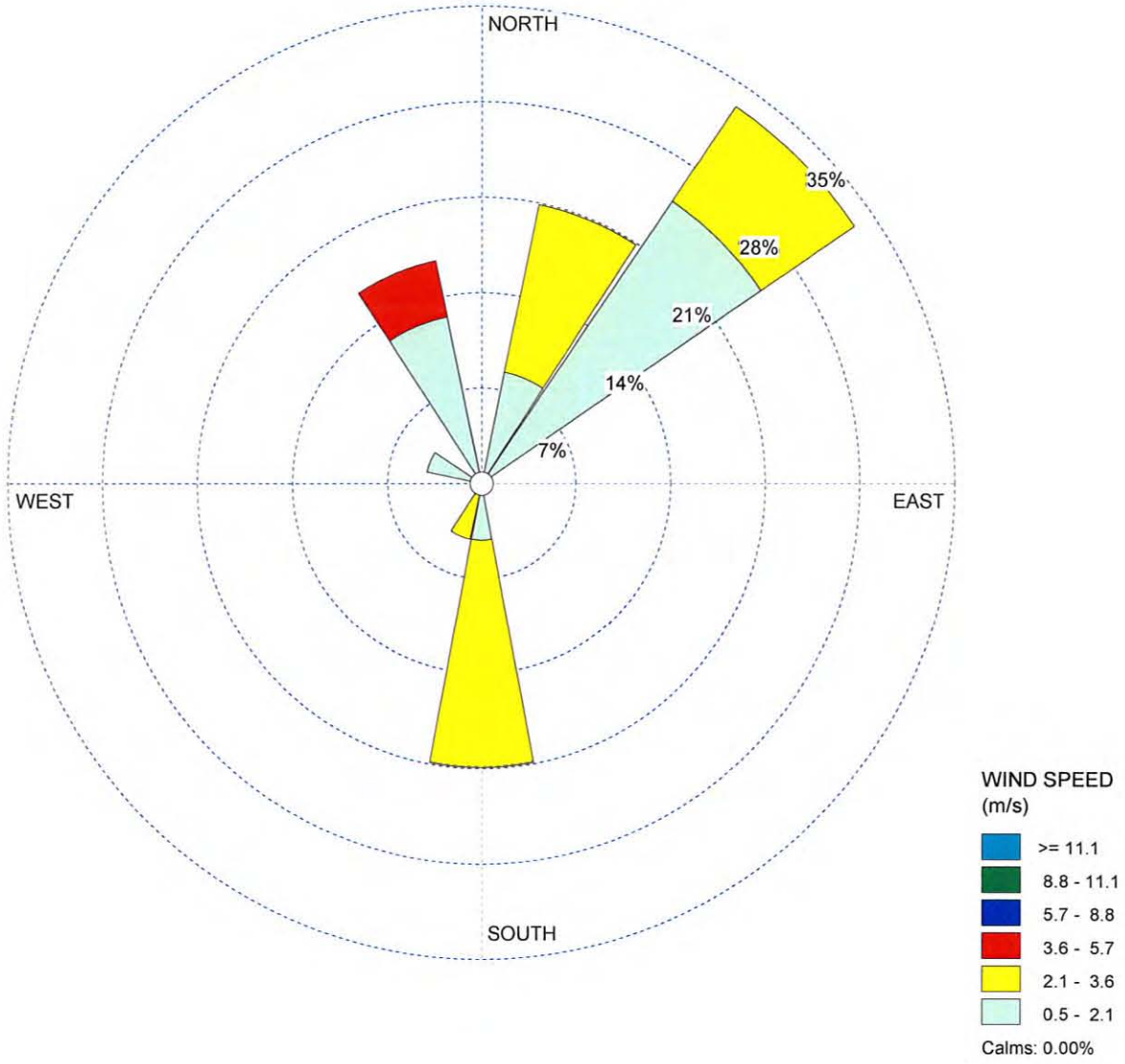
COMMENTS:	DATA PERIOD: **Start Date: 7/1/2012 - 00:00** **End Date: 7/31/2012 - 23:00**	COMPANY NAME: **Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **0.26%**	TOTAL COUNT: **744 hrs.**	
	AVG. WIND SPEED: **2.63 m/s**	DATE: **10/2/2012**	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2012 August

DISPLAY:

Wind Speed
Direction (blowing from)



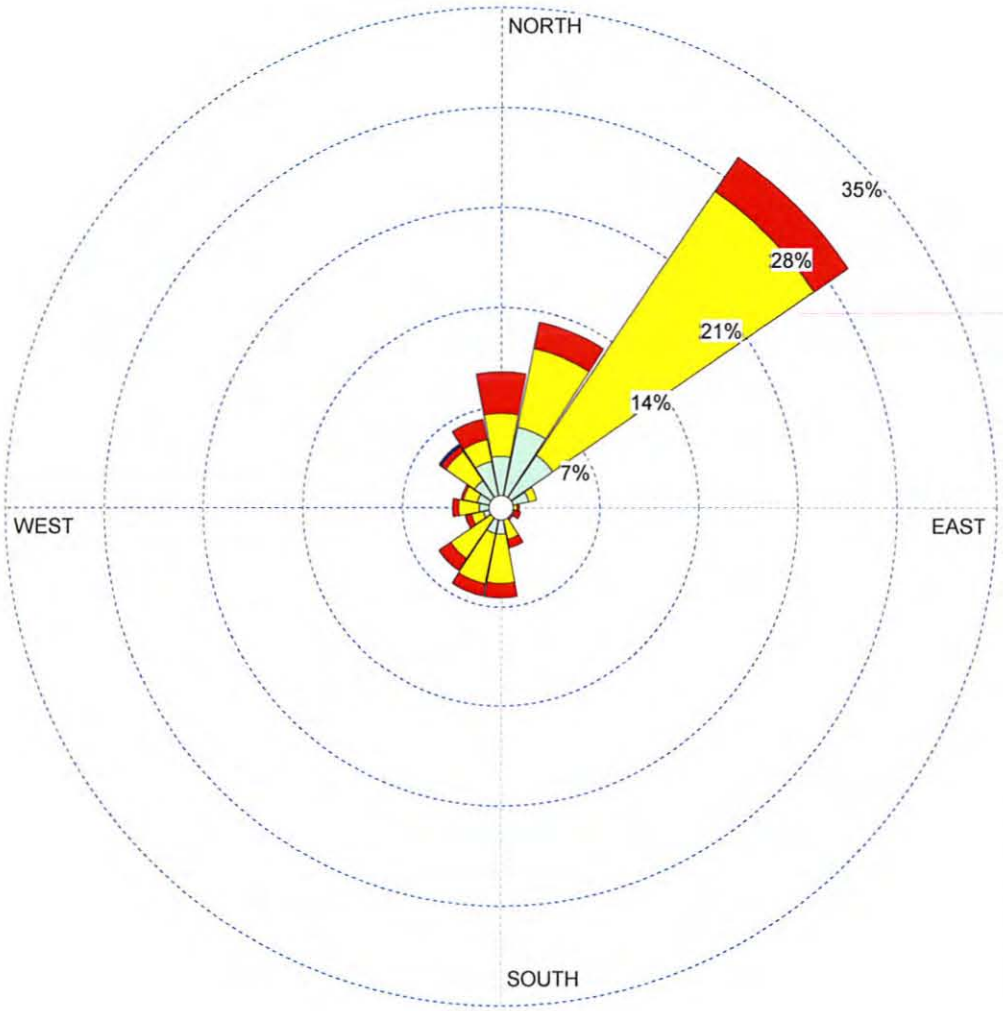
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 8/1/2012 - 00:00 **End Date: 8/1/2012 - 23:00**	**Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **0.00%**	TOTAL COUNT: **24 hrs.**	
	AVG. WIND SPEED: **2.06 m/s**	DATE: **10/2/2012**	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2012 September

DISPLAY:

Wind Speed
Direction (blowing from)



WIND SPEED
(m/s)

- >= 11.1
- 8.8 - 11.1
- 5.7 - 8.8
- 3.6 - 5.7
- 2.1 - 3.6
- 0.5 - 2.1

Calms: 0.00%

COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 9/2/2012 - 00:00 **End Date: 9/30/2012 - 23:00**	**Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **0.00%**	TOTAL COUNT: **696 hrs.**	
	AVG. WIND SPEED: **2.58 m/s**	DATE: **10/2/2012**	PROJECT NO.:

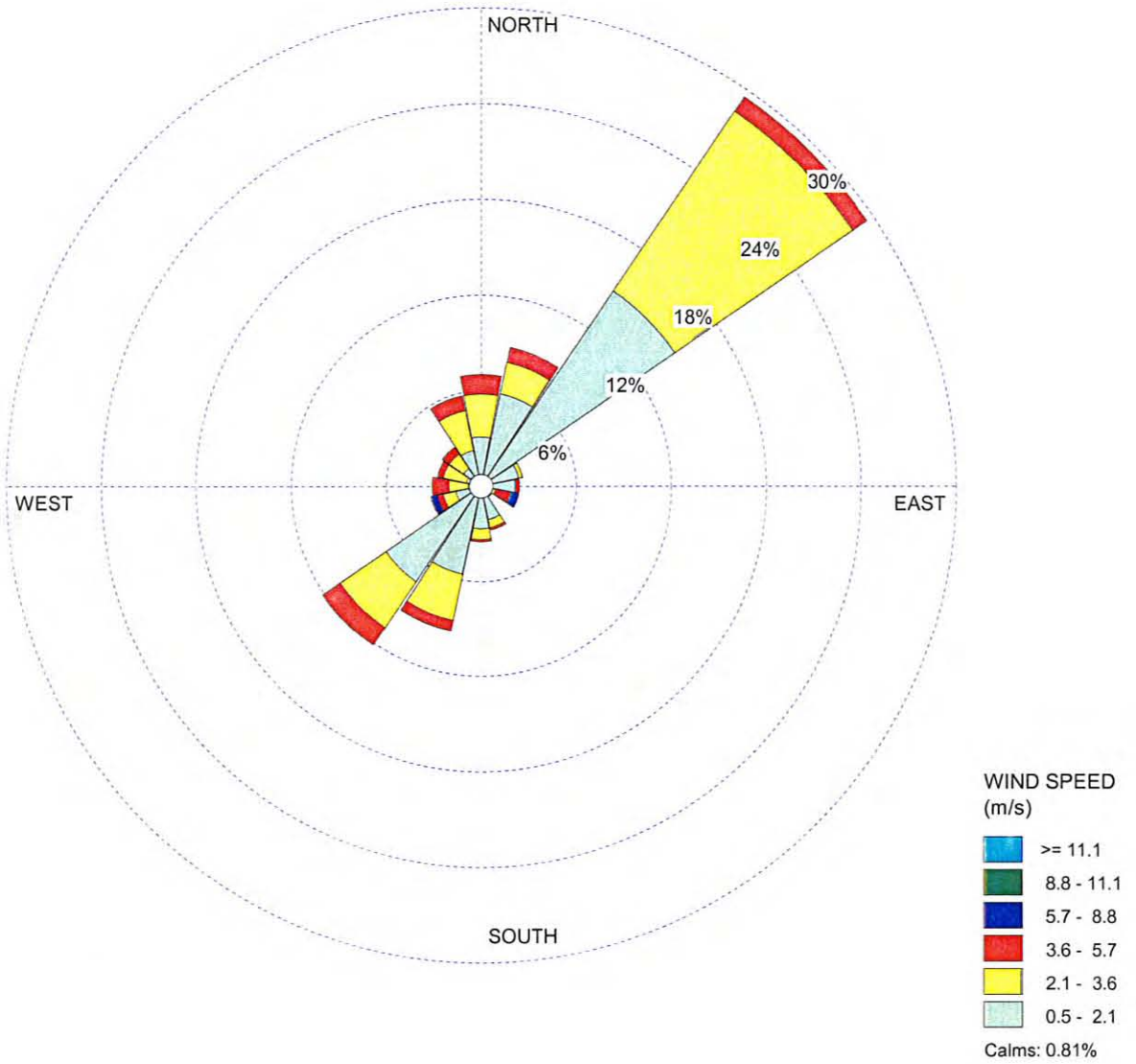
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2012 October

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 10/1/2012 - 00:00** **End Date: 10/31/2012 - 23:00**	COMPANY NAME: **Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **0.81%**	TOTAL COUNT: **744 hrs.**	
	AVG. WIND SPEED: **2.11 m/s**	DATE: **1/15/2013**	PROJECT NO.:

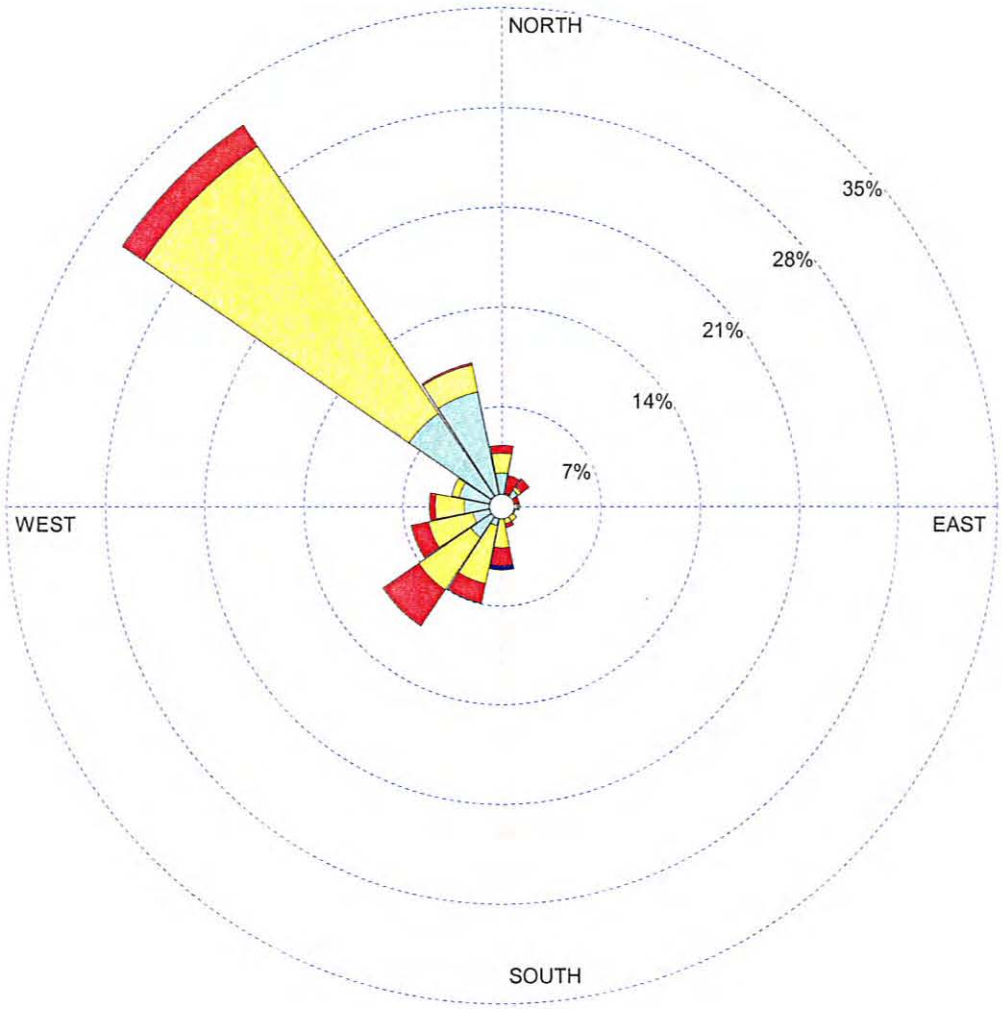
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2012 November

DISPLAY:

Wind Speed
Direction (blowing from)



WIND SPEED
(m/s)

- >= 11.1
- 8.8 - 11.1
- 5.7 - 8.8
- 3.6 - 5.7
- 2.1 - 3.6
- 0.5 - 2.1

Calms: 5.42%

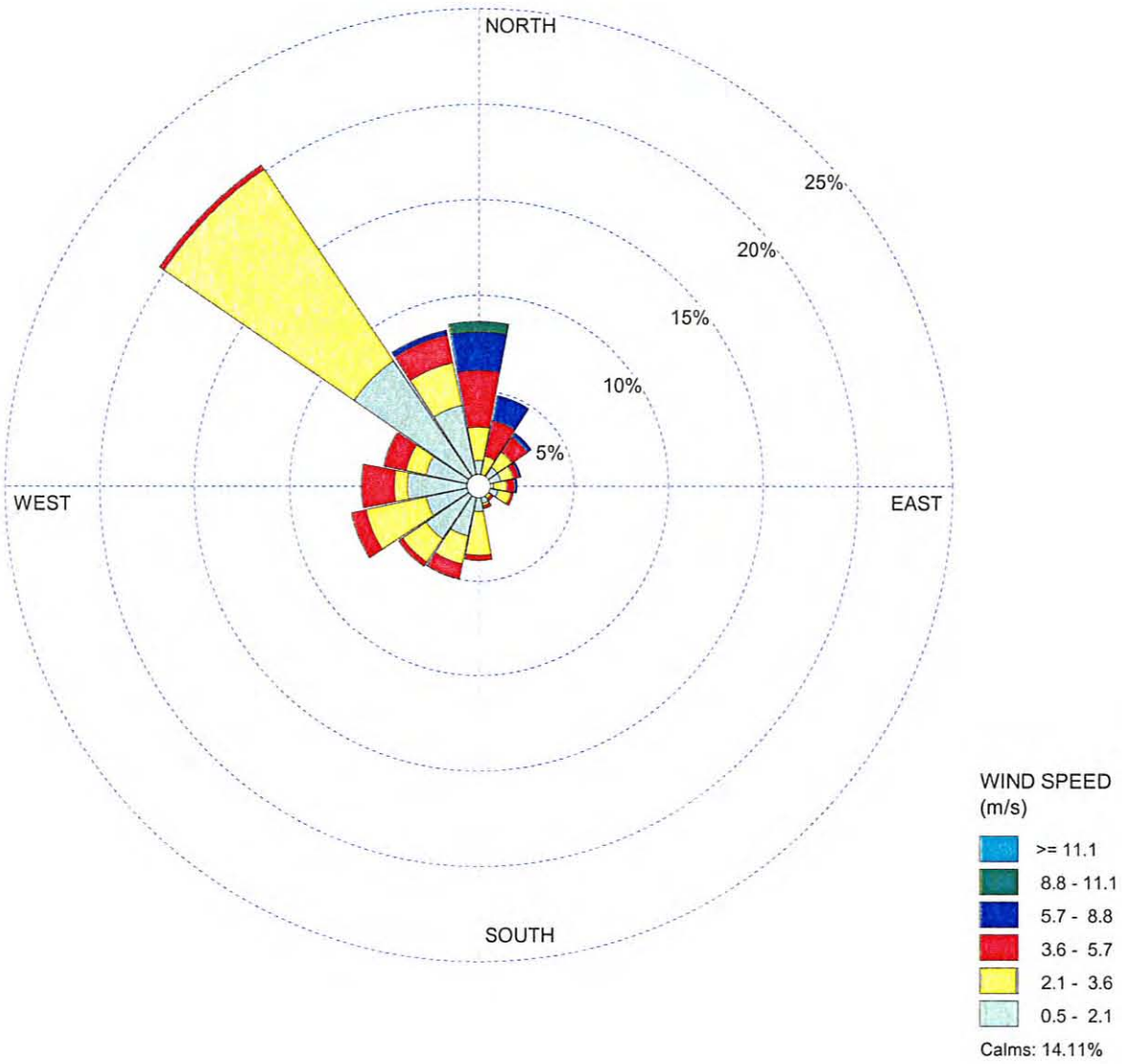
COMMENTS:	DATA PERIOD: **Start Date: 11/1/2012 - 00:00** **End Date: 11/30/2012 - 23:00**	COMPANY NAME: **Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **5.42%**	TOTAL COUNT: **720 hrs.**	
	AVG. WIND SPEED: **2.36 m/s**	DATE: **1/15/2013**	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2012 December

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 12/1/2012 - 00:00 **End Date: 12/31/2012 - 23:00**	**Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **14.11%**	TOTAL COUNT: **744 hrs.**	
	AVG. WIND SPEED: **2.26 m/s**	DATE: **1/15/2013**	PROJECT NO.:

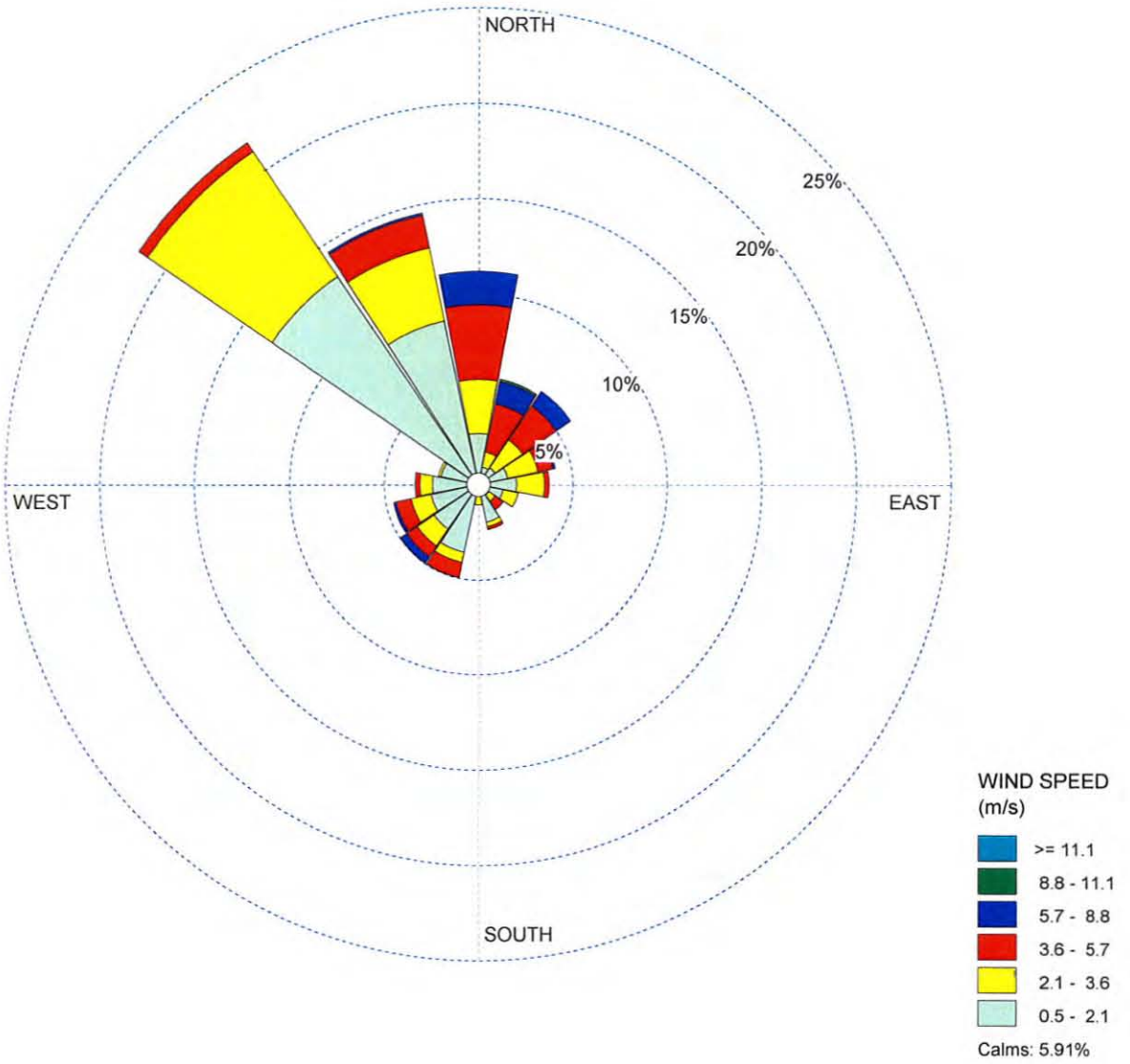
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2013 Januarary

DISPLAY:

Wind Speed
Direction (blowing from)



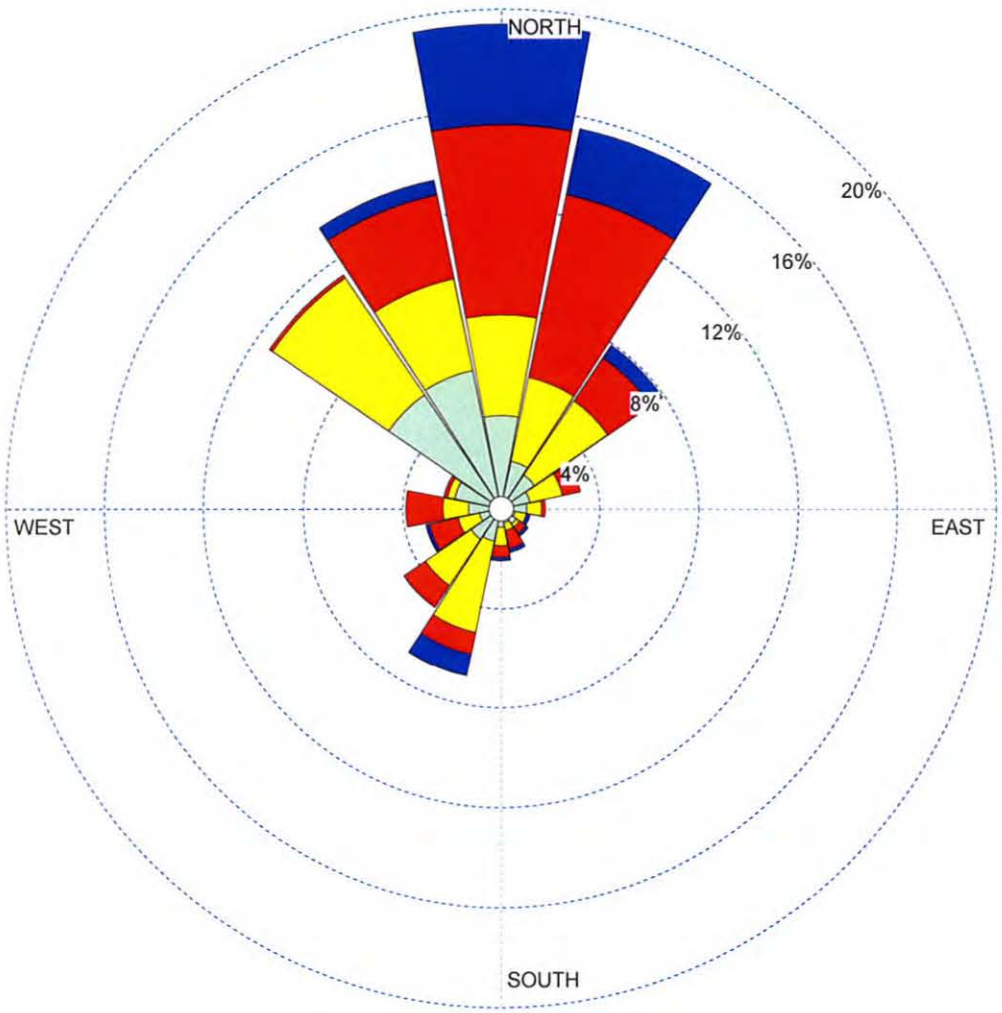
COMMENTS:	DATA PERIOD: **Start Date: 1/1/2013 - 00:00** **End Date: 1/31/2013 - 23:00**	COMPANY NAME: **Alton Coal Development, LLC - Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **5.91%**	TOTAL COUNT: **744 hrs.**	
	AVG. WIND SPEED: **2.39 m/s**	DATE: **4/12/2013**	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2013 February

DISPLAY:

Wind Speed
Direction (blowing from)



WIND SPEED
(m/s)

- >= 11.1
- 8.8 - 11.1
- 5.7 - 8.8
- 3.6 - 5.7
- 2.1 - 3.6
- 0.5 - 2.1

Calms: 0.15%

COMMENTS:	DATA PERIOD: **Start Date: 2/1/2013 - 00:00** **End Date: 2/28/2013 - 23:00**	COMPANY NAME: **Alton Coal Development, LLC - Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **0.15%**	TOTAL COUNT: **672 hrs.**	
	AVG. WIND SPEED: **3.22 m/s**	DATE: **4/12/2013**	PROJECT NO.:

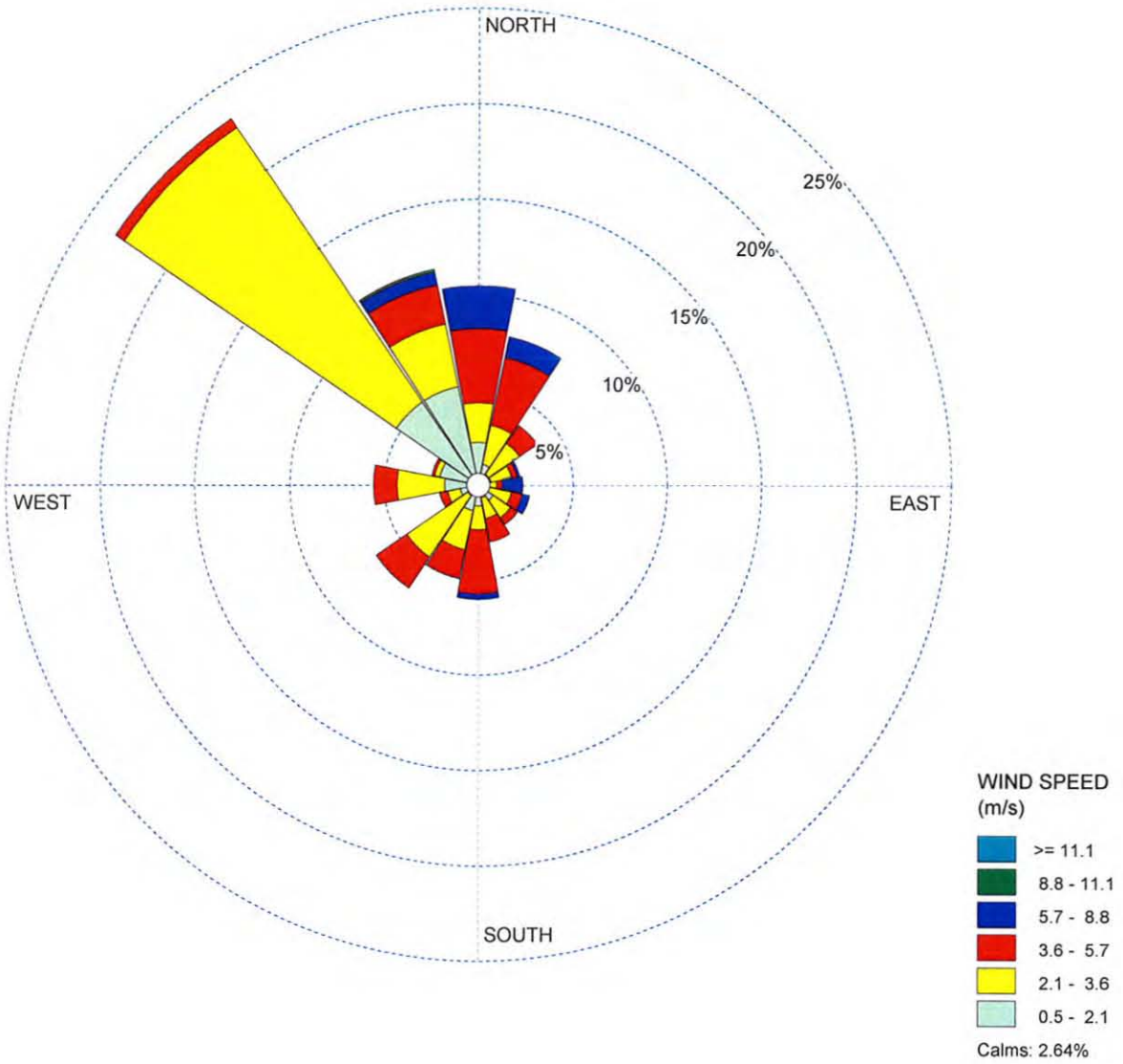
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2013 March

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 3/1/2013 - 00:00** **End Date: 3/30/2013 - 23:00**	COMPANY NAME: **Alton Coal Development, LLC - Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **2.64%**	TOTAL COUNT: **720 hrs.**	
	AVG. WIND SPEED: **2.98 m/s**	DATE: **4/12/2013**	PROJECT NO.:

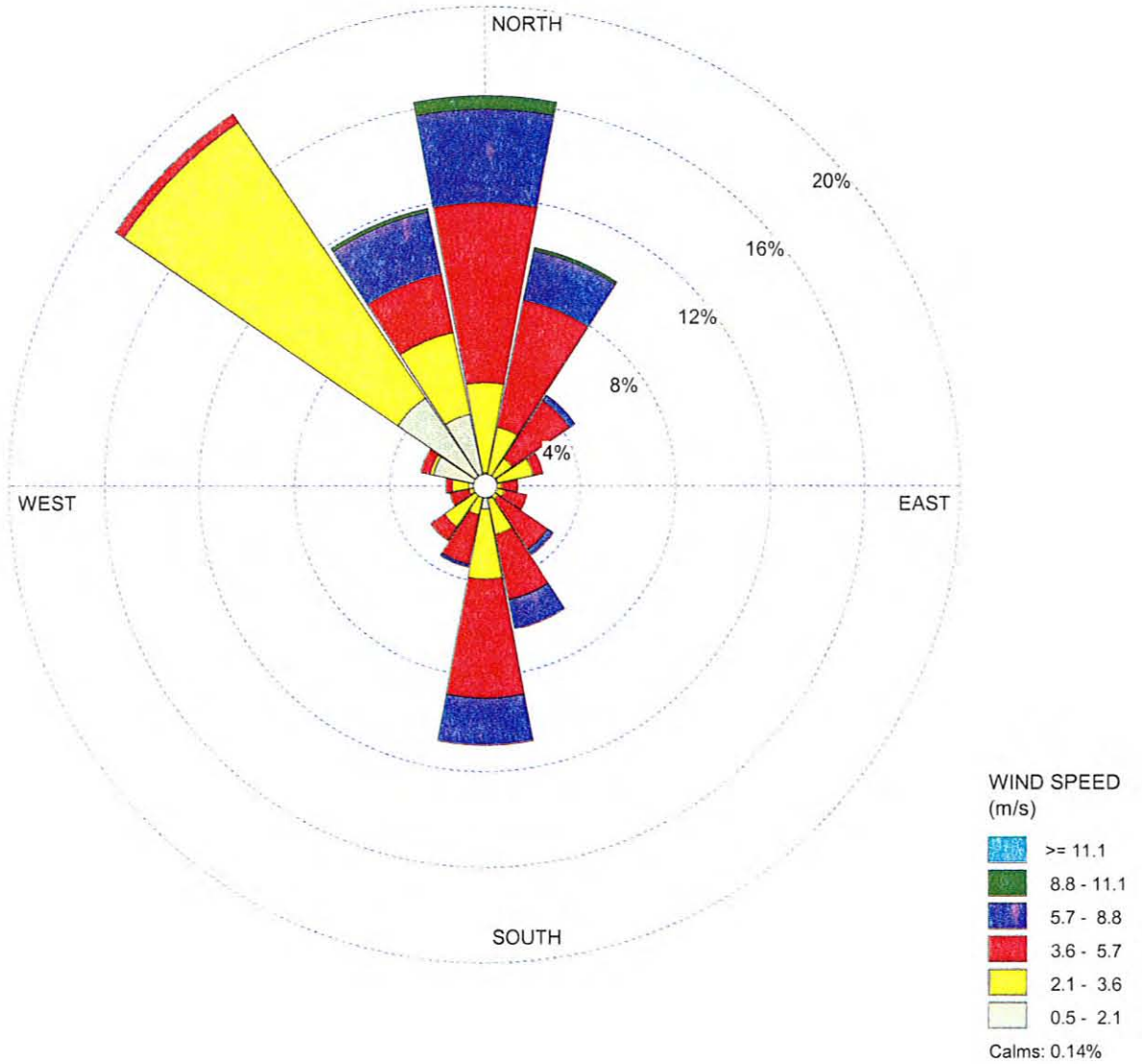
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2013 April

DISPLAY:

Wind Speed
Direction (blowing from)



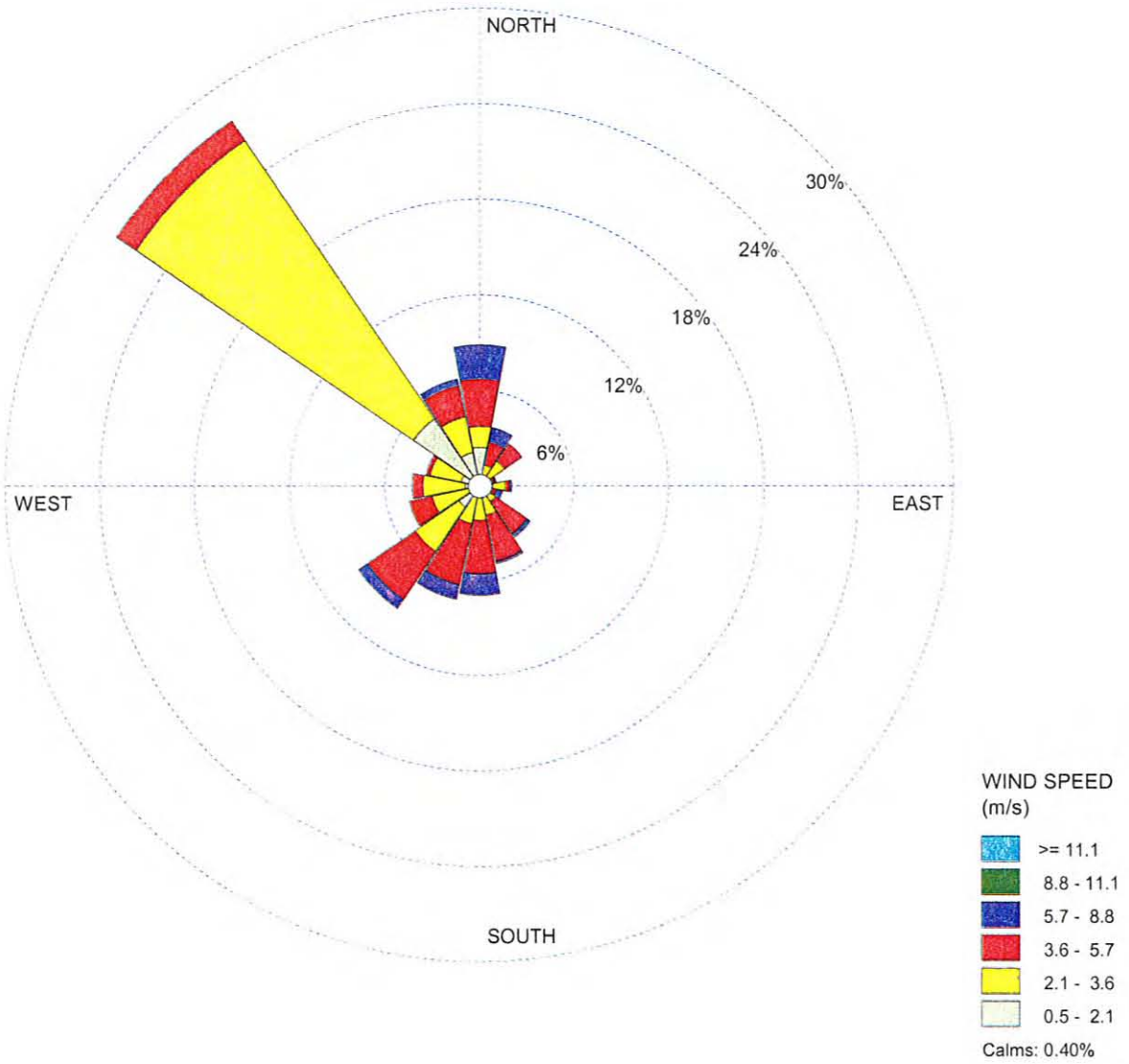
COMMENTS:	DATA PERIOD: **Start Date: 4/1/2013 - 00:00** **End Date: 4/30/2013 - 23:00**	COMPANY NAME: **Alton Coal Development, LLC - Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **0.14%**	TOTAL COUNT: **720 hrs.**	
	AVG. WIND SPEED: **3.74 m/s**	DATE: **7/31/2013**	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2013 May

DISPLAY:

Wind Speed
Direction (blowing from)



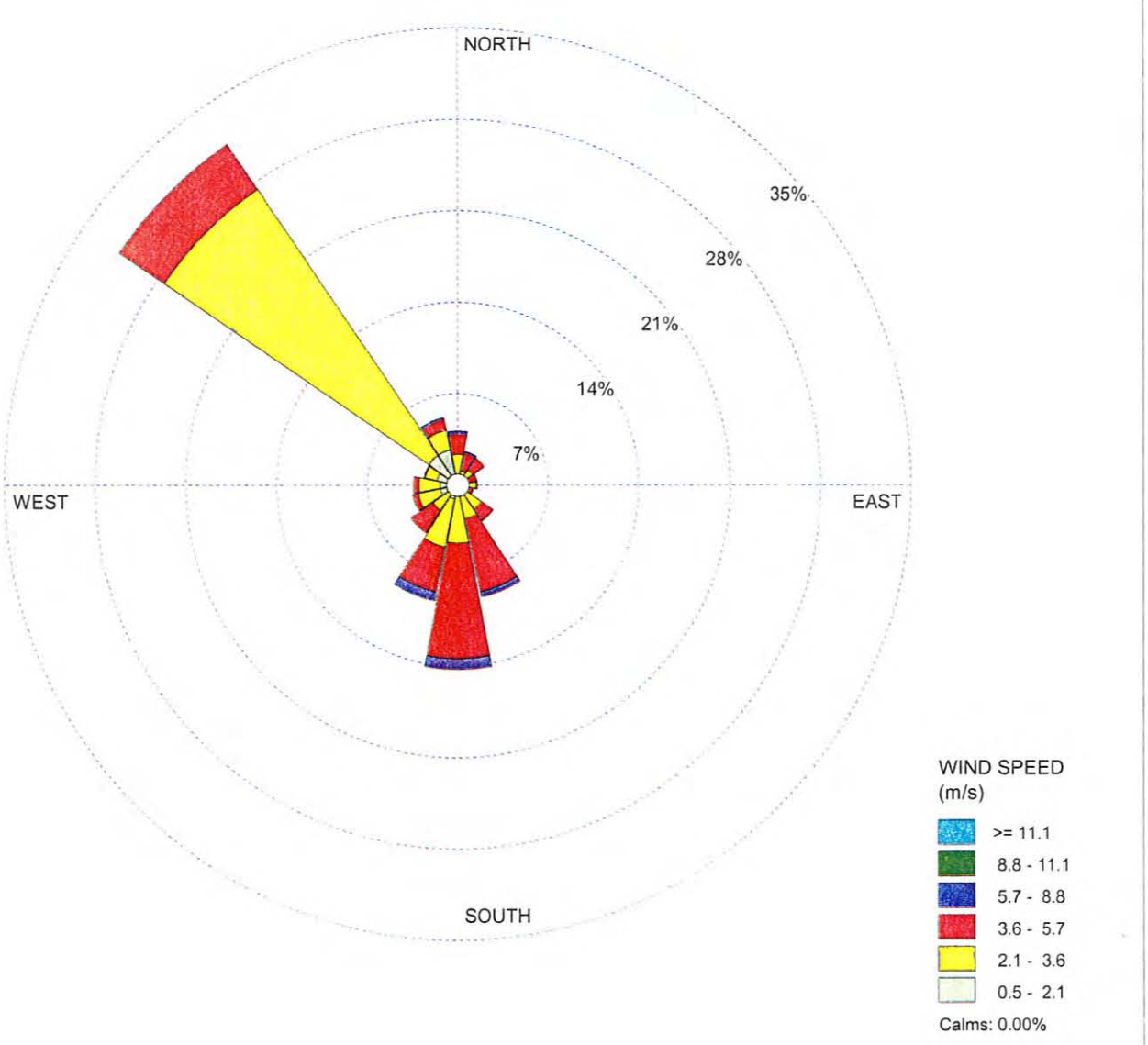
COMMENTS:	DATA PERIOD: **Start Date: 5/1/2013 - 00:00** **End Date: 5/31/2013 - 23:00**	COMPANY NAME: **Alton Coal Development, LLC - Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **0.40%**	TOTAL COUNT: **744 hrs.**	
	AVG. WIND SPEED: **3.31 m/s**	DATE: **7/31/2013**	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2013 June

DISPLAY:

Wind Speed
Direction (blowing from)



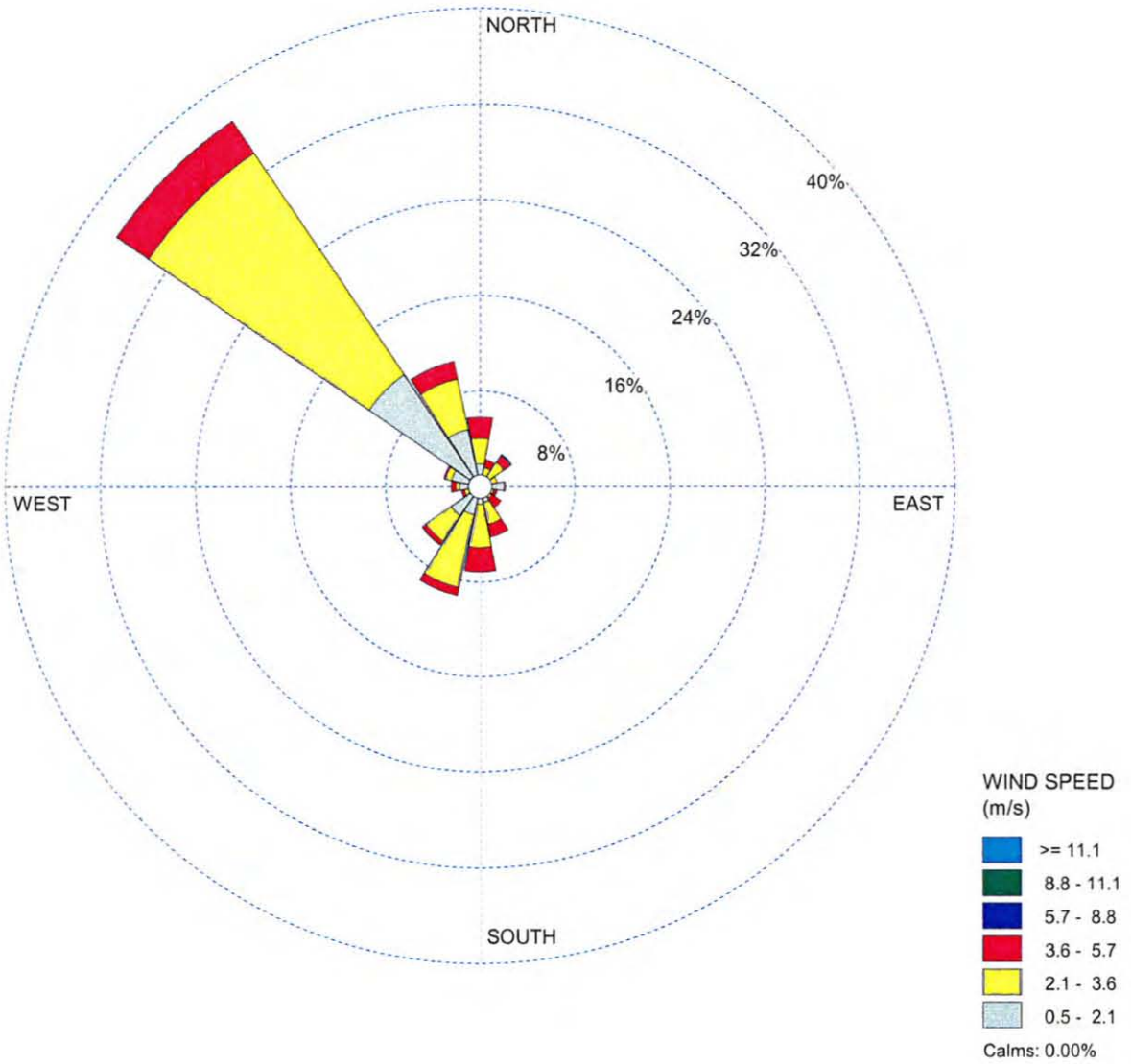
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 6/1/2013 - 00:00 **End Date: 6/30/2013 - 23:00**	**Alton Coal Development, LLC - Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **0.00%**	TOTAL COUNT: **720 hrs.**	
	AVG. WIND SPEED: **3.21 m/s**	DATE: **7/31/2013**	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2013 July

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 7/1/2013 - 00:00** **End Date: 7/31/2013 - 23:00**	COMPANY NAME: **Alton Coal Development, LLC - Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **0.00%**	TOTAL COUNT: **742 hrs.**	
	AVG. WIND SPEED: **2.52 m/s**	DATE: **10/30/2013**	PROJECT NO.:

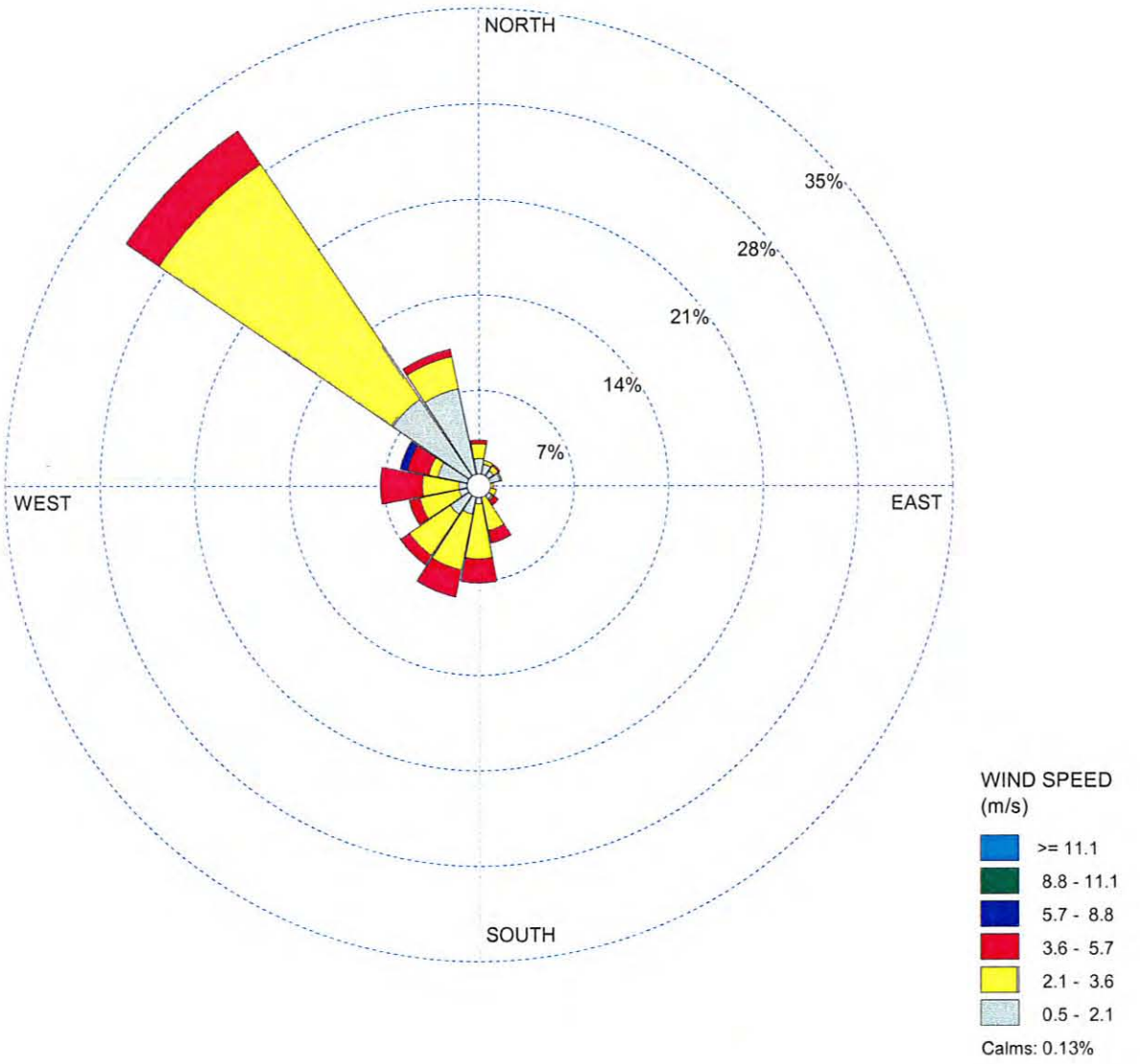
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2013 August

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 8/1/2013 - 00:00** **End Date: 8/31/2013 - 23:00**	COMPANY NAME: **Alton Coal Development, LLC - Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **0.13%**	TOTAL COUNT: **744 hrs.**	
	AVG. WIND SPEED: **2.53 m/s**	DATE: **10/30/2013**	PROJECT NO.:

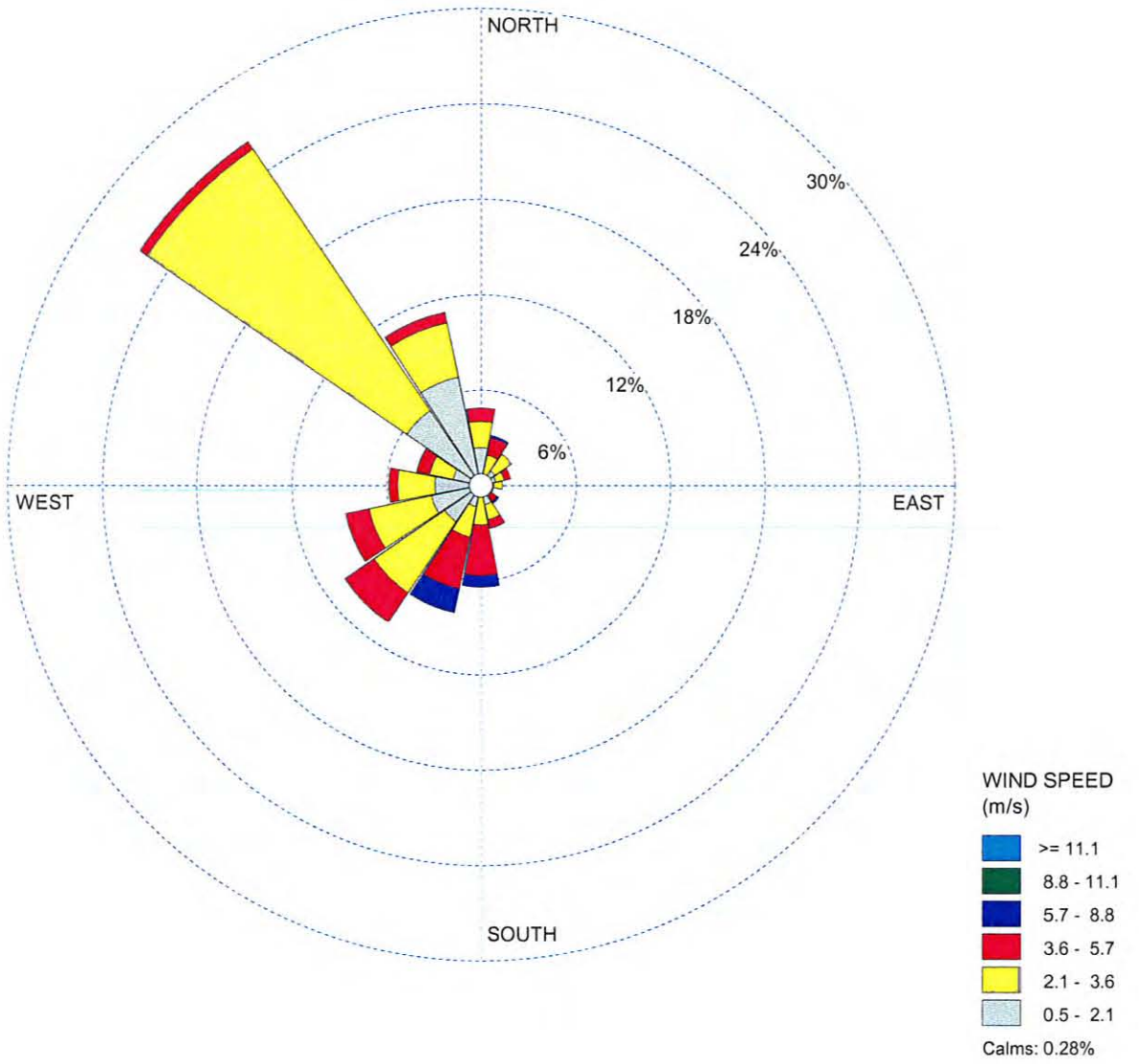
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2013 September

DISPLAY:

Wind Speed
Direction (blowing from)



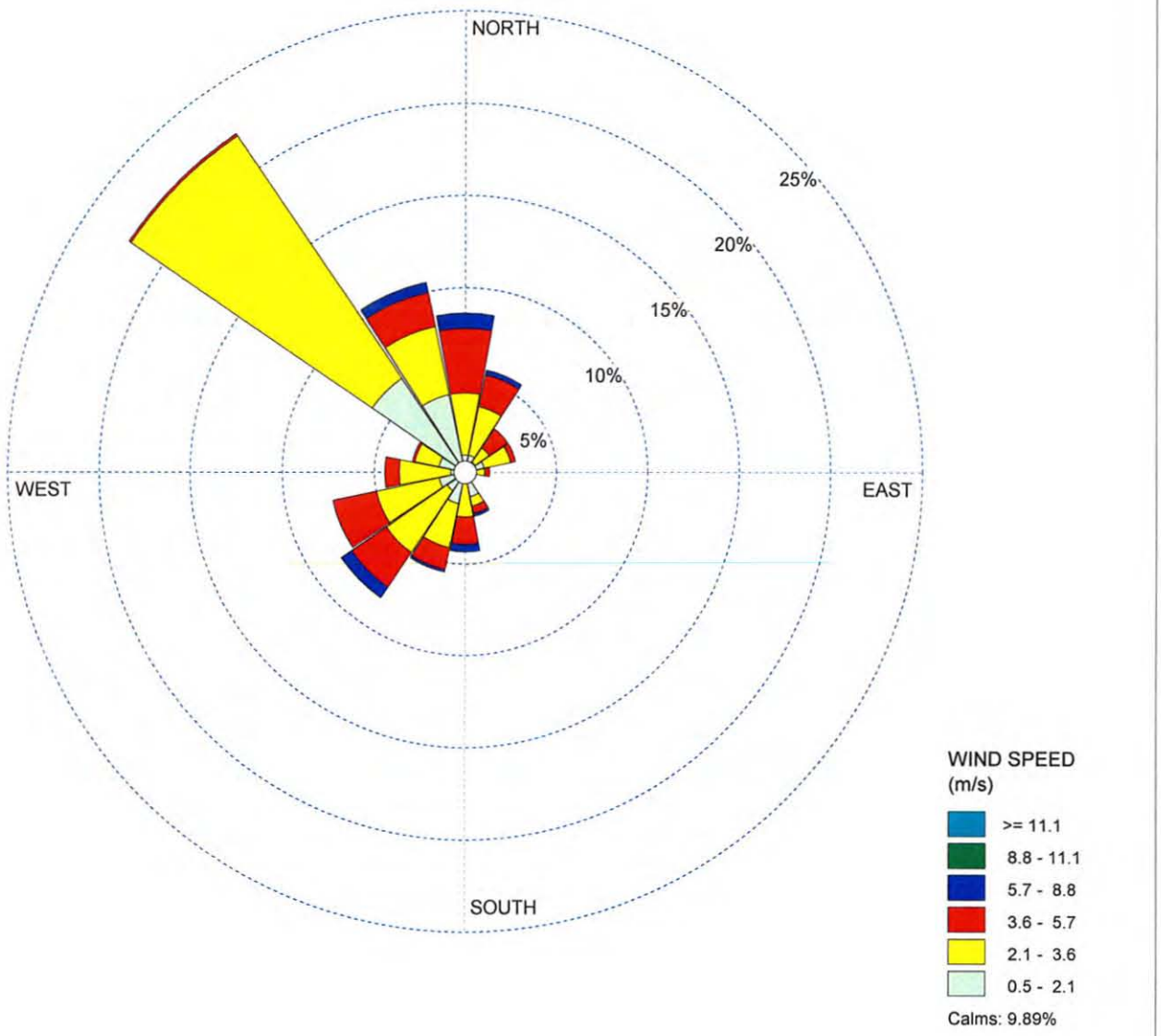
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 9/1/2013 - 00:00 **End Date: 9/30/2013 - 23:00**	**Alton Coal Development, LLC - Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **0.28%**	TOTAL COUNT: **720 hrs.**	
	AVG. WIND SPEED: **2.67 m/s**	DATE: **10/30/2013**	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2013 October

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 10/1/2013 - 00:00** **End Date: 10/31/2013 - 23:00**	COMPANY NAME: **Alton Coal Development, LLC - Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **9.89%**	TOTAL COUNT: **744 hrs.**	
	AVG. WIND SPEED: **2.58 m/s**	DATE: **1/21/2014**	PROJECT NO.:

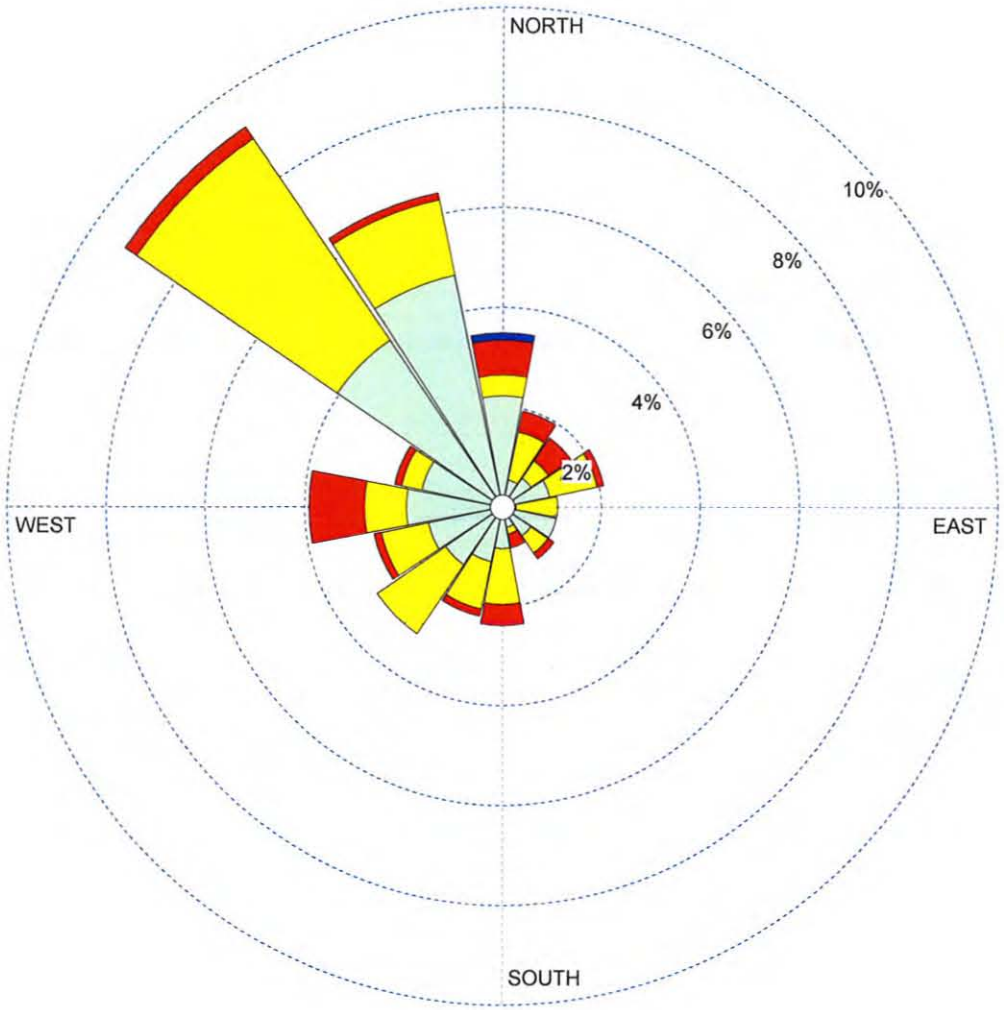
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2013 November

DISPLAY:

Wind Speed
Direction (blowing from)



WIND SPEED
(m/s)

- >= 11.1
- 8.8 - 11.1
- 5.7 - 8.8
- 3.6 - 5.7
- 2.1 - 3.6
- 0.5 - 2.1

Calms: 54.16%

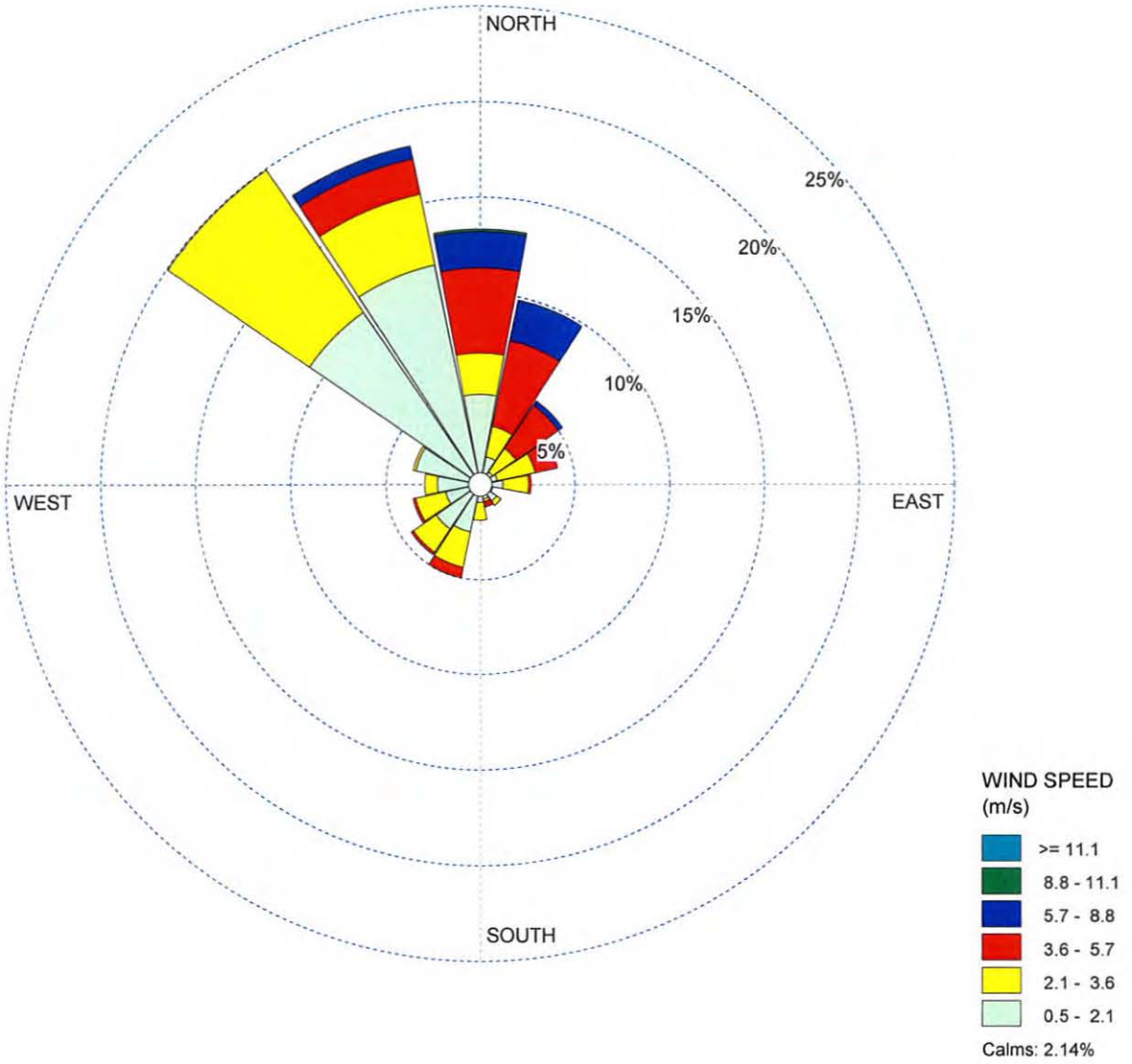
COMMENTS:	DATA PERIOD: **Start Date: 11/1/2013 - 00:00** **End Date: 11/30/2013 - 23:00**	COMPANY NAME: **Alton Coal Development, LLC - Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **54.16%**	TOTAL COUNT: **718 hrs.**	
	AVG. WIND SPEED: **0.98 m/s**	DATE: **1/21/2014**	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2013 December

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 12/1/2013 - 00:00** **End Date: 12/31/2013 - 23:00**	COMPANY NAME: **Alton Coal Development, LLC - Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **2.14%**	TOTAL COUNT: **744 hrs.**	
	AVG. WIND SPEED: **2.56 m/s**	DATE: **1/21/2014**	PROJECT NO.:

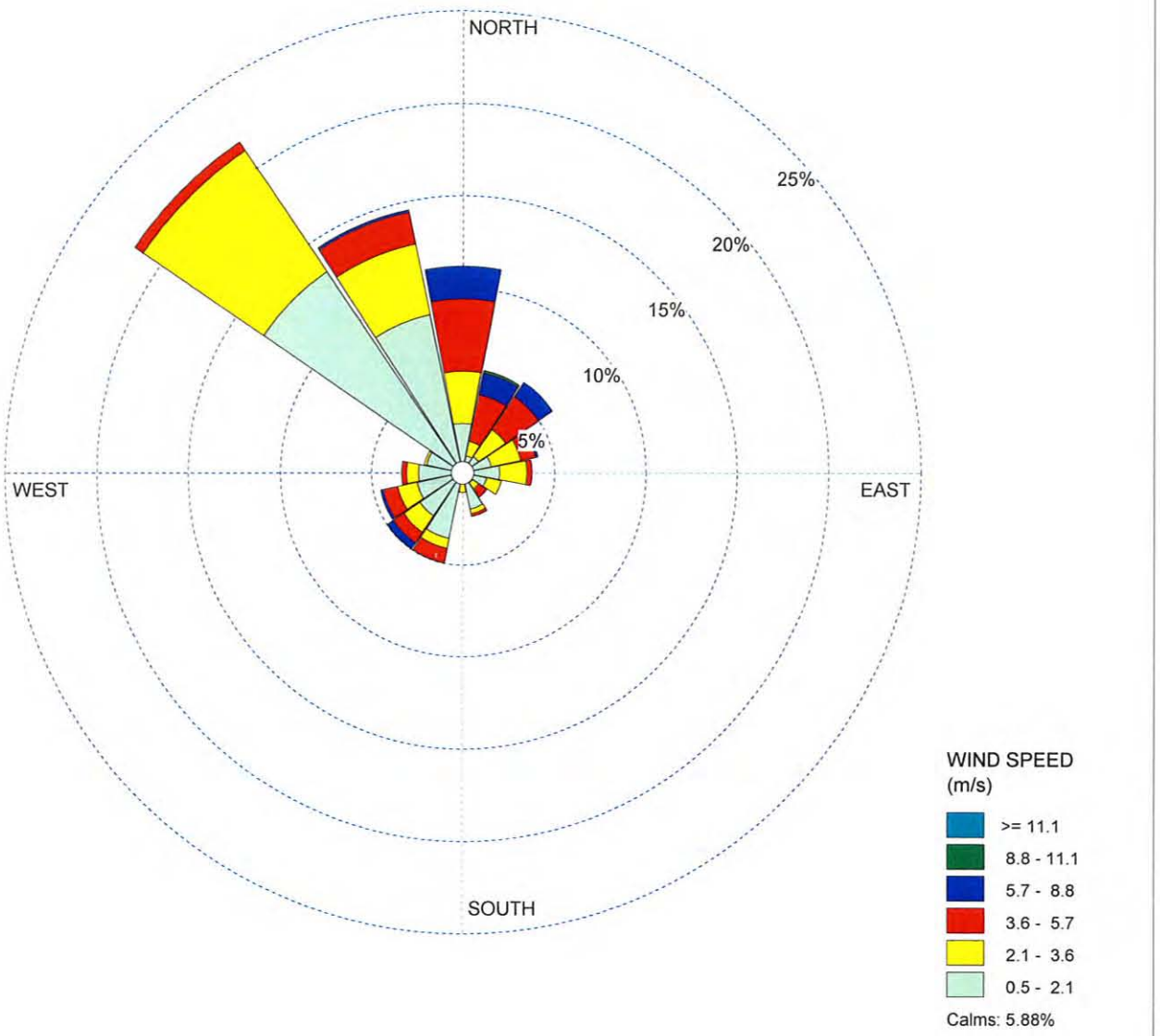
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2014 January

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 1/1/2013 - 00:00** **End Date: 1/31/2013 - 23:00**	COMPANY NAME: **Alton Coal Development, LLC - Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **5.88%**	TOTAL COUNT: **744 hrs.**	
	AVG. WIND SPEED: **2.39 m/s**	DATE: **4/3/2014**	PROJECT NO.:

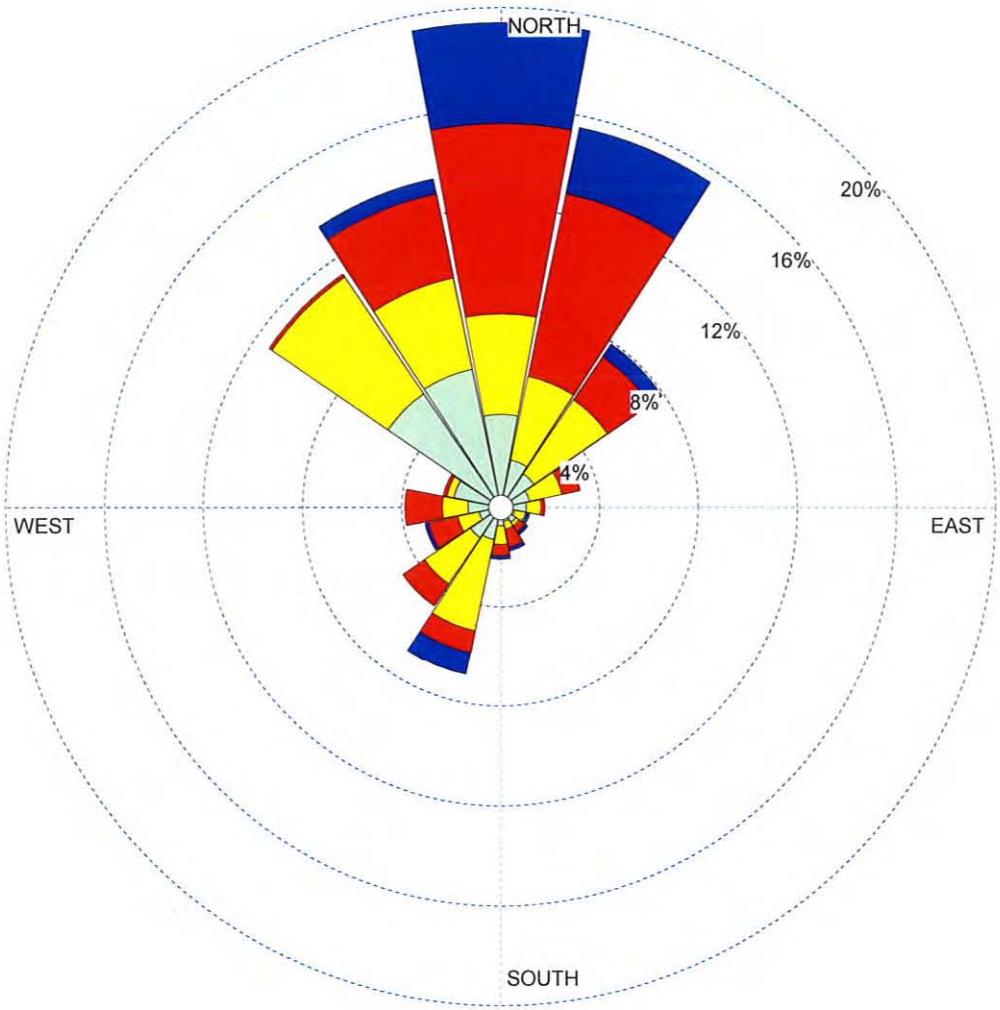
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2014 February

DISPLAY:

Wind Speed
Direction (blowing from)



WIND SPEED
(m/s)

- >= 11.1
- 8.8 - 11.1
- 5.7 - 8.8
- 3.6 - 5.7
- 2.1 - 3.6
- 0.5 - 2.1

Calms: 0.15%

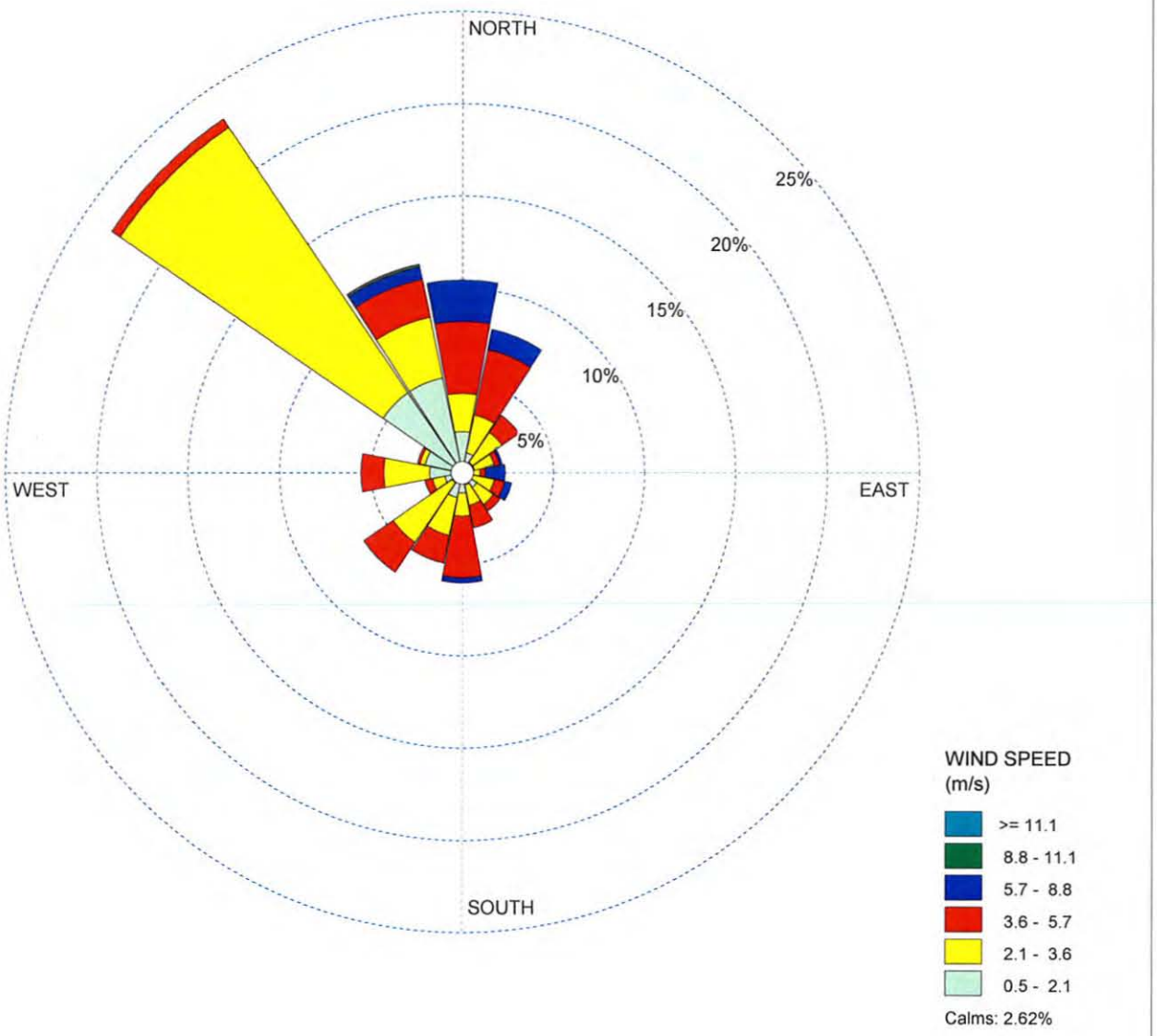
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 2/1/2013 - 00:00 **End Date: 2/28/2013 - 23:00**	**Alton Coal Development, LLC - Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **0.15%**	TOTAL COUNT: **672 hrs.**	
	AVG. WIND SPEED: **3.22 m/s**	DATE: **4/3/2014**	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2014 March

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 3/1/2013 - 00:00** **End Date: 3/30/2013 - 23:00**	COMPANY NAME: **Alton Coal Development, LLC - Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **2.62%**	TOTAL COUNT: **720 hrs.**	
	AVG. WIND SPEED: **2.98 m/s**	DATE: **4/3/2014**	PROJECT NO.:

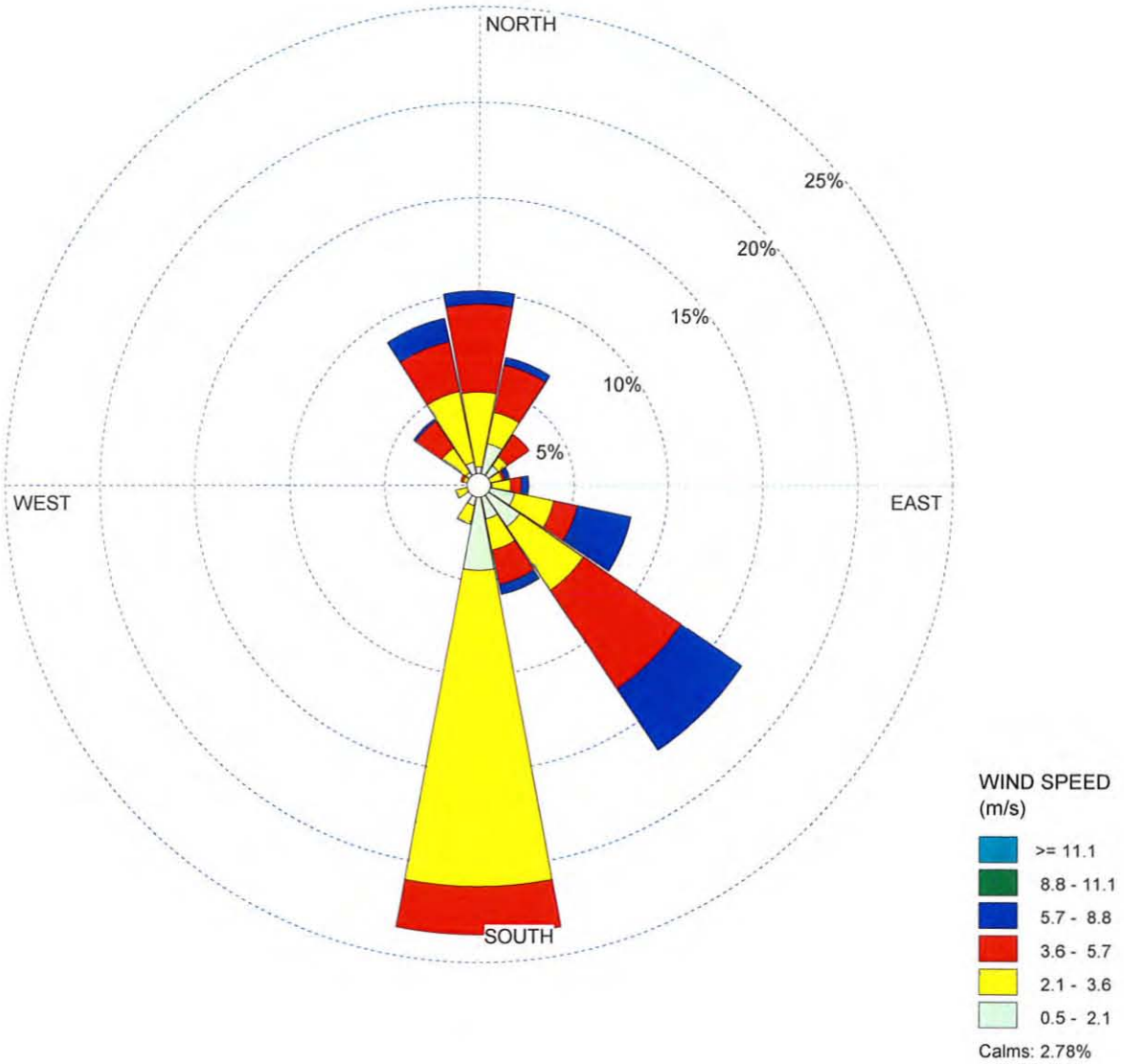
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2014 April

DISPLAY:

Wind Speed
Direction (blowing from)



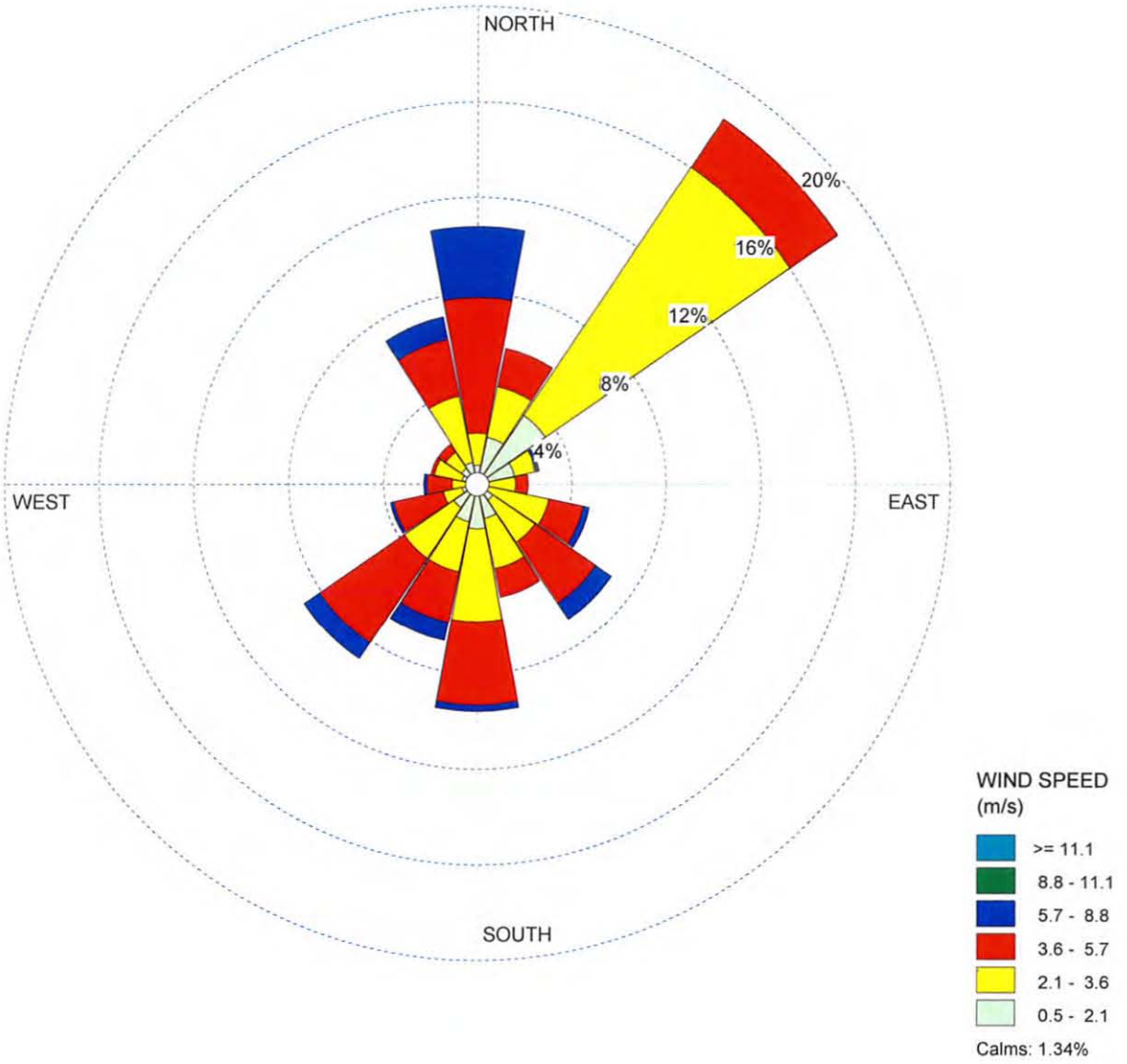
COMMENTS:	DATA PERIOD: **Start Date: 4/1/2014 - 00:00** **End Date: 4/30/2014 - 23:00**	COMPANY NAME: **Alton Coal Development, LLC - Coal Hollow Mine**	
		MODELER: **K. Nicholes**	
	CALM WINDS: **2.78%**	TOTAL COUNT: **720 hrs.**	
	AVG. WIND SPEED: **3.23 m/s**	DATE: **7/11/2014**	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2014 May

DISPLAY:

Wind Speed
Direction (blowing from)



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		MODELER: **K. Nicholes**	
	CALM WINDS: **1.34%**	TOTAL COUNT: **744 hrs.**	
	AVG. WIND SPEED: **3.31 m/s**	DATE: **7/11/2014**	PROJECT NO.:

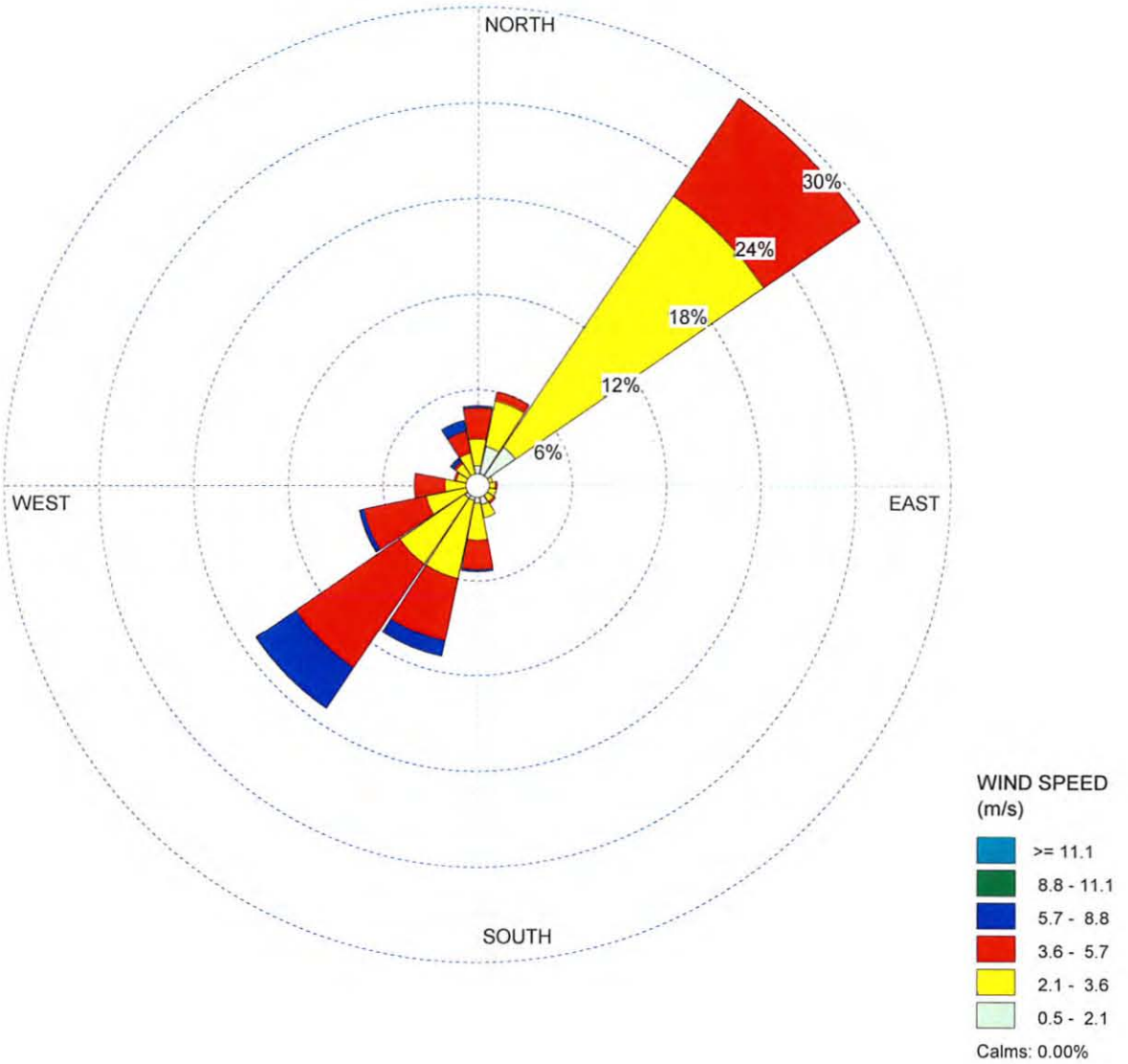
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2014 June

DISPLAY:

Wind Speed
Direction (blowing from)



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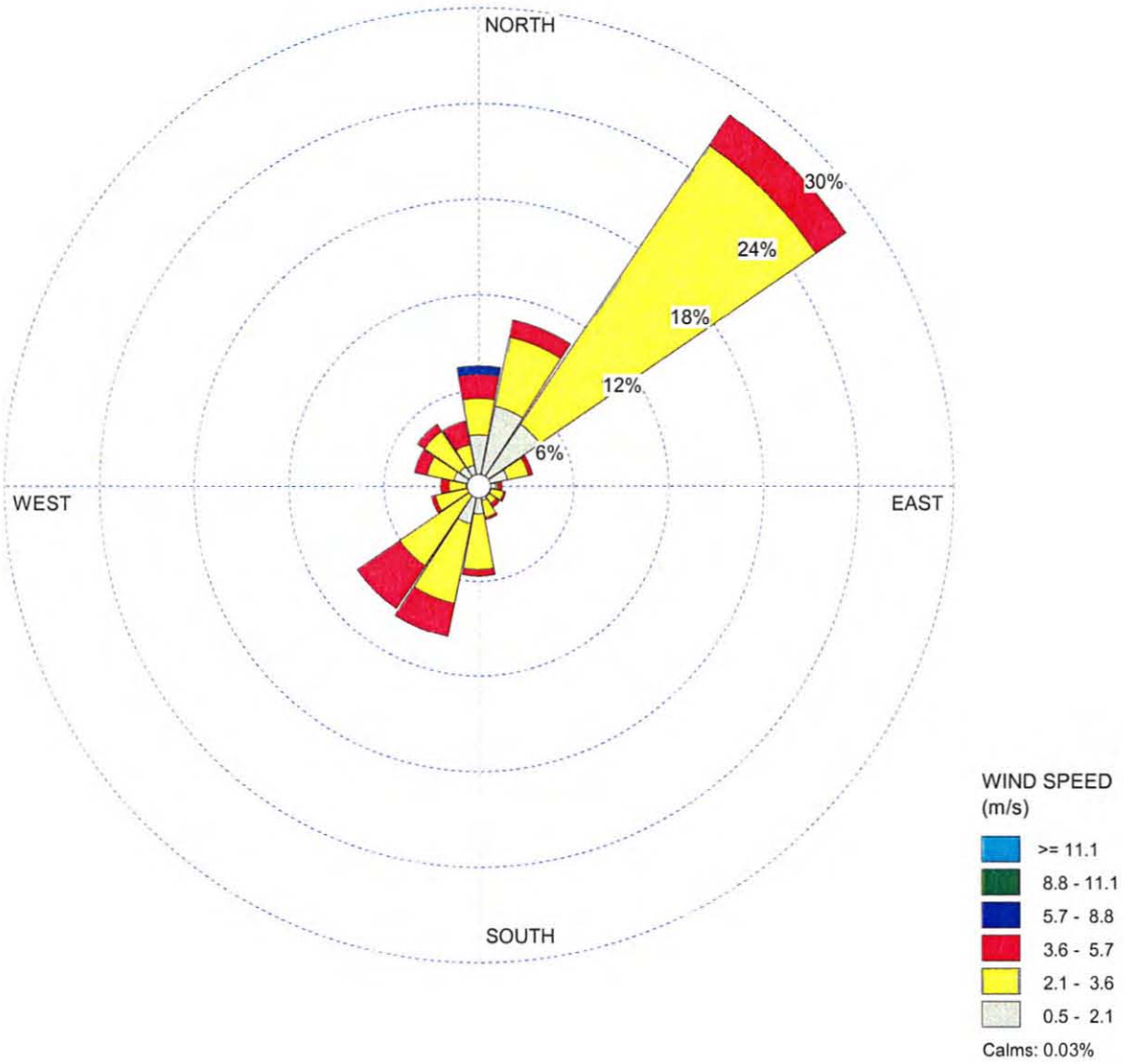
WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2014 July

DISPLAY:

Wind Speed
Direction (blowing from)



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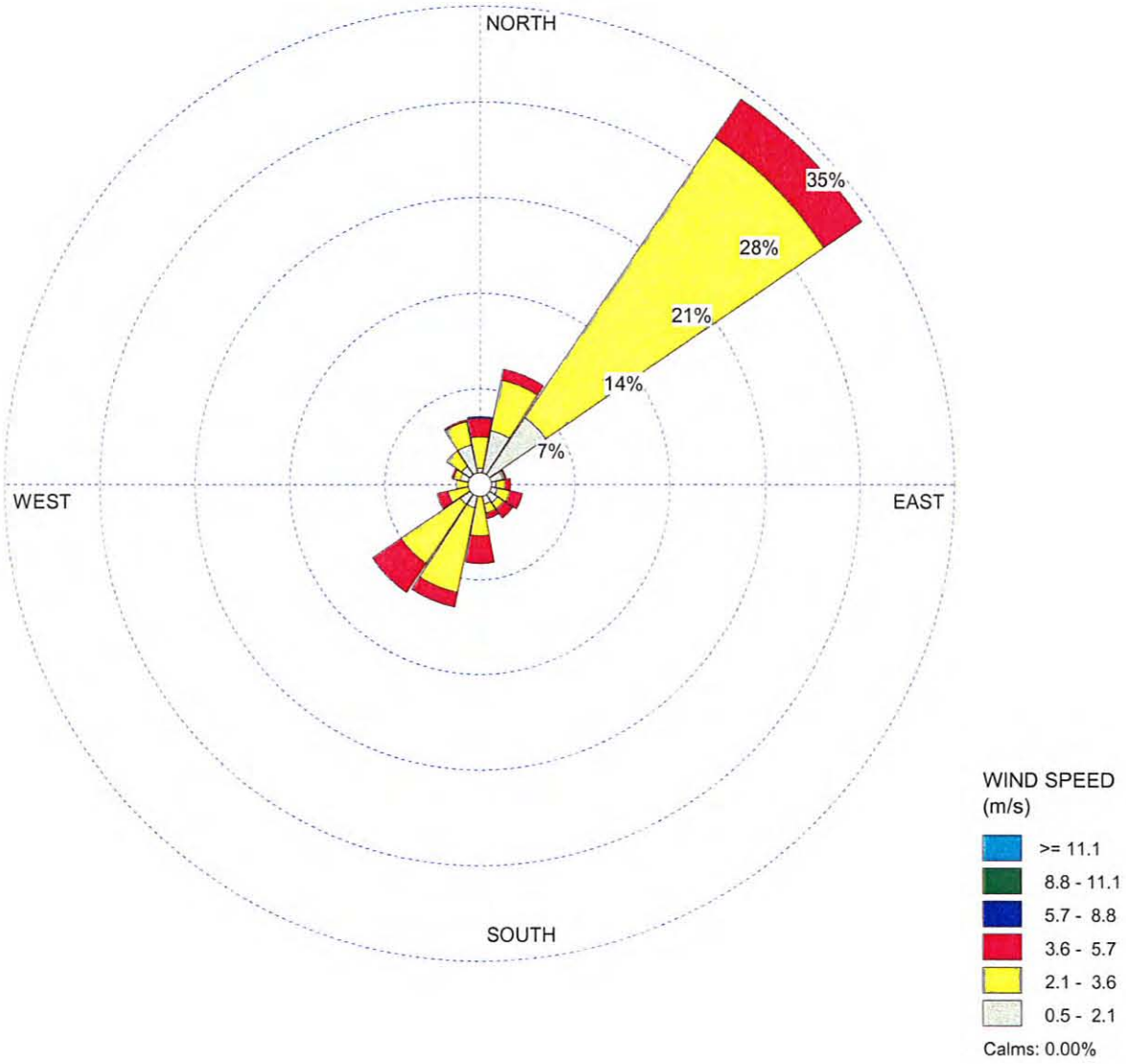
WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2014 August

DISPLAY:

Wind Speed
Direction (blowing from)



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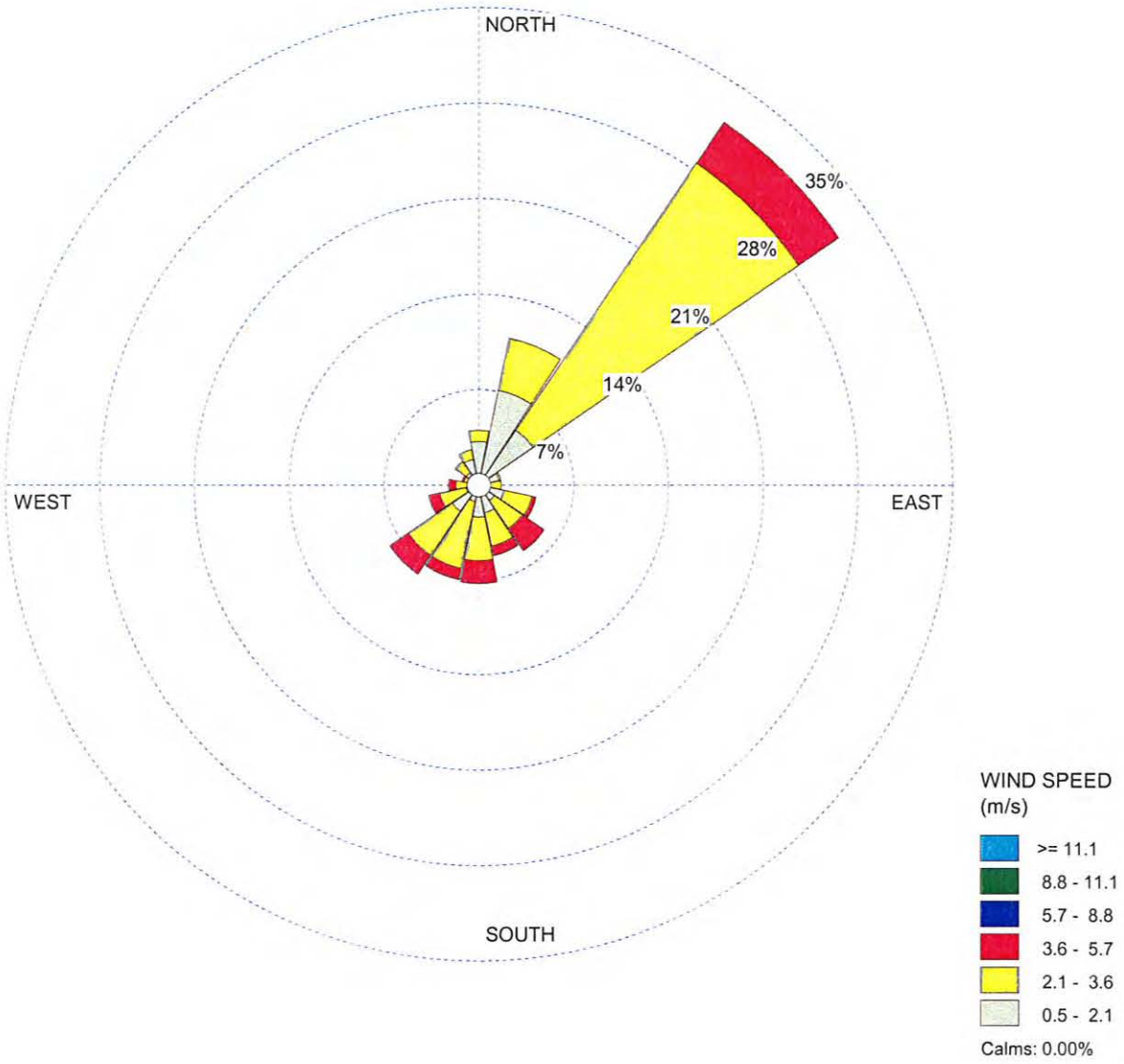
WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2014 September

DISPLAY:

Wind Speed
Direction (blowing from)



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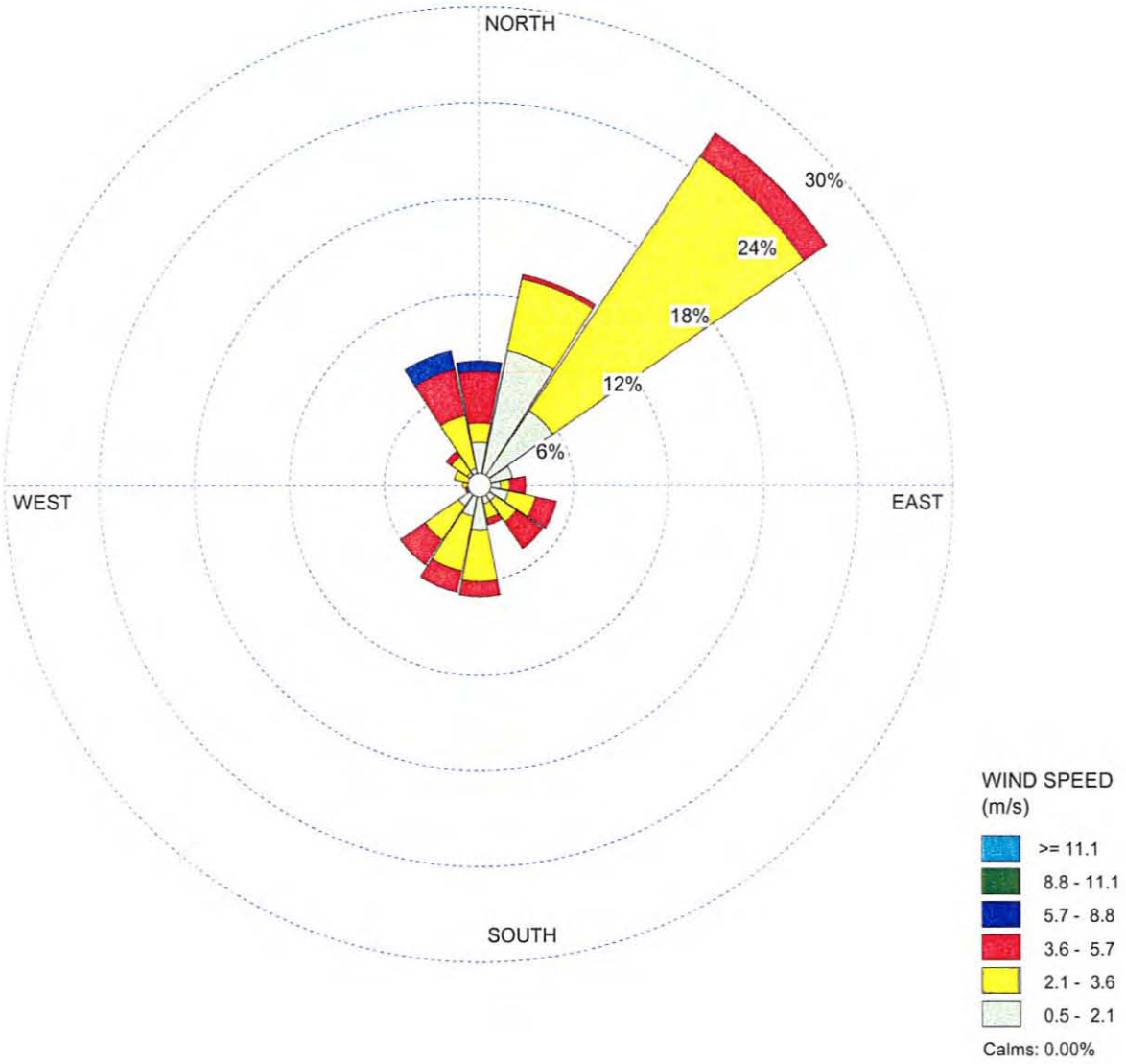
	AVG. WIND SPEED: **2.50 m/s**	DATE: **10/6/2014**	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2014 October

DISPLAY:

Wind Speed
Direction (blowing from)



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	CALM WINDS: **0.00%**	TOTAL COUNT: **744 hrs.**	
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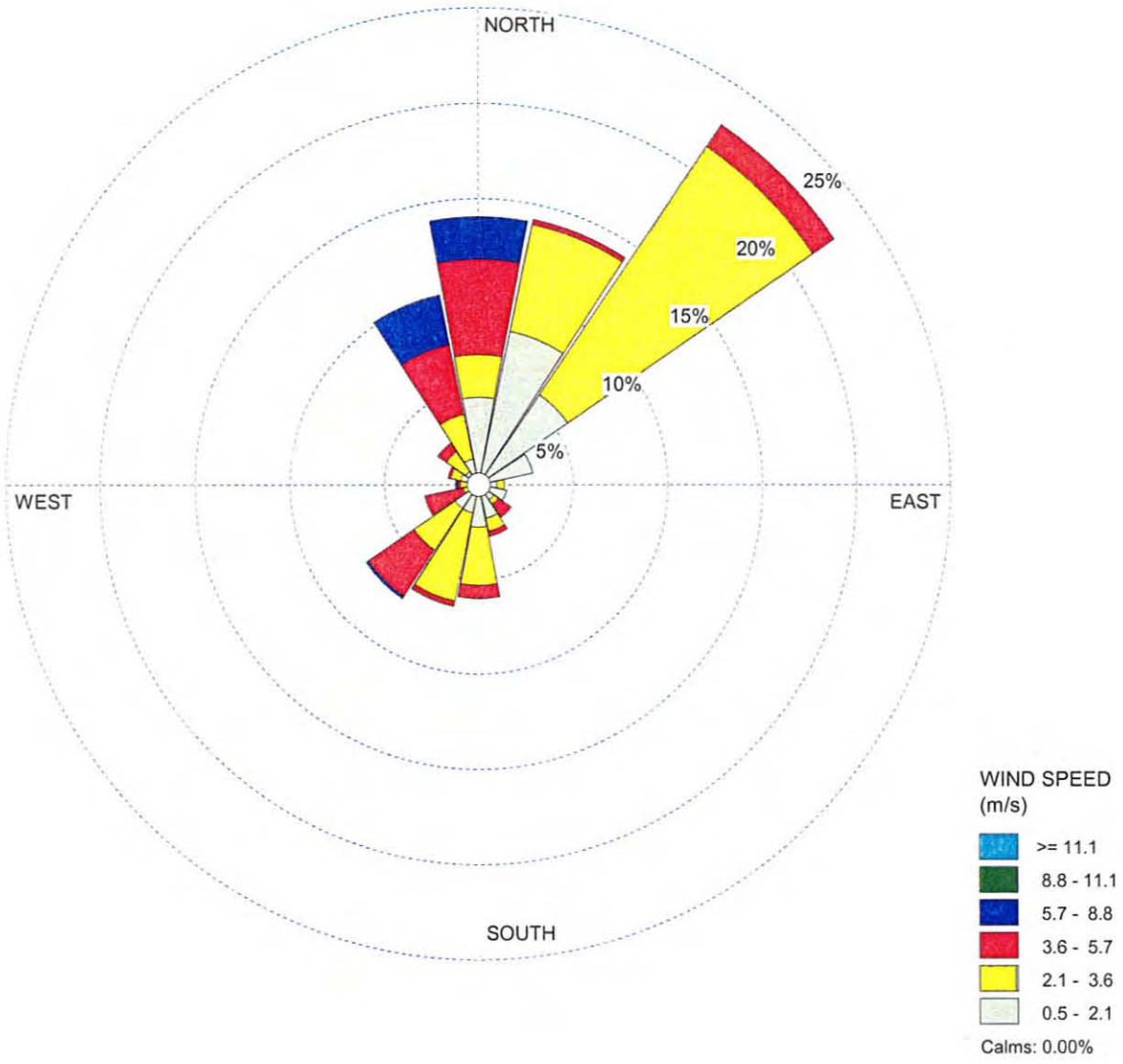
WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2014 November

DISPLAY:

Wind Speed
Direction (blowing from)



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		MODELER: **K. Nicholes**	
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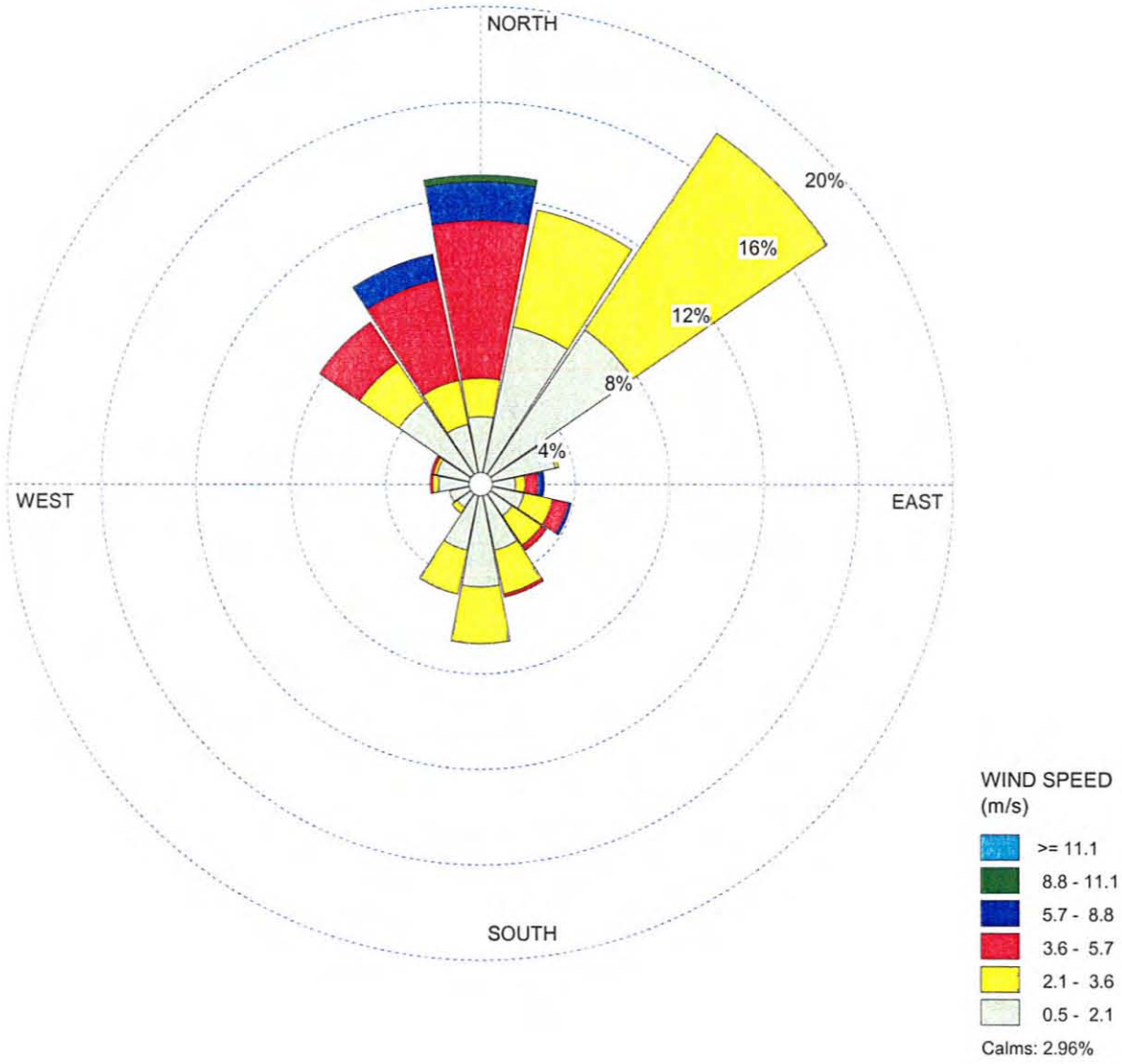
	AVG. WIND SPEED: **2.84 m/s**	DATE: **1/8/2015**	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2014 December

DISPLAY:

Wind Speed
Direction (blowing from)



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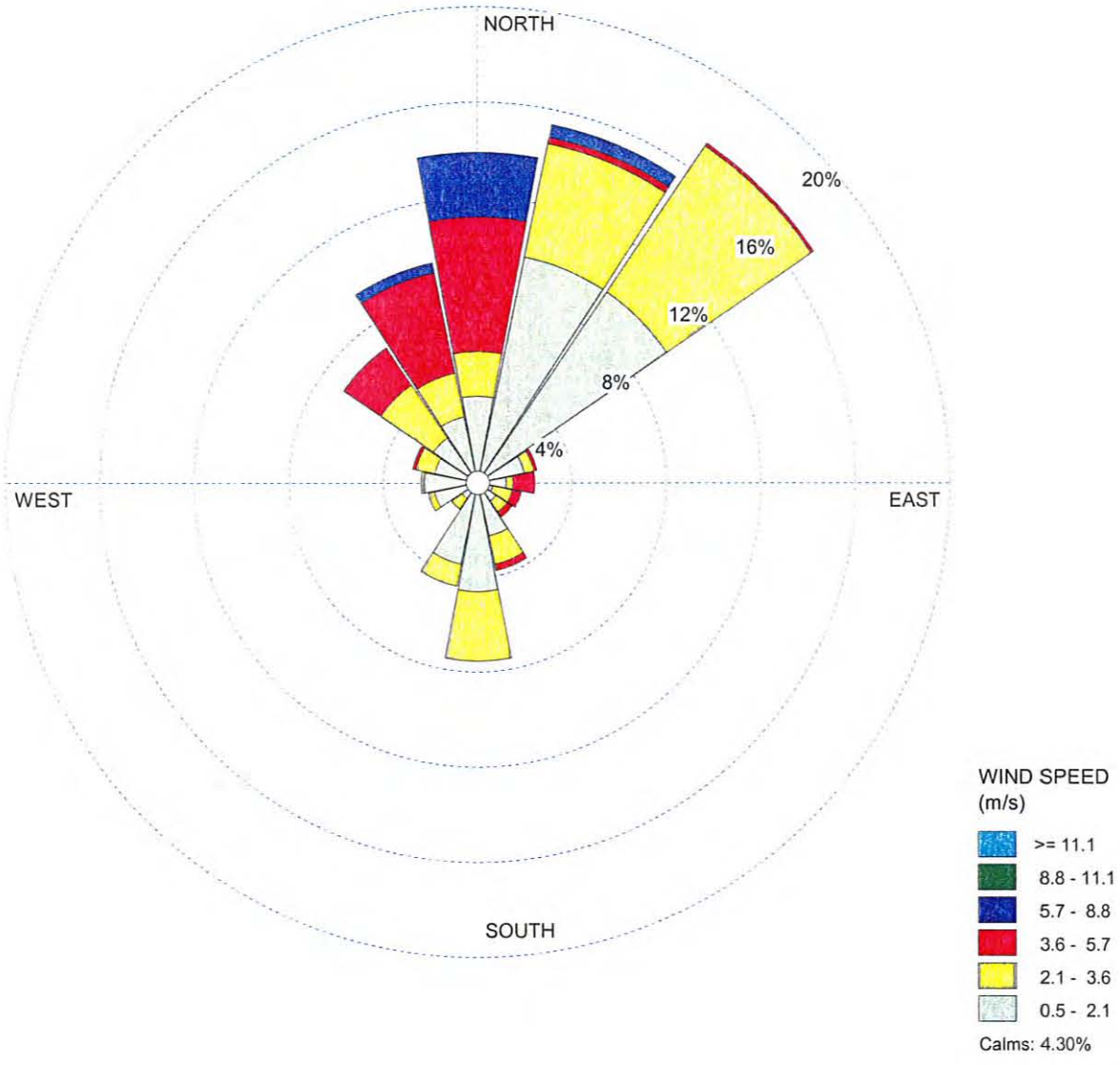
WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2015 January

DISPLAY:

Wind Speed
Direction (blowing from)



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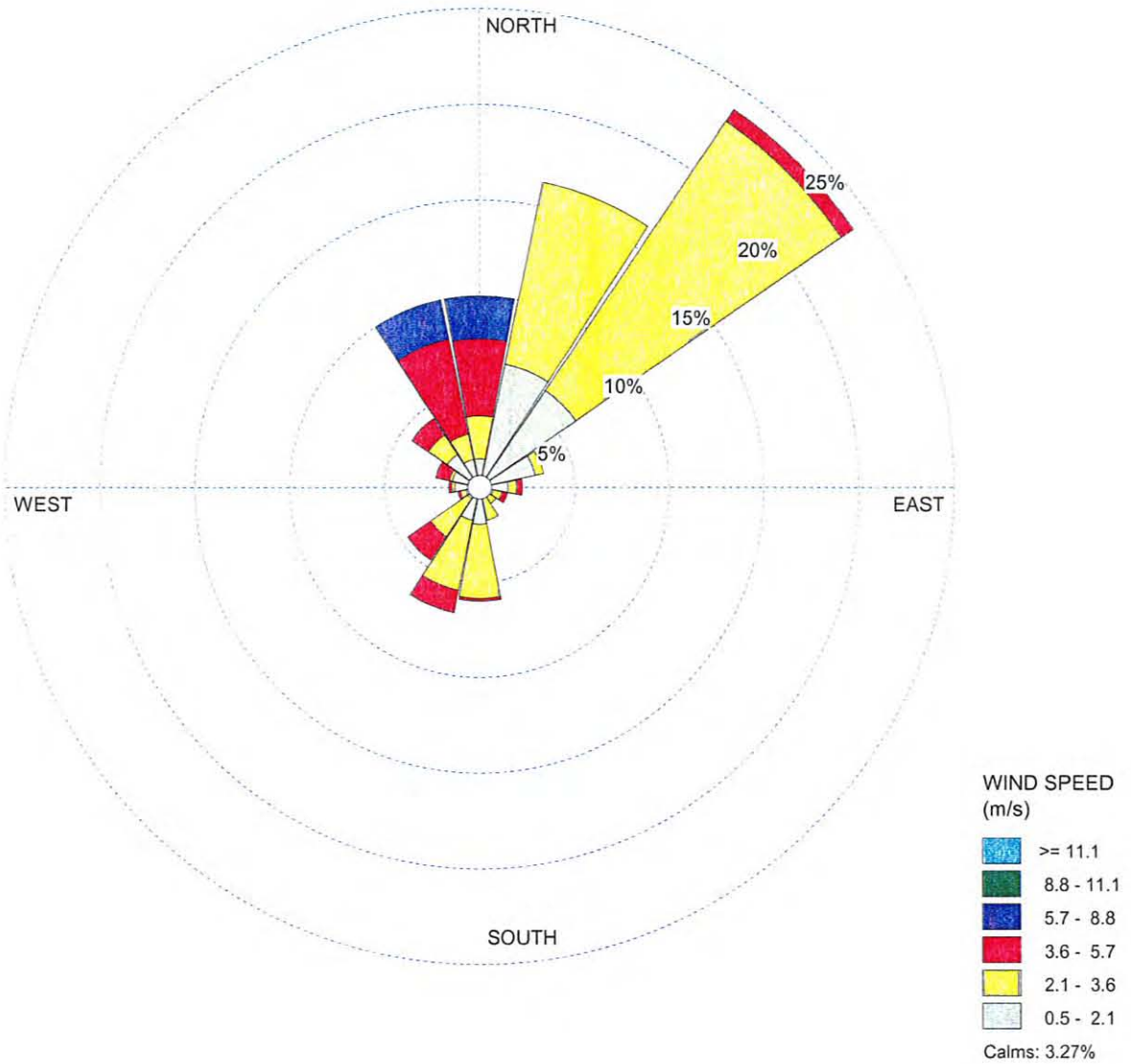
WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2015 February

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 2/1/2015 - 00:00** **End Date: 2/28/2015 - 23:00**	COMPANY NAME: **Alton Coal Development, LLC - Coal Hollow Mine**	
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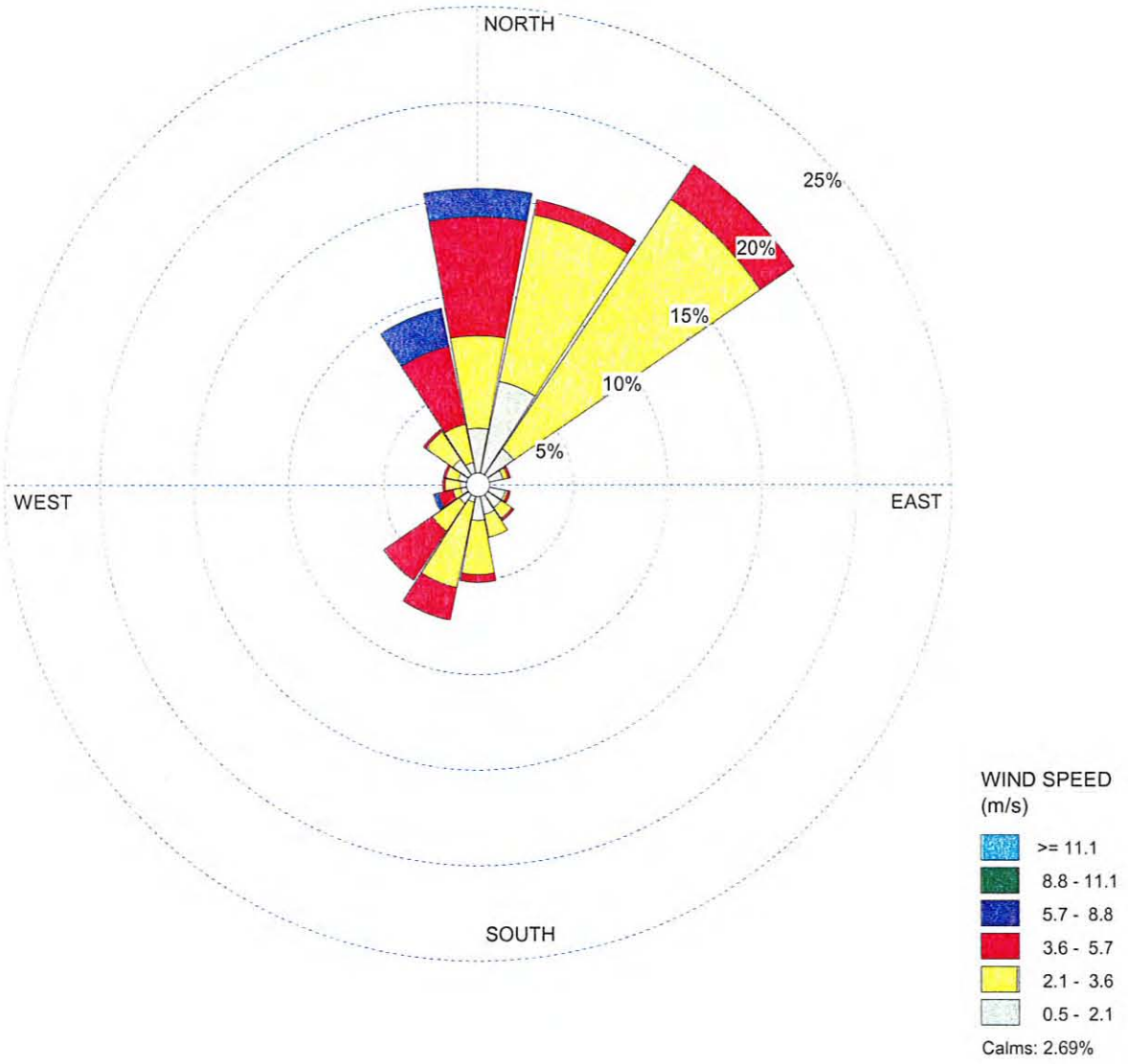
	CALM WINDS: **3.27%**	TOTAL COUNT: **672 hrs.**	
	AVG. WIND SPEED: **2.69 m/s**	DATE: **4/27/2015**	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2015 March

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 3/1/2015 - 00:00** **End Date: 3/31/2015 - 23:00**	COMPANY NAME: **Alton Coal Development, LLC - Coal Hollow Mine**	
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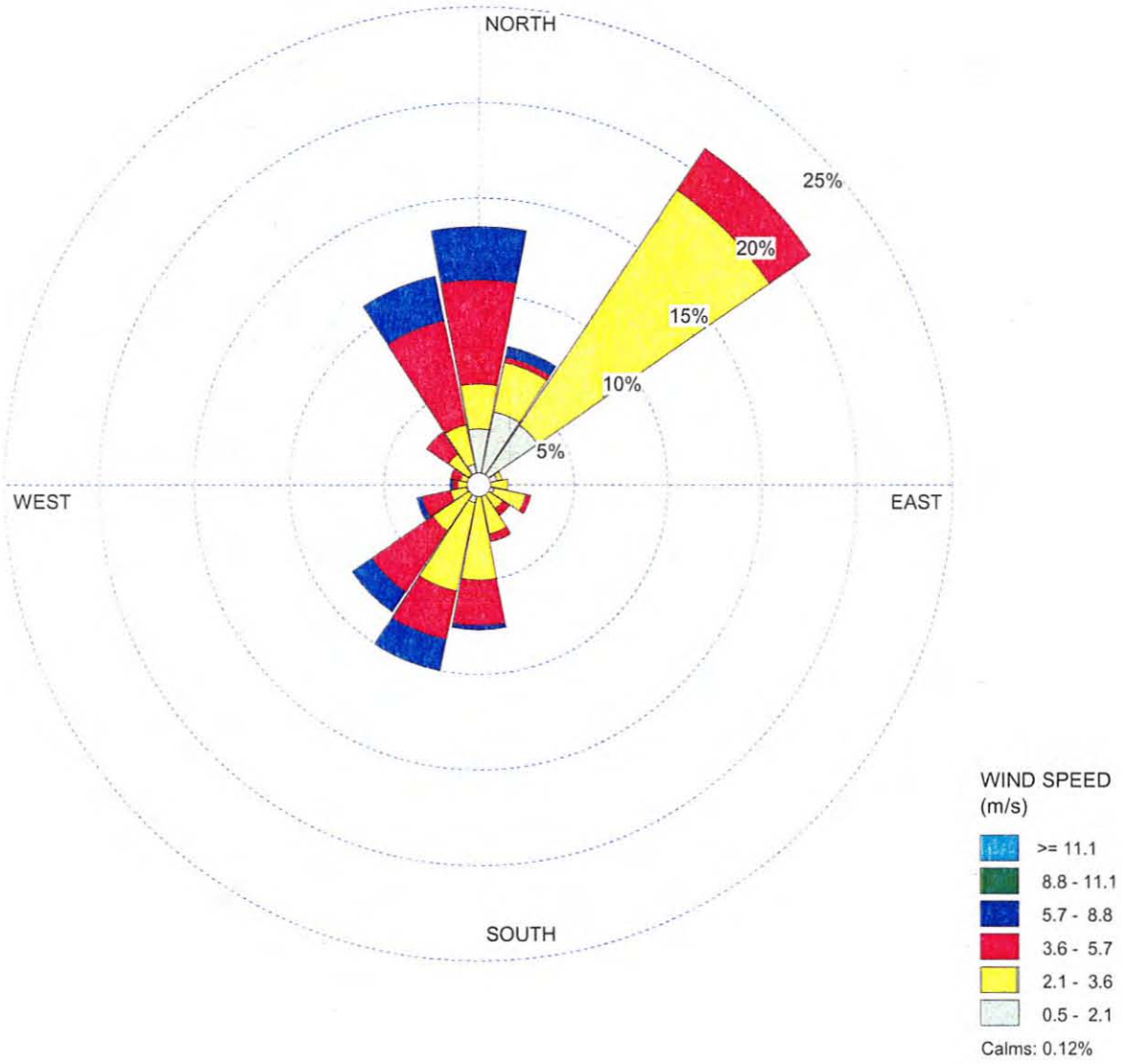
	CALM WINDS: **2.69%**	TOTAL COUNT: **744 hrs.**	
	AVG. WIND SPEED: **2.78 m/s**	DATE: **4/27/2015**	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2015 April

DISPLAY:

Wind Speed
Direction (blowing from)



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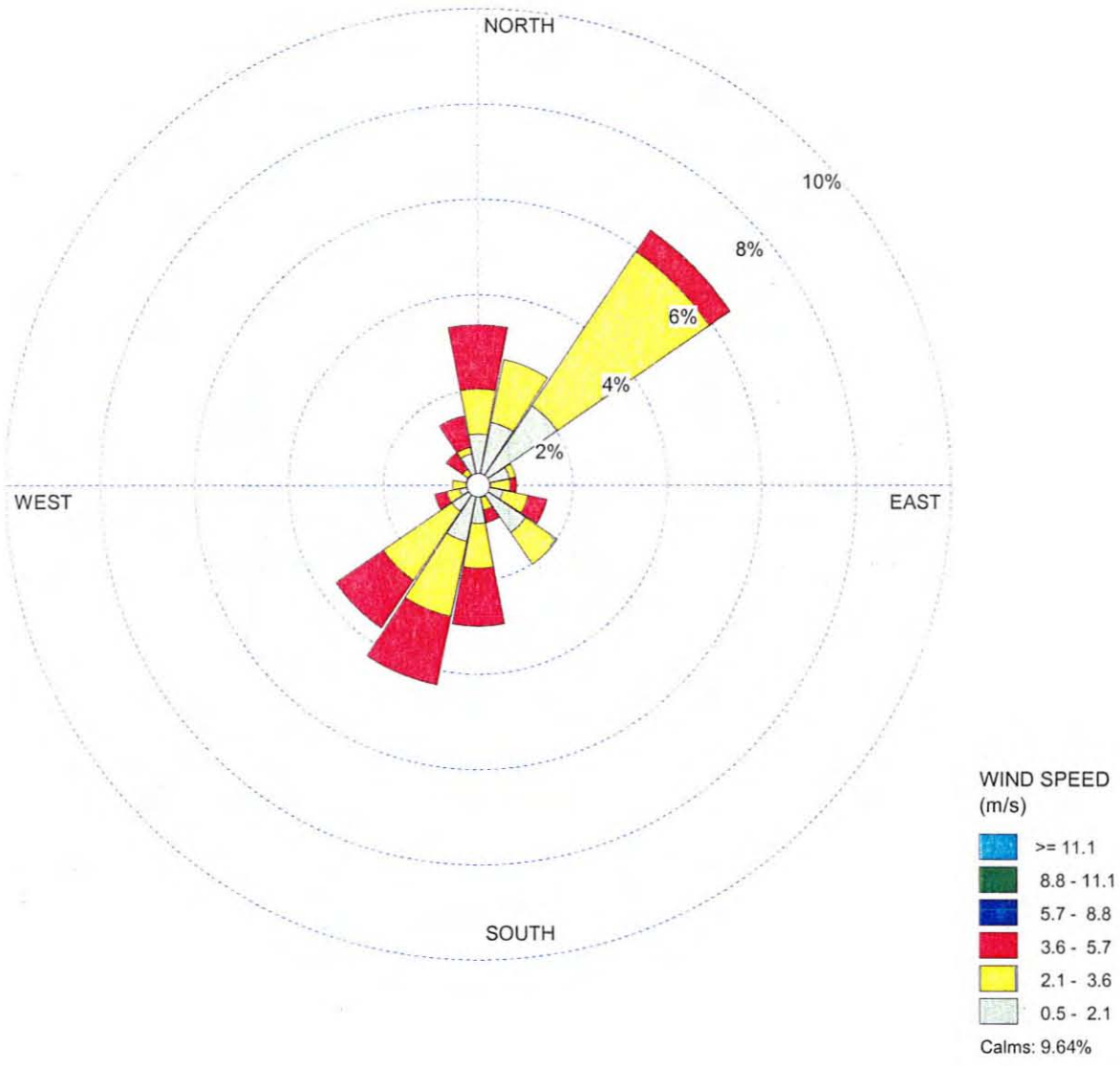
WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2015 May

DISPLAY:

Wind Speed
Direction (blowing from)



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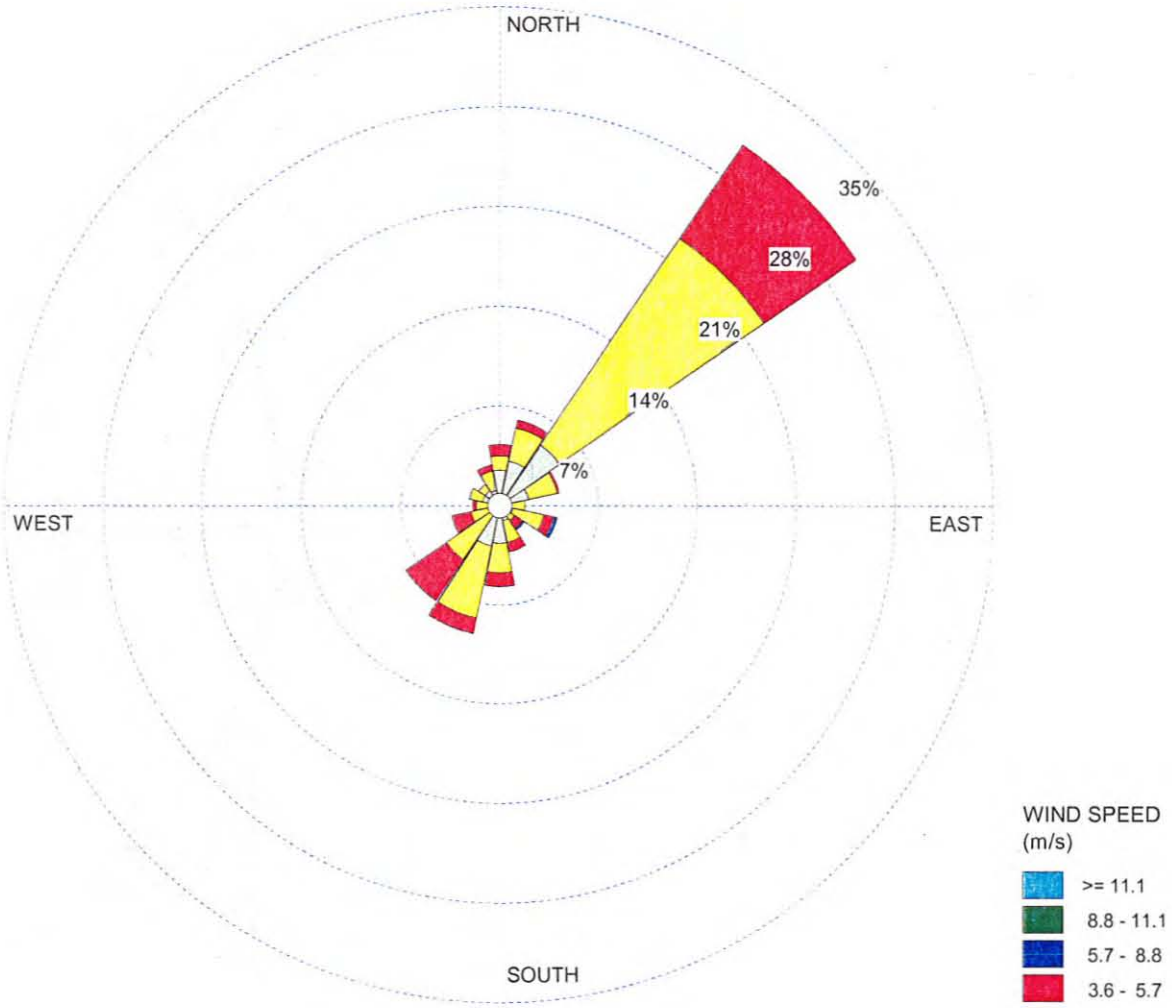
	AVG. WIND SPEED: **0.88 m/s**	DATE: **8/3/2015**	PROJECT NO.:

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2015 June

DISPLAY:

Wind Speed
Direction (blowing from)



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		MODELER: **K. Nicholes**	
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	AVG. WIND SPEED: **2.50 m/s**	DATE: **8/3/2015**	PROJECT NO.:

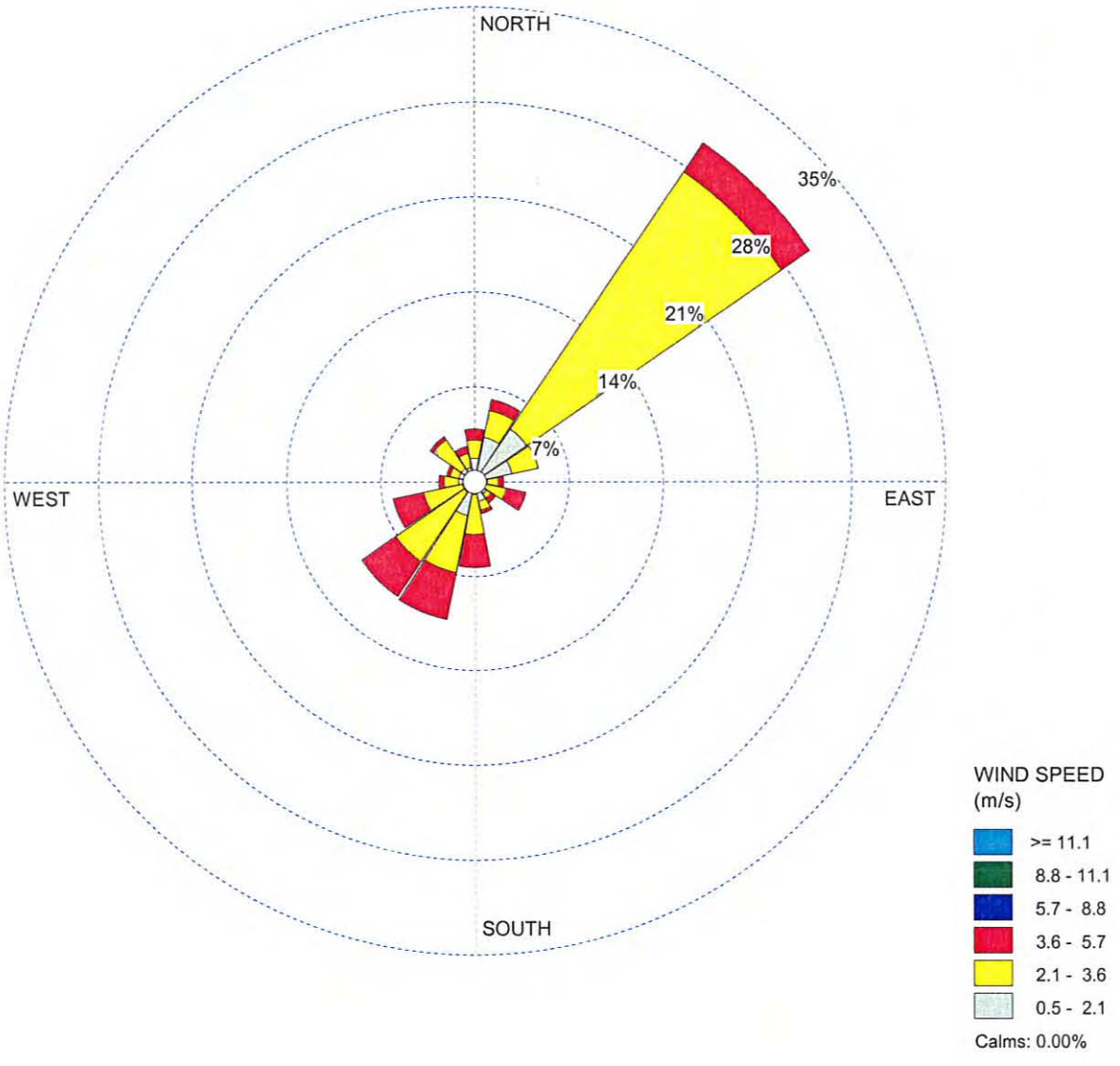
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2015 ~~3rd QT~~ July

DISPLAY:

Wind Speed
Direction (blowing from)



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	AVG. WIND SPEED: **2.69 m/s**	DATE: **10/13/2015**	PROJECT NO.:

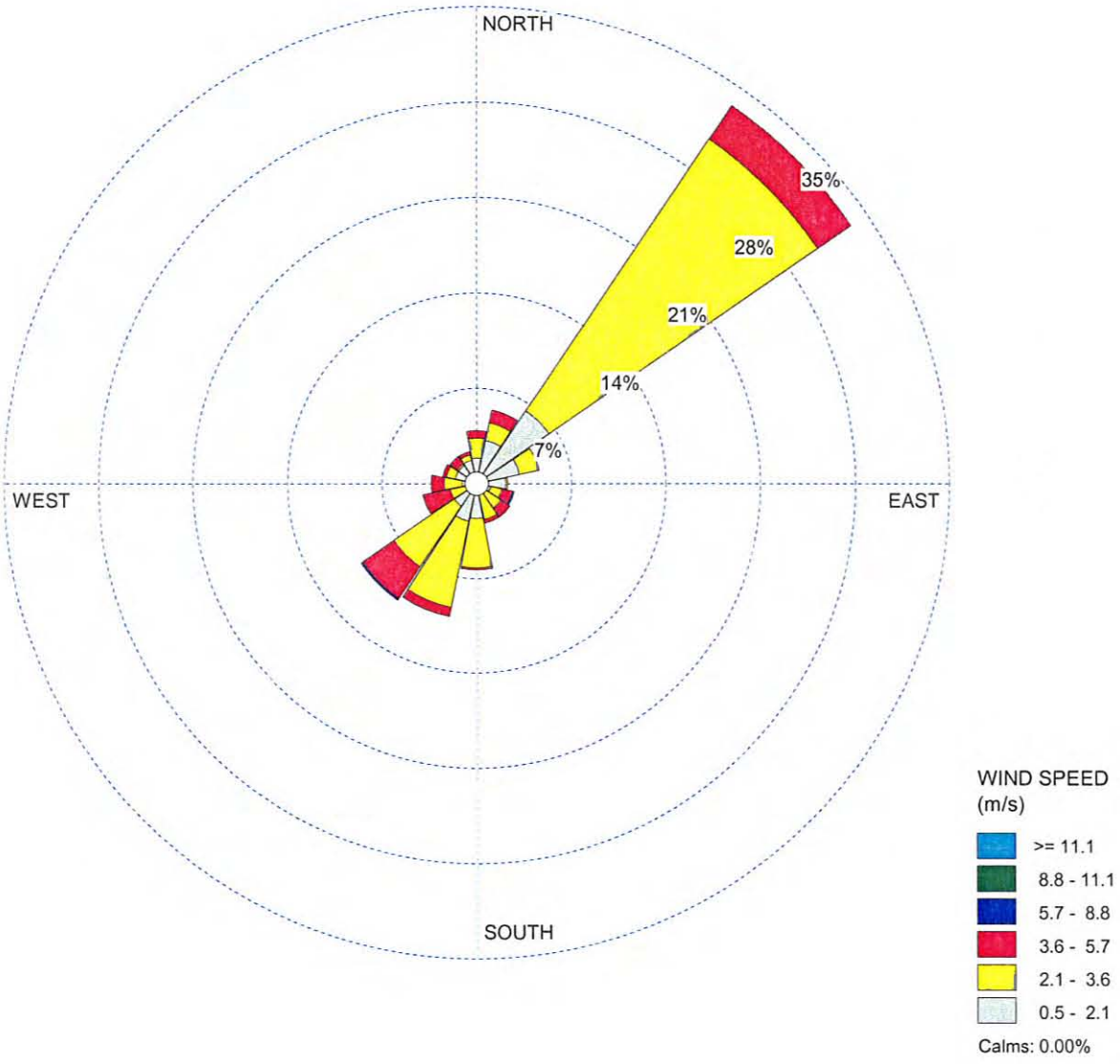
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2015 August

DISPLAY:

Wind Speed
Direction (blowing from)



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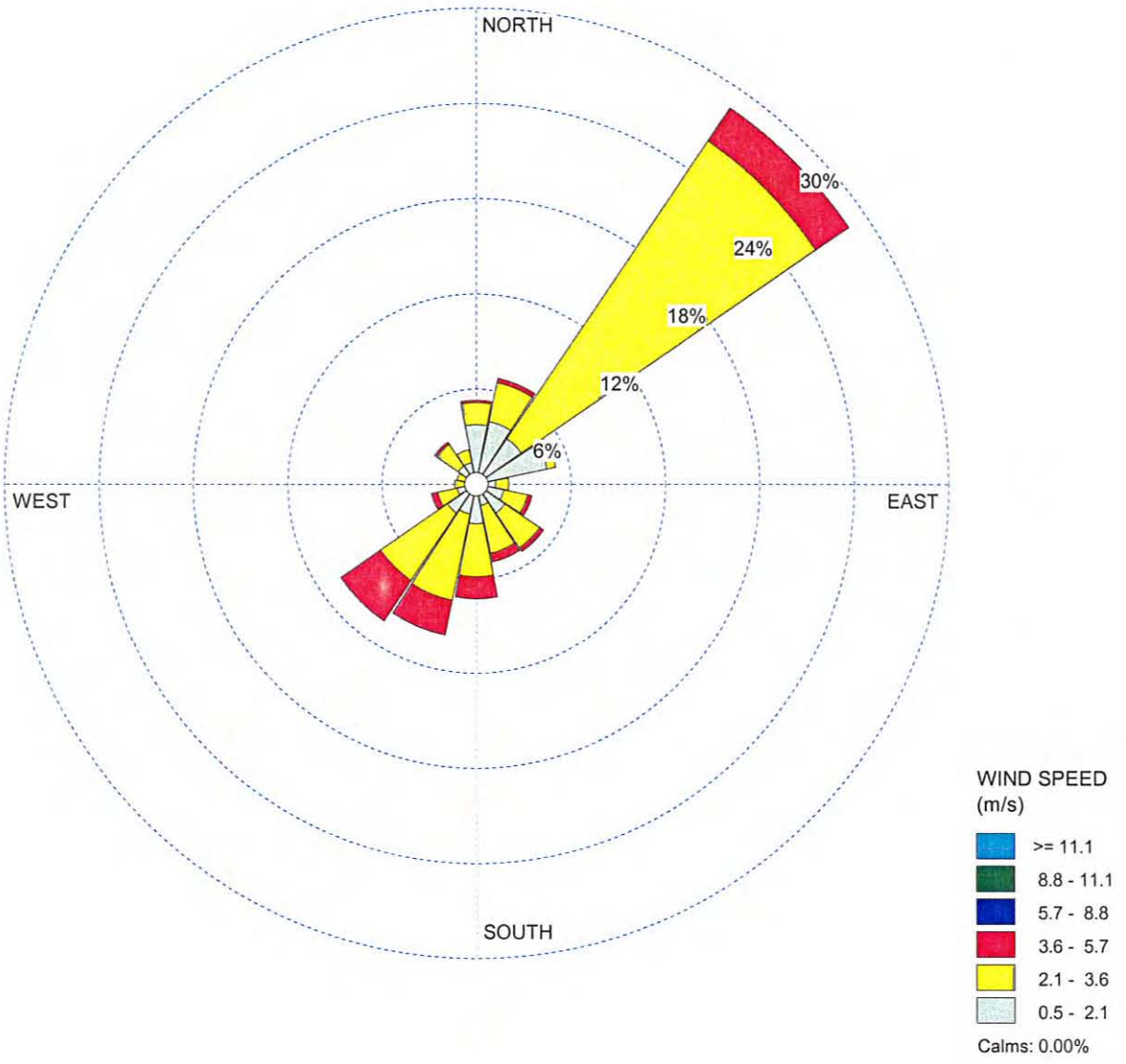
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Alton Coal Development , Alton, Utah
2015 September

DISPLAY:

Wind Speed
Direction (blowing from)



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		MODELER: **K. Nicholes**	
	CALM WINDS: **0.00%**	TOTAL COUNT: **720 hrs.**	
	AVG. WIND SPEED: **2.53 m/s**	DATE: **10/13/2015**	PROJECT NO.:

APPENDIX 7-16

Probable Hydrologic Consequences of Mining in the North Private Lease area at the Alton Coal Development, LLC Coal Hollow Mine

Probable Hydrologic Consequences of Mining in the North Private Lease area at the Alton Coal Development, LLC Coal Hollow Mine

9 October 2015

Alton Coal Development, LLC
Cedar City, Utah

PETERSEN HYDROLOGIC, LLC
CONSULTANTS IN HYDROGEOLOGY

Probable Hydrologic Consequences of Mining in the North Private Lease area at the Alton Coal Development, LLC Coal Hollow Mine

9 October 2015

Alton Coal Development, LLC
Cedar City, Utah

Prepared by:

Erik C. Petersen, P.G.
Principal Hydrogeologist
Utah P.G. No. 5373615-2250

PETERSEN HYDROLOGIC, LLC
CONSULTANTS IN HYDROGEOLOGY

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1.0 INTRODUCTION

The Alton Coal Development, LLC (ACD) Coal Hollow Mine is located approximately 3 miles south of the town of Alton, Utah (Figure 1). A permit to operate the Coal Hollow Mine was issued on 10 November 2010. The first coal was mined in early February 2011.

Alton Coal Development, LLC is currently applying for a permit from the Utah Division of Oil, Gas and Ming to extend the mining operations at the existing Coal Hollow Mine into the coal reserves at the proposed North Private Lease area. The purposes of this document are to present the baseline hydrologic data and to describe the Probable Hydrologic Consequences (PHC) of the proposed mining activities in the North Private Lease area.

The reader is referred to the mining and reclamation plan for the Coal Hollow Mine (C0250005) and to Appendix 7-1 (Petersen Hydrologic, 2007) of the Coal Hollow Mine MRP which provides an analysis of groundwater and surface-water systems in the region for supporting information for this document. The reader is also referred to the report of an alluvial valley floor field investigation that was previously conducted in the North Private Lease area (Petersen Hydrologic, et al, 2012). This document provides additional geologic, hydrologic, and hydrogeologic information from the North Private Lease area and is available as Appendix 7-17 in Chapter 7 of the Coal Hollow Mine MRP.

Including this introduction, this report includes the following sections:

- Introduction
- Mining Overview
- Methods of Study
- Presentation of Data
- Climate
- Geology
- Baseline Information
- Probable Hydrologic Consequences Determination
- Recommended Monitoring Plans for Surface Water and Groundwater
- References Cited

2.0 MINING OVERVIEW

Prior to 2014, coal mining operations at the Coal Hollow Mine were performed using conventional surface mining (open pit) techniques. Beginning in 2014, ACD began using highwall mining techniques in selected portions of the mine permit area in addition to conventional open pit techniques. Using highwall mining techniques, the coal resource can be extracted from an above-ground surface location without causing disturbance of the land surface overlying coal extraction areas. Because of the hydrogeologic characteristics of the Tropic Shale bedrock present above the coal seam to be mined, highwall mining operations can be performed without disruption of overlying shallow alluvial groundwater systems or surface water resources.

ACD is currently proposing to extend their Coal Hollow Mine operations into private coal reserves in the North Private Lease area. Mining operations in the North Private Lease area will be performed using both conventional open-pit surface mining techniques and highwall mining techniques.

3.0 METHODS OF STUDY

The methods of study utilized in this hydrogeologic investigation, including data collection methods and investigative techniques, are described below.

- Existing published and unpublished maps and reports were obtained and reviewed

- An alluvial valley floor field investigation was performed in the North Private Lease area as a joint effort by Petersen Hydrologic, LLC, Mt. Nebo Scientific, Inc., and Long Resource Consultants, Inc. The investigation was performed to allow the Division of Oil, Gas and Mining to identify the existence of any probable alluvial valley floors in the proposed permit and adjacent area. As part of that investigation, detailed studies of groundwater and surface-water systems, geology, geomorphology, soils, and vegetation were performed.

- Discharge, water-quality, and potentiometric data were obtained from several sources and compiled into an electronic database for analysis. These included hydrologic data collected by Utah International, Inc. in the 1980's as part of a previous (unsuccessful) coal mine permitting action, and data collected by Petersen Hydrologic, LLC during baseline monitoring activities commissioned by Alton Coal Development, LLC.

- A spring and seep survey of the North Private Lease and adjacent area was performed by Petersen Hydrologic, LLC. Hydrologic reconnaissance was also performed in conjunction with wetland studies performed in the region (Frontier, 2012; Long and Collins, 2012). At each identified spring and seep location, discharge measurements and field water-quality measurements were performed. Each spring and seep location was also digitally photographed and the site location determined by handheld GPS.

- Data analysis was performed using graphical, statistical, and computer methods. Solute chemical data were analyzed graphically using Stiff (1951) diagrams and using the computer code WATEQF (Plummer et al., 1976).

- As part of this investigation, thirteen monitoring wells were installed during the fall of 2012 and 2013. Additionally, continuous core drilling was performed at eight locations near proposed mining areas during the summer of 2012. Geologic logging of the lithologic and hydrogeologic properties of continuous core samples obtained during the core drilling activities was performed. Samples for physical and chemical analysis were collected from the continuous cores and also from auger returns. The samples were analyzed for acid- and toxic-forming potential and other chemical and physical parameters by Inter-Mountain Labs of Sheridan, Wyoming.

- Monitoring well ground coordinates and collar elevations were determined by ACD personnel using survey-grade GPS.

- Samples for laboratory water quality analysis were analyzed according to standard EPA methods. Laboratory water quality measurements were performed by Chemtech-Ford Laboratories of Murray, Utah, which is a Utah state-certified analytical laboratory. Information on laboratory analytical methods is provided on the Chemtech-Ford laboratory reporting sheets in Appendix A.

- Discharge measurements for springs and seeps were typically performed using a calibrated container and a stopwatch. The measurements were performed by damming and diverting the spring discharge through a pipe. Using an appropriately sized container, time-to-fill measurements were typically performed at least 3 times at each location. An average time-to-fill value was used to calculate the reported discharge measurement.

- Discharge measurements at stream monitoring stations were performed using a portable 3-inch Parshall flume, electronic current-velocity meter and wading rod, portable 90-degree v-notch weir, or a stopwatch and calibrated container as appropriate. Discharge measurements and calculations were performed using techniques described by the U.S. Bureau of Reclamation.

- Potentiometric levels were monitored in wells using a Waterline Envirotech, Ltd. Model 150 tape or a Model 500 coaxial water-level indicator.

- Temperature measurements were performed using a Taylor brand electronic digital thermometer. Discharge temperature measurements at springs were performed as close to the spring discharge locations as possible. Stream temperature measurements were performed, where possible, in a shaded, actively flowing portion of the stream.

- Specific conductance measurements were performed using an Extech brand model EC400 conductivity meter with automatic temperature compensation. The instrument was regularly calibrated using traceable ASTM conductivity standard solutions.

- pH Measurements were performed using an Oakton brand Acorn 6 model electronic pH meter or an Oakton pHTestr model 30, both models incorporating a double junction pH electrode and automatic temperature compensation. The instruments were regularly calibrated using traceable ASTM pH standard solutions.

- Dissolved oxygen measurements were performed using a YSI brand model 55 dissolved oxygen meter. The meter was routinely calibrated using atmospheric oxygen calibration methods.

4.0 PRESENTATION OF DATA

Baseline monitoring site locations are shown on Figure 2. A map showing the planned locations of open pit and highwall mining trenches is provided on Figure 3. Information gained from the proposed alluvial groundwater drilling program will be used to refine the locations of proposed highwall mining holes. A map showing the results of a spring and seep survey conducted in the North Private Lease area is presented in Figure 4. Surface-water drainages in the North Private Lease and adjacent areas are also shown on Figure 2. Monitoring site details are presented in Table 1. Baseline discharge, water level and chemical information for springs, wells, and streams are provided in Tables 2a (field measurements and major ion chemical compositions) and 2b (trace constituent chemical compositions). Completion data for monitoring wells is summarized in Table 3. A plot of the Palmer Hydrologic Drought Index for the region (Utah Region 4) is provided in Figure 5. A geologic map of the North Private Lease and adjacent area is presented in Figure 6. A series of geologic cross-sections through the North Private Lease area are presented in Figure 7. Water-level hydrographs for monitoring wells are presented in Figure 8. Discharge hydrographs for springs and seeps are presented in Figure 9. Discharge hydrographs for streams are presented in Figure 10. Major-ion geochemical compositions of groundwaters and surface-waters in the North Private Lease area are depicted graphically as Stiff (1951) diagrams in Figure 11. The locations of ponds and ditches in the North Private Lease area

are mapped on Figure 12. A water table contour map for the alluvial groundwater system in the North Private lease area is presented in Figure 18. The proposed hydrologic monitoring plans for groundwaters and surface-waters in the North Private Lease and adjacent area are summarized in Tables 4 and 5. Recommended hydrologic monitoring locations for the North Private Lease area are shown on Figure 19. A map showing the wells within the North Private Lease that will be intercepted and destroyed in the future by mining operations is provided as Figure 20. A map showing shallow alluvial groundwater flow directions and depths to water under seasonal conditions is provided as Figure 21. Supporting calculations for the UII well test performed on alluvial groundwater monitoring well Y-103 is provided in Appendix C. Selected gain/loss discharge data from measurements performed on Kanab Creek within and adjacent to the North Private Lease area are provided in Table 6. Plots of selected gain/loss data are provided in Figure 22.

5.0 CLIMATE

Climatological information, including temperature and precipitation data, have been routinely measured and recorded at the Alton, Utah weather station (420086) since 1928. The station is located in the town of Alton, approximately three miles north of the Coal Hollow Mine permit area. Climatological data collected at the Alton station for the 77-year period from 1928 to 2005 have been summarized by the Western Regional Climate Center (2013). The month with the minimum monthly average temperature at the Alton station is January (15.1 °F), while the month with the warmest average maximum temperature is July (82.6 °F). Total precipitation averages 16.40 inches. Precipitation in the Alton area occurs during two annual wet cycles. These include wintertime cyclonic storms which bring precipitation to the area (usually as snowfall), and summertime storms originating from convection in the Gulf of Mexico or the Pacific Ocean (Doelling, 1972). Average monthly precipitation at the Alton station ranges from a low of 0.57 inches in June to a maximum of 1.79 inches in January and February. The average monthly precipitation falling during the month of September is nearly as great, averaging 1.76 inches.

The Palmer Hydrologic Drought Index (PHDI; NCDC, 2015) indicates long-term climatic trends for the region. The PHDI is a monthly value generated by the National Climatic Data Center (NCDC) that indicates the severity of a wet or dry spell. The PHDI is computed from climatic and hydrologic parameters such as temperature, precipitation, evapotranspiration, soil water recharge, soil water loss, and runoff. Because the PHDI takes into account parameters that affect the balance between moisture supply and moisture demand, the index is useful for evaluating the long-term relationship between climate and groundwater recharge and discharge. As such, it can be a useful tool for evaluating whether changes in groundwater or surface-water discharge rates are attributable to climatic variability or to other factors. A plot of the PHDI for Utah Region 4 (which includes the proposed Coal Hollow Mine permit and surrounding area) is shown in Figure 5. It is apparent in Figure 5 that the region has experienced alternating periods of drought and wetness. Baseline hydrologic monitoring conducted in the region since 2005 has occurred during periods in which climatic conditions have ranged from extreme wetness to severe drought. During 2005, the region experienced a period of extreme wetness after previously having undergone a multi-year period of much dryer conditions (Figure 5). In 2006, the region transitioned to dryer conditions, with notable periods of drought occurring during 2007 and 2009. Near-normal conditions prevailed during most of 2008. During 2010, the region began a transition toward wetter climatic conditions that peaked in mid-2011 with severe to extreme wetness. Beginning in late 2011, the region began a transition towards dryer climatic conditions with most of 2012, 2013, and 2014 being characterized by mild to severe drought. Conditions in the region continued to be dry during early 2015.

Wind data have been collected at the Coal Hollow Project weather station since December 2005. Wind data from the Coal Hollow Project weather station indicates that the predominant wind directions in the Coal Hollow Mine permit area are from the northeast, with secondary peaks from the north and south-southwest. Surface winds recorded at the Coal Hollow Project weather station averaged about 6.4 miles per hour. Wind data have also been collected historically at nearby locations by governmental and other entities. The regionally predominant direction of winds in the region is southwest through west. Secondary peaks are from the southeast and northwest. Surface winds in the regional area

average approximately 8 miles per hour. Higher wind speeds are associated with passage of weather fronts and storms and generally occur during the springtime.

6.0 GEOLOGY

The geology of the Coal Hollow Mine permit and adjacent area (including the North Private Lease area) is described in Chapter 6 of the Coal Hollow Mine MRP. Within the proposed North Private Lease area mining area, Cretaceous Tropic Shale bedrock and Quaternary alluvium is exposed at the land surface. The Cretaceous Dakota Formation is present beneath the Tropic Shale in the proposed mining areas within the North Private Lease area and is present at the surface in lower lying areas where the Tropic Shale has been removed by erosion. A series of geologic cross-sections through the proposed North Private Lease mining areas is presented in Figure 7. These geologic units are described below.

Quaternary Deposits

The Quaternary deposits in the North Private Lease area consist predominantly of unconsolidated alluvial sediments (interbedded clays, silts, sands, and gravels). The alluvium/colluvium sediments include colluvium derived from erosion of adjacent upland areas surrounding the lease area. Alluvial sediments transported by Kanab Creek are present in the center of the valley within the North Private Lease area. Drilling logs for selected holes drilled near the proposed North Private Lease mining areas are included in Appendix B. Within the North Private Lease area, the alluvial deposits range from a thin veneer along the valley margins to more than 100 feet in thickness nearer the center of the valley.

Tropic Shale (Cretaceous)

The Tropic Shale consists predominantly of gray and carbonaceous silty shale with a few marine sandstone beds. The sandstone beds in the Tropic Shale are exposed in the upper portions of the Tropic Shale along the eastern valley margins. However, sandstone beds of appreciable thickness were not encountered in drillholes within the North Private Lease mining areas (Appendix B), as the upper portion of the Tropic Shale in the proposed mining area has been removed by erosion. The Tropic Shale typically weathers at the surface to a clayey soil

that typically forms gentle, vegetated slopes such as those present along both the eastern and western margins of the North private Lease area. In the central portion of the Kanab Creek valley that runs through the North Private Lease area, the quaternary alluvium deposits are underlain by Tropic Shale bedrock in all proposed mining areas. The formation was deposited in an open-marine offshore environment during the maximum westward transgression of the Cretaceous Western Interior Seaway in the Late Cretaceous (Tilton, 2001). Near the top of the formation, more sandy horizons are interbedded with the mudstone units of the formation. These sandy units together with the sandstone at the base of the overlying Straight Cliffs Formation reflect the initial sand influx onto the marine environment of the Tropic Shale. The thickness of the Tropic Shale in the Alton Quadrangle is about 700 feet.

Dakota Formation (Cretaceous)

The Dakota Formation contains the economic coal seams in the Alton Coal Field. The formation consists of fine- to medium-grained sandstone (commonly lenticular) with interbedded gray shale, carbonaceous shale, and coal. In most locations, shaley strata dominate the formation, comprising about 60 to 75 percent of the formation (Doelling, 1972). Where exposed at the surface to the south and west of the North Private Lease area, the unit characteristically forms ledge and slope topography. In the Alton area, the Dakota Formation directly overlies the Carmel Formation. The economic coal seams in the Alton Coal Field are present near the base (Bald Knoll coal zone) and near the top of the formation (Smirl coal zone). The Smirl coal zone is the mineable economic coal seam in the North Private Lease area. Local thinner coal seams that are not of economic importance are present in the center of the formation. The thickness in the western portion of the Alton Coal Field is about 450 feet. In the eastern portion of the Alton Coal Field, the Dakota Formation is about 150 feet thick and rests on the Entrada Sandstone.

Structure

Rock strata in the region dip gently toward the north and east, generally from 1 to 5 degrees. The Alton Coal Field is bounded on the east by the Paunsaugunt Fault and on the west by the Sevier Fault. Regional displacements on these two faults are about 1,000 to 2,000 feet, and 100 to 800 feet, respectively. Additionally, several faults with lesser displacements have been

mapped in the region, including the Sand Pass Fault zone (about 400 feet of offset), the Bald Knoll Fault (about 650 feet of offset), and the Sink Valley Fault. The Sink Valley Fault, which trends in an approximately north-south direction, is mapped in the westernmost portions of the existing Coal Hollow Mine area. However, this fault is not projected to intercept the North Private Lease area. (see Tilton, 2001). Most local faults in the Alton Quadrangle trend in a northerly or north-westerly direction, are several miles long, and are near vertical. A prominent north- to northwest-trending vertical joint set is present in the Upper Cretaceous sandstone rocks in the region. Stratal dips vary appreciably near the fault zones.

No appreciable faulting has been identified in the North Private Lease area during field mapping and drilling activities. However, smaller scale faulting, which is common regionally, could potentially be present but obscured at the surface by alluvium/colluvium.

Prominent geologic features in the North Private Lease area include 1) the broad, relatively flat alluvial surface that occupies most of the central and northern portions of the lease area, and 2) the upland Tropic Shale bedrock ridges that bound the region on both the east and the west (Figure 4). The low-permeability bedrock ridges hydrological isolate shallow groundwater systems and surface-water systems within the North Private Lease area from surrounding regions.

7.0 BASELINE HYDROLOGIC DATA

Large amounts of hydrologic data have been collected from the Coal Hollow Mine permit and adjacent area. Utah International Inc. (1988) conducted baseline monitoring of springs, streams, and wells in and around the Coal Hollow Mine area as part of previous mine permitting activities. Baseline and operational hydrologic monitoring has also been performed in the Coal Hollow Mine and adjacent areas since 2005. Baseline hydrologic monitoring of springs, streams, and wells in and around the North Private Lease area has also been performed for several years. Through these monitoring activities, a large quantity of surface-water and groundwater quantity and quality data, including field and laboratory water

quality data, spring and stream discharge-rate data, and groundwater potentiometric data from wells has been collected.

Selected baseline hydrologic data for the North Private Lease data are tabulated in Tables 2a and 2b. Chemical laboratory reporting sheets for baseline monitoring samples are provided in Appendix A. Drilling information and well completion logs from the area are provided in Appendix B.

Seasonal water quality characteristics for groundwaters in the North Private Lease area are summarized below.

Groundwater water-quality characteristics

Source	Chemical type	TDS (mg/L)
Alluvial groundwaters	Variable, magnesium-sulfate common.	Variable, TDS commonly in range of 1,000 to 4,000 mg/L, greater in some locations. Commonly increased TDS with increased distance from Kanab Creek. Little seasonal variability.
Smirl coal seam	Mixed cation-sulfate	Generally in the range of 3,000 mg/L. Little seasonal variability.
Dakota Formation	Mixed cation-sulfate	Elevated TDS, 7,000 – 8,000 mg/L common, little seasonal variability.
Tropic Shale	Magnesium-sulfate	Elevated TDS, 9,000 – 12,600 mg/L common, little seasonal variability.

Surface water water-quality characteristics

Source	Chemical type	TDS (mg/L)
Kanab Creek	Variable, magnesium sulfate and calcium-magnesium-bicarbonate common.	400 – 1,350 mg/L typical. High seasonal variability, increased TDS during low-flow conditions, naturally increased TDS with increased downstream distance.
Simpson Hollow Creek	Magnesium sulfate common.	Variable, 500-2,500 mg/L, variable by season and in response to precipitation runoff events.
SW-11 intermittent drainage	Variable, magnesium-sulfate, mixed types.	650 to 2,500 mg/L, variable by season and in response to runoff events.
Ephemeral Washes	Variable.	1,600 to 4,000 mg/L typical. Variable by season and in response to runoff events.

Information on seasonal variability of water quantity in groundwaters and surface waters is provided in Table 2a. Seasonal variation (or lack thereof) in water quantity is also documented in the water level hydrographs for wells (Figure 8), discharge hydrographs for springs and seeps (Figure 9), and discharge hydrographs for creeks (Figure 10).

Geochemistry

The major ion compositions of groundwaters and surface waters in the North Private Lease and adjacent area are depicted graphically with a series of Stiff diagrams in Figure 11. Stiff diagrams are a useful analytical tool in evaluating the geochemical compositions of groundwaters and surface-waters. The solute composition (chemical type) of the water is represented by the shape of the diagram. The size of the Stiff diagram is a function of the total dissolved solids.

Groundwaters and surface waters in the vicinity of the North Private Lease area commonly acquire their solute compositions through a series of geochemical reactions. These geochemical pathways are discussed below.

Carbon dioxide gas is produced naturally in the soil at concentrations greatly exceeding atmospheric concentrations by root-zone respiration and also by the decay of organic matter. Recharge water (rain and snow melt), upon entering the soil mantle, reacts with CO_2 to produce carbonic acid according to:

$$CO_2 + H_2O = H_2CO_3 \text{ (carbonic acid)} \qquad \text{(Equation 1)}$$

The produced carbonic acid subsequently dissociates into hydrogen ions (acid) and bicarbonate according to:

$$H_2CO_3 = H^+ + HCO_3^- \qquad \text{(Equation 2)}$$

The H^+ produced from Equation 2 reacts with carbonate minerals pervasive in the rocks of the Alton Coal Field, yielding calcium and magnesium ions and additional bicarbonate ions to the water according to:

$$CaCO_{3\ (calcite)} + H^+ = Ca^{2+} + HCO_3^- \quad \text{(Equation 3)}$$

and

$$CaMg(CO_3)_{2\ (dolomite)} + 2H^+ = Ca^{2+} + Mg^{2+} + 2\ HCO_3^- \quad \text{(Equation 4)}$$

Because of the limited solubility of calcite and dolomite in the absence of an additional source of CO_2, waters acquiring their solute compositions through the geochemical evolutionary pathway described in Equations 1 through 4 typically have relatively low TDS concentrations.

Groundwaters or surface waters of the low-TDS calcium–bicarbonate or calcium–magnesium–bicarbonate type upon entering the Tropic Shale or Tropic Shale-derived alluvial sediments can experience appreciable increases in TDS concentration and a change in chemical type due to the dissolution of various soluble minerals present in the Tropic Shale. Although a leaching study of the Tropic Shale sediments has not been performed in this investigation, geochemical reactions potentially occurring in marine shales may include:

$$CaSO_4 \cdot 2H_2O_{\ (gypsum)} = Ca^{2+} + 2H_2O \quad \text{(Equation 5)}$$

$$Na_2SO_{4\ (thenardite)} = Na^+ + 2SO_4^{2-} \quad \text{(Equation 6)}$$

$$NaCl_{\ (halite)} = Na^+ + Cl^- \quad \text{(Equation 7)}$$

$$Na_2SO_4 \cdot 10H_2O_{\ (mirabolite)} = Na^+ + 2SO_4^{2-} + 10H_2O \quad \text{(Equation 8)}$$

Waters rich in Ca^{2+} resulting from the dissolution of gypsum (Equation 5) may undergo ion exchange on clay minerals likely present in the Tropic Shale resulting in an increase in Na^{+} concentrations at the expense of exchanged Ca^{2+} ions according to:

$$Ca^{2+} + \text{Na-clay} = 2Na^{+} + \text{Ca-Clay} \qquad \text{(Equation 9)}$$

Ion exchange may also occur on zeolite minerals such as the sodium zeolite analcime according to:

$$2NaAlSi_2O_6 \cdot H_2O + Ca^{2+} = Ca(AlSi_2O6)_2 \cdot H_2O + 2Na^{+} \qquad \text{(Equation 10)}$$

Through reactions 9 and 10, groundwater may evolve chemically into Na^{+} - SO_4^{2-} chemical type with elevated TDS concentration. An elevated TDS, Na^{+} - SO_4^{2-} chemical type may also result directly from the dissolution of thenardite (Equation 6), a highly soluble mineral potentially present in Tropic Shale sediments. The dissolution of halite (Equation 7), where present, results in elevated Cl^{-} concentrations and also contributes a corresponding quantity of Na^{+}.

It is noteworthy that while Ca^{2+} and HCO_3^{-} concentrations are largely constrained by the solubilities of calcite (Equation 3), Mg^{2+} concentrations are elevated in some groundwaters and surface waters in the North Private Lease area (Tables 2a and 2b; Figure 11). The source of the elevated Mg^{2+} remains problematic. The dissolution of soluble magnesium bearing minerals such as epsomite ($MgSO_4 \cdot 7H_2O$) and magnesium chloride ($MgCl_2$) potentially present in the Tropic Shale may be in part responsible for the observed Mg^{2+} in the groundwater. Additionally, kinetic restraints inhibiting dolomite precipitation may also contribute to the observed elevated magnesium concentrations (i.e., dolomite is readily dissolved in the presence of CO_2, but is not readily precipitated, which may result in enriched magnesium concentrations).

Groundwater and Surface-Water Systems

All surface-water runoff from the North Private Lease area is tributary to Kanab Creek, either directly or through the Simpson Hollow tributary to Kanab Creek. Simpson Hollow creek

flows into Kanab Creek about 1 mile south of the North Private Lease area. Most of the water in Kanab Creek upstream of the town of Alton is diverted for irrigation during much of the year, leaving low flows in Kanab Creek downstream of the town and through the tract. It is common for Kanab Creek to have little or no discharge south of the tract during much of the year (BLM, 2015b).

Under current conditions, during the irrigation season most of the surface water in Kanab Creek is diverted for agricultural use at locations along the western margins of the Paunsaugunt Plateau approximately 5 miles above the Town of Alton. When available, additional water is diverted from Kanab Creek for irrigation use at diversions located in Section 24, Township 39 South, Range 6 West (located upstream of the confluence with Lower Robinson Creek). There are no identified irrigation diversions located further south on Kanab Creek for a distance of about 24 miles (UDWRi, 2014), a situation likely due primarily to a lack of available surface water.

There is commonly very little discharge present in Kanab Creek below these diversions during the irrigation season (see data for monitoring site SW-2 in the Division's coal water quality database). Data reported to the Division for monitoring site SW-2 below the Coal Hollow Mine area indicates that on 38 percent of the quarterly monitoring events at SW-2 (2nd quarter 2005 through 2nd quarter 2014), the discharge in the stream was less than 0.05 cfs.

Early historical information from the United States Geological Survey (1917) indicates that Kanab Creek ceases to flow as a surface stream at about the Utah-Arizona state line and that only the flood waters reach the Colorado River. A study published by the Utah Geological and Mineralogical Survey in 1964 (prior to the current mining activity in the area) noted that the base flow discharge from the upper portion of Kanab Creek did not flow to the lower reaches of Kanab Creek:

> *Lower Kanab Creek and upper Kanab Creek form a connected drainage system, but the sources of base flow for the two sections of the system are different, and normally*

> *only spring runoff and flood waters provide a continuous flow of water from the head of Kanab Creek through its lower reaches. Thus for most of any year the flow of upper Kanab Creek does not go below the Elbow [near STORET site 04951830], and base flow in lower Kanab Creek is maintained by springs that rise below the elbow. … The springs that supply the base flow for lower Kanab creek are in the Navajo Sandstone.*

EPA has collected water quality data at STORET 04951830 on a routine basis during the summer months, even though the Kanab Creek stream channel just above that location is commonly dry during the summer months. The STORET 04951830 site is located at Latitude 37.291111° N, Longitude 112.491944° W (EPA, 2014). This location is at The Falls, which is a bedrock ledge that outcrops in the bottom of the Kanab Creek stream channel at that location. Water is commonly present in a pool at the base of this ledge. The pool is likely sustained by seepage of water from the bedrock outcrop at The Falls. This pool of water persists at the base of The Falls during the summertime months even when no surface flow is present in Kanab Creek above this location.

As reflected in Figure 11, other than waters closely associated with the main stem of Kanab Creek, the overall water quality of groundwaters and surface waters in the North Private Lease and adjacent areas is relatively poor. The surface waters in the main stem of Kanab Creek and the associated alluvial groundwaters immediately adjacent to the stream are of better quality. The better water quality in Kanab Creek is a reflection of the lower-TDS waters that originate from the creek source areas along the upland western flanks of the Paunsaugunt Plateau. Surface waters in Kanab Creek are diverted for irrigation and stock watering use in areas both above and below the North Private Lease area (see Appendix 7-17 in Coal Hollow Mine MRP). It is noteworthy that in the shallow alluvial groundwater systems within the North Private Lease area, the shallow groundwater systems near the stream (NLP-3, NLP-4, and NLP-5) have appreciably better water quality (as reflected by TDS concentrations) than do many of the wells that are located at greater distances from the stream (NLP-1, NLP-2, NLP-8, NLP-9, NLP-10, and Y-103). We attribute this phenomenon as being likely a function of the spatial variability in the flux rate of groundwater through the

alluvial sediments. It is likely that the alluvial sediments immediately adjacent to the stream are in good hydraulic communication with the relatively low-TDS stream waters, while in more distant and/or deeper portions of the system, the alluvial groundwaters exist under more stagnant conditions with more opportunity to interact with soluble minerals in the aquifer matrix and with a lesser influx of relatively fresh Kanab Creek water. An important implication of this conclusion is that, while the quality of groundwaters in these distal, relatively stagnant portions of the alluvial groundwater system groundwaters is poor, the quantity of the groundwaters in the more clayey margins of the basin where the alluvial thickness is lower is likely lesser. Therefore, in the event that such groundwaters were to be intercepted in the mine pit areas, while the quality of such waters may be poor, there is likely a corresponding decrease in the quantity of groundwater in those locations that would need to be managed.

As mentioned previously, there are no Utah state-appropriated groundwater rights within the North Private Lease area. A point-to-point stockwatering water right exists within the North Private Lease area along Kanab Creek (see Appendix 7-3N in Coal Hollow Mine MRP).

It is noteworthy that the water quality in Kanab Creek is degraded as it flows through the Alton Amphitheater area. As apparent in Figures 13 and 14, the TDS of Kanab Creek water increases in a downstream direction during both high flow and low flow conditions. Monitoring data (see Table 2a and information submitted to the Division's on-line coal water quality database) indicate that the TDS of surface water in Kanab Creek increases as it flows through the lease tract area during both high flow and low flow conditions. Plots of TDS concentrations in Kanab Creek water are presented in Figures 13 and 14. During high-flow conditions (March 2013), TDS concentrations increased by 156 mg/L (about 40%) from the upstream monitoring station SW-1A (384 mg/L) to the downstream monitoring station Kanab-L (540 mg/L). During low-flow conditions (September 2012), the TDS in the creek increased by 746 mg/L (about 76%) from SW-1A to Kanab-L. (It should be noted that there had been no discharges of mine water from the Coal Hollow Mine in the year prior to these monitoring events.)

As Kanab Creek waters flow over the tract area, the TDS concentrations in the creek increase, likely in response to 1) the inflow of higher TDS locally derived groundwaters and surface waters; 2) the dissolution of soluble evaporite minerals present in the rocks and sediments of the streambed and streambanks; and 3) evapoconcentration of creek waters, particularly during the warm summertime months when the evaporation potential is greatest. In areas where unstable bed and bank conditions result in appreciable erosion potential and associated transport of eroded sediment particles into the stream flow, the potential for increases in both TDS and suspended solids concentrations in the stream is exacerbated. It is apparent in the graph on Figure 15 that TDS concentrations in Kanab Creek are lowest during the high-flow season, and greatest during the low-flow season. In Figures 16 and 17, the discharge rates measured in Kanab Creek at upstream and downstream monitoring locations are plotted under high-flow and low-flow conditions, respectively.

The Simpson Hollow drainage is a tributary to Kanab Creek situated below the town of Alton (Figure 2). Surface waters in the Simpson Hollow drainage (monitored at Priscilla Creek, April Creek, and SW-15) commonly have TDS concentrations of several thousand milligrams per liter. TDS concentrations ranging to greater than 10,000 mg/L have been measured in the east fork headwaters area in the Tropic Shale (Priscilla Seep). On a single monitoring event at April Creek during April of 2013, an uncharacteristically low TDS concentration of 656 mg/L was measured. The low TDS measured on that occasion was likely in response to appreciable snowmelt and/or precipitation runoff in the drainage. The poor water quality characteristics of these waters limit their potential for use in irrigation or stock watering. Four seeps adjacent to the North Private Lease within the Simpson Hollow drainage area have been identified. These include Priscilla Seep, April Seep, Seep Y, and Seep Z. Like the surface waters in the drainage, these seeps usually have elevated TDS concentrations and low discharge rates which limit their potential for use (Table 2a, Table 2b). While the quality of these groundwaters is poor, the quantity of the groundwater discharge is meager. Therefore, in the event that such groundwater systems were to be intercepted in the mine pit areas, the quantities of these poor-quality waters would likely not be large. This factor would minimize the potential that such poor quality intercepted groundwaters would need to be discharged through UPDES discharge points.

Two additional seep areas are present south of the North Private Lease area. These include Alkali Seep and Dakota Seep, both of which discharge from the upper Dakota Formation. No measurable discharge has been observed at Alkali Seep during any of the baseline monitoring events. The TDS concentrations of the meager quantities of groundwater at the seep have averaged about 3,000 mg/L, with no appreciable seasonal variation being observed. Similarly, no measurable discharge has been observed at Dakota Seep during baseline monitoring activities. On the first monitoring event at Dakota Seep in May of 2012, there was wet mud present, but on all subsequent monitoring events at Dakota Seep, no water was present (there was slightly damp ground at the location on some monitoring events).

Within the North Private lease area boundaries, only one groundwater seep/spring has been identified. This seep (Coyote Seep) discharges at rates usually less than about 1.3 gpm from the bottom of the middle incised channel in the central portion of the lease area (Figure 2). The elevation of this seep is approximately coincident with the elevation of the local water table surface, suggesting that the seep exists where the bottom of the incised drainage intersects the top of the alluvial groundwater table at that location (i.e., the seep is essentially an alluvial groundwater drain).

It is noteworthy that the water table in the alluvial groundwater system in the North Private Lease area (Kanab Creek valley) is likely appreciably lower in its current state than it likely was prior to the commencement of downcutting and stream entrenchment that likely began in the late 1800s to early 1900s. As the deeply incised channels were cut into the alluvium, alluvial groundwater that would likely have been present to within shallow depths below the surface in the alluvium-filled valley containing Kanab Creek, likely drained from the then saturated shallow alluvial sediments leaving the water levels near the elevation of the base of the incised drainages (as is the current condition). Local residents indicate that prior to the early 1900s, (about 1912) Kanab Creek in the North Private Lease area was comparable to a shallow irrigation ditch and was not incised as it is currently (personal communication, Claron Heaton, 2015). Rather it was possible at that time to jump from one side of the creek to the other.

It has been the experience at the existing Coal Hollow Mine area that only very limited quantities of groundwater have been encountered when the Smirl coal seam has been intercepted by the mine. During the spring and seep survey of the North Private Lease and adjacent areas, no use of groundwater in the Smirl coal seam was identified. The lack of appreciable groundwater in the Smirl coal seam is likely a result of 1) the presence of the low-permeability Tropic Shale bedrock above the unit which prevents the downward migration of potential recharge waters, and 2) the overall low hydraulic conductivity and groundwater storage potential in the coal unit.

Similarly, appreciable groundwater inflows into the mine pit areas when the upper surface of the Dakota Formation has been exposed in the pit floor have not been observed. This occurrence is likely a result of the facts that 1) only the upper surface of the formation has been exposed in the mine pits and the underlying sediments are generally not disturbed during mining operations, 2) vertical and horizontal groundwater flow in the Dakota Formation is impeded by the presence of low-permeability mudstones and shales that encase the interbedded lenticular sandstone strata in the formation (i.e., the formation is not a good aquifer), and 3) the potential for vertical recharge to the unit is prohibited by the presence of the low-permeability Tropic Shale bedrock that overlies the Dakota Formation in mining areas.

A drilling core consisting of unweathered Tropic Shale was analyzed at the laboratory to determine its hydraulic conductivity. The core sample was remolded and compacted at the laboratory prior to the analysis. The measured hydraulic conductivity of this sample was 8.24×10^{-8} cm per second, which supports the conclusion that the potential for groundwater migration through the Tropic Shale is low. The pervasive presence of the Tropic Shale and Tropic Shale–derived clayey sediments 1) minimizes the potential for vertical groundwater recharge to the unit and to deeper, underlying geologic formations; and 2) minimizes the potential for appreciable lateral or vertical flow of groundwater through the formation to potential discharge locations.

It is noted that the discharge rates in Kanab Creek commonly increase between the upper monitoring sites (SW-1A and SW-1) and the lower monitoring sites (Kanab Creek @ C.R. and SW-3). This increase is likely in large part attributable to groundwater-surface water interactions within this reach of the stream. While the Kanab Creek valley in the North Private Lease area and adjacent up-gradient areas is a broad, alluvium-filled valley, in the southern margins of the lease area the valley constricts appreciably (Figure 4). As the valley width constricts, the cross-sectional area of saturated alluvium decreases substantially. Alluvial groundwaters coursing through the alluvial sediments in the lower margin of the valley are likely forced to the surface as the cross-sectional area decreases, resulting in increased discharge rates in the creek (i.e. groundwater exits the alluvial groundwater system and becomes part of the surface flow in the creek). Irrigation return flows and migration of infiltrated irrigation waters through the subsurface toward the creek may also contribute to the increase in discharge in the creek over this reach. Because the bedrock underlying the stream alluvium in this reach is mostly Tropic Shale (which has low groundwater transmitting properties), contributions to the stream from bedrock groundwater discharge is not suspected as a significant source of flow in this reach of the creek.

Discharge data from Kanab Creek in the vicinity of the North Private Lease area are presented in Table 2a. Selected time contemporaneous (same day) discharge measurements from Kanab Creek in the North Private Lease and adjacent area are presented in Table 6. Graphs of selected time contemporaneous data in the North Private Lease area are presented in Figure 22 for representative very low flow, low flow, moderate flow, and high flow conditions. It is apparent in Figure 22 and Table 6 that there is usually a gain in discharge between the upstream locations above the North Private Lease boundary (SW-1a and SW-1) and the downstream locations (Kanab @ C.R. and SW-3).

It is noteworthy, however, that when the meager discharge in Kanab Creek was measured during very low flow conditions on 29 June 2012, the flow between SW-1A (5.15 gpm) and Kanab @ C.R. (23/8 gpm) increased as it flowed across the North Private Lease area by only 18.7 gpm. This suggests that the flux of water flowing through the alluvial groundwater system in the Kanab Creek valley up-gradient of monitoring site Kanab @ C.R. is probably

not large. At that time, the maximum alluvial groundwater contribution to the flow in the creek would have been no more than about 18.7 gpm plus any potential losses to evapotranspiration that may have occurred. If it were the condition that substantial quantities of alluvial groundwater were freely flowing from north to south through a broad area of saturated alluvium beneath the North Private Lease (i.e. multi-year groundwater storage in the active system), it would be anticipated that appreciably greater quantities of groundwater would emerge into the stream channel where the valley restricts and alluvial groundwater is forced to the surface. The fact that this was not the case suggests the probability that the much of the observed increases in the discharge rate at Kanab at C.R. may attributable more to the localized emergence of alluvial groundwater flowing shallowly beneath the Kanab Creek stream channel rather than from a more regional emergence of alluvial groundwater sourced from a more broad and/or deep area of saturated alluvial deposits beneath the North Private Lease area. It is noted that when Kanab Creek was monitored a few days previously at monitoring station SW-3 (which is located about 0.5 miles downstream of Kanab @ C.R.) on 21 June 2012, a flow of only 14.9 gpm was measured in Kanab Creek at that location, further suggesting that there was apparently no substantial gain (upwelling of alluvial groundwater) into the stream channel further below the North Private Lease area at that time.

The source of water to the Pond Spring, Hill Spring, and Car Seep complex area (which is outside the North Private Lease potential impacts area) is not completely understood. The potential for the vertical or lateral migration of groundwater through unweathered shale or clay deposits in the Tropic Shale or Dakota Formation is low. However, it is possible that groundwater may flow to some of the spring areas through fractured sandstone channel deposits (which are visible at the surface near several of the seepage locations). Although groundwater flow through sandstone channels in the Dakota Formation occurs, because of the lenticular, discontinuous nature of permeable and impermeable strata in the Dakota Formation, the potential for the migration of groundwater in appreciable quantities over large distances is limited. The potential for groundwater recharge and groundwater flow in this area may also be enhanced locally as a result of increased bedrock hydraulic conductivity associated with coal burn in areas where the coal seam is burned. Such burned zones are common in the Alton Coal Field near coal seam outcrop areas or in locations where the coal

seam is present in the shallow subsurface. Faulting associated with the Sevier Fault Zone has also been mapped in the area immediately to the west of the spring discharge locations (Tilton, 2001). Such faulting could result in damaged zones that could locally enhance the potential for groundwater flow through fractured bedrock.

The discharge hydrographs for Pond Spring and Hill Spring show similar and rapid responses to seasonal recharge events (Figure 9, Table 2a). Although the magnitude of the flow rates at the two springs are dissimilar and solute compositions of the water discharged at these two springs are somewhat variable, the notable similarity of the discharge hydrographs suggests similar recharge and groundwater flow mechanisms. The recharge location(s) for the groundwater systems that support these springs are not known. The regional stratal dip (to the east or northeast) would suggest recharge in up-gradient areas to the west or southwest (the opposite direction to the North Private Lease area). Possible recharge mechanisms may include 1) the infiltration of irrigation waters in nearby up-gradient agricultural fields, and/or 2) the infiltration of the sometimes copious amounts of late-winter and early-spring snowmelt that occurs in the surrounding areas (Petersen 2013).

The quality of the groundwater in the Dakota Formation seeps (April Seep, Seep Y, Seep Z) and monitoring well (NLP-13) adjacent to the western margin of the North Private Lease area is appreciably poorer than that in the Pond Spring area (Figure 11). This suggests that meager quantities of groundwater in the Dakota Formation near the lease area is not the source of water to the springs and seeps in the Pond Spring area (i.e. the groundwater would not become fresher were it to migrate westward through the Cretaceous strata under this hypothetical flow path). Additionally, the fact that the regional dip of bedrock strata in the region is generally to the east or northeast indicates that if there were to be a connection between these areas, the mine area would be in a stratigraphically down-dip area relative to those springs and seeps.

8.0 PROBABLE HYDROLOGIC CONSEQUENCES (PHC) DETERMINATION

This section describes the probable hydrologic consequences of coal mining and reclamation activities associated with the proposed mining and reclamation activities in the North Private Lease area at the Coal Hollow Mine. The information presented herein is considered as a supplement to the existing Coal Hollow Mine PHC determination. This determination is based on data presented herein and on information provided elsewhere in the Coal Hollow Mine MRP. The mining and reclamation plan has been designed to minimize potential adverse impacts to the hydrologic balance.

Potential adverse impacts to the hydrologic balance

Appreciable adverse impacts to the hydrologic balance, either on or off the permit area are not expected to occur as a result of the proposed mining and reclamation activities in the North Private Lease at the Coal Hollow Mine. The mine plan for the North Private Lease has been designed to minimize impacts to the hydrologic balance.

It should be noted that lands in the North Private Lease area that are currently utilized for agricultural operations are not dependent on the local groundwater systems for their operations (i.e. there are no groundwater production wells and no state-appropriated groundwater rights for springs or seeps), although livestock watering on the surface water drainages does occur. Surface waters that are utilized for irrigation in the North Private Lease and adjacent area are obtained from Kanab Creek through stream diversions that are located miles upstream of the North Private Lease area. The Kanab Creek stream diversions are located in areas that are clearly outside the area where mining-related impacts could be expected to occur. Accordingly, after mining in the North Private Lease area is complete, reclamation of the land to the designated agricultural post-mining land use should be feasible.

Monitoring wells and geologic borings

No previous coal mining is known to have occurred within the proposed North Private Lease area. However, during several decades prior to the commencement of coal mine permitting activities by Alton Coal Development, LLC in 2005, it is known that several operators

performed various permitting activities, conducted coal exploration drilling programs, and performed miscellaneous environmental studies in conjunction with the these permitting activities. In conjunction with these activities, it is known that numerous monitoring wells were drilled and completed, geologic borings were made, and miscellaneous other drilling activities occurred in the area. If the proposed highwall mining holes were to intersect an open borehole or improperly abandoned well, there would be the potential for groundwaters from overlying areas (if saturated permeable zones are present at that location) to flow through the open boreholes into the highwall mining holes at appreciable rates. To minimize the potential for this occurrence, where possible identified historic monitoring well and geologic boring locations that penetrated to the Smirl coal seam will be avoided in the proposed highwall mining operations. It should be noted that the Nevada Power #1 Well, which is a large-diameter well that was drilled by Nevada Power in 1961 to a depth of 1,600 feet is known to be present in the southeastern portion of the North Private Lease area.

Presence of acid-forming or toxic-forming materials

Eight boreholes were drilled in the North Private Lease area from which depth-discrete rock and sediment samples were collected and analyzed for acid- and toxic-forming characteristics. The results of these analyzes are presented in Appendix 6-2 of Chapter 6 of the Coal Hollow Mine MRP. Chemical information from the Smirl coal seam proposed for mining is presented in the Coal Hollow Mine MRP (Appendix 6-1; confidential binder).

For all overburden samples analyzed, the neutralization potential appreciably exceeded the acid potential. For most sampled intervals, the neutralization potential exceeded the acid potential by many times. The average neutralization potential (by hole) exceeds the acid potential by at least a factor of two for each of the eight boreholes for which data were collected. The average neutralization potential value for all holes also greatly exceeds the acid potential. The average neutralization potential of the overburden (average of all samples) of 166 tons per kiloton exceeds the acid potential of 10.6 tons per kiloton by more than 15 times. A general consensus opinion mentioned by the National Mine Land Reclamation Center (OSM, 1998) is that if the net acid/base potential exceeds 30 tons per kiloton, and the ratio of neutralization potential to acid potential exceeds two, then *alkaline*

water will be generated and acid mine drainage will not occur. The acid/base characteristics of overburden in the North Private Lease area appreciably exceed both of these two criteria, suggesting the strong likelihood that acid mine drainage will not be an issue at the North Private Lease area at the Coal Hollow Mine. The historic lack of acid mine drainage at the Coal Hollow Mine, which exists under a similar geochemical regime, supports that conclusion that acid mine discharge at the North Private lease area will, likewise, not be a concern.

It is noted that the acid potential exceeded the neutralization potential for some sampled intervals from the Dakota Formation beneath the coal seam. However, the Dakota Formation will generally not be disturbed during mining operations.

Acid-forming materials in western coal mine environments often consist of sulfide minerals, commonly including pyrite and marcasite, which, when exposed to air and water, are oxidized causing the liberation of H^+ ions (acid) into the water. Oxidation of sulfide minerals may occur in limited amounts in the mine pits where oxygenated water encounters sulfide minerals. However, the acid produced by pyrite oxidation is quickly consumed by dissolution of abundant, naturally occurring carbonate minerals (Appendix 6-2). Dissolved iron is readily precipitated as iron-hydroxide in well aerated waters, and consequently excess iron is not anticipated in mine discharge water.

Overburden materials disturbed during mining and reclamation activities that could potentially result in acid- or toxic-forming conditions at the Coal Hollow Mine will be managed in a manner that will minimize the potential for such occurrences (see Appendix 6-2).

If any Utah state-appropriated water rights are impacted by the proposed mining and reclamation activities in the North Private Lease area, these will be replaced according to all applicable Utah State laws and regulations using the designated water replacement source described in Chapter 7 of the Coal Hollow Mine MRP (Section 727).

Sediment yield from the disturbed area

Erosion from disturbed areas will be minimized through the use of silt fences and other sediment control devices. Surface runoff occurring on disturbed areas will be collected and treated as necessary to remove suspended matter. Diversion ditches along with sediment impoundments are proposed for the North Private Lease permit area. In addition, miscellaneous controls such as silt fence and berms are also proposed for specific areas.

The smallest practicable area, consistent with reasonable and safe mine operational practices will be disturbed at any one time during the mining operation and reclamation phases. This will be accomplished through progressive backfilling, grading, and prompt revegetation of disturbed areas. The backfilled material will be stabilized by grading to promote a reduction of the rate and volume of runoff in accordance with the applicable requirements.

Cut ditches will be established on the shoulders of all primary roads to control drainage and erosion. Cut and fill slopes along the primary roads will be minimal and are not expected to cause significant erosion. In locations where there are culvert crossings, the fills slopes will be stabilized by utilizing standard methods such as grass matting or straw wattles.

In those portions of the North Private Lease areas that will be mined using highwall mining techniques, surface disturbance above highwall mined areas is not anticipated. The highwall mining plan has been designed and engineered to prevent subsidence of the land surface overlying highwall mined areas. It has been the experience at the existing Coal Hollow Mine under similar geologic conditions that subsidence of the land surface above highwall mined areas has not occurred and impacts to overlying shallow alluvial groundwaters have not been observed during rigorous monitoring of nearby springs and wells. Accordingly, impacts to overlying shallow alluvial groundwater systems and surface-water systems, including increases in sediment yield in areas overlying highwall mined areas in the North Private Lease area are not anticipated.

Through the implementation of these sediment control measures, it is anticipated that sediment yield from disturbed areas in the North Private Lease area at the Coal Hollow Mine will be minimized.

Impacts to important water quality parameters

As discussed above, appreciable quantities of intercepted groundwater are not anticipated in connection with the proposed mining activities at the North Private Lease areas. Similarly, appreciable quantities of groundwater are not expected to upwell from the Dakota Formation into the proposed mine openings. This conclusion is based on the fact that 1) vertical and horizontal groundwater flow in the Dakota Formation is impeded by the presence of low-permeability shales that encase the interbedded lenticular sandstone strata in the formation (i.e., the formation is not a good aquifer), and 2) appreciable natural discharge from the Dakota Formation in the surrounding area to springs or streams is not observed. Similarly, no appreciable inflows of groundwater from the Dakota Formation into the previously mined pits at the Coal Hollow Mine have been observed. Rather, as anticipated, the only appreciable source of groundwater inflow to the mine pit areas has been from saturated near-surface alluvial deposits. These observations support the conclusion that the natural flux of groundwater through the Dakota Formation is meager (i.e. the quantity of intercepted water from the Dakota Formation that could potentially be impacted is minimal).

As groundwater naturally migrates through the rocks and sediments in the vicinity of the North Private Lease area, the quality of the water is naturally degraded. The potential for TDS increases associated with interaction of waters with the Tropic Shale (a marine unit known to contain soluble minerals) can be minimized by avoiding contact where practical between water sources and earth materials containing soluble minerals.

As discussed above, acid mine drainage is not anticipated in the North Private Lease area nor has it been encountered at the existing Coal Hollow Mine permit area. This is due primarily to the relatively low sulfur content of the coal and rock strata in the permit and adjacent area, and to the pervasiveness of carbonate minerals in the soil and rock strata which neutralize the acidity of the water if it occurs. If sulfide mineral oxidation and subsequent acid neutralization via carbonate dissolution were to occur, increases in TDS, calcium, magnesium, sulfate, and bicarbonate concentrations (and possibly also sodium concentrations via ion-exchange with calcium or magnesium on exchangeable clays) would be anticipated.

At any mining operation there is the potential for contamination of soils, surface-water and groundwater resources resulting from the spillage of hydrocarbons. Diesel fuels, oils, greases, and other hydrocarbons products will be stored and used at the mine site for a variety of purposes. A spill Prevention Control and Countermeasure Plan has been implemented at the Coal Hollow Mine that helps to minimize any potential detrimental impacts to the environment.

Spill control kits are provided on all mining equipment and personnel will be trained to properly control spills and dispose of any contaminated soils in an appropriate manner.

Similarly, while some minor amounts of groundwater have occasionally been encountered within the Smirl coal seam at the Coal Hollow Mine, large or sustained groundwater inflows through the coal seam have not been encountered. This is likely due because 1) the hydraulic conductivity and porosity of the Smirl coal seam is low, and 2) there is little potential for recharge of the coal seam through the overlying low-permeability Tropic Shale bedrock. Consequently, the quantity of water from the Smirl coal seam that could enter the mine pit areas and be potentially impacted is minimal. Because the quantity of water from the Smirl coal seam is small, it can be managed within the mine and it is generally not necessary to discharge the water to receiving streams.

Flooding or streamflow alteration

Appreciable groundwater inflows to the mine workings at the proposed North Private Lease are not anticipated. This conclusion is based on the hydrogeologic characteristics of the Tropic Shale, Dakota Formation, and the Smirl coal seam, and is also based on previous experience at the Coal Hollow Mine (appreciable groundwater inflows from the Tropic Shale, Smirl coal seam, or the Dakota Formation have not been encountered in any of the mine pits or from the highwall mining holes). Historically, the inflows of groundwater to the Coal Hollow Mine workings from surrounding saturated alluvial sediments have been modest (usually less than about 25 gpm at any one time). Discharges of this magnitude have been successfully managed, usually without the need to discharge mine water to surrounding

surface streams. Historically, after the Coal Hollow Mine was constructed and operations at the mine commenced, discharges of mine water to receiving waters have been rare, occurring on only a few occasions in the past several years. The rates of discharge to receiving waters have been modest, usually only at most a few tens of gallons per minute and usually lasting for a period of only a few days.

If the proposed open pit workings were to come into hydraulic communication with permeable units of adjacent alluvial groundwater systems, alluvial groundwater could potentially flow into the mine pits in appreciable quantities. The mine plan has been designed to avoid areas where saturated alluvial thicknesses are greatest, thus minimizing the potential for the interception of appreciable quantities of alluvial groundwater from the alluvial groundwater systems. Based on information obtained during drilling activities in the North Private Lease area, it is considered likely that the nature of the intercepted groundwater inflows will be of similar magnitude to that encountered during mining operations at the existing Coal Hollow Mine permit area (i.e. in most areas the general character of the alluvium [as observed in drill holes] is similar). While groundwater has been encountered during mining activities at the existing Coal Hollow Mine permit area, the overall quantities have generally been small (typically less than 25 gpm in total at any one time in the mining sequence). It has been possible to manage such modest quantities of mine water by utilizing some of the water for mine process/dust control and by burying accumulated groundwaters remaining in the bottom of mine pits at the completion of mining of the pit during backfill operations.

Aquifer testing (slug testing) has previously been performed on the alluvial groundwater monitoring well Y-103 (A6) by UII (1987). Details and raw data from the aquifer testing are presented in Appendix C. Saturated alluvial sediments encountered in this well consist mostly of sandy gravel. The results of the testing (UII, 1987) indicated a value of hydraulic conductivity for the alluvial sediments in which the well is screened of 9.0×10^{-3} cm/sec (2.95×10^{-4} ft/sec). Using this value, it is possible to estimate the rate at which groundwater intercepted by the mine pit highwalls would enter the mine. Assuming a conservative worst case scenario that the maximum measured thickness of saturated alluvium (about 70 feet)

was to be entirely exposed in a mine pit wall, the projected flow may be calculated using Darcy's Law, which may be expressed as:

$$Q = KIA$$

Where Q = groundwater discharge rate
K = hydraulic conductivity
I = hydraulic gradient
A = cross-sectional area

The hydraulic gradient in the alluvial groundwater system in the vicinity of Y-103 is determined to be 0.022 (10 feet change in hydraulic head over a lateral distance of 450 feet). Using the value of hydraulic conductivity determined for well Y-103 (2.95×10^{-4} ft/sec), a saturated thickness of 70 feet, and a horizontal length of 100 feet, an inflow rate of 0.045 ft^3/sec, or about 20 gpm per hundred lineal feet of mine highwall in which the sediments are exposed. It should be noted that during drilling activities in the North Private Lease area, thick sequences of sandy gravels similar to what was identified in Y-103 were not encountered elsewhere. In mining areas where finer-grained alluvial sediments or Tropic Shale bedrock is present, and where saturated thicknesses are smaller, it is anticipated that rates of groundwater inflow into the mine pits will be lower.

It should be noted that the results of slug tests are generally considered to be order-of-magnitude approximations of actual values. Consequently, the mine inflow estimates calculated here should likewise be considered as approximations. Additionally, it should be emphasized that because of the common heterogeneous character of alluvial deposits, it is not possible to completely characterize and identify the detailed conditions in the subsurface alluvial deposits by collecting hydrologic data from a finite number of boreholes. Accordingly, it should be stated that there is the possibility that some zones within the subsurface alluvial deposits which have elevated values of hydraulic conductivity may not have been identified with the existing network of boreholes. Although not anticipated, such deposits could be encountered during mining operations which could then result in zones of increased groundwater inflows to the mine areas.

Historically, while mine water has occasionally been discharged under the mine's UPDES permit to receiving waters, most of the incoming water that has necessitated the infrequent UPDES discharges has come from runoff from snowmelt and torrential precipitation events. Given the general similarities of the geologic conditions between the existing Coal Hollow Mine permit area and the nearby North Private Lease area (i.e. some areas of Tropic Shale bedrock at the surface, and some areas of heterogeneous saturated alluvial deposits overlying mining areas), it is considered likely that the general magnitude and character of intercepted groundwater will be similar between these two areas and that it will be possible to manage the encountered mine waters without the need for frequent UPDES discharges. Accordingly, there would likely not be a need to discharge mine water from the North Private Lease area in quantities that would cause flooding or streamflow alteration to the receiving waters. Any discharges of mine waters to the receiving streams that do occur will be done in compliance with the stipulations of the mine's UPDES discharge permit as administered by the Utah Division of Water Quality. Alluvial groundwater that may be intercepted in the mine pits at the North Private Lease will be managed in a manner similar to the way it has been successfully managed at the existing Coal Hollow Mine area. While some groundwater inflows into pit areas are anticipated, if groundwater inflows to a mine pit exceed one cfs in total, a qualified hydrogeologist will be consulted to evaluate the nature of the inflow and the Division of Oil, Gas and Mining will be notified.

The principal surface-water drainages in the vicinity of the Coal Hollow Mine have large discharge capacities (lower Sink Valley Wash, Lower Robinson Creek, and Kanab Creek). These drainages periodically convey very large amounts of precipitation water from intense runoff associated with torrential precipitation events. The anticipated maximum discharge rates that could occur from mining operations in the North Private Lease area are much lower than that periodically occurring during major torrential precipitation events (thousands of gallons per minute). While the addition of modest amounts of sediment-free water into these stream channels has the potential to cause minor increases in channel erosion, the magnitude of this potential impact would be minimal relative to that occurring during torrential precipitation runoff events.

The potential for flooding or streamflow alteration resulting from the proposed mining operations in the North Private Lease area is considered minimal.

Groundwater and surface water availability

There are only minimal groundwater resources in the North Private Lease area. Only a single seep (Coyote Seep) has been identified within the proposed lease area. This seep typically discharges at about 1.3 gpm or less and there is no Utah state-appropriated water right associated with this seep. There is a point-to-point stock watering right on Kanab Creek within the North Private Lease. Irrigation within the North Private Lease is performed using Kanab Creek surface waters that are diverted at locations several miles above the lease area. There are no groundwater production wells within the North Private Lease or adjacent area. While Coyote Seep is anticipated to be impacted when the seep area is intercepted by planned mine pits, there are no other appreciable groundwater resources in the lease area that could be impacted. The Kanab Creek stream channel will not be disturbed by the proposed mining, as the area will be protected by the stream buffer zone.

Irrigated agricultural fields are present in the lands north of proposed mining areas north of the North Private Lease area. Lands immediately north of the North Private Lease area are irrigated using modern sprinkler irrigation techniques and consequently, by design, return flows from these fields are minimal. Some isolated smaller agricultural fields located further north are irrigated using flood irrigation techniques. These fields are located more than 0.6 miles distant from the nearest proposed mine pits in the North Private Lease. Additionally, a large Tropic Shale bedrock outcrop occupies much of the land surface between the northernmost fields and the North Private Lease to the south (Figure 6). Geologic and soils information from the area north of the North Private Lease indicate predominantly clay-rich sediments in the region. For these reasons, it is considered unlikely that the surface mining pits of the North Private Lease would disrupt surface irrigation flows in the irrigated fields up-gradient of the planned surface mining pits.

Consequently, the potential for impacts to groundwater and surface-water availability as a result of the proposed mining and reclamation activities in the North Private Lease area is considered low.

If any Utah state-appropriated water rights are impacted by the proposed mining and reclamation activities in the North Private Lease area, these will be replaced according to all applicable Utah State laws and regulations using the designated water replacement source described in Chapter 7 of the Coal Hollow Mine MRP (Section 727).

Whether mining and reclamation activity will result in contamination, diminution or interruption of State-appropriated waters

As discussed previously, it is considered unlikely that appreciable impacts to groundwater or surface-water resources will occur as a result of the proposed mining operations at the North Private Lease. There are no Utah state-appropriated groundwaters within the North Private Lease area or adjacent area. Kanab Creek lies within the designated stream buffer zone and will not be disturbed by the proposed mine pits in the North Private Lease area. Consequently, the potential for the proposed mining and reclamation activities to result in the contamination, diminution, or interruption of State-appropriated waters is considered low. In the event that any Utah state-appropriated waters were to be contaminated, diminished, or interrupted due to mining and reclamation activities in the North Private Lease or adjacent area, the water will be replaced according to all applicable State laws and regulations using the replacement water source described in Chapter 7 of the Coal Hollow Mine MRP (Section 727).

9.0 RECOMMENDED MONITORING PLANS FOR SURFACE WATER AND GROUNDWATER

In order to monitor for potential impacts to surface-water and groundwater resources resulting from the proposed mining and reclamation activities at the proposed North Private Lease area, we recommend the monitoring of groundwater and surface-water monitoring sites as specified in Tables 4 and 5 and as described below. The locations of these recommended monitoring sites are shown on Figure 19.

Surface water

We recommend the monitoring of 11 stream monitoring stations in and around the North Private Lease area. These include SW-1A, SW-1M, SW-1, Kanab Creek @ C.R., and SW-3 on the main stem of Kanab Creek; Priscilla Creek, April Creek, and SW-15 on Simpson Hollow Creek; RSD-1 and SW-11, which are tributaries to Kanab Creek in and adjacent to the North Private Lease area; and EW-1, which is an ephemeral wash adjacent to the permit area. Monitoring protocols for these surface water monitoring sites are as listed in Tables 4 and 5. We recommend the monitoring of SW-1, Kanab Creek @ C.R., SW-3, SW-11, April Creek, and SW-15 for discharge rate and field and laboratory water quality measurements. We recommend that monitoring at the other surface-water monitoring sites be for discharge rate and for field water quality parameters only.

Groundwater

We recommend the monitoring of six springs and seeps in and around the North Private Lease area. These include Coyote Seep (which is located within the lease boundary area), Seep Z, Alkali Seep, and Dakota Seep (which are located adjacent to the lease area), and Pond Spring and Hill Spring (which are located below the town of Alton west of the lease area). Impacts to Coyote Seep are anticipated to occur because the seep area is situated within the planned location of a mine pit. Impacts to the other springs and seeps are not anticipated, but are proposed for monitoring 1) to verify that impacts do not occur, and 2) to document any influence of seasonal variability on water quantity and water quality at these locations. It is noted that upper Dakota Formation strata at Pond Spring and Hill Spring are up-gradient from the elevation of the Dakota Formation strata in proposed mining areas in

the North Private Lease area (i.e. the stratigraphic dip is toward the east or northeast). Accordingly, impacts to these springs are not anticipated. However, because these springs are associated with Utah state-appropriated water rights and have importance to agriculture, we recommend the monitoring of these two springs. We recommend the monitoring of Pond Spring and Coyote Seep for discharge rate and field and operational laboratory water quality measurements. The other spring locations are recommended for discharge rate and field water quality measurements only.

We recommend the monitoring of 18 monitoring wells in the North Private Lease and adjacent areas. These include Y-103, NLP-1, NLP-2, NLP-3, NLP-4, NLP-5, NLP-6, NLP-7, NLP-8, NLP-9, NLP-10, NLP-11 and NLP-12, which are monitoring wells completed in the alluvial groundwater system in the Kanab Creek valley in and around the permit area. Of these wells, we recommend the monitoring of Y-103, NLP-4, NLP-5, and NLP-12 for water levels and field and operational laboratory water quality measurements. The other alluvial monitoring wells are recommended for water level measurements only. Monitoring wells Y-53, Y-55, Y-69, and Y-70 monitor groundwater in the Smirl coal seam. We recommend that these wells be monitored for water level only.

It is noted that some monitoring wells that are currently existing in proposed mine pit areas will in the future be intercepted by the mine pits and destroyed. These wells are shown on Figure 20.

The monitoring plan for groundwaters and surface-waters for the proposed North Private Lease area at the Coal Hollow Mine may be used to provide verification that mining-related impacts to groundwater and surface-water systems do not occur, and to determine the magnitude and character of potential impacts if they do occur. Comparisons between monitoring data (for the parameter of interest or concern) collected during baseline pre-mining conditions should be made with monitoring data (for the same parameter or interest of concern) collected during the operational and/or reclamation phase of mining to determine impacts. When changes to monitored parameters subsequent to mining in an area are observed in the monitoring data, an analysis of all data should be performed to determine the

cause(s) of the change in the hydrologic condition. In utilizing the monitoring data to detect or quantify potential mining-related impacts, it is necessary to evaluate all factors relevant to the prevailing hydrologic conditions together with the monitoring data. This is because other factors, which are not related to the mining activity, may cause changes in the prevailing hydrologic conditions. In particular, climatic variability (which may result in increased or decreased groundwater and surface-water flow rates, changes in water levels in wells, and changes in water quality) should be carefully evaluated together with the monitoring data. Other factors that may influence coal mine hydrology include grazing practices, land use, and range condition. A convenient and useful means of evaluating regional climatic data is through the use of the Palmer Hydrologic Drought Index, which is a monthly value that indicates the severity of wet and dry spells that is generated by the National Climatic Data Center and available on-line at http://www1.ncdc.noaa.gov/pub/data/cirs/drd964x.phdi.txt.

The use of Stiff (1951) diagrams is a useful technique that is frequently used to analyze and compare groundwater and surface-water quality characteristics from various sources. Information required to create Stiff diagrams is available from the Division of Oil, Gas and Mining Coal Water Quality Database, which is freely accessible at: http://ogm.utah.gov/coal/edi/wqdb.htm. Additional information on coal mining hydrology and potential mining-related impacts, which can be used to assist in the evaluation of monitoring data and potential mining-related impacts is provided on the Utah Division of Oil, Gas and Mining web page at http://ogm.utah.gov/coal/water/default.htm.

10.0 R645-302-240 DUE DILIGENCE INVESTIGATION

As part of this investigation, a due diligence investigation for the North Private Lease area has been performed. As required under R645-302-240, the purpose of this this investigation is to identify potential environmental and safety problems related to prior mining activity at the site and that could be reasonably anticipated to occur. The identification is based on this due diligence investigation which includes visual observations at the site, a record review of past mining at the site, and environmental sampling tailored to current site conditions.

Visual observations have been made at the North Private Lease and adjacent area by Petersen Hydrologic, LLC personnel during numerous site visits since 2005. During these site visits, Petersen Hydrologic found no visual indications of the presence of past mining within the North Private Lease or areas immediately bordering the lease. Additionally, during conversations with residents and landowners from the Alton area, there were no indications of past mining at the North Private Lease.

A record review was performed to investigate whether there are records of prior mining activity in the North Private Lease area. Information from the Utah Geological Survey (Doelling, 1972) was obtained and reviewed. Additional information on historic mining operations in the vicinity of the North Private Lease area was obtained from Tilton (2001). Information from the United States Geological Survey, Alton, Utah 7.5-minute quadrangle was also obtained and reviewed. It is apparent that historically there were some small-scale coal mining operations in the area surrounding the North Private Lease. However, there are no records in these sources of past mining within the North Private Lease boundaries. Information obtained and reviewed from the U.S. Bureau of Land Management (2015) indicates that there are no coal leases within the area (other than the existing Coal Hollow Mine lease). The BLM (2015a) also indicates that in the past, 31 coal leases have been issued, but no mining ever occurred before termination or expiration of the leases. The BLM is currently processing a lease to mine coal in the Alton coal field adjacent to the Coal Hollow Mine area.

As presented in this report and in other sections of the Coal Hollow Mine MRP, extensive environmental sampling has been performed on and adjacent to the North Private Lease. This includes hydrologic sampling data from streams, springs, and wells, geologic sampling data obtained during drilling and field mapping activities, soils sampling data, vegetation sampling data, and other related information. Through this environmental sampling and associated scientific analysis, which has been tailored to current site conditions, a comprehensive characterization of the environmental characteristics at the North Private Lease has been developed.

Based on the findings of this due diligence investigation (the absence of prior mining activity in the North Private Lease area), we do not identify any significant environmental or safety problems related to prior mining activity at the site that could be reasonably anticipated to occur.

It should be noted that while no prior mining activity has been identified within the North Private Lease area, a deep well was drilled by Nevada Power in 1961 within the North Private Lease area. This well, which is identified as the Nevada Power #1 Well, is a large-diameter well that was drilled by Nevada Power in 1961 to a depth of 1,600 feet into the upper Navajo Sandstone geologic formation. The well was drilled to evaluate the groundwater production potential from the Navajo Sandstone aquifer in the area. Additionally, two shallow monitoring wells (Y-103 and Y-70) were installed within the North Private Lease area during a previous unsuccessful coal mine permitting activity by Utah International, Inc. in the mid-1980s. Well Y-103 is completed in the alluvial groundwater system and well Y-70 is completed in the Smirl coal seam. These wells will be appropriately managed as required during mining and reclamation operations to prevent damage to the environment.

R645-302-240

The proposed highwall mining methods to be used in the North Private Lease and the measures to be used to comply with R645-302-244 and R645-302-245 are provided in Chapter 5 of the Coal Hollow Mine MRP.

Proposed highwall mining in the proposed North Private Lease will be conducted so as to maximize the utilization and conservation of the coal in accordance with R645-301-522.

Proposed highwall mining in the proposed North Private Lease has been planned and will be conducted to maximize recoverability of mineral reserves remaining after coal mining and reclamation operations are completed.

As required by the Division, ACD will leave areas of undisturbed coal, as approved by the Division, to provide access for future underground coal mining and reclamation activities to

coal reserves remaining after the proposed highwall mining is completed, unless it is established that the coal reserves have been depleted or are so limited in thickness or extent that it will not be practicable to recover the remaining coal.

Proposed highwall mining operations have been planned and will be conducted to minimize disturbances to the prevailing hydrologic balance in accordance with the requirements of R645-301-731.100 through R645-301-731.522, R645-301-731.800, and R645-301-751.

As required, all proposed highwall mining holes, except as provided in R645-302-245.230, will be sealed within 72 hours after completion with an impervious and noncombustible material, if the holes are discharging water containing acid- or toxic-forming material. If sealing is not possible within 72 hours, the discharge will be treated commencing within 72 hours after completion to meet applicable effluent limitations and water-quality standards until the holes are sealed. The proposed highwall holes will be sealed with an impervious noncombustible material, as contemporaneously as practicable with the proposed highwall mining operation, as approved by the Division, if the holes are not discharging water containing acid- or toxic-forming material.

The proposed highwall mining holes have been engineered to prevent subsidence to overlying land areas. The proposed highwall mining operations will be conducted in accordance with the requirements of R645-301-525.210 and R645-301-525.230.

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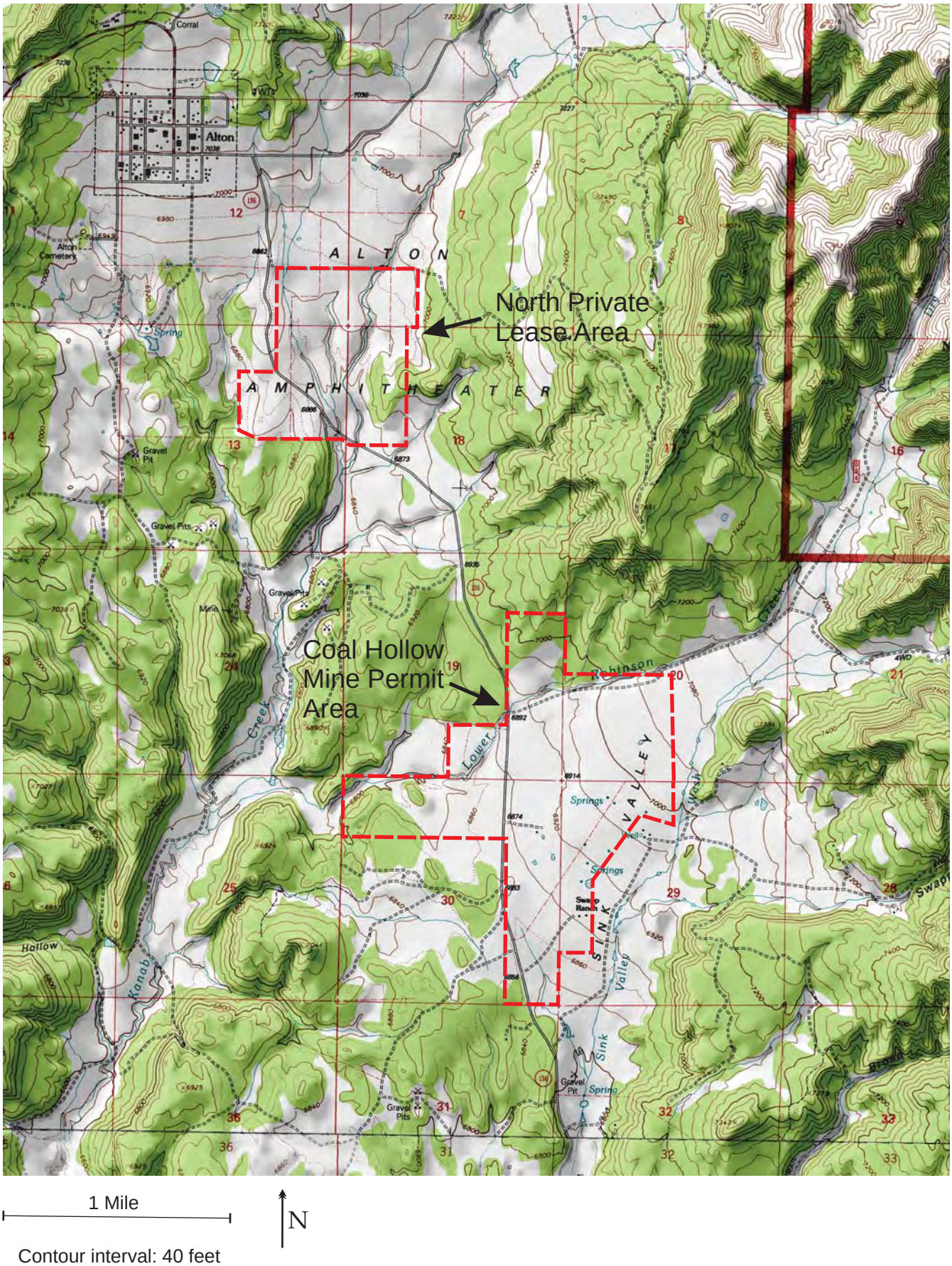

Figure 1 Location of the North Private Lease area at the Coal Hollow Mine.

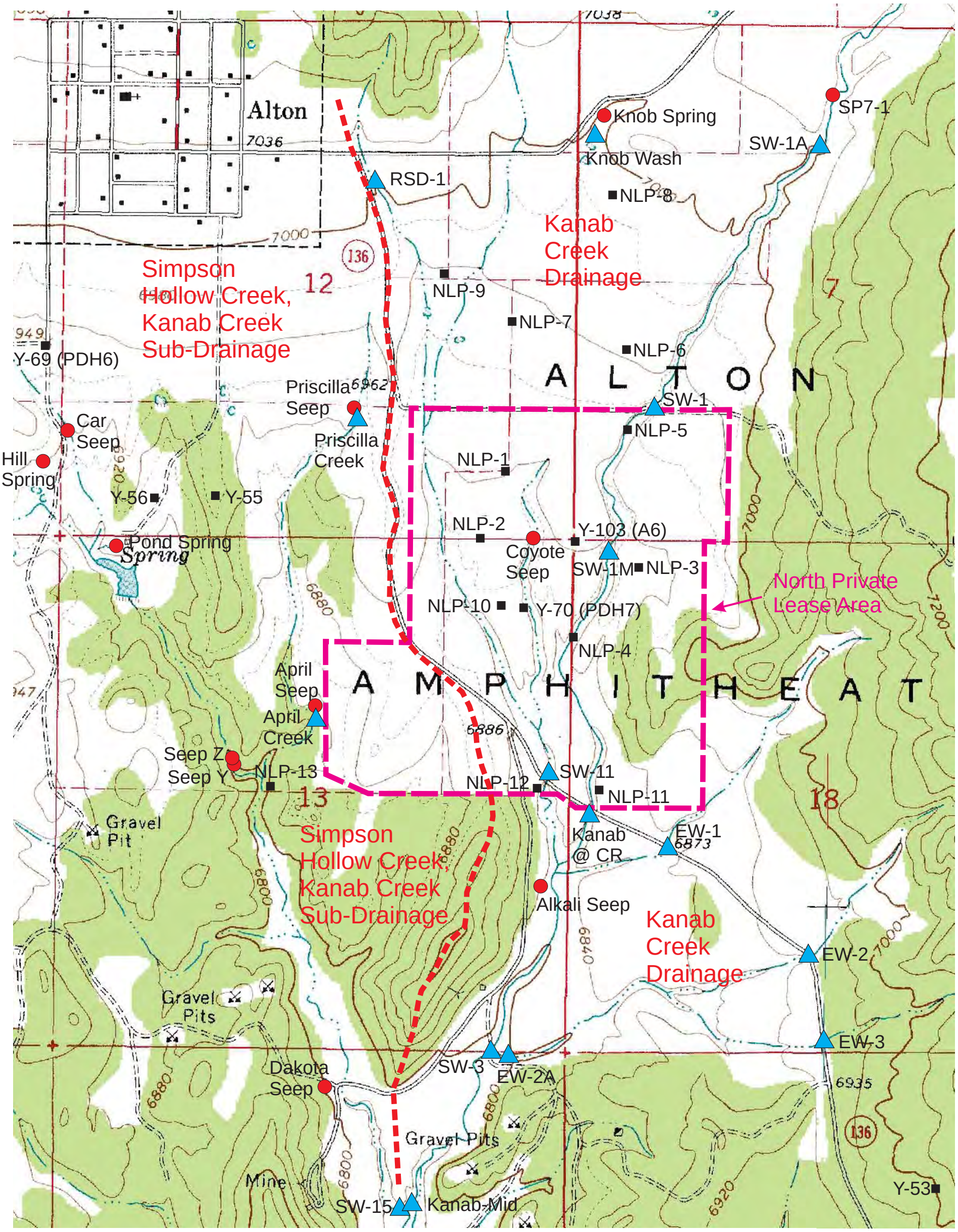

Figure 2 Baseline monitoring stations.

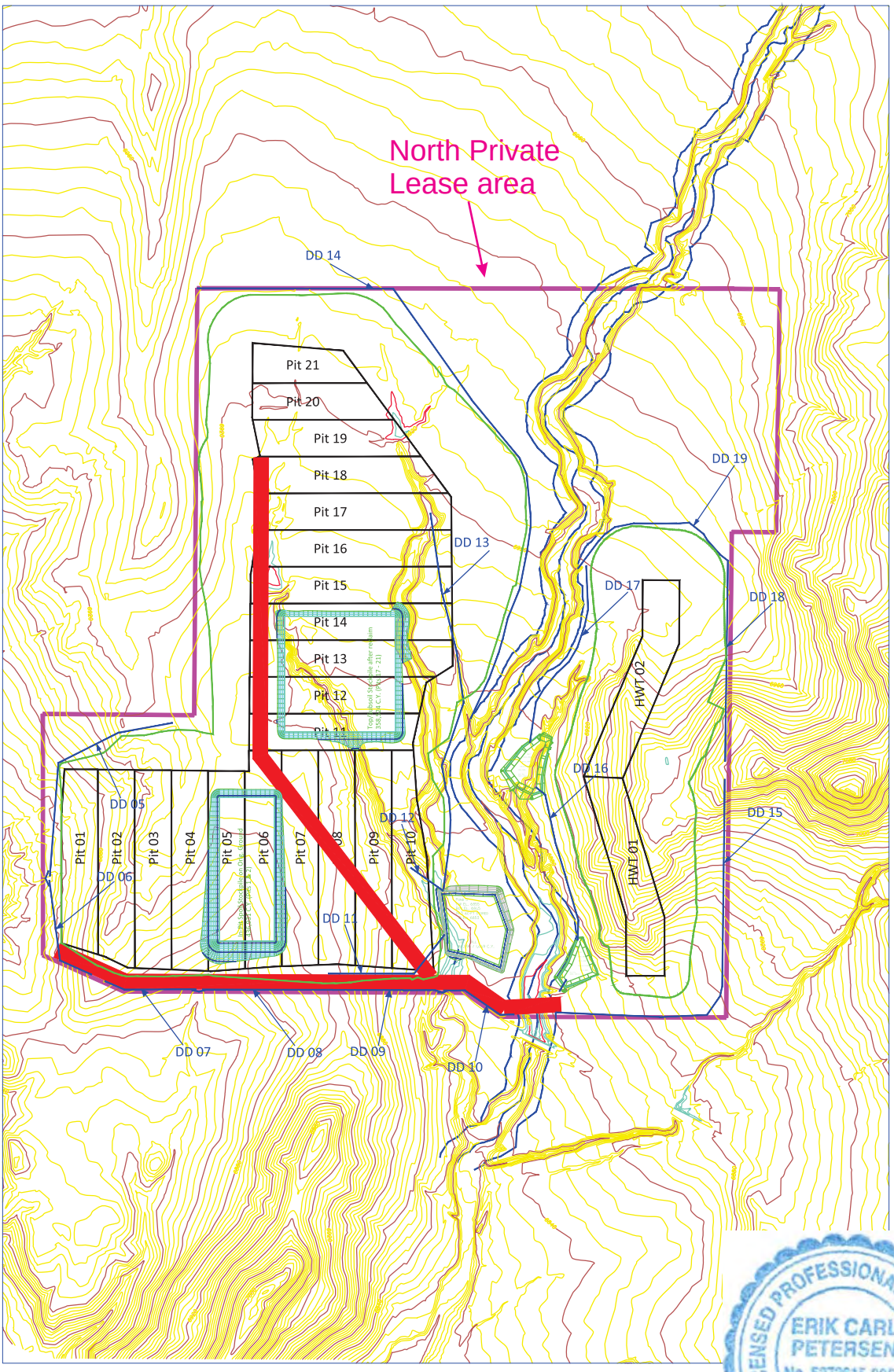

Figure 3 Proposed mine plan for the North Private Lease area.

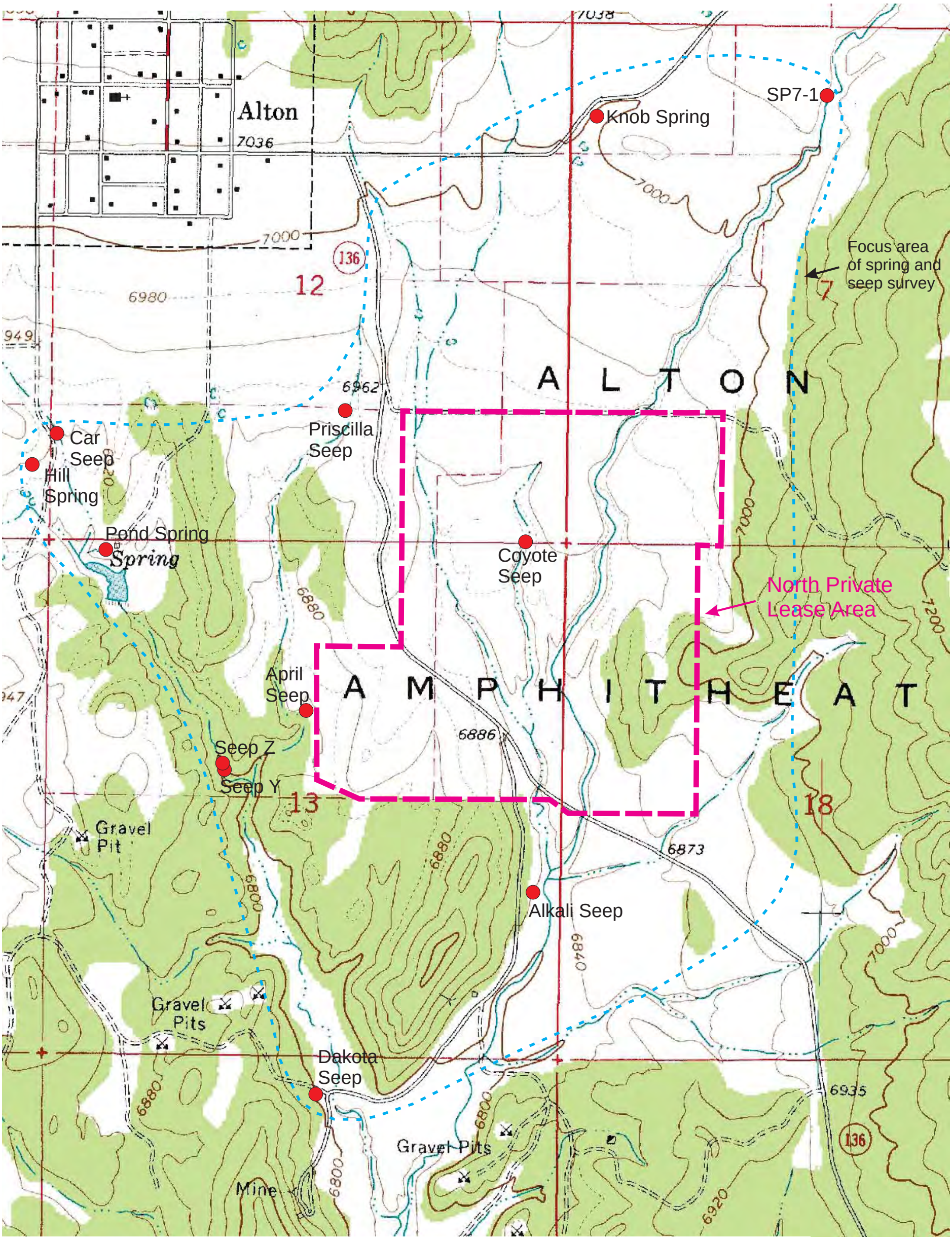

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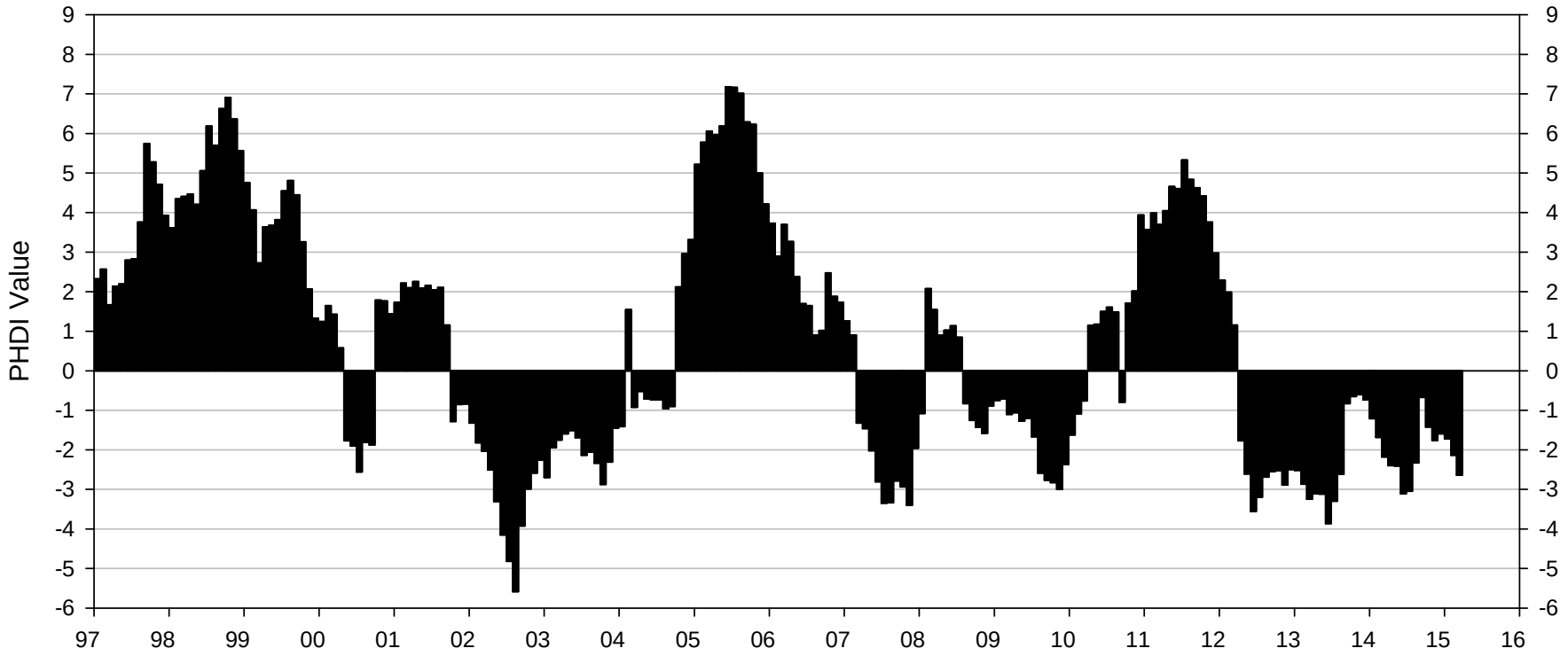
Figure 4 Spring and seep locations.



-1 to -2 Mild Drought	1 to 2 Mild Wet Spell
-2 to -3 Moderate Drought	2 to 3 Moderate Wet Spell
-3 to -4 Severe Drought	3 to 4 Severe Wet Spell
-4 to -5 Extreme Drought	4 to 5 Extreme Wet Spell

Figure 5 plot of Palmer Hydrologic Drought Index for Utah Region 4.

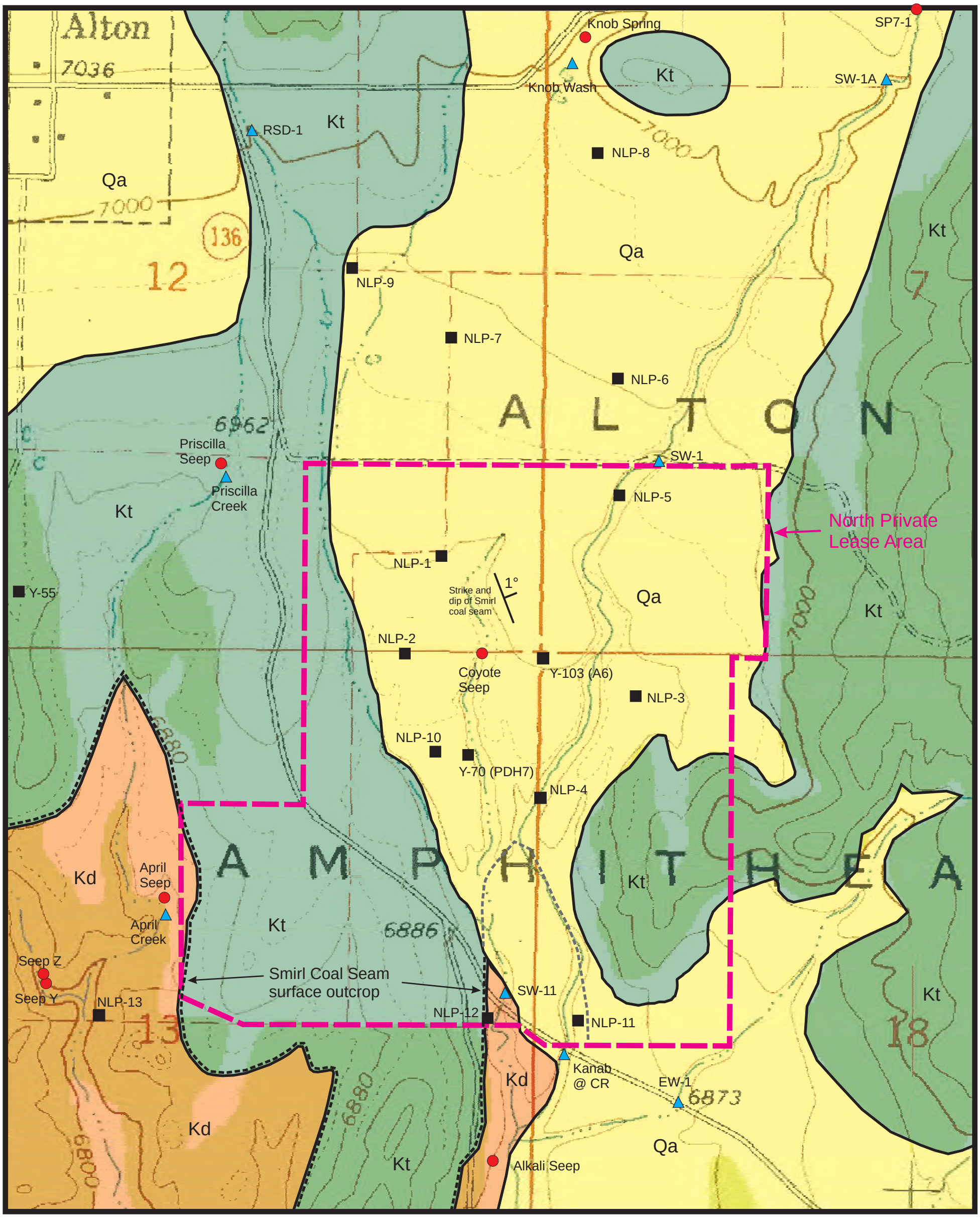
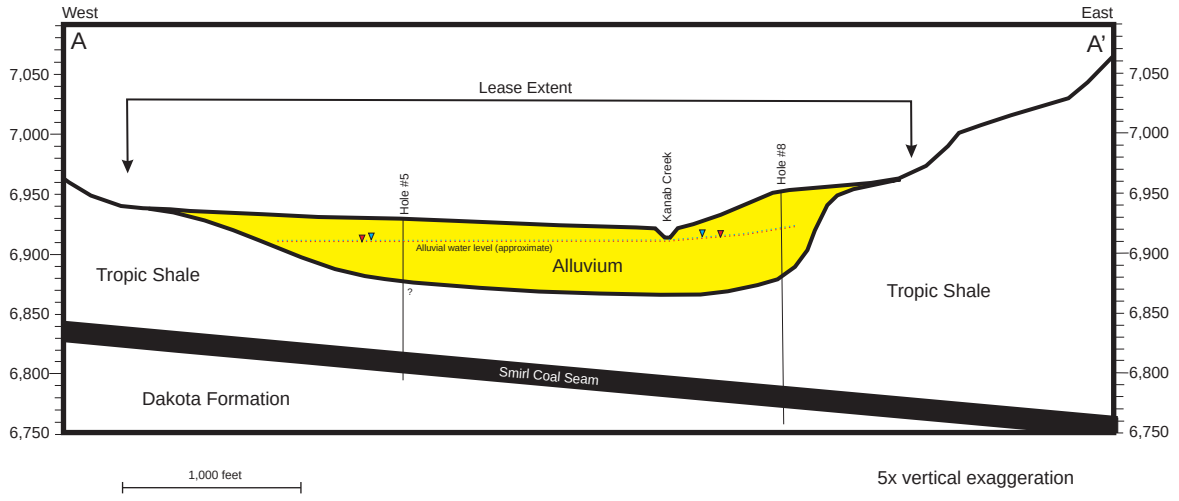
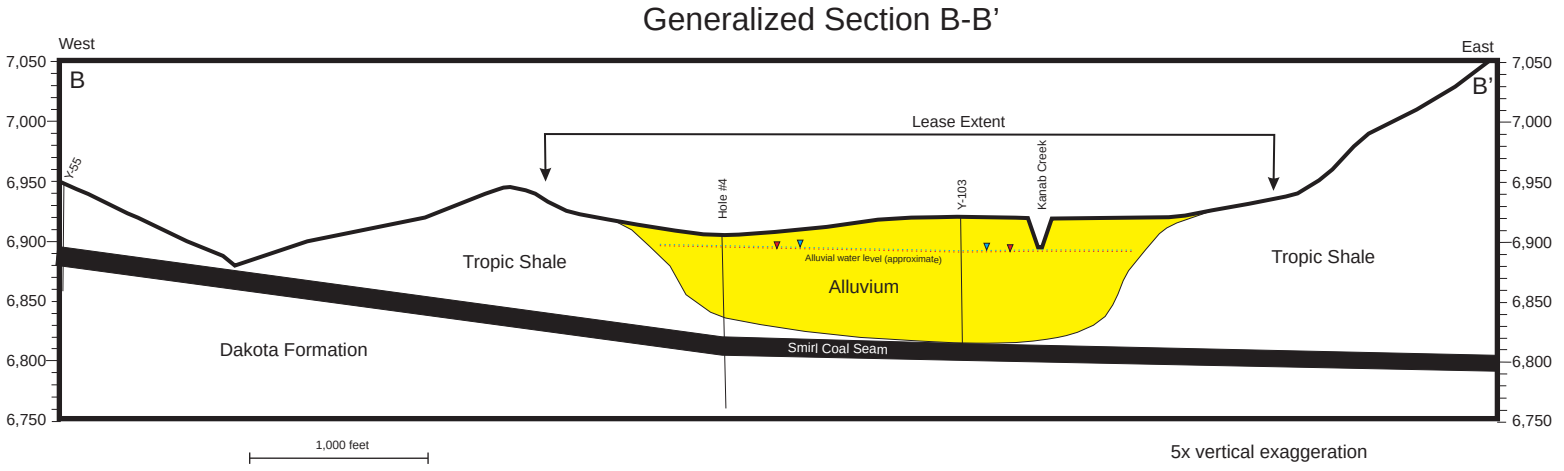


Figure 6 Geologic map of the North Private Lease area.

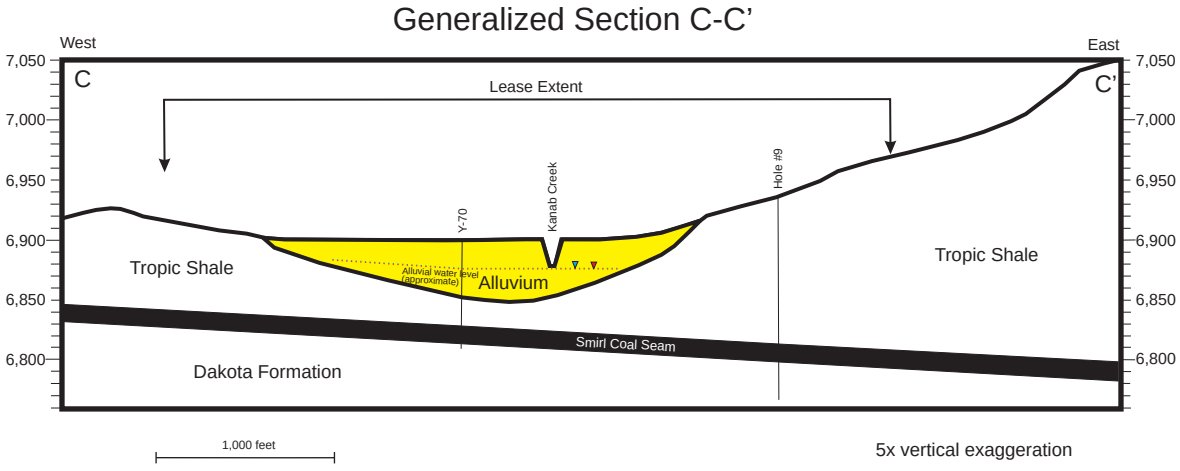
Generalized Section A-A’



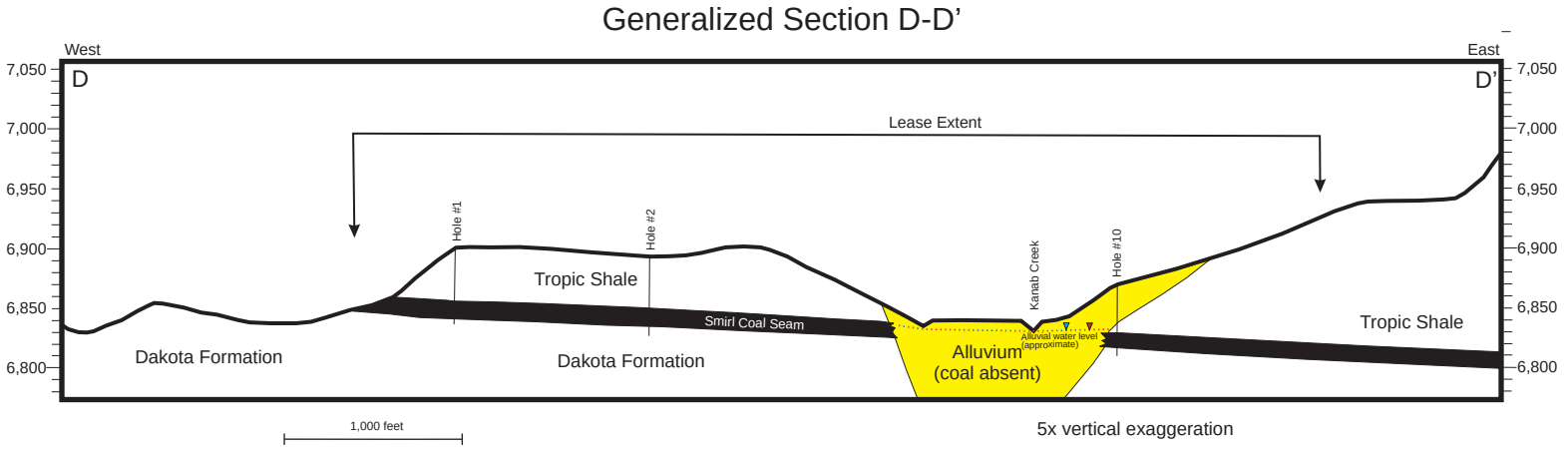
Generalized Section B-B’



Generalized Section C-C’

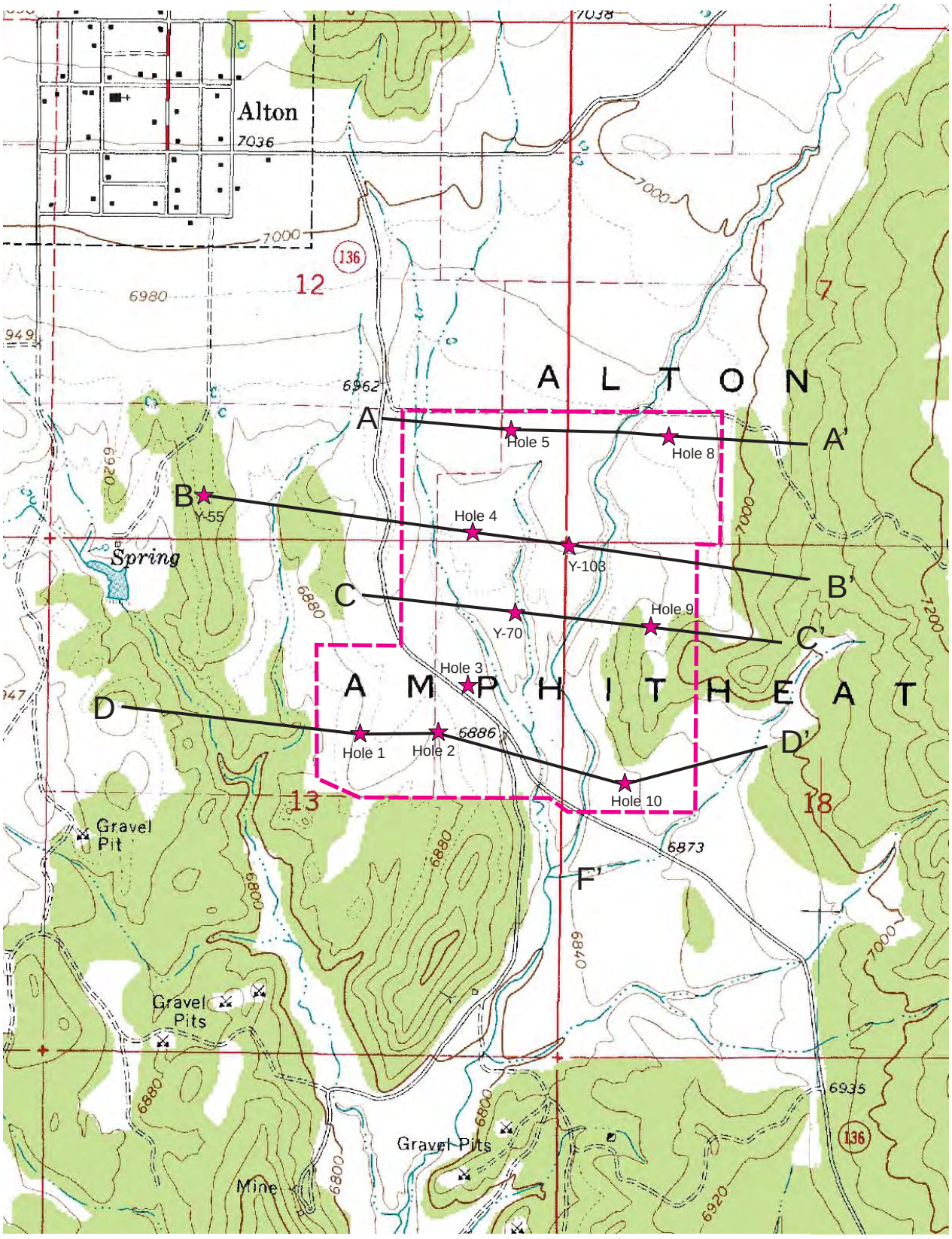


Generalized Section D-D’



Seasonal high and low water levels
High water level
Low water level

Figure 7 Generalized geologic cross-sections through the North Private Lease area.



North

0 500 1,000
feet

Contour interval: 40 feet

★ Borehole location
(see Appendix B for information)

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Cross-section location map
(Figure 7)

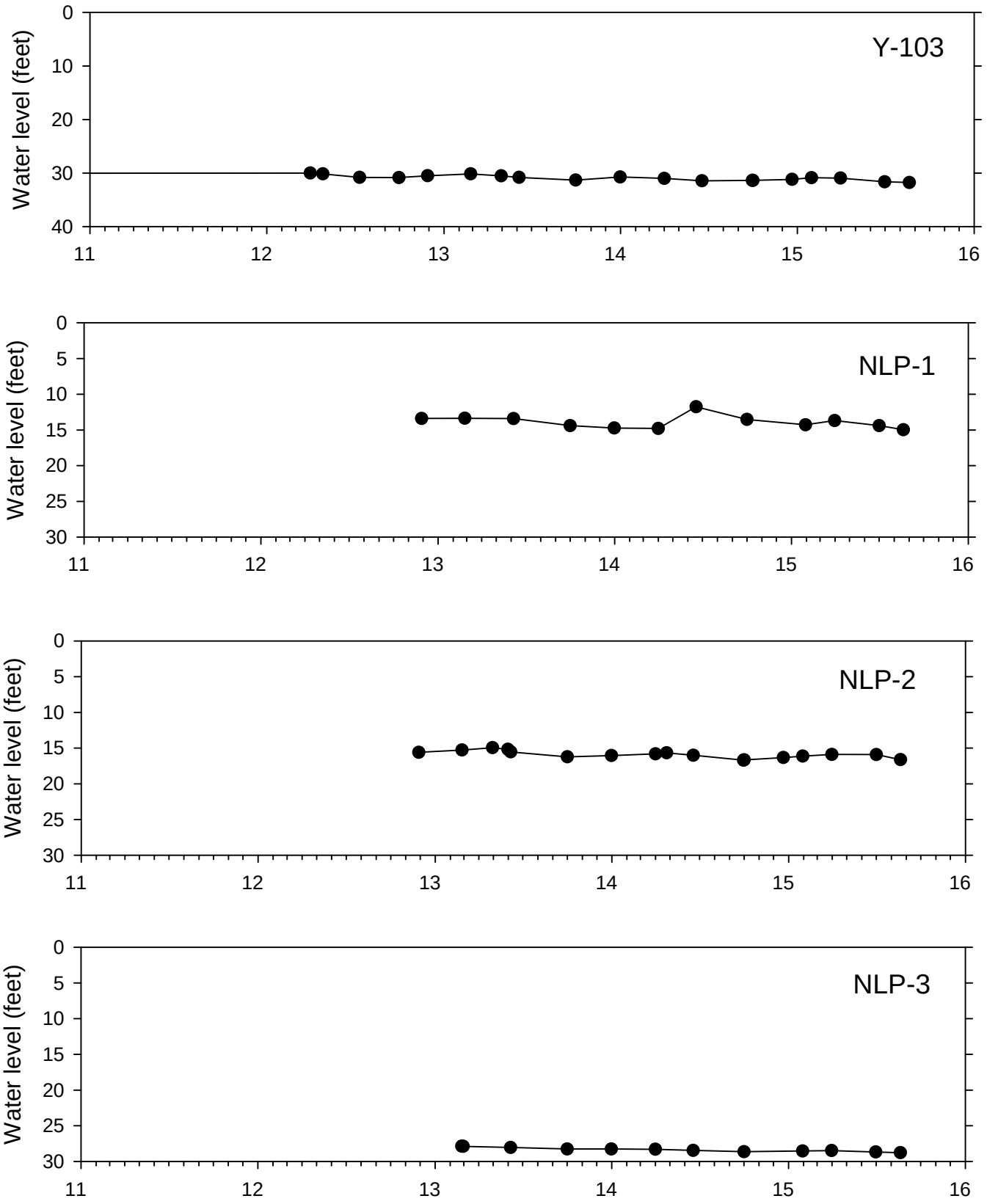


Figure 8 Water level hydrographs for wells.

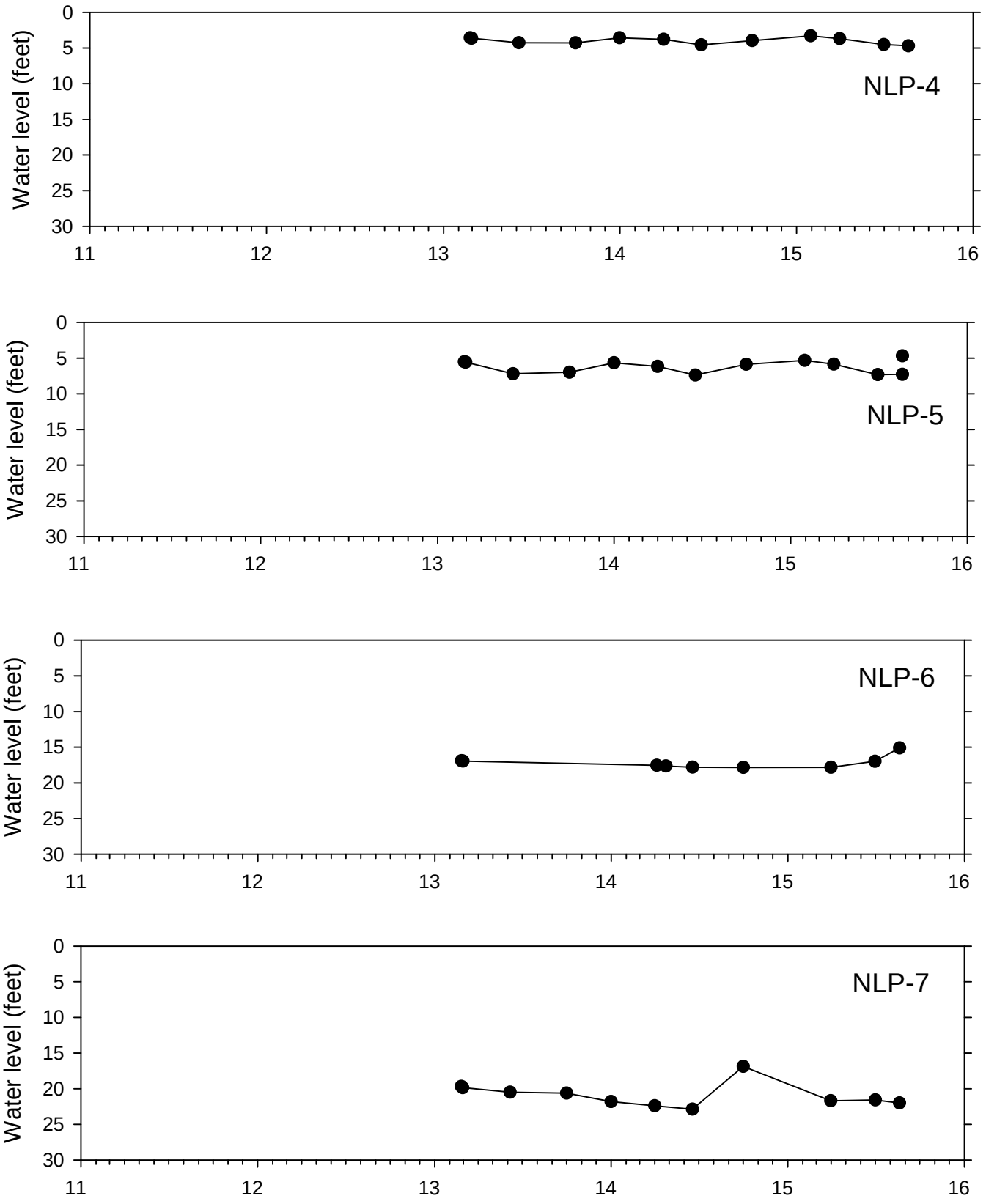
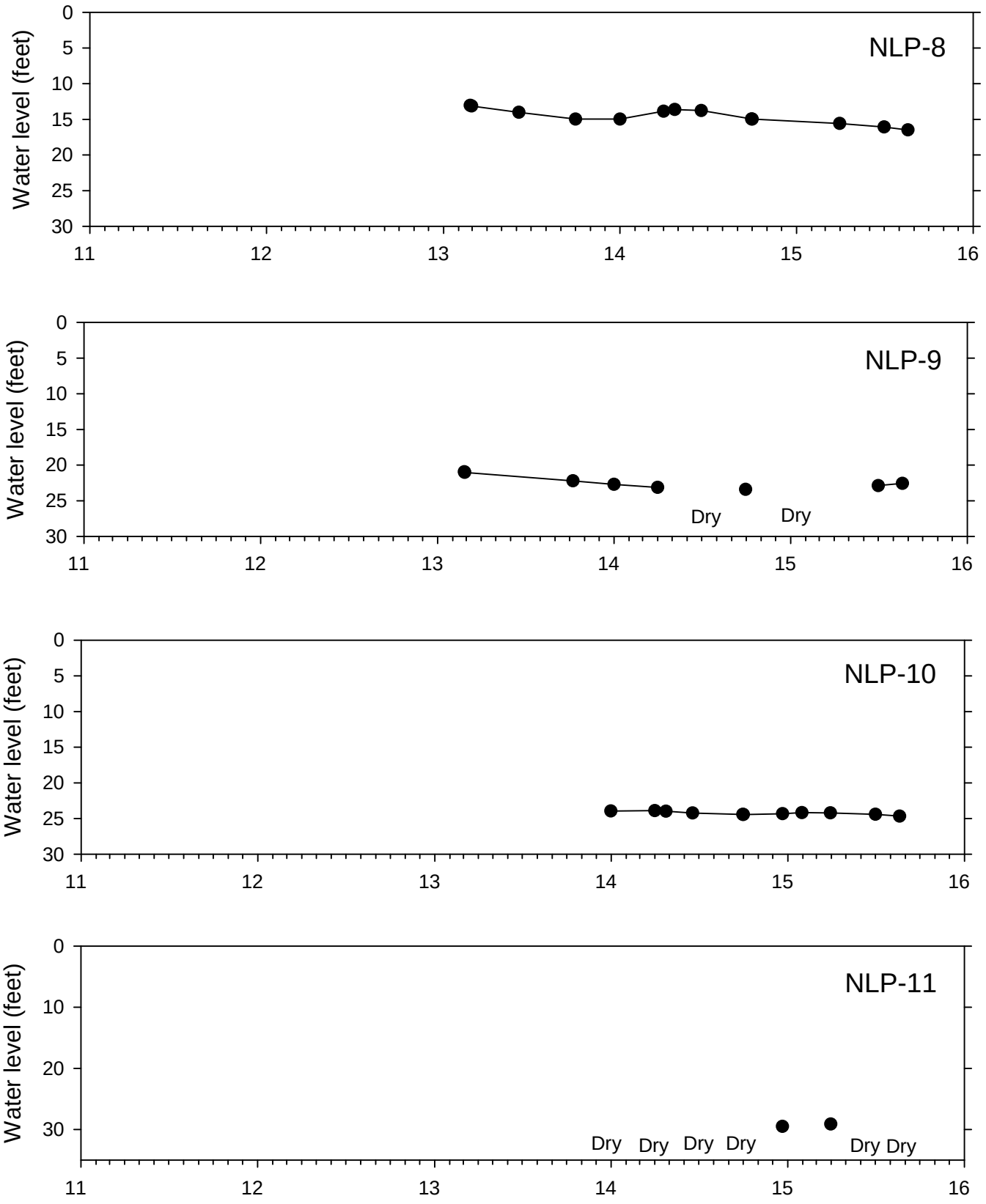


Figure 8 (continued)



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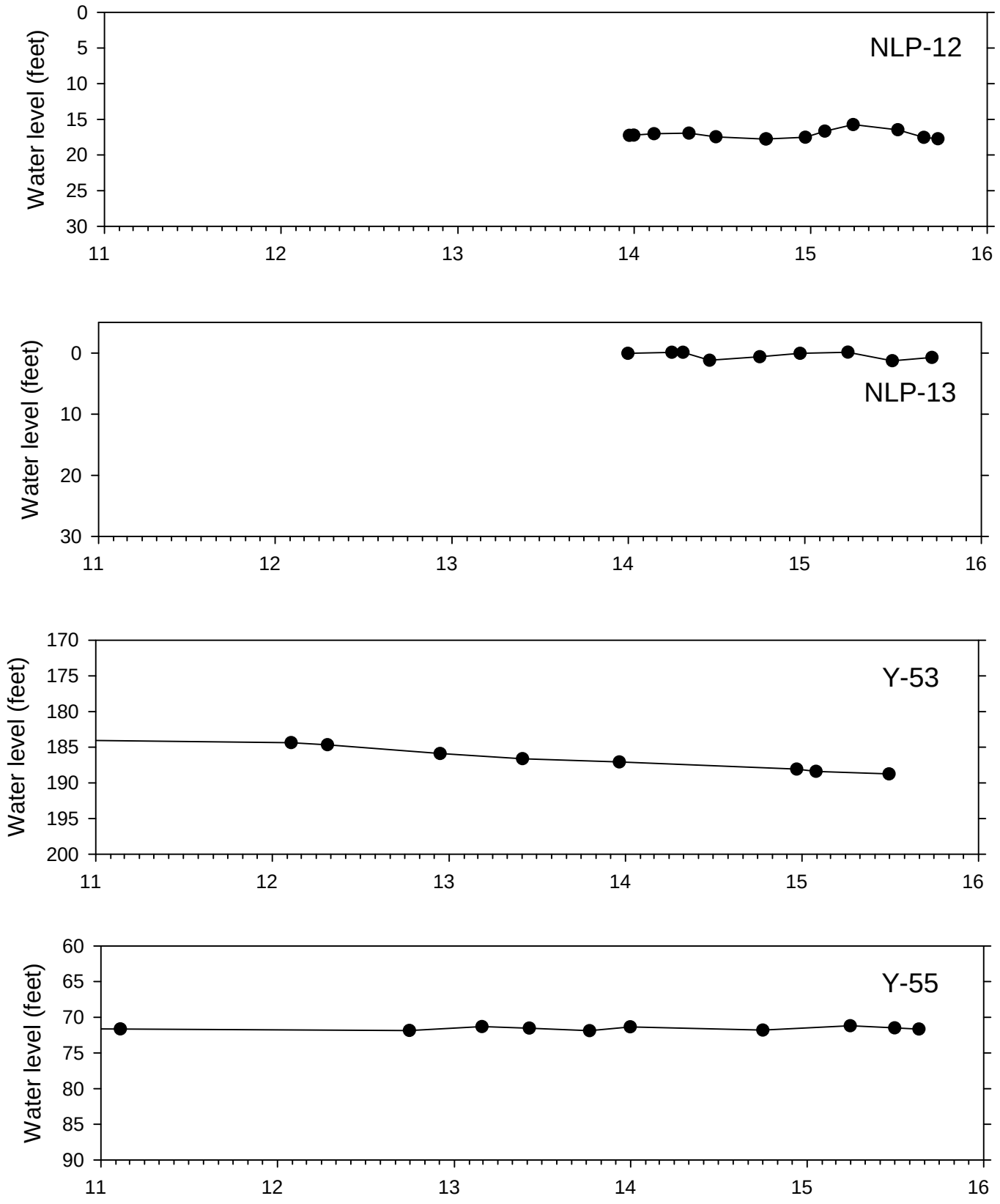

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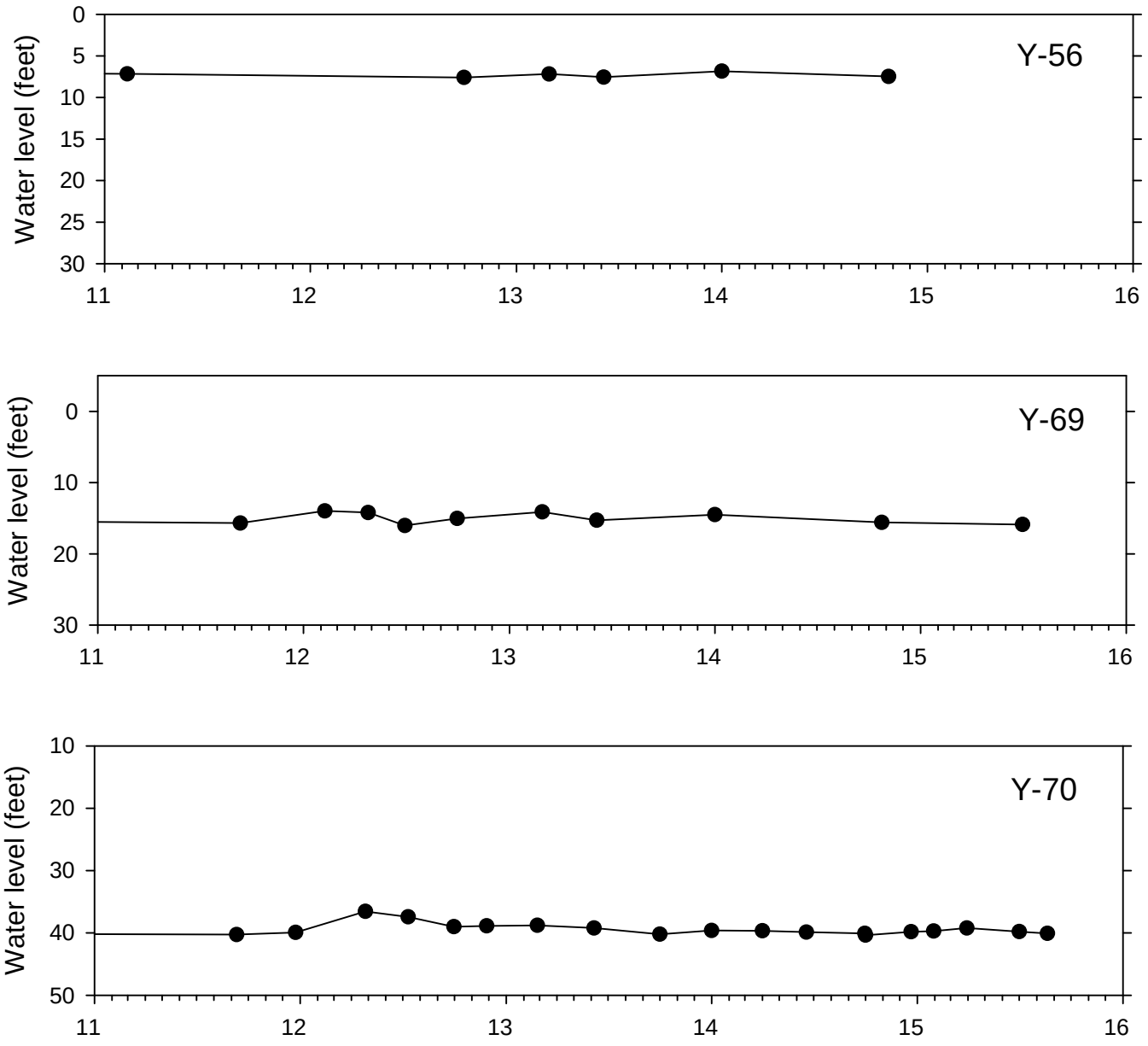

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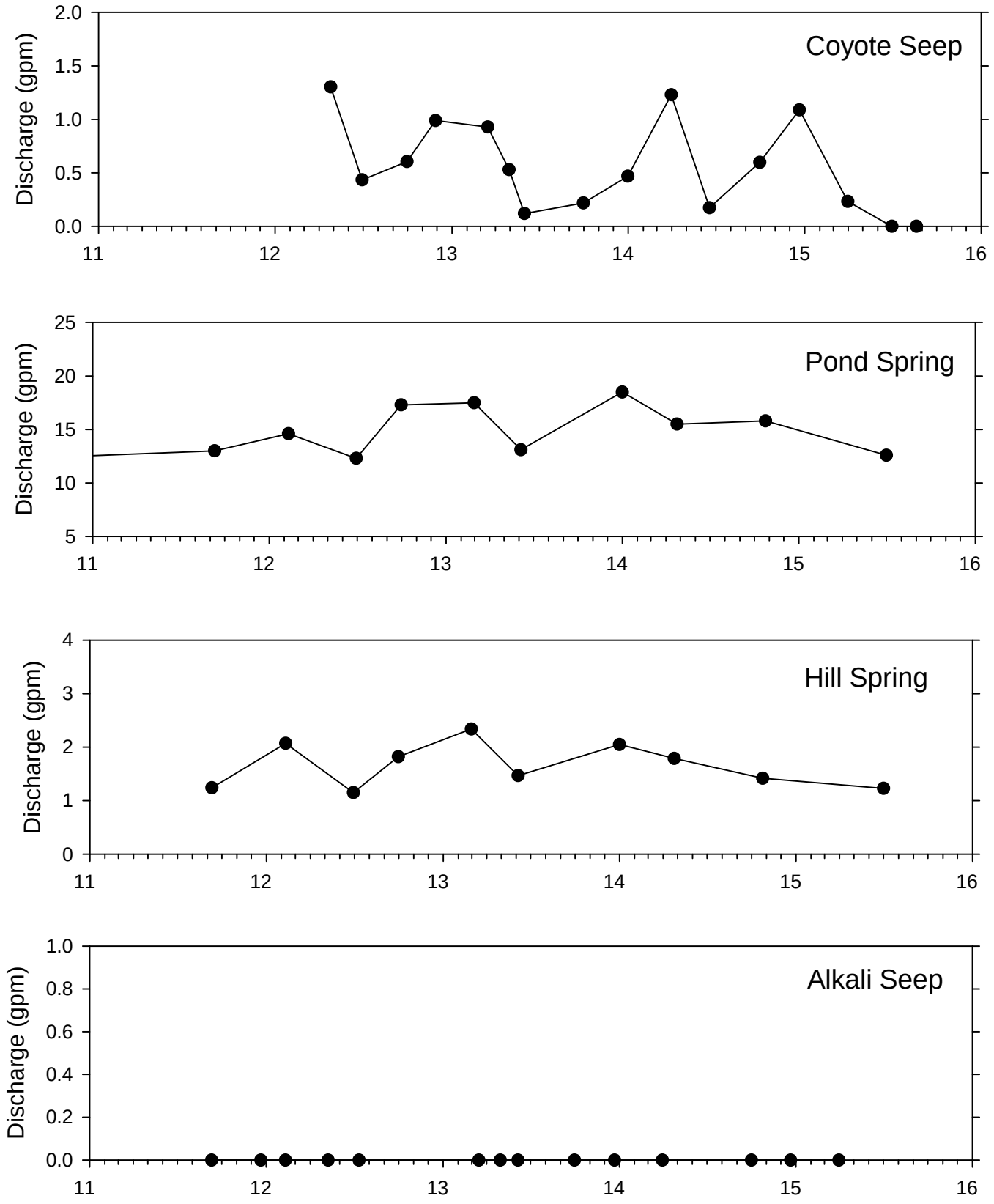


Figure 9 Discharge hydrographs for springs.

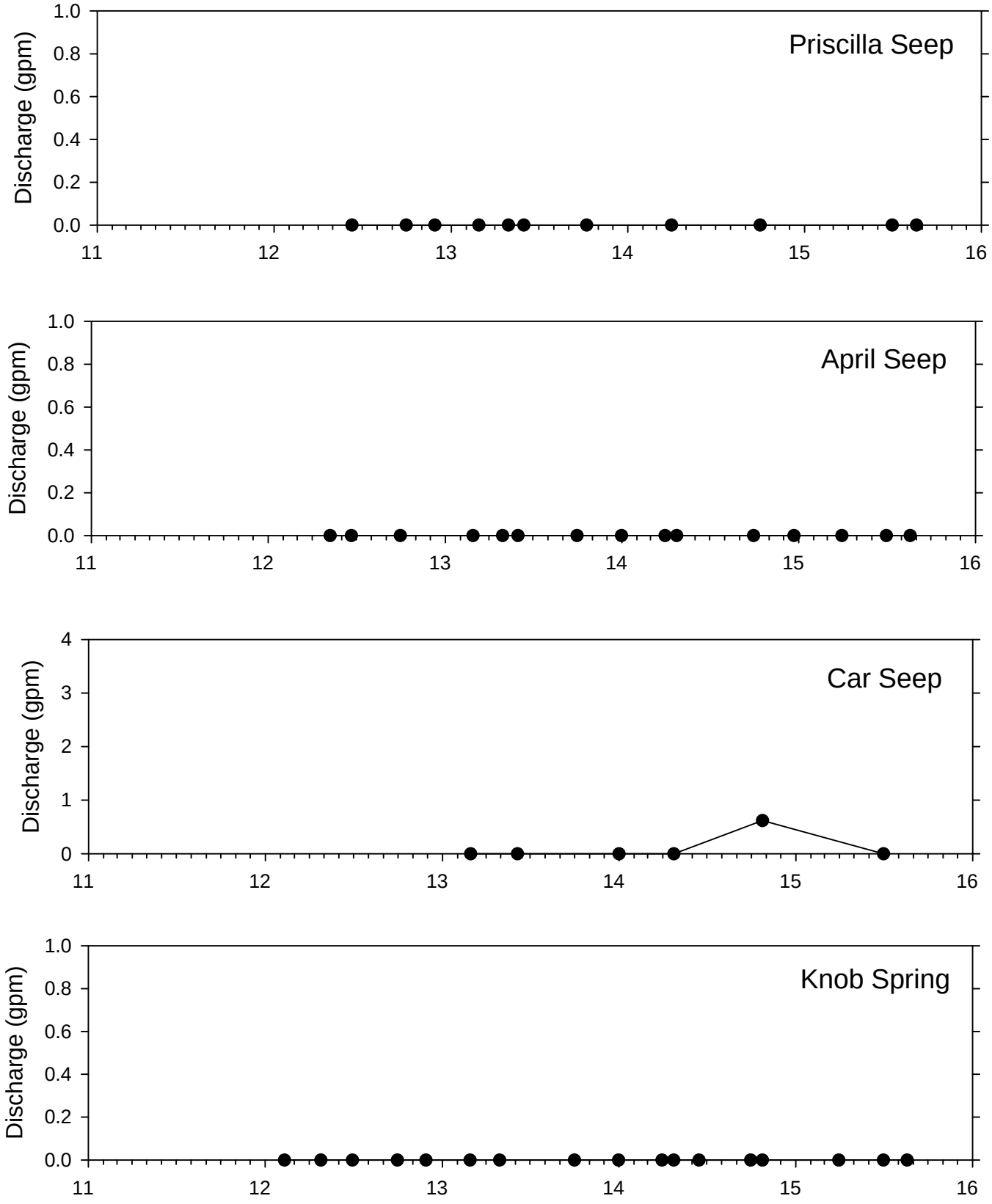


Figure 9 (continued)

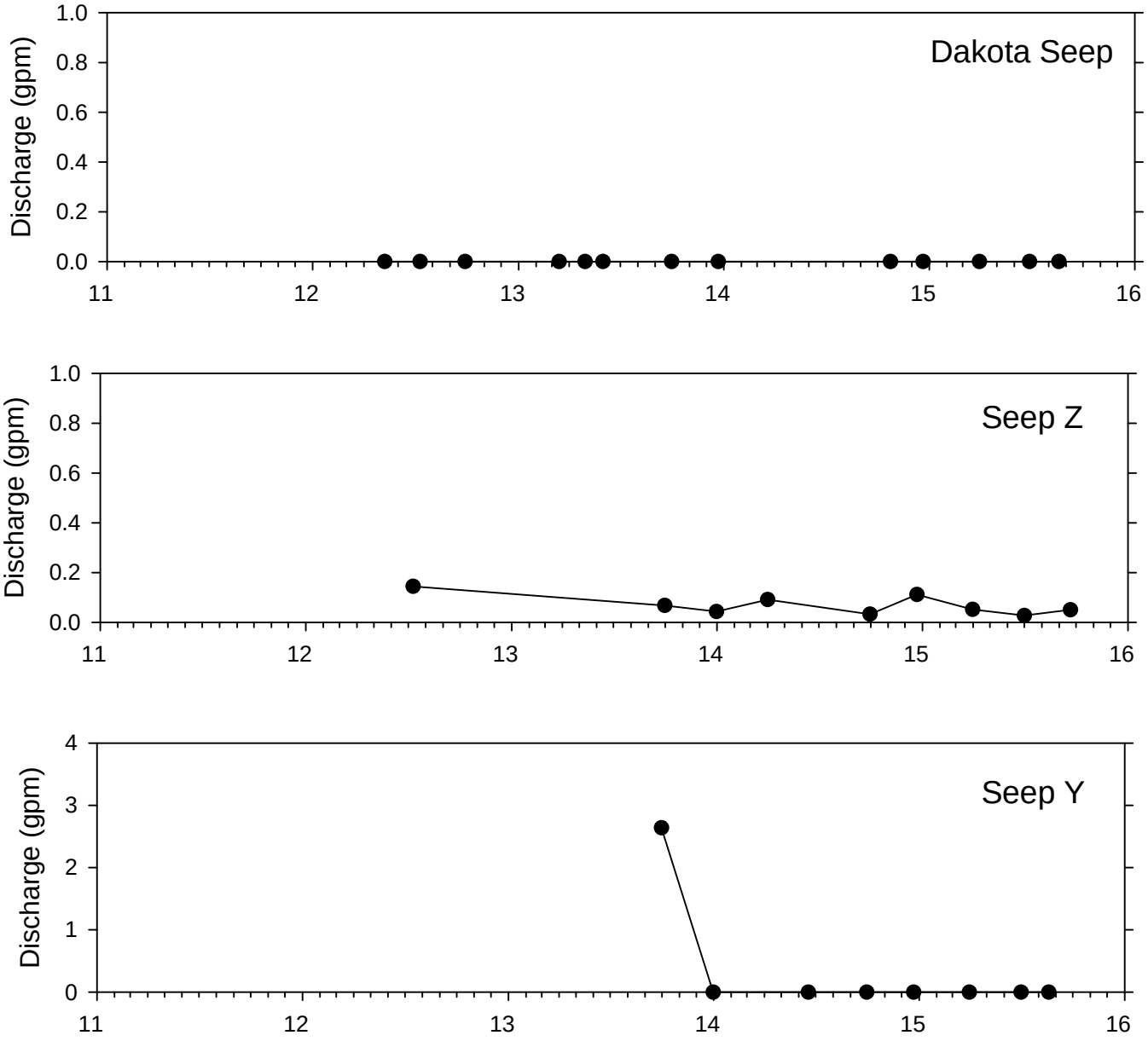


Figure 9 (continued).

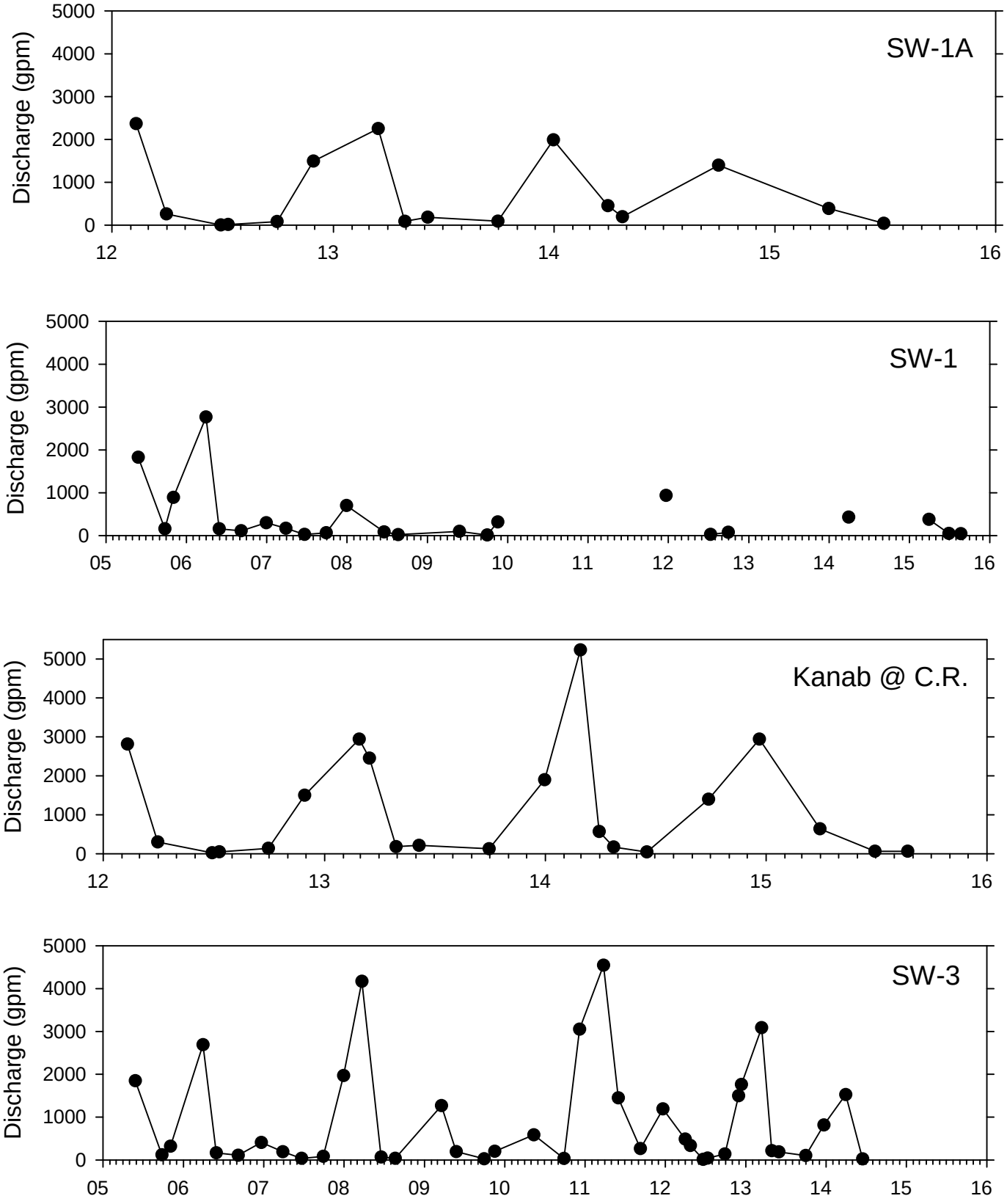


Figure 10 Discharge hydrographs for creeks.

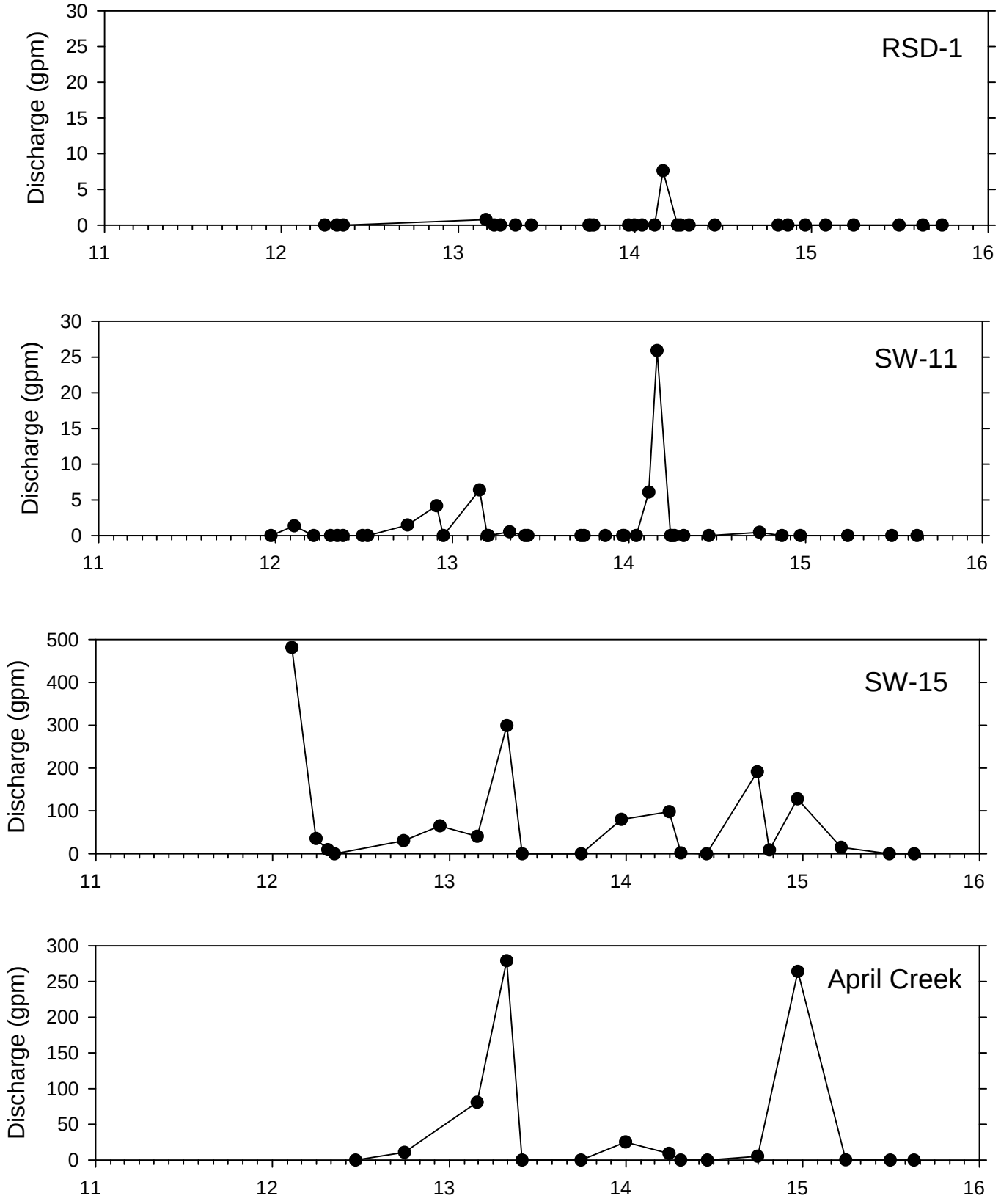
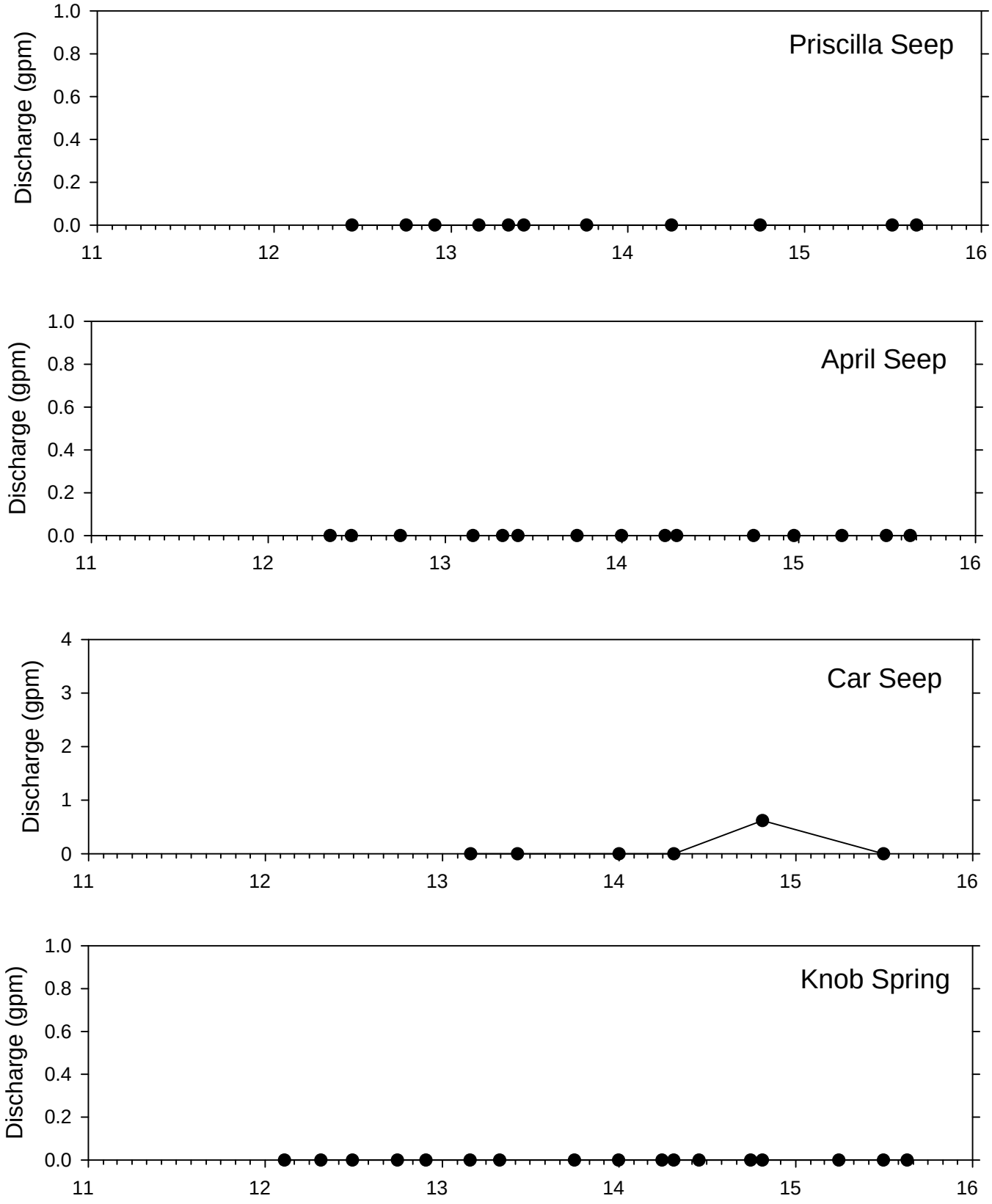


Figure 10 (continued)



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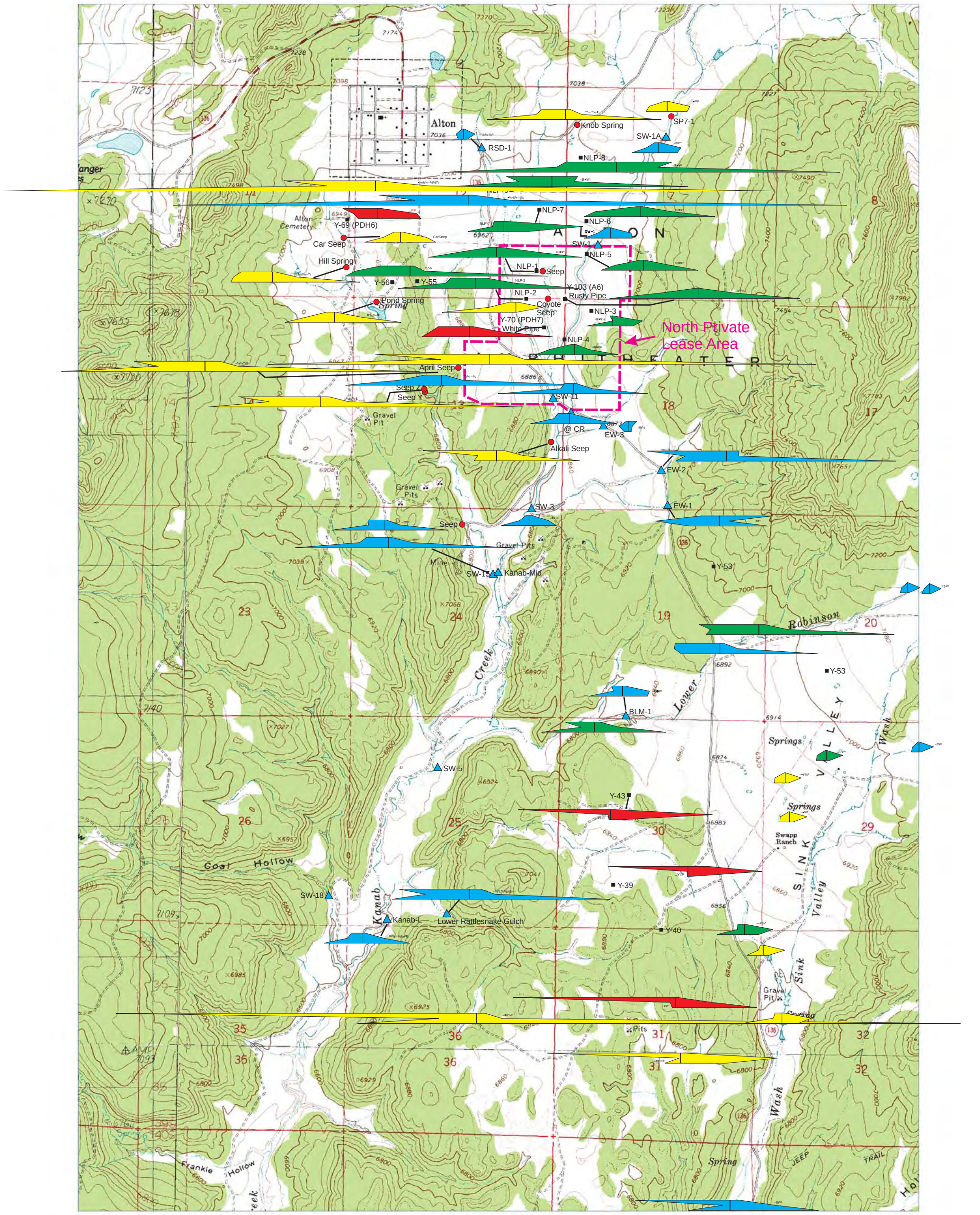
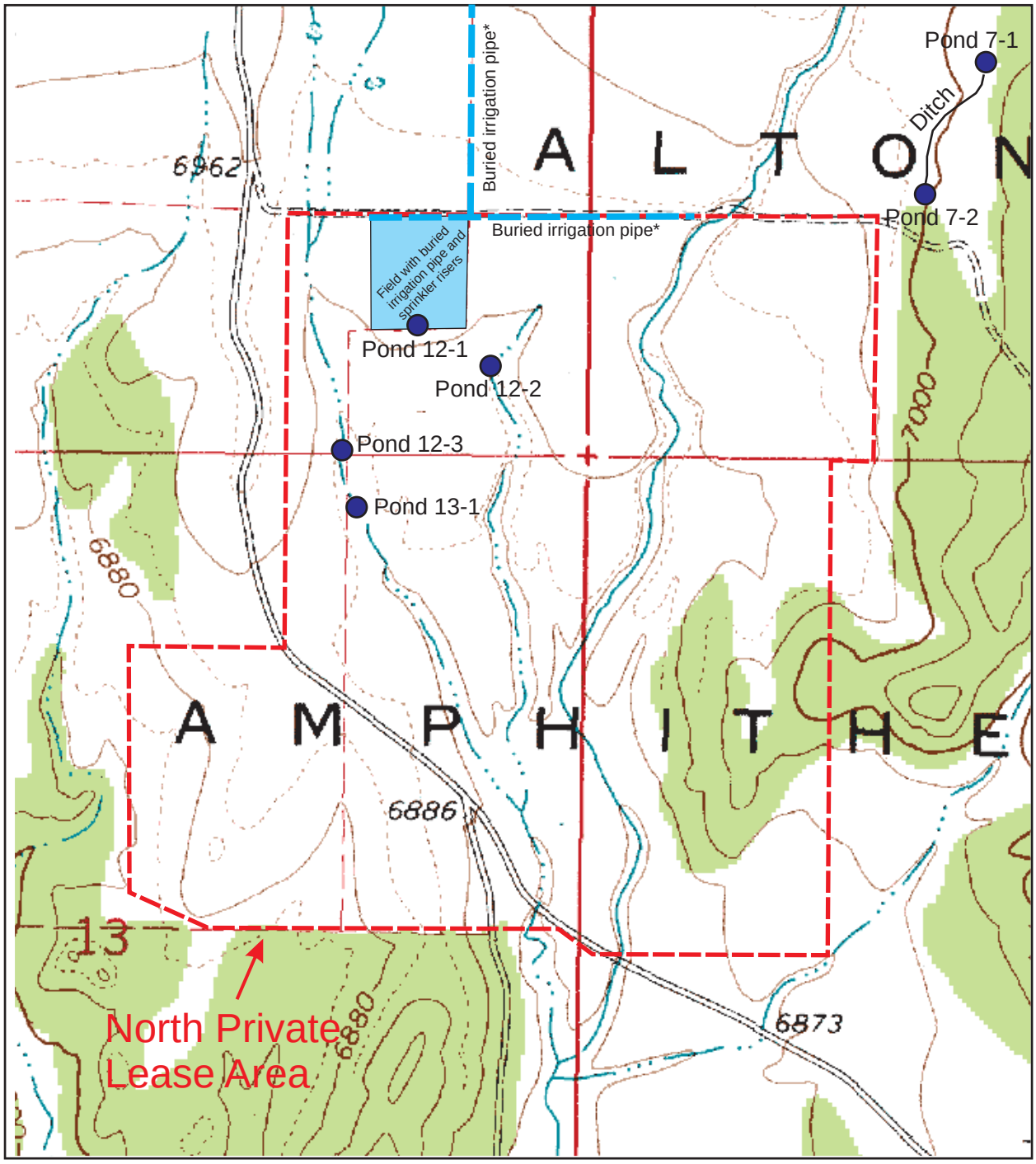


Figure 11 Stiff diagram map for selected groundwaters and surface waters in the Coal Hollow Mine area.



* Note: Mapped buried irrigation pipe locations are based on visual observations of sprinklers and pipe risers.

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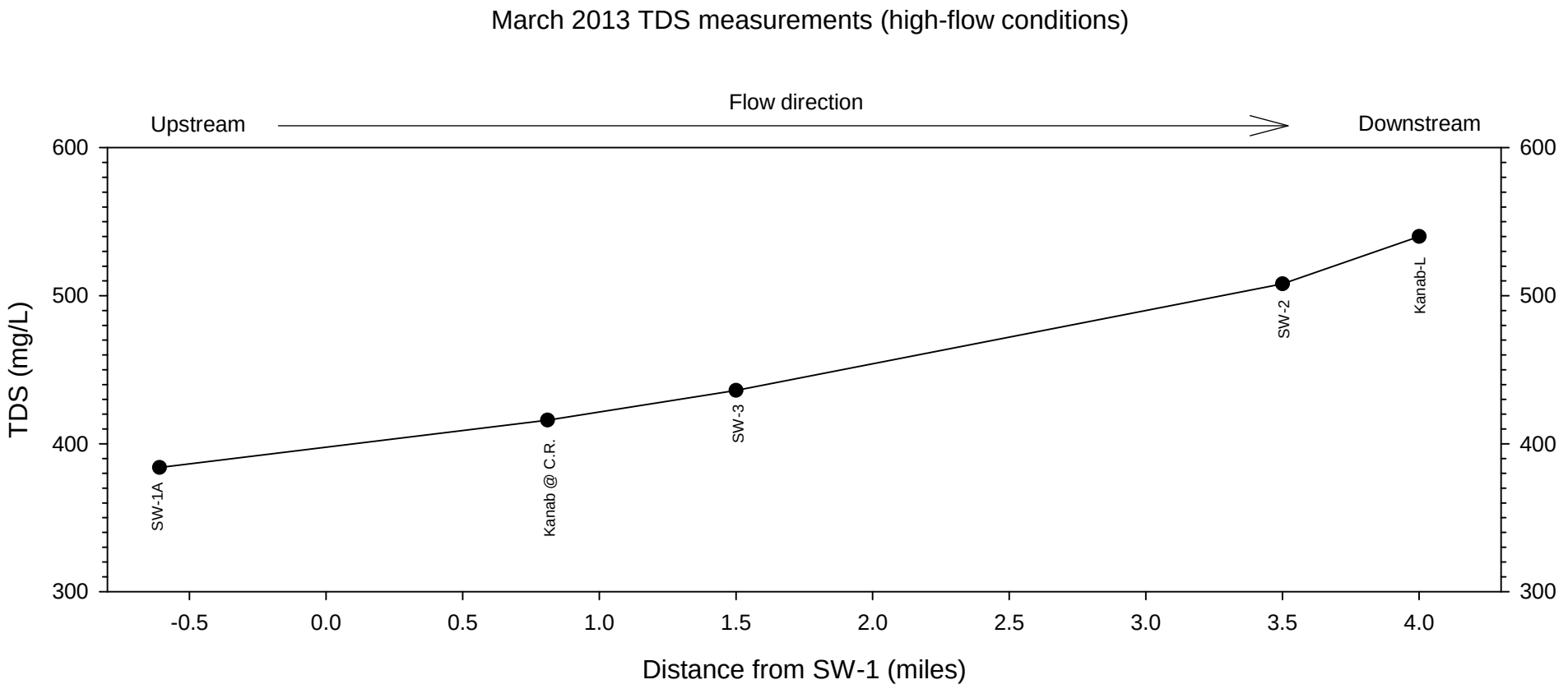
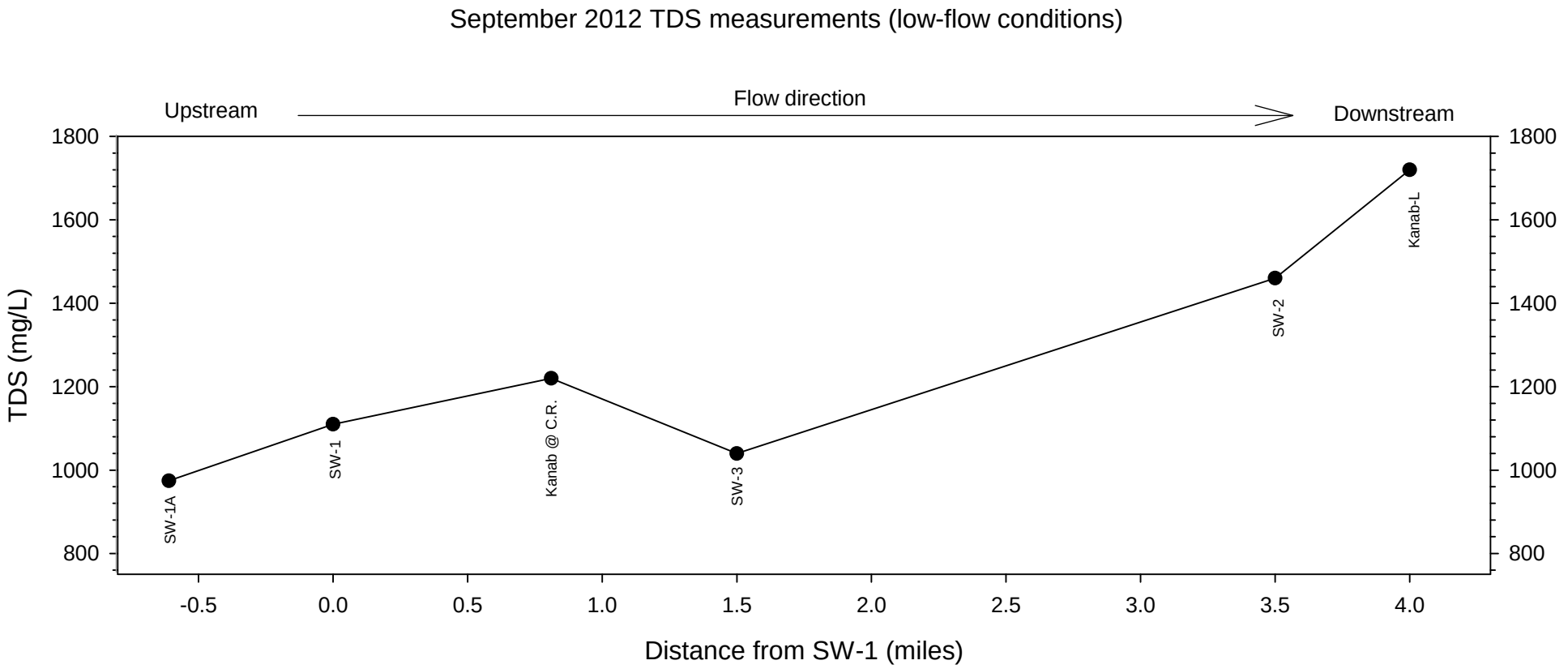
Figure 12 Locations of ponds, ditches, and pipelines.



Note: There had been no discharges of mine water from the Coal Hollow Mine in 15 months prior to the March 2013 monitoring events.

Figure 13 TDS concentrations at Kanab Creek monitoring stations during high-flow conditions (March 2013).



Note: There had been no discharges of mine water from the Coal Hollow Mine in 9 months prior to the March 2013 monitoring events.

Figure 14 TDS concentrations at Kanab Creek monitoring stations during Low-flow conditions (September 2012).

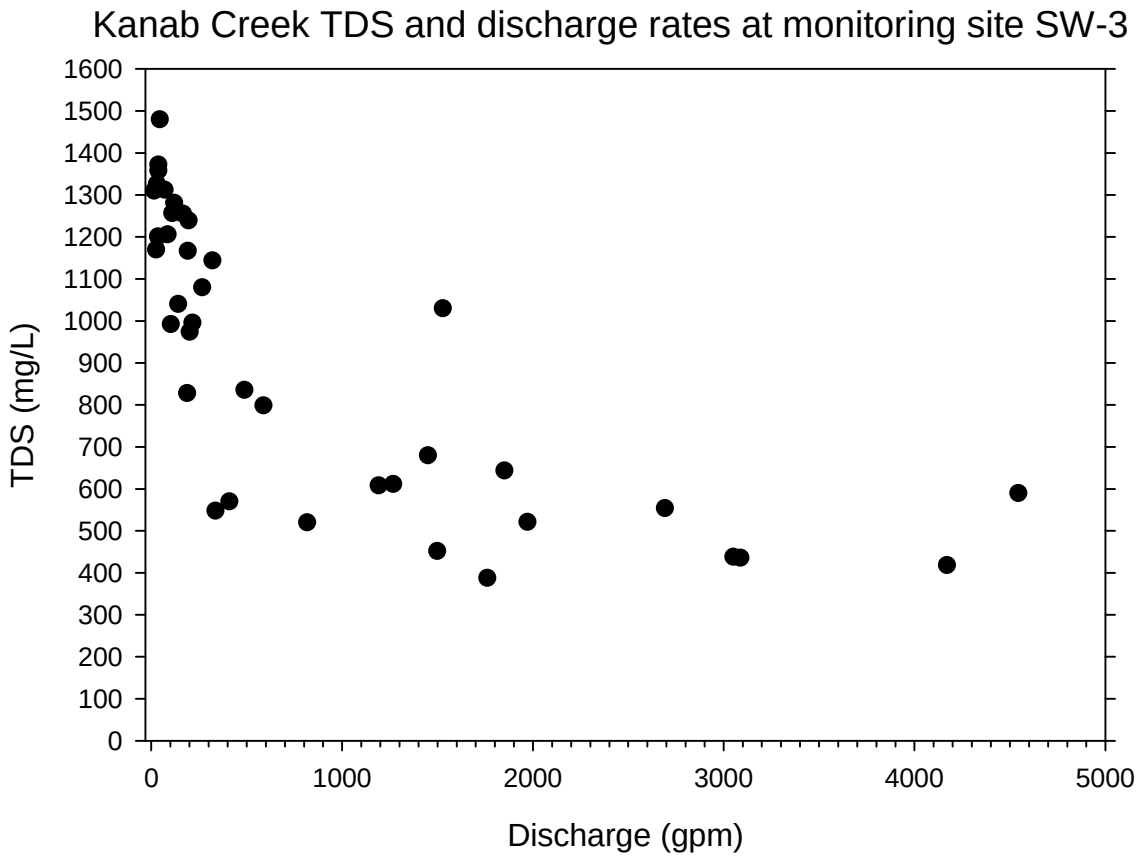


Figure 15 Plot of TDS concentrations and stream discharge rates in Kanab Creek at monitoring site SW-3.

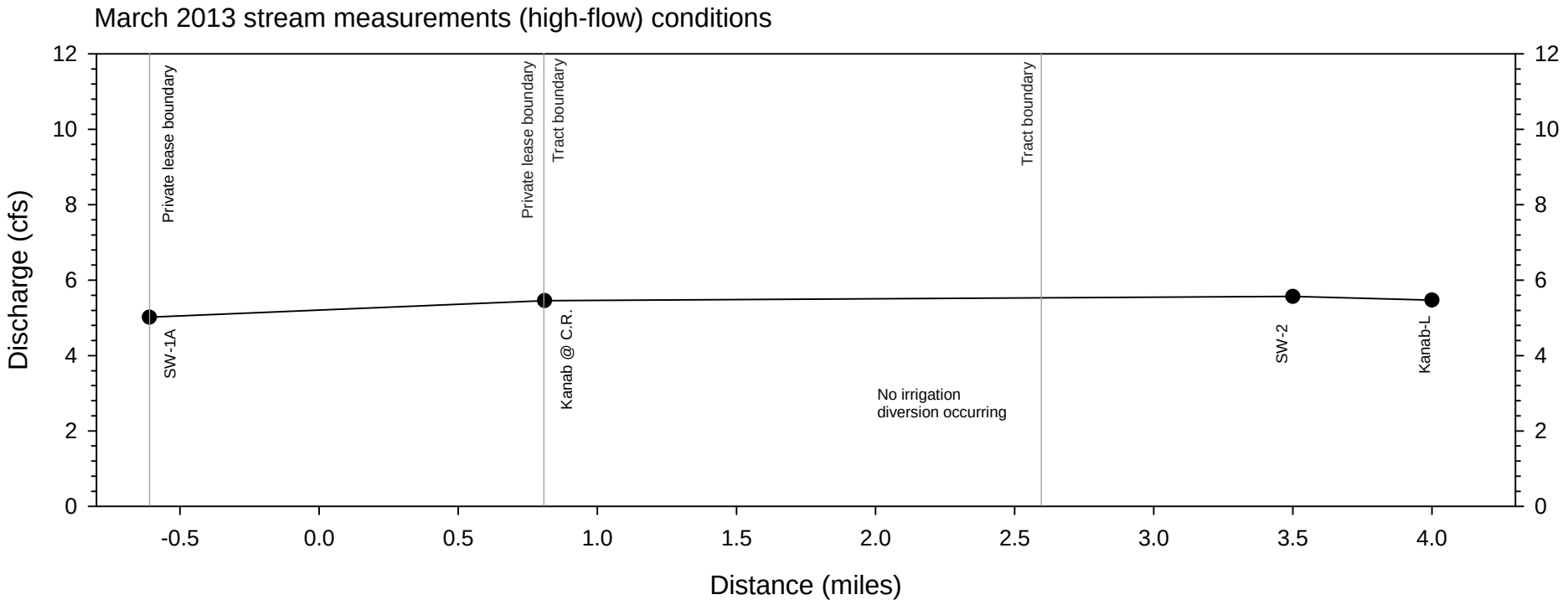


Figure 16 Plot of discharge measurements on Kanab Creek during high-flow conditions (March 2013).

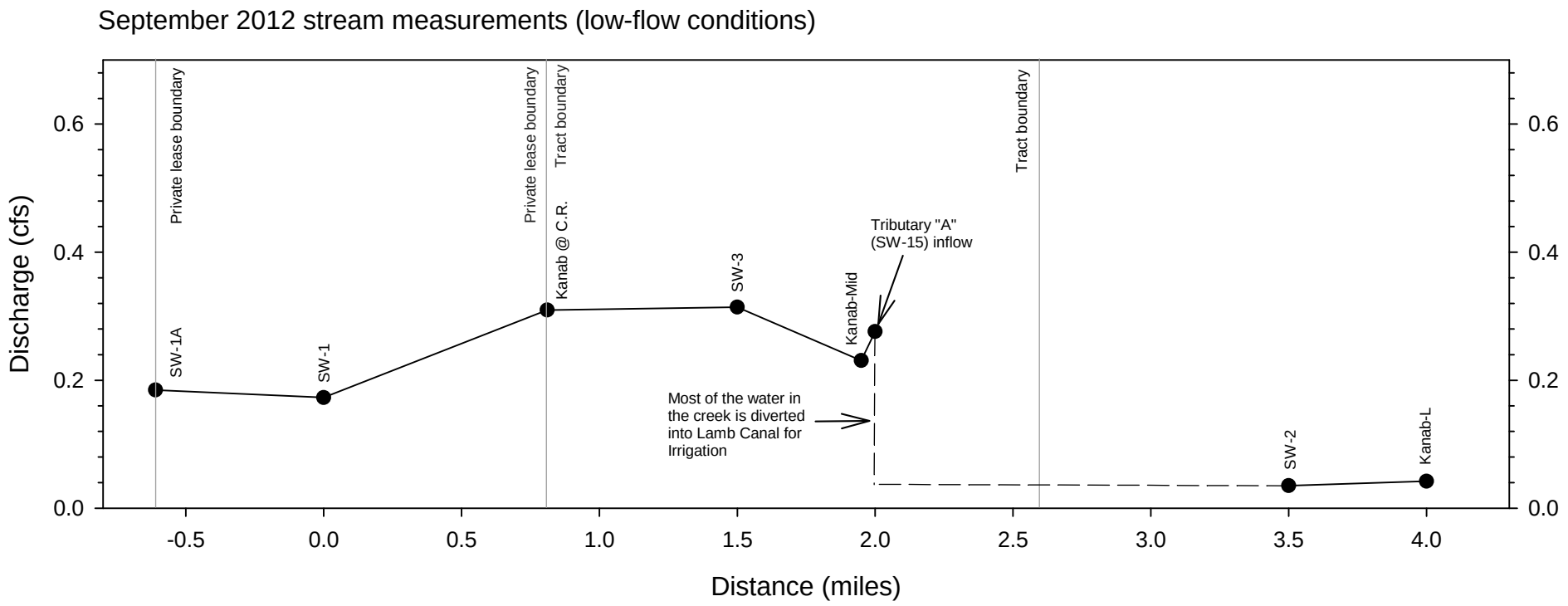
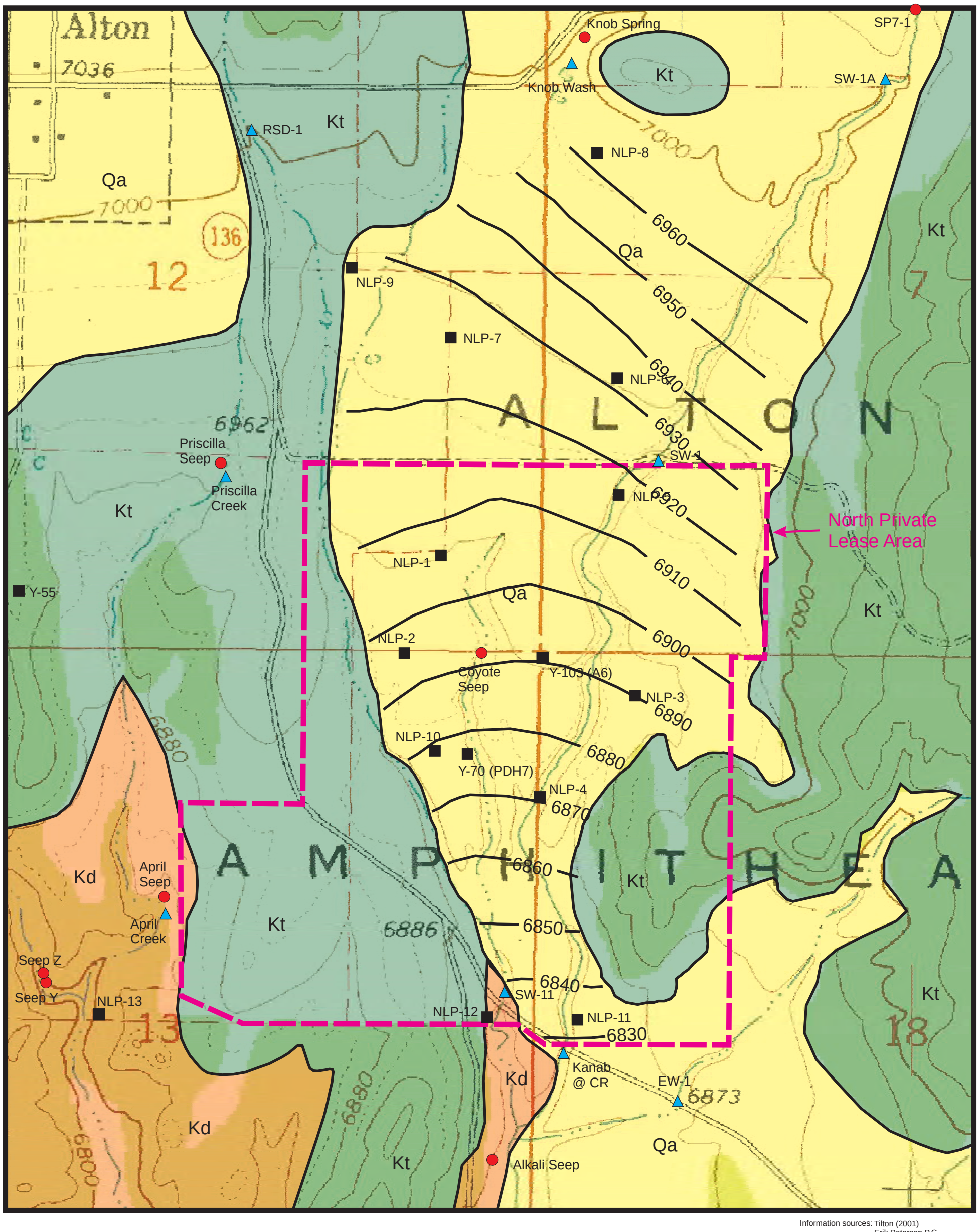


Figure 17 Plot of discharge measurements on Kanab Creek during low-flow conditions (September 2012).



Information sources: Tilton (2001)
Erik Petersen P.G.
Petersen Hydrologic, LLC

North

0 500 1,000
feet

Contour interval: 40 feet

Quaternary alluvium
Tropic Shale (Cretaceous)
Dakota Formation (Cretaceous)

6850 Water level in alluvial groundwater system (approximate)

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Figure 18 Water level contours for the alluvial groundwater system in the North Private Lease area.

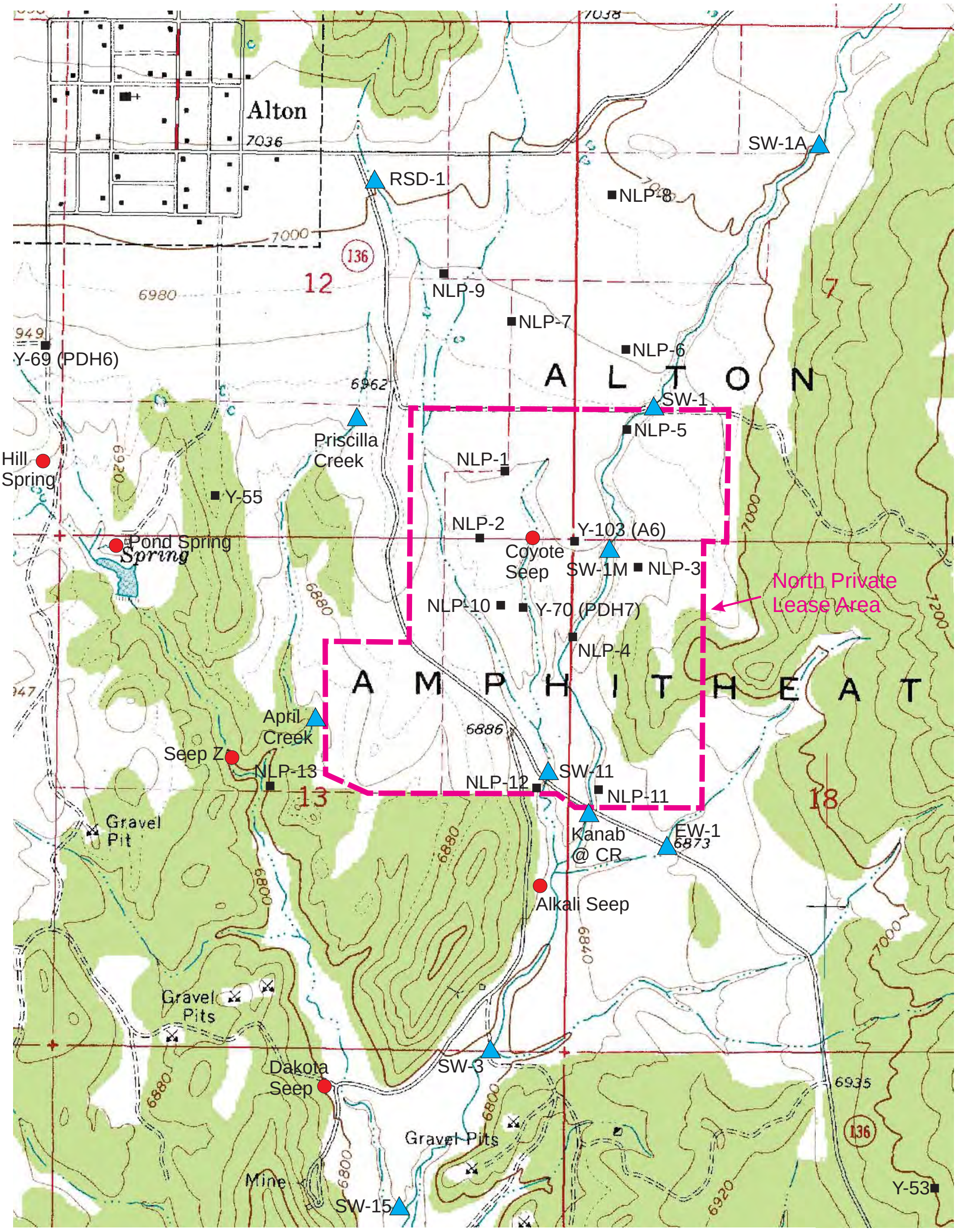

Figure 19 Hydrologic monitoring stations for the North Private Lease..

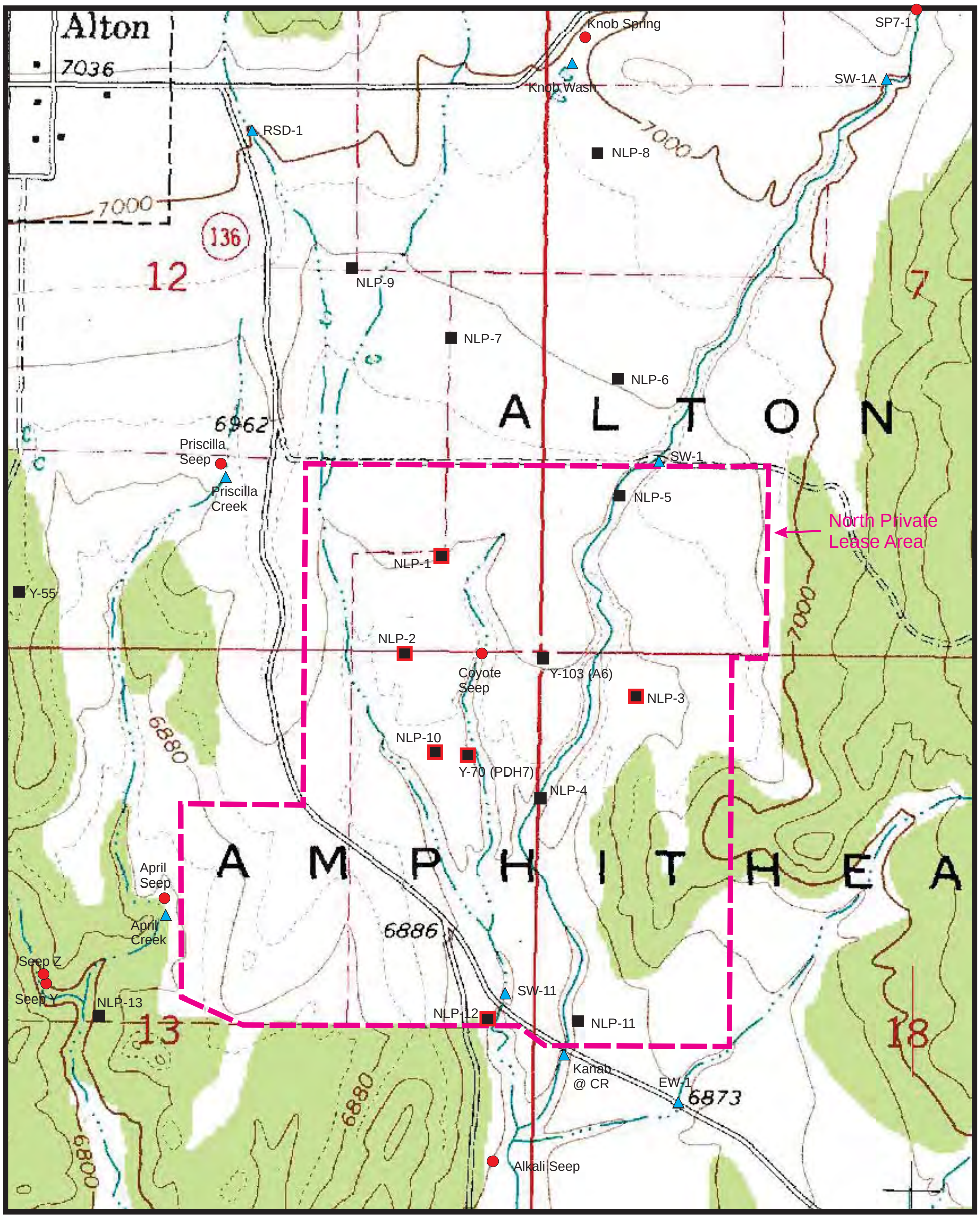

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Figure 20 Monitoring wells to be removed by mining activities.

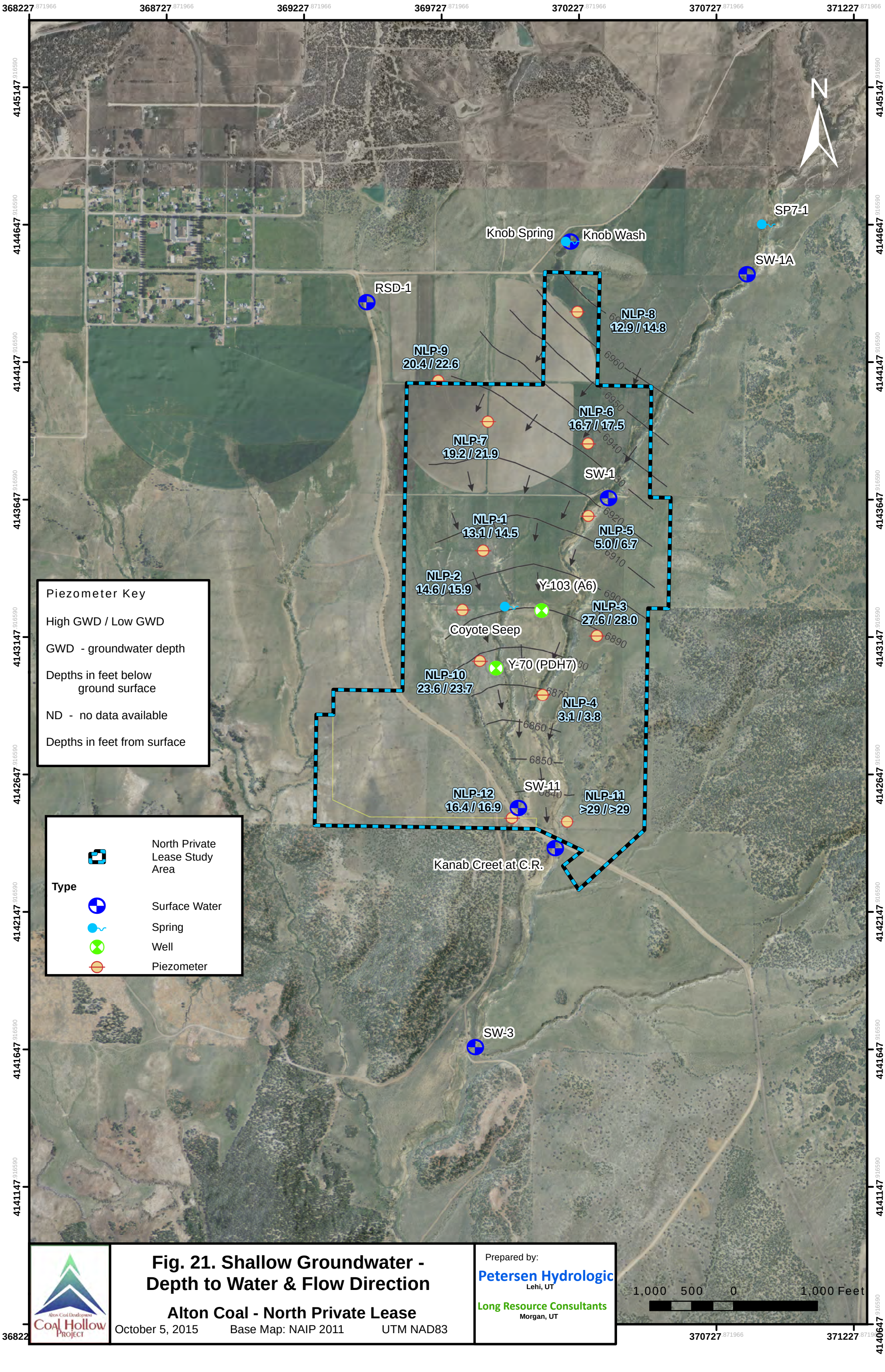


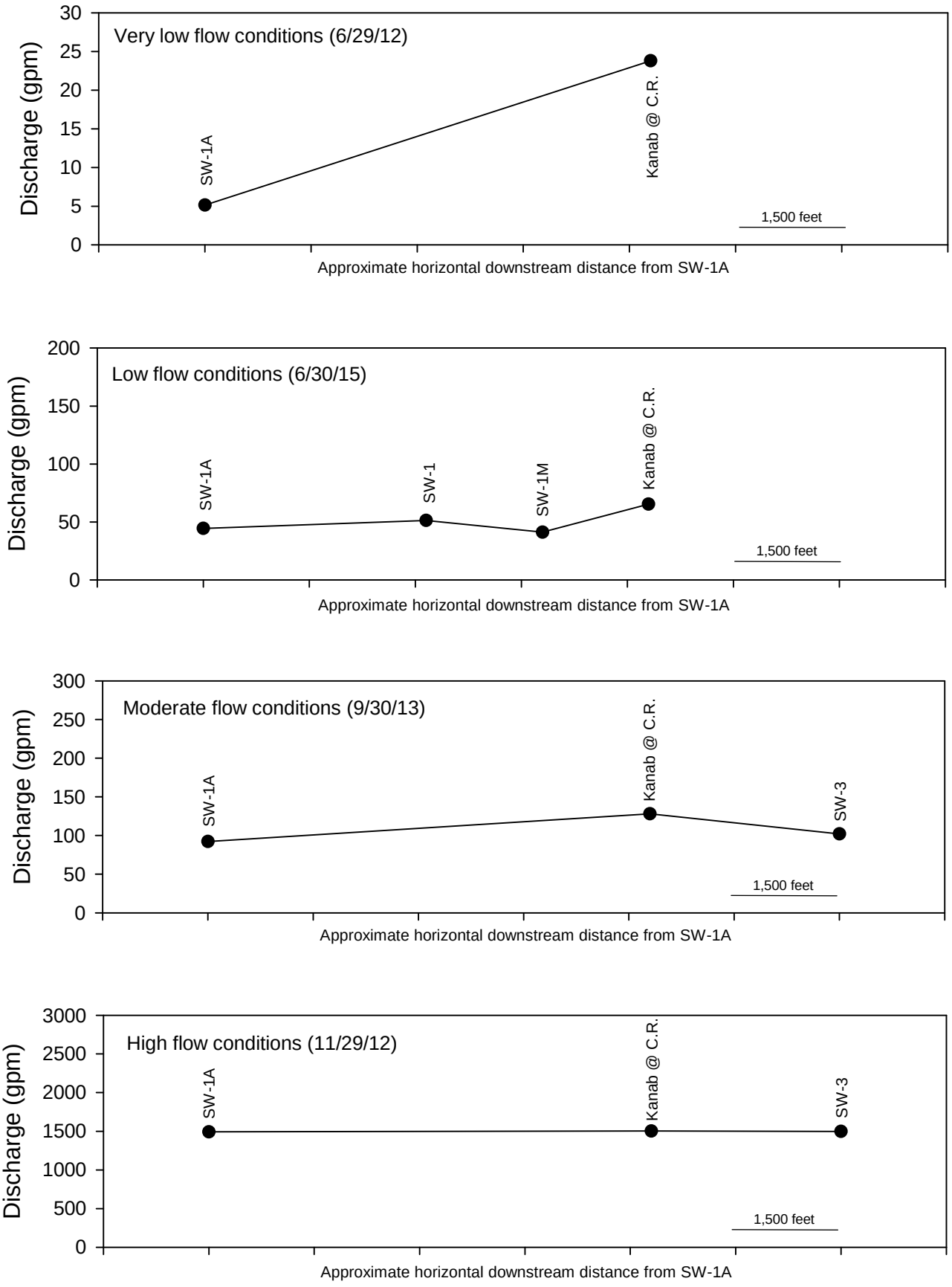
Fig. 21. Shallow Groundwater - Depth to Water & Flow Direction

Alton Coal - North Private Lease

October 5, 2015 Base Map: NAIP 2011 UTM NAD83

Alton Coal Development
Coal Hollow Project

Prepared by:
Petersen Hydrologic
Lehi, UT
Long Resource Consultants
Morgan, UT



Note: Vertical axis scale range set at approximately two times avearge discharge.

Figure 22 Selected contemporaneous (same day) discharge measurements on Kanab Creek in the North Private Lease area.

Table 1 Monitoring site details

	Location, UTM NAD 27		Elevation	Geologic Formation	Description/Comments
Streams					
SW-1A	370905	4144264	7005	---	Kanab Creek above North Private Lease area
SW-1	370400	4143450	6925	---	Kanab Creek at North Private Lease upper boundary
Kanab Creek @ C.R.	370208	4142177	6845	---	Kanab Creek at county road crossing at lower lease boundary
SW-3	369916	4141454	6800	---	Kanab Creek below North Private Lease area (existing Coal Hollow Mine site)
RSD-1	369521	4144161	7005	---	Ephemeral tributary to Kanab Creek along western margins of lease boundary
SW-11	370072	4142323	6845	---	Intermittent tributary to Kanab Creek in North Private Lease area
April Creek	369342	4142477	6835	---	E. Fork Simpson Hollow Creek adjacent to western lease boundary
Priscilla Creek	369399	4143387	6937	---	Headwaters E. Fork Simpson Hollow Creek west of permit area
SW-15	369637	4140936	6755	---	Lower Simpson Hollow creek at confluence with Kanab Creek
EW-1	370938	4141368	6870	---	Ephemeral tributaray to Kanab Creek below permit area
Knob Wash	370261	4144383	7000	---	Alluvial seepage zone north of lease area
Springs					
Coyote Seep	370040	4143054	6900	Quaternary alluvium	Alluvial seep in incised channel within lease boundary
SW7-1	370975	4144444	7045	Quaternary alluvium	Alluvial seep adjacent to Kanab Creek stream channel above lease area
Knob Spring	370261	4144383	7000	Quaternary alluvium	Alluvial seep in wash north of lease area
Car Seep	368551	4143413	6920	Quaternary alluvium	Seepage below irrigated fields south of Alton
Priscilla Seep	369400	4143416	6936	Tropic Shale	Tropic Shale/Qa seep in headwaters of E. Fork Simpson Hollow Creek west of lease
Pond Spring	368716	4143023	6880	Dakota Formation/coal burn?	Spring below Alton, feeds large pond below , aka Shed Spring
Hill Spring	368484	4143290	6920	Dakota Formation/coal burn?	Spring below Alton, flows to small stock pond, aka slope spring area
April Seep	369338	4142516	6835	Dakota Formation	Seep from Dakota Formation/Qa west of least boundary - rarely has measurable flow
Alkali Seep	370034	4141944	6850	Dakota Formation	Dakota Formation seep south of lease area - rarely has measurable flow
Dakota Seep	369372	4141318	6800	Dakota formation	Seep from Dakota Formation south of mining area near old mine workings
Seep Y	369375	4141339	6785	Dakota Formation	Dakota Fm. seep w. of lease, rare measurable flow, often obscured by surface flow
Seep Z	369087	4142348	6800	Dakota Formation	Dakota Formation seep west of lease area, low flow rates
Wells					
NLP-1	369942	4143256	6920.23	Quaternary alluvium	Monitoring well in the alluvial groundwater system within permit area
NLP-2	369867	4143044	6910.39	Quaternary alluvium	Monitoring well in the alluvial groundwater system within permit area
NLP-3	370357	4142946	6917.98	Quaternary alluvium	Monitoring well in the alluvial groundwater system within permit area
NLP-4	370156	4142838	6871.86	Quaternary alluvium	Monitoring well in the alluvial groundwater system within permit area
NLP-5	370327	4143385	6921.45	Quaternary alluvium	Monitoring well in the alluvial groundwater system within permit area
NLP-6	370322	4143649	6957.29	Quaternary alluvium	Monitoring well in the alluvial groundwater system north of permit area
NLP-7	369961	4143728	6946.76	Quaternary alluvium	Monitoring well in the alluvial groundwater system north of permit area
NLP-8	370285	4144121	6980.54	Quaternary alluvium	Monitoring well in the alluvial groundwater system north of permit area
NLP-9	369751	4143874	6951.01	Quaternary alluvium	Monitoring well in the alluvial groundwater system north of permit area
NLP-10	369936	4142855	6902.62	Quaternary alluvium	Monitoring well in the alluvial groundwater system within permit area
NLP-11	370250	4142273	6862.71	Quaternary alluvium	Monitoring well in the alluvial groundwater system within permit area
NLP-12	370047	4142287	6848.57	Quaternary alluvium	Monitoring well in the alluvial groundwater system near southern lease boundary
NLP-13	369184	4142266	6803.46	Q. alluv/Dakota Formation	Monitoring well in clayey Dakota Formation/Qa sediments west of lease area
Y-53	371300	4140980	7001.56	Smirl coal seam	Monitoring well in Smirl coal seam in upland area south of lease area
Y-55	369029	4143183	6949.4	Smirl coal seam	Monitoring well in Smirl coal seam in upland area west of lease area
Y-56	368826	4143173	6891.5	Quaternary alluvium	Monitoring well in the alluvial groundwater system within Simpson Hollow drainage
Y-69 (PDH6)	368474	4143661	6950.2	Smirl coal seam	Monitoring well in the Smirl coal seam within Simpson Hollow drainage
Y-70 (PDH7)	369991	4142830	6902.8	Smirl coal seam	Monitoring well in the Smirl coal seam within permit area
Y-103 (A6)	370158	4143039	6921.75	Quaternary alluvium	Monitoring well in the alluvial groundwater system within permit area

Table 2a Hydrologic data for the North Private Lease area.

Petersen Hydrologic, LLC

Includes selected data from Petersen Hydrologic, LLC monitoring in the Alton Coal Tract area 2005-2015 (Petersen) and selected data provided by the Utah Division of Oil, Gas and Mining from Utah International permit application 1986-1988 (UII).

Monitoring Site	DATE	Data source	Discharge gpm	Depth (feet b. toc)	T °C	pH S.U.	Sp. Cond. µS/cm	D.O. mg/L	O & G mg/L	Turb. NTU	TDS mg/L	TSS mg/L	Set. Sol. ml/L	T. hard. mg/L	acidity mg/L	T. Alk mg/L $CaCO_3$	Ca (d) mg/L	Mg (d) mg/L	Na (d) mg/L	K (d) mg/L	HCO3 mg/L $CaCO_3$	CO3 mg/L $CaCO_3$	SO4 mg/L	Cl mg/L	cations meq/L	anions meq/L	bal. % diff.
Surface Waters																											
SW-1	6/23/1986	UII	0.32		14.0	7.95	1,390	8.2																			
SW-1	8/7/1986	UII	0.23		20.0	7.95	1,490	9.4																			
SW-1	8/28/1986	UII	0.52		20.0	8.05	1,080	7.2																			
SW-1	9/28/1986	UII	1.1		7.5	8.10	1,335	9.3																			
SW-1	10/24/1986	UII	0.61		12.5	8.05	1,550	8.3																			
SW-1	11/12/1986	UII	1.3		2.5	8.05	1,280	10.2																			
SW-1	12/4/1986	UII	4.8		2.0	7.95	760	10.3																			
SW-1	4/16/1987	UII	4.5		19.9	8.1	565	9.4																			
SW-1	5/12/1987	UII	0.91		14.0	8.05	1,725	14.0																			
SW-1	6/4/1987	UII	0.51		23.8	8.15	1,360	6.9																			
SW-1	7/1/1987	UII	45		25.2	8.25	1,320	8.4																			
SW-1	8/3/1987	UII	117		18.4	8.1	1,320	6.3																			
SW-1	9/4/1987	UII	144		11.2	8.05	1,415	8.3	<1		1050	4	<0.1	867		430	114	142	33	5	430	<5	416	18			2.96
SW-1	10/26/1987	UII	206		18.9	7.9	1,260	7																			
SW-1	11/13/1987	UII	390		7.5	8	1,510	11.3																			
SW-1	12/8/1987	UII	449		2	6.7	950	13.8	<1		554	68	<0.1	575		376	89	86	9	3	376	<5	150	8			4.63
SW-1	1/15/1988	UII	3460		0	7.9	735	10.3																			
SW-1	2/20/1988	UII	3190		3.9	7.8	770	8.4																			
SW-1	3/17/1988	UII	3280		1.5	7.8	920	9.8	<1		600	118	0.10	470		343	78	67	9	2	343	<5	181	7			4.93
SW-1	5/27/2005	Petersen	1830		21.9	8.2	813	7.21	< 2.	57.9	578			519	< 5.	303	72.4	82.1	10.4	2.33	365	< 5.	170	6	10.9	9.7	5.8
SW-1	9/25/2005	Petersen	161		12.2	7.9	1,962	7.58	< 2.	4.21	1293		< .1	1023		500	146	160	37.9	3.78	610	< 5.	521	14	22.2	21.2	2.2
SW-1	11/3/2005	Petersen	893		8.4	8.24	1,551	8.09	< 2.	25.1	1085		< .1	870		460	124	136	27.4	5.46	561	< 5.	453	14	18.7	19	0.8
SW-1	3/31/2006	Petersen	2770		10	8.89	846	8.32	< 2.	241	530		0.4	482		353	77.2	70.2	9.31	2.65	417	11	154	7	10.1	10.5	1.8
SW-1	5/30/2006	Petersen	158		19.2	8.53	1,544	7.22	< 2.	6.47	815	8	< .1	877		427	104	150	35	4.27	521	< 5.	485	19	19.2	19.2	0
SW-1	9/7/2006	Petersen	115		14.3	8.44	1,579	7.93	< 2.	12.1	1292	21	< .1	997		445	121.8	168.37	46.32	7.47	543	< 5.	592	29	22.1	22	0.2
SW-1	12/30/2006	Petersen	300		0.1	8.76	738	11.2	< 2.	27.4	442	27	< .1	440		330	78.38	59.23	7.04	1.7	402	< 5.	95	4	9.1	8.7	2.5
SW-1	3/29/2007	Petersen	172		1.7	8.41	1,592	10.99	< 2.	8.51	1238	6	< .1	1006		554	139	160	36.4	4.13	675	< 5.	515	21	21.8	22.4	1.4
SW-1	6/22/2007	Petersen	27.1		12.8	8.16	1,685	7.7	< 2.		1350	< 5.	< .1	1055		465	142	170	46.6	5.36	567	< 5.	565	25	23.2	21.8	3.3
SW-1	9/29/2007	Petersen	67.9		11.1	8.19	1,369	7.64	< 2.	14.6	1095	11	< .1	893		441	130	138	35.8	4.35	538	< 5.	449	20	19.5	18.7	2
SW-1	12/30/2007	Petersen	703		0.5	8.26	520	8.65	< 2.	7.19	454	6	< .1	402		319	71.54	54.34	7.28	1.76	378	9	83	4	8.4	8.2	1.1
SW-1	6/18/2008	Petersen	87.7		17.8	7.85	1,723	8.38	< 5.	11.1	1271	6	< .1	1051		443	133.1	174.65	45.81	4.3	540	< 5.	602	24	23.1	22.1	2.3
SW-1	8/21/2008	Petersen	25.4		16.8	7.95	1,601	8.45	< 5.	4.87	1230	11	< .1	952		452	144	143.78	47.5	3.97	551	< 5.	514	30	21.2	20.6	1.4
SW-1	5/26/2009	Petersen	101		10.4	7.9	1,522	8.2	< 5.	6.31	1207	< 5.	< .1	1016		471	121.8	172.78	38.05	4.89	574	< 5.	508	21	22.1	20.6	3.5
SW-1	9/29/2009	Petersen	15.3		16.3	7.88	1,716	8.75		3.57																	
SW-1	11/16/2009	Petersen	321		2.6	8.19	1,390	10.04		5.31																	
SW-1	12/22/2011	Petersen	940		0.2	8.59	1,004	10.46		4.70																	
SW-1	7/11/2012	Petersen	28.8		15.7	8.11	2,030	6.85		8.27	1520	<4															

Monitoring Site	DATE	Data source	Discharge gpm	Depth (feet b. toc)	T °C	pH S.U.	Sp. Cond. µS/cm	D.O. mg/L	O & G mg/L	Turb. NTU	TDS mg/L	TSS mg/L	Set. Sol. ml/L	T. hard. mg/L	acidity mg/L	T. Alk mg/L CaCO3	Ca (d) mg/L	Mg (d) mg/L	Na (d) mg/L	K (d) mg/L	HCO3 mg/L CaCO3	CO3 mg/L CaCO3	SO4 mg/L	Cl mg/L	cations meq/L	anions meq/L	bal. % diff.
SW-1	9/30/2012	Petersen	77.6		15.9	8.21	1,527	7.93	<5	5.34	1110	6		755	<10	410	97.8	124	31.5	5.5	500	<1	418	18	16.6	17.4	-2.4
SW-1	3/31/2014	Petersen	431		7.7	8.54	1,022	10.18	<6	19.9	600	18		551	<5	395	72.7	89.7	15.0	3.3	372	23	210	9	11.7	12.1	-1.3
SW-1	3/31/2015	Petersen	380		14.4	8.37	1,022	9.25	<5	8.70	660	6		543	<5	357	71.5	88.6	14.9	4.9	357	<1	202	9	11.6	11.6	0.1
SW-1	6/30/2015	Petersen	51		20.3	8.05	1,441	8.28	<5		936	<5		808	<5	414	106	132	31.0	3.8	414	<1	413	15	17.6	17.3	0.9
SW-1	8/23/2015	Petersen	43.7		19.9	8.24	1,407	7.61	<5		976	10		763	<5	392	94.6	128	28.6	4.0	392	<1	396	16	17.0	16.5	0.2
SW-1A	2/10/2012	Petersen	2,367		10.3	8.70	785	10.75	8	50.6	500	63		441	<5	359	70.9	64	7.3	2.2	433	2	100	5	9.2	9.4	-1.1
SW-1A	3/31/2012	Petersen	262		9.7	8.53	1,074	9.44	<5	5.26	738	4		679	<5	391	82.3	115	21.1	4.4	477	<1	263	12	14.6	13.6	3.4
SW-1A	6/29/2012	Petersen	5.16		23.1	8.18	1,581	6.11	<5	4.66	1180	<4		903	<5	413	79.9	171	40.4	6.4	503	<1	530	20	20.0	19.8	0.4
SW-1A	7/11/2012	Petersen	14.6		15.6	8.33	1,765	6.80		6.42	1340	5															
SW-1A	9/30/2012	Petersen	82.8		21.9	8.21	1,380	---	<5	5.98	974	4		752	<10	445	93.3	126	27.6	6.3	543	<1	360	15	16.4	16.8	-1.3
SW-1A	11/29/2012	Petersen	1,493		3.1	8.40	642	9.76	<5	9.76	412	9		353	<5	305	58.5	50.3	5.0	1.6	372	<1	65	3	7.3	7.5	-1.5
SW-1A	3/16/2013	Petersen	2,253		14.6	8.55	653	8.13	<5	35.8	384	47		338	<5	290	50.8	51.2	6.1	1.9	354	<1	84	4	7.1	7.7	-4.1
SW-1A	4/29/2013	Petersen	89.2		17.2	8.49	1,210	8.28		3.63	868	<4															
SW-1A	6/6/2013	Petersen	185		26.0	8.50	939	6.30	<5	5.24	544	<4		505	<5	384	57.8	87.7	15.6	3.0	442	13	160	7	10.9	10.8	0.4
SW-1A	9/30/2013	Petersen	92.3		12.2	8.35	1,179	8.54	<6	4.46	876	<4		660	<5	402	78.1	113	22.5	5.2	402	<1	306	12	14.3	14.7	-1.5
SW-1A	12/31/2013	Petersen	1990		0.3	8.58	678	11.01	<6	19.0	380	25		362	<5	325	60.0	51.6	5.3	1.9	308	17	76	4	7.5	7.8	-2.2
SW-1A	3/31/2014	Petersen	454		8.5	8.60	954	9.65	<5	5.40	584	5		560	<5	388	70.5	93.2	13.9	3.8	350	38	193	8	11.9	11.2	2.8
SW-1A	4/24/2014	Petersen	197		10.7	8.36	1,386	7.88		4.01	976	<4															
SW-1A	9/30/2014	Petersen	1399		14.1	8.48	713	8.36		23.6																	
SW-1A	3/31/2015	Petersen	388		15.2	8.44	970	9.19	<5	40.1	628	6		497	<5	364	67.1	80.1	12.6	5.1	364	<1	174	7	10.6	11.1	-2.2
SW-1A	6/30/2015	Petersen	45		25.3	7.88	1,324	7.37	<5		840	<5		816	<5	414	101	137	26.7	4.3	414	<1	369	10	17.6	16.0	4.0
SW-1M	7/2/2015	Petersen	41		21.2	8.10	1,324	7.90	<6		840	<5		681	<5	339	70.0	123	31.9	3.8	339	<1	412	15	15.1	16.0	-2.1
SW-3	6/23/1986	UII	0.24		19.5	8.15	1,060	7.30			1190	<2	<0.4	951		362	113	163	38	5.0	362	<5	595	19			1.34
SW-3	8/9/1986	UII	0.24		20	8.15	1,380	8.1																			
SW-3	8/31/1986	UII	0.22		16.9	8.2	1,360	8.1																			
SW-3	9/16/1986	UII	0.31		19.5	8.30	1,230	7.70			970	4	<0.4	847		425	96	148	36	6.0	415	10	424	16			2.27
SW-3	10/26/1986	UII	1.2		13.9	8.4	1,030	8.8																			
SW-3	11/15/1986	UII	3.7		8.2	8.3	1,030	9.3																			
SW-3	11/18/1986	UII	22.49		6.9	7.25	980	11.50			760	4465	18.2	578		300	82	91	40	13.0	300	<5	302	27			2.09
SW-3	12/3/1986	UII	3		0.5	8.15	810	10.90			614	502	0.4	526		328	79	80	10	2.0	328	<5	193	8			0.73
SW-3	1/24/1987	UII	0		---	---	---	---																			
SW-3	2/19/1987	UII	5.2		1	8.1	700	13.5																			
SW-3	3/11/1987	UII	5.76		11.0	8.05	725	14.90			486	294	0.4	456		320	66	71	11	2.0	320	<5	130	6			1.9
SW-3	4/9/1987	UII	4.1		10	8	555	11.2																			
SW-3	5/11/1987	UII	0.67		13.8	8.1	1,515	13.3																			
SW-3	6/4/1987	UII	0.56		25.8	8.35	1,320	6.6			944	2	<0.1	772		350	71	145	37	5	350	<5	459	17			0.23
SW-3	7/1/1987	UII	206		15.7	8.4	1,210	8.2																			
SW-3	8/3/1987	UII	184		22.1	8.5	1,110	6.2																			
SW-3	9/4/1987	UII	126		14.9	8.45	1,450	8.4	<1		1014	16	<0.1	850		368	99	147	32	5	368	<5	438	17			4.25
SW-3	10/26/1987	UII	233		18.5	8.1	1,350	8.2																			
SW-3	11/13/1987	UII	350		7.5	8.3	1,525	9.4																			
SW-3	12/16/1987	UII	54		0.2	7.9	860	11	<1		518	158	<0.1	440		300	63	69	9	3	300	<5	130	6			2.09
SW-3	1/9/1988	UII	449		0.9	8	800	10.1																			
SW-3	2/20/1988	UII	3366		2.1	8	780	9.9																			
SW-3	3/17/1988	UII	3590		5	7.9	795	8.3	<1		424	2836	13.8	358		286	63	49	7	2	286	<5	111	5			4.2

Monitoring Site	DATE	Data source	Discharge gpm	Depth (feet b. toc)	T °C	pH S.U.	Sp. Cond. µS/cm	D.O. mg/L	O & G mg/L	Turb. NTU	TDS mg/L	TSS mg/L	Set. Sol. ml/L	T. hard. mg/L	acidity mg/L	T. Alk mg/L CaCO3	Ca (d) mg/L	Mg (d) mg/L	Na (d) mg/L	K (d) mg/L	HCO3 mg/L CaCO3	CO3 mg/L CaCO3	SO4 mg/L	Cl mg/L	cations meq/L	anions meq/L	bal. % diff.
SW-3	5/27/2005	Petersen	1850		12.1	8.26	874	9.22	2	19.6	644			591	< 5.	337	84.1	92.5	12.4	2.47	411	< 5.	210	7	12.4	11.3	4.6
SW-3	9/25/2005	Petersen	119		9.8	8.12	1,665	836	< 2.	7.91	1281		< .1	962		392	110	167	35.7	0.86	478	< 5.	< 1.	16	20.8	20.4	0.9
SW-3	11/3/2005	Petersen	320		9.6	8.33	1,519	7.83	< 2.	4.06	1144		< .1	917		416	125	147	30.1	5.22	507	< 5.	538	14	19.8	19.9	0.4
SW-3	3/31/2006	Petersen	2692		9.5	8.94	878	7.44	< 2.	144	554		0.2	503		348	79.3	74.1	9.94	2.63	424	< 5.	170	7	10.6	10.7	0.7
SW-3	5/30/2006	Petersen	166		12.4	8.64	1,563	8.09	< 2.	2.16	1255	< 5.	< .1	892		403	100	156	33.4	4.42	491	< 5.	554	18	19.4	20.1	1.8
SW-3	9/7/2006	Petersen	109		13.7	8.37	1,465	8.11	< 2.	6.73	1257	13	< .1	962		358	103.2	170.99	37.73	5.28	436	< 5.	594	21	21	20.1	2.1
SW-3	12/21/2006	Petersen	409		0	8.72	819	12.1	< 2.	13.3	570	24	< .1	518		355	88	72.31	9.39	2.12	433	< 5.	146	6	10.8	10.3	2.4
SW-3	3/29/2007	Petersen	191		0.5	8.63	1,503	10.8	< 2.	7.07	1167	< 5.	< .1	948		461	124	155	33.3	4.12	562	< 5.	525	19	20.5	20.7	0.5
SW-3	6/22/2007	Petersen	36.7		11.9	8.51	1,662	7	< 2.		1372	< 5.	< .1	1054		375	112	188	37.2	5.05	457	< 5.	638	20	22.8	21.3	3.3
SW-3	9/29/2007	Petersen	85		11.2	8.48	1,422	7.53	< 2.	3.5	1206	< 5.	< .1	942		366	110	162	31.7	4.68	446	< 5.	557	19	20.3	19.5	2.2
SW-3	12/30/2007	Petersen	1970		0.5	8.21	572	8.46	< 2.	24.9	521	26	0.1	442		332	74.9	61.95	7.65	2.02	405	< 5.	118	5	9.2	9.2	0.1
SW-3	3/22/2008	Petersen	4170		6.9	8.21	592	9.75	< 2.	2410	418	3616	7	358		222	71.47	43.52	15.27	3.59	256	12	146	5	7.9	7.6	1.8
SW-3	6/18/2008	Petersen	68.9		20.5	8.05	1,679	7.42	< 5.		1312	< 5.	< .1	1022		364	110.9	180.98	39.84	6.09	444	< 5.	659	22	22.3	21.6	1.6
SW-3	8/21/2008	Petersen	37.1		20	8.38	1,636	7.21	< 5.	6.95	1358	6	< .1	1038		357	111.2	184.56	40.17	5.46	435	< 5.	673	23	22.6	21.8	1.8
SW-3	3/19/2009	Petersen	1267		10.4	8.51	934	9.38	< 5.	6.21	612	11	< .1	568		349	80.16	89.25	13.06	3.18	410	13	187	8	12	11.1	3.9
SW-3	5/25/2009	Petersen	195		19.5	8.18	1,556	7.02	< 5.	1.7	1239	< 5.	< .1	1024		389	103.9	185.75	38.2	5.5	474	< 5.	582	22	22.3	20.5	4.1
SW-3	9/29/2009	Petersen	28.8		20.4	8.34	1,618	8.25	< 5.	2.01	1326	< 5.	< .1	1083		308	86.49	210.63	43.69	6.22	343	28	702	26	23.7	21.51	4.85
SW-3	11/16/2009	Petersen	201		1.2	8.6	1,252	10.1	< 5.	2.79	974	< 5.				347	87.64	136.61	28.74	7.41	397	22	426	18	17.05	16.32	2.18
SW-3	5/13/2010	Petersen	587		14.4	8.47	1,096	7.78	< 5.	3.2	799	< 5.		667		373	91.09	106.77	19.23	3.18	450	< 5.	283	11	14.25	13.65	2.14
SW-3	9/27/2010	Petersen	34.9		22.5	8.31	1,544	8.19	< 5.		1201	< 5.		934		260	72.03	183.14	40.27	6.85	317	< 5.	641	24	20.59	19.21	3.46
SW-3	12/7/2010	Petersen	3051		1.8	8.65	724	9.57	< 5.		438	56		416		315	69.92	58.59	8.07	2.35	384	< 5.	94	5	8.72	8.4	1.89
SW-3	3/26/2011	Petersen	4544		0.4	8.67	871	9.53	< 5.		590	379		488		336	80.53	69.77	11.46	2.54	410	< 5.	164	7	10.32	10.32	0
SW-3	6/1/2011	Petersen	1449		14.7	8.63	1,002	7.61	< 5.		680	341				353	82.8	96.8	13.1	4.5	525	< 2.	226	8	13	12	4
SW-3	9/10/2011	Petersen	266		12.2	8.53	1,390	8.4	<5		1080	<4		802	<5	360	97.2	136	32.6	9.0	436	1	501	23	17.7	18.3	-1.7
SW-3	12/21/2011	Petersen	1191		0.2	8.68	969	10.67	< 5.		608	13				293	78.1	76.8	11.9	2.3	357	< 1.	189	8	10.8	10	3.6
SW-3	3/31/2012	Petersen	488		4.9	8.62	1,158	9.65	< 5.		836	< 4.				395	91	123	22	3.7	482	< 1.	302	12	15.7	14.5	4
SW-3	4/24/2012	Petersen	336		15.7	8.5	860	8.2	< 6.	6.43	548	8				318	63.2	75.4	11.3	2.7	388	< 1.	181	7	9.9	10.3	-2
SW-3	6/21/2012	Petersen	14.9		20.4	8.39	1,687	6.36	< 6.		1310	< 4.				333	97.7	196	43.6	6.2	406	< 1.	720	23	23.1	22.3	1.7
SW-3	7/11/2012	Petersen	43.8		29.2	8.36	1,897	7.30		8.10	1480	10															
SW-3	9/28/2012	Petersen	141		16.5	8.4	1,464	8.03	< 5.		1040	< 4.				353	81.5	137	30.5	6.6	430	10	500	19	16.8	18	-3.3
SW-3	11/29/2012	Petersen	1,498		5.1	8.67	701	10.03	<5		452	<4				296	63.2	59.8	7.2	2	296	<1	100	4	8.4	8.1	2
SW-3	12/12/2012	Petersen	1760 est.		0.3	8.68	753	10.69	< 6.		388	34				292	61	55.8	6.7	1.9	356	< 1.	92	4	8	7.9	0.7
SW-3	3/14/2013	Petersen	3087		14.6	8.60	733	8.18		54.2	436																
SW-3	4/29/2013	Petersen	215		19.2	8.38	1,385	8.18			996	<4															
SW-3	5/31/2013	Petersen	188		18.9	8.46	1,179	7.55		2.23	828																
SW-3	9/30/2013	Petersen	102		19.7	8.47	1,339	7.63	<5	22.4	992	31				361	74.6	136	29.0	6.2	361	<1	485	18	16.3	17.8	-4.3
SW-3	12/22/2013	Petersen	817		0.3	8.56	899	10.55	<6	10.3	520	16				280	48.5	74	9.8	2.3	271	9	159	6	9.0	9.1	-0.4
SW-3	3/31/2014	Petersen	1527		11	8.58	1,520	9.24	<5	43.6	1030	49				463	91.8	161	29.5	4.7	463	<1	444	18	19.2	19.0	0.6
SW-3	6/16/2014	Petersen	25		19.9	8.36	1,610	7.41		3.61	1170	<4															
SW-11	8/21/2008	Petersen	0																								
SW-11	12/23/2011	Petersen	0																								
SW-11	2/9/2012	Petersen	1.38		0.2	8.89	783	9.78	25	22.7	540	30		409		128	56.9	64.9	14.8	8.9	128	<1	255	28	9.1	8.7	2.3
SW-11	3/20/2012	Petersen	0																								
SW-11	4/24/2012	Petersen	0																								
SW-11	5/8/2012	Petersen	0																								
SW-11	5/20/2012	Petersen	0																								
SW-11	6/29/2012	Petersen	0																								

Monitoring Site	DATE	Data source	Discharge gpm	Depth (feet b. toc)	T °C	pH S.U.	Sp. Cond. µS/cm	D.O. mg/L	O & G mg/L	Turb. NTU	TDS mg/L	TSS mg/L	Set. Sol. ml/L	T. hard. mg/L	acidity mg/L	T. Alk mg/L $CaCO_3$	Ca (d) mg/L	Mg (d) mg/L	Na (d) mg/L	K (d) mg/L	HCO3 mg/L $CaCO_3$	CO3 mg/L $CaCO_3$	SO4 mg/L	Cl mg/L	cations meq/L	anions meq/L	bal. % diff.
SW-11	7/10/2012	Petersen	0																								
SW-11	9/30/2012	Petersen	1.49		17.7	8.62	2,770	7.89		7.89	2,390																
SW-11	11/29/2012	Petersen	4.19		6.4	8.50	2,410	9.67		12.0	2,200	15		1600	<5	403	150	298	59.0	6.5	403	<1	1180	29	34.7	33.4	2.0
SW-11	12/13/2012	Petersen	0																								
SW-11	2/26/2013	Petersen	6.41		0.2	8.43	1,860	10.43			2,530																
SW-11	3/14/2013	Petersen	0																								
SW-11	3/16/2013	Petersen	0																								
SW-11	4/29/2013	Petersen	0.533		23.9	8.68	2,530	7.61	<5	19.6	2,300	31		1560	<5	297	101	317	69.9	7.2	293	4	1320	29.0	34.4	34.2	0.2
SW-11	5/31/2013	Petersen	0																								
SW-11	6/6/2013	Petersen	0																								
SW-11	9/24/2013	Petersen	0																								
SW-11	9/30/2013	Petersen	0																								
SW-11	11/13/2013	Petersen	0																								
SW-11	12/19/2013	Petersen	0																								
SW-11	12/22/2013	Petersen	0																								
SW-11	1/16/2014	Petersen	0																								
SW-11	2/11/2014	Petersen	6.09		2.8	8.29	1,050	9.89	<6	15.3	668	8		521	<5	204	54.3	93.5	18.7	5.6	204	<1	360	12	11.4	11.9	-2.3
SW-11	2/28/2014	Petersen	25.9		3.2	8.40	2,000	9.13	<5	37.7	1,620	41		1170	<5	211	116	214	44.3	5.9	211	<1	980	26	25.5	25.3	0.3
SW-11	3/28/2014	Petersen	0																								
SW-11	3/31/2014	Petersen	0																								
SW-11	4/5/2014	Petersen	0																								
SW-11	4/24/2014	Petersen	0																								
SW-11	6/15/2014	Petersen	0																								
SW-11	9/28/2014	Petersen	0.46		10.7	8.5	1,220	8.79		22.6																	
SW-11	11/13/2014	Petersen	0																								
SW-11	12/21/2014	Petersen	0																								
SW-11	3/29/2015	Petersen	0																								
SW-11	6/28/2015	Petersen	0																								
SW-11	8/19/2015	Petersen	0																								
SW-15	2/10/2012	Petersen	481		0.4	8.67	3,010	9.53	<6		2840	4		1840	<5		209	319	129	19.2	445	<1	1680	29	42.8	43.1	-0.3
SW-15	3/31/2012	Petersen	35.2		14.5	8.41	3,680	8.46	<5		3650	12		2420	<10		240	441	264	17.4	609	<1	2000	51	60.2	53	6.3
SW-15	4/24/2012	Petersen	9.3		17.3	8.34	3,870	7.95	<5		3740	14		2290	<5		218	423	278	19.3	625	<1	2140	62	58.3	56.5	1.5
SW-15	5/8/2012	Petersen	0																								
SW-15	9/28/2012	Petersen	30.5		16.1	8.38	2,530	7.41	<5		2100	4		1340	<5	316	123	251	135	18.6	385	<1	1210	32	33.1	32.4	1.2
SW-15	12/12/2012	Petersen	64.8		0.2	8.45	4,470	10.6	<6		3880	13		2430	<5	480	231	449	191	20.9	585	<1	2330	47	57.3	59.4	-1.8
SW-15	2/27/2013	Petersen	40.6		1.1	8.47	3,640	11.8	<5		3400	8		2140	<5	473	230	380	161	17.3	577	<1	1990	37	50.2	51.9	-1.7
SW-15	4/29/2013	Petersen	299		13.6	8.51	1,944	7.95			1620	9															
SW-15	5/31/2013	Petersen	0																								
SW-15	9/30/2013	Petersen	0																								
SW-15	12/22/2013	Petersen	80.2		0.2	8.43	3,890	10.29		1.71																	
SW-15	3/31/2014	Petersen	98		9.3	8.48	4,420	9.59	<5	4.8	4050	7					238	530	220	17.8	455	18	2710	47			
SW-15	4/24/2014	Petersen	1.92		23	8.50	3,810	7.97		6.1	3510	16															
SW-15	6/16/2014	Petersen	0																								
SW-15	9/29/2014	Petersen	191		14.9	8.49	1,712	8.07		7.17																	
SW-15	10/24/2014	Petersen	8.79		15.8	8.54	2,820																				
SW-15	12/21/2014	Petersen	128		0.8	8.48	3,560	10.54	1510		3,370	19		2080	<5	400	187	391	145	15.6	391	8	1980	36	48.2	50.2	-2.0
SW-15	3/21/2015	Petersen	14.9		11.2	8.53	3,570	9.23	<5		3,140	10		2100	<5	404	183	399	233	16.4	404	<1	1730	57	52.5	45.7	7.0

Monitoring Site	DATE	Data source	Discharge gpm	Depth (feet b. toc)	T °C	pH S.U.	Sp. Cond. µS/cm	D.O. mg/L	O & G mg/L	Turb. NTU	TDS mg/L	TSS mg/L	Set. Sol. ml/L	T. hard. mg/L	acidity mg/L	T. Alk mg/L CaCO3	Ca (d) mg/L	Mg (d) mg/L	Na (d) mg/L	K (d) mg/L	HCO3 mg/L CaCO3	CO3 mg/L CaCO3	SO4 mg/L	Cl mg/L	cations meq/L	anions meq/L	bal. % diff.
SW-15	6/29/2015	Petersen	0																								
SW-15	8/19/2015	Petersen	0																								
Kanab at C.R.	2/10/2012	Petersen	2,814		3.6	8.70	791	10.23	<5	37.2	514	36		427	<5	357	66.5	63.3	8.1	2.2	431	2	122	6	8.9	9.8	-4.8
Kanab at C.R.	3/31/2012	Petersen	302		12.2	8.59	1,186	8.99	<5	3.62	890	<4		758	<5	393	92.5	128	23.9	4.3	479	<1	335	13	16.3	15.2	3.5
Kanab at C.R.	6/29/2012	Petersen	24		22.2	8.41	1,702	6.52	<6	1.98	1360	<4		926	<5	322	85.7	173	34.5	5.2	392	<1	710	24	20.1	21.9	-4.1
Kanab at C.R.	7/11/2012	Petersen	48.7		26.9	8.27	1,856	6.34		4.51	198*	5															
Kanab at C.R.	9/30/2012	Petersen	139		17.3	8.37	1,650	7.71	<5	1.37	1220	4		848	<5	414	94.1	149	33.2	6.1	392	<1	530	20	18.6	19.4	-2.3
Kanab at C.R.	11/29/2012	Petersen	1,503		6.4	8.52	712	9.23	<6	2.62	400	<4		360	<5	301	56.9	53.0	6.3	1.7	367	<1	95	4	7.5	8.1	-3.7
Kanab at C.R.	2/27/2013	Petersen	2,942		0.3	8.69	641	10.82	<5	195	476	147		331	<5	297	56.1	46.4	5.3	1.7	359	1	72	3	6.9	7.4	-4.0
Kanab at C.R.	3/16/2013	Petersen	2,455		14.2	8.56	686	8.15	<5	23.0	416	34		351	<5	292	52.4	53.4	6.8	2.0	356	<1	105	5	7.4	8.2	-5.2
Kanab at C.R.	4/29/2013	Petersen	181		23.2	8.42	1,352	7.32		3.48	988	<4															
Kanab at C.R.	6/6/2013	Petersen	215		19.9	8.50	1,213	7.26	<5	3.74	796	<4		667	<5	365	75.8	116	23.0	3.6	436	4	343	12	14.4	14.8	-1.4
Kanab at C.R.	9/30/2013	Petersen	128		17.5	8.48	1,332	7.83	<6	3.86	1020	<4		775	<5	367	86.2	136	27.9	5.4	367	<1	467	17	16.8	17.5	-2.0
Kanab at C.R.	12/31/2013	Petersen	1900		0.3	8.56	756	11.16	<6	34.6	520	35		414	<5	297	67.0	59.9	6.7	2.1	297	<1	108	5	8.6	8.3	1.6
Kanab at C.R.	2/28/2014	Petersen	5230		3.5	8.57	838	9.62	<6	824	536	613		469	<5	322	63.2	75.6	10.2	3.3	322	<1	165	10	9.9	10.1	-1.2
Kanab at C.R.	3/31/2014	Petersen	571		7.5	8.61	1,174	10.32	<5	22.1	752	20		601	<5	410	70.8	103	16.4	3.6	388	22	295	12	12.8	14.2	-5.2
Kanab at C.R.	4/24/2014	Petersen	172		19.8	8.40	1,462	7.93		3.38	1030	<4															
Kanab at C.R.	6/18/2014	Petersen	47		12.5	8.43	1,672	7.78	<6	18.5	1220	4		989	<5	373	109	174	34.0	4.4	373	<1	590	19	21.3	20.3	2.6
Kanab at C.R.	12/21/2014	Petersen	2940		0.9	8.65	702	10.55	16		420	17		352	<5	277	58.5	50.1	6.6	2.2	274	3	83	4	7.4	7.4	0.045
Kanab at C.R.	3/31/2015	Petersen	638		14.3	8.46	1,101	8.78	<5	4.27	740	<5		552	<5	331	71.4	90.8	16.2	2.9	331	<1	264	10	11.8	12.4	-2.3
Kanab at C.R.	6/30/2015	Petersen	65		23.9	8.11	1,605	7.66	<5		1090	<4		969	<5	334	101	174	35.3	4.8	335	<1	558	17	21.0	18.8	5.6
Kanab at C.R.	8/23/2015	Petersen	65		24.6	8.40	1,500	6.89	268		1050	<4		918	<5	325	83.9	172	35.6	5.9	325	<1	580	21	20.0	19.1	2.3
RSD-1	3/31/2012	Petersen	0																								
RSD-1	4/25/2012	Petersen	0																								
RSD-1	5/8/2012	Petersen	0																								
RSD-1	2/27/2013	Petersen	0.77		0.6	8.65	546	9.06	<5	12.3	400	9		254	<5	225	59.3	25.6	7.7	6.0	274	<1	68	7	5.6	6.1	-4.7
RSD-1	3/16/2013	Petersen	0																								
RSD-1	3/29/2013	Petersen	0																								
RSD-1	4/29/2013	Petersen	0																								
RSD-1	6/1/2013	Petersen	0																								
RSD-1	9/28/2013	Petersen	0																								
RSD-1	10/1/2013	Petersen	0																								
RSD-1	10/8/2013	Petersen	0																								
RSD-1	12/19/2013	Petersen	0																								
RSD-1	12/31/2013	Petersen	0																								
RSD-1	1/16/2014	Petersen	0																								
RSD-1	2/11/2014	Petersen	0																								
RSD-1	2/28/2014	Petersen	7.62		3.9	8.97	707	9.01	<6	12,900	780	16200		174	<5	60.0	24.1	27.6	46.2	3.7	60.0	<1	26	163	5.6	6.3	-6.3
RSD-1	3/30/2014	Petersen	0																								
RSD-1	4/5/2014	Petersen	0																								
RSD-1	4/23/2014	Petersen	0																								
RSD-1	6/15/2014	Petersen	0																								
RSD-1	9/28/2015	Petersen	0																								
RSD-1	10/24/2014	Petersen	0																								
RSD-1	11/13/2014	Petersen	0																								
RSD-1	12/19/2014	Petersen	0																								

Monitoring Site	DATE	Data source	Discharge gpm	Depth (feet b. toc)	T °C	pH S.U.	Sp. Cond. µS/cm	D.O. mg/L	O & G mg/L	Turb. NTU	TDS mg/L	TSS mg/L	Set. Sol. ml/L	T. hard. mg/L	acidity mg/L	T. Alk mg/L $CaCO_3$	Ca (d) mg/L	Mg (d) mg/L	Na (d) mg/L	K (d) mg/L	HCO3 mg/L $CaCO_3$	CO3 mg/L $CaCO_3$	SO4 mg/L	Cl mg/L	cations meq/L	anions meq/L	bal. % diff.
RSD-1	1/30/2015	Petersen	0																								
RSD-1	3/29/2015	Petersen	0																								
RSD-1	7/1/2015	Petersen	0																								
RSD-1	8/19/2015	Petersen	0																								
EW-1	12/23/2011	Petersen	0																								
EW-1	2/9/2012	Petersen	0.47		5.5	8.65	144	9.63	<5	35.9	112	22		68	<5	65.0	19.7	4.6	2.4	4.5	79	<1	4	6	1.6	1.5	1.2
EW-1	3/29/2012	Petersen	0																								
EW-1	3/30/2012	Petersen	0																								
EW-1	4/24/2012	Petersen	0																								
EW-1	4/25/2012	Petersen	0																								
EW-1	5/8/2012	Petersen	0																								
EW-1	6/21/2012	Petersen	0																								
EW-1	7/10/2012	Petersen	0																								
EW-1	9/29/2012	Petersen	0																								
EW-1	11/27/2012	Petersen	0																								
EW-1	12/13/2012	Petersen	0																								
EW-1	2/26/2013	Petersen	0																								
EW-1	3/12/2013	Petersen	0.132		12.3	7.95	3,780	8.62	<6	22.2	2740	48		1840	<5	186	<0.005	142	157	14.2	226	<1	920	750	44.0	44.0	-0.02
EW-1	3/15/2013	Petersen	0																								
EW-1	4/29/2013	Petersen	0																								
EW-1	5/31/2013	Petersen	0																								
EW-1	6/6/2013	Petersen	0																								
EW-1	10/1/2013	Petersen	0																								
EW-1	10/8/2013	Petersen	0																								
EW-1	12/19/2013	Petersen	0																								
EW-1	1/1/2014	Petersen	0																								
EW-1	2/11/2014	Petersen	0																								
EW-1	2/28/2014	Petersen	0.41		4.1	8.52	810	9.71	<5	>1,000	588	2610					42.5	39.6	17	6.4	61	<1	23	210			
EW-1	3/28/2014	Petersen	0																								
EW-1	4/5/2014	Petersen	0																								
EW-1	4/24/2014	Petersen	0																								
EW-1	6/15/2014	Petersen	0																								
EW-1	9/29/2014	Petersen	0																								
EW-1	10/24/2014	Petersen	0																								
EW-1	11/13/2014	Petersen	0																								
EW-1	12/20/2014	Petersen	0																								
EW-1	3/29/2015	Petersen	0																								
EW-1	7/1/2015	Petersen	3350		4.1	8.35	483		<250		428	55000		211	<5	162	65.7	11.5	16.8	6.8	162	<1	170	3	5.1	6.9	-14
EW-1	8/19/2015	Petersen	0																								
April Creek	6/21/2012	Petersen	0																								
April Creek	9/30/2012	Petersen	10.7		16.1	8.33	4,310	6.99	<6	4.04	4250	8		2720	<10	414	334	459	130	34.6	505	<1	2670	46	61.0	65.1	-3.3
April Creek	2/27/2013	Petersen	80.7		0.2	8.45	3,710	10.96	<5	11.7	3550	14		2310	<5	380	277	394	118	15.9	461	1.0	2130	17	51.8	52.3	-0.5
April Creek	4/29/2013	Petersen	279		23.8	8.75	941	7.34	<5	8.49	656	9		464	<5	211	59.6	76.5	24.7	10.6	235	11	290	5.0	10.6	10.4	1.1
April Creek	5/31/2013	Petersen	0																								
April Creek	9/30/2013	Petersen	0																								
April Creek	12/31/2013	Petersen	25.2		0.3	8.28	5,260	11.23		9.16																	

Monitoring Site	DATE	Data source	Discharge gpm	Depth (feet b. toc)	T °C	pH S.U.	Sp. Cond. µS/cm	D.O. mg/L	O & G mg/L	Turb. NTU	TDS mg/L	TSS mg/L	Set. Sol. ml/L	T. hard. mg/L	acidity mg/L	T. Alk mg/L CaCO3	Ca (d) mg/L	Mg (d) mg/L	Na (d) mg/L	K (d) mg/L	HCO3 mg/L CaCO3	CO3 mg/L CaCO3	SO4 mg/L	Cl mg/L	cations meq/L	anions meq/L	bal. % diff.
April Creek	3/31/2014	Petersen	9.26		6.5	8.44	5,530	10.1	<5	4.41	5440	36					374	764	238	24.8	440	10	3740	33.0			
April Creek	4/24/2014	Petersen	0																								
April Creek	6/18/2014	Petersen	0																								
April Creek	9/30/2014	Petersen	5.25		16.1	8.36	3,720	8.05		3.54																	
April Creek	12/22/2014	Petersen	264		0.2	8.41	4,860	9.88	5		4930	6		3330	<5	436	342	602	153	20.3	436	<1	3010	27	73.8	72.1	1.2
April Creek	3/31/2015	Petersen	0.06		11.7	8.33	7,100	9.76	<5	4.24	7420	8		4780	<5	477	421	905	424	26.2	477	<1	4510	71	115	105	4.2
April Creek	7/1/2015	Petersen	0																								
April Creek	8/19/2015	Petersen	0																								
Priscilla Creek	7/10/2012	Petersen	0																								
Priscilla Creek	2/27/2013	Petersen	0.875		0.4	8.18	8,620	10.06			10700	10		6910	<5	667	410	1430	704	35.4	813	<1	6400	60	169	148	6.7
Priscilla Creek	4/29/2013	Petersen	0.296		14.1	7.79	8,830	8.59			10000	15		5990	<5	729	387	1220	632	31.3	888	<1	6100	59	148	143	1.7
Priscilla Creek	5/31/2013	Petersen	<0.1		11.4	7.35	9,730	8.63	<5		10100	348		6860	<5	840	420	1410	785	29.7	1020	<1	7160	70	174	168	1.9
Priscilla Creek	10/8/2013	Petersen	<0.1		13.0	8.23	9,890	9.28		23.2																	
Priscilla Creek	4/1/2014	Petersen	0.61		8.6	7.74	8,950	8.65	<5		9600	13					402	1370	641	33.4	765	<1	6350	60			
Priscilla Creek	10/1/2014	Petersen	<0.25		12.4	7.31	10,030	6.75		17.8																	
Priscilla Creek	7/1/2015	Petersen	0																								
Priscilla Creek	8/20/2015	Petersen	0																								
Knob Wash	10-Feb-12	Petersen	0																								
Knob Wash	25-Apr-12	Petersen	0																								
Knob Wash	29-Jun-12	Petersen	0																								
Knob Wash	30-Sep-12	Petersen	0																								
Knob Wash	28-Nov-12	Petersen	0																								
Knob Wash	27-Feb-13	Petersen	0																								
Knob Wash	29-Apr-13	Petersen	0																								
Knob Wash	1-Oct-13	Petersen	0																								
Knob Wash	31-Dec-13	Petersen	0																								
Knob Wash	31-Mar-14	Petersen	0																								
Knob Wash	4/24/2014	Petersen	0																								
Knob Wash	6/15/2014	Petersen	0																								
Knob Wash	9/30/2014	Petersen	0																								
Knob Wash	10/24/2014	Petersen	0																								
Knob Wash	11/13/2014	Petersen	0																								
Knob Wash	3/31/2015	Petersen	0																								
Knob Wash	7/1/2015	Petersen	0																								
Knob Wash	8/19/2015	Petersen	0																								

Springs

Coyote Seep	25-Apr-12	Petersen	1.30		15.5	8.12	2,520	7.29	<6	22.3	2350	12		1660	<5	504	204	279	37.9	5.2	504	<2	1140	20	34.9	34.3	0.8
Coyote Seep	29-Jun-12	Petersen	0.435		25.7	7.99	2,960				2760	7		1950	<5	283	116	403	54.8	1.0	283	<1	1750	22	41.4	42.7	-1.6
Coyote Seep	30-Sep-12	Petersen	0.605		18.4	7.9	2,860				2370	17		1980	<10	528	212	352	53.3	7.5	528	<1	1340	29	42.1	39.2	3.5
Coyote Seep	11/28/2012	Petersen	0.99		2.3	7.55	2,930				2640	7		1970	<5	690	279	309	43.2	7.7	690	<2	1190	23	41.4	39.2	2.8
Coyote Seep	3/16/2013	Petersen	0.929		15.2	7.81	2,160				2040	62		1510	<5	497	229	227	31.1	6.5	497	<1	1030	18	31.6	31.9	-0.4
Coyote Seep	4/29/2013	Petersen	0.530		21.4	7.96	2,560				2260	69															
Coyote Seep	5/31/2013	Petersen	0.120		12.2	8.04	2,750				2590	16		1840	<5	375	148	356	52.3	2.2	372	3	1760	22	39.0	44.6	-6.7
Coyote Seep	9/30/2013	Petersen	0.219		9.7	8.20	2,130				1910	147		1460	<5	383	120	282	42.0	6.0	357	26	1210	22	31.2	32.9	-2.7

Monitoring Site	DATE	Data source	Discharge gpm	Depth (feet b. toc)	T °C	pH S.U.	Sp. Cond. µS/cm	D.O. mg/L	O & G mg/L	Turb. NTU	TDS mg/L	TSS mg/L	Set. Sol. ml/L	T. hard. mg/L	acidity mg/L	T. Alk mg/L $CaCO_3$	Ca (d) mg/L	Mg (d) mg/L	Na (d) mg/L	K (d) mg/L	HCO3 mg/L $CaCO_3$	CO3 mg/L $CaCO_3$	SO4 mg/L	Cl mg/L	cations meq/L	anions meq/L	bal. % diff.
Coyote Seep	12/31/2013	Petersen	0.469		0.2	7.55	2,120				2130	32		1620	<5	660	236	250	36.2	6.8	660	<1	1110	24	34.1	36.9	-4.0
Coyote Seep	3/31/2014	Petersen	1.23		5.2	8.25	2,460				2140	455		1660	<5	419	170	301	45.4	6.0	419	<1	1270	24	35.4	35.5	-0.1
Coyote Seep	6/18/2014	Petersen	0.174		14.7	8.15	2,320				2200	40		1750	<5	296	102	362	52.8	1.0	296	<1	1280	22	37.2	33.1	5.7
Coyote Seep	9/30/2014	Petersen	0.598		16.9	8.15	2,200																				
Coyote Seep	12/21/2014	Petersen	1.09		1.0	7.90	2,690				2410	88		1620	<5	666	208	268	41.5	7.2	666	<1	1150	30	34.4	38.1	-5.0
Coyote Seep	3/31/2015	Petersen	0.233		18.3	7.98	2,590				2240	16		1610	<5	474	178	284	40.8	6.3	474		1230	24	34.2	35.7	-2.2
Coyote Seep	6/30/2015	Petersen	0																								
Coyote Seep	8/20/2015	Petersen	0																								
Alkali Seep	9/10/2011	Petersen	seep		17.3	7.4	4,670				3040	44		1150	<5	489	164	104	591	10.3	596	<1	1630	116	42.7	47.2	-5.1
Alkali Seep	12/21/2011	Petersen	<0.05		6	7.27	3,750				2850	880		792	<5	581	164	92.8	595	10.1	709	<1	1400	96	42.0	43.7	-2.1
Alkali Seep	2/10/2012	Petersen	seep																								
Alkali Seep	5/8/2012	Petersen	<0.05		10.2	7.69	3,710				2790	290		842	<5	485	164	105	635	11.1	591	<2	1480	100	44.7	43.3	1.6
Alkali Seep	7/11/2012	Petersen	<0.25		25.6	7.11	6,160				3250	62		1130	<5	629	189	160	912	18.0	767	<1	2370	153	62.7	66.2	-2.7
Alkali Seep	3/16/2013	Petersen	<0.1		9.2	7.47	3,560				2900	110		775	<5	493	139	104	628	12.1	601	<1	1590	104	43.1	45.8	-3.1
Alkali Seep	4/29/2013	Petersen	<0.05		12.2	7.60	3,710																				
Alkali Seep	6/5/2013	Petersen	<0.1		18.8	7.65	3,710				3010	164		810	<5	536	148	107	657	11.2	639	7	1570	110	45.2	46.2	-1.1
Alkali Seep	9/30/2013	Petersen	<0.1		15.7	7.50	3,890																				
Alkali Seep	12/22/2013	Petersen	<0.1		4.2	7.39	3,730																				
Alkali Seep	3/31/2014	Petersen	<0.1		8.3	7.69	3,830				3150	71					153	111	655	10.2	533	<1	1690	107			
Alkali Seep	10/1/2014	Petersen	<0.1		12.9	7.35	4,090																				
Alkali Seep	12/21/2014	Petersen	<0.25		2.3	7.64	3,380				2630	3920		767	<5	513	149	95.9	586	9.3	513	<1	1360	93	41.1	41.2	-0.07
Alkali Seep	3/31/2015	Petersen	<0.25		11.5	7.14	3,740				2780	231		849	<5	554	170	103	578	9.5	554	<1	1510	92	42.3	45.1	-3.1
April Seep	5/8/2012	Petersen	<0.05								7360	93		3750	<5	646	368	687	634	12.9	788	<2	4050	207	103	103	-0.09
April Seep	6/21/2012	Petersen	0																								
April Seep	9/30/2012	Petersen	0																								
April Seep	2/27/2013	Petersen	0																								
April Seep	4/29/2013	Petersen	0																								
April Seep	5/31/2013	Petersen	0		14.1	8.17	9,200				9160	1520		5330	<5	686	387	1060	1020	23.3	836	<1	6170	270	157	150	2.3
April Seep	9/30/2013	Petersen	<0.05		11.8	7.68	8,010																				
April Seep	12/31/2013	Petersen	<0.05		0.8	8.50	2,280																				
April Seep	3/31/2014	Petersen	0																								
April Seep	4/24/2014	Petersen	<0.05		9.9	7.26	7,310				7390	88					357	762	725	12.2	643	<1	4350	209			
April Seep	9/30/2014	Petersen	0																								
April Seep	12/22/2014	Petersen	0																								
April Seep	3/31/2015	Petersen	<0.1		9.8	7.52	7,520				7380	276		4200	<5	744	447	750	714	12.2	744	<1	4190	187	115	107	3.6
April Seep	7/1/2015	Petersen	0																								
April Seep	8/19/2015	Petersen	0																								
Hill Spring	9/10/2011	Petersen	1.24		11.6	6.84	3,290				3250	26		1660	<5	456	277	180	236	10.6	556	<1	1550	45	39.2	42.9	-4.5
Hill Spring	2/10/2012	Petersen	2.07		9.8	6.84	3,190				3200	57		1590	<5	461	306	201	282	12.4	564	<1	1670	45	44.4	45.2	-0.9
Hill Spring	6/29/2012	Petersen	1.15		11.2	6.79	3,300				3150	105		1480	<10	496	289	184	246	10.9	605	<1	1690	47	40.9	46.4	-6.3
Hill Spring	9/30/2012	Petersen	1.82		12.1	6.74	3,430				3040	<20		1590	<10	483	307	199	277	12.2	589	<1	1660	46	44.1	45.5	-1.6
Hill Spring	2/28/2013	Petersen	2.34		9.9	6.60	3,450				3020	12		1580	<5	459	312	194	269	12.1	560	<1	1580	45	43.5	43.3	0.3
Hill Spring	6/5/2013	Petersen	1.47		10.8	6.79	3,320				3140	<20		1520	<5	440	294	190	248	10.3	536	<1	1800	48	41.4	47.6	-7.0
Hill Spring	1/1/2014	Petersen	2.05		9.5	6.88	3,180																				
Hill Spring	4/24/2014	Petersen	1.79		9.8	6.89	3,210				2940	27					303	209	257	11	491	<1	1630	44			

Monitoring Site	DATE	Data source	Discharge gpm	Depth (feet b. toc)	T °C	pH S.U.	Sp. Cond. µS/cm	D.O. mg/L	O & G mg/L	Turb. NTU	TDS mg/L	TSS mg/L	Set. Sol. ml/L	T. hard. mg/L	acidity mg/L	T. Alk mg/L $CaCO_3$	Ca (d) mg/L	Mg (d) mg/L	Na (d) mg/L	K (d) mg/L	HCO3 mg/L $CaCO_3$	CO3 mg/L $CaCO_3$	SO4 mg/L	Cl mg/L	cations meq/L	anions meq/L	bal. % diff.
Hill Spring	10/24/2014	Petersen	1.42		11.7	6.8	3,340																				
Hill Spring	7/1/2015	Petersen	1.23		10.9	6.68	3,460				2880	21		1510	<5	480	300	184	240	9.9	480	<1	1680	40	40.8	45.7	-5.6
Pond Spring	7/27/2008	Petersen	11 (est)																								
Pond Spring	9/10/2011	Petersen	13.0		9.5	7.5	2,660				2420	<4		1790	<5	549	261	253	63.2	14.3	669	<1	1250	15	37.0	37.6	-0.9
Pond Spring	2/10/2012	Petersen	14.6		9.4	7.56	2,510				2410	<4		1750	<10	535	257	268	77.2	18.0	652	<1	1240	16	38.7	36.9	2.3
Pond Spring	6/29/2012	Petersen	12.3		9.7	7.57	2,660				2420	4		1710	<10	547	236	272	67.5	15.6	667	<1	1300	17	34.5	38.5	-1.3
Pond Spring	9/30/2012	Petersen	17.3		9.9	7.37	2,710				2300	5		1550	<10	548	229	237	63.3	14.6	668	<1	1260	16	34.1	37.6	-5.0
Pond Spring	2/28/2013	Petersen	17.5		9.8	7.43	2,500				2190	<4		1630	<5	534	246	246	66.4	16.3	651	<1	1220	16	35.8	36.5	-0.9
Pond Spring	6/5/2013	Petersen	13.1		10.4	7.51	2,520				2270	<4		1660	<5	470	249	251	63.0	15.2	572	<1	1260	16	36.2	36.0	0.2
Pond Spring	1/1/2014	Petersen	18.5		9.6	7.32	2,390																				
Pond Spring	4/24/2014	Petersen	15.5		9.9	7.48	2,380				2120	<4					215	242	55.2	14.0	486	<1	1120	15			
Pond Spring	10/24/2014	Petersen	15.8		10.3	7.4	2,510																				
Pond Spring	7/1/2015	Petersen	12.6		10.9	7.25	2,580				2020	<4		1520	<5	533	223	233	56.1	13.8	530	<1	1090	15	33.1	33.8	-1.0
Priscilla Seep	6/10/2012	Petersen	Damp																								
Priscilla Seep	9/30/2012	Petersen	0																								
Priscilla Seep	11/28/2012	Petersen	<0.1		7.43	7.43	11,180				12600	102		8280	<5	1050	382	1780	797	53.9	1280	<2	7480	50	201	178	6.2
Priscilla Seep	2/27/2013	Petersen	0																								
Priscilla Seep	4/29/2013	Petersen	<0.25		19.7	7.71	10,460				12200	28		7100	<5	748	387	1490	674	47.9	912	<1	6800	51	172	158	4.4
Priscilla Seep	5/31/2013	Petersen	Damp																								
Priscilla Seep	10/8/2013	Petersen	Damp																								
Priscilla Seep	4/1/2014	Petersen	<0.1		8.9	7.61	9,210				9040	10					401	1240	487	35.9	765	<1	5950	40			
Priscilla Seep	10/1/2014	Petersen	Damp																								
Priscilla Seep	7/1/2015	Petersen	Damp																								
Priscilla Seep	8/20/2015	Petersen	Damp																								
Car Seep	2/28/2013	Petersen	<1		10.8	7.52	2,180				1680	20		1300	<5	547	161	218	81.6	10.6	667	<1	850	35	29.8	29.6	0.3
Car Seep	6/5/2013	Petersen	<0.5		13.0	7.44	1,815				1450	94		1040	<5	501	134	172	54.5	8.6	611	<1	670	30	23.4	24.8	-2.8
Car Seep	1/1/2014	Petersen	<1		0.9	7.67	2,540																				
Car Seep	4/24/2014	Petersen	<1		11.9	7.40	1,826				1260	37					136	172	51.9	10.5	450	<1	500	31			
Car Seep	10/24/2014	Petersen	0.62		11.3	7.42	1,753																				
Car Seep	7/1/2015	Petersen	<0.5		16.5	7.08	1,823				984	176		1000	<5	538	135	162	56.0	10.8	538	<1	430	30	22.8	20.5	5.2
Seep Y	9/30/2013	Petersen	2.64		15.7	8.51	3,990																				
Seep Y	12/31/2013	Petersen	0																								
Seep Y	6/18/2014	Petersen	0																								
Seep Y	9/30/2014	Petersen	0																								
Seep Y	12/22/2014	Petersen	0																								
Seep Y	7/1/2015	Petersen	0																								
Seep Y	8/19/2015	Petersen	0																								
Seep Z	7/10/2012	Petersen	0.145		14.7	7.26	7,950				6560	1230		3210	<5	565	404	534	727	22.2	689	<1	3810	120	96.3	93.9	1.2
Seep Z	9/30/2013	Petersen	0.068		14.2	7.23	6,430																				
Seep Z	12/31/2013	Petersen	0.044		9.2	7.16	6,240																				
Seep Z	4/1/2014	Petersen	0.092		7.3	7.35	6,180				6190	656					391	501	698	18.2	536	<1	3800	122			
Seep Z	6/18/2014	Petersen	0.025		14.7	7.12	5,930				6450	1380		2620	<5	543	341	429	596	15.7	543	<1	3260	119	78.6	82.0	-2.1
Seep Z	9/30/2014	Petersen	0.033		15.1	7.38	6,520																				

Monitoring Site	DATE	Data source	Discharge gpm	Depth (feet b. toc)	T °C	pH S.U.	Sp. Cond. µS/cm	D.O. mg/L	O & G mg/L	Turb. NTU	TDS mg/L	TSS mg/L	Set. Sol. ml/L	T. hard. mg/L	acidity mg/L	T. Alk mg/L $CaCO_3$	Ca (d) mg/L	Mg (d) mg/L	Na (d) mg/L	K (d) mg/L	HCO3 mg/L $CaCO_3$	CO3 mg/L $CaCO_3$	SO4 mg/L	Cl mg/L	cations meq/L	anions meq/L	bal. % diff.
Seep Z	12/22/2014	Petersen	0.112		6.1	7.24	6,500				6410	360		3100	<5	590	390	515	672	18.1	590	<1	3790	121	91.5	94.1	-1.4
Seep Z	3/31/2015	Petersen	0.052		9.3	7.15	6,530				6540	2970		2980	<5	868	377	496	649	17.4	868	<1	3750	113	88.3	98.6	-5.5
Seep Z	7/1/2015	Petersen	0.028		15.8	7.10	6,420				6150	506		3330	<5	613	434	545	738	18.4	613	<1	3950	123	99.0	97.9	0.6
Seep Z	9/21/2015	Petersen	0.051		18.9	7.68	6,480				6500	125		3470	<5	708	394	603	659	17.9			3240	114	98.0	82.0	9.0
Dakota Seep	5/8/2012	Petersen	damp																								
Dakota Seep	7/10/2012	Petersen	0																								
Dakota Seep	9/28/2012	Petersen	0																								
Dakota Seep	3/14/2013	Petersen	0																								
Dakota Seep	4/29/2013	Petersen	0																								
Dakota Seep	5/31/2013	Petersen	0																								
Dakota Seep	9/30/2013	Petersen	0																								
Dakota Seep	12/22/2013	Petersen	0																								
Dakota Seep	10/24/2014	Petersen	0																								
Dakota Seep	12/21/2014	Petersen	0																								
Dakota Seep	3/31/2015	Petersen	0																								
Dakota Seep	6/28/2015	Petersen	0																								
Dakota Seep	8/19/2015	Petersen	0																								
SP7-1	2/9/2012	Petersen	1.63		10.1	7.39	1,353				1030	4		790	<15	457	150	101	20.6	4.5	457	<1	391	11	16.8	17.6	-2.2
SP7-1	6/29/2012	Petersen	0.726		16.9	7.30	1,390				1040	36		663	<10	444	97.2	102	18.7	3.7	444	<1	405	12	14.2	17.6	-11
SP7-1	9/30/2012	Petersen	3.49		19.0	7.43	1,489				1050	19		766	<10	<10	142	100	18.4	4.5	445	<1	380	10	16.2	17.1	-2.6
SP7-1	11/29/2012	Petersen	1.21		7.2	7.22	1,396				1070	38		334	<5	481	56.4	46.8	4.7	1.5	481	<2	422	11	6.9	18.7	-46
SP7-1	6/6/2013	Petersen	0.620		23.4	7.25	1,486				936	122		317	<5	339	127	97.9	18.4	3.5	339	<1	420	10	15.5	15.8	-1.0
SP7-1	10/8/2013	Petersen	3.46		11.4	7.58	1,443				1030	61		829	<5	437	154	108	18.3	4.4	437	<1	410	10	17.5	17.5	-0.1
SP7-1	3/31/2014	Petersen	0.622		9.6	7.30	1,438				1000	59		856	<5	453	158	112	16.2	4.3	453	<1	390	9	17.9	17.4	1.4
Knob Spring	10-Feb-12	Petersen	<0.05		5.8	8.23	3,160				2930	15		2120	<5	327	231	374	195	28.4	327	<1	1810	61	51.5	45.9	5.7
Knob Spring	25-Apr-12	Petersen	0																								
Knob Spring	29-Jun-12	Petersen	0																								
Knob Spring	30-Sep-12	Petersen	0																								
Knob Spring	28-Nov-12	Petersen	0																								
Knob Spring	27-Feb-13	Petersen	0																								
Knob Spring	29-Apr-13	Petersen	0																								
Knob Spring	1-Oct-13	Petersen	0																								
Knob Spring	31-Dec-13	Petersen	0																								
Knob Spring	31-Mar-14	Petersen	0																								
Knob Spring	4/24/2014	Petersen	0																								
Knob Spring	6/15/2014	Petersen	0																								
Knob Spring	9/30/2014	Petersen	0																								
Knob Spring	10/24/2014	Petersen	0																								
Knob Spring	3/31/2015	Petersen	0																								
Knob Spring	7/1/2015	Petersen	0																								
Knob Spring	8/19/2015	Petersen	0																								

Wells

Y-53	10/9/1980	UII		141.0

Monitoring Site	DATE	Data source	Discharge gpm	Depth (feet b. toc)	T °C	pH S.U.	Sp. Cond. µS/cm	D.O. mg/L	O & G mg/L	Turb. NTU	TDS mg/L	TSS mg/L	Set. Sol. ml/L	T. hard. mg/L	acidity mg/L	T. Alk mg/L $CaCO_3$	Ca (d) mg/L	Mg (d) mg/L	Na (d) mg/L	K (d) mg/L	HCO3 mg/L $CaCO_3$	CO3 mg/L $CaCO_3$	SO4 mg/L	Cl mg/L	cations meq/L	anions meq/L	bal. % diff.
Y-53	12/13/1980	UII		179.0																							
Y-53	6/27/1986	UII		179.0	18.5	7.8	3,095				2065																
Y-53	8/2/1986	UII		178.9	14	7.85	3,165																				
Y-53	9/10/1986	UII		178.9	13	7.7	2,995																				
Y-53	10/4/1986	UII		178.8	13.4	7.7	3,185				2038																
Y-53	11/3/1986	UII		177.5	10.9	7.85	3,150																				
Y-53	11/22/1986	UII		177.5	10.8	7.7	3,295																				
Y-53	12/14/1986	UII		178.7	11.8	7.75	3,100				1934																
Y-53	1/17/1987	UII		178.5	10.8	7.7	3,120																				
Y-53	2/13/1987	UII		177.6	11.9	7.55	3,200																				
Y-53	2/9/2012	Petersen		184.36																							
Y-53	4/24/2012	Petersen		184.67																							
Y-53	12/13/2012	Petersen		185.88																							
Y-53	6/2/2013	Petersen		186.61																							
Y-53	12/19/2013	Petersen		187.07																							
Y-53	12/21/2014	Petersen		188.07																							
Y-53	1/30/2015	Petersen		188.40																							
Y-53	6/30/2015	Petersen		188.75																							
Y-55	12/13/1980	UII		67.0																							
Y-55	6/24/1986	UII		68.8	12.5	10.80	3220				2915																
Y-55	7/31/1986	UII		69.0	13.5	6.85	4453																				
Y-55	9/2/1986	UII		69.1	11.5	8.40	3910																				
Y-55	10/12/1986	UII		67.7	9.8	7.05	4225				4570																
Y-55	11/2/1986	UII		68.7	10	7.45	4260																				
Y-55	11/20/1986	UII		68.6	12	7.6	4230																				
Y-55	12/11/1986	UII		68.4	11	6.80	3850				4292																
Y-55	1/6/1987	UII		68.3	8.8	6.55	3895																				
Y-55	1/31/1987	UII		68.4	9.5	7.1	4150																				
Y-55	2/10/2011	Petersen		71.64																							
Y-55	9/30/2012	Petersen		71.86																							
Y-55	2/27/2013	Petersen		71.31																							
Y-55	6/5/2013	Petersen		71.52																							
Y-55	10/8/2013	Petersen		71.89																							
Y-55	12/31/2013	Petersen		71.35	12.0	6.97	4,420																				
Y-55	10/1/2014	Petersen		71.81	12.1	7.13	4,410																				
Y-55	3/31/2015	Petersen		71.19																							
Y-55	7/1/2015	Petersen		71.49																							
Y-55	8/20/2015	Petersen		71.67																							
Y-56	6/23/1986	UII		4.5	10	6.65	3,785				4375																
Y-56	7/31/1986	UII		5.5	14	6.7	4,148																				
Y-56	9/2/1986	UII		5.8	12.6	6.65	4,030																				
Y-56	10/12/1986	UII		4.1	10	6.75	4,065				4526																
Y-56	10/31/1986	UII		4.9	10	6.7	4,190																				
Y-56	11/20/1986	UII		4.9	11	6.65	4,260																				
Y-56	12/11/1986	UII		4.7	9.8	6.75	4,070				4264																
Y-56	1/6/1987	UII		4.1	8.8	6.6	4,125																				

Monitoring Site	DATE	Data source	Discharge gpm	Depth (feet b. toc)	T °C	pH S.U.	Sp. Cond. µS/cm	D.O. mg/L	O & G mg/L	Turb. NTU	TDS mg/L	TSS mg/L	Set. Sol. ml/L	T. hard. mg/L	acidity mg/L	T. Alk mg/L $CaCO_3$	Ca (d) mg/L	Mg (d) mg/L	Na (d) mg/L	K (d) mg/L	HCO3 mg/L $CaCO_3$	CO3 mg/L $CaCO_3$	SO4 mg/L	Cl mg/L	cations meq/L	anions meq/L	bal. % diff.
Y-56	1/31/1987	UII		4.6	9	6.75	4,105																				
Y-56	2/10/2011	Petersen		7.15																							
Y-56	9/30/2012	Petersen		7.59																							
Y-56	2/28/2013	Petersen		7.17	9.6	7.05	4,250																				
Y-56	6/5/2013	Petersen		7.55	10.4	7.04	4,190																				
Y-56	1/1/2014	Petersen		6.84	10.8	7.02	4,210																				
Y-56	10/24/2014	Petersen		7.47	12.9	6.91	4,260																				
Y-69 (PDH6)	6/21/1986	UII		10.2	10	8.15	2,100																				
Y-69 (PDH6)	10/17/1986	UII		9.9	10	6.95	2,650																				
Y-69 (PDH6)	12/16/1986	UII		10	9.5	7.05	2,415																				
Y-69 (PDH6)	9/11/2011	Petersen		15.67	11.1	7.09	2,720																				
Y-69 (PDH6)	2/8/2012	Petersen		13.98	10.9	7.03	2,670																				
Y-69 (PDH6)	4/25/2012	Petersen		14.20																							
Y-69 (PDH6)	6/29/2012	Petersen		16.02																							
Y-69 (PDH6)	9/30/2012	Petersen		15.03																							
Y-69 (PDH6)	2/28/2013	Petersen		14.10																							
Y-69 (PDH6)	6/5/2013	Petersen		15.28	11.4	7.07	2,640																				
Y-69 (PDH6)	1/1/2014	Petersen		14.51	10.5	7.02	2,590																				
Y-69 (PDH6)	10/24/2014	Petersen		15.58	11.1	7.15	2,730																				
Y-69 (PDH6)	7/1/2015	Petersen		15.89																							
Y-70 (PDH7)	6/24/1986	UII		37.60	10.1	7.7	1,025																				
Y-70 (PDH7)	8/3/1986	UII		38.30	11.1	7.85	810																				
Y-70 (PDH7)	9/2/1986	UII		38.40	10.6	7.7	1,035																				
Y-70 (PDH7)	10/2/1986	UII		38.20	10.9	7.4	960																				
Y-70 (PDH7)	10/29/1986	UII		38.10	10	7.3	970																				
Y-70 (PDH7)	11/20/1986	UII		37.90	10.1	7.1	1,000																				
Y-70 (PDH7)	12/14/1986	UII		37.90	10.2	7.5	875																				
Y-70 (PDH7)	1/20/1987	UII		38.20	10.2	7.6	990																				
Y-70 (PDH7)	2/9/1987	UII		38.80	10.7	7.3	985																				
Y-70 (PDH7)	9/16/1987	UII		38.50	10.6	7.7	1,035				578			382			61	56	89	12	386	<5	130	8			5.32
Y-70 (PDH7)	12/8/1987	UII		38.10	10.1	7.1	1,000				546			425			70	61	79	8	398	<5	128	11			5.22
Y-70 (PDH7)	3/17/1988	UII		37.90	10.7	7.3	985				576			384			65	54	69	7	402	<5	140	8			1.36
Y-70 (PDH7)	9/10/2011	Petersen		40.25																							
Y-70 (PDH7)	12/23/2011	Petersen		39.91	10.5	8.13	1,375				1050	1410		269	<5	457	52.3	33.6	200	11.9	457	<2	350	9	14.4	16.3	-6.1
Y-70 (PDH7)	4/25/2012	Petersen		36.56	10.3	7.07	3,390				2950	646		1740	<5	603	319	230	271	10.2	603	<2	1480	47	47.0	44.2	3.1
Y-70 (PDH7)	7/10/2012	Petersen		37.41	10.6	7.03	3,800				3740	93		1730	<10	631	318	228	277	10.2	631	<2	1640	53	47.0	48.2	-1.3
Y-70 (PDH7)	9/30/2012	Petersen		38.99																							
Y-70 (PDH7)	11/27/2012	Petersen		38.86	10.6	6.99	3,470				3220	42		1700	<5	603	307	226	274	9.6	603	<2	1570	53	46.5	46.2	0.3
Y-70 (PDH7)	2/25/2013	Petersen		38.78																							
Y-70 (PDH7)	6/6/2013	Petersen		39.21	11.8	7.08	2,800				2940	130		1690	<5	484	301	228	240	8.8	484	<1	1630	59	44.9	45.2	-0.4
Y-70 (PDH7)	10/1/2013	Petersen		40.21	11.3	7.03	3,280				2840	116		1600	<5	471	286	215	240	9.5	471	<1	1520	58	42.7	42.7	-0.01
Y-70 (PDH7)	12/31/2013	Petersen		39.59	9.4	7.09	3,230				2920	32		1710	<5	637	294	236	250	8.2	637	<1	1520	58	-0.9	46.0	-0.9
Y-70 (PDH7)	4/1/2014	Petersen		39.65	11.0	7.01	3,260				2850	83		1620	<5	629	280	224	248	8.6	629	<1	1540	58	43.4	46.2	-3.1
Y-70 (PDH7)	6/18/2014	Petersen		39.87	10.5	7.03	3,200				2910	109		1650	<5	596	278	232	242	8.3	596	<1	1470	55	43.7	44.0	-0.4
Y-70 (PDH7)	9/30/2014	Petersen		40.08																							
Y-70 (PDH7)	10/1/2014	Petersen		40.37	12.2	6.97	3,440																				

Monitoring Site	DATE	Data source	Discharge gpm	Depth (feet b. toc)	T °C	pH S.U.	Sp. Cond. µS/cm	D.O. mg/L	O & G mg/L	Turb. NTU	TDS mg/L	TSS mg/L	Set. Sol. ml/L	T. hard. mg/L	acidity mg/L	T. Alk mg/L CaCO3	Ca (d) mg/L	Mg (d) mg/L	Na (d) mg/L	K (d) mg/L	HCO3 mg/L CaCO3	CO3 mg/L CaCO3	SO4 mg/L	Cl mg/L	cations meq/L	anions meq/L	bal. % diff.
Y-70 (PDH7)	12/21/2014	Petersen		39.81																							
Y-70 (PDH7)	1/30/2015	Petersen		39.70	10.1	7.02	3,590																				
Y-70 (PDH7)	3/30/2015	Petersen		39.21	10.9	6.92	3,380				2910	104		1570	<5	587	267	219	212	7.8	587	<1		58	40.8	45.8	-5.8
Y-70 (PDH7)	7/1/2015	Petersen		39.77																							
Y-70 (PDH7)	8/20/2015	Petersen		40.08																							
Y-103 (A6)	8/4/1986	UII		22.9	13.5	7.15	2,465																				
Y-103 (A6)	9/3/1986	UII		31	11	6.85	1,845																				
Y-103 (A6)	10/15/1986	UII		30.7	10	6.85	2,970																				
Y-103 (A6)	11/2/1986	UII		30.6	8.8	6.85	2,825																				
Y-103 (A6)	11/21/1986	UII		25.3	8.3	6.80	2,820																				
Y-103 (A6)	12/14/1986	UII		30.4	8.1	6.85	3,455																				
Y-103 (A6)	1/21/1987	UII		31	8.5	6.85	3,250																				
Y-103 (A6)	2/11/1987	UII		30.9	10.2	6.75	3,055																				
Y-103 (A6)	9/16/1987	UII		30.84	10.3	6.45	4,410				3980			3543			384	630	40	11	788	<5	2551	14			2.24
Y-103 (A6)	12/8/1987	UII		30.52	8.9	6.60	3,785				3156			2802			286	509	37	10	704	<5	1978	14			1.69
Y-103 (A6)	3/17/1988	UII		30.33	9.8	6.70	3,830				3420			2600			243	486	10	8	735	<5	2058	15			4.42
Y-103 (A6)	3/31/2012	Petersen		29.99																							
Y-103 (A6)	4/25/2012	Petersen		30.16	10.0	6.97	3,760				3560	10700		2580	<5	743	316	435	23.0	14.6	743	<2	1890	8	53.1	54.4	-1.2
Y-103 (A6)	7/10/2012	Petersen		30.81	10.0	7.03	3,740				3560	179		2660	<10	798	344	438	25.0	16.3	798	<2	1890	9	54.8	55.5	-0.7
Y-103 (A6)	9/30/2012	Petersen		30.83																							
Y-103 (A6)	11/28/2012	Petersen		30.50	10.1	6.90	3,690				3630	1040		2580	<5	770	328	427	24.1	15.7	770	<2	1910	8	53.0	55.3	-2.2
Y-103 (A6)	2/25/2013	Petersen		30.16																							
Y-103 (A6)	4/29/2013	Petersen		30.53																							
Y-103 (A6)	6/5/2013	Petersen		30.81	10.3	7.09	3,460				3240	170		2510	<5	741	324	413	22.9	14.7	741	<1	1860	10	51.7	53.7	-2.0
Y-103 (A6)	9/30/2013	Petersen		31.32	9.8	6.96	3,080				2850	49		2200	<5	589	286	362	24.1	13.4	589	<1	1520	11	45.4	43.7	1.9
Y-103 (A6)	12/31/2013	Petersen		30.73	9.8	7.03	3,690				3120	130		2490	<5	741	315	414	22.7	14.2	741	<1	1800	10	51.1	52.5	-1.3
Y-103 (A6)	4/1/2014	Petersen		30.99	9.7	6.96	2,790				2570	22		2020	<5	693	263	331	24.2	11.8	693	<1	1470	11	41.7	44.7	-3.5
Y-103 (A6)	6/18/2014	Petersen		31.44	10.0	6.98	3,030				2800	270		2290	<5	710	275	390	22.5	12.5	710	<1	1470	10	47.1	45.1	2.2
Y-103 (A6)	9/30/2014	Petersen		31.37																							
Y-103 (A6)	10/1/2014	Petersen		31.36	9.7	6.95	2,750																				
Y-103 (A6)	12/21/2014	Petersen		31.18																							
Y-103 (A6)	1/30/2015	Petersen		30.87	9.0	7.01	2,770																				
Y-103 (A6)	3/31/2015	Petersen		30.95	10.7	6.92	3,120				2770	28		2230	<5	677	288	367	25.2	12.8	677	<1	1360	10	46.0	42.1	4.4
Y-103 (A6)	6/30/2015	Petersen		31.63	10.5	6.76	3,750				3270	166		2930	<5	813	381	480	26.8	18.2	813	<1	1950	9	60.0	57.0	2.6
Y-103 (A6)	8/20/2015	Petersen		31.75																							
NLP-1	11/28/2012	Petersen		13.39	12.0	7.34	3,130				3020	104		2030	<5	611	292	316	46.2	5.1	611	<2	1460	34	43.1	43.5	-0.5
NLP-1	2/25/2013	Petersen		13.36																							
NLP-1	6/6/2013	Petersen		13.41	12.5	7.23	3,190				2840	2680		2080	<5	809	297	326	49.1	4.6	809	<1	1610	39	46.3	50.7	-4.6
NLP-1	10/1/2013	Petersen		14.38	11.1	7.22	3,030				2670	1090		1960	<5	617	271	312	49.3	5.0	617	<1	1560	39	41.5	45.9	-5.0
NLP-1	12/31/2013	Petersen		14.73	6.5	7.17	3,130				2700	4210		1900	<5	617	267	300	57.7	4.6	617	<1	1560	40	40.6	45.9	-7.1
NLP-1	4/1/2014	Petersen		14.79																							
NLP-1	6/18/2014	Petersen		11.74	14.0	6.97	3,290				2950	1510		2420	<5	490	412	338	37.7	5.0	490	<1	1670	21	50.1	45.1	5.2
NLP-1	10/1/2014	Petersen		13.53	10.5	7.02	3,100																				
NLP-1	1/30/2015	Petersen		14.27	8.4	7.20	3,190																				
NLP-1	3/31/2015	Petersen		13.68																							
NLP-1	7/1/2015	Petersen		14.38																							

Monitoring Site	DATE	Data source	Discharge gpm	Depth (feet b. toc)	T °C	pH S.U.	Sp. Cond. µS/cm	D.O. mg/L	O & G mg/L	Turb. NTU	TDS mg/L	TSS mg/L	Set. Sol. ml/L	T. hard. mg/L	acidity mg/L	T. Alk mg/L caco3	Ca (d) mg/L	Mg (d) mg/L	Na (d) mg/L	K (d) mg/L	HCO3 mg/L caco3	CO3 mg/L caco3	SO4 mg/L	Cl mg/L	cations meq/L	anions meq/L	bal. % diff.
NLP-1	8/20/2015	Petersen		14.96																							
NLP-2	11/28/2012	Petersen		15.59	12.5	7.36	3,900				3610	216		2120	<5	594	249	364	227	6.1	594	<2	1730	134	52.8	51.6	1.1
NLP-2	2/25/2013	Petersen		15.28																							
NLP-2	4/29/2013	Petersen		14.94																							
NLP-2	5/31/2013	Petersen		15.17																							
NLP-2	6/6/2013	Petersen		15.54	15.1	7.16	3,980				3170	7720		2130	<5	792	241	371	223	5.0	792	<1	1950	149	54.9	60.6	-4.9
NLP-2	10/1/2013	Petersen		16.22	14.2	7.23	3,910				3130	3050		2100	<5	463	240	364	228	5.5	463	<1	1930	147	52.0	53.6	-1.5
NLP-2	12/31/2013	Petersen		16.04	7.2	7.39	3,830				3670	5250		2010	<5	544	223	354	215	4.9	544	<1	1940	148	49.7	55.4	-5.4
NLP-2	4/1/2014	Petersen		15.80																							
NLP-2	4/24/2014	Petersen		15.67																							
NLP-2	6/18/2014	Petersen		16.01	10.0	7.20	3,750				3170	1000		2240	<5	595	223	408	220	4.8	595	<1	1580	135	54.4	48.6	5.7
NLP-2	9/30/2014	Petersen		16.69																							
NLP-2	10/1/2014	Petersen		16.65	11.9	7.15	3,950																				
NLP-2	12/21/2014	Petersen		16.32																							
NLP-2	1/30/2015	Petersen		16.13	8.6	7.40	4,100																				
NLP-2	3/31/2015	Petersen		15.89																							
NLP-2	7/1/2015	Petersen		15.90																							
NLP-2	8/20/2015	Petersen		16.61																							
NLP-3	2/25/2013	Petersen		27.86																							
NLP-3	2/28/2013	Petersen		27.88	8.4	7.25	1,526				1090	28300		829	<5	860	139	117	21.1	8.6	860	<1	<1	<1	17.7	17.2	1.4
NLP-3	6/6/2013	Petersen		28.03	21.3	7.18	1,782				1200	6100		944	<5	589	172	125	21.3	7.7	589	<1	380	5	21.5	19.8	4.1
NLP-3	10/1/2013	Petersen		28.25	16.6	7.22	1,584				1080	2600		677	<5	699	65.1	125	23.1	8.3	699	<1	386	5	14.8	16.8	-6.4
NLP-3	12/31/2013	Petersen		28.25	6.9	7.19	1,665				1090	15500		956	<5	526	170	129	24.6	8.3	526	<1	410	6	20.4	19.2	3.0
NLP-3	4/1/2014	Petersen		28.29																							
NLP-3	6/18/2014	Petersen		28.45	17.6	7.23	1,713				1110	477		1020	<5	552	168	147	30.7	8.4	552	<1	390	10	22.0	19.4	6.3
NLP-3	10/1/2014	Petersen		28.62	14.3	7.26	1,697																				
NLP-3	1/30/2015	Petersen		28.53																							
NLP-3	3/31/2015	Petersen		28.48																							
NLP-3	6/30/2015	Petersen		28.67	12.1	7.72	1,626				900	8790		887	<5	547	139	131	31.3	9.5	547		374	9	19.3	19.0	0.9
NLP-3	8/20/2015	Petersen		28.76																							
NLP-4	2/25/2013	Petersen		3.57																							
NLP-4	2/28/2013	Petersen		3.61	3.1	7.15	2,090				1700	7790		1340	<5	638	207	201	33.2	5.5	638	<1	850	14	28.5	30.8	-4.0
NLP-4	6/6/2013	Petersen		4.25	13.6	7.11	2,270				1480	3080		1260	<5	276	198	187	28.9	6.0	276	<1	817	14	26.7	22.9	7.6
NLP-4	10/1/2013	Petersen		4.27	15.4	7.02	2,240				1730	668		1330	<5	531	202	200	34.4	7.0	531	<1	910	18	28.2	30.1	-3.2
NLP-4	12/31/2013	Petersen		3.56	3.6	7.24	2,200				1750	6690		1350	<5	476	204	204	36.1	5.4	476	<1	830	18	28.7	27.3	2.5
NLP-4	4/1/2014	Petersen		3.78																							
NLP-4	6/18/2014	Petersen		4.54	14.0	7.00	1,932				1520	2530		1280	<5	536	196	191	32.3	6.5	536	<1	690	15	27.1	25.5	3.0
NLP-4	10/1/2014	Petersen		3.96	15.5	7.07	2,130																				
NLP-4	1/30/2015	Petersen		3.28	3.5	7.32	2,230																				
NLP-4	3/31/2015	Petersen		3.68	8.4	7.06	2,070				1680	168		1320	<5	556	194	204	34.9	5.7	556	<1	730	17	28.1	26.8	2.5
NLP-4	6/30/2015	Petersen		4.50	15.3	7.11	2,090				1490	100		1370	<5	601	199	213	37.3	6.9	601	<1	740	17	29.3	27.9	2.4
NLP-4	8/20/2015	Petersen		4.68																							
NLP-5	2/25/2013	Petersen		5.52																							
NLP-5	2/28/2013	Petersen		5.58	5.6	7.52	2,070				1820	3010		1250	<5	503	203	180	29.0	4.1	503	<1	910	17	26.3	29.4	-5.6

Monitoring Site	DATE	Data source	Discharge gpm	Depth (feet b. toc)	T °C	pH S.U.	Sp. Cond. µS/cm	D.O. mg/L	O & G mg/L	Turb. NTU	TDS mg/L	TSS mg/L	Set. Sol. ml/L	T. hard. mg/L	acidity mg/L	T. Alk mg/L $CaCO_3$	Ca (d) mg/L	Mg (d) mg/L	Na (d) mg/L	K (d) mg/L	HCO3 mg/L $CaCO_3$	CO3 mg/L $CaCO_3$	SO4 mg/L	Cl mg/L	cations meq/L	anions meq/L	bal. % diff.
NLP-5	6/6/2013	Petersen		7.18	15.1	7.59	2,390				1950	392		1400	<5	529	224	204	26.6	4.5	529	<1	1030	14	29.6	32.3	-4.5
NLP-5	10/1/2013	Petersen		6.98	14.2	7.62	2,080				1810	540		1270	<5	490	207	184	26.9	5.4	490	<1	960	14	26.8	30.2	-5.9
NLP-5	1/1/2014	Petersen		5.65	6.6	7.33	2,130				1800	222		1380	<5	392	226	199	29.6	4.7	392	<1	940	17	29.1	27.9	2.1
NLP-5	4/1/2014	Petersen		6.17																							
NLP-5	6/18/2014	Petersen		7.37	19.9	7.87	1,627				1140	551		1020	<5	429	164	149	24.9	4.2	429	<1	490	11	21.6	19.1	6.2
NLP-5	10/1/2014	Petersen		5.87	14.5	7.50	1,366																				
NLP-5	1/30/2015	Petersen		5.32	4.9	7.59	1,754																				
NLP-5	3/31/2015	Petersen		5.84	9.2	7.50	1,114				776	590		667	<5	433	107	97.0	17.7	3.5	433	<1	282	7	14.2	14.7	-1.8
NLP-5	6/30/2015	Petersen		7.31	14.9	7.50	1,367				948	137		698	<5	438	83.2	119	24.9	4.0	438	<1	370	11	15.1	16.8	-5.0
NLP-5	8/20/2015	Petersen		7.26																							
NLP-6	2/25/2013	Petersen		16.90																							
NLP-6	2/28/2013	Petersen		16.96	10.8	7.21	3,010				2380	21500		2010	<5	609	359	270	21.7	5.8	609	<1	1400	8	41.2	41.5	-0.4
NLP-6	4/5/2014	Petersen		17.54	5.2	7.59	2,750																				
NLP-6	4/24/2014	Petersen		17.65																							
NLP-6	6/18/2014	Petersen		17.80	19.7	6.98	2,740																				
NLP-6	10/1/2014	Petersen		17.85	10.8	6.94	2,940				2360												1320	7			
NLP-6	3/31/2015	Petersen		17.82																							
NLP-6	8/19/2015	Petersen		15.04																							
NLP-6	6/30/2015	Petersen		16.97	12.4	6.98	2,930				2560	853		2160	<5	656	409	277	23.4	5.5	656	<1	1420	8	44.3	42.9	1.7
NLP-6	8/20/2015	Petersen		15.09																							
NLP-7	2/25/2013	Petersen		19.67																							
NLP-7	2/28/2013	Petersen		19.86	10.9	7.72	1,894				2020	72500		920	<5	742	75.0	178	139	3.3	742	<1	21	<1	24.4	15.3	23
NLP-7	6/6/2013	Petersen		20.49	12.8	7.73	2,040				1120	30300		936	<5	1560	89.5	173	87.3	3.4	1560	<1	476	36	27.0	42.0	-22
NLP-7	10/1/2013	Petersen		20.62	8.9	7.74	1,946				1250	18800		961	<5	2320	86.5	181	116	3.4	2320	<1	470	34	24.3	26.6	-4.4
NLP-7	1/1/2014	Petersen		21.81	8.6	7.35	1,796				1140	7980		929	<5	657	96.5	167	68.8	3.9	647	18	339	37	21.6	20.9	1.8
NLP-7	4/1/2014	Petersen		22.40																							
NLP-7	6/18/2014	Petersen		22.86	10.7	7.46	1,787				1050	3470		986	<5	708	99.8	179	52.0	3.8	708	<1	285	34	22.1	21.0	2.4
NLP-7	10/1/2014	Petersen		16.87	9.5	7.36	1,885																				
NLP-7	3/31/2015	Petersen		21.68																							
NLP-7	7/1/2015	Petersen		21.57																							
NLP-7	8/20/2015	Petersen		22.00																							
NLP-8	2/25/2013	Petersen		13.05																							
NLP-8	2/28/2013	Petersen		13.12	10.2	7.03	8,730				9250	476		5430	<5	840	508	1010	572	16.3	840	<1	4510	1000	134	139	-1.8
NLP-8	6/6/2013	Petersen		14.01	12.8	7.00	8,140				7740	17000		4580	<5	808	475	825	450	14.9	808	<1	4220	775	118	126	-3.2
NLP-8	10/1/2013	Petersen		14.96	9.8	7.13	6,790				6190	1370		4080	<5	571	466	708	360	18.1	571	<1	3310	530	97.6	95.2	1.3
NLP-8	1/1/2014	Petersen		14.97																							
NLP-8	4/1/2014	Petersen		13.85																							
NLP-8	4/24/2014	Petersen		13.62																							
NLP-8	6/18/2014	Petersen		13.76	14.9	6.97	4,630				4060	890		2620	<5	784	266	475	323	10.4	784	<1	2000	260	66.7	64.6	1.6
NLP-8	9/30/2014	Petersen		14.94																							
NLP-8	10/1/2014	Petersen		14.97	10.6	7.18	2,120																				
NLP-8	3/31/2015	Petersen		15.57																							
NLP-8	7/1/2015	Petersen		16.06																							
NLP-8	8/19/2015	Petersen		16.47																							

Monitoring Site	DATE	Data source	Discharge gpm	Depth (feet b. toc)	T °C	pH S.U.	Sp. Cond. µS/cm	D.O. mg/L	O & G mg/L	Turb. NTU	TDS mg/L	TSS mg/L	Set. Sol. ml/L	T. hard. mg/L	acidity mg/L	T. Alk mg/L $CaCO_3$	Ca (d) mg/L	Mg (d) mg/L	Na (d) mg/L	K (d) mg/L	HCO3 mg/L $CaCO_3$	CO3 mg/L $CaCO_3$	SO4 mg/L	Cl mg/L	cations meq/L	anions meq/L	bal. % diff.
NLP-9	2/25/2013	Petersen		20.93																							
NLP-9	2/26/2013	Petersen		21.02	7.3	7.37	5,510				4990	135		2600	<5	440	259	474	407	7.7	440	<1	2570	360	69.8	72.4	-1.8
NLP-9	10/8/2013	Petersen		22.19	13.7	7.75	5,810				4720	294		2880	<5	462	278	531	425	8.1	462	<1	2830	443	76.2	80.6	-2.8
NLP-9	1/1/2014	Petersen		22.70																							
NLP-9	4/1/2014	Petersen		23.13																							
NLP-9	6/18/2014	Petersen		Dry																							
NLP-9	9/30/2014	Petersen		23.41																							
NLP-9	3/31/2015	Petersen		Dry																							
NLP-9	7/1/2015	Petersen		22.87																							
NLP-9	8/20/2015	Petersen		22.56																							
NLP-10	12/31/2013	Petersen		23.96	6.7	7.36	4,320				3150	325000		2400	<5	814	309	396	194	9.6	814	<1	2060	134	56.7	62.9	-5.1
NLP-10	4/1/2014	Petersen		23.89																							
NLP-10	4/24/2014	Petersen		23.97	8.6	7.26	4,290				3750	7160		2800	<5	696	320	486	202	6.4	696	<1	2120	133	64.9	61.7	2.5
NLP-10	6/18/2014	Petersen		24.23	10.9	7.29	4,050				3560	1970		2420	<5	672	296	407	190	6.4	672	<1	1760	124	56.7	53.5	2.9
NLP-10	9/30/2014	Petersen		24.42																							
NLP-10	10/1/2014	Petersen		24.45	14.3	7.11	4,310																				
NLP-10	12/21/2014	Petersen		24.33																							
NLP-10	1/30/2014	Petersen		24.17	9.3	7.33	4,490																				
NLP-10	3/30/2015	Petersen		24.21																							
NLP-10	7/1/2015	Petersen		24.41																							
NLP-10	8/20/2015	Petersen		24.66																							
NLP-11	12/22/2013	Petersen		Dry																							
NLP-11	4/1/2014	Petersen		Dry																							
NLP-11	6/18/2014	Petersen		Dry																							
NLP-11	10/1/2014	Petersen		Dry																							
NLP-11	12/21/2014	Petersen		29.5																							
NLP-11	1/30/2014	Petersen		Dry																							
NLP-11	3/31/2015	Petersen		29.12																							
NLP-11	6/30/2015	Petersen		Dry																							
NLP-11	8/20/2015	Petersen		Dry																							
NLP-12	12/22/2013	Petersen		17.25																							
NLP-12	12/31/2013	Petersen		17.20	6.1	7.07	3,190				2250	278000		1820	<5	390	327	243	116	8.1	390	<1	1610	55	41.6	42.8	-1.5
NLP-12	2/11/2014	Petersen		17.01																							
NLP-12	4/24/2014	Petersen		16.94	9.2	7.02	3,150				2900	3530		2190	<5	532	389	295	136	8.2	532	<1	1620	54	49.8	45.9	4.1
NLP-12	6/19/2014	Petersen		17.45	10.8	6.87	3,130				2870	742		2020	<5	568	351	277	125	7.3	568	<1	1510	53	45.9	44.3	1.9
NLP-12	9/30/2014	Petersen		17.77																							
NLP-12	10/1/2014	Petersen		17.74	12.1	6.86	3,300																				
NLP-12	12/21/2014	Petersen		17.50																							
NLP-12	1/30/2015	Petersen		16.65	10.1	7.02	3,380																				
NLP-12	3/30/2015	Petersen		15.73	11.0	6.87	3,340				2910	722		1960	<5	759	350	265	128	7.4	759	<1	1550	53	45.0	48.9	-4.1
NLP-12	6/30/2015	Petersen		16.46	10.7	6.84	3,470				3050	256		2110	<5	620	303	280	147	7.7	620	<1	1750	54	48.7	50.3	-1.6
NLP-12	8/23/2015	Petersen		17.53																							
NLP-12	9/21/2015	Petersen		17.73	12.3	7.05	3,390				3120	56		2040	<5	608	345	287	121	7.2	608	<2	1540	54	46.0	45.7	0.6
NLP-13	12/31/2013	Petersen		0.05	7.1	7.16	7,730				7040	7590		3110	<5	667	301	572	935	13.4	667	<1	4380	186	103	110	-3.1

Monitoring Site	DATE	Data source	Discharge gpm	Depth (feet b. toc)	T °C	pH S.U.	Sp. Cond. µS/cm	D.O. mg/L	O & G mg/L	Turb. NTU	TDS mg/L	TSS mg/L	Set. Sol. ml/L	T. hard. mg/L	acidity mg/L	T. Alk mg/L CaCO3	Ca (d) mg/L	Mg (d) mg/L	Na (d) mg/L	K (d) mg/L	HCO3 mg/L CaCO3	CO3 mg/L CaCO3	SO4 mg/L	Cl mg/L	cations meq/L	anions meq/L	bal. % diff.
NLP-13	4/1/2014	Petersen		-0.1																							
NLP-13	4/24/2014	Petersen		-0.1	8.4	7.29	7,530				7500	694		3530	<5	690	355	641	1000	15.8	690	<1	4270	176	114	108	3.1
NLP-13	6/18/2014	Petersen		1.19	12.1	7.05	7,510				6970	30		3170	<5	597	305	585	948	14.8	597	<1	4190	169	105	104	0.5
NLP-13	9/30/2014	Petersen		0.60	14.2	7.05	7,750																				
NLP-13	12/22/2014	Petersen		0.05	8.7	7.35	7740				7920	443		3180	<5	702	319	579	993	15.8	702	<1	4320	180	107	109	-0.8
NLP-13	3/31/2015	Petersen		-0.13	8.4	7.05	7840				7840	195		3150	<5	675	314	574	940	14.5	675	<1	4380	172	104	109	-2.5
NLP-13	7/1/2015	Petersen		1.26	12.6	6.90	7,770				7220	499		3430	<5	657	356	618	1020	15.6	657	<1	4320	179	113	108	2.4
NLP-13	9/21/2015	Petersen		0.72	15.3	7.19	7,810				7350	322		3650	<5	859	350	675	987	17.7	705	<2	4290	168	116		3.7

Table 2b Hydrologic data for the North Private Lease area.

Petersen Hydrologic, LLC

Includes selected data from Petersen Hydrologic, LLC monitoring in the Alton Coal Tract area 2005-2015 (Petersen) and selected data provided by the Utah Division of Oil, Gas and Mining from Utah International permit application 1986-1988 (UII).

			Trace metals																					Nutrients						
			Al (d)	Al (t)	As (d)	As (t)	B (d)	B (t)	Ba (d)	Cd (d)	Cr (d)	Cu (d)	Fe (d)	Fe (t)	Pb (d)	Pb (t)	Hg (d)	Mn (d)	Mn (t)	Mo (d)	Ni (d)	Se (d)	Se (t)	Zn (d)	NH3	F	NO3	NO2	NO2+NO3	T-P	O-PO4
Monitoring Site	Date	Data source	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	(µg/L)	mg/L	mg/L N	mg/L	mg/L	mg/L	mg/L N	mg/L	mg/L
Surface Waters																														
SW-1	6/23/1986	UII																												
SW-1	8/7/1986	UII																												
SW-1	8/28/1986	UII																												
SW-1	9/28/1986	UII																												
SW-1	10/24/1986	UII																												
SW-1	11/12/1986	UII																												
SW-1	12/4/1986	UII																												
SW-1	4/16/1987	UII																												
SW-1	5/12/1987	UII																												
SW-1	6/4/1987	UII																												
SW-1	7/1/1987	UII																												
SW-1	8/3/1987	UII																												
SW-1	9/4/1987	UII		<0.05		<0.001	0.09	0.04						0.27		<0.02	<0.0002		0.03				<0.001			0.4	0.58	0.01			
SW-1	10/26/1987	UII																												
SW-1	11/13/1987	UII																												
SW-1	12/8/1987	UII		0.17		<0.001	0.03	0.15						1.8		<0.02	<0.0002		0.06				<0.002			0.2	0.2	<0.02			
SW-1	1/15/1988	UII																												
SW-1	2/20/1988	UII																												
SW-1	3/17/1988	UII		0.28		<0.001	<0.02	0.15						2.89		<0.02	<0.0002		0.06				<0.001			0.2	0.2	<0.01			
SW-1	5/27/2005	Petersen	< .03		< .01		0.07		0.179	< .001	< .001	< .01	< .03	0.77	< .01			0.005	0.034	< .005	< .001	< .02		0.005	< .1	0.2				< .05	
SW-1	9/25/2005	Petersen	< .03		< .01		0.09		0.073	< .001	< .001	0.01	< .03	< .05	< .01			0.043	< .002	< .005	< .001	< .02		< .004	0.1	0.21	< .05	< .05	< .02	< .05	< .05
SW-1	11/3/2005	Petersen	< .03		< .01		0.08		0.12	< .001	< .001	< .01	< .03		< .01			0.011		< .005	0.002			< .004	< .1	0.15				< .05	
SW-1	3/31/2006	Petersen	< .03		< .01		0.04		0.145	< .001	< .001	< .01	< .03	4.63	< .01			0.007	0.071	< .005	0.001			< .004	< .1	0.2	0.06	< .05			< .05
SW-1	5/30/2006	Petersen	< .03		< .01		0.1		0.043	< .001	< .001	< .01	< .03	0.47	< .01			0.002	0.026	< .005	0.001	< .02		< .004	< .1	0.32	< .05	< .05		< .05	< .05
SW-1	9/7/2006	Petersen	< .03		< .01		0.1		0.055	< .001	< .001	< .01	< .03	0.52	< .01			0.009	0.016	< .005	< .001	< .02		< .004	< .1	0.33	< .05	< .05			< .05
SW-1	12/30/2006	Petersen	< .03		< .01		0.02		0.199	< .001	< .001	< .01	< .03	0.79	< .01			0.012	0.025	< .005	< .001	< .02		< .004	< .1	0.16			0.11	< .05	
SW-1	3/29/2007	Petersen	< .03		< .01		0.08		0.12	< .001	< .001	< .01	< .03	0.56	< .01			0.061	0.067	< .005	0.002	< .02		< .004	< .1	0.51	< .05	< .05		< .05	< .05
SW-1	6/22/2007	Petersen	< .03		< .01		0.1		0.016	< .001	< .001	< .01	< .03	0.64	< .01			0.033	0.038	< .005	0.001	< .02		0.004	< .1	0.27	< .05	< .05		< .05	< .05
SW-1	9/29/2007	Petersen	< .03		< .01		0.09		0.116	< .001	< .001	< .01	< .03	0.4	< .01			0.04	0.045	< .005	< .001	< .02		0.008	< .1	0.33			2.17	< .05	
SW-1	12/30/2007	Petersen	< .03		< .01		0.02		0.191	< .001	< .001	< .01	< .03	0.19	< .01			0.007	0.012	< .005	< .001	< .02		0.013	< .1	0.17			2.04	< .05	
SW-1	6/18/2008	Petersen	< .03		< .01		0.1		0.066	< .001	< .001	0.01	< .03	0.72	< .01			0.006	0.029	< .005	< .001	< .02		< .004	< .1	0.24	< .05	< .05	< .05	< .05	< .05
SW-1	8/21/2008	Petersen	< .03		< .01		0.08		0.054	< .001	< .001	0.01	< .03	0.45	< .01			0.033	0.038	< .005	< .001	< .02		0.009	< .1	0.2	< .05	< .05	< .05	< .05	< .05
SW-1	5/26/2009	Petersen	< .03		< .01		0.11		0.09	< .001	< .001	0.01	< .03	0.56	< .01			0.021	0.024	< .005	0.002	< .02		< .004	< .1	0.24	< .05	< .05		< .05	< .05
SW-1	9/29/2009	Petersen																												
SW-1	11/16/2009	Petersen																												
SW-1	12/22/2011	Petersen																												
SW-1	7/11/2012	Petersen												0.63					0.008											
SW-1	9/30/2012	Petersen	<0.05	0.07	<0.05	<0.05	0.08	0.08	0.106	<0.005	<0.005	<0.005	<0.02	0.18	<0.02	<0.02	0.0002	0.005	0.011	<0.01	<0.005	0.02	<0.02	<0.01	<0.2	0.2	<0.1	<0.1		<0.01	
SW-1	3/31/2014	Petersen	<0.05	0.1	<0.05	<0.05	0.05	<0.05	0.105	<0.005	<0.005	<0.005	<0.02	0.42	<0.02	<0.02	<0.0002	0.009	0.018	<0.01	<0.005	0.17	0.15	<0.01	<0.2	0.2			<0.1	0.01	
SW-1	3/31/2015	Petersen											<0.02	0.31				0.012	0.017												
SW-1	6/30/2015	Petersen											0.02	0.47				<0.005	0.012												
SW-1	8/23/2015	Petersen											<0.02	0.29				<0.005	0.020												
SW-1A	2/10/2012	Petersen	<0.05	0.4	<0.05	<0.05	<0.05	<0.05	0.224	<0.005	<0.005	<0.005	<0.02	1.01	<0.02	<0.02	<0.0002	0.013	0.044	<0.01	<0.005	0.02	0.02	<0.01	<0.2	0.2	<0.1	<0.1		0.05	
SW-1A	3/31/2012	Petersen	<0.05	<0.05	0.05	<0.05	0.08	0.06	0.254	<0.005	<0.005	<0.005	0.02	0.34	0.02	<0.02	<0.0002	<0.005	0.031	<0.01	<0.005	0.03	0.03	<0.01	<0.2	0.2	<0.1	<0.1		0.02	
SW-1A	6/29/2012	Petersen	<0.05	<0.05	<0.05	<0.05	0.14	0.13	0.083	<0.005	<0.005	<0.005	<0.02	0.31	<0.02	<0.02	<0.0002	<0.005	0.009	<0.01	<0.005	0.02	0.02	<0.01	<0.2	0.2			<0.1	0.02	
SW-1A	7/11/2012	Petersen												0.38					0.010											
SW-1A	9/30/2012	Petersen	<0.05	<0.05	<0.05	<0.05	0.10	0.10	0.136	<0.005	<0.005	<0.005	<0.02	0.63	<0.02	<0.02	0.0002	0.009	0.029	<0.01	<0.005	0.02	0.02	<0.01	<0.2	0.3	<0.1	<0.1		<0.01	

			Trace metals																				Nutrients						
Monitoring Site	Date	Data source	Al (d) mg/L	Al (t) mg/L	As (d) mg/L	As (t) mg/L	B (d) mg/L	B (t) mg/L	Ba (d) mg/L	Cd (d) mg/L	Cr (d) mg/L	Cu (d) mg/L	Fe (d) mg/L	Fe (t) mg/L	Pb (d) mg/L	Pb (t) mg/L	Hg (d) mg/L	Mn (d) mg/L	Mn (t) mg/L	Mo (d) mg/L	Ni (d) mg/L	Se (d) mg/L	Se (t) (µg/L)	Zn (d) mg/L	NH3 mg/L N	F mg/L	NO3 mg/L	NO2 mg/L	NO2+NO3 mg/L N	T-P mg/L	O-PO4 mg/L
SW-1A	11/29/2012	Petersen	<0.05	0.07	<0.05	<0.05	<0.06	<0.05	0.227	<0.005	<0.005	<0.005	<0.02	0.15	<0.02	<0.02	<0.0002	0.005	0.009	<0.01	<0.005	0.02	<0.02	<0.01	<0.2	0.2			<0.1	<0.01	
SW-1A	3/16/2013	Petersen	<0.05	0.5	<0.05	<0.05	<0.05	<0.05	0.171	<0.005	<0.005	<0.005	<0.02	0.64	<0.02	<0.02	<0.0002	<0.005	0.024	<0.01	<0.005	<0.02	0.03	<0.01	<0.2	0.2			<0.1	<0.05	
SW-1A	4/29/2013	Petersen												0.30					0.016												
SW-1A	6/6/2013	Petersen	<0.05	<0.05	<0.05	<0.05	0.06	0.07	0.153	<0.005	<0.005	<0.005	<0.02	0.19	<0.02	<0.02	<0.0002	<0.005	0.006	<0.01	<0.005	,02	0.02	<0.01	<0.2	0.3			<0.1	0.01	
SW-1A	9/30/2013	Petersen	0.06	<0.05	<0.05	<0.05	0.10	<0.05	0.105	<0.005	<0.005	<0.005	0.02	<0.02	0.02	<0.02	<0.0002	0.006	<0.005	<0.01	<0.005	<0.02	0.03	<0.01	<0.2	0.3			<0.1	<0.01	
SW-1A	12/31/2013	Petersen	<0.05	0.2	<0.05	<0.05	<0.05	<0.05	0.186	<0.005	<0.005	<0.005	<0.02	0.42	<0.02	<0.02	<0.0002	0.007	0.016	<0.01	<0.005	0.07	0.06	<0.01	<0.2	0.2			<0.1	0.02	
SW-1A	3/31/2014	Petersen	<0.05	<0.05	<0.05	0.05	0.05	<0.05	0.120	<0.005	<0.005	<0.005	<0.02	0.16	<0.02	<0.02	<0.0002	0.005	0.008	<0.01	<0.005	0.17	0.15	<0.01	<0.2	0.2			<0.1	<0.01	
SW-1A	4/24/2014	Petersen												0.26					0.023												
SW-1A	9/30/2014	Petersen											<0.02	0.38				0.006	0.013												
SW-1A	3/31/2015	Petersen											<0.02	0.24				0.008	0.011												
SW-1A	6/30/2015	Petersen											0.02	0.21				0.005	0.007												
SW-1M	7/2/2015	Petersen											0.02	0.16				<0.005	0.008												
SW-3	6/23/1986	UII		<0.05		0.001	0.08							0.37		<0.02			0.01				0.002		<0.02	0.2	1.18	<0.02			
SW-3	8/9/1986	UII																													
SW-3	8/31/1986	UII																													
SW-3	9/16/1986	UII		<0.05		0.001	0.1							0.09		<0.02			0.01				0.002		<0.02	0.2	1	<0.02			
SW-3	10/26/1986	UII																													
SW-3	11/15/1986	UII																													
SW-3	11/18/1986	UII		1.97		0.002	0.08							56.30		<0.02			1.01				<0.001		0.05	0.3	0.08	<0.02			
SW-3	12/3/1986	UII		1.93		<0.001	0.04							10.15		<0.02			0.15				0.001		0.02	0.3	0.26	<0.02			
SW-3	1/24/1987	UII																													
SW-3	2/19/1987	UII																													
SW-3	3/11/1987	UII		0.37		0.001	0.05							4.55		<0.02			0.06				<0.001		0.09	0.3	0.05	<0.02			
SW-3	4/9/1987	UII																													
SW-3	5/11/1987	UII																													
SW-3	6/4/1987	UII		<0.05		<0.001	0.02							0.1		<0.02			0.01				0.001		<0.02	1.1	0.38	<0.01			
SW-3	7/1/1987	UII																													
SW-3	8/3/1987	UII																													
SW-3	9/4/1987	UII		<0.05		<0.001	0.08							0.2		<0.02	<0.0002		0.01				<0.001		0.02	0.4	0.30	0.01			
SW-3	10/26/1987	UII																													
SW-3	11/13/1987	UII																													
SW-3	12/16/1987	UII		0.45		<0.001	<0.01							5		<0.02	<0.0002		0.08				<0.001		0.04	0.2	0.22	<0.01			
SW-3	1/9/1988	UII																													
SW-3	2/20/1988	UII																													
SW-3	3/17/1988	UII		3.05		0.004	<0.02							56.8		<0.02	<0.0002		0.71				<0.001		0.1	0.2	0.12	<0.01			
SW-3	5/27/2005	Petersen	< .03		< .01		0.05		0.17	< .001	< .001	< .01	< .03	0.4	< .01			< .002	0.033	< .005	0.001	< .02		< .004	< .1	0.19				0.05		
SW-3	9/25/2005	Petersen	< .03		< .01		0.02		0.01	< .001	< .001	< .01	< .03		< .01			< .002		< .005	< .001	< .02		< .004	0.2	0.21	< .05	< .05	< .02	< .05	< .05
SW-3	11/3/2005	Petersen	< .03		< .01		0.08		0.096	< .001	< .001	< .01	< .03		< .01			0.008		< .005	0.001			< .004	< .1	0.07				< .05	
SW-3	3/31/2006	Petersen	0.05		< .01		0.04		0.143	< .001	< .001	< .01	< .03	2.43	< .01			0.01	0.049	< .005	0.001			0.008	0.1	0.2	0.06	< .05			< .05
SW-3	5/30/2006	Petersen	< .03		< .01		0.1		0.059	< .001	< .001	< .01	< .03	0.24	< .01			0.002	0.011	< .005	0.002	< .02		0.006	< .1	0.3	< .05	< .05		< .05	< .05
SW-3	9/7/2006	Petersen	< .03		< .01		0.09		0.028	< .001	< .001	< .01	< .03	0.2	< .01			< .002	< .002	< .005	< .001	< .02		< .004	< .1	0.27	< .05	< .05			< .05
SW-3	12/21/2006	Petersen	< .03		< .01		0.03		0.202	< .001	< .001	< .01	< .03	0.46	< .01			0.011	0.021	< .005	< .001	< .02		< .004	< .1	0.18	0.1	< .05			< .05
SW-3	3/29/2007	Petersen	< .03		< .01		0.07		0.091	< .001	< .001	< .01	< .03	0.23	< .01			0.044	0.051	< .005	0.002	< .02		< .004	< .1	0.43	< .05	< .05		< .05	< .05
SW-3	6/22/2007	Petersen	< .03		< .01		0.09		0.048	< .001	< .001	< .01	0.04	0.13	< .01			0.004	0.004	< .005	0.001	< .02		0.028	< .1	0.22	< .05	< .05		< .05	< .05
SW-3	9/29/2007	Petersen	< .03		< .01		0.08		0.085	< .001	< .001	< .01	< .03	0.06	< .01			0.007	0.012	< .005	< .001	< .02		0.01	< .1	0.33			2.92	< .05	
SW-3	12/30/2007	Petersen	< .03		< .01		0.03		0.153	< .001	< .001	< .01	< .03	0.64	< .01			0.006	0.019	< .005	< .001	< .02		< .004	< .1	0.18			2.41	< .05	
SW-3	3/22/2008	Petersen	< .03		< .01		0.04		0.054	< .001	< .001	< .01	< .03	46.22	< .01			< .002	0.618	< .005	0.001	< .02		< .004	< .1	0.29			1.69	0.11	< .05
SW-3	6/18/2008	Petersen	< .03		< .01		0.09		0.053	< .001	< .001	0.01	< .03	0.12	< .01			< .002	0.003	< .005	< .001	< .02		< .004	< .1	0.19	< .05	< .05	< .05	< .05	< .05
SW-3	8/21/2008	Petersen	< .03		< .01		0.05		0.057	< .001	< .001	0.01	< .03	0.19	< .01			0.006	0.009	< .005	< .001	< .02		< .004	< .1	0.16	< .05	< .05	< .05	< .05	< .05
SW-3	3/19/2009	Petersen	< .03		< .01		0.04		0.104	< .001	< .001	< .01	< .03	0.23	< .01			0.004	0.019	< .005	0.001	< .02		< .004	< .1	0.35			1.36	0.18	
SW-3	5/25/2009	Petersen	< .03		< .01		0.12		0.07	< .001	< .001	0.01	< .03	0.15	< .01			< .002	0.002	< .005	0.002	< .02		< .004	< .1	0.22	< .05	< .05		< .05	< .05
SW-3	9/29/2009	Petersen	< .03		< .01		0.09		0.032	< .001	0.001	0.01	< .03	< .05	< .01			< .002	0.004	< .005	0.002	< .02		< .004	0.1	0.15	< .05	< .05		< .05	< .05
SW-3	11/16/2009	Petersen					0.06	0.06					< .03	0.09				0.002	0.002			< .02	< 100.								
SW-3	5/13/2010	Petersen					0.05	0.05					< .03	0.13				0.012	0.016			< .02	< 20.								
SW-3	9/27/2010	Petersen					0.1	0.1					< .03	< .05				< .002	< .002			< .02	< 20.								

			Trace metals																				Nutrients						
Monitoring Site	Date	Data source	Al (d) mg/L	Al (t) mg/L	As (d) mg/L	As (t) mg/L	B (d) mg/L	B (t) mg/L	Ba (d) mg/L	Cd (d) mg/L	Cr (d) mg/L	Cu (d) mg/L	Fe (d) mg/L	Fe (t) mg/L	Pb (d) mg/L	Pb (t) mg/L	Hg (d) mg/L	Mn (d) mg/L	Mn (t) mg/L	Mo (d) mg/L	Ni (d) mg/L	Se (d) mg/L	Se (t) (µg/L)	Zn (d) mg/L	NH3 mg/L N	F mg/L	NO3 mg/L	NO2 mg/L	NO2+NO3 mg/L N	T-P mg/L	O-PO4 mg/L
SW-3	12/7/2010	Petersen					0.02	0.03					< .03	1.03				0.006	0.034			< .02	< 20.								
SW-3	3/26/2011	Petersen					0.03	0.04					< .03	1.58				0.017	0.127			< .02	< 20.								
SW-3	6/1/2011	Petersen					0.07	0.08					< .02	4.72				0.013	0.082			0.06	60								
SW-3	9/10/2011	Petersen	<0.05	<0.05	<0.05	<0.05	0.11	0.11	0.035	<0.005	<0.005	<0.005	0.02	0.06	<0.02	<0.02	<0.0002	<0.005	<0.005	<0.01	<0.005	0.02	0.04	<0.01	<0.2	0.2			<0.1	<0.01	
SW-3	12/21/2011	Petersen					< .05	0.1					< .02	0.16				< .005	0.014			0.02	< 20.								
SW-3	3/31/2012	Petersen					0.06	0.05					< .02	0.17				< .005	0.036			0.02	20								
SW-3	4/24/2012	Petersen					0.06	0.08					< .02	0.26				0.009	0.016			0.02	< 20.			< .1	< .1			< .01
SW-3	6/21/2012	Petersen					0.1	0.09					0.02	0.24				< .005	0.01			0.02	20								
SW-3	7/11/2012	Petersen												0.32					0.007											
SW-3	9/28/2012	Petersen					0.09	0.09					< .02	0.13				< .005	0.007			0.03	< 20.								
SW-3	11/29/2012	Petersen					<0.05	<0.05					<0.02	0.07				0.005	0.006			<0.02	<0.02								
SW-3	12/12/2012	Petersen					< .05	0.05					< .02	0.46				< .005	0.014			0.02	20								
SW-3	3/14/2013	Petersen																													
SW-3	4/29/2013	Petersen												0.17					0.016												
SW-3	5/31/2013	Petersen																													
SW-3	9/30/2013	Petersen					0.09	0.11					<0.02	0.41				<0.005	0.018			0.02	0.02						<0.1		
SW-3	12/22/2013	Petersen					<0.05	<0.05					<0.02	0.21				<0.005	0.008			0.05	0.08						<0.1		
SW-3	3/31/2014	Petersen					0.06	0.05					<0.02	0.86				<0.005	0.028			0.20	0.23						<0.1		
SW-3	6/16/2014	Petersen												0.17					0.008												
SW-11	8/21/2008	Petersen																													
SW-11	12/23/2011	Petersen																													
SW-11	2/9/2012	Petersen	0.05	0.2	<0.05	<0.05	0.07	0.07	0.027	<0.005	<0.005	<0.005	0.06	0.34	<0.02	<0.02	0.0002	0.044	0.052	<0.01	<0.005	0.02	0.02	<0.01	<0.2	<0.1				0.13	
SW-11	3/20/2012	Petersen																													
SW-11	4/24/2012	Petersen																													
SW-11	5/8/2012	Petersen																													
SW-11	5/20/2012	Petersen																													
SW-11	6/29/2012	Petersen																													
SW-11	7/10/2012	Petersen																													
SW-11	9/30/2012	Petersen																													
SW-11	11/29/2012	Petersen	<0.05	0.1	0.05	<0.05	0.07	0.07	0.026	<0.005	<0.005	<0.005	<0.005	0.16	0.02	<0.02	<0.0002	<0.005	0.005	<0.01	<0.005	0.02	<0.02	<0.01	<0.2	0.2			<0.1	0.02	
SW-11	2/26/2013	Petersen																													
SW-11	3/14/2013	Petersen																													
SW-11	3/16/2013	Petersen																													
SW-11	4/29/2013	Petersen	<0.05	0.2	<0.05	<0.05	0.11	0.14	0.025	<0.005	<0.005	<0.005	<0.02	0.27	<0.02	<0.02	<0.0002	<0.005	0.006	<0.01	<0.005	0.02	0.02	<0.01	<0.2	<0.5			<0.1	0.05	
SW-11	5/31/2013	Petersen																													
SW-11	6/6/2013	Petersen																													
SW-11	9/24/2013	Petersen																													
SW-11	9/30/2013	Petersen																													
SW-11	11/13/2013	Petersen																													
SW-11	12/19/2013	Petersen																													
SW-11	12/22/2013	Petersen																													
SW-11	1/16/2014	Petersen																													
SW-11	2/11/2014	Petersen	<0.05	0.1	<0.05	<0.05	0.05	<0.05	0.025	<0.005	<0.005	<0.005	0.07	0.20	<0.02	<0.02	<0.0002	0.010	<0.005	<0.01	<0.005	0.12	0.11	<0.01	<0.2	<0.1	<0.1	<0.1		0.07	
SW-11	2/28/2014	Petersen	<0.05	0.3	0.05	<0.05	<0.05	<0.05	0.03	<0.005	0.010	<0.005	<0.02	0.51	<0.02	<0.02	<0.0002	<0.005	0.012	<0.01	<0.005	0.18	0.15	<0.01	<0.2	0.2			<0.1	0.04	
SW-11	3/28/2014	Petersen																													
SW-11	3/31/2014	Petersen																													
SW-11	4/5/2014	Petersen																													
SW-11	4/24/2014	Petersen																													
SW-11	6/15/2014	Petersen																													
SW-11	9/28/2014	Petersen																													
SW-15	2/10/2012	Petersen	<0.05	0.09	<0.05	<0.05	0.42		0.029	<0.005	<0.005	<0.005	0.02	0.11	0.02	<0.02	<0.0002	0.087	0.103	<0.01	<0.005	0.02	0.04	<0.01	<0.2	<0.5	<0.5	<0.5		0.07	
SW-15	3/31/2012	Petersen	<0.05	0.2	<0.05	<0.05	0.52	0.51	0.039	<0.005	<0.005	<0.005	<0.02	0.13	0.03	<0.02	<0.0002	<0.005	0.053	<0.01	<0.005	0.05	0.03	<0.01	<0.2	<0.5	<0.5	<0.5		0.05	
SW-15	4/24/2012	Petersen	<0.05	0.2	<0.05	<0.05	0.64	0.66	0.040	<0.005	<0.005	<0.005	<0.02	0.22	<0.02	<0.02	<0.0002	0.027	0.039	<0.01	<0.005	0.02	0.04	<0.01	0.3	0.6	<0.5	<0.5		0.05	
SW-15	5/8/2012	Petersen																													
SW-15	9/28/2012	Petersen	<0.05	<0.05	<0.05	<0.05	0.44	0.59	0.064	<0.005	<0.005	<0.005	<0.02	0.05	<0.02	<0.02	0.0002	<0.005	0.005	<0.01	<0.005	0.02	0.02	<0.01	<0.2	0.6			<0.1	0.03	

			Trace metals																				Nutrients						
Monitoring Site	Date	Data source	Al (d) mg/L	Al (t) mg/L	As (d) mg/L	As (t) mg/L	B (d) mg/L	B (t) mg/L	Ba (d) mg/L	Cd (d) mg/L	Cr (d) mg/L	Cu (d) mg/L	Fe (d) mg/L	Fe (t) mg/L	Pb (d) mg/L	Pb (t) mg/L	Hg (d) mg/L	Mn (d) mg/L	Mn (t) mg/L	Mo (d) mg/L	Ni (d) mg/L	Se (d) mg/L	Se (t) (µg/L)	Zn (d) mg/L	NH3 mg/L N	F mg/L	NO3 mg/L	NO2 mg/L	NO2+NO3 mg/L N	T-P mg/L	O-PO4 mg/L
SW-15	12/12/2012	Petersen	<0.05	0.08	<0.05	<0.05	0.62	0.72	0.029	<0.005	<0.005	<0.005	<0.02	0.10	<0.02	<0.02	<0.0002	<0.005	0.012	<0.01	<0.005	0.06	0.04	<0.01	<0.2	0.4			<0.1	0.03	
SW-15	2/27/2013	Petersen	<0.05	0.08	<0.05	0.05	0.52	0.53	0.024	<0.005	<0.005	<0.005	<0.02	0.12	<0.02	0.02	<0.0002	0.031	0.057	<0.01	<0.005	0.03	0.04	<0.01	<0.2	0.4			<0.1	0.02	
SW-15	4/29/2013	Petersen												0.16					0.035												
SW-15	5/31/2013	Petersen																													
SW-15	12/22/2013	Petersen																													
SW-15	3/31/2014	Petersen																													
SW-15	4/24/2014	Petersen																													
SW-15	9/29/2014	Petersen																													
SW-15	10/24/2014	Petersen																													
SW-15	12/21/2014	Petersen											<0.02	0.09				<0.005	0.008												
SW-15	3/21/2015	Petersen											<0.02	0.16				<0.005	0.010												
Kanab at C.R.	2/10/2012	Petersen	<0.05	<0.3	<0.05	<0.05	<0.05	<0.05	0.191	<0.005	<0.005	<0.005	<0.02	0.69	0.02	<0.02	<0.0002	0.014	0.036	<0.01	<0.005	0.02	0.03	<0.01	<0.2	0.2	<0.1	<0.1		0.04	
Kanab at C.R.	3/31/2012	Petersen	<0.05	<0.05	<0.05	<0.05	0.10	0.07	0.221	<0.005	<0.005	<0.005	<0.02	0.15	0.02	0.02	<0.0002	<0.005	0.034	<0.01	<0.005	0.03	0.02	<0.01	<0.2	0.2	<0.1	<0.1		<0.01	
Kanab at C.R.	6/29/2012	Petersen	<0.05	<0.05	<0.05	<0.05	0.09	0.11	0.033	<0.005	<0.005	<0.005	<0.02	0.05	<0.02	<0.02	<0.0002	<0.005	0.010	<0.01	<0.005	0.02	0.03	<0.01	<0.2	0.2			<0.1	0.02	
Kanab at C.R.	7/11/2012	Petersen												0.10					0.009												
Kanab at C.R.	9/30/2012	Petersen	<0.05	<0.05	<0.05	<0.05	0.09	0.09	0.073	<0.005	<0.005	<0.005	<0.02	0.03	<0.02	<0.02	0.0002	<0.005	<0.005	<0.01	<0.005	0.02	0.02	<0.01	<0.2	0.2	<0.1	<0.1	<0.1	<0.01	
Kanab at C.R.	11/29/2012	Petersen	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	0.192	<0.005	<0.005	<0.005	<0.02	0.06	0.02	<0.02	<0.0002	<0.005	0.007	<0.01	<0.005	<0.02	<0.02	<0.01	<0.2	0.2			<0.1	<0.01	
Kanab at C.R.	2/27/2013	Petersen	<0.05	1.4	<0.05	<0.05	<0.05	<0.05	0.157	<0.005	<0.005	<0.005	<0.02	2.38	<0.02	<0.02	<0.0002	<0.005	0.063	<0.01	<0.005	<0.02	0.02	<0.01	<0.2	0.2			<0.1	0.08	
Kanab at C.R.	3/16/2013	Petersen	<0.05	0.3	<0.05	<0.05	<0.05	<0.05	0.156	<0.005	<0.005	<0.005	<0.02	0.36	<0.02	<0.02	<0.0002	<0.004	0.022	<0.01	<0.005	<0.02	<0.02	<0.01	<0.2	0.2			<0.1	<0.05	
Kanab at C.R.	4/29/2013	Petersen												0.30					0.016												
Kanab at C.R.	6/6/2013	Petersen	<0.05	<0.05	<0.05	<0.05	0.07	0.08	0.083	<0.005	<0.005	<0.005	<0.02	0.11	<0.02	<0.02	<0.0002	<0.005	<0.005	<0.01	<0.005	0.03	<0.02	<0.01	<0.2	0.2			<0.1	<0.01	
Kanab at C.R.	9/30/2013	Petersen	0.05	<0.05	<0.05	<0.05	0.10	0.10	0.067	<0.005	<0.005	<0.005	<0.02	0.06	0.03	<0.02	<0.0002	0.005	0.007	<0.01	<0.005	<0.02	<0.02	<0.01	<0.2	0.2			<0.1	<0.01	
Kanab at C.R.	12/31/2013	Petersen	<0.05	0.1	<0.05	<0.05	<0.05	<0.05	0.173	<0.005	<0.005	<0.005	<0.02	0.40	<0.02	<0.02	<0.0002	0.009	0.018	<0.01	<0.005	0.08	0.06	<0.01	<0.2	0.2			<0.1	0.02	
Kanab at C.R.	2/28/2014	Petersen	0.07	5.7	<0.05	<0.05	0.06	0.09	0.165	<0.005	<0.005	<0.005	0.06	9.49	<0.02	<0.02	<0.0002	0.005	0.261	<0.01	<0.005	0.14	0.14	<0.01	<0.2	0.2			<0.1	0.42	
Kanab at C.R.	3/31/2014	Petersen	<0.05	0.06	<0.05	<0.05	0.05	<0.05	0.093	<0.005	0.005	<0.005	<0.02	0.30	<0.02	<0.02	<0.0002	0.006	0.017	<0.01	<0.005	0.14	0.16	<0.01	<0.2	0.2			<0.1	0.01	
Kanab at C.R.	4/24/2014	Petersen												0.05					0.017												
Kanab at C.R.	6/18/2014	Petersen											<0.02	0.04				<0.005	<0.005												
Kanab at C.R.	9/28/2014	Petersen											<0.02	0.23				<0.005	0.097												
Kanab at C.R.	12/21/2014	Petersen	2940										<0.02	0.28				<0.005	0.013												
Kanab at C.R.	3/31/2015	Petersen	638										<0.02	0.08				0.007	0.011												
Kanab at C.R.	6/30/2015	Petersen	65										<0.02	0.02				<0.005	<0.005												
Kanab at C.R.	8/23/2015	Petersen	65										<0.02	0.02				<0.005	<0.005												
RSD-1	3/31/2012	Petersen																													
RSD-1	4/25/2012	Petersen																													
RSD-1	5/8/2012	Petersen																													
RSD-1	2/27/2013	Petersen	<0.05	0.1	<0.05	<0.05	0.06	0.05	0.036	<0.005	<0.005	<0.005	<0.02	0.12	<0.02	0.02	<0.0002	<0.005	<0.005	<0.01	<0.005	<0.02	0.03	<0.01	<0.2	0.2			0.2	0.04	
RSD-1	3/16/2013	Petersen																													
RSD-1	3/29/2013	Petersen																													
RSD-1	4/29/2013	Petersen																													
RSD-1	6/1/2013	Petersen																													
RSD-1	9/28/2013	Petersen																													
RSD-1	10/1/2013	Petersen																													
RSD-1	10/8/2013	Petersen																													
RSD-1	12/19/2013	Petersen																													
RSD-1	12/31/2013	Petersen																													
RSD-1	1/16/2014	Petersen																													
RSD-1	2/11/2014	Petersen																													
RSD-1	2/28/2014	Petersen	<0.05	65.1	<0.05	0.12	0.23	0.41	0.073	<0.005	<0.005	<0.005	0.02	43.1	<0.02	0.03	<0.0002	0.024	3.83	<0.01	<0.005	0.07	0.14	<0.01	<0.2	0.2			1.3	4.0	
RSD-1	3/30/2014	Petersen																													
RSD-1	4/5/2014	Petersen																													
RSD-1	4/23/2014	Petersen																													
RSD-1	6/15/2014	Petersen																													
RSD-1	9/28/2015	Petersen	0																												
RSD-1	10/24/2014	Petersen	0																												
RSD-1	11/13/2014	Petersen	0																												

			Trace metals																					Nutrients						
Monitoring Site	Date	Data source	Al (d) mg/L	Al (t) mg/L	As (d) mg/L	As (t) mg/L	B (d) mg/L	B (t) mg/L	Ba (d) mg/L	Cd (d) mg/L	Cr (d) mg/L	Cu (d) mg/L	Fe (d) mg/L	Fe (t) mg/L	Pb (d) mg/L	Pb (t) mg/L	Hg (d) mg/L	Mn (d) mg/L	Mn (t) mg/L	Mo (d) mg/L	Ni (d) mg/L	Se (d) mg/L	Se (t) (µg/L)	Zn (d) mg/L	NH3 mg/L N	F mg/L	NO3 mg/L	NO2 mg/L	NO2+NO3 mg/L N	T-P mg/L	O-PO4 mg/L
RSD-1	12/19/2014	Petersen	0																											
RSD-1	1/30/2015	Petersen	0																											
RSD-1	3/29/2015	Petersen	0																											
RSD-1	7/1/2015	Petersen	0																											
RSD-1	8/19/2015	Petersen	0																											
Knob Wash	10-Feb-12	Petersen																												
Knob Wash	25-Apr-12	Petersen																												
Knob Wash	29-Jun-12	Petersen																												
Knob Wash	30-Sep-12	Petersen																												
Knob Wash	28-Nov-12	Petersen																												
Knob Wash	27-Feb-13	Petersen																												
Knob Wash	29-Apr-13	Petersen																												
Knob Wash	1-Oct-13	Petersen																												
Knob Wash	31-Dec-13	Petersen																												
Knob Wash	31-Mar-14	Petersen																												
Knob Wash	4/24/2014	Petersen																												
Knob Wash	6/15/2014	Petersen																												
EW-1	12/23/2011	Petersen																												
EW-1	2/9/2012	Petersen	0.09	0.5	<0.05	<0.05	0.07	0.07	0.016	<0.005	<0.005	<0.005	0.08	0.42	<0.02	<0.02	0.0002	0.006	0.014	<0.01	<0.005	<0.02	<0.02	0.11	<0.2	<0.1	<0.1	<0.1		0.16	
EW-1	3/29/2012	Petersen																												
EW-1	3/30/2012	Petersen																												
EW-1	4/24/2012	Petersen																												
EW-1	4/25/2012	Petersen																												
EW-1	5/8/2012	Petersen																												
EW-1	6/21/2012	Petersen																												
EW-1	7/10/2012	Petersen																												
EW-1	9/29/2012	Petersen																												
EW-1	11/27/2012	Petersen																												
EW-1	12/13/2012	Petersen																												
EW-1	3/12/2013	Petersen	<0.05	0.9	0.05	0.05	0.58	0.61	0.139	503	<0.005	<0.005	<0.02	0.63	<0.02	<0.02	<0.0002	0.016	0.038	<0.01	<0.005	0.02	0.04	<0.01	<0.2	0.4			11.9	<0.05
EW-1	4/29/2013	Petersen																												
EW-1	5/31/2013	Petersen																												
EW-1	6/6/2013	Petersen																												
EW-1	2/28/2014	Petersen																												
EW-1	7/1/2015	Petersen	3350										0.03	22.4				0.016	5.95												
April Creek	6/21/2012	Petersen																												
April Creek	9/30/2012	Petersen	<0.05	0.05	0.05	0.05	1.15	1.28	0.068	<0.005	<0.005	<0.005	<0.02	0.06	<0.02	<0.02	0.0003	0.010	0.030	<0.01	<0.005	0.04	0.03	<0.01	<0.2	0.4	<0.02	<0.2		0.05	
April Creek	2/27/2013	Petersen	<0.05	0.2	<0.05	<0.05	0.60	0.55	0.016	<0.005	<0.005	<0.005	<0.02	0.18	<0.02	0.02	<0.0002	0.047	0.097	<0.01	<0.005	0.03	0.04	<0.01	<0.2	0.4			<0.1	0.04	
April Creek	4/29/2013	Petersen	<0.05	0.2	<0.05	<0.05	0.31	0.36	0.021	<0.005	<0.005	0.005	<0.02	0.14	0.02	<0.02	<0.0002	<0.005	0.016	<0.01	<0.005	0.02	<0.02	<0.01	<0.2	<0.5			<0.1	0.09	
April Creek	5/31/2013	Petersen																												
April Creek	9/30/2013	Petersen																												
April Creek	12/31/2013	Petersen											<0.02	0.36				0.013	0.028												
April Creek	3/31/2014	Petersen																												
April Creek	4/24/2014	Petersen																												
April Creek	6/18/2014	Petersen																												
April Creek	9/30/2014	Petersen											<0.02	0.06				0.007	0.009												
April Creek	12/22/2014	Petersen											<0.02	<0.02				0.005	0.007												
April Creek	3/31/2015	Petersen											<0.02	0.11				0.055	0.063												
April Creek	7/1/2015	Petersen																												
April Creek	8/19/2015	Petersen																												
Priscilla Creek	2/27/2013	Petersen	<0.05	<0.05	0.07	0.07	1.08	0.99	0.024	<0.005	<0.005	<0.005	0.02	0.37	<0.02	0.03	<0.0002	0.512	0.527	<0.01	<0.005	0.05	0.05	<0.01	0.2	<1			<0.1	0.04	
Priscilla Creek	4/29/2013	Petersen	<0.05	0.1	0.07	0.06	1.59	1.77	0.024	<0.005	<0.005	<0.005	<0.02	0.41	<0.02	0.02	<0.0002	0.343	0.424	<0.01	<0.005	0.06	0.06	<0.01	<0.2	<1			<0.1	0.03	
Priscilla Creek	5/31/2013	Petersen	<0.05	19.3	0.08	0.10	1.86	1.88	0.021	<0.005	<0.005	<0.005	<0.02	40.9	0.02	0.06	<0.0002	0.170	5.72	<0.01	<0.005	0.07	0.04	<0.01	1.0	<1			<0.1	1.3	

			Trace metals																				Nutrients						
			Al (d)	Al (t)	As (d)	As (t)	B (d)	B (t)	Ba (d)	Cd (d)	Cr (d)	Cu (d)	Fe (d)	Fe (t)	Pb (d)	Pb (t)	Hg (d)	Mn (d)	Mn (t)	Mo (d)	Ni (d)	Se (d)	Se (t)	Zn (d)	NH3	F	NO3	NO2	NO2+NO3	T-P	O-PO4
Monitoring Site	Date	Data source	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	(µg/L)	mg/L	mg/L N	mg/L	mg/L	mg/L	mg/L N	mg/L	mg/L
Priscilla Creek	10/8/2013	Petersen																												
Priscilla Creek	4/1/2014	Petersen																												
Priscilla Creek	10/1/2014	Petersen											<0.02	3.16				0.431	0.627											
Priscilla Creek	7/1/2015	Petersen																												
Priscilla Creek	8/20/2015	Petersen																												
Springs																														
SP7-1	2/9/2012	Petersen	<0.05	<0.05	<0.05	<0.05	0.06	0.06	0.046	<0.005	<0.005	<0.005	0.10	0.86	<0.02	<0.02	0.0002	0.126	0.128	<0.01	<0.005	0.03	0.03	<0.01	<0.2	0.2				0.03	
SP7-1	6/29/2012	Petersen	<0.05	0.2	<0.05	<0.05	0.07	0.08	0.039	<0.005	<0.005	<0.005	<0.02	1.31	<0.02	<0.02	<0.0002	<0.005	0.081	<0.01	<0.005	0.02	0.04	<0.01	<0.2	0.2			<0.1	0.04	
SP7-1	9/30/2012	Petersen	<0.05	0.05	<0.05	<0.05	0.06	0.18	0.061	<0.005	<0.005	<0.005	<0.02	1.69	<0.02	<0.02	0.0002	0.087	0.131	<0.01	<0.005	<0.02	0.02	<0.01	<0.2	0.2	<0.1	<0.1		0.02	
SP7-1	11/29/2012	Petersen	<0.05	0.1	<0.05	0.05	<0.05	0.07	0.215	<0.005	<0.005	<0.005	<0.02	7.22	<0.02	<0.02	<0.0002	0.006	0.185	<0.01	<0.005	<0.02	0.02	<0.01	<0.2	0.2			<0.1	0.04	
SP7-1	6/6/2013	Petersen	<0.05	0.6	<0.05	<0.05	0.05	0.07	0.054	<0.005	<0.005	<0.005	<0.02	3.37	<0.02	<0.02	<0.0002	0.006	0.157	<0.01	<0.005	0.05	0.03	<0.01	<0.2	0.2			<0.1	0.09	
SP7-1	10/8/2013	Petersen	0.08	0.2	<0.05	<0.05	0.06	0.07	0.051	<0.005	<0.005	<0.005	0.03	1.26	<0.02	0.02	<0.0002	0.082	0.138	<0.01	<0.005	0.03	0.03	<0.01	<0.2	0.2			<0.1	0.02	
SP7-1	3/31/2014	Petersen	<0.05	0.08	0.05	0.05	0.05	0.08	0.044	<0.005	<0.005	<0.005	0.09	1.68	<0.02	<0.02	<0.0002	0.044	0.076	<0.01	<0.005	0.23	0.22	<0.01	<0.2	0.2			<0.1	0.02	
Knob Spring	10-Feb-12	Petersen	<0.05	0.09	<0.05	<0.05	0.08	0.09	0.057	<0.005	<0.005	0.005	0.26	0.58	<0.02	0.02	<0.0002	0.776	1.35	<0.01	<0.005	0.03	0.04	<0.01	<0.2	0.2				0.20	
Knob Spring	25-Apr-12	Petersen																													
Knob Spring	29-Jun-12	Petersen																													
Knob Spring	30-Sep-12	Petersen																													
Knob Spring	28-Nov-12	Petersen																													
Knob Spring	27-Feb-13	Petersen																													
Knob Spring	29-Apr-13	Petersen																													
Knob Spring	1-Oct-13	Petersen																													
Knob Spring	31-Dec-13	Petersen																													
Knob Spring	31-Mar-14	Petersen																													
Knob Spring	4/24/2014	Petersen																													
Knob Spring	6/15/2014	Petersen																													
Coyote Seep	25-Apr-12	Petersen	<0.05	0.05	<0.05	<0.05	0.08	0.11	0.028	<0.005	<0.005	<0.005	0.02		<0.02	<0.02	<0.0002	0.021	0.028	<0.01	<0.005	0.02	0.03	<0.01	<0.2	<0.5	<0.5	<0.5		0.03	<0.01
Coyote Seep	29-Jun-12	Petersen	<0.05	<0.05	<0.05	<0.05	0.13	0.13	0.023	<0.005	<0.005	<0.005	<0.02	0.39	<0.02	<0.02	<0.0002	<0.005	0.023	<0.01	<0.005	0.03	0.03	<0.01	<0.2	<0.2			<0.1	0.04	
Coyote Seep	30-Sep-12	Petersen	<0.05	<0.05	0.05	0.05	0.10	0.20	0.046	<0.005	<0.005	<0.005	0.02	0.27	<0.02	<0.02	0.0002	0.068	0.068	<0.01	<0.005	0.03	0.03	<0.01	<0.2	<0.2	<0.2	<0.2		0.02	
Coyote Seep	11/28/2012	Petersen	<0.05	<0.05	0.05	0.05	0.07	0.06	0.030	<0.005	<0.005	<0.005	0.24	0.35	<0.02	<0.02	<0.0002	0.098	0.090	<0.01	<0.005	0.08	0.02	<0.01	<0.2	0.2			<0.1	0.02	
Coyote Seep	3/16/2013	Petersen	<0.05	0.09	<0.05	0.05	0.07	0.07	0.036	<0.005	<0.005	<0.005	<0.02	0.54	<0.02	<0.02	<0.0002	<0.005	0.081	<0.01	<0.005	0.03	0.03	<0.01	<0.2	<0.2			<0.1	<0.05	
Coyote Seep	4/29/2013	Petersen												0.80					0.043												
Coyote Seep	5/31/2013	Petersen	<0.05	0.2	0.05	0.05	0.10	0.11	0.027	<0.005	<0.005	<0.005	<0.02	0.90	0.02	<0.02	<0.0002	0.041	0.101	<0.01	<0.005	0.04	0.03	<0.01	<0.2	<0.2			<0.1	0.02	
Coyote Seep	9/30/2013	Petersen	0.06	0.5	<0.05	<0.05	0.09	0.10	0.056	<0.005	<0.005	<0.005	<0.02	1.93	0.05	<0.02	<0.0002	0.005	0.099	<0.01	<0.005	0.02	<0.02	<0.01	<0.2	<0.1			<0.1	0.23	
Coyote Seep	12/31/2013	Petersen	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	0.044	<0.005	0.010	<0.005	0.18	1.93	<0.02	<0.02	<0.0002	0.155	0.185	<0.01	<0.005	0.14	0.12	<0.01	0.5	<0.1			<0.1	0.07	
Coyote Seep	3/31/2014	Petersen	<0.05	0.6	0.05	0.07	0.05	0.05	0.029	<0.005	0.011	<0.005	0.03	3.74	<0.02	<0.02	<0.0002	<0.005	0.136	<0.01	<0.005	0.27	0.25	<0.01	<0.2	<0.2			<0.1	0.30	
Coyote Seep	6/18/2014	Petersen											<0.02	0.38				0.026	0.034												
Coyote Seep	9/30/2014	Petersen	0.598										0.02	0.18				0.033	0.041												
Coyote Seep	12/21/2014	Petersen	1.09										0.03	0.68				0.050	0.080												
Coyote Seep	3/31/2015	Petersen	0.233										0.11	0.63				0.024	0.036												
Coyote Seep	6/30/2015	Petersen	0																												
Coyote Seep	8/20/2015	Petersen	0																												
Alkali Seep	9/10/2011	Petersen	<0.05	0.05	0.05	0.05	0.67	1.16	0.035	<0.005	<0.005	<0.005	0.02	1.25	0.02	0.02	<0.0002	0.009	0.021	<0.01	<0.005	0.03	0.04	<0.01	<0.2	<0.5			<0.1	0.04	
Alkali Seep	12/21/2011	Petersen	<0.05	4.3	<0.05	<0.05	0.52	0.64	0.044	<0.005	<0.005	<0.005	0.02	2.57	<0.02	<0.02	<0.0002	0.008	0.047	<0.01	<0.005	0.03	<0.02	<0.01	1.0	0.06			<0.1	0.97	
Alkali Seep	2/10/2012	Petersen																													
Alkali Seep	5/8/2012	Petersen	<0.05	1.1	<0.05	<0.05	0.6	0.6	0.044	<0.005	<0.005	<0.005	0.04	1.14	<0.02	0.02	<0.0002	0.011	0.016	<0.01	<0.005	<0.04	<0.04	<0.01	0.3	0.6	<0.1	<0.02	<0.1	0.36	
Alkali Seep	7/11/2012	Petersen	<0.05	2.2	<0.05	<0.05	1.09	0.80	0.049	<0.005	<0.005	<0.005	0.04	1.59	<0.02	<0.02	<0.0002	0.007	0.047	<0.01	<0.005	0.03	0.03	<0.01	0.5	0.7			<0.1	0.14	
Alkali Seep	3/16/2013	Petersen	<0.05	1.9	<0.05	0.05	0.67	0.80	0.035	<0.005	<0.005	<0.005	<0.02	1.88	0.02	<0.02	<0.0002	<0.005	0.021	<0.01	<0.005	0.02	0.03	<0.01	<0.2	0.4			<0.1	<0.05	
Alkali Seep	6/5/2013	Petersen	<0.05	3	0.05	0.05	0.68	0.88	0.042	<0.005	<0.005	<0.005	0.02	2.68	0.02	<0.02	<0.0002	0.007	0.034	<0.01	<0.005	0.04	0.03	<0.01	<0.2	<0.5			<0.1	0.13	
Alkali Seep	9/30/2013	Petersen																													
Alkali Seep	12/22/2013	Petersen																													
Alkali Seep	3/31/2014	Petersen																													

			Trace metals																				Nutrients						
Monitoring Site	Date	Data source	Al (d) mg/L	Al (t) mg/L	As (d) mg/L	As (t) mg/L	B (d) mg/L	B (t) mg/L	Ba (d) mg/L	Cd (d) mg/L	Cr (d) mg/L	Cu (d) mg/L	Fe (d) mg/L	Fe (t) mg/L	Pb (d) mg/L	Pb (t) mg/L	Hg (d) mg/L	Mn (d) mg/L	Mn (t) mg/L	Mo (d) mg/L	Ni (d) mg/L	Se (d) mg/L	Se (t) (µg/L)	Zn (d) mg/L	NH3 mg/L N	F mg/L	NO3 mg/L	NO2 mg/L	NO2+NO3 mg/L N	T-P mg/L	O-PO4 mg/L
Alkali Seep	10/1/2014	Petersen											0.05	1.32				0.013	0.020											
Alkali Seep	12/21/2014	Petersen											0.82	37.0				0.013	0.406											
Alkali Seep	3/31/2015	Petersen											0.16	76.0				0.544	5.51											
April Seep	5/8/2012	Petersen	<0.05	1.6	<0.05	0.05	0.09	0.09	0.023	<0.005	<0.005	<0.005	0.02	7.26	0.02	0.02	<0.0002	1.28	2.12	<0.01	<0.005	0.04	0.05	<0.01	0.3	0.9	<0.1	<0.02	<0.1	0.15	
April Seep	6/21/2012	Petersen																													
April Seep	9/30/2012	Petersen																													
April Seep	2/27/2013	Petersen																													
April Seep	4/29/2013	Petersen																													
April Seep	5/31/2013	Petersen	<0.05	53.1	0.07	0.12	1.07	1.23	0.050	<0.005	<0.005	<0.005	0.02	94.3	0.03	0.10	<0.0002	0.025	4.70	<0.01	<0.005	0.07	0.04	<0.01	0.6	<1			<0.1	2	
April Seep	9/30/2013	Petersen																													
April Seep	12/31/2013	Petersen											0.04	12.4				0.016	0.294											
April Seep	3/31/2014	Petersen																													
April Seep	4/24/2014	Petersen																													
April Seep	9/30/2014	Petersen																													
April Seep	12/22/2014	Petersen																													
April Seep	3/31/2015	Petersen											<0.02	2.55				0.007	0.046											
April Seep	7/1/2015	Petersen																													
April Seep	8/19/2015	Petersen																													
Hill Spring	9/10/2011	Petersen	<0.05	0.2	0.06	0.05	0.62	0.76	0.022	<0.005	<0.005	<0.005	1.28	2.88	0.03	0.03	<0.0002	0.131	0.154	<0.01	<0.005	0.05	0.04	<0.01	<0.2	0.6			<0.1	<0.05	
Hill Spring	2/10/2012	Petersen	0.06	0.6	<0.05	<0.05	0.67	0.71	0.023	<0.005	<0.005	<0.005	0.19	4.43	<0.02	<0.02	<0.0002	0.147	0.172	<0.01	<0.005	0.04	0.04	<0.01	<0.2	<0.5	<0.5	<0.5		0.04	
Hill Spring	6/29/2012	Petersen	<0.05	0.8	<0.05	<0.05	0.59	0.69	0.025	<0.005	<0.005	<0.005	6.97	11.4	<0.02	<0.02	<0.0002	0.200		<0.01	<0.005	0.04	0.03	<0.01	0.3	0.4			<0.1	0.07	
Hill Spring	9/30/2012	Petersen	<0.05	<0.05	<0.05	0.05	0.67	0.64	0.025	<0.005	<0.005	<0.005	0.06	1.13	<0.02	<0.02	<0.0002	0.15	0.15	<0.01	<0.005	0.04	0.02	<0.01	<0.2	0.4	<0.2	<0.2		<0.01	
Hill Spring	2/28/2013	Petersen	<0.05	0.2	<0.05	0.05	0.67	0.78	0.024	<0.005	<0.005	<0.005	0.24	1.01	<0.02	<0.02	<0.0002	0.130	0.166	<0.01	<0.005	0.03	0.04	<0.01	<0.2	0.3	0.2	<0.1		<0.003	
Hill Spring	6/5/2013	Petersen	<0.05	0.1	0.05	0.06	0.62	0.76	0.022	<0.005	<0.005	<0.005	0.09	0.88	0.02	<0.02	<0.0002	0.128	0.161	<0.01	<0.005	0.03	0.03	<0.01	<0.2	0.4			<0.1	0.01	
Hill Spring	1/1/2014	Petersen																													
Hill Spring	4/24/2014	Petersen																													
Hill Spring	10/24/2014	Petersen																													
Hill Spring	7/1/2015	Petersen											0.05	1.63				0.134	0.163											
Pond Spring	7/27/2008	Petersen																													
Pond Spring	9/10/2011	Petersen	<0.05	<0.05	0.05	0.07	0.36	0.37	0.013	<0.005	<0.005	<0.005	<0.02	<0.02	0.02	0.03	<0.0002	<0.005	<0.005	<0.01	<0.005	0.05	0.05	<0.01	<0.2	0.4			0.3	<0.01	
Pond Spring	2/10/2012	Petersen	<0.05	<0.05	<0.05	0.05	0.41	0.39	0.015	<0.005	<0.005	<0.005	<0.02	<0.02	<0.02	<0.02	<0.0002	<0.005	<0.005	<0.01	<0.005	0.04	0.04	<0.01	<0.2	0.4	0.3	<0.1		<0.01	
Pond Spring	6/29/2012	Petersen	<0.05	<0.05	<0.05	<0.05	0.35	0.32	0.011	<0.005	<0.005	<0.005	<0.02	<0.02	<0.02	<0.02	<0.0002	<0.005	<0.005	<0.01	<0.005	0.04	0.02	<0.01	<0.2	0.4			0.2	0.02	
Pond Spring	9/30/2012	Petersen	<0.05	<0.05	0.05	0.05	0.34	0.34	0.013	<0.005	<0.005	<0.005	<0.02	<0.02	<0.02	<0.02	<0.0002	<0.005	<0.005	<0.01	<0.005	0.04	0.03	<0.01	<0.2	0.5	0.4	<0.2		<0.01	
Pond Spring	2/28/2013	Petersen	<0.05	<0.05	0.05	<0.05	0.39	0.37	0.015	<0.005	<0.005	<0.005	<0.02	0.02	<0.02	<0.02	<0.0002	<0.005	<0.005	<0.01	<0.005	0.03	0.04	<0.01	<0.2	0.4	0.3	<0.1		<0.01	
Pond Spring	6/5/2013	Petersen	<0.05	<0.05	0.06	0.07	0.36	0.4	0.014	<0.005	<0.005	<0.005	<0.02	<0.02	<0.02	<0.02	<0.0002	<0.005	<0.005	<0.01	<0.005	0.05	0.03	<0.01	<0.2	0.4			0.2	0.01	
Pond Spring	1/1/2014	Petersen																													
Pond Spring	4/24/2014	Petersen																													
Pond Spring	10/24/2014	Petersen																													
Pond Spring	7/1/2015	Petersen											<0.02	<0.02				<0.005	<0.005											
Priscilla Seep	11/28/2012	Petersen	<0.05	0.1	0.08	0.06	1.69	1.72	0.028	<0.005	<0.005	<0.005	1.1	3.57	0.02	<0.02	<0.0002	0.848	0.820	<0.01	<0.005	0.07	0.09	<0.01	0.4	2.0			<0.1	0.07	
Priscilla Seep	2/27/2013	Petersen																													
Priscilla Seep	4/29/2013	Petersen	<0.05	<0.05	0.08	0.07	1.69	1.97	0.017	<0.005	<0.005	<0.005	0.04	1.56	0.02	0.03	<0.0002	0.131	0.1800	<0.01	<0.005	0.05	0.08	<0.01	<0.2	<1			<0.1	0.06	
Priscilla Seep	5/31/2013	Petersen																													
Priscilla Seep	10/8/2013	Petersen																													
Priscilla Seep	4/1/2014	Petersen																													
Priscilla Seep	10/1/2014	Petersen																													
Priscilla Seep	7/1/2015	Petersen											0.09	2.14				0.008	0.0380											
Priscilla Seep	8/20/2015	Petersen																													
Car Seep	2/28/2013	Petersen	<0.05	<0.05	<0.05	<0.05	0.37	0.35	0.024	<0.005	<0.005	<0.005	<0.02	0.48	0.02	0.02	<0.0002	0.152	0.381	<0.01	<0.005	0.03	0.03	<0.01	<0.2	0.5	0.2	<0.1		0.06	
Car Seep	6/5/2013	Petersen	<0.05	0.2	<0.05	<0.05	0.35	0.36	0.018	<0.005	<0.005	<0.005	0.03	0.47	<0.02	<0.02	<0.002	0.031	0.458	<0.01	<0.005	0.03	0.03	<0.01	<0.2	0.5			<0.1	0.18	
Car Seep	1/1/2014	Petersen																													
Car Seep	4/24/2014	Petersen																													

			Trace metals																				Nutrients						
Monitoring Site	Date	Data source	Al (d) mg/L	Al (t) mg/L	As (d) mg/L	As (t) mg/L	B (d) mg/L	B (t) mg/L	Ba (d) mg/L	Cd (d) mg/L	Cr (d) mg/L	Cu (d) mg/L	Fe (d) mg/L	Fe (t) mg/L	Pb (d) mg/L	Pb (t) mg/L	Hg (d) mg/L	Mn (d) mg/L	Mn (t) mg/L	Mo (d) mg/L	Ni (d) mg/L	Se (d) mg/L	Se (t) (µg/L)	Zn (d) mg/L	NH3 mg/L N	F mg/L	NO3 mg/L	NO2 mg/L	NO2+NO3 mg/L N	T-P mg/L	O-PO4 mg/L
Car Seep	10/24/2014	Petersen																											
Car Seep	7/1/2015	Petersen											0.04	0.28				0.370	0.297											
Seep Z	7/10/2012	Petersen	<0.05	9.9	0.05	0.05	1.20	1.96	0.013	<0.005	<0.005	<0.005	<0.02	22.7	<0.02	0.03	<0.0002	<0.067	1.20	<0.01	<0.005	0.03	0.05	<0.01	<0.2	<1			0.2	0.29	
Seep Z	9/30/2013	Petersen																													
Seep Z	12/31/2013	Petersen											<0.02	9.24				0.006	0.203											
Seep Z	4/1/2014	Petersen																													
Seep Z	6/18/2014	Petersen											<0.02	23.7				<0.005	0.378											
Seep Z	9/30/2014	Petersen											0.22	17.8				0.078	0.24											
Seep Z	12/22/2014	Petersen											<0.02	23.6				<0.005	0.333											
Seep Z	3/31/2015	Petersen											0.12	29.2				0.007	0.421											
Seep Z	7/1/2015	Petersen																													
Seep Z	9/21/2015	Petersen											<0.02	1.38				<0.005	0.024											
Wells																															
Y-70 (PDH7)	6/24/1986	UII																													
Y-70 (PDH7)	8/3/1986	UII																													
Y-70 (PDH7)	9/2/1986	UII																													
Y-70 (PDH7)	10/2/1986	UII																													
Y-70 (PDH7)	10/29/1986	UII																													
Y-70 (PDH7)	11/20/1986	UII																													
Y-70 (PDH7)	12/14/1986	UII																													
Y-70 (PDH7)	1/20/1987	UII																													
Y-70 (PDH7)	2/9/1987	UII																													
Y-70 (PDH7)	9/16/1987	UII	<0.05		<0.001		0.22		0.11	<0.005	<0.01	<0.01	0.03		<0.02		<0.0002	0.02		<0.05	<0.02	<0.001		0.02	0.62	0.6	0.01	0.01			0.01
Y-70 (PDH7)	12/8/1987	UII	<0.05		<0.001		0.22		0.09	0.005	0.01	<0.01	0.24		<0.02		<0.0002	0.01		<0.05	<0.02	<0.002		<0.01	0.5	0.3	<0.02	<0.02			<0.01
Y-70 (PDH7)	3/17/1988	UII	<0.05		<0.001		0.20		0.08	<.005	<0.01	<0.01	0.25		<0.02		<0.0002	0.02		<0.05	<0.02	<0.001		<0.01	0.45	0.3	0.02	<0.01			<0.01
Y-70 (PDH7)	9/10/2011	Petersen																													
Y-70 (PDH7)	12/23/2011	Petersen	<0.2	6.6	<0.25	0.05	0.65	0.71	0.090	<0.025	<0.025	<0.025	<0.10	14.4	<0.10	0.05	<0.0002	0.058	0.740	<0.05	<0.02	<0.10	0.03	<0.05							
Y-70 (PDH7)	4/25/2012	Petersen	<0.05	4.3	<0.05	0.05	0.28	0.30	0.065	<0.005	<0.005	<0.005	1.17	15.3	<0.02	0.03	<0.0002	0.651	0.805	<0.01	<0.005	0.02	0.04	<0.01	1.3	0.6	<0.5	<0.5		0.47	<0.01
Y-70 (PDH7)	7/10/2012	Petersen	<0.05	1.0	<0.05	<0.05	0.25	0.27	0.013	<0.005	<0.005	<0-.005	<0.02	<0.02	<0.02	<0.02	<0.0002	0.685	0.714	<0.01	<0.005	0.02	0.03	<0.01	1.0	0.6			<0.1	0.07	
Y-70 (PDH7)	9/30/2012	Petersen																													
Y-70 (PDH7)	11/27/2012	Petersen	<0.05	0.1	0.05	<0.05	0.26	0.24	0.016	<0.005	<0.005	<0.005	7.27	7.62	<0.02	<0.02	<0.0002	0.633	0.584	<0.01	<0.005	0.04	0.02	<0.01	1.5	0.6			<0.1	0.07	
Y-70 (PDH7)	2/25/2013	Petersen																													
Y-70 (PDH7)	6/6/2013	Petersen	<0.05	0.5	0.06	0.05	0.22	0.24	0.017	<0.005	<0.005	<0.005	0.48	8.45	<0.02	<0.02	<0.0002	0.497	0.542	<0.01	<0.005	0.04	0.03	<0.01	1.4	0.5			<0.1	0.14	
Y-70 (PDH7)	10/1/2013	Petersen	<0.05	0.5	<0.05	<0.05	0.23	0.23	0.015	<0.005	<0.005	<0.005	0.06	8.48	0.04	<0.02	<0.0002	0.555	0.544	<0.01	<0.005	0.03	<0.02	<0.01	1.4	0.5			0.2	0.10	
Y-70 (PDH7)	12/31/2013	Petersen	<0.05	<0.05	0.05	0.05	0.22	0.18	0.013	<0.005	0.010	<0.005	0.04	8.35	<0.02	<0.02	<0.0002	0.539	0.592	<0.01	0.008	0.15	0.13	<0.01	1.4	0.5			<0.1	0.04	
Y-70 (PDH7)	4/1/2014	Petersen	<0.05	0.3	0.08	0.09	0.23	0.25	0.014	<0.005	0.009	<0.005	0.61	8.59	<0.02	<0.02	<0.0002	0.481	0.54	<0.01	<0.005	0.28	0.28	<0.01	1.5	0.5			<0.1	0.04	
Y-70 (PDH7)	6/18/2014	Petersen											0.02	9.39				0.575	0.594											
Y-70 (PDH7)	9/30/2014	Petersen																													
Y-70 (PDH7)	10/1/2014	Petersen											1.39	8.12				0.493	0.535											
Y-70 (PDH7)	12/21/2014	Petersen																													
Y-70 (PDH7)	1/30/2015	Petersen											0.14	8.56				0.567	0.601											
Y-70 (PDH7)	3/30/2015	Petersen											0.14	9.68				0.486	0.551											
Y-70 (PDH7)	7/1/2015	Petersen																													
Y-70 (PDH7)	8/20/2015	Petersen																													
Y-103 (A6)	8/4/1986	UII																													
Y-103 (A6)	9/3/1986	UII																													
Y-103 (A6)	10/15/1986	UII																													
Y-103 (A6)	11/2/1986	UII																													
Y-103 (A6)	11/21/1986	UII																													
Y-103 (A6)	12/14/1986	UII																													
Y-103 (A6)	1/21/1987	UII																													
Y-103 (A6)	2/11/1987	UII																													
Y-103 (A6)	9/16/1987	UII	<0.05		0.004		0.09		0.02	<0.005	<0.01	<0.01	13.3		<0.02		<0.0002	0.35		<0.05	0.02	<0.001		0.01	0.27	0.5	<0.02	<0.01			0.02

			Trace metals																				Nutrients						
Monitoring Site	Date	Data source	Al (d) mg/L	Al (t) mg/L	As (d) mg/L	As (t) mg/L	B (d) mg/L	B (t) mg/L	Ba (d) mg/L	Cd (d) mg/L	Cr (d) mg/L	Cu (d) mg/L	Fe (d) mg/L	Fe (t) mg/L	Pb (d) mg/L	Pb (t) mg/L	Hg (d) mg/L	Mn (d) mg/L	Mn (t) mg/L	Mo (d) mg/L	Ni (d) mg/L	Se (d) mg/L	Se (t) (µg/L)	Zn (d) mg/L	NH3 mg/L N	F mg/L	NO3 mg/L	NO2 mg/L	NO2+NO3 mg/L N	T-P mg/L	O-PO4 mg/L
Y-103 (A6)	12/8/1987	UII	0.11		0.003		0.09		0.02	<0.005	<0.01	<0.01	11.7		<0.02		<0.0002	0.37		<0.05	<0.02	<0.002		<0.02	0.25	0.2	<0.02	<0.02			0.01
Y-103 (A6)	3/17/1988	UII	<0.05		0.005		0.08		0.01	<0.005	<0.01	<0.01	11.9		<0.02		<0.0002	0.28		<0.05	<0.02	<0.001		0.01	0.33	0.2	0.02	<0.01			0.01
Y-103 (A6)	3/31/2012	Petersen																												
Y-103 (A6)	4/25/2012	Petersen	<0.05	29.7	<0.05	0.10	0.11	0.12	0.013	<0.005	<0.005	<0.005	2.32	112	<0.02	0.23	<0.0002	0.099	2.99	<0.01	<0.005	0.04	0.03	<0.01	0.3	<0.5	<0.5	<0.5		1.3	<0.01
Y-103 (A6)	7/10/2012	Petersen	<0.05	2.7	<0.05	0.05	0.10	0.11	0.011	<0.005	<0.005	<0.005	0.81	17.2	<0.02	0.02	<0.0002	0.099	0.151	<0.01	<0.005	0.04	0.04	<0.01	<0.2	0.3			<0.1	0.08	
Y-103 (A6)	9/30/2012	Petersen																													
Y-103 (A6)	11/28/2012	Petersen	<0.05	2.1	0.05	0.07	0.10	0.12	0.012	<0.005	<0.005	<0.005	0.25	20.3	0.02	<0.02	0.0002	0.085	,217	<0.01	<0.005	0.04	<0.02	<0.01	0.4	0.3			0.1	0.29	
Y-103 (A6)	2/25/2013	Petersen																													
Y-103 (A6)	4/29/2013	Petersen																													
Y-103 (A6)	6/5/2013	Petersen	<0.05	1.1	0.06	0.06	0.08	0.09	0.011	<0.005	<0.005	<0.005	2.35	15.5	<0.02	<0.02	<0.0002	0.083	0.131	<0.01	<0.005	0.03	0.03	<0.01	<0.2	0.3			<0.1	0.02	
Y-103 (A6)	9/30/2013	Petersen	<0.05	0.2	<0.05	<0.05	0.09	0.11	0.011	<0.005	<0.005	<0.005	0.02	10.8	0.04	<0.02	<0.0002	0.102	0.114	<0.01	<0.005	0.03	0.02	<0.01	<0.2	0.3			0.1	0.01	
Y-103 (A6)	12/31/2013	Petersen	0.6	0.2	0.05	0.05	0.08	0.12	0.015	<0.005	0.016	<0.005	2.77	12.2	<0.02	<0.02	0.0004	0.083	0.096	<0.01	0.008	0.15	0.10	<0.01	<0.2	0.3			<0.1	0.04	
Y-103 (A6)	4/1/2014	Petersen	<0.05	<0.05	0.07	0.08	0.06	0.07	0.010	<0.005	0.011	<0.005	0.45	8.69	<0.02	<0.02	<0.0002	0.098	0.110	<0.01	<0.005	0.27	0.29	<0.01	<0.2	0.3			<0.1	<0.01	
Y-103 (A6)	6/18/2014	Petersen											<0.02	14.4				0.252	0.138												
Y-103 (A6)	9/30/2014	Petersen																													
Y-103 (A6)	10/1/2014	Petersen											0.22	7.51				0.108	0.113												
Y-103 (A6)	12/21/2014	Petersen																													
Y-103 (A6)	1/30/2015	Petersen											0.07	6.07				0.127	0.126												
Y-103 (A6)	3/31/2015	Petersen											0.32	9.96				0.107	0.110												
Y-103 (A6)	6/30/2015	Petersen											0.09	13.8				0.079	0.110												
Y-103 (A6)	8/20/2015	Petersen																													
NLP-1	11/28/2012	Petersen	<0.05	0.4	0.05	0.06	0.05	0.07	0.020	<0.005	<0.005	<0.005	6.98	12.9	<0.02	<0.02	0.0002	0.081	0.121	<0.01	<0.005	0.03	0.04	<0.01	0.5	0.3			<0.1	0.05	
NLP-1	2/25/2013	Petersen																													
NLP-1	6/6/2013	Petersen	<0.05	8.0	0.06	0.08	<0.05	<0.05	0.025	<0.005	<0.005	<0.005	<0.02	45.2	<0.02	0.05	<0.0002	0.076	0.641	<0.01	<0.005	0.03	0.03	<0.01	0.3	0.4			<0.1	0.15	
NLP-1	10/1/2013	Petersen	<0.05	5.0	<0.05	0.05	0.06	0.06	0.014	<0.005	<0.005	<0.005	0.37	42.2	0.04	0.03	<0.0002	0.060	0.480	<0.01	<0.005	<0.02	<0.02	<0.01	<0.2	0.3			<0.1	0.12	
NLP-1	12/31/2013	Petersen	<0.05	2.8	<0.05	0.07	<0.05	0.15	0.019	<0.005	0.012	<0.005	<0.02	32.3	<0.02	<0.02	<0.0002	0.068	0.400	<0.01	<0.005	0.16	0.07	<0.01	0.3	0.3			0.1	2.1	
NLP-1	4/1/2014	Petersen																													
NLP-1	6/18/2014	Petersen												64.5					0.757												
NLP-1	10/1/2014	Petersen											<0.02	38.7				0.153	0.461												
NLP-1	1/30/2015	Petersen											1.29	41.0				0.060	0.346												
NLP-1	3/31/2015	Petersen																													
NLP-1	7/1/2015	Petersen																													
NLP-1	8/20/2015	Petersen																													
NLP-2	11/28/2012	Petersen	<0.05	0.2	0.05	0.05	0.14	0.16	0.028	<0.005	<0.005	<0.005	7.47	9.78	<0.02	<0.02	<0.0002	0.050	0.059	<0.01	<0.005	0.03	<0.02	<0.01	1.2	0.4			<0.1	0.05	
NLP-2	2/25/2013	Petersen																													
NLP-2	4/29/2013	Petersen																													
NLP-2	5/31/2013	Petersen																													
NLP-2	6/6/2013	Petersen	<0.05	16.9	0.05	0.07	0.12	0.14	0.026	<0.005	<0.005	<0.005	<0.02	47.0	<0.02	0.06	<0.0002	0.058	0.984	<0.01	<0.005	0.03	0.04	<0.01	1.0	0.5			0.1	1.2	
NLP-2	10/1/2013	Petersen	<0.05	7.2	<0.05	<0.05	0.15	0.15	0.016	<0.005	<0.005	<0.005	0.03	34.3	0.05	0.02	<0.0002	0.043	0.427	<0.01	<0.005	0.02	0.02	<0.01	0.9	0.4			0.1	0.37	
NLP-2	12/31/2013	Petersen	0.2	20.9	0.05	0.10	0.12	0.41	0.024	<0.005	0.015	<0.005	0.24	67.9	<0.02	0.02	<0.0002	0.044	1.47	<0.01	<0.005	0.13	0.03	<0.01	1.1	0.4			0.1	1.7	
NLP-2	4/1/2014	Petersen																													
NLP-2	4/24/2014	Petersen																													
NLP-2	6/18/2014	Petersen											<0.02	54.5				0.037	0.408												
NLP-2	9/30/2014	Petersen																													
NLP-2	10/1/2014	Petersen											<0.02	12.4				0.030	0.069												
NLP-2	12/21/2014	Petersen																													
NLP-2	1/30/2015	Petersen											0.19	38.4				0.042	0.263												
NLP-2	3/31/2015	Petersen																													
NLP-2	7/1/2015	Petersen																													
NLP-2	8/20/2015	Petersen																													
NLP-3	2/25/2013	Petersen																													
NLP-3	2/28/2013	Petersen	<0.05	39.1	<0.05	0.07	0.13	0.10	0.028	<0.005	<0.005	<0.005	<0.02	86.0	<0.02	0.18	<0.0002	0.011	4.22	<0.01	<0.005	0.04	0.02	<0.01	<0.2	<0.1	<0.1	<0.1		1.0	
NLP-3	6/6/2013	Petersen	<0.05	7.6	0.05	0.07	0.10	0.11	0.025	<0.005	<0.005	<0.005	<0.02	28.5	<0.02	0.03	<0.0002	0.224	0.650	<0.01	<0.005	0.03	0.02	<0.01	<0.2	0.2			<0.1	0.14	
NLP-3	10/1/2013	Petersen	0.09	7.9	<0.05	<0.05	0.13	0.13	0.013	<0.005	<0.005	<0.005	0.04	39.4	0.03	<0.02	<0.0002	0.007	0.981	<0.01	<0.005	<0.02	0.03	<0.01	<0.2	0.2			0.1	0.22	

			Trace metals																				Nutrients						
Monitoring Site	Date	Data source	Al (d) mg/L	Al (t) mg/L	As (d) mg/L	As (t) mg/L	B (d) mg/L	B (t) mg/L	Ba (d) mg/L	Cd (d) mg/L	Cr (d) mg/L	Cu (d) mg/L	Fe (d) mg/L	Fe (t) mg/L	Pb (d) mg/L	Pb (t) mg/L	Hg (d) mg/L	Mn (d) mg/L	Mn (t) mg/L	Mo (d) mg/L	Ni (d) mg/L	Se (d) mg/L	Se (t) (µg/L)	Zn (d) mg/L	NH3 mg/L N	F mg/L	NO3 mg/L	NO2 mg/L	NO2+NO3 mg/L N	T-P mg/L	O-PO4 mg/L
NLP-3	12/31/2013	Petersen	0.4	10.0	<0.05	0.06	0.10	0.24	0.033	<0.005	0.006	<0.005	0.25	30.2	<0.02	<0.02	<0.0002	0.206	0.892	<0.01	0.006	0.12	0.08	<0.01	<0.2	0.2			0.2	0.22	
NLP-3	4/1/2014	Petersen																													
NLP-3	6/18/2013	Petersen											<0.02	17.4				0.272	0.531												
NLP-3	10/1/2014	Petersen											0.31	74.4				0.235	2.10												
NLP-3	1/30/2015	Petersen																													
NLP-3	3/31/2015	Petersen																													
NLP-3	6/30/2015	Petersen											<0.02	77.2				0.140	2.01												
NLP-3	8/20/2015	Petersen																													
NLP-4	2/25/2013	Petersen																													
NLP-4	2/28/2013	Petersen	<0.05	14.4	<0.05	0.08	0.07	0.07	0.021	<0.005	<0.005	<0.005	<0.02	46.6	<0.02	0.07	<0.0002	0.067	1.08	<0.01	<0.005	0.02	0.06	<0.01	<0.2	0.2	<0.1	<0.1		0.32	
NLP-4	6/6/2013	Petersen	<0.05	5.1	0.05	0.07	0.09	0.10	0.018	<0.005	<0.005	<0.005	<0.02	20.4	0.02	0.03	<0.0002	0.150	0.465	<0.01	<0.005	0.04	0.04	<0.01	<0.2	0.3			<0.1	0.25	
NLP-4	10/1/2013	Petersen	0.09	2.5	<0.05	<0.05	0.11	0.11	0.020	<0.005	<0.005	<0.005	0.03	14.4	0.04	<0.02	<0.0002	0.236	0.485	<0.01	<0.005	0.02	0.02	<0.01	<0.2	0.3			<0.1	0.42	
NLP-4	12/31/2013	Petersen	0.2	10.4	<0.05	0.12	0.05	0.34	0.018	<0.005	0.009	<0.005	0.18	75.8	<0.02	<0.02	<0.0002	0.148	2.61	<0.01	<0.005	0.12	0.03	<0.01	<0.2	0.2			<0.1	0.5	
NLP-4	4/1/2014	Petersen																													
NLP-4	6/18/2014	Petersen											<0.02	7.11				0.170	0.220												
NLP-4	10/1/2014	Petersen																													
NLP-4	1/30/2015	Petersen											0.07	5.82				0.160	0.278												
NLP-4	3/31/2015	Petersen											0.03	12.0				0.271	0.369												
NLP-4	6/30/2015	Petersen											0.03	3.63				0.084	0.211												
NLP-4	8/20/2015	Petersen																													
NLP-5	2/25/2013	Petersen																													
NLP-5	2/28/2013	Petersen	<0.05	8.1	<0.05	0.06	0.07	0.05	0.022	<0.005	<0.005	<0.005	<0.02	24.6	<0.02	0.05	<0.0002	<0.005	1.39	<0.01	<0.005	0.04	0.03	<0.01	<0.2	0.2	<0.1	<0.1		0.65	
NLP-5	6/6/2013	Petersen	<0.05	2.1	0.06	0.05	0.08	0.10	0.020	<0.005	<0.005	<0.005	<0.02	5.98	<0.02	<0.02	<0.0002	<0.005	0.162	<0.01	<0.005	0.03	0.03	<0.01	<0.2	0.2			<0.1	0.14	
NLP-5	10/1/2013	Petersen	<0.05	8.6	<0.05	<0.05	0.12	0.13	0.022	<0.005	<0.005	<0.005	<0.02	27.4	0.04	0.04	<0.0002	<0.005	1.04	<0.01	<0.005	0.02	0.03	<0.01	<0.2	0.2			0.2	0.36	
NLP-5	1/1/2014	Petersen	0.8	0.6	<0.05	<0.05	0.05	0.07	0.025	<0.005	0.009	<0.005	0.35	2.15	<0.02	<0.02	<0.0002	0.016	0.083	<0.01	<0.005	0.15	0.12	<0.01	<0.2	0.2			0.1	0.04	
NLP-5	4/1/2014	Petersen																													
NLP-5	6/18/2014	Petersen											<0.02	16.1				0.009	0.427												
NLP-5	10/1/2014	Petersen											0.29	9.86				<0.005	0.405												
NLP-5	1/30/2015	Petersen											0.27	10.2				0.047	0.418												
NLP-5	3/31/2015	Petersen											0.24	6.02				0.018	0.238												
NLP-5	6/30/2015	Petersen											<0.04	0.41				<0.010	0.014												
NLP-5	8/20/2015	Petersen																													
NLP-6	2/25/2013	Petersen																													
NLP-6	2/28/2013	Petersen	<0.05	0.8	0.05	0.05	0.09	0.06	0.022	<0.005	<0.005	<0.005	<0.02	21.5	<0.02	0.02	<0.0002	0.211	0.484	<0.01	<0.005	0.04	0.04	<0.01	0.3	0.2	<0.1	<0.1		0.06	
NLP-6	4/5/2014	Petersen												24.2					7.41												
NLP-6	4/24/2014	Petersen																													
NLP-6	6/18/2014	Petersen												71.5					2.32												
NLP-6	10/1/2014	Petersen												39.2					0.621												
NLP-6	3/31/2015	Petersen																													
NLP-6	8/19/2015	Petersen																													
NLP-6	6/30/2015	Petersen											<0.02	17.5				0.284	0.365												
NLP-6	8/20/2015	Petersen																													
NLP-7	2/25/2013	Petersen																													
NLP-7	2/28/2013	Petersen	<0.05	35.5	<0.05	0.08	0.12	0.11	0.023	<0.005	<0.005	<0.005	<0.02	37.5	<0.02	0.32	<0.0002	0.129	7.72	<0.01	<0.005	0.02	<0.02	<0.01	<0.2	<0.1	<0.1	<0.1		2.6	
NLP-7	6/6/2013	Petersen	<0.05	37.5	<0.05	0.09	0.07	0.07	0.022	<0.005	<0.005	<0.005	<0.02	83.0	<0.02	0.18	<0.0002	0.226	4.75	<0.01	<0.005	0.02	0.02	<0.01	<0.2	0.6			0.7	1.6	
NLP-7	10/1/2013	Petersen	0.09	23.8	<0.05	0.06	0.11	0.11	0.022	<0.005	<0.005	<0.005	0.02	77.0	0.02	0.09	<0.0002	0.184	3.18	<0.01	<0.005	0.03	0.03	<0.01	<0.2	0.5			2.1	0.61	
NLP-7	1/1/2014	Petersen	1.0	10.8	<0.05	0.06	0.07	0.22	0.030	<0.005	0.009	<0.005	0.55	37.5	<0.02	<0.02	<0.0002	0.177	1.80	<0.01	<0.005	0.09	0.08	<0.01	<0.2	0.5			1.2	0.50	
NLP-7	4/1/2014	Petersen																													
NLP-7	6/18/2014	Petersen											<0.02	67.4				0.274	3.95												
NLP-7	10/1/2014	Petersen											<0.02	30.2				0.032	0.978												
NLP-7	3/31/2015	Petersen																													
NLP-7	7/1/2015	Petersen																													
NLP-7	8/20/2015	Petersen																													

			Trace metals																				Nutrients						
Monitoring Site	Date	Data source	Al (d) mg/L	Al (t) mg/L	As (d) mg/L	As (t) mg/L	B (d) mg/L	B (t) mg/L	Ba (d) mg/L	Cd (d) mg/L	Cr (d) mg/L	Cu (d) mg/L	Fe (d) mg/L	Fe (t) mg/L	Pb (d) mg/L	Pb (t) mg/L	Hg (d) mg/L	Mn (d) mg/L	Mn (t) mg/L	Mo (d) mg/L	Ni (d) mg/L	Se (d) mg/L	Se (t) (µg/L)	Zn (d) mg/L	NH3 mg/L N	F mg/L	NO3 mg/L	NO2 mg/L	NO2+NO3 mg/L N	T-P mg/L	O-PO4 mg/L
NLP-8	2/25/2013	Petersen																											
NLP-8	2/28/2013	Petersen	<0.05	0.3	0.06	0.06	0.25	0.24	0.017	<0.005	<0.005	<0.005	<0.02	10.6	<0.02	<0.02	<0.0002	2.09	2.22	<0.01	0.010	0.03	0.04	<0.01	0.8	0.2	<0.1	<0.1		0.1	
NLP-8	6/6/2013	Petersen	<0.05	26.7	0.08	0.15	0.21	0.16	0.013	<0.005	<0.005	<0.005	<0.02	122	<0.02	0.15	<0.0002	1.74	4.76	<0.01	0.007	0.06	0.03	<0.01	0.5	<0.5			0.8	1.1	
NLP-8	10/1/2013	Petersen	<0.05	8.6	<0.05	0.09	0.25	0.24	0.018	<0.005	<0.005	<0.005	0.02	78.5	0.03	0.05	<0.0002	1.38	2.13	<0.01	<0.005	0.04	0.04	<0.01	0.4	<0.5			0.2	0.35	
NLP-8	1/1/2014	Petersen																													
NLP-8	4/1/2014	Petersen																													
NLP-8	4/24/2014	Petersen																													
NLP-8	6/18/2017	Petersen											<0.02	50.5				1.12	1.74												
NLP-8	9/30/2014	Petersen																													
NLP-8	10/1/2014	Petersen											0.02	10.4				0.538	0.588												
NLP-8	3/31/2015	Petersen																													
NLP-8	7/1/2015	Petersen																													
NLP-8	8/19/2015	Petersen																													
NLP-9	2/25/2013	Petersen																													
NLP-9	2/26/2013	Petersen	<0.05	0.7	0.05	0.05	0.20	0.21	0.014	<0.005	<0.005	<0.005	<0.02	2.34	<0.02	<0.02	<0.0002	0.037	0.056	<0.01	<0.005	0.05	0.06	<0.01	<0.2	0.5			1.7	0.20	
NLP-9	10/8/2013	Petersen	0.07	5.4	0.05	<0.05	0.23	0.25	0.024	<0.005	<0.005	<0.005	<0.02	14.9	<0.02	0.03	<0.0002	0.012	0.181	<0.01	<0.005	0.07	0.04	<0.01	<0.2	0.7			2.0	0.36	
NLP-9	1/1/2014	Petersen																													
NLP-9	4/1/2014	Petersen																													
NLP-9	6/18/2014	Petersen																													
NLP-9	9/30/2014	Petersen																													
NLP-9	3/31/2015	Petersen																													
NLP-9	7/1/2015	Petersen																													
NLP-9	8/20/2015	Petersen																													
NLP-10	12/31/2013	Petersen	<0.05	25.9	0.07	0.15	0.15	0.55	0.036	<0.005	0.015	<0.005	0.05	106	<0.02	0.06	<0.0002	0.167	3.01	0.02	<0.005	0.18	<0.02	<0.01	2.4	0.4			<0.1	14	
NLP-10	4/1/2014	Petersen																													
NLP-10	4/24/2014	Petersen	0.8	10.6	<0.05	<0.05	0.17	0.12	0.028	<0.005	<0.005	<0.005	1.76	62.2	<0.02	<0.02	<0.0002	0.077	0.754	<0.01	<0.005	0.02	<0.02	<0.01	1.6	<0.5	<0.5	<0.5	<0.1	0.19	
NLP-10	6/18/2014	Petersen											<0.02	43.7				0.098	0.666												
NLP-10	9/30/2014	Petersen																													
NLP-10	10/1/2014	Petersen											0.02	33.8				0.056	0.295												
NLP-10	12/21/2014	Petersen																													
NLP-10	1/30/2015	Petersen											0.36	24.7				0.072	0.232												
NLP-10	3/30/2015	Petersen																													
NLP-10	7/1/2015	Petersen																													
NLP-10	8/20/2015	Petersen																													
NLP-11	12/22/2013	Petersen																													
NLP-11	4/1/2014	Petersen																													
NLP-11	6/18/2014	Petersen																													
NLP-11	10/1/2014	Petersen																													
NLP-11	12/21/2014	Petersen																													
NLP-11	1/30/2014	Petersen																													
NLP-11	3/31/2015	Petersen																													
NLP-11	6/30/2015	Petersen																													
NLP-11	8/20/2015	Petersen																													
NLP-12	12/22/2013	Petersen																													
NLP-12	12/31/2013	Petersen	<0.05	36.5	0.05	0.41	0.13	0.86	0.033	<0.005	0.010	<0.005	<0.02	211	<0.02	0.15	<0.0002	0.394	7.01	<0.01	0.007	0.15	<0.02	<0.01	0.3	0.4			<0.1	4.8	
NLP-12	2/11/2014	Petersen																													
NLP-12	4/24/2014	Petersen	0.04	7.6	<0.05	0.07	0.14	0.09	0.024	<0.005	<0.005	<0.005	0.32	42	<0.02	<0.02	<0.0002	0.528	0.933	<0.01	<0.005	0.02	<0.2	<0.01	<0.2	0.3	<0.2	<0.2	0.1	0.17	
NLP-12	6/19/2014	Petersen											<0.02	23.4				0.522	0.562												
NLP-12	9/30/2014	Petersen																													
NLP-12	10/1/2014	Petersen											2.29	17.1				0.465	0.529												
NLP-12	12/21/2014	Petersen																													
NLP-12	1/30/2015	Petersen											0.37	13.0				0.578	0.526												

			Trace metals																				Nutrients						
Monitoring Site	Date	Data source	Al (d) mg/L	Al (t) mg/L	As (d) mg/L	As (t) mg/L	B (d) mg/L	B (t) mg/L	Ba (d) mg/L	Cd (d) mg/L	Cr (d) mg/L	Cu (d) mg/L	Fe (d) mg/L	Fe (t) mg/L	Pb (d) mg/L	Pb (t) mg/L	Hg (d) mg/L	Mn (d) mg/L	Mn (t) mg/L	Mo (d) mg/L	Ni (d) mg/L	Se (d) mg/L	Se (t) (µg/L)	Zn (d) mg/L	NH3 mg/L N	F mg/L	NO3 mg/L	NO2 mg/L	NO2+NO3 mg/L N	T-P mg/L	O-PO4 mg/L
NLP-12	3/30/2015	Petersen											0.11	22.1				0.690	0.842											
NLP-12	6/30/2015	Petersen											0.05	10.7				0.486	0.514											
NLP-12	8/23/2015	Petersen																												
NLP-12	9/21/2015	Petersen											<0.02	11.2				0.494	0.577											
NLP-13	12/31/2013	Petersen	<0.05	18.3	0.06	0.09	0.92	1.05	0.007	<0.005	0.018	<0.005	0.03	26.1	<0.02	<0.02	<0.0002	0.190	0.898	<0.01	0.007	0.16	0.1	<0.01	<0.2	0.9			0.1	1.5	
NLP-13	4/1/2014	Petersen																												
NLP-13	4/24/2014	Petersen	0.2	15.6	<0.05	<0.05	0.99	1.03	0.007	<0.005	<0.005	<0.005	0.02	18.7	<0.02	<0.02	<0.0002	0.188	0.705	<0.01	<0.005	0.04	<0.02	<0.01	<0.2	0.9	<0.5	<0.5	0.4	0.80	
NLP-13	6/18/2014	Petersen											<0.02	0.59				0.146	0.261											
NLP-13	9/30/2014	Petersen											0.386	5.87				0.386	0.751											
NLP-13	12/22/2014	Petersen											0.02	8.59				0.185	0.463											
NLP-13	3/31/2015	Petersen											<0.02	2.05				0.236	0.565											
NLP-13	7/1/2015	Petersen											<0.02	0.34				0.193	0.235											
NLP-13	9/21/2015	Petersen											<0.02	2.45				0.236	0.336											

Table 3 Monitoring well details.

Well iD	Date constructed	Drilled for*	Elevation (feet asl)	Stick-up (feet aprox.)	Tot. Depth (feet bgs)	Screened interval (feet bgs)	Gravel-zone (feet)	Borehole diameter	Drilling method	Well casing diameter/type	Screened Formation
NLP-1	28-Nov-12	ACD	6920.23	0.3	20.0	10.0 - 20.0	8.0 - 20.0	2.5-inch	Direct push	1- inch PVC	Quaternary Alluvium
NLP-2	28-Nov-12	ACD	6910.39	0.3	24.0	14.0 - 24.0	12.0 - 24.0	2.5-inch	Direct push	1- inch PVC	Quaternary Alluvium
NLP-3	28-Nov-12	ACD	6917.98	0.3	30.0	20.0 - 30.0	17.4 - 30.0	2.5-inch	Direct push	1- inch PVC	Quaternary Alluvium
NLP-4	28-Nov-12	ACD	6871.86	0.5	8.0	3.0 - 8.0	2.0 - 8.0	2.5-inch	Direct push	1- inch PVC	Quaternary Alluvium
NLP-5	28-Nov-12	ACD	6921.45	0.5	10.0	5.0 - 10.0	3.0 - 10.0	2.5-inch	Direct push	1- inch PVC	Quaternary Alluvium
NLP-6	29-Nov-12	ACD	6957.29	0.2	20.0	10.0 - 20.0	8.0 - 20.0	2.5-inch	Direct push	1- inch PVC	Quaternary Alluvium
NLP-7	29-Nov-12	ACD	6946.76	0.5	26.0	16.0 - 26.0	12.0 - 26.0	2.5-inch	Direct push	1- inch PVC	Quaternary Alluvium
NLP-8	29-Nov-12	ACD	6980.54	0.2	20.0	10.0 - 20.0	8.0 - 20.8	2.5-inch	Direct push	1- inch PVC	Quaternary Alluvium
NLP-9	30-Nov-12	ACD	6951.01	0.5	24.0	14.0 - 24.0	12.0 - 24.0	2.5-inch	Direct push	1- inch PVC	Quaternary Alluvium
NLP-10	12-Nov-13	ACD	6902.62	0.3	28.0	18.0 - 28.0	17.0 - 28.0	2.5-inch	Direct push	1- inch PVC	Quaternary Alluvium
NLP-11	13-Nov-13	ACD	6862.71	0.3	29.0	19.0 - 29.0	19.0 - 29.0	2.5-inch	Direct push	1- inch PVC	Quaternary Alluvium
NLP-12	13-Nov-13	ACD	6848.57	0.5	23.5	13.5 - 23.5	12.5 - 23.5	2.5-inch	Direct push	1- inch PVC	Quaternary Alluvium
NLP-13	13-Nov-13	ACD	6803.46	0.5	16.0	6.0 -16.0	6.0 -16.0	2.5-inch	Direct push	1-inch PVC	Qa/Dakota Fm.
Y-53	8-Oct-80	UII	7001.56	3	210.0	195-210		8.875	Rotary	2-inch PVC	Smirl Coal Seam
Y-55	10-Oct-80	UII	6949.4	3	69.0	53.0-69.0		6.625	Rotary	2-inch PVC	Smirl Coal Seam
Y-56	20-Nov-80	UII	6891.5	3	40.0	13.0-40.0		5.625	Rotary	2-inch PVC	Quaternary Alluvium
Y-69 (PDH6)	26-Nov-85	UII	6950.2	3	53.0	38.0-53.0		5.625	Rotary	2-inch PVC	Smirl Coal Seam
Y-70 (PDH7)	20-Nov-85	UII	6900.0	2.6	97.0	72.0 - 87.0		5.625-inch to 60 ft. 3.0-inch to 97 ft.	Rotary/core w/wat. inj.	2-inch PVC	Smirl Coal Seam
Y-103 (A6)	11-Nov-86	UII	6919.8	2.9	77.81	17-9 - 77.8	4.6 - 77.96	5.875-inch	Rotary	2-inch PVC	Quaternary Alluvium

*ACD - Alton Coal Development, LLC
UII - Utah International, Inc.

Table 4 Hydrologic monitoring protocols.

Discharge and water level measurements

Protocol	Applies to	Parameter	Frequency
A	Streams	Discharge	Quarterly
B	Springs	Discharge	Quarterly
C	Monitoring wells	Water elevation	Quarterly

Water quality measurements

Protocol	Applies to	Parameters	Table	Frequency
1	Streams	Operational field and laboratory water quality measurements	7-6A*	Quarterly
2	Streams	Field water quality measurements only	7-6A*	Quarterly
3	Springs	Operational field and laboratory water quality measurements	7-7A*	Quarterly
4	Springs	Field water quality measurements only	7-7A*	Quarterly
5	Monitoring wells	Operational field and laboratory water quality measurements	7-7A*	Quarterly
6	Monitoring wells	Field water quality measurements only	7-7A*	Quarterly

*Note: Every 5 years for the third or fourth quarter monitoring event, laboratory analysis will be performed according to the baseline parameter lists specified in Tables 7-6B and 7-7B for surface waters and groundwaters, respectively. This will first be performed in the year 2015, continuing on a schedule of every five years thereafter.

Table 5 Hydrologic monitoring locations and protocols for operational and reclamation phase monitoring.

Site	Protocols	Comments
Streams		
SW-1A	A, 2	Kanab Creek above permit area
SW-1	A, 1	Kanab Creek at upper permit boundary
SW-1M	A, 1	Kanab Creek within North Private Lease area
Kanab @ C.R	A, 1	Kanab Creek at lower permit boundary
SW-3	A, 1	Kanab Creek below North Private Lease area (existing monitoring site)
RSD-1	A, 2	Ephemeral wash above permit area
SW-11	A, 1	Intermittent drainage at lower permit boundary
April Creek	A, 1	E. Fork Simpson Hollow adjacent to permit boundary
Priscilla Creek	A, 2	Headwaters E. Fk. Simpson Hollow west of permit area
SW-15	A, 1	Simpson Hollow below mining area at Kanab Ck. conf.
EW-1	A, 2	Ephemeral tributary to Kanab Creek
Springs		
Pond Spring	B, 3	Spring below Alton Town, flows to adjacent pond
Hill Spring	B, 4	Spring below Alton Town
Coyote Seep	B, 3	Alluvial seep in North Private Lease area
Alkali Seep	B, 4	Dakota Formation seep below North Lease permit area
Dakota Seep	B, 4	Dakota Formation seep below permit area (usually dry)
Seep Z	B, 4	Dakota Formation seep adjacent to North Lease area
Wells		
Y-103	C, 5	Alluvial well in North Private Lease area
Y-53	C	Smirl coal seam well southeast of North Private Lease
Y-55	C	Smirl coal seam well west of North Private Lease area
Y-69	C	Smirl coal seam well west of North Private Lease area
Y-70[+]	C	Smirl coal seam well in North Private Lease area
NLP-1[+]	C	Alluvial monitoring well in North Private Lease area
NLP-2[+]	C	Alluvial monitoring well in North Private Lease area
NLP-3[+]	C	Alluvial monitoring well in North Private Lease area
NLP-4	C, 5	Alluvial monitoring well in North Private Lease area
NLP-5	C, 5	Alluvial monitoring well in North Private Lease area
NLP-6	C	Alluvial monitoring well above North Private Lease area
NLP-7	C	Alluvial monitoring well above North Private Lease area
NLP-8	C	Alluvial monitoring well above North Private Lease area
NLP-9	C	Alluvial monitoring well above North Private Lease area
NLP-10[+]	C	Alluvial monitoring well in North Private Lease area
NLP-11	C	Alluvial monitoring well in North Private Lease area
NLP-12[+]	C, 5	Alluvial monitoring well below mining area
NLP-13	C, 5	Dakota Formation/alluvial well below mining area

[+] Wells in proposed mine pit areas that will be mined through in the future

Appendix A

Laboratory Reporting Sheets

Chemtech-Ford Laboratories

Not submitted with this submittal

Please use laboratory reporting sheets from previous submittal

Appendix B

Well geologic logs and completion information

BOREHOLE AND MONITORING WELL DRILLING LOGS

List of Boreholes and monitoring wells

Borehole #1

Borehole #2

Borehole #3

Borehole #4

Borehole # 5

Borehole #8

Borehole #9

Borehole #10

NLP-1

NLP-2

NLP-3

NLP-4

NLP-5

NLP-6

NLP-7

NLP-8

NLP-9

NLP-10

NLP-11

NLP-12

NLP-13

Y-70 (PDH-7)

Y-103 (A6)

Y-53

Y-55

Y-56

Y-69 (PDH-6)

Petersen Hydrologic, LLC

Borehole drilling log - North Private Lease exploration drilling project

Borehole #1 (13-39-06-001)

Date drilled:	21 June 2015	
Driller:	AGEC Applied Geotechnical Engineering Consultants, Inc., Sandy, Utah.	
Borehole diameter:	Auger - 4-inch	
	Core - HQ (2.5 inch)	
Logged by:	Erik Petersen, P.G.	
	Garrett Luallen	
Drilling method:	0-30 feet	Solid stem dry auger
	30-40 feet	Solid stem auger with some added water
	40-43 feet	Core drilling with drilling mud

From (ft)	To (ft)	Formation	Description
0	5	Tropic Shale	Dark gray silt and clayey silty clay, moist
5	10	Tropic Shale	Brownish gray clay and silty clay, moist
10	33	Tropic Shale	As above, dark to medium gray silty clay, slightly moist, harder drilling, more competent
33	35	Tropic Shale	Darker gray to almost black waxy clay - Tropic Shale
35	39	Tropic Shale	Dark gray silty clay
39	40	Tropic Shale	Dark gray to greenish gray waxy clay
40	43	Tropic Shale	Boney black carb. shale with white fossils
43	59	Dakota Formation	Coal, hit appreciable water at 56 feet
59	61	Dakota Formation	Medium gray waxy claystone with minor silt

PETERSEN HYDROLOGIC, LLC

Borehole drilling log - North Private Lease exploration drilling project

Borehole #2 (13-39-06-002)

Date drilled:	21 June 2015	
Driller:	AGEC Applied Geotechnical Engineering Consultants, Inc., Sandy, Utah.	
Borehole diameter:	Auger - 4-inch	
	Core - HQ (2.5 inch)	
Logged by:	Erik Petersen, P.G.	
	Garrett Luallen	
Drilling method:	0-40 feet	Solid stem dry auger
	40-65 feet	Core drilling with drilling mud

From (ft)	To (ft)	Formation	Description
0	14	Tropic Shale	Clayey silt (weathered Tropic Shale)
14	40	Tropic Shale	Tropic Shale, Augered silty claystone
40	42	Dakota Formation	Dark, organic shaley material with minor coal
42	56.6	Dakota Formation	Coal
56.6	57.2	Dakota Formation	Brownish Gray shaley underburden, soft clayeye shale with silt
57.2	58	Dakota Formation	Medium to light gray claystone, coal was all dry
58	59	Dakota Formation	Gray silty claystone, moist, first moist interval
59	62	Dakota Formation	Light gray clayey siltstone
62	63	Dakota Formation	Sandstone, very fine grained with clayey matrix, light to medium gray mottled, moist
63	64	Dakota Formation	Sandstone, vfg, and siltstone, moist, medium gray
64	65	Dakota Formation	Interbeded sandy siltstone and silty claystone, light gray

Petersen Hydrologic, LLC

Borehole drilling log - North Private Lease exploration drilling project

Borehole #3 (13-39-06-003)

Date drilled:	22 June 2015	
Driller:	AGEC Applied Geotechnical Engineering Consultants, Inc., Sandy, Utah.	
Borehole diameter:	Auger - 4-inch	
	Core - HQ (2.5 inch)	
Logged by:	Erik Petersen, P.G.	
	Garrett Luallen	
Drilling method:	0-41.5 feet	Solid stem dry auger
	41.5-61 feet	Core drilling with drilling mud

From (ft)	To (ft)	Formation	Description
0-1	1	Tropic Shale	Brown silty clayey soil, dry
1-4	4	Tropic Shale	Light gray silty clay, dry
4-6	6	Tropic Shale	Silty clay with broken pieces of siltstone in cuttings (probably concretions in Tropic)
6-10	10	Tropic Shale	Medium brown silty clay
10-28	28	Tropic Shale	Brownish gry and brown silty clay, moist (tropic)
25-28	28	Tropic Shale	Silty clay and brownish
28-33	33	Tropic Shale	Dark greenish gray waxy clay, moist
33-41	41	Tropic Shale	Dark greenish gray silty clay/shale minor silt, moist
40-41.5	41.5	Tropic Shale	Dense, dark greenish gray shale
41.5-57.5	57.5	Dakota Formation	Coal, wet zone noted from 52-54 feet
57.7-58	58	Dakota Formation	Shaley siltstone, mottled, brownish gray to dark gray/black
58-61	61	Dakota Formation	Medium gray soft and wet silty claystone and siltstone (check cores)

PETERSEN HYDROLOGIC, LLC

Borehole drilling log - North Private Lease exploration drilling project

Borehole #4 (12-39-06-004)

Date drilled:	28 June 2015	
Driller:	AGEC Applied Geotechnical Engineering Consultants, Inc., Sandy, Utah.	
Borehole diameter:	Auger - 4-inch	
	Core - HQ (2.5 inch)	
Logged by:	Erik Petersen, P.G.	
	Garrett Luallen	
Drilling method:	0-80 feet	Solid stem dry auger
	80-150	Core drilling with drilling mud

From (ft)	To (ft)	Formation	Description
0	5	Alluvium	Soil/clayey silt, brown, dry
5	10	Alluvium	Silt, light brown, yellowish, dry
10	15	Alluvium	Clayey silt, brown, moist
15	20	Alluvium	Clayey silt, brown, damp
20	25	Alluvium	Clayey silt, brown, wet
25	50	Alluvium	Clayey silt, brown, very wet
50	70	Alluvium	Clayey silt, wet, water from drill hole
70	75	Tropic Shale	Silty clay, not as wet, sticky, brown (Tropic)
75	78	Tropic Shale	Silty clay/claystone, dark greenish, grayish brown, not as wet (Tropic)
78	80.3	Tropic Shale	Clayey siltstone, medium to dark gray (Tropic)
80.3	84	Tropic Shale	Organic shale, soft, dark gray to black, fossiliferous
84	101	Dakota Formation	Coal
101	101.7	Dakota Formation	Organic-rich shale/claystone, organic fragments, medium gray
101.7	102	Dakota Formation	Clayey siltstone, light to medium gray
102	106.4	Dakota Formation	Silty claystone/shale, soft, fissile, medium gray
106.4	107.1	Dakota Formation	Siltstone, hard and well lithified, medium gray, brownish gray
107.1	109	Dakota Formation	Clayey siltstone, light gray, softer and less competent than above
109	109.3	Dakota Formation	Silty claystone/shale, soft, light gray
109.3	110.4	Dakota Formation	Clayey siltstone, light gray

Hole 4 (12-39-06-004) continued

From (ft)	To (ft)	Formation	Description
110.4	114.9	Dakota Formation	Silty claystone/shale, soft, fissile, light to medium gray
114.9	115.4	Dakota Formation	Sandstone, fine grained, light to medium gray
115.4	118	Dakota Formation	Silty claystone, soft, light to medium gray
118	118.2	Dakota Formation	Clayey siltstone, light gray
118.2	118.9	Dakota Formation	Silty claystone, medium gray
118.9	122	Dakota Formation	Silty claystone/shale, fissile, mottled medium gray
122	122.4	Dakota Formation	Siltstone, medium gray
122.4	122.9	Dakota Formation	Organic shale, dark gray to black, near coal composition
122.9	124	Dakota Formation	Silty claystone/shale, medium gray
124	124.9	Dakota Formation	Silty claystone/shale fissile, light gray
124.9	125.5	Dakota Formation	Clayey siltstone, light gray
125.5	126.3	Dakota Formation	Silty claystone, soft, light gray
126.3	127	Dakota Formation	Siltstone, light gray
127	128	Dakota Formation	Silty claystone, light gray
128	130	Dakota Formation	Siltstone, light to medium gray
130	130.3	Dakota Formation	Silty claystone, medium gray
130.3	133.5	Dakota Formation	Slayey siltstone, light gray, soft
133.5	134	Dakota Formation	Silty claystone, medium gray
134	136.3	Dakota Formation	Siltstone, light to medium gray
136.3	136.7	Dakota Formation	Silty claystone, light to medium gray
136.7	137	Dakota Formation	Siltstone, light to medium gray
137	137.7	Dakota Formation	Claystone, light to medium gray
137.7	138.8	Dakota Formation	Siltstone, light to medium gray
138.8	140	Dakota Formation	Silty claystone, light to medium gray
140	144	Dakota Formation	Sandstone, vfg, and siltstone, light to medium gray
144	145	Dakota Formation	Silty claystone, light gray
145	146	Dakota Formation	Siltstone, light gray
146	150	Dakota Formation	Sandstone, vfg, and silty claystone, light to medium gray

Petersen Hydrologic, LLC

Borehole drilling log - North Private Lease exploration drilling project

Borehole #5 (12-39-06-005)

Date drilled:	29 June 2015	
Driller:	AGEC Applied Geotechnical Engineering Consultants, Inc., Sandy, Utah.	
Borehole diameter:	Auger - 4-inch	
	Core - HQ (2.5 inch)	
Logged by:	Erik Petersen, P.G.	
	Garrett Luallen	
Drilling method:	0-50 feet	Solid stem dry auger
	50-95	Solid stem auger (mixed return)
	95-133	Core drilling with drilling mud

From (ft)	To (ft)	Formation	Description
0	3	Alluvium	Silty soil, grayish brown, dry
3	5	Alluvium	Sandy silt, brown
5	10	Alluvium	silt, sandy, clayey, gray
15	20	Alluvium	sandy silt, gray
20	55	Alluvium	Silty sand (very fine grained), yellowish brown
55	93	Alluvium/Tropic	Drilling became harder, returns were silty sand with dark gray to black clay on auger flights
93	95	Tropic Shale	Black silty claystone (Tropic)
95	96	Tropic Shale	Bentonitic claystone, gray, grading to bentonite
96	98	Tropic Shale	Black silty claystone, soft, waxy
98	100.7	Tropic Shale	Black silty claystone
100.7	101	Tropic Shale	Mottled gray siltstone
101	102	Tropic Shale	Dark gray to brownish black organic rich silt, soft, poorly consolidated
102	103.7	Tropic Shale	Dark gray and light gray banded/mottled clayey siltstone
103.7	105.3	Tropic Shale	Silty claystone, black to dark gray
105.3	105.6	Tropic Shale	Broken hard siltstone, black
105.6	108	Tropic Shale	Dark gray to black organic rich silt, banded, poorly lithified
108	111	Tropic Shale	Fossiliferous shale
111	127	Dakota Formation	Coal

Borehole #5 (12-39-06-005) Continued

From (ft)	To (ft)	Formation	Description
127	128	Dakota Formation	Silty claystone, soft, mottled gray
128	129.1	Dakota Formation	Silty claystone, medium gray
129.1	130.2	Dakota Formation	Siltstone, light gray
130.2	130.5	Dakota Formation	Siltstone, medium gray, poorly lithified
130.5	130.8	Dakota Formation	Siltstone, light gray
130.8	131	Dakota Formation	Silty claystone, medium gray
131	133	Dakota Formation	Clayey siltstone, medium gray

PETERSEN HYDROLOGIC, LLC

Borehole drilling log - North Private Lease exploration drilling project

Borehole #8 (07-39-05-008)

Date drilled:	3 July 2015	
Driller:	AGEC Applied Geotechnical Engineering Consultants, Inc., Sandy, Utah.	
Borehole diameter:	Auger - 4-inch	
	Core - HQ (2.5 inch)	
Logged by:	Erik Petersen, P.G.	
	Garrett Luallen	
Drilling method:	0-159 feet	Solid stem dry auger
	159-193 feet	Core drilling with drilling mud

From (ft)	To (ft)	Formation	Description
0	4	Alluvium	Silt/soil, light brown, dry
4	9	Alluvium	Silt, sandy, medium brown
9	14	Alluvium	Silt, medium borwn, minor clay and fine-grained sand, moist
14	19	Alluvium	Silty clay, damp, medium brown
19	24	Alluvium	Sandy silt, medium brown, damp
24	34	Alluvium	Gravel with silt and sand, dry, gravel subrounded, moist, medium brown, gravel < ~1-inch
34	39	Alluvium	Silty sand, medium brown, wet
39	49	Alluvium	Sandy silt, medium brown, moist
49	69	Alluvium	Silty sand, medium brown, moist/wet
69	74	Alluvium	silty, clayey sand, greenish brown, wet
74	79	Tropic Shale	Clay/claystone, minor silt, brownish gray and dark greenish gray, wet
79	95	Tropic Shale	Claystone/clay, minor silt, greenish gray to black, wet
95	159	Tropic Shale	Difficult drilling with fluids, no drilling returns
159	160	Tropic Shale	Siltstone with interbedded shale layers
160	164	Tropic Shale	Shale, black, fossiliferous, varying hardness
164	179.5	Dakota Formation	Coal
179.5	180.1	Dakota Formation	Silty claystone, gray, soft
180.1	182.2	Dakota Formation	Sandy siltstone, gray, vfg, hard

Borehole #8 (07-39-05-008) Continued

From (ft)	To (ft)	Formation	Description
182.5	184.2	Dakota Formation	Silty claystone, gray
184.2	185.4	Dakota Formation	Siltstone, gray, banded
184.5	188	Dakota Formation	Silty claystone, gray
188	193	Dakota Formation	Claystone, soft, locally silty, gray

PETERSEN HYDROLOGIC, LLC

Borehole drilling log - North Private Lease exploration drilling project

Borehole #9 (18-39-05-009)

Date drilled:	5 July 2015	
Driller:	AGEC Applied Geotechnical Engineering Consultants, Inc., Sandy, Utah.	
Borehole diameter:	Auger - 4-inch	
	Core - HQ (2.5 inch)	
Logged by:	Erik Petersen, P.G.	
	Garrett Luallen	
Drilling method:	0-69 feet	Solid stem dry auger
	69-84 feet	Solid stem auger with added water
	84-163 feet	Core drilling with drilling mud

From (ft)	To (ft)	Formation	Description
0	4	Tropic Shale	Dark brown soil, darg gray brownish gray tight clay (Tropic)
4	9	Tropic Shale	Dark gray dense, tight clay, no water
9	14	Tropic Shale	Medium brownish gray moist silty clay
14	19	Tropic Shale	Grayish brown silty clay, moist
37	39	Tropic Shale	Dark brown, grayish brown silty clay
39	49	Tropic Shale	Clay, dark greenish gray, tight, moist
49	84	Tropic Shale	Silty clay, dark greenish gray, moist
84	113	Tropic Shale	Probably as above, hard drilling with bentonite fluid
113	113.5	Tropic Shale	Dark gray silty clay
113.5	114.8	Tropic Shale	Siltstone, mottled gray and black
114.8	118	Tropic Shale	Shale/claystone, fossiliferous, black and dark gray
118	121.6	Tropic Shale	Organic shale, fossiliferous, black
121.6	137.6	Dakota Formation	Coal
137.6	138	Dakota Formation	Siltstone, clayey, soft, medium to light gray
138	141.5	Dakota Formation	Silty claystone, mottled gray
141.5	142.8	Dakota Formation	Clayey siltstone, light gray
142.8	143	Dakota Formation	Sandstone, fine-grained, gray
143	160.5	Dakota Formation	Sandstone, fine grained, gray, minor thin shaley partings
160.5	163	Dakota Formation	Claystone, silty, gray, soft

Petersen Hydrologic, LLC

Borehole drilling log - North Private Lease exploration drilling project

Borehole #10 (18-39-05-010)

Date drilled:	22 June 2015	
Driller:	AGEC Applied Geotechnical Engineering Consultants, Inc., Sandy, Utah.	
Borehole diameter:	Auger - 4-inch	
	Core - HQ (2.5 inch)	
Logged by:	Erik Petersen, P.G.	
	Garrett Luallen	
Drilling method:	0-40 feet	Solid stem dry auger
	40-57 feet	Core drilling with drilling mud

From (ft)	To (ft)	Formation	Description
0	5	Alluvium	Grayish brown clayey silt, minor very fine grained sand, dry
5	30	Alluvium	Grayish brown clayey silt, slightly moist
30	35	Alluvium	Brownish gray silty clay, moist
35	38	Tropic Shale	Dark gray to black silty clay/shale
38	40	Tropic Shale	Dark gray to black silty clay/shale, slightly moist
40	42	Tropic Shale	Shaley carbonaceous shale and clay
42	52	Dakota Formation	Coal, 2.5-inch gray siltstone parting at 45 feet, 1-foot siltstone parting at 52-53 feet
52	53	Dakota Formation	Siltstone parting at 52-53 feet, medium to dark gray
53	54.5	Dakota Formation	Siltstone with minor coal stringers
54.5	57	Dakota Formation	Dakota Formation claystone, light gray, soft, moist

PETERSEN HYDROLOGIC, LLC

Piezometer drilling log - North Private Lease

NLP-1 (12AS020)

Date drilled: 27 November 2012
Driller: Clement Drilling and Geophysical, Inc, Cedar Hills, Utah
Borehole diameter: 2.5 inch - direct push

Logged by: Erik Petersen, P.G.
Bob Long, CPSS

From (ft)	To (ft)	Formation	Description
0	9	Alluvium	Clayey silt, gray and orange, wet at 9 feet
9	20	Alluvium	Silty fine-grained sand, brownish gray, wet

PETERSEN HYDROLOGIC, LLC

Piezometer drilling log - North Private Lease

NLP-2 (12AS018)

Date drilled: 28 November 2012
Driller: Clement Drilling and Geophysical, Inc, Cedar Hills, Utah
Borehole diameter: 2.5 inch - direct push

Logged by: Erik Petersen, P.G.
Bob Long, CPSS

From (ft)	To (ft)	Formation	Description
0	0.7	Alluvium	Clay Loam
0.7	2.2	Alluvium	Clay Loam
2.2	3.8	Alluvium	Silty Clay
3.8	4.9	Alluvium	Silty Clay
4.9	8	Alluvium	Sandy Loam
8	10.4	Alluvium	Loamy Sand
10.4	12.7	Alluvium	Silty Clay
12.7	13.3	Alluvium	Sandy Loam
13.3	18.8	Alluvium	Silty Loam
18.8	21	Alluvium	Silty Clay Loam
21	24	Alluvium	Silty Clay

PETERSEN HYDROLOGIC, LLC

Piezometer drilling log - North Private Lease

NLP-3 (12AS021)

Date drilled: 28 November 2012
Driller: Clement Drilling and Geophysical, Inc, Cedar Hills, Utah
Borehole diameter: 2.5 inch - direct push

Logged by: Erik Petersen, P.G.
Bob Long, CPSS

From (ft)	To (ft)	Formation	Description
0	4	Alluvium	Silty soil with fine-grained sand, dark and medium brown
4	7	Alluvium	Clayey silt, brown
7	9	Alluvium	Fine-grained silty sand, brown
9	12	Alluvium	Very-fine-grained sand and silty sand
12	17	Alluvium	Silty sand, brown
17	25	Alluvium	fine-grained sand with silt lenses
25	30	Alluvium	sandy gravel, became wet/saturated at 27.5 feet

PETERSEN HYDROLOGIC, LLC

Piezometer drilling log - North Private Lease

NLP-4 (12AS022)

Date drilled: 28 November 2012
Driller: Clement Drilling and Geophysical, Inc, Cedar Hills, Utah
Borehole diameter: 2.5 inch - direct push

Logged by: Erik Petersen, P.G.
Bob Long, CPSS

From (ft)	To (ft)	Formation	Description
0	4.5	Alluvium	gravelly sand
4.5	5.5	Alluvium	silty clay loam
5.5	8	Alluvium	gravelly sand

PETERSEN HYDROLOGIC, LLC

Piezometer drilling log - North Private Lease

NLP-5 (12AS024)

Date drilled: 28 November 2012
Driller: Clement Drilling and Geophysical, Inc, Cedar Hills, Utah
Borehole diameter: 2.5 inch - direct push

Logged by: Erik Petersen, P.G.
Bob Long, CPSS

From (ft)	To (ft)	Formation	Description
0	6.5	Alluvium	Gravelly and loamy sand
6.5	8	Alluvium	Loamy sand
8	10	Alluvium	Loose silty sand, brown

PETERSEN HYDROLOGIC, LLC

Piezometer drilling log - North Private Lease

NLP-6 (12AS028)

Date drilled: 29 November 2012
Driller: Clement Drilling and Geophysical, Inc, Cedar Hills, Utah
Borehole diameter: 2.5 inch - direct push

Logged by: Erik Petersen, P.G.
Bob Long, CPSS

From (ft)	To (ft)	Formation	Description
0	1	Alluvium	Brown soil
1	3	Alluvium	silt, clayey silt, grayish
3	4.2	Alluvium	Silt, petrocalcic
4.2	5.2	Alluvium	Silty clay
5.2	7.7	Alluvium	Loam
7.7	10.7	Alluvium	Sandy loam
10.7	20	Alluvium	Loam and sandy loam

PETERSEN HYDROLOGIC, LLC

Piezometer drilling log - North Private Lease

NLP-7 (12AS027)

Date drilled: 29 November 2012
Driller: Clement Drilling and Geophysical, Inc, Cedar Hills, Utah
Borehole diameter: 2.5 inch - direct push

Logged by: Erik Petersen, P.G.
Bob Long, CPSS

From (ft)	To (ft)	Formation	Description
0	1	Alluvium	Soil
1	21.5	Alluvium	Silt/clay petrocalcic
21.5	26	Alluvium	Fine-grained sand, orange/brown wet

PETERSEN HYDROLOGIC, LLC

Piezometer drilling log - North Private Lease

NLP-8 (12AS029)

Date drilled: 29 November 2012
Driller: Clement Drilling and Geophysical, Inc, Cedar Hills, Utah
Borehole diameter: 2.5 inch - direct push

Logged by: Erik Petersen, P.G.
Bob Long, CPSS

From (ft)	To (ft)	Formation	Description
0	6	Alluvium	Silty soil and silty clay
6	7.5	Alluvium	Silt, hard, dense
7.5	10	Alluvium	Gravelly clay
10	19	Alluvium	Sand, saturated
19	20	Alluvium	silty clay, dense

PETERSEN HYDROLOGIC, LLC

Piezometer drilling log - North Private Lease

NLP-9 (DP-30)

Date drilled: 30 November 2012
Driller: Clement Drilling and Geophysical, Inc, Cedar Hills, Utah
Borehole diameter: 2.5 inch - direct push

Logged by: Erik Petersen, P.G.
Bob Long, CPSS

From (ft)	To (ft)	Formation	Description
0	8	Alluvium/Tropic colluv.	Clay, dense brownish to greenish gray
8	12	Alluvium/Tropic colluv.	Clay, tight, brownish gray, very hard
12	16	Alluvium/Tropic colluv.	Clay, brownish gray, more moist at bottom
16	21	Alluvium/Tropic colluv.	Clay, darker gray, hard
21	24	Alluvium	Fine-grained sand, medium brown, moist, last 3 inches finer grained and silty

PETERSEN HYDROLOGIC, LLC

Piezometer drilling log - North Private Lease

NLP-10 (12AS019)

Date drilled: 12 November 2013
Driller: Clement Drilling and Geophysical, Inc, Cedar Hills, Utah
Borehole diameter: 2.5 inch - direct push

Logged by: Erik Petersen, P.G.
Bob Long, CPSS

From (ft)	To (ft)	Formation	Description
0	2	Alluvium	Clay and silty clay, gray and brown
2	12	Alluvium	Loam, sandy loam, gray and brown
12	13.4	Alluvium	Silty clay, yellow to light gray
13.4	20	Alluvium	Loam, sandy loam, pale yellow
20	26.6	Alluvium	Clay loam, light brownish gray, moist
26.6	28	Alluvium	Loamy sand, light yellowish brown

Petersen Hydrologic, LLC

Piezometer drilling log - North Private Lease

NLP-11 (13AS06)

Date drilled: 13 November 2013
Driller: Clement Drilling and Geophysical, Inc, Cedar Hills, Utah
Borehole diameter: 2.5 inch - direct push

Logged by: Erik Petersen, P.G.
Bob Long, CPSS

From (ft)	To (ft)	Formation	Description
0	20.8	Alluvium	Clay loam, sandy clay, clay, brown, browhish gray, gray
20.8	29	Alluvium	Loamy sand and sandy loam, light yellowish brown

PETERSEN HYDROLOGIC, LLC

Piezometer drilling log - North Private Lease

NLP-12 (13AS07)

Date drilled: 13 November 2013
Driller: Clement Drilling and Geophysical, Inc, Cedar Hills, Utah
Borehole diameter: 2.5 inch - direct push

Logged by: Erik Petersen, P.G.
Bob Long, CPSS

From (ft)	To (ft)	Formation	Description
0	2	Alluvium	Clay and clay loam, yellowish brown
2	12	Alluvium	Sandy clay loam, sandy loam, grayish brown and olive brown
12	21.5	Alluvium	Gravelly loamy sand, pale yellow
21.5	24	Alluvium	Clay, gray, moist, became hard drilling

PETERSEN HYDROLOGIC, LLC

Piezometer drilling log - North Private Lease

NLP-13 (13AS08)

Date drilled: 13 November 2013
Driller: Clement Drilling and Geophysical, Inc, Cedar Hills, Utah
Borehole diameter: 2.5 inch - direct push

Logged by: Erik Petersen, P.G.
Bob Long, CPSS

From (ft)	To (ft)	Formation	Description
0	4	Alluvium	soft gray clay, soil, no recovery
4	8	Alluvium	Clay, gray dense, moist
8	12	Alluvium	Clay, gray dense, moist
12	16	Alluvium	Clay, gray dense, moist

UTAH INTERNATIONAL BOREHOLE LITHOLOGY LISTINGS

table 1 of 1

CODE	ENDING DEPTH	DESCRIPTION
** SAMPLE INDENTIFIER : PDH-7		
427	20.0	SILTSTONE, MOD. SOFT, SANDY
522	25.0	SANDSTONE W/CLAYSTONE (26-49%), VERY FINE-MED. GR. SST., CALC.
000	30.0	LOST
075	39.0	ALLUVIUM, PEBBLES (PEDIMENT GRAVELS)
350	40.0	SILTSTONE W/SANDSTONE & MINOR CLAYSTONE
132	45.0	SHALE, MOD. HARD, CALCAREOUS
002	48.0	BENTONITE
132	53.5	SHALE, MOD. HARD, CALCAREOUS
002	55.5	BENTONITE
132	57.0	SHALE, MOD. HARD, CALCAREOUS
002	58.5	BENTONITE
132	62.2	SHALE, MOD. HARD, CALCAREOUS
373	64.3	SILTSTONE W/SANDSTONE (26-49%), BIOTURBATED
373	65.1	SILTSTONE W/SANDSTONE (26-49%), BIOTURBATED
009	66.5	COQUINA
439	67.2	SILTSTONE, MOD. HARD, CLAYEY
363	68.0	SILTSTONE W/SANDSTONE (5-25%), BIOTURBATED
138	71.5	SHALE, MOD. HARD, SILTY
900	71.7	COAL
900	74.6	COAL
900	77.2	COAL
900	87.0	COAL
900	87.5	COAL
138	87.9	SHALE, MOD. HARD, SILTY
128	92.6	SHALE, SILTY
439	93.0	SILTSTONE, MOD. HARD, CLAYEY
447	93.5	SILTSTONE, HARD, SANDY
439	95.1	SILTSTONE, MOD. HARD, CLAYEY
627	97.0	SANDSTONE, SOFT-HARD, VERY FINE-FINE GR., FRIABLE

HOLE NO. ADH-7

DRILL HOLE COMPLETION REPORT

COORDINATES: N-S _____ _____ QUADRANGLE (7½,15')

E-W _____ _____ AREA/AMS

ALTON PROSPECT/PROJECT

SEC 13 . TWP 39S . RNG 6W . SALT LAKE MER.

GR. ELE. 6895

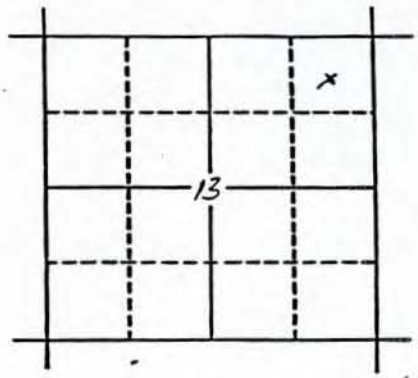
STATE UTAH : COUNTY KANE

STATE OR FEDERAL LEASE NO. _____

SURFACE OWNER NEVADA POWER

COMMENCED 11-20-85 COMPLETED 11-20-85

TOTAL DEPTH 97.0' PROBE DEPTH 95.0'



BITS:	TYPE	SIZE	INTERVAL USED
SURFACE	DRAG	(5 5/8)	0-60
MAIN HOLE	3" core	( )	60-97.0
		( )	

(WIRELINE, (ROTARY), HAMMER, REV. CIRC.)

DRILLING MEDIUMS AND ADDITIVES:

MEDIUM	INTERVAL	ADDITIVE	INTERVAL(S)
air	0 - 30		
water injection	30 - 97.0		

CORED: (YES) (NO): (WIRELINE, (ROTARY))

CORED INTERVALS: _____

LOST CIRCULATION DEPTH(S) 25-30 REGAINED?: yes

NOTICEABLE WATER INVASION?: yes INTERVALS: 25-30'

NOTICEABLE GAS INVASION?: no INTERVALS: _____

CASING: DEPTH 90' : DIAMETER 2" pvc RECOVERED?: no - hydro monitoring well

LOGS RUN: (NATURAL GAMMA, GAMMA GAMMA DENSITY, RESISTANCE, CALIPER, NEUTRON, SP, DRIFT, SONIC, TEMPERTURE) ID

LOGGING CO.: UII MFGR: _____

PLUGGED?: yes : IF NO, EXPLAIN _____

IF HOLE PLUGGED BY OTHER THAN CONTRACTOR, GIVE NAME AND ADDRESS:

CONTRACTOR: NAME AND ADDRESS MD-TE Drilling Co

MODEL & MFG. OF DRILL Mayhew 1000

ROCK CLASSIFICATION I.D. Oct 1982

COMMENTS: (ON REVERSE SIDE)

CDM

BOREHOLE LOG RECORD

Project Alton Coal No. 8448-111
By J. Kiefer Date 7/11/86 Page 1 of 1
Chkd By ____ Date ____

Q.A. No. F6132
Rev. ____
Page ____ of ____

Project ID* ____ Hole No.* A 6
Record Type B L R Site No.* ____ Date* ____ Time* ____
Twsp ____ Rng ____ Sec ____ 1/4 ____ 1/4 ____ 1/4 ____
Location N ____ E ____
SR. EL.* ____ FT M Survey Elevation ____ FT M

Contractor MOTE Driller ____ Rig Failing 1500
Bit(s) 5-7/8" Tricone Core ____ Fluid ____
Borehole Diameter(s) ____ Total Depth ____
Geophysical Log: Yes ___ No ___ Date: St ___ Fn ___ Status ____

Depth (ft)	Air Lift (Q)	Symbol	Material Description and Comments
0-10'		MC	Silt, hard (clayey w/fine-grained sand)
10-15'		CL	Silty clay, hard
15-35'		SM-SC	Silty sand w/clay, hard
35-55'		GM	Sandy gravel
55-75'		GM	Gravel
75-90'		GM	Sandy gravel
90-105'		GM	Gravel
105-106.5		CL	Shale
106.5-120		Coal	Coal

* SEE EXPLANATIONS ON BACK

Q.C. ____

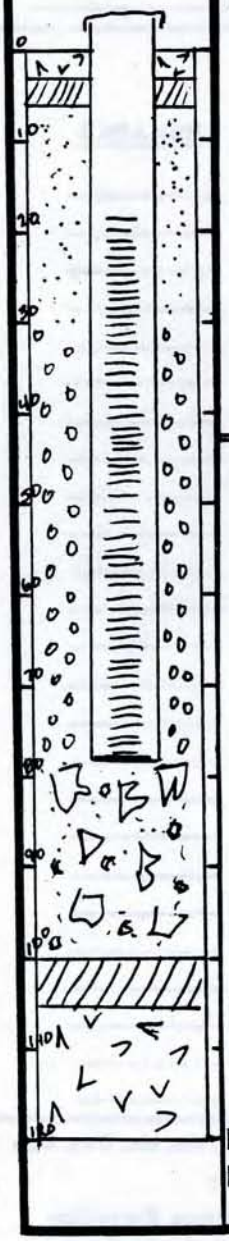
CDM

WELL CONSTRUCTION SUMMARY

Project Utah Int. - Alton Coal No. 8448-111 Q.A. No. F6216
By JGS Date 7/11/36 Page 1 of 1 Rev.
Chkd By Date Page of

Project ID* [ ] Well No.* A 6
Record Type W C S Site No.* [ ] Date* 8 6 0 7 1 1 Time* [ ]
Twsp [ ] Rng [ ] Sec [ ] 1/4 [ ] 1/4 [ ] 1/4 [ ]
Location N [ ] E [ ]
SR. EL.* [ ] FT M Survey Elevation [ ] FT M

PERSONNEL JGS TOP OF CASING ELEVATION



DRILLING SUMMARY

Total Depth 120'
Borehole Diameter From 0 to 120'
= 5-7/8"
Driller Jack
Rig Gardner-Denver 74
Bit(s)
Drilling Fluids From 0 to 120
Revert
Surface Casing From - to -

CONSTRUCTION TIME LOG

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling	7/10		7/10	
Geophysical Logging	7/10		7/10	
Casing	7/11	0950	7/11	1030
Filter Placement	7/11	1030	7/11	1120
Cementing #2	7/11	1145	7/11	1150
Development	7/11	1150	7/11	1335
Other				
Cement #1	7/10		7/10	
Bentonite #1	7/11	0850	7/11	0950
Bentonite #2	7/11	1140	7/11	1150

WELL DESIGN

Basis: Geologic Log X
Geophysical Log
Casing String(s): C-Casing S-Screen

C-Casing		S-Screen	
+2.93	17.93 C-1	17.93	77.81 S-1

CONSTRUCTION DESCRIPTION

Casing: C1 2", Sch 40 PVC
C2
C3
C4
Screen: S1 2", Sch 40, PVC
S2
S3
S4
Centralizers None
Filter Material Pea gravel - silica sand (10-20) 4.6'-77.96,
Cement 0.0-2.0 (#2) and 105'-120'(±1)
Slot Sizes 10 slot 105'-120'
Other 2.0-4.6 Bentonite pellet seal (#2); 100-105' Bentonite seal (#1) 77.81'-100' voids and sloughed material (Rock at 77.81 blocking hole).

* SEE EXPLANATIONS ON BACK Q.C.

SAMPLE DESCRIPTION
and
CORE DESCRIPTION

10-5-80
Large Diameter Core

HOLE # Y-53-C PROSPECT Alton Coal

FROM 0 TO 231.4 BY Alan Gibbs

FROM	TO		DESCRIPTION
0	5	111	Claystone, Lt olive gray, soft, calcareous
5	10	111	As above
10	15	310	Siltstone, yellow gray, soft, calcareous, slightly fissile
15	20	310	" , med. gray, soft calcareous
20	185	310	As above
185	190		6" core Run 1 Rec 0' 0% Rec.
185	190		Run 2 Rec 4.0' 80% Rec.
190	194		Run 3 Rec 0' 0% Rec.
194	196		Run 4 Rec 5.4' 270% Rec. - picked up lost core
194.6			TOP OF COAL
196	201.4		Run 5 Rec 5.4' 100% Rec.
201.4	206.3		Run 6 Rec 4.9' 98% Rec.
206.3	211.0		Run 7 Rec 4.7' 100% Rec.
210.6			BOT. OF COAL
211.0	216.4		Run 8 Rec 5.4' 100% Rec.
216.4	225	560	Sandstone, buff, yellow gray silt vfg, calcareous
225	230	560	As above
230	231.4	573	Sandstone, light gray, silty vfg wavy bands, bands of carbanaceous debris, calcareous; mod. hard. 50% silt 50% vfg sandstone

COAL PIEZOMETER INSTALLED

PROJECT Alton Coal

DRILL HOLE # Y-53-C

DEPTH TOP COAL 194.6'

BASE COAL 210.6

COAL THICKNESS – GROSS 16.0

NET 15.8

COAL CONDITION

MEGASCOPIC DESCRIPTION

SAMPLE "U"

COAL #

OUTCROP LOCATION

DATE 10/6/80

INVESTIGATOR A. D. Gibbs

BENCH NO.	TENTHS OF FOOT TOP OF BENCH	THICKNESS	TENTHS OF FOOT BASE OF BENCH	VITRAIN (Indicate Approx. Percent)				ATTRITUS (Luster %)				SURFACE 1. earthy 2. rough 3. granular 4. silky 5. smooth etc.	FUSAIN		BONE	CLEAT C-CALCITE P-PYRITE K-KAOLIN	NOTES
				THICK 6-50MM	MED. 2-5MM	THIN 1/2-2MM	MICRO <1/2MM	BRIGHT	MED BRIGHT	MOD. DULL	DULL		APPROX. PCT.	BEDDING PLANE THICKNESS	APPROX. PCT. IF > 5%		
A	194.6	0.2	194.8			~3		~2	~40	~50	~4		~1				COAL Black, massive, calcite stringers, mod. dull, cleat mod, 194.8-195.0 clay
B	195.0	1.0	196.0			~3		~2	~40	~50	~4		~1				COAL As above, no evid. calc stringer, to massive, mod dull, marcasite swirls top 0.6', marcasite infusain on bedding planes
C	196.0	5.4	201.4				~3	~10	50	30	~7						COAL Black, massive, cleat mod, blocky; 196-198 contains small resin-light tan dots about 0.1mm in dia. 200.6' is a stringer of marcasite otherwise no evid. in rest of interval, fusain mod. on bedding planes, concoidal fracture
D	201.4	4.9	206.3				3	~5	40	40	~12						COAL Black, massive, cleat poor to fair, not as much as above; 201.4-203.0 contains light tan material resin dots and small stringers on bedding; 203.4-203.8 stringers of marcasite fusain somewhat more abund on bedding planes, no evid. marcasite on bedding planes; some shiny concoidal fracturing towards bottom; cleating better developed where there is less fusain on bedding plane; fusain materail crumbles with thumb rub
E	206.3	4.3	210.6				3	5	50	40	~2						COAL As above, black massive, marcasite stringer at 206.8; no resin as above no marcasite observed except in stringer

UTAH INTERNATIONAL INC.

DRILL & CORE LOG

HOLE NO. Y-53-C
LOG BY: A. D. Gibbs
DATE: 10/5/80
ELEV.: 7001.56
N: 357,778.27
E: 1,768,060.54
HOLE SIZE: 8 7/8"
AIR [X] WATER [X]
T.D. 231.4 P.D.
HOLE NO. Y-53-C
PROJECT: Alton Coal
LEASE: U-060745
SEC. 19 T. 39 S. R. 5 W.

% REC.	DEPTH	STRIP LOG	THICK	SAMPLE NO.	GRAV.	LITHOLOGY	ANALYSIS
	185					Run #1 LOST	
	186					172 Claystone, dk gray, mod. hard massive, top 2.6' non-calcareous	
						bottom 1.4' weakly calc; 187.7'-188.4' bentonitic, light gray, soft	
	187		4.0				
	188						
	189						
			1.0			172 As above, top ½' weakly calc, bot. ½' not calcareous	
	190					End of Run #2 (lost 1.0') (lost Run #1)	
		Lost	?			Lost interval unknown--could be ground up, or top of last run or bot. of	
	190.6					this run??	
	191		0.8			111 Claystone, light gray, soft, bentonitic, calcareous, abund biotite flks	
	191.2						
	192		1.2			172 Claystone, drk gray, mod hard, trace fossils, 191.2-193.2 calc,	
	192.4					bottom- half is non calc,	
	193		1.6			possible slickenslided horizontal fractures	
						As above with some coal stringers	
	194					~~End of Run #3 (lost4.0') 0% rec.~~	
			0.6			Top of Coal Bench A	
	194.6			0.2		Clayst, light gray, soft, calc, silst chips mod had mixed in.	
	194.8						
	195						
			1.2			Coal Bench B	
	196					~~End of Run #4 (picked up 3.4 feet of Run #3) 100+ recovery~~	
	197						
	198						
			5.4			Bench C	
	199						
	200						
	201						
	201.4					End of Run#5 (100% recovery)	
	202						
	203						
	204						
			4.9			Bench D	
	205						
	206						
	206.3					End of Run #6 (4.9' rec ou of 5' cored) 98% rec.	
	207						

UTAH INTERNATIONAL INC.

DRILL & CORE LOG

HOLE NO. Y-53-C
LOGGED BY: A. D. Gibbs
DATE: 10/6/80

ELEV.: 7001.56
N: ~~357,778.27~~
E: 1,768,060.54

HOLE SIZE: 8 7/8
AIR [X] WATER [X]
T.D. 231.4 P.D.

HOLE NO. Y-53-C
PROJECT: Alton Coal
LEASE: U-060745
SEC. 19 T. 39S R. 5W

% REC.	DEPTH	STRIP LOG	THICK	BOX SAMPLE NO.	HOLE (WHAT'S OMITTED)	LITHOLOGY	ANALYSIS
	208						
	209					Bench E	
	210					Bottom of Coal Seam @ 210.6	
						166 Clayst, med gray, mod hard, massive, coal stringers, non calc	
	210.6		0.4				
	211	++++	+++	++++		End of Run #7 (100%)	
						166 As above, trace carbonaceous stringers	
	212		3.0				
	213						
	214						
						612 Sandst, light gray, vfg, massive, mod hard, non calc	
	215		2.4				
	216						
	216.4	++++	+++	++++		End of Run #8 (100%)	
	217						

WELL COMPLETION REPORT

ALTON AMPHITHEATER AREA

HOLE NO. 4-53-C — ALTON COAL PROSPECT

LOCATION 1510 FWL, FNL, (FSL), FEL X 1340 (FWL), FNL, FSL, FEL NE CORNER OF

LOT _____, SEC 19, TWP 39 S., R 5 W., SLB MER.

GR. ELEV. 7001.56 — COORDINATES N. 357,778.27

STATE UTAH COUNTY KANE — E. 1,768,060.54

SURFACE OWNER ROGER PUGH

DATE COMMENCED 10-4-80 — STATE OR FEDERAL LEASE NO. U-060745

DATE COMPLETED 10-8-80

TOTAL DEPTH 231.4

HOLE SIZE 8 7/8"

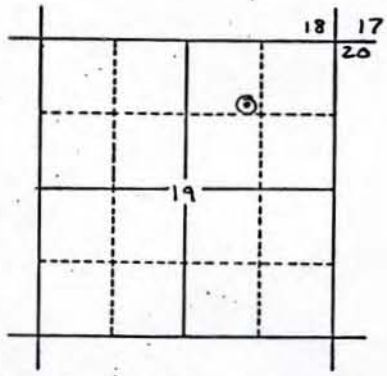
MODEL & MFG. OF DRILL FAILING 1500

AIR TO 231.4 WATER (MUD) TO _____

BITS: SURFACE 10' (12")

MAIN HOLE 231.4 (8 7/8)

(WIRELINE (CONVENTIONAL)
(REVERSE-CIRC) (HAMMER)



(testhole location in section)
Scale: 2" = 1 mile

CORED: (YES) (NO): INTERVALS 185-216.4'

CORE HEAD: (HWD-3), I.D. 5 7/8, O.D. 7 3/4, MFGR CHRISTENSEN

LOGS RUN: E-LOG (X), GAMMA RAY (x), DENSITY (X), OTHER CALIPER

MFGR. _____

LOGGING CO. TERRA DATA AND UTAH INTERNATIONAL

CHEMICALS AIRQUICK AND REVERT

LOST CIRCULATION AT DEPTH (S) _____ REGAINED (YES) (NO)

NOTICEABLE WATER INVATION: (NO) (YES); INTERVALS: _____

NOTICEABLE GAS INVASTION: (NO) (YES); INTERVALS _____

CASING: DEPTH 10' : DIAMETER 10" RECOVERED (YES) (NO)

PLUGGED: (YES) (NO): IF NO, EXPLAIN CEMENTED AROUND 2" PVC PIPE. HYDROLOGICAL MONITORING STATION IN COAL

IF HOLE PLUGGED BY OTHER THAN CONTRACTOR, GIVE NAME AND

ADDRESS _____

INVOICE NUMBER FOR ABOVE _____

CONTRACTOR: NAME AND ADDRESS BOYLES BROS. DRILLING CO.

SALT LAKE CITY UTAH

SAMPLES AND CORE DESCRIPTIONS BY: ALAN GIBBS

REPORT PREPARED BY: ALAN GIBBS & JOEL CART DATE 1/7/81

SAMPLE DESCRIPTION
and
CORE DESCRIPTION

10/9/80

HOLE # Y-55-C PROSPECT Alton Coal Project

FROM 0 TO _____ BY Alan Gibbs

FROM	TO	DESCRIPTION
0	5	Siltstone, yellow gray, mod. soft drilling, calcareous Fe Oxide stained
5	10	As above
10	15	As above greater Fe-Oxide stains and Gypsum blades
15	20	As above
20	25	As above
25	30	Claystone, olive gray mud, soft drilling ~25% siltstone, Fe Ox stains & Gypsum
30	35	As above Pale brown
35	40	CORE POINT @ 35'
40	45	T.D. 90.0' COAL PIEZOMETER INSTALLED
45	50	
50	55	
55	60	
60	65	
65	70	
70	75	
75	80	
80	85	
85	90	
90	95	
95	100	
100	105	
105	110	
110	115	
115	120	
120	125	
125	130	
130	135	
135	140	
140	145	
145	150	
150	155	
155	160	
160	165	
165	170	
170	175	
175	180	
180	185	
185	190	
190	195	
195	200	
200	205	
205	210	
210	215	
215	220	

PLOT
Y-55-C

MEGASCOPIC DESCRIPTION

OUTCROP LOCATION

DEPTH TOP COAL 53.6'
BASE COAL 68.7'

COAL THICKNESS – GROSS 15.10'
NET 15.00'

COAL CONDITION

SAMPLE
COAL # "U" seam

DATE Oct. 9, 1980
INVESTIGATOR ADG

Y-55-C

BENCH NO.	TENTHS OF FOOT TOP OF BENCH	THICKNESS	TENTHS OF FOOT BASE OF BENCH	VITRAIN (Indicate Approx. Percent)				ATTRITUS (Luster %)				SURFACE 1. earthy 2. rough 3. granular 4. silky 5. smooth etc.	FUSAIN		BONE	CLEAT C-CALCITE P-PYRITE K-KAOLIN	NOTES
				THICK 6-50MM	MED. 2-5MM	THIN 1/2-2MM	MICRO <1/2MM	BRIGHT	MED BRIGHT	MOD. DULL	DULL		APPROX. PCT.	BEDDING PLANE THICKNESS	APPROX. PCT. IF > 5%		
A	53.6'	1.4'	55.0'				1	2	30	60	7	Earthy					Coal, black massive, top 1.1' dull, bottom 0.3' med bright & fair cleating, fusain on bedding, trace gypsum on cleat, trace fossil
B	55.0'	10.0'	65.0'				3	10	50	30	7						top 0.1', no evid. marcasite Coal Black massive; top 2' slightly FeOx stained, crumbly in places, no evid. marcasi
																	At 57.7' pyrite stringer, another at 58.0'. from 57.7' to bottom, small blebs of marcasi occur on parting in coal. Fusain on bedding
																	concoidal fractures towards bottom. 56-57' vertical parting in FeOx and gypsum
C	65.0'	3.7'	68.7'				1	5	40	40	4						Coal Black, brumbly to blocky, fair to well cleated, marcasite blebs on cleats, diagonal slickensided fracture at 66.2'
																	67.6'-thin (0.1' siltstone parting); concoidal tractures towards bottom
		15.1	TOTAL														Y-55-C

UTAH INTERNATIONAL INC.

DRILL & CORE LOG

HOLE NO. Y-55-C

LOG BY: ADG

DATE: 10/9/80

ELEV: 6949.39

N: 364,978.76

E: 1,760,559.16

HOLE SIZE: 2 1/2" NC

AIR [X] Foam WATER [ ]

T.D. 90.0 P.D.

HOLE NO. Y-55-C

PROJECT: Alton Coal

LEASE: U-060745

SEC. 12 T. 39S R. 6W

% REC.	DEPTH	STRIP LOG	THICK	SAMPLE NO.	GRAV.	LITHOLOGY	ANALYSIS
	35					Run #1	
			0.3			110 Claystone, soft, yellow gray, non calcareous	
	35.3			1		324 Siltstone (approx. 50% claystone), dk gray, soft, noncalcareous, gypsum blades	
	36		1.9			36.5 Gypsum & FeOx on parting	
	37						
	37.2		0.5			114 Claystone, cream, soft, bentonitic, FeOx bands, non calcareous	
	37.7						
	38					210 Claystone, dk gray, soft, FeOx stain increasing downward	
						39.7' - Gypsum & FeOx on fracture	
	39		2.8				
	40						
	40.3						
	40.5			0.2		114 Claystone, cream, soft, bentonitic, FeOx bands, non calcareous	
	40.8		0.3				
	41					210 Claystone, dk gray, soft, top 2.0' calcareous	
						47.0' Gypsum & FeOx on fracture also calcareous	
	42						
			4.2				
	43						
	44						
	45					End of Run #1 (Recovered 9.9' of 10.0' cored) 99% REC	
			2.8			221 Claystone w 50% siltstone interbeds, claystone dk gray mod soft massiv non calcareous, siltstone, yellow gray, wavy bands, trace FeOx in	
	46					siltstone. Diagonal fracture 45.5' w gypsum mod FeOx stains	
	47						
	47.8						
	48					474 Siltstone, dk gray mod hd. wavy bands very light gray calcareous mater	
			1.4			(fine grained calcitic material) approx 5% fossil shells	
	49						
	49.2					479 Siltstone, dk gray, mod hd, approx 50% fossil shells, calcareous	
	49.8		0.6			473 Siltstone, dk gray, mod hd, flat beds fine grained calcite, approx. 5-10% fo	
	50						
			2.5			51.5' Diagonal fracture with FeOx stains	
	51						
	52						
	52.2					479 siltstone, dk gray, mod hd, approx 50% fossils, calcareous	
	53		1.3				
	53.6					920 Coal Top of Coal @ 53.6	
	54						
			1.4			Bench A	
	55					End of Run #2 (100%) 45.0'-55.0'	
	56						
	57						

UTAH INTERNATIONAL INC.

DRILL & CORE LOG

HOLE NO. Y-55-C
LOG BY: ADG
DATE: 10/9/80

ELEV.: 6949.39
N: 364,978.76
E: 1,760,559.16

HOLE SIZE: 2 1/2" NC
AIR [X] Foam WATER [ ]
T.D. 95 P.D.

HOLE NO. Y-55-C
PROJECT: Alton Coal
LEASE: U-060745
SEC. 12 T. 39S R. 6W

% REC.	DEPTH	STRIP LOG	THICK	SAMPLE NO.	GRAV.	LITHOLOGY	ANALYSIS
	58					Coal	
	59					Bench B	
			10.0				
	60						
	61						
	62						
	63						
	64						
	65					End of Run #3 (100%) 55.0-65.0	
	66						
	67					Bench C	
	68					Bottom of Coal @ 68.7	
	68.7					412 Siltstone, light gray, soft, non calcareous, carbonaceous towards bottom	
	69		0.8				
	68.5 70						
	71						
			5.5				
	72					LOST	
	73						
	74						
	75					End of Run #4 (lost 5.5') 65.0-75.0 45% REC	
			2.4			462 Siltstone, med gray, mod hd, massive, noncalcareous	
	76						
	77						
	77.4					482 siltstone, light tan, hd, massive, non calcareous	
	78		1.3				
	78.7					462 siltstone, med gray, mod hd, massive, noncalcareous, clayey	
	79		3.5				
	80						

UTAH INTERNATIONAL INC.

DRILL & CORE LOG

HOLE NO. Y-55-C
LOG BY: ADG
DATE: 10/9/80

ELEV.: 6949.39
N: 364,978.76
E: 1,760,559.16

HOLE SIZE: 2 1/2" NC
AIR [X] WATER [ ]
T.D. Foam 90' P.D.

HOLE NO. Y-55-C
PROJECT: Alton Coal
LEASE: U-060745
SEC. 12 T. 39S R. 6W

% REC.	DEPTH	STRIP LOG	THICK	SAMPLE NO.	GRAV.	LITHOLOGY	ANALYSIS
	81						
	82						
	82.2					562 Sandstone light gray, mod hd, massive, wavy bands (carb debris or dark silt) Non calcareous	
	83						
	84		2.8				
	85					End of Run #5 (Lost 0.3') 97% REC 75.0'-85.0' 562 As above	
	85.8		0.8			472 Siltstone, dk gray, mod hd, massive, slightly calcareous	
	86						
	86.4		0.6				
	86.7		0.3			482 Siltstone, light tan, hd, massive, concoidal fracture, noncalcareous	
	87					422 Siltstone, dk gray, soft massive, calcareous towards top, FeOx Stains towards bottom	
	88		3.3				
	89						
	90					End of Run #6 (100%) 85'-90'	
	91						
	92						
	93						
	94						
	95						
	96						
	97						
	98						
	99						
	100						

HOLE NO. Y-55

SAMPLE DESCRIPTION
and
CORE DESCRIPTION

10-5-80
Large Diameter Core

HOLE # Y-53-C PROSPECT Alton Coal

FROM 0 TO 231.4 BY Alan Gibbs

FROM	TO		DESCRIPTION
0	5	111	Claystone, Lt olive gray, soft, calcareous
5	10	111	As above
10	15	310	Siltstone, yellow gray, soft, calcareous, slightly fissile
15	20	310	" , med. gray, soft calcareous
20	185	310	As above
185	190		6" core Run 1 Rec 0' 0% Rec.
185	190		Run 2 Rec 4.0' 80% Rec.
190	194		Run 3 Rec 0' 0% Rec.
194	196		Run 4 Rec 5.4' 270% Rec. - picked up lost core
194.6			TOP OF COAL
196	201.4		Run 5 Rec 5.4' 100% Rec.
201.4	206.3		Run 6 Rec 4.9' 98% Rec.
206.3	211.0		Run 7 Rec 4.7' 100% Rec.
210.6			BOT. OF COAL
211.0	216.4		Run 8 Rec 5.4' 100% Rec.
216.4	225	560	Sandstone, buff, yellow gray silt vfg, calcareous
225	230	560	As above
230	231.4	573	Sandstone, light gray, silty vfg wavy bands, bands of carbanaceous debris, calcareous; mod. hard. 50% silt 50% vfg sandstone

COAL PIEZOMETER INSTALLED

PROJECT Alton Coal

DRILL HOLE # Y-53-C

DEPTH TOP COAL 194.6'

BASE COAL 210.6

COAL THICKNESS – GROSS 16.0

NET 15.8

COAL CONDITION

MEGASCOPIC DESCRIPTION

SAMPLE "U"

COAL #

OUTCROP LOCATION

DATE 10/6/80

INVESTIGATOR A. D. Gibbs

BENCH NO.	TENTHS OF FOOT TOP OF BENCH	THICKNESS	TENTHS OF FOOT BASE OF BENCH	VITRAIN (Indicate Approx. Percent)				ATTRITUS (Luster %)				SURFACE 1. earthy 2. rough 3. granular 4. silky 5. smooth etc.	FUSAIN		BONE	CLEAT C-CALCITE P-PYRITE K-KAOLIN	NOTES
				THICK 6-50MM	MED. 2-5MM	THIN 1/2-2MM	MICRO <1/2MM	BRIGHT	MED BRIGHT	MOD. DULL	DULL		APPROX. PCT.	BEDDING PLANE THICKNESS	APPROX. PCT. IF > 5%		
A	194.6	0.2	194.8			~3		~2	~40	~50	~4		~1				COAL Black, massive, calcite stringers, mod. dull, cleat mod, 194.8-195.0 clay
B	195.0	1.0	196.0			~3		~2	~40	~50	~4		~1				COAL As above, no evid. calc stringer, to massive, mod dull, marcasite swirls top 0.6', marcasite infusain on bedding planes
C	196.0	5.4	201.4				~3	~10	50	30	~7						COAL Black, massive, cleat mod, blocky; 196-198 contains small resin-light tan dots about 0.1mm in dia. 200.6' is a stringer of marcasite otherwise no evid. in rest of interval, fusain mod. on bedding planes, concoidal fracture
D	201.4	4.9	206.3				3	~5	40	40	~12						COAL Black, massive, cleat poor to fair, not as much as above; 201.4-203.0 contains light tan material resin dots and small stringers on bedding; 203.4-203.8 stringers of marcasite fusain somewhat more abund on bedding planes, no evid. marcasite on bedding planes; some shiny concoidal fracturing towards bottom; cleating better developed where there is less fusain on bedding plane; fusain materail crumbles with thumb rub
E	206.3	4.3	210.6				3	5	50	40	~2						COAL As above, black massive, marcasite stringer at 206.8; no resin as above no marcasite observed except in stringer

UTAH INTERNATIONAL INC.

DRILL & CORE LOG

HOLE NO. Y-53-C
LOG BY: A. D. Gibbs
DATE: 10/5/80
ELEV.: 7001.56
N: 357,778.27
E: 1,768,060.54
HOLE SIZE: 8 7/8"
AIR [X] WATER [X]
T.D. 231.4 P.D.
HOLE NO. Y-53-C
PROJECT: Alton Coal
LEASE: U-060745
SEC. 19 T. 39 S. R. 5 W.

% REC.	DEPTH	STRIP LOG	THICK	SAMPLE NO.	GRAV.	LITHOLOGY	ANALYSIS
	185					Run #1 LOST	
	186					172 Claystone, dk gray, mod. hard massive, top 2.6' non-calcareous	
						bottom 1.4' weakly calc; 187.7'-188.4' bentonitic, light gray, soft	
	187		4.0				
	188						
	189						
			1.0			172 As above, top ½' weakly calc, bot. ½' not calcareous	
	190					End of Run #2 (lost 1.0') (lost Run #1)	
		Lost	?			Lost interval unknown--could be ground up, or top of last run or bot. of	
	190.6					this run??	
	191		0.8			111 Claystone, light gray, soft, bentonitic, calcareous, abund biotite flks	
	191.2						
	192		1.2			172 Claystone, drk gray, mod hard, trace fossils, 191.2-193.2 calc,	
	192.4					bottom- half is non calc,	
	193		1.6			possible slickenslided horizontal fractures	
						As above with some coal stringers	
	194					~~End of Run #3 (lost4.0') 0% rec.~~	
			0.6			Top of Coal Bench A	
	194.6			0.2		Clayst, light gray, soft, calc, silst chips mod had mixed in.	
	194.8						
	195						
			1.2			Coal Bench B	
	196					~~End of Run #4 (picked up 3.4 feet of Run #3) 100+ recovery~~	
	197						
	198						
			5.4			Bench C	
	199						
	200						
	201						
	201.4					End of Run#5 (100% recovery)	
	202						
	203						
	204						
			4.9			Bench D	
	205						
	206						
	206.3					End of Run #6 (4.9' rec ou of 5' cored) 98% rec.	
	207						

UTAH INTERNATIONAL INC.

DRILL & CORE LOG

HOLE NO. Y-53-C
LOGGED BY: A. D. Gibbs
DATE: 10/6/80

ELEV.: 7001.56
N: ~~357,778.27~~
E: 1,768,060.54

HOLE SIZE: 8 7/8
AIR [X] WATER [X]
T.D. 231.4 P.D.

HOLE NO. Y-53-C
PROJECT: Alton Coal
LEASE: U-060745
SEC. 19 T. 39S R. 5W

% REC.	DEPTH	STRIP LOG	THICK	BOX SAMPLE NO.	HOLE (WHAT'S OMITTED)	LITHOLOGY	ANALYSIS
	208						
	209					Bench E	
	210					Bottom of Coal Seam @ 210.6	
						166 Clayst, med gray, mod hard, massive, coal stringers, non calc	
	210.6		0.4				
	211	++++	+++	++++		End of Run #7 (100%)	
						166 As above, trace carbonaceous stringers	
	212		3.0				
	213						
	214						
						612 Sandst, light gray, vfg, massive, mod hard, non calc	
	215		2.4				
	216						
	216.4	++++	+++	++++		End of Run #8 (100%)	
	217						

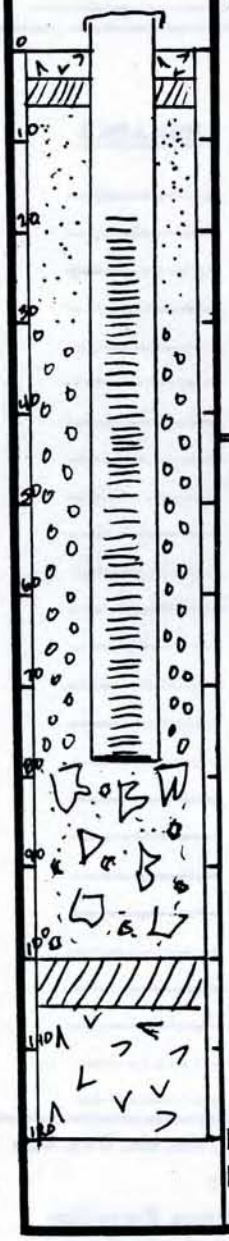
CDM

WELL CONSTRUCTION SUMMARY

Project Utah Int. - Alton Coal No. 8448-111 Q.A. No. F6216
By JGS Date 7/11/36 Page 1 of 1 Rev.
Chkd By Date Page of

Project ID* [ ] Well No.* A 6
Record Type W C S Site No.* [ ] Date* 8 6 0 7 1 1 Time* [ ]
Twsp [ ] Rng [ ] Sec [ ] 1/4 [ ] 1/4 [ ] 1/4 [ ]
Location N [ ] E [ ]
SR. EL.* [ ] FT M Survey Elevation [ ] FT M

PERSONNEL JGS TOP OF CASING ELEVATION



DRILLING SUMMARY

Total Depth 120'
Borehole Diameter From 0 to 120'
= 5-7/8"
Driller Jack
Rig Gardner-Denver 74
Bit(s)
Drilling Fluids From 0 to 120
Revert
Surface Casing From - to -

CONSTRUCTION TIME LOG

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling	7/10		7/10	
Geophysical Logging	7/10		7/10	
Casing	7/11	0950	7/11	1030
Filter Placement	7/11	1030	7/11	1120
Cementing #2	7/11	1145	7/11	1150
Development	7/11	1150	7/11	1335
Other				
Cement #1	7/10		7/10	
Bentonite #1	7/11	0850	7/11	0950
Bentonite #2	7/11	1140	7/11	1150

WELL DESIGN

Basis: Geologic Log X
Geophysical Log
Casing String(s): C-Casing S-Screen

C-Casing		S-Screen	
+2.93	17.93 C-1	17.93	77.81 S-1

CONSTRUCTION DESCRIPTION

Casing: C1 2", Sch 40 PVC
C2
C3
C4
Screen: S1 2", Sch 40, PVC
S2
S3
S4
Centralizers None
Filter Material Pea gravel - silica sand (10-20) 4.6'-77.96,
Cement 0.0-2.0 (#2) and 105'-120'(±1)
Slot Sizes 10 slot 105'-120'
Other 2.0-4.6 Bentonite pellet seal (#2); 100-105' Bentonite seal (#1) 77.81'-100' voids and sloughed material (Rock at 77.81 blocking hole).

* SEE EXPLANATIONS ON BACK Q.C.

WELL COMPLETION REPORT

ALTON AREA

HOLE NO. Y-56 ALTON COAL PROSPECT

LOCATION 288 FWL (FNL), FSL, FEL X 938 FWL, FNL, FSL (FEL) SW CORNER OF

LOT _____, SEC 12, TWP 39 S., R 6 W., SLB MER.

GR. ELEV. 6890.72 COORDINATES N. 364,932.10

STATE UTAH COUNTY KANE E. 1,759,899.42

SURFACE OWNER HEATON BROS.

DATE COMMENCED 10/10/80 STATE OR FEDERAL LEASE NO. U-060745

DATE COMPLETED 10/13/80

TOTAL DEPTH 40'

HOLE SIZE 5 5/8"

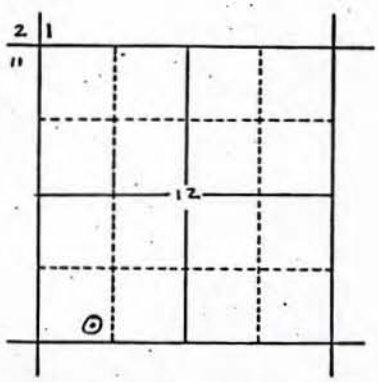
MODEL & MFG. OF DRILL FAILING 1500

AIR TO 40' WATER (MUD) TO _____

BITS: SURFACE 40' (5 5/8")

MAIN HOLE ____ ( )

(WIRELINE, (CONVENTIONAL))
(REVERSE-CIRC) (HAMMER)



(testhole location in section)
Scale: 2" = 1 mile

CORED: (YES) (NO): INTERVALS _____

CORE HEAD: ( ), I.D. _____, O.D. _____, MFGR _____

LOGS RUN: E-LOG ( ), GAMMA RAY ( ), DENSITY ( ), OTHER _____

MFGR. _____

LOGGING CO. _____

CHEMICALS _____

LOST CIRCULATION AT DEPTH (S) _____ REGAINED (YES) (NO)

NOTICEABLE WATER INVATION: (NO) (YES); INTERVALS: 15'-40'

NOTICEABLE GAS INVASTION: (NO) (YES); INTERVALS _____

CASING: DEPTH _____: DIAMETER _____ RECOVERED (YES) (NO)

PLUGGED: (YES) (NO): IF NO, EXPLAIN CEMENTED ~~OFF~~ AROUND 2" PVC PIPE HYDROLOGICAL MONITORING STATION IN THE ALLUVIUM

IF HOLE PLUGGED BY OTHER THAN CONTRACTOR, GIVE NAME AND

ADDRESS _____

INVOICE NUMBER FOR ABOVE _____

CONTRACTOR: NAME AND ADDRESS BOYLES BROS. DRILLING CO.
SALT LAKE CITY UTAH

SAMPLES AND CORE DESCRIPTIONS BY: ALAN GIBBS

REPORT PREPARED BY: JOEL CORT DATE 1/8/81

HOLE NO. ADH-7

DRILL HOLE COMPLETION REPORT

COORDINATES: N-S _____ _____ QUADRANGLE (7½,15')

E-W _____ _____ AREA/AMS

ALTON PROSPECT/PROJECT

SEC 13 . TWP 39S . RNG 6W . SALT LAKE MER.

GR. ELE. 6895

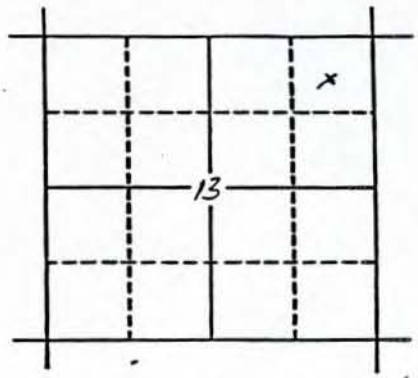
STATE UTAH : COUNTY KANE

STATE OR FEDERAL LEASE NO. _____

SURFACE OWNER NEVADA POWER

COMMENCED 11-20-85 COMPLETED 11-20-85

TOTAL DEPTH 97.0' PROBE DEPTH 95.0'



BITS:	TYPE	SIZE	INTERVAL USED
SURFACE	DRAG	(5 5/8)	0-60
MAIN HOLE	3" core	( )	60-97.0
		( )	

(WIRELINE, (ROTARY), HAMMER, REV. CIRC.)

DRILLING MEDIUMS AND ADDITIVES:

MEDIUM	INTERVAL	ADDITIVE	INTERVAL(S)
air	0 - 30		
water injection	30 - 97.0		

CORED: (YES) (NO): (WIRELINE, (ROTARY))

CORED INTERVALS: _____

LOST CIRCULATION DEPTH(S) 25-30 REGAINED?: yes

NOTICEABLE WATER INVASION?: yes INTERVALS: 25-30'

NOTICEABLE GAS INVASION?: no INTERVALS: _____

CASING: DEPTH 90' : DIAMETER 2" pvc RECOVERED?: no - hydro monitoring well

LOGS RUN: (NATURAL GAMMA, GAMMA GAMMA DENSITY, RESISTANCE, CALIPER, NEUTRON, SP, DRIFT, SONIC, TEMPERTURE) ID

LOGGING CO.: UII MFGR: _____

PLUGGED?: yes : IF NO, EXPLAIN _____

IF HOLE PLUGGED BY OTHER THAN CONTRACTOR, GIVE NAME AND ADDRESS:

CONTRACTOR: NAME AND ADDRESS MD-TE Drilling Co

MODEL & MFG. OF DRILL Mayhew 1000

ROCK CLASSIFICATION I.D. Oct 1982

COMMENTS: (ON REVERSE SIDE)

HOLE NO. PDH-6

DRILL HOLE COMPLETION REPORT

COORDINATES: N-S _____ _____ QUADRANGLE (7½,15')

E-W _____ _____ AREA/AMS

ALTON PROSPECT (PROJECT)

SEC 11, TWP 39S, RNG 6W, SALT LAKE MER.

GR. ELE. 6954

STATE UTAH : COUNTY KANE

STATE OR FEDERAL LEASE NO. _____

SURFACE OWNER _____

COMMENCED 11-26-85 COMPLETED 11-26-85

TOTAL DEPTH 65.3 PROBE DEPTH _____

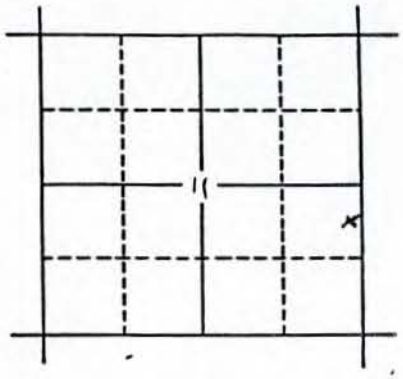
BITS: TYPE SIZE INTERVAL USED

SURFACE TRICONE 5⅝ 0-30'

MAIN HOLE Core (under b.H 3") 30'-65.3'

_____ ( ) _____

(WIRELINE, ROTARY, HAMMER, REV. CIRC.)



DRILLING MEDIUMS AND ADDITIVES:

MEDIUM	INTERVAL	ADDITIVE	INTERVAL(S)
AIR	0-15'		
water	15-65.3		

CORED: (YES) (NO): (WIRELINE, ROTARY)

CORED INTERVALS: 30' - 65.3'

LOST CIRCULATION DEPTH(S) _____ REGAINED?: _____

NOTICEABLE WATER INVASION?: no INTERVALS: _____

NOTICEABLE GAS INVASION?: no INTERVALS: _____

CASING: DEPTH 55' : DIAMETER 2" PVC RECOVERED?: no - monitoring well

LOGS RUN: (NATURAL GAMMA, GAMMA GAMMA DENSITY, RESISTANCE, CALIPER, NEUTRON, SP, DRIFT, SONIC, TEMPERTURE)

LOGGING CO.: UII MFGR: _____

PLUGGED?: yes : IF NO, EXPLAIN _____

IF HOLE PLUGGED BY OTHER THAN CONTRACTOR, GIVE NAME AND ADDRESS:

CONTRACTOR: NAME AND ADDRESS Mo-Te Inc. FARMINGTON NM.

MODEL & MFG. OF DRILL MAYHEW 1000

ROCK CLASSIFICATION I.D. OCTOBER, 1982

COMMENTS: (ON REVERSE SIDE)

WELL COMPLETION REPORT

ALTON AREA

HOLE NO. Y-55-C ALTON COAL PROSPECT

LOCATION 760 FWL, (FNL), FSL, FEL X 1605 FWL, FNL, FSL, (FEL) SW CORNER OF

LOT _____, SEC 12, TWP 39S., R 6W., SLB MER.

GR. ELEV. 6949.39 COORDINATES N. 364,978.76

STATE UTAH COUNTY KANE E. 1,760,559.16

SURFACE OWNER HEATON BROS.

DATE COMMENCED 10/9/80 STATE OR FEDERAL LEASE NO. U-060745

DATE COMPLETED 10/9/80

TOTAL DEPTH 95'

HOLE SIZE 5 5/8, NC

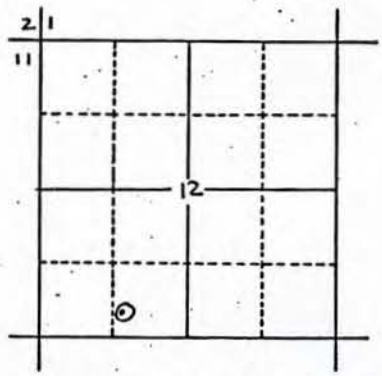
MODEL & MFG. OF DRILL FAILING 1500

~~AIR~~ FOAM TO 95' WATER (MUD) TO _____

BITS: SURFACE 35' (5 5/8)

MAIN HOLE 95' (NC/5 5/8)

(WIRELINE) (CONVENTIONAL)
(REVERSE-CIRC) (HAMMER)



(testhole location in section)
Scale: 2" = 1 mile

CORED: (YES) (NO): INTERVALS 35'-95'

CORE HEAD: (NC), I.D. 2.48, O.D. 3.94, MFGR CHRISTENSEN

LOGS RUN: E-LOG (X), GAMMA RAY (X), DENSITY ( ), OTHER CALIPER

MFGR. _____

LOGGING CO. TERRA DATA GEOPHYSICAL CO.

CHEMICALS AIRQUICK

LOST CIRCULATION AT DEPTH (S) _____ REGAINED (YES) (NO)

NOTICEABLE WATER INVATION: (NO) (YES); INTERVALS: _____

NOTICEABLE GAS INVASTION: (NO) (YES); INTERVALS _____

CASING: DEPTH _____: DIAMETER _____ RECOVERED (YES) (NO)

PLUGGED: (YES) (NO): IF NO, EXPLAIN CEMENTED AROUND 2" PVC PIPE, HYDROLOGICAL MONITORING STATION IN THE COAL

IF HOLE PLUGGED BY OTHER THAN CONTRACTOR, GIVE NAME AND

ADDRESS _____

INVOICE NUMBER FOR ABOVE _____

CONTRACTOR: NAME AND ADDRESS ROYLES BROS DRILLING CO.

SALT LAKE CITY UTAH

SAMPLES AND CORE DESCRIPTIONS BY: ALAN GIBBS

REPORT PREPARED BY: JOEL CORT DATE 1/8/81

WELL COMPLETION REPORT

ALTON AMPHITHEATER AREA

HOLE NO. 4-53-C — ALTON COAL PROSPECT

LOCATION 1510 FWL, FNL, (FSL), FEL X 1340 (FWL), FNL, FSL, FEL NE CORNER OF

LOT _____, SEC 19, TWP 39 S., R 5 W., SLB MER.

GR. ELEV. 7001.56 — COORDINATES N. 357,778.27

STATE UTAH COUNTY KANE — E. 1,768,060.54

SURFACE OWNER ROGER PUGH

DATE COMMENCED 10-4-80 — STATE OR FEDERAL LEASE NO. U-060745

DATE COMPLETED 10-8-80

TOTAL DEPTH 231.4

HOLE SIZE 8 7/8"

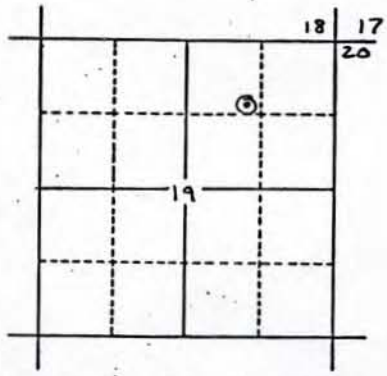
MODEL & MFG. OF DRILL FAILING 1500

AIR TO 231.4 WATER (MUD) TO _____

BITS: SURFACE 10' (12")

MAIN HOLE 231.4 (8 7/8)

(WIRELINE (CONVENTIONAL)
(REVERSE-CIRC) (HAMMER)



(testhole location in section)
Scale: 2" = 1 mile

CORED: (YES) (NO): INTERVALS 185-216.4'

CORE HEAD: (HWD-3), I.D. 5 7/8, O.D. 7 3/4, MFGR CHRISTENSEN

LOGS RUN: E-LOG (X), GAMMA RAY (x), DENSITY (X), OTHER CALIPER

MFGR. _____

LOGGING CO. TERRA DATA AND UTAH INTERNATIONAL

CHEMICALS AIRQUICK AND REVERT

LOST CIRCULATION AT DEPTH (S) _____ REGAINED (YES) (NO)

NOTICEABLE WATER INVATION: (NO) (YES); INTERVALS: _____

NOTICEABLE GAS INVASTION: (NO) (YES); INTERVALS _____

CASING: DEPTH 10' : DIAMETER 10" RECOVERED (YES) (NO)

PLUGGED: (YES) (NO): IF NO, EXPLAIN CEMENTED AROUND 2" PVC PIPE. HYDROLOGICAL MONITORING STATION IN COAL

IF HOLE PLUGGED BY OTHER THAN CONTRACTOR, GIVE NAME AND

ADDRESS _____

INVOICE NUMBER FOR ABOVE _____

CONTRACTOR: NAME AND ADDRESS BOYLES BROS. DRILLING CO.

SALT LAKE CITY UTAH

SAMPLES AND CORE DESCRIPTIONS BY: ALAN GIBBS

REPORT PREPARED BY: ALAN GIBBS & JOEL CART DATE 1/7/81

UTAH INTERNATIONAL BOREHOLE LITHOLOGY LISTINGS

table 1 of 1

CODE	ENDING DEPTH	DESCRIPTION
** SAMPLE INDENTIFIER : PDH-7		
427	20.0	SILTSTONE, MOD. SOFT, SANDY
522	25.0	SANDSTONE W/CLAYSTONE (26-49%), VERY FINE-MED. GR. SST., CALC.
000	30.0	LOST
075	39.0	ALLUVIUM, PEBBLES (PEDIMENT GRAVELS)
350	40.0	SILTSTONE W/SANDSTONE & MINOR CLAYSTONE
132	45.0	SHALE, MOD. HARD, CALCAREOUS
002	48.0	BENTONITE
132	53.5	SHALE, MOD. HARD, CALCAREOUS
002	55.5	BENTONITE
132	57.0	SHALE, MOD. HARD, CALCAREOUS
002	58.5	BENTONITE
132	62.2	SHALE, MOD. HARD, CALCAREOUS
373	64.3	SILTSTONE W/SANDSTONE (26-49%), BIOTURBATED
373	65.1	SILTSTONE W/SANDSTONE (26-49%), BIOTURBATED
009	66.5	COQUINA
439	67.2	SILTSTONE, MOD. HARD, CLAYEY
363	68.0	SILTSTONE W/SANDSTONE (5-25%), BIOTURBATED
138	71.5	SHALE, MOD. HARD, SILTY
900	71.7	COAL
900	74.6	COAL
900	77.2	COAL
900	87.0	COAL
900	87.5	COAL
138	87.9	SHALE, MOD. HARD, SILTY
128	92.6	SHALE, SILTY
439	93.0	SILTSTONE, MOD. HARD, CLAYEY
447	93.5	SILTSTONE, HARD, SANDY
439	95.1	SILTSTONE, MOD. HARD, CLAYEY
627	97.0	SANDSTONE, SOFT-HARD, VERY FINE-FINE GR., FRIABLE

UTAH INTERNATIONAL BOREHOLE LITHOLOGY LISTINGS

table 1 of 1

CODE	ENDING DEPTH	DESCRIPTION
** SAMPLE INDENTIFIER : PDH-6		
061	5.0	SOIL, CLAYEY
118	10.0	CLAYSTONE, SOFT, SILTY
349	15.0	SILTSTONE W/CLAYSTONE (5-25%)
349	20.0	SILTSTONE W/CLAYSTONE (5-25%)
118	30.0	CLAYSTONE, SOFT, SILTY
266	35.2	CLAYSTONE W/SANDSTONE (5-25%), I/B 0-1/4"
138	38.3	SHALE, MOD. HARD, SILTY
900	49.4	COAL
000	51.9	LOST
900	53.7	COAL
114	54.0	CLAYSTONE, SOFT, ROOTED
128	56.5	SHALE, SILTY
628	56.8	SANDSTONE, SOFT-HARD, VERY FINE-FINE GR., SILTY
128	64.5	SHALE, SILTY
442	65.2	SILTSTONE, HARD, CALCAREOUS
118	65.3	CLAYSTONE, SOFT, SILTY

SAMPLE DESCRIPTION
and
CORE DESCRIPTION

10/13/80

HOLE # Y-56 PROSPECT ALTON COAL PROJECT

FROM 0 TO 40.0' BY Joel B. Cort

FROM	TO	DESCRIPTION
0	5	Olive gray soft claystone
5	10	As above with some wetness - balling up
10	15	As above
15	20	Light gray claystone very wet
20	25	As above with more water
25	30	As above
30	35	As above
35	40	As above
		T.D. 40' Alluvial Piezometer set
		Lots of water in hole

SAMPLE DESCRIPTION
and
CORE DESCRIPTION

10-5-80
Large Diameter Core

HOLE # Y-53-C PROSPECT Alton Coal

FROM 0 TO 231.4 BY Alan Gibbs

FROM	TO		DESCRIPTION
0	5	111	Claystone, Lt olive gray, soft, calcareous
5	10	111	As above
10	15	310	Siltstone, yellow gray, soft, calcareous, slightly fissile
15	20	310	" , med. gray, soft calcareous
20	185	310	As above
185	190		6" core Run 1 Rec 0' 0% Rec.
185	190		Run 2 Rec 4.0' 80% Rec.
190	194		Run 3 Rec 0' 0% Rec.
194	196		Run 4 Rec 5.4' 270% Rec. - picked up lost core
194.6			TOP OF COAL
196	201.4		Run 5 Rec 5.4' 100% Rec.
201.4	206.3		Run 6 Rec 4.9' 98% Rec.
206.3	211.0		Run 7 Rec 4.7' 100% Rec.
210.6			BOT. OF COAL
211.0	216.4		Run 8 Rec 5.4' 100% Rec.
216.4	225	560	Sandstone, buff, yellow gray silt vfg, calcareous
225	230	560	As above
230	231.4	573	Sandstone, light gray, silty vfg wavy bands, bands of carbanaceous debris, calcareous; mod. hard. 50% silt 50% vfg sandstone

COAL PIEZOMETER INSTALLED

PROJECT Alton Coal

DRILL HOLE # Y-53-C

DEPTH TOP COAL 194.6'

BASE COAL 210.6

COAL THICKNESS – GROSS 16.0

NET 15.8

COAL CONDITION

MEGASCOPIC DESCRIPTION

SAMPLE "U"

COAL #

OUTCROP LOCATION

DATE 10/6/80

INVESTIGATOR A. D. Gibbs

BENCH NO.	TENTHS OF FOOT TOP OF BENCH	THICKNESS	TENTHS OF FOOT BASE OF BENCH	VITRAIN (Indicate Approx. Percent)				ATTRITUS (Luster %)				SURFACE 1. earthy 2. rough 3. granular 4. silky 5. smooth etc.	FUSAIN		BONE	CLEAT C-CALCITE P-PYRITE K-KAOLIN	NOTES
				THICK 6-50MM	MED. 2-5MM	THIN 1/2-2MM	MICRO <1/2MM	BRIGHT	MED BRIGHT	MOD. DULL	DULL		APPROX. PCT.	BEDDING PLANE THICKNESS	APPROX. PCT. IF > 5%		
A	194.6	0.2	194.8			~3		~2	~40	~50	~4		~1				COAL Black, massive, calcite stringers, mod. dull, cleat mod, 194.8-195.0 clay
B	195.0	1.0	196.0			~3		~2	~40	~50	~4		~1				COAL As above, no evid. calc stringer, to massive, mod dull, marcasite swirls top 0.6', marcasite infusain on bedding planes
C	196.0	5.4	201.4				~3	~10	50	30	~7						COAL Black, massive, cleat mod, blocky; 196-198 contains small resin-light tan dots about 0.1mm in dia. 200.6' is a stringer of marcasite otherwise no evid. in rest of interval, fusain mod. on bedding planes, concoidal fracture
D	201.4	4.9	206.3				3	~5	40	40	~12						COAL Black, massive, cleat poor to fair, not as much as above; 201.4-203.0 contains light tan material resin dots and small stringers on bedding; 203.4-203.8 stringers of marcasite fusain somewhat more abund on bedding planes, no evid. marcasite on bedding planes; some shiny concoidal fracturing towards bottom; cleating better developed where there is less fusain on bedding plane; fusain materail crumbles with thumb rub
E	206.3	4.3	210.6				3	5	50	40	~2						COAL As above, black massive, marcasite stringer at 206.8; no resin as above no marcasite observed except in stringer

UTAH INTERNATIONAL INC.

DRILL & CORE LOG

HOLE NO. Y-53-C
LOG BY: A. D. Gibbs
DATE: 10/5/80
ELEV.: 7001.56
N: 357,778.27
E: 1,768,060.54
HOLE SIZE: 8 7/8"
AIR [X] WATER [X]
T.D. 231.4 P.D.
HOLE NO. Y-53-C
PROJECT: Alton Coal
LEASE: U-060745
SEC. 19 T. 39 S. R. 5 W.

% REC.	DEPTH	STRIP LOG	THICK	SAMPLE NO.	GRAV.	LITHOLOGY	ANALYSIS
	185					Run #1 LOST	
	186					172 Claystone, dk gray, mod. hard massive, top 2.6' non-calcareous	
						bottom 1.4' weakly calc; 187.7'-188.4' bentonitic, light gray, soft	
	187		4.0				
	188						
	189						
			1.0			172 As above, top ½' weakly calc, bot. ½' not calcareous	
	190					End of Run #2 (lost 1.0') (lost Run #1)	
		Lost	?			Lost interval unknown--could be ground up, or top of last run or bot. of	
	190.6					this run??	
	191		0.8			111 Claystone, light gray, soft, bentonitic, calcareous, abund biotite flks	
	191.2						
	192		1.2			172 Claystone, drk gray, mod hard, trace fossils, 191.2-193.2 calc,	
	192.4					bottom- half is non calc,	
	193		1.6			possible slickenslided horizontal fractures	
						As above with some coal stringers	
	194					~~End of Run #3 (lost4.0') 0% rec.~~	
			0.6			Top of Coal Bench A	
	194.6			0.2		Clayst, light gray, soft, calc, silst chips mod had mixed in.	
	194.8						
	195						
			1.2			Coal Bench B	
	196					~~End of Run #4 (picked up 3.4 feet of Run #3) 100+ recovery~~	
	197						
	198						
			5.4			Bench C	
	199						
	200						
	201						
	201.4					End of Run#5 (100% recovery)	
	202						
	203						
	204						
			4.9			Bench D	
	205						
	206						
	206.3					End of Run #6 (4.9' rec ou of 5' cored) 98% rec.	
	207						

UTAH INTERNATIONAL INC.

DRILL & CORE LOG

HOLE NO. Y-53-C
LOGGED BY: A. D. Gibbs
DATE: 10/6/80

ELEV.: 7001.56
N: ~~357,778.27~~
E: 1,768,060.54

HOLE SIZE: 8 7/8
AIR [X] WATER [X]
T.D. 231.4 P.D.

HOLE NO. Y-53-C
PROJECT: Alton Coal
LEASE: U-060745
SEC. 19 T. 39S R. 5W

% REC.	DEPTH	STRIP LOG	THICK	BOX SAMPLE NO.	HOLE (WHAT'S OMITTED)	LITHOLOGY	ANALYSIS
	208						
	209					Bench E	
	210					Bottom of Coal Seam @ 210.6	
						166 Clayst, med gray, mod hard, massive, coal stringers, non calc	
	210.6		0.4				
	211	++++	+++	++++		End of Run #7 (100%)	
						166 As above, trace carbonaceous stringers	
	212		3.0				
	213						
	214						
						612 Sandst, light gray, vfg, massive, mod hard, non calc	
	215		2.4				
	216						
	216.4	++++	+++	++++		End of Run #8 (100%)	
	217						

UTAH INTERNATIONAL INC.

DRILL & CORE LOG

HOLE NO. Y-55-C
LOG BY: ADG
DATE: 10/9/80

ELEV.: 6949.39
N: 364,978.76
E: 1,760,559.16

HOLE SIZE: 2 1/2" NC
AIR [X] Foam WATER [ ]
T.D. 95 P.D.

HOLE NO. Y-55-C
PROJECT: Alton Coal
LEASE: U-060745
SEC. 12 T. 39S R. 6W

% REC.	DEPTH	STRIP LOG	THICK	SAMPLE NO.	GRAV.	LITHOLOGY	ANALYSIS
	58					Coal	
	59					Bench B	
			10.0				
	60						
	61						
	62						
	63						
	64						
	65					End of Run #3 (100%) 55.0-65.0	
	66						
	67					Bench C	
	68					Bottom of Coal @ 68.7	
	68.7					412 Siltstone, light gray, soft, non calcareous, carbonaceous towards bottom	
	69		0.8				
	68.5 70						
	71						
			5.5				
	72					LOST	
	73						
	74						
	75					End of Run #4 (lost 5.5') 65.0-75.0 45% REC	
			2.4			462 Siltstone, med gray, mod hd, massive, noncalcareous	
	76						
	77						
	77.4					482 siltstone, light tan, hd, massive, non calcareous	
	78		1.3				
	78.7					462 siltstone, med gray, mod hd, massive, noncalcareous, clayey	
	79		3.5				
	80						

UTAH INTERNATIONAL INC.

DRILL & CORE LOG

HOLE NO. Y-55-C
LOG BY: ADG
DATE: 10/9/80

ELEV.: 6949.39
N: 364,978.76
E: 1,760,559.16

HOLE SIZE: 2 1/2" NC
AIR [X] WATER [ ]
T.D. Foam 90' P.D.

HOLE NO. Y-55-C
PROJECT: Alton Coal
LEASE: U-060745
SEC. 12 T. 39S R. 6W

% REC.	DEPTH	STRIP LOG	THICK	SAMPLE NO.	GRAV.	LITHOLOGY	ANALYSIS
	81						
	82						
	82.2					562 Sandstone light gray, mod hd, massive, wavy bands (carb debris or dark silt) Non calcareous	
	83						
	84		2.8				
	85					End of Run #5 (Lost 0.3') 97% REC 75.0'-85.0' 562 As above	
	85.8		0.8			472 Siltstone, dk gray, mod hd, massive, slightly calcareous	
	86						
	86.4		0.6				
	86.7		0.3			482 Siltstone, light tan, hd, massive, concoidal fracture, noncalcareous	
	87					422 Siltstone, dk gray, soft massive, calcareous towards top, FeOx Stains towards bottom	
	88		3.3				
	89						
	90					End of Run #6 (100%) 85'-90'	
	91						
	92						
	93						
	94						
	95						
	96						
	97						
	98						
	99						
	100						

HOLE NO. Y-55

WELL COMPLETION REPORT

ALTON AREA

HOLE NO. Y-55-C ALTON COAL PROSPECT

LOCATION 760 FWL, (FNL), FSL, FEL X 1605 FWL, FNL, FSL, (FEL) SW CORNER OF

LOT _____, SEC 12, TWP 39S., R 6W., SLB MER.

GR. ELEV. 6949.39 COORDINATES N. 364,978.76

STATE UTAH COUNTY KANE E. 1,760,559.16

SURFACE OWNER HEATON BROS.

DATE COMMENCED 10/9/80 STATE OR FEDERAL LEASE NO. U-060745

DATE COMPLETED 10/9/80

TOTAL DEPTH 95'

HOLE SIZE 5 5/8, NC

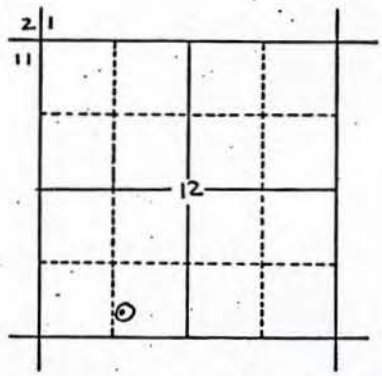
MODEL & MFG. OF DRILL FAILING 1500

~~AIR~~ FOAM TO 95' WATER (MUD) TO _____

BITS: SURFACE 35' (5 5/8)

MAIN HOLE 95' (NC/5 5/8)

(WIRELINE) (CONVENTIONAL)
(REVERSE-CIRC) (HAMMER)



(testhole location in section)
Scale: 2" = 1 mile

CORED: (YES) (NO): INTERVALS 35'-95'

CORE HEAD: (NC), I.D. 2.48, O.D. 3.94, MFGR CHRISTENSEN

LOGS RUN: E-LOG (X), GAMMA RAY (X), DENSITY ( ), OTHER CALIPER

MFGR. _____

LOGGING CO. TERRA DATA GEOPHYSICAL CO.

CHEMICALS AIRQUICK

LOST CIRCULATION AT DEPTH (S) _____ REGAINED (YES) (NO)

NOTICEABLE WATER INVATION: (NO) (YES); INTERVALS: _____

NOTICEABLE GAS INVASTION: (NO) (YES); INTERVALS _____

CASING: DEPTH _____: DIAMETER _____ RECOVERED (YES) (NO)

PLUGGED: (YES) (NO): IF NO, EXPLAIN CEMENTED AROUND 2" PVC PIPE, HYDROLOGICAL MONITORING STATION IN THE COAL

IF HOLE PLUGGED BY OTHER THAN CONTRACTOR, GIVE NAME AND

ADDRESS _____

INVOICE NUMBER FOR ABOVE _____

CONTRACTOR: NAME AND ADDRESS ROYLES BROS DRILLING CO.

SALT LAKE CITY UTAH

SAMPLES AND CORE DESCRIPTIONS BY: ALAN GIBBS

REPORT PREPARED BY: JOEL CORT DATE 1/8/81

SAMPLE DESCRIPTION
and
CORE DESCRIPTION

10/13/80

HOLE # Y-56 PROSPECT ALTON COAL PROJECT

FROM 0 TO 40.0' BY Joel B. Cort

FROM	TO	DESCRIPTION
0	5	Olive gray soft claystone
5	10	As above with some wetness - balling up
10	15	As above
15	20	Light gray claystone very wet
20	25	As above with more water
25	30	As above
30	35	As above
35	40	As above
		T.D. 40' Alluvial Piezometer set
		Lots of water in hole

WELL COMPLETION REPORT

ALTON AREA

HOLE NO. Y-56 ALTON COAL PROSPECT

LOCATION 288 FWL (FNL), FSL, FEL X 938 FWL, FNL, FSL (FEL) SW CORNER OF

LOT _____, SEC 12, TWP 39 S., R 6 W., SLB MER.

GR. ELEV. 6890.72 COORDINATES N. 364,932.10

STATE UTAH COUNTY KANE E. 1,759,899.42

SURFACE OWNER HEATON BROS.

DATE COMMENCED 10/10/80 STATE OR FEDERAL LEASE NO. U-060745

DATE COMPLETED 10/13/80

TOTAL DEPTH 40'

HOLE SIZE 5 5/8"

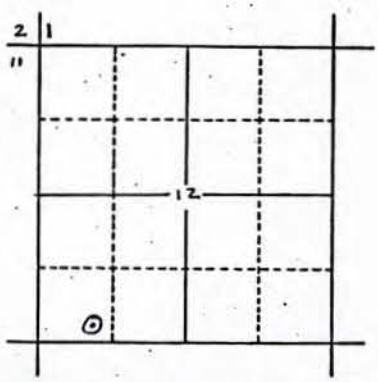
MODEL & MFG. OF DRILL FAILING 1500

AIR TO 40' WATER (MUD) TO _____

BITS: SURFACE 40' (5 5/8")

MAIN HOLE ____ ( )

(WIRELINE, (CONVENTIONAL))
(REVERSE-CIRC) (HAMMER)



(testhole location in section)
Scale: 2" = 1 mile

CORED: (YES) (NO): INTERVALS _____

CORE HEAD: ( ), I.D. _____, O.D. _____, MFGR _____

LOGS RUN: E-LOG ( ), GAMMA RAY ( ), DENSITY ( ), OTHER _____

MFGR. _____

LOGGING CO. _____

CHEMICALS _____

LOST CIRCULATION AT DEPTH (S) _____ REGAINED (YES) (NO)

NOTICEABLE WATER INVATION: (NO) (YES); INTERVALS: 15'-40'

NOTICEABLE GAS INVASTION: (NO) (YES); INTERVALS _____

CASING: DEPTH _____: DIAMETER _____ RECOVERED (YES) (NO)

PLUGGED: (YES) (NO): IF NO, EXPLAIN CEMENTED ~~OFF~~ AROUND 2" PVC PIPE HYDROLOGICAL MONITORING STATION IN THE ALLUVIUM

IF HOLE PLUGGED BY OTHER THAN CONTRACTOR, GIVE NAME AND

ADDRESS _____

INVOICE NUMBER FOR ABOVE _____

CONTRACTOR: NAME AND ADDRESS BOYLES BROS. DRILLING CO.
SALT LAKE CITY UTAH

SAMPLES AND CORE DESCRIPTIONS BY: ALAN GIBBS

REPORT PREPARED BY: JOEL CORT DATE 1/8/81

UTAH INTERNATIONAL BOREHOLE LITHOLOGY LISTINGS

table 1 of 1

CODE	ENDING DEPTH	DESCRIPTION
** SAMPLE INDENTIFIER : PDH-6		
061	5.0	SOIL, CLAYEY
118	10.0	CLAYSTONE, SOFT, SILTY
349	15.0	SILTSTONE W/CLAYSTONE (5-25%)
349	20.0	SILTSTONE W/CLAYSTONE (5-25%)
118	30.0	CLAYSTONE, SOFT, SILTY
266	35.2	CLAYSTONE W/SANDSTONE (5-25%), I/B 0-1/4"
138	38.3	SHALE, MOD. HARD, SILTY
900	49.4	COAL
000	51.9	LOST
900	53.7	COAL
114	54.0	CLAYSTONE, SOFT, ROOTED
128	56.5	SHALE, SILTY
628	56.8	SANDSTONE, SOFT-HARD, VERY FINE-FINE GR., SILTY
128	64.5	SHALE, SILTY
442	65.2	SILTSTONE, HARD, CALCAREOUS
118	65.3	CLAYSTONE, SOFT, SILTY

HOLE NO. PDH-6

DRILL HOLE COMPLETION REPORT

COORDINATES: N-S _____ _____ QUADRANGLE (7½,15')

E-W _____ _____ AREA/AMS

ALTON PROSPECT (PROJECT)

SEC 11, TWP 39S, RNG 6W, SALT LAKE MER.

GR. ELE. 6954

STATE UTAH : COUNTY KANE

STATE OR FEDERAL LEASE NO. _____

SURFACE OWNER _____

COMMENCED 11-26-85 COMPLETED 11-26-85

TOTAL DEPTH 65.3 PROBE DEPTH _____

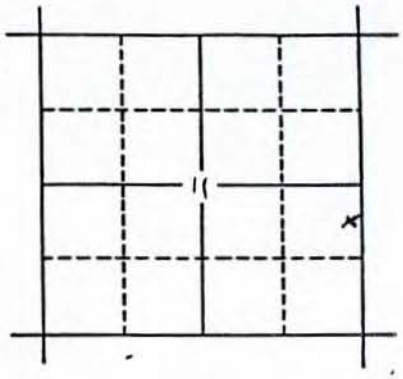
BITS: TYPE SIZE INTERVAL USED

SURFACE TRICONE 5⅝ 0-30'

MAIN HOLE Core (under b.H 3") 30'-65.3'

_____ ( ) _____

(WIRELINE, ROTARY, HAMMER, REV. CIRC.)



DRILLING MEDIUMS AND ADDITIVES:

MEDIUM	INTERVAL	ADDITIVE	INTERVAL(S)
AIR	0-15'		
water	15-65.3		

CORED: (YES) (NO): (WIRELINE, ROTARY)

CORED INTERVALS: 30' - 65.3'

LOST CIRCULATION DEPTH(S) _____ REGAINED?: _____

NOTICEABLE WATER INVASION?: no INTERVALS: _____

NOTICEABLE GAS INVASION?: no INTERVALS: _____

CASING: DEPTH 55' : DIAMETER 2" PVC RECOVERED?: no - monitoring well

LOGS RUN: (NATURAL GAMMA, GAMMA GAMMA DENSITY, RESISTANCE, CALIPER, NEUTRON, SP, DRIFT, SONIC, TEMPERTURE)

LOGGING CO.: UII MFGR: _____

PLUGGED?: yes : IF NO, EXPLAIN _____

IF HOLE PLUGGED BY OTHER THAN CONTRACTOR, GIVE NAME AND ADDRESS:

CONTRACTOR: NAME AND ADDRESS Mo-Te Inc. FARMINGTON NM.

MODEL & MFG. OF DRILL MAYHEW 1000

ROCK CLASSIFICATION I.D. OCTOBER, 1982

COMMENTS: (ON REVERSE SIDE)

Appendix C

Well testing information for UII Y-103 well test

Selected information from UII, 1987

APPENDIX 4.3-5

1986 AQUIFER TEST FIELD DATA, DATA PLOTS,
AND SUPPORTING CALCULATIONS

APPENDIX 4.3-5

TABLE OF CONTENTS

Method of Analysis

Cooper, Bredehoeft, and Papadopulos (1967)

Hvorslev (1951)

Bouwer and Rice (1976) with Corrections by Black (1978)

Representative Plots for Wells

Raw Data

Method of Analysis:

The following section details the methods of analysis for one well for each method used to analyze the slug test data. Subsequent sections contain the raw data for each of the slug tests as well as a representative plot of the data collected for each well.

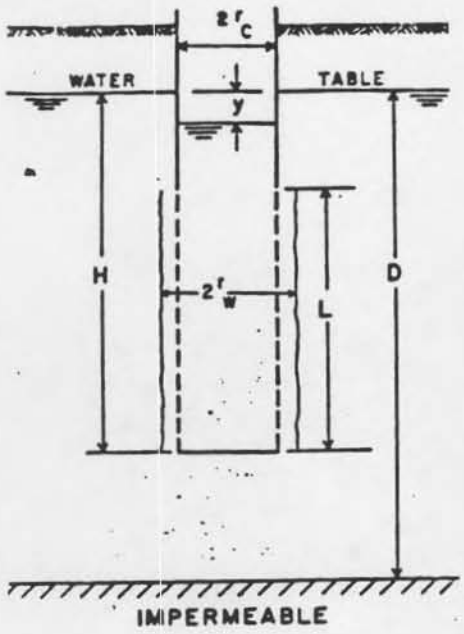
WELLS: X71 (A9), Y98 (A1), Y103 (A6), X69 (A7)

TYPE OF TEST: SLUG

METHOD OF ANALYSIS: BOUWER AND RICE (1976) WITH CORRECTIONS BY BLACK (1978)

ANALYSIS AS FOLLOWS FOR WELL X71 (A9):

Depicted below are the geometry and symbols of a partially penetrating, partially perforated well in an unconfined aquifer with gravel pack or developed cone around the perforated section.



Where

r_c = Inside radius of casing.

$r_b = r_w$ = radial distance between the undisturbed aquifer and the well center. (bore hole radius).

H = Height of standing water.

L = Height of screen.

D = Thickness of aquifer.

y = Change in water level.

Other symbols used in this analysis are as follows:

r_{co} = Outside radius of casing
n = Porosity of gravel pack
r_c' = Radial distance between the undisturbed aquifer and the well center accounting for gravel pack
C = Dimensionless parameter that is a function of L/r_w
Y = Vertical distance between water level in well and equilibrium water table in aquifer
R_e = Effective radius over which y is displaced
Y_o = y at t = o
Y_t = y at t = t
K = Hydraulic conductivity
T = Transmissivity

Assumptions

- For H<L, use H = L
- Porosity, n, assumed to be 30% weighted borehole radius, r_w, based on caliper log

Theoretical Assumptions

- Drawdown of water table around the well is negligible
- Flow in capillary fringe can be ignored
- Well losses are negligible
- Aquifer is homogeneous and isotropic

Test # 2 (Rising Head)

The following well geometry data were ascertained from well construction reports, Appendix 4.3-5.

D = (Depth of bedrock) - (water level)

Depth to bedrock = 41.0 ft
Water level = tapedown (ft) - stickup (ft) =
27.35 ft - 2.33 ft = 25.02 ft = 25.0 ft

D = 41.0 ft - 25.0 ft = 16.0 ft

H = (TD of well) - (water level)

H = 41.0 ft - 25.0 = 16.0 ft

L = (Depth to bottom of screen) - (Depth to top of screen)

L = 41.0 ft - 22.6 ft = 18.4 ft

In this case, water level does not exceed top of screen; therefore, L = H

r_c = 0.97 in = 0.081 ft

r_w = weighted borehole radius (radii measurements from caliper log)

$r_b = r_w = \Sigma \ Ri^2 \ Li/L$

Where

Borehole Depth Interval	Interval Length (Li)	Radius (Ri)
21-24 ft	3 ft	2.70 in = 0.23 ft
24-27 ft	3 ft	3.25 in = 0.27
27-33 ft	6 ft	2.85 in = 0.24
33-40 ft	7 ft	4.50 in = 0.38 ft

$$r_w = \sqrt{(0.23\ ft)^2\ (3\ ft/19\ ft) + (0.27\ ft)^2\ (3\ ft/19\ ft) + (0.24\ ft)^2\ (6\ ft/19\ ft) + (0.38\ ft)^2\ (7\ ft/19\ ft)}$$

$$r_w = 3.02 * 10^{-1}\ ft$$

$$r_{co} = 1.19\ in = 0.099\ ft$$

$$r_c' = [r_c^2 + n(r_w^2 - r_{co})]^{1/2}$$

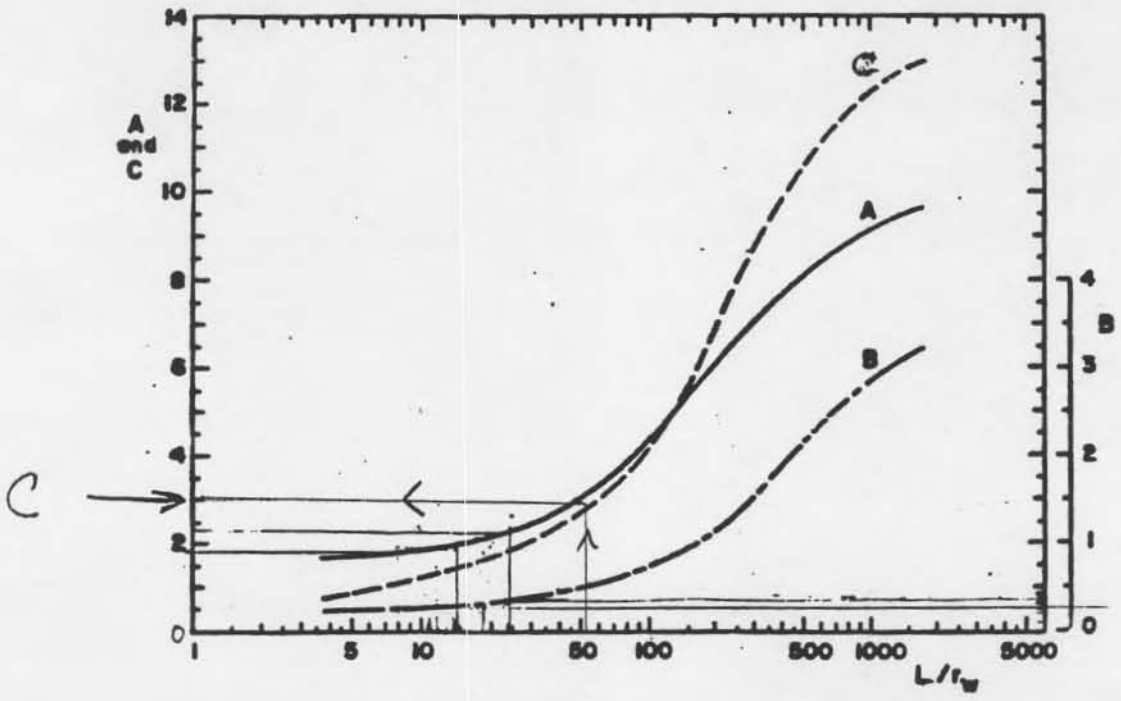
$$= [(0.081\ ft)^2 + 0.30\ [(0.302\ ft)^2 - (0.099\ ft)^2]]^{1/2}$$

$$r_c' = 0.176\ ft$$

To determine C for a fully penetrating well first determine L/r_w.

$$L/r_w = 16.0\ ft/0.299\ ft = 53.5\ ft$$

Then, using Curve C from the Figure below,



Determine C by finding 53.5 on x axis, project vertically to curve C, then project horizontally to read C off y axis.

$C = 3.0$

Next, determine $\ln (R_e/r_w)$ by using the equation

$$\ln (R_e/r_w) = [1.1/\ln (H/r_w) + C/(l/r_w)]^{-1}$$

$$\ln (R_e/r_w) = [1.1/\ln (16 \text{ ft}/0.299 \text{ ft}) + 3.0/(16 \text{ ft}/10.299 \text{ ft})]^{-1}$$

$$\ln (R_e/r_w) = 0.276 + 0.056$$

$$\ln (R_e/r_w) = 3.0$$

Determine hydraulic conductivity by using the equation

$$K = (r_c'^2 \ln (R_e/r_w)/2L)(l/t) \ln (Y_o/Y_t)$$

Using t determined from the attached data plot and Y_o and Y_e from attached data plot

$$K = (0.176 \text{ ft})^2 (3.0)/(2)(16.0 \text{ ft})(1/0.72 \text{ min}) \ln (0.65 \text{ ft}/0.06 \text{ ft})$$

$$K = 9.61 * 10^{-3} \text{ ft/min}$$

Converting to ft/day

$$K = 9.61 * 10^{-3} \text{ (ft/min)(60 min/hr)(24 hr/day)} = 13.7 \text{ ft/day}$$

Converting to metric

$$K = (9.61 * 10^{-3} \text{ ft/min})(\text{min}/60 \text{ sec})(12 \text{ in/ft})(2.54 \text{ cm/in})$$

$$K = 490 * 10^{-5} \text{ cm/sec}$$

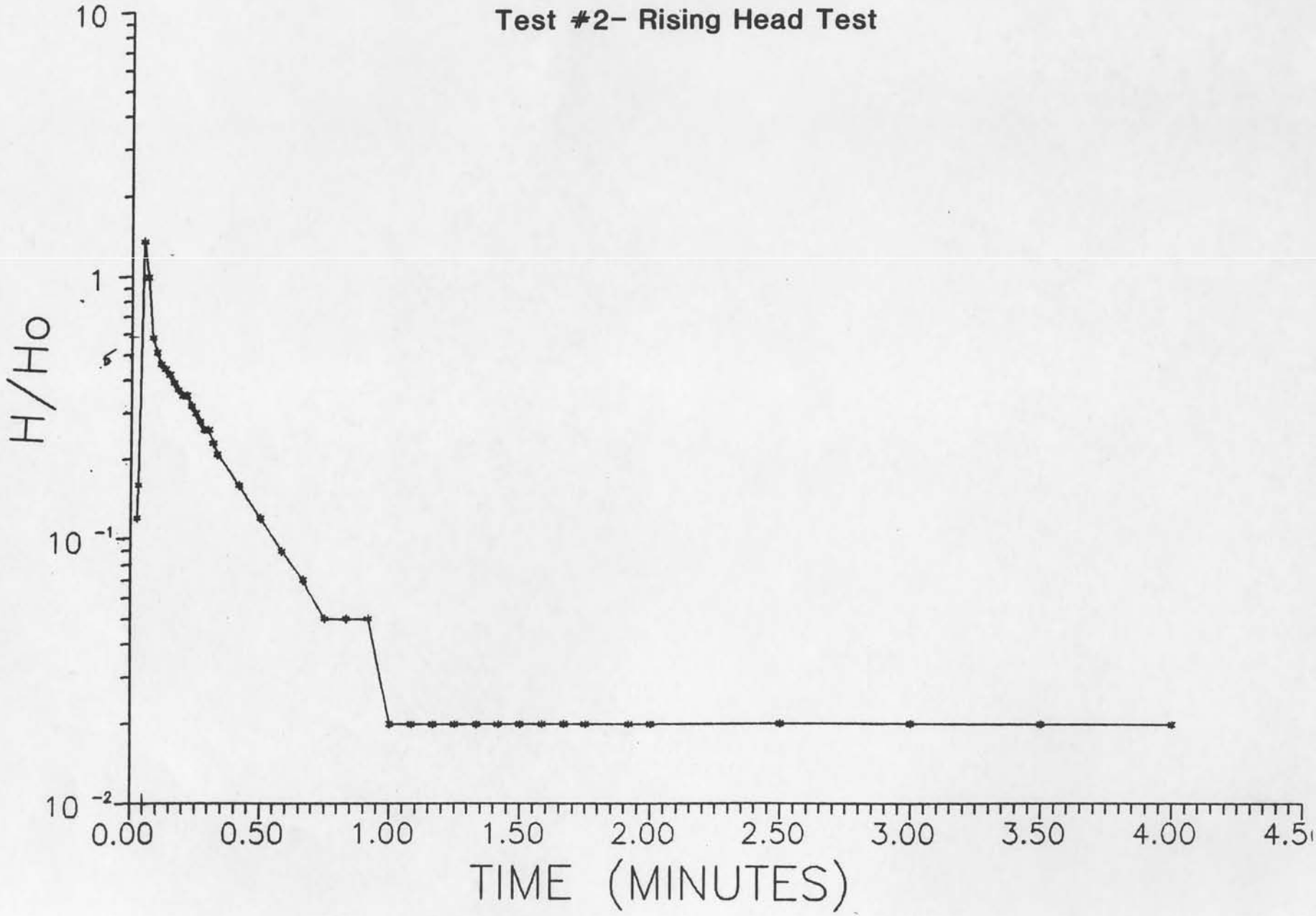
To determine T

$$T = KD = (13.7 \text{ ft/day})(16.0 \text{ ft}) = 218.9 \text{ ft}^2/\text{day}$$

Converting to metric

$$T = (4.9 * 10^{-3} \text{ cm/sec})(16 \text{ ft})(12 \text{ in/ft})(2.54 \text{ cm/in})$$

$$T = 240 * 10^{-2} \text{ cm}^2/\text{sec}$$



Slug Test Data for A9

Test #1 (Falling Head)

$t = 1.24$ min; $Y_o = 0.75$; $Y_t = 0.01$

According to previously used equation for determining K,

$K = (0.176 \text{ ft})^2 (3.0)/(2)(16.0 \text{ ft}) * (1/1.24 \text{ min}) \ln (0.75/0.01)$

$K = 1.01 * 10^{-2}$ ft/min

Converting to metric

$K = (1.01 * 10^{-2} \text{ ft/min})(\text{min}/60 \text{ sec})(12 \text{ in/ft})(2.54 \text{ cm/in})$

$K = 5.14 * 10^{-3}$ cm/sec

$T = KD = (5.14 * 10^{-3} \text{ cm/sec})(16 \text{ ft})(12 \text{ in/ft})(2.54 \text{ cm/in})$

$T = 2.5 \text{ cm}^2/\text{sec}$

Test #3 (Rising Head)

$t = 1.15$; $Y_o = 0.58$; $Y_t = 0.01$

According to previously used equation for determining K,

$K = (0.176 \text{ ft})^2 (3.0)/(2) (16.0 \text{ ft})(1/1.40 \text{ min}) \ln (0.58/0.01)$

$K = 1.03 * 10^{-2}$ ft/min

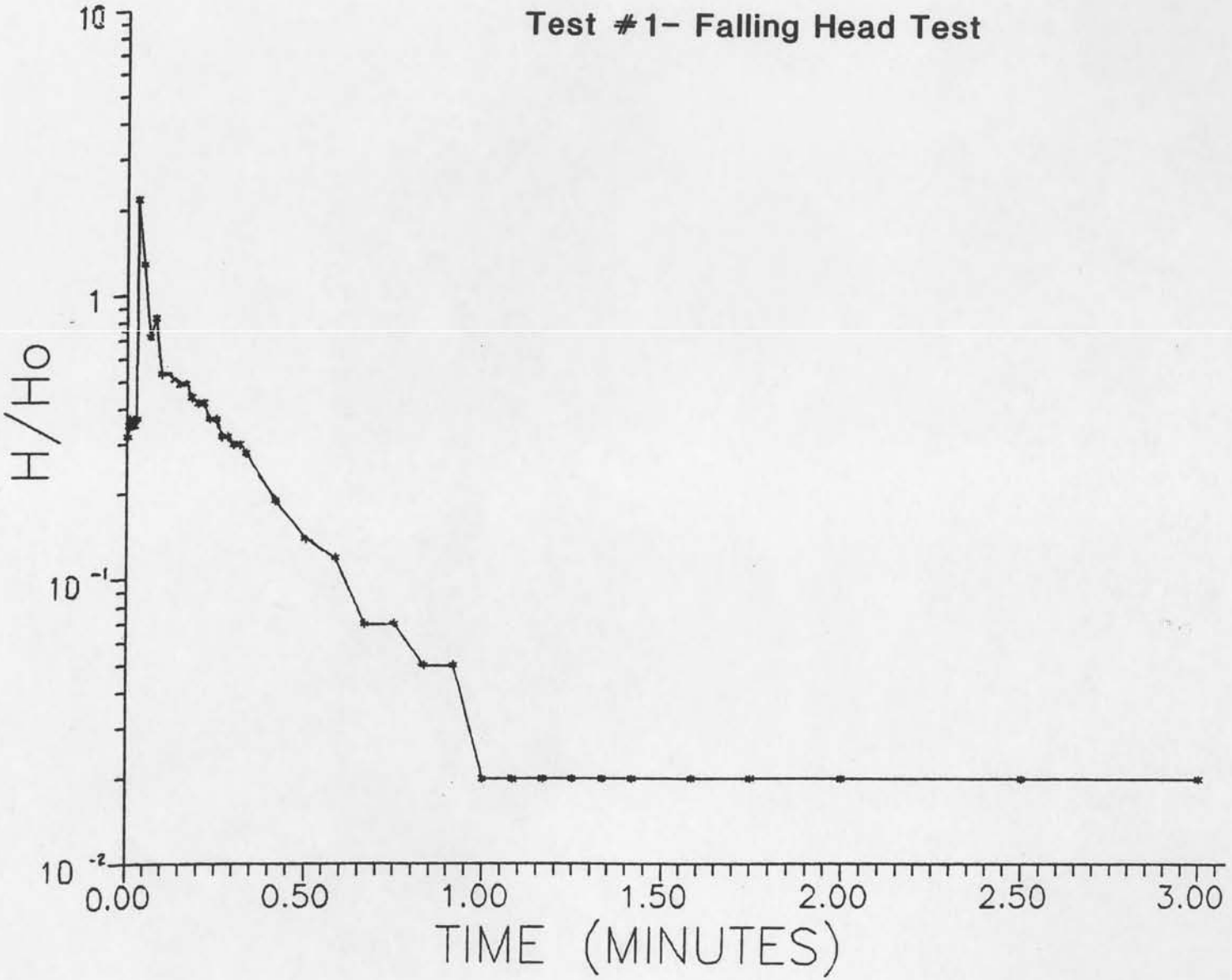
Converting to metric

$K = (1.03 * 10^{-2} \text{ ft/min})(\text{min}/60 \text{ sec})(12 \text{ in/ft})(2.54 \text{ cm/in})$

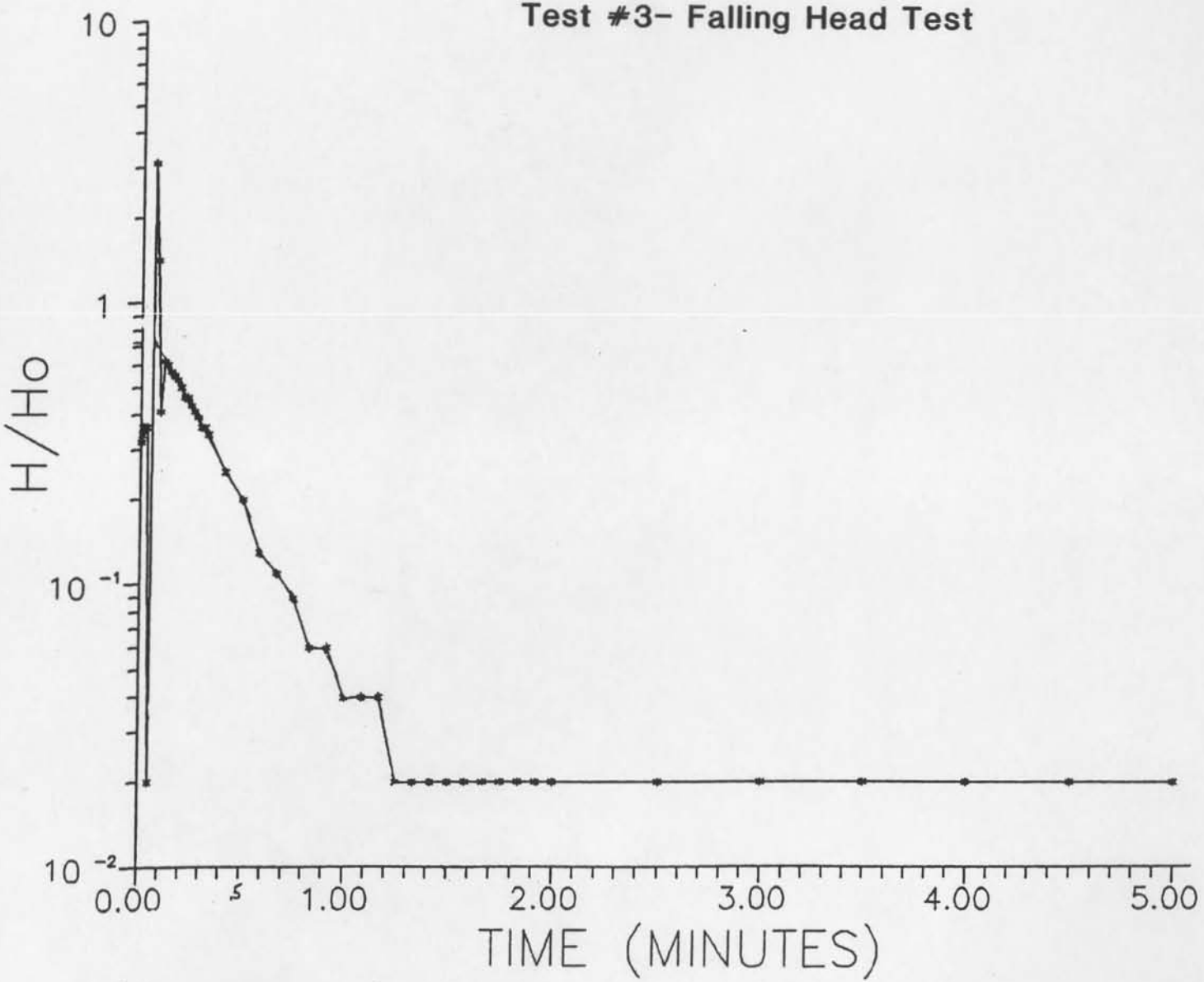
$K = 5.21 * 10^{-3}$ cm/sec

$T = KD = (5.21 * 10^{-3} \text{ cm/sec})(16 \text{ ft})(12 \text{ in/ft})(2.54 \text{ cm/in})$

$T = 2.54 \text{ cm}^2/\text{sec}$



Slug Test Data for A9



Slug Test Data for A9

Test #4 (Falling Head)

$t = 1.40$; $Y_o = 0.72$; $Y_t = 0.01$

$$K = (0.176 \text{ ft})^2 (3.0)/(2)(16.0 \text{ ft})(1/1.40 \text{ min}) \ln (0.72/0.01)$$

$$K = 8.87 * 10^{-3} \text{ ft/min}$$

Converting to metric

$$K = (8.87 * 10^{-3} \text{ ft/min})(\text{min}/60 \text{ sec})(12 \text{ in/ft})(2.54 \text{ cm/in})$$

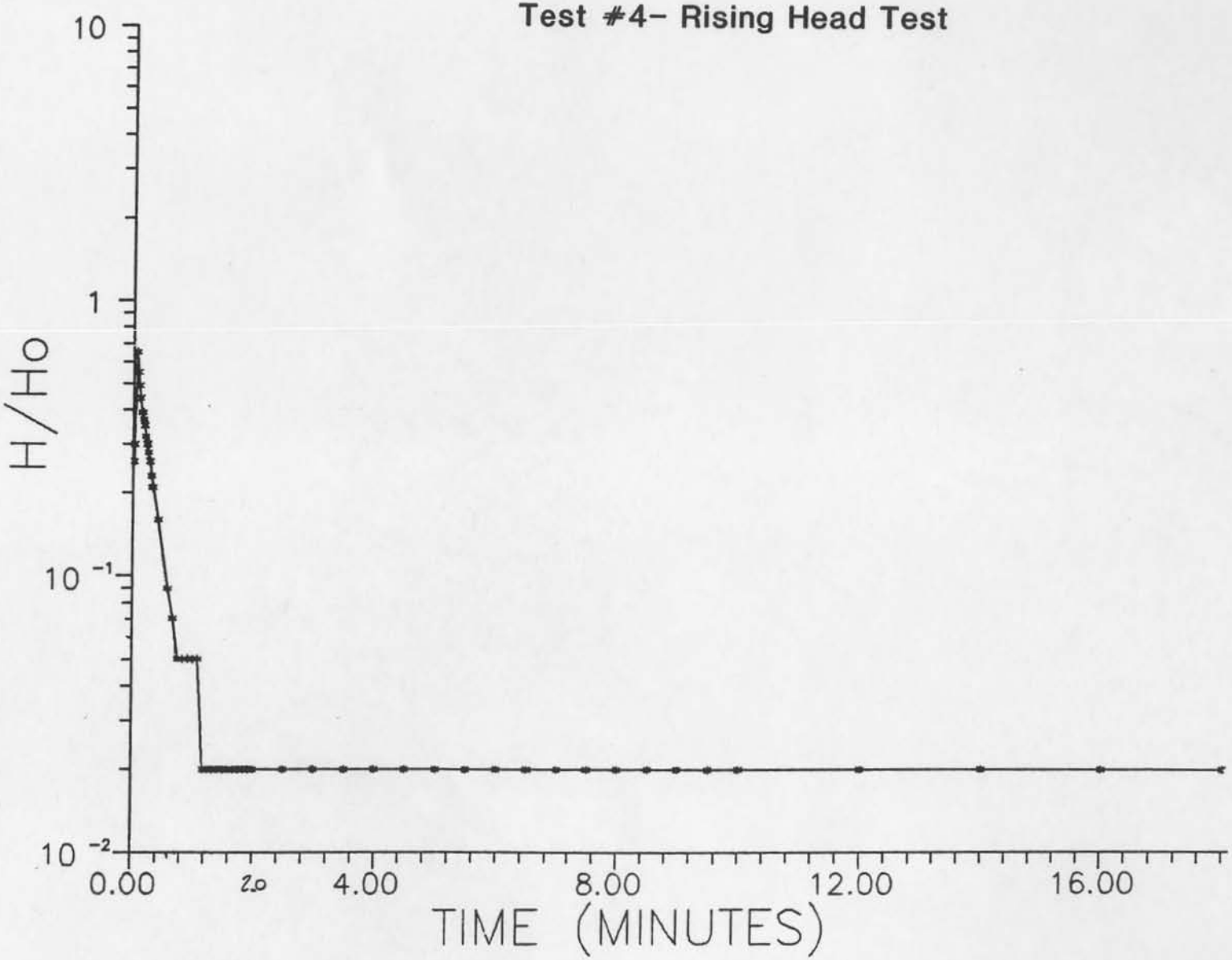
$$K = 4.51 * 10^{-3} \text{ cm/sec}$$

$$T = KD = (4.51 * 10^{-3} \text{ cm/sec})(16.0)(12 \text{ in/ft})(2.54 \text{ cm/in})$$

$$T = 2.2 \text{ cm}^2/\text{sec}$$

Arithmetic Average of T for 4 Tests = 2.4 cm^2/sec

Arithmetic Average of K for 4 Tests = 4.9×10^{-3} cm/sec

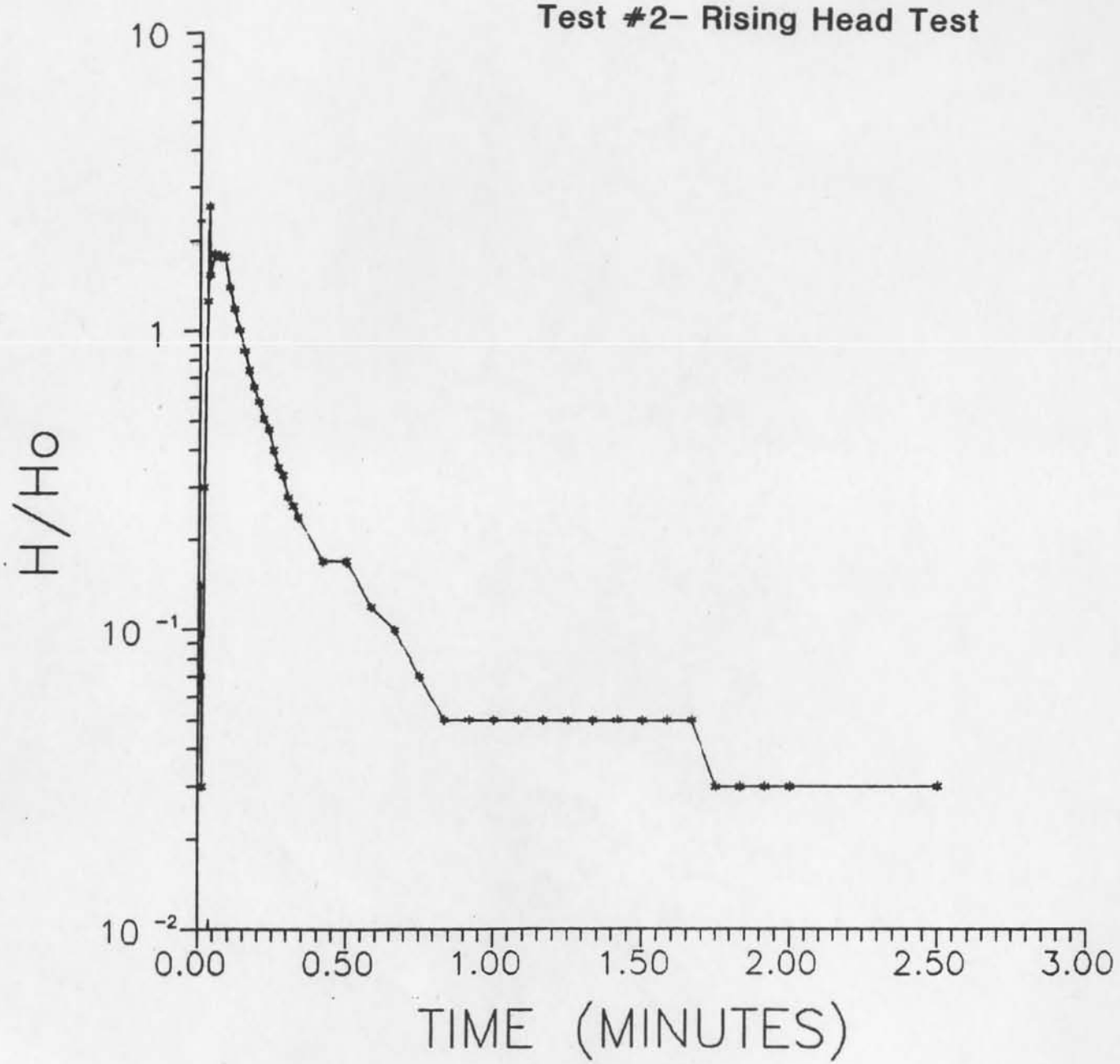


Slug Test Data for A9

Representative Plots for Wells

The following section contains representative data plots for the remainder of the wells not included in the Method of Analysis section. The data plots are presented in the following order:

A1
A6
A7
PDH7
X49



Slug Test Data for A6

Raw Data

The following section contains the raw data recorded on the In Situ Model 1000B Data Logger for each test which was run. The header information preceding the raw data is output by the data logger. An explanation of the header information is as follows:

Header Information:	Explanation:
SE1000B	Model number
Environmental Logger	Type of Unit
08/27 12:01	Date and time data were downloaded to a personal computer
Unit# 00100 Test# 3	Number corresponding to unit; Test number used internally by the logger
INPUT 1: Function	Denotes how data from Input 1, the pressure transducer, will be presented (Function relates to psi).
Scale factor 50.34	Pressure transducer scale factor.
Offset 3.00	Arbitrary reference point.
Step# 0 08/26 20:40	Step # corresponds to the test number at a well: Step 0 is Test 1 (Falling Head Test). Step 1 is Test 2 (Rising Head Test), etc; Date and time to test.
Elapsed Time Value	Elapsed time (in minutes) from start of test; Value is pressure in psi.

As noted in the explanation, the Step numbers correspond to the individual tests which were run. The pressure data (in psi) were converted to heads (in feet) for data analysis.

Well A6 Falling Head Test #1

SE1000B
Environmental Logger
08/23 21:26

Unit# 00100 Test# 2

INPUT 1: Function

Scale factor 50.34
Offset 3.00

Step# 0 08/23 16:16

Elapsed Time	Value
0.0000	15.89
0.0033	15.98
0.0066	16.00
0.0099	16.00
0.0133	16.00
0.0166	16.00
0.0200	16.00
0.0233	16.06
0.0266	16.32
0.0300	16.12
0.0333	16.48
0.0500	16.21
0.0666	16.70
0.0833	16.55
0.1000	16.43
0.1166	16.09
0.1333	16.04
0.1500	15.95
0.1666	16.15
0.1833	16.16
0.2000	16.02
0.2166	16.10
0.2333	16.00
0.2500	16.00
0.2666	16.00
0.2833	16.00
0.3000	16.00
0.3166	16.00
0.3333	16.00
0.4167	15.97
0.5000	15.96
0.5833	15.95
0.6667	15.94
0.7500	15.94
0.8333	15.93
0.9167	15.93
1.0000	15.92
1.0833	15.91
1.1667	15.91
1.2500	15.91
1.3333	15.91
1.4166	15.90
1.5000	15.91
1.5833	15.90
1.6667	15.90
1.7500	15.90
1.8333	15.89
1.9167	15.89

Elapsed Time	Value
2.0000	15.89
2.5000	15.89
3.0000	15.89
3.5000	15.89
4.0000	15.89
4.5000	15.89
5.0000	15.89
5.5000	15.89
6.0000	15.89
6.5000	15.89
7.0000	15.89
7.5000	15.89
8.0000	15.89
8.5000	15.89
9.0000	15.89
9.5000	15.89
10.0000	15.89

END

Well A6 Rising Head Test #2

SE1000B
Environmental Logger
08/23 21:16

Unit# 00100 Test# 2

INPUT 1: Function

Scale factor 50.34
Offset 3.00

Step# 1 08/23 16:26

Elapsed Time	Value
0.0000	15.89
0.0033	15.99
0.0066	16.00
0.0099	15.98
0.0133	15.99
0.0166	16.00
0.0200	15.69
0.0233	15.38
0.0266	15.32
0.0300	15.08
0.0333	15.41
0.0500	15.04
0.0666	14.90
0.0833	15.06
0.1000	15.12
0.1166	15.27
0.1333	15.37
0.1500	15.45
0.1666	15.52
0.1833	15.57
0.2000	15.61
0.2166	15.64
0.2333	15.67
0.2500	15.69
0.2666	15.72
0.2833	15.74
0.3000	15.75
0.3166	15.77
0.3333	15.78
0.4167	15.81
0.5000	15.82
0.5833	15.84
0.6667	15.84
0.7500	15.85
0.8333	15.86
0.9167	15.86
1.0000	15.86
1.0833	15.85
1.1667	15.86
1.2500	15.86
1.3333	15.86
1.4166	15.86
1.5000	15.87
1.5833	15.87
1.6667	15.87
1.7500	15.87
1.8333	15.87
1.9167	15.87
2.0000	15.87
2.5000	15.87
3.0000	15.87
3.5000	15.87
4.0000	15.87
4.5000	15.87
5.0000	15.87
5.5000	15.87
6.0000	15.87
6.5000	15.87
7.0000	15.87
7.5000	15.87
8.0000	15.87
8.5000	15.87
9.0000	15.87
9.5000	15.87
10.0000	15.87

END

Well A6 Falling Head Test #3

SE1000B
Environmental Logger
08/23 21:17

Unit# 00100 Test# 2

INPUT 1: Function

Scale factor 50.34
Offset 3.00

Step# 2 08/23 16:37

Elapsed Time	Value
0.0000	15.87
0.0033	15.97
0.0066	15.97
0.0099	15.98
0.0133	15.98
0.0166	15.99
0.0200	15.98
0.0233	15.98
0.0266	15.98
0.0300	15.98
0.0333	15.99
0.0500	15.87
0.0666	15.87
0.0833	15.87
0.1000	16.02
0.1166	16.17
0.1333	16.00
0.1500	15.87
0.1666	16.00
0.1833	15.98
0.2000	15.95
0.2166	15.97
0.2333	15.94
0.2500	15.95
0.2666	15.95
0.2833	15.93
0.3000	15.82
0.3166	16.12
0.3333	16.00
0.4167	15.70
0.5000	15.81
0.5833	15.84
0.6667	15.84
0.7500	15.85
0.8333	15.86
0.9167	15.86
1.0000	15.87
1.0833	15.87
1.1667	15.87
1.2500	15.87
1.3333	15.87
1.4166	15.87
1.5000	15.87
1.5833	15.87
1.6667	15.87
1.7500	15.87
1.8333	15.87
1.9167	15.87

Elapsed Time	Value
2.0000	15.87
2.5000	15.87
3.0000	15.82
3.5000	15.92
4.0000	15.89
4.5000	15.88
5.0000	15.88
5.5000	15.88
6.0000	15.88
6.5000	15.88
7.0000	15.87
7.5000	15.88
8.0000	15.87
8.5000	15.87
9.0000	15.89
9.5000	15.89
10.0000	15.89
12.0000	15.89

END

Well A6 Rising Head Test #4

SE1000B
Environmental Logger
08/23 21:19

Unit# 00100 Test# 2

INPUT 1: Function

Scale factor 50.34
Offset 3.00

Step# 3 08/23 16:49

Elapsed Time	Value
0.0000	15.89
0.0033	15.99
0.0066	15.83
0.0099	15.86
0.0133	15.88
0.0166	15.76
0.0200	15.90
0.0233	15.97
0.0266	15.35
0.0300	14.77
0.0333	15.23
0.0500	15.11
0.0666	15.13
0.0833	15.13
0.1000	15.29
0.1166	15.38
0.1333	15.46
0.1500	15.52
0.1666	15.57
0.1833	15.61
0.2000	15.64
0.2166	15.67
0.2333	15.69
0.2500	15.72
0.2666	15.74
0.2833	15.75
0.3000	15.77
0.3166	15.78
0.3333	15.79
0.4167	15.82
0.5000	15.82
0.5833	15.84
0.6667	15.85
0.7500	15.86
0.8333	15.87
0.9167	15.87
1.0000	15.87
1.0833	15.87
1.1667	15.87
1.2500	15.87
1.3333	15.87
1.4166	15.87
1.5000	15.87
1.5833	15.87
1.6667	15.87
1.7500	15.88
1.8333	15.88
1.9167	15.89

Elapsed Time	Value
[illegible]	[illegible]
2.5000	15.88
3.0000	15.88
3.5000	15.89
4.0000	15.89
4.5000	15.89
5.0000	15.89
5.5000	15.89
6.0000	15.89
6.5000	15.89
7.0000	15.89
7.5000	15.89
8.0000	15.89
8.5000	15.89
9.0000	15.89
9.5000	15.89
10.0000	15.89
11.0000	15.89
14.0000	15.89

END

Appendix 7-17

Alluvial Valley Field Investigation
North Private Lease

Summary

Alluvial Valley Floor Field Investigation

in the

North Private Lease

Prepared for

Alton Coal Development, LLC
Cedar City, UT

Prepared by

Petersen Hydrologic, LLC
Lehi, UT

Mt Nebo Scientific, Inc.
Springville, UT

Long Resource Consultants, Inc
Morgan, UT

July 7, 2014

Forward

The information and narrative in this report is provided to the Utah Division of Oil, Gas, and Mining as an explanation of the data collected during the alluvial valley floor field investigation. This information is supplemented by more detailed reports which are referenced within this report.

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321. ALLUVIAL VALLEY FLOOR DETERMINATION

INTRODUCTION

Alton Coal Development, LLC (ACD) owns and operates the Coal Hollow Mine, which is located near the town of Alton, Utah (Figure 1). A permit to operate the Coal Hollow Mine was issued by the Utah Division of Oil, Gas and Mining (UDOGM) on 10 November 2010. The first coal was mined in early February 2011. ACD has acquired the mining rights on private fee coal lands situated north of the existing Coal Hollow Mine permit area. This lease region is designated as the North Private Lease (Figure 1).

In Rule R645-302 of the Utah Administrative Code, minimum requirements are given for approval to conduct coal mining and reclamation operations under special categories and areas of mining. One of the special categories and areas of mining is the Alluvial Valley Floor (AVF). The regulatory process for mining on or adjacent to an Alluvial Valley Floor is described in R645-302-321. Additional guidelines for the study and identification of Alluvial Valley Floors have been provided by the United States Department of the Interior, Office of Surface Mining (OSM, 1983). The Alluvial Valley Floor permitting process is administered by the Utah Division of Oil, Gas and Mining (UDOGM).

R645-302.100

As described in UDOGM Administrative Code

> *Before applying for a permit to conduct, or before conducting surface coal mining and reclamation operations within a valley holding a stream or in a location where the adjacent area includes any stream, the applicant shall either affirmatively demonstrate, based on available data, the presence of an alluvial valley floor, or submit to the Division the results of a field investigation of the proposed permit and adjacent area.*

As indicated in the 1983 OSM AVF study guide:

> *An alluvial valley floor is not merely an area meeting geologic criteria. It is also an area where water is available in sufficient quantities for subirrigation or flood irrigation agricultural activities (Chapter II, page 9).*

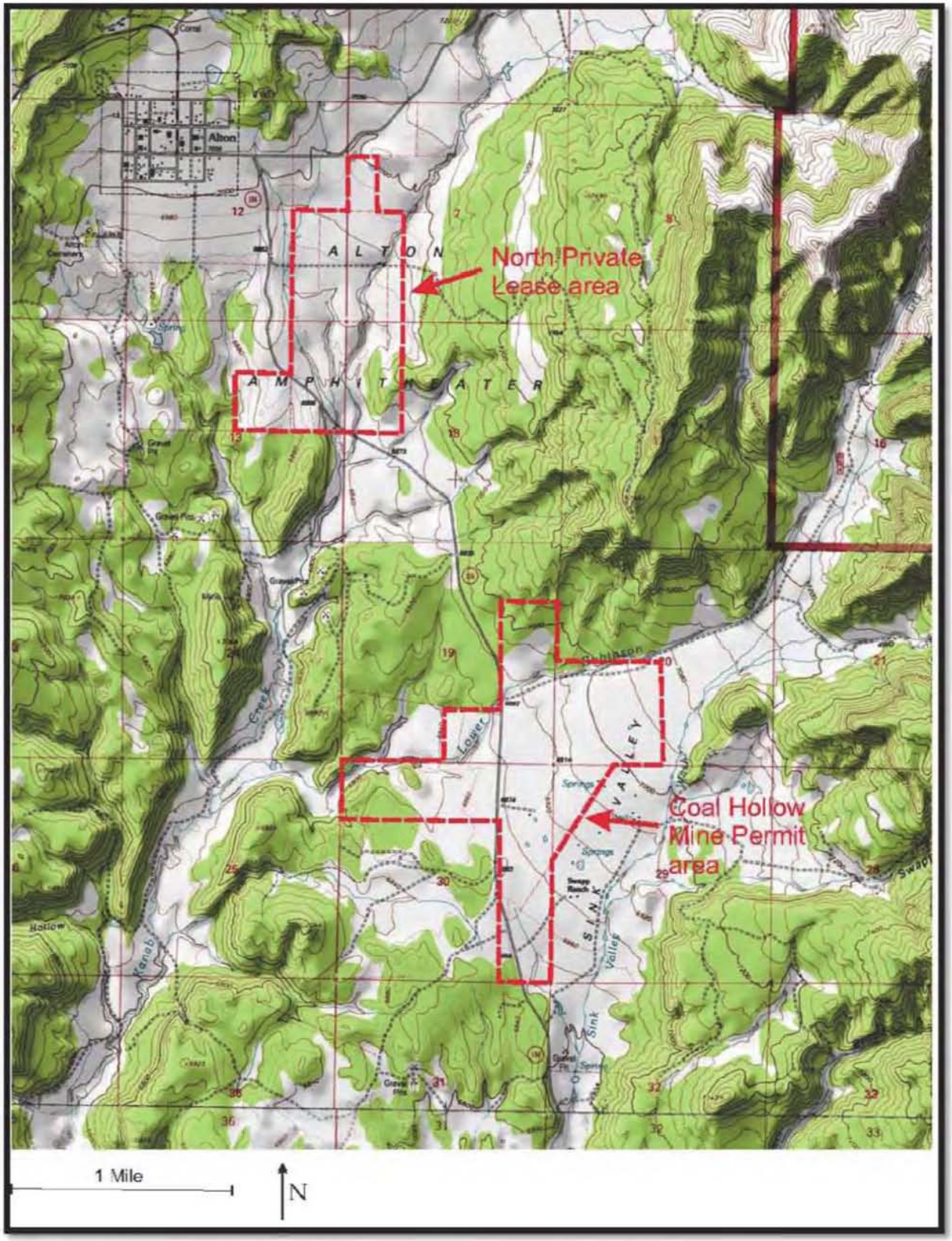

Figure 1. General location of the Alton Coal Development's North Private Lease.

As specified in the rules and guidelines mentioned above, the field investigation shall include sufficiently detailed information in the following areas:

- Geologic
- Hydrologic
- Land use
- Soils
- Vegetation

The information from the field investigation will enable the Utah Division of Oil, Gas and Mining:

> *To make an evaluation regarding the existence of the probable alluvial valley floor in the proposed permit or adjacent area and to determine which areas, if any, require more detailed study in order to allow the Division to make a final determination regarding the existence of an alluvial valley floor.*

The purpose of this document is to present to the Utah Division of Oil, Gas and Mining the results of the field investigation for the North Private Lease area as required under R645-302-321.100. To facilitate cross-referencing, the information provided in this report is organized according to the format presented in the R645-302 Administrative Code.

Evaluation Area

The evaluation area for this field investigation includes the region bounded on the east and west by the Tropic Shale bedrock that is present at or near the surface on both the eastern and western margins of the Kanab Creek valley in and adjacent to the North Private Lease area (see Hydrology Map 5). The basis for the selection of these evaluation area boundaries is 1) the very low hydraulic conductivity of the Tropic Shale bedrock, and 2) the elevated topography of the Tropic Shale bedrock upland areas relative to adjacent areas. Combined, these two factors effectively isolate the surface-water systems and shallow alluvial groundwater regimes in the Kanab Creek valley from surrounding areas to the east and west. As described in this document, the water supply to the agricultural areas in and adjacent to the North Private Lease area is derived entirely from surface-water diversions located several miles upstream of the North Private Lease area on Kanab Creek. Consequently, there is no significant potential for impacting this water supply as a result of proposed mining operations in the North Private Lease area. The northern and southern boundary extents for the evaluation area are located at reasonable distances within the Kanab Creek valley upstream and downstream of the North Private Lease area.

METHODS

The methods of study utilized in the collection and analysis of the data presented in this document are described individually in the pertinent subsections of this and other referenced documents. The information and data analysis presented in this report has been prepared by individuals qualified in their respective fields. These personnel include: Erik C. Petersen, P.G. (geology and hydrology), Robert E. Long, CPSS (soils) and Patrick D. Collins, Ph.D. (biology).

RESULTS

321.200 Studies Performed

Soils

An order 2 soil survey was conducted within the boundaries of the North Private Lease area during 2012 through 2014 (Long 2014). The area encompassed by the North Private soil survey is approximately 428 acres. This soil survey was made in accordance with the guidelines for an order II soil survey as detailed in the *Soil Survey Manual* (USDA NRCS 1993) and *National Soil Survey Handbook* (2014b). Soils were classified using the *Keys to Soil Taxonomy, Eleventh Edition* (USDA NRCS 2010). The dominant soil Great Groups identified in the North Private Lease soil survey area are Calciustepts, Haplustalfs, Haplusterts, Endoaquepts, Ustifluvents, and Ustorthents.

The details of the order 2 soil survey are summarized in the Supplemental Soils section of this report. The impact of soils on the AVF determination is summarized in the Prime Farmland portion of section 321.220.

321.210. *Mapping of unconsolidated stream-laid deposits holding streams including, but not limited to, geologic maps of unconsolidated deposits, and stream-laid deposits, maps of streams, delineation of surface watersheds and directions of shallow groundwater flows through and into the unconsolidated deposits, topography showing local and regional terrace levels, and topography of terraces, flood plains and channels showing surface drainage patterns*;

Geologic map of unconsolidated deposits and stream laid deposits

A geologic map showing the locations of unconsolidated deposits and stream laid deposits is provided in Hydrology Map 5. The mapped extent of unconsolidated deposits is based on the Utah Geological Survey geologic map of the Alton, Utah Quadrangle, from field observations, from drilling information, and from soils information. Areas mapped as unconsolidated deposits on Hydrology Map 5 include colluvial deposits, slopewash deposits, and stream-laid deposits. Areas mapped as stream-laid deposits include those areas where the surface morphology is a flood plain or terrace and also in those sideslope areas where likely stream-laid deposits were identified in drill holes.

In most locations, the mapping of unconsolidated deposits is relatively straightforward. In many areas to both the east and west of the North Private Lease area there are upland areas where Tropic Shale bedrock is obviously present at or near the surface. In many instances, the contact between the bedrock and the unconsolidated sediments is readily mappable. In the central portion of the North Private Lease area along Kanab Creek substantial thicknesses of alluvium are present. In the adjacent upland regions to the east and west, there are regions where colluvium, slopewash, and fan deposits overlying the Tropic Shale bedrock are present. As described by Tilton (2001):

> *Quaternary alluvial deposits within the Alton Quadrangle consist of unconsolidated clay, silt, sand, and gravel present in and near existing drainages. The unit includes stream and fan alluvium, and terrace deposits. The alluvium is predominantly sand and gravel in the headwaters of streams coming off the plateau. Downstream from these deposits are mostly mud where the streams cut through the Tropic Shale. Alluvial deposits vary in thickness from a thin covering to an estimated 10 feet or more. These deposits are mostly Holocene.*

Drilling information along the eastern and western margins of the North Private Lease area indicated predominantly thin, fine-grained unconsolidated deposits consistent with that described by Tilton (2001) (see Soils information data in this report).

Within the central portions of the Kanab Creek valley in the North Private Lease area, thicker deposits of unconsolidated sediments were identified. An alluvial thickness of 105 feet was

encountered in the Y-103 (A6) drill hole in the North Private Lease area (see well log information in Volume 9 of UII, 1987). Along portions of the eastern and western margins of the North Private Lease area where the land surface rises gradually to meet the adjacent bedrock hills the delineation of a precise boundary is more complicated.

It should be noted that unweathered surface exposures of the Tropic Shale claystones are not naturally present in the North Private Lease area. This is because the Tropic Shale claystones are soft and easily eroded/decomposed. Consequently, where the Tropic Shale claystones are present at or near the surface, the surface expression is typically a weathered material with the consistency of a silty clay (i.e. a residuum of the weathered claystone which is either in place or may have been transported a short distance due to gravity movement, slopewash, or from unconcentrated flows). Consequently, it is sometimes difficult to distinguish between stream-laid silty clays and weathered claystone that is not associated with fluvial deposition. Guidance is given in the OSM AVF study guidelines (1983) regarding differentiation of stream-laid alluvial deposits and deposits of colluvium and slopewash derived from erosion from the adjacent upland hillsides.

> *Given the difficulty in distinguishing the two types of deposits, the geologist must use not only the evidence afforded by the deposits but also the evidence provided by the landform. Emphasis on landform data has been made by regulatory authorities because such data are more easily collected. As a general rule, all unconsolidated deposits beneath terraces and flood plains are considered to meet the criteria of an alluvial valley floor. Uplands, such as the middle and upper portions of the hillslopes, are clearly not alluvial valley floors. Along the margins of the valley floors, where the land surface slopes gently upward and underlying deposits are unconsolidated, the geologist must use all available evidence in determining the extent of alluvial deposits (Appendix A, page 15).*

To accomplish this, a drilling program was commenced in selected locations along the margins of the regions where alluvial sediments were obviously present in and adjacent to the North Private Lease area. Using direct-push drilling techniques, a series of holes were drilled in an attempt to identify locations where probable stream-laid deposits (sand) were present in the subsurface. In most locations, direct-push holes were drilled in upslope areas where easily identifiable colluvium/bedrock was encountered and then also in nearby downslope areas until sand layers were encountered. It should be noted that the layers of sand encountered in the drill holes could possibly also have been derived from erosion of the sandstone strata that have been identified in many locations in the adjacent Tropic Shale hillsides or transported by minor streams flowing from the adjacent upland areas. Generally, for the purposes of this field investigation, stream-laid deposits were mapped as being present where the sand layers were encountered in the drill holes within or immediately adjacent to the terrace and flood plain deposits.

It should be noted that in the location of the drill hole for piezometer NLP-9, the material encountered in the upper 21 feet consisted of uniform brownish gray silty clay with a rubbery-like texture similar to the Tropic shale derived soils (Sideshow family) identified in the southwest portion of the North Private Lease. This material is almost certainly derived from slopewash or gravity movement of weathered Tropic Shale silty claystone from the adjacent Tropic Shale bedrock ridge located about 300 feet to the west. From 21 to 24 feet depth a 3-foot layer of fine-grained sand was encountered. This thin sand layer could be related to fluvial deposition, or it could possibly be related to weathering of a sandstone unit in the Tropic Shale (these have been identified in hillside exposures of the Tropic Shale locally). Because of the thickness of the layer of colluvium/slopewash and the small thickness of the sand unit, and close proximity to the bedrock ridge, this area was identified as containing unconsolidated deposits, but not containing stream-laid deposits. As indicated by OSM (1983):

> *The criteria of an alluvial valley floor place greatest emphasis on identification of alluvial landforms and secondary importance on detailed stratigraphic descriptions of deposits. Only in thse valleys where the sloping land adjacent to terraces can be shown to be underlain by the same deposits that underlie the terraces is the knowledge of stratigraphy important in the identification process (Chapter 2, page 8).*

Regardless of its origin, the presence of the thin (three-foot) sand layer beneath 21 feet of colluvial deposits in the vicinity of NLP-9 does not seem to constitute a deposit that is the same as the much thicker sequence of fluvial deposits that underlie the adjacent flood plain and terrace complex.

Based on soils information, Soil map units E, G, H, J, and portions of K have developed in stream laid deposits, Soils Map 3.

The information regarding unconsolidated sediments within the North Private Lease area was obtained from several sources. These included examination of surficial deposits, examination of exposures of unconsolidated deposits in erosional scours and in the walls of the deeply incised stream channels, and from drilling information. The direct-push drilling was performed by Clement Drilling and Geophysical using a using a tractor-mounted PowerProbe drilling rig. Using this technique, continuous or near continuous cores were collected in clear plastic sleeves. This drilling technique is advantageous for the purpose of identifying the characteristics and small-scale internal structures of the subsurface stratigraphy because a relatively undisturbed sample is collected and available for preservation from depths of 30 feet or more. Laboratory samples for physical and chemical analysis were sent to Inter-Mountain Laboratory, Inc. of Sheraton, Wyoming for analysis.

Map of streams, delineation of surface watersheds

Maps showing the locations of streams and surface watersheds in the North Private Lease area are provided in Hydrology Map 4. The entire land surface within the North Private Lease area is

tributary to Kanab Creek. With the exception of the land in the southwest corner of the North Private Lease area, surface waters generally drain directly into Kanab Creek or through one its local tributaries. Surface waters in the southwest corner of the property drain into the Simpson Hollow Creek sub-drainage which flows into Kanab Creek approximately 0.9 miles south of the North Private Lease boundary (Hydrology Map 4). The direction of surface-water runoff from the land surface within the North Private Lease area is generally perpendicular to the topographic contours as shown on Hydrology Map 6.

Map showing directions of shallow groundwater flows through and into the unconsolidated deposits

A map showing the directions of shallow groundwater flow in the shallow alluvial groundwater system in the North Private Lease area is provided in Hydrology Map 2. Also shown on Hydrology Map 2 are the potentiometric levels (expressed as feet elevation above sea level) within the alluvial groundwater system. The potentiometric data and shallow groundwater flow direction information presented in Hydrology Map 2 is based on water level measurements from wells screened in the alluvial groundwater system, Table 1 in appendix B. Reference elevations at the monitoring wells were surveyed using a survey-grade GPS system by Alton Coal Development, LLC personnel. Water levels were measured using an electronic water level depth sounder. The water level potentiometric contours were generated by contouring monitoring well water level data using SigmaPlot Version 12 software. Groundwater flow directions were determined based on flow perpendicular to the potentiometric contours.

The North Private Lease piezometers installed during 2012 and 2013 were drilled and constructed by Clement Drilling and Geophysical, Inc. of Cedar Hills, Utah using a tractor-mounted PowerProbe drilling rig. Piezometer completion details are presented in Table B-3 in appendix B. The piezometers were completed using 0.010 PVC well screen and solid PVC riser pipe. Typically, a sand filter-pack was emplaced in the well annulus opposite of and to within about 1 to 2 feet above the top of the well screen. The sand filter-pack consisted of 10-20 Colorado silica sand. The annular space above the sand filter pack was filled with anhydrous bentonite chips to the ground surface. The piezometers were protected at the surface by a driven 4-inch PVC casing and cap.

Map of topography showing local and regional terrace levels and topography of terraces, flood plains and channels showing surface drainage patterns.

The topography showing terrace levels and the topography of terraces, flood plains and channels is shown on Hydrology Map 6. Surface drainage patterns are shown on Hydrology Maps 4 and 6. Additional topographic information from the stream channels is available in the wetlands delineation report for the North Private Lease area (Long and Collins, 2012).

Surface drainage patterns are shown on Hydrology Maps 4 and 6. Surface water drainage is through the existing stream channel network, Hydrology Map 4. Unconcentrated surface-water runoff of precipitation or snow melt waters occurs in a direction that is generally perpendicular to the orientation of the surface topography contours in Hydrology Map 6.

It is apparent that the flood plain and terrace complex in the North Private Lease area includes the following principal geomorphic features:

1) Kanab Creek active stream channel located within the narrow-bottomed, deeply incised unconsolidated alluvial sediments,
2) narrow flood plain and stream terrace features within the narrow-bottomed deeply incised unconsolidated alluvial sediments, and
3) the broad terrace feature that likely represents the flood plain associated with Kanab Creek prior to its most recent entrenchment into its underlying unconsolidated alluvial sediments.

No mappable higher terraces along the valley margins in the Kanab Creek valley within the North Private Lease and adjacent area have been identified. Rather, the relatively flat flood plain/terrace complex gradually merges into the upland areas that bound the valley on both the east and the west margins of the lease area.

The existing narrow-bottomed stream channels associated with Kanab Creek and its tributaries within the North Private Lease area are not sufficiently wide to support substantial agricultural crop production or livestock grazing activities. As indicated in the OSM guidelines (1983):

> *Some subirrigated areas may be too small, too narrow, or too difficult to reach to be reasonably used for grazing operations. Subirrigated areas of nonagriculturally useful vegetation do not qualify as alluvial valleys. (Chapter II, page 14)*
>
> *If there is consensus in a region that certain types of areas are too small to matter in grazing land use, or are characterized by unpalatable species, they need not be identified. (Chapter II, page 18)*

Historic information suggests that prior to about 1913, Kanab Creek near the center of the North Private Lease area was not deeply incised but rather was a shallow channel (like a ditch) (personal communication, Claron Heaton, 2014).

As observed during the field investigation of the North Private Lease and adjacent area, there has been deep entrenchment of the stream channels in the Kanab Creek relative to the position of the

previously existing flood plain. The presence of the deeply incised stream channels in the alluvial sediments has likely acted as a groundwater drain allowing groundwater that may have been historically nearer to the surface than presently identified to drain to the approximate elevation of Kanab Creek. The shallow groundwater potentiometric contours shown on Hydrology Map 2 indicate that the water levels in the shallow alluvial groundwater are approximately coincident with the local elevation of Kanab Creek (i.e.Kanab Creek is in hydraulic communication with the local shallow groundwater table).

Currently, many of the principal surface-water drainages in the Alton area in many locations are not stable in their current configurations. At present, many stream drainages are actively eroding their channels during precipitation events, resulting in down-cutting and entrenchment of stream channels, the formation of unstable near-vertical erosional escarpments adjacent to stream channels (which occasionally spall off into the stream channel), aggressive headward erosion of stream channels and side tributaries, and the transport of large quantities of sediment associated with torrential precipitation events. These processes are currently actively ongoing in the Kanab Creek area and the upper extents of these erosional processes are in many locations migrating upward in stream channels, resulting in substantial lengths of unstable stream channels.

Hereford (2002) suggests that the valley fill alluviation in the southern Colorado Plateau occurred during a long-term decrease in the frequency of large, destructive floods, which ended in about 1880 with the beginning of the historic arroyo cutting. Hereford (2002) further suggests that the shift from deposition to valley entrenchment coincided with the beginning of an episode of the largest floods in the preceding 400-500 years, which was probably caused by an increased recurrence and intensity of flood-producing El Nino Southern Oscillation events beginning at ca. A.D. 1870.

The exact causes of the entrenchment of stream channels and the creation of the numerous arroyos currently in existence in the southwestern United States are not completely understood. Vogt (2008) suggests that three primary factors resulted in the arroyo formation. These factors included 1) changes in climate that produced heavy rainfall, 2) land-use practices such as livestock grazing, and 3) natural cycles of erosion and deposition caused by internal adjustments to the channel system. The temporal coincidence of the causes may have magnified the effect of each factor.

Each of these factors likely contributed to the formation of the entrenched stream drainages in the area. Gregory (1917) states that historical evidence indicates that the cutting of Kanab Creek began when a large storm occurred on 29 July 1883, and that unusually large amounts of precipitation were received in 1884-85. In this period the Kanab Creek channel was down-cut by 60 feet and widened by 70 feet for a distance of about 15 miles. As suggested by Vogt (2008), other factors, such as the heavy livestock grazing in the local area, which was occurring

contemporaneously with the heavy thunderstorm events, likely also contributed to the overall conditions that brought about the stream down-cutting episode in the late 1800s.

While the precise sequence of events and conditions that triggered the arroyo formation and stream entrenchment in the principle surface drainages in the area is not known, it is readily apparent that the principle surface water drainages are not currently in a condition of equilibrium. Stream head-cutting (headward erosion), bank erosion, and spalling of the steep stream channel walls are ongoing processes in the area.

As a result of the entrenchment of the Kanab Creek stream channels into the surrounding alluvial deposits, the stream channel in the North Private Lease area is now situated at elevation that is approximately 30 feet below the previous stream flood plain level. The previously existing stream flood plain is now considered a terrace feature, as it is elevated and isolated from the associated stream (Kanab Creek). The broad surface associated with the previous flood plain is the surface upon which agricultural activities in the North Private Lease area occur.

321.220. *Mapping of all lands included in the area in accordance with R645-302-321 and subject to agricultural activities, showing the area in which different types of agricultural lands, such as flood irrigated lands, pasture lands and undeveloped rangelands, exist, and accompanied by measurements of vegetation in terms of productivity and type;*

Agriculture

Irrigated agricultural fields are located north of the elk fence and west of Kanab Creek (AVF Map 1). These areas are irrigated with center pivot, wheel-line, and hand-line sprinklers (Soils Map 5). The fields north of the "Farm Road" have first priority when irrigation water supplies are limited.

Agricultural operations between the Farm Road and elk fence are limited to occasionally irrigated pastures and a field of grass-alfalfa mix.

Determination of the suitability of soils within the North Private Lease area for agricultural production of forage, hay, or small grains is directly related to the amount of Prime Farmland that may or may not be present.

Prime Farmland

The guidelines for *Prime Farmland* exclude soils with pH greater than 8.4 in the upper 100 cm or 40 inches (Grow, 2014), conductivity greater than 4 mmhos/cm (dS/m) and very slow permeability, Table 1. Basic criteria for Identification of important farmlands as set forth in the Code of Federal Regulations, Title 7, Part 657.5 (Grow 2014).. Soils Map 4 shows the areas with limiting soil features.

Soils with pH greater than 8.4 in the upper 100 cm (40 inches), very slow permeability, and limited irrigation water supplies are the primary limitations to agricultural production within the North Private Lease.

"Soils map units are classified as *prime* where 50 percent of the components in the map unit are *prime* (Domeier 2014)." This criterion was applied to each of the North Private Lease soil map units to determine which were *prime* map units.

NRCS Prime Farmland Determination

The Natural Resource Conservation Service (NRCS) conducted a Prime Farmland determination in the North Private Lease soil survey area (Domeir 2012). This determination found that map units 1111 (Naplene-Teromote-Arboles-Oxyaquic Ustifluvents complex, 2 to 8 percent slopes and 1113 (Flugle-Teromote-Plumasano complex, 2 to 15 percent slopes) are considered Prime Farmland, if irrigated. These soil map units are part of the unpublished (in-progress) Kane County Area, Utah order 2 and 3 soil survey (Parslow 2012).

The NRCS Prime Farmland determination found that 292 acres of NRCS map unit 1111 was under irrigation based on the Southwest Regional Gap Analysis Project (SWReGAP) and was within the proposed boundaries as of the date of the determination. Soil map units considered by the NRCS to be Prime Farmland, if irrigated, within the North Private Lease soil survey area and in adjacent areas are shown in Soils Map 8.

Table 1. Basic criteria for Identification of important farmlands as set forth in the Code of Federal Regulations, Title 7, Part 657.5 (Grow 2014).

Soil Parameter	Criteria Limits
Moisture regime	Aquic, udic, ustic, or xeric and sufficient available water capacity
Irrigation water supply	Enough water is available for irrigation in 8 out 10 years
Temperature regime	Frigid, mesic, thermic, or hyperthermic
Soil pH	Between 4.5 and 8.4 within 40 inches (1 meter) or root zone if less than 40 inches
Conductivity (ECe)	Less than 4 mmhos/cm
Exchangeable Sodium (ESP)	Less than 15 percent
Flooding	Soils are not flooded during the growing season (less often than once in 2 years).
Erodibility, water	K (erodibility factor[1]) X percent slope does not exceed 2.0
Erodibility, wind	I (soils erodibility[2]) X C (climatic factor[3]) does not exceed 60
Permeability	Rate of at least 0.06 inch (0.15 cm) per hour in the upper 20 inches
Surface rock	Less than 10 percent of the surface layer (upper 6 inches) in these soils consists of rock fragments coarser than 3 inches (7.6 cm).

1. K factor calculated by Inter Mountain Labs was used for erodibility factor.
2. Soil erodibility factor (I) from Part 618.95 Wind Erodibility Groups was used for calculation.
3. Climatic factor (C) obtained from National C-Factor Values for Utah, May 1987 (Domeier 2014a).

Prime Farmland Evaluation

Field studies and lab analysis in the North Private Lease soil survey were more intensive than work done by the NRCS in the unpublished Kane County Area, Utah soil survey (broad order 2 and order 3). Therefore, an evaluation of Prime Farmland areas within the North Private Lease was conducted using field and lab data collected for the soil survey along with the criteria listed

in Table 1. The results found a difference between the areas identified by the NRCS determination and those identified by the more intensive North Private Lease soil survey.

Prime Soil Families

Eight soil families meet the criteria for *prime,* Table 2. Three of these families do not meet the criteria for *prime* when the slope increases and they become more susceptible to water erosion. The limiting soil features for the seven soil families which do not meet the criteria for *Prime Farmland* are listed in Table 4.

Table 2. North Private Lease soil families that meet Important (prime) farmland criteria as set forth in the Code of Federal Regulations Title 7, Part 657.5 Identification of important farmlands (Grow 2014).

Soil Family	Prime Farmland	Limiting Features[1]
AAA	Yes	
Atlatl	No	pH > 8.4
BBB	Yes/No	K factor X slope
Bobknoll	Yes	
Boxcanyon	Yes	Permeability may be limiting in some profiles
Brumley	Yes/No	K factor X slope
CCC	No	pH > 8.4; permeability
DDD	No	Water table; surface cobbles
Flugle	Yes	
Quezcan	No	Very slow permeability; K factor X Slope
Sideshow	No	Very slow permeability; K factor X Slope; Ece > 4
Sideslide	No	Water table
Teromote	Yes/No	K factor X slope
Vesilla	No	Shallow to sandstone; limited available water capacity
Wimmer	Yes	

1. Based on map unit slope ranges when soil family is a major component.

Prime Farmland Soil Map Units

Three of the twelve soil map units in the North Private Lease soil survey have at least 50 percent *prime* components as stipulated in Part 622.3 - Farmland Classification in the National Soils Handbook (Domeier 2014) and are considered Prime Farmland. The other nine soil map units have less than 50 percent *prime* components and are not considered *Prime Farmland*. Table 3 identifies the soil map units considered *Prime Farmland*.

Table 3. North Private Lease soil map units that qualify as Prime Farmland, if irrigated.

	North Private Lease Soil Map Units												
	A1	A2	A3	B	C	D	E	F	G	H	J	K	P
Prime Farmland, if Irrigated	No	No	No	Yes	No	Yes	No	Yes	Yes	No	No	No	No

Results of Prime Farmland Evaluation

The site specific Prime Farmland evaluation using field and lab data from the project area determined that 103 acres meet the criteria for Prime Farmland, if irrigated, and are presently irrigated. An additional 69 acres meet the criteria of Prime Farmland, if irrigated, but are not irrigated. The results of this evaluation are shown on Soils Map 9.

Vegetation

Major vegetation types within the North Private Lease including the potential AVF portions were first mapped in the field. The general plant community types within the boundary of the North Private Lease are shown on Vegetation Map 1.

The majority of the area consists of rangelands that have been converted to pasturelands. Total acreage of the pasturelands in the study area is approximately 306 acres. Although there were differences in the vegetation between pastures due to land ownership and management practices, seed mixtures planted and soils the pasturelands are often dominated by grass species such as: intermediate wheatgrass (*Elymus hispidus*), western wheatgrass (*E. smithii*), thickspike wheatgrass (*E. lanceolatus*), smooth brome (*Bromus inerme*) and crested wheatgrass (*Agropyron cristatum*).

There is also a fair amount of land that has been converted to croplands in the study area, or about 87 acres. Although crops can vary from year-to-year due to rotation practices, the most common crops raised in the study area are: alfalfa (*Medicago sativa*), wheat (*Triticum aestivum*) and silage crops *(Triticale)*.

Additionally, there are other areas that support native, relatively undisturbed, plant communities (or undeveloped rangelands). These areas consist of pinyon-juniper, sagebrush and mountain brush communities -- including transitional zones between these types. These types comprise nearly 25 acres of the study area. Examples of plant species common in these communities include: pinyon-pine (*Pinus edulis*), Utah juniper (*Juniperus osteosperma*), Gambel's oak (*Quercus gambelii*), Moki-apple (*Peraphyllum ramosissimum*), Wyoming big sagebrush (*Artemisia tridentata* var. *wyomingensis*), black sagebrush (*A. nova*), alder-leaf mountain-mahogany (*Cercocarpus montanus*), corymb buckwheat (*Eriogonum corymbosum*) and snowberry (*Symophoricarpos oreophilus*).

There are also channels or drainages that dissect the area. These channels often support wetland communities, which consist of about 9 acres of the study area. Field studies reveal differences in total living cover, species present and composition of the wetlands, but the plants common here are: beaded sedge (*Carex utriculata*), bluegrass (*Poa pratensis*), wooly-sedge (*Carex pellita*), Douglas' sedge (*C. douglasii*), small-wing sedge (*C. microptera*), maritime arrowgrass (*Triglochin maritima*), common threesquare (*Scirpus pungens*), longstyle rush (*Juncus longistylis*), Missouri iris (*Iris missouriensis*), willows (*Salix boothii* and *S. exigua*), wiregrass (*Juncus arcticus*), Wood's rose (*Rosa woodsii*) and Russian olive (*Elaeagnus angustifolia*).

In addition, there are also upland plant communities supported within the above-mentioned drainage channels. Other than grazing pressure, these upland communities are relatively undisturbed and located are on the flood plains and stream terraces bordering the wetlands. These communities are primarily dominated by Wyoming big sagebrush and black sagebrush. The acreage measurements of the channel uplands were not separated from the upland pasturelands, but the acreage is closer to that of the wetlands.

Total living cover was measured at representative sample sites in the pasturelands, uplands, wetlands and undeveloped rangelands using standard quantitative field sampling methods. Total annual biomass production was also estimated and reported for the sample sites. Total living cover, production estimates, photograph references and NRCS site names for each sample site are shown in Table 4. The vegetation sample site locations are shown on Vegetation Map 2. Color photographs of the sample sites are shown in Figures 1 through 21 of appendix C.

Table 4. Total living cover, annual biomass production, photograph references, and ecological site names of vegetation sample areas in the North Private Lease.

SAMPLE SITE	PLANT COMMUNITY	PHOTOGRAPH REFERENCE	NRCS ECOLOGICAL SITE NAME*	COVER (Percent Living)	PRODUCTION (Pounds/Acre)	
V-01	Sagebrush	Figure 1	Upland Stony Loam (black sagebrush)	34.00[a]	500[a]	700[e]
V-02	Wetland	Figure 2	Semiwet Fresh Meadow	46.67[a]	300[a]	2,400[e]
V-03	Sagebrush	Figure 3	Upland Stony Loam (black sagebrush)	45.00[a]	600[a]	700[e]
V-04	Wetland	Figure 4	Semiwet Fresh Meadow	45.00[a]	1,000[a]	2,400[e]
V-05	Sagebrush	Figure 5	Upland Loam Wyoming big sagebrush	74.00[a]	1,000[a]	1,100[f]
V-06	Wetland	Figure 6	Semiwet Fresh Meadow	73.00[a]	1,900[a]	2,400[e]
V-07	Sagebrush	Figure 7	Upland Loam (Wyoming big sagebrush)	45.00[a]	900[a]	1,100[f]
V-08	Wetland	Figure 8	Semiwet Fresh Meadow	77.00[a]	2,100[a]	2,400[e]
V-09	Wetland	Figure 9	Semiwet Fresh Meadow	84.00[a]	2,500[a]	2,400[e]
V-10	Wetland	Figure 10	Semiwet Fresh Meadow	71.67[a]	1,100[a]	2,400[e]
V-11	Cropland	Figure 11	Upland Loam (Wyoming big sagebrush)	91.67[a]	8,000[c]	1,100[f]
V-12	Pastureland	Figure 12	Upland Loam (Wyoming big sagebrush)	72.00[b]	1,150[b]	1,100[f]
V-13	Pastureland	Figure 13	Upland Loam (Wyoming big sagebrush)	71.00[b]	1,200[b]	1,100[f]
V-14	Pinyon-Juniper/ Sagebrush	Figure 14	Upland Clay (Pinyon-Juniper)/ Upland Loam	52.25[b]	1,200[b]	550[e]/ 1,100[f]

SAMPLE SITE	PLANT COMMUNITY	PHOTOGRAPH REFERENCE	NRCS ECOLOGICAL SITE NAME*	COVER (Percent Living)	PRODUCTION (Pounds/Acre)	
			(Wyoming big sagebrush)			
V-15	Pastureland	Figure 15	Upland Loam (Wyoming big sagebrush)	82.00[(b)]	1,200[(b)]	1,100[(f)]
V-16	Pastureland	Figure 16	Upland Loam (Wyoming big sagebrush)	66.00[(b)]	750[(b)]	1,100[(f)]
V-17	Pastureland	Figure 17	Upland Loam (Wyoming big sagebrush)	60.00[(b)]	700[(b)]	1,100[(f)]
V-18	Pastureland	Figure 18	Upland Loam (Wyoming big sagebrush)	75.00[(b)]	1,200[b)]	1,100[(f)]
V-19	Pastureland	Figure 19	Upland Loam (Wyoming big sagebrush)	48.50[(b)]	500[(b)]	1,100[(f)]
V-20	Pastureland	Figure 20	Upland Loam (Wyoming big sagebrush)	61.50[(b)]	700[(b)]	1,100[(f)]
V-21	Cropland	Figure 21	Upland Loam (Wyoming big sagebrush)	92.50[(b)]	2,500[(b)]	1,100[(f)]

Sources:

[(a)] Data collected in 2012 by Mt. Nebo Scientific, Inc., Springville, UT.

[(b)] Data collected in 2013-14 by Mt. Nebo Scientific, Inc., Springville, UT.

[(c)] Personal communications in 2014 with landowners/farmers.

[(d)] Benson, Brock. May 2014. Personal communications. USDA, Natural Resources Conservation Service. Utah ecological sites applicable to the Alton, Utah area. Unpublished ecological site description for Upland Clay* (black sagebrush). Ogden, Utah. (The document date on this ESD was March 27, 2012).

[(e)] USDA. Natural Resources Conservation Service. 2014 Soil Survey Staff. Utah ecological site descriptions*. Downloaded in May 2014 at: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/ut/technical/landuse/pasture/?cid=nrcs141p2_034193.

[(f)] Benson, Brock. May 2014. Personal communications. USDA, Natural Resources Conservation Service. Utah ecological sites applicable to the Alton, Utah area. Unpublished ecological site description for Upland Loam * (Wyoming big sagebrush). Ogden, Utah. (The document date on this ESD was April 19, 1992).

* Estimates based on vegetation of undeveloped rangelands for this soil type.

321.230. *Mapping of all lands that are currently or were historically flood irrigated, showing the location of each diversion structure, ditch, dam and related reservoir, irrigated land, and topography of those lands;*

Flood Irrigation

Soils Map 5 shows the areas currently irrigated within the North Private Lease.

No flood irrigation is currently done in the North Private Lease area. Historically, flood irrigation was done on the nearly level to gently sloping areas north of the Farm Road and west of Kanab Creek (see statement by Raymond Heaton, 2014). Historical information does not indicate that there has been any appreciable flood irrigation south of the Farm Road.

321.240. *Documentation that areas identified in R645-302-321 are, or are not, subirrigated, based on groundwater monitoring data, representative water quality, soil moisture measurements, and measurements of rooting depth, soil mottling, and water requirements of vegetation;*

Subirrigation

One indicator of water requirements for the vegetation in the study area could be determined by considering what types of plants are supported in a given area. For example, whether or not the study area supports upland, wetland, riparian or cropland vegetation types. Quantitative and qualitative data have been recorded in plant communities of the North Private Lease area. Water requirements were first addressed in a wetland delineation and ordinary high water mark identification study conducted in 2012 (Long and Collins 2012). One section of that report studied the wetland and upland vegetation in those drainages that dissect the study area. The report provided descriptions, quantitative data and vegetation maps for the area. The wetland section of the report provided quantitative data of the wetland vegetation as well as the adjacent uplands. The Ordinary High Water Mark (OHWM) section identified the lateral limits of non-wetland waters and vegetation. In doing so, cross-sections of the vegetation were measured according to their location in the channel including the low-flow, active floodplain and low terrace areas. Cover estimates by lifeform were also provided within for those areas.

Another function of water required for the vegetation was also addressed by mapping the areas that are currently irrigated by local farmers as croplands and pastures. The croplands and pasturelands are shown on Vegetation Map 1. Current and past irrigated areas are shown on Soils Map 5.

The observed plant rooting depths within the alluvial soil map units on the terrace remnants are much shallower (closer to the surface) than the identified ground water levels. Groundwater depths range from approximately 12.6 to 23.5 feet below the soil surface on the terrace west of

Kanab Creek and 27.4 to greater than 28.5 feet below the surface on the terrace and alluvial fans east of Kanab Creek. Rooting depths range from 2.5 to 4.5 feet below the surface for common root densities (very fine, fine, medium, and coarse roots). **Error! Reference source not found.** shows the relationship between rooting depths, soil redox mottles, soil pH, and groundwater depths.

A summary of groundwater monitoring data from the North Private Lease area is provided in Tables B-2a and B-2b in appendix B. These tables include information on: depth to groundwater; groundwater quality; and surface-water quality information. Additionally, Figure 2 shows the relationship between rooting depths, soil redox mottles, soil pH, and groundwater depths. The figure shows the observed plant rooting depths within the alluvial soil map units on the terrace remnants, or those areas *outside* the deeply incised channels (see Hydrology Map 5), are much shallower (closer to the surface) than the ground water levels. Groundwater depths range from approximately 12.6 to 23.5 feet below the soil surface on the terrace west of Kanab Creek and 27.4 to greater than 28.5 feet below the surface on the terrace and alluvial fans east of Kanab Creek. Rooting depths range from 2.5 to 4.5 feet below the surface for common root densities (very fine, fine, medium, and coarse roots). Accordingly, Figure 2 provides insights regarding the presence and absence of subirrigation in the North Private Lease study area. For example, the depths to groundwater in all areas drilled and sampled on the terrace remnants were much deeper than the functional rooting zones of the plant species present (sample sites: NPL-1, NPL-2, NPL-3, NPL-6, NPL-7, NPL-8, NPL-9, NPL-10, NPL-11, NPL-12). This suggests that subirrigation is not occurring in these upland areas. In the areas where the rooting zones were much closer to groundwater (NPL-4, NPL-5), subirrigation is likely influencing the vegetation composition and productivity.

Examples of subirrigation conditions were found at NLP-4 and NLP-5 which are located on the stream terraces *within* the deeply incised channel of Kanab Creek. NLP-4 is located at the interface between the active floodplain and stream terrace. The surface elevation of NLP-4 is closest to the elevation of Kanab Creek of any of the piezometer locations. The overlapping relationship between the rooting depth, soil redox mottles, and the groundwater is an example of subirrigated conditions. NLP-5 is located higher on the stream terrace and the plant community is more upland compared to NLP-4. The relationship between rooting depth and measured groundwater depth at NLP-5 indicates that subirrigation may be an intermittent condition. Subirrigation at NLP-5 may only occur during periods of above normal flow in Kanab Creek.

Soil redox mottles are a redoximorphic (redox) soil feature that form under anaerobic conditions when the soil is saturated. "Iron released from minerals coats soil particles with a thin oxide-coating," as part of the reduction process (Fletcher 2014). The basic requirements for the reduction process are an absence of oxygen caused by saturated soil conditions and temperatures above biological zero (41 F^{o}), and organic matter. Once soil redox mottles form they can persist for "1,000's of years (Whitehead 2000)." Redox mottles that formed in conditions unrelated to the present moisture regime are considered relic (Veneman et. al. 1998). Redox mottles identified at locations on the upper terrace remnants are likely the result of relic soil conditions when the water table was much higher than current conditions, prior to the down cutting of Kanab Creek.

In summary, as indicated by the plant species present, root zone depths and their proximity to surface and ground-waters, subirrigation is likely occurring only within the incised channels of

the study area and not on the upper terrace remnants. In other words, subirrigation within the North Private Lease is limited to active floodplain and stream terrace areas shown in soil map unit J, Soils Map 6.

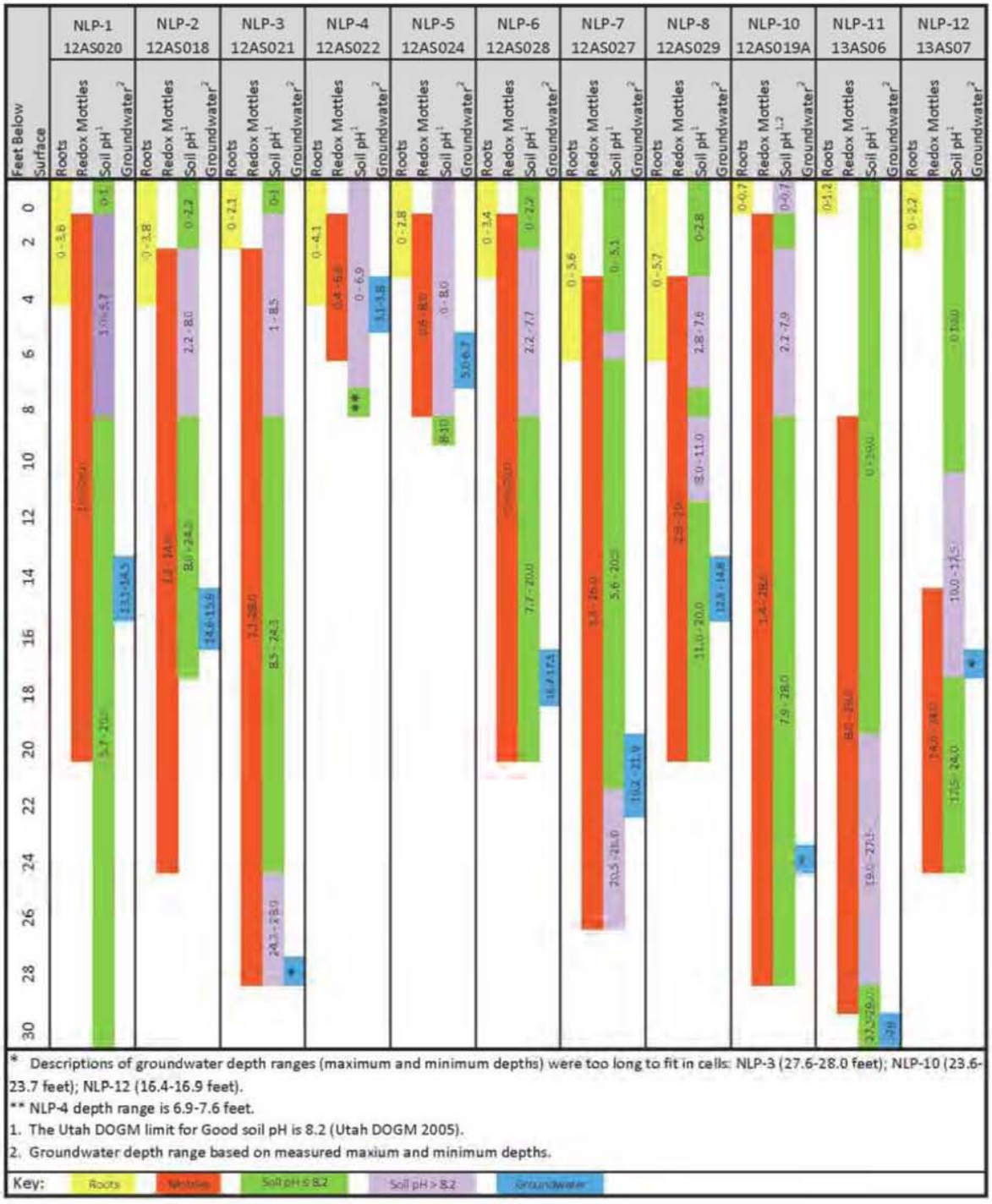

Figure 2. Comparison of rooting depth (common density), zone of soil mottle, and measured groundwater depth. Illustrated depths are not to scale and are shown for relative comparisons. Piezometer locations (NLP-1, NLP-2, etc.) and soil profile identification (12AS020, 12AAS018, etc.) are listed at the top of each column. Locations are shown in Hydrology Map 3.

321.250. *Documentation, based on representative sampling, that areas identified under R645-302-321 are, or are not, flood irrigable, based on streamflow, water quality, water yield, soil measurements, and topographic characteristics.*

Flood Irrigation Potential

The potential for flood irrigation is limited by available water for irrigation, carbonatic soils, physiography, and slope. Soils Map 7 shows the slope ranges within the North Private Lease. Slopes in excess of 3 percent are less suitable for flood irrigation due to the increased potential for soil erosion.

It should be noted that historic and ongoing erosion of the relatively flat land adjacent to Kanab Creek and its tributaries is substantial and has been an ongoing problem for agriculture in the area. There is evidence of recent and historic efforts to control erosion along the incised stream channels through the use of all manner of rip-rap (including old vehicles, household items, woody debris, etc.)

Hydrology Map 7 shows the areas where irrigation water has been allocated based on information obtained from the *Hydrographic Survey Maps (Area 85)* on file with the Utah State Division of Water Rights. These maps are available on-line at: http://www.waterrights.utah.gov/adjdinfo/hydromap.asp?

Information on streamflow, water quality, and water yield is provided in Table 2a and Table 2b. Table 2a includes information on depths to water measured in wells in the shallow alluvial groundwater system, surface water discharge rates in Kanab Creek and its tributaries, and groundwater discharge rates from springs and seeps. Water quality information for groundwaters and surface waters is provided in Table B-2a and Table B-2b in appendix B. Additional information regarding streamflow, water quality, and water yield is available on-line at the Utah Division of Oil, Gas and Mining Coal Water Quality Database at: http://linux1.ogm.utah.gov/cgi-bin/appx-ogm.cgi.

The quality of the groundwater in the shallow alluvial groundwater system in the North Private Lease area is mostly poor with TDS concentrations exceeding the State of Utah irrigation standard of 1,200 mg/L in most locations.

It should be noted that all waters of the State of Utah in the North Private Lease and adjacent areas have been fully appropriated. Based on information obtained from the Utah Division of Water Rights, Adjudication Area 85 (Kanab Creek and Johnson Creek areas) is closed to further water appropriations.

Groundwater and surface-water monitoring data from the greater Alton Amphitheater area support the conclusion that appreciable additional water beyond that currently being used is not available for flood irrigation or subirrigation activities within the North Private Lease area (see

Table B-2a and also information from the Utah Division of Oil, Gas and Mining Coal Water Quality Database). During the irrigation season, most of the water flowing in Kanab Creek is diverted into existing irrigation systems several miles upstream of the North Private Lease area. Most or all of the remaining surface water present in Kanab Creek downstream of the North Private Lease area is commonly diverted for irrigation use at diversions located approximately 1.5 miles south of the North Private Lease area. As a result of these diversions, during typical water years, there is commonly very little water (<0.1 cfs) remaining in the stream below these diversions during the irrigation season. There are no irrigation diversions further south on Kanab Creek for a distance of about 24 miles (a situation likely due primarily to a lack of available surface water).

The hydrologic monitoring data indicate that the alluvial groundwater systems present within and adjacent to the North Private Lease area do not contribute to the essential hydrologic function of agricultural lands within the North Private Lease area. No irrigation wells are present in the shallow alluvial groundwater system within the North Private Lease area.

Waters that are currently or have historically been utilized for irrigation of lands within the North Private Lease area have been derived from the Kanab Creek surface-water system. The surface-water diversions to the existing and historic irrigation systems are located up-stream of the North Private Lease area. The depths to water in the shallow groundwater systems within agricultural areas in the North Private Lease area are too deep to facilitate subirrigation of agricultural vegetation within the area. Additionally, the water quality of shallow groundwaters in much of the North Private Lease area is poor (Table B-2a, Table B-2b in appendix B), which would likely limit its usefulness for flood irrigation and/or subirrigation even if it were accessible for use.

As indicated in the OSM (1983) guidelines:

> *Schmidt (1980) identified the major irrigation practice in southern Utah to be diversion of streams heading on high plateaus. Hay is the dominant irrigated crop. (Appendix B, page 36).*
>
> *Valleys in the study area are generally entrenched, often as much as 40 feet. Subirrigated meadows are limited and are usually located close to bedrock springs. Prior to entrenchment of the valleys, subirrigated meadows existed along many of the stream courses, but ground water was drained from these areas when gullying began. Sagebrush is the dominant vegetation on the valley flats, and, although contributing somewhat more forage than the upland pinyon-juniper vegetation, sagebrush areas are not considered especially productive land for grazing. (Appendix D, page 4).*

The characteristics that impart agricultural importance to those lands in potential AVF areas in the North Private Lease area that are agriculturally important include:

1) the existence of relatively flat lands situated on the broad Kanab Creek terrace deposit, and

2) the availability of limited quantities of surface waters that are diverted from Kanab Creek considerable distances above the North Private Lease area.

Consequently, there is essentially no potential for mining-related activities to affect the water supply of any potential AVF areas in the North Private Lease area. Also, because it is possible to successfully restore the flat land surface and associated soils during reclamation, the potential for mining-related activities to cause material damage to the land resource within potential AVF areas is very low. In other words, proposed mining operations in the North Private Lease area will not cause damage to the water source of any identified alluvial valley floors in the North Private Lease.

321.260. *Analysis of a series of aerial photographs, including color infrared imagery flown at a time of year to show any late summer and fall differences between upland and valley floor vegetative growth and of a scale adequate for reconnaissance identification of areas that may be alluvial valley floors.*

Color and Infrared Aerial Photographs

One geologic/hydrologic criterion used for identification of an AVF is the presence of groundwater that is sufficient for subirrigation in agricultural activities. Biologists often characterize the plant communities in the study area to help make such determinations. For example, the presence of phreatophytes, hydrophytes or riparian vegetation suggests the existence of subirrigation. Plants that are subirrigated are in areas where the water is recharged more by groundwater rather than being dependent on infiltration by recent precipitation events, surface runoff or snowmelt. Subirrigated plants usually have water available to them throughout the entire growing season and do not experience as much water-related stress as other upland plants late in the growing season.

With that in mind, standard color aerial photographs can provide indications or changes in vegetation types. Color aerial photographs of the study area during the growing season show differences in the vegetation and suggest some areas may have more soil moisture than other areas. For example, Vegetation Map 1 clearly shows the wetlands in the drainages and the irrigated croplands and pastures by the darker colors. Note that the west center-pivot field outside the study area appears to be irrigated and has crops actively growing, whereas the east center-pivot seems to be dry (unirrigated) at least when this photograph was taken. As indicated by the color changes, one can also observe which pastures appear to have greater soil moisture, or possibly more total living cover than other fields. A review of historical color imagery from map programs such as Google™ Earth also provided validation to similar water requirement information of the study area.

Color infrared (CIR) aerial photographs can also provide valuable information for the determination of subirrigated areas and evidence for the existence of potential alluvial valley floors. Furthermore, a series of CIR photographs taken at different times of the year can be helpful to determine changes in vegetation types as well as changes in growing patterns. For example, if the photographs are taken late in the growing season and water from precipitation events such as surface runoff and snowmelt has been depleted, high reflectivity shown in these photographs suggest more water in the leaves which is a function of the water available to the rooting systems. This is often a characteristic of subirrigated areas and provides valid reasons for field reconnaissance visits for identification of evidence in the determination of alluvial valley floors. That said, visiting the study site late in the growing season to identify those plant communities that remain green and vigorous and have faded in color or become dormant, along

with identification of the plant species present in them, is similar to using CIR to make such determinations.

Available CIR photographs were reviewed to provide information about the presence of subirrigation in the North Private Lease study area. One CIR (Vegetation Map 3; photograph dated June 22, 2011) shows changes in reflectivity by the different shades of red. As mentioned, high reflectivity is a function of the water content in the leaves which also means that water is available to the root systems. Because this image was taken relatively close to the beginning of the growing season, there is probably a greater amount of soil moisture available to *all* plant communities due to the winter recharge period. It appears in this photograph that the center-pivot in the study area had not yet begun to irrigate for the season -- or perhaps had been left fallow for that year. The summer CIR images (Vegetation Map 4; photograph dated August 7, 2009 and Vegetation Map 5; photograph dated August 19, 2006) clearly show the wettest areas during the mid-growing season. These images show more water available in the irrigated pastures, the drainage wetlands, and in a few pastures south of the center-pivot. The late-fall CIR (Vegetation Map 6; November 2, 2007) suggests some moisture remains in the irrigated croplands, fields and drainages, but not as much in those pastures south of the center-pivot mentioned above. Follow up biological and soil field investigations as well as piezometric data (depth to shallow alluvial groundwater; Table B-2a in appendix B) confirm that those areas are probably not subirrigated.

Summary

321.300. *Based on the investigations conducted under R645-302-321.200, the Division will make a determination of the extent of any alluvial valley floors within the study area and whether any stream in the study area may be excluded from further consideration as lying within an alluvial valley floor. The Division will determine that an alluvial valley floor exists if it finds that:*

321.310. *Unconsolidated streamlaid deposits holding streams are present*

The information presented in this field investigation indicates that stream laid deposits holding streams are apparently present within certain portions of the North Private Lease area (see Hydrology Maps 4 and 5) .

321.320. *There is sufficient water to support agricultural activities as evidenced by:*

The information presented in this field investigation indicates that there is likely not sufficient water availability to support agricultural activities in portions of the North Private Lease area beyond those areas that are currently being irrigated (note that current irrigation operations in the North Private Lease area are performed using an efficient sprinkler system that is likely much more efficient than flood irrigation techniques.) The Kanab Creek and Johnson Creek adjudication area (85) is closed to new appropriations by the Utah Division of Water Rights. Historic water monitoring data demonstrate that during most years most or all of the surface water in Kanab Creek is diverted for existing use in the vicinity of Alton, Utah. Kanab Creek downstream of the existing diversions near Alton, Utah commonly has very little discharge during the irrigation season. The conclusion that there is not sufficient water is supported by the fact that areas south of the Farm Road have not been historically flood irrigated even though substantial agricultural activities have been continuously occurring in adjacent lands for more than 50 years. (see attached statement by Raymond Heaton)

321.321. *The existence of flood irrigation in the area in question or its historical use;*

Available information (Utah Division of Water Rights Hydrographic Survey Maps for Area 85 and statement from Raymond Heaton) indicates that flood irrigation has not occurred south of the Farm Road. Reportedly, attempts were made to irrigate lands east of Kanab Creek more than 50 years ago. However, these attempts were abandoned and the area now consists of unirrigated pasture lands. As indicated in the 1983 OSM study guide:

> *Data concerning the success of presently abandoned irrigation structures is also helpful in assessing capability. Administrative decisions to date show a clear pattern of rejecting capability where abandoned irrigation systems clearly failed due to lack of water or poor quality water or soils. (Chapter II, page 17)*

As indicated in Soils Map 5, portions of the North Private Lease area north of the Farm Road were historically flood irrigated.

321.322. *The capability of an area to be flood irrigated, based on streamflow water yield, soils, water quality, and topography; or,*

Information provided in this field investigation indicates that certain lands within the North Private Lease area are probably not capable of being successfully flood irrigated based on several considerations including the lack of available surface water in Kanab Creek, specific soils characteristics, and topographic characteristics.

321.323. *Subirrigation of the lands in question, derived from the groundwater system of the valley floor.*

The information presented in this field investigation indicates that subirrigation of the stream-laid deposits (with the exception of the narrow, deeply incised stream channels immediately adjacent to Kanab Creek and the middle tributary) is apparently not occurring. The lack of subirrigation on the farmable areas is because the depth to water in the shallow alluvial groundwater system in the North Private Lease area is greater than the rooting depth of the vegetation.

AVF Map 2 illustrates the area within the North Private Lease evaluation area that meets the regulatory criteria for an alluvial valley floor.

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Appendix A

Supplemental Alluvial Valley Floor Guidelines

and

Supporting Documents

Supplemental Alluvial Valley Floor Guidelines & Supporting Documents

Information regarding exemption for disturbance of small acreage

The following guidance regarding the exemptions from the mining prohibition and allowing mining in certain alluvial valley floors is provided in the 1983 OSM investigation guidelines as follows:

> *The significance of alluvial valley floors to farming operations is a critical aspect of the regulatory process because the SMCRA exempts certain portions of an alluvial valley floor from the mining prohibition and hydrologic protection provisions of Section 510(b) (5) (A) and (B). The basis for these exemptions is that some land can be removed from agricultural production without adversely affecting agricultural operations. Undeveloped rangeland that is determined to be insignificant to a farming operation is one exemption; the other exemption allows disruption of a small acreage of a significant alluvial valley floor. It is suggested that the alluvial valley floors be assumed to be either significant or insignificant in the manner outlined below. With this basis, a regulatory decision focuses on the area that can be disrupted while creating only a negligible impact on a ranching operation.*
>
> *Alluvial valley floors having only the capability to be surface irrigated can be assumed to be insignificant and need not be evaluated further. All alluvial valley floors which are currently* flood irrigated or subirrigated are assumed to be significant. For these significant valleys, the central question to be addressed is: What constitutes and insignificant acreage whose loss would have a negligible impact on the particular ranching or farming operation?*
>
> *Negligible impact is based on the relative importance of vegetation and water of the alluvial valley floor to the individual farm's production. Some loss in production is acceptable, and the issue concerns the point at which losses cease to be negligible.*
>
> **Currently, in this context, means the most developed level of irrigation in use on or after August 3, 1977.*
>
> *Identification of alluvial valleys does not imply prohibition from mining. Irrigated areas would have to be evaluated as to the amount of acreage that could be removed from production and still have only a negligible impact on a particular farm's operation. (Appendix D, page 11)*

Stream valleys which do not have any agricultural importance or whose importance is not related to the greater water availability of the valleys are not alluvial valley floors. (Chapter II, page 1)

Potential for reclamation of Alluvial Valley Floors

Because there is no subirrigation within the farmable terrace area, and because the supply of water to the potential AVF is derived exclusively of Kanab Creek surface waters that are diverted several miles upstream of the North Private Lease area, there is no reasonable potential for mining activities to materially damage the water supply to any designated AVFs in the area. For this reason, it is anticipated that reclamation of any designated alluvial valley floors would be possible. As indicated in the 1983 OSM guidelines surface-water irrigated valleys or valleys with the capability to be surface-water irrigated are the easiest to reclaim:

- Subirrigated valleys.—These valleys support either rangeland important to a grazing operation or a cropped area. Subirrigated valleys pose the greatest problems for reclamation plan development because of the need to reestablish an alluvial aquifer with adequate water quantity and quality to support the kinds of vegetation which existed before mining.
- Surface-water irrigated valleys.—These valleys will be part of an existing agricultural operation, and reclamation will focus on restoring the irrigated land use. Such reclamation involves restoration of the stable stream channels, land surfaces, and suitable soils. This kind of reclamation is generally considered easier than restoration of subirrigation.
- Valleys with the capability to be surface-water irrigated.—These valleys, not now in any "developed" agricultural use, are the easiest to reclaim. The goal of reclamation in such valleys is to restore the physical characteristics which give the valley its capability to be surface-water irrigated. In other words, the stream channel, valley topography, and soils must be restored to their premining condition. (Appendix E, page 2)

April 23, 2014

Dear Larry,

As pertaining to our conversation of the flood irrigation in the valley, I know of no flood irrigation that took place below south of the farm road, (we call it the lane going to the east bench). I have been the president of the irrigation co for many years and have researched the old records of water usage and maps of old ditches before my time and have not found evidence of the ditch system going that far south. There was some flood irrigation on the fields north of the farm road but those supply ditches came to the fields ½ mile to the north.

Sincerely

Raymond Heaton

Raymond Heaton

Appendix B

Hydrology Data Summary & Well Information

Table B-1. Hydrologic monitoring site details.

Monitoring site	Location UTM NAD27		Elevation	Geologic Formation
	East (meters)	North (meters)	feet	
Surface Water				
SW-1A	370905	4144264	7005	Quaternary Alluvium
SW-1	370400	4143450	6925	Quaternary Alluvium
Kanab Creek at C.R.	370208	4142177	6845	Quaternary Alluvium
SW-3	369916	4141454	6800	Quaternary Alluvium
SW-11	370072	4142323	6845	Quaternary Alluvium
RSD-1	369521	4144161	7005	Quaternary Alluvium
Knob Wash	370261	4144383	7000	Quaternary Alluvium
Springs				
Coyote Seep	370040	4143054	6900	Quaternary Alluvium
SP7-1	370975	4144444	7045	Quaternary Alluvium
Knob Spring	370261	4144383	7000	Quaternary Alluvium
Wells				
Alluvial groundwater system				
Y-103 (A6)	370158	4143039	6921.75	Quaternary Alluvium
NLP-1	369942	4143256	6920.23	Quaternary Alluvium
NLP-2	369867	4143044	6910.39	Quaternary Alluvium
NLP-3	370357	4142946	6917.98	Quaternary Alluvium
NLP-4	370156	4142838	6871.86	Quaternary Alluvium
NLP-5	370327	4143385	6921.45	Quaternary Alluvium
NLP-6	370322	4143649	6957.29	Quaternary Alluvium
NLP-7	369961	4143728	6946.76	Quaternary Alluvium
NLP-8	370285	4144121	6980.54	Quaternary Alluvium
NLP-9	369751	4143874	6951.01	Quaternary Alluvium
NLP-10	369936	4142855	6902.62	Quaternary Alluvium
NLP-11	370250	4142273	6862.71	Quaternary Alluvium
NLP-12	370047	4142287	6848.57	Quaternary Alluvium
Smirl Coal Seam				
Y-70 (PDH7)	369991	4142830	6902.8	Smirl Coal Seam

etersen Hydrologic, LLC monitoring in the Alton Coal Tract area 2005-2014 (Petersen) and selected data
of Oil, Gas and Mining from Utah International permit application 1986-1988 (UII).

ource	Discharge gpm	Depth (feet b.toc)	T °C	pH S.U.	Sp. Cond. µS/cm	D.O. mg/L	O & G mg/L	Turb. NTU	TDS mg/L	TSS mg/L	Set. Sol. ml/L	T. hard. mg/L	acidity mg/L	T. Alk mg/L CaCO3	Ca (d) mg/L	Mg (d) mg/L	Na (d) mg/L	K (d) mg/L	HCO3 mg/L CaCO3	CO3 mg/L CaCO3	SO4 mg/L
II	0.32		14.0	7.95	1390	8.2															
II	0.23		20.0	7.95	1490	9.4															
II	0.52		20.0	8.05	1080	7.2															
II	1.1		7.5	8.10	1335	9.3															
II	0.61		12.5	8.05	1550	8.3															
II	1.3		2.5	8.05	1280	10.2															
II	4.8		2.0	7.95	760	10.3															
II	4.5		19.9	8.1	565	9.4															
II	0.91		14.0	8.05	1725	14.0															
II	0.51		23.8	8.15	1360	6.9															
II	45		25.2	8.25	1320	8.4															
II	117		18.4	8.1	1320	6.3															
II	144		11.2	8.05	1415	8.3	<1		1050	4	<0.1	867		430	114	142	33	5	430	<5	416
II	206		18.9	7.9	1260	7															
II	390		7.5	8	1510	11.3															
II	449		2	6.7	950	13.8	<1		554	68	<0.1	575		376	89	86	9	3	376	<5	150
II	3460		0	7.9	735	10.3															
II	3190		3.9	7.8	770	8.4															
II	3280		1.5	7.8	920	9.8	<1		600	118	0.10	470		343	78	67	9	2	343	<5	181
rsen	1830		21.9	8.2	813	7.21	< 2.	57.9	578			519	< 5.	303	72.4	82.1	10.4	2.33	365	< 5.	170
rsen	161		12.2	7.9	1962	7.58	< 2.	4.21	1293		< .1	1023		500	146	160	37.9	3.78	610	< 5.	521
rsen	893		8.4	8.24	1551	8.09	< 2.	25.1	1085		< .1	870		460	124	136	27.4	5.46	561	< 5.	453
rsen	2770		10	8.89	846	8.32	< 2.	241	530		0.4	482		353	77.2	70.2	9.31	2.65	417	11	154
rsen	158		19.2	8.53	1544	7.22	< 2.	6.47	815	8	< .1	877		427	104	150	35	4.27	521	< 5.	485
rsen	115		14.3	8.44	1579	7.93	< 2.	12.1	1292	21	< .1	997		445	121.8	168.37	46.32	7.47	543	< 5.	592
rsen	300		0.1	8.76	738	11.2	< 2.	27.4	442	27	< .1	440		330	78.38	59.23	7.04	1.7	402	< 5.	95
rsen	172		1.7	8.41	1592	10.99	< 2.	8.51	1238	6	< .1	1006		554	139	160	36.4	4.13	675	< 5.	515
rsen	27.1		12.8	8.16	1685	7.7	< 2.		1350	< 5.	< .1	1055		465	142	170	46.6	5.36	567	< 5.	565
rsen	67.9		11.1	8.19	1369	7.64	< 2.	14.6	1095	11	< .1	893		441	130	138	35.8	4.35	538	< 5.	449
rsen	703		0.5	8.26	520	8.65	< 2.	7.19	454	6	< .1	402		319	71.54	54.34	7.28	1.76	378	9	83
rsen	87.7		17.8	7.85	1723	8.38	< 5.	11.1	1271	6	< .1	1051		443	133.1	174.65	45.81	4.3	540	< 5.	602
rsen	25.4		16.8	7.95	1601	8.45	< 5.	4.87	1230	11	< .1	952		452	144	143.78	47.5	3.97	551	< 5.	514
rsen	101		10.4	7.9	1522	8.2	< 5.	6.31	1207	< 5.	< .1	1016		471	121.8	172.78	38.05	4.89	574	< 5.	508

rsen	28.8	15.7	8.11	2,030	6.85		8.27	1520	<4											
rsen	77.6	15.9	8.21	1,527	7.93	<5	5.34	1110	6		755	<10	410	97.8	124	31.5	5.5	500	<1	418
rsen	431	7.7	8.54	1,022	10.18	<6	19.9	600	18		551	<5	395	72.7	89.7	15.0	3.3	372	23	210
rsen	2,367	10.3	8.70	785	10.75	8	50.6	500	63		441	<5	359	70.9	64	7.3	2.2	433	2	100
rsen	262	9.7	8.53	1,074	9.44	<5	5.26	738	4		679	<5	391	82.3	115	21.1	4.4	477	<1	263
rsen	5.16	23.1	8.18	1,581	6.11	<5	4.66	1180	<4		903	<5	413	79.9	171	40.4	6.4	503	<1	530
rsen	14.6	15.6	8.33	1,765	6.80		6.42	1340	5											
rsen	82.8	21.9	8.21	1,380	---	<5	5.98	974	4		752	<10	445	93.3	126	27.6	6.3	543	<1	360
rsen	1,493	3.1	8.40	642	9.76	<5	9.76	412	9		353	<5	305	58.5	50.3	5.0	1.6	372	<1	65
rsen	2,253	14.6	8.55	653	8.13	<5	35.8	384	47		338	<5	290	50.8	51.2	6.1	1.9	354	<1	84
rsen	89.2	17.2	8.49	1,210	8.28		3.63	868	<4											
rsen	185	26.0	8.50	939	6.30	<5	5.24	544	<4		505	<5	384	57.8	87.7	15.6	3.0	442	13	160
rsen	92.3	12.2	8.35	1,179	8.54	<6	4.46	876	<4		660	<5	402	78.1	113	22.5	5.2	402	<1	306
rsen	1990	0.3	8.58	678	11.01	<6	19.0	380	25		362	<5	325	60.0	51.6	5.3	1.9	308	17	76
rsen	454	8.5	8.60	954	9.65	<5	5.40	584	5		560	<5	388	70.5	93.2	13.9	3.8	350	38	193
rsen	197	10.7	8.36	1,386	7.88		4.01	976	<4											
ll	0.24	19.5	8.15	1,060	7.30			1190	<2	<0.4	951		362	113	163	38	5.0	362	<5	595
ll	0.24	20	8.15	1380	8.1															
ll	0.22	16.9	8.2	1360	8.1															
ll	0.31	19.5	8.30	1,230	7.70			970	4	<0.4	847		425	96	148	36	6.0	415	10	424
ll	1.2	13.9	8.4	1030	8.8															
ll	3.7	8.2	8.3	1030	9.3															
ll	22.49	6.9	7.25	980	11.50			760	4465	18.2	578		300	82	91	40	13.0	300	<5	302
ll	3	0.5	8.15	810	10.90			614	502	0.4	526		328	79	80	10	2.0	328	<5	193
ll	0	---	---	---	---															
ll	5.2	1	8.1	700	13.5															
ll	5.76	11.0	8.05	725	14.90			486	294	0.4	456		320	66	71	11	2.0	320	<5	130
ll	4.1	10	8	555	11.2															
ll	0.67	13.8	8.1	1515	13.3															
ll	0.56	25.8	8.35	1320	6.6			944	2	<0.1	772		350	71	145	37	5	350	<5	459
ll	206	15.7	8.4	1210	8.2															
ll	184	22.1	8.5	1110	6.2															
ll	126	14.9	8.45	1450	8.4	<1		1014	16	<0.1	850		368	99	147	32	5	368	<5	438
ll	233	18.5	8.1	1350	8.2															
ll	350	7.5	8.3	1525	9.4															
ll	54	0.2	7.9	860	11	<1		518	158	<0.1	440		300	63	69	9	3	300	<5	130
ll	449	0.9	8	800	10.1															
ll	3366	2.1	8	780	9.9															
ll	3590	5	7.9	795	8.3	<1		424	2836	13.8	358		286	63	49	7	2	286	<5	111
rsen	1850	12.1	8.26	874	9.22	2	19.6	644			591	< 5.	337	84.1	92.5	12.4	2.47	411	< 5.	210
rsen	119	9.8	8.12	1665	836	< 2.	7.91	1281		< .1	962		392	110	167	35.7	0.86	478	< 5.	< 1.
rsen	320	9.6	8.33	1519	7.83	< 2.	4.06	1144		< .1	917		416	125	147	30.1	5.22	507	< 5.	538

rsen	109		13.7	8.37	1465	8.11	< 2.	6.73	1257	13	< .1	962		358	103.2	170.99	37.73	5.28	436	< 5.	594
rsen	409		0	8.72	819	12.1	< 2.	13.3	570	24	< .1	518		355	88	72.31	9.39	2.12	433	< 5.	146
rsen	191		0.5	8.63	1503	10.8	< 2.	7.07	1167	< 5.	< .1	948		461	124	155	33.3	4.12	562	< 5.	525
rsen	36.7		11.9	8.51	1662	7	< 2.		1372	< 5.	< .1	1054		375	112	188	37.2	5.05	457	< 5.	638
rsen	85		11.2	8.48	1422	7.53	< 2.	3.5	1206	< 5.	< .1	942		366	110	162	31.7	4.68	446	< 5.	557
rsen	1970		0.5	8.21	572	8.46	< 2.	24.9	521	26	0.1	442		332	74.9	61.95	7.65	2.02	405	< 5.	118
rsen	4170		6.9	8.21	592	9.75	< 2.	2410	418	3616	7	358		222	71.47	43.52	15.27	3.59	256	12	146
rsen	68.9		20.5	8.05	1679	7.42	< 5.		1312	< 5.	< .1	1022		364	110.9	180.98	39.84	6.09	444	< 5.	659
rsen	37.1		20	8.38	1636	7.21	< 5.	6.95	1358	6	< .1	1038		357	111.2	184.56	40.17	5.46	435	< 5.	673
rsen	1267		10.4	8.51	934	9.38	< 5.	6.21	612	11	< .1	568		349	80.16	89.25	13.06	3.18	410	13	187
rsen	195		19.5	8.18	1556	7.02	< 5.	1.7	1239	< 5.	< .1	1024		389	103.9	185.75	38.2	5.5	474	< 5.	582
rsen	28.8		20.4	8.34	1618	8.25	< 5.	2.01	1326	< 5.	< .1	1083		308	86.49	210.63	43.69	6.22	343	28	702
rsen	201		1.2	8.6	1252	10.1	< 5.	2.79	974	< 5.				347	87.64	136.61	28.74	7.41	397	22	426
rsen	587		14.4	8.47	1096	7.78	< 5.	3.2	799	< 5.		667		373	91.09	106.77	19.23	3.18	450	< 5.	283
rsen	34.9		22.5	8.31	1544	8.19	< 5.		1201	< 5.		934		260	72.03	183.14	40.27	6.85	317	< 5.	641
rsen	3051		1.8	8.65	724	9.57	< 5.		438	56		416		315	69.92	58.59	8.07	2.35	384	< 5.	94
rsen	4544		0.4	8.67	871	9.53	< 5.		590	379		488		336	80.53	69.77	11.46	2.54	410	< 5.	164
rsen	1449		14.7	8.63	1002	7.61	< 5.		680	341				353	82.8	96.8	13.1	4.5	525	< 2.	226
rsen	266		12.2	8.53	1,390	8.4	<5		1080	<4		802	<5	360	97.2	136	32.6	9.0	436	1	501
rsen	1191		0.2	8.68	969	10.67	< 5.		608	13				293	78.1	76.8	11.9	2.3	357	< 1.	189
rsen	488		4.9	8.62	1158	9.65	< 5.		836	< 4.				395	91	123	22	3.7	482	< 1.	302
rsen	336		15.7	8.5	860	8.2	< 6.	6.43	548	8				318	63.2	75.4	11.3	2.7	388	< 1.	181
rsen	14.9		20.4	8.39	1687	6.36	< 6.		1310	< 4.				333	97.7	196	43.6	6.2	406	< 1.	720
rsen	43.8		29.2	8.36	1,897	7.30		8.10	1480	10											
rsen	141		16.5	8.4	1464	8.03	< 5.		1040	< 4.				353	81.5	137	30.5	6.6	430	10	500
rsen	1,498		5.1	8.67	701	10.03	<5		452	<4				296	63.2	59.8	7.2	2	296	<1	100
rsen	1760 est.		0.3	8.68	753	10.69	< 6.		388	34				292	61	55.8	6.7	1.9	356	< 1.	92
rsen	3087		14.6	8.60	733	8.18		54.2	436												
rsen	215		19.2	8.38	1,385	8.18			996	<4											
rsen	188		18.9	8.46	1179	7.55		2.23	828												
rsen	102		19.7	8.47	1339	7.63	<5	22.4	992	31				361	74.6	136	29.0	6.2	361	<1	485
rsen	817		0.3	8.56	899	10.55	<6	10.3	520	16				280	48.5	74	9.8	2.3	271	9	159
rsen	1527		11	8.58	1520	9.24	<5	43.6	1030	49				463	91.8	161	29.5	4.7	463	<1	444
rsen	25		19.9	8.36	1610	7.41		3.61	1170	<4											
rsen	Dry																				
rsen	Dry																				
rsen	1.38		0.2	8.89	783	9.78	25	22.7	540	30		409		128	56.9	64.9	14.8	8.9	128	<1	255
rsen	Dry																				
rsen	Dry																				
rsen	Dry																				
rsen	Dry																				
rsen	Dry																				
rsen	Dry																				
rsen	1.49		17.7	8.62	2,770	7.89		7.89	2,390												

rsen	Dry																		
rsen	Dry																		
rsen	0.533	23.9	8.68	2,530	7.61	<5	19.6	2,300	31	1560	<5	297	101	317	69.9	7.2	293	4	1320
rsen	Dry																		
rsen	Dry																		
rsen	Dry																		
rsen	Dry																		
rsen	Dry																		
rsen	Dry																		
rsen	Dry																		
rsen	Dry																		
rsen	Dry																		
rsen	6.09	2.8	8.29	1,050	9.89	<6	15.3	668	8	521	<5	204	54.3	93.5	18.7	5.6	204	<1	360
rsen	25.9	3.2	8.40	2,000	9.13	<5	37.7	1,620	41	1170	<5	211	116	214	44.3	5.9	211	<1	980
rsen	Dry																		
rsen	Dry																		
rsen	Dry																		
rsen	Dry																		
rsen	Dry																		
rsen	2,814	3.6	8.70	791	10.23	<5	37.2	514	36	427	<5	357	66.5	63.3	8.1	2.2	431	2	122
rsen	302	12.2	8.59	1,186	8.99	<5	3.62	890	<4	758	<5	393	92.5	128	23.9	4.3	479	<1	335
rsen	24	22.2	8.41	1,702	6.52	<6	1.98	1360	<4	926	<5	322	85.7	173	34.5	5.2	392	<1	710
rsen	48.7	26.9	8.27	1,856	6.34		4.51	198*	5										
rsen	139	17.3	8.37	1,650	7.71	<5	1.37	1220	4	848	<5	414	94.1	149	33.2	6.1	392	<1	530
rsen	1,503	6.4	8.52	712	9.23	<6	2.62	400	<4	360	<5	301	56.9	53.0	6.3	1.7	367	<1	95
rsen	2,942	0.3	8.69	641	10.82	<5	195	476	147	331	<5	297	56.1	46.4	5.3	1.7	359	1	72
rsen	2,455	14.2	8.56	686	8.15	<5	23.0	416	34	351	<5	292	52.4	53.4	6.8	2.0	356	<1	105
rsen	181	23.2	8.42	1,352	7.32		3.48	988	<4										
rsen	215	19.9	8.50	1,213	7.26	<5	3.74	796	<4	667	<5	365	75.8	116	23.0	3.6	436	4	343
rsen	128	17.5	8.48	1,332	7.83	<6	3.86	1020	<4	775	<5	367	86.2	136	27.9	5.4	367	<1	467
rsen	1900	0.3	8.56	756	11.16	<6	34.6	520	35	414	<5	297	67.0	59.9	6.7	2.1	297	<1	108
rsen	5230	3.5	8.57	838	9.62	<6	824	536	613	469	<5	322	63.2	75.6	10.2	3.3	322	<1	165
rsen	571	7.5	8.61	1,174	10.32	<5	22.1	752	20	601	<5	410	70.8	103	16.4	3.6	388	22	295
rsen	172	19.8	8.40	1,462	7.93		3.38	1030	<4										
rsen	47	12.5	8.43	1,672	7.78		18.5	1220	4										
rsen	Dry																		
rsen	Dry																		
rsen	Dry																		
rsen	0.77	0.6	8.65	546	9.06	<5	12.3	400	9	254	<5	225	59.3	25.6	7.7	6.0	274	<1	68
rsen	Dry																		
rsen	Dry																		
rsen	Dry																		
rsen	Dry																		

rsen	Dry																			
rsen	Dry																			
rsen	Dry																			
rsen	Dry																			
rsen	Dry																			
rsen	7.62	3.9	8.97	707	9.01	<6	12,900	780	16200	174	<5	60.0	24.1	27.6	46.2	3.7	60.0	<1	26	
rsen	Dry																			
rsen	Dry																			
rsen	Dry																			
rsen	Dry																			
rsen	0																			
rsen	Dry																			
rsen	Dry																			
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rsen	Dry																			
rsen	Dry																			
rsen	Dry																			
rsen	Dry																			
rsen	Dry																			
rsen	Dry																			
rsen	1.63	10.1	7.39	1353				1030	4	790	<15	457	150	101	20.6	4.5	457	<1	391	
rsen	0.726	16.9	7.30	1390				1040	36	663	<10	444	97.2	102	18.7	3.7	444	<1	405	
rsen	3.49	19.0	7.43	1489				1050	19	766	<10	<10	142	100	18.4	4.5	445	<1	380	
rsen	1.21	7.2	7.22	1396				1070	38	334	<5	481	56.4	46.8	4.7	1.5	481	<2	422	
rsen	0.620	23.4	7.25	1486				936	122	317	<5	339	127	97.9	18.4	3.5	339	<1	420	
rsen	3.46	11.4	7.58	1443				1030	61	829	<5	437	154	108	18.3	4.4	437	<1	410	
rsen	0.622	9.6	7.30	1438				1000	59	856	<5	453	158	112	16.2	4.3	453	<1	390	
rsen	<0.05	5.8	8.23	3160				2930	15	2120	<5	327	231	374	195	28.4	327	<1	1810	
rsen	Dry																			
rsen	Dry																			
rsen	Dry																			
rsen	Dry																			
rsen	Dry																			
rsen	Dry																			
rsen	Dry																			
rsen	Dry																			
rsen	Dry																			
rsen	Dry																			

rsen	1.30		15.5	8.12	2520	7.29	<6	22.3	2350	12	1660	<5	504	204	279	37.9	5.2	504	<2	1140
rsen	0.435		25.7	7.99	2960				2760	7	1950	<5	283	116	403	54.8	1.0	283	<1	1750
rsen	0.605		18.4	7.9	2860				2370	17	1980	<10	528	212	352	53.3	7.5	528	<1	1340
rsen	0.99		2.3	7.55	2930				2640	7	1970	<5	690	279	309	43.2	7.7	690	<2	1190
rsen	0.929		15.2	7.81	2160				2040	62	1510	<5	497	229	227	31.1	6.5	497	<1	1030
rsen	0.530		21.4	7.96	2560				2260	69										
rsen	0.120		12.2	8.04	2750				2590	16	1840	<5	375	148	356	52.3	2.2	372	3	1760
rsen	0.219		9.7	8.20	2130				1910	147	1460	<5	383	120	282	42.0	6.0	357	26	1210
rsen	0.469		0.2	7.55	2120				2130	32	1620	<5	660	236	250	36.2	6.8	660	<1	1110
rsen	1.23		5.2	8.25	2460				2140	455	1660	<5	419	170	301	45.4	6.0	419	<1	1270
rsen	0.174		14.7	8.15	2320				2200	40										
ll		37.60	10.1	7.7	1025															
ll		38.30	11.1	7.85	810															
ll		38.40	10.6	7.7	1035															
ll		38.20	10.9	7.4	960															
ll		38.10	10	7.3	970															
ll		37.90	10.1	7.1	1000															
ll		37.90	10.2	7.5	875															
ll		38.20	10.2	7.6	990															
ll		38.80	10.7	7.3	985															
ll		38.50	10.6	7.7	1035				578		382			61	56	89	12	386	<5	130
ll		38.10	10.1	7.1	1000				546		425			70	61	79	8	398	<5	128
ll		37.90	10.7	7.3	985				576		384			65	54	69	7	402	<5	140
rsen		40.25																		
rsen		39.91	10.5	8.13	1375				1050	1410	269	<5	457	52.3	33.6	200	11.9	457	<2	350
rsen		36.56	10.3	7.07	3390				2950	646	1740	<5	603	319	230	271	10.2	603	<2	1480
rsen		37.41	10.6	7.03	3800				3740	93	1730	<10	631	318	228	277	10.2	631	<2	1640
rsen		38.99																		
rsen		38.86	10.6	6.99	3470				3220	42	1700	<5	603	307	226	274	9.6	603	<2	1570
rsen		38.78																		
rsen		39.21	11.8	7.08	2800				2940	130	1690	<5	484	301	228	240	8.8	484	<1	1630
rsen		40.21	11.3	7.03	3280				2840	116	1600	<5	471	286	215	240	9.5	471	<1	1520
rsen		39.59	9.4	7.09	3230				2920	32	1710	<5	637	294	236	250	8.2	637	<1	1520
rsen		39.65	11.0	7.01	3260				2850	83	1620	<5	629	280	224	248	8.6	629	<1	1540
rsen		39.87	10.5	7.03	3200				2910	109										
ll		22.9	13.5	7.15	2465															
ll		31	11	6.85	1845															
ll		30.7	10	6.85	2970															
ll		30.6	8.8	6.85	2825															
ll		25.3	8.3	6.80	2820															
ll		30.4	8.1	6.85	3455															

ll	30.84	10.3	6.45	4410	3980		3543			384	630	40	11	788	<5	2551
ll	30.52	8.9	6.60	3785	3156		2802			286	509	37	10	704	<5	1978
ll	30.33	9.8	6.70	3830	3420		2600			243	486	10	8	735	<5	2058
rsen	29.99															
rsen	30.16	10.0	6.97	3760	3560	10700	2580	<5	743	316	435	23.0	14.6	743	<2	1890
rsen	30.81	10.0	7.03	3740	3560	179	2660	<10	798	344	438	25.0	16.3	798	<2	1890
rsen	30.83															
rsen	30.50	10.1	6.90	3690	3630	1040	2580	<5	770	328	427	24.1	15.7	770	<2	1910
rsen	30.16															
rsen	30.53															
rsen	30.81	10.3	7.09	3460	3240	170	2510	<5	741	324	413	22.9	14.7	741	<1	1860
rsen	31.32	9.8	6.96	3080	2850	49	2200	<5	589	286	362	24.1	13.4	589	<1	1520
rsen	30.73	9.8	7.03	3690	3120	130	2490	<5	741	315	414	22.7	14.2	741	<1	1800
rsen	30.99	9.7	6.96	2790	2570	22	2020	<5	693	263	331	24.2	11.8	693	<1	1470
rsen	31.44	10.0	6.98	3030	2800	270										
rsen	13.39	12.0	7.34	3130	3020	104	2030	<5	611	292	316	46.2	5.1	611	<2	1460
rsen	13.36															
rsen	13.41	12.5	7.23	3190	2840	2680	2080	<5	809	297	326	49.1	4.6	809	<1	1610
rsen	14.38	11.1	7.22	3030	2670	1090	1960	<5	617	271	312	49.3	5.0	617	<1	1560
rsen	14.73	6.5	7.17	3130	2700	4210	1900	<5	617	267	300	57.7	4.6	617	<1	1560
rsen	14.79															
rsen	11.74	14.0	6.97	3290	2950	1510										
rsen	15.59	12.5	7.36	3900	3610	216	2120	<5	594	249	364	227	6.1	594	<2	1730
rsen	15.28															
rsen	14.94															
rsen	15.17															
rsen	15.54	15.1	7.16	3980	8740	7720	2130	<5	792	241	371	223	5.0	792	<1	1950
rsen	16.22	14.2	7.23	3910	3130	3050	2100	<5	463	240	364	228	5.5	463	<1	1930
rsen	16.04	7.2	7.39	3830	3670	5250	2010	<5	544	223	354	215	4.9	544	<1	1940
rsen	15.80															
rsen	15.67															
rsen	16.01	10.0	7.20	3750	3170	1000										
rsen	27.86															
rsen	27.88	8.4	7.25	1526	1090	28300	829	<5	860	139	117	21.1	8.6	860	<1	<1
rsen	28.03	21.3	7.18	1782	1200	6100	944	<5	589	172	125	21.3	7.7	589	<1	380
rsen	28.25	16.6	7.22	1584	1080	2600	677	<5	699	65.1	125	23.1	8.3	699	<1	386
rsen	28.25	6.9	7.19	1665	1090	15500	956	<5	526	170	129	24.6	8.3	526	<1	410
rsen	28.29															
rsen	28.45	17.6	7.23	1713	1110	477										
rsen	3.57															
rsen	3.61	3.1	7.15	2090	1700	7790	1340	<5	638	207	201	33.2	5.5	638	<1	850

rsen	3.56	3.6	7.24	2200	1750	6690	1350	<5	476	204	204	36.1	5.4	476	<1	830
rsen	3.78															
rsen	4.54	14.0	7.00	1932	1520	2530										
rsen	5.52															
rsen	5.58	5.6	7.52	2070	1820	3010	1250	<5	503	203	180	29.0	4.1	503	<1	910
rsen	7.18	15.1	7.59	2390	1950	392	1400	<5	529	224	204	26.6	4.5	529	<1	1030
rsen	6.98	14.2	7.62	2080	1810	540	1270	<5	490	207	184	26.9	5.4	490	<1	960
rsen	5.65	6.6	7.33	2130	1800	222	1380	<5	392	226	199	29.6	4.7	392	<1	940
rsen	6.17															
rsen	7.37	19.9	7.87	1627	1140	551										
rsen	16.90															
rsen	16.96	10.8	7.21	3010	2380	21500	2010	<5	609	359	270	21.7	5.8	609	<1	1400
rsen	17.54	5.2	7.59	2750												
rsen	17.65															
rsen	17.80	19.7	6.98	2740												
rsen	19.67															
rsen	19.86	10.9	7.72	1894	2020	72500	920	<5	742	75.0	178	139	3.3	742	<1	21
rsen	20.49	12.8	7.73	2040	1120	30300	936	<5	1560	89.5	173	87.3	3.4	1560	<1	476
rsen	20.62	8.9	7.74	1946	1250	18800	961	<5	2320	86.5	181	116	3.4	2320	<1	470
rsen	21.81	8.6	7.35	1796	1140	7980	929	<5	657	96.5	167	68.8	3.9	647	18	339
rsen	22.40															
rsen	22.86	10.7	7.46	1787	1050	3470										
rsen	13.05															
rsen	13.12	10.2	7.03	8730	9250	476	5430	<5	840	508	1010	572	16.3	840	<1	4510
rsen	14.01	12.8	7.00	8140	7740	17000	4580	<5	808	475	825	450	14.9	808	<1	4220
rsen	14.96	9.8	7.13	6790	6190	1370	4080	<5	571	466	708	360	18.1	571	<1	3310
rsen	14.97															
rsen	13.85															
rsen	13.62															
rsen	13.76	14.9	6.97	4630	4060	890										
rsen	20.93															
rsen	21.02	7.3	7.37	5510	4990	135	2600	<5	440	259	474	407	7.7	440	<1	2570
rsen	22.19	13.7	7.75	5810	4720	294	2880	<5	462	278	531	425	8.1	462	<1	2830
rsen	22.70															
rsen	23.13															
rsen	Dry															
rsen	23.96	6.7	7.36	4320	3150	325000	2400	<5	814	309	396	194	9.6	814	<1	2060
rsen	23.89															
rsen	23.97	8.6	7.26	4290	3750	7160	2800	<5	696	320	486	202	6.4	696	<1	2120

rsen	Dry															
rsen	Dry															
rsen	Dry															
rsen	17.25															
rsen	17.20	6.1	7.07	3190	2250	278000	1820	<5	390	327	243	116	8.1	390	<1	1610
rsen	17.01															
rsen	16.94	9.2	7.02	3150	2900	3530	2190	<5	532	389	295	136	8.2	532	<1	1620
rsen	17.45	10.8	6.87	3130	2870	742										
rsen	0.05	7.1	7.16	7730	7040	7590	3110	<5	667	301	572	935	13.4	667	<1	4380
rsen	-0.1															
rsen	-0.1	8.4	7.29	7530	7500	694	3530	<5	690	355	641	1000	15.8	690	<1	4270
rsen	1.19	12.1	7.05	7510	6970	30										

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en Hydrologic, LLC monitoring in the Alton Coal Tract area 2005-2014 (Petersen) and selected data
l, Gas and Mining from Utah International permit application 1986-1988 (UII).

											Trace metals												
Al (d) mg/L	Al (t) mg/L	As (d) mg/L	As (t) mg/L	B (d) mg/L	B (t) mg/L	Ba (d) mg/L	Cd (d) mg/L	Cr (d) mg/L	Cu (d) mg/L	Fe (d) mg/L	Fe (t) mg/L	Pb (d) mg/L	Pb (t) mg/L	Hg (d) mg/L	Mn (d) mg/L	Mn (t) mg/L	Mo (d) mg/L	Ni (d) mg/L	Se (d) mg/L	Se (t) (µg/L)	Zn (d) mg/L	NH3 mg/L N	F mg/L
	<0.05		<0.001	0.09	0.04						0.27		<0.02	<0.0002		0.03				<0.001			0.4
	0.17		<0.001	0.03	0.15						1.8		<0.02	<0.0002		0.06				<0.002			0.2
	0.28		<0.001	<0.02	0.15						2.89		<0.02	<0.0002		0.06				<0.001			0.2
< .03		< .01		0.07		0.179	< .001	< .001	< .01	< .03	0.77	< .01			0.005	0.034	< .005	< .001	< .02		0.005	< .1	0.2
< .03		< .01		0.09		0.073	< .001	< .001	0.01	< .03	< .05	< .01			0.043	< .002	< .005	< .001	< .02		< .004	0.1	0.21
< .03		< .01		0.08		0.12	< .001	< .001	< .01	< .03		< .01			0.011		< .005	0.002			< .004	< .1	0.15
< .03		< .01		0.04		0.145	< .001	< .001	< .01	< .03	4.63	< .01			0.007	0.071	< .005	0.001			< .004	< .1	0.2
< .03		< .01		0.1		0.043	< .001	< .001	< .01	< .03	0.47	< .01			0.002	0.026	< .005	0.001	< .02		< .004	< .1	0.32
< .03		< .01		0.1		0.055	< .001	< .001	< .01	< .03	0.52	< .01			0.009	0.016	< .005	< .001	< .02		< .004	< .1	0.33
< .03		< .01		0.02		0.199	< .001	< .001	< .01	< .03	0.79	< .01			0.012	0.025	< .005	< .001	< .02		< .004	< .1	0.16
< .03		< .01		0.08		0.12	< .001	< .001	< .01	< .03	0.56	< .01			0.061	0.067	< .005	0.002	< .02		< .004	< .1	0.51
< .03		< .01		0.1		0.016	< .001	< .001	< .01	< .03	0.64	< .01			0.033	0.038	< .005	0.001	< .02		0.004	< .1	0.27
< .03		< .01		0.09		0.116	< .001	< .001	< .01	< .03	0.4	< .01			0.04	0.045	< .005	< .001	< .02		0.008	< .1	0.33
< .03		< .01		0.02		0.191	< .001	< .001	< .01	< .03	0.19	< .01			0.007	0.012	< .005	< .001	< .02		0.013	< .1	0.17
< .03		< .01		0.1		0.066	< .001	< .001	0.01	< .03	0.72	< .01			0.006	0.029	< .005	< .001	< .02		< .004	< .1	0.24
< .03		< .01		0.08		0.054	< .001	< .001	0.01	< .03	0.45	< .01			0.033	0.038	< .005	< .001	< .02		0.009	< .1	0.2
< .03		< .01		0.11		0.09	< .001	< .001	0.01	< .03	0.56	< .01			0.021	0.024	< .005	0.002	< .02		< .004	< .1	0.24
											0.63					0.008							
<0.05	0.07	<0.05	<0.05	0.08	0.08	0.106	<0.005	<0.005	<0.005	<0.02	0.18	<0.02	<0.02	0.0002	0.005	0.011	<0.01	<0.005	0.02	<0.02	<0.01	<0.2	0.2
<0.05	0.1	<0.05	<0.05	0.05	<0.05	0.105	<0.005	<0.005	<0.005	<0.02	0.42	<0.02	<0.02	<0.0002	0.009	0.018	<0.01	<0.005	0.17	0.15	<0.01	<0.2	0.2
<0.05	0.4	<0.05	<0.05	<0.05	<0.05	0.224	<0.005	<0.005	<0.005	<0.02	1.01	<0.02	<0.02	<0.0002	0.013	0.044	<0.01	<0.005	0.02	0.02	<0.01	<0.2	0.2
<0.05	<0.05	0.05	<0.05	0.08	0.06	0.254	<0.005	<0.005	<0.005	0.02	0.34	0.02	<0.02	<0.0002	<0.005	0.031	<0.01	<0.005	0.03	0.03	<0.01	<0.2	0.2
<0.05	<0.05	<0.05	<0.05	0.14	0.13	0.083	<0.005	<0.005	<0.005	<0.02	0.31	<0.02	<0.02	<0.0002	<0.005	0.009	<0.01	<0.005	0.02	0.02	<0.01	<0.2	0.2

<0.05	0.07	<0.05	<0.05	<0.06	<0.05	0.227	<0.005	<0.005	<0.005	<0.02	0.15	<0.02	<0.02	<0.0002	0.005	0.009	<0.01	<0.005	0.02	<0.02	<0.01	<0.2	0.2
<0.05	0.5	<0.05	<0.05	<0.05	<0.05	0.171	<0.005	<0.005	<0.005	<0.02	0.64	<0.02	<0.02	<0.0002	<0.005	0.024	<0.01	<0.005	<0.02	0.03	<0.01	<0.2	0.2
											0.30					0.016							
<0.05	<0.05	<0.05	<0.05	0.06	0.07	0.153	<0.005	<0.005	<0.005	<0.02	0.19	<0.02	<0.02	<0.0002	<0.005	0.006	<0.01	<0.005	,02	0.02	<0.01	<0.2	0.3
0.06	<0.05	<0.05	<0.05	0.10	<0.05	0.105	<0.005	<0.005	<0.005	0.02	<0.02	0.02	<0.02	<0.0002	0.006	<0.005	<0.01	<0.005	<0.02	0.03	<0.01	<0.2	0.3
<0.05	0.2	<0.05	<0.05	<0.05	<0.05	0.186	<0.005	<0.005	<0.005	<0.02	0.42	<0.02	<0.02	<0.0002	0.007	0.016	<0.01	<0.005	0.07	0.06	<0.01	<0.2	0.2
<0.05	<0.05	<0.05	0.05	0.05	<0.05	0.120	<0.005	<0.005	<0.005	<0.02	0.16	<0.02	<0.02	<0.0002	0.005	0.008	<0.01	<0.005	0.17	0.15	<0.01	<0.2	0.2
											0.26					0.023							
	<0.05		0.001	0.08							0.37		<0.02			0.01				0.002		<0.02	0.2
	<0.05		0.001	0.1							0.09		<0.02			0.01				0.002		<0.02	0.2
	1.97		0.002	0.08							56.30		<0.02			1.01				<0.001		0.05	0.3
	1.93		<0.001	0.04							10.15		<0.02			0.15				0.001		0.02	0.3
	0.37		0.001	0.05							4.55		<0.02			0.06				<0.001		0.09	0.3
	<0.05		<0.001	0.02							0.1		<0.02			0.01				0.001		<0.02	1.1
	<0.05		<0.001	0.08							0.2		<0.02	<0.0002		0.01				<0.001		0.02	0.4
	0.45		<0.001	<0.01							5		<0.02	<0.0002		0.08				<0.001		0.04	0.2
	3.05		0.004	<0.02							56.8		<0.02	<0.0002		0.71				<0.001		0.1	0.2
< .03		< .01		0.05		0.17	< .001	< .001	< .01	< .03	0.4	< .01			< .002	0.033	< .005	0.001	< .02		< .004	< .1	0.19
< .03		< .01		0.02		0.01	< .001	< .001	< .01	< .03		< .01			< .002		< .005	< .001	< .02		< .004	0.2	0.21
< .03		< .01		0.08		0.096	< .001	< .001	< .01	< .03		< .01			0.008		< .005	0.001			< .004	< .1	0.07
0.05		< .01		0.04		0.143	< .001	< .001	< .01	< .03	2.43	< .01			0.01	0.049	< .005	0.001			0.008	0.1	0.2
< .03		< .01		0.1		0.059	< .001	< .001	< .01	< .03	0.24	< .01			0.002	0.011	< .005	0.002	< .02		0.006	< .1	0.3
< .03		< .01		0.09		0.028	< .001	< .001	< .01	< .03	0.2	< .01			< .002	< .002	< .005	< .001	< .02		< .004	< .1	0.27
< .03		< .01		0.03		0.202	< .001	< .001	< .01	< .03	0.46	< .01			0.011	0.021	< .005	< .001	< .02		< .004	< .1	0.18
< .03		< .01		0.07		0.091	< .001	< .001	< .01	< .03	0.23	< .01			0.044	0.051	< .005	0.002	< .02		< .004	< .1	0.43
< .03		< .01		0.09		0.048	< .001	< .001	< .01	0.04	0.13	< .01			0.004	0.004	< .005	0.001	< .02		0.028	< .1	0.22
< .03		< .01		0.08		0.085	< .001	< .001	< .01	< .03	0.06	< .01			0.007	0.012	< .005	< .001	< .02		0.01	< .1	0.33
< .03		< .01		0.03		0.153	< .001	< .001	< .01	< .03	0.64	< .01			0.006	0.019	< .005	< .001	< .02		< .004	< .1	0.18
< .03		< .01		0.04		0.054	< .001	< .001	< .01	< .03	46.22	< .01			< .002	0.618	< .005	0.001	< .02		< .004	< .1	0.29
< .03		< .01		0.09		0.053	< .001	< .001	0.01	< .03	0.12	< .01			< .002	0.003	< .005	< .001	< .02		< .004	< .1	0.19
< .03		< .01		0.05		0.057	< .001	< .001	0.01	< .03	0.19	< .01			0.006	0.009	< .005	< .001	< .02		< .004	< .1	0.16
< .03		< .01		0.04		0.104	< .001	< .001	< .01	< .03	0.23	< .01			0.004	0.019	< .005	0.001	< .02		< .004	< .1	0.35
< .03		< .01		0.12		0.07	< .001	< .001	0.01	< .03	0.15	< .01			< .002	0.002	< .005	0.002	< .02		< .004	< .1	0.22
< .03		< .01		0.09		0.032	< .001	0.001	0.01	< .03	< .05	< .01			< .002	0.004	< .005	0.002	< .02		< .004	0.1	0.15
				0.06	0.06					< .03	0.09				0.002	0.002			< .02	< 100.			
				0.05	0.05					< .03	0.13				0.012	0.016			< .02	< 20.			
				0.1	0.1					< .03	< .05				< .002	< .002			< .02	< 20.			

<0.05	<0.05	<0.05	<0.05	0.11	0.11	0.035	<0.005	<0.005	<0.005	0.02	0.06	<0.02	<0.02	<0.0002	<0.005	<0.005	<0.01	<0.005	0.02	0.04	<0.01	<0.2	0.2
				< .05	0.1					< .02	0.16				< .005	0.014			0.02	< 20.			
				0.06	0.05					< .02	0.17				< .005	0.036			0.02	20			
				0.06	0.08					< .02	0.26				0.009	0.016			0.02	< 20.			
				0.1	0.09					0.02	0.24				< .005	0.01			0.02	20			
											0.32					0.007							
				0.09	0.09					< .02	0.13				< .005	0.007			0.03	< 20.			
				<0.05	<0.05					<0.02	0.07				0.005	0.006			<0.02	<0.02			
				< .05	0.05					< .02	0.46				< .005	0.014			0.02	20			
											0.17					0.016							
				0.09	0.11					<0.02	0.41				<0.005	0.018			0.02	0.02			
				<0.05	<0.05					<0.02	0.21				<0.005	0.008			0.05	0.08			
				0.06	0.05					<0.02	0.86				<0.005	0.028			0.20	0.23			
											0.17					0.008							
0.05	0.2	<0.05	<0.05	0.07	0.07	0.027	<0.005	<0.005	<0.005	0.06	0.34	<0.02	<0.02	0.0002	0.044	0.052	<0.01	<0.005	0.02	0.02	<0.01	<0.2	<0.1
<0.05	0.1	0.05	<0.05	0.07	0.07	0.026	<0.005	<0.005	<0.005	<0.005	0.16	0.02	<0.02	<0.0002	<0.005	0.005	<0.01	<0.005	0.02	<0.02	<0.01	<0.2	0.2
<0.05	0.2	<0.05	<0.05	0.11	0.14	0.025	<0.005	<0.005	<0.005	<0.02	0.27	<0.02	<0.02	<0.0002	<0.005	0.006	<0.01	<0.005	0.02	0.02	<0.01	<0.2	<0.5
<0.05	0.1	<0.05	<0.05	0.05	<0.05	0.025	<0.005	<0.005	<0.005	0.07	0.20	<0.02	<0.02	<0.0002	0.010	<0.005	<0.01	<0.005	0.12	0.11	<0.01	<0.2	<0.1
<0.05	0.3	0.05	<0.05	<0.05	<0.05	0.03	<0.005	0.010	<0.005	<0.02	0.51	<0.02	<0.02	<0.0002	<0.005	0.012	<0.01	<0.005	0.18	0.15	<0.01	<0.2	0.2
<0.05	<0.3	<0.05	<0.05	<0.05	<0.05	0.191	<0.005	<0.005	<0.005	<0.02	0.69	0.02	<0.02	<0.0002	0.014	0.036	<0.01	<0.005	0.02	0.03	<0.01	<0.2	0.2
<0.05	<0.05	<0.05	<0.05	0.10	0.07	0.221	<0.005	<0.005	<0.005	<0.02	0.15	0.02	0.02	<0.0002	<0.005	0.034	<0.01	<0.005	0.03	0.02	<0.01	<0.2	0.2
<0.05	<0.05	<0.05	<0.05	0.09	0.11	0.033	<0.005	<0.005	<0.005	<0.02	0.05	<0.02	<0.02	<0.0002	<0.005	0.010	<0.01	<0.005	0.02	0.03	<0.01	<0.2	0.2
											0.10					0.009							
<0.05	<0.05	<0.05	<0.05	0.09	0.09	0.073	<0.005	<0.005	<0.005	<0.02	0.03	<0.02	<0.02	0.0002	<0.005	<0.005	<0.01	<0.005	0.02	0.02	<0.01	<0.2	0.2

										0.30					0.016							
<0.05	<0.05	<0.05	<0.05	0.07	0.08	0.083	<0.005	<0.005	<0.005	<0.02	0.11	<0.02	<0.02	<0.0002	<0.005	<0.005	<0.01	<0.005	0.03	<0.02	<0.01	<0.2	0.2
0.05	<0.05	<0.05	<0.05	0.10	0.10	0.067	<0.005	<0.005	<0.005	<0.02	0.06	0.03	<0.02	<0.0002	0.005	0.007	<0.01	<0.005	<0.02	<0.02	<0.01	<0.2	0.2
<0.05	0.1	<0.05	<0.05	<0.05	<0.05	0.173	<0.005	<0.005	<0.005	<0.02	0.40	<0.02	<0.02	<0.0002	0.009	0.018	<0.01	<0.005	0.08	0.06	<0.01	<0.2	0.2
0.07	5.7	<0.05	<0.05	0.06	0.09	0.165	<0.005	<0.005	<0.005	0.06	9.49	<0.02	<0.02	<0.0002	0.005	0.261	<0.01	<0.005	0.14	0.14	<0.01	<0.2	0.2
<0.05	0.06	<0.05	<0.05	0.05	<0.05	0.093	<0.005	0.005	<0.005	<0.02	0.30	<0.02	<0.02	<0.0002	0.006	0.017	<0.01	<0.005	0.14	0.16	<0.01	<0.2	0.2
											0.05					0.017							
											0.04					<0.005							
<0.05	0.1	<0.05	<0.05	0.06	0.05	0.036	<0.005	<0.005	<0.005	<0.02	0.12	<0.02	0.02	<0.0002	<0.005	<0.005	<0.01	<0.005	<0.02	0.03	<0.01	<0.2	0.2
<0.05	65.1	<0.05	0.12	0.23	0.41	0.073	<0.005	<0.005	<0.005	0.02	43.1	<0.02	0.03	<0.0002	0.024	3.83	<0.01	<0.005	0.07	0.14	<0.01	<0.2	0.2
<0.05	<0.05	<0.05	<0.05	0.06	0.06	0.046	<0.005	<0.005	<0.005	0.10	0.86	<0.02	<0.02	0.0002	0.126	0.128	<0.01	<0.005	0.03	0.03	<0.01	<0.2	0.2
<0.05	0.2	<0.05	<0.05	0.07	0.08	0.039	<0.005	<0.005	<0.005	<0.02	1.31	<0.02	<0.02	<0.0002	<0.005	0.081	<0.01	<0.005	0.02	0.04	<0.01	<0.2	0.2
<0.05	0.05	<0.05	<0.05	0.06	0.18	0.061	<0.005	<0.005	<0.005	<0.02	1.69	<0.02	<0.02	0.0002	0.087	0.131	<0.01	<0.005	<0.02	0.02	<0.01	<0.2	0.2
<0.05	0.1	<0.05	0.05	<0.05	0.07	0.215	<0.005	<0.005	<0.005	<0.02	7.22	<0.02	<0.02	<0.0002	0.006	0.185	<0.01	<0.005	<0.02	0.02	<0.01	<0.2	0.2
<0.05	0.6	<0.05	<0.05	0.05	0.07	0.054	<0.005	<0.005	<0.005	<0.02	3.37	<0.02	<0.02	<0.0002	0.006	0.157	<0.01	<0.005	0.05	0.03	<0.01	<0.2	0.2
0.08	0.2	<0.05	<0.05	0.06	0.07	0.051	<0.005	<0.005	<0.005	0.03	1.26	<0.02	0.02	<0.0002	0.082	0.138	<0.01	<0.005	0.03	0.03	<0.01	<0.2	0.2
<0.05	0.08	0.05	0.05	0.05	0.08	0.044	<0.005	<0.005	<0.005	0.09	1.68	<0.02	<0.02	<0.0002	0.044	0.076	<0.01	<0.005	0.23	0.22	<0.01	<0.2	0.2
<0.05	0.09	<0.05	<0.05	0.08	0.09	0.057	<0.005	<0.005	0.005	0.26	0.58	<0.02	0.02	<0.0002	0.776	1.35	<0.01	<0.005	0.03	0.04	<0.01	<0.2	0.2

<0.05	0.05	<0.05	<0.05	0.08	0.11	0.028	<0.005	<0.005	<0.005	0.02		<0.02	<0.02	<0.0002	0.021	0.028	<0.01	<0.005	0.02	0.03	<0.01	<0.2	<0.5
<0.05	<0.05	<0.05	<0.05	0.13	0.13	0.023	<0.005	<0.005	<0.005	<0.02	0.39	<0.02	<0.02	<0.0002	<0.005	0.023	<0.01	<0.005	0.03	0.03	<0.01	<0.2	<0.2
<0.05	<0.05	0.05	0.05	0.10	0.20	0.046	<0.005	<0.005	<0.005	0.02	0.27	<0.02	<0.02	0.0002	0.068	0.068	<0.01	<0.005	0.03	0.03	<0.01	<0.2	<0.2
<0.05	<0.05	0.05	0.05	0.07	0.06	0.030	<0.005	<0.005	<0.005	0.24	0.35	<0.02	<0.02	<0.0002	0.098	0.090	<0.01	<0.005	0.08	0.02	<0.01	<0.2	0.2
<0.05	0.09	<0.05	0.05	0.07	0.07	0.036	<0.005	<0.005	<0.005	<0.02	0.54	<0.02	<0.02	<0.0002	<0.005	0.081	<0.01	<0.005	0.03	0.03	<0.01	<0.2	<0.2
											0.80					0.043							
<0.05	0.2	0.05	0.05	0.10	0.11	0.027	<0.005	<0.005	<0.005	<0.02	0.90	0.02	<0.02	<0.0002	0.041	0.101	<0.01	<0.005	0.04	0.03	<0.01	<0.2	<0.2
0.06	0.5	<0.05	<0.05	0.09	0.10	0.056	<0.005	<0.005	<0.005	<0.02	1.93	0.05	<0.02	<0.0002	0.005	0.099	<0.01	<0.005	0.02	<0.02	<0.01	<0.2	<0.1
<0.05	<0.05	<0.05	0.05	<0.05	<0.05	0.044	<0.005	0.010	<0.005	0.18	1.93	<0.02	<0.02	<0.0002	0.155	0.185	<0.01	<0.005	0.14	0.12	<0.01	0.5	<0.1
<0.05	0.6	0.05	0.07	0.05	0.05	0.029	<0.005	0.011	<0.005	0.03	3.74	<0.02	<0.02	<0.0002	<0.005	0.136	<0.01	<0.005	0.27	0.25	<0.01	<0.2	<0.2
											0.38					0.034							

<0.05		<0.001		0.22		0.11	<0.005	<0.01	<0.01	0.03		<0.02		<0.0002	0.02		<0.05	<0.02	<0.001		0.02	0.62	0.6
<0.05		<0.001		0.22		0.09	0.005	0.01	<0.01	0.24		<0.02		<0.0002	0.01		<0.05	<0.02	<0.002		<0.01	0.5	0.3
<0.05		<0.001		0.20		0.08	<.005	<0.01	<0.01	0.25		<0.02		<0.0002	0.02		<0.05	<0.02	<0.001		<0.01	0.45	0.3
<0.2	6.6	<0.25	0.05	0.65	0.71	0.090	<0.025	<0.025	<0.025	<0.10	14.4	<0.10	0.05	<0.0002	0.058	0.740	<0.05	<0.02	<0.10	0.03	<0.05		
<0.05	4.3	<0.05	0.05	0.28	0.30	0.065	<0.005	<0.005	<0.005	1.17	15.3	<0.02	0.03	<0.0002	0.651	0.805	<0.01	<0.005	0.02	0.04	<0.01	1.3	0.6
<0.05	1.0	<0.05	<0.05	0.25	0.27	0.013	<0.005	<0.005	<0-.005	<0.02	<0.02	<0.02	<0.02	<0.0002	0.685	0.714	<0.01	<0.005	0.02	0.03	<0.01	1.0	0.6
<0.05	0.1	0.05	<0.05	0.26	0.24	0.016	<0.005	<0.005	<0.005	7.27	7.62	<0.02	<0.02	<0.0002	0.633	0.584	<0.01	<0.005	0.04	0.02	<0.01	1.5	0.6
<0.05	0.5	0.06	0.05	0.22	0.24	0.017	<0.005	<0.005	<0.005	0.48	8.45	<0.02	<0.02	<0.0002	0.497	0.542	<0.01	<0.005	0.04	0.03	<0.01	1.4	0.5
<0.05	0.5	<0.05	<0.05	0.23	0.23	0.015	<0.005	<0.005	<0.005	0.06	8.48	0.04	<0.02	<0.0002	0.555	0.544	<0.01	<0.005	0.03	<0.02	<0.01	1.4	0.5
<0.05	<0.05	0.05	0.05	0.22	0.18	0.013	<0.005	0.010	<0.005	0.04	8.35	<0.02	<0.02	<0.0002	0.539	0.592	<0.01	0.008	0.15	0.13	<0.01	1.4	0.5
<0.05	0.3	0.08	0.09	0.23	0.25	0.014	<0.005	0.009	<0.005	0.61	8.59	<0.02	<0.02	<0.0002	0.481	0.54	<0.01	<0.005	0.28	0.28	<0.01	1.5	0.5
											9.39					0.594							

<0.05		0.004		0.09		0.02	<0.005	<0.01	<0.01	13.3		<0.02		<0.0002	0.35		<0.05	0.02	<0.001		0.01	0.27	0.5
0.11		0.003		0.09		0.02	<0.005	<0.01	<0.01	11.7		<0.02		<0.0002	0.37		<0.05	<0.02	<0.002		<0.02	0.25	0.2
<0.05		0.005		0.08		0.01	<0.005	<0.01	<0.01	11.9		<0.02		<0.0002	0.28		<0.05	<0.02	<0.001		0.01	0.33	0.2
<0.05	29.7	<0.05	0.10	0.11	0.12	0.013	<0.005	<0.005	<0.005	2.32	112	<0.02	0.23	<0.0002	0.099	2.99	<0.01	<0.005	0.04	0.03	<0.01	0.3	<0.5
<0.05	2.7	<0.05	0.05	0.10	0.11	0.011	<0.005	<0.005	<0.005	0.81	17.2	<0.02	0.02	<0.0002	0.099	0.151	<0.01	<0.005	0.04	0.04	<0.01	<0.2	0.3
<0.05	2.1	0.05	0.07	0.10	0.12	0.012	<0.005	<0.005	<0.005	0.25	20.3	0.02	<0.02	0.0002	0.085	,217	<0.01	<0.005	0.04	<0.02	<0.01	0.4	0.3
<0.05	1.1	0.06	0.06	0.08	0.09	0.011	<0.005	<0.005	<0.005	2.35	15.5	<0.02	<0.02	<0.0002	0.083	0.131	<0.01	<0.005	0.03	0.03	<0.01	<0.2	0.3
<0.05	0.2	<0.05	<0.05	0.09	0.11	0.011	<0.005	<0.005	<0.005	0.02	10.8	0.04	<0.02	<0.0002	0.102	0.114	<0.01	<0.005	0.03	0.02	<0.01	<0.2	0.3
0.6	0.2	0.05	0.05	0.08	0.12	0.015	<0.005	0.016	<0.005	2.77	12.2	<0.02	<0.02	0.0004	0.083	0.096	<0.01	0.008	0.15	0.10	<0.01	<0.2	0.3
<0.05	<0.05	0.07	0.08	0.06	0.07	0.010	<0.005	0.011	<0.005	0.45	8.69	<0.02	<0.02	<0.0002	0.098	0.110	<0.01	<0.005	0.27	0.29	<0.01	<0.2	0.3
											14.4					0.138								
<0.05	0.4	0.05	0.06	0.05	0.07	0.020	<0.005	<0.005	<0.005	6.98	12.9	<0.02	<0.02	0.0002	0.081	0.121	<0.01	<0.005	0.03	0.04	<0.01	0.5	0.3
<0.05	8.0	0.06	0.08	<0.05	<0.05	0.025	<0.005	<0.005	<0.005	<0.02	45.2	<0.02	0.05	<0.0002	0.076	0.641	<0.01	<0.005	0.03	0.03	<0.01	0.3	0.4
<0.05	5.0	<0.05	0.05	0.06	0.06	0.014	<0.005	<0.005	<0.005	0.37	42.2	0.04	0.03	<0.0002	0.060	0.480	<0.01	<0.005	<0.02	<0.02	<0.01	<0.2	0.3
<0.05	2.8	<0.05	0.07	<0.05	0.15	0.019	<0.005	0.012	<0.005	<0.02	32.3	<0.02	<0.02	<0.0002	0.068	0.400	<0.01	<0.005	0.16	0.07	<0.01	0.3	0.3
											64.5					0.757								
<0.05	0.2	0.05	0.05	0.14	0.16	0.028	<0.005	<0.005	<0.005	7.47	9.78	<0.02	<0.02	<0.0002	0.050	0.059	<0.01	<0.005	0.03	<0.02	<0.01	1.2	0.4
<0.05	16.9	0.05	0.07	0.12	0.14	0.026	<0.005	<0.005	<0.005	<0.02	47.0	<0.02	0.06	<0.0002	0.058	0.984	<0.01	<0.005	0.03	0.04	<0.01	1.0	0.5
<0.05	7.2	<0.05	<0.05	0.15	0.15	0.016	<0.005	<0.005	<0.005	0.03	34.3	0.05	0.02	<0.0002	0.043	0.427	<0.01	<0.005	0.02	0.02	<0.01	0.9	0.4
0.2	20.9	0.05	0.10	0.12	0.41	0.024	<0.005	0.015	<0.005	0.24	67.9	<0.02	0.02	<0.0002	0.044	1.47	<0.01	<0.005	0.13	0.03	<0.01	1.1	0.4
											54.5					0.408								
<0.05	39.1	<0.05	0.07	0.13	0.10	0.028	<0.005	<0.005	<0.005	<0.02	86.0	<0.02	0.18	<0.0002	0.011	4.22	<0.01	<0.005	0.04	0.02	<0.01	<0.2	<0.1
<0.05	7.6	0.05	0.07	0.10	0.11	0.025	<0.005	<0.005	<0.005	<0.02	28.5	<0.02	0.03	<0.0002	0.224	0.650	<0.01	<0.005	0.03	0.02	<0.01	<0.2	0.2
0.09	7.9	<0.05	<0.05	0.13	0.13	0.013	<0.005	<0.005	<0.005	0.04	39.4	0.03	<0.02	<0.0002	0.007	0.981	<0.01	<0.005	<0.02	0.03	<0.01	<0.2	0.2
0.4	10.0	<0.05	0.06	0.10	0.24	0.033	<0.005	0.006	<0.005	0.25	30.2	<0.02	<0.02	<0.0002	0.206	0.892	<0.01	0.006	0.12	0.08	<0.01	<0.2	0.2
											17.4					0.531								
<0.05	14.4	<0.05	0.08	0.07	0.07	0.021	<0.005	<0.005	<0.005	<0.02	46.6	<0.02	0.07	<0.0002	0.067	1.08	<0.01	<0.005	0.02	0.06	<0.01	<0.2	0.2
<0.05	5.1	0.05	0.07	0.09	0.10	0.018	<0.005	<0.005	<0.005	<0.02	20.4	0.02	0.03	<0.0002	0.150	0.465	<0.01	<0.005	0.04	0.04	<0.01	<0.2	0.3
0.09	2.5	<0.05	<0.05	0.11	0.11	0.020	<0.005	<0.005	<0.005	0.03	14.4	0.04	<0.02	<0.0002	0.236	0.485	<0.01	<0.005	0.02	0.02	<0.01	<0.2	0.3
0.2	10.4	<0.05	0.12	0.05	0.34	0.018	<0.005	0.009	<0.005	0.18	75.8	<0.02	<0.02	<0.0002	0.148	2.61	<0.01	<0.005	0.12	0.03	<0.01	<0.2	0.2
											7.11					0.220								

<0.05	8.6	<0.05	<0.05	0.12	0.13	0.022	<0.005	<0.005	<0.005	<0.02	27.4	0.04	0.04	<0.0002	<0.005	1.04	<0.01	<0.005	0.02	0.03	<0.01	<0.2	0.2
0.8	0.6	<0.05	<0.05	0.05	0.07	0.025	<0.005	0.009	<0.005	0.35	2.15	<0.02	<0.02	<0.0002	0.016	0.083	<0.01	<0.005	0.15	0.12	<0.01	<0.2	0.2
											16.1					0.427							
<0.05	0.8	0.05	0.05	0.09	0.06	0.022	<0.005	<0.005	<0.005	<0.02	21.5	<0.02	0.02	<0.0002	0.211	0.484	<0.01	<0.005	0.04	0.04	<0.01	0.3	0.2
											24.2					7.41							
											71.5					2.32							
<0.05	35.5	<0.05	0.08	0.12	0.11	0.023	<0.005	<0.005	<0.005	<0.02	37.5	<0.02	0.32	<0.0002	0.129	7.72	<0.01	<0.005	0.02	<0.02	<0.01	<0.2	<0.1
<0.05	37.5	<0.05	0.09	0.07	0.07	0.022	<0.005	<0.005	<0.005	<0.02	83.0	<0.02	0.18	<0.0002	0.226	4.75	<0.01	<0.005	0.02	0.02	<0.01	<0.2	0.6
0.09	23.8	<0.05	0.06	0.11	0.11	0.022	<0.005	<0.005	<0.005	0.02	77.0	0.02	0.09	<0.0002	0.184	3.18	<0.01	<0.005	0.03	0.03	<0.01	<0.2	0.5
1.0	10.8	<0.05	0.06	0.07	0.22	0.030	<0.005	0.009	<0.005	0.55	37.5	<0.02	<0.02	<0.0002	0.177	1.80	<0.01	<0.005	0.09	0.08	<0.01	<0.2	0.5
											67.4					3.95							
<0.05	0.3	0.06	0.06	0.25	0.24	0.017	<0.005	<0.005	<0.005	<0.02	10.6	<0.02	<0.02	<0.0002	2.09	2.22	<0.01	0.010	0.03	0.04	<0.01	0.8	0.2
<0.05	26.7	0.08	0.15	0.21	0.16	0.013	<0.005	<0.005	<0.005	<0.02	122	<0.02	0.15	<0.0002	1.74	4.76	<0.01	0.007	0.06	0.03	<0.01	0.5	<0.5
<0.05	8.6	<0.05	0.09	0.25	0.24	0.018	<0.005	<0.005	<0.005	0.02	78.5	0.03	0.05	<0.0002	1.38	2.13	<0.01	<0.005	0.04	0.04	<0.01	0.4	<0.5
											50.5					1.74							
<0.05	0.7	0.05	0.05	0.20	0.21	0.014	<0.005	<0.005	<0.005	<0.02	2.34	<0.02	<0.02	<0.0002	0.037	0.056	<0.01	<0.005	0.05	0.06	<0.01	<0.2	0.5
0.07	5.4	0.05	<0.05	0.23	0.25	0.024	<0.005	<0.005	<0.005	<0.02	14.9	<0.02	0.03	<0.0002	0.012	0.181	<0.01	<0.005	0.07	0.04	<0.01	<0.2	0.7
<0.05	25.9	0.07	0.15	0.15	0.55	0.036	<0.005	0.015	<0.005	0.05	106	<0.02	0.06	<0.0002	0.167	3.01	0.02	<0.005	0.18	<0.02	<0.01	2.4	0.4
0.8	10.6	<0.05	<0.05	0.17	0.12	0.028	<0.005	<0.005	<0.005	1.76	62.2	<0.02	<0.02	<0.0002	0.077	0.754	<0.01	<0.005	0.02	<0.02	<0.01	1.6	<0.5
											43.7					0.666							
<0.05	36.5	0.05	0.41	0.13	0.86	0.033	<0.005	0.010	<0.005	<0.02	211	<0.02	0.15	<0.0002	0.394	7.01	<0.01	0.007	0.15	<0.02	<0.01	0.3	0.4
0.04	7.6	<0.05	0.07	0.14	0.09	0.024	<0.005	<0.005	<0.005	0.32	42	<0.02	<0.02	<0.0002	0.528	0.933	<0.01	<0.005	0.02	<0.2	<0.01	<0.2	0.3
											23.4					0.562							
<0.05	18.3	0.06	0.09	0.92	1.05	0.007	<0.005	0.018	<0.005	0.03	26.1	<0.02	<0.02	<0.0002	0.190	0.898	<0.01	0.007	0.16	0.1	<0.01	<0.2	0.9
0.2	15.6	<0.05	<0.05	0.99	1.03	0.007	<0.005	<0.005	<0.005	0.02	18.7	<0.02	<0.02	<0.0002	0.188	0.705	<0.01	<0.005	0.04	<0.02	<0.01	<0.2	0.9

Table B-3. Piezometer well details.

Well ID	Date constructed	Drilled for*	Elevation (feet asl)	Stick-up (feet aprox.)	Tot. Depth (feet bgs)	Screened interval (feet bgs)	Gravel-zone (feet)	Borehole diameter	Drilling method	Well casing diameter/type	Screened Formation
NLP-1	28-Nov-12	ACD	6920.23	0.3	20.0	10.0 - 20.0	8.0 - 20.0	2.5-inch	Direct push	1- inch PVC	Quaternary Alluvium
NLP-2	28-Nov-12	ACD	6910.39	0.3	24.0	14.0 - 24.0	12.0 - 24.0	2.5-inch	Direct push	1- inch PVC	Quaternary Alluvium
NLP-3	28-Nov-12	ACD	6917.98	0.3	30.0	20.0 - 30.0	17.4 - 30.0	2.5-inch	Direct push	1- inch PVC	Quaternary Alluvium
NLP-4	28-Nov-12	ACD	6871.86	0.5	8.0	3.0 - 8.0	2.0 - 8.0	2.5-inch	Direct push	1- inch PVC	Quaternary Alluvium
NLP-5	28-Nov-12	ACD	6921.45	0.5	10.0	5.0 - 10.0	3.0 - 10.0	2.5-inch	Direct push	1- inch PVC	Quaternary Alluvium
NLP-6	29-Nov-12	ACD	6957.29	0.2	20.0	10.0 - 20.0	8.0 - 20.0	2.5-inch	Direct push	1- inch PVC	Quaternary Alluvium
NLP-7	29-Nov-12	ACD	6946.76	0.5	26.0	16.0 - 26.0	12.0 - 26.0	2.5-inch	Direct push	1- inch PVC	Quaternary Alluvium
NLP-8	29-Nov-12	ACD	6980.54	0.2	20.0	10.0 - 20.0	8.0 - 20.8	2.5-inch	Direct push	1- inch PVC	Quaternary Alluvium
NLP-9	30-Nov-12	ACD	6951.01	0.5	24.0	14.0 - 24.0	12.0 - 24.0	2.5-inch	Direct push	1- inch PVC	Quaternary Alluvium
NLP-10	12-Nov-13	ACD	6902.62	0.3	28.0	18.0 - 28.0	17.0 - 28.0	2.5-inch	Direct push	1- inch PVC	Quaternary Alluvium
NLP-11	13-Nov-13	ACD	6862.71	0.3	29.0	19.0 - 29.0	19.0 - 29.0	2.5-inch	Direct push	1- inch PVC	Quaternary Alluvium
NLP-12	13-Nov-13	ACD	6848.57	0.5	23.5	13.5 - 23.5	12.5 - 23.5	2.5-inch	Direct push	1- inch PVC	Quaternary Alluvium
Y-103 (A6)	11-Nov-86	UII	6919.8	2.9	77.81	17-9 - 77.8	4.6 - 77.96	5.875-inch	Rotary	2-inch PVC	Quaternary Alluvium
Y-70 (PDH7)	20-Nov-85	UII	6900.0	2.6	97.0	72.0 - 87.0		5.625-inch to 60 ft. 3.0-inch to 97 ft.	Rotary/core w/wat. inj.	2-inch PVC	Smirl Coal Seam

*ACD - Alton Coal Development, LLC
UII - Utah International, Inc.

Appendix C

Vegetation Site Photos

Figure 1: Sample Site V-01

Figure 2: Sample Site V-02

Figure 3: Sample Site V-03

Figure 4: Sample Site V-04

Figure 5: Sample Site V-05

Figure 6: Sample Site V-06

Figure 7: Sample Site V-07

Figure 8: Sample Site V-08

Figure 9: Sample Site V-09

Figure 10: Sample Site V-10

Figure 11: Sample Site V-11

Figure 12: Sample Site V-12

Figure 13: Sample Site V-13

Figure 14: Sample Site V-14

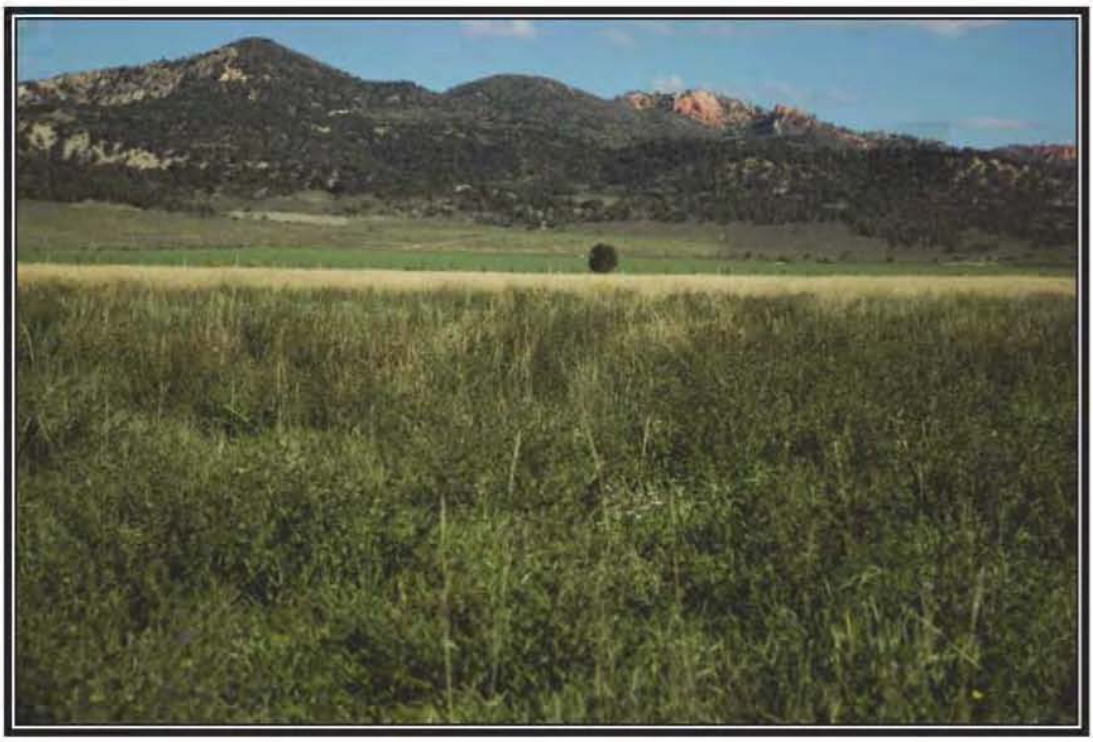


Figure 15: Sample Site V-15

Figure 16: Sample Site V-16

Figure 17: Sample Site V-17

Figure 18: Sample Site V-18

Figure 19: Sample Site V-19

Figure 20: Sample Site V-20

Figure 21: Sample Site V-21

Appendix D

Soil Survey Methods

Supplemental Soils Information

The following summary of soils data collected as part of the order 2 soil survey in the North Private Lease area is provided as an enhancement to soils information discussed within the AVF report.

Order 2 Soil Survey

An order 2 soil survey was conducted within the boundaries of the North Private Lease area during 2012 through 2014 (Long 2014). This soil survey was made in accordance with the guidelines for an order II soil survey as detailed in the *Soil Survey Manual* (USDA NRCS 1993) and *National Soil Survey Handbook* (2014b). Soils were classified using the *Keys to Soil Taxonomy, Eleventh Edition* (USDA NRCS 2010). The dominant soil Great Groups identified in the North Private soil survey area are Calciustepts, Haplustalfs, Haplusterts, Endoaquepts, Ustifluvents, and Ustorthents.

Evaluation of Soils

Soils were examined, described, and sampled in hand dug pits (6), cutbanks (3), backhoe (2), and hydraulic push probe tubes (58), soils map 1. Ten of the push probe locations were outside the soil survey boundary. Soil samples were collected in July/August 2012, October 2012, November 2012, November 2013, and April 2014.

Soil characteristics normally seen in backhoe pits or cutbanks were also observed when the push probe tube liners were opened. These soil characteristics included: horizons; soil structure; dry and moist consistence; ped surface features (clay films, slickensides, and carbonate coats); root size and density; pore size and density; concentrations (secondary carbonates); rock fragment size, amount, shape, roundness, and kind; and qualitative soil moisture estimates. Soil horizon boundary descriptions were limited to vertical descriptions (abrupt, clear, gradual, and diffuse) for the push tubes.

Soil Profile Descriptions

Soil profile descriptions were completed for each soil sample location. This occurred in the field for the hand dug pits, cutbanks, and backhoe pits when they were sampled. Push probe holes were analyzed and described when the push tubes were opened in the office. Soil colors (Munsell 2012) were evaluated in the office under natural lighting using the profile box samples collected for each location. Soil *Pedon Description Forms* (USDA - NRCS 1997) were completed for each soil pit using the methods detailed in the *Field Book for Describing and Sampling Soils*, version 3.0 (Schoeneberger et. al., 2012). All soil descriptions were completed by Robert E. Long, Certified Professional Soil Scientist. Soil profile descriptions are in

Appendix B of the *North Private Lease Soil Survey Report* (Long 2014). Site photos of each soil sample location are in Appendix D of the *North Private Lease Soil Survey Report* (Long 2014).

Soil samples of each horizon were collected in new gallon size plastic freezer bags and in micromonolith boxes. The sealed sample bags were shipped to Inter Mountain Laboratory in Sheridan, Wyoming for analysis. The box samples were used for further examination of soil profile characteristics and retained as a record of each soil profile. Photos of the soil profile boxes are in Appendix E of the *North Private Lease Soil Survey Report* (Long 2014).

Analysis of Soil Samples

Soil samples (430) from 69 representative soil profiles collected by soil horizon from within or immediately adjacent to the North Private Lease soil survey area were submitted for chemical and physical analysis.

Soil samples were analyzed for the parameters outlined by the Utah Division of Oil Gas and Mining's (DOGM) *Guidelines for Management of Topsoil and Overburden* (DOGM, 2005) along with additional parameters deemed necessary for this study, soils table 1.

Soils Table 1. Soil analysis parameters for topsoil and overburden (Utah DOGM, 2005).

Parameter	Unit	Full Analysis	Short Analysis	Limited Analysis
Paste pH	s.u.	X[1]	X[1]	X[1]
Saturation percent	%	X[1]	X[1]	
Electrical Conductivity (ECe)	dS/m	X[1]	X[1]	X[1]
Moisture percent	%	X[1]	X[1]	
Field Capacity	%	X	X	
Wilting Point	%	X	X	
Organic Matter Percent	%	X[1]	X[1]	X[1]
Soluble Na, K, Mg, and Ca	meq/l	X[1]	X[1]	X[1]
Sodium Adsorption Ratio		X[1]	X[1]	X[1]
Particle Size Analysis (report very fine sand, sand, silt, and clay)	%	X[1]	X[1]	X[1]
Boron, available		X[2]	X[2]	
Nitrate (as N)		X	X	
CaCO3 Percent	%	X[1]	X[1]	X[1]
Phosphorus, available	ppm	X	X[3]	
Selenium, available	ppm	X[2]	X[2]	X[2]
Total Organic Carbon	%	X[1]	X[1]	X[1]
Acid Base Potential	Tons/Kton	X[2]		
Arsenic, Total	mg/kg	X		
Barium, total	mg/kg	X		
Cadmium, total	mg/kg	X		
Chromium, total	mg/kg	X		
Copper, total	mg/kg	X		
Iron, total	mg/kg	X		
Lead, total	mg/kg	X		
Manganese, total	mg/kg	X		
Molybdenum, total	mg/kg	X		
Selenium, total	mg/kg	X		
Silver, total	mg/kg	X		
Zinc, total	mg/kg	X		
Bulk Density	g/cm^3	X		
Coarse Fragments, >2mm	%	As deemed necessary for the sample		
K factor calculation		X	X[4]	X[4]

1. Parameter listed in *Guidelines for Management of Topsoil and Overburden*, Table 4 for soil suitability evaluation (Utah DOGM 2005).
2. Parameter listed in *Guidelines for Management of Topsoil and Overburden*, Table 8 for substitute topsoil and overburden (Utah DOGM 2005).
3. Available phosphorus was not analyzed on all medium list samples.
4. K factors were calculated for medium and short list samples when the necessary data was available.

Soil Families

The order 2 soil survey identified 15 distinct soil families within the North Private Lease (Long 2014). The taxonomic classification of these soil families is listed in soils table 2. The soil families were delineated on the soils map in twelve soil map units based on soil types, slope, and physiographic setting, soils table 3. The order 2 soil survey is shown in soils map 2.

Soils Table 2. Taxonomic classification and parent material for soils in the North Private Lease.

Soil Family	Taxonomic Classification	Parent Material[2]
AAA[1]	Aridic Haplustepts fine-loamy, carbonatic, mesic	Alluvium
Atlatl	Aridic Calciustepts coarse-loamy, carbonatic, mesic	Alluvium
BBB[1]	Aridic Calciustepts fine-loamy, carbonatic, mesic	Alluvium
Bobknoll	Aridic Calciustepts coarse-loamy, mixed, superactive, mesic	Slope Alluvium
Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic	Slope Alluvium
Brumley	Calcidic Haplustalfs fine-loamy, mixed, superactive, mesic	Residuum & Colluvium
CCC[1]	Aridic Calciustepts fine, carbonatic, mesic	Alluvium
DDD[1]	Oxyaquic Ustifluvent sandy-skeletal, carbonatic, mesic	Alluvium
Flugle	Aridic Haplustalfs fine-loamy, mixed, superactive, mesic	Residuum & Colluvium
Quezcan	Aridic Ustorthent fine, smectitic, superactive, mesic	Residuum
Sideshow	Aridic Haplusterts fine, smectitic, mesic	Residuum & Colluvium
Sideslide	Typic Endoaquepts fine-loamy, mixed, superactive, mesic	Alluvium
Teromote	Aridic Haplustepts fine-loamy, mixed, superactive, mesic	Colluvium
Vessilla	Aridic Lithic Ustorthents loamy, mixed, calcareous, active, mesic	Residuum
Wimmer	Aridic Calciustepts fine-loamy, mixed, superactive, mesic	Slope Alluvium

1. No soil series have been established in this taxonomic family.
2. Dominant parent material source.

Physiographic settings within the North Private Lease soil survey included terrace remnants, hills, alluvial fans, fan aprons, structural benches, floodplains, and stream terraces (USDA NRCS 2008). Parent material sources had a significant impact on soil development, soils map 3. Fine textured soils developed in slope alluvium and residuum from tropic shale dominated the hillslopes and upper portions of the alluvial fans. Fine-loamy soils with argillic, cambic, and calcic horizons occur on the lower portions of the alluvial fans. Shallow to moderately deep soils developed from Tropic shale and sandstone dominate the structural bench area. Active floodplains and stream terraces are dominated by aquic soils that formed in carbonatic alluvium.

Carbonatic soils (greater than 40 percent calcium carbonate equivalent) dominate on the terrace remnants, soils map 4.

Soils Table 3. Soil map unit composition in the North Private Lease.

Map Unit Symbol	Pct	Map Unit Soil Family	Taxonomic Classification	Physiographic Setting[1]
A1		**Sideshow family, 0-4% slopes**		
	85	Sideshow	Aridic Haplusterts fine, smectitic, mesic	Concave Footslopes
	10	Teremote	Aridic Haplustepts fine-loamy, mixed, super, mesic	Convex Hillslopes
	5	Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic	Concave Toeslopes
A2		**Sideshow - Teromote families, 4 to 8% slopes**		
	50	Sideshow	Aridic Haplusterts fine, smectitic, mesic	Hillslopes
	35	Teromote	Aridic Haplustepts fine-loamy, mixed, super, mesic	Convex Hillslopes
	10	Wimmer	Aridic Calciustepts fine-loamy, mixed, super, mesic	Toeslopes
	5	Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic	Concave Toeslopes
A3		**Sideshow family, 8 to 18% slopes**		
	80	Sideshow	Aridic Haplusterts fine, smectitic, mesic	Convex Hillslopes
	10	Teremote	Aridic Haplustepts fine-loamy, mixed, super, mesic	Linear Hillslopes
	7	Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic	Concave Toeslopes
	3	Quezcan	Aridic Ustorthent fine, smectitic, super, mesic	Convex Ridges
B		**Flugle - Brumley families, 8 to 15% slopes**		
	60	Flugle	Aridic Haplustalfs fine-loamy, mixed, supere, mesic	Structural Benches
	30	Brumley	Calcidic Haplustalfs fine-loamy, mixed, super, mesic	Hillslopes
	10	Bobknoll	Aridic Calciustepts coarse-loamy, mixed, super, mesic	Toeslopes
C		**Quezcan family - Vesilla family - Rock Outcrop, 20 to 45% slopes**		
	50	Quezcan	Aridic Ustorthent fine, smectitic, superactive, mesic	Structural Benches
	30	Vesilla	Aridic Lithic Ustorthents loamy, mix, calcs, act, mesic	Structural Benches
	15	Rock Outcrop		Ridges
	5	Brumley	Calcidic Haplustalfs fine-loamy, mixed, supere, mesic	Swales
D		**Wimmer - Teromote - Bobknoll families, 2 to 8% slopes**		
	50	Wimmer	Aridic Calciustepts fine-loamy, mixed, super, mesic	Toe of Alluvial Fans
	25	Teromote	Aridic Haplustepts fine-loamy, mixed, supere, mesic	Alluvial Fans
	15	Bobknoll	Aridic Calciustepts coarse-loamy, mixed, super, mesic	Terrace Remnants
	10	Flugle	Aridic Haplustalfs fine-loamy, mixed, super, mesic	Terrace Remnant

Map Unit Symbol	Pct	Map Unit Soil Family	Taxonomic Classification	Physiographic Setting[1]
E		**Atlatl - CCC families, 0 to 4% slopes**		
	45	Atlatl	Aridic Calciustepts coarse-loamy, carbonatic, mesic	Terrace Remnants
	40	CCC	Aridic Haplustepts fine-loamy, carbonatic, mesic	Terrace Remnants
	10	Bobknoll	Aridic Calciustepts coarse-loamy, mixed, super, mesic	Terrace Remnants
	5	Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic	Terrace Remnants
F		**Boxcanyon family, 0 to 4% slopes**		
	85	Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic	Alluvial Fans
	10	Wimmer	Aridic Calciustepts fine-loamy, mixed, super, mesic	Toe of Alluvial fans
	5	Bobknoll	Aridic Calciustepts coarse-loamy, mixed, super, mesic	Terrace Remnants
G		**AAA family, 0 to 5% slopes**		
	75	AAA	Aridic Haplustepts fine-loamy, carbonatic, mesic	Terrace Remnants
	10	BBB	Aridic Calciustepts fine-loamy, carbonatic, mesic	Terrace Remnants
	10	CCC	Aridic Calciustepts fine, carbonatic, mesic	Terrace Remnants
	5	Atlatl	Aridic Calciustepts coarse-loamy, carbonatic, mesic	Terrace Remnants
H		**BBB - Atlatl families, 15 to 70% slopes**		
	75	BBB	Aridic Calciustepts fine-loamy, carbonatic, mesic	Valley sideslopes
	20	Atlatl	Aridic Calciustepts coarse-loamy, carbonatic, mesic	Valley sideslopes
	5	AAA	Aridic Haplustepts fine-loamy, carbonatic, mesic	Toeslopes
J		**Sideslide - DDD families, 4 to 12% slopes**		
	50	Sideslide	Typic Endoaquepts fine-loamy, mixed, mesic	Floodplain
	40	DDD	Oxyaquic Ustifluvent sandy-skeletal, carbonatic, mesic	Stream Terrace
	10	Teromote	Aridic Haplustepts fine-loamy, mixed, super, mesic	Alluvial fans
K		**BBB family, 15 to 70% slopes**		
	80	BBB	Aridic Calciustepts fine-loamy, carbonatic, mesic	Hillslopes
	10	Quezcan	Aridic Ustorthent fine, smectitic, superactive, mesic	Arroyo sideslopes
	10	Sideshow	Aridic Haplusterts fine, smectitic, mesic	Hillslopes
P		**Pond**		

1. Dominant physiographic setting.

Soil Limiting Features

Determination of *Good, Fair, Poor, or Unacceptable* for topsoil, subsoil, and overburden is based on the *Guidelines for Management of Topsoil and Overburden* (Utah DOGM 2005).

Available Water Capacity

The available water capacity (AWC) was determined in the laboratory with pressure plates at field capacity (1/3 atmosphere) and wilting point (15 atmosphere). The difference between the two test results is the available water capacity.

AWC ranges from fair to poor in most of the soil horizons. Soil horizons with poor AWC are primarily associated with clay, silty clay, and loamy sand soil textures.

Calcium Carbonate

The calcium carbonate equivalent was analyzed by the laboratory and reported as percent carbonate. Calcium carbonate levels ranged from less than 1 percent to as high as 76 percent. Measured calcium carbonate is greater than 30 percent in at least one soil horizon within 150 cm (5 feet) of the soil surface at 35 of the 69 soil profile locations. Soils with greater than 30 percent calcium carbonate are considered *Poor* in the *Guidelines for Topsoil and Overburden Management* (Utah DOGM 2005).

Calcium carbonate levels correlate with parent material and physiographic setting. Soils that developed in alluvium from limestone and sandstone on terrace remnants have calcium carbonate levels greater than 30 percent in at least one soil horizon within 150 cm (5 feet)of the soil surface. Alluvial fan soils developed in mixed slope alluvium and colluvium with Tropic shale and sandstone as their primary source and typically have calcium carbonate levels ranging from 10 to approximately 25 percent. Soils that have developed directly from the Tropic shale have low amounts of calcium carbonate.

Soil calcium carbonate levels were greater than 30 percent on the surface at 14 soil profile locations. Ten of these profiles had greater than 40 percent calcium carbonate at the surface. These conditions are typically associated with poor vegetative cover in the North Private Lease soil survey area. Soils table 4 lists the soil families with calcium carbonate limitations.

Soils Table 4. Calcium carbonate conditions for soil families in the North Private Lease soil survey.

Soil Family	Taxonomic Classification	Calcium Carbonate Equivalent > 30% in Upper 150 cm	Calcium Carbonate Equivalent > 40% in Upper 150 cm
AAA	Aridic Haplustepts fine-loamy, carbonatic, mesic	Yes	Yes
Atlatl	Aridic Calciustepts coarse-loamy, carbonatic, mesic	Yes	Yes
BBB	Aridic Calciustepts fine-loamy, carbonatic, mesic	Yes	Yes
Bobknoll	Aridic Calciustepts coarse-loamy, mixed, superactive, mesic	Yes	Yes
Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic	Yes	Yes
Brumley	Calcidic Haplustalfs fine-loamy, mixed, superactive, mesic		
CCC	Aridic Calciustepts fine, carbonatic, mesic	Yes	Yes
DDD	Oxyaquic Ustifluvent sandy-skeletal, carbonatic, mesic	Yes	Yes
Flugle	Aridic Haplustalfs fine-loamy, mixed, superactive, mesic		
Quezcan	Aridic Ustorthent fine, smectitic, superactive, mesic		
Sideshow	Aridic Haplusterts fine, smectitic, mesic		
Sideslide	Typic Endoaquepts fine-loamy, mixed, superactive, mesic	Yes	Yes
Teromote	Aridic Haplustepts fine-loamy, mixed, superactive, mesic		
Vessilla	Aridic Lithic Ustorthents loamy, mixed, calcareous, active, mesic		
Wimmer	Aridic Calciustepts fine-loamy, mixed, superactive, mesic	Yes	

Calcium carbonate contributes to plant nutrient deficiencies. The availability of phosphorus is reduced by the formation of insoluble Ca and Mg phosphates. "Iron, Zn, Mn, and Cu deficiencies are common in soils that have high calcium carbonate due to reduced solubility at alkaline pH values (Imas 2014).

K factor

The K factor is an estimate of the potential erodibility of a soil by water. Soils with a K factor greater than 0.37 are considered Poor and have an increased potential of being eroded by water (Utah DOGM 2005). Soils with K factors greater than 0.37 were of limited amount in the North Private Lease soil survey area.

Permeability

Very slow permeability is a limiting factor in the Sideshow and Quezcan soil families. Soil permeability estimates were derived from estimates of the saturated hydraulic conductivity, K_{sat}. The K_{sat} estimates were obtained from soil textural triangles in the *Guide for Estimating Ksat from Soil Properties* in section 618.88 of the National Soil Survey Handbook (USDA NRCS 2014c). The lab analysis percents sand, silt, and clay were used to estimate K_{sat}.

Salinity

Soil salinity is not a significant problem in the North Private Lease soil survey area. Conductivities of 4 to 8 dS/m occur in the lower subsoil of the Sideshow family which develops from Tropic shale. A soil conductivity of 10.9 dS/m was measured in a Tropic shale bedrock sample at soil profile location 12AS015.

Soil profile 12AS029 is a Boxcanyon family soil with conductivities of 4.81 to 5.24 dS/m at a depth of 232 to 500 cm (7.6 to 16.4 feet) below the surface. Weathered Tropic sandstone is present at 334 to 500 cm (11.0 to 16.4 feet) and strongly weathered Tropic shale is present at (16.4 feet) in this soil profile.

Sodicity

Sodium concentrations are not a significant problem in the North Private Lease soil survey area. Sodium adsorption ratios (SAR) levels were generally 4 or less for most of the soil horizons. The SAR increases to 5 to 10 in the lower subsoil of soils that developed from Tropic shale (Sideshow family) and in soils with high water tables along Kanab Creek.

The maximum measured SAR was 10.3. This SAR was detected at the bottom of two Sideshow family soil profiles w developed from Tropic shale residuum.

Soil pH

The soil pH is neutral to very strongly alkaline in the North Private Lease soil survey area. The pH measurements ranged from 6.9 to 9.4.

Soil pH has a direct effect on plant growth and development. Alfalfa and small grain production does well when the soil pH is between 5.7 and 8.1, but nutrient deficiency and growth reduction occur beyond this range (Gale et. al. 2001). Alfalfa seedlings establish and develop rapidly when the soil pH range is 6.5 to 7.0 (Dixon et. al. 2005). Research in Idaho, Oregon, and Washington has determined that 7.0 is the ideal soil pH for alfalfa with a tolerance range of 6.0 to 8.2 (Koenig et. al. 2009). The Alfalfa and Forage Systems Workgroup determined the ideal soil pH

range to be 6.3 to 7.5 for alfalfa and that values greater than 8.2 are often associated with unproductive sites (Orloff 2007). High soil pH can contribute to reduced nutrient availability (Imas 2014).

Atlatl, CCC, and DDD families have soil pH greater than 8.4 in at least one horizon above 100 cm (3.28 feet) and the AAA and Bobknoll have soil pH greater than 8.4 in at least one horizon between 100 and 150 cm (5 feet). The upper soil pH limit for Prime Farmland soils is no horizons with greater than 8.4 within 100 cm (3.28 feet) of the surface (Grow 2014). Atlatl and CCC families are the major soils in map unit E.

DDD family soils have soil pH greater 9.0 at the surface and are the dominant soil in map unit J.

A soil pH of 5.3 was measured in weathered Tropic shale at soil profile location 12AS017. This was the only pH less than 6.9 identified in the soil survey area.

Appendix E

NRCS Prime Farmland Determination

United States Department of Agriculture

NRCS
Natural Resources Conservation Service
125 South State Street, Room 4402
Salt Lake City, UT 84138-1100
(801) 524-4550
FAX (801) 524-4403

December 5, 2012

Larry Johnson
Alton Coal Development LLC
463 N. 100 W. Suite 1
Cedar City, UT 84720

RE: Prime Farmland Status

Dear Mr. Johnson:

Please find attached Farmland Conversion Impact Rating (AD-1006), Farmland Classification Report, and Hydric Soil Rating for the proposed project in Kane County, Utah.

The proposed Alton coal mining lease Project will impact important farmland resources in Utah. Soil map units affected by this proposed project include 1111 – Naplene-Termote-Arboles-Oxyaquic Ustifluvent complex, 2 to 8 percent slopes and 1113 – Flugle-Termote-Plumasano complex, 2 to 15 percent slopes. Soil map units 1111 and 1113 are considered Prime Farmland, if irrigated. Based on the most current imagery available and the Southwest Regional Gap Analysis Project (SWReGAP) it was determined that this soil is being irrigated or that there is a reliable water source. The term "irrigated" means that there is an irrigation water supply that is dependable and of adequate quality. Based on project site information provided, approximately 292 acres of soil map unit 1111 will be converted.

The Soil Survey of Kane County Area, Utah does indicate the presence of hydric soils in the project area. The third component of map unit 1111 is on flood plains, is frequently flooded and has sedges on the plant list. However, on-site verification is necessary to establish the existence, size, shape, and type of wetlands. The NRCS cannot perform wetland determinations unless it is in support of USDA farm programs.

The U.S. Army Corps of Engineers administers the Section 404 program governing the discharge of dredge and fill material into waters in the U.S. as defined and guided by Section 404 of the Clean Water Act. The wetlands which fall within the Section 404 regulation are referred to as jurisdictional wetlands.

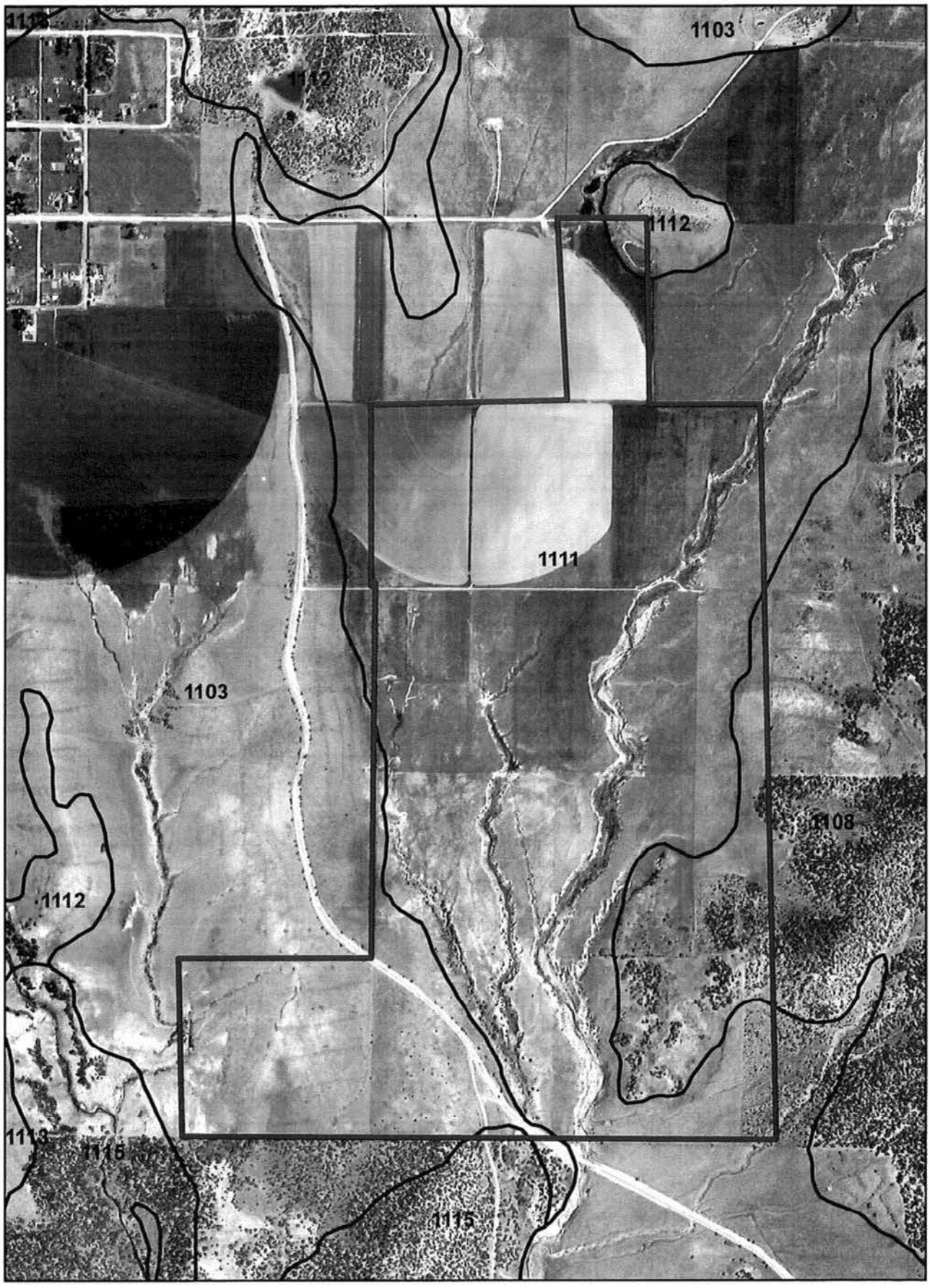
I hope you find this information helpful. Please don't hesitate to call (801.524.4574) or email (mike.domeier@ut.usda.gov) with any further questions.

Sincerely,

Mike Domeier
State Soil Scientist, NRCS, Utah

Enclosure: Form AD-1006, Farmland Classification Report, and Hydric Soil Rating for project area

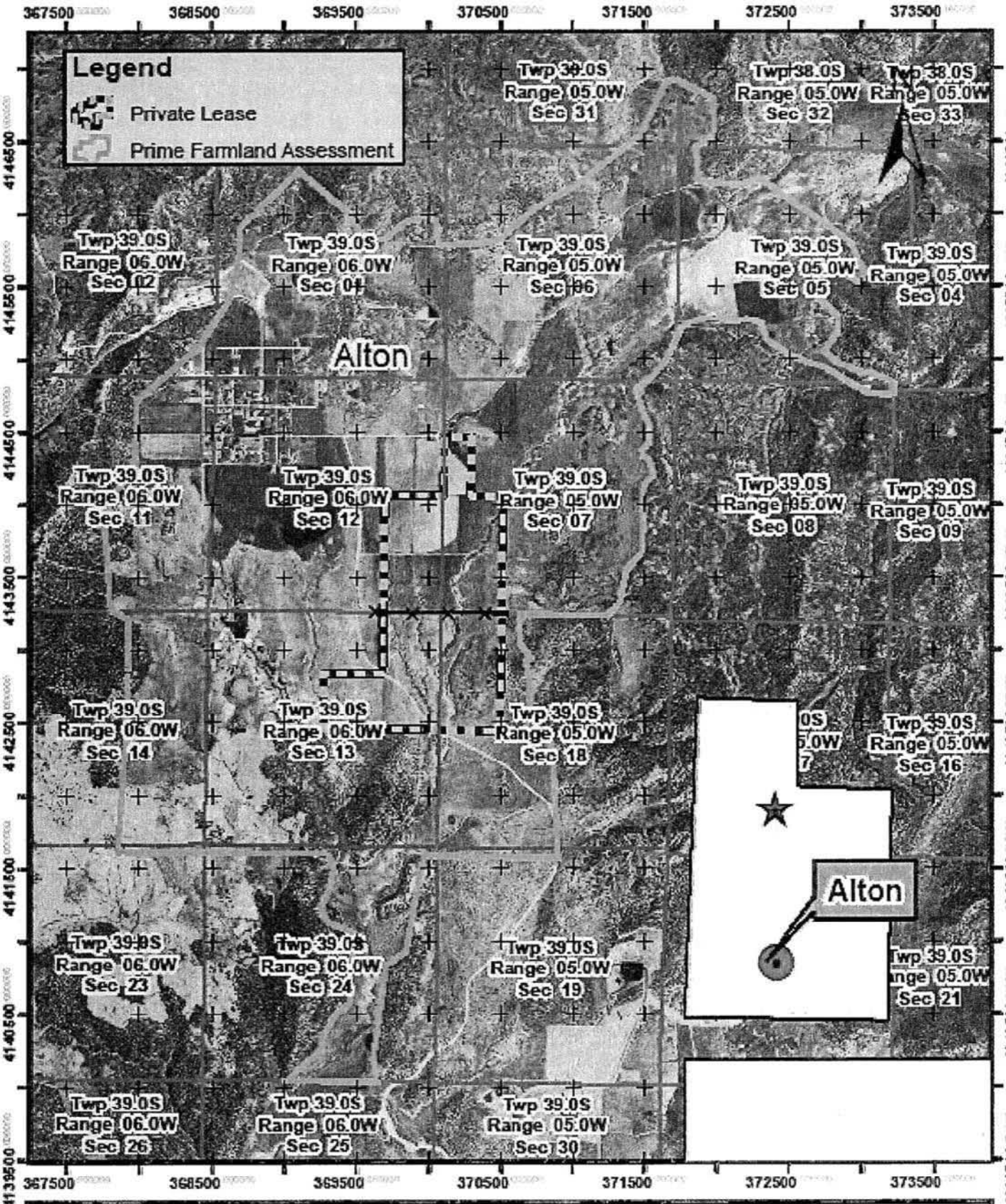
Alton Coal Lease



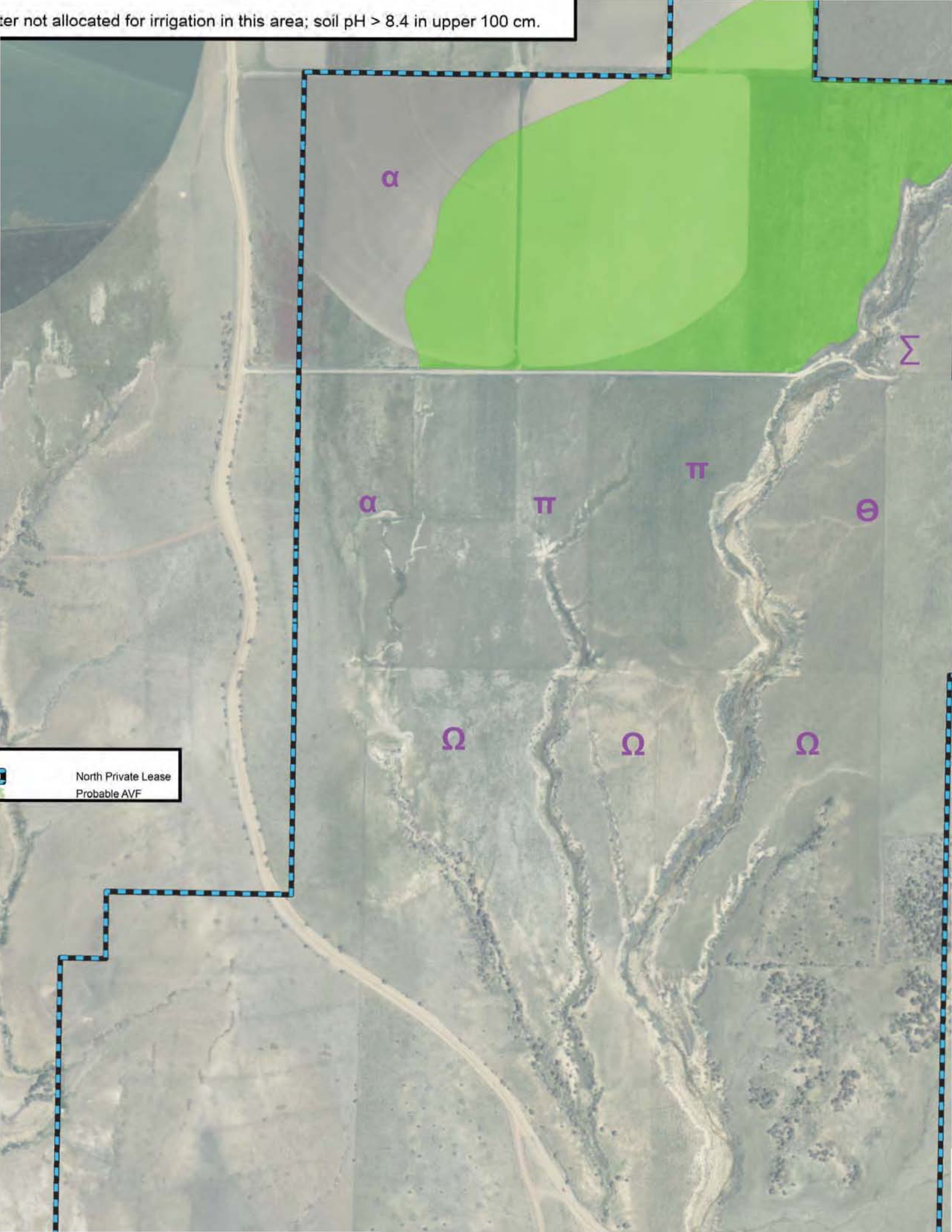
0 400 800 1,600 2,400 3,200 Feet

1:12,000

1 inch = 1,000 feet



Alton Coal - Private Lease Area	Location Map
Alton Coal Development 463 N 100 W Cedar City, Utah	General Location of Private Lease Area southeast of Alton, Utah
	Coordinate System: UTM, NAD 1983, Zone 12 North
	Alton, Utah USGS 7.5' Topographic Map — 1 inch = 3,000 feet
	October 9, 2012 — 0 750 1,500 3,000 4,500 6,000 Feet


ter not allocated for irrigation in this area; soil pH > 8.4 in upper 100 cm.
α
Σ
α
π
π
Θ
Ω
Ω
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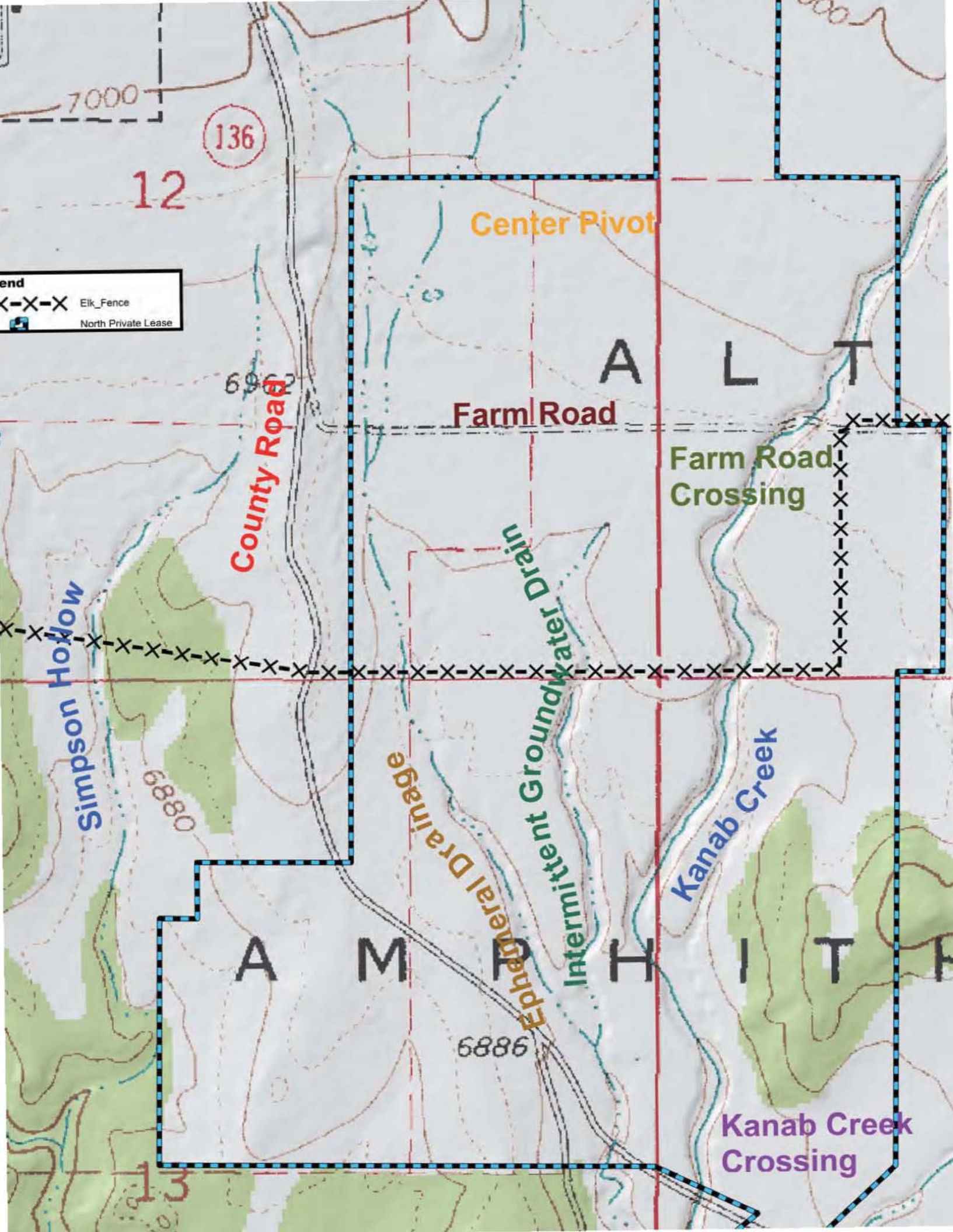
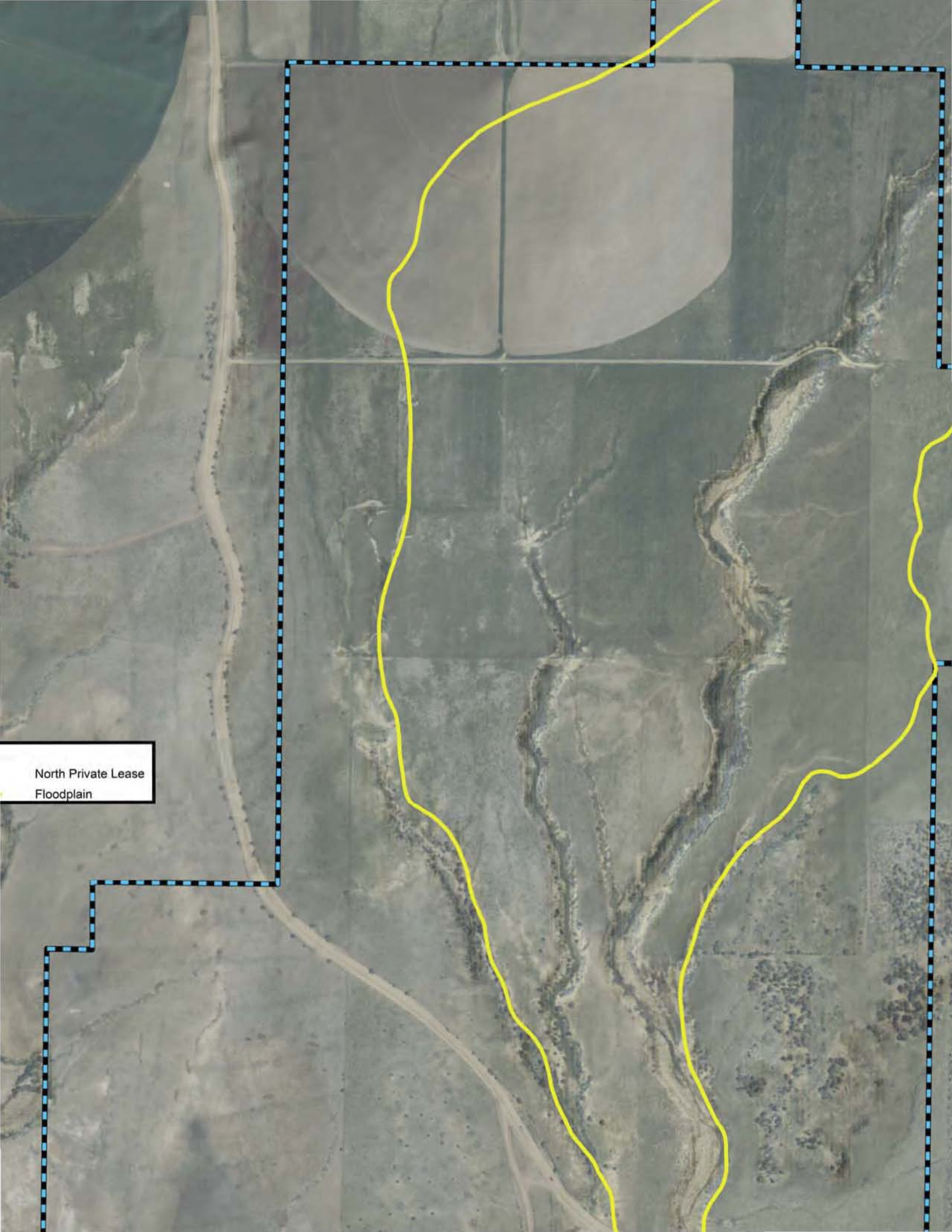
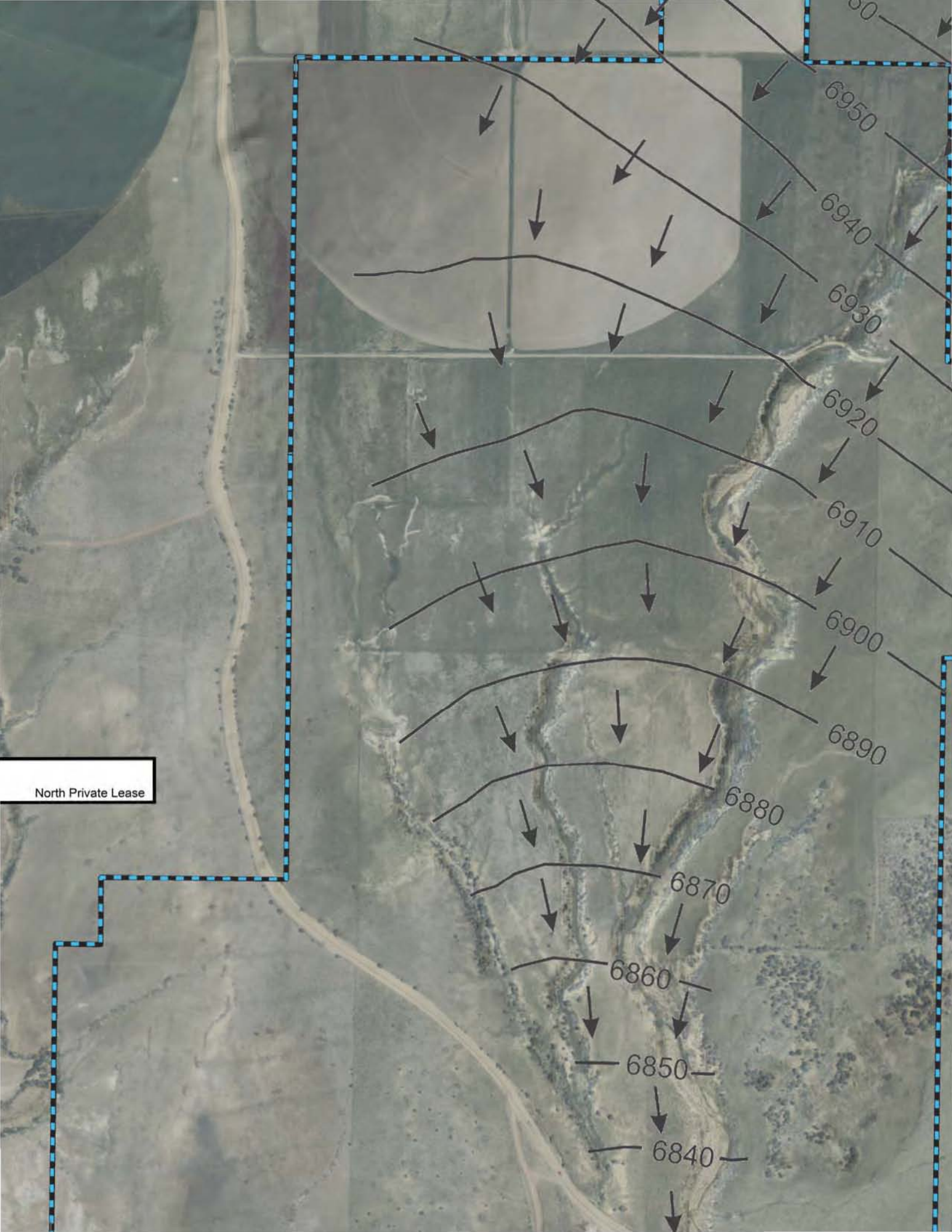
North Private Lease
Probable AVF


1000
136
12
Center Pivot
end
Elk_Fence
North Private Lease
A L T
6962
County Road
Farm Road
Farm Road
Crossing
Simpson Hollow
6880
Ephemeral Drainage
Intermittent Groundwater Drain
Kanab Creek
A M P H I T
6886
Kanab Creek
Crossing
13


North Private Lease
Floodplain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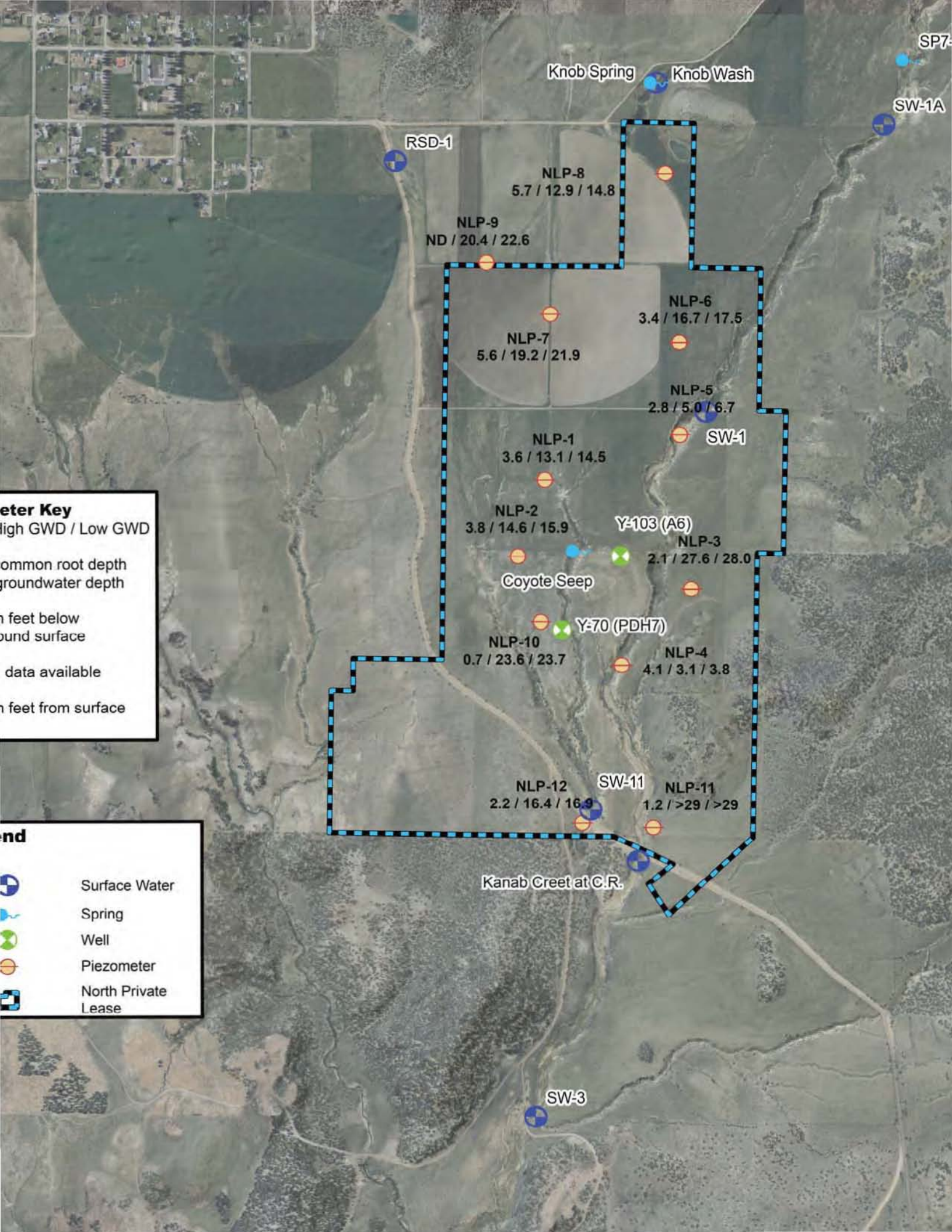
North Private Lease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Knob Spring
Knob Wash
SW-1A
RSD-1
NLP-8
5.7 / 12.9 / 14.8
NLP-9
ND / 20.4 / 22.6
NLP-6
3.4 / 16.7 / 17.5
NLP-7
5.6 / 19.2 / 21.9
NLP-5
2.8 / 5.0 / 6.7
SW-1
NLP-1
3.6 / 13.1 / 14.5
NLP-2
3.8 / 14.6 / 15.9
Y-103 (A6)
NLP-3
2.1 / 27.6 / 28.0
Coyote Seep
Y-70 (PDH7)
NLP-10
0.7 / 23.6 / 23.7
NLP-4
4.1 / 3.1 / 3.8
SW-11
NLP-12
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Kanab Creet at C.R.
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Surface Water
Spring
Well
Piezometer
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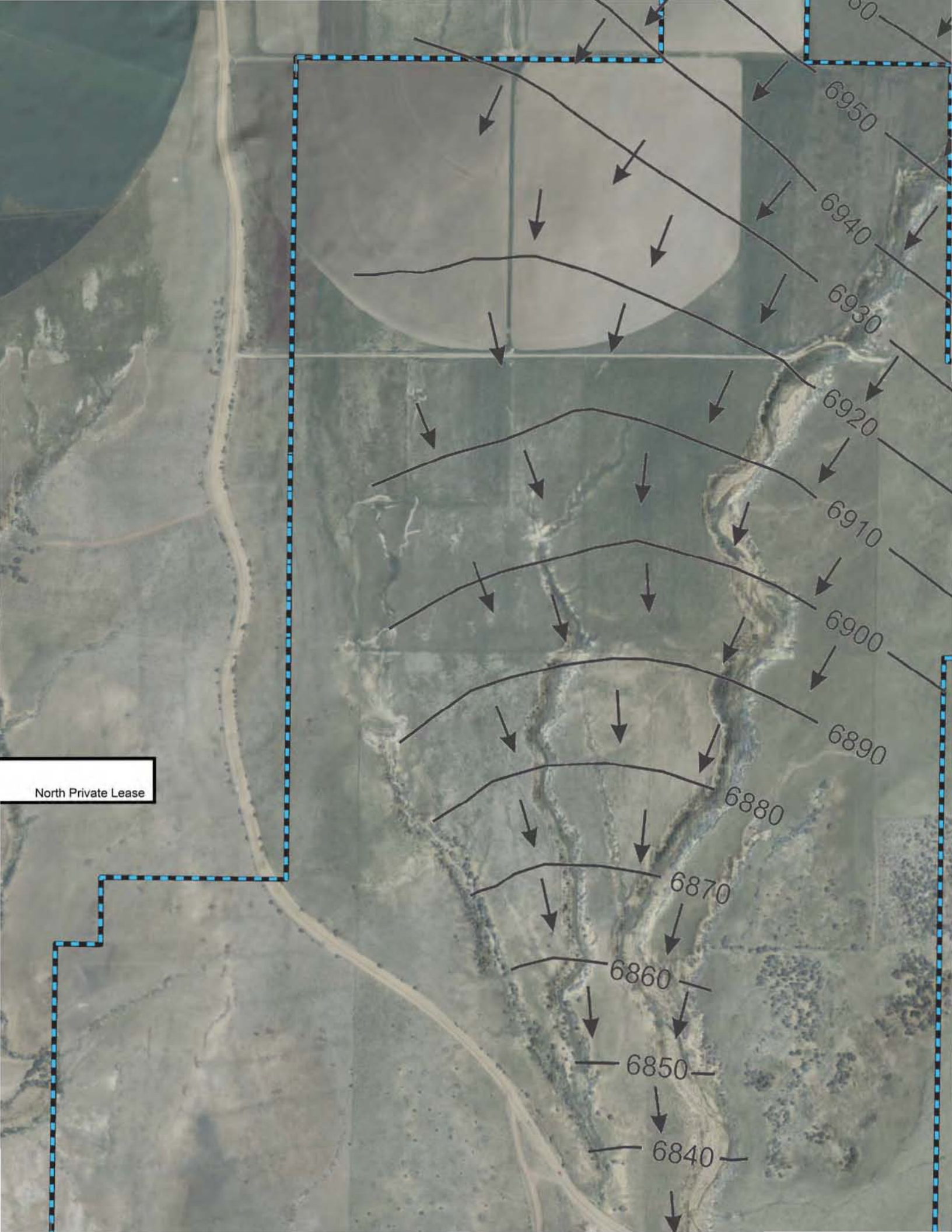
Lease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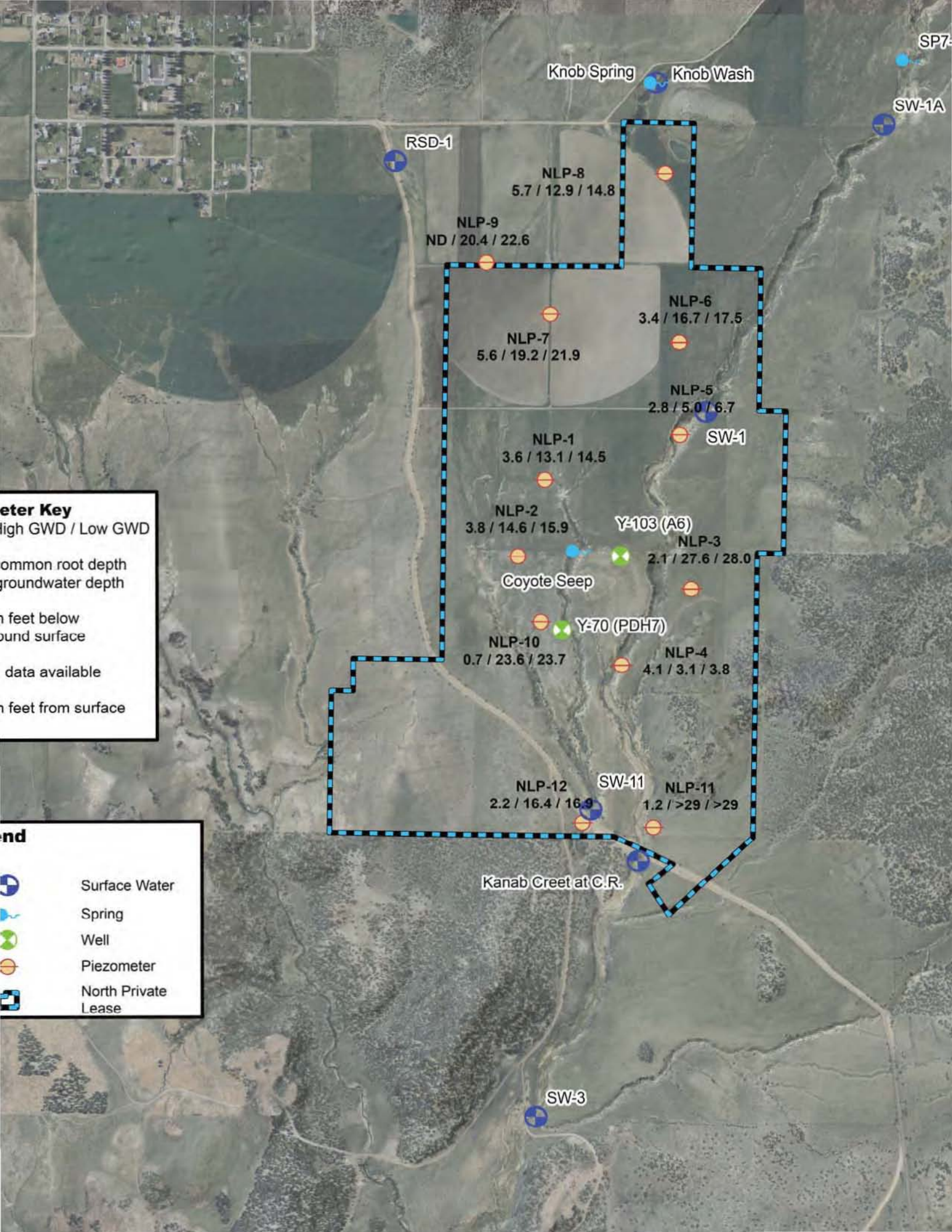
North Private Lease


SP7-
Knob Spring
Knob Wash
SW-1A
RSD-1
NLP-8
5.7 / 12.9 / 14.8
NLP-9
ND / 20.4 / 22.6
NLP-6
3.4 / 16.7 / 17.5
NLP-7
5.6 / 19.2 / 21.9
NLP-5
2.8 / 5.0 / 6.7
SW-1
NLP-1
3.6 / 13.1 / 14.5
NLP-2
3.8 / 14.6 / 15.9
Y-103 (A6)
NLP-3
2.1 / 27.6 / 28.0
Coyote Seep
Y-70 (PDH7)
NLP-10
0.7 / 23.6 / 23.7
NLP-4
4.1 / 3.1 / 3.8
SW-11
NLP-12
2.2 / 16.4 / 16.9
NLP-11
1.2 / >29 / >29
Kanab Creet at C.R.
SW-3
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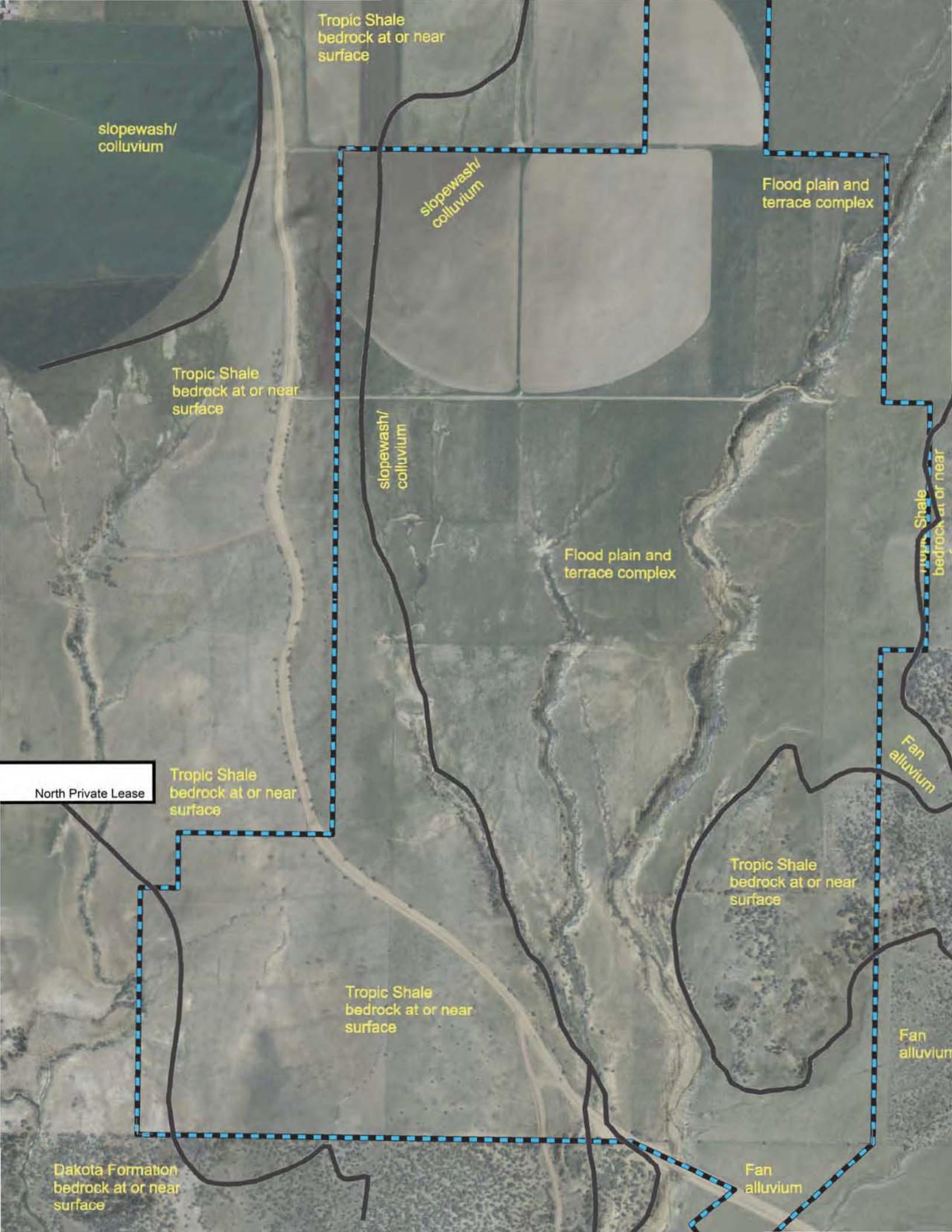
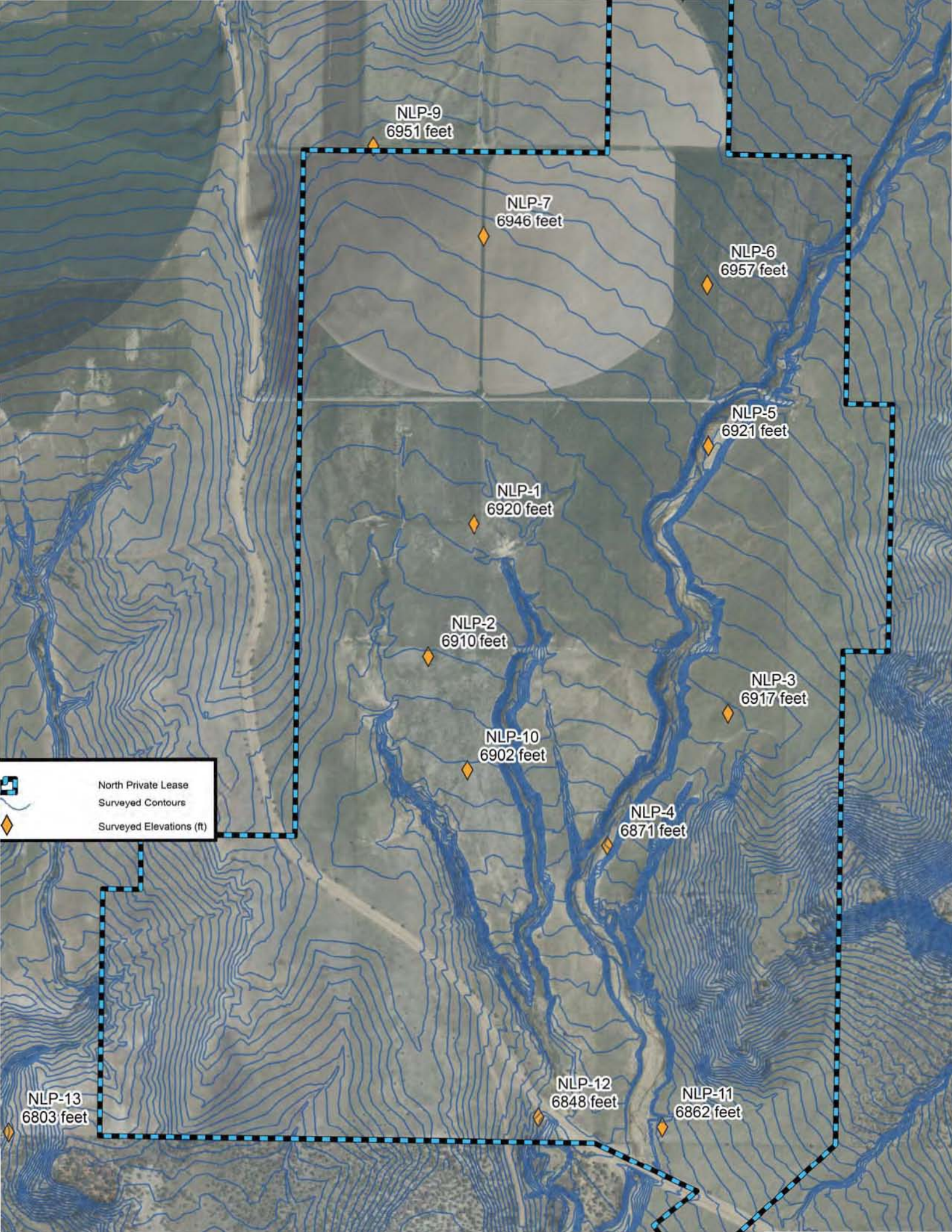
groundwater depth
n feet below
ound surface
data available
n feet from surface
end
Surface Water
Spring
Well
Piezometer
North Private
Lease

Sub-drainage
nab Creek
drainage
Surface Water Divide
Kanab Creek
Kanb Creek
drainage
North Private Lease
intermittent wash
Kanab Creek
ephemeral wash
ephemeral wash
Surface Water Divide
Simpson Hollow
Creek Sub-drainage
of Kanab Creek
Kanab Creek
Kanb Creek
drainage


Tropic Shale bedrock at or near surface
slopewash/ colluvium
slopewash/ colluvium
Flood plain and terrace complex
Tropic Shale bedrock at or near surface
slopewash/ colluvium
Flood plain and terrace complex
Fan alluvium
North Private Lease
Tropic Shale bedrock at or near surface
Tropic Shale bedrock at or near surface
Tropic Shale bedrock at or near surface
Fan alluvium
Dakota Formation bedrock at or near surface
Fan alluvium


NLP-9
6951 feet
NLP-7
6946 feet
NLP-6
6957 feet
NLP-5
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NLP-1
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NLP-2
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NLP-3
6917 feet
NLP-10
6902 feet
NLP-4
6871 feet
NLP-12
6848 feet
NLP-11
6862 feet
NLP-13
6803 feet
North Private Lease
Surveyed Contours
Surveyed Elevations (ft)

8600 (qb, qd, ql, and qn)
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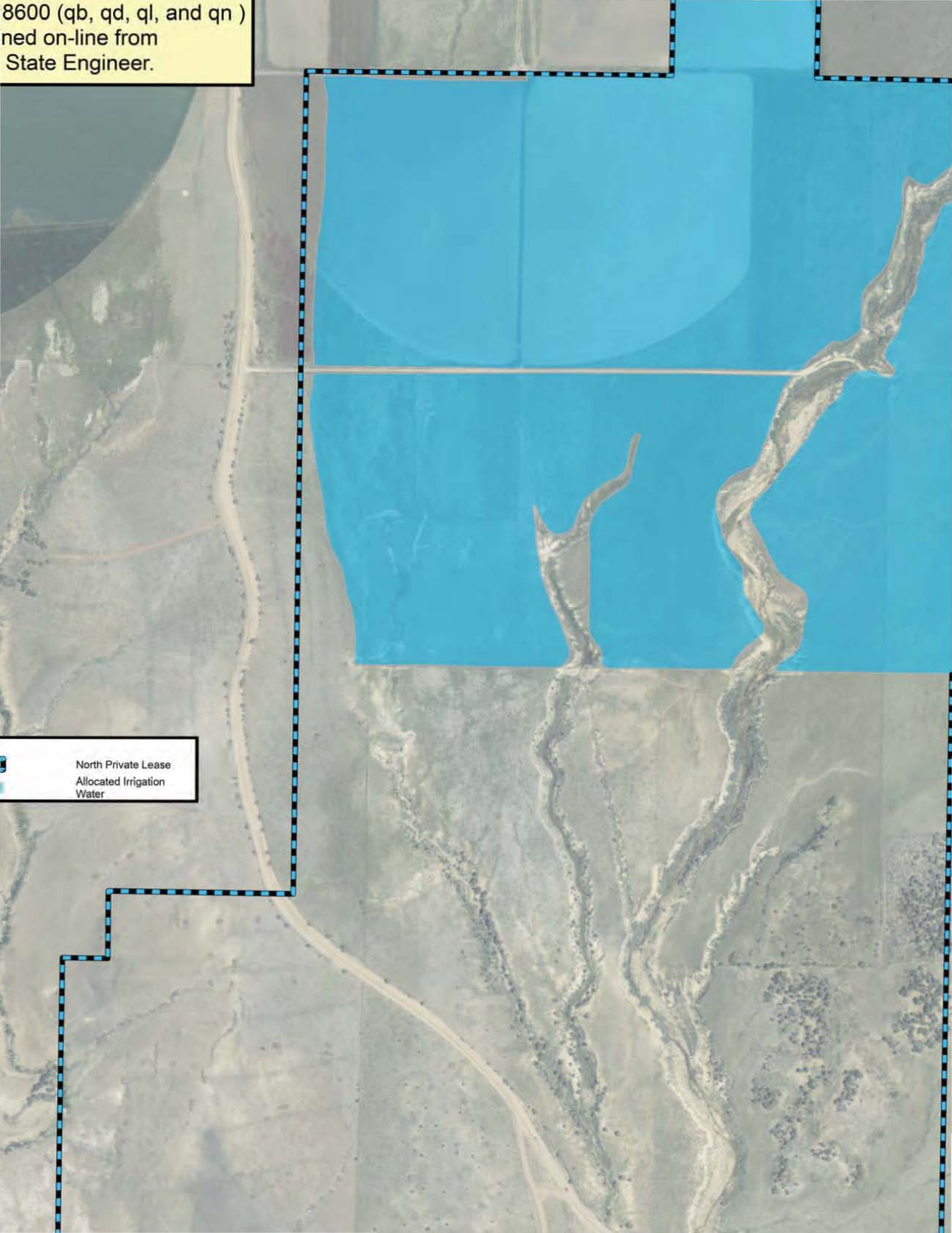
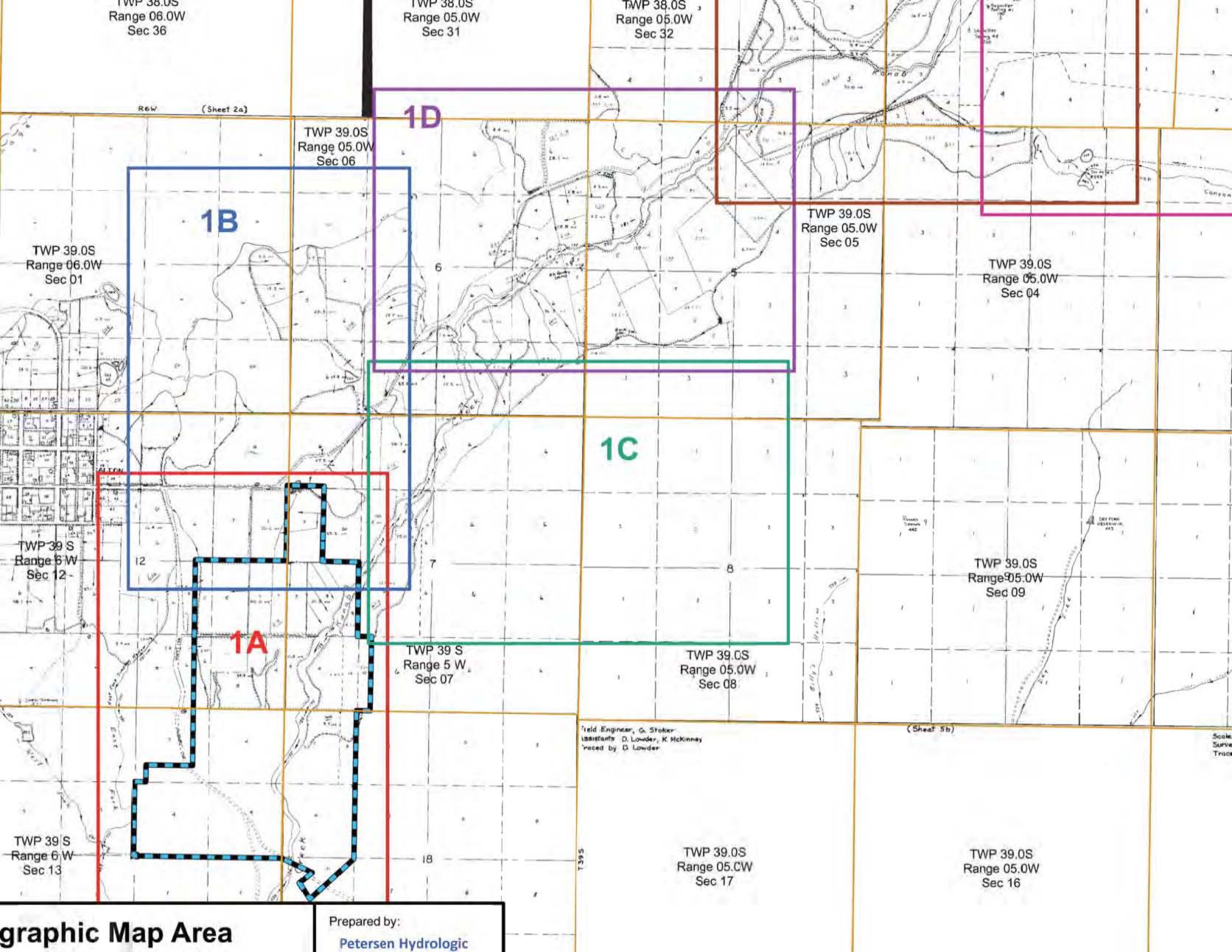
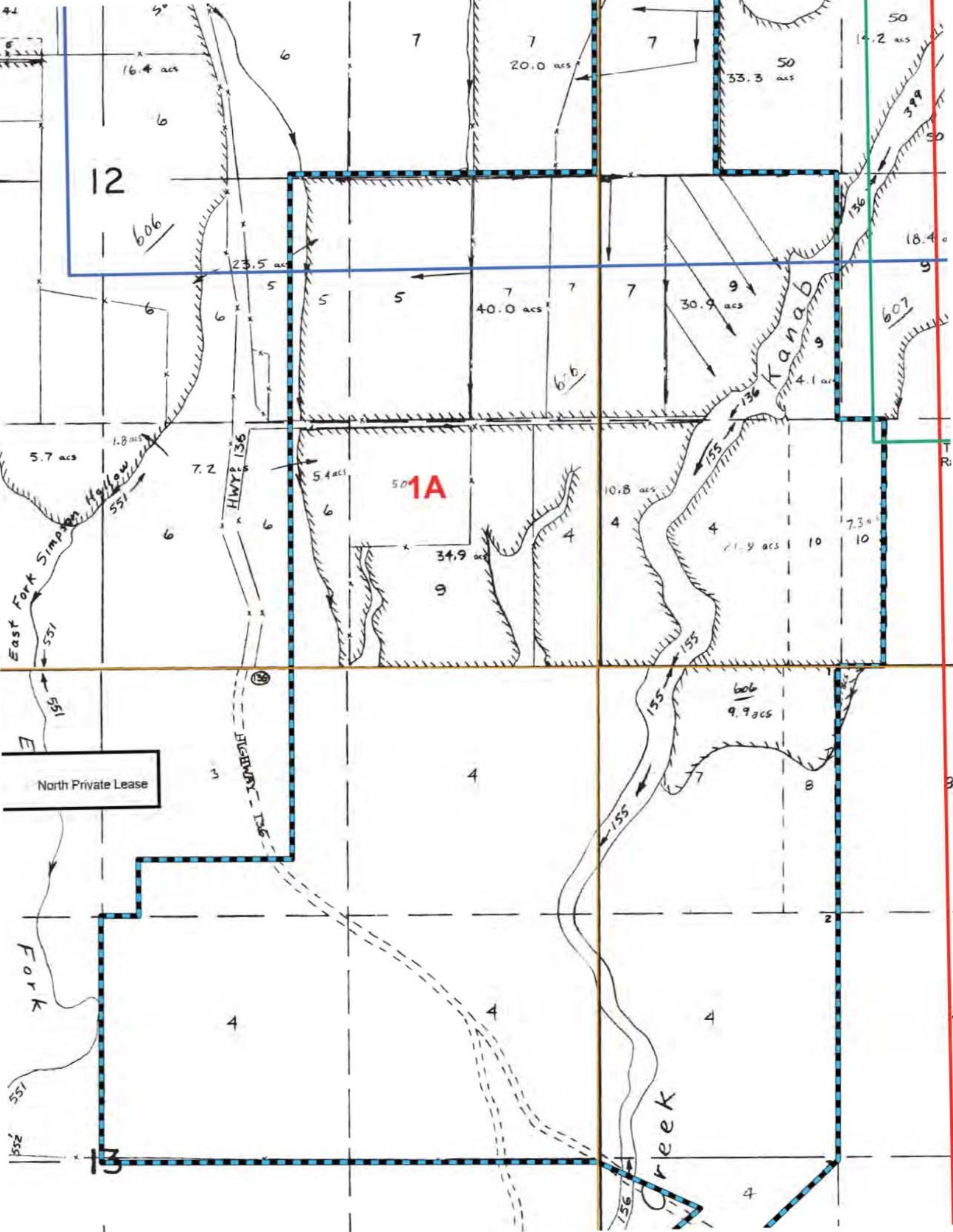
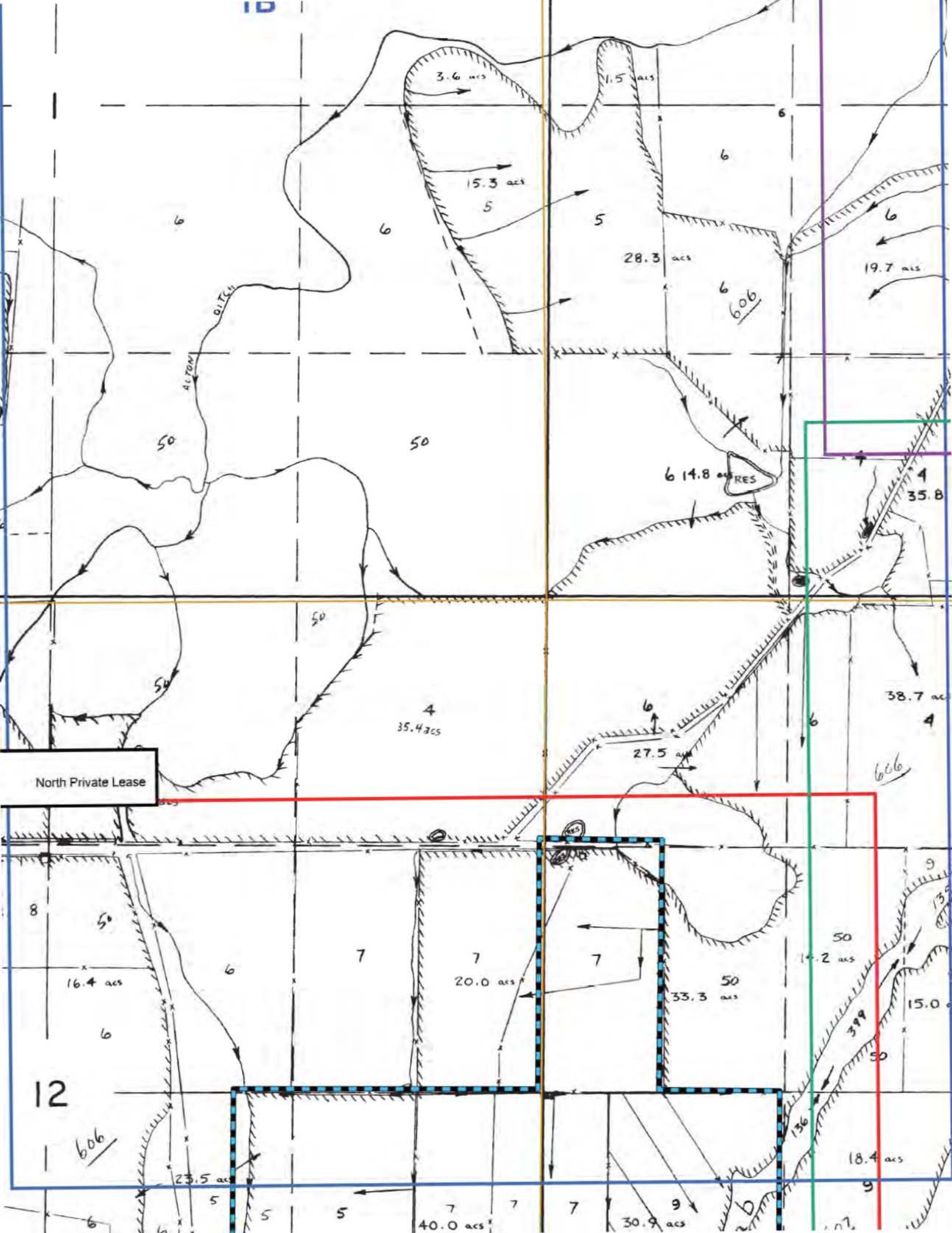
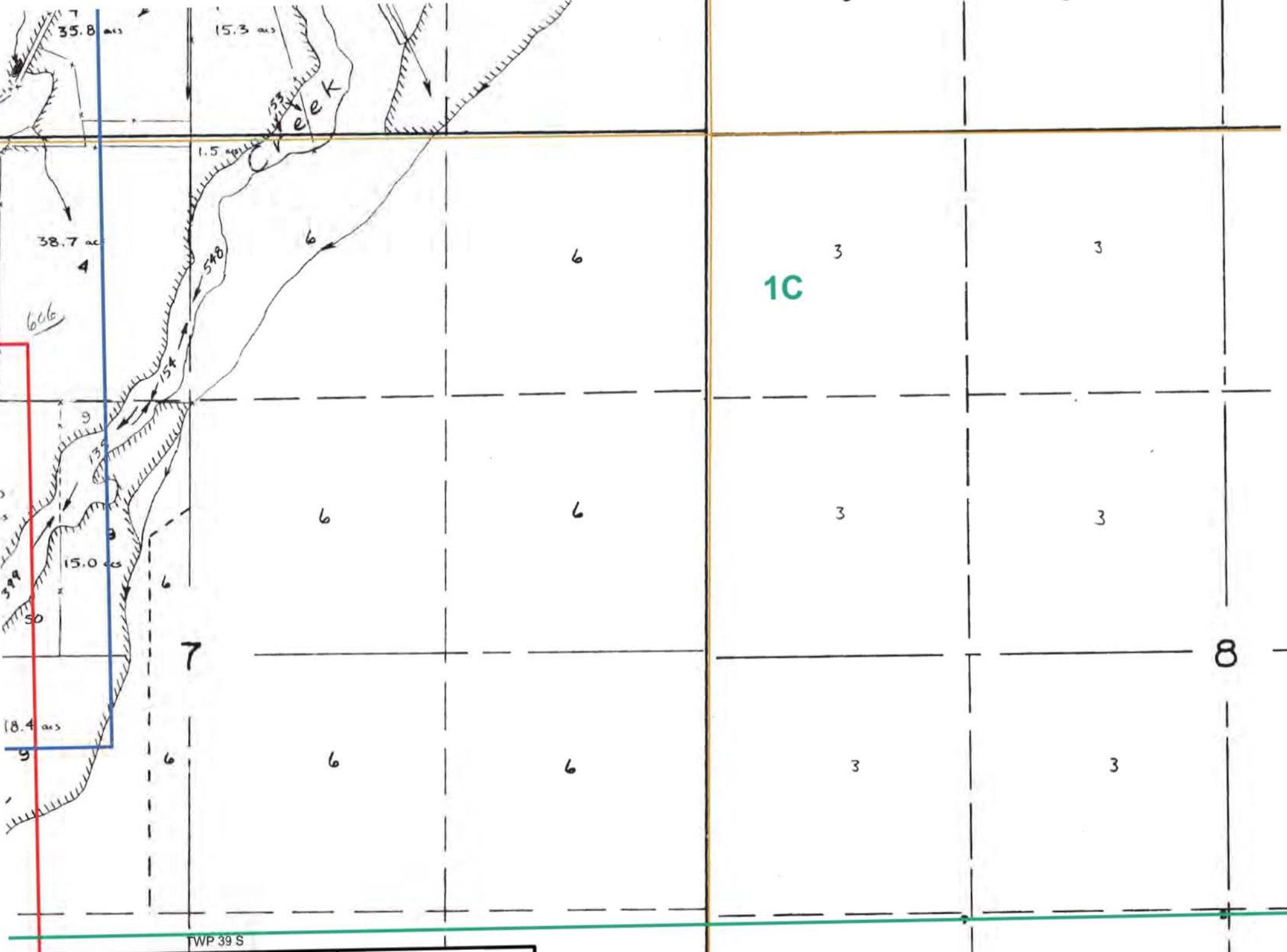
State Engineer.




TWP 38.0S
Range 06.0W
Sec 36
TWP 38.0S
Range 05.0W
Sec 31
TWP 38.0S
Range 05.0W
Sec 32
R6W
(Sheet 2a)
1D
TWP 39.0S
Range 05.0W
Sec 06
1B
TWP 39.0S
Range 06.0W
Sec 01
TWP 39.0S
Range 05.0W
Sec 05
TWP 39.0S
Range 05.0W
Sec 04
1C
1A
TWP 39 S
Range 6 W
Sec 12
TWP 39 S
Range 5 W
Sec 07
TWP 39.0S
Range 05.0W
Sec 08
TWP 39.0S
Range 05.0W
Sec 09
(Sheet 5b)
TWP 39 S
Range 6 W
Sec 13
T39S
TWP 39.0S
Range 05.0W
Sec 17
TWP 39.0S
Range 05.0W
Sec 16
graphic Map Area
Prepared by:
Petersen Hydrologic

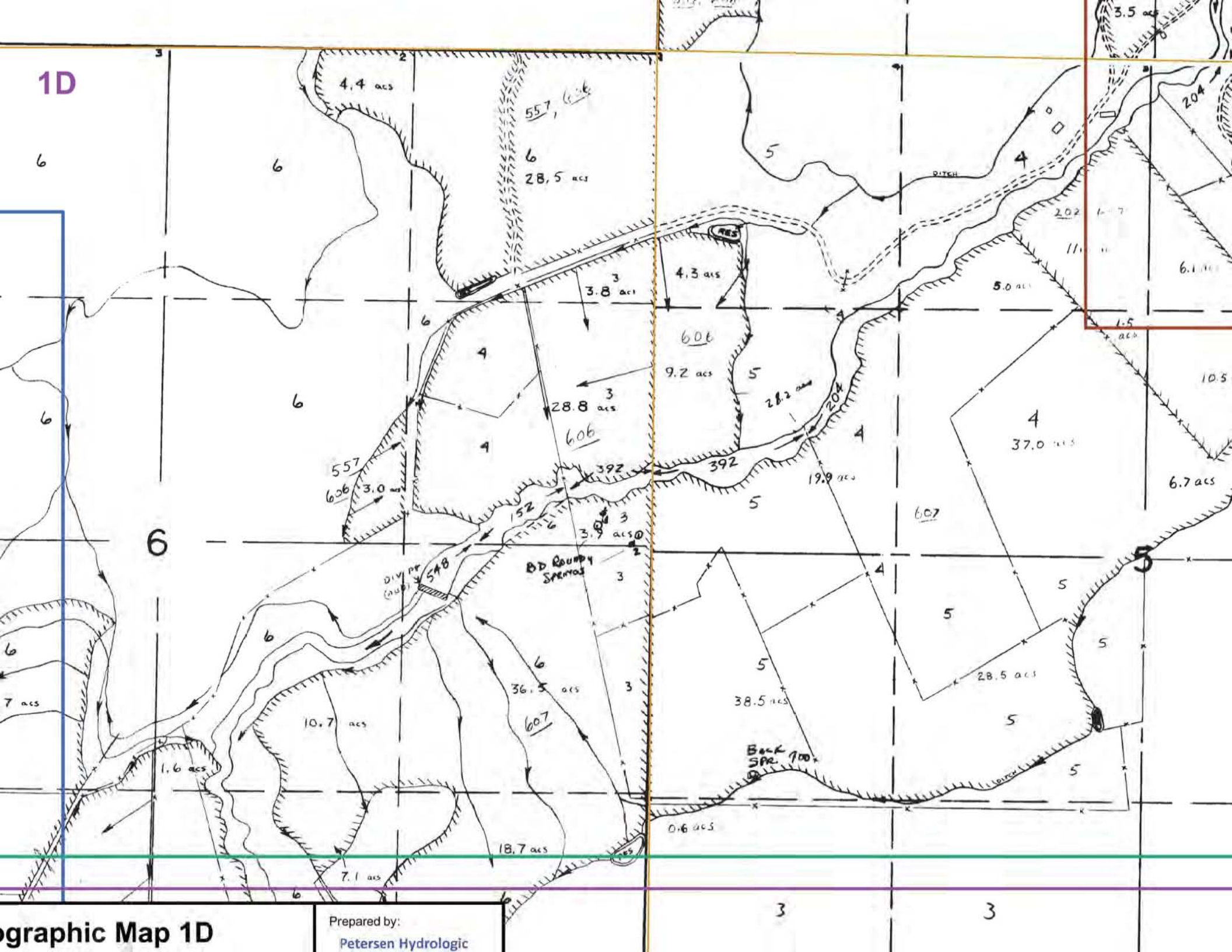

12
606
16.4 acs
23.5 acs
20.0 acs
33.3 acs
14.2 acs
40.0 acs
30.9 acs
607
Knab
5.7 acs
7.2
HWY 136
5.4 acs
1A
34.9 acs
10.8 acs
4.1 acs
9.9 acs
East Fork Simpson Hollow
551
155
136
North Private Lease
East Fork
Creek
13


North Private Lease
12
606
3.6 acs
1.5 acs
15.3 acs
28.3 acs
19.7 acs
14.8 acs
RES
35.8
35.4 acs
38.7 ac
27.5 ac
16.4 acs
20.0 acs
33.3 acs
14.2 acs
23.5 acs
40.0 acs
30.9 acs
18.4 acs
DITCH
ALTON



ographic Map 1C

Prepared by:
Petersen Hydrologic



ographic Map 1D

Prepared by:
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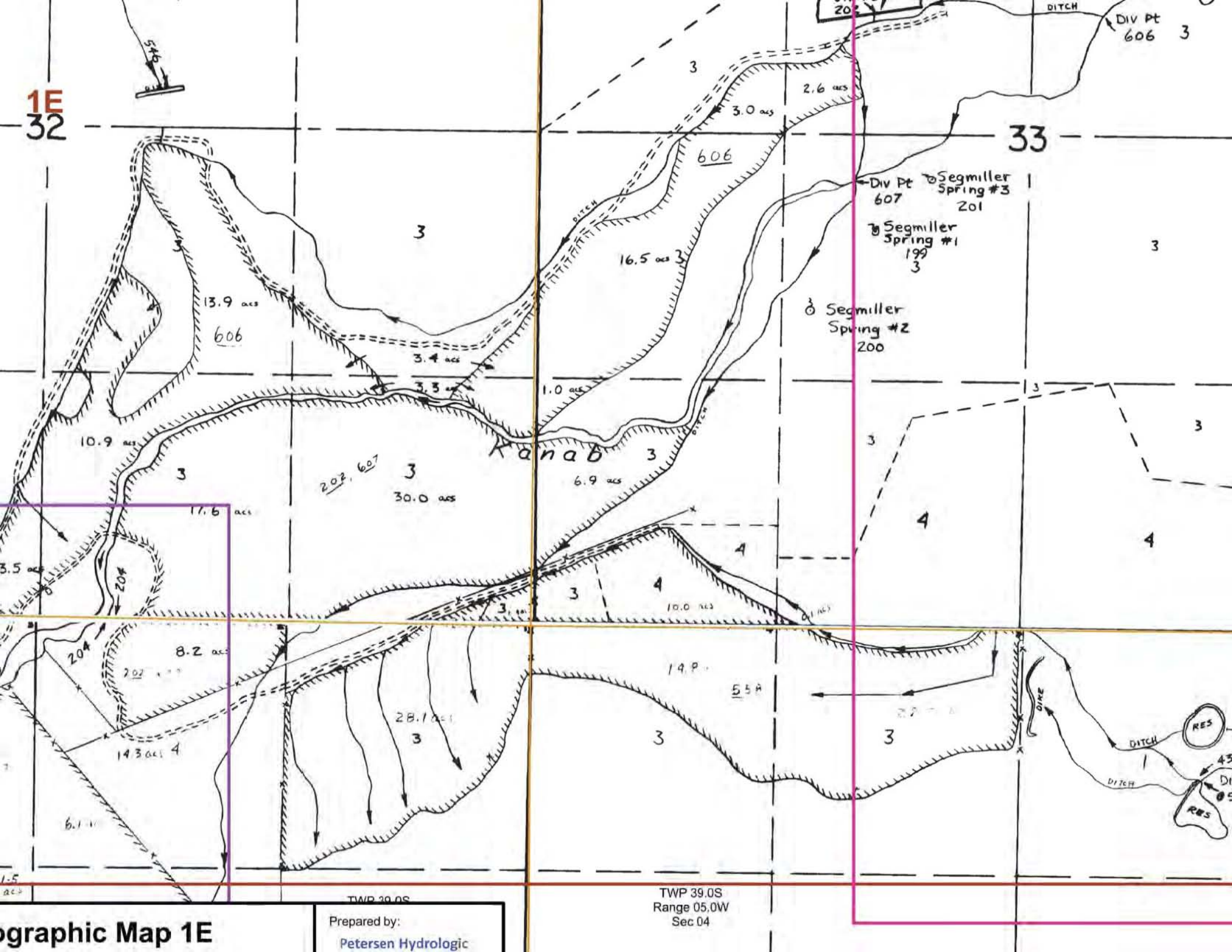

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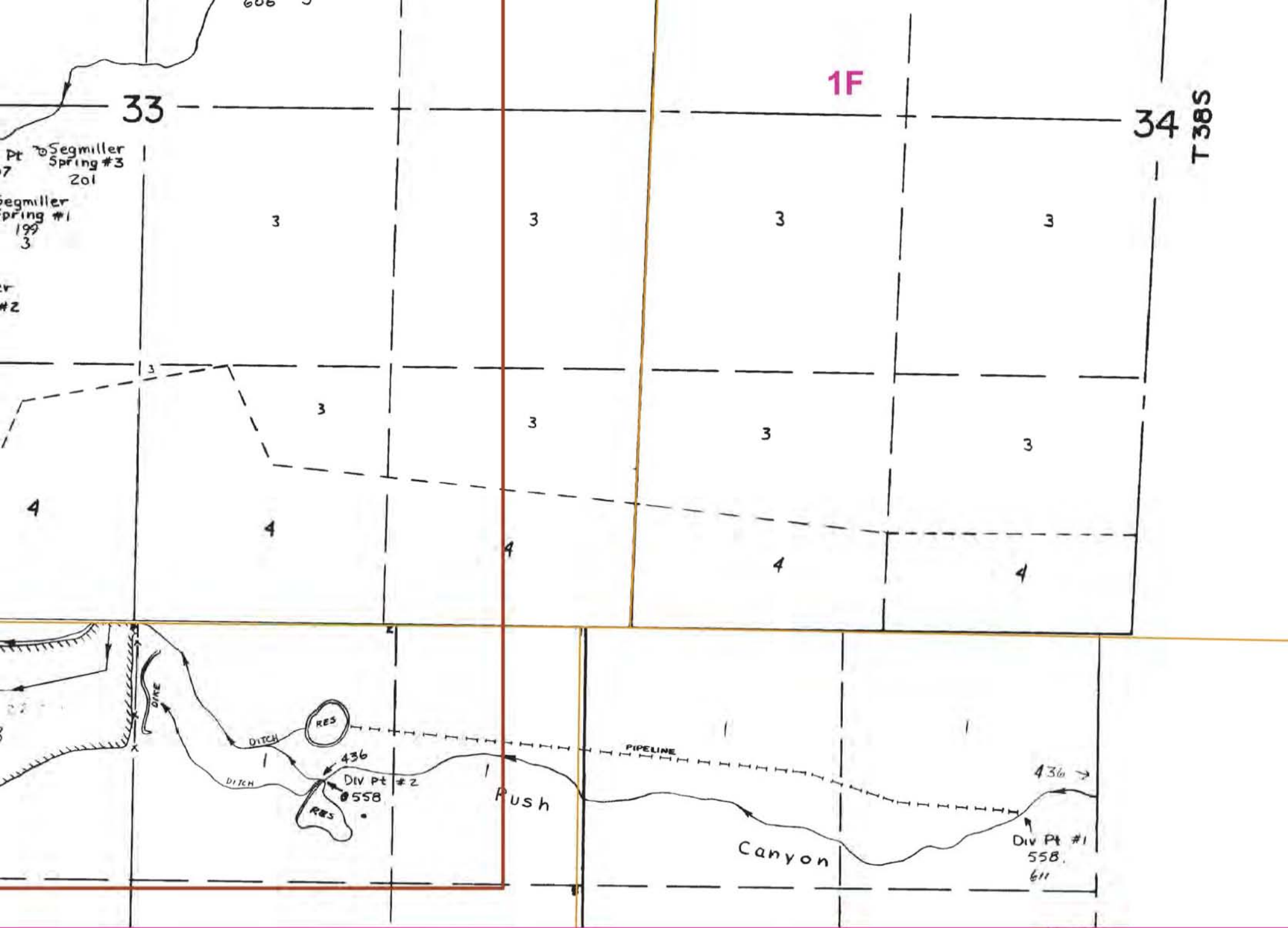
Prepared by:
Petersen Hydrologic



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Prepared by:
Petersen Hydrologic

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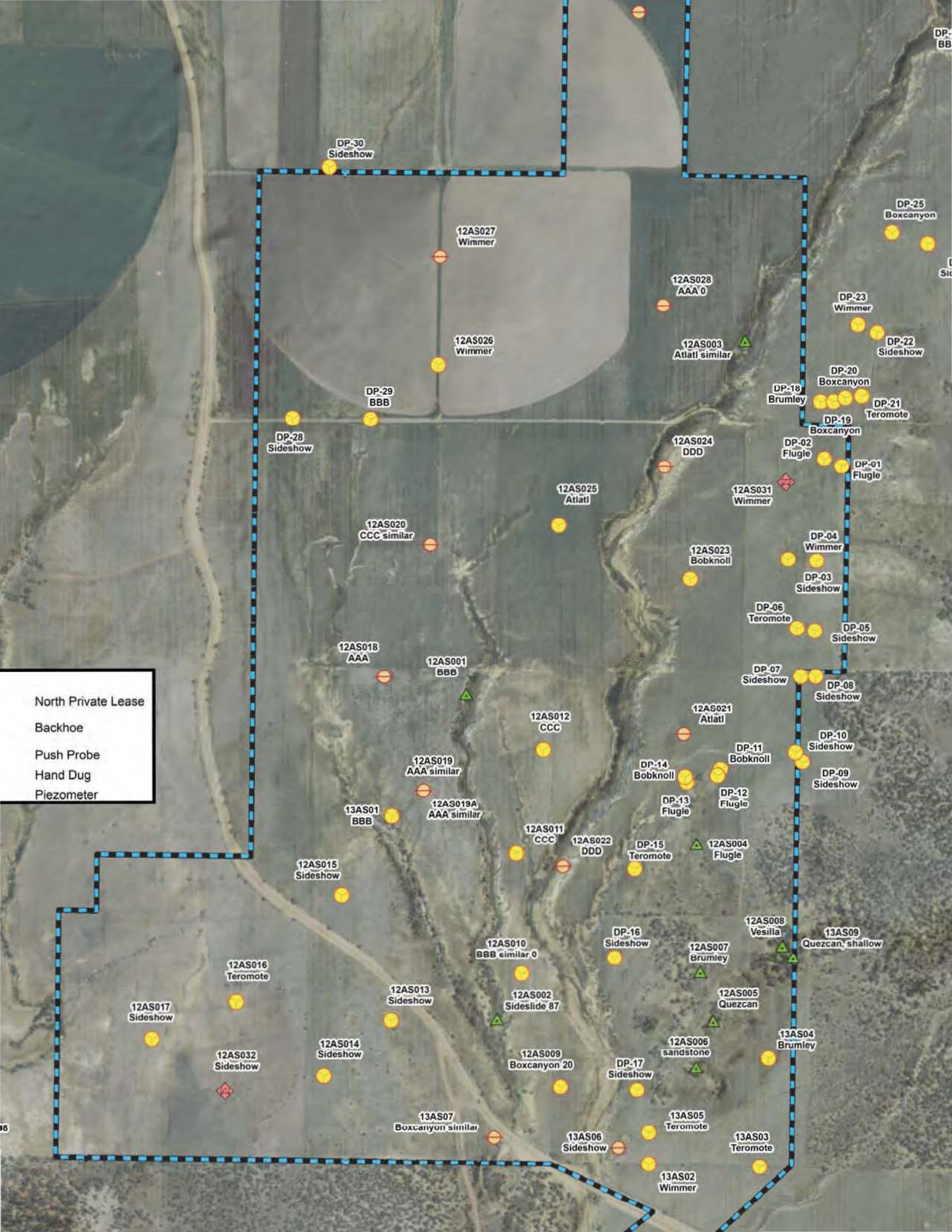
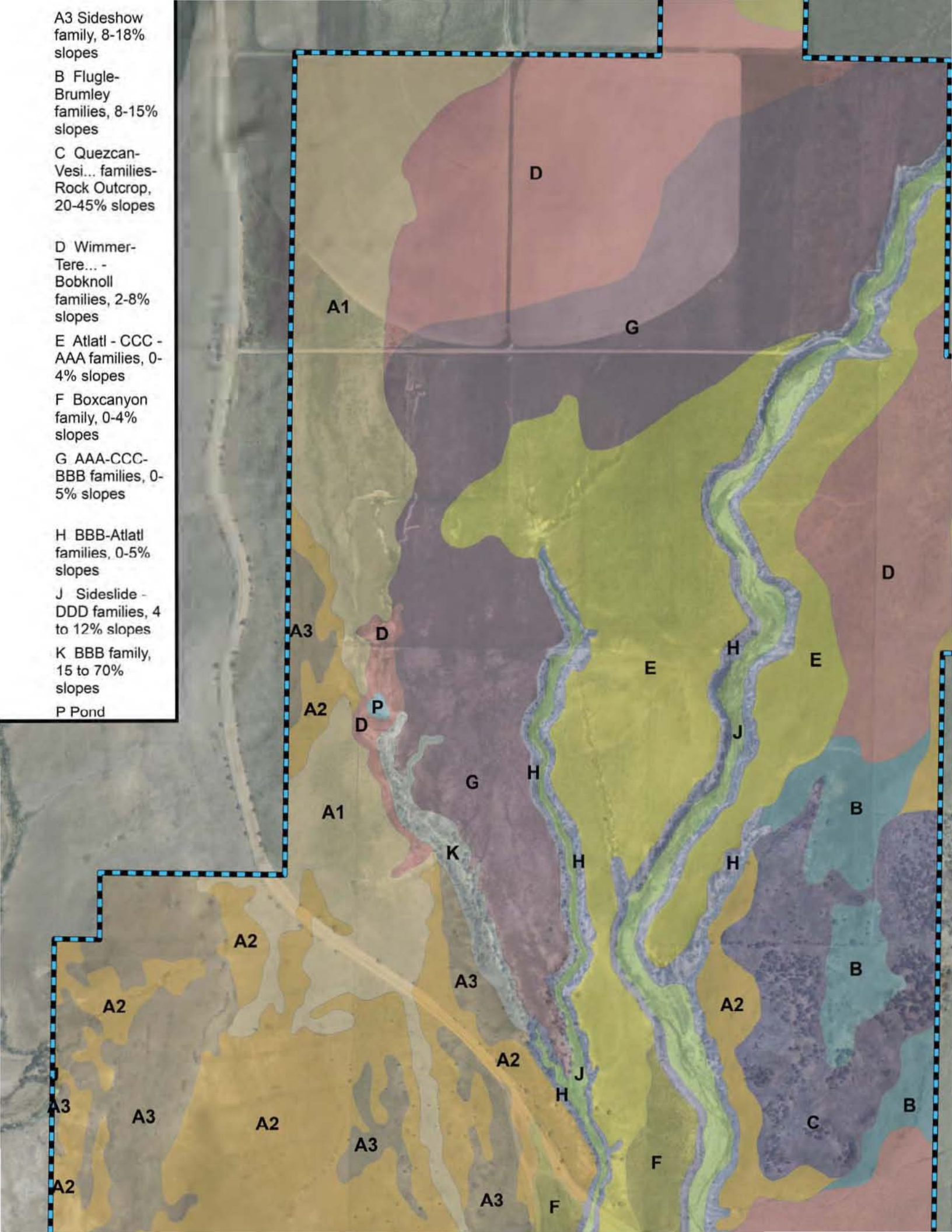
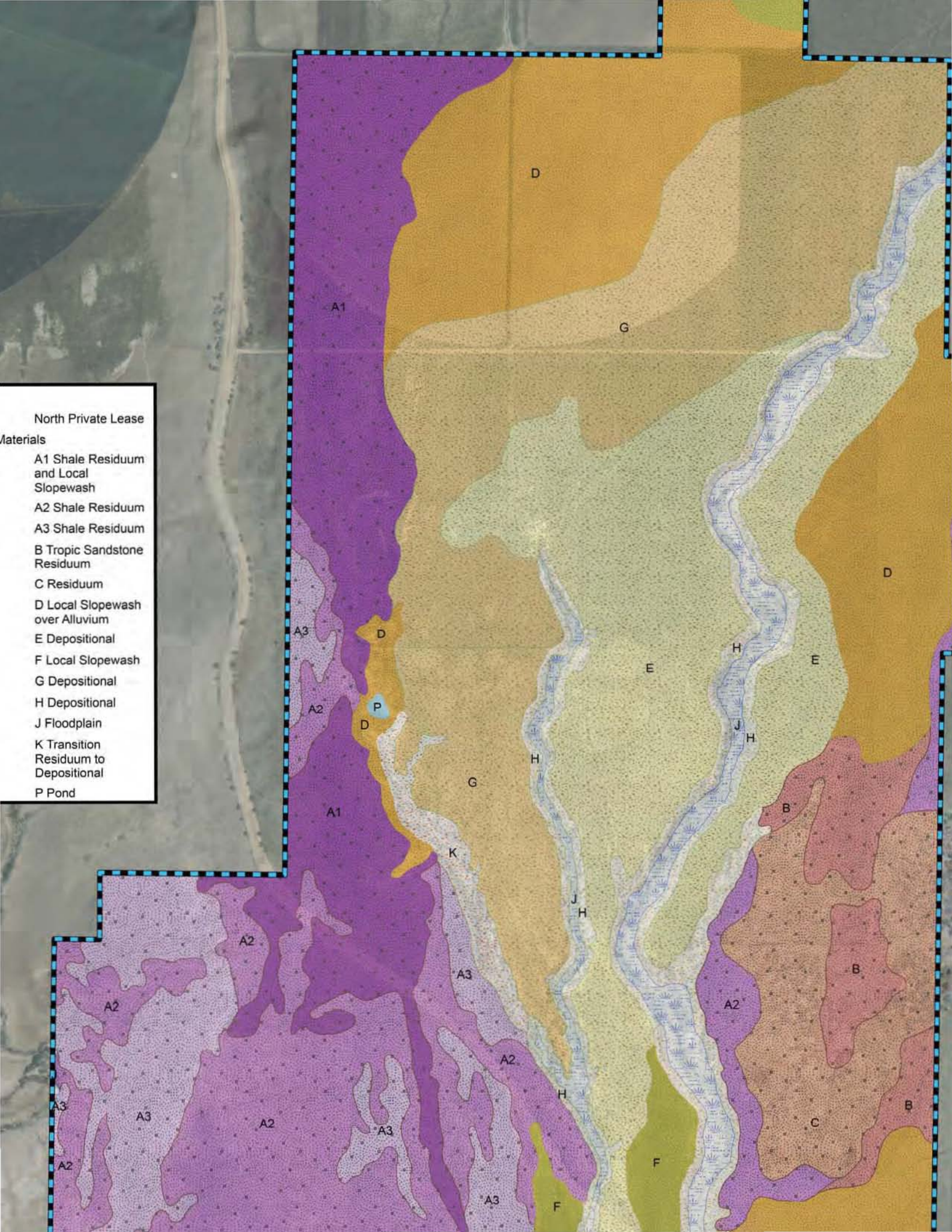
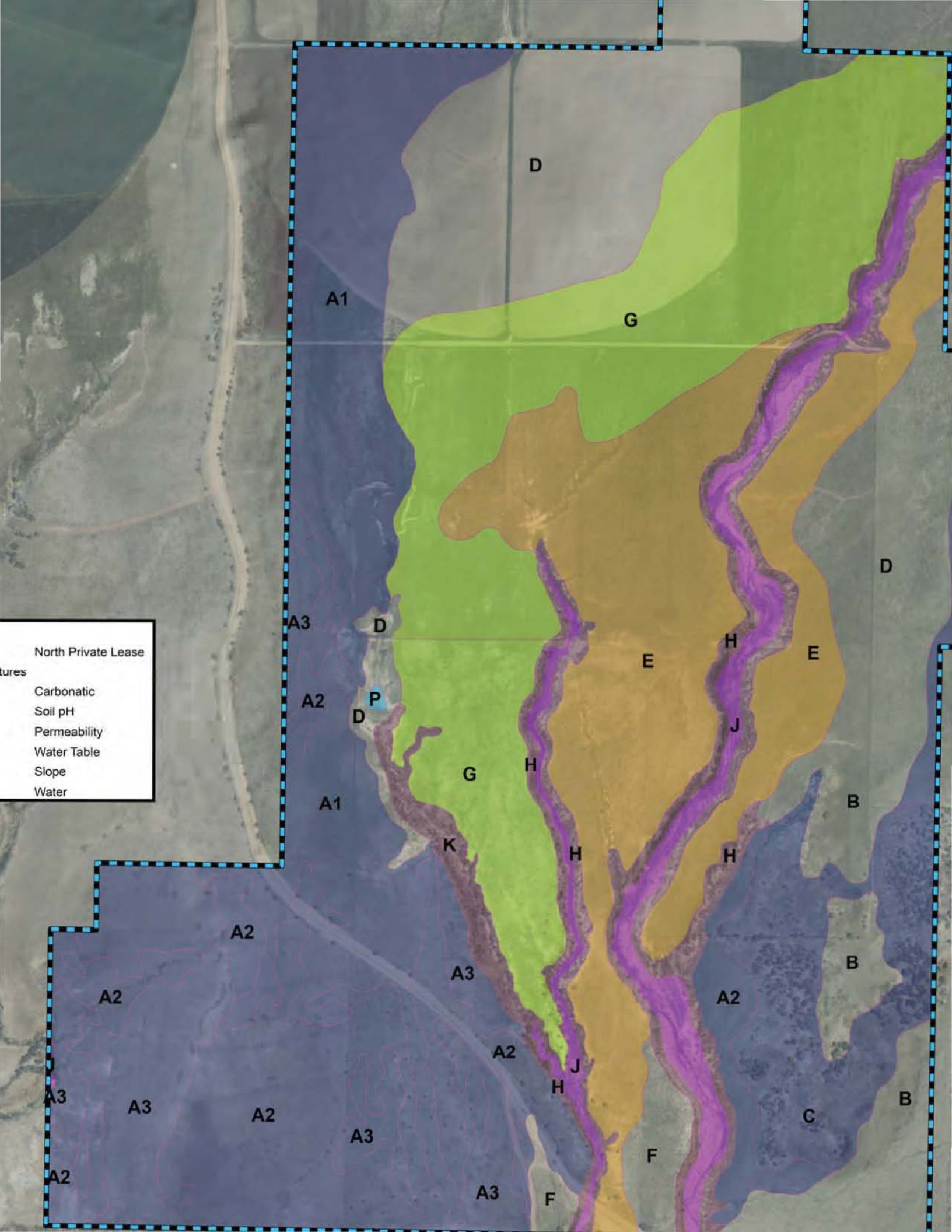
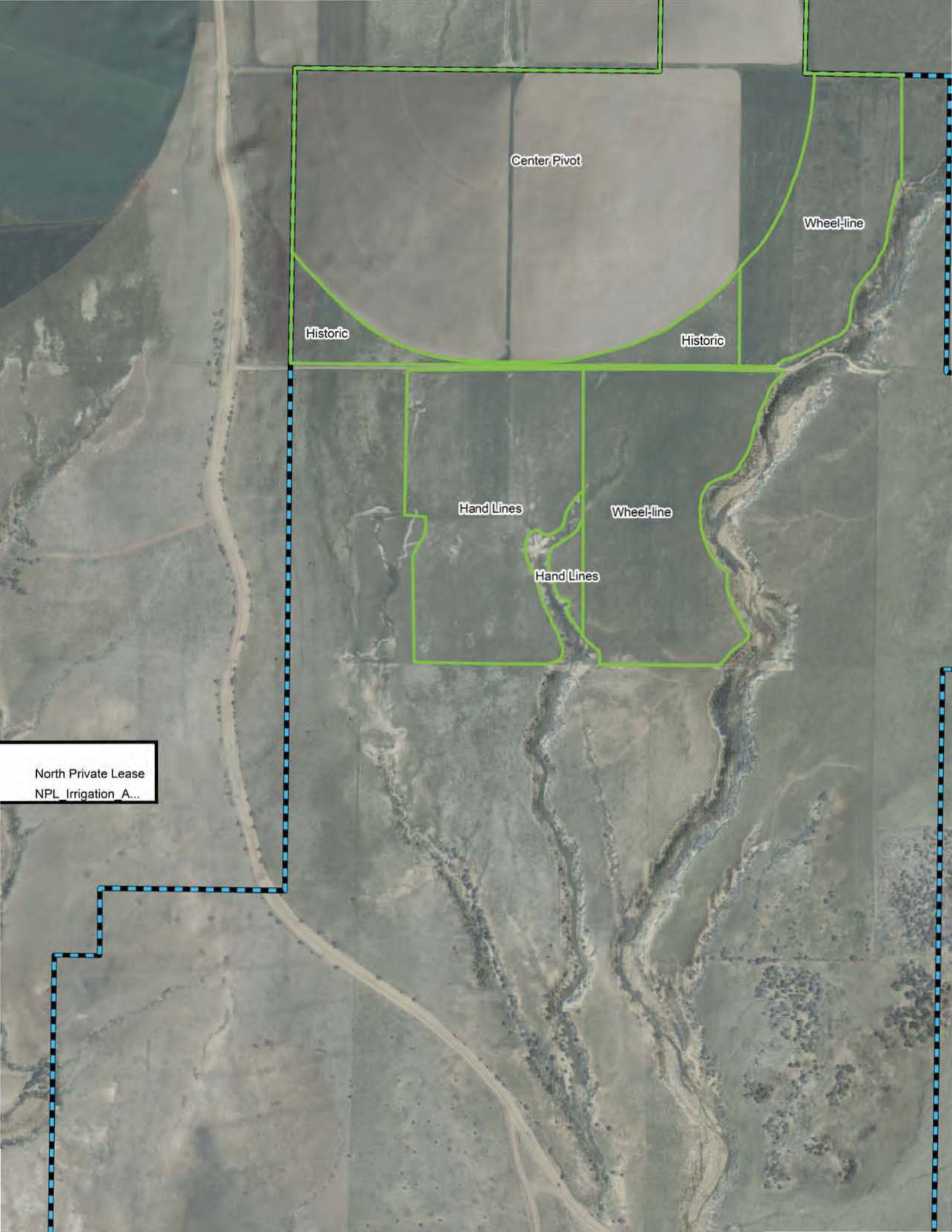
Range 05.0W
Sec 03

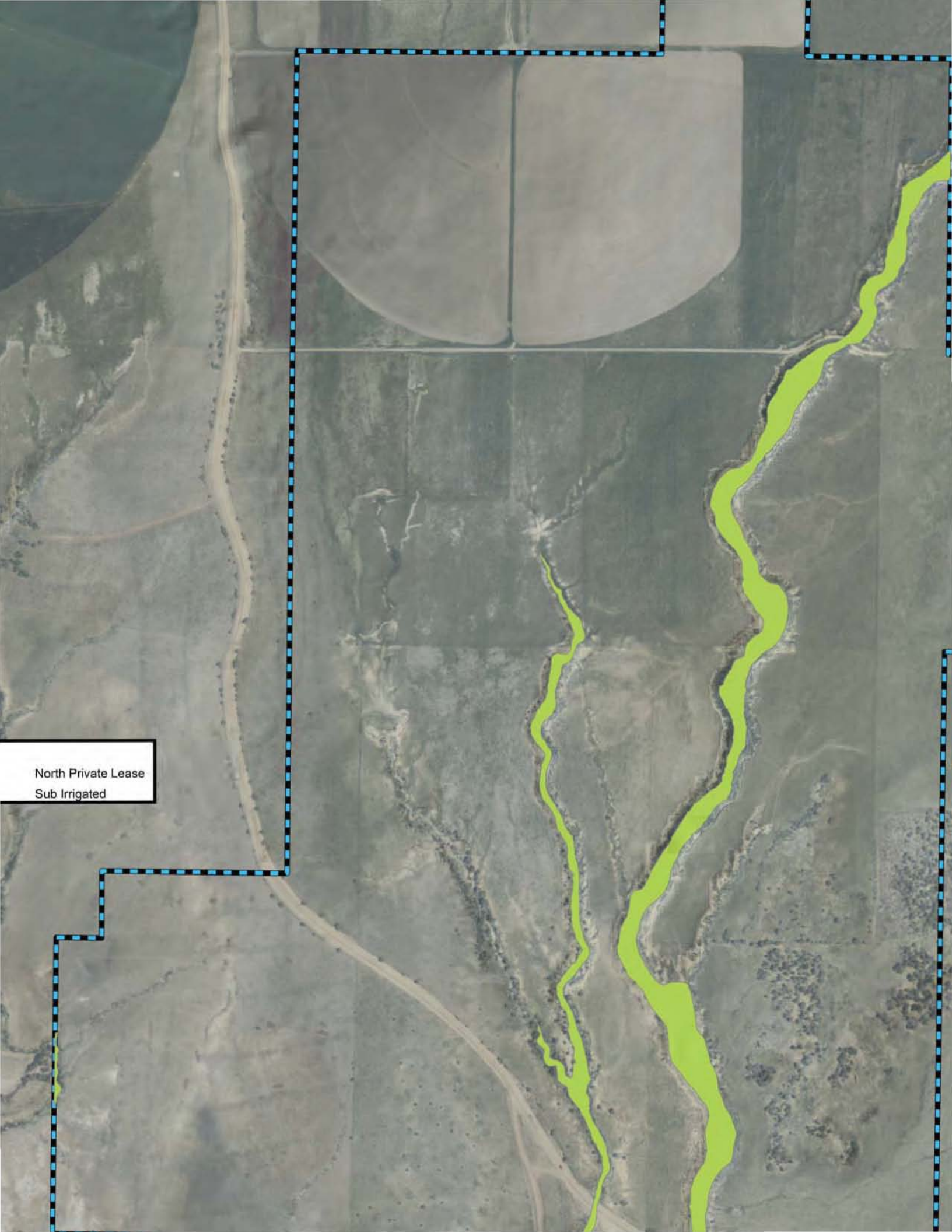

North Private Lease
Backhoe
Push Probe
Hand Dug
Piezometer
DP-30 Sideshow
12AS027 Wimmer
12AS028 AAA 0
12AS026 Wimmer
12AS003 Atlatl similar
DP-29 BBB
DP-28 Sideshow
12AS024 DDD
12AS025 Atlatl
12AS031 Wimmer
12AS020 CCC similar
12AS023 Bobknoll
12AS018 AAA
12AS001 BBB
12AS012 CCC
12AS021 Atlatl
12AS019 AAA similar
12AS019A AAA similar
13AS01 BBB
12AS011 CCC
12AS022 DDD
12AS004 Flugle
12AS015 Sideshow
12AS008 Vesilla
13AS09 Quezcan, shallow
12AS010 BBB similar 0
12AS007 Brumley
12AS016 Teromote
12AS013 Sideshow
12AS002 Sideslide 87
12AS005 Quezcan
12AS017 Sideshow
12AS014 Sideshow
12AS006 sandstone
13AS04 Brumley
12AS032 Sideshow
12AS009 Boxcanyon 20
13AS07 Boxcanyon similar
13AS05 Teromote
13AS06 Sideshow
13AS03 Teromote
13AS02 Wimmer
DP-25 Boxcanyon
DP-23 Wimmer
DP-22 Sideshow
DP-20 Boxcanyon
DP-18 Brumley
DP-21 Teromote
DP-19 Boxcanyon
DP-02 Flugle
DP-01 Flugle
DP-04 Wimmer
DP-03 Sideshow
DP-06 Teromote
DP-05 Sideshow
DP-07 Sideshow
DP-08 Sideshow
DP-10 Sideshow
DP-11 Bobknoll
DP-14 Bobknoll
DP-09 Sideshow
DP-13 Flugle
DP-12 Flugle
DP-15 Teromote
DP-16 Sideshow
DP-17 Sideshow

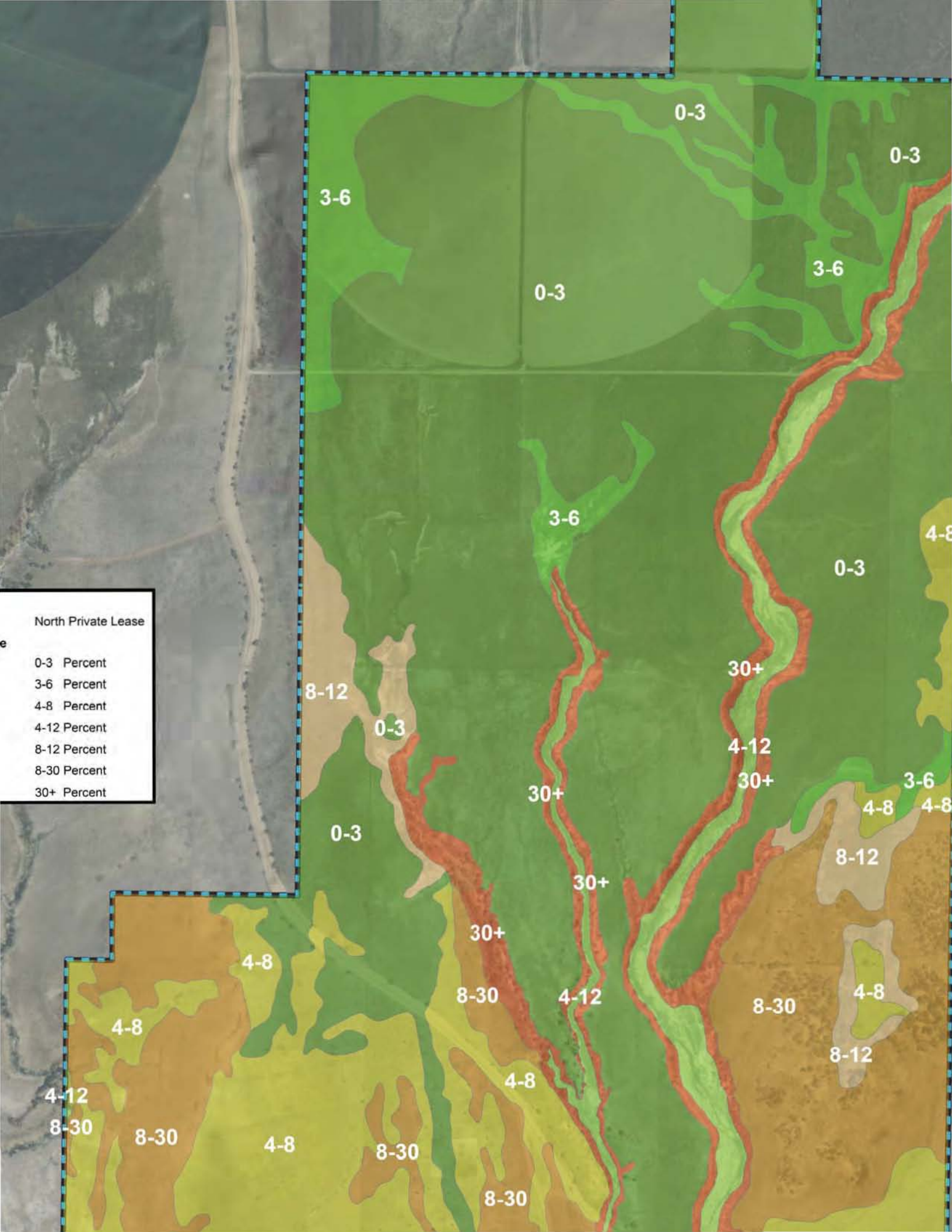

A3 Sideshow family, 8-18% slopes
B Flugle-Brumley families, 8-15% slopes
C Quezcan-Vesi... families-Rock Outcrop, 20-45% slopes
D Wimmer-Tere... - Bobknoll families, 2-8% slopes
E Atlatl - CCC - AAA families, 0-4% slopes
F Boxcanyon family, 0-4% slopes
G AAA-CCC-BBB families, 0-5% slopes
H BBB-Atlatl families, 0-5% slopes
J Sideslide - DDD families, 4 to 12% slopes
K BBB family, 15 to 70% slopes
P Pond
A1
A2
A3
B
C
D
E
F
G
H
J
K
P


North Private Lease
Materials
A1 Shale Residuum and Local Slopewash
A2 Shale Residuum
A3 Shale Residuum
B Tropic Sandstone Residuum
C Residuum
D Local Slopewash over Alluvium
E Depositional
F Local Slopewash
G Depositional
H Depositional
J Floodplain
K Transition Residuum to Depositional
P Pond


North Private Lease
tures
Carbonatic
Soil pH
Permeability
Water Table
Slope
Water
D
A1
G
A3
D
E
H
E
D
A2
P
D
J
G
H
A1
B
K
H
H
A2
A2
B
A3
A2
A2
J
H
A3
A3
A2
A3
C
B
F
A2
A3
F


Center Pivot
Wheel-line
Historic
Historic
Hand Lines
Wheel-line
Hand Lines
North Private Lease
NPL_Irrigation_A...


North Private Lease
Sub Irrigated


North Private Lease
e
0-3 Percent
3-6 Percent
4-8 Percent
4-12 Percent
8-12 Percent
8-30 Percent
30+ Percent
0-3
0-3
3-6
3-6
0-3
3-6
4-8
0-3
30+
8-12
0-3
4-12
30+
30+
3-6
4-8
4-8
0-3
8-12
30+
30+
4-8
8-30
4-12
8-30
4-8
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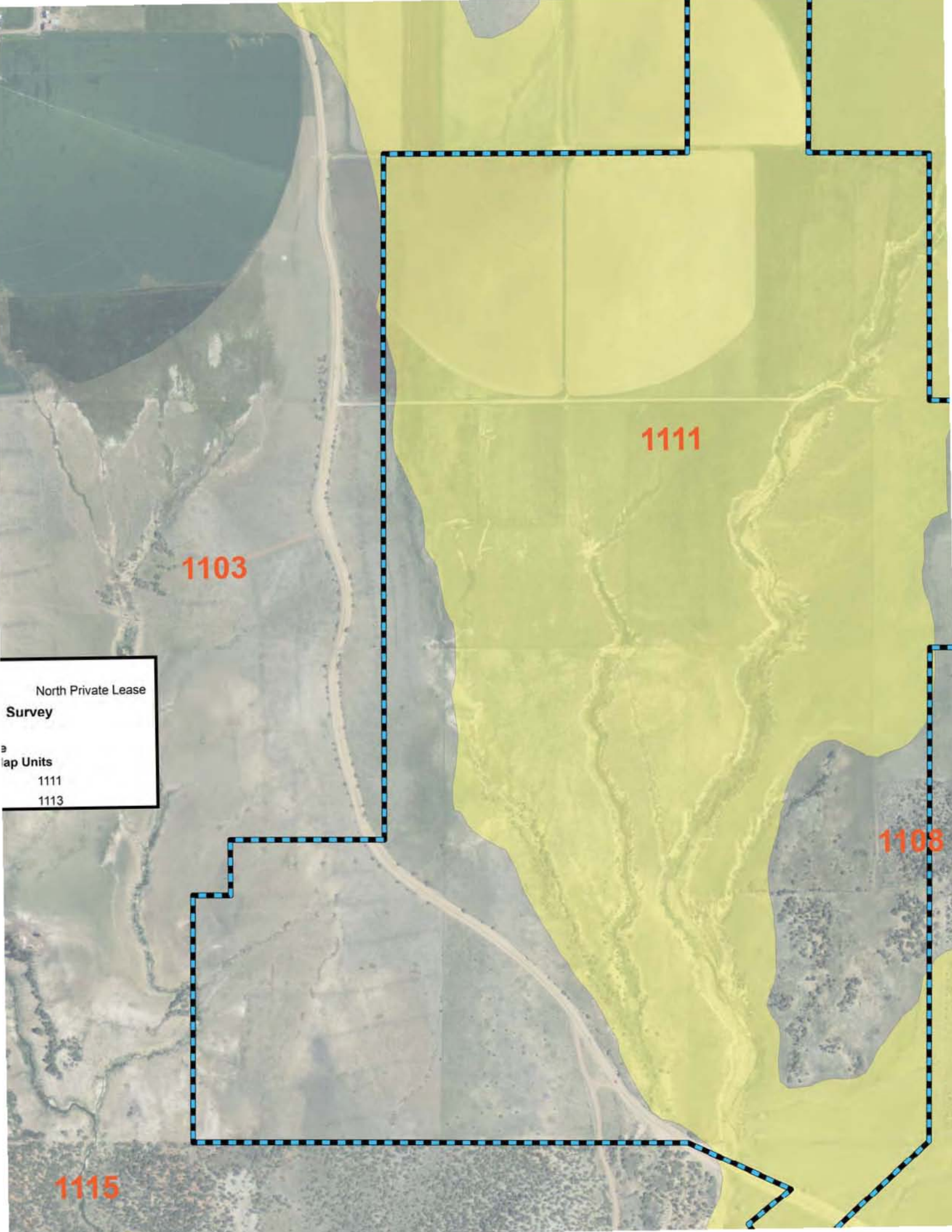
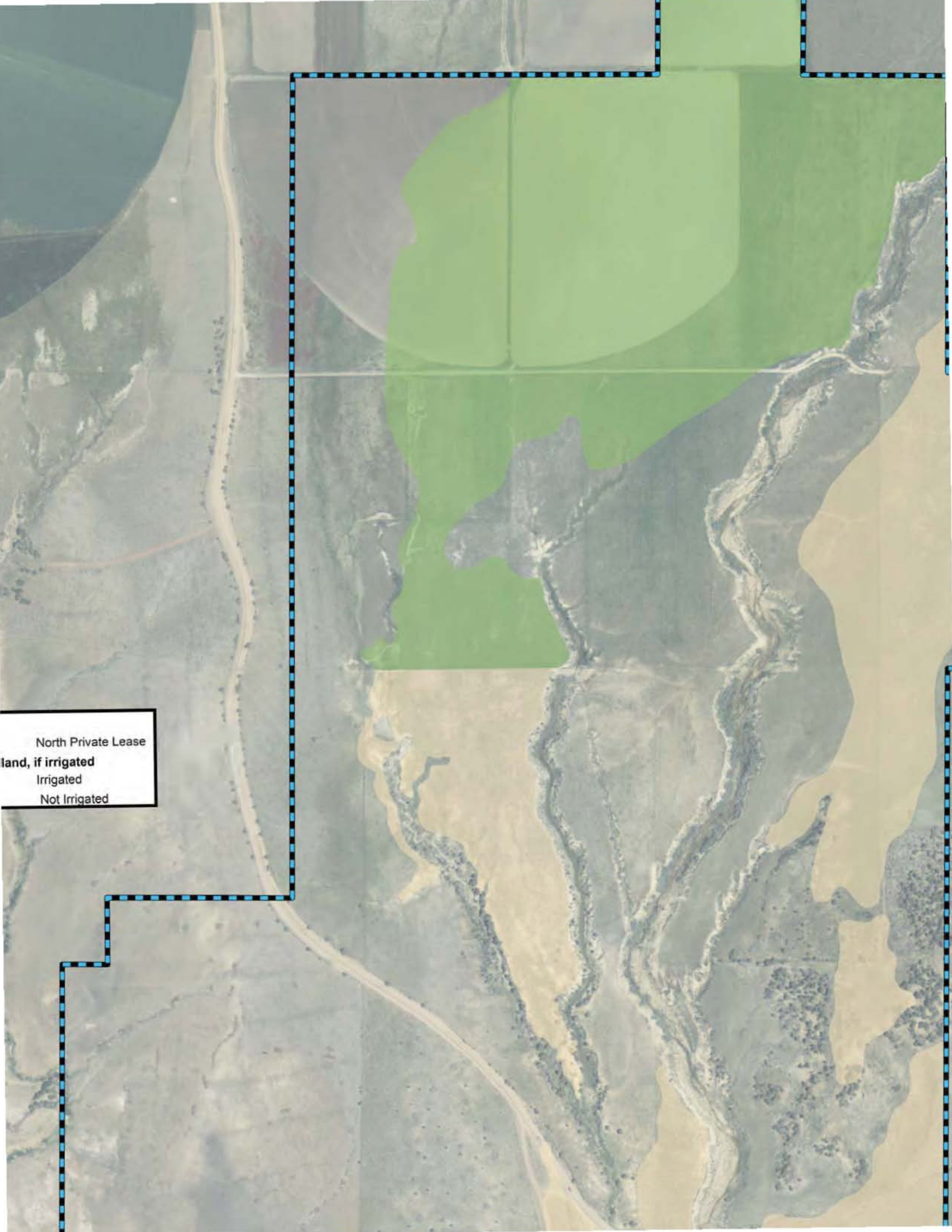
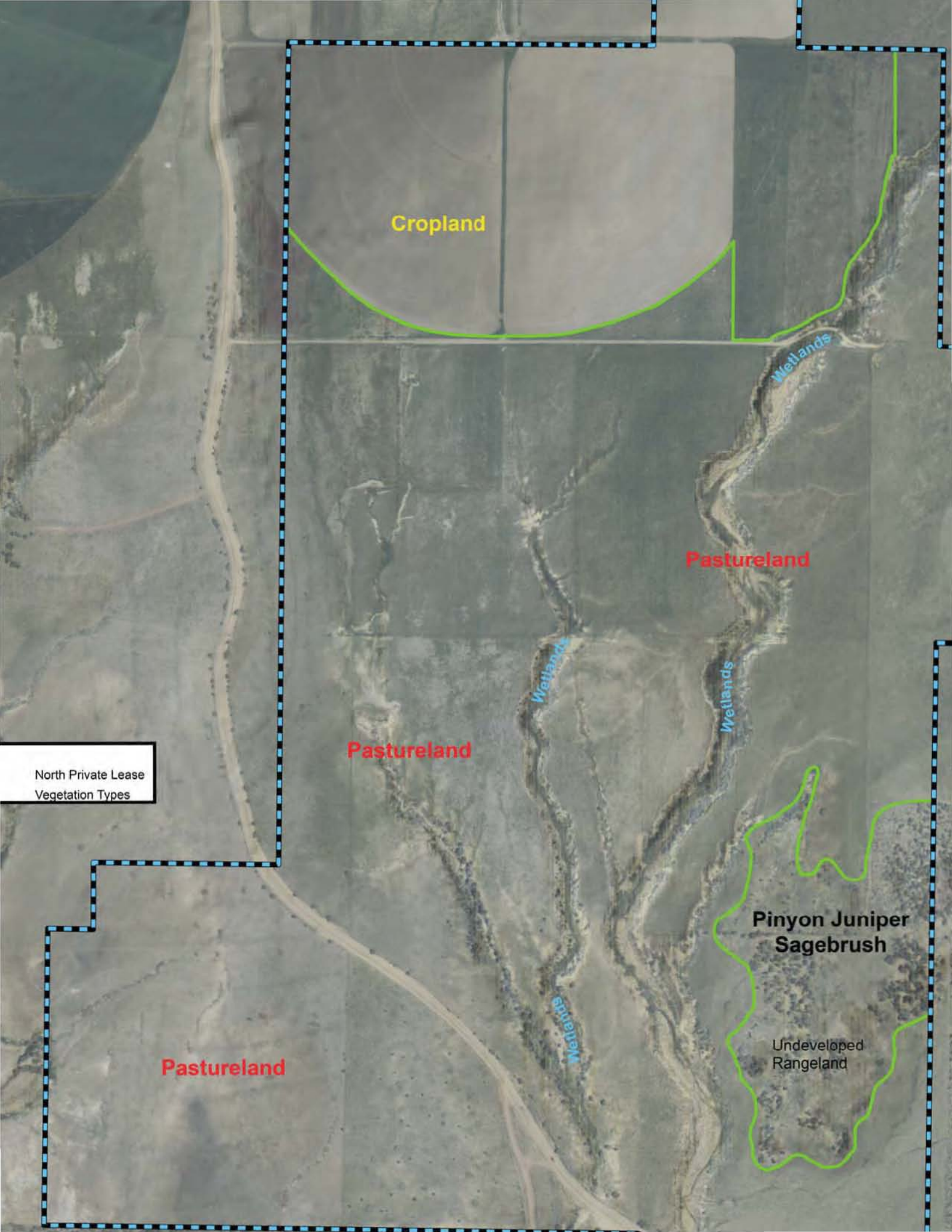
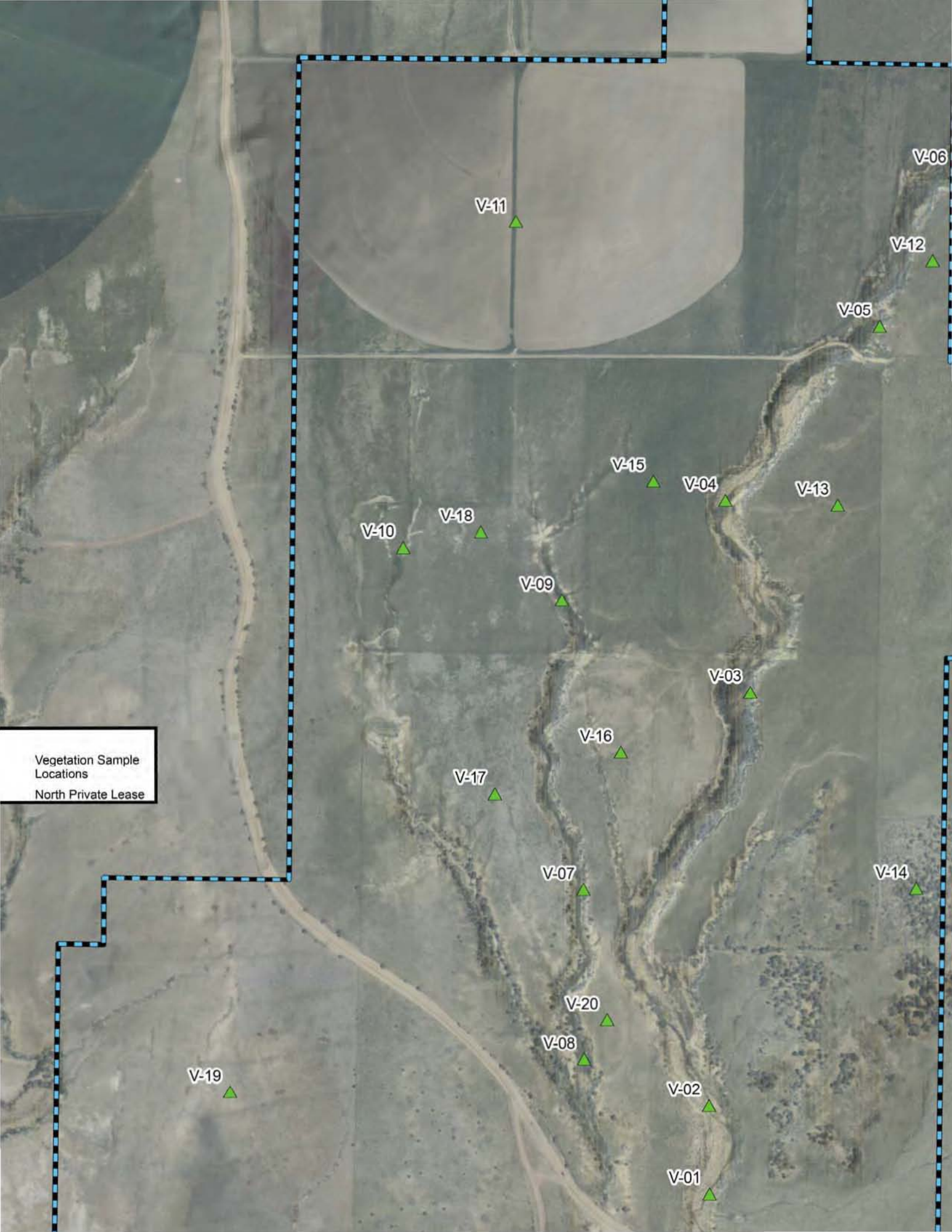
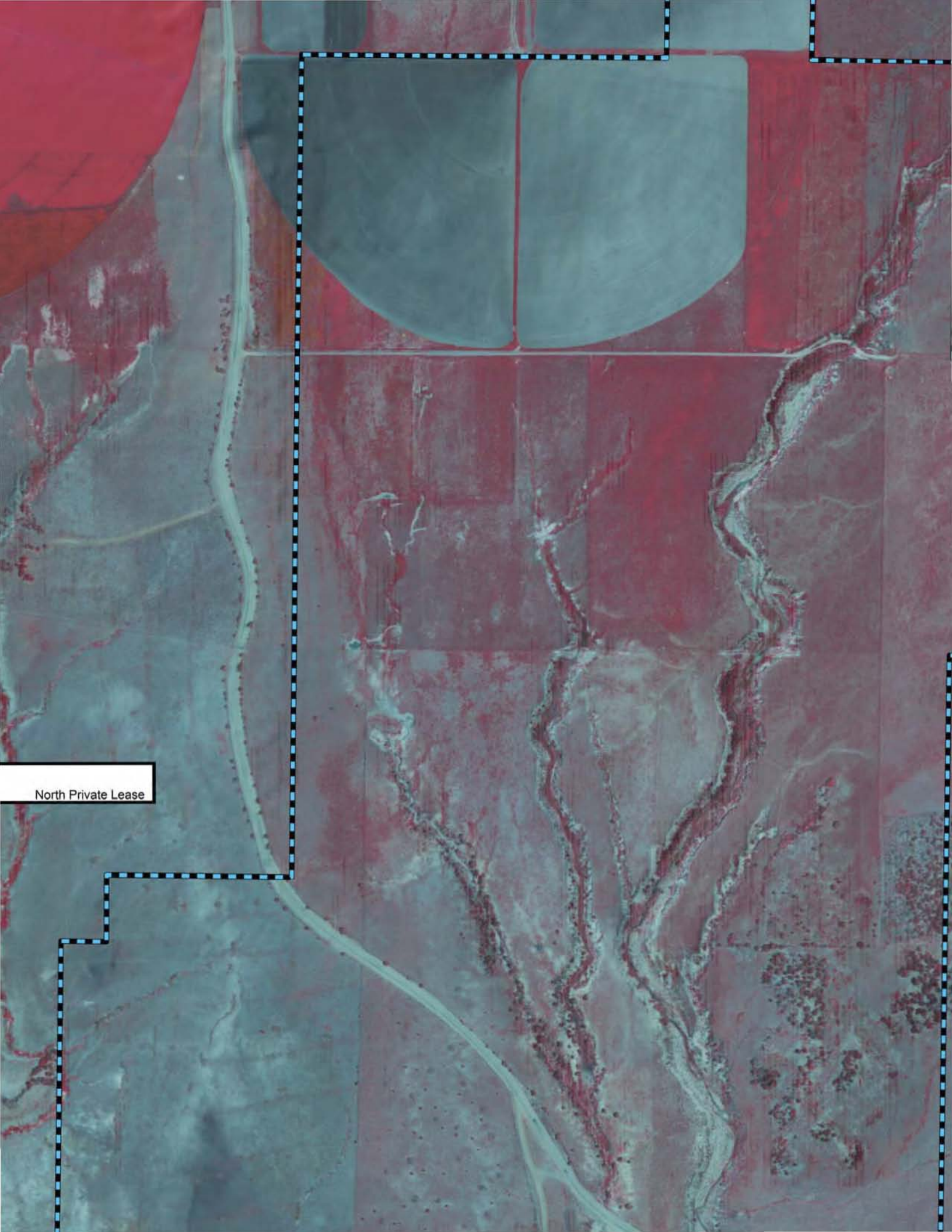
8-12
4-12
4-8
8-30
8-30
4-8
8-30
8-30

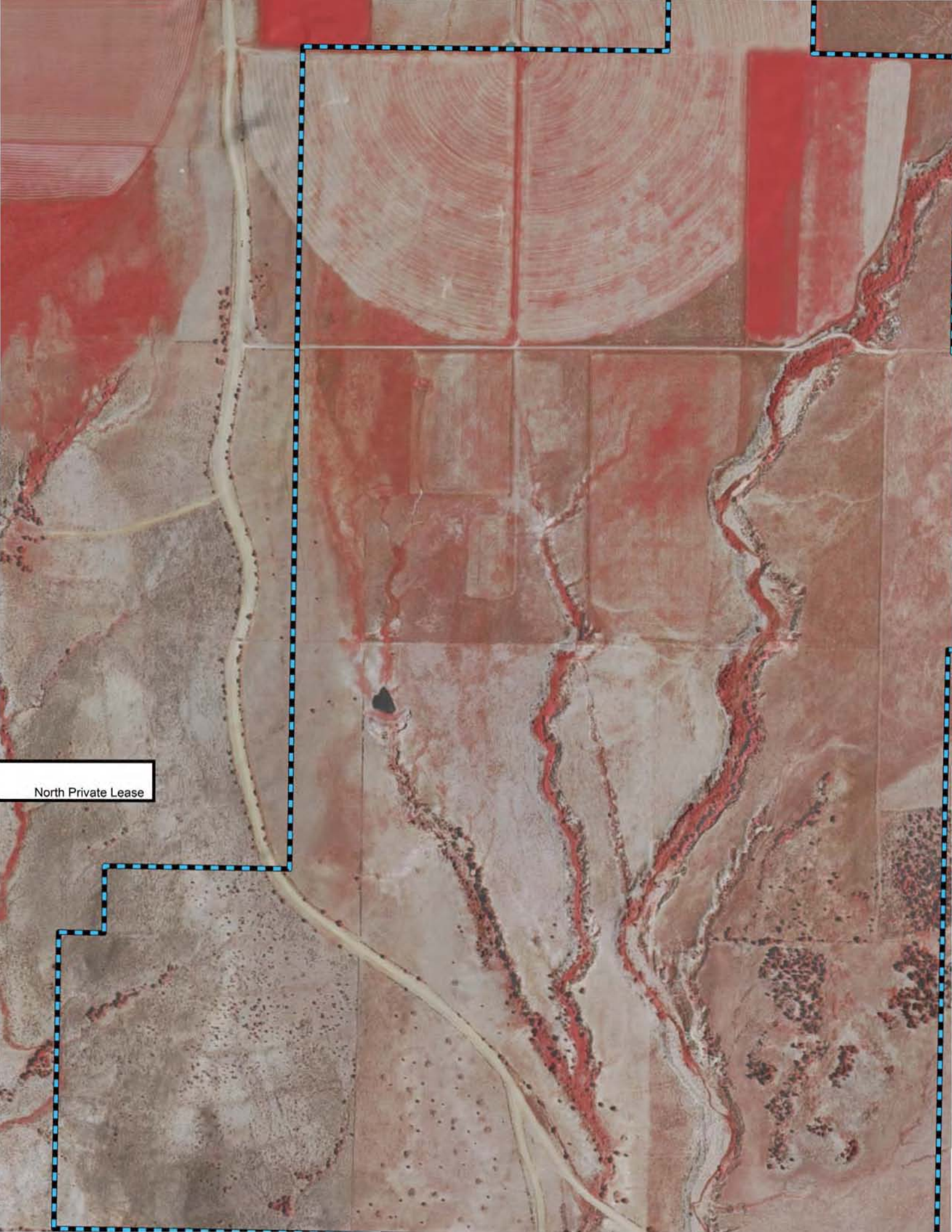

1111
1103
1108
1115
North Private Lease
Survey
ap Units
1111
1113


North Private Lease
land, if irrigated
Irrigated
Not Irrigated


Cropland
Wetlands
Pastureland
Wetlands
Wetlands
Pastureland
North Private Lease
Vegetation Types
Pinyon Juniper
Sagebrush
Wetlands
Undeveloped
Rangeland
Pastureland


V-06
V-11
V-12
V-05
V-15
V-04
V-13
V-18
V-10
V-09
V-03
V-16
V-17
V-07
V-14
V-20
V-08
V-19
V-02
V-01
Vegetation Sample Locations
North Private Lease


North Private Lease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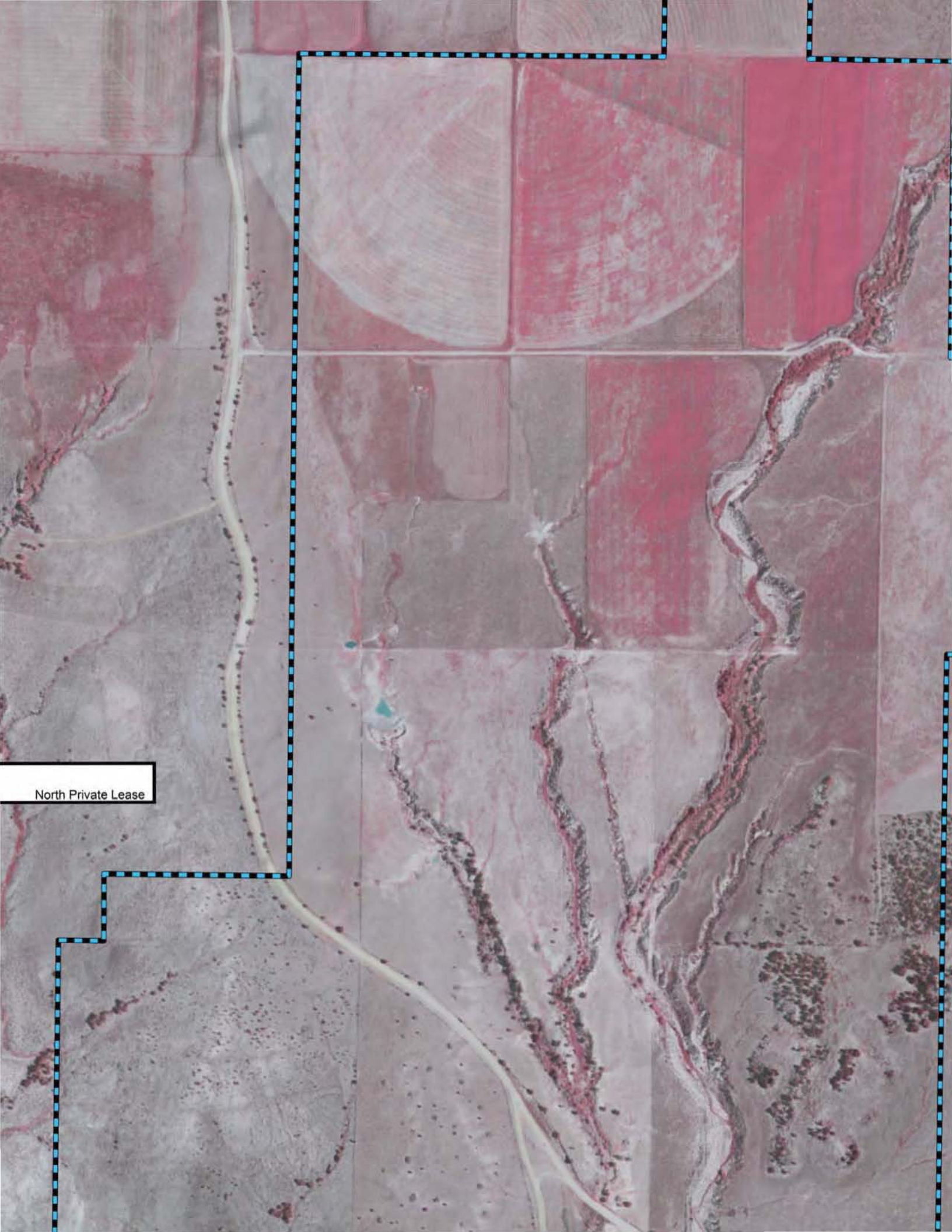
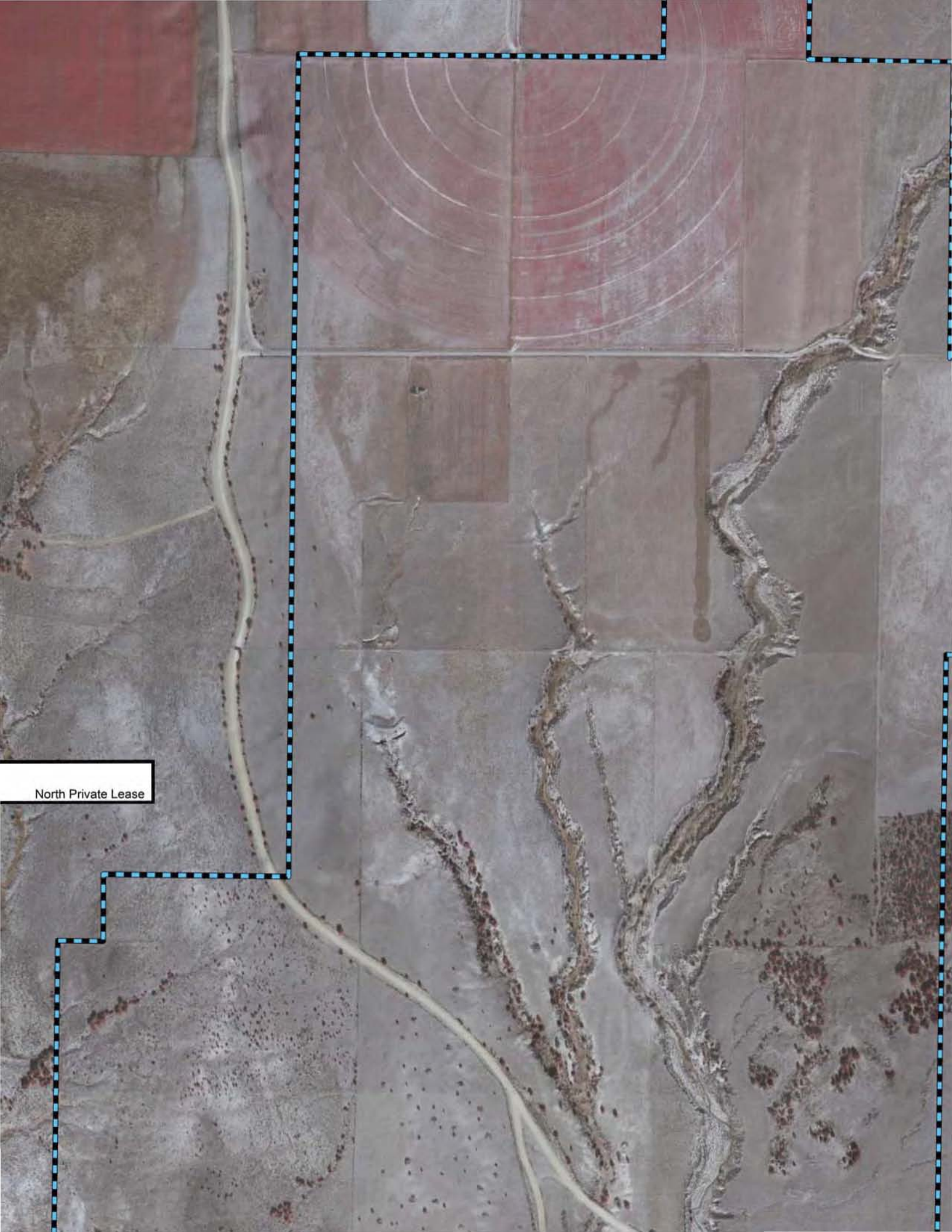

North Private Lease


North Private Lease

Appendix K

Soil Laboratory Analysis

Table of Contents

- Summary pages of laboratory analysis results
- Laboratory analysis reports
- K factors calculated by laboratory

Saturation	Electrical Conductivity	Field Capacity	Wilt Point	Water Capacity	Organic Matter	SAR	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment	Boron	Nitrate (as N)	CO_3	Selenium
%	dS/m	%	%	%	%		%	%	%		%	%	ppm	ppm	%	ppm
56.7	0.67	29.8	21.8	8.0	4.9	0.06	30	39	31	Clay Loam	8		0.58	1.2	46.2	<0.02
54.2	0.53	29.1	22.3	6.8	3.9	0.08	24	41	35	Clay Loam	5		0.60	0.8	47.9	<0.02
62.5	0.50	31.7	23.9	7.8	3.3	0.25	10	49	41	Silty Clay	<0.1		0.63	0.3	52.2	<0.02
66.7	0.67	37.1	29.6	7.5	4.2	0.79	16	40	44	Silty Clay	7		0.71	<0.1	42.9	<0.02
55.4	1.00	27.7	20.7	7.0	1.1	0.19	26	42	32	Clay Loam	6		0.40	0.4	51.8	<0.02
31.7	0.81	17.8	7.6	10.2	0.6	0.10	64	24	12	Sandy Loam	14		0.17	0.7	30.4	<0.02
63.2	1.79	29.0	20.4	8.6	2.2	0.56	30	41	29	Clay Loam	10		0.34	0.6	27.3	<0.02
74.3	1.45	32.8	24.3	8.5	3.3	0.53	20	46	34	Clay Loam	11		0.43	1.1	23.8	<0.02
78.1	1.28	32.4	26.2	6.2	2.6	0.65	24	39	37	Clay Loam	14		0.25	1.4	22.2	<0.02
73.2	1.45	33.1	26.9	6.2	2.5	0.67	18	42	40	Silty Clay	8		0.26	2.2	33.2	<0.02
70.9	1.91	35.3	27.4	7.9	2.7	0.69	10	52	38	Silty Clay Loam	1		0.47	1.4	47.9	<0.02
61.6	0.64	31.2	22.8	8.4	4.4	0.11	24	39	37	Clay Loam	6		0.79	11.9	46.4	<0.02
57.9	0.61	30.3	22.2	8.1	2.7	0.07	25	33	42	Clay	11		0.72	15.8	50.8	<0.02
45.4	0.38	24.2	14.7	9.5	0.5	0.11	25	53	22	Silty Loam	13		0.37	4.5	45.4	<0.02
48.0	0.42	24.6	15.3	9.3	0.9	0.14	27	50	23	Silty Loam	10		0.34	4.7	41.1	<0.02
40.2	0.45	22.3	11.9	10.4	1.1	0.25	43	41	16	Loam	7		0.39	4.4	33.4	<0.02
63.6	0.61	28.6	19.8	8.8	6.4	0.04	65	15	20	Sandy Clay Loam	16		0.37	0.3	4.1	<0.02
46.8	0.35	21.7	11.4	10.3	1.4	0.05	67	10	23	Sandy Clay Loam	17		0.25	0.2	1.8	<0.02
34.8	0.26	9.5	5.3	4.2	0.6	0.07	77	14	9	Sandy Loam	10		0.15	0.5	5.9	<0.02
49.7	0.33	23.2	16.2	7.0	1.3	0.09	39	34	27	Clay Loam	10		0.25	0.3	14.4	<0.02
62.6	0.45	32.1	27.3	4.8	3.9	0.09	17	33	50	Clay	5		0.45	0.2	23.1	<0.02
74.9	0.33	37.2	29.6	7.6	2.3	0.14	9	33	58	Silty Clay	5		0.22	0.2	23.5	<0.02
82.1	0.44	44.7	37.7	7.0	1.1	0.90	7	29	64	Clay	3		0.54	0.6	24.4	<0.02
50.3	0.40	22.8	15.4	7.4	1.9	0.05	47	24	29	Sandy Clay Loam	12		0.30	0.3	3.0	<0.02
51.5	0.34	25.1	19.0	6.1	1.8	0.07	37	27	36	Clay Loam	4		0.36	0.9	1.4	<0.02
42.5	0.32	15.3	15.9	-0.6	1.3	0.09	67	11	22	Sandy Clay Loam	17		0.25	0.5	19.9	<0.02
46.4	0.43	22.9	12.7	10.2	4.0	0.05	63	20	17	Sandy Loam	12		0.19	0.7	11.8	<0.02
44.3	0.48	21.6	9.0	12.6	2.5	0.04	77	11	12	Sandy Loam	11		0.13	0.2	15.7	<0.02
65.2	0.59	29.6	24.5	5.1	4.8	0.07	26	35	39	Clay Loam	7		0.65	3.5	22.2	<0.02
60.7	0.45	28.2	21.1	7.1	3.4	0.06	10	46	44	Silty Clay	<0.1		0.51	0.5	25.4	<0.02
64.1	0.33	30.9	23.9	7.0	1.8	0.13	<0.1	47	53	Silty Clay	<0.1		0.34	0.5	42.4	<0.02
62.9	0.26	27.7	22.9	4.8	1.3	0.13	<0.1	48	52	Silty Clay	<0.1		0.49	0.6	52.6	<0.02
55.8	0.25	26.7	22.2	4.5	0.9	0.11	<0.1	53	47	Silty Clay	<0.1		0.36	0.5	51.8	<0.02
64.0	0.28	27.7	23.7	4.0	1.0	0.15	<0.1	49	51	Silty Clay	<0.1		0.33	0.4	49.2	<0.02
52.7	0.32	25.7	20.3	5.4	2.3	0.22	6	58	36	Silty Clay Loam	<0.1		0.25	0.5	45.2	<0.02
26.4	0.38	17.6	5.1	12.5	1.0	0.41	60	30	10	Sandy Loam	3		0.11	0.2	25.7	<0.02
29.6	0.44	19.1	6.3	12.8	1.2	0.21	56	32	12	Sandy Loam	7		0.15	0.2	25.6	<0.02
31.3	0.35	19.8	4.9	14.9	1.1	0.20	66	26	8	Sandy Loam	8		0.11	0.2	20.5	<0.02
38.9	0.44				1.2	0.33	35	50	15	Silty Loam	17		0.21	0.2	25.0	<0.02

Saturation	Electrical Conductivity	Field Capacity	Wilt Point	Water Capacity	Organic Matter	SAR	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment	Boron	Nitrate (as N)	CO_3	Selenium
%	dS/m	%	%	%	%		%	%	%		%	%	ppm	ppm	%	ppm
72.5	0.56	41.6	28.7	12.9	5.7	0.12	10	50	40	Silty Clay	<0.1		0.68	1.9	47.6	<0.02
65.2	0.42	43.3	26.9	16.4	2.4	0.06	8	68	24	Silty Loam	<0.1		0.63	0.5	57.6	<0.02
52.0	0.37	31.1	20.5	10.6	2.1	0.12	16	50	34	Silty Clay Loam	<0.1		0.22	0.4	50.1	<0.02
32.5	0.27	22.3	7.4	14.9	0.5	0.07	66	18	16	Sandy Loam	18		0.18	0.3	24.4	<0.02
40.2	0.34	23.0	15.9	7.1	0.5	0.10	42	36	22	Loam	10		0.25	0.4	32.4	<0.02
49.3	0.30	24.2	13.0	11.2	1.1	0.08	20	60	20	Silty Loam	11		0.29	<0.1	37.0	<0.02
31.3	0.26	16.9	6.0	10.9	0.5	0.12	60	28	12	Sandy Loam	9		0.18	0.4	25.8	<0.02
80.4	0.30	30.4	25.4	5.0	0.9	0.21	<0.1	48	52	Silty Clay	<0.1		0.57	0.8	48.0	<0.02
66.5	0.54	35.7	25.7	10.0	6.1	0.05	18	41	41	Silty Clay	<0.1		0.83	0.9	39.8	<0.02
65.8	0.46	32.8	23.3	9.5	4.5	0.04	18	40	42	Silty Clay	1		1.06	0.8	43.3	<0.02
39.4	0.37	22.7	14.2	8.5	1.3	0.07	<0.1	61	39	Silty Clay Loam	<0.1		0.27	0.4	41.4	<0.02
51.0	0.36	30.9	24.4	6.5	0.6	0.11	<0.1	37	63	Clay	<0.1		0.25	0.4	55.2	<0.02
31.3	0.31				1.0	0.41	70	18	12	Sandy Loam	4		0.17	0.3	24.4	<0.02
66.4	0.35	29.8	25.0	4.8	1.0	0.11	<0.1	25	75	Clay	<0.1		0.64	0.5	51.0	<0.02
65.7	0.50	26.5	22.2	4.3	1.3	0.21	<0.1	17	83	Clay	<0.1		0.34	1.1	49.5	<0.02
66.4	0.53	34.1	23.2	10.9	6.0	0.04	<0.1	37	63	Clay	<0.1		0.50	1.2	38.6	<0.02
73.3	0.45	35.8	28.1	7.7	4.1	0.04	<0.1	25	75	Clay	<0.1		0.95	0.7	49.0	<0.02
49.5	0.40	27.6	19.8	7.8	0.8	0.08	<0.1	37	63	Clay	<0.1		0.45	0.5	61.7	<0.02
30.9	0.26	13.3	7.7	5.6	0.3	0.09	42	33	25	Loam	<0.1		0.20	0.3	28.9	<0.02
29.0	0.35	10.3	5.2	5.1	0.3	0.83	50	32	18	Loam	<0.1		0.14	0.4	25.5	<0.02
29.3	0.28	12.3	4.9	7.4	0.6	0.09	50	33	17	Loam	<0.1		0.13	0.6	25.6	<0.02
31.9	0.25	7.3	3.2	4.1	0.3	0.08	50	33	17	Loam	<0.1		0.13	0.4	18.1	<0.02
97.3	0.37	28.4	22.5	5.9	4.4	0.06	<0.1	28	72	Clay	<0.1		0.44	1.0	3.5	<0.02
29.3	0.30	22.3	15.2	7.1	1.6	0.11	<0.1	39	61	Clay	<0.1		0.18	0.9	10.7	<0.02
51.8	0.27	21.4	15.9	5.5	0.9	1.11	<0.1	39	61	Clay	<0.1		0.17	0.3	14.9	<0.02
53.8	0.30	25.9	22.3	3.6	0.8	2.54	<0.1	27	73	Clay	<0.1		0.45	0.4	10.1	<0.02
65.9	0.34	35.4	27.0	8.4	2.5	0.26	6	43	51	Silty Clay	2		0.55	2.3	4.1	<0.02
69.1	0.31	34.3	28.0	6.3	1.8	1.09	6	43	51	Silty Clay	2		0.28	0.2	5.9	<0.02
75.8	0.39	35.5	30.2	5.3	1.1	3.41	4	44	52	Silty Clay	0		0.40	0.1	6.4	<0.02
76.7	0.80	36.0	29.8	6.2	2.0	5.57	10	37	53	Clay	6		0.76	<0.1	6.3	<0.02
82.7	1.65	37.9	31.1	6.8	1.0	7.44	6	39	55	Silty Clay	2		0.93	0.2	6.6	0.04
72.1	0.47	39.8	30.8	9.0	3.7	0.34	10	39	51	Clay	4		0.71	3.4	5.3	<0.02
76.7	0.39	39.4	34.0	5.4	2.4	1.08	12	32	56	Silty Clay	7		0.55	1.1	8.4	<0.02
84.0	0.98	42.4	37.2	5.2	1.7	4.44	10	30	60	Clay	6		1.01	1.1	12.6	<0.02
52.7	6.55	44.2	39.2	5.0	1.0	6.85	10	31	59	Silty Clay	6		3.35	0.9	7.4	0.02
72.5	10.9	36.8	32.0	4.8	0.8	7.29	20	32	48	Clay	16		2.47	0.9	11.9	0.02

Saturation	Electrical Conductivity	Field Capacity	Wilt Point	Water Capacity	Organic Matter	SAR	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment	Boron	Nitrate (as N)	CO_3	Selenium
%	dS/m	%	%	%	%		%	%	%		%	%	ppm	ppm	%	ppm
50.7	0.43	28.0	17.6	10.4	2.9	0.17	22	46	32	Clay Loam	14		0.40	1.5	11.6	<0.02
51.6	0.37	26.8	16.8	10.0	1.9	0.09	18	49	33	Silty Clay Loam	10		0.32	0.4	13.9	<0.02
57.2	0.78	25.5	18.0	7.5	1.3	3.53	22	37	41	Clay	16		0.37	0.3	14.5	<0.02
47.8	0.38	26.0	16.8	9.2	1.7	0.44	22	47	31	Clay Loam	13		0.34	0.5	17.8	<0.02
84.5	0.33	47.8	38.8	9.0	3.5	0.57	14	31	55	Silty Clay	9		0.62	3.0	4.0	<0.02
186	0.24	99.0	96.6	2.4	1.9	1.30	10	23	67	Clay	7		0.43	0.3	4.4	<0.02
87.9	3.35	47.8	42.8	5.0	0.3	4.55	16	31	53	Clay	6		0.93	0.4	2.7	<0.02
83.7	4.64	44.6	40.0	4.6	0.6	6.60	18	24	58	Silty Clay	5		0.76	0.7	1.6	<0.02
80.2	6.14	44.6	38.9	5.7	0.2	10.3	16	29	55	Silty Clay	9		0.62	0.2	1.3	<0.02
72.1	0.46	40.8	30.8	10.0	5.6	0.06	26	38	36	Clay Loam	9		1.03	0.4	61.5	<0.02
63.2	0.24	34.2	22.2	12.0	1.9	0.07	26	42	32	Clay Loam	7		0.31	<0.1	59.5	<0.02
65.5	0.25	27.2	23.6	3.6	1.3	0.14	8	48	44	Silty Clay	4		0.45	<0.1	54.1	<0.02
70.9	0.26	27.3	22.7	4.6	1.2	0.19	18	42	40	Silty Clay	12		0.31	<0.1	55.4	<0.02
40.7	0.21	14.6	8.3	6.3	0.5	0.14	60	28	12	Sandy Loam	17		0.12	<0.1	27.9	<0.02
20.1	0.34	12.6	3.0	9.6	0.2	0.21	80	14	6	Loamy Sand	7		0.09	0.8	18.3	<0.02
77.4	1.19	29.3	24.9	4.4	2.2	0.58	<0.1	53	47	Silty Clay	<0.1		0.34	3.6	42.9	<0.02
30.1	1.73	14.3	6.4	7.9	0.9	0.75	74	15	11	Sandy Loam	7		0.11	0.9	20.0	<0.02
45.2	2.62	19.8	12.7	7.1	1.4	1.26	28	51	21	Silty Loam	2		0.21	1.4	37.1	<0.02
70.1	2.37	27.3	21.1	6.2	3.0	1.23	14	54	32	Silty Clay Loam	4		0.47	0.2	37.1	<0.02
87.1	1.57	25.6	20.8	4.8	1.8	1.33	16	44	40	Silty Clay	<0.1	1.8	0.30	0.2	35.1	<0.02
67.6	0.60	40.7	33.0	7.7	5.5	0.21	16	41	43	Silty Clay	2		0.70	2.6	56.0	<0.02
72.6	0.40	40.2	33.3	6.9	5.8	0.04	12	41	47	Silty Clay	0		0.76	1.5	57.2	<0.02
62.8	0.33	42.0	31.2	10.8	3.9	0.09	10	46	44	Silty Clay	<0.1		0.70	0.7	57.1	<0.02
61.1	0.20	26.8	23.5	3.3	1.1	0.07	24	35	41	Clay	19		0.56	0.4	50.8	<0.02
36.6	0.27	19.1	11.7	7.4	0.4	0.16	46	35	19	Loam	11		0.28	0.4	32.1	<0.02
35.0	0.31	20.8	10.6	10.2	2.8	0.11	44	41	15	Loam	12		0.22	0.3	32.4	<0.02
33.0	0.44	20.1	10.9	9.2	0.2	0.31	52	33	15	Sandy Loam	11		0.20	0.3	30.7	<0.02
87.7	0.59	38.8	32.4	6.4	7.4	0.04	20	49	31	Clay Loam	3		0.52	4.7	38.2	<0.02
84.9	0.29	35.2	29.5	5.7	4.2	0.05	12	51	37	Silty Clay Loam	2		0.75	<0.1	76.3	<0.02
81.2	0.30	36.7	29.3	7.4	2.8	0.10	10	50	40	Silty Clay	2		0.64	<0.1	60.4	<0.02
67.0	0.31	27.4	24.6	2.8	0.9	0.29	8	51	41	Silty Clay	2		0.33	<0.1	52.4	<0.02
61.4	0.51	26.6	22.8	3.8	1.2	0.40	10	54	36	Silty Clay Loam	5		0.29	<0.1	44.9	<0.02
51.1	0.66	23.3	18.3	5.0	1.1	0.43	10	64	26	Silty Loam	5		0.28	<0.1	54.2	<0.02
51.8	1.48	18.8	10.7	8.1	1.1	0.90	38	40	22	Loam	2		0.09	1.4	35.4	<0.02
35.4	2.57	19.0	8.6	10.4	1.0	0.18	56	30	14	Sandy Loam	6		0.09	0.2	28.2	<0.02
45.2	1.63	20.3	14.3	6.0	1.1	0.22	32	48	20	Loam	10		0.06	0.1	34.8	<0.02
	1.86					0.30	88	8	5	Sand	13		0.24		18.6	<0.02

Saturation	Electrical Conductivity	Field Capacity	Wilt Point	Water Capacity	Organic Matter	SAR	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment	Boron	Nitrate (as N)	CO_3	Selenium
%	dS/m	%	%	%	%		%	%	%		%	%	ppm	ppm	%	ppm
75.3	0.48	32.5	24.2	8.3	5.1	0.05	24	41	35	Clay Loam	11		1.07	<0.1	19.7	<0.02
70.1	0.43	36.1	25.0	11.1	3.9	0.04	22	45	33	Clay Loam	11		1.37	<0.1	30.7	<0.02
68.7	0.39	38.8	25.6	13.2	2.7	0.10	22	46	32	Clay Loam	8		1.42	<0.1	56.3	<0.02
47.4	0.33	29.4	14.6	14.8	0.7	0.11	32	56	12	Silty Loam	16		0.31	<0.1	60.8	<0.02
34.3	0.34	20.8	12.4	8.4	1.1	0.12	52	36	12	Sandy Loam	10		0.31	<0.1	45.9	<0.02
34.4	0.23	9.3	4.7	4.6	0.9	0.12	82	15	3	Loamy Sand	18		0.16	<0.1	26.1	<0.02
26.4	0.23	8.5	3.4	5.1	0.4	0.13	82	16	2	Loamy Sand	13		0.10	<0.1	22.5	<0.02
86.2	0.54	26.1	22.2	3.9	1.9	0.18	<0.1	59	41	Silty Clay	<0.1		0.46	2.3	47.8	0.03
30.1	2.36	18.7	4.4	14.3	1.4	0.09	73	21	6	Sandy Loam	5		0.12	2.7	19.4	<0.02
31.7	2.41	18.2	5.6	12.6	1.5	0.14	75	19	6	Sandy Loam	<0.1	22.8	0.09	2.3	31.0	<0.02
54.2	2.75	27.2	15.0	12.2	2.3	0.12	31	52	17	Silty Loam	10		0.24	1.5	35.2	<0.02
46.1	2.85	26.4	16.9	9.5	2.6	0.15	37	37	26	Loam	3		0.37	0.2	24.6	<0.02
30.5	2.68	20.5	6.8	13.7	1.2	0.15	73	17	10	Sandy Loam	6		0.16	0.4	22.9	<0.02
23.5	0.71	12.3	5.6	6.7	0.8	0.19	81	13	6	Loamy Sand	3	60.7	0.08	0.2	70.7	<0.02
23.9	0.28	12.3	6.1	6.2	0.7	0.11	84	14	2	Loamy Sand	13		0.08	<0.1	53.1	<0.02
27.2	0.25	11.8	5.1	6.7	0.3	0.12	90	8	2	Sand	9	65.9	0.08	<0.1	62.2	<0.02
29.2	0.36	11.4	5.8	5.6	0.4	0.18	86	12	2	Sand	7	63.1	0.11	<0.1	60.5	<0.02
26.5	0.37	15.1	4.7	10.4	0.3	0.16	90	9	1	Sand	5	65.9	0.06	<0.1	61.9	<0.02
26.8	0.62	15.6	5.9	9.7	1.0	0.17	82	15	3	Loamy Sand	10	70.2	0.13	<0.1	68.2	<0.02
27.6	0.59	16.3	6.0	10.3	0.5	0.17	84	14	2	Loamy Sand	11	73.8	0.08	<0.1	68.6	<0.02
30.1	2.01	20.5	7.3	13.2	2.5	0.25	80	16	4	Loamy Sand	17	1.1	0.41	<0.1	22.9	<0.02
43.9	0.41	19.0	13.6	5.4	0.3	0.03	50	25	25	Sandy Clay Loam	6		0.32	2.2	16.7	<0.02
38.3	0.32	16.6	11.3	5.3	2.9	0.07	51	25	24	Sandy Clay Loam	2	9.6	0.26	0.5	22.9	<0.02
32.5	0.26	15.1	10.3	4.8	3.0	0.05	64	18	18	Sandy Loam	11	2.7	0.18	0.4	31.5	<0.02
28.7	0.31	12.5	7.1	5.4	1.9	0.36	60	26	14	Sandy Loam	<0.1	6.1	0.26	0.3	22.2	<0.02
29.0	0.26	10.2	5.8	4.4	0.7	0.19	84	8	8	Loamy Sand	11	63.5	0.15	0.3	31.4	<0.02
28.8	0.20	8.6	3.0	5.6	0.2	0.07	80	14	6	Loamy Sand	7	17.9	0.09	0.3	19.2	<0.02
25.6	0.22	15.1	6.7	8.4	0.3	0.11	74	20	6	Sandy Loam	2	62.6	0.12	<0.1	56.7	<0.02
33.1	0.20	16.0	5.6	10.4	0.3	0.10	80	18	2	Loamy Sand	6	64.5	0.08	<0.1	56.6	<0.02
27.9	0.18	15.6	5.0	10.6	0.3	0.09	88	10	2	Sand	10	60.5	0.06	<0.1	55.7	<0.02
27.5	0.78	16.0	5.2	10.8	1.3	0.14	84	14	2	Loamy Sand	8	60.0	0.08	<0.1	54.7	<0.02
30.3	0.55	15.0	5.2	9.8	0.4	0.19	88	11	1	Sand	9	54.4	0.08	<0.1	53.7	<0.02
26.7	1.19	17.6	4.6	13.0	0.7	0.29	80	12	8	Loamy Sand	7		0.08	0.1	20.2	<0.02

Saturation	Electrical Conductivity	Field Capacity	Wilt Point	Water Capacity	Organic Matter	SAR	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment	Boron	Nitrate (as N)	CO_3	Selenium
%	dS/m	%	%	%	%		%	%	%		%	%	ppm	ppm	%	ppm
69.0	0.57	35.4	28.7	6.7	6.4	0.10	22	56	22	Silty Loam	8	0.2	0.98	5.0	27.3	<0.02
60.0	0.50	31.6	26.7	4.9	3.8	0.10	16	41	43	Silty Clay	8	<0.1	0.66	0.4	45.3	<0.02
49.6	0.36	30.4	24.0	6.4	0.7	0.09	12	56	32	Silty Clay Loam	7		0.39	0.2	55.0	<0.02
43.8	0.31	27.5	21.7	5.8	0.5	0.10	32	49	19	Loam	27		0.38	0.2	53.3	<0.02
35.2	0.31	23.2	13.2	10.0	0.2	0.10	38	46	16	Loam	14		0.24	0.2	44.6	<0.02
56.2	0.33	27.2	23.6	3.6	0.7	0.15	20	44	36	Clay Loam	13		0.49	0.3	50.1	<0.02
30.9	0.31	18.5	10.6	7.9	0.2	0.18	58	26	16	Sandy Loam	16		0.38	0.2	30.1	<0.02
28.1	0.27	19.0	6.3	12.7	<0.1	0.11	60	32	8	Sandy Loam	17		0.29	0.3	30.6	<0.02
68.4	0.73	34.8	29.8	5.0	7.0	0.24	20	39	41	Clay	8		0.53	23.0	28.8	<0.02
55.2	0.65	28.9	21.6	7.3	1.9	0.66	20	47	33	Clay Loam	4		0.34	1.4	33.6	<0.02
56.2	0.51	31.3	23.0	8.3	2.0	0.32	30	31	39	Clay Loam	6		0.39	1.0	30.9	<0.02
58.3	0.51	34.2	29.4	4.8	2.3	0.35	10	41	49	Silty Clay	2		0.49	1.1	48.8	<0.02
61.2	0.36	27.8	23.6	4.2	1.2	0.58	20	37	43	Clay	16		0.29	0.6	53.8	<0.02
75.5	0.59	37.7	34.4	3.3	5.5	0.33	24	36	40	Clay	14		0.41	8.4	26.4	<0.02
75.0	0.44	33.6	30.3	3.3	5.0	0.13	24	40	36	Clay Loam	10		0.48	<0.1	26.5	<0.02
65.4	0.45	30.7	26.0	4.7	3.6	0.26	26	36	38	Clay Loam	7		0.68	2.0	33.4	<0.02
58.2	0.42	28.2	21.5	6.7	2.1	1.06	34	30	36	Clay Loam	12		0.21	<0.1	29.0	<0.02
78.6	0.44	35.2	30.0	5.2	1.7	1.37	12	50	38	Silty Clay Loam	6		0.25	<0.1	46.6	<0.02
57.8	0.45	27.8	23.5	4.3	1.2	1.48	6	54	40	Silty Clay	3		0.37	<0.1	51.6	<0.02
80.4	0.49	27.0	22.1	4.9	1.7	1.27	<0.1	52	48	Silty Clay	<0.1		0.13	0.9	46.2	<0.02
66.7	0.59	31.0	23.0	8.0	1.5	1.09	12	39	49	Clay	<0.1		0.11	0.6	27.2	<0.02
88.6	0.60	35.6	29.0	6.6	1.4	1.04	4	37	59	Silty Clay	<0.1		0.21	0.4	29.0	<0.02
38.6	0.76	23.6	11.6	12.0	0.9	1.45	46	32	22	Loam	8		0.17	0.3	26.5	<0.02
31.6	0.88	21.7	5.7	16.0	0.6	1.68	64	26	10	Sandy Loam	7		0.13	0.4	24.9	<0.02
71.5	0.82	34.2	30.3	3.9	5.9	0.17	18	38	44	Clay	6		1.01	23.9	48.6	<0.02
71.5	0.63	33.0	28.3	4.7	4.0	0.17	18	43	39	Silty Clay Loam	8		0.79	7.2	49.4	<0.02
63.3	0.36	31.0	25.6	5.4	1.6	0.19	10	46	44	Silty Clay	5		0.38	0.4	53.8	<0.02
39.5	0.34	20.8	13.5	7.3	0.4	0.19	52	36	12	Sandy Loam	17		0.17	<0.1	42.6	<0.02
61.4	0.36	28.0	22.6	5.4	1.0	0.24	12	56	32	Silty Clay Loam	6		0.29	<0.1	47.1	<0.02
68.2	0.38	30.9	25.6	5.3	1.4	0.30	12	46	42	Silty Clay	2		0.28	<0.1	51.7	<0.02
38.8	0.35	20.1	13.7	6.4	0.9	0.29	48	40	12	Loam	12		0.12	<0.1	46.7	<0.02
30.7	0.52	22.8	8.0	14.8	0.6	0.35	50	38	12	Loam	10		0.07	1.7	33.2	<0.02
33.4	0.57				1.0	0.40	72	18	10	Sandy Loam	7		0.11	2.0	18.7	<0.02
25.9	0.77	20.9	5.0	15.9	3.3	0.41	72	20	8	Sandy Loam	7		0.07	1.6	21.2	<0.02
56.3	2.61	29.4	18.3	11.1	1.7	0.20	28	46	26	Loam	6		0.10	1.6	27.1	<0.02
33.9	2.38	21.8	8.8	13.0	1.1	0.13	54	32	14	Sandy Loam	5		0.09	0.2	25.3	<0.02

Saturation	Electrical Conductivity	Field Capacity	Wilt Point	Water Capacity	Organic Matter	SAR	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment	Boron	Nitrate (as N)	CO_3	Selenium
%	dS/m	%	%	%	%		%	%	%		%	%	ppm	ppm	%	ppm
60.7	1.18	30.8	22.8	8.0	5.0	0.09	46	24	30	Sandy Clay Loam	28		0.71	56.5	25.6	<0.02
60.2	0.40	29.3	18.7	10.6	2.4	0.09	32	30	38	Clay Loam	7		0.26	6.5	16.5	<0.02
68.2	0.36	31.6	25.2	6.4	2.1	0.15	12	40	48	Silty Clay	<0.1		0.45	0.9	24.1	<0.02
72.4	0.45	39.7	33.1	6.6	5.1	0.19	2	40	58	Clay	<0.1		0.33	1.2	39.2	<0.02
60.8	0.36	34.8	27.9	6.9	1.6	0.27	8	34	58	Silty Clay	3		0.21	1.2	51.2	<0.02
52.5	0.38	29.2	23.4	5.8	1.0	0.39	6	56	38	Silty Clay Loam	1		0.27	0.7	57.7	<0.02
67.4	0.48	33.2	25.4	7.8	1.1	0.64	8	40	52	Silty Clay	4		0.39	0.9	47.1	<0.02
53.6	4.85	27.5	17.1	10.4	1.1	1.69	44	24	32	Clay Loam	3		0.35	0.4	24.9	<0.02
25.9	5.24	21.4	7.5	13.9	0.6	3.10	62	24	14	Sandy Loam	2	8.0	0.09	0.9	25.6	<0.02
29.8	4.81	21.1	6.0	15.1	0.6	2.56	4	40	56	Clay	<0.1		0.11	0.1	23.2	<0.02
114	1.85				1.5	1.03	64	16	20	Sandy Clay Loam	60		0.36	0.2	26.6	<0.02
65.1	0.39	32.0	26.9	5.1	2.5	0.44	12	35	53	Clay	8		0.65	1.1	21.6	<0.02
66.5	0.37	32.7	28.5	4.2	1.9	1.17	16	30	54	Clay	12		0.71	0.6	21.5	<0.02
69.5	0.36	32.8	29.2	3.6	1.8	2.42	14	32	54	Clay	10		0.94	<0.1	21.8	<0.02
59.7	0.69	33.7	29.9	3.8	1.9	4.65	10	36	54	Clay	6		1.05	<0.1	21.3	<0.02
82.2	1.57	36.1	31.0	5.1	1.9	8.03	10	34	56	Silty Clay	6		1.35	0.2	21.6	0.03
65.4	0.47	32.3	22.6	9.7	3.7	0.08	20	37	43	Clay	11		0.26	2.8	23.3	<0.02
67.1	0.46	32.1	24.8	7.3	3.4	0.12	20	35	45	Clay	11		0.32	1.1	23.4	<0.02
60.8	0.46	32.2	25.2	7.0	3.7	0.08	20	36	44	Clay	6		0.51	0.6	18.4	<0.02
60.2	0.37	24.4	17.6	6.8	2.2	0.15	46	22	32	Sandy Clay Loam	17		0.29	0.5	22.4	<0.02
39.8	0.29	20.5	11.3	9.2	0.9	0.16	46	36	18	Loam	13		0.21	0.6	36.4	<0.02
39.4	0.22	13.6	5.8	7.8	0.7	0.18	68	20	12	Sandy Loam	8		0.14	0.5	35.0	<0.02
32.9	0.24	14.4	7.2	7.2	0.7	0.23	74	16	10	Sandy Loam	13		0.14	<0.1	24.0	<0.02
84.2	0.59	41.5	27.9	13.6	4.5	0.44	26	31	43	Clay	19		0.67	1.7	6.5	<0.02
75.7	0.45	38.7	33.1	5.6	1.9	1.49	20	31	49	Clay	16		0.66	0.6	7.6	<0.02
83.7	0.79	41.3	30.3	11.0	3.0	3.77	16	28	56	Silty Clay	12		1.11	<0.1	12.4	<0.02
82.9	4.96	43.9	29.1	14.8	3.0	7.56	16	24	60	Clay	10		3.04	0.5	9.1	<0.02
79.7	6.16	39.2	28.1	11.1	3.0	10.3	16	31	53	Clay	11		2.62	0.7	9.3	<0.02

Poor	Unacceptable

Saturation	Electrical Conductivity	Field Capacity	Wilt Point	Water Capacity	Organic Matter	SAR	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment	Boron	Nitrate (as N)	CO3	Selenium
%	dS/m	%	%	%	%		%	%	%		%	%	ppm	ppm	%	ppm
	0.35				3.6	0.13	10	44	46	Silty Clay	<0.1		0.33	1.9	47.9	<0.02
68.9	0.37				1.1	0.17	9	39	53	Clay	2.7				50.4	
64.9	0.26				1.0	0.16	6	44	50	Silty Clay	0.3		0.21	0.5	50.1	<0.02
43.6	0.35				0.6	0.20	37	42	21	Loam	26.5		0.24	0.8	45.9	<0.02
29.9	0.28				0.4	0.12	63	28	9	Sandy Loam	34.6		0.16	0.3	32.4	<0.02
31.7	0.52				1.2	0.20	58	31	11	Sandy Loam	26.3		0.17	3.3	31.6	0.03
72.1	1.87				2.6	0.15	18	43	39	Silty Clay Loam	13.2		0.31	54.1	42.8	0.05
46.3	1.96				1.0	0.18	38	42	20	Loam	29.0		0.10	11.4	47.0	<0.02
29.7	2.20				1.1	0.37	59	32	9	Sandy Loam	34.5		0.16	4.8	32.0	<0.02
66.1	1.98				2.9	0.67	26	40	34	Clay Loam	21.3		0.48	0.5	29.3	<0.02
27.4	1.69				0.5	1.17	86	9	5	Loamy Sand	28.2		0.17	<0.1	19.4	<0.02
60.5	0.45				6.0	0.08	24	35	41	Clay	17.9		0.56	1.5	36.7	<0.02
56.9	0.17				2.3	0.13	24	33	43	Clay	19.6		0.47	0.6	45.9	<0.02
58.3	0.24				1.4	0.11	24	37	39	Clay Loam	19.1		0.46	0.6	49.0	<0.02
40.1	0.31				0.5	0.26	39	40	21	Loam	25.0		0.45	0.3	39.9	<0.02
					0.4		70	20	10	Sandy Loam	11.5				23.3	
72.0	0.59				0.9	1.14	36	24	40	Clay	32.2		0.37	0.6	42.5	<0.02
51.9	0.65				0.6	1.13	44	32	24	Loam	34.5		0.29	0.5	17.5	0.06
56.4	0.21				2.4	0.15	38	31	31	Clay Loam	25.7		0.47	<0.1	14.8	<0.02
58.6	0.18				1.8	0.65	32	36	32	Clay Loam	22.7		0.26	0.7	21.3	<0.02
54.8	0.19				1.9	1.76	34	32	34	Clay Loam	28.9		0.42	0.4	23.9	<0.02
60.2	0.24				2.6	0.13	36	31	33	Clay Loam	27.2		0.52	<0.1	18.6	<0.02
54.8	0.24				1.6	0.16	36	30	34	Clay Loam	25.1		0.28	0.6	21.4	<0.02
56.0	0.20				1.4	0.37	38	26	36	Clay Loam	27.5		0.42	0.6	21.3	<0.02
53.2	0.95				1.3	1.39	38	27	35	Clay Loam	25.3		0.62	0.2	22.4	<0.02
63.2	0.46				1.0	5.21	38	26	36	Clay Loam	26.3		0.92	1.5	21.8	<0.02
51.4	0.24				2.7	0.09	50	27	23	Sandy Clay Loam	25.5		0.30	0.6	6.3	<0.02
54.5	0.21				2.3	0.14	48	25	27	Sandy Clay Loam	28.6		0.29	0.2	10.2	<0.02
57.0	0.18				1.8	0.15	42	27	31	Clay Loam	28.7		0.41	1.6	15.2	<0.02
62.9	0.20				1.4	0.59	40	28	32	Clay Loam	28.6		0.60	0.6	17.3	<0.02
59.1	0.40				1.0	1.61	46	24	30	Sandy Clay Loam	31.3		0.67	0.1	17.5	<0.02
60.5	0.20				2.5	0.20	34	31	35	Clay Loam	24.9		0.29	2.8	17.1	<0.02
64.6	1.05				2.4	1.13	34	28	38	Clay Loam	26.5		0.34	3.6	18.0	<0.02
63.2	0.33				2.4	1.88	28	33	39	Clay Loam	21.0		0.54	2.2	18.9	<0.02
73.1	0.92				2.8	5.82	32	29	39	Clay Loam	25.5		0.75	0.8	19.4	<0.02
76.3	2.20				1.7	6.35	10	37	53	Clay	4.5		0.94	1.0	22.1	0.08
73.0	2.63				1.4	4.73	32	18	50	Clay	24.2		1.18	3.6	22.8	0.07
78.9	2.30				1.4	3.80	10	37	53	Clay	5.3		0.93	7.4	22.9	0.02
76.0	1.17				1.2	5.22	14	35	51	Clay	8.4		0.94	5.7	24.3	0.02

Saturation	Electrical Conductivity	Field Capacity	Wilt Point	Water Capacity	Organic Matter	SAR	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment	Boron	Nitrate (as N)	CO3	Seleniur
%	dS/m	%	%	%	%		%	%	%		%	%	ppm	ppm	%	ppm
72.8	0.55				4.6	0.21	23	38	39	Clay Loam	8.5		0.58	2.1	16.1	<0.02
61.7	0.37				2.7	0.73	46	12	42	Sandy Clay	36.3		0.57	0.3	18.9	<0.02
62.3	0.39				1.7	2.78	16	37	47	Clay	8.7		0.51	<0.1	20.8	<0.02
74.9	3.20				1.8	3.83	16	33	51	Clay	10.5		0.84	<0.1	21.3	<0.02
73.8	3.17				1.4	3.61	47	4	49	Sandy Clay	41.2		1.38	0.9	24.0	0.06
65.5	2.87				1.3	3.78	18	36	46	Clay	6.3		0.97	1.3	24.0	0.03
72.7	2.40				1.4	4.19	48	11	41	Sandy Clay	41.5		1.03	0.3	22.4	0.03
79.7	2.93				1.1	3.10	12	35	53	Clay	5.6		1.06	0.3	24.1	0.03
79.7	1.67				1.1	3.52	56	8	36	Sandy Clay	50.4		0.70	0.3	23.0	<0.02
69.8	1.41				1.1	3.02	10	39	51	Clay	3.8		0.53	0.7	23.5	<0.02
65.5	0.85				1.1	2.29	32	19	49	Clay	23.1		0.41	0.2	25.3	<0.02
22.9	0.41				0.4	0.69	82	13	5	Loamy Sand	3.7		0.10	0.3	51.9	<0.02
22.8	0.60				0.7	0.56	86	6	8	Loamy Sand	27.3		0.11	0.3	28.2	<0.02
34.0	0.57				1.0	0.38	64	21	15	Sandy Loam	31.8		0.15	0.4	26.1	<0.02
53.2	0.62				3.3	0.60	28	36	36	Clay Loam	12.0		0.69	<0.1	20.5	<0.02
54.4	0.72				2.6	0.61	32	23	45	Clay	21.9		0.40	0.5	35.6	<0.02
56.7	0.75				1.9	0.57	22	37	41	Clay	8.0		0.37	0.1	30.9	<0.02
49.5	0.29				1.3	0.53	52	16	32	Sandy Clay Loam	30.5		0.26	1.4	43.1	<0.02
26.1	0.27				0.9	0.51	76	15	9	Sandy Loam	14.3		0.12	0.2	18.7	<0.02
22.5	0.53				0.6	0.59	80	12	8	Loamy Sand	13.7		0.11	0.2	56.7	<0.02
23.2	0.58				0.5	0.62	78	16	6	Loamy Sand	4.2		0.07	0.1	68.8	<0.02
24.1	1.47				1.8	0.77	84	9	7	Loamy Sand	21.4		0.19	0.1	43.1	<0.02
71.2	0.63				1.4	0.75	26	28	46	Clay	20.6		0.32	1.2	12.0	<0.02
61.0	0.21				3.2	0.14	14	32	54	Clay	8.0		0.53	<0.1	17.8	<0.02
61.9	0.16				1.4	0.22	28	23	49	Clay	24.1		0.50	1.0	19.7	<0.02
61.8	1.43	35.6	28.4	7.2	3.0	3.04	14	36	50	Clay	5.6		1.00	4.9	18.9	<0.02
52.5	2.96	34.5	22.0	12.5	2.5	2.16	22	35	43	Clay	4.4		0.68	0.5	20.1	<0.02
24.1	1.81				0.7	1.56	78	10	12	Sandy Loam	9.6		0.16	0.3	20.6	<0.02
63.3	4.06	38.2	27.2	11.0	2.6	3.01	20	32	48	Clay	5.0		1.43	11.4	22.2	0.06
23.8	2.52	20.1	7.7	12.4	0.6	2.93	66	22	12	Sandy Loam	13.0		0.40	1.1	31.6	<0.02
25.6	0.37	21.1	7.9	13.2	0.8	0.37	54	32	14	Sandy Loam	8.5		0.20	2.1	34.2	<0.02
					0.4		83	10	8	Loamy Sand	12.0				18.8	
75.8	4.06	34.9	27.5	7.4	1.7	5.87	10	42	48	Silty Clay	<0.1		1.64	0.9	20.4	<0.02
66.9	2.27	31.2	23.8	7.4	1.6	5.41	16	43	41	Silty Clay	8.0		1.19	2.0	24.3	<0.02
79.6	4.22	37.1	28.7	8.4	1.7	6.09	6	37	57	Silty Clay	0.9		1.12	0.6	22.8	<0.02

Poor	Unacceptable

Saturation	Electrical Conductivity	Field Capacity	Wilt Point	Water Capacity	Organic Matter	SAR	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment	Boron	Nitrate (as N)	CO_3	Selenium
%	dS/m	%	%	%	%		%	%	%		%	%	ppm	ppm	%	ppm
56.7	0.67	29.8	21.8	8.0	4.9	0.06	30	39	31	Clay Loam	8		0.58	1.2	46.2	<0.02
54.2	0.53	29.1	22.3	6.8	3.9	0.08	24	41	35	Clay Loam	5		0.60	0.8	47.9	<0.02
62.5	0.50	31.7	23.9	7.8	3.3	0.25	10	49	41	Silty Clay	<0.1		0.63	0.3	52.2	<0.02
66.7	0.67	37.1	29.6	7.5	4.2	0.79	16	40	44	Silty Clay	7		0.71	<0.1	42.9	<0.02
55.4	1.00	27.7	20.7	7.0	1.1	0.19	26	42	32	Clay Loam	6		0.40	0.4	51.8	<0.02
31.7	0.81	17.8	7.6	10.2	0.6	0.10	64	24	12	Sandy Loam	14		0.17	0.7	30.4	<0.02
63.2	1.79	29.0	20.4	8.6	2.2	0.56	30	41	29	Clay Loam	10		0.34	0.6	27.3	<0.02
74.3	1.45	32.8	24.3	8.5	3.3	0.53	20	46	34	Clay Loam	11		0.43	1.1	23.8	<0.02
78.1	1.28	32.4	26.2	6.2	2.6	0.65	24	39	37	Clay Loam	14		0.25	1.4	22.2	<0.02
73.2	1.45	33.1	26.9	6.2	2.5	0.67	18	42	40	Silty Clay	8		0.26	2.2	33.2	<0.02
70.9	1.91	35.3	27.4	7.9	2.7	0.69	10	52	38	Silty Clay Loam	1		0.47	1.4	47.9	<0.02
61.6	0.64	31.2	22.8	8.4	4.4	0.11	24	39	37	Clay Loam	6		0.79	11.9	46.4	<0.02
57.9	0.61	30.3	22.2	8.1	2.7	0.07	25	33	42	Clay	11		0.72	15.8	50.8	<0.02
45.4	0.38	24.2	14.7	9.5	0.5	0.11	25	53	22	Silty Loam	13		0.37	4.5	45.4	<0.02
48.0	0.42	24.6	15.3	9.3	0.9	0.14	27	50	23	Silty Loam	10		0.34	4.7	41.1	<0.02
40.2	0.45	22.3	11.9	10.4	1.1	0.25	43	41	16	Loam	7		0.39	4.4	33.4	<0.02
63.6	0.61	28.6	19.8	8.8	6.4	0.04	65	15	20	Sandy Clay Loam	16		0.37	0.3	4.1	<0.02
46.8	0.35	21.7	11.4	10.3	1.4	0.05	67	10	23	Sandy Clay Loam	17		0.25	0.2	1.8	<0.02
34.8	0.26	9.5	5.3	4.2	0.6	0.07	77	14	9	Sandy Loam	10		0.15	0.5	5.9	<0.02
49.7	0.33	23.2	16.2	7.0	1.3	0.09	39	34	27	Clay Loam	10		0.25	0.3	14.4	<0.02
62.6	0.45	32.1	27.3	4.8	3.9	0.09	17	33	50	Clay	5		0.45	0.2	23.1	<0.02
74.9	0.33	37.2	29.6	7.6	2.3	0.14	9	33	58	Silty Clay	5		0.22	0.2	23.5	<0.02
82.1	0.44	44.7	37.7	7.0	1.1	0.90	7	29	64	Clay	3		0.54	0.6	24.4	<0.02
50.3	0.40	22.8	15.4	7.4	1.9	0.05	47	24	29	Sandy Clay Loam	12		0.30	0.3	3.0	<0.02
51.5	0.34	25.1	19.0	6.1	1.8	0.07	37	27	36	Clay Loam	4		0.36	0.9	1.4	<0.02
42.5	0.32	15.3	15.9	-0.6	1.3	0.09	67	11	22	Sandy Clay Loam	17		0.25	0.5	19.9	<0.02
46.4	0.43	22.9	12.7	10.2	4.0	0.05	63	20	17	Sandy Loam	12		0.19	0.7	11.8	<0.02
44.3	0.48	21.6	9.0	12.6	2.5	0.04	77	11	12	Sandy Loam	11		0.13	0.2	15.7	<0.02
65.2	0.59	29.6	24.5	5.1	4.8	0.07	26	35	39	Clay Loam	7		0.65	3.5	22.2	<0.02
60.7	0.45	28.2	21.1	7.1	3.4	0.06	10	46	44	Silty Clay	<0.1		0.51	0.5	25.4	<0.02
64.1	0.33	30.9	23.9	7.0	1.8	0.13	<0.1	47	53	Silty Clay	<0.1		0.34	0.5	42.4	<0.02
62.9	0.26	27.7	22.9	4.8	1.3	0.13	<0.1	48	52	Silty Clay	<0.1		0.49	0.6	52.6	<0.02
55.8	0.25	26.7	22.2	4.5	0.9	0.11	<0.1	53	47	Silty Clay	<0.1		0.36	0.5	51.8	<0.02
64.0	0.28	27.7	23.7	4.0	1.0	0.15	<0.1	49	51	Silty Clay	<0.1		0.33	0.4	49.2	<0.02
52.7	0.32	25.7	20.3	5.4	2.3	0.22	6	58	36	Silty Clay Loam	<0.1		0.25	0.5	45.2	<0.02
26.4	0.38	17.6	5.1	12.5	1.0	0.41	60	30	10	Sandy Loam	3		0.11	0.2	25.7	<0.02
29.6	0.44	19.1	6.3	12.8	1.2	0.21	56	32	12	Sandy Loam	7		0.15	0.2	25.6	<0.02
31.3	0.35	19.8	4.9	14.9	1.1	0.20	66	26	8	Sandy Loam	8		0.11	0.2	20.5	<0.02
38.9	0.44				1.2	0.33	35	50	15	Silty Loam	17		0.21	0.2	25.0	<0.02

Saturation	Electrical Conductivity	Field Capacity	Wilt Point	Water Capacity	Organic Matter	SAR	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment	Boron	Nitrate (as N)	CO_3	Selenium
%	dS/m	%	%	%	%		%	%	%		%	%	ppm	ppm	%	ppm
72.5	0.56	41.6	28.7	12.9	5.7	0.12	10	50	40	Silty Clay	<0.1		0.68	1.9	47.6	<0.02
65.2	0.42	43.3	26.9	16.4	2.4	0.06	8	68	24	Silty Loam	<0.1		0.63	0.5	57.6	<0.02
52.0	0.37	31.1	20.5	10.6	2.1	0.12	16	50	34	Silty Clay Loam	<0.1		0.22	0.4	50.1	<0.02
32.5	0.27	22.3	7.4	14.9	0.5	0.07	66	18	16	Sandy Loam	18		0.18	0.3	24.4	<0.02
40.2	0.34	23.0	15.9	7.1	0.5	0.10	42	36	22	Loam	10		0.25	0.4	32.4	<0.02
49.3	0.30	24.2	13.0	11.2	1.1	0.08	20	60	20	Silty Loam	11		0.29	<0.1	37.0	<0.02
31.3	0.26	16.9	6.0	10.9	0.5	0.12	60	28	12	Sandy Loam	9		0.18	0.4	25.8	<0.02
80.4	0.30	30.4	25.4	5.0	0.9	0.21	<0.1	48	52	Silty Clay	<0.1		0.57	0.8	48.0	<0.02
66.5	0.54	35.7	25.7	10.0	6.1	0.05	18	41	41	Silty Clay	<0.1		0.83	0.9	39.8	<0.02
65.8	0.46	32.8	23.3	9.5	4.5	0.04	18	40	42	Silty Clay	1		1.06	0.8	43.3	<0.02
39.4	0.37	22.7	14.2	8.5	1.3	0.07	<0.1	61	39	Silty Clay Loam	<0.1		0.27	0.4	41.4	<0.02
51.0	0.36	30.9	24.4	6.5	0.6	0.11	<0.1	37	63	Clay	<0.1		0.25	0.4	55.2	<0.02
31.3	0.31				1.0	0.41	70	18	12	Sandy Loam	4		0.17	0.3	24.4	<0.02
66.4	0.35	29.8	25.0	4.8	1.0	0.11	<0.1	25	75	Clay	<0.1		0.64	0.5	51.0	<0.02
65.7	0.50	26.5	22.2	4.3	1.3	0.21	<0.1	17	83	Clay	<0.1		0.34	1.1	49.5	<0.02
66.4	0.53	34.1	23.2	10.9	6.0	0.04	<0.1	37	63	Clay	<0.1		0.50	1.2	38.6	<0.02
73.3	0.45	35.8	28.1	7.7	4.1	0.04	<0.1	25	75	Clay	<0.1		0.95	0.7	49.0	<0.02
49.5	0.40	27.6	19.8	7.8	0.8	0.08	<0.1	37	63	Clay	<0.1		0.45	0.5	61.7	<0.02
30.9	0.26	13.3	7.7	5.6	0.3	0.09	42	33	25	Loam	<0.1		0.20	0.3	28.9	<0.02
29.0	0.35	10.3	5.2	5.1	0.3	0.83	50	32	18	Loam	<0.1		0.14	0.4	25.5	<0.02
29.3	0.28	12.3	4.9	7.4	0.6	0.09	50	33	17	Loam	<0.1		0.13	0.6	25.6	<0.02
31.9	0.25	7.3	3.2	4.1	0.3	0.08	50	33	17	Loam	<0.1		0.13	0.4	18.1	<0.02
97.3	0.37	28.4	22.5	5.9	4.4	0.06	<0.1	28	72	Clay	<0.1		0.44	1.0	3.5	<0.02
29.3	0.30	22.3	15.2	7.1	1.6	0.11	<0.1	39	61	Clay	<0.1		0.18	0.9	10.7	<0.02
51.8	0.27	21.4	15.9	5.5	0.9	1.11	<0.1	39	61	Clay	<0.1		0.17	0.3	14.9	<0.02
53.8	0.30	25.9	22.3	3.6	0.8	2.54	<0.1	27	73	Clay	<0.1		0.45	0.4	10.1	<0.02
65.9	0.34	35.4	27.0	8.4	2.5	0.26	6	43	51	Silty Clay	2		0.55	2.3	4.1	<0.02
69.1	0.31	34.3	28.0	6.3	1.8	1.09	6	43	51	Silty Clay	2		0.28	0.2	5.9	<0.02
75.8	0.39	35.5	30.2	5.3	1.1	3.41	4	44	52	Silty Clay	0		0.40	0.1	6.4	<0.02
76.7	0.80	36.0	29.8	6.2	2.0	5.57	10	37	53	Clay	6		0.76	<0.1	6.3	<0.02
82.7	1.65	37.9	31.1	6.8	1.0	7.44	6	39	55	Silty Clay	2		0.93	0.2	6.6	0.04
72.1	0.47	39.8	30.8	9.0	3.7	0.34	10	39	51	Clay	4		0.71	3.4	5.3	<0.02
76.7	0.39	39.4	34.0	5.4	2.4	1.08	12	32	56	Silty Clay	7		0.55	1.1	8.4	<0.02
84.0	0.98	42.4	37.2	5.2	1.7	4.44	10	30	60	Clay	6		1.01	1.1	12.6	<0.02
52.7	6.55	44.2	39.2	5.0	1.0	6.85	10	31	59	Silty Clay	6		3.35	0.9	7.4	0.02
72.5	10.9	36.8	32.0	4.8	0.8	7.29	20	32	48	Clay	16		2.47	0.9	11.9	0.02

Saturation	Electrical Conductivity	Field Capacity	Wilt Point	Water Capacity	Organic Matter	SAR	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment	Boron	Nitrate (as N)	CO_3	Selenium
%	dS/m	%	%	%	%		%	%	%		%	%	ppm	ppm	%	ppm
50.7	0.43	28.0	17.6	10.4	2.9	0.17	22	46	32	Clay Loam	14		0.40	1.5	11.6	<0.02
51.6	0.37	26.8	16.8	10.0	1.9	0.09	18	49	33	Silty Clay Loam	10		0.32	0.4	13.9	<0.02
57.2	0.78	25.5	18.0	7.5	1.3	3.53	22	37	41	Clay	16		0.37	0.3	14.5	<0.02
47.8	0.38	26.0	16.8	9.2	1.7	0.44	22	47	31	Clay Loam	13		0.34	0.5	17.8	<0.02
84.5	0.33	47.8	38.8	9.0	3.5	0.57	14	31	55	Silty Clay	9		0.62	3.0	4.0	<0.02
186	0.24	99.0	96.6	2.4	1.9	1.30	10	23	67	Clay	7		0.43	0.3	4.4	<0.02
87.9	3.35	47.8	42.8	5.0	0.3	4.55	16	31	53	Clay	6		0.93	0.4	2.7	<0.02
83.7	4.64	44.6	40.0	4.6	0.6	6.60	18	24	58	Silty Clay	5		0.76	0.7	1.6	<0.02
80.2	6.14	44.6	38.9	5.7	0.2	10.3	16	29	55	Silty Clay	9		0.62	0.2	1.3	<0.02
72.1	0.46	40.8	30.8	10.0	5.6	0.06	26	38	36	Clay Loam	9		1.03	0.4	61.5	<0.02
63.2	0.24	34.2	22.2	12.0	1.9	0.07	26	42	32	Clay Loam	7		0.31	<0.1	59.5	<0.02
65.5	0.25	27.2	23.6	3.6	1.3	0.14	8	48	44	Silty Clay	4		0.45	<0.1	54.1	<0.02
70.9	0.26	27.3	22.7	4.6	1.2	0.19	18	42	40	Silty Clay	12		0.31	<0.1	55.4	<0.02
40.7	0.21	14.6	8.3	6.3	0.5	0.14	60	28	12	Sandy Loam	17		0.12	<0.1	27.9	<0.02
20.1	0.34	12.6	3.0	9.6	0.2	0.21	80	14	6	Loamy Sand	7		0.09	0.8	18.3	<0.02
77.4	1.19	29.3	24.9	4.4	2.2	0.58	<0.1	53	47	Silty Clay	<0.1		0.34	3.6	42.9	<0.02
30.1	1.73	14.3	6.4	7.9	0.9	0.75	74	15	11	Sandy Loam	7		0.11	0.9	20.0	<0.02
45.2	2.62	19.8	12.7	7.1	1.4	1.26	28	51	21	Silty Loam	2		0.21	1.4	37.1	<0.02
70.1	2.37	27.3	21.1	6.2	3.0	1.23	14	54	32	Silty Clay Loam	4		0.47	0.2	37.1	<0.02
87.1	1.57	25.6	20.8	4.8	1.8	1.33	16	44	40	Silty Clay	<0.1	1.8	0.30	0.2	35.1	<0.02
67.6	0.60	40.7	33.0	7.7	5.5	0.21	16	41	43	Silty Clay	2		0.70	2.6	56.0	<0.02
72.6	0.40	40.2	33.3	6.9	5.8	0.04	12	41	47	Silty Clay	0		0.76	1.5	57.2	<0.02
62.8	0.33	42.0	31.2	10.8	3.9	0.09	10	46	44	Silty Clay	<0.1		0.70	0.7	57.1	<0.02
61.1	0.20	26.8	23.5	3.3	1.1	0.07	24	35	41	Clay	19		0.56	0.4	50.8	<0.02
36.6	0.27	19.1	11.7	7.4	0.4	0.16	46	35	19	Loam	11		0.28	0.4	32.1	<0.02
35.0	0.31	20.8	10.6	10.2	2.8	0.11	44	41	15	Loam	12		0.22	0.3	32.4	<0.02
33.0	0.44	20.1	10.9	9.2	0.2	0.31	52	33	15	Sandy Loam	11		0.20	0.3	30.7	<0.02
87.7	0.59	38.8	32.4	6.4	7.4	0.04	20	49	31	Clay Loam	3		0.52	4.7	38.2	<0.02
84.9	0.29	35.2	29.5	5.7	4.2	0.05	12	51	37	Silty Clay Loam	2		0.75	<0.1	76.3	<0.02
81.2	0.30	36.7	29.3	7.4	2.8	0.10	10	50	40	Silty Clay	2		0.64	<0.1	60.4	<0.02
67.0	0.31	27.4	24.6	2.8	0.9	0.29	8	51	41	Silty Clay	2		0.33	<0.1	52.4	<0.02
61.4	0.51	26.6	22.8	3.8	1.2	0.40	10	54	36	Silty Clay Loam	5		0.29	<0.1	44.9	<0.02
51.1	0.66	23.3	18.3	5.0	1.1	0.43	10	64	26	Silty Loam	5		0.28	<0.1	54.2	<0.02
51.8	1.48	18.8	10.7	8.1	1.1	0.90	38	40	22	Loam	2		0.09	1.4	35.4	<0.02
35.4	2.57	19.0	8.6	10.4	1.0	0.18	56	30	14	Sandy Loam	6		0.09	0.2	28.2	<0.02
45.2	1.63	20.3	14.3	6.0	1.1	0.22	32	48	20	Loam	10		0.06	0.1	34.8	<0.02
	1.86					0.30	88	8	5	Sand	13		0.24		18.6	<0.02

Saturation	Electrical Conductivity	Field Capacity	Wilt Point	Water Capacity	Organic Matter	SAR	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment	Boron	Nitrate (as N)	CO_3	Selenium
%	dS/m	%	%	%	%		%	%	%		%	%	ppm	ppm	%	ppm
75.3	0.48	32.5	24.2	8.3	5.1	0.05	24	41	35	Clay Loam	11		1.07	<0.1	19.7	<0.02
70.1	0.43	36.1	25.0	11.1	3.9	0.04	22	45	33	Clay Loam	11		1.37	<0.1	30.7	<0.02
68.7	0.39	38.8	25.6	13.2	2.7	0.10	22	46	32	Clay Loam	8		1.42	<0.1	56.3	<0.02
47.4	0.33	29.4	14.6	14.8	0.7	0.11	32	56	12	Silty Loam	16		0.31	<0.1	60.8	<0.02
34.3	0.34	20.8	12.4	8.4	1.1	0.12	52	36	12	Sandy Loam	10		0.31	<0.1	45.9	<0.02
34.4	0.23	9.3	4.7	4.6	0.9	0.12	82	15	3	Loamy Sand	18		0.16	<0.1	26.1	<0.02
26.4	0.23	8.5	3.4	5.1	0.4	0.13	82	16	2	Loamy Sand	13		0.10	<0.1	22.5	<0.02
86.2	0.54	26.1	22.2	3.9	1.9	0.18	<0.1	59	41	Silty Clay	<0.1		0.46	2.3	47.8	0.03
30.1	2.36	18.7	4.4	14.3	1.4	0.09	73	21	6	Sandy Loam	5		0.12	2.7	19.4	<0.02
31.7	2.41	18.2	5.6	12.6	1.5	0.14	75	19	6	Sandy Loam	<0.1	22.8	0.09	2.3	31.0	<0.02
54.2	2.75	27.2	15.0	12.2	2.3	0.12	31	52	17	Silty Loam	10		0.24	1.5	35.2	<0.02
46.1	2.85	26.4	16.9	9.5	2.6	0.15	37	37	26	Loam	3		0.37	0.2	24.6	<0.02
30.5	2.68	20.5	6.8	13.7	1.2	0.15	73	17	10	Sandy Loam	6		0.16	0.4	22.9	<0.02
23.5	0.71	12.3	5.6	6.7	0.8	0.19	81	13	6	Loamy Sand	3	60.7	0.08	0.2	70.7	<0.02
23.9	0.28	12.3	6.1	6.2	0.7	0.11	84	14	2	Loamy Sand	13		0.08	<0.1	53.1	<0.02
27.2	0.25	11.8	5.1	6.7	0.3	0.12	90	8	2	Sand	9	65.9	0.08	<0.1	62.2	<0.02
29.2	0.36	11.4	5.8	5.6	0.4	0.18	86	12	2	Sand	7	63.1	0.11	<0.1	60.5	<0.02
26.5	0.37	15.1	4.7	10.4	0.3	0.16	90	9	1	Sand	5	65.9	0.06	<0.1	61.9	<0.02
26.8	0.62	15.6	5.9	9.7	1.0	0.17	82	15	3	Loamy Sand	10	70.2	0.13	<0.1	68.2	<0.02
27.6	0.59	16.3	6.0	10.3	0.5	0.17	84	14	2	Loamy Sand	11	73.8	0.08	<0.1	68.6	<0.02
30.1	2.01	20.5	7.3	13.2	2.5	0.25	80	16	4	Loamy Sand	17	1.1	0.41	<0.1	22.9	<0.02
43.9	0.41	19.0	13.6	5.4	0.3	0.03	50	25	25	Sandy Clay Loam	6		0.32	2.2	16.7	<0.02
38.3	0.32	16.6	11.3	5.3	2.9	0.07	51	25	24	Sandy Clay Loam	2	9.6	0.26	0.5	22.9	<0.02
32.5	0.26	15.1	10.3	4.8	3.0	0.05	64	18	18	Sandy Loam	11	2.7	0.18	0.4	31.5	<0.02
28.7	0.31	12.5	7.1	5.4	1.9	0.36	60	26	14	Sandy Loam	<0.1	6.1	0.26	0.3	22.2	<0.02
29.0	0.26	10.2	5.8	4.4	0.7	0.19	84	8	8	Loamy Sand	11	63.5	0.15	0.3	31.4	<0.02
28.8	0.20	8.6	3.0	5.6	0.2	0.07	80	14	6	Loamy Sand	7	17.9	0.09	0.3	19.2	<0.02
25.6	0.22	15.1	6.7	8.4	0.3	0.11	74	20	6	Sandy Loam	2	62.6	0.12	<0.1	56.7	<0.02
33.1	0.20	16.0	5.6	10.4	0.3	0.10	80	18	2	Loamy Sand	6	64.5	0.08	<0.1	56.6	<0.02
27.9	0.18	15.6	5.0	10.6	0.3	0.09	88	10	2	Sand	10	60.5	0.06	<0.1	55.7	<0.02
27.5	0.78	16.0	5.2	10.8	1.3	0.14	84	14	2	Loamy Sand	8	60.0	0.08	<0.1	54.7	<0.02
30.3	0.55	15.0	5.2	9.8	0.4	0.19	88	11	1	Sand	9	54.4	0.08	<0.1	53.7	<0.02
26.7	1.19	17.6	4.6	13.0	0.7	0.29	80	12	8	Loamy Sand	7		0.08	0.1	20.2	<0.02

Saturation	Electrical Conductivity	Field Capacity	Wilt Point	Water Capacity	Organic Matter	SAR	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment	Boron	Nitrate (as N)	CO_3	Selenium
%	dS/m	%	%	%	%		%	%	%		%	%	ppm	ppm	%	ppm
69.0	0.57	35.4	28.7	6.7	6.4	0.10	22	56	22	Silty Loam	8	0.2	0.98	5.0	27.3	<0.02
60.0	0.50	31.6	26.7	4.9	3.8	0.10	16	41	43	Silty Clay	8	<0.1	0.66	0.4	45.3	<0.02
49.6	0.36	30.4	24.0	6.4	0.7	0.09	12	56	32	Silty Clay Loam	7		0.39	0.2	55.0	<0.02
43.8	0.31	27.5	21.7	5.8	0.5	0.10	32	49	19	Loam	27		0.38	0.2	53.3	<0.02
35.2	0.31	23.2	13.2	10.0	0.2	0.10	38	46	16	Loam	14		0.24	0.2	44.6	<0.02
56.2	0.33	27.2	23.6	3.6	0.7	0.15	20	44	36	Clay Loam	13		0.49	0.3	50.1	<0.02
30.9	0.31	18.5	10.6	7.9	0.2	0.18	58	26	16	Sandy Loam	16		0.38	0.2	30.1	<0.02
28.1	0.27	19.0	6.3	12.7	<0.1	0.11	60	32	8	Sandy Loam	17		0.29	0.3	30.6	<0.02
68.4	0.73	34.8	29.8	5.0	7.0	0.24	20	39	41	Clay	8		0.53	23.0	28.8	<0.02
55.2	0.65	28.9	21.6	7.3	1.9	0.66	20	47	33	Clay Loam	4		0.34	1.4	33.6	<0.02
56.2	0.51	31.3	23.0	8.3	2.0	0.32	30	31	39	Clay Loam	6		0.39	1.0	30.9	<0.02
58.3	0.51	34.2	29.4	4.8	2.3	0.35	10	41	49	Silty Clay	2		0.49	1.1	48.8	<0.02
61.2	0.36	27.8	23.6	4.2	1.2	0.58	20	37	43	Clay	16		0.29	0.6	53.8	<0.02
75.5	0.59	37.7	34.4	3.3	5.5	0.33	24	36	40	Clay	14		0.41	8.4	26.4	<0.02
75.0	0.44	33.6	30.3	3.3	5.0	0.13	24	40	36	Clay Loam	10		0.48	<0.1	26.5	<0.02
65.4	0.45	30.7	26.0	4.7	3.6	0.26	26	36	38	Clay Loam	7		0.68	2.0	33.4	<0.02
58.2	0.42	28.2	21.5	6.7	2.1	1.06	34	30	36	Clay Loam	12		0.21	<0.1	29.0	<0.02
78.6	0.44	35.2	30.0	5.2	1.7	1.37	12	50	38	Silty Clay Loam	6		0.25	<0.1	46.6	<0.02
57.8	0.45	27.8	23.5	4.3	1.2	1.48	6	54	40	Silty Clay	3		0.37	<0.1	51.6	<0.02
80.4	0.49	27.0	22.1	4.9	1.7	1.27	<0.1	52	48	Silty Clay	<0.1		0.13	0.9	46.2	<0.02
66.7	0.59	31.0	23.0	8.0	1.5	1.09	12	39	49	Clay	<0.1		0.11	0.6	27.2	<0.02
88.6	0.60	35.6	29.0	6.6	1.4	1.04	4	37	59	Silty Clay	<0.1		0.21	0.4	29.0	<0.02
38.6	0.76	23.6	11.6	12.0	0.9	1.45	46	32	22	Loam	8		0.17	0.3	26.5	<0.02
31.6	0.88	21.7	5.7	16.0	0.6	1.68	64	26	10	Sandy Loam	7		0.13	0.4	24.9	<0.02
71.5	0.82	34.2	30.3	3.9	5.9	0.17	18	38	44	Clay	6		1.01	23.9	48.6	<0.02
71.5	0.63	33.0	28.3	4.7	4.0	0.17	18	43	39	Silty Clay Loam	8		0.79	7.2	49.4	<0.02
63.3	0.36	31.0	25.6	5.4	1.6	0.19	10	46	44	Silty Clay	5		0.38	0.4	53.8	<0.02
39.5	0.34	20.8	13.5	7.3	0.4	0.19	52	36	12	Sandy Loam	17		0.17	<0.1	42.6	<0.02
61.4	0.36	28.0	22.6	5.4	1.0	0.24	12	56	32	Silty Clay Loam	6		0.29	<0.1	47.1	<0.02
68.2	0.38	30.9	25.6	5.3	1.4	0.30	12	46	42	Silty Clay	2		0.28	<0.1	51.7	<0.02
38.8	0.35	20.1	13.7	6.4	0.9	0.29	48	40	12	Loam	12		0.12	<0.1	46.7	<0.02
30.7	0.52	22.8	8.0	14.8	0.6	0.35	50	38	12	Loam	10		0.07	1.7	33.2	<0.02
33.4	0.57				1.0	0.40	72	18	10	Sandy Loam	7		0.11	2.0	18.7	<0.02
25.9	0.77	20.9	5.0	15.9	3.3	0.41	72	20	8	Sandy Loam	7		0.07	1.6	21.2	<0.02
56.3	2.61	29.4	18.3	11.1	1.7	0.20	28	46	26	Loam	6		0.10	1.6	27.1	<0.02
33.9	2.38	21.8	8.8	13.0	1.1	0.13	54	32	14	Sandy Loam	5		0.09	0.2	25.3	<0.02

Saturation	Electrical Conductivity	Field Capacity	Wilt Point	Water Capacity	Organic Matter	SAR	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment	Boron	Nitrate (as N)	CO_3	Selenium
%	dS/m	%	%	%	%		%	%	%		%	%	ppm	ppm	%	ppm
60.7	1.18	30.8	22.8	8.0	5.0	0.09	46	24	30	Sandy Clay Loam	28		0.71	56.5	25.6	<0.02
60.2	0.40	29.3	18.7	10.6	2.4	0.09	32	30	38	Clay Loam	7		0.26	6.5	16.5	<0.02
68.2	0.36	31.6	25.2	6.4	2.1	0.15	12	40	48	Silty Clay	<0.1		0.45	0.9	24.1	<0.02
72.4	0.45	39.7	33.1	6.6	5.1	0.19	2	40	58	Clay	<0.1		0.33	1.2	39.2	<0.02
60.8	0.36	34.8	27.9	6.9	1.6	0.27	8	34	58	Silty Clay	3		0.21	1.2	51.2	<0.02
52.5	0.38	29.2	23.4	5.8	1.0	0.39	6	56	38	Silty Clay Loam	1		0.27	0.7	57.7	<0.02
67.4	0.48	33.2	25.4	7.8	1.1	0.64	8	40	52	Silty Clay	4		0.39	0.9	47.1	<0.02
53.6	4.85	27.5	17.1	10.4	1.1	1.69	44	24	32	Clay Loam	3		0.35	0.4	24.9	<0.02
25.9	5.24	21.4	7.5	13.9	0.6	3.10	62	24	14	Sandy Loam	2	8.0	0.09	0.9	25.6	<0.02
29.8	4.81	21.1	6.0	15.1	0.6	2.56	4	40	56	Clay	<0.1		0.11	0.1	23.2	<0.02
114	1.85				1.5	1.03	64	16	20	Sandy Clay Loam	60		0.36	0.2	26.6	<0.02
65.1	0.39	32.0	26.9	5.1	2.5	0.44	12	35	53	Clay	8		0.65	1.1	21.6	<0.02
66.5	0.37	32.7	28.5	4.2	1.9	1.17	16	30	54	Clay	12		0.71	0.6	21.5	<0.02
69.5	0.36	32.8	29.2	3.6	1.8	2.42	14	32	54	Clay	10		0.94	<0.1	21.8	<0.02
59.7	0.69	33.7	29.9	3.8	1.9	4.65	10	36	54	Clay	6		1.05	<0.1	21.3	<0.02
82.2	1.57	36.1	31.0	5.1	1.9	8.03	10	34	56	Silty Clay	6		1.35	0.2	21.6	0.03
65.4	0.47	32.3	22.6	9.7	3.7	0.08	20	37	43	Clay	11		0.26	2.8	23.3	<0.02
67.1	0.46	32.1	24.8	7.3	3.4	0.12	20	35	45	Clay	11		0.32	1.1	23.4	<0.02
60.8	0.46	32.2	25.2	7.0	3.7	0.08	20	36	44	Clay	6		0.51	0.6	18.4	<0.02
60.2	0.37	24.4	17.6	6.8	2.2	0.15	46	22	32	Sandy Clay Loam	17		0.29	0.5	22.4	<0.02
39.8	0.29	20.5	11.3	9.2	0.9	0.16	46	36	18	Loam	13		0.21	0.6	36.4	<0.02
39.4	0.22	13.6	5.8	7.8	0.7	0.18	68	20	12	Sandy Loam	8		0.14	0.5	35.0	<0.02
32.9	0.24	14.4	7.2	7.2	0.7	0.23	74	16	10	Sandy Loam	13		0.14	<0.1	24.0	<0.02
84.2	0.59	41.5	27.9	13.6	4.5	0.44	26	31	43	Clay	19		0.67	1.7	6.5	<0.02
75.7	0.45	38.7	33.1	5.6	1.9	1.49	20	31	49	Clay	16		0.66	0.6	7.6	<0.02
83.7	0.79	41.3	30.3	11.0	3.0	3.77	16	28	56	Silty Clay	12		1.11	<0.1	12.4	<0.02
82.9	4.96	43.9	29.1	14.8	3.0	7.56	16	24	60	Clay	10		3.04	0.5	9.1	<0.02
79.7	6.16	39.2	28.1	11.1	3.0	10.3	16	31	53	Clay	11		2.62	0.7	9.3	<0.02

Poor	Unacceptable

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Date: 1/30/2013

CLIENT: Alton Coal Development, LLC
Project: Private Lease Soils
Lab Order: S1211393

CASE NARRATIVE

Report ID: S1211393001

Samples 12AS001, 12AS002, 12AS003, 12AS004, 12AS005, 12AS007, and 12AS008 were received on November 26, 2012.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1211393001

Project: Private Lease Soils
Date Received: 11/26/2012

Date Reported: 1/30/2013
Work Order: S1211393

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1211393-001	12AS001	0-12	7.5	56.7	0.67	8.6	29.8	21.8	4.9
S1211393-002	12AS001	12-28	7.6	54.2	0.53	8.2	29.1	22.3	3.9
S1211393-003	12AS001	28-56	7.8	62.5	0.50	10.0	31.7	23.9	3.3
S1211393-004	12AS001	56-90	7.9	66.7	0.67	14.7	37.1	29.6	4.2
S1211393-005	12AS001	90-122	8.2	55.4	1.00	9.0	27.7	20.7	1.1
S1211393-006	12AS001	122-160	8.2	31.7	0.81	5.0	17.8	7.6	0.6
S1211393-007	12AS002	0-9	7.3	63.2	1.79	24.6	29.0	20.4	2.2
S1211393-008	12AS002	9-26	7.6	74.3	1.45	22.7	32.8	24.3	3.3
S1211393-009	12AS002	26-55	7.9	78.1	1.28	24.2	32.4	26.2	2.6
S1211393-010	12AS002	55-87	7.9	73.2	1.45	26.6	33.1	26.9	2.5
S1211393-011	12AS002	87-110	7.8	70.9	1.91	31.2	35.3	27.4	2.7
S1211393-012	12AS003	0-8	7.9	61.6	0.64	4.5	31.2	22.8	4.4
S1211393-013	12AS003	8-34	7.9	57.9	0.61	5.9	30.3	22.2	2.7
S1211393-014	12AS003	34-88	8.3	45.4	0.38	5.1	24.2	14.7	0.5
S1211393-015	12AS003	88-122	8.3	48.0	0.42	6.8	24.6	15.3	0.9
S1211393-016	12AS003	122-155	8.5	40.2	0.45	4.0	22.3	11.9	1.1
S1211393-017	12AS004	0-8	7.5	63.6	0.61	5.6	28.6	19.8	6.4
S1211393-018	12AS004	8-22	7.4	46.8	0.35	5.9	21.7	11.4	1.4
S1211393-019	12AS004	22-48	7.6	34.8	0.26	2.6	9.5	5.3	0.6
S1211393-020	12AS004	48-788	7.8	49.7	0.33	6.6	23.2	16.2	1.3

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

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Lab ID	Sample ID	Depths cm	pH s.u.	Saturation %	Electrical Conductivity dS/m	Percent Moisture %	Field Capacity %	Wilt Point %	Organic Matter %
S1211393-021	12AS005	0-5	7.5	62.6	0.45	11.1	32.1	27.3	3.9
S1211393-022	12AS005	5-35	7.6	74.9	0.33	15.1	37.2	29.6	2.3
S1211393-023	12AS005	35-78	8.1	82.1	0.44	18.1	44.7	37.7	1.1
S1211393-024	12AS007	0-7	7.5	50.3	0.40	3.8	22.8	15.4	1.9
S1211393-025	12AS007	7-44	7.4	51.5	0.34	11.3	25.1	19.0	1.8
S1211393-026	12AS007	44-83	7.7	42.5	0.32	5.3	15.3	15.9	1.3
S1211393-027	12AS008	0-9	7.5	46.4	0.43	4.8	22.9	12.7	4.0
S1211393-028	12AS008	9-23	7.5	44.3	0.48	4.9	21.6	9.0	2.5

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Karen Secor, Soil Lab Supervisor

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Lab ID	Sample ID	Depths cm	PE Calcium meq/L	PE Magnesium meq/L	PE Potassium meq/L	PE Sodium meq/L	SAR
S1211393-001	12AS001	0-12	4.46	1.87	0.97	0.10	0.06
S1211393-002	12AS001	12-28	3.78	2.07	0.51	0.13	0.08
S1211393-003	12AS001	28-56	3.08	2.00	0.23	0.40	0.25
S1211393-004	12AS001	56-90	2.84	3.11	0.14	1.35	0.79
S1211393-005	12AS001	90-122	3.26	8.52	0.12	0.46	0.19
S1211393-006	12AS001	122-160	4.01	5.16	0.15	0.22	0.10
S1211393-007	12AS002	0-9	5.96	16.7	0.64	1.87	0.56
S1211393-008	12AS002	9-26	4.77	11.2	0.45	1.50	0.53
S1211393-009	12AS002	26-55	3.52	9.73	0.37	1.68	0.65
S1211393-010	12AS002	55-87	4.58	12.3	0.36	1.96	0.67
S1211393-011	12AS002	87-110	6.95	16.3	0.37	2.35	0.69
S1211393-012	12AS003	0-8	3.74	2.53	0.99	0.20	0.11
S1211393-013	12AS003	8-34	3.15	3.52	0.17	0.13	0.07
S1211393-014	12AS003	34-88	1.47	2.48	0.09	0.15	0.11
S1211393-015	12AS003	88-122	1.41	3.17	0.08	0.21	0.14
S1211393-016	12AS003	122-155	0.90	3.64	0.11	0.38	0.25
S1211393-017	12AS004	0-8	5.74	0.94	0.59	0.07	0.04
S1211393-018	12AS004	8-22	3.28	0.61	0.23	0.07	0.05
S1211393-019	12AS004	22-48	2.24	0.51	0.13	0.08	0.07
S1211393-020	12AS004	48-788	2.56	0.92	0.06	0.12	0.09

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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

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Report ID: S1211393001

Project: Private Lease Soils

Date Received: 11/26/2012

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Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1211393-021	12AS005	0-5	4.24	1.10	0.21	0.15	0.09
S1211393-022	12AS005	5-35	2.54	1.25	0.15	0.19	0.14
S1211393-023	12AS005	35-78	1.83	1.98	0.16	1.24	0.90
S1211393-024	12AS007	0-7	3.32	1.00	0.30	0.07	0.05
S1211393-025	12AS007	7-44	2.76	0.87	0.19	0.09	0.07
S1211393-026	12AS007	44-83	2.83	0.87	0.08	0.12	0.09
S1211393-027	12AS008	0-9	4.30	0.57	0.18	0.07	0.05
S1211393-028	12AS008	9-23	4.45	0.75	0.24	0.06	0.04

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Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Boron	Nitrate (as N)	CO3	Selenium
		cm	%	%	%		%	ppm	ppm	%	ppm
S1211393-001	12AS001	0-12	30.0	39.0	31.0	Clay Loam	8.0	0.58	1.2	46.2	<0.02
S1211393-002	12AS001	12-28	24.0	41.0	35.0	Clay Loam	5.4	0.60	0.8	47.9	<0.02
S1211393-003	12AS001	28-56	10.0	49.0	41.0	Silty Clay	<0.1	0.63	0.3	52.2	<0.02
S1211393-004	12AS001	56-90	16.0	40.0	44.0	Silty Clay	6.9	0.71	<0.1	42.9	<0.02
S1211393-005	12AS001	90-122	26.0	42.0	32.0	Clay Loam	6.4	0.40	0.4	51.8	<0.02
S1211393-006	12AS001	122-160	64.0	24.0	12.0	Sandy Loam	14.4	0.17	0.7	30.4	<0.02
S1211393-007	12AS002	0-9	30.0	41.0	29.0	Clay Loam	10.4	0.34	0.6	27.3	<0.02
S1211393-008	12AS002	9-26	20.0	46.0	34.0	Clay Loam	11.2	0.43	1.1	23.8	<0.02
S1211393-009	12AS002	26-55	24.0	39.0	37.0	Clay Loam	13.9	0.25	1.4	22.2	<0.02
S1211393-010	12AS002	55-87	18.0	42.0	40.0	Silty Clay	7.7	0.26	2.2	33.2	<0.02
S1211393-011	12AS002	87-110	10.0	52.0	38.0	Silty Clay Loam	0.6	0.47	1.4	47.9	<0.02
S1211393-012	12AS003	0-8	24.0	39.0	37.0	Clay Loam	5.9	0.79	11.9	46.4	<0.02
S1211393-013	12AS003	8-34	25.0	33.0	42.0	Clay	10.5	0.72	15.8	50.8	<0.02
S1211393-014	12AS003	34-88	25.0	53.0	22.0	Silty Loam	12.5	0.37	4.5	45.4	<0.02
S1211393-015	12AS003	88-122	27.0	50.0	23.0	Silty Loam	10.1	0.34	4.7	41.1	<0.02
S1211393-016	12AS003	122-155	43.0	41.0	16.0	Loam	7.0	0.39	4.4	33.4	<0.02
S1211393-017	12AS004	0-8	65.0	15.0	20.0	Sandy Clay Loam	15.9	0.37	0.3	4.1	<0.02
S1211393-018	12AS004	8-22	67.0	10.0	23.0	Sandy Clay Loam	16.7	0.25	0.2	1.8	<0.02
S1211393-019	12AS004	22-48	77.0	14.0	9.0	Sandy Loam	10.2	0.15	0.5	5.9	<0.02
S1211393-020	12AS004	48-788	39.0	34.0	27.0	Clay Loam	9.9	0.25	0.3	14.4	<0.02

These results apply only to the samples tested.

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Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Boron	Nitrate (as N)	CO3	Selenium
		cm	%	%	%		%	ppm	ppm	%	ppm
S1211393-021	12AS005	0-5	17.0	33.0	50.0	Clay	5.0	0.45	0.2	23.1	<0.02
S1211393-022	12AS005	5-35	9.0	33.0	58.0	Silty Clay	4.5	0.22	0.2	23.5	<0.02
S1211393-023	12AS005	35-78	7.0	29.0	64.0	Clay	3.3	0.54	0.6	24.4	<0.02
S1211393-024	12AS007	0-7	47.0	24.0	29.0	Sandy Clay Loam	11.5	0.30	0.3	3.0	<0.02
S1211393-025	12AS007	7-44	37.0	27.0	36.0	Clay Loam	4.2	0.36	0.9	1.4	<0.02
S1211393-026	12AS007	44-83	67.0	11.0	22.0	Sandy Clay Loam	16.6	0.25	0.5	19.9	<0.02
S1211393-027	12AS008	0-9	63.0	20.0	17.0	Sandy Loam	12.2	0.19	0.7	11.8	<0.02
S1211393-028	12AS008	9-23	77.0	11.0	12.0	Sandy Loam	11.4	0.13	0.2	15.7	<0.02

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Lab ID	Sample ID	Depths	Total Carbon	TOC	Total Sulfur	T.S. AB	Neutral. Potential	T.S. ABP	Total Mercury
		cm	%	%	%	t/1000t	t/1000t	t/1000t	mg/Kg
S1211393-001	12AS001	0-12	8.5	3.0	0.03	0.83	462	461	<0.2
S1211393-002	12AS001	12-28	8.5	2.7	<0.01	<0.01	479	479	<0.2
S1211393-003	12AS001	28-56	8.6	2.4	<0.01	<0.01	522	522	<0.2
S1211393-004	12AS001	56-90	9.2	4.1	0.02	0.72	429	428	<0.2
S1211393-005	12AS001	90-122	7.5	1.3	<0.01	<0.01	518	518	<0.2
S1211393-006	12AS001	122-160	4.4	0.7	<0.01	<0.01	304	304	<0.2
S1211393-007	12AS002	0-9	4.8	1.6	0.02	0.54	273	273	<0.2
S1211393-008	12AS002	9-26	4.5	1.6	<0.01	<0.01	239	239	<0.2
S1211393-009	12AS002	26-55	3.7	1.1	<0.01	<0.01	222	222	<0.2
S1211393-010	12AS002	55-87	5.4	1.5	<0.01	<0.01	332	332	<0.2
S1211393-011	12AS002	87-110	7.8	2.0	<0.01	<0.01	479	479	<0.2
S1211393-012	12AS003	0-8	8.8	3.2	0.02	0.50	464	463	<0.2
S1211393-013	12AS003	8-34	8.5	2.4	<0.01	<0.01	508	508	<0.2
S1211393-014	12AS003	34-88	6.6	1.1	<0.01	<0.01	454	454	<0.2
S1211393-015	12AS003	88-122	6.3	1.3	0.01	0.40	411	410	<0.2
S1211393-016	12AS003	122-155	4.7	0.7	<0.01	<0.01	334	334	<0.2
S1211393-017	12AS004	0-8	5.1	4.6	0.03	0.85	41.3	40.4	<0.2
S1211393-018	12AS004	8-22	0.8	0.6	<0.01	<0.01	18.0	18.0	<0.2
S1211393-019	12AS004	22-48	1.0	0.3	<0.01	<0.01	59.0	59.0	<0.2
S1211393-020	12AS004	48-788	3.0	1.3	<0.01	<0.01	144	144	<0.2

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1211393001

Project: Private Lease Soils
Date Received: 11/26/2012

Date Reported: 1/30/2013
Work Order: S1211393

Lab ID	Sample ID	Depths cm	Total Carbon %	TOC %	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t	Total Mercury mg/Kg
S1211393-021	12AS005	0-5	5.4	2.6	<0.01	<0.01	231	231	<0.2
S1211393-022	12AS005	5-35	4.9	2.1	<0.01	<0.01	235	235	<0.2
S1211393-023	12AS005	35-78	3.6	0.6	<0.01	<0.01	244	244	<0.2
S1211393-024	12AS007	0-7	1.5	1.2	<0.01	<0.01	29.6	29.6	<0.2
S1211393-025	12AS007	7-44	1.2	1.0	<0.01	<0.01	13.7	13.7	<0.2
S1211393-026	12AS007	44-83	3.2	0.8	<0.01	<0.01	199	199	<0.2
S1211393-027	12AS008	0-9	4.0	2.6	0.01	0.32	118	117	<0.2
S1211393-028	12AS008	9-23	3.4	1.5	0.02	0.70	157	156	<0.2

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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
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Report ID: S1211393001

Project: Private Lease Soils
Date Received: 11/26/2012

Date Reported: 1/30/2013
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Lab ID	Sample ID	Depths cm	Total Arsenic mg/Kg	Total Barium mg/Kg	Total Cadmium mg/Kg	Total Chromium mg/Kg	Total Copper mg/Kg	Total Iron mg/Kg	Total Lead mg/Kg	Total Manganese mg/Kg	Total Molybdenum mg/Kg
S1211393-001	12AS001	0-12	6.5	449	0.81	15.2	12.1	11100	7.2	291	<0.7
S1211393-002	12AS001	12-28	6.9	611	0.58	21.1	17.5	15200	10.2	398	<0.7
S1211393-003	12AS001	28-56	6.5	821	0.75	28.2	19.4	17700	10.4	469	<0.7
S1211393-004	12AS001	56-90	4.1	911	0.60	25.2	23.7	17300	8.9	538	<0.7
S1211393-005	12AS001	90-122	10.5	653	0.65	26.2	11.8	16600	10.2	337	<0.7
S1211393-006	12AS001	122-160	5.6	346	0.41	13.1	8.44	7570	6.5	195	<0.7
S1211393-007	12AS002	0-9	8.0	295	0.51	17.1	13.9	13700	10.5	329	<0.7
S1211393-008	12AS002	9-26	6.1	197	0.46	21.3	14.2	14100	10.8	237	<0.7
S1211393-009	12AS002	26-55	8.5	266	0.41	24.8	17.9	18100	13.0	336	<0.7
S1211393-010	12AS002	55-87	6.3	207	0.52	19.6	11.3	12700	9.6	254	<0.7
S1211393-011	12AS002	87-110	7.6	204	0.54	18.8	10.9	13300	9.5	268	0.8
S1211393-012	12AS003	0-8	7.5	565	0.76	26.0	17.6	16200	10.4	550	<0.7
S1211393-013	12AS003	8-34	8.8	658	0.68	28.7	18.3	19500	10.6	594	<0.7
S1211393-014	12AS003	34-88	5.0	281	0.56	19.5	8.23	10200	8.3	269	<0.7
S1211393-015	12AS003	88-122	9.0	358	0.71	23.9	13.6	17300	12.0	340	<0.7
S1211393-016	12AS003	122-155	3.8	131	0.55	12.9	10.1	6890	7.0	202	<0.7
S1211393-017	12AS004	0-8	3.1	64.9	0.55	17.7	11.9	13700	12.2	234	<0.7
S1211393-018	12AS004	8-22	4.2	36.7	0.27	17.7	8.41	13200	8.6	161	<0.7
S1211393-019	12AS004	22-48	2.9	17.3	0.26	10.7	6.48	7730	4.6	150	<0.7
S1211393-020	12AS004	48-788	3.4	44.9	0.49	12.8	10.4	11400	8.6	315	<0.7

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1211393001

Project: Private Lease Soils
Date Received: 11/26/2012

Date Reported: 1/30/2013
Work Order: S1211393

Lab ID	Sample ID	Depths	Total Arsenic	Total Barium	Total Cadmium	Total Chromium	Total Copper	Total Iron	Total Lead	Total Manganese	Total Molybdenum
		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
S1211393-021	12AS005	0-5	7.6	147	0.71	19.1	14.2	32000	17.4	577	1.3
S1211393-022	12AS005	5-35	3.1	115	0.39	15.7	11.8	15300	12.2	263	0.9
S1211393-023	12AS005	35-78	6.1	107	0.37	14.4	10.9	13600	13.7	146	<0.7
S1211393-024	12AS007	0-7	5.9	68.6	0.37	21.4	8.97	17500	11.1	239	<0.7
S1211393-025	12AS007	7-44	6.0	79.0	0.25	25.6	9.12	19000	11.6	209	<0.7
S1211393-026	12AS007	44-83	2.9	63.6	0.31	10.9	7.12	8180	5.0	142	<0.7
S1211393-027	12AS008	0-9	3.2	52.1	0.45	15.0	11.0	12600	12.2	266	<0.7
S1211393-028	12AS008	9-23	3.5	27.3	0.16	7.33	6.90	6270	3.7	144	<0.7

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Lab ID	Sample ID	Depths cm	Total Selenium mg/Kg	Total Silver mg/Kg	Total Zinc mg/Kg	Bulk Density g/cm³
S1211393-001	12AS001	0-12	<0.96	<0.5	43.4	3.4
S1211393-002	12AS001	12-28	<0.96	<0.5	58.8	3.0
S1211393-003	12AS001	28-56	1.09	<0.5	65.3	3.2
S1211393-004	12AS001	56-90	<0.96	<0.5	70.9	2.4
S1211393-005	12AS001	90-122	<0.96	<0.5	45.5	2.6
S1211393-006	12AS001	122-160	<0.96	<0.5	27.9	2.9
S1211393-007	12AS002	0-9	<0.96	<0.5	44.7	2.4
S1211393-008	12AS002	9-26	<0.96	<0.5	49.7	2.7
S1211393-009	12AS002	26-55	<0.96	<0.5	54.7	2.3
S1211393-010	12AS002	55-87	<0.96	<0.5	43.7	2.2
S1211393-011	12AS002	87-110	<0.96	<0.5	40.2	2.2
S1211393-012	12AS003	0-8	<0.96	<0.5	66.5	4.1
S1211393-013	12AS003	8-34	<0.96	<0.5	64.0	7.4
S1211393-014	12AS003	34-88	<0.96	<0.5	33.4	2.7
S1211393-015	12AS003	88-122	<0.96	<0.5	50.4	2.6
S1211393-016	12AS003	122-155	<0.96	<0.5	28.5	3.2
S1211393-017	12AS004	0-8	<0.96	<0.5	46.9	3.5
S1211393-018	12AS004	8-22	<0.96	<0.5	34.4	2.7
S1211393-019	12AS004	22-48	<0.96	<0.5	18.2	2.7
S1211393-020	12AS004	48-788	<0.96	<0.5	28.6	2.7

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1211393001

Project: Private Lease Soils
Date Received: 11/26/2012

Date Reported: 1/30/2013
Work Order: S1211393

Lab ID	Sample ID	Depths cm	Total Selenium mg/Kg	Total Silver mg/Kg	Total Zinc mg/Kg	Bulk Density g/cm³
S1211393-021	12AS005	0-5	<0.96	<0.5	74.5	3.2
S1211393-022	12AS005	5-35	<0.96	<0.5	47.8	2.5
S1211393-023	12AS005	35-78	<0.96	<0.5	50.2	2.6
S1211393-024	12AS007	0-7	<0.96	<0.5	45.5	2.9
S1211393-025	12AS007	7-44	<0.96	<0.5	49.5	2.6
S1211393-026	12AS007	44-83	<0.96	<0.5	19.6	2.5
S1211393-027	12AS008	0-9	<0.96	<0.5	39.0	3.5
S1211393-028	12AS008	9-23	<0.96	<0.5	14.6	3.4

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Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Karen Secor, Soil Lab Supervisor

Soil Lab Analysis
Inter-Mountain Labs, Inc
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Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 11/26/2012

Report ID: S1211393001
Date Reported: 1/30/2013
Work Order: S1211393

Lab ID	Sample ID	Organic Matter %	Sand %	Silt %	Clay %	Very Fine Sand %	Texture	K-factor (t.ac.h/100acft.tf.in)	Structure s	Permeability p	M
S1211393-001	12AS001 (1-12)	4.9	30.0	39.0	31.0	8.0	Clay Loam	0.17	2	4	3243.0
S1211393-002	12AS001 (12-28)	3.9	24.0	41.0	35.0	5.4	Clay Loam	0.18	2	4	3016.0
S1211393-003	12AS001 (28-56)	3.3	10.0	49.0	41.0	0	Silty Clay	0.24	2	6	2891.0
S1211393-004	12AS001 (56-90)	4.2	16.0	40.0	44.0	6.9	Silty Clay	0.20	2	6	2626.4
S1211393-005	12AS001 (90-122)	1.1	26.0	42.0	32.0	6.4	Clay Loam	0.26	2	4	3291.2
S1211393-006	12AS001 (122-160)	0.6	64.0	24.0	12.0	14.4	Sandy Loam	0.23	2	2	3379.2
S1211393-007	12AS002 (0-9)	2.2	30.0	41.0	29.0	10.4	Clay Loam	0.29	3	4	3649.4
S1211393-008	12AS002 (9-26)	3.3	20.0	46.0	34.0	11.2	Clay Loam	0.28	3	4	3775.2
S1211393-009	12AS002 (26-55)	2.6	24.0	39.0	37.0	13.9	Clay Loam	0.26	3	4	3332.7
S1211393-010	12AS002 (55-87)	2.5	18.0	42.0	40.0	7.7	Silty Clay	0.29	3	6	2982.0
S1211393-011	12AS002 (87-110)	2.7	10.0	52.0	38.0	0.6	Silty Clay Loam	0.28	3	5	3261.2
S1211393-012	12AS003 (0-8)	4.4	24.0	39.0	37.0	5.9	Clay Loam	0.16	2	4	2828.7
S1211393-013	12AS003 (8-34)	2.7	25.0	33.0	42.0	10.5	Clay	0.22	2	6	2523.0
S1211393-014	12AS003 (34-88)	0.5	25.0	53.0	22.0	12.5	Silty Loam	0.41	2	3	5109.0
S1211393-015	12AS003 (88-122)	0.9	27.0	50.0	23.0	10.1	Silty Loam	0.35	2	3	4627.7
S1211393-016	12AS003 (122-155)	1.1	43.0	41.0	16.0	7.0	Loam	0.30	2	3	4032.0
S1211393-017	12AS004 (0-8)	6.4	65.0	15.0	20.0	15.9	Sandy Clay Loam	0.11	2	4	2472.0
S1211393-018	12AS004 (8-22)	1.4	67.0	10.0	23.0	16.7	Sandy Clay Loam	0.16	2	4	2055.9
S1211393-019	12AS004 (22-48)	0.6	77.0	14.0	9.0	10.2	Sandy Loam	0.13	2	2	2202.2
S1211393-020	12AS004 (48-78)	1.3	39.0	34.0	27.0	9.9	Clay Loam	0.25	2	4	3204.7
S1211393-021	12AS005 (0-5)	3.9	17.0	33.0	50.0	5.0	Clay	0.17	2	6	1900.0
S1211393-022	12AS005 (5-35)	2.3	9.0	33.0	58.0	4.5	Silty Clay	0.16	2	6	1575.0
S1211393-023	12AS005 (35-78)	1.1	7.0	29.0	64.0	3.3	Clay	0.15	2	6	1162.8
S1211393-024	12AS007 (0-7)	1.9	47.0	24.0	29.0	11.5	Sandy Clay Loam	0.19	2	4	2520.5
S1211393-025	12AS007 (7-44)	1.8	37.0	27.0	36.0	4.2	Clay Loam	0.15	2	4	1996.8
S1211393-026	12AS007 (44-83)	1.3	67.0	11.0	22.0	16.6	Sandy Clay Loam	0.17	2	4	2152.8
S1211393-027	12AS008 (0-9)	4.0	63.0	20.0	17.0	12.2	Sandy Loam	0.11	2	2	2672.6
S1211393-028	12AS008 (9-23)	2.5	77.0	11.0	12.0	11.4	Sandy Loam	0.09	2	2	1971.2

These Results apply only to the samples tested.

Reviewed by: Karen Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Date: 1/30/2013

CLIENT: Alton Coal Development, LLC
Project: Private Lease Soils
Lab Order: S1301063

CASE NARRATIVE

Report ID: S1301063001

Samples 12AS031, and 12AS032 were received on December 31, 2012.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

Bulk density analysis could not be performed on sample 12AS031 (26-44cm) due to lack of appropriate sample (no clods).

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301063001

Project: Private Lease Soils
Date Received: 12/31/2012

Date Reported: 1/30/2013
Work Order: S1301063

Lab ID	Sample ID	Depths cm	pH s.u.	Saturation %	Electrical Conductivity dS/m	Percent Moisture %	Field Capacity %	Wilt Point %	Organic Matter %
S1301063-001	12AS031	0-12	7.5	65.4	0.47	13.8	32.3	22.6	3.7
S1301063-002	12AS031	12-26	7.5	67.1	0.46	13.3	32.1	24.8	3.4
S1301063-003	12AS031	26-44	7.5	60.8	0.46	12.2	32.2	25.2	3.7
S1301063-004	12AS031	44-71	7.9	60.2	0.37	8.7	24.4	17.6	2.2
S1301063-005	12AS031	71-108	8.2	39.8	0.29	4.7	20.5	11.3	0.9
S1301063-006	12AS031	108-134	8.2	39.4	0.22	3.8	13.6	5.8	0.7
S1301063-007	12AS031	134-172	8.2	32.9	0.24	3.9	14.4	7.2	0.7
S1301063-008	12AS032	0-10	7.7	84.2	0.59	17.7	41.5	27.9	4.5
S1301063-009	12AS032	10-24	7.8	75.7	0.45	15.1	38.7	33.1	1.9
S1301063-010	12AS032	24-66	7.9	83.7	0.79	16.4	41.3	30.3	3.0
S1301063-011	12AS032	66-143	7.8	82.9	4.96	18.7	43.9	29.1	3.0
S1301063-012	12AS032	143-165	7.9	79.7	6.16	18.0	39.2	28.1	3.0

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301063001

Project: Private Lease Soils
Date Received: 12/31/2012

Date Reported: 1/30/2013
Work Order: S1301063

Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1301063-001	12AS031	0-12	3.71	1.11	0.45	0.13	0.08
S1301063-002	12AS031	12-26	3.60	1.35	0.31	0.18	0.12
S1301063-003	12AS031	26-44	3.84	2.40	0.16	0.14	0.08
S1301063-004	12AS031	44-71	2.19	1.97	0.11	0.21	0.15
S1301063-005	12AS031	71-108	1.39	1.68	0.07	0.20	0.16
S1301063-006	12AS031	108-134	1.30	1.20	0.07	0.20	0.18
S1301063-007	12AS031	134-172	1.19	1.30	0.07	0.25	0.23
S1301063-008	12AS032	0-10	4.49	1.15	0.38	0.75	0.44
S1301063-009	12AS032	10-24	2.52	0.79	0.13	1.91	1.49
S1301063-010	12AS032	24-66	2.57	1.05	0.11	5.08	3.77
S1301063-011	12AS032	66-143	21.8	15.5	0.35	32.6	7.56
S1301063-012	12AS032	143-165	20.5	20.2	0.51	46.5	10.3

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Lab ID	Sample ID	Depths cm	Sand %	Silt %	Clay %	Texture	Very Fine Sand %	Boron ppm	Nitrate (as N) ppm	CO3 %	Selenium ppm
S1301063-001	12AS031	0-12	20.0	37.0	43.0	Clay	10.6	0.26	2.8	23.3	<0.02
S1301063-002	12AS031	12-26	20.0	35.0	45.0	Clay	11.2	0.32	1.1	23.4	<0.02
S1301063-003	12AS031	26-44	20.0	36.0	44.0	Clay	5.8	0.51	0.6	18.4	<0.02
S1301063-004	12AS031	44-71	46.0	22.0	32.0	Sandy Clay Loam	16.8	0.29	0.5	22.4	<0.02
S1301063-005	12AS031	71-108	46.0	36.0	18.0	Loam	13.1	0.21	0.6	36.4	<0.02
S1301063-006	12AS031	108-134	68.0	20.0	12.0	Sandy Loam	7.8	0.14	0.5	35.0	<0.02
S1301063-007	12AS031	134-172	74.0	16.0	10.0	Sandy Loam	13.3	0.14	<0.1	24.0	<0.02
S1301063-008	12AS032	0-10	26.0	31.0	43.0	Clay	19.3	0.67	1.7	6.5	<0.02
S1301063-009	12AS032	10-24	20.0	31.0	49.0	Clay	15.6	0.66	0.6	7.6	<0.02
S1301063-010	12AS032	24-66	16.0	28.0	56.0	Silty Clay	11.8	1.11	<0.1	12.4	<0.02
S1301063-011	12AS032	66-143	16.0	24.0	60.0	Clay	10.4	3.04	0.5	9.1	<0.02
S1301063-012	12AS032	143-165	16.0	31.0	53.0	Clay	11.2	2.62	0.7	9.3	<0.02

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

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Project: Private Lease Soils
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Work Order: S1301063

Lab ID	Sample ID	Depths	Total Carbon	TOC	Total Sulfur	T.S. AB	Neutral. Potential	T.S. ABP	Total Mercury
		cm	%	%	%	t/1000t	t/1000t	t/1000t	mg/Kg
S1301063-001	12AS031	0-12	4.4	1.6	0.13	4.19	233	229	<0.2
S1301063-002	12AS031	12-26	4.2	1.4	0.09	2.87	234	231	<0.2
S1301063-003	12AS031	26-44	3.1	0.9	0.06	2.00	184	182	<0.2
S1301063-004	12AS031	44-71	3.9	1.2	0.09	2.87	224	221	<0.2
S1301063-005	12AS031	71-108	4.8	0.4	0.08	2.61	364	361	<0.2
S1301063-006	12AS031	108-134	4.0	<0.1	0.08	2.46	350	347	<0.2
S1301063-007	12AS031	134-172	2.3	<0.1	0.07	2.21	240	238	<0.2
S1301063-008	12AS032	0-10	3.0	2.2	0.10	3.13	64.8	61.6	<0.2
S1301063-009	12AS032	10-24	1.8	0.9	0.12	3.69	76.3	72.6	<0.2
S1301063-010	12AS032	24-66	2.8	1.3	0.07	2.29	124	122	<0.2
S1301063-011	12AS032	66-143	2.9	1.8	1.13	35.5	91.0	55.5	<0.2
S1301063-012	12AS032	143-165	2.3	1.2	0.33	10.4	93.4	83.0	<0.2

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Soil Analysis Report

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Lab ID	Sample ID	Depths	Total Arsenic	Total Barium	Total Cadmium	Total Chromium	Total Copper	Total Iron	Total Lead	Total Manganese	Total Molybdenum
		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
S1301063-001	12AS031	0-12	6.7	20.3	0.12	7.45	128	5340	16.5	90.6	14.6
S1301063-002	12AS031	12-26	10.3	138	0.81	33.4	18.6	20800	16.4	350	3.3
S1301063-003	12AS031	26-44	7.8	109	1.06	26.1	14.3	16200	12.2	277	2.5
S1301063-004	12AS031	44-71	8.8	137	0.68	30.1	15.9	16900	12.3	321	2.6
S1301063-005	12AS031	71-108	7.7	123	0.49	17.4	7.61	9630	8.5	200	1.7
S1301063-006	12AS031	108-134	8.7	111	0.43	22.2	13.7	17100	16.3	180	3.9
S1301063-007	12AS031	134-172	7.6	103	0.40	12.3	5.46	8630	6.8	173	1.4
S1301063-008	12AS032	0-10	5.8	149	0.37	11.3	4.99	6250	5.8	123	0.9
S1301063-009	12AS032	10-24	7.5	107	0.41	31.4	16.5	19500	14.5	300	1.7
S1301063-010	12AS032	24-66	7.8	116	0.41	37.8	16.4	22100	13.9	218	2.9
S1301063-011	12AS032	66-143	8.5	127	0.43	27.9	15.4	19600	16.3	147	2.1
S1301063-012	12AS032	143-165	5.8	71.4	0.21	13.8	8.30	12100	11.6	105	2.3

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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
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Cedar City, UT 84721

Report ID: S1301063001

Project: Private Lease Soils
Date Received: 12/31/2012

Date Reported: 1/30/2013
Work Order: S1301063

Lab ID	Sample ID	Depths cm	Total Selenium mg/Kg	Total Silver mg/Kg	Total Zinc mg/Kg	Bulk Density g/cm³
S1301063-001	12AS031	0-12	43.5	0.5	7.84	2.9
S1301063-002	12AS031	12-26	1.15	<0.5	98.2	2.9
S1301063-003	12AS031	26-44	1.58	<0.5	79.4	
S1301063-004	12AS031	44-71	1.98	<0.5	91.8	2.3
S1301063-005	12AS031	71-108	<0.96	<0.5	43.4	2.5
S1301063-006	12AS031	108-134	2.59	<0.5	85.8	2.6
S1301063-007	12AS031	134-172	<0.96	<0.5	30.9	2.6
S1301063-008	12AS032	0-10	1.93	<0.5	29.4	3.4
S1301063-009	12AS032	10-24	<0.96	<0.5	69.1	2.3
S1301063-010	12AS032	24-66	<0.96	<0.5	64.9	2.3
S1301063-011	12AS032	66-143	<0.96	0.6	69.0	2.3
S1301063-012	12AS032	143-165	<0.96	<0.5	44.5	2.7

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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Soil Lab Analysis
Inter-Mountain Labs, Inc
1673 Terra Ave, Sheridan, Wyoming, 82801
(307) 672-8945

Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 12/31/2012

Report ID: S1301063001
Date Reported: 1/30/2013
Work Order: S1301063

Lab ID	Sample ID	Organic Matter %	Sand %	Silt %	Clay %	Very Fine Sand %	Texture	K-factor (t.ac.h/100acft.tf.in)	Structure s	Permeability p	M
S1301063-001	12AS031 (0-12)	3.7	20.0	37.0	43.0	10.6	Clay	0.25	3	6	2713.2
S1301063-002	12AS031 (12-26)	3.4	20.0	35.0	45.0	11.2	Clay	0.25	3	6	2541.0
S1301063-003	12AS031 (26-44)	3.7	20.0	36.0	44.0	5.8	Clay	0.23	3	6	2340.8
S1301063-004	12AS031 (44-71)	2.2	46.0	22.0	32.0	16.8	Sandy Clay Loam	0.22	3	4	2638.4
S1301063-005	12AS031 (71-108)	0.9	46.0	36.0	18.0	13.1	Loam	0.30	2	3	4026.2
S1301063-006	12AS031 (108-134)	0.7	68.0	20.0	12.0	7.8	Sandy Loam	0.15	2	2	2446.4
S1301063-007	12AS031 (134-172)	0.7	74.0	16.0	10.0	13.3	Sandy Loam	0.16	2	2	2637.0
S1301063-008	12AS032 (1-10)	4.5	26.0	31.0	43.0	19.3	Clay	0.25	3	6	2867.1
S1301063-009	12AS032 (10-24)	1.9	20.0	31.0	49.0	15.6	Clay	0.26	3	6	2376.6
S1301063-010	12AS032 (24-66)	3.0	16.0	28.0	56.0	11.8	Silty Clay	0.23	4	6	1751.2
S1301063-011	12AS032 (66-143)	3.0	16.0	24.0	60.0	10.4	Clay	0.21	4	6	1376.0
S1301063-012	12AS032 (143-165)	3.0	16.0	31.0	53.0	11.2	Clay	0.22	3	6	1983.4

These Results apply only to the samples tested.

Reviewed by: Karen Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Date: 4/3/2013

CLIENT: Alton Coal Development, LLC
Project: Private Lease Soils - Full List
Lab Order: S1301363

CASE NARRATIVE

Report ID: S1301363001

Samples 12AS018, 12AS020, 12AS021, 12AS022, 12AS024, 12AS027, 12AS028, and 12AS029 were received on January 22, 2013.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
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Report ID: S1301363001

Project: Private Lease Soils - Full List
Date Received: 1/22/2013

Date Reported: 4/3/2013
Work Order: S1301363

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1301363-001	12AS018	0-22	7.7	72.1	0.46	15.4	40.8	30.8	5.6
S1301363-002	12AS018	22-68	8.2	63.2	0.24	18.8	34.2	22.2	1.9
S1301363-003	12AS018	68-115	8.4	65.5	0.25	13.9	27.2	23.6	1.3
S1301363-004	12AS018	115-148	8.6	70.9	0.26	11.5	27.3	22.7	1.2
S1301363-005	12AS018	148-244	9.0	40.7	0.21	10.9	14.6	8.3	0.5
S1301363-006	12AS020	0-13	7.8	87.7	0.59	13.1	38.8	32.4	7.4
S1301363-007	12AS020	13-30	8.1	84.9	0.29	10.6	35.2	29.5	4.2
S1301363-008	12AS020	30-80	8.3	81.2	0.30	22.9	36.7	29.3	2.8
S1301363-009	12AS020	80-111	8.6	67.0	0.31	11.7	27.4	24.6	0.9
S1301363-010	12AS020	111-140	8.5	61.4	0.51	10.6	26.6	22.8	1.2
S1301363-011	12AS020	140-175	8.7	51.1	0.66	26.2	23.3	18.3	1.1
S1301363-012	12AS021	0-9	7.8	75.3	0.48	11.2	32.5	24.2	5.1
S1301363-013	12AS021	9-32	7.9	70.1	0.43	8.9	36.1	25.0	3.9
S1301363-014	12AS021	32-65	8.7	68.7	0.39	10.8	38.8	25.6	2.7
S1301363-015	12AS021	65-95	9.4	47.4	0.33	7.6	29.4	14.6	0.7
S1301363-016	12AS021	95-150	9.0	34.3	0.34	13.9	20.8	12.4	1.1
S1301363-017	12AS021	150-202	9.1	34.4	0.23	18.2	9.3	4.7	0.9
S1301363-018	12AS021	202-230	9.0	26.4	0.23	15.0	8.5	3.4	0.4
S1301363-019	12AS022	0-12	8.6	23.9	0.28	3.6	12.3	6.1	0.7
S1301363-020	12AS022	12-50	9.3	27.2	0.25	2.7	11.8	5.1	0.3

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Soil Analysis Report

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Report ID: S1301363001

Project: Private Lease Soils - Full List
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Date Reported: 4/3/2013
Work Order: S1301363

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1301363-021	12AS022	50-87	9.2	29.2	0.36	8.4	11.4	5.8	0.4
S1301363-022	12AS022	87-126	9.0	26.5	0.37	9.6	15.1	4.7	0.3
S1301363-023	12AS022	126-160	8.8	26.8	0.62	14.6	15.6	5.9	1.0
S1301363-024	12AS022	160-210	9.2	27.6	0.59	13.3	16.3	6.0	0.5
S1301363-025	12AS022	210-232	7.7	30.1	2.01	23.7	20.5	7.3	2.5
S1301363-026	12AS024	0-18	9.1	25.6	0.22	5.1	15.1	6.7	0.3
S1301363-027	12AS024	18-84	9.3	33.1	0.20	2.3	16.0	5.6	0.3
S1301363-028	12AS024	84-136	9.4	27.9	0.18	2.6	15.6	5.0	0.3
S1301363-029	12AS024	136-186	9.3	27.5	0.78	5.7	16.0	5.2	1.3
S1301363-030	12AS024	186-233	9.1	30.3	0.55	13.9	15.0	5.2	0.4
S1301363-031	12AS027	0-20	7.7	75.5	0.59	18.1	37.7	34.4	5.5
S1301363-032	12AS027	20-52	7.5	75.0	0.44	13.5	33.6	30.3	5.0
S1301363-033	12AS027	52-100	7.8	65.4	0.45	8.1	30.7	26.0	3.6
S1301363-034	12AS027	100-116	8.1	58.2	0.42	9.0	28.2	21.5	2.1
S1301363-035	12AS027	116-156	8.2	78.6	0.44	14.5	35.2	30.0	1.7
S1301363-036	12AS027	156-170	8.3	57.8	0.45	9.0	27.8	23.5	1.2
S1301363-037	12AS028	0-12	7.7	71.5	0.82	12.9	34.2	30.3	5.9
S1301363-038	12AS028	12-25	7.8	71.5	0.63	12.2	33.0	28.3	4.0
S1301363-039	12AS028	25-68	8.1	63.3	0.36	12.9	31.0	25.6	1.6
S1301363-040	12AS028	68-103	8.4	39.5	0.34	4.1	20.8	13.5	0.4

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301363001

Project: Private Lease Soils - Full List
Date Received: 1/22/2013

Date Reported: 4/3/2013
Work Order: S1301363

Lab ID	Sample ID	Depths cm	pH s.u.	Saturation %	Electrical Conductivity dS/m	Percent Moisture %	Field Capacity %	Wilt Point %	Organic Matter %
S1301363-041	12AS028	103-128	8.4	61.4	0.36	12.5	28.0	22.6	1.0
S1301363-042	12AS028	128-157	8.5	68.2	0.38	13.9	30.9	25.6	1.4
S1301363-043	12AS028	157-173	8.8	38.8	0.35	5.5	20.1	13.7	0.9
S1301363-044	12AS029	0-14	7.6	60.7	1.18	10.5	30.8	22.8	5.0
S1301363-045	12AS029	14-36	7.9	60.2	0.40	6.9	29.3	18.7	2.4
S1301363-046	12AS029	36-58	8.0	68.2	0.36	10.6	31.6	25.2	2.1
S1301363-047	12AS029	58-86	7.9	72.4	0.45	15.1	39.7	33.1	5.1
S1301363-048	12AS029	86-118	8.4	60.8	0.36	12.0	34.8	27.9	1.6
S1301363-049	12AS029	118-173	8.5	52.5	0.38	7.2	29.2	23.4	1.0
S1301363-050	12AS029	173-232	8.4	67.4	0.48	12.6	33.2	25.4	1.1
S1301363-051	12AS029	232-244	8.1	53.6	4.85	7.1	27.5	17.1	1.1

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Lab ID	Sample ID	Depths cm	PE Calcium meq/L	PE Magnesium meq/L	PE Potassium meq/L	PE Sodium meq/L	SAR
S1301363-001	12AS018	0-22	3.10	1.57	0.49	0.09	0.06
S1301363-002	12AS018	22-68	1.84	0.96	0.12	0.08	0.07
S1301363-003	12AS018	68-115	1.17	1.84	0.07	0.17	0.14
S1301363-004	12AS018	115-148	0.93	2.00	0.06	0.23	0.19
S1301363-005	12AS018	148-244	1.01	1.57	0.08	0.15	0.14
S1301363-006	12AS020	0-13	4.09	1.46	1.06	0.06	0.04
S1301363-007	12AS020	13-30	2.37	0.96	0.43	0.07	0.05
S1301363-008	12AS020	30-80	1.88	1.52	0.27	0.13	0.10
S1301363-009	12AS020	80-111	0.97	2.23	0.07	0.37	0.29
S1301363-010	12AS020	111-140	1.32	3.73	0.09	0.63	0.40
S1301363-011	12AS020	140-175	1.26	5.80	0.11	0.82	0.43
S1301363-012	12AS021	0-9	2.76	1.70	1.02	0.08	0.05
S1301363-013	12AS021	9-32	2.50	2.66	0.18	0.07	0.04
S1301363-014	12AS021	32-65	1.04	3.40	0.10	0.15	0.10
S1301363-015	12AS021	65-95	0.83	2.94	0.09	0.16	0.11
S1301363-016	12AS021	95-150	0.95	3.02	0.10	0.17	0.12
S1301363-017	12AS021	150-202	0.81	1.71	0.06	0.14	0.12
S1301363-018	12AS021	202-230	0.87	1.85	0.07	0.15	0.13
S1301363-019	12AS022	0-12	2.05	1.03	0.26	0.13	0.11
S1301363-020	12AS022	12-50	1.37	1.16	0.18	0.14	0.12

These results apply only to the samples tested.

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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
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Report ID: S1301363001

Project: Private Lease Soils - Full List
Date Received: 1/22/2013

Date Reported: 4/3/2013
Work Order: S1301363

Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1301363-021	12AS022	50-87	1.24	2.28	0.12	0.24	0.18
S1301363-022	12AS022	87-126	1.38	2.40	0.13	0.22	0.16
S1301363-023	12AS022	126-160	2.50	4.48	0.17	0.31	0.17
S1301363-024	12AS022	160-210	1.89	4.04	0.14	0.29	0.17
S1301363-025	12AS022	210-232	12.0	15.1	0.36	0.92	0.25
S1301363-026	12AS024	0-18	1.29	1.16	0.13	0.12	0.11
S1301363-027	12AS024	18-84	1.04	1.25	0.09	0.11	0.10
S1301363-028	12AS024	84-136	0.89	1.23	0.08	0.09	0.09
S1301363-029	12AS024	136-186	1.24	1.98	0.10	0.17	0.14
S1301363-030	12AS024	186-233	1.68	4.25	0.13	0.32	0.19
S1301363-031	12AS027	0-20	3.52	2.55	0.46	0.58	0.33
S1301363-032	12AS027	20-52	3.03	1.52	0.48	0.19	0.13
S1301363-033	12AS027	52-100	2.61	1.88	0.22	0.39	0.26
S1301363-034	12AS027	100-116	1.61	1.83	0.07	1.39	1.06
S1301363-035	12AS027	116-156	1.63	1.74	0.06	1.78	1.37
S1301363-036	12AS027	156-170	1.53	1.75	0.04	1.89	1.48
S1301363-037	12AS028	0-12	4.67	4.40	0.65	0.36	0.17
S1301363-038	12AS028	12-25	3.67	3.59	0.17	0.33	0.17
S1301363-039	12AS028	25-68	1.97	2.13	0.13	0.28	0.19
S1301363-040	12AS028	68-103	1.48	2.13	0.08	0.26	0.19

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
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Report ID: S1301363001

Project: Private Lease Soils - Full List
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Date Reported: 4/3/2013
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Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1301363-041	12AS028	103-128	1.76	2.52	0.09	0.36	0.24
S1301363-042	12AS028	128-157	1.62	3.04	0.08	0.46	0.30
S1301363-043	12AS028	157-173	1.36	2.64	0.08	0.41	0.29
S1301363-044	12AS029	0-14	7.07	5.16	1.19	0.22	0.09
S1301363-045	12AS029	14-36	2.70	2.19	0.12	0.14	0.09
S1301363-046	12AS029	36-58	2.22	2.26	0.10	0.22	0.15
S1301363-047	12AS029	58-86	2.73	2.83	0.09	0.32	0.19
S1301363-048	12AS029	86-118	2.05	2.53	0.07	0.41	0.27
S1301363-049	12AS029	118-173	1.75	2.82	0.07	0.59	0.39
S1301363-050	12AS029	173-232	1.76	3.06	0.07	1.00	0.64
S1301363-051	12AS029	232-244	12.2	57.4	0.42	9.96	1.69

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Lab ID	Sample ID	Depths cm	Sand %	Silt %	Clay %	Texture	Very Fine Sand %	Coarse Fragment %
S1301363-001	12AS018	0-22	26.0	38.0	36.0	Clay Loam	9.4	
S1301363-002	12AS018	22-68	26.0	42.0	32.0	Clay Loam	7.3	
S1301363-003	12AS018	68-115	8.0	48.0	44.0	Silty Clay	4.0	
S1301363-004	12AS018	115-148	18.0	42.0	40.0	Silty Clay	12.3	
S1301363-005	12AS018	148-244	60.0	28.0	12.0	Sandy Loam	17.2	
S1301363-006	12AS020	0-13	20.0	49.0	31.0	Clay Loam	3.3	
S1301363-007	12AS020	13-30	12.0	51.0	37.0	Silty Clay Loam	2.1	
S1301363-008	12AS020	30-80	10.0	50.0	40.0	Silty Clay	1.8	
S1301363-009	12AS020	80-111	8.0	51.0	41.0	Silty Clay	2.4	
S1301363-010	12AS020	111-140	10.0	54.0	36.0	Silty Clay Loam	5.2	
S1301363-011	12AS020	140-175	10.0	64.0	26.0	Silty Loam	4.8	
S1301363-012	12AS021	0-9	24.0	41.0	35.0	Clay Loam	10.9	
S1301363-013	12AS021	9-32	22.0	45.0	33.0	Clay Loam	10.7	
S1301363-014	12AS021	32-65	22.0	46.0	32.0	Clay Loam	8.3	
S1301363-015	12AS021	65-95	32.0	56.0	12.0	Silty Loam	15.5	
S1301363-016	12AS021	95-150	52.0	36.0	12.0	Sandy Loam	9.6	
S1301363-017	12AS021	150-202	82.0	15.0	3.0	Loamy Sand	18.3	
S1301363-018	12AS021	202-230	82.0	16.0	2.0	Loamy Sand	12.5	
S1301363-019	12AS022	0-12	84.0	14.0	2.0	Loamy Sand	12.5	
S1301363-020	12AS022	12-50	90.0	8.0	2.0	Sand	8.5	65.9

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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
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Report ID: S1301363001

Project: Private Lease Soils - Full List
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Work Order: S1301363

Lab ID	Sample ID	Depths cm	Sand %	Silt %	Clay %	Texture	Very Fine Sand %	Coarse Fragment %
S1301363-021	12AS022	50-87	86.0	12.0	2.0	Sand	6.9	63.1
S1301363-022	12AS022	87-126	90.0	9.0	1.0	Sand	4.9	65.9
S1301363-023	12AS022	126-160	82.0	15.0	3.0	Loamy Sand	9.9	70.2
S1301363-024	12AS022	160-210	84.0	14.0	2.0	Loamy Sand	11.3	73.8
S1301363-025	12AS022	210-232	80.0	16.0	4.0	Loamy Sand	17.2	1.1
S1301363-026	12AS024	0-18	74.0	20.0	6.0	Sandy Loam	2.2	62.6
S1301363-027	12AS024	18-84	80.0	18.0	2.0	Loamy Sand	6.4	64.5
S1301363-028	12AS024	84-136	88.0	10.0	2.0	Sand	9.5	60.5
S1301363-029	12AS024	136-186	84.0	14.0	2.0	Loamy Sand	8.3	60.0
S1301363-030	12AS024	186-233	88.0	11.0	1.0	Sand	8.8	54.4
S1301363-031	12AS027	0-20	24.0	36.0	40.0	Clay	13.6	
S1301363-032	12AS027	20-52	24.0	40.0	36.0	Clay Loam	10.0	
S1301363-033	12AS027	52-100	26.0	36.0	38.0	Clay Loam	7.4	
S1301363-034	12AS027	100-116	34.0	30.0	36.0	Clay Loam	12.0	
S1301363-035	12AS027	116-156	12.0	50.0	38.0	Silty Clay Loam	5.7	
S1301363-036	12AS027	156-170	6.0	54.0	40.0	Silty Clay	2.5	
S1301363-037	12AS028	0-12	18.0	38.0	44.0	Clay	5.8	
S1301363-038	12AS028	12-25	18.0	43.0	39.0	Silty Clay Loam	7.9	
S1301363-039	12AS028	25-68	10.0	46.0	44.0	Silty Clay	4.8	
S1301363-040	12AS028	68-103	52.0	36.0	12.0	Sandy Loam	17.2	

These results apply only to the samples tested.

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Soil Analysis Report

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Lab ID	Sample ID	Depths cm	Sand %	Silt %	Clay %	Texture	Very Fine Sand %	Coarse Fragment %
S1301363-041	12AS028	103-128	12.0	56.0	32.0	Silty Clay Loam	6.3	
S1301363-042	12AS028	128-157	12.0	46.0	42.0	Silty Clay	2.4	
S1301363-043	12AS028	157-173	48.0	40.0	12.0	Loam	11.7	
S1301363-044	12AS029	0-14	46.0	24.0	30.0	Sandy Clay Loam	27.5	
S1301363-045	12AS029	14-36	32.0	30.0	38.0	Clay Loam	7.1	
S1301363-046	12AS029	36-58	12.0	40.0	48.0	Silty Clay	<0.1	
S1301363-047	12AS029	58-86	2.0	40.0	58.0	Clay	<0.1	
S1301363-048	12AS029	86-118	8.0	34.0	58.0	Silty Clay	3.3	
S1301363-049	12AS029	118-173	6.0	56.0	38.0	Silty Clay Loam	0.7	
S1301363-050	12AS029	173-232	8.0	40.0	52.0	Silty Clay	4.1	
S1301363-051	12AS029	232-244	44.0	24.0	32.0	Clay Loam	3.1	

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Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1301363-001	12AS018	0-22	1.03	0.4	61.5	9.9	<0.02	10.5	3.1
S1301363-002	12AS018	22-68	0.31	<0.1	59.5	2.1	<0.02	8.0	0.9
S1301363-003	12AS018	68-115	0.45	<0.1	54.1	1.8	<0.02	6.9	0.4
S1301363-004	12AS018	115-148	0.31	<0.1	55.4	1.7	<0.02	6.8	0.2
S1301363-005	12AS018	148-244	0.12	<0.1	27.9	1.2	<0.02	3.8	0.4
S1301363-006	12AS020	0-13	0.52	4.7	38.2	10.1	<0.02	11.2	6.6
S1301363-007	12AS020	13-30	0.75	<0.1	76.3	4.1	<0.02	9.3	0.2
S1301363-008	12AS020	30-80	0.64	<0.1	60.4	2.5	<0.02	9.1	1.8
S1301363-009	12AS020	80-111	0.33	<0.1	52.4	3.4	<0.02	7.2	0.9
S1301363-010	12AS020	111-140	0.29	<0.1	44.9	2.0	<0.02	6.1	0.8
S1301363-011	12AS020	140-175	0.28	<0.1	54.2	2.3	<0.02	7.1	0.6
S1301363-012	12AS021	0-9	1.07	<0.1	19.7	8.4	<0.02	5.4	3.0
S1301363-013	12AS021	9-32	1.37	<0.1	30.7	6.5	<0.02	5.2	1.6
S1301363-014	12AS021	32-65	1.42	<0.1	56.3	4.0	<0.02	7.8	1.1
S1301363-015	12AS021	65-95	0.31	<0.1	60.8	1.8	<0.02	7.7	0.4
S1301363-016	12AS021	95-150	0.31	<0.1	45.9	1.5	<0.02	6.1	0.6
S1301363-017	12AS021	150-202	0.16	<0.1	26.1	1.3	<0.02	3.3	0.2
S1301363-018	12AS021	202-230	0.10	<0.1	22.5	4.2	<0.02	2.6	<0.1
S1301363-019	12AS022	0-12	0.08	<0.1	53.1	2.9	<0.02	7.3	0.9
S1301363-020	12AS022	12-50	0.08	<0.1	62.2	2.6	<0.02	8.0	0.6

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301363001

Project: Private Lease Soils - Full List
Date Received: 1/22/2013

Date Reported: 4/3/2013
Work Order: S1301363

Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1301363-021	12AS022	50-87	0.11	<0.1	60.5	1.7	<0.02	8.0	0.8
S1301363-022	12AS022	87-126	0.06	<0.1	61.9	1.9	<0.02	7.8	0.3
S1301363-023	12AS022	126-160	0.13	<0.1	58.2	1.6	<0.02	8.9	0.8
S1301363-024	12AS022	160-210	0.08	<0.1	58.6	1.7	<0.02	8.8	0.6
S1301363-025	12AS022	210-232	0.41	<0.1	22.9	1.9	<0.02	3.5	0.7
S1301363-026	12AS024	0-18	0.12	<0.1	56.7	2.1	<0.02	7.3	0.5
S1301363-027	12AS024	18-84	0.08	<0.1	56.6	3.3	<0.02	7.0	0.2
S1301363-028	12AS024	84-136	0.06	<0.1	55.7	1.8	<0.02	7.0	0.3
S1301363-029	12AS024	136-186	0.08	<0.1	54.7	1.9	<0.02	7.4	0.8
S1301363-030	12AS024	186-233	0.08	<0.1	53.7	1.6	<0.02	6.8	0.3
S1301363-031	12AS027	0-20	0.07	8.4	26.4	19.3	<0.02	5.4	2.2
S1301363-032	12AS027	20-52	0.48	<0.1	26.5	11.9	<0.02	5.0	1.8
S1301363-033	12AS027	52-100	0.68	2.0	33.4	6.3	<0.02	5.2	1.2
S1301363-034	12AS027	100-116	0.21	<0.1	29.0	2.1	<0.02	3.8	0.4
S1301363-035	12AS027	116-156	0.25	<0.1	46.6	2.0	<0.02	6.2	0.6
S1301363-036	12AS027	156-170	0.37	<0.1	51.6	4.3	<0.02	6.7	0.5
S1301363-037	12AS028	0-12	1.01	23.9	48.6	11.0	<0.02	8.5	2.7
S1301363-038	12AS028	12-25	0.79	7.2	49.4	11.1	<0.02	7.7	1.7
S1301363-039	12AS028	25-68	0.38	0.4	53.8	2.8	<0.02	6.8	0.3
S1301363-040	12AS028	68-103	0.17	<0.1	42.6	1.7	<0.02	4.4	<0.1

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

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Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1301363-041	12AS028	103-128	0.29	<0.1	47.1	1.4	<0.02	5.8	0.2
S1301363-042	12AS028	128-157	0.28	<0.1	51.7	1.5	<0.02	6.7	0.4
S1301363-043	12AS028	157-173	0.12	<0.1	46.7	1.6	<0.02	5.3	<0.1
S1301363-044	12AS029	0-14	0.71	56.5	25.6	41.2	<0.02	5.1	2.0
S1301363-045	12AS029	14-36	0.26	6.5	16.5	8.7	<0.02	3.2	1.2
S1301363-046	12AS029	36-58	0.45	0.9	24.1	4.0	<0.02	3.3	0.4
S1301363-047	12AS029	58-86	0.33	1.2	39.2	5.1	<0.02	6.5	1.8
S1301363-048	12AS029	86-118	0.21	1.2	51.2	2.2	<0.02	6.7	0.5
S1301363-049	12AS029	118-173	0.27	0.7	57.7	2.6	<0.02	7.5	0.6
S1301363-050	12AS029	173-232	0.39	0.9	47.1	2.7	<0.02	6.2	0.5
S1301363-051	12AS029	232-244	0.35	0.4	24.9	2.4	<0.02	3.1	0.1

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Lab ID	Sample ID	Depths cm	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t
S1301363-001	12AS018	0-22	0.09	2.69	615	612
S1301363-002	12AS018	22-68	0.06	1.98	595	593
S1301363-003	12AS018	68-115	0.04	1.19	541	540
S1301363-004	12AS018	115-148	0.03	0.92	554	553
S1301363-005	12AS018	148-244	0.01	0.44	279	279
S1301363-006	12AS020	0-13	0.49	15.4	382	367
S1301363-007	12AS020	13-30	0.04	1.23	763	761
S1301363-008	12AS020	30-80	0.06	1.98	604	602
S1301363-009	12AS020	80-111	0.04	1.20	524	523
S1301363-010	12AS020	111-140	0.04	1.13	449	448
S1301363-011	12AS020	140-175	0.01	0.41	542	541
S1301363-012	12AS021	0-9	0.15	4.61	197	192
S1301363-013	12AS021	9-32	0.74	23.1	307	284
S1301363-014	12AS021	32-65	1.29	40.3	563	523
S1301363-015	12AS021	65-95	0.02	0.48	608	608
S1301363-016	12AS021	95-150	0.03	0.79	459	458
S1301363-017	12AS021	150-202	0.02	0.73	261	261
S1301363-018	12AS021	202-230	0.19	5.81	225	219
S1301363-019	12AS022	0-12	0.02	0.47	531	530
S1301363-020	12AS022	12-50	0.03	0.87	622	621

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S1301363-021	12AS022	50-87	0.02	0.70	605	604
S1301363-022	12AS022	87-126	0.02	0.55	619	618
S1301363-023	12AS022	126-160	0.07	2.09	682	680
S1301363-024	12AS022	160-210	0.07	2.03	686	684
S1301363-025	12AS022	210-232	0.68	21.2	229	208
S1301363-026	12AS024	0-18	0.02	0.74	567	566
S1301363-027	12AS024	18-84	0.03	0.80	566	565
S1301363-028	12AS024	84-136	0.02	0.53	557	557
S1301363-029	12AS024	136-186	0.03	0.82	547	546
S1301363-030	12AS024	186-233	0.02	0.72	537	537
S1301363-031	12AS027	0-20	0.04	1.13	264	262
S1301363-032	12AS027	20-52	0.04	1.21	265	264
S1301363-033	12AS027	52-100	0.03	1.02	334	333
S1301363-034	12AS027	100-116	0.02	0.52	290	290
S1301363-035	12AS027	116-156	0.05	1.60	466	465
S1301363-036	12AS027	156-170	0.16	5.02	516	511
S1301363-037	12AS028	0-12	0.05	1.65	486	485
S1301363-038	12AS028	12-25	0.05	1.65	494	493
S1301363-039	12AS028	25-68	0.03	1.02	538	537
S1301363-040	12AS028	68-103	0.01	0.37	426	426

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Lab ID	Sample ID	Depths cm	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t
S1301363-041	12AS028	103-128	0.02	0.77	471	470
S1301363-042	12AS028	128-157	0.03	0.84	517	516
S1301363-043	12AS028	157-173	0.02	0.71	467	466
S1301363-044	12AS029	0-14	0.03	0.95	256	255
S1301363-045	12AS029	14-36	0.02	0.65	165	165
S1301363-046	12AS029	36-58	0.01	0.46	241	241
S1301363-047	12AS029	58-86	0.04	1.11	392	391
S1301363-048	12AS029	86-118	0.02	0.53	512	511
S1301363-049	12AS029	118-173	0.03	0.91	577	576
S1301363-050	12AS029	173-232	0.04	1.13	471	470
S1301363-051	12AS029	232-244	0.08	2.64	249	247

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Your Environmental Monitoring Partner

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Lab ID	Sample ID	Depths cm	Total Arsenic mg/Kg	Total Barium mg/Kg	Total Cadmium mg/Kg	Total Chromium mg/Kg	Total Copper mg/Kg	Total Iron mg/Kg	Total Lead mg/Kg	Total Manganese mg/Kg	Total Molybdenum mg/Kg
S1301363-001	12AS018	0-22	6.6	681	0.30	15.5	12.8	8980	7.0	303	<0.7
S1301363-002	12AS018	22-68	9.7	750	0.38	21.0	12.4	12800	7.4	570	<0.7
S1301363-003	12AS018	68-115	24.0	392	0.76	27.7	9.33	31100	10.9	398	1.0
S1301363-004	12AS018	115-148	13.8	498	0.65	29.1	11.0	18800	11.3	284	<0.7
S1301363-005	12AS018	148-244	3.6	96.0	0.26	11.7	6.81	4630	5.9	119	<0.7
S1301363-006	12AS020	0-13	6.7	596	0.37	18.4	14.2	10800	9.3	388	<0.7
S1301363-007	12AS020	13-30	7.4	544	0.35	18.6	12.3	10300	7.7	309	<0.7
S1301363-008	12AS020	30-80	9.6	546	0.34	16.0	10.7	10800	6.3	449	<0.7
S1301363-009	12AS020	80-111	26.3	309	0.63	19.6	6.75	27400	7.9	316	0.8
S1301363-010	12AS020	111-140	34.9	353	0.72	20.9	11.6	31400	9.0	201	1.0
S1301363-011	12AS020	140-175	5.3	224	0.37	17.6	7.50	6490	7.9	172	<0.7
S1301363-012	12AS021	0-9	6.3	103	0.43	20.1	12.7	14400	10.2	287	<0.7
S1301363-013	12AS021	9-32	7.6	153	0.50	27.6	15.6	18200	11.0	396	<0.7
S1301363-014	12AS021	32-65	6.2	331	0.36	17.2	9.14	13400	6.5	373	<0.7
S1301363-015	12AS021	65-95	7.4	215	0.33	12.3	4.94	10700	6.1	217	<0.7
S1301363-016	12AS021	95-150	4.8	201	0.33	11.5	5.13	8610	5.7	163	<0.7
S1301363-017	12AS021	150-202	12.8	123	0.29	5.74	2.58	11600	3.5	196	<0.7
S1301363-018	12AS021	202-230	2.7	75.6	0.21	5.61	2.86	3240	3.8	89.4	<0.7
S1301363-019	12AS022	0-12	5.0	134	0.26	7.35	3.05	6880	4.7	187	<0.7
S1301363-020	12AS022	12-50	5.6	127	0.24	6.40	2.70	6740	3.7	231	<0.7

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Lab ID	Sample ID	Depths	Total Arsenic	Total Barium	Total Cadmium	Total Chromium	Total Copper	Total Iron	Total Lead	Total Manganese	Total Molybdenum
		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
S1301363-021	12AS022	50-87	5.9	139	0.20	6.26	2.65	7320	3.4	250	<0.7
S1301363-022	12AS022	87-126	5.6	130	0.25	6.32	2.64	7440	3.6	231	<0.7
S1301363-023	12AS022	126-160	6.6	149	0.28	8.80	3.48	7370	4.1	226	<0.7
S1301363-024	12AS022	160-210	5.5	180	0.32	7.71	2.99	6780	4.1	251	0.8
S1301363-025	12AS022	210-232	8.7	96.5	0.26	9.63	5.46	8660	5.5	105	1.5
S1301363-026	12AS024	0-18	6.6	169	0.30	8.03	3.31	8890	4.3	252	<0.7
S1301363-027	12AS024	18-84	6.7	120	0.26	6.58	2.61	7640	3.7	219	0.7
S1301363-028	12AS024	84-136	4.6	167	0.29	7.19	2.80	6770	4.3	246	<0.7
S1301363-029	12AS024	136-186	3.9	142	0.34	6.46	2.54	7080	3.9	236	<0.7
S1301363-030	12AS024	186-233	5.6	174	0.25	6.49	2.51	6510	3.7	208	<0.7
S1301363-031	12AS027	0-20	6.2	118	0.38	22.4	12.3	14000	10.7	219	1.3
S1301363-032	12AS027	20-52	7.7	148	0.46	23.1	14.2	16200	12.9	272	1.0
S1301363-033	12AS027	52-100	9.3	272	0.50	27.7	13.2	15100	11.2	262	<0.7
S1301363-034	12AS027	100-116	8.7	300	0.38	28.4	13.5	17600	11.2	239	1.3
S1301363-035	12AS027	116-156	8.7	562	0.58	36.6	16.6	21200	12.7	456	<0.7
S1301363-036	12AS027	156-170	16.4	332	0.58	35.2	9.92	22900	12.4	308	2.6
S1301363-037	12AS028	0-12	9.5	453	0.53	27.7	15.0	15300	10.8	456	1.6
S1301363-038	12AS028	12-25	9.9	476	0.52	32.6	15.2	16700	11.5	456	1.9
S1301363-039	12AS028	25-68	13.5	441	0.60	36.7	12.6	18900	12.7	334	<0.7
S1301363-040	12AS028	68-103	3.5	170	0.30	13.9	4.06	4940	6.6	164	<0.7

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		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
S1301363-041	12AS028	103-128	8.3	270	0.39	19.6	9.97	10600	9.4	177	1.5
S1301363-042	12AS028	128-157	9.3	362	0.50	25.8	12.5	13400	11.0	253	2.9
S1301363-043	12AS028	157-173	3.5	173	0.32	12.2	5.28	4240	6.7	188	1.2
S1301363-044	12AS029	0-14	5.7	131	0.43	18.2	12.0	12700	10.8	219	2.1
S1301363-045	12AS029	14-36	5.7	116	0.22	15.7	9.32	11800	9.7	202	2.2
S1301363-046	12AS029	36-58	6.2	117	0.24	19.2	12.0	14000	11.8	217	1.7
S1301363-047	12AS029	58-86	6.4	317	0.39	25.2	19.1	14800	10.6	433	3.1
S1301363-048	12AS029	86-118	9.5	271	0.40	27.9	9.51	12600	10.4	261	3.6
S1301363-049	12AS029	118-173	8.6	195	0.37	20.8	8.02	10400	9.7	236	2.1
S1301363-050	12AS029	173-232	11.6	261	0.39	23.0	10.6	14200	9.4	192	1.9
S1301363-051	12AS029	232-244	11.2	202	0.36	16.7	11.2	18300	8.2	125	1.8

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Work Order: S1301363

Lab ID	Sample ID	Depths cm	Total Selenium mg/Kg	Total Silver mg/Kg	Total Zinc mg/Kg	Total Mercury mg/Kg	Bulk Density g/cm³
S1301363-001	12AS018	0-22	1.12	<0.5	59.6	<0.2	6.2
S1301363-002	12AS018	22-68	<0.96	<0.5	52.3	<0.2	2.6
S1301363-003	12AS018	68-115	1.68	<0.5	45.4	<0.2	2.4
S1301363-004	12AS018	115-148	1.18	<0.5	46.5	<0.2	
S1301363-005	12AS018	148-244	<0.96	<0.5	25.2	<0.2	2.4
S1301363-006	12AS020	0-13	1.48	<0.5	88.1	<0.2	5.2
S1301363-007	12AS020	13-30	1.78	<0.5	50.8	<0.2	
S1301363-008	12AS020	30-80	1.56	<0.5	41.2	<0.2	
S1301363-009	12AS020	80-111	1.81	<0.5	37.0	<0.2	2.6
S1301363-010	12AS020	111-140	<0.96	<0.5	50.1	<0.2	2.2
S1301363-011	12AS020	140-175	<0.96	<0.5	25.8	<0.2	2.2
S1301363-012	12AS021	0-9	<0.96	<0.5	81.0	<0.2	2.3
S1301363-013	12AS021	9-32	1.84	<0.5	76.3	<0.2	2.8
S1301363-014	12AS021	32-65	<0.96	<0.5	43.8	<0.2	7.3
S1301363-015	12AS021	65-95	1.53	<0.5	27.4	<0.2	3.4
S1301363-016	12AS021	95-150	1.53	<0.5	26.6	<0.2	2.5
S1301363-017	12AS021	150-202	<0.96	<0.5	15.6	<0.2	2.3
S1301363-018	12AS021	202-230	<0.96	<0.5	12.6	<0.2	2.6
S1301363-019	12AS022	0-12	<0.96	<0.5	17.0	<0.2	
S1301363-020	12AS022	12-50	1.58	<0.5	13.7	<0.2	

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301363001

Project: Private Lease Soils - Full List
Date Received: 1/22/2013

Date Reported: 4/3/2013
Work Order: S1301363

Lab ID	Sample ID	Depths cm	Total Selenium mg/Kg	Total Silver mg/Kg	Total Zinc mg/Kg	Total Mercury mg/Kg	Bulk Density g/cm³
S1301363-021	12AS022	50-87	<0.96	<0.5	14.4	<0.2	2.4
S1301363-022	12AS022	87-126	<0.96	<0.5	14.8	<0.2	
S1301363-023	12AS022	126-160	2.15	<0.5	16.6	<0.2	2.0
S1301363-024	12AS022	160-210	<0.96	<0.5	19.5	<0.2	2.0
S1301363-025	12AS022	210-232	1.54	<0.5	25.5	<0.2	2.1
S1301363-026	12AS024	0-18	<0.96	<0.5	19.3	<0.2	2.1
S1301363-027	12AS024	18-84	<0.96	<0.5	15.4	<0.2	
S1301363-028	12AS024	84-136	<0.96	<0.5	13.6	<0.2	
S1301363-029	12AS024	136-186	<0.96	<0.5	19.2	<0.2	2.1
S1301363-030	12AS024	186-233	<0.96	<0.5	13.6	<0.2	2.2
S1301363-031	12AS027	0-20	<0.96	<0.5	63.4	<0.2	2.7
S1301363-032	12AS027	20-52	<0.96	<0.5	72.4	<0.2	2.5
S1301363-033	12AS027	52-100	<0.96	<0.5	73.3	<0.2	2.1
S1301363-034	12AS027	100-116	<0.96	<0.5	82.5	<0.2	2.5
S1301363-035	12AS027	116-156	1.57	<0.5	73.1	<0.2	2.4
S1301363-036	12AS027	156-170	<0.96	<0.5	56.8	<0.2	2.2
S1301363-037	12AS028	0-12	1.41	<0.5	75.1	<0.2	4.0
S1301363-038	12AS028	12-25	1.37	<0.5	75.8	<0.2	3.0
S1301363-039	12AS028	25-68	<0.96	<0.5	59.1	<0.2	2.5
S1301363-040	12AS028	68-103	<0.96	<0.5	22.9	<0.2	2.5

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301363001

Project: Private Lease Soils - Full List
Date Received: 1/22/2013

Date Reported: 4/3/2013
Work Order: S1301363

Lab ID	Sample ID	Depths cm	Total Selenium mg/Kg	Total Silver mg/Kg	Total Zinc mg/Kg	Total Mercury mg/Kg	Bulk Density g/cm³
S1301363-041	12AS028	103-128	<0.96	<0.5	41.0	<0.2	2.2
S1301363-042	12AS028	128-157	<0.96	<0.5	50.9	<0.2	2.1
S1301363-043	12AS028	157-173	<0.96	<0.5	25.3	<0.2	2.4
S1301363-044	12AS029	0-14	<0.96	<0.5	58.1	<0.2	4.3
S1301363-045	12AS029	14-36	<0.96	<0.5	47.3	<0.2	2.4
S1301363-046	12AS029	36-58	<0.96	<0.5	60.1	<0.2	2.2
S1301363-047	12AS029	58-86	1.04	<0.5	89.9	<0.2	2.3
S1301363-048	12AS029	86-118	1.43	<0.5	47.1	<0.2	2.6
S1301363-049	12AS029	118-173	<0.96	<0.5	41.2	<0.2	2.7
S1301363-050	12AS029	173-232	1.20	<0.5	48.2	<0.2	2.3
S1301363-051	12AS029	232-244	<0.96	<0.5	68.2	<0.2	2.0

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Date: 4/1/2013

CLIENT: Alton Coal Development, LLC
Project: Private Lease Soils - Short List
Lab Order: S1301365

CASE NARRATIVE

Report ID: S1301365001

Samples 12AS009, 12AS010, 12AS011, 12AS012, 12AS013, 12AS014, 12AS015, 12AS016, 12AS017, 12AS019, 12AS023, 12AS025, 12AS026, and 12AS030 were received on January 22, 2013.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
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Report ID: S1301365001

Project: Private Lease Soils - Short List
Date Received: 1/22/2013

Date Reported: 4/1/2013
Work Order: S1301365

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1301365-001	12AS009	0-7	7.7	65.2	0.59	11.4	29.6	24.5	4.8
S1301365-002	12AS009	7-20	7.6	60.7	0.45	8.8	28.2	21.1	3.4
S1301365-003	12AS009	20-62	7.9	64.1	0.33	9.9	30.9	23.9	1.8
S1301365-004	12AS009	62-99	8.1	62.9	0.26	9.1	27.7	22.9	1.3
S1301365-005	12AS009	99-137	8.4	55.8	0.25	9.0	26.7	22.2	0.9
S1301365-006	12AS009	137-183	8.5	64.0	0.28	10.8	27.7	23.7	1.0
S1301365-007	12AS009	183-232	8.6	52.7	0.32	6.8	25.7	20.3	2.3
S1301365-008	12AS010	0-9	7.9	72.5	0.56	15.4	41.6	28.7	5.7
S1301365-009	12AS010	9-31	8.2	65.2	0.42	13.5	43.3	26.9	2.4
S1301365-010	12AS010	31-67	8.6	52.0	0.37	9.1	31.1	20.5	2.1
S1301365-011	12AS010	67-96	8.9	32.5	0.27	6.6	22.3	7.4	0.5
S1301365-012	12AS010	96-134	8.9	40.2	0.34	15.0	23.0	15.9	0.5
S1301365-013	12AS010	134-183	8.9	49.3	0.30	16.2	24.2	13.0	1.1
S1301365-014	12AS010	183-200	9.0	31.3	0.26	9.9	16.9	6.0	0.5
S1301365-015	12AS010	200-284	8.5	80.4	0.30	19.1	30.4	25.4	0.9
S1301365-016	12AS011	0-10	7.9	66.5	0.54	14.2	35.7	25.7	6.1
S1301365-017	12AS011	10-32	8.0	65.8	0.46	10.1	32.8	23.3	4.5
S1301365-018	12AS011	32-71	8.4	39.4	0.37	3.9	22.7	14.2	1.3
S1301365-019	12AS011	71-116	8.6	51.0	0.36	5.8	30.9	24.4	0.6
S1301365-020	12AS011	116-128	8.9	31.3	0.31	2.3			1.0

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
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Report ID: S1301365001

Project: Private Lease Soils - Short List
Date Received: 1/22/2013

Date Reported: 4/1/2013
Work Order: S1301365

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1301365-021	12AS011	128-154	8.8	66.4	0.35	13.3	29.8	25.0	1.0
S1301365-022	12AS011	154-214	8.6	65.7	0.50	13.0	26.5	22.2	1.3
S1301365-023	12AS012	0-11	7.9	66.4	0.53	12.6	34.1	23.2	6.0
S1301365-024	12AS012	11-30	8.0	73.3	0.45	13.3	35.8	28.1	4.1
S1301365-025	12AS012	30-72	8.4	49.5	0.40	7.0	27.6	19.8	0.8
S1301365-026	12AS012	72-116	9.0	30.9	0.26	3.0	13.3	7.7	0.3
S1301365-027	12AS012	116-160	8.8	29.0	0.35	3.5	10.3	5.2	0.3
S1301365-028	12AS012	160-187	9.2	29.3	0.28	5.3	12.3	4.9	0.6
S1301365-029	12AS012	187-230	9.0	31.9	0.25	4.5	7.3	3.2	0.3
S1301365-030	12AS013	0-16	7.7	97.3	0.37	13.1	28.4	22.5	4.4
S1301365-031	12AS013	16-52	7.8	29.3	0.30	6.8	22.3	15.2	1.6
S1301365-032	12AS013	52-102	8.1	51.8	0.27	6.8	21.4	15.9	0.9
S1301365-033	12AS013	102-114	8.2	53.8	0.30	8.7	25.9	22.3	0.8
S1301365-034	12AS014	0-20	7.8	65.9	0.34	46.5	35.4	27.0	2.5
S1301365-035	12AS014	20-45	7.9	69.1	0.31	30.4	34.3	28.0	1.8
S1301365-036	12AS014	45-66	8.4	75.8	0.39	18.8	35.5	30.2	1.1
S1301365-037	12AS014	66-88	8.2	76.7	0.80	12.6	36.0	29.8	2.0
S1301365-038	12AS014	88-114	8.1	82.7	1.65	12.3	37.9	31.1	1.0
S1301365-039	12AS015	0-20	7.9	72.1	0.47	14.0	39.8	30.8	3.7
S1301365-040	12AS015	20-54	8.0	76.7	0.39	13.7	39.4	34.0	2.4

These results apply only to the samples tested.

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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301365001

Project: Private Lease Soils - Short List
Date Received: 1/22/2013

Date Reported: 4/1/2013
Work Order: S1301365

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1301365-041	12AS015	54-87	8.4	84.0	0.98	14.0	42.4	37.2	1.7
S1301365-042	12AS015	87-119	8.2	52.7	6.55	16.5	44.2	39.2	1.0
S1301365-083	12AS015	119-132	8.2	72.5	10.9	13.9	36.8	32.0	0.8
S1301365-043	12AS016	0-11	7.7	50.7	0.43	9.9	28.0	17.6	2.9
S1301365-044	12AS016	11-40	7.7	51.6	0.37	6.7	26.8	16.8	1.9
S1301365-045	12AS016	40-71	8.1	57.2	0.78	7.1	25.5	18.0	1.3
S1301365-046	12AS016	71-120	7.7	47.8	0.38	5.2	26.0	16.8	1.7
S1301365-047	12AS017	0-13	7.7	84.5	0.33	20.7	47.8	38.8	3.5
S1301365-048	12AS017	13-57	7.9	186	0.24	20.0	99.0	96.6	1.9
S1301365-049	12AS017	57-84	7.8	87.9	3.35	20.7	47.8	42.8	0.3
S1301365-050	12AS017	84-118	7.7	83.7	4.64	19.5	44.6	40.0	0.6
S1301365-051	12AS017	118-161	5.3	80.2	6.14	17.3	44.6	38.9	0.2
S1301365-052	12AS019	0-12	7.7	67.6	0.60	13.9	40.7	33.0	5.5
S1301365-053	12AS019	12-32	7.8	72.6	0.40	11.8	40.2	33.3	5.8
S1301365-054	12AS019	32-72	8.0	62.8	0.33	11.3	42.0	31.2	3.9
S1301365-055	12AS019	72-100	8.3	61.1	0.20	8.8	26.8	23.5	1.1
S1301365-056	12AS019	100-147	8.4	36.6	0.27	5.9	19.1	11.7	0.4
S1301365-057	12AS019	147-196	8.7	35.0	0.31	5.7	20.8	10.6	2.8
S1301365-058	12AS019	196-240	8.7	33.0	0.44	8.2	20.1	10.9	0.2
S1301365-059	12AS023	0-18	7.8	43.9	0.41	9.0	19.0	13.6	0.3

These results apply only to the samples tested.

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
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Report ID: S1301365001

Project: Private Lease Soils - Short List
Date Received: 1/22/2013

Date Reported: 4/1/2013
Work Order: S1301365

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1301365-060	12AS023	18-47	7.8	38.3	0.32	3.5	16.6	11.3	2.9
S1301365-061	12AS023	47-78	8.1	32.5	0.26	2.0	15.1	10.3	3.0
S1301365-062	12AS023	78-120	8.2	28.7	0.31	1.5	12.5	7.1	1.9
S1301365-063	12AS023	120-180	8.7	29.0	0.26	1.6	10.2	5.8	0.7
S1301365-064	12AS023	180-230	8.6	28.8	0.20	3.8	8.6	3.0	0.2
S1301365-065	12AS025	0-12	7.8	69.0	0.57	12.5	35.4	28.7	6.4
S1301365-066	12AS025	12-30	8.1	60.0	0.50	10.6	31.6	26.7	3.8
S1301365-067	12AS025	30-70	8.5	49.6	0.36	4.8	30.4	24.0	0.7
S1301365-068	12AS025	70-101	8.7	43.8	0.31	6.5	27.5	21.7	0.5
S1301365-069	12AS025	101-123	8.8	35.2	0.31	2.9	23.2	13.2	0.2
S1301365-070	12AS025	123-156	8.8	56.2	0.33	11.4	27.2	23.6	0.7
S1301365-071	12AS025	156-186	8.9	30.9	0.31	8.1	18.5	10.6	0.2
S1301365-072	12AS025	186-204	8.9	28.1	0.27	8.0	19.0	6.3	<0.1
S1301365-073	12AS026	3-20	7.7	68.4	0.73	18.9	34.8	29.8	7.0
S1301365-074	12AS026	20-65	7.7	55.2	0.65	9.2	28.9	21.6	1.9
S1301365-075	12AS026	65-104	7.9	56.2	0.51	9.5	31.3	23.0	2.0
S1301365-076	12AS026	104-144	8.0	58.3	0.51	12.7	34.2	29.4	2.3
S1301365-077	12AS026	144-202	8.0	61.2	0.36	9.2	27.8	23.6	1.2
S1301365-078	12AS030	0-15	7.7	65.1	0.39	12.6	32.0	26.9	2.5
S1301365-079	12AS030	15-30	7.7	66.5	0.37	11.0	32.7	28.5	1.9

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Cedar City, UT 84721

Report ID: S1301365001

Project: Private Lease Soils - Short List
Date Received: 1/22/2013

Date Reported: 4/1/2013
Work Order: S1301365

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1301365-080	12AS030	30-42	7.9	69.5	0.36	10.1	32.8	29.2	1.8
S1301365-081	12AS030	42-67	7.9	59.7	0.69	11.2	33.7	29.9	1.9
S1301365-082	12AS030	67-95	7.9	82.2	1.57	12.8	36.1	31.0	1.9

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
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Report ID: S1301365001

Project: Private Lease Soils - Short List

Date Received: 1/22/2013

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Lab ID	Sample ID	Depths cm	PE Calcium meq/L	PE Magnesium meq/L	PE Potassium meq/L	PE Sodium meq/L	SAR
S1301365-001	12AS009	0-7	3.75	1.40	0.98	0.11	0.07
S1301365-002	12AS009	7-20	3.51	1.26	0.55	0.10	0.06
S1301365-003	12AS009	20-62	2.50	1.06	0.17	0.17	0.13
S1301365-004	12AS009	62-99	1.62	1.06	0.12	0.15	0.13
S1301365-005	12AS009	99-137	1.39	1.19	0.10	0.13	0.11
S1301365-006	12AS009	137-183	1.23	1.66	0.10	0.18	0.15
S1301365-007	12AS009	183-232	1.23	1.92	0.13	0.27	0.22
S1301365-008	12AS010	0-9	3.42	2.43	0.30	0.21	0.12
S1301365-009	12AS010	9-31	2.30	2.07	0.16	0.09	0.06
S1301365-010	12AS010	31-67	1.16	2.40	0.16	0.16	0.12
S1301365-011	12AS010	67-96	0.93	2.12	0.09	0.09	0.07
S1301365-012	12AS010	96-134	0.89	3.05	0.11	0.14	0.10
S1301365-013	12AS010	134-183	0.75	2.50	0.12	0.10	0.08
S1301365-014	12AS010	183-200	0.67	2.27	0.11	0.15	0.12
S1301365-015	12AS010	200-284	1.06	2.14	0.10	0.27	0.21
S1301365-016	12AS011	0-10	3.04	2.04	0.81	0.07	0.05
S1301365-017	12AS011	10-32	2.64	2.42	0.31	0.07	0.04
S1301365-018	12AS011	32-71	1.37	2.22	0.12	0.09	0.07
S1301365-019	12AS011	71-116	1.16	3.13	0.09	0.16	0.11
S1301365-020	12AS011	116-128	0.85	2.15	0.08	0.50	0.41

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
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Lab ID	Sample ID	Depths cm	PE Calcium meq/L	PE Magnesium meq/L	PE Potassium meq/L	PE Sodium meq/L	SAR
S1301365-021	12AS011	128-154	0.88	3.07	0.09	0.16	0.11
S1301365-022	12AS011	154-214	1.39	3.89	0.11	0.35	0.21
S1301365-023	12AS012	0-11	3.54	2.01	0.74	0.06	0.04
S1301365-024	12AS012	11-30	2.97	2.26	0.21	0.06	0.04
S1301365-025	12AS012	30-72	1.17	2.41	0.12	0.11	0.08
S1301365-026	12AS012	72-116	0.85	1.84	0.07	0.10	0.09
S1301365-027	12AS012	116-160	0.98	1.77	0.08	0.98	0.83
S1301365-028	12AS012	160-187	0.88	2.02	0.08	0.11	0.09
S1301365-029	12AS012	187-230	0.96	1.97	0.06	0.09	0.08
S1301365-030	12AS013	0-16	3.34	0.68	0.35	0.08	0.06
S1301365-031	12AS013	16-52	2.69	0.62	0.21	0.14	0.11
S1301365-032	12AS013	52-102	1.34	0.65	0.11	1.10	1.11
S1301365-033	12AS013	102-114	1.01	0.48	0.07	2.20	2.54
S1301365-034	12AS014	0-20	2.23	1.18	0.12	0.35	0.26
S1301365-035	12AS014	20-45	1.69	0.91	0.05	1.24	1.09
S1301365-036	12AS014	45-66	1.01	0.56	0.04	3.02	3.41
S1301365-037	12AS014	66-88	1.52	0.96	0.06	6.21	5.57
S1301365-038	12AS014	88-114	2.90	2.72	0.10	12.5	7.44
S1301365-039	12AS015	0-20	3.15	1.83	0.13	0.54	0.34
S1301365-040	12AS015	20-54	1.91	1.63	0.05	1.43	1.08

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

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Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1301365-041	12AS015	54-87	1.54	2.88	0.04	6.60	4.44
S1301365-042	12AS015	87-119	7.10	55.1	0.30	38.2	6.85
S1301365-083	12AS015	119-132	24.2	115	0.47	60.8	7.29
S1301365-043	12AS016	0-11	3.86	0.66	0.34	0.25	0.17
S1301365-044	12AS016	11-40	3.06	0.80	0.29	0.13	0.09
S1301365-045	12AS016	40-71	1.95	1.65	0.14	4.73	3.53
S1301365-046	12AS016	71-120	2.82	0.75	0.19	0.59	0.44
S1301365-047	12AS017	0-13	2.52	0.57	0.22	0.71	0.57
S1301365-048	12AS017	13-57	1.41	0.27	0.11	1.23	1.30
S1301365-049	12AS017	57-84	22.3	6.99	0.34	17.4	4.55
S1301365-050	12AS017	84-118	22.4	11.3	0.51	27.1	6.60
S1301365-051	12AS017	118-161	16.9	20.0	0.65	44.1	10.3
S1301365-052	12AS019	0-12	4.14	1.03	0.71	0.34	0.21
S1301365-053	12AS019	12-32	3.52	1.05	0.37	0.06	0.04
S1301365-054	12AS019	32-72	2.64	1.41	0.09	0.12	0.09
S1301365-055	12AS019	72-100	1.45	0.90	0.05	0.08	0.07
S1301365-056	12AS019	100-147	1.42	1.47	0.07	0.19	0.16
S1301365-057	12AS019	147-196	1.20	1.96	0.06	0.13	0.11
S1301365-058	12AS019	196-240	1.63	2.74	0.09	0.46	0.31
S1301365-059	12AS023	0-18	3.68	0.90	0.32	0.05	0.03

These results apply only to the samples tested.

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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
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Lab ID	Sample ID	Depths cm	PE Calcium meq/L	PE Magnesium meq/L	PE Potassium meq/L	PE Sodium meq/L	SAR
S1301365-060	12AS023	18-47	2.94	0.84	0.07	0.10	0.07
S1301365-061	12AS023	47-78	2.09	0.80	0.06	0.05	0.05
S1301365-062	12AS023	78-120	2.17	1.29	0.06	0.47	0.36
S1301365-063	12AS023	120-180	1.48	1.24	0.10	0.22	0.19
S1301365-064	12AS023	180-230	1.26	0.98	0.06	0.08	0.07
S1301365-065	12AS025	0-12	3.88	2.92	0.20	0.18	0.10
S1301365-066	12AS025	12-30	2.44	2.16	0.05	0.15	0.10
S1301365-067	12AS025	30-70	1.35	3.11	0.05	0.13	0.09
S1301365-068	12AS025	70-101	1.12	2.44	0.08	0.13	0.10
S1301365-069	12AS025	101-123	1.05	2.56	0.09	0.13	0.10
S1301365-070	12AS025	123-156	1.25	2.54	0.14	0.20	0.15
S1301365-071	12AS025	156-186	0.93	2.19	0.16	0.22	0.18
S1301365-072	12AS025	186-204	0.95	2.04	0.17	0.13	0.11
S1301365-073	12AS026	3-20	4.37	3.22	0.44	0.47	0.24
S1301365-074	12AS026	20-65	3.53	2.19	0.54	1.12	0.66
S1301365-075	12AS026	65-104	3.51	2.05	0.18	0.53	0.32
S1301365-076	12AS026	104-144	3.45	2.05	0.08	0.58	0.35
S1301365-077	12AS026	144-202	2.11	1.55	0.03	0.79	0.58
S1301365-078	12AS030	0-15	3.02	0.60	0.22	0.59	0.44
S1301365-079	12AS030	15-30	2.67	0.60	0.17	1.50	1.17

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Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1301365-080	12AS030	30-42	1.80	0.45	0.09	2.56	2.42
S1301365-081	12AS030	42-67	1.96	0.60	0.09	5.26	4.65
S1301365-082	12AS030	67-95	3.47	1.11	0.14	12.1	8.03

These results apply only to the samples tested.

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Lab ID	Sample ID	Depths cm	Sand %	Silt %	Clay %	Texture	Very Fine Sand %	Coarse Fragment %
S1301365-001	12AS009	0-7	26.0	35.0	39.0	Clay Loam	7.1	
S1301365-002	12AS009	7-20	10.0	46.0	44.0	Silty Clay	<0.1	
S1301365-003	12AS009	20-62	<0.1	47.0	53.0	Silty Clay	<0.1	
S1301365-004	12AS009	62-99	<0.1	48.0	52.0	Silty Clay	<0.1	
S1301365-005	12AS009	99-137	<0.1	53.0	47.0	Silty Clay	<0.1	
S1301365-006	12AS009	137-183	<0.1	49.0	51.0	Silty Clay	<0.1	
S1301365-007	12AS009	183-232	6.0	58.0	36.0	Silty Clay Loam	<0.1	
S1301365-008	12AS010	0-9	10.0	50.0	40.0	Silty Clay	<0.1	
S1301365-009	12AS010	9-31	8.0	68.0	24.0	Silty Loam	<0.1	
S1301365-010	12AS010	31-67	16.0	50.0	34.0	Silty Clay Loam	<0.1	
S1301365-011	12AS010	67-96	66.0	18.0	16.0	Sandy Loam	17.7	
S1301365-012	12AS010	96-134	42.0	36.0	22.0	Loam	9.8	
S1301365-013	12AS010	134-183	20.0	60.0	20.0	Silty Loam	10.5	
S1301365-014	12AS010	183-200	60.0	28.0	12.0	Sandy Loam	8.8	
S1301365-015	12AS010	200-284	<0.1	48.0	52.0	Silty Clay	<0.1	
S1301365-016	12AS011	0-10	18.0	41.0	41.0	Silty Clay	<0.1	
S1301365-017	12AS011	10-32	18.0	40.0	42.0	Silty Clay	0.5	
S1301365-018	12AS011	32-71	<0.1	61.0	39.0	Silty Clay Loam	<0.1	
S1301365-019	12AS011	71-116	<0.1	37.0	63.0	Clay	<0.1	
S1301365-020	12AS011	116-128	70.0	18.0	12.0	Sandy Loam	3.6	

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Lab ID	Sample ID	Depths cm	Sand %	Silt %	Clay %	Texture	Very Fine Sand %	Coarse Fragment %
S1301365-021	12AS011	128-154	<0.1	25.0	75.0	Clay	<0.1	
S1301365-022	12AS011	154-214	<0.1	17.0	83.0	Clay	<0.1	
S1301365-023	12AS012	0-11	<0.1	37.0	63.0	Clay	<0.1	
S1301365-024	12AS012	11-30	<0.1	25.0	75.0	Clay	<0.1	
S1301365-025	12AS012	30-72	<0.1	37.0	63.0	Clay	<0.1	
S1301365-026	12AS012	72-116	42.0	33.0	25.0	Loam	<0.1	
S1301365-027	12AS012	116-160	50.0	32.0	18.0	Loam	<0.1	
S1301365-028	12AS012	160-187	50.0	33.0	17.0	Loam	<0.1	
S1301365-029	12AS012	187-230	50.0	33.0	17.0	Loam	<0.1	
S1301365-030	12AS013	0-16	<0.1	28.0	72.0	Clay	<0.1	
S1301365-031	12AS013	16-52	<0.1	39.0	61.0	Clay	<0.1	
S1301365-032	12AS013	52-102	<0.1	39.0	61.0	Clay	<0.1	
S1301365-033	12AS013	102-114	<0.1	27.0	73.0	Clay	<0.1	
S1301365-034	12AS014	0-20	6.0	43.0	51.0	Silty Clay	1.7	
S1301365-035	12AS014	20-45	6.0	43.0	51.0	Silty Clay	2.2	
S1301365-036	12AS014	45-66	4.0	44.0	52.0	Silty Clay	0.3	
S1301365-037	12AS014	66-88	10.0	37.0	53.0	Clay	6.3	
S1301365-038	12AS014	88-114	6.0	39.0	55.0	Silty Clay	2.4	
S1301365-039	12AS015	0-20	10.0	39.0	51.0	Clay	4.4	
S1301365-040	12AS015	20-54	12.0	32.0	56.0	Silty Clay	7.2	

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Lab ID	Sample ID	Depths cm	Sand %	Silt %	Clay %	Texture	Very Fine Sand %	Coarse Fragment %
S1301365-041	12AS015	54-87	10.0	30.0	60.0	Clay	5.6	
S1301365-042	12AS015	87-119	10.0	31.0	59.0	Silty Clay	6.1	
S1301365-083	12AS015	119-132	20.0	32.0	48.0	Clay	15.6	
S1301365-043	12AS016	0-11	22.0	46.0	32.0	Clay Loam	13.9	
S1301365-044	12AS016	11-40	18.0	49.0	33.0	Silty Clay Loam	10.2	
S1301365-045	12AS016	40-71	22.0	37.0	41.0	Clay	15.5	
S1301365-046	12AS016	71-120	22.0	47.0	31.0	Clay Loam	13.0	
S1301365-047	12AS017	0-13	14.0	31.0	55.0	Silty Clay	9.2	
S1301365-048	12AS017	13-57	10.0	23.0	67.0	Clay	6.6	
S1301365-049	12AS017	57-84	16.0	31.0	53.0	Clay	6.3	
S1301365-050	12AS017	84-118	18.0	24.0	58.0	Silty Clay	4.5	
S1301365-051	12AS017	118-161	16.0	29.0	55.0	Silty Clay	8.5	
S1301365-052	12AS019	0-12	16.0	41.0	43.0	Silty Clay	2.3	
S1301365-053	12AS019	12-32	12.0	41.0	47.0	Silty Clay	0.2	
S1301365-054	12AS019	32-72	10.0	46.0	44.0	Silty Clay	<0.1	
S1301365-055	12AS019	72-100	24.0	35.0	41.0	Clay	19.1	
S1301365-056	12AS019	100-147	46.0	35.0	19.0	Loam	10.5	
S1301365-057	12AS019	147-196	44.0	41.0	15.0	Loam	11.5	
S1301365-058	12AS019	196-240	52.0	33.0	15.0	Sandy Loam	11.1	
S1301365-059	12AS023	0-18	50.0	25.0	25.0	Sandy Clay Loam	5.9	

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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945
Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301365001

Project: Private Lease Soils - Short List
Date Received: 1/22/2013

Date Reported: 4/1/2013
Work Order: S1301365

Lab ID	Sample ID	Depths cm	Sand %	Silt %	Clay %	Texture	Very Fine Sand %	Coarse Fragment %
S1301365-060	12AS023	18-47	51.0	25.0	24.0	Sandy Clay Loam	2.0	9.6
S1301365-061	12AS023	47-78	64.0	18.0	18.0	Sandy Loam	10.7	2.7
S1301365-062	12AS023	78-120	60.0	26.0	14.0	Sandy Loam	<0.1	6.1
S1301365-063	12AS023	120-180	84.0	8.0	8.0	Loamy Sand	10.6	63.5
S1301365-064	12AS023	180-230	80.0	14.0	6.0	Loamy Sand	6.8	17.9
S1301365-065	12AS025	0-12	22.0	56.0	22.0	Silty Loam	7.5	0.2
S1301365-066	12AS025	12-30	16.0	41.0	43.0	Silty Clay	8.1	<0.1
S1301365-067	12AS025	30-70	12.0	56.0	32.0	Silty Clay Loam	6.9	
S1301365-068	12AS025	70-101	32.0	49.0	19.0	Loam	27.3	
S1301365-069	12AS025	101-123	38.0	46.0	16.0	Loam	13.8	
S1301365-070	12AS025	123-156	20.0	44.0	36.0	Clay Loam	13.3	
S1301365-071	12AS025	156-186	58.0	26.0	16.0	Sandy Loam	16.2	
S1301365-072	12AS025	186-204	60.0	32.0	8.0	Sandy Loam	17.0	
S1301365-073	12AS026	3-20	20.0	39.0	41.0	Clay	7.7	
S1301365-074	12AS026	20-65	20.0	47.0	33.0	Clay Loam	3.9	
S1301365-075	12AS026	65-104	34.0	27.0	39.0	Clay Loam	6.3	
S1301365-076	12AS026	104-144	10.0	41.0	49.0	Silty Clay	2.2	
S1301365-077	12AS026	144-202	20.0	37.0	43.0	Clay	15.5	
S1301365-078	12AS030	0-15	12.0	35.0	53.0	Clay	7.9	
S1301365-079	12AS030	15-30	16.0	30.0	54.0	Clay	11.9	

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Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment
		cm	%	%	%		%	%
S1301365-080	12AS030	30-42	14.0	32.0	54.0	Clay	10.0	
S1301365-081	12AS030	42-67	10.0	36.0	54.0	Clay	6.2	
S1301365-082	12AS030	67-95	10.0	34.0	56.0	Silty Clay	6.2	

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Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1301365-001	12AS009	0-7	0.65	3.5	22.2	11.0	<0.02	5.0	2.3
S1301365-002	12AS009	7-20	0.51	0.5	25.4	6.0	<0.02	4.4	1.4
S1301365-003	12AS009	20-62	0.34	0.5	42.4	3.8	<0.02	6.0	0.9
S1301365-004	12AS009	62-99	0.49	0.6	52.6	1.7	<0.02	6.8	0.5
S1301365-005	12AS009	99-137	0.36	0.5	51.8	2.2	<0.02	6.8	0.7
S1301365-006	12AS009	137-183	0.33	0.4	49.2	20.4	<0.02	6.5	0.7
S1301365-007	12AS009	183-232	0.25	0.5	45.2	1120	<0.02	5.8	0.3
S1301365-008	12AS010	0-9	0.68	1.9	47.6	38.7	<0.02	8.5	2.8
S1301365-009	12AS010	9-31	0.63	0.5	57.6	3.3	<0.02	8.1	1.2
S1301365-010	12AS010	31-67	0.22	0.4	50.1	1.4	<0.02	6.3	0.3
S1301365-011	12AS010	67-96	0.18	0.3	24.4	2.3	<0.02	3.0	<0.1
S1301365-012	12AS010	96-134	0.25	0.4	32.4	2.0	<0.02	4.3	0.4
S1301365-013	12AS010	134-183	0.29	<0.1	37.0	2.3	<0.02	4.8	0.3
S1301365-014	12AS010	183-200	0.18	0.4	25.8	0.3	<0.02	3.5	0.4
S1301365-015	12AS010	200-284	0.57	0.8	48.0	0.5	<0.02	6.4	0.7
S1301365-016	12AS011	0-10	0.83	0.9	39.8	8.5	<0.02	7.2	2.4
S1301365-017	12AS011	10-32	1.06	0.8	43.3	5.0	<0.02	6.7	1.5
S1301365-018	12AS011	32-71	0.27	0.4	41.4	1.7	<0.02	5.3	0.4
S1301365-019	12AS011	71-116	0.25	0.4	55.2	1.4	<0.02	7.2	0.6
S1301365-020	12AS011	116-128	0.17	0.3	24.4	0.7	<0.02	3.2	0.2

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Soil Analysis Report

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Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1301365-021	12AS011	128-154	0.64	0.5	51.0	<0.1	<0.02	6.7	0.5
S1301365-022	12AS011	154-214	0.34	1.1	49.5	0.8	<0.02	6.6	0.6
S1301365-023	12AS012	0-11	0.50	1.2	38.6	8.9	<0.02	7.0	2.3
S1301365-024	12AS012	11-30	0.95	0.7	49.0	4.8	<0.02	7.4	1.5
S1301365-025	12AS012	30-72	0.45	0.5	51.7	1.0	<0.02	8.0	0.6
S1301365-026	12AS012	72-116	0.20	0.3	28.9	0.7	<0.02	3.6	0.1
S1301365-027	12AS012	116-160	0.14	0.4	25.5	0.6	<0.02	3.1	<0.1
S1301365-028	12AS012	160-187	0.13	0.6	25.6	0.7	<0.02	3.4	0.3
S1301365-029	12AS012	187-230	0.13	0.4	18.1	0.3	<0.02	2.5	0.3
S1301365-030	12AS013	0-16	0.44	1.0	3.5	4.2	<0.02	2.8	2.3
S1301365-031	12AS013	16-52	0.18	0.9	10.7	1.2	<0.02	1.9	0.6
S1301365-032	12AS013	52-102	0.17	0.3	14.9	<0.1	<0.02	2.0	0.3
S1301365-033	12AS013	102-114	0.45	0.4	10.1	0.3	<0.02	1.5	0.2
S1301365-034	12AS014	0-20	0.55	2.3	4.1	3.6	<0.02	1.6	1.1
S1301365-035	12AS014	20-45	0.28	0.2	5.9	2.1	<0.02	1.4	0.6
S1301365-036	12AS014	45-66	0.40	0.1	6.4	1.9	<0.02	1.3	0.6
S1301365-037	12AS014	66-88	0.76	<0.1	6.3	1.8	<0.02	1.3	0.5
S1301365-038	12AS014	88-114	0.93	0.2	6.6	1.2	0.04	1.2	0.5
S1301365-039	12AS015	0-20	0.71	3.4	5.3	5.6	<0.02	2.0	1.4
S1301365-040	12AS015	20-54	0.55	1.1	8.4	2.3	<0.02	1.9	0.9

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Date Reported: 4/1/2013
Work Order: S1301365

Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1301365-041	12AS015	54-87	1.01	1.1	12.6	1.0	<0.02	1.9	0.5
S1301365-042	12AS015	87-119	3.35	0.9	7.4	2.3	0.02	1.1	0.3
S1301365-083	12AS015	119-132	2.47	0.9	11.9	3.1	0.02	1.7	0.3
S1301365-043	12AS016	0-11	0.40	1.5	11.6	3.7	<0.02	2.8	1.4
S1301365-044	12AS016	11-40	0.32	0.4	13.9	2.1	<0.02	2.6	0.9
S1301365-045	12AS016	40-71	0.37	0.3	14.5	0.2	<0.02	2.2	0.4
S1301365-046	12AS016	71-120	0.34	0.5	17.8	1.2	<0.02	3.1	0.9
S1301365-047	12AS017	0-13	0.62	3.0	4.0	4.3	<0.02	2.2	1.7
S1301365-048	12AS017	13-57	0.43	0.3	4.4	2.3	<0.02	0.9	0.3
S1301365-049	12AS017	57-84	0.93	0.4	2.7	2.9	<0.02	0.6	0.3
S1301365-050	12AS017	84-118	0.76	0.7	1.6	1.3	<0.02	0.4	0.2
S1301365-051	12AS017	118-161	0.62	0.2	1.3	4.0	<0.02	0.4	0.2
S1301365-052	12AS019	0-12	0.70	2.6	56.0	12.8	<0.02	10.2	3.5
S1301365-053	12AS019	12-32	0.76	1.5	57.2	5.2	<0.02	9.9	3.1
S1301365-054	12AS019	32-72	0.70	0.7	57.1	2.1	<0.02	9.2	2.4
S1301365-055	12AS019	72-100	0.56	0.4	50.8	0.5	<0.02	6.7	0.6
S1301365-056	12AS019	100-147	0.28	0.4	32.1	0.6	<0.02	4.2	0.4
S1301365-057	12AS019	147-196	0.22	0.3	32.4	0.8	<0.02	4.4	0.5
S1301365-058	12AS019	196-240	0.20	0.3	30.7	0.8	<0.02	3.8	<0.1
S1301365-059	12AS023	0-18	0.32	2.2	16.7	5.9	<0.02	3.0	1.0

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		cm	ppm	ppm	%	ppm	ppm	%	%
S1301365-060	12AS023	18-47	0.26	0.5	22.9	2.1	<0.02	3.3	0.5
S1301365-061	12AS023	47-78	0.18	0.4	31.5	1.5	<0.02	4.3	0.5
S1301365-062	12AS023	78-120	0.26	0.3	22.2	0.9	<0.02	2.9	<0.1
S1301365-063	12AS023	120-180	0.15	0.3	31.4	0.8	<0.02	5.9	2.2
S1301365-064	12AS023	180-230	0.09	0.3	19.2	0.5	<0.02	2.8	0.5
S1301365-065	12AS025	0-12	0.98	5.0	27.3	11.9	<0.02	8.4	5.1
S1301365-066	12AS025	12-30	0.66	0.3	45.3	3.1	<0.02	7.1	1.7
S1301365-067	12AS025	30-70	0.39	0.2	55.0	1.1	<0.02	7.3	0.8
S1301365-068	12AS025	70-101	0.38	0.2	53.3	1.2	<0.02	7.2	0.7
S1301365-069	12AS025	101-123	0.24	0.2	44.6	<0.1	<0.02	6.2	0.8
S1301365-070	12AS025	123-156	0.49	0.3	50.1	1.8	<0.02	6.7	0.9
S1301365-071	12AS025	156-186	0.38	0.2	30.1	0.6	<0.02	4.3	0.6
S1301365-072	12AS025	186-204	0.29	0.3	30.6	0.8	<0.02	3.8	<0.1
S1301365-073	12AS026	3-20	0.53	23.0	28.8	31.9	<0.02	6.6	3.1
S1301365-074	12AS026	20-65	0.34	1.4	33.6	5.6	<0.02	5.3	1.3
S1301365-075	12AS026	65-104	0.39	1.0	30.9	3.7	<0.02	4.3	0.6
S1301365-076	12AS026	104-144	0.49	1.1	48.8	2.7	<0.02	7.5	1.6
S1301365-077	12AS026	144-202	0.29	0.6	53.8	1.2	<0.02	7.2	0.8
S1301365-078	12AS030	0-15	0.65	1.1	21.6	9.3	<0.02	3.5	0.9
S1301365-079	12AS030	15-30	0.71	0.6	21.5	4.5	<0.02	3.5	0.9

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Work Order: S1301365

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		cm	ppm	ppm	%	ppm	ppm	%	%
S1301365-080	12AS030	30-42	0.94	<0.1	21.8	3.1	<0.02	3.4	0.8
S1301365-081	12AS030	42-67	1.05	<0.1	21.3	2.8	<0.02	3.3	0.8
S1301365-082	12AS030	67-95	1.35	0.2	21.6	3.1	0.03	3.3	0.7

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Karen Secor, Soil Lab Supervisor

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1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Date: 5/31/2013

CLIENT: Alton Coal Development, LLC
Project: Private Lease Soils - Full List
Lab Order: S1304177

CASE NARRATIVE

Report ID: S1304177001

Samples DP-17, and DP-29 were received on April 11, 2013.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

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Soil Analysis Report

Alton Coal Development, LLC

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Report ID: S1304177001

Project: Private Lease Soils - Full List
Date Received: 4/11/2013

Date Reported: 5/31/2013
Work Order: S1304177

Lab ID	Sample ID	Depths cm	pH s.u.	Saturation %	Electrical Conductivity dS/m	Percent Moisture %	Field Capacity %	Wilt Point %	Organic Matter %
S1304177-001	DP-17	0-20	7.5	62.7	0.68	18.7	31.3	20.8	2.9
S1304177-002	DP-17	20-32	7.7	63.0	0.50	21.0	30.1	22.4	2.3
S1304177-003	DP-17	32-54	7.9	63.7	0.42	21.5	33.7	25.0	2.0
S1304177-004	DP-17	54-122	8.1	76.4	1.58	22.4	35.7	27.4	2.3
S1304177-005	DP-17	122-170	7.9	75.0	6.01	24.7	35.8	26.4	1.9
S1304177-006	DP-29	0-24	7.7	69.0	0.87	16.4	33.3	24.3	5.2
S1304177-007	DP-29	24-52	8.0	62.3	0.62	22.7	33.6	25.4	4.1
S1304177-008	DP-29	52-72	8.1	46.3	0.44	13.2	21.1	11.1	1.4
S1304177-009	DP-29	72-97	8.0	75.1	0.44	21.7	33.6	27.2	2.4
S1304177-010	DP-29	97-155	8.2	67.5	0.40	25.6	28.5	23.6	1.3
S1304177-011	DP-29	155-210	8.3	63.2	0.45	25.1	29.2	24.8	1.2
S1304177-012	DP-29	210-266	8.3	62.4	0.53	26.1	33.4	27.2	1.0
S1304177-013	DP-29	266-345	8.2	78.4	0.83	32.4	34.9	28.8	1.5
S1304177-014	DP-29	345-365	8.3	94.6	0.75	22.8			1.0

These results apply only to the samples tested.

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1304177001

Project: Private Lease Soils - Full List
Date Received: 4/11/2013

Date Reported: 5/31/2013
Work Order: S1304177

Lab ID	Sample ID	Depths cm	PE Calcium meq/L	PE Magnesium meq/L	PE Potassium meq/L	PE Sodium meq/L	SAR
S1304177-001	DP-17	0-20	4.94	0.95	0.20	0.19	0.11
S1304177-002	DP-17	20-32	3.37	0.88	0.12	0.31	0.21
S1304177-003	DP-17	32-54	2.09	0.70	0.09	1.08	0.91
S1304177-004	DP-17	54-122	2.78	2.77	0.10	8.13	4.88
S1304177-005	DP-17	122-170	19.8	32.8	0.28	23.2	4.53
S1304177-006	DP-29	0-24	4.25	3.33	0.40	0.40	0.21
S1304177-007	DP-29	24-52	2.90	2.37	0.18	0.43	0.26
S1304177-008	DP-29	52-72	2.22	1.68	0.11	0.28	0.20
S1304177-009	DP-29	72-97	2.02	1.91	0.09	0.38	0.27
S1304177-010	DP-29	97-155	1.72	1.59	0.05	0.47	0.37
S1304177-011	DP-29	155-210	1.44	2.12	0.05	0.88	0.66
S1304177-012	DP-29	210-266	1.47	2.68	0.12	1.36	0.94
S1304177-013	DP-29	266-345	1.67	4.14	0.19	1.86	1.09
S1304177-014	DP-29	345-365	1.91	3.36	0.20	1.32	0.81

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Alton Coal Development, LLC

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Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand
		cm	%	%	%		%
S1304177-001	DP-17	0-20	28.0	34.0	38.0	Clay Loam	11.1
S1304177-002	DP-17	20-32	30.0	29.0	41.0	Clay	10.8
S1304177-003	DP-17	32-54	28.0	28.0	44.0	Clay	11.7
S1304177-004	DP-17	54-122	22.0	32.0	46.0	Clay	10.0
S1304177-005	DP-17	122-170	16.0	34.0	50.0	Clay	4.7
S1304177-006	DP-29	0-24	20.0	38.0	42.0	Clay	3.3
S1304177-007	DP-29	24-52	18.0	38.0	44.0	Clay	6.0
S1304177-008	DP-29	52-72	50.0	32.0	18.0	Loam	10.4
S1304177-009	DP-29	72-97	10.0	46.0	44.0	Silty Clay	<0.1
S1304177-010	DP-29	97-155	4.0	52.0	44.0	Silty Clay	<0.1
S1304177-011	DP-29	155-210	10.0	44.0	46.0	Silty Clay	6.7
S1304177-012	DP-29	210-266	14.0	40.0	46.0	Silty Clay	3.3
S1304177-013	DP-29	266-345	6.0	44.0	50.0	Silty Clay	2.5
S1304177-014	DP-29	345-365	17.5	37.5	45.0	Clay	13.2

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Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1304177-001	DP-17	0-20	0.68	28.0	19.2	5.3	<0.02	3.4	1.1
S1304177-002	DP-17	20-32	0.51	13.6	15.9	4.0	<0.02	2.6	0.7
S1304177-003	DP-17	32-54	0.42	12.0	15.1	3.3	<0.02	2.6	0.8
S1304177-004	DP-17	54-122	0.99	6.4	16.9	4.8	<0.02	2.5	0.5
S1304177-005	DP-17	122-170	1.34	12.9	19.9	3.4	<0.02	2.8	0.4
S1304177-006	DP-29	0-24	0.42	25.5	45.3	14.6	<0.02	7.3	1.8
S1304177-007	DP-29	24-52	0.33	12.7	43.2	6.4	<0.02	6.0	0.9
S1304177-008	DP-29	52-72	0.24	0.9	28.4	1.0	<0.02	3.4	<0.1
S1304177-009	DP-29	72-97	0.46	<0.1	61.6	0.8	<0.02	7.8	0.4
S1304177-010	DP-29	97-155	0.23	<0.1	58.5	1.4	<0.02	6.7	<0.1
S1304177-011	DP-29	155-210	0.37	0.7	57.0	1.6	<0.02	6.4	<0.1
S1304177-012	DP-29	210-266	0.39	0.5	31.0	2.1	<0.02	3.5	<0.1
S1304177-013	DP-29	266-345	0.39	0.7	37.2	1.9	0.04	4.2	<0.1
S1304177-014	DP-29	345-365			42.5			4.9	<0.1

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
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Report ID: S1304177001

Project: Private Lease Soils - Full List

Date Received: 4/11/2013

Date Reported: 5/31/2013

Work Order: S1304177

Lab ID	Sample ID	Depths	Total Sulfur	T.S. AB	Neutral. Potential	T.S. ABP
		cm	%	t/1000t	t/1000t	t/1000t
S1304177-001	DP-17	0-20	0.05	1.69	192	190
S1304177-002	DP-17	20-32	0.05	1.54	159	157
S1304177-003	DP-17	32-54	0.05	1.48	151	149
S1304177-004	DP-17	54-122	0.06	1.93	169	167
S1304177-005	DP-17	122-170	0.20	6.34	199	193
S1304177-006	DP-29	0-24	0.10	3.07	453	450
S1304177-007	DP-29	24-52	0.07	2.05	432	430
S1304177-008	DP-29	52-72	0.05	1.59	284	282
S1304177-009	DP-29	72-97	0.10	3.07	616	613
S1304177-010	DP-29	97-155	0.08	2.36	585	583
S1304177-011	DP-29	155-210	0.08	2.53	570	567
S1304177-012	DP-29	210-266	0.08	2.45	310	307
S1304177-013	DP-29	266-345	0.08	2.50	372	370
S1304177-014	DP-29	345-365	0.07	2.05	425	423

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Soil Analysis Report

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Lab ID	Sample ID	Depths cm	Total Arsenic mg/Kg	Total Barium mg/Kg	Total Cadmium mg/Kg	Total Chromium mg/Kg	Total Copper mg/Kg	Total Iron mg/Kg	Total Lead mg/Kg	Total Manganese mg/Kg	Total Molybdenum mg/Kg
S1304177-001	DP-17	0-20	4.8	80.5	0.30	16.4	9.01	12200	13.3	177	1.5
S1304177-002	DP-17	20-32	6.1	100	0.34	18.6	10.9	14400	15.2	226	2.8
S1304177-003	DP-17	32-54	5.9	98.4	0.41	20.8	11.0	15900	15.5	228	2.6
S1304177-004	DP-17	54-122	5.8	130	0.50	22.6	11.9	17700	17.1	239	2.7
S1304177-005	DP-17	122-170	5.5	125	0.40	26.2	12.4	16200	15.3	211	3.7
S1304177-006	DP-29	0-24	8.7	460	0.54	22.9	14.3	13900	14.6	353	2.9
S1304177-007	DP-29	24-52	9.1	384	0.52	27.2	14.4	15100	15.5	319	2.3
S1304177-008	DP-29	52-72	5.1	174	0.27	15.0	5.81	7630	10.1	147	1.5
S1304177-009	DP-29	72-97	8.7	630	0.40	22.7	12.0	14600	11.8	630	2.9
S1304177-010	DP-29	97-155	24.0	508	0.79	28.3	10.1	27000	17.4	310	3.1
S1304177-011	DP-29	155-210	10.4	205	0.47	31.0	12.2	12700	15.0	209	2.6
S1304177-012	DP-29	210-266	8.0	150	0.56	32.3	15.9	17000	17.1	220	3.4
S1304177-013	DP-29	266-345	7.9	115	0.61	29.4	13.7	17800	16.5	235	3.6
S1304177-014	DP-29	345-365	8.6	97.4	0.62	30.4	13.8	18000	17.4	256	2.8

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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945
Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1304177001

Project: Private Lease Soils - Full List
Date Received: 4/11/2013

Date Reported: 5/31/2013
Work Order: S1304177

Lab ID	Sample ID	Depths cm	Total Selenium mg/Kg	Total Silver mg/Kg	Total Zinc mg/Kg	Total Mercury mg/Kg	Bulk Density g/cm³
S1304177-001	DP-17	0-20	<0.96	<0.5	45.7	<0.2	2.7
S1304177-002	DP-17	20-32	<0.96	<0.5	61.4	<0.2	2.5
S1304177-003	DP-17	32-54	<0.96	<0.5	58.5	<0.2	2.7
S1304177-004	DP-17	54-122	<0.96	<0.5	68.1	<0.2	2.2
S1304177-005	DP-17	122-170	<0.96	<0.5	58.7	<0.2	2.1
S1304177-006	DP-29	0-24	<0.96	<0.5	72.4	<0.2	3.9
S1304177-007	DP-29	24-52	<0.96	<0.5	72.8	<0.2	2.4
S1304177-008	DP-29	52-72	<0.96	<0.5	34.9	<0.2	2.3
S1304177-009	DP-29	72-97	<0.96	<0.5	53.1	<0.2	3.1
S1304177-010	DP-29	97-155	<0.96	<0.5	50.2	<0.2	2.5
S1304177-011	DP-29	155-210	<0.96	<0.5	51.6	<0.2	2.1
S1304177-012	DP-29	210-266	<0.96	<0.5	77.6	<0.2	2.1
S1304177-013	DP-29	266-345	<0.96	<0.5	65.4	<0.2	2.2
S1304177-014	DP-29	345-365	<0.96	<0.5	68.1	<0.2	2.3

These results apply only to the samples tested.

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1307417002
(Replaces S1307417001)

Project: Private Lease Soils - Full List

Date Received: 7/30/2013

Date Reported: 10/15/2013

Work Order: S1307417

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1307417-001	12AS009	232-320	8.2	26.4	0.38	2.8	17.6	5.1	1.0
S1307417-002	12AS009	320-366	8.3	29.6	0.44	4.9	19.1	6.3	1.2
S1307417-003	12AS009	366-514	8.2	31.3	0.35	3.2	19.8	4.9	1.1
S1307417-004	12AS018	244-318	8.1	20.1	0.34	1.8	12.6	3.0	0.2
S1307417-006	12AS018	318-388	7.7	77.4	1.19	17.0	29.3	24.9	2.2
S1307417-007	12AS018	406-572	7.6	45.2	2.62	14.9	19.8	12.7	1.4
S1307417-008	12AS018	572-640	7.3	70.1	2.37	31.0	27.3	21.1	3.0
S1307417-009	12AS018	640-732	7.7	87.1	1.57	13.6	25.6	20.8	1.8
S1307417-010	12AS020	175-300	7.8	51.8	1.48	8.1	18.8	10.7	1.1
S1307417-011	12AS020	300-488	7.5	35.4	2.57	16.4	19.0	8.6	1.0
S1307417-012	12AS020	488-600	7.7	45.2	1.63	16.1	20.3	14.3	1.1
S1307417-013	12AS021	260-374	8.1	86.2	0.54	18.0	26.1	22.2	1.9
S1307417-014	12AS021	374-448	7.6	30.1	2.36	4.2	18.7	4.4	1.4
S1307417-015	12AS021	448-524	7.5	31.7	2.41	7.3	18.2	5.6	1.5
S1307417-016	12AS021	524-570	7.5	54.2	2.75	17.7	27.2	15.0	2.3
S1307417-017	12AS021	570-660	7.4	46.1	2.85	13.4	26.4	16.9	2.6
S1307417-018	12AS021	660-742	7.7	30.5	2.68	12.5	20.5	6.8	1.2
S1307417-019	12AS021	742-853	8.3	23.5	0.71	5.9	12.3	5.6	0.8
S1307417-020	12AS024	243-305	8.0	26.7	1.19	15.0	17.6	4.6	0.7
S1307417-021	12AS027	170-305	8.2	80.4	0.49	13.0	27.0	22.1	1.7

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Soil Analysis Report

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(Replaces S1307417001)

Project: Private Lease Soils - Full List

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Work Order: S1307417

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1307417-022	12AS027	305-427	8.1	66.7	0.59	14.2	31.0	23.0	1.5
S1307417-023	12AS027	427-560	8.2	88.6	0.60	18.6	35.6	29.0	1.4
S1307417-024	12AS027	560-625	8.2	38.6	0.76	15.0	23.6	11.6	0.9
S1307417-025	12AS027	625-792	8.3	31.6	0.88	14.1	21.7	5.7	0.6
S1307417-026	12AS028	173-235	8.4	30.7	0.52	6.4	22.8	8.0	0.6
S1307417-027	12AS028	235-275	8.1	33.4	0.57	5.7			1.0
S1307417-028	12AS028	275-325	8.2	25.9	0.77	6.3	20.9	5.0	3.3
S1307417-029	12AS028	325-460	7.7	56.3	2.61	15.1	29.4	18.3	1.7
S1307417-030	12AS028	460-610	7.5	33.9	2.38	17.1	21.8	8.8	1.1
S1307417-031	12AS029	244-334	8.4	25.9	5.24	7.4	21.4	7.5	0.6
S1307417-032	12AS029	334-500	8.1	29.8	4.81	15.3	21.1	6.0	0.6
S1307417-033	12AS029	500-610	8.1	114	1.85	23.2			1.5
S1307417-034	DP-12	0-28	7.4		0.87	4.8			4.6
S1307417-035	DP-12	28-62	7.3	34.8	0.41	3.4			1.6
S1307417-036	DP-12	62-126	7.4	36.9	0.30	4.4	27.1	11.3	0.8
S1307417-037	DP-12	126-183	7.8	36.3	0.27	6.8	26.5	11.1	0.1
S1307417-038	DP-12	183-244	8.2	48.8	0.40	7.9	27.2	13.1	0.9
S1307417-039	DP-21	140-188	7.9	73.7	2.52	11.8	40.8	29.1	2.7
S1307417-040	DP-21	188-260	7.9	70.8	3.66	11.2	39.3	29.9	2.2
S1307417-041	DP-21	260-360	7.9	82.5	3.02	14.3	39.5	30.5	1.9

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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1307417002
(Replaces S1307417001)

Project: Private Lease Soils - Full List

Date Received: 7/30/2013

Date Reported: 10/15/2013

Work Order: S1307417

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1307417-042	DP-22	120-180	8.6	93.4	7.94	18.0	47.1	36.1	1.6
S1307417-043	DP-22	180-240	8.3	89.8	6.22	17.1	48.2	35.1	1.2
S1307417-044	DP-24	22-40	7.9	58.6	0.50	9.2	40.5	25.0	4.4
S1307417-045	DP-24	40-65	8.0	58.9	0.39	10.6	40.6	26.8	3.5
S1307417-046	DP-24	65-126	8.3	64.0	0.86	11.1	39.0	27.3	3.6
S1307417-047	DP-24	126-244	8.1	81.1	4.35	17.3	38.7	31.0	2.3
S1307417-048	DP-26	0-15	7.7	55.5	0.55	9.4	35.7	26.4	4.9
S1307417-049	DP-26	15-32	7.9	55.7	0.33	11.5	33.2	25.7	4.4
S1307417-050	DP-26	32-59	8.0	61.2	0.34	11.1	37.3	28.0	2.0
S1307417-051	DP-26	59-90	8.2	57.3	0.28	9.1	33.7	27.2	1.7
S1307417-052	DP-26	90-148	8.5	57.2	0.26	9.2	28.0	23.3	1.2
S1307417-053	DP-26	148-230	8.4	35.1	0.26	5.6	22.1	14.1	0.5
S1307417-054	DP-26	230-294	8.5	31.4	0.31	7.0	22.5	8.1	0.5
S1307417-055	DP-26	294-350	8.5	25.6	0.34	7.6	22.0	5.5	0.6

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1307417002
(Replaces S1307417001)
Date Reported: 10/15/2013
Work Order: S1307417

Project: Private Lease Soils - Full List
Date Received: 7/30/2013

Lab ID	Sample ID	Depths cm	PE Calcium meq/L	PE Magnesium meq/L	PE Potassium meq/L	PE Sodium meq/L	SAR
S1307417-001	12AS009	232-320	1.57	2.66	0.15	0.60	0.41
S1307417-002	12AS009	320-366	1.39	3.63	0.17	0.33	0.21
S1307417-003	12AS009	366-514	1.42	2.67	0.16	0.28	0.20
S1307417-004	12AS018	244-318	1.73	2.23	0.12	0.30	0.21
S1307417-006	12AS018	318-388	5.06	8.91	0.17	1.53	0.58
S1307417-007	12AS018	406-572	16.4	22.8	0.29	5.56	1.26
S1307417-008	12AS018	572-640	13.9	18.2	0.41	4.93	1.23
S1307417-009	12AS018	640-732	6.31	10.6	0.39	3.87	1.33
S1307417-010	12AS020	175-300	5.88	10.4	0.29	2.56	0.90
S1307417-011	12AS020	300-488	25.6	20.7	0.38	0.88	0.18
S1307417-012	12AS020	488-600	10.5	12.8	0.31	0.76	0.22
S1307417-013	12AS021	260-374	2.19	3.88	0.15	0.31	0.18
S1307417-014	12AS021	374-448	25.5	12.0	0.34	0.38	0.09
S1307417-015	12AS021	448-524	26.6	15.1	0.40	0.62	0.14
S1307417-016	12AS021	524-570	24.8	21.9	0.59	0.57	0.12
S1307417-017	12AS021	570-660	22.4	29.8	0.67	0.74	0.15
S1307417-018	12AS021	660-742	24.7	24.1	0.50	0.72	0.15
S1307417-019	12AS021	742-853	3.23	4.81	0.22	0.38	0.19
S1307417-020	12AS024	243-305	6.27	8.23	0.23	0.77	0.29
S1307417-021	12AS027	170-305	1.93	2.09	0.03	1.80	1.27

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
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Report ID: S1307417002
(Replaces S1307417001)
Date Reported: 10/15/2013
Work Order: S1307417

Project: Private Lease Soils - Full List
Date Received: 7/30/2013

Lab ID	Sample ID	Depths cm	PE Calcium meq/L	PE Magnesium meq/L	PE Potassium meq/L	PE Sodium meq/L	SAR
S1307417-022	12AS027	305-427	2.21	2.91	0.08	1.74	1.09
S1307417-023	12AS027	427-560	1.93	3.20	0.14	1.67	1.04
S1307417-024	12AS027	560-625	2.21	4.10	0.16	2.57	1.45
S1307417-025	12AS027	625-792	2.54	4.77	0.11	3.21	1.68
S1307417-026	12AS028	173-235	1.95	3.86	0.10	0.59	0.35
S1307417-027	12AS028	235-275	1.97	4.19	0.10	0.70	0.40
S1307417-028	12AS028	275-325	2.40	5.90	0.11	0.84	0.41
S1307417-029	12AS028	325-460	23.9	21.6	0.47	0.97	0.20
S1307417-030	12AS028	460-610	21.9	15.8	0.34	0.58	0.13
S1307417-031	12AS029	244-334	14.2	71.8	0.38	20.3	3.10
S1307417-032	12AS029	334-500	25.0	51.7	0.46	15.8	2.56
S1307417-033	12AS029	500-610	6.02	15.9	0.67	3.39	1.03
S1307417-034	DP-12	0-28	5.38	2.88	1.17	0.14	0.07
S1307417-035	DP-12	28-62	3.33	1.50	0.23	0.12	0.07
S1307417-036	DP-12	62-126	2.18	1.61	0.07	0.19	0.14
S1307417-037	DP-12	126-183	1.94	1.55	0.06	0.31	0.23
S1307417-038	DP-12	183-244	2.31	1.99	0.06	0.46	0.31
S1307417-039	DP-21	140-188	13.4	13.3	0.21	8.67	2.37
S1307417-040	DP-21	188-260	28.4	24.7	0.30	11.8	2.29
S1307417-041	DP-21	260-360	24.3	19.2	0.27	8.47	1.81

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
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Report ID: S1307417002
(Replaces S1307417001)
Date Reported: 10/15/2013
Work Order: S1307417

Project: Private Lease Soils - Full List
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Lab ID	Sample ID	Depths cm	PE Calcium meq/L	PE Magnesium meq/L	PE Potassium meq/L	PE Sodium meq/L	SAR
S1307417-042	DP-22	120-180	22.8	83.1	0.57	63.8	8.77
S1307417-043	DP-22	180-240	21.9	51.1	0.63	44.0	7.28
S1307417-044	DP-24	22-40	4.35	1.16	0.22	0.38	0.23
S1307417-045	DP-24	40-65	2.85	1.05	0.10	1.05	0.75
S1307417-046	DP-24	65-126	2.92	1.79	0.09	5.39	3.52
S1307417-047	DP-24	126-244	22.5	30.7	0.33	22.2	4.30
S1307417-048	DP-26	0-15	5.02	1.09	0.41	0.13	0.08
S1307417-049	DP-26	15-32	3.00	0.97	0.19	0.16	0.11
S1307417-050	DP-26	32-59	3.04	1.20	0.17	0.17	0.11
S1307417-051	DP-26	59-90	2.40	1.24	0.11	0.14	0.11
S1307417-052	DP-26	90-148	2.13	1.59	0.11	0.13	0.10
S1307417-053	DP-26	148-230	1.72	1.61	0.08	0.17	0.13
S1307417-054	DP-26	230-294	1.81	1.99	0.09	0.18	0.13
S1307417-055	DP-26	294-350	1.87	1.94	0.09	0.38	0.28

These results apply only to the samples tested.

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Karen Secor, Soil Lab Supervisor

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Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

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Report ID: S1307417002
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Project: Private Lease Soils - Full List

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Lab ID	Sample ID	Depths cm	Sand %	Silt %	Clay %	Texture	Very Fine Sand %	Coarse Fragment %
S1307417-001	12AS009	232-320	60.0	30.0	10.0	Sandy Loam	2.7	
S1307417-002	12AS009	320-366	56.0	32.4	11.6	Sandy Loam	7.3	
S1307417-003	12AS009	366-514	66.0	26.0	8.0	Sandy Loam	7.5	
S1307417-004	12AS018	244-318	80.0	14.0	6.0	Loamy Sand	6.5	
S1307417-006	12AS018	318-388	<0.1	53.0	47.0	Silty Clay	<0.1	
S1307417-007	12AS018	406-572	28.0	51.0	21.0	Silty Loam	2.0	
S1307417-008	12AS018	572-640	14.0	54.0	32.0	Silty Clay Loam	3.9	
S1307417-009	12AS018	640-732	16.0	44.0	40.0	Silty Clay	<0.1	1.8
S1307417-010	12AS020	175-300	38.0	40.0	22.0	Loam	2.2	
S1307417-011	12AS020	300-488	56.0	30.0	14.0	Sandy Loam	5.9	
S1307417-012	12AS020	488-600	32.0	48.0	20.0	Loam	10.2	
S1307417-013	12AS021	260-374	<0.1	59.0	41.0	Silty Clay	<0.1	
S1307417-014	12AS021	374-448	73.0	21.0	6.0	Sandy Loam	4.7	
S1307417-015	12AS021	448-524	75.0	19.0	6.0	Sandy Loam	<0.1	22.8
S1307417-016	12AS021	524-570	31.0	52.0	17.0	Silty Loam	9.5	
S1307417-017	12AS021	570-660	37.0	37.0	26.0	Loam	3.3	
S1307417-018	12AS021	660-742	73.0	17.0	10.0	Sandy Loam	5.9	
S1307417-019	12AS021	742-853	81.0	13.0	6.0	Loamy Sand	2.5	60.7
S1307417-020	12AS024	243-305	80.0	12.0	8.0	Loamy Sand	7.0	
S1307417-021	12AS027	170-305	<0.1	52.0	48.0	Silty Clay	<0.1	

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

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463 North 100 West
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Lab ID	Sample ID	Depths cm	Sand %	Silt %	Clay %	Texture	Very Fine Sand %	Coarse Fragment %
S1307417-022	12AS027	305-427	12.0	39.0	49.0	Clay	<0.1	
S1307417-023	12AS027	427-560	4.0	37.0	59.0	Silty Clay	<0.1	
S1307417-024	12AS027	560-625	46.0	32.0	22.0	Loam	8.3	
S1307417-025	12AS027	625-792	64.0	26.0	10.0	Sandy Loam	7.2	
S1307417-026	12AS028	173-235	50.0	38.0	12.0	Loam	10.2	
S1307417-027	12AS028	235-275	72.0	18.0	10.0	Sandy Loam	7.4	
S1307417-028	12AS028	275-325	72.0	20.0	8.0	Sandy Loam	7.0	
S1307417-029	12AS028	325-460	28.0	46.0	26.0	Loam	5.6	
S1307417-030	12AS028	460-610	54.0	32.0	14.0	Sandy Loam	4.9	
S1307417-031	12AS029	244-334	62.0	24.0	14.0	Sandy Loam	1.9	8.0
S1307417-032	12AS029	334-500	4.0	40.0	56.0	Clay	<0.1	
S1307417-033	12AS029	500-610	64.0	16.0	20.0	Sandy Clay Loam	59.6	
S1307417-034	DP-12	0-28	58.0	25.0	17.0	Sandy Loam	11.1	
S1307417-035	DP-12	28-62	50.0	35.0	15.0	Loam	2.4	
S1307417-036	DP-12	62-126	66.0	12.0	22.0	Sandy Clay Loam	23.9	
S1307417-037	DP-12	126-183	52.0	26.0	22.0	Sandy Clay Loam	<0.1	
S1307417-038	DP-12	183-244	50.0	28.0	22.0	Loam	18.4	
S1307417-039	DP-21	140-188	11.0	41.0	48.0	Silty Clay	0.9	
S1307417-040	DP-21	188-260	11.0	40.0	49.0	Silty Clay	2.2	
S1307417-041	DP-21	260-360	7.0	39.0	54.0	Clay	<0.1	

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Lab ID	Sample ID	Depths cm	Sand %	Silt %	Clay %	Texture	Very Fine Sand %	Coarse Fragment %
S1307417-042	DP-22	120-180	<0.1	39.0	61.0	Clay	<0.1	
S1307417-043	DP-22	180-240	5.0	39.0	56.0	Silty Clay	0.6	
S1307417-044	DP-24	22-40	15.0	41.0	44.0	Silty Clay	3.4	
S1307417-045	DP-24	40-65	15.0	39.0	46.0	Clay	4.9	
S1307417-046	DP-24	65-126	13.0	39.0	48.0	Clay	3.0	
S1307417-047	DP-24	126-244	15.0	35.0	50.0	Clay	6.7	
S1307417-048	DP-26	0-15	15.0	43.0	42.0	Silty Clay	3.9	
S1307417-049	DP-26	15-32	9.0	47.0	44.0	Silty Clay	0.9	
S1307417-050	DP-26	32-59	3.0	49.0	48.0	Silty Clay	<0.1	
S1307417-051	DP-26	59-90	1.0	51.0	48.0	Silty Clay	<0.1	
S1307417-052	DP-26	90-148	<0.1	64.0	36.0	Silty Clay Loam	<0.1	
S1307417-053	DP-26	148-230	35.0	45.0	20.0	Loam	6.8	
S1307417-054	DP-26	230-294	55.0	31.0	14.0	Sandy Loam	15.2	
S1307417-055	DP-26	294-350	69.0	23.0	8.0	Sandy Loam	10.4	

These results apply only to the samples tested.

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Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1307417-001	12AS009	232-320	0.11	0.2	25.7	2.9	<0.02	3.4	0.3
S1307417-002	12AS009	320-366	0.15	0.2	25.6	3.3	<0.02	3.4	0.4
S1307417-003	12AS009	366-514	0.11	0.2	20.5	3.0	<0.02	2.7	0.2
S1307417-004	12AS018	244-318	0.09	0.8	18.3	2.6	<0.02	2.4	0.2
S1307417-006	12AS018	318-388	0.34	3.6	42.9	3.3	<0.02	6.2	1.1
S1307417-007	12AS018	406-572	0.21	1.4	37.1	2.7	<0.02	4.6	0.2
S1307417-008	12AS018	572-640	0.47	0.2	37.1	6.3	<0.02	5.3	0.9
S1307417-009	12AS018	640-732	0.30	0.2	35.1	3.4	<0.02	4.8	0.6
S1307417-010	12AS020	175-300	0.09	1.4	35.4	2.1	<0.02	4.2	<0.1
S1307417-011	12AS020	300-488	0.09	0.2	28.2	3.1	<0.02	3.8	0.4
S1307417-012	12AS020	488-600	0.06	0.1	34.8	2.7	<0.02	4.4	0.2
S1307417-013	12AS021	260-374	0.46	2.3	47.8	2.5	0.03	6.4	0.7
S1307417-014	12AS021	374-448	0.12	2.7	19.4	2.2	<0.02	2.6	0.3
S1307417-015	12AS021	448-524	0.09	2.3	31.0	2.3	<0.02	4.3	0.6
S1307417-016	12AS021	524-570	0.24	1.5	35.2	3.1	<0.02	5.4	1.2
S1307417-017	12AS021	570-660	0.37	0.2	24.6	4.5	<0.02	4.0	1.1
S1307417-018	12AS021	660-742	0.16	0.4	22.9	2.7	<0.02	2.7	<0.1
S1307417-019	12AS021	742-853	0.08	0.2	70.7	2.5	<0.02	8.3	<0.1
S1307417-020	12AS024	243-305	0.08	0.1	20.2	3.5	<0.02	2.3	<0.1
S1307417-021	12AS027	170-305	0.13	0.9	46.2	3.7	<0.02	5.9	0.3

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1307417002
(Replaces S1307417001)

Project: Private Lease Soils - Full List

Date Received: 7/30/2013

Date Reported: 10/15/2013

Work Order: S1307417

Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1307417-022	12AS027	305-427	0.11	0.6	27.2	3.6	<0.02	3.5	0.2
S1307417-023	12AS027	427-560	0.21	0.4	29.0	3.2	<0.02	3.8	0.4
S1307417-024	12AS027	560-625	0.17	0.3	26.5	3.0	<0.02	3.5	0.3
S1307417-025	12AS027	625-792	0.13	0.4	24.9	2.9	<0.02	3.2	0.2
S1307417-026	12AS028	173-235	0.07	1.7	33.2	3.2	<0.02	4.4	0.4
S1307417-027	12AS028	235-275	0.11	2.0	18.7	3.0	<0.02	2.6	0.4
S1307417-028	12AS028	275-325	0.07	1.6	21.2	3.4	<0.02	2.8	0.3
S1307417-029	12AS028	325-460	0.10	1.6	27.1	2.1	<0.02	3.7	0.5
S1307417-030	12AS028	460-610	0.09	0.2	25.3	3.6	<0.02	3.0	<0.1
S1307417-031	12AS029	244-334	0.09	0.9	25.6	3.8	<0.02	3.7	0.6
S1307417-032	12AS029	334-500	0.11	0.1	23.2	2.3	<0.02	2.8	<0.1
S1307417-033	12AS029	500-610	0.36	0.2	26.6	3.1	<0.02	3.8	0.6
S1307417-034	DP-12	0-28	0.31	3.7	2.6	1.3	<0.02	2.0	1.7
S1307417-035	DP-12	28-62	0.18	1.0	0.4	10.0	<0.02	0.8	0.7
S1307417-036	DP-12	62-126	0.12	0.6	0.4	8.2	<0.02	0.8	0.8
S1307417-037	DP-12	126-183	0.10	0.3	0.3	3.2	<0.02	0.4	0.3
S1307417-038	DP-12	183-244	0.12	0.3	11.1	2.5	<0.02	1.5	0.1
S1307417-039	DP-21	140-188	0.92	1.5	18.6	4.5	<0.02	2.9	0.6
S1307417-040	DP-21	188-260	0.68	3.8	19.3	5.5	0.03	2.9	0.6
S1307417-041	DP-21	260-360	0.75	7.3	18.7	5.3	<0.02	2.8	0.5

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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
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(Replaces S1307417001)

Project: Private Lease Soils - Full List

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Work Order: S1307417

Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1307417-042	DP-22	120-180	0.91	0.4	22.2	2.6	<0.02	3.1	0.4
S1307417-043	DP-22	180-240	0.89	0.5	23.0	2.0	<0.02	3.2	0.5
S1307417-044	DP-24	22-40	0.41	1.6	18.3	6.5	<0.02	3.4	1.2
S1307417-045	DP-24	40-65	0.43	2.0	18.4	6.5	<0.02	3.3	1.1
S1307417-046	DP-24	65-126	0.55	1.9	18.2	5.8	<0.02	3.2	1.0
S1307417-047	DP-24	126-244	0.87	1.7	20.9	5.8	<0.02	3.2	0.7
S1307417-048	DP-26	0-15	0.32	0.8	18.7	18.0	<0.02	4.1	1.9
S1307417-049	DP-26	15-32	0.25	3.3	25.1	8.0	<0.02	4.5	1.5
S1307417-050	DP-26	32-59	0.22	2.0	46.8	5.7	<0.02	6.6	0.9
S1307417-051	DP-26	59-90	0.24	0.8	54.4	3.8	<0.02	7.2	0.6
S1307417-052	DP-26	90-148	0.20	0.9	50.2	3.9	<0.02	6.3	0.2
S1307417-053	DP-26	148-230	0.13	2.5	43.8	3.6	<0.02	5.4	0.2
S1307417-054	DP-26	230-294	0.10	0.2	24.6	2.8	<0.02	3.2	0.3
S1307417-055	DP-26	294-350	0.08	0.2	15.3	2.9	<0.02	1.9	<0.1

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

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Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1307417002
(Replaces S1307417001)
Date Reported: 10/15/2013
Work Order: S1307417

Project: Private Lease Soils - Full List
Date Received: 7/30/2013

Lab ID	Sample ID	Depths cm	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t
S1307417-001	12AS009	232-320	<0.01	<0.01	257	257
S1307417-002	12AS009	320-366	<0.01	<0.01	256	256
S1307417-003	12AS009	366-514	<0.01	<0.01	205	205
S1307417-004	12AS018	244-318	<0.01	<0.01	183	183
S1307417-006	12AS018	318-388	0.03	0.93	429	428
S1307417-007	12AS018	406-572	0.03	1.07	371	370
S1307417-008	12AS018	572-640	0.32	10.0	371	361
S1307417-009	12AS018	640-732	0.09	2.84	351	348
S1307417-010	12AS020	175-300	0.01	0.35	354	354
S1307417-011	12AS020	300-488	0.13	4.16	282	278
S1307417-012	12AS020	488-600	0.04	1.33	348	347
S1307417-013	12AS021	260-374	0.04	1.16	478	476
S1307417-014	12AS021	374-448	0.03	1.08	194	193
S1307417-015	12AS021	448-524	0.23	7.25	310	303
S1307417-016	12AS021	524-570	0.21	6.47	352	345
S1307417-017	12AS021	570-660	0.22	7.01	246	239
S1307417-018	12AS021	660-742	0.05	1.54	229	228
S1307417-019	12AS021	742-853	0.01	0.39	707	707
S1307417-020	12AS024	243-305	0.01	0.34	202	202
S1307417-021	12AS027	170-305	<0.01	<0.01	462	462

These results apply only to the samples tested.

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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

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463 North 100 West
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(Replaces S1307417001)
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Lab ID	Sample ID	Depths cm	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t
S1307417-022	12AS027	305-427	<0.01	<0.01	272	272
S1307417-023	12AS027	427-560	<0.01	<0.01	290	290
S1307417-024	12AS027	560-625	0.01	0.33	265	264
S1307417-025	12AS027	625-792	0.01	0.36	249	248
S1307417-026	12AS028	173-235	<0.01	<0.01	332	332
S1307417-027	12AS028	235-275	<0.01	<0.01	187	187
S1307417-028	12AS028	275-325	<0.01	<0.01	212	212
S1307417-029	12AS028	325-460	0.35	10.9	271	260
S1307417-030	12AS028	460-610	0.08	2.56	253	250
S1307417-031	12AS029	244-334	0.03	1.06	256	255
S1307417-032	12AS029	334-500	0.08	2.64	232	229
S1307417-033	12AS029	500-610	0.16	5.12	266	261
S1307417-034	DP-12	0-28	0.02	0.53	26.5	26.0
S1307417-035	DP-12	28-62	<0.01	<0.01	4.04	4.04
S1307417-036	DP-12	62-126	<0.01	<0.01	3.65	3.65
S1307417-037	DP-12	126-183	<0.01	<0.01	2.73	2.73
S1307417-038	DP-12	183-244	<0.01	<0.01	111	111
S1307417-039	DP-21	140-188	0.03	1.00	186	185
S1307417-040	DP-21	188-260	0.19	5.77	193	187
S1307417-041	DP-21	260-360	0.04	1.40	187	185

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
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Report ID: S1307417002
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Project: Private Lease Soils - Full List

Date Received: 7/30/2013

Date Reported: 10/15/2013

Work Order: S1307417

Lab ID	Sample ID	Depths	Total Sulfur	T.S. AB	Neutral. Potential	T.S. ABP
		cm	%	t/1000t	t/1000t	t/1000t
S1307417-042	DP-22	120-180	1.09	34.1	222	187
S1307417-043	DP-22	180-240	0.86	26.7	230	203
S1307417-044	DP-24	22-40	0.01	0.37	183	183
S1307417-045	DP-24	40-65	<0.01	<0.01	184	184
S1307417-046	DP-24	65-126	<0.01	<0.01	182	182
S1307417-047	DP-24	126-244	0.27	8.29	209	201
S1307417-048	DP-26	0-15	0.02	0.52	187	187
S1307417-049	DP-26	15-32	0.02	0.48	251	251
S1307417-050	DP-26	32-59	0.02	0.48	468	467
S1307417-051	DP-26	59-90	0.02	0.48	544	543
S1307417-052	DP-26	90-148	<0.01	<0.01	502	502
S1307417-053	DP-26	148-230	<0.01	<0.01	438	438
S1307417-054	DP-26	230-294	<0.01	<0.01	246	246
S1307417-055	DP-26	294-350	<0.01	<0.01	153	153

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Lab ID	Sample ID	Depths cm	Total Arsenic mg/Kg	Total Barium mg/Kg	Total Cadmium mg/Kg	Total Chromium mg/Kg	Total Copper mg/Kg	Total Iron mg/Kg	Total Lead mg/Kg	Total Manganese mg/Kg	Total Molybdenum mg/Kg
S1307417-001	12AS009	232-320	4.2	64.1	0.46	8.85	4.89	4930	5.2	108	1.1
S1307417-002	12AS009	320-366	6.6	167	0.64	15.5	11.1	6590	10.3	156	2.3
S1307417-003	12AS009	366-514	4.4	214	0.71	12.6	6.88	9360	7.2	244	1.2
S1307417-004	12AS018	244-318	3.4	76.9	0.33	8.10	4.65	3320	5.5	118	0.8
S1307417-006	12AS018	318-388	14.3	269	1.64	32.2	16.0	24700	15.9	426	3.9
S1307417-007	12AS018	406-572	9.2	159	0.83	18.3	10.9	10600	13.2	257	2.5
S1307417-008	12AS018	572-640	6.3	161	1.03	24.1	13.0	13900	12.7	285	2.1
S1307417-009	12AS018	640-732	10.7	173	1.20	26.8	14.4	18000	13.1	337	2.7
S1307417-010	12AS020	175-300	6.2	107	0.71	23.0	11.8	7690	15.0	211	2.6
S1307417-011	12AS020	300-488	6.2	62.4	0.59	9.98	5.69	8920	5.7	151	1.2
S1307417-012	12AS020	488-600	10.0	166	1.01	19.3	11.2	14200	11.9	327	2.1
S1307417-013	12AS021	260-374	15.3	194	1.16	32.9	16.1	15100	17.4	360	3.8
S1307417-014	12AS021	374-448	5.8	84.5	0.53	10.1	6.08	6160	7.3	165	1.0
S1307417-015	12AS021	448-524	14.4	122	0.79	8.28	3.15	12000	4.9	237	1.5
S1307417-016	12AS021	524-570	8.6	100	1.16	20.5	14.2	15000	13.2	410	3.0
S1307417-017	12AS021	570-660	7.2	88.3	1.02	19.5	11.5	14800	11.4	220	1.9
S1307417-018	12AS021	660-742	10.2	106	0.55	10.2	5.31	7670	6.3	132	0.9
S1307417-019	12AS021	742-853	5.9	184	0.67	8.89	3.67	9020	8.0	416	1.3
S1307417-020	12AS024	243-305	2.3	157	0.43	8.29	4.63	5180	6.2	121	0.9
S1307417-021	12AS027	170-305	6.8	199	0.91	25.8	10.9	12200	28.5	177	<0.7

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

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Report ID: S1307417002
(Replaces S1307417001)
Date Reported: 10/15/2013
Work Order: S1307417

Project: Private Lease Soils - Full List
Date Received: 7/30/2013

Lab ID	Sample ID	Depths cm	Total Arsenic mg/Kg	Total Barium mg/Kg	Total Cadmium mg/Kg	Total Chromium mg/Kg	Total Copper mg/Kg	Total Iron mg/Kg	Total Lead mg/Kg	Total Manganese mg/Kg	Total Molybdenum mg/Kg
S1307417-022	12AS027	305-427	5.0	130	1.27	32.0	16.1	18700	51.1	323	<0.7
S1307417-023	12AS027	427-560	3.9	108	1.24	30.0	15.0	19000	47.6	236	<0.7
S1307417-024	12AS027	560-625	4.6	203	0.98	18.6	10.7	12400	33.4	254	<0.7
S1307417-025	12AS027	625-792	4.0	202	0.64	11.8	6.56	7330	18.1	234	<0.7
S1307417-026	12AS028	173-235	5.2	131	0.72	14.1	7.16	9060	18.0	200	<0.7
S1307417-027	12AS028	235-275	3.1	65.4	0.38	11.9	8.01	3780	13.3	107	<0.7
S1307417-028	12AS028	275-325	3.6	51.8	0.37	9.96	5.46	3100	12.6	129	<0.7
S1307417-029	12AS028	325-460	8.5	123	1.26	23.7	13.2	16800	41.9	417	0.7
S1307417-030	12AS028	460-610	10.0	262	1.02	18.8	10.7	12700	31.6	245	<0.7
S1307417-031	12AS029	244-334	4.6	101	0.55	9.09	5.15	7640	13.6	115	<0.7
S1307417-032	12AS029	334-500	9.1	178	0.79	10.7	6.33	10600	16.5	205	0.8
S1307417-033	12AS029	500-610	3.5	114	1.19	34.8	17.6	18600	56.6	302	<0.7
S1307417-034	DP-12	0-28	5.7	59.2	1.16	16.6	13.2	15600	10.7	321	0.8
S1307417-035	DP-12	28-62	2.5	33.7	0.65	12.9	8.94	11700	20.8	210	<0.7
S1307417-036	DP-12	62-126	5.2	58.0	1.23	24.4	14.9	21100	48.2	334	<0.7
S1307417-037	DP-12	126-183	6.5	37.7	1.09	22.7	6.57	20800	36.6	228	<0.7
S1307417-038	DP-12	183-244	2.9	47.2	0.83	17.9	8.78	13800	27.3	217	<0.7
S1307417-039	DP-21	140-188	6.3	117	1.47	30.9	19.1	21700	48.2	335	1.5
S1307417-040	DP-21	188-260	6.8	104	1.49	31.9	19.5	21800	57.8	320	1.7
S1307417-041	DP-21	260-360	8.9	103	1.51	30.3	19.6	22200	48.1	317	1.4

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Project: Private Lease Soils - Full List
Date Received: 7/30/2013

Lab ID	Sample ID	Depths cm	Total Arsenic mg/Kg	Total Barium mg/Kg	Total Cadmium mg/Kg	Total Chromium mg/Kg	Total Copper mg/Kg	Total Iron mg/Kg	Total Lead mg/Kg	Total Manganese mg/Kg	Total Molybdenum mg/Kg
S1307417-042	DP-22	120-180	6.6	56.3	0.41	18.1	15.6	15300	10.4	170	<0.7
S1307417-043	DP-22	180-240	11.3	84.7	0.89	26.8	26.6	24100	17.2	260	2.8
S1307417-044	DP-24	22-40	7.0	93.5	0.61	25.5	16.3	18300	12.8	299	<0.7
S1307417-045	DP-24	40-65	8.0	107	0.55	32.2	19.0	21400	14.9	337	<0.7
S1307417-046	DP-24	65-126	6.9	90.7	0.61	27.8	17.0	19200	13.4	320	<0.7
S1307417-047	DP-24	126-244	7.9	95.2	0.72	27.0	17.7	19700	13.7	307	<0.7
S1307417-048	DP-26	0-15	10.6	127	0.69	35.4	22.3	21800	16.2	426	<0.7
S1307417-049	DP-26	15-32	12.9	173	0.81	39.8	24.0	23300	16.8	494	<0.7
S1307417-050	DP-26	32-59	11.5	224	0.53	32.8	13.7	16600	12.5	317	<0.7
S1307417-051	DP-26	59-90	13.2	372	0.62	33.6	14.5	17300	13.1	290	<0.7
S1307417-052	DP-26	90-148	6.4	147	0.34	19.0	8.32	8260	7.8	183	<0.7
S1307417-053	DP-26	148-230	7.7	152	0.53	14.4	8.70	8990	7.7	185	<0.7
S1307417-054	DP-26	230-294	5.0	112	0.39	13.0	7.90	7010	6.1	151	<0.7
S1307417-055	DP-26	294-350	3.5	142	0.43	9.52	6.60	5070	6.3	173	<0.7

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1307417002
(Replaces S1307417001)
Date Reported: 10/15/2013
Work Order: S1307417

Project: Private Lease Soils - Full List
Date Received: 7/30/2013

Lab ID	Sample ID	Depths cm	Total Selenium mg/Kg	Total Silver mg/Kg	Total Zinc mg/Kg	Total Mercury mg/Kg	Bulk Density g/cm³
S1307417-001	12AS009	232-320	<0.96	1.1	23.6	<0.2	2.20
S1307417-002	12AS009	320-366	<0.96	1.7	44.8	<0.2	2.44
S1307417-003	12AS009	366-514	<0.96	1.0	34.9	<0.2	3.09
S1307417-004	12AS018	244-318	<0.96	1.6	22.5	<0.2	3.38
S1307417-006	12AS018	318-388	<0.96	2.0	64.8	<0.2	2.31
S1307417-007	12AS018	406-572	<0.96	1.7	44.6	<0.2	2.24
S1307417-008	12AS018	572-640	<0.96	1.5	61.8	<0.2	2.20
S1307417-009	12AS018	640-732	<0.96	1.5	68.4	<0.2	2.09
S1307417-010	12AS020	175-300	<0.96	1.1	52.7	<0.2	2.21
S1307417-011	12AS020	300-488	<0.96	1.7	30.3	<0.2	1.96
S1307417-012	12AS020	488-600	1.22	2.0	52.9	<0.2	2.11
S1307417-013	12AS021	260-374	<0.96	1.8	68.3	<0.2	2.07
S1307417-014	12AS021	374-448	<0.96	2.0	33.8	<0.2	2.63
S1307417-015	12AS021	448-524	<0.96	1.9	24.1	<0.2	
S1307417-016	12AS021	524-570	<0.96	2.0	59.6	<0.2	2.50
S1307417-017	12AS021	570-660	<0.96	1.1	56.0	<0.2	2.26
S1307417-018	12AS021	660-742	<0.96	1.4	32.7	<0.2	2.28
S1307417-019	12AS021	742-853	<0.96	3.7	24.6	<0.2	
S1307417-020	12AS024	243-305	<0.96	1.3	24.2	<0.2	2.28
S1307417-021	12AS027	170-305	<0.96	<0.5	44.7	<0.2	2.05

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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1307417002
(Replaces S1307417001)

Project: Private Lease Soils - Full List

Date Received: 7/30/2013

Date Reported: 10/15/2013

Work Order: S1307417

Lab ID	Sample ID	Depths cm	Total Selenium mg/Kg	Total Silver mg/Kg	Total Zinc mg/Kg	Total Mercury mg/Kg	Bulk Density g/cm³
S1307417-022	12AS027	305-427	1.20	0.8	74.5	<0.2	2.12
S1307417-023	12AS027	427-560	1.29	0.8	67.7	<0.2	2.19
S1307417-024	12AS027	560-625	1.46	0.6	53.0	<0.2	2.24
S1307417-025	12AS027	625-792	1.21	1.0	27.6	<0.2	2.46
S1307417-026	12AS028	173-235	<0.96	0.8	30.2	<0.2	2.46
S1307417-027	12AS028	235-275	1.57	0.5	34.1	<0.2	3.16
S1307417-028	12AS028	275-325	<0.96	1.2	27.6	<0.2	2.18
S1307417-029	12AS028	325-460	1.53	0.6	60.6	<0.2	2.26
S1307417-030	12AS028	460-610	1.37	0.9	46.7	<0.2	2.40
S1307417-031	12AS029	244-334	1.12	<0.5	26.3	<0.2	2.35
S1307417-032	12AS029	334-500	<0.96	0.8	33.0	<0.2	2.43
S1307417-033	12AS029	500-610	1.22	<0.5	30.1	<0.2	2.28
S1307417-034	DP-12	0-28	<0.96	<0.5	62.1	<0.2	
S1307417-035	DP-12	28-62	<0.96	<0.5	36.9	<0.2	
S1307417-036	DP-12	62-126	<0.96	<0.5	71.4	<0.2	
S1307417-037	DP-12	126-183	<0.96	<0.5	63.3	<0.2	2.51
S1307417-038	DP-12	183-244	<0.96	<0.5	39.0	<0.2	2.10
S1307417-039	DP-21	140-188	<0.96	0.8	80.8	<0.2	2.09
S1307417-040	DP-21	188-260	<0.96	<0.5	82.1	<0.2	2.08
S1307417-041	DP-21	260-360	<0.96	<0.5	84.2	<0.2	2.05

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
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Report ID: S1307417002
(Replaces S1307417001)

Project: Private Lease Soils - Full List

Date Received: 7/30/2013

Date Reported: 10/15/2013

Work Order: S1307417

Lab ID	Sample ID	Depths cm	Total Selenium mg/Kg	Total Silver mg/Kg	Total Zinc mg/Kg	Total Mercury mg/Kg	Bulk Density g/cm³
S1307417-042	DP-22	120-180	<0.96	<0.5	59.2	<0.2	2.24
S1307417-043	DP-22	180-240	<0.96	<0.5	94.6	<0.2	2.20
S1307417-044	DP-24	22-40	<0.96	<0.5	70.1	<0.2	2.61
S1307417-045	DP-24	40-65	<0.96	<0.5	80.0	<0.2	2.51
S1307417-046	DP-24	65-126	<0.96	<0.5	71.2	<0.2	2.30
S1307417-047	DP-24	126-244	<0.96	<0.5	73.8	<0.2	2.62
S1307417-048	DP-26	0-15	<0.96	<0.5	95.5	<0.2	2.84
S1307417-049	DP-26	15-32	<0.96	<0.5	105	<0.2	3.34
S1307417-050	DP-26	32-59	<0.96	<0.5	63.1	<0.2	3.69
S1307417-051	DP-26	59-90	<0.96	<0.5	52.3	<0.2	
S1307417-052	DP-26	90-148	<0.96	<0.5	31.9	<0.2	
S1307417-053	DP-26	148-230	<0.96	<0.5	33.6	<0.2	2.64
S1307417-054	DP-26	230-294	<0.96	<0.5	33.2	<0.2	2.74
S1307417-055	DP-26	294-350	<0.96	<0.5	34.9	<0.2	2.55

These results apply only to the samples tested.

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Date: 5/28/2013

CLIENT: Alton Coal Development, LLC
Project: Private Lease Soils - Short List
Lab Order: S1304178

CASE NARRATIVE

Report ID: S1304178001

Samples DP-04, DP-05, DP-16, and DP-28 were received on April 11, 2013.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1304178001

Project: Private Lease Soils - Short List
Date Received: 4/11/2013

Date Reported: 5/28/2013
Work Order: S1304178

Lab ID	Sample ID	Depths cm	pH s.u.	Saturation %	Electrical Conductivity dS/m	Percent Moisture %	Field Capacity %	Wilt Point %	Organic Matter %
S1304178-001	DP-16	0-18	7.7	54.4	0.84	8.5	35.6	22.0	2.9
S1304178-002	DP-16	18-43	7.9	59.7	0.48	11.9	35.0	25.8	1.8
S1304178-003	DP-16	43-70	7.9	58.7	0.50	12.2	35.3	29.8	2.1
S1304178-004	DP-16	70-102	8.1	63.1	0.36	15.2	37.1	31.8	2.9
S1304178-005	DP-28	0-14	7.7	61.1	0.80	12.4	34.6	28.5	3.6
S1304178-006	DP-28	14-38	8.1	64.3	0.58	13.9	36.4	28.2	2.3
S1304178-007	DP-28	38-62	8.0	66.9	0.44	13.4	36.8	31.0	1.7
S1304178-008	DP-28	62-100	7.9	53.3	0.46	12.2	31.6	25.2	2.0
S1304178-009	DP-28	100-120	8.0	59.1	0.43	11.6	34.1	26.9	2.3
S1304178-010	DP-28	120-140	8.2	68.5	0.45	6.6	36.0	28.3	1.7
S1304178-011	DP-04	0-20	7.7	46.5	0.76	6.6	30.6	18.1	2.7
S1304178-012	DP-04	20-46	7.8	48.1	0.41	7.3	28.1	20.1	2.3
S1304178-013	DP-04	46-90	7.9	47.4	0.38	10.1	28.6	20.6	2.4
S1304178-014	DP-04	90-153	8.1	41.2	0.39	8.4	26.0	17.8	2.3
S1304178-015	DP-04	153-232	8.4	25.6	0.37	5.0	19.7	8.8	0.9
S1304178-016	DP-05	0-35	7.8	48.3	0.65	9.6	31.0	23.4	2.6
S1304178-017	DP-05	35-70	7.8	51.7	0.39	11.0	32.3	25.1	2.5
S1304178-018	DP-05	70-162	8.2	62.2	1.01	11.3	34.3	28.1	1.8

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1304178001

Project: Private Lease Soils - Short List

Date Received: 4/11/2013

Date Reported: 5/28/2013

Work Order: S1304178

Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1304178-001	DP-16	0-18	5.38	1.28	0.26	0.41	0.23
S1304178-002	DP-16	18-43	3.17	1.07	0.12	0.84	0.58
S1304178-003	DP-16	43-70	1.67	0.85	0.09	1.80	1.61
S1304178-004	DP-16	70-102	1.55	0.96	0.13	1.26	1.12
S1304178-005	DP-28	0-14	4.63	2.71	0.41	0.69	0.36
S1304178-006	DP-28	14-38	2.76	2.26	0.21	0.83	0.53
S1304178-007	DP-28	38-62	2.21	1.74	0.10	0.54	0.38
S1304178-008	DP-28	62-100	2.04	1.95	0.13	0.66	0.47
S1304178-009	DP-28	100-120	1.64	1.80	0.08	0.89	0.68
S1304178-010	DP-28	120-140	1.83	1.82	0.11	1.41	1.05
S1304178-011	DP-04	0-20	4.94	1.70	0.48	0.18	0.10
S1304178-012	DP-04	20-46	2.56	1.35	0.15	0.24	0.17
S1304178-013	DP-04	46-90	1.91	1.79	0.09	0.28	0.21
S1304178-014	DP-04	90-153	1.84	1.99	0.11	0.26	0.19
S1304178-015	DP-04	153-232	1.65	1.69	0.10	0.27	0.21
S1304178-016	DP-05	0-35	4.20	1.06	0.34	0.16	0.10
S1304178-017	DP-05	35-70	2.62	0.88	0.15	0.32	0.24
S1304178-018	DP-05	70-162	2.58	2.20	0.12	3.72	2.41

These results apply only to the samples tested.

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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1304178001

Project: Private Lease Soils - Short List
Date Received: 4/11/2013

Date Reported: 5/28/2013
Work Order: S1304178

Lab ID	Sample ID	Depths cm	Sand %	Silt %	Clay %	Texture	Very Fine Sand %	Coarse Fragment %
S1304178-001	DP-16	0-18	36.0	28.0	36.0	Clay Loam	18.2	
S1304178-002	DP-16	18-43	24.0	32.0	44.0	Clay	13.4	
S1304178-003	DP-16	43-70	18.0	36.0	46.0	Clay	9.0	
S1304178-004	DP-16	70-102	22.0	30.0	48.0	Clay	14.4	
S1304178-005	DP-28	0-14	20.0	34.0	46.0	Clay	10.3	
S1304178-006	DP-28	14-38	10.0	38.0	52.0	Clay	5.0	
S1304178-007	DP-28	38-62	10.0	35.0	55.0	Silty Clay	5.8	
S1304178-008	DP-28	62-100	20.0	44.0	36.0	Clay Loam	10.6	
S1304178-009	DP-28	100-120	12.0	44.0	44.0	Silty Clay	1.1	
S1304178-010	DP-28	120-140	14.0	34.0	52.0	Clay	4.6	
S1304178-011	DP-04	0-20	30.0	42.0	28.0	Clay Loam	6.6	
S1304178-012	DP-04	20-46	30.0	38.0	32.0	Clay Loam	10.3	
S1304178-013	DP-04	46-90	36.0	32.0	32.0	Clay Loam	12.3	
S1304178-014	DP-04	90-153	38.0	34.0	28.0	Clay Loam	8.0	5.9
S1304178-015	DP-04	153-232	66.0	24.0	10.0	Sandy Loam	11.0	4.2
S1304178-016	DP-05	0-35	20.0	42.0	38.0	Clay Loam	8.4	
S1304178-017	DP-05	35-70	18.0	39.0	43.0	Clay	9.5	
S1304178-018	DP-05	70-162	16.0	39.0	45.0	Clay	9.1	

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Soil Analysis Report

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Date Reported: 5/28/2013
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Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1304178-001	DP-16	0-18	0.64	24.1	12.1	4.9	<0.02	2.8	1.4
S1304178-002	DP-16	18-43	0.37	2.5	15.6	4.0	<0.02	2.5	0.7
S1304178-003	DP-16	43-70	0.49	6.8	14.2	4.1	<0.02	2.4	0.7
S1304178-004	DP-16	70-102	0.82	8.3	14.6	5.3	<0.02	2.3	0.5
S1304178-005	DP-28	0-14	0.57	12.2	17.3	15.1	<0.02	3.2	1.2
S1304178-006	DP-28	14-38	0.35	7.6	24.5	5.8	<0.02	3.5	0.6
S1304178-007	DP-28	38-62	0.55	5.5	25.2	5.3	<0.02	3.5	0.4
S1304178-008	DP-28	62-100	0.72	8.1	29.2	5.9	<0.02	4.0	0.5
S1304178-009	DP-28	100-120	0.38	7.3	29.4	6.1	<0.02	3.9	0.4
S1304178-010	DP-28	120-140	0.26	1.7	33.3	3.5	<0.02	4.0	<0.1
S1304178-011	DP-04	0-20	0.48	21.8	20.0	13.6	<0.02	3.4	1.0
S1304178-012	DP-04	20-46	0.53	8.6	24.4	5.9	<0.02	3.8	0.9
S1304178-013	DP-04	46-90	0.67	7.2	9.1	6.0	<0.02	2.0	0.9
S1304178-014	DP-04	90-153	0.34	2.6	22.5	5.1	<0.02	3.3	0.6
S1304178-015	DP-04	153-232	0.15	0.4	42.4	3.5	<0.02	4.7	<0.1
S1304178-016	DP-05	0-35	0.38	15.2	20.8	10.8	<0.02	3.4	0.9
S1304178-017	DP-05	35-70	0.38	6.8	22.7	5.5	<0.02	3.5	0.7
S1304178-018	DP-05	70-162	0.78	0.5	25.9	4.5	0.04	3.6	0.4

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Date: 5/29/2013

CLIENT: Alton Coal Development, LLC
Project: Private Lease Soils - Limited List
Lab Order: S1304179

CASE NARRATIVE

Report ID: S1304179001

Samples DP-02, DP-03, DP-06, DP-09, DP-11, DP-13, DP-15, and DP-18 were received on April 11, 2013.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1304179001

Project: Private Lease Soils - Limited List
Date Received: 4/11/2013

Date Reported: 5/29/2013
Work Order: S1304179

Lab ID	Sample ID	Depths cm	pH s.u.	Electrical Conductivity dS/m	PE Calcium meq/L	PE Magnesium meq/L	PE Potassium meq/L	PE Sodium meq/L	SAR
S1304179-004	DP-18	0-18	6.9	1.01	5.90	1.94	0.56	0.10	0.05
S1304179-005	DP-18	18-44	6.9	0.39	2.87	1.02	0.29	0.11	0.08
S1304179-006	DP-18	44-68	7.0	0.74	4.56	2.39	0.27	0.19	0.10
S1304179-007	DP-18	68-144	7.0	0.43	2.88	1.50	0.19	0.24	0.16
S1304179-008	DP-18	144-184	7.2	0.35	2.21	1.16	0.13	0.20	0.16
S1304179-009	DP-18	184-240	7.3	0.28	1.90	0.91	0.11	0.16	0.14
S1304179-010	DP-02	0-13	7.0	4.09	25.7	7.25	4.55	0.40	0.10
S1304179-011	DP-02	13-35	7.3	0.44	3.05	1.24	0.39	0.11	0.07
S1304179-012	DP-02	35-68	7.3	0.47	2.84	2.12	0.16	0.14	0.09
S1304179-013	DP-02	68-92	7.4	0.45	2.46	2.22	0.09	0.36	0.24
S1304179-014	DP-02	92-170	7.3	0.40	1.99	1.87	0.11	0.41	0.29
S1304179-015	DP-02	170-220	7.4	1.26	5.84	4.65	0.14	2.51	1.10
S1304179-016	DP-02	220-261	7.5	1.77	8.25	7.45	0.26	2.95	1.05
S1304179-017	DP-02	261-412	7.7	1.13	4.52	4.47	0.23	2.34	1.10
S1304179-018	DP-03	0-24	7.2	0.57	3.95	0.96	0.28	0.14	0.09
S1304179-019	DP-03	24-47	7.7	0.38	2.52	0.92	0.15	0.26	0.20
S1304179-020	DP-03	47-87	7.6	0.32	1.88	1.16	0.08	0.63	0.51
S1304179-021	DP-03	87-137	7.9	0.64	1.54	2.07	0.10	2.86	2.13
S1304179-022	DP-06	0-18	7.3	0.63	4.72	1.07	0.74	0.16	0.09
S1304179-023	DP-06	18-35	7.3	0.40	3.20	0.83	0.37	0.14	0.10

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1304179001

Project: Private Lease Soils - Limited List
Date Received: 4/11/2013

Date Reported: 5/29/2013
Work Order: S1304179

Lab ID	Sample ID	Depths cm	pH s.u.	Electrical Conductivity dS/m	PE Calcium meq/L	PE Magnesium meq/L	PE Potassium meq/L	PE Sodium meq/L	SAR
S1304179-024	DP-06	35-75	7.5	0.33	2.69	0.76	0.18	0.17	0.13
S1304179-025	DP-06	75-145	7.5	0.31	2.29	0.72	0.14	0.21	0.17
S1304179-026	DP-06	145-187	7.7	0.30	2.05	0.73	0.15	0.28	0.24
S1304179-027	DP-06	187-230	7.9	0.34	1.84	1.18	0.18	0.39	0.31
S1304179-028	DP-09	0-38	7.3	0.83	5.58	1.24	0.37	0.59	0.32
S1304179-029	DP-09	38-68	7.7	0.54	1.96	0.99	0.07	2.77	2.28
S1304179-030	DP-09	68-166	7.6	1.54	3.29	2.02	0.22	9.07	5.57
S1304179-031	DP-09	166-194	7.8	6.01	19.1	24.0	0.30	32.7	7.05
S1304179-032	DP-09	194-244	7.8	6.15	19.9	23.6	0.32	31.4	6.73
S1304179-033	DP-11	0-27	7.3	1.15	5.58	3.08	1.27	0.32	0.15
S1304179-034	DP-11	27-60	7.5	0.38	2.24	1.40	0.19	0.17	0.13
S1304179-035	DP-11	60-138	7.6	0.64	2.75	3.80	0.17	0.27	0.15
S1304179-036	DP-11	138-169	7.7	0.36	1.64	1.97	0.13	0.20	0.15
S1304179-037	DP-11	169-243	7.8	0.32	1.23	1.92	0.09	0.20	0.16
S1304179-038	DP-13	15-54	7.1	0.54	4.12	1.16	0.22	0.28	0.17
S1304179-039	DP-13	54-88	7.5	0.34	2.30	1.10	0.15	0.22	0.17
S1304179-040	DP-15	0-24	7.0	0.84	6.78	1.35	0.49	0.13	0.06
S1304179-041	DP-15	24-56	7.3	0.43	3.60	0.89	0.27	0.12	0.08
S1304179-042	DP-15	56-152	7.4	0.32	2.43	0.72	0.21	0.11	0.09
S1304179-043	DP-15	152-207	7.5	0.31	2.15	0.94	0.16	0.17	0.14

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1304179001

Project: Private Lease Soils - Limited List

Date Received: 4/11/2013

Date Reported: 5/29/2013

Work Order: S1304179

Lab ID	Sample ID	Depths cm	pH s.u.	Electrical Conductivity dS/m	PE Calcium meq/L	PE Magnesium meq/L	PE Potassium meq/L	PE Sodium meq/L	SAR
S1304179-001	DP-15	207-250	7.4	0.32	2.03	1.66	0.14	0.23	0.17
S1304179-002	DP-15	250-280	7.5	0.51	1.73	2.99	0.18	0.28	0.18
S1304179-003	DP-15	280-362	7.5	0.60	1.67	4.00	0.15	0.50	0.30

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
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Report ID: S1304179001

Project: Private Lease Soils - Limited List
Date Received: 4/11/2013

Date Reported: 5/29/2013
Work Order: S1304179

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment	Boron	CO3	Selenium
		cm	%	%	%		%	%	ppm	%	ppm
S1304179-004	DP-18	0-18	30.0	36.0	34.0	Clay Loam	11.9			17.8	
S1304179-005	DP-18	18-44	40.0	31.0	29.0	Clay Loam	10.2			23.1	
S1304179-006	DP-18	44-68	22.0	42.0	36.0	Clay Loam	3.1		0.33	20.3	<0.02
S1304179-007	DP-18	68-144	30.0	41.0	29.0	Clay Loam	1.9		0.26	35.9	<0.02
S1304179-008	DP-18	144-184	36.0	44.0	20.0	Loam	6.7		0.14	43.1	<0.02
S1304179-009	DP-18	184-240	78.0	14.0	8.0	Loamy Sand	7.4		0.08	17.3	<0.02
S1304179-010	DP-02	0-13	44.0	32.0	24.0	Loam	9.4		0.28	21.2	<0.02
S1304179-011	DP-02	13-35	40.0	37.0	23.0	Loam	5.7		0.24	22.0	<0.02
S1304179-012	DP-02	35-68	30.0	40.0	30.0	Clay Loam	4.5		0.28	24.7	<0.02
S1304179-013	DP-02	68-92	24.0	36.0	40.0	Clay	8.8		0.44	18.1	<0.02
S1304179-014	DP-02	92-170	26.0	28.0	46.0	Clay	12.5		0.38	17.6	<0.02
S1304179-015	DP-02	170-220	22.0	46.0	32.0	Clay Loam	1.8		0.36	47.8	<0.02
S1304179-016	DP-02	220-261	78.0	12.0	10.0	Sandy Loam	9.8		0.14	19.3	<0.02
S1304179-017	DP-02	261-412	70.0	22.0	8.0	Sandy Loam	12.4		0.11	25.0	<0.02
S1304179-018	DP-03	0-24	10.0	42.0	48.0	Silty Clay	4.0		0.49	28.9	<0.02
S1304179-019	DP-03	24-47	10.0	39.0	51.0	Clay	6.2		0.32	33.4	<0.02
S1304179-020	DP-03	47-87	4.0	42.0	54.0	Silty Clay	0.4		0.30	29.8	<0.02
S1304179-021	DP-03	87-137	6.0	45.0	49.0	Silty Clay	2.4		0.73	31.7	<0.02
S1304179-022	DP-06	0-18	28.0	39.0	33.0	Clay Loam	5.6		0.54	19.8	<0.02
S1304179-023	DP-06	18-35	28.0	36.0	36.0	Clay Loam	6.8		0.32	19.6	<0.02

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1304179001

Project: Private Lease Soils - Limited List
Date Received: 4/11/2013

Date Reported: 5/29/2013
Work Order: S1304179

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment	Boron	CO3	Selenium
		cm	%	%	%		%	%	ppm	%	ppm
S1304179-024	DP-06	35-75	20.0	40.0	40.0	Silty Clay	9.3		0.27	19.7	<0.02
S1304179-025	DP-06	75-145	24.0	38.0	38.0	Clay Loam	8.4		0.39	24.1	<0.02
S1304179-026	DP-06	145-187	64.0	22.0	14.0	Sandy Loam	7.3	4.3	0.21	27.0	<0.02
S1304179-027	DP-06	187-230	84.0	10.0	6.0	Loamy Sand	3.9	40.6	0.10	52.2	<0.02
S1304179-028	DP-09	0-38	20.0	33.0	47.0	Clay	9.5		0.40	20.9	<0.02
S1304179-029	DP-09	38-68	12.0	36.0	52.0	Clay	4.3		0.45	22.2	<0.02
S1304179-030	DP-09	68-166	10.0	38.0	52.0	Clay	1.9		0.71	22.2	<0.02
S1304179-031	DP-09	166-194	10.0	36.0	54.0	Clay	2.3		1.16	23.1	0.11
S1304179-032	DP-09	194-244	14.0	34.0	52.0	Clay	4.4	0.5	1.09	23.7	0.07
S1304179-033	DP-11	0-27	50.0	28.0	22.0	Loam	12.2		0.39	4.9	<0.02
S1304179-034	DP-11	27-60	50.0	26.0	24.0	Sandy Clay Loam	8.2		0.32	13.0	<0.02
S1304179-035	DP-11	60-138	64.0	20.0	16.0	Sandy Loam	12.8	0.5	0.27	33.5	<0.02
S1304179-036	DP-11	138-169	60.0	22.0	18.0	Sandy Loam	10.3		0.19	10.7	<0.02
S1304179-037	DP-11	169-243	68.0	14.0	18.0	Sandy Loam	5.9		0.18	11.6	<0.02
S1304179-038	DP-13	15-54	48.0	24.0	28.0	Sandy Clay Loam	11.3	2.4	0.38	17.9	<0.02
S1304179-039	DP-13	54-88	48.0	21.0	31.0	Sandy Clay Loam	16.4	5.3		15.8	
S1304179-040	DP-15	0-24	44.0	26.0	30.0	Clay Loam	19.5			8.5	
S1304179-041	DP-15	24-56	38.0	28.0	34.0	Clay Loam	12.4			8.4	
S1304179-042	DP-15	56-152	36.0	30.0	34.0	Clay Loam	10.8		0.33	10.9	<0.02
S1304179-043	DP-15	152-207	22.0	38.0	40.0	Clay	9.1		0.40	18.5	<0.02

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1304179001

Project: Private Lease Soils - Limited List
Date Received: 4/11/2013

Date Reported: 5/29/2013
Work Order: S1304179

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment	Boron	CO3	Selenium
		cm	%	%	%		%	%	ppm	%	ppm
S1304179-001	DP-15	207-250	26.0	47.0	27.0	Clay Loam	9.0		0.25	43.9	<0.02
S1304179-002	DP-15	250-280	36.0	34.0	30.0	Clay Loam	16.9		0.30	25.8	<0.02
S1304179-003	DP-15	280-362	42.0	33.0	25.0	Loam	10.9		0.24	21.8	<0.02

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Date: 10/11/2013

CLIENT: Alton Coal Development, LLC
Project: Private Lease Soils - Short List
Lab Order: S1307425

CASE NARRATIVE

Report ID: S1307425001

Samples 12AS009, 12AS018, DP-21, DP-22, DP-25, and DP-27 were received on July 30, 2013.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1307425001

Project: Private Lease Soils - Short List
Date Received: 7/30/2013

Date Reported: 10/11/2013
Work Order: S1307425

Lab ID	Sample ID	Depths cm	pH s.u.	Saturation %	Electrical Conductivity dS/m	Percent Moisture %	Field Capacity %	Wilt Point %	Organic Matter %
S1307425-001	12AS009	514-610	8.6	38.9	0.44	4.9			1.2
S1307425-002	12AS018	388-406	8.1	30.1	1.73	7.1	14.3	6.4	0.9
S1307425-003	DP-21	0-33	7.8	58.8	0.45	8.5			4.0
S1307425-004	DP-21	33-140	7.9	61.9	0.41	10.1	33.3	24.7	2.6
S1307425-005	DP-22	0-28	8.0		0.65	10.9			3.3
S1307425-006	DP-22	28-50	8.0		3.60	14.9			2.2
S1307425-007	DP-22	50-120	8.4	126	6.68	16.0			1.8
S1307425-008	DP-25	0-16	7.7	59.2	0.83	8.2	35.3	23.9	6.2
S1307425-009	DP-25	16-28	7.8	59.1	0.48	10.2	34.8	25.7	4.0
S1307425-010	DP-25	28-54	7.8	63.7	0.49	11.7	35.1	27.8	3.3
S1307425-011	DP-25	54-75	7.8	57.0	0.49	11.0	31.7	25.6	3.7
S1307425-012	DP-25	75-144	8.0	44.3	0.44	7.6	25.8	18.3	2.0
S1307425-013	DP-25	144-208	8.6	27.6	0.35	3.1	16.2	8.2	1.0
S1307425-014	DP-27	0-22	7.7	55.5	0.63	9.2	33.1	23.7	5.3
S1307425-015	DP-27	22-40	7.8	58.2	0.32	12.2	33.9	27.9	3.9
S1307425-016	DP-27	40-80	7.8	56.1	0.40	10.7	36.3	25.7	4.1
S1307425-017	DP-27	80-152	8.0	59.0	0.39	10.4	32.8	26.7	2.4
S1307425-018	DP-27	152-224	8.5	48.9	0.31	8.3	26.7	21.6	1.1
S1307425-019	DP-27	224-310	8.7	57.0	0.43	9.4			1.2
S1307425-020	DP-27	310-350	8.6	54.9	0.59	10.3	28.2	19.5	1.6

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1307425001

Project: Private Lease Soils - Short List
Date Received: 7/30/2013

Date Reported: 10/11/2013
Work Order: S1307425

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1307425-021	DP-27	350-396	8.3	44.2	1.35	10.5	24.7	19.0	1.2
S1307425-022	DP-27	396-488	8.4	78.9	3.38	16.0	39.8	28.1	1.6

These results apply only to the samples tested.

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Lab ID	Sample ID	Depths cm	PE Calcium meq/L	PE Magnesium meq/L	PE Potassium meq/L	PE Sodium meq/L	SAR
S1307425-001	12AS009	514-610	1.07	3.29	0.15	0.49	0.33
S1307425-002	12AS018	388-406	7.55	13.5	0.22	2.42	0.75
S1307425-003	DP-21	0-33	3.44	1.07	0.52	0.19	0.12
S1307425-004	DP-21	33-140	2.50	1.34	0.27	0.43	0.31
S1307425-005	DP-22	0-28	3.09	2.24	0.17	2.02	1.24
S1307425-006	DP-22	28-50	20.8	21.3	0.23	15.2	3.31
S1307425-007	DP-22	50-120	23.8	64.2	0.38	42.0	6.34
S1307425-008	DP-25	0-16	6.52	1.80	0.63	0.30	0.15
S1307425-009	DP-25	16-28	4.08	1.06	0.40	0.13	0.08
S1307425-010	DP-25	28-54	3.79	1.03	0.35	0.17	0.11
S1307425-011	DP-25	54-75	3.92	1.13	0.30	0.20	0.13
S1307425-012	DP-25	75-144	3.27	1.11	0.20	0.33	0.22
S1307425-013	DP-25	144-208	2.17	1.33	0.15	0.19	0.15
S1307425-014	DP-27	0-22	5.41	1.13	0.59	0.12	0.06
S1307425-015	DP-27	22-40	2.56	0.81	0.20	0.13	0.10
S1307425-016	DP-27	40-80	3.03	1.02	0.26	0.18	0.13
S1307425-017	DP-27	80-152	2.65	1.07	0.16	0.15	0.11
S1307425-018	DP-27	152-224	1.51	1.45	0.11	0.31	0.26
S1307425-019	DP-27	224-310	1.16	2.55	0.10	0.68	0.50
S1307425-020	DP-27	310-350	1.45	4.04	0.17	1.65	0.99

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

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Project: Private Lease Soils - Short List

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Work Order: S1307425

Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1307425-021	DP-27	350-396	3.15	8.40	0.29	4.13	1.72
S1307425-022	DP-27	396-488	5.76	34.7	0.43	12.9	2.88

These results apply only to the samples tested.

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Lab ID	Sample ID	Depths cm	Sand %	Silt %	Clay %	Texture	Very Fine Sand %	Coarse Fragment %
S1307425-001	12AS009	514-610	35.0	50.0	15.0	Silty Loam	16.5	
S1307425-002	12AS018	388-406	73.8	15.0	11.3	Sandy Loam	6.8	
S1307425-003	DP-21	0-33	23.8	37.5	38.8	Clay Loam	6.5	
S1307425-004	DP-21	33-140	26.3	35.0	38.8	Clay Loam	12.5	<0.1
S1307425-005	DP-22	0-28	7.5	40.0	52.5	Silty Clay	<0.1	
S1307425-006	DP-22	28-50	8.8	33.8	57.5	Silty Clay	1.5	
S1307425-007	DP-22	50-120	2.5	50.0	47.5	Silty Clay	<0.1	
S1307425-008	DP-25	0-16	18.8	41.3	40.0	Silty Clay	5.7	
S1307425-009	DP-25	16-28	15.0	41.3	43.8	Silty Clay	2.5	
S1307425-010	DP-25	28-54	11.3	41.3	47.5	Silty Clay	1.6	
S1307425-011	DP-25	54-75	18.8	38.8	42.5	Clay	<0.1	7.4
S1307425-012	DP-25	75-144	36.3	31.3	32.5	Clay Loam	3.2	13.8
S1307425-013	DP-25	144-208	72.5	15.0	12.5	Sandy Loam	4.0	41.0
S1307425-014	DP-27	0-22	13.8	43.8	42.5	Silty Clay	2.2	
S1307425-015	DP-27	22-40	3.8	47.5	48.8	Silty Clay	<0.1	
S1307425-016	DP-27	40-80	8.8	46.3	45.0	Silty Clay	1.3	
S1307425-017	DP-27	80-152	<0.1	52.5	47.5	Silty Clay	<0.1	
S1307425-018	DP-27	152-224	6.3	58.8	35.0	Silty Clay Loam	<0.1	
S1307425-019	DP-27	224-310	6.3	61.3	32.5	Silty Clay Loam	<0.1	
S1307425-020	DP-27	310-350	32.5	35.0	32.5	Clay Loam	7.1	

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

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Project: Private Lease Soils - Short List
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Work Order: S1307425

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment
		cm	%	%	%		%	%
S1307425-021	DP-27	350-396	46.3	31.3	22.5	Loam	4.8	
S1307425-022	DP-27	396-488	7.5	25.0	67.5	Clay	2.6	

These results apply only to the samples tested.

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Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1307425-001	12AS009	514-610	0.21	0.2	25.0	1.9	<0.02	3.1	0.1
S1307425-002	12AS018	388-406	0.11	0.9	20.0	1.8	<0.02	2.8	0.4
S1307425-003	DP-21	0-33	0.41	4.2	13.0	14.8	<0.02	2.9	1.3
S1307425-004	DP-21	33-140	0.40	1.6	15.0	4.9	<0.02	2.7	0.9
S1307425-005	DP-22	0-28	0.69	7.5	16.0	9.4	<0.02	2.8	0.9
S1307425-006	DP-22	28-50	0.80	4.5	14.2	3.2	<0.02	2.3	0.6
S1307425-007	DP-22	50-120	0.90	2.9	16.6	3.3	<0.02	2.4	0.4
S1307425-008	DP-25	0-16	0.23	7.7	18.2	16.5	<0.02	3.9	1.7
S1307425-009	DP-25	16-28	0.32	5.5	16.1	6.2	<0.02	3.3	1.3
S1307425-010	DP-25	28-54	0.38	4.3	16.1	6.7	<0.02	3.3	1.4
S1307425-011	DP-25	54-75	0.28	1.9	19.6	6.3	<0.02	3.5	1.2
S1307425-012	DP-25	75-144	0.25	0.9	27.1	4.5	<0.02	4.3	1.0
S1307425-013	DP-25	144-208	0.12	0.4	51.8	4.7	<0.02	6.7	0.5
S1307425-014	DP-27	0-22	0.33	9.7	17.8	14.8	<0.02	3.9	1.8
S1307425-015	DP-27	22-40	0.42	2.1	17.0	6.8	<0.02	3.5	1.5
S1307425-016	DP-27	40-80	0.37	2.5	18.9	6.9	<0.02	3.9	1.6
S1307425-017	DP-27	80-152	0.27	3.0	38.1	5.5	<0.02	5.4	0.9
S1307425-018	DP-27	152-224	0.15	0.6	53.4	2.3	<0.02	5.8	<0.1
S1307425-019	DP-27	224-310	0.27	0.3	57.1	2.8	<0.02	7.0	0.1
S1307425-020	DP-27	310-350	0.45	0.4	22.9	2.7	<0.02	2.9	0.2

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Soil Analysis Report

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Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1307425-021	DP-27	350-396	0.36	1.3	35.0	4.1	<0.02	4.5	0.3
S1307425-022	DP-27	396-488	0.45	0.5	22.9	1.8	<0.02	3.2	0.4

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Karen Secor, Soil Lab Supervisor

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1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Date: 10/4/2013

CLIENT: Alton Coal Development, LLC
Project: Private Lease Soils - Limited List
Lab Order: S1307426

CASE NARRATIVE

Report ID: S1307426001

Samples 12AS020, DP-20, DP-23, DP-24, DP-25, and DP-26 were received on July 30, 2013.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Lab ID	Sample ID	Depths cm	pH s.u.	Electrical Conductivity dS/m	PE Calcium meq/L	PE Magnesium meq/L	PE Potassium meq/L	PE Sodium meq/L	SAR
S1307426-001	12AS020	600-610	7.9	1.86	12.4	14.3	0.29	1.09	0.30
S1307426-002	DP-20	0-38	7.7	0.95	7.06	2.99	0.56	0.16	0.07
S1307426-004	DP-20	38-55	8.0	0.52	3.47	2.13	0.18	0.43	0.26
S1307426-005	DP-20	122-170	8.0	2.76	15.4	20.2	0.36	8.49	2.01
S1307426-006	DP-20	170-240	8.2	3.90	19.9	39.0	0.21	13.0	2.39
S1307426-008	DP-20	240-310	8.4	1.69	3.32	12.1	0.14	6.74	2.43
S1307426-009	DP-20	310-366	8.4	1.84	3.57	12.2	0.13	6.95	2.48
S1307426-010	DP-23	0-30	7.8	0.87	7.04	2.31	0.60	0.41	0.19
S1307426-011	DP-23	30-57	7.9	0.35	2.90	1.40	0.22	0.20	0.14
S1307426-012	DP-23	57-80	7.8	0.47	3.21	1.70	0.23	0.39	0.25
S1307426-013	DP-23	80-122	7.8	0.67	4.73	2.39	0.23	0.32	0.17
S1307426-014	DP-24	0-22	7.8	0.52	3.79	1.48	0.30	0.38	0.23
S1307426-015	DP-25	208-244	8.5	0.37	2.05	1.74	0.13	0.19	0.14
S1307426-016	DP-26	350-366	8.2	0.39	1.74	2.60	0.14	0.23	0.15

These results apply only to the samples tested.

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Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment	Boron	CO3	Selenium
		cm	%	%	%		%	%	ppm	%	ppm
S1307426-001	12AS020	600-610	87.5	7.5	5.0	Sand	12.6		0.24	18.6	<0.02
S1307426-002	DP-20	0-38	20.0	40.0	40.0	Silty Clay	6.0		0.64	14.5	<0.02
S1307426-004	DP-20	38-55	17.5	40.0	42.5	Silty Clay	3.6			14.8	
S1307426-005	DP-20	122-170	18.8	38.8	42.5	Clay	3.4	<0.1		21.5	
S1307426-006	DP-20	170-240	23.8	50.0	26.3	Silty Loam	3.6		0.29	41.1	0.02
S1307426-008	DP-20	240-310	52.5	40.0	7.5	Sandy Loam	23.1		0.14	36.8	<0.02
S1307426-009	DP-20	310-366	52.5	37.5	10.0	Sandy Loam	18.9		0.13	15.1	<0.02
S1307426-010	DP-23	0-30	18.8	41.3	40.0	Silty Clay	4.1		0.58	16.8	<0.02
S1307426-011	DP-23	30-57	26.3	33.8	40.0	Clay	14.8		0.32	16.1	<0.02
S1307426-012	DP-23	57-80	25.0	36.3	38.8	Clay Loam	3.7		0.38	30.9	<0.02
S1307426-013	DP-23	80-122	62.5	<0.1	37.5	Sandy Clay	6.2		0.18	29.6	<0.02
S1307426-014	DP-24	0-22	18.8	43.8	37.5	Silty Clay Loam	4.8		0.47	18.9	<0.02
S1307426-015	DP-25	208-244	87.5	5.0	7.5	Loamy Sand	19.5	1.8	0.13	32.5	<0.02
S1307426-016	DP-26	350-366	25.0	55.0	20.0	Silty Loam	13.5		0.34	37.0	<0.02

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Date: 3/31/2014

CLIENT: Alton Coal Development, LLC
Project: Private Lease Soils - Full List
Lab Order: S1312084

CASE NARRATIVE

Report ID: S1312084001

Samples 12AS019A, 13AS01, 13AS02, 13AS03, 13AS04, 13AS05, 13AS06, 13AS07, and 13AS09 were received on December 2, 2013.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1312084001

Project: Private Lease Soils - Full List
Date Received: 12/2/2013

Date Reported: 3/31/2014
Work Order: S1312084

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1312084-001	12AS019A	0-22	8.3		0.35	17.6			3.6
S1312084-002	12AS019A	22-43	8.1	68.9	0.37	13.0			1.1
S1312084-003	12AS019A	43-67	8.2	64.9	0.26	11.7			1.0
S1312084-004	12AS019A	67-154	8.4	43.6	0.35	5.9	26.9	17.4	0.6
S1312084-005	12AS019A	154-242	8.6	29.9	0.28	6.8	22.6	8.0	0.4
S1312084-006	12AS019A	242-363	8.2	31.7	0.52	4.3	22.3	8.9	1.2
S1312084-007	12AS019A	363-408	7.6	72.1	1.87	17.6	36.7	28.0	2.6
S1312084-008	12AS019A	408-548	7.7	46.3	1.96	7.4	26.6	16.1	1.0
S1312084-009	12AS019A	548-610	7.7	29.7	2.20	8.1	24.6	9.1	1.1
S1312084-010	12AS019A	610-810	7.6	66.1	1.98	19.6	40.2	26.0	2.9
S1312084-011	12AS019A	810-852	7.8	27.4	1.69	15.4	24.0	5.0	0.5
S1312084-012	13AS01	0-18	7.6	60.5	0.45	17.0	39.8	27.1	6.0
S1312084-013	13AS01	18-45	7.9	56.9	0.17	12.0	36.2	24.8	2.3
S1312084-014	13AS01	45-106	8.4	58.3	0.24	9.5	35.1	25.2	1.4
S1312084-015	13AS01	106-180	8.6	40.1	0.31	5.3	26.2	15.9	0.5
S1312084-016	13AS01	180-213	8.5			1.4			0.4
S1312084-017	13AS01	213-320	8.4	72.0	0.59	12.2	32.2	24.7	0.9
S1312084-018	13AS01	320-475	8.3	51.9	0.65	6.3	26.7	18.4	0.6
S1312084-019	13AS02	0-10	7.9	56.4	0.21	17.4	35.4	25.2	2.4
S1312084-020	13AS02	10-42	8.0	58.6	0.18	17.2	35.5	25.6	1.8

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1312084001

Project: Private Lease Soils - Full List
Date Received: 12/2/2013

Date Reported: 3/31/2014
Work Order: S1312084

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1312084-021	13AS02	42-76	8.3	54.8	0.19	10.4	36.5	25.9	1.9
S1312084-022	13AS03	0-18	7.6	60.2	0.24	13.0	36.3	27.6	2.6
S1312084-023	13AS03	18-44	7.8	54.8	0.24	10.9	34.8	23.0	1.6
S1312084-024	13AS03	44-66	7.9	56.0	0.20	9.5	37.6	23.2	1.4
S1312084-025	13AS03	66-135	8.5	53.2	0.95	9.3	34.0	22.8	1.3
S1312084-026	13AS03	135-164	8.2	63.2	0.46	9.8	33.4	25.8	1.0
S1312084-027	13AS04	0-13	8.0	51.4	0.24	13.4	35.9	17.8	2.7
S1312084-028	13AS04	13-40	7.9	54.5	0.21	15.4	35.4	21.7	2.3
S1312084-029	13AS04	40-90	7.9	57.0	0.18	13.0	34.4	21.7	1.8
S1312084-030	13AS04	90-150	8.2	62.9	0.20	10.8	33.6	24.4	1.4
S1312084-031	13AS04	150-210	8.3	59.1	0.40	9.6	31.8	24.1	1.0
S1312084-032	13AS05	0-10	8.2	60.5	0.20	11.6			2.5
S1312084-033	13AS05	10-24	8.1	64.6	1.05	16.8	34.4	27.8	2.4
S1312084-034	13AS05	24-49	7.9	63.2	0.33	10.6	34.8	26.5	2.4
S1312084-035	13AS05	49-90	8.0	73.1	0.92	11.0	37.0	29.1	2.8
S1312084-036	13AS05	90-153	7.9	76.3	2.20	11.5	38.1	28.4	1.7
S1312084-037	13AS05	153-242	7.8	73.0	2.63	10.6	35.0	26.0	1.4
S1312084-038	13AS05	242-300	7.7	78.9	2.30	13.7	37.5	25.9	1.4
S1312084-039	13AS05	300-394	8.0	76.0	1.17	13.7	35.4	27.3	1.2
S1312084-040	13AS05	394-516	8.0	72.4	1.06	14.9	34.3	26.1	1.1

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1312084001

Project: Private Lease Soils - Full List
Date Received: 12/2/2013

Date Reported: 3/31/2014
Work Order: S1312084

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1312084-041	13AS06	0-13	7.5	72.8	0.55	16.3	33.4	25.5	4.6
S1312084-042	13AS06	13-38	7.9	61.7	0.37	17.0	34.3	25.5	2.7
S1312084-043	13AS06	38-68	8.1	62.3	0.39	15.5	34.7	26.8	1.7
S1312084-044	13AS06	68-112	8.0	74.9	3.20	12.2	37.8	28.6	1.8
S1312084-045	13AS06	112-170	8.2	73.8	3.17	12.0	37.8	27.5	1.4
S1312084-046	13AS06	170-245	8.0	65.5	2.87	10.5	36.1	25.0	1.3
S1312084-047	13AS06	245-315	8.2	72.7	2.40	12.8	37.8	28.4	1.4
S1312084-048	13AS06	315-396	8.0	79.7	2.93	14.2	40.6	28.6	1.1
S1312084-049	13AS06	396-457	8.2	79.7	1.67	13.7	39.2	27.8	1.1
S1312084-050	13AS06	457-579	8.2	69.8	1.41	13.2	39.2	27.2	1.1
S1312084-051	13AS06	579-632	8.5	65.5	0.85	13.2	38.3	26.0	1.1
S1312084-052	13AS06	632-770	8.9	22.9	0.41	2.5	17.7	4.6	0.4
S1312084-053	13AS06	770-838	8.4	22.8	0.60	6.8	20.1	6.1	0.7
S1312084-054	13AS06	838-884	8.0	34.0	0.57	13.2	20.5	11.1	1.0
S1312084-055	13AS07	0-19	7.7	53.2	0.62	12.1	31.6	20.7	3.3
S1312084-056	13AS07	19-46	7.8	54.4	0.72	17.0	33.9	24.1	2.6
S1312084-057	13AS07	46-67	7.9	56.7	0.75	15.5	34.1	23.3	1.9
S1312084-058	13AS07	67-183	8.1	49.5	0.29	10.3	32.7	20.2	1.3
S1312084-059	13AS07	183-305	8.2	26.1	0.27	2.5	21.8	5.4	0.9
S1312084-060	13AS07	305-427	8.4	22.5	0.53	3.2	19.6	6.6	0.6

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
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Project: Private Lease Soils - Full List
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Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1312084-061	13AS07	427-532	8.6	23.2	0.58	5.4	18.3	6.0	0.5
S1312084-062	13AS07	532-656	7.7	24.1	1.47	13.2	20.9	6.1	1.8
S1312084-063	13AS07	656-732	8.1	71.2	0.63	21.0	40.9	30.1	1.4
S1312084-064	13AS09	0-14	8.0	61.0	0.21	14.0	38.5	27.0	3.2
S1312084-065	13AS09	14-46	7.9	61.9	0.16	13.3	39.7	29.8	1.4

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Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1312084-001	12AS019A	0-22	2.83	1.30	0.17	0.19	0.13
S1312084-002	12AS019A	22-43	1.53	1.59	0.11	0.22	0.17
S1312084-003	12AS019A	43-67	1.03	1.52	0.08	0.18	0.16
S1312084-004	12AS019A	67-154	1.03	2.64	0.13	0.27	0.20
S1312084-005	12AS019A	154-242	0.79	2.31	0.12	0.14	0.12
S1312084-006	12AS019A	242-363	1.58	4.93	0.20	0.37	0.20
S1312084-007	12AS019A	363-408	17.3	18.6	0.51	0.63	0.15
S1312084-008	12AS019A	408-548	19.7	19.2	0.50	0.79	0.18
S1312084-009	12AS019A	548-610	23.3	23.4	0.46	1.77	0.37
S1312084-010	12AS019A	610-810	15.3	18.8	0.64	2.75	0.67
S1312084-011	12AS019A	810-852	9.40	14.8	0.35	4.08	1.17
S1312084-012	13AS01	0-18	3.61	1.12	0.40	0.12	0.08
S1312084-013	13AS01	18-45	1.42	0.75	0.15	0.13	0.13
S1312084-014	13AS01	45-106	1.94	1.41	0.17	0.15	0.11
S1312084-015	13AS01	106-180	0.74	2.39	0.16	0.32	0.26
S1312084-016	13AS01	180-213					
S1312084-017	13AS01	213-320	1.30	4.16	0.15	1.89	1.14
S1312084-018	13AS01	320-475	2.07	3.81	0.19	1.94	1.13
S1312084-019	13AS02	0-10	2.00	0.38	0.30	0.16	0.15
S1312084-020	13AS02	10-42	1.68	0.57	0.10	0.69	0.65

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
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Project: Private Lease Soils - Full List
Date Received: 12/2/2013

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Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1312084-021	13AS02	42-76	0.91	0.61	0.06	1.53	1.76
S1312084-022	13AS03	0-18	2.73	0.78	0.36	0.17	0.13
S1312084-023	13AS03	18-44	2.58	0.78	0.17	0.21	0.16
S1312084-024	13AS03	44-66	1.76	0.59	0.11	0.40	0.37
S1312084-025	13AS03	66-135	6.31	6.02	0.26	3.44	1.39
S1312084-026	13AS03	135-164	1.65	0.89	0.12	5.87	5.21
S1312084-027	13AS04	0-13	2.29	0.58	0.20	0.10	0.09
S1312084-028	13AS04	13-40	2.12	0.80	0.12	0.17	0.14
S1312084-029	13AS04	40-90	1.41	0.68	0.11	0.15	0.15
S1312084-030	13AS04	90-150	1.28	0.91	0.10	0.62	0.59
S1312084-031	13AS04	150-210	1.63	1.80	0.12	2.11	1.61
S1312084-032	13AS05	0-10	2.06	0.42	0.22	0.22	0.20
S1312084-033	13AS05	10-24	6.18	8.21	0.27	3.03	1.13
S1312084-034	13AS05	24-49	2.16	0.73	0.12	2.27	1.88
S1312084-035	13AS05	49-90	2.69	1.38	0.11	8.30	5.82
S1312084-036	13AS05	90-153	10.7	7.76	0.31	19.3	6.35
S1312084-037	13AS05	153-242	19.7	14.4	0.50	19.5	4.73
S1312084-038	13AS05	242-300	20.0	13.1	0.58	15.5	3.80
S1312084-039	13AS05	300-394	3.98	2.72	0.29	9.55	5.22
S1312084-040	13AS05	394-516	4.05	2.92	0.28	8.29	4.44

These results apply only to the samples tested.

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Karen Secor, Soil Lab Supervisor

Soil Analysis Report

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Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1312084-041	13AS06	0-13	5.01	1.26	0.55	0.38	0.21
S1312084-042	13AS06	13-38	2.35	1.06	0.20	0.95	0.73
S1312084-043	13AS06	38-68	1.34	0.92	0.09	2.95	2.78
S1312084-044	13AS06	68-112	20.4	45.9	0.45	22.1	3.83
S1312084-045	13AS06	112-170	16.0	50.6	0.62	20.9	3.61
S1312084-046	13AS06	170-245	16.1	36.2	0.64	19.3	3.78
S1312084-047	13AS06	245-315	6.11	26.8	0.66	17.0	4.19
S1312084-048	13AS06	315-396	17.8	45.1	0.82	17.4	3.10
S1312084-049	13AS06	396-457	4.29	14.4	0.48	10.7	3.52
S1312084-050	13AS06	457-579	2.72	11.2	0.48	7.98	3.02
S1312084-051	13AS06	579-632	1.54	5.18	0.28	4.19	2.29
S1312084-052	13AS06	632-770	1.09	3.25	0.19	1.02	0.69
S1312084-053	13AS06	770-838	2.39	3.15	0.15	0.93	0.56
S1312084-054	13AS06	838-884	3.56	3.88	0.23	0.73	0.38
S1312084-055	13AS07	0-19	4.60	2.03	0.45	1.10	0.60
S1312084-056	13AS07	19-46	4.86	2.71	0.29	1.18	0.61
S1312084-057	13AS07	46-67	3.92	4.39	0.23	1.16	0.57
S1312084-058	13AS07	67-183	1.40	1.69	0.12	0.66	0.53
S1312084-059	13AS07	183-305	1.18	1.54	0.07	0.59	0.51
S1312084-060	13AS07	305-427	2.47	4.02	0.17	1.06	0.59

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945
Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1312084001

Project: Private Lease Soils - Full List
Date Received: 12/2/2013

Date Reported: 3/31/2014
Work Order: S1312084

Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1312084-061	13AS07	427-532	2.10	4.73	0.20	1.15	0.62
S1312084-062	13AS07	532-656	14.5	14.2	0.44	2.92	0.77
S1312084-063	13AS07	656-732	3.84	2.99	0.27	1.38	0.75
S1312084-064	13AS09	0-14	1.66	0.64	0.24	0.15	0.14
S1312084-065	13AS09	14-46	1.25	0.46	0.18	0.20	0.22

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
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Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Boron	Nitrate(as N)	CO3	Selenium
		cm	%	%	%		%	ppm	ppm	%	ppm
S1312084-001	12AS019A	0-22	10.0	43.8	46.3	Silty Clay	<0.1	0.33	1.9	47.9	<0.02
S1312084-002	12AS019A	22-43	8.8	38.8	52.5	Clay	2.7			50.4	
S1312084-003	12AS019A	43-67	6.3	43.8	50.0	Silty Clay	0.3	0.21	0.5	50.1	<0.02
S1312084-004	12AS019A	67-154	37.0	42.0	21.0	Loam	26.5	0.24	0.8	45.9	<0.02
S1312084-005	12AS019A	154-242	63.0	28.0	9.0	Sandy Loam	34.6	0.16	0.3	32.4	<0.02
S1312084-006	12AS019A	242-363	58.0	31.0	11.0	Sandy Loam	26.3	0.17	3.3	31.6	0.03
S1312084-007	12AS019A	363-408	18.0	43.0	39.0	Silty Clay Loam	13.2	0.31	54.1	42.8	0.05
S1312084-008	12AS019A	408-548	38.0	42.0	20.0	Loam	29.0	0.10	11.4	47.0	<0.02
S1312084-009	12AS019A	548-610	59.0	32.0	9.0	Sandy Loam	34.5	0.16	4.8	32.0	<0.02
S1312084-010	12AS019A	610-810	26.0	40.0	34.0	Clay Loam	21.3	0.48	0.5	29.3	<0.02
S1312084-011	12AS019A	810-852	86.0	9.0	5.0	Loamy Sand	28.2	0.17	<0.1	19.4	<0.02
S1312084-012	13AS01	0-18	24.0	35.0	41.0	Clay	17.9	0.56	1.5	36.7	<0.02
S1312084-013	13AS01	18-45	24.0	33.0	43.0	Clay	19.6	0.47	0.6	45.9	<0.02
S1312084-014	13AS01	45-106	24.0	37.0	39.0	Clay Loam	19.1	0.46	0.6	49.0	<0.02
S1312084-015	13AS01	106-180	39.0	40.0	21.0	Loam	25.0	0.45	0.3	39.9	<0.02
S1312084-016	13AS01	180-213	70.0	20.0	10.0	Sandy Loam	11.5			23.3	
S1312084-017	13AS01	213-320	36.0	24.0	40.0	Clay	32.2	0.37	0.6	42.5	<0.02
S1312084-018	13AS01	320-475	44.0	32.0	24.0	Loam	34.5	0.29	0.5	17.5	0.06
S1312084-019	13AS02	0-10	38.0	31.0	31.0	Clay Loam	25.7	0.47	<0.1	14.8	<0.02
S1312084-020	13AS02	10-42	32.0	36.0	32.0	Clay Loam	22.7	0.26	0.7	21.3	<0.02

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
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Report ID: S1312084001

Project: Private Lease Soils - Full List
Date Received: 12/2/2013

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Work Order: S1312084

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Boron	Nitrate(as N)	CO3	Selenium
		cm	%	%	%		%	ppm	ppm	%	ppm
S1312084-021	13AS02	42-76	34.0	32.0	34.0	Clay Loam	28.9	0.42	0.4	23.9	<0.02
S1312084-022	13AS03	0-18	36.0	31.0	33.0	Clay Loam	27.2	0.52	<0.1	18.6	<0.02
S1312084-023	13AS03	18-44	36.0	30.0	34.0	Clay Loam	25.1	0.28	0.6	21.4	<0.02
S1312084-024	13AS03	44-66	38.0	26.0	36.0	Clay Loam	27.5	0.42	0.6	21.3	<0.02
S1312084-025	13AS03	66-135	38.0	27.0	35.0	Clay Loam	25.3	0.62	0.2	22.4	<0.02
S1312084-026	13AS03	135-164	38.0	26.0	36.0	Clay Loam	26.3	0.92	1.5	21.8	<0.02
S1312084-027	13AS04	0-13	50.0	27.0	23.0	Sandy Clay Loam	25.5	0.30	0.6	6.3	<0.02
S1312084-028	13AS04	13-40	48.0	25.0	27.0	Sandy Clay Loam	28.6	0.29	0.2	10.2	<0.02
S1312084-029	13AS04	40-90	42.0	27.0	31.0	Clay Loam	28.7	0.41	1.6	15.2	<0.02
S1312084-030	13AS04	90-150	40.0	28.0	32.0	Clay Loam	28.6	0.60	0.6	17.3	<0.02
S1312084-031	13AS04	150-210	46.0	24.0	30.0	Sandy Clay Loam	31.3	0.67	0.1	17.5	<0.02
S1312084-032	13AS05	0-10	34.0	31.0	35.0	Clay Loam	24.9	0.29	2.8	17.1	<0.02
S1312084-033	13AS05	10-24	34.0	28.0	38.0	Clay Loam	26.5	0.34	3.6	18.0	<0.02
S1312084-034	13AS05	24-49	28.0	33.0	39.0	Clay Loam	21.0	0.54	2.2	18.9	<0.02
S1312084-035	13AS05	49-90	32.0	29.0	39.0	Clay Loam	25.5	0.75	0.8	19.4	<0.02
S1312084-036	13AS05	90-153	10.0	37.0	53.0	Clay	4.5	0.94	1.0	22.1	0.08
S1312084-037	13AS05	153-242	32.0	18.0	50.0	Clay	24.2	1.18	3.6	22.8	0.07
S1312084-038	13AS05	242-300	10.0	37.0	53.0	Clay	5.3	0.93	7.4	22.9	0.02
S1312084-039	13AS05	300-394	14.0	35.0	51.0	Clay	8.4	0.94	5.7	24.3	0.02
S1312084-040	13AS05	394-516	40.0	14.0	46.0	Clay	34.7	0.93	4.0	23.8	<0.02

These results apply only to the samples tested.

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
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Report ID: S1312084001

Project: Private Lease Soils - Full List
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Date Reported: 3/31/2014
Work Order: S1312084

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Boron	Nitrate(as N)	CO3	Selenium
		cm	%	%	%		%	ppm	ppm	%	ppm
S1312084-041	13AS06	0-13	23.0	38.0	39.0	Clay Loam	8.5	0.58	2.1	16.1	<0.02
S1312084-042	13AS06	13-38	46.0	12.0	42.0	Sandy Clay	36.3	0.57	0.3	18.9	<0.02
S1312084-043	13AS06	38-68	16.0	37.0	47.0	Clay	8.7	0.51	<0.1	20.8	<0.02
S1312084-044	13AS06	68-112	16.0	33.0	51.0	Clay	10.5	0.84	<0.1	21.3	<0.02
S1312084-045	13AS06	112-170	47.0	4.0	49.0	Sandy Clay	41.2	1.38	0.9	24.0	0.06
S1312084-046	13AS06	170-245	18.0	36.0	46.0	Clay	6.3	0.97	1.3	24.0	0.03
S1312084-047	13AS06	245-315	48.0	11.0	41.0	Sandy Clay	41.5	1.03	0.3	22.4	0.03
S1312084-048	13AS06	315-396	12.0	35.0	53.0	Clay	5.6	1.06	0.3	24.1	0.03
S1312084-049	13AS06	396-457	56.0	8.0	36.0	Sandy Clay	50.4	0.70	0.3	23.0	<0.02
S1312084-050	13AS06	457-579	10.0	39.0	51.0	Clay	3.8	0.53	0.7	23.5	<0.02
S1312084-051	13AS06	579-632	32.0	19.0	49.0	Clay	23.1	0.41	0.2	25.3	<0.02
S1312084-052	13AS06	632-770	82.0	13.0	5.0	Loamy Sand	3.7	0.10	0.3	51.9	<0.02
S1312084-053	13AS06	770-838	86.0	6.0	8.0	Loamy Sand	27.3	0.11	0.3	28.2	<0.02
S1312084-054	13AS06	838-884	64.0	21.0	15.0	Sandy Loam	31.8	0.15	0.4	26.1	<0.02
S1312084-055	13AS07	0-19	28.0	36.0	36.0	Clay Loam	12.0	0.69	<0.1	20.5	<0.02
S1312084-056	13AS07	19-46	32.0	23.0	45.0	Clay	21.9	0.40	0.5	35.6	<0.02
S1312084-057	13AS07	46-67	22.0	37.0	41.0	Clay	8.0	0.37	0.1	30.9	<0.02
S1312084-058	13AS07	67-183	52.0	16.0	32.0	Sandy Clay Loam	30.5	0.26	1.4	43.1	<0.02
S1312084-059	13AS07	183-305	76.0	15.0	9.0	Sandy Loam	14.3	0.12	0.2	18.7	<0.02
S1312084-060	13AS07	305-427	80.0	12.0	8.0	Loamy Sand	13.7	0.11	0.2	56.7	<0.02

These results apply only to the samples tested.

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
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Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Boron	Nitrate(as N)	CO3	Selenium
		cm	%	%	%		%	ppm	ppm	%	ppm
S1312084-061	13AS07	427-532	78.0	16.0	6.0	Loamy Sand	4.2	0.07	0.1	68.8	<0.02
S1312084-062	13AS07	532-656	84.0	9.0	7.0	Loamy Sand	21.4	0.19	0.1	43.1	<0.02
S1312084-063	13AS07	656-732	26.0	28.0	46.0	Clay	20.6	0.32	1.2	12.0	<0.02
S1312084-064	13AS09	0-14	14.0	32.0	54.0	Clay	8.0	0.53	<0.1	17.8	<0.02
S1312084-065	13AS09	14-46	28.0	23.0	49.0	Clay	24.1	0.50	1.0	19.7	<0.02

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Lab ID	Sample ID	Depths cm	Total Carbon %	TOC %	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t
S1312084-001	12AS019A	0-22	8.0	2.2	<0.01	<0.01	479	479
S1312084-002	12AS019A	22-43	7.0	0.9	0.18	5.74	504	499
S1312084-003	12AS019A	43-67	6.6	0.6	<0.01	<0.01	501	501
S1312084-004	12AS019A	67-154	5.8	0.3	<0.01	<0.01	459	459
S1312084-005	12AS019A	154-242	4.2	0.3	<0.01	<0.01	324	324
S1312084-006	12AS019A	242-363	4.2	0.4	<0.01	<0.01	316	316
S1312084-007	12AS019A	363-408	6.7	1.6	0.21	6.61	428	422
S1312084-008	12AS019A	408-548	6.4	0.7	0.07	2.11	470	468
S1312084-009	12AS019A	548-610	3.9	<0.1	0.18	5.50	320	314
S1312084-010	12AS019A	610-810	5.2	1.7	0.37	11.6	293	282
S1312084-011	12AS019A	810-852	2.6	0.3	0.02	0.74	194	194
S1312084-012	13AS01	0-18	7.2	2.8	0.02	0.58	367	366
S1312084-013	13AS01	18-45	6.7	1.2	<0.01	<0.01	459	459
S1312084-014	13AS01	45-106	6.7	0.8	<0.01	<0.01	490	490
S1312084-015	13AS01	106-180	5.3	0.5	<0.01	<0.01	399	399
S1312084-016	13AS01	180-213	3.0	0.2	<0.01	<0.01	233	233
S1312084-017	13AS01	213-320	5.7	0.6	<0.01	<0.01	425	425
S1312084-018	13AS01	320-475	2.3	0.2	<0.01	<0.01	175	175
S1312084-019	13AS02	0-10	3.3	1.5	0.07	2.09	148	146
S1312084-020	13AS02	10-42	3.5	1.0	<0.01	<0.01	213	213

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Lab ID	Sample ID	Depths	Total Carbon	TOC	Total Sulfur	T.S. AB	Neutral. Potential	T.S. ABP
		cm	%	%	%	t/1000t	t/1000t	t/1000t
S1312084-021	13AS02	42-76	3.8	1.0	<0.01	<0.01	239	239
S1312084-022	13AS03	0-18	3.9	1.6	<0.01	<0.01	186	186
S1312084-023	13AS03	18-44	3.5	0.9	<0.01	<0.01	214	214
S1312084-024	13AS03	44-66	3.4	0.8	<0.01	<0.01	213	213
S1312084-025	13AS03	66-135	3.5	0.8	<0.01	<0.01	224	224
S1312084-026	13AS03	135-164	3.3	0.7	<0.01	<0.01	218	218
S1312084-027	13AS04	0-13	2.1	1.4	<0.01	<0.01	62.9	62.9
S1312084-028	13AS04	13-40	2.4	1.2	<0.01	<0.01	102	102
S1312084-029	13AS04	40-90	2.9	1.1	<0.01	<0.01	152	152
S1312084-030	13AS04	90-150	2.8	0.7	<0.01	<0.01	173	173
S1312084-031	13AS04	150-210	2.7	0.6	<0.01	<0.01	175	175
S1312084-032	13AS05	0-10	3.3	1.2	<0.01	<0.01	171	171
S1312084-033	13AS05	10-24	3.3	1.1	<0.01	<0.01	180	180
S1312084-034	13AS05	24-49	3.3	1.0	<0.01	<0.01	189	189
S1312084-035	13AS05	49-90	3.3	1.0	<0.01	<0.01	194	194
S1312084-036	13AS05	90-153	3.3	0.7	0.02	0.61	221	220
S1312084-037	13AS05	153-242	3.4	0.7	0.27	8.26	228	220
S1312084-038	13AS05	242-300	3.4	0.7	0.26	8.04	229	221
S1312084-039	13AS05	300-394	3.5	0.6	<0.01	<0.01	243	243
S1312084-040	13AS05	394-516	3.5	0.6	<0.01	<0.01	238	238

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Lab ID	Sample ID	Depths	Total Carbon	TOC	Total Sulfur	T.S. AB	Neutral. Potential	T.S. ABP
		cm	%	%	%	t/1000t	t/1000t	t/1000t
S1312084-041	13AS06	0-13	3.5	1.6	0.01	0.32	161	160
S1312084-042	13AS06	13-38	3.3	1.1	<0.01	<0.01	189	189
S1312084-043	13AS06	38-68	3.4	0.9	<0.01	<0.01	208	208
S1312084-044	13AS06	68-112	3.3	0.8	0.35	10.8	213	202
S1312084-045	13AS06	112-170	3.6	0.7	0.41	12.8	240	227
S1312084-046	13AS06	170-245	3.5	0.6	0.23	7.27	240	233
S1312084-047	13AS06	245-315	3.1	0.4	0.05	1.65	224	223
S1312084-048	13AS06	315-396	3.4	0.5	0.14	4.26	241	236
S1312084-049	13AS06	396-457	3.4	0.7	0.01	0.44	230	229
S1312084-050	13AS06	457-579	3.2	0.4	<0.01	<0.01	235	235
S1312084-051	13AS06	579-632	3.6	0.5	<0.01	<0.01	253	253
S1312084-052	13AS06	632-770	6.2	<0.1	<0.01	<0.01	519	519
S1312084-053	13AS06	770-838	3.6	0.2	<0.01	<0.01	282	282
S1312084-054	13AS06	838-884	3.5	0.4	<0.01	<0.01	261	261
S1312084-055	13AS07	0-19	3.9	1.5	<0.01	<0.01	205	205
S1312084-056	13AS07	19-46	5.4	1.2	<0.01	<0.01	356	356
S1312084-057	13AS07	46-67	4.8	1.1	<0.01	<0.01	309	309
S1312084-058	13AS07	67-183	5.9	0.7	<0.01	<0.01	431	431
S1312084-059	13AS07	183-305	2.7	0.4	0.02	0.54	187	187
S1312084-060	13AS07	305-427	7.3	0.5	0.02	0.49	567	567

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1312084001

Project: Private Lease Soils - Full List

Date Received: 12/2/2013

Date Reported: 3/31/2014

Work Order: S1312084

Lab ID	Sample ID	Depths	Total Carbon	TOC	Total Sulfur	T.S. AB	Neutral. Potential	T.S. ABP
		cm	%	%	%	t/1000t	t/1000t	t/1000t
S1312084-061	13AS07	427-532	8.6	0.4	<0.01	<0.01	687	687
S1312084-062	13AS07	532-656	5.4	0.2	0.20	6.28	431	425
S1312084-063	13AS07	656-732	2.0	0.6	0.06	1.95	120	118
S1312084-064	13AS09	0-14	3.9	1.7	<0.01	<0.01	178	178
S1312084-065	13AS09	14-46	3.1	0.7	<0.01	<0.01	197	197

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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
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Report ID: S1312084001

Project: Private Lease Soils - Full List
Date Received: 12/2/2013

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Lab ID	Sample ID	Depths cm	Total Arsenic mg/Kg	Total Barium mg/Kg	Total Cadmium mg/Kg	Total Chromium mg/Kg	Total Copper mg/Kg	Total Iron mg/Kg	Total Lead mg/Kg	Total Manganese mg/Kg	Total Molybdenum mg/Kg
S1312084-001	12AS019A	0-22	5.8	470	0.27	18.6	9.68	11900	5.8	300	<0.7
S1312084-002	12AS019A	22-43	5.6	277	0.50	25.5	6.18	11600	8.9	206	<0.7
S1312084-003	12AS019A	43-67	8.5	253	0.60	25.0	6.43	13800	8.6	234	<0.7
S1312084-004	12AS019A	67-154	2.5	170	0.34	16.2	4.99	6420	7.0	151	<0.7
S1312084-005	12AS019A	154-242	1.9	116	0.31	8.62	4.04	4160	4.3	99.5	<0.7
S1312084-006	12AS019A	242-363	3.0	72.8	0.35	8.07	5.15	3690	4.7	91.9	<0.7
S1312084-007	12AS019A	363-408	7.3	191	0.72	21.2	10.4	20700	8.9	290	1.1
S1312084-008	12AS019A	408-548	6.8	115	0.40	16.0	8.63	9340	8.0	179	<0.7
S1312084-009	12AS019A	548-610	6.1	60.7	0.42	9.18	5.95	7450	5.7	163	<0.7
S1312084-010	12AS019A	610-810	6.6	99.9	0.42	17.9	10.6	13300	8.5	191	0.9
S1312084-011	12AS019A	810-852	3.0	115	0.33	5.68	2.96	5220	3.7	94.5	<0.7
S1312084-012	13AS01	0-18	7.6	241	0.58	22.0	13.5	13500	9.3	391	<0.7
S1312084-013	13AS01	18-45	6.8	208	0.43	23.5	8.48	11100	9.8	310	1.4
S1312084-014	13AS01	45-106	8.2	399	0.43	21.9	8.84	12200	9.0	199	0.7
S1312084-015	13AS01	106-180	2.8	265	0.40	13.9	5.66	6710	7.1	153	0.8
S1312084-016	13AS01	180-213	4.5	128	0.26	5.71	3.41	5610	3.7	189	<0.7
S1312084-017	13AS01	213-320	10.5	119	0.53	21.5	9.97	16200	9.6	242	1.3
S1312084-018	13AS01	320-475	3.9	72.7	0.19	10.2	5.79	8150	5.1	141	<0.7
S1312084-019	13AS02	0-10	3.3	63.6	0.43	16.2	11.5	12700	9.7	171	<0.7
S1312084-020	13AS02	10-42	3.5	56.5	0.39	14.8	8.52	11400	8.2	134	<0.7

These results apply only to the samples tested.

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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1312084001

Project: Private Lease Soils - Full List
Date Received: 12/2/2013

Date Reported: 3/31/2014
Work Order: S1312084

Lab ID	Sample ID	Depths cm	Total Arsenic mg/Kg	Total Barium mg/Kg	Total Cadmium mg/Kg	Total Chromium mg/Kg	Total Copper mg/Kg	Total Iron mg/Kg	Total Lead mg/Kg	Total Manganese mg/Kg	Total Molybdenum mg/Kg
S1312084-021	13AS02	42-76	3.5	60.6	0.38	16.0	9.30	12600	9.8	142	<0.7
S1312084-022	13AS03	0-18	3.3	63.6	0.38	16.7	11.8	13400	10.7	170	<0.7
S1312084-023	13AS03	18-44	3.2	62.3	0.39	14.4	9.32	12400	9.4	161	<0.7
S1312084-024	13AS03	44-66	2.0	51.8	0.21	13.0	7.52	10200	7.4	117	<0.7
S1312084-025	13AS03	66-135	2.9	63.7	0.31	15.9	9.85	13600	9.6	156	<0.7
S1312084-026	13AS03	135-164	4.4	65.9	0.37	17.4	9.75	13400	10.2	169	<0.7
S1312084-027	13AS04	0-13	3.8	71.6	0.37	16.8	9.58	12800	7.7	219	<0.7
S1312084-028	13AS04	13-40	3.4	75.4	0.33	16.7	9.53	13000	8.5	217	<0.7
S1312084-029	13AS04	40-90	4.5	78.3	0.33	16.3	9.14	12800	8.5	191	<0.7
S1312084-030	13AS04	90-150	3.8	85.5	0.35	15.7	9.07	12800	8.6	185	<0.7
S1312084-031	13AS04	150-210	2.8	89.8	0.32	14.2	8.02	11800	7.8	178	<0.7
S1312084-032	13AS05	0-10	4.0	65.6	0.27	13.5	10.6	12300	10.1	162	<0.7
S1312084-033	13AS05	10-24	3.1	60.3	0.28	13.5	8.67	11000	8.3	139	<0.7
S1312084-034	13AS05	24-49	2.9	65.5	0.37	15.7	9.89	12800	9.5	159	<0.7
S1312084-035	13AS05	49-90	2.6	63.5	0.29	15.3	9.88	12700	9.8	152	<0.7
S1312084-036	13AS05	90-153	4.2	76.6	0.27	16.3	9.86	13300	10.0	151	<0.7
S1312084-037	13AS05	153-242	3.6	82.0	0.32	13.8	9.21	12300	9.6	134	<0.7
S1312084-038	13AS05	242-300	3.9	66.7	0.34	15.5	10.0	13000	9.9	140	<0.7
S1312084-039	13AS05	300-394	4.5	73.0	0.40	16.9	10.3	13600	10.6	150	<0.7
S1312084-040	13AS05	394-516	3.2	65.8	0.49	16.6	10.3	13700	10.4	143	<0.7

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1312084001

Project: Private Lease Soils - Full List
Date Received: 12/2/2013

Date Reported: 3/31/2014
Work Order: S1312084

Lab ID	Sample ID	Depths	Total Arsenic	Total Barium	Total Cadmium	Total Chromium	Total Copper	Total Iron	Total Lead	Total Manganese	Total Molybdenum
		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
S1312084-041	13AS06	0-13	3.9	75.4	0.31	19.0	10.9	12500	14.7	168	<0.7
S1312084-042	13AS06	13-38	4.1	65.8	0.35	15.7	10.7	13100	10.5	166	<0.7
S1312084-043	13AS06	38-68	2.2	61.3	0.33	15.4	9.94	12700	9.3	155	<0.7
S1312084-044	13AS06	68-112	1.9	70.5	0.34	19.4	10.7	14300	10.9	168	<0.7
S1312084-045	13AS06	112-170	1.0	64.2	0.41	15.7	9.71	12600	9.7	152	<0.7
S1312084-046	13AS06	170-245	0.7	65.4	0.36	14.3	9.25	12300	9.3	137	<0.7
S1312084-047	13AS06	245-315	1.3	64.3	0.18	15.7	10.2	13100	10.1	142	<0.7
S1312084-048	13AS06	315-396	<0.6	62.1	0.34	13.3	9.26	12100	9.8	121	<0.7
S1312084-049	13AS06	396-457	1.9	60.2	0.37	12.8	9.70	12700	10.5	141	<0.7
S1312084-050	13AS06	457-579	0.9	66.3	0.25	14.6	9.69	12900	10.0	132	<0.7
S1312084-051	13AS06	579-632	2.0	122	0.30	13.9	9.43	13400	9.9	120	<0.7
S1312084-052	13AS06	632-770	1.1	149	0.15	4.65	1.86	5120	3.7	192	<0.7
S1312084-053	13AS06	770-838	2.4	204	0.40	6.88	3.64	7970	4.3	128	<0.7
S1312084-054	13AS06	838-884	2.0	122	0.39	10.9	6.70	6250	6.2	143	<0.7
S1312084-055	13AS07	0-19	2.1	83.3	0.30	15.5	9.20	10700	7.2	166	<0.7
S1312084-056	13AS07	19-46	4.1	136	0.37	20.9	10.2	13500	8.9	272	<0.7
S1312084-057	13AS07	46-67	3.7	197	0.28	18.4	8.24	12000	7.7	296	<0.7
S1312084-058	13AS07	67-183	2.7	361	0.38	15.6	7.48	11100	6.5	355	<0.7
S1312084-059	13AS07	183-305	0.8	67.4	0.28	7.27	3.83	4600	4.6	77.1	<0.7
S1312084-060	13AS07	305-427	1.1	121	0.17	6.42	2.40	4880	3.3	152	<0.7

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
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Report ID: S1312084001

Project: Private Lease Soils - Full List
Date Received: 12/2/2013

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Lab ID	Sample ID	Depths	Total Arsenic	Total Barium	Total Cadmium	Total Chromium	Total Copper	Total Iron	Total Lead	Total Manganese	Total Molybdenum
		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
S1312084-061	13AS07	427-532	1.8	125	0.21	5.08	2.03	4740	3.5	265	<0.7
S1312084-062	13AS07	532-656	3.0	69.1	0.35	6.40	3.17	6810	3.9	149	<0.7
S1312084-063	13AS07	656-732	2.3	69.9	0.34	13.8	8.60	11400	9.2	145	<0.7
S1312084-064	13AS09	0-14	1.4	79.1	0.26	14.2	10.1	11300	8.5	81.4	<0.7
S1312084-065	13AS09	14-46	<0.6	175	0.20	10.2	9.11	10100	8.3	97.0	<0.7

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Report ID: S1312084001

Project: Private Lease Soils - Full List
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Lab ID	Sample ID	Depths	Total Selenium	Total Silver	Total Zinc	Total Mercury	Bulk Density
		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	g/cm³
S1312084-001	12AS019A	0-22	<0.96	<0.5	57.5	<0.2	6.18
S1312084-002	12AS019A	22-43	<0.96	<0.5	37.5	<0.2	2.83
S1312084-003	12AS019A	43-67	<0.96	<0.5	36.9	<0.2	4.05
S1312084-004	12AS019A	67-154	<0.96	<0.5	23.6	<0.2	3.58
S1312084-005	12AS019A	154-242	<0.96	<0.5	17.9	<0.2	2.78
S1312084-006	12AS019A	242-363	<0.96	<0.5	23.7	<0.2	2.98
S1312084-007	12AS019A	363-408	<0.96	<0.5	49.4	<0.2	2.98
S1312084-008	12AS019A	408-548	<0.96	<0.5	36.8	<0.2	3.18
S1312084-009	12AS019A	548-610	<0.96	<0.5	27.9	<0.2	2.64
S1312084-010	12AS019A	610-810	<0.96	<0.5	53.5	<0.2	3.80
S1312084-011	12AS019A	810-852	<0.96	<0.5	19.7	<0.2	3.81
S1312084-012	13AS01	0-18	<0.96	<0.5	91.2	<0.2	6.65
S1312084-013	13AS01	18-45	<0.96	<0.5	48.2	<0.2	4.46
S1312084-014	13AS01	45-106	<0.96	<0.5	46.5	<0.2	
S1312084-015	13AS01	106-180	<0.96	<0.5	29.7	<0.2	
S1312084-016	13AS01	180-213	<0.96	<0.5	19.9	<0.2	
S1312084-017	13AS01	213-320	<0.96	<0.5	45.9	<0.2	2.47
S1312084-018	13AS01	320-475	<0.96	<0.5	23.1	<0.2	2.64
S1312084-019	13AS02	0-10	<0.96	<0.5	52.8	<0.2	3.94
S1312084-020	13AS02	10-42	<0.96	<0.5	43.3	<0.2	2.43

These results apply only to the samples tested.

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Soil Analysis Report

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Project: Private Lease Soils - Full List
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Lab ID	Sample ID	Depths	Total Selenium	Total Silver	Total Zinc	Total Mercury	Bulk Density
		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	g/cm³
S1312084-021	13AS02	42-76	<0.96	<0.5	48.4	<0.2	2.72
S1312084-022	13AS03	0-18	<0.96	<0.5	58.8	<0.2	2.42
S1312084-023	13AS03	18-44	<0.96	<0.5	47.6	<0.2	2.69
S1312084-024	13AS03	44-66	<0.96	<0.5	37.8	<0.2	2.72
S1312084-025	13AS03	66-135	<0.96	<0.5	49.4	<0.2	2.76
S1312084-026	13AS03	135-164	<0.96	<0.5	49.8	<0.2	2.72
S1312084-027	13AS04	0-13	<0.96	<0.5	43.9	<0.2	2.84
S1312084-028	13AS04	13-40	<0.96	<0.5	43.0	<0.2	2.35
S1312084-029	13AS04	40-90	<0.96	<0.5	43.0	<0.2	2.19
S1312084-030	13AS04	90-150	<0.96	<0.5	41.4	<0.2	2.43
S1312084-031	13AS04	150-210	<0.96	<0.5	36.4	<0.2	2.26
S1312084-032	13AS05	0-10	<0.96	<0.5	49.8	<0.2	2.58
S1312084-033	13AS05	10-24	<0.96	<0.5	42.7	<0.2	2.22
S1312084-034	13AS05	24-49	<0.96	<0.5	49.0	<0.2	2.43
S1312084-035	13AS05	49-90	<0.96	<0.5	49.1	<0.2	2.19
S1312084-036	13AS05	90-153	<0.96	<0.5	49.8	<0.2	2.19
S1312084-037	13AS05	153-242	<0.96	<0.5	46.8	<0.2	2.32
S1312084-038	13AS05	242-300	<0.96	<0.5	50.1	<0.2	2.13
S1312084-039	13AS05	300-394	<0.96	<0.5	51.6	<0.2	2.15
S1312084-040	13AS05	394-516	<0.96	<0.5	52.0	<0.2	2.26

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1312084001

Project: Private Lease Soils - Full List
Date Received: 12/2/2013

Date Reported: 3/31/2014
Work Order: S1312084

Lab ID	Sample ID	Depths	Total Selenium	Total Silver	Total Zinc	Total Mercury	Bulk Density
		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	g/cm³
S1312084-041	13AS06	0-13	<0.96	<0.5	51.7	<0.2	3.20
S1312084-042	13AS06	13-38	<0.96	<0.5	49.3	<0.2	2.21
S1312084-043	13AS06	38-68	<0.96	<0.5	48.8	<0.2	2.24
S1312084-044	13AS06	68-112	<0.96	<0.5	57.1	<0.2	2.16
S1312084-045	13AS06	112-170	<0.96	<0.5	49.8	<0.2	2.25
S1312084-046	13AS06	170-245	<0.96	<0.5	47.2	<0.2	2.17
S1312084-047	13AS06	245-315	<0.96	<0.5	57.2	<0.2	2.21
S1312084-048	13AS06	315-396	<0.96	<0.5	48.6	<0.2	2.25
S1312084-049	13AS06	396-457	<0.96	<0.5	51.4	<0.2	2.20
S1312084-050	13AS06	457-579	<0.96	<0.5	50.3	<0.2	2.42
S1312084-051	13AS06	579-632	<0.96	<0.5	48.4	<0.2	2.29
S1312084-052	13AS06	632-770	<0.96	<0.5	12.5	<0.2	
S1312084-053	13AS06	770-838	<0.96	<0.5	20.5	<0.2	2.60
S1312084-054	13AS06	838-884	<0.96	<0.5	30.9	<0.2	2.49
S1312084-055	13AS07	0-19	<0.96	<0.5	40.9	<0.2	2.60
S1312084-056	13AS07	19-46	<0.96	<0.5	51.1	<0.2	2.29
S1312084-057	13AS07	46-67	<0.96	<0.5	42.5	<0.2	2.42
S1312084-058	13AS07	67-183	<0.96	<0.5	30.5	<0.2	3.07
S1312084-059	13AS07	183-305	<0.96	<0.5	19.8	<0.2	5.43
S1312084-060	13AS07	305-427	<0.96	<0.5	15.0	<0.2	2.90

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1312084001

Project: Private Lease Soils - Full List

Date Received: 12/2/2013

Date Reported: 3/31/2014

Work Order: S1312084

Lab ID	Sample ID	Depths	Total Selenium	Total Silver	Total Zinc	Total Mercury	Bulk Density
		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	g/cm³
S1312084-061	13AS07	427-532	<0.96	<0.5	11.7	<0.2	
S1312084-062	13AS07	532-656	<0.96	<0.5	19.4	<0.2	2.71
S1312084-063	13AS07	656-732	<0.96	<0.5	38.6	<0.2	2.69
S1312084-064	13AS09	0-14	<0.96	<0.5	45.5	<0.2	4.55
S1312084-065	13AS09	14-46	<0.96	<0.5	39.1	<0.2	2.68

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

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1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Date: 3/11/2014

CLIENT: Alton Coal Development, LLC
Project: Private Lease Soils - Short List
Lab Order: S1312086

CASE NARRATIVE

Report ID: S1312086001

Samples 13AS08, DP-10, DP-19, and DP-7 were received on December 2, 2013.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1312086001

Project: Private Lease Soils - Short List
Date Received: 12/2/2013

Date Reported: 3/11/2014
Work Order: S1312086

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1312086-001	DP-7	122-165	7.8	61.8	1.43	10.6	35.6	28.4	3.0
S1312086-002	DP-7	165-200	7.7	52.5	2.96	7.9	34.5	22.0	2.5
S1312086-003	DP-7	200-244	7.9	24.1	1.81	1.2			0.7
S1312086-004	DP-10	122-172	8.0	63.3	4.06	11.5	38.2	27.2	2.6
S1312086-005	DP-10	172-244	8.4	23.8	2.52	1.5	20.1	7.7	0.6
S1312086-006	DP-19	122-225	8.2	25.6	0.37	2.1	21.1	7.9	0.8
S1312086-007	DP-19	225-244				0.3			0.4
S1312086-008	13AS08	122-244	8.1	75.8	4.06	19.0	34.9	27.5	1.7
S1312086-009	13AS08	244-366	8.1	66.9	2.27	18.5	31.2	23.8	1.6
S1312086-010	13AS08	366-488	8.0	79.6	4.22	19.2	37.1	28.7	1.7

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
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Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
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Report ID: S1312086001

Project: Private Lease Soils - Short List
Date Received: 12/2/2013

Date Reported: 3/11/2014
Work Order: S1312086

Lab ID	Sample ID	Depths cm	PE Calcium meq/L	PE Magnesium meq/L	PE Potassium meq/L	PE Sodium meq/L	SAR
S1312086-001	DP-7	122-165	22.0	13.5	1.30	12.8	3.04
S1312086-002	DP-7	165-200	23.0	21.2	0.46	10.2	2.16
S1312086-003	DP-7	200-244	11.6	10.7	0.33	5.21	1.56
S1312086-004	DP-10	122-172	15.9	37.2	0.45	15.5	3.01
S1312086-005	DP-10	172-244	4.30	18.1	0.22	9.82	2.93
S1312086-006	DP-19	122-225	1.62	1.35	0.12	0.45	0.37
S1312086-007	DP-19	225-244					
S1312086-008	13AS08	122-244	11.4	23.1	0.54	24.4	5.87
S1312086-009	13AS08	244-366	4.96	8.62	0.44	14.1	5.41
S1312086-010	13AS08	366-488	15.7	26.6	0.59	28.0	6.09

These results apply only to the samples tested.

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1312086001

Project: Private Lease Soils - Short List
Date Received: 12/2/2013

Date Reported: 3/11/2014
Work Order: S1312086

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Boron	Nitrate(as N)	CO3	Selenium
		cm	%	%	%		%	ppm	ppm	%	ppm
S1312086-001	DP-7	122-165	14.0	36.0	50.0	Clay	5.6	1.00	4.9	18.9	<0.02
S1312086-002	DP-7	165-200	22.0	35.0	43.0	Clay	4.4	0.68	0.5	20.1	<0.02
S1312086-003	DP-7	200-244	78.0	10.0	12.0	Sandy Loam	9.6	0.16	0.3	20.6	<0.02
S1312086-004	DP-10	122-172	20.0	32.0	48.0	Clay	5.0	1.43	11.4	22.2	0.06
S1312086-005	DP-10	172-244	66.0	22.0	12.0	Sandy Loam	13.0	0.40	1.1	31.6	<0.02
S1312086-006	DP-19	122-225	54.0	32.0	14.0	Sandy Loam	8.5	0.20	2.1	34.2	<0.02
S1312086-007	DP-19	225-244	82.5	10.0	7.5	Loamy Sand	12.0			18.8	
S1312086-008	13AS08	122-244	10.0	42.0	48.0	Silty Clay	<0.1	1.64	0.9	20.4	<0.02
S1312086-009	13AS08	244-366	16.0	43.0	41.0	Silty Clay	8.0	1.19	2.0	24.3	<0.02
S1312086-010	13AS08	366-488	6.0	37.0	57.0	Silty Clay	0.9	1.12	0.6	22.8	<0.02

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1312086001

Project: Private Lease Soils - Short List

Date Received: 12/2/2013

Date Reported: 3/11/2014

Work Order: S1312086

Lab ID	Sample ID	Depths cm	Total Carbon %	TOC %
S1312086-001	DP-7	122-165	3.3	1.1
S1312086-002	DP-7	165-200	3.1	0.7
S1312086-003	DP-7	200-244	3.0	0.5
S1312086-004	DP-10	122-172	3.7	1.0
S1312086-005	DP-10	172-244	4.7	0.9
S1312086-006	DP-19	122-225	4.7	0.6
S1312086-007	DP-19	225-244	2.5	0.2
S1312086-008	13AS08	122-244	3.2	0.7
S1312086-009	13AS08	244-366	3.5	0.6
S1312086-010	13AS08	366-488	3.6	0.8

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Lab Analysis
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Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 11/26/2012

Report ID: S1211393001
Date Reported: 1/30/2013
Work Order: S1211393

Lab ID	Sample ID	Organic Matter %	Sand %	Silt %	Clay %	Very Fine Sand %	Texture	K-factor (t.ac.h/100acft.tf.in)	Structure s	Permeability p	M
S1211393-001	12AS001 (1-12)	4.9	30.0	39.0	31.0	8.0	Clay Loam	0.17	2	4	3243.0
S1211393-002	12AS001 (12-28)	3.9	24.0	41.0	35.0	5.4	Clay Loam	0.18	2	4	3016.0
S1211393-003	12AS001 (28-56)	3.3	10.0	49.0	41.0	0	Silty Clay	0.24	2	6	2891.0
S1211393-004	12AS001 (56-90)	4.2	16.0	40.0	44.0	6.9	Silty Clay	0.20	2	6	2626.4
S1211393-005	12AS001 (90-122)	1.1	26.0	42.0	32.0	6.4	Clay Loam	0.26	2	4	3291.2
S1211393-006	12AS001 (122-160)	0.6	64.0	24.0	12.0	14.4	Sandy Loam	0.23	2	2	3379.2
S1211393-007	12AS002 (0-9)	2.2	30.0	41.0	29.0	10.4	Clay Loam	0.29	3	4	3649.4
S1211393-008	12AS002 (9-26)	3.3	20.0	46.0	34.0	11.2	Clay Loam	0.28	3	4	3775.2
S1211393-009	12AS002 (26-55)	2.6	24.0	39.0	37.0	13.9	Clay Loam	0.26	3	4	3332.7
S1211393-010	12AS002 (55-87)	2.5	18.0	42.0	40.0	7.7	Silty Clay	0.29	3	6	2982.0
S1211393-011	12AS002 (87-110)	2.7	10.0	52.0	38.0	0.6	Silty Clay Loam	0.28	3	5	3261.2
S1211393-012	12AS003 (0-8)	4.4	24.0	39.0	37.0	5.9	Clay Loam	0.16	2	4	2828.7
S1211393-013	12AS003 (8-34)	2.7	25.0	33.0	42.0	10.5	Clay	0.22	2	6	2523.0
S1211393-014	12AS003 (34-88)	0.5	25.0	53.0	22.0	12.5	Silty Loam	0.41	2	3	5109.0
S1211393-015	12AS003 (88-122)	0.9	27.0	50.0	23.0	10.1	Silty Loam	0.35	2	3	4627.7
S1211393-016	12AS003 (122-155)	1.1	43.0	41.0	16.0	7.0	Loam	0.30	2	3	4032.0
S1211393-017	12AS004 (0-8)	6.4	65.0	15.0	20.0	15.9	Sandy Clay Loam	0.11	2	4	2472.0
S1211393-018	12AS004 (8-22)	1.4	67.0	10.0	23.0	16.7	Sandy Clay Loam	0.16	2	4	2055.9
S1211393-019	12AS004 (22-48)	0.6	77.0	14.0	9.0	10.2	Sandy Loam	0.13	2	2	2202.2
S1211393-020	12AS004 (48-78)	1.3	39.0	34.0	27.0	9.9	Clay Loam	0.25	2	4	3204.7
S1211393-021	12AS005 (0-5)	3.9	17.0	33.0	50.0	5.0	Clay	0.17	2	6	1900.0
S1211393-022	12AS005 (5-35)	2.3	9.0	33.0	58.0	4.5	Silty Clay	0.16	2	6	1575.0
S1211393-023	12AS005 (35-78)	1.1	7.0	29.0	64.0	3.3	Clay	0.15	2	6	1162.8
S1211393-024	12AS007 (0-7)	1.9	47.0	24.0	29.0	11.5	Sandy Clay Loam	0.19	2	4	2520.5
S1211393-025	12AS007 (7-44)	1.8	37.0	27.0	36.0	4.2	Clay Loam	0.15	2	4	1996.8
S1211393-026	12AS007 (44-83)	1.3	67.0	11.0	22.0	16.6	Sandy Clay Loam	0.17	2	4	2152.8
S1211393-027	12AS008 (0-9)	4.0	63.0	20.0	17.0	12.2	Sandy Loam	0.11	2	2	2672.6
S1211393-028	12AS008 (9-23)	2.5	77.0	11.0	12.0	11.4	Sandy Loam	0.09	2	2	1971.2

These Results apply only to the samples tested.

Reviewed by: _____
Karen Secor, Soil Lab Supervisor

Soil Lab Analysis
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Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
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Project ID: Private Lease Soils
Date Received: 1/22/2013

Report ID: S1301365001
Date Reported: 4/9/2013
Work Order: S1301365

Lab ID	Sample ID	Organic Matter %	Sand %	Silt %	Clay %	Very Fine Sand %	Texture	K-factor (t.ac.h/100acft.tf.in)	Structure s	Permeability p	M
S1301365-001	12AS009 (0-7)	4.8	26.0	35.0	39.0	7.1	Clay Loam	0.17	3	4	2568.1
S1301365-002	12AS009 (7-20)	3.4	10.0	46.0	44.0	0.1	Silty Clay	0.25	3	6	2581.6
S1301365-003	12AS009 (20-62)	1.8	<0.1	47.0	53.0	0.1	Silty Clay	0.25	3	6	2213.7
S1301365-004	12AS009 (62-99)	1.3	<0.1	48.0	52.0	0.1	Silty Clay	0.26	3	6	2308.8
S1301365-005	12AS009 (99-137)	0.9	<0.1	53.0	47.0	0.1	Silty Clay	0.27	2	6	2814.3
S1301365-006	12AS009 (137-183)	1.0	<0.1	49.0	51.0	0.1	Silty Clay	0.24	2	6	2405.9
S1301365-007	12AS009 (183-232)	2.3	6.0	58.0	36.0	0.1	Silty Clay Loam	0.32	3	5	3718.4
S1301365-008	12AS010 (0-9)	5.7	10.0	50.0	40.0	0.1	Silty Clay	0.23	3	6	3006.0
S1301365-009	12AS010 (9-31)	2.4	8.0	68.0	24.0	0.1	Silty Loam	0.35	2	3	5175.6
S1301365-010	12AS010 (31-67)	2.1	16.0	50.0	34.0	0.1	Silty Clay Loam	0.26	2	5	3306.6
S1301365-011	12AS010 (67-96)	0.5	66.0	18.0	16.0	17.7	Sandy Loam	0.20	2	2	2998.8
S1301365-012	12AS010 (96-134)	0.5	42.0	36.0	22.0	9.8	Loam	0.27	2	3	3572.4
S1301365-013	12AS010 (134-183)	1.1	20.0	60.0	20.0	10.5	Silty Loam	0.43	2	3	5640.0
S1301365-014	12AS010 (183-200)	0.5	60.0	28.0	12.0	8.8	Sandy Loam	0.22	2	2	3238.4
S1301365-015	12AS010 (200-284)	0.9	<0.1	48.0	52.0	0.1	Silty Clay	0.27	3	6	2308.8
S1301365-016	12AS011 (0-10)	6.1	18.0	41.0	41.0	0.1	Silty Clay	0.16	2	6	2424.9
S1301365-017	12AS011 (10-32)	4.5	18.0	40.0	42.0	0.5	Silty Clay	0.18	2	6	2349.0
S1301365-018	12AS011 (32-71)	1.3	<0.1	61.0	39.0	0.1	Silty Clay Loam	0.31	2	5	3727.1
S1301365-019	12AS011 (71-116)	0.6	<0.1	37.0	63.0	0.1	Clay	0.20	3	6	1372.7
S1301365-020	12AS011 (116-128)	1.0	70.0	18.0	12.0	3.6	Sandy Loam	0.10	2	2	1900.8
S1301365-021	12AS011 (128-154)	1.0	<0.1	25.0	75.0	0.1	Clay	0.14	3	6	627.5
S1301365-022	12AS011 (154-214)	1.3	<0.1	17.0	83.0	0.1	Clay	0.12	3	6	290.7
S1301365-023	12AS012 (0-11)	6.0	<0.1	37.0	63.0	0.1	Clay	0.16	3	6	1372.7
S1301365-024	12AS012 (11-30)	4.1	<0.1	25.0	75.0	0.1	Clay	0.13	3	6	627.5
S1301365-025	12AS012 (30-72)	0.8	<0.1	37.0	63.0	0.1	Clay	0.20	3	6	1372.7

These Results apply only to the samples tested.

Reviewed by:

Karen Secor, Soil Lab Supervisor

Soil Lab Analysis
Inter-Mountain Labs, Inc
1673 Terra Ave, Sheridan, Wyoming, 82801
(307) 672-8945

Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 1/22/2013

Report ID: S1301365001
Date Reported: 4/9/2013
Work Order: S1301365

Lab ID	Sample ID	Organic Matter	Sand	Silt	Clay	Very Fine Sand	Texture	K-factor	Structure	Permeability	M
		%	%	%	%	%		(t.ac.h/100acft.tf.in)	s	p	
S1301365-026	12AS012 (72-116)	0.3	42.0	33.0	25.0	0.1	Loam	0.18	2	3	2482.5
S1301365-027	12AS012 (116-160)	0.3	50.0	32.0	18.0	0.1	Loam	0.19	2	3	2632.2
S1301365-028	12AS012 (160-187)	0.6	50.0	33.0	17.0	0.1	Loam	0.20	2	3	2747.3
S1301365-029	12AS012 (187-230)	0.3	50.0	33.0	17.0	0.1	Loam	0.20	2	3	2747.3
S1301365-030	12AS013 (0-16)	4.4	<0.1	28.0	72.0	0.1	Clay	0.14	3	6	786.8
S1301365-031	12AS013 (16-52)	1.6	<0.1	39.0	61.0	0.1	Clay	0.20	3	6	1524.9
S1301365-032	12AS013 (52-102)	0.9	<0.1	39.0	61.0	0.1	Clay	0.21	3	6	1524.9
S1301365-033	12AS013 (102-114)	0.8	<0.1	27.0	73.0	0.1	Clay	0.18	4	6	731.7
S1301365-034	12AS014 (0-20)	2.5	6.0	43.0	51.0	1.7	Silty Clay	0.24	3	6	2190.3
S1301365-035	12AS014 (20-45)	1.8	6.0	43.0	51.0	2.2	Silty Clay	0.25	3	6	2214.8
S1301365-036	12AS014 (45-66)	1.1	4.0	44.0	52.0	0.3	Silty Clay	0.25	3	6	2126.4
S1301365-037	12AS014 (66-88)	2.0	10.0	37.0	53.0	6.3	Clay	0.23	3	6	2035.1
S1301365-038	12AS014 (88-114)	1.0	6.0	39.0	55.0	2.4	Silty Clay	0.23	3	6	1863.0
S1301365-039	12AS015 (0-20)	3.7	10.0	39.0	51.0	4.4	Clay	0.22	3	6	2126.6
S1301365-040	12AS015 (20-54)	2.4	12.0	32.0	56.0	7.2	Silty Clay	0.21	3	6	1724.8
S1301365-041	12AS015 (54-87)	1.7	10.0	30.0	60.0	5.6	Clay	0.19	3	6	1424.0
S1301365-042	12AS015 (87-119)	1.0	10.0	31.0	59.0	6.1	Silty Clay	0.17	2	6	1521.1
S1301365-083	12AS015 (119-132)	0.8	20.0	32.0	48.0	15.6	Clay	0.28	3	6	2475.2
S1301365-043	12AS016 (0-11)	2.9	22.0	46.0	32.0	13.9	Clay Loam	0.27	2	4	4073.2
S1301365-044	12AS016 (11-40)	1.9	18.0	49.0	33.0	10.2	Silty Clay Loam	0.32	2	5	3966.4
S1301365-045	12AS016 (40-71)	1.3	22.0	37.0	41.0	15.5	Clay	0.32	3	6	3097.5
S1301365-046	12AS016 (71-120)	1.7	22.0	47.0	31.0	13.0	Clay Loam	0.34	3	4	4140.0
S1301365-047	12AS017 (0-13)	3.5	14.0	31.0	55.0	9.2	Silty Clay	0.17	2	6	1809.0
S1301365-048	12AS017 (13-57)	1.9	10.0	23.0	67.0	6.6	Clay	0.19	4	6	976.8
S1301365-049	12AS017 (57-84)	0.3	16.0	31.0	53.0	6.3	Clay	0.23	3	6	1753.1
S1301365-050	12AS017 (84-118)	0.6	18.0	24.0	58.0	4.5	Silty Clay	0.22	4	6	1197.0

These Results apply only to the samples tested.

Reviewed by: Karen Secor

Karen Secor, Soil Lab Supervisor

Soil Lab Analysis
Inter-Mountain Labs, Inc
1673 Terra Ave, Sheridan, Wyoming, 82801
(307) 672-8945

Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 1/22/2013

Report ID: S1301365001
Date Reported: 4/9/2013
Work Order: S1301365

Lab ID	Sample ID	Organic Matter	Sand	Silt	Clay	Very Fine Sand	Texture	K-factor	Structure	Permeability	M
		%	%	%	%	%		(t.ac.h/100acft.tf.in)	s	p	
S1301365-051	12AS017 (118-161)	0.2	16.0	29.0	55.0	8.5	Silty Clay	0.23	3	6	1687.5
S1301365-052	12AS019 (0-12)	5.5	16.0	41.0	43.0	2.3	Silty Clay	0.21	3	6	2468.1
S1301365-053	12AS019 (12-32)	5.8	12.0	41.0	47.0	0.2	Silty Clay	0.19	3	6	2183.6
S1301365-054	12AS019 (32-72)	3.9	10.0	46.0	44.0	0.1	Silty Clay	0.24	3	6	2581.6
S1301365-055	12AS019 (72-100)	1.1	24.0	35.0	41.0	19.1	Clay	0.33	3	6	3191.9
S1301365-056	12AS019 (100-147)	0.4	46.0	35.0	19.0	10.5	Loam	0.28	2	3	3685.5
S1301365-057	12AS019 (147-196)	2.8	44.0	41.0	15.0	11.5	Loam	0.28	2	3	4462.5
S1301365-058	12AS019 (196-240)	0.2	52.0	33.0	15.0	11.1	Sandy Loam	0.27	2	2	3748.5
S1301365-059	12AS023 (0-18)	0.3	50.0	25.0	25.0	5.9	Sandy Clay Loam	0.23	3	4	2317.5
S1301365-060	12AS023 (18-47)	2.9	51.0	25.0	24.0	2.0	Sandy Clay Loam	0.14	2	4	2052.0
S1301365-061	12AS023 (47-78)	3.0	64.0	18.0	18.0	10.7	Sandy Loam	0.11	2	2	2353.4
S1301365-062	12AS023 (78-120)	1.9	60.0	26.0	14.0	0.1	Sandy Loam	0.12	2	2	2244.6
S1301365-063	12AS023 (120-180)	0.7	84.0	8.0	8.0	10.6	Loamy Sand	0.09	2	2	1711.2
S1301365-064	12AS023 (180-230)	0.2	80.0	14.0	6.0	6.8	Loamy Sand	0.11	2	2	1955.2
S1301365-065	12AS025 (0-12)	6.4	22.0	56.0	22.0	7.5	Silty Loam	0.19	2	3	4953.0
S1301365-066	12AS025 (12-30)	3.8	16.0	41.0	43.0	8.1	Silty Clay	0.25	3	6	2798.7
S1301365-067	12AS025 (30-70)	0.7	12.0	56.0	32.0	6.9	Silty Clay Loam	0.38	2	5	4277.2
S1301365-068	12AS025 (70-101)	0.5	32.0	49.0	19.0	27.3	Loam	0.51	2	3	6180.3
S1301365-069	12AS025 (101-123)	0.2	38.0	46.0	16.0	13.8	Loam	0.41	2	3	5023.2
S1301365-070	12AS025 (123-156)	0.7	20.0	44.0	36.0	13.3	Clay Loam	0.33	3	4	3667.2
S1301365-071	12AS025 (156-186)	0.2	58.0	26.0	16.0	16.2	Sandy Loam	0.25	2	2	3544.8
S1301365-072	12AS025 (186-204)	0.1	60.0	32.0	8.0	17.0	Sandy Loam	0.34	2	2	4508.0
S1301365-073	12AS026 (3-20)	7.0	20.0	39.0	41.0	7.7	Clay	0.20	3	6	2755.3
S1301365-074	12AS026 (20-65)	1.9	20.0	47.0	33.0	3.9	Clay Loam	0.28	3	4	3410.3
S1301365-075	12AS026 (65-104)	2.0	30.0	31.0	39.0	6.4	Clay Loam	0.17	2	4	2281.4
S1301365-076	12AS026 (104-144)	2.3	10.0	41.0	49.0	2.2	Silty Clay	0.24	3	6	2203.2

These Results apply only to the samples tested.

Reviewed by: Karen Secor

Karen Secor, Soil Lab Supervisor

Soil Lab Analysis
Inter-Mountain Labs, Inc
1673 Terra Ave, Sheridan, Wyoming, 82801
(307) 672-8945

Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 1/22/2013

Report ID: S1301365001
Date Reported: 4/9/2013
Work Order: S1301365

Lab ID	Sample ID	Organic Matter	Sand	Silt	Clay	Very Fine Sand	Texture	K-factor	Structure	Permeability	M
		%	%	%	%	%		(t.ac.h/100acft.tf.in)	s	p	
S1301365-077	12AS026 (144-202)	1.2	20.0	37.0	43.0	15.5	Clay	0.32	3	6	2992.5
S1301365-078	12AS030 (0-15)	2.5	12.0	35.0	53.0	7.9	Clay	0.22	3	6	2016.3
S1301365-079	12AS030 (15-30)	1.9	16.0	30.0	54.0	11.9	Clay	0.23	3	6	1927.4
S1301365-080	12AS030 (30-42)	1.8	14.0	32.0	54.0	10.0	Clay	0.26	4	6	1932.0
S1301365-081	12AS030 (42-67)	1.9	10.0	36.0	54.0	6.2	Clay	0.26	4	6	1941.2
S1301365-082	12AS030 (67-95)	1.9	10.0	34.0	56.0	6.2	Silty Clay	0.21	3	6	1768.8

These Results apply only to the samples tested.

Reviewed by: Karen Secor

Karen Secor, Soil Lab Supervisor

Soil Lab Analysis
Inter-Mountain Labs, Inc
1673 Terra Ave, Sheridan, Wyoming, 82801
(307) 672-8945

Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 1/22/2013

Report ID: S1301363001
Date Reported: 4/9/2013
Work Order: S1301363

Lab ID	Sample ID	Organic Matter %	Sand %	Silt %	Clay %	Very Fine Sand %	Texture	K-factor (t.ac.h/100acft.tf.in)	Structure s	Permeability p	M
S1301363-001	12AS018 (0-22)	5.6	26.0	38.0	36.0	9.4	Clay Loam	0.18	3	4	3033.6
S1301363-002	12AS018 (22-68)	1.9	26.0	42.0	32.0	7.3	Clay Loam	0.28	3	4	3352.4
S1301363-003	12AS018 (68-115)	1.3	8.0	48.0	44.0	4.0	Silty Clay	0.31	3	6	2912.0
S1301363-004	12AS018 (115-148)	1.2	18.0	42.0	40.0	12.3	Silty Clay	0.34	3	6	3258.0
S1301363-005	12AS018 (148-244)	0.5	60.0	28.0	12.0	17.2	Sandy Loam	0.28	2	2	3977.6
S1301363-006	12AS020 (0-13)	7.4	20.0	49.0	31.0	3.3	Clay Loam	0.13	2	4	3608.7
S1301363-007	12AS020 (13-30)	4.2	12.0	51.0	37.0	2.1	Silty Clay Loam	0.25	3	5	3345.3
S1301363-008	12AS020 (30-80)	2.8	10.0	50.0	40.0	1.8	Silty Clay	0.29	3	6	3108.0
S1301363-009	12AS020 (80-11)	0.9	8.0	51.0	41.0	2.4	Silty Clay	0.30	2	6	3150.6
S1301363-010	12AS020 (111-140)	1.2	10.0	54.0	36.0	5.2	Silty Clay Loam	0.32	2	5	3788.8
S1301363-011	12AS020 (140-175)	1.1	10.0	64.0	26.0	4.8	Silty Loam	0.42	3	3	5091.2
S1301363-012	12AS021 (0-9)	5.1	24.0	41.0	35.0	10.9	Clay Loam	0.21	3	4	3373.5
S1301363-013	12AS021 (9-32)	3.9	22.0	45.0	33.0	10.7	Clay Loam	0.26	3	4	3731.9
S1301363-014	12AS021 (32-65)	2.7	22.0	46.0	32.0	8.3	Clay Loam	0.29	3	4	3692.4
S1301363-015	12AS021 (65-95)	0.7	32.0	56.0	12.0	15.5	Silty Loam	0.54	3	3	6292.0
S1301363-016	12AS021 (95-150)	1.1	52.0	36.0	12.0	9.6	Sandy Loam	0.27	2	2	4012.8
S1301363-017	12AS021 (150-202)	0.9	82.0	15.0	3.0	18.3	Loamy Sand	0.21	2	2	3230.1
S1301363-018	12AS021 (202-230)	0.4	82.0	16.0	2.0	12.5	Loamy Sand	0.18	2	2	2793.0
S1301363-019	12AS022 (0-12)	0.7	84.0	14.0	2.0	12.5	Loamy Sand	0.19	3	2	2597.0
S1301363-020	12AS022 (12-50)	0.3	90.0	8.0	2.0	8.5	Sand	0.09	3	1	1617.0
S1301363-021	12AS022 (50-87)	0.4	86.0	12.0	2.0	6.9	Sand	0.08	2	1	1852.2
S1301363-022	12AS022 (87-126)	0.3	90.0	9.0	1.0	4.9	Sand	0.04	2	1	1376.1
S1301363-023	12AS022 (126-160)	1.0	82.0	15.0	3.0	9.9	Loamy Sand	0.17	3	2	2415.3
S1301363-024	12AS022 (160-210)	0.5	84.0	14.0	2.0	11.3	Loamy Sand	0.15	2	2	2479.4
S1301363-025	12AS022 (210-232)	2.5	80.0	16.0	4.0	17.2	Loamy Sand	0.15	2	1	3187.2

These Results apply only to the samples tested.

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Lab Analysis
Inter-Mountain Labs, Inc
1673 Terra Ave, Sheridan, Wyoming, 82801
(307) 672-8945

Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 1/22/2013

Report ID: S1301363001
Date Reported: 4/9/2013
Work Order: S1301363

Lab ID	Sample ID	Organic Matter	Sand	Silt	Clay	Very Fine Sand	Texture	K-factor	Structure	Permeability	M
		%	%	%	%	%		(t.ac.h/100acft.tf.in)	s	p	
S1301363-026	12AS024 (0-18)	0.3	74.0	20.0	6.0	2.2	Sandy Loam	0.16	3	2	2086.8
S1301363-027	12AS024 (18-84)	0.3	80.0	18.0	2.0	6.4	Loamy Sand	0.18	3	2	2391.2
S1301363-028	12AS024 (84-136)	0.3	88.0	10.0	2.0	9.5	Sand	0.12	3	1	1911.0
S1301363-029	12AS024 (136-186)	1.3	84.0	14.0	2.0	8.3	Loamy Sand	0.15	3	2	2185.4
S1301363-030	12AS024 (186-233)	0.4	88.0	11.0	1.0	8.8	Sand	0.09	2	1	1960.2
S1301363-031	12AS027 (0-20)	5.5	24.0	36.0	40.0	13.6	Clay	0.20	2	6	2976.0
S1301363-032	12AS027 (20-52)	5.0	24.0	40.0	36.0	10.0	Clay Loam	0.17	2	4	3200.0
S1301363-033	12AS027 (52-100)	3.6	26.0	36.0	38.0	7.4	Clay Loam	0.20	3	4	2690.8
S1301363-034	12AS027 (100-116)	2.1	34.0	30.0	36.0	12.0	Clay Loam	0.23	3	4	2688.0
S1301363-035	12AS027 (116-156)	1.7	12.0	50.0	38.0	5.7	Silty Clay Loam	0.28	2	5	3453.4
S1301363-036	12AS027 (156-170)	1.2	6.0	54.0	40.0	2.5	Silty Clay	0.31	2	6	3390.0
S1301363-037	12AS028 (0-12)	5.9	18.0	38.0	44.0	5.8	Clay	0.20	3	6	2452.8
S1301363-038	12AS028 (12-25)	4.0	18.0	43.0	39.0	7.9	Silty Clay Loam	0.24	3	5	3104.9
S1301363-039	12AS028 (25-68)	1.6	10.0	46.0	44.0	4.8	Silty Clay	0.30	3	6	2844.8
S1301363-040	12AS028 (68-103)	0.4	52.0	36.0	12.0	17.2	Sandy Loam	0.38	3	2	4681.6
S1301363-041	12AS028 (103-128)	1.0	12.0	56.0	32.0	6.3	Silty Clay Loam	0.40	3	5	4236.4
S1301363-042	12AS028 (128-157)	1.4	12.0	46.0	42.0	2.4	Silty Clay	0.26	2	6	2807.2
S1301363-043	12AS028 (157-173)	0.9	48.0	40.0	12.0	11.7	Loam	0.34	2	3	4549.6
S1301363-044	12AS029 (0-14)	5.0	46.0	24.0	30.0	27.5	Sandy Clay Loam	0.19	2	4	3605.0
S1301363-045	12AS029 (14-36)	2.4	32.0	30.0	38.0	7.1	Clay Loam	0.19	3	4	2300.2
S1301363-046	12AS029 (36-58)	2.1	12.0	40.0	48.0	0.1	Silty Clay	0.23	3	6	2085.2
S1301363-047	12AS029 (58-86)	5.1	2.0	40.0	58.0	0.1	Clay	0.14	2	6	1684.2
S1301363-048	12AS029 (86-118)	1.6	8.0	34.0	58.0	3.3	Silty Clay	0.17	2	6	1566.6
S1301363-049	12AS029 (118-173)	1.0	6.0	56.0	38.0	0.7	Silty Clay Loam	0.34	3	5	3515.4
S1301363-050	12AS029 (173-232)	1.1	8.0	40.0	52.0	4.1	Silty Clay	0.22	2	6	2116.8
S1301363-051	12AS029 (232-244)	1.1	44.0	24.0	32.0	3.1	Clay Loam	0.15	2	4	1842.8

These Results apply only to the samples tested.

Reviewed by: Karen Secor

Karen Secor, Soil Lab Supervisor

Soil Lab Analysis
Inter-Mountain Labs, Inc
1673 Terra Ave, Sheridan, Wyoming, 82801
(307) 672-8945

Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 4/11/2013

Report ID: S1304177001
Date Reported: 5/31/2013
Work Order: S1304177

Lab ID	Sample ID	Organic Matter %	Sand %	Silt %	Clay %	Very Fine Sand %	Texture	K-factor (t.ac.h/100acft.tf.in)	Structure s	Permeability p	M
S1304177-001	DP-17 (0-20)	2.9	28.0	34.0	38.0	11.1	Clay Loam	0.15	1	4	2796.2
S1304177-002	DP-17 (20-32)	2.3	30.0	29.0	41.0	10.8	Clay	0.22	2	6	2348.2
S1304177-003	DP-17 (32-54)	2.0	28.0	28.0	44.0	11.7	Clay	0.21	2	6	2223.2
S1304177-004	DP-17 (54-122)	2.3	22.0	32.0	46.0	10.0	Clay	0.21	2	6	2268.0
S1304177-005	DP-17 (122-170)	1.9	16.0	34.0	50.0	4.7	Clay	0.23	3	6	1935.0
S1304177-006	DP-29 (0-24)	5.2	20.0	38.0	42.0	3.3	Clay	0.18	2	6	2395.4
S1304177-007	DP-29 (24-52)	4.1	18.0	38.0	44.0	6.0	Clay	0.23	3	6	2464.0
S1304177-008	DP-29 (52-72)	1.4	50.0	32.0	18.0	10.4	Loam	0.27	3	3	3476.8
S1304177-009	DP-29 (72-97)	2.4	10.0	46.0	44.0	0.1	Silty Clay	0.26	3	6	2581.6
S1304177-010	DP-29 (97-155)	1.3	4.0	52.0	44.0	0.1	Silty Clay	0.31	3	6	2917.6
S1304177-011	DP-29 (155-210)	1.2	10.0	44.0	46.0	6.7	Silty Clay	0.30	3	6	2737.8
S1304177-012	DP-29 (210-266)	1.0	14.0	40.0	46.0	3.3	Silty Clay	0.30	4	6	2338.2
S1304177-013	DP-29 (266-345)	1.5	6.0	44.0	50.0	2.5	Silty Clay	0.29	4	6	2325.0
S1304177-014	DP-29 (345-365)	1.0	17.5	37.5	45.0	13.2	Clay	0.34	4	6	2788.5

These Results apply only to the samples tested.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Soil Lab Analysis
Inter-Mountain Labs, Inc
1673 Terra Ave, Sheridan, Wyoming, 82801
(307) 672-8945

Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 4/11/2013

Report ID: S1304178001
Date Reported: 5/29/2013
Work Order: S1304178

Lab ID	Sample ID	Organic Matter %	Sand %	Silt %	Clay %	Very Fine Sand %	Texture	K-factor (t.ac.h/100acft.tf.in)	Structure s	Permeability p	M
S1304178-001	DP-16 (0-18)	2.9	36.0	28.0	36.0	18.2	Clay Loam	0.20	2	4	2956.8
S1304178-002	DP-16 (18-43)	1.8	24.0	32.0	44.0	13.4	Clay	0.24	2	6	2542.4
S1304178-003	DP-16 (43-70)	2.1	18.0	36.0	46.0	9.0	Clay	0.23	2	6	2430.0
S1304178-004	DP-16 (70-102)	2.9	22.0	30.0	48.0	14.4	Clay	0.21	2	6	2308.8
S1304178-005	DP-28 (0-14)	3.6	20.0	34.0	46.0	10.3	Clay	0.20	2	6	2392.2
S1304178-006	DP-28 (14-38)	2.3	10.0	38.0	52.0	5.0	Clay	0.20	2	6	2064.0
S1304178-007	DP-28 (38-62)	1.7	10.0	35.0	55.0	5.8	Silty Clay	0.22	3	6	1836.0
S1304178-008	DP-28 (62-100)	2.0	20.0	44.0	36.0	10.6	Clay Loam	0.29	3	4	3494.4
S1304178-009	DP-28 (100-120)	2.3	12.0	44.0	44.0	1.1	Silty Clay	0.26	3	6	2525.6
S1304178-010	DP-28 (120-140)	1.7	14.0	34.0	52.0	4.6	Clay	0.22	3	6	1852.8
S1304178-011	DP-04 (0-20)	2.7	30.0	42.0	28.0	6.6	Clay Loam	0.24	2	4	3499.2
S1304178-012	DP-04 (20-46)	2.3	30.0	38.0	32.0	10.3	Clay Loam	0.23	2	4	3284.4
S1304178-013	DP-04 (46-90)	2.4	36.0	32.0	32.0	12.3	Clay Loam	0.21	2	4	3012.4
S1304178-014	DP-04 (90-153)	2.3	38.0	34.0	28.0	8.0	Clay Loam	0.21	2	4	3024.0
S1304178-015	DP-04 (153-232)	0.9	66.0	24.0	10.0	11.0	Sandy Loam	0.17	1	2	3150.0
S1304178-016	DP-05 (0-35)	2.6	20.0	42.0	38.0	8.4	Clay Loam	0.22	2	4	3124.8
S1304178-017	DP-05 (35-70)	2.5	18.0	39.0	43.0	9.5	Clay	0.27	3	6	2764.5
S1304178-018	DP-05 (70-162)	1.8	16.0	39.0	45.0	9.1	Clay	0.28	3	6	2645.5

These Results apply only to the samples tested.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Soil Lab Analysis
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Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 7/30/2013

Report ID: S1307417001
Date Reported: 10/15/2013
Work Order: S1307417

Lab ID	Sample ID	Organic Matter %	Sand %	Silt %	Clay %	Very Fine Sand %	Texture	K-factor (t.ac.h/100acft.tf.in)	Structure s	Permeability p	M
S1307417-001	12AS009 (232-230)	1.0	60.0	30.0	10.0	2.7	Sandy Loam	0.15	1	2	2943.0
S1307417-002	12AS009 (320-366)	1.2	56.0	32.4	11.6	7.3	Sandy Loam	0.22	2	2	3509.5
S1307417-003	12AS009 (366-514)	1.1	66.0	26.0	8.0	7.5	Sandy Loam	0.16	1	2	3082.0
S1307417-004	12AS018 (244-318)	0.2	80.0	14.0	6.0	6.5	Loamy Sand	0.08	1	2	1927.0
S1307417-006	12AS018 (318-388)	2.2	<0.1	53.0	47.0	0.1	Silty Clay	0.28	3	6	2814.3
S1307417-007	12AS018 (406-572)	1.4	28.0	51.0	21.0	2.0	Silty Loam	0.30	2	3	4187.0
S1307417-008	12AS018 (572-640)	3.0	14.0	54.0	32.0	3.9	Silty Clay Loam	0.32	3	5	3937.2
S1307417-009	12AS018 (640-732)	1.8	16.0	44.0	40.0	0.1	Silty Clay	0.28	3	6	2646.0
S1307417-010	12AS020 (175-300)	1.1	38.0	40.0	22.0	2.2	Loam	0.23	2	3	3291.6
S1307417-011	12AS020 (300-488)	1.0	56.0	30.0	14.0	5.9	Sandy Loam	0.23	3	2	3087.4
S1307417-012	12AS020 (488-600)	1.1	32.0	48.0	20.0	10.2	Loam	0.38	3	3	4656.0
S1307417-013	12AS021 (260-374)	1.9	<0.1	59.0	41.0	0.1	Silty Clay	0.37	4	6	3486.9
S1307417-014	12AS021 (374-448)	1.4	73.0	21.0	6.0	4.7	Sandy Loam	0.14	2	2	2415.8
S1307417-015	12AS021 (448-524)	1.5	75.0	19.0	6.0	0.1	Sandy Loam	0.09	2	2	1795.4
S1307417-016	12AS021 (524-570)	2.3	31.0	52.0	17.0	9.5	Silty Loam	0.38	3	3	5104.5
S1307417-017	12AS021 (570-660)	2.6	37.0	37.0	26.0	3.3	Loam	0.21	3	3	2982.2
S1307417-018	12AS021 (660-742)	1.2	73.0	17.0	10.0	5.9	Sandy Loam	0.11	2	2	2061.0
S1307417-019	12AS021 (742-853)	0.8	81.0	13.0	6.0	2.5	Loamy Sand	0.07	2	2	1457.0
S1307417-020	12AS024 (243-305)	0.7	80.0	12.0	8.0	7.0	Loamy Sand	0.13	3	2	1748.0
S1307417-021	12AS027 (170-305)	1.7	<0.1	52.0	48.0	0.1	Silty Clay	0.32	4	6	2709.2
S1307417-022	12AS027 (305-427)	1.5	12.0	39.0	49.0	0.1	Clay	0.27	4	6	1994.1
S1307417-023	12AS027 (427-560)	1.4	4.0	37.0	59.0	0.1	Silty Clay	0.20	3	6	1521.1
S1307417-024	12AS027 (560-625)	0.9	46.0	32.0	22.0	8.3	Loam	0.26	3	3	3143.4
S1307417-025	12AS027 (625-792)	0.6	64.0	26.0	10.0	7.2	Sandy Loam	0.19	2	2	2988.0
S1307417-026	12AS028 (173-235)	0.6	50.0	38.0	12.0	10.2	Loam	0.29	1	3	4241.6
S1307417-027	12AS028 (235-275)	1.0	72.0	18.0	10.0	7.4	Sandy Loam	0.10	1	2	2286.0
S1307417-028	12AS028 (275-325)	3.3	72.0	20.0	8.0	7.0	Sandy Loam	0.11	2	2	2484.0

These Results apply only to the samples tested

Reviewed by: Karen Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs, Inc
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Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 7/30/2013

Report ID: S1307417001
Date Reported: 10/15/2013
Work Order: S1307417

Lab ID	Sample ID	Organic Matter	Sand	Silt	Clay	Very Fine Sand	Texture	K-factor	Structure	Permeability	M
		%	%	%	%	%		(t.ac.h/100acft.tf.in)	s	p	
S1307417-029	12AS028 (325-460)	3.3	28.0	46.0	26.0	5.6	Loam	0.25	3	3	3818.4
S1307417-030	12AS028 (460-610)	1.7	54.0	32.0	14.0	4.9	Sandy Loam	0.22	3	2	3173.4
S1307417-031	12AS029 (244-334)	1.1	62.0	24.0	14.0	1.9	Sandy Loam	0.13	2	2	2227.4
S1307417-032	12AS029 (334-500)	0.6	4.0	40.0	56.0	0.1	Clay	0.20	2	6	1764.4
S1307417-033	12AS029 (500-610)	0.6	64.0	16.0	20.0	59.6	Sandy Clay Loam	0.55	3	4	6048.0
S1307417-034	DP-12 (0-28)	1.5	58.0	25.0	17.0	11.1	Sandy Loam	0.15	1	2	2996.3
S1307417-035	DP-12 (28-62)	4.6	50.0	35.0	15.0	2.4	Loam	0.12	1	3	3179.0
S1307417-036	DP-12 (62-126)	1.6	66.0	12.0	22.0	23.9	Sandy Clay Loam	0.21	2	4	2800.2
S1307417-037	DP-12 (126-183)	0.8	52.0	26.0	22.0	0.1	Sandy Clay Loam	0.20	3	4	2035.8
S1307417-038	DP-12 (183-244)	0.1	50.0	28.0	22.0	18.4	Loam	0.35	4	3	3619.2
S1307417-039	DP-21 (140-188)	0.9	11.0	41.0	48.0	0.9	Silty Clay	0.29	4	6	2178.8
S1307417-040	DP-21 (188-260)	2.7	11.0	40.0	49.0	2.2	Silty Clay	0.26	4	6	2152.2
S1307417-041	DP-21 (260-360)	2.2	7.0	39.0	54.0	0.1	Clay	0.25	4	6	1798.6
S1307417-042	DP-22 (120-180)	1.9	<0.1	39.0	61.0	0.1	Clay	0.23	4	6	1524.9
S1307417-043	DP-22 (180-240)	1.6	5.0	39.0	56.0	0.6	Silty Clay	0.25	4	6	1742.4
S1307417-044	DP-24 (22-40)	1.2	15.0	41.0	44.0	3.4	Silty Clay	0.28	3	6	2486.4
S1307417-045	DP-24 (40-65)	4.4	15.0	39.0	46.0	4.9	Clay	0.22	3	6	2370.6
S1307417-046	DP-24 (65-126)	3.5	13.0	39.0	48.0	3.0	Clay	0.22	3	6	2184.0
S1307417-047	DP-24 (126-244)	3.6	15.0	35.0	50.0	6.7	Clay	0.25	4	6	2085.0
S1307417-048	DP-26 (0-15)	2.3	15.0	43.0	42.0	3.9	Silty Clay	0.28	3	6	2720.2
S1307417-049	DP-26 (15-32)	4.9	9.0	47.0	44.0	0.9	Silty Clay	0.23	3	6	2682.4
S1307417-050	DP-26 (32-59)	4.4	3.0	49.0	48.0	0.1	Silty Clay	0.20	2	6	2553.2
S1307417-051	DP-26 (59-90)	2.0	1.0	51.0	48.0	0.1	Silty Clay	0.24	2	6	2657.2
S1307417-052	DP-26 (90-148)	1.7	<0.1	64.0	36.0	0.1	Silty Clay Loam	0.33	2	5	4102.4
S1307417-053	DP-26 (148-230)	1.2	35.0	45.0	20.0	6.8	Loam	0.30	2	3	4144.0
S1307417-054	DP-26 (230-294)	0.5	55.0	31.0	14.0	15.2	Sandy Loam	0.25	1	2	3973.2
S1307417-055	DP-26 (294-350)	0.5	69.0	23.0	8.0	10.4	Sandy Loam	0.20	2	2	3072.8

These Results apply only to the samples tested.

Reviewed by: Karen Secor

Karen Secor, Soil Lab Supervisor

Soil Lab Analysis
Inter-Mountain Labs, Inc
1673 Terra Ave, Sheridan, Wyoming, 82801
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Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 7/30/2013

Report ID: S1307425001
Date Reported: 10/15/2013
Work Order: S1307425

Lab ID	Sample ID	Organic Matter %	Sand %	Silt %	Clay %	Very Fine Sand %	Texture	K-factor (t.ac.h/100acft.tf.in)	Structure s	Permeability p	M
S1307425-001	12AS009 (514-610)	1.2	35.0	50.0	15.0	16.5	Silty Loam	0.43	2	3	5652.5
S1307425-002	12AS018 (388-406)	0.9	73.8	15.0	11.3	6.8	Sandy Loam	0.11	2	2	1933.7
S1307425-003	DP-21 (0-33)	4.0	23.8	37.5	38.8	6.5	Clay Loam	0.16	2	4	2692.8
S1307425-004	DP-21 (33-140)	2.6	26.3	35.0	38.8	12.5	Clay Loam	0.20	2	4	2907.0
S1307425-005	DP-22 (0-28)	3.3	7.5	40.0	52.5	0.1	Silty Clay	0.21	3	6	1904.8
S1307425-006	DP-22 (28-50)	2.2	8.8	33.8	57.5	1.5	Silty Clay	0.19	3	6	1500.3
S1307425-007	DP-22 (50-120)	1.8	2.5	50.0	47.5	0.1	Silty Clay	0.28	3	6	2630.3
S1307425-008	DP-25 (0-16)	6.2	18.8	41.3	40.0	5.7	Silty Clay	0.21	3	6	2820.0
S1307425-009	DP-25 (16-28)	4.0	15.0	41.3	43.8	2.5	Silty Clay	0.23	3	6	2461.6
S1307425-010	DP-25 (28-54)	3.3	11.3	41.3	47.5	1.6	Silty Clay	0.23	3	6	2252.3
S1307425-011	DP-25 (54-75)	3.7	18.8	38.8	42.5	0.1	Clay	0.22	3	6	2236.8
S1307425-012	DP-25 (75-144)	2.0	36.3	31.3	32.5	3.2	Clay Loam	0.17	2	4	2328.8
S1307425-013	DP-25 (144-208)	1.0	72.5	15.0	12.5	4.0	Sandy Loam	0.08	2	2	1662.5
S1307425-014	DP-27 (0-22)	5.3	13.8	43.8	42.5	2.2	Silty Clay	0.22	3	6	2645.0
S1307425-015	DP-27 (22-40)	3.9	3.8	47.5	48.8	0.1	Silty Clay	0.20	2	6	2437.1
S1307425-016	DP-27 (40-80)	4.1	8.8	46.3	45.0	1.3	Silty Clay	0.24	3	6	2618.0
S1307425-017	DP-27 (80-152)	2.4	<0.1	52.5	47.5	0.1	Silty Clay	0.28	3	6	2761.5
S1307425-018	DP-27 (152-224)	1.1	6.3	58.8	35.0	0.1	Silty Clay Loam	0.33	2	5	3828.5
S1307425-019	DP-27 (224-310)	1.2	6.3	61.3	32.5	0.1	Silty Clay Loam	0.35	2	5	4144.5
S1307425-020	DP-27 (310-350)	1.6	32.5	35.0	32.5	7.1	Clay Loam	0.25	3	4	2841.8
S1307425-021	DP-27 (350-396)	1.2	46.3	31.3	22.5	4.8	Loam	0.19	2	3	2797.8
S1307425-022	DP-27 (396-488)	1.6	7.5	25.0	67.5	2.6	Clay	0.19	4	6	897.0

These Results apply only to the samples tested.

Reviewed by: Karen Secor

Karen Secor, Soil Lab Supervisor

Soil Lab Analysis
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Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 12/2/2013

Report ID: S1312084001
Date Reported: 4/3/2014
Work Order: S1312084

Lab ID	Sample ID	Organic Matter %	Sand %	Silt %	Clay %	Very Fine Sand %	Texture	K-factor (t.ac.h/100acft.tf.in)	Structure s	Permeability p	M
S1312084-001	12AS019A(0-22)	3.6	10.0	43.8	46.3	0.1	Silty Clay	0.20	2	6	2357.4
S1312084-002	12AS019 (22-43)	1.1	8.8	38.8	52.5	2.7	Clay	0.21	2	6	1971.3
S1312084-003	12AS019A(43-67)	1.0	6.3	43.8	50.0	0.3	Silty Clay	0.22	2	6	2205.0
S1312084-004	12AS019A(67-154)	0.6	37.0	42.0	21.0	26.5	Loam	0.40	1	3	5411.5
S1312084-005	12AS019A(154-242)	0.4	63.0	28.0	9.0	34.6	Sandy Loam	0.41	1	2	5696.6
S1312084-006	12AS019A(242-363)	1.2	58.0	31.0	11.0	26.3	Sandy Loam	0.32	1	2	5099.7
S1312084-007	12AS019A(363-408)	2.6	18.0	43.0	39.0	13.2	Silty Clay Loam	0.29	3	5	3428.2
S1312084-008	12AS019A(408-548)	1.0	38.0	42.0	20.0	29.0	Loam	0.44	2	3	5680.0
S1312084-009	12AS019A(548-610)	1.1	59.0	32.0	9.0	34.5	Sandy Loam	0.41	1	2	6051.5
S1312084-010	12AS019A(610-810)	2.9	26.0	40.0	34.0	21.3	Clay Loam	0.30	3	4	4045.8
S1312084-011	12AS019A(810-852)	0.5	86.0	9.0	5.0	28.2	Loamy Sand	0.21	1	2	3534.0
S1312084-012	13AS01(0-18)	6.0	24.0	35.0	41.0	17.9	Clay	0.20	2	6	3121.1
S1312084-013	13AS01(18-45)	2.3	24.0	33.0	43.0	19.6	Clay	0.26	2	6	2998.2
S1312084-014	13AS01(45-106)	1.4	24.0	37.0	39.0	19.1	Clay Loam	0.26	2	4	3422.1
S1312084-015	13AS01(106-180)	0.5	39.0	40.0	21.0	25.0	Loam	0.38	1	3	5135.0
S1312084-016	13AS01(180-213)	0.4	70.0	20.0	10.0	11.5	Sandy Loam	0.15	1	2	2835.0
S1312084-017	13AS01(213-320)	0.9	36.0	24.0	40.0	32.2	Clay	0.32	2	6	3372.0
S1312084-018	13AS01(320-475)	0.6	44.0	32.0	24.0	34.5	Loam	0.40	2	3	5054.0
S1312084-019	13AS02(0-10)	2.4	38.0	31.0	31.0	25.7	Clay Loam	0.28	2	4	3912.3
S1312084-020	13AS02(10-42)	1.8	32.0	36.0	32.0	22.7	Clay Loam	0.33	3	4	3991.6
S1312084-021	13AS02(42-76)	1.9	34.0	32.0	34.0	28.9	Clay Loam	0.33	3	4	4019.4
S1312084-022	13AS03(0-18)	2.6	36.0	31.0	33.0	27.2	Clay Loam	0.30	3	4	3899.4
S1312084-023	13AS03(18-44)	1.6	36.0	30.0	34.0	25.1	Clay Loam	0.31	3	4	3636.6
S1312084-024	13AS03(44-66)	1.4	38.0	26.0	36.0	27.5	Clay Loam	0.30	3	4	3424.0
S1312084-025	13AS03(66-135)	1.3	38.0	27.0	35.0	25.3	Clay Loam	0.30	3	4	3399.5

These Results apply only to the samples tested.

Reviewed by: Karen Secor

Karen Secor, Soil Lab Supervisor

Soil Lab Analysis
Inter-Mountain Labs, Inc
1673 Terra Ave, Sheridan, Wyoming, 82801
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Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 12/2/2013

Report ID: S1312084001
Date Reported: 4/3/2014
Work Order: S1312084

Lab ID	Sample ID	Organic Matter	Sand	Silt	Clay	Very Fine Sand	Texture	K-factor	Structure	Permeability	M
		%	%	%	%	%		(t.ac.h/100acft.tf.in)	s	p	
S1312084-026	13AS03(135-164)	1.0	38.0	26.0	36.0	26.3	Clay Loam	0.30	3	4	3347.2
S1312084-027	13AS04(0-13)	2.7	50.0	27.0	23.0	25.5	Sandy Clay Loam	0.28	2	4	4042.5
S1312084-028	13AS04(13-40)	2.3	48.0	25.0	27.0	28.6	Sandy Clay Loam	0.31	3	4	3912.8
S1312084-029	13AS04(40-90)	1.8	42.0	27.0	31.0	28.7	Clay Loam	0.32	3	4	3843.3
S1312084-030	13AS04(90-150)	1.4	40.0	28.0	32.0	28.6	Clay Loam	0.33	3	4	3848.8
S1312084-031	13AS04(150-210)	1.0	46.0	24.0	30.0	31.3	Sandy Clay Loam	0.34	3	4	3871.0
S1312084-032	13AS05(0-10)	2.5	34.0	31.0	35.0	24.9	Clay Loam	0.25	2	4	3633.5
S1312084-033	13AS05(10-24)	2.4	34.0	28.0	38.0	26.5	Clay Loam	0.27	3	4	3379.0
S1312084-034	13AS05(24-49)	2.4	28.0	33.0	39.0	21.0	Clay Loam	0.26	3	4	3294.0
S1312084-035	13AS05(49-90)	2.8	32.0	29.0	39.0	25.5	Clay Loam	0.26	3	4	3324.5
S1312084-036	13AS05(90-153)	1.7	10.0	37.0	53.0	4.5	Clay	0.23	3	6	1950.5
S1312084-037	13AS05(153-242)	1.4	32.0	18.0	50.0	24.2	Clay	0.21	2	6	2110.0
S1312084-038	13AS05(242-300)	1.4	10.0	37.0	53.0	5.3	Clay	0.24	3	6	1988.1
S1312084-039	13AS05(300-394)	1.2	14.0	35.0	51.0	8.4	Clay	0.25	3	6	2126.6
S1312084-040	13AS05(394-516)	1.1	40.0	14.0	46.0	34.7	Clay	0.29	3	6	2629.8
S1312084-041	13AS06(0-13)	4.6	23.0	38.0	39.0	8.5	Clay Loam	0.19	3	4	2836.5
S1312084-042	13AS06(13-38)	2.7	46.0	12.0	42.0	36.3	Sandy Clay	0.25	3	5	2801.4
S1312084-043	13AS06(38-68)	1.7	16.0	37.0	47.0	8.7	Clay	0.26	3	6	2422.1
S1312084-044	13AS06(68-112)	1.8	16.0	33.0	51.0	10.5	Clay	0.24	3	6	2131.5
S1312084-045	13AS06(112-170)	1.4	47.0	4.0	49.0	41.2	Sandy Clay	0.23	3	5	2305.2
S1312084-046	13AS06(170-245)	1.3	18.0	36.0	46.0	6.3	Clay	0.23	2	6	2284.2
S1312084-047	13AS06(245-315)	1.4	48.0	11.0	41.0	41.5	Sandy Clay	0.29	3	5	3097.5
S1312084-048	13AS06(315-396)	1.1	12.0	35.0	53.0	5.6	Clay	0.23	3	6	1908.2
S1312084-049	13AS06(396-457)	1.1	56.0	8.0	36.0	50.4	Sandy Clay	0.35	3	5	3737.6
S1312084-050	13AS06(457-579)	1.1	10.0	39.0	51.0	3.8	Clay	0.25	3	6	2097.2

These Results apply only to the samples tested.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Soil Lab Analysis
Inter-Mountain Labs, Inc
1673 Terra Ave, Sheridan, Wyoming, 82801
(307) 672-8945

Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 12/2/2013

Report ID: S1312084001
Date Reported: 4/3/2014
Work Order: S1312084

Lab ID	Sample ID	Organic Matter	Sand	Silt	Clay	Very Fine Sand	Texture	K-factor	Structure	Permeability	M
		%	%	%	%	%		(t.ac.h/100acft.tf.in)	s	p	
S1312084-051	13AS06(579-632)	1.1	32.0	19.0	49.0	23.1	Clay	0.22	2	6	2147.1
S1312084-052	13AS06(632-770)	0.4	82.0	13.0	5.0	3.7	Loamy Sand	0.05	1	2	1586.5
S1312084-053	13AS06(770-838)	0.7	86.0	6.0	8.0	27.3	Loamy Sand	0.20	2	2	3063.6
S1312084-054	13AS06(838-884)	1.0	64.0	21.0	15.0	31.8	Sandy Loam	0.34	3	2	4488.0
S1312084-055	13AS07(0-19)	3.3	28.0	36.0	36.0	12.0	Clay Loam	0.23	3	4	3072.0
S1312084-056	13AS07(19-46)	2.6	32.0	23.0	45.0	21.9	Clay	0.25	3	6	2469.5
S1312084-057	13AS07(46-67)	1.9	22.0	37.0	41.0	8.0	Clay	0.28	3	6	2655.0
S1312084-058	13AS07(67-183)	1.3	52.0	16.0	32.0	30.5	Sandy Clay Loam	0.21	1	4	3162.0
S1312084-059	13AS07(183-305)	0.9	76.0	15.0	9.0	14.3	Sandy Loam	0.13	1	2	2666.3
S1312084-060	13AS07(305-427)	0.6	80.0	12.0	8.0	13.7	Loamy Sand	0.14	2	2	2364.4
S1312084-061	13AS07(427-532)	0.5	78.0	16.0	6.0	4.2	Loamy Sand	0.11	2	2	1898.8
S1312084-062	13AS07(532-656)	1.8	84.0	9.0	7.0	21.4	Loamy Sand	0.19	3	2	2827.2
S1312084-063	13AS07(656-732)	1.4	26.0	28.0	46.0	20.6	Clay	0.28	3	6	2624.4
S1312084-064	13AS09(0-14)	3.2	14.0	32.0	54.0	8.0	Clay	0.17	2	6	1840.0
S1312084-065	13AS09(14-46)	1.4	28.0	23.0	49.0	24.1	Clay	0.27	3	6	2402.1

These Results apply only to the samples tested.

Reviewed by: Karen Secor

Karen Secor, Soil Lab Supervisor

Soil Lab Analysis
Inter-Mountain Labs, Inc
1673 Terra Ave, Sheridan, Wyoming, 82801
(307) 672-8945

Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 12/6/2013

Report ID: S1312086001
Date Reported: 4/3/2014
Work Order: S1312086

Lab ID	Sample ID	Organic Matter %	Sand %	Silt %	Clay %	Very Fine Sand %	Texture	K-factor (t.ac.h/100acft.tf.in)	Structure s	Permeability p	M
S1312086-001	DP-7(122-165)	3.0	14.0	36.0	50.0	5.6	Clay	0.19	2	6	2080.0
S1312086-002	DP-7(165-200)	2.5	22.0	35.0	43.0	4.4	Clay	0.21	2	6	2245.8
S1312086-003	DP-7(200-244)	0.7	78.0	10.0	12.0	9.6	Sandy Loam	0.06	1	2	1724.8
S1312086-004	DP-10(122-172)	2.6	20.0	32.0	48.0	5.0	Clay	0.22	3	6	1924.0
S1312086-005	DP-10(172-244)	0.6	66.0	22.0	12.0	13.0	Sandy Loam	0.17	1	2	3080.0
S1312086-006	DP-19(122-225)	0.8	54.0	32.0	14.0	8.5	Sandy Loam	0.20	1	2	3483.0
S1312086-007	DP-19(225-244)	0.4	82.5	10.0	7.5	12.0	Loamy Sand	0.09	1	2	2035.0
S1312086-008	13AS08(122-244)	1.7	10.0	42.0	48.0	0.1	Silty Clay	0.25	3	6	2189.2
S1312086-009	13AS08(244-366)	1.6	16.0	43.0	41.0	8.0	Silty Clay	0.31	3	6	3009.0
S1312086-010	13AS08(366-488)	1.7	6.0	37.0	57.0	0.9	Silty Clay	0.21	3	6	1629.7

These Results apply only to the samples tested.

Reviewed by: Karen Secor

Karen Secor, Soil Lab Supervisor

Appendix L

Soil Profile Descriptions

Appendix L

Soil Profile Descriptions

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12AS001

Pedon ID: 12AS001

Description Date: 10/24/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 29% and 15% fine sand or coarser in control section.

Current Taxonomic Name: BBB
Current Taxonomic Class: Fine-loamy, carbonatic, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369936E, 4143218N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: terrace, valley side and hillslope
Geomorphic Component: Riser
Profile Pos: Backslope
Slope: 45 percent
Elevation: 2106 meters (6909.4 feet)
Aspect: 101°
Shape: up/down: Convex; **across:** Convex
Surface Fragments: none.

Drainage: Well drained
Runoff: Very high
Erosion: Class 2 - Rill erosion

Earth Cover: Shrubby rangeland

Existing Vegetation: CHRYS9 - rabbitbrush (*Chrysothamnus*); BROMU - brome (*Bromus*); LESAS - Salina wildrye (*Leymus salinus ssp. salinus*); ROWO - Woods' rose (*Rosa woodsii*); JUOS - Utah juniper (*Juniperus osteosperma*)

Parent Materials: alluvium derived from limestone, sandstone, and shale

Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)
Diagnostic Features: Calcic horizon: 90 to 122 centimeters (35.4 to 48 inches)

A --- 0 to 12 centimeters (0 to 4.7 inches); light brownish gray (10YR 6/2) dry, clay loam; brown (10YR 5/3) moist; 30 percent sand; 39 percent silt; 31 percent clay; weak medium platy parting to moderate medium granular structure; very friable, slightly hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.67 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear smooth boundary; CaCO3 46.2 percent.

Bw --- 12 to 28 centimeters (4.7 to 11 inches); light brownish gray (10YR 6/2) dry, clay loam; brown (10YR 5/3) moist; 24 percent sand; 41 percent silt; 35 percent clay; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common fine roots throughout, common medium roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.53 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; clear wavy boundary; CaCO3 47.9 percent.

Bk --- 28 to 56 centimeters (11 to 22 inches); 80 percent light brownish gray (2.5Y 6/2) dry, 15 percent pale yellow (2.5Y 8/2) dry and 5 percent yellow (10YR 7/6) dry, silty clay; 80 percent dark grayish brown (2.5Y 4/2) moist, 15 percent light brownish gray (2.5Y 6/2) moist and 5 percent brownish yellow (10YR 6/6) moist; 10 percent sand; 49 percent silt; 41 percent clay; moderate medium subangular blocky structure; friable, hard, moderately sticky, slightly plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 6 percent (common) fine finely disseminated carbonates and 2 percent (common) fine masses of carbonate in matrix; 30 percent shale parachanners; electrical conductivity of 0.5 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; varied colors in Bk due to decomposing shale and sandstone.; clear smooth boundary; CaCO3 52.2 percent.

2Bw --- 56 to 90 centimeters (22 to 35.4 inches); dark grayish brown (10YR 4/2) dry, silty clay; very dark grayish brown (10YR 3/2) moist; 16 percent sand; 40 percent silt; 44 percent clay; strong medium subangular blocky structure; firm, very hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.67 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; 2Bw is buried surface.; abrupt smooth boundary; CaCO3 42.9 percent.

2Bk --- 90 to 122 centimeters (35.4 to 48 inches); light gray (2.5Y 7/2) dry, clay loam; light yellowish brown (2.5Y 6/3) moist; 26 percent sand; 42 percent silt; 32 percent clay; weak medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common very fine roots throughout; common very fine tubular pores finely disseminated carbonates; 2 percent sandstone parachanners; electrical conductivity of 1

mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; Varied colors in 2Bk due to parachanners.; gradual smooth boundary; CaCO3 51.8 percent.

2BCk --- 122 to 160 centimeters (48 to 63 inches); pale yellow (2.5Y 7/3) dry, paragravelly sandy loam; light olive brown (2.5Y 5/3) moist; 64 percent sand; 24 percent silt; 12 percent clay; massive parting to single grain; friable, hard, nonsticky, nonplastic; common very fine roots throughout; common very fine interstitial pores finely disseminated carbonates; 25 percent sandstone paragravels; electrical conductivity of 0.81 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; CaCO3 30.4 percent.

12AS002

Pedon ID: 12AS002

Description Date: 10/24/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 31% and 17% fine sand or coarser in control section.

Current Taxonomic Name: Sideslide family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Typic Endoaquepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369987E, 4142687N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: flood plain
Geomorphic Component: Base Slope
Profile Pos: Toeslope
Slope: 3 percent
Elevation: 2092 meters (6863.5 feet)
Aspect: 161°
Shape: up/down: Linear; **across:** Linear
Surface Fragments: none.

Drainage: Very poorly drained
Runoff: Very low
Erosion: None - deposition

Earth Cover: Grassland rangeland

Existing Vegetation: CAUT - Northwest Territory sedge (*Carex utriculata*); JUARL - Baltic rush (*Juncus arcticus ssp. littoralis*); POPR - Kentucky bluegrass (*Poa pratensis*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Aquic conditions: 0 to 110 centimeters (0 to 43.3 inches) and Calcic horizon: 55 to 110 centimeters (21.7 to 43.3 inches)

A --- 0 to 9 centimeters (0 to 3.5 inches); light olive brown (2.5Y 5/3) moist, clay loam; light brownish gray (2.5Y 6/2) dry; 30 percent sand; 41 percent silt; 29 percent clay; 20 percent medium strong brown (7.5YR 5/6) mottles; moderate medium platy structure; friable, hard, slightly sticky, slightly plastic; common fine roots throughout, common medium roots throughout and many very fine roots throughout; common very fine tubular pores; 20 percent (many) medium strong brown (7.5YR 5/6), moist; electrical conductivity of 1.79 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; neutral, pH 7.3, pH meter; abrupt smooth boundary; CaCO3 27.3 percent.

Bg1 --- 9 to 26 centimeters (3.5 to 10.2 inches); grayish brown (2.5Y 5/2) moist, clay loam; light yellowish brown (2.5Y 6/3) dry; 20 percent sand; 46 percent silt; 34 percent clay; 5 percent fine strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm, very hard, slightly sticky, slightly plastic; common fine roots throughout, common medium roots throughout and common very fine roots throughout; common very fine tubular pores; 10 percent (common) medium prominent light greenish gray (10Y 7/1), moist, reduced matrix; electrical conductivity of 1.45 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; clear smooth boundary; CaCO3 23.8 percent.

Bg2 --- 26 to 55 centimeters (10.2 to 21.7 inches); grayish brown (2.5Y 5/2) moist, clay loam; pale yellow (2.5Y 7/3) dry; 24 percent sand; 39 percent silt; 37 percent clay; 12 percent fine brownish yellow (10YR 6/6) mottles; moderate medium subangular blocky structure; firm, very hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; 3 percent (common) fine prominent greenish gray (10Y 5/1), moist, reduced matrix; electrical conductivity of 1.28 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear smooth boundary; CaCO3 22.2 percent.

Bg3 --- 55 to 87 centimeters (21.7 to 34.3 inches); light olive brown (2.5Y 5/3) moist, silty clay; pale yellow (2.5Y 7/3) dry; 18 percent sand; 42 percent silt; 40 percent clay; 25 percent medium brownish yellow (10YR 6/6) mottles; strong medium subangular blocky parting to moderate medium prismatic structure; firm, very hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; 10 percent (common) fine prominent greenish gray (10Y 5/1), moist, reduced matrix; 2 percent (common) fine masses of carbonate in matrix; electrical conductivity of 1.45 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; abrupt smooth boundary; CaCO3 33.2 percent.

Bg4 --- 87 to 110 centimeters (34.3 to 43.3 inches); light brownish gray (2.5Y 6/2) moist, silty clay loam; light gray (2.5Y 7/2) dry; 10 percent sand; 52 percent silt; 38 percent clay; 15 percent medium light greenish gray (10Y 7/1) and 30 percent coarse yellow (10YR 7/6) mottles; strong medium subangular blocky parting to moderate coarse prismatic structure; firm, very hard, moderately sticky, moderately plastic; common fine roots

throughout and common very fine roots throughout; 15 percent (common) medium prominent light greenish gray (10Y 7/1), moist, reduced matrix; 5 percent (common) fine masses of carbonate in matrix; electrical conductivity of 1.91 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear smooth boundary; CaCO3 47.9 percent.

Bg5 --- 110 centimeters (43.3 inches); Hit large cobble.

12AS003

Pedon ID: 12AS003

Description Date: 10/24/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 15% and 22% fine sand or coarser in control section.

Current Taxonomic Name: Wimmer similar
Current Taxonomic Class: Coarse-loamy, carbonatic, mesic Aridic Haplustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370393E, 4143794N -- Datum NAD83, Zone 13
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace, valley side, and hillslope
Geomorphic Component: Side Slope
Profile Pos: Backslope
Slope: 40 percent
Elevation: 2127 meters (6978.3 feet)
Aspect: 93°
Shape: up/down: Concave; **across:** Linear
Surface Fragments: none.

Drainage: Poorly drained
Runoff: High
Erosion: Class 2 - Rill erosion

Earth Cover: Shrubby rangeland

Existing Vegetation: CHRYS9 - rabbitbrush (*Chrysothamnus*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: alluvium
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)
Diagnostic Features: Cambic horizon: 8 to 34 centimeters (3.1 to 13.4 inches)

A --- 0 to 8 centimeters (0 to 3.1 inches); light brownish gray (2.5Y 6/2) dry, clay loam; olive brown (2.5Y 4/3) moist; 24 percent sand; 39 percent silt; 37 percent clay; moderate medium platy parting to moderate medium granular structure; very friable, slightly hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; electrical conductivity of 0.64 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear smooth boundary; CaCO3 46.4 percent.

Bw --- 8 to 34 centimeters (3.1 to 13.4 inches); light brownish gray (2.5Y 6/2) dry, clay; light olive brown (2.5Y 5/3) moist; 25 percent sand; 33 percent silt; 42 percent clay; moderate medium prismatic parting to moderate medium subangular blocky structure; friable, hard, very sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; electrical conductivity of 0.61 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; abrupt smooth boundary; CaCO3 50.8 percent.

Bk1 --- 34 to 88 centimeters (13.4 to 34.6 inches); pale yellow (2.5Y 8/2) dry, silt loam; pale yellow (2.5Y 7/3) moist; 25 percent sand; 53 percent silt; 22 percent clay; 12 percent medium distinct yellow (10YR 7/6) mottles; moderate medium subangular blocky and moderate fine subangular blocky structure; friable, very hard, slightly sticky, slightly plastic; common fine roots throughout and common very fine roots throughout; 12 percent (common) fine distinct yellow (10YR 7/6), moist; 8 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.38 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; gradual smooth boundary; CaCO3 45.4 percent.

Bk2 --- 88 to 122 centimeters (34.6 to 48 inches); pale yellow (2.5Y 7/3) dry, silt loam; light yellowish brown (2.5Y 6/3) moist; 27 percent sand; 50 percent silt; 23 percent clay; 8 percent fine prominent yellow (10YR 7/6) mottles; weak medium subangular blocky structure; very friable, hard, slightly sticky, slightly plastic; common very fine roots throughout; 10 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.42 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; clear smooth boundary; CaCO3 41.1 percent.

Bk3 --- 122 to 155 centimeters (48 to 61 inches); 75 percent light gray (2.5Y 7/2) dry and 25 percent pale yellow (2.5Y 7/4) dry, paragravelly loam; 75 percent light brownish gray (2.5Y 6/2) moist and 25 percent light olive brown (2.5Y 5/4) moist; 43 percent sand; 41 percent silt; 16 percent clay; 5 percent medium prominent yellow (10YR 7/6) mottles; medium structure; very friable, slightly hard, nonsticky, nonplastic; common very fine roots throughout; 7 percent (common) medium masses of carbonate in matrix; 20 percent sandstone paragravels; electrical conductivity of 0.45 mmhos/cm by EC meter,

saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; dual colors are result of weathering shale and sand stone (75/25); CaCO3 33.4 percent.

12AS004

Pedon ID: 12AS004

Description Date: 10/25/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 23% and 56% fine sand or coarser in control section.

Current Taxonomic Name: Flugle
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Haplustalfs

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370313E, 4142972N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: hills
Landform: structural bench
Geomorphic Component: Side Slope
Profile Pos: Backslope
Slope: 13 percent
Elevation: 2124 meters (6968.5 feet)
Aspect: 58°
Shape: up/down: Convex; **across:** Linear
Surface Fragments: none.

Drainage: Well drained
Runoff: Medium
Erosion: Class 2 - Sheet erosion

Earth Cover: Shrub cover

Existing Vegetation: PUTR2 - antelope bitterbrush (*Purshia tridentata*); CHRYS9 - rabbitbrush (*Chrysothamnus*)

Parent Materials: residuum weathered from sandstone
Bedrock: Sandstone at 78 centimeters (30.7 inches)
Particle Size Control Section: 8 to 22 centimeters (3.1 to 8.7 inches)

Diagnostic Features: Argillic horizon: 8 to 22 centimeters (3.1 to 8.7 inches), Secondary carbonates: 48 to 78 centimeters (18.9 to 30.7 inches) and Lithic contact: 78 centimeters (30.7 inches)

Restrictions: Lithic bedrock: 78 centimeters (30.7 inches)

A --- 0 to 8 centimeters (0 to 3.1 inches); pale brown (10YR 6/3) dry, sandy clay loam; brown (10YR 4/3) moist; 65 percent sand; 15 percent silt; 20 percent clay; moderate medium platy structure; very friable, hard, slightly sticky, nonplastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.61 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear smooth boundary; CaCO3 4.1 percent.

Bt --- 8 to 22 centimeters (3.1 to 8.7 inches); brownish yellow (10YR 6/6) dry, sandy clay loam; yellowish brown (10YR 5/6) moist; 67 percent sand; 10 percent silt; 23 percent clay; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 35 percent (common) clay films between sand grains; 5 percent subangular sandstone gravels; electrical conductivity of 0.35 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; slightly alkaline, pH 7.4, pH meter; clear smooth boundary; CaCO3 1.8 percent.

Bk1 --- 22 to 48 centimeters (8.7 to 18.9 inches); brownish yellow (10YR 6/6) dry, silt loam; yellowish brown (10YR 5/6) moist; 77 percent sand; 14 percent silt; 9 percent clay; weak medium subangular blocky structure; very friable, slightly hard, nonsticky, nonplastic; common fine roots throughout and common very fine roots throughout; common very fine interstitial pores; 3 percent (common) fine masses of carbonate on vertical faces of peds; electrical conductivity of 0.26 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; gradual smooth boundary; CaCO3 5.9 percent.

Bk2 --- 48 to 78 centimeters (18.9 to 30.7 inches); pale yellow (2.5Y 7/3) dry, clay loam; light yellowish brown (2.5Y 6/3) moist; 39 percent sand; 34 percent silt; 27 percent clay; moderate medium subangular blocky structure; friable, very hard, slightly sticky, slightly plastic; common very fine roots throughout; 20 percent (many) medium masses of carbonate on faces of peds; electrical conductivity of 0.33 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; abrupt smooth boundary; CaCO3 14.4 percent.

R --- 78 centimeters (30.7 inches); sandstone.

12AS005

Pedon ID: 12AS005

Description Date: 10/25/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 54% and 7% fine sand or coarser in control section.

Current Taxonomic Name: Quezcan family
Current Taxonomic Class: Fine, smectitic, calcareous, mesic Aridic Ustorthents
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370339E, 4142683N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: hills
Landform: structural bench
Geomorphic Component: Side Slope
Profile Pos: Shoulder
Slope: 11 percent
Elevation: 2124 meters (6968.5 feet)
Aspect: 215°
Shape: up/down: Convex; **across:** Convex
Surface Fragments: subangular sandstone - 15 percent gravels, 20 percent cobbles, 10 percent channers, and 5 percent flags.

Drainage: Well drained
Runoff: Very high
Erosion: Class 3 - Sheet erosion

Earth Cover: Other tree cover

Existing Vegetation: PIED - twoneedle pinyon (*Pinus edulis*); JUOS - Utah juniper (*Juniperus osteosperma*); SYMPH - snowberry (*Symphoricarpos*); POA - bluegrass (*Poa*)

Parent Materials: residuum weathered from shale
Bedrock: Calcareous shale at 78 centimeters (30.7 inches)
Particle Size Control Section: 25 to 78 centimeters (9.8 to 30.7 inches)
Diagnostic Features: Paralithic contact: 78 centimeters (30.7 inches)
Restrictions: Paralithic bedrock: 78 centimeters (30.7 inches)

A --- 0 to 5 centimeters (0 to 2 inches); light yellowish brown (2.5Y 6/3) dry, cobbly clay; light olive brown (2.5Y 5/3) moist; 17 percent sand; 33 percent silt; 50 percent clay; moderate coarse platy parting to moderate medium granular structure; firm, very hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; common fine tubular pores; 5 percent subangular sandstone flags, 10 percent subangular sandstone cobbles and 5 percent sandstone gravels; electrical conductivity of 0.45 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear smooth boundary; CaCO3 23.1 percent.

C1 --- 5 to 35 centimeters (2 to 13.8 inches); light gray (2.5Y 7/2) dry, parachannery silty clay; light yellowish brown (2.5Y 6/3) moist; 9 percent sand; 33 percent silt; 58 percent clay; weak medium subangular blocky structure; firm, very hard, very sticky, very plastic; common coarse roots throughout, common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; 15 percent angular shale parachanners and 10 percent subangular sandstone gravels; electrical conductivity of 0.33 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; clear smooth boundary; CaCO3 23.5 percent.

C2 --- 35 to 78 centimeters (13.8 to 30.7 inches); light gray (2.5Y 7/2) dry, very parachannery clay; light yellowish brown (2.5Y 6/3) moist; 7 percent sand; 29 percent silt; 64 percent clay; massive; firm, very hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; 45 percent angular parachanners; shale electrical conductivity of 0.44 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; gradual smooth boundary; CaCO3 24.4 percent.

Cr --- 78 centimeters (30.7 inches); weathering Tropic shale.

12AS006

Pedon ID: 12AS006

Description Date: 10/25/2012
Describer: Robert Long

Pedon Notes: Text: Sandstone outcrop

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370311E, 4142608N -- Datum NAD83, Zone 12
Location Description:
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: hills
Landform: ledge
Slope: 8 percent
Elevation: 2123 meters (6965.2 feet)
Aspect: 172°

12AS007

Pedon ID: 12AS007

Description Date: 10/25/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 35% and 35% fine sand or coarser in control section.

Current Taxonomic Name: Brumley family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Calcidic Haplustalfs
Current Taxon Kind: Family
County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370318E, 4142763N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: hills
Landform: structural bench
Geomorphic Component: Side Slope
Profile Pos: Shoulder
Slope: 19 percent
Elevation: 2131 meters (6991.5 feet)
Aspect: 258°
Shape: up/down: Convex; **across:** Linear
Surface Fragments: subangular sandstone - 15 percent gravels, 3 percent cobbles, 5 percent stones, 1 percent boulders, 20 percent channers, and 6 percent flags.

Drainage: Well drained
Runoff: High
Erosion: Class 3 - Sheet erosion

Earth Cover: Shrubby rangeland

Existing Vegetation: LESAS - Salina wildrye (*Leymus salinus ssp. salinus*); CHRYS9 - rabbitbrush (*Chrysothamnus*); QUGA - Gambel oak (*Quercus gambelii*); SYOR2 - mountain snowberry (*Symphoricarpos oreophilus*); PIED - twoneedle pinyon (*Pinus edulis*); JUOS - Utah juniper (*Juniperus osteosperma*)

Parent Materials: residuum weathered from sandstone
Bedrock: Sandstone at 83 centimeters (32.7 inches)
Particle Size Control Section: 7 to 44 centimeters (2.8 to 17.3 inches)

Diagnostic Features: Argillic horizon: 7 centimeters (2.8 inches), Calcic horizon: 44 centimeters (17.3 inches) and Lithic contact: 83 centimeters (32.7 inches)

Restrictions: Lithic bedrock: 83 centimeters (32.7 inches)

A --- 0 to 7 centimeters (0 to 2.8 inches); brown (10YR 4/3) dry, channery sandy clay loam; dark brown (10YR 3/3) moist; 47 percent sand; 24 percent silt; 29 percent clay; moderate medium platy structure; very friable, slightly hard, slightly sticky, slightly plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 12 percent subangular sandstone channers, 1 percent subangular sandstone boulders, 3 percent subangular sandstone cobbles and 10 percent subangular sandstone gravels; electrical conductivity of 0.4 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear smooth boundary; CaCO3 3 percent.

Bt --- 7 to 44 centimeters (2.8 to 17.3 inches); light yellowish brown (10YR 6/4) dry, clay loam; yellowish brown (10YR 5/4) moist; 37 percent sand; 27 percent silt; 36 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 40 percent (common) clay films on all faces of peds; 1 percent subangular sandstone boulders; electrical conductivity of 0.34 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; slightly alkaline, pH 7.4, pH meter; abrupt smooth boundary; CaCO3 1.4 percent.

Bk --- 44 to 83 centimeters (17.3 to 32.7 inches); pale yellow (2.5Y 7/4) dry, sandy clay loam; light yellowish brown (2.5Y 6/4) moist; 67 percent sand; 11 percent silt; 22 percent clay; weak medium subangular blocky structure; loose, loose, slightly sticky, slightly plastic; common fine roots throughout and common very fine roots throughout; common very fine interstitial pores; 8 percent (few) carbonate coats on bottom surfaces of rock fragments; 25 percent (many) medium masses of carbonate on faces of peds; electrical conductivity of 0.32 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; abrupt smooth boundary; CaCO3 19.9 percent.

R --- 83 centimeters (32.7 inches); Tropic sandstone.

12AS008

Pedon ID: 12AS008

Description Date: 10/25/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 12% and 63% fine sand or coarser in control section.

Current Taxonomic Name: Vessilla family
Current Taxonomic Class: Loamy, mixed, active, calcareous, mesic Aridic Lithic Ustorthents
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370452E, 4142806N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: hills
Landform: structural bench
Geomorphic Component: Side Slope
Profile Pos: Backslope
Slope: 18 percent
Elevation: 2114 meters (6935.7 feet)
Aspect: 250°
Shape: up/down: Linear; **across:** Convex
Surface Fragments: subangular sandstone - 10 percent gravels, 5 percent cobbles, 15 percent channers, and 5 percent flags.

Drainage: Somewhat excessively drained
Runoff: Medium
Erosion: Class 1 - Sheet erosion

Earth Cover: Tree cover

Existing Vegetation: PIED - twoneedle pinyon (*Pinus edulis*); JUOS - Utah juniper (*Juniperus osteosperma*); QUGA - Gambel oak (*Quercus gambelii*); SYOR2 - mountain snowberry (*Symphoricarpos oreophilus*)

Parent Materials: residuum weathered from sandstone
Bedrock: Sandstone at 23 centimeters (9.1 inches)
Particle Size Control Section: 0 to 23 centimeters (0 to 9.1 inches)

Diagnostic Features: Secondary carbonates: 9 to 23 centimeters (3.5 to 9.1 inches) and Lithic contact: 23 centimeters (9.1 inches)

Restrictions: Lithic bedrock: 23 centimeters (9.1 inches)

A --- 0 to 9 centimeters (0 to 3.5 inches); light yellowish brown (2.5Y 6/4) dry, channery sandy loam; olive brown (2.5Y 4/4) moist; 63 percent sand; 20 percent silt; 17 percent clay; moderate medium platy structure; very friable, slightly hard, slightly sticky, slightly plastic; common very fine roots throughout; common very fine interstitial pores; 2 percent subangular sandstone flags, 10 percent subangular sandstone channers, 3 percent subangular sandstone cobbles and 5 percent subangular sandstone gravels; electrical conductivity of 0.43 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear smooth boundary; CaCO3 11.8 percent.

Ck --- 9 to 23 centimeters (3.5 to 9.1 inches); light yellowish brown (2.5Y 6/4) dry, sandy loam; light olive brown (2.5Y 5/4) moist; 77 percent sand; 11 percent silt; 12 percent clay; weak medium subangular blocky parting to single grain structure; loose, soft, nonsticky, nonplastic; common coarse roots throughout, common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine interstitial pores; 2 percent (very few) carbonate coats on bottom surfaces of rock fragments; 5 percent subangular sandstone gravels; electrical conductivity of 0.48 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; abrupt smooth boundary; CaCO3 15.7 percent.

R --- 23 centimeters (9.1 inches); Tropic sandstone.

12AS009

Pedon ID: 12AS009

Description Date: 11/26/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 40% and 3% fine sand or coarser in control section.

Current Taxonomic Name: Boxcanyon family
Current Taxonomic Class: Fine, smectitic, superactive, mesic Calcidic Haplustalfs
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370090E, 4142575N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Tread
Profile Pos: Summit
Slope: 2 percent
Elevation: 2095 meters (6873.4 feet)
Aspect: 225°
Shape: up/down: Linear; **across:** Linear
Surface Fragments: none.

Drainage: Moderately well drained
Runoff: Medium
Erosion: None - deposition

Earth Cover: Shrub cover

Existing Vegetation: CHRYS9 - rabbitbrush (*Chrysothamnus*); JUOS - Utah juniper (*Juniperus osteosperma*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Bedrock: Sandstone at 514 centimeters (202.4 inches)
Particle Size Control Section: 7 to 57 centimeters (2.8 to 22.4 inches)

Diagnostic Features: Argillic horizon: 7 to 62 centimeters (2.8 to 24.4 inches) and Calcic horizon: 20 to 232 centimeters (7.9 to 91.3 inches)

A --- 0 to 7 centimeters (0 to 2.8 inches); brown (10YR 5/3) dry, clay loam; (10Y 4/3) moist; 26 percent sand; 35 percent silt; 39 percent clay; moderate medium platy parting to moderate medium granular structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.59 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 22.2 percent.

Bt --- 7 to 20 centimeters (2.8 to 7.9 inches); pale brown (10YR 6/3) dry, silty clay; brown (10YR 4/3) moist; 10 percent sand; 46 percent silt; 44 percent clay; moderate medium prismatic parting to strong medium angular blocky structure; friable, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; 20 percent (few) clay films between sand grains and 25 percent (common) clay films on all faces of peds; electrical conductivity of 0.45 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; clear; CaCO3 25.4 percent.

Btk --- 20 to 62 centimeters (7.9 to 24.4 inches); very pale brown (10YR 7/4) dry, silty clay; light yellowish brown (10YR 6/4) moist; 0 percent sand; 47 percent silt; 53 percent clay; moderate medium prismatic parting to moderate medium subangular blocky structure; friable, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 15 percent (few) clay films on all faces of peds; 8 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.33 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; gradual; CaCO3 42.4 percent.

Bk1 --- 62 to 99 centimeters (24.4 to 39 inches); pink (7.5YR 8/3) dry, silty clay; pink (7.5YR 7/4) moist; 0 percent sand; 48 percent silt; 52 percent clay; moderate medium prismatic parting to moderate fine subangular blocky structure; friable, very hard, very sticky, very plastic; common very fine roots throughout; common very fine tubular pores; 15 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.26 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; gradual; CaCO3 52.6 percent.

Bk2 --- 99 to 137 centimeters (39 to 53.9 inches); very pale brown (10YR 8/3) dry, silty clay; very pale brown (10YR 7/4) moist; 0 percent sand; 53 percent silt; 47 percent clay; 8 percent medium distinct strong brown (7.5YR 5/6) mottles; moderate medium prismatic parting to moderate medium subangular blocky structure; friable, hard, very sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; 8 percent (common) medium strong brown (7.5YR 5/6), moist; 15 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.25 mmhos/cm by EC meter,

saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; gradual; CaCO3 51.8 percent.

Bk3 --- 137 to 183 centimeters (53.9 to 72 inches); pale yellow (2.5Y 8/2) dry, silty clay; light gray (2.5Y 7/2) moist; 0 percent sand; 49 percent silt; 51 percent clay; 10 percent coarse reddish yellow (7.5YR 6/6) and 10 percent medium prominent reddish yellow (7.5YR 6/6) mottles; moderate medium subangular blocky structure; friable, hard, very sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; 10 percent (common) coarse reddish yellow (7.5YR 6/6), moist and 10 percent (common) medium reddish yellow (7.5YR 6/6), moist; 20 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.28 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; gradual; CaCO3 49.2 percent.

Bk4 --- 183 to 232 centimeters (72 to 91.3 inches); pale yellow (2.5Y 8/2) dry, silty clay loam; light gray (2.5Y 7/2) moist; 6 percent sand; 58 percent silt; 36 percent clay; 5 percent medium prominent strong brown (7.5YR 5/6) mottles; weak medium angular blocky structure; friable, hard, very sticky, moderately plastic; 5 percent (common) medium strong brown (7.5YR 5/6), moist; 15 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.32 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; clear; CaCO3 45.2 percent.

2C --- 232 to 320 centimeters (91.3 to 126 inches); white (2.5Y 8/1) dry, sandy loam; light gray (2.5Y 7/1) moist; 60 percent sand; 30 percent silt; 10 percent clay; 25 percent coarse prominent brownish yellow (10YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; electrical conductivity of 0.38 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear; CaCO3 25.7 percent.

3C --- 320 to 366 centimeters (126 to 144.1 inches); white (2.5Y 8/1) dry, sandy loam; light gray (2.5Y 7/1) moist; 56 percent sand; 32 percent silt; 12 percent clay; 15 percent coarse prominent brownish yellow (10YR 6/6) mottles; massive; friable, very hard, nonsticky, nonplastic; electrical conductivity of 0.44 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; water is perching on this horizon; clear; CaCO3 25.6 percent.

4C --- 366 to 514 centimeters (144.1 to 202.4 inches); white (2.5Y 8/1) dry, sandy loam; light gray (2.5Y 7/2) moist; 55 percent sand; 26 percent silt; 8 percent clay; 20 percent coarse prominent brownish yellow (10YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; electrical conductivity of 0.35 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; diffuse; CaCO3 20.5 percent.

4Cr --- 514 to 610 centimeters (202.4 to 240.2 inches); light gray (2.5Y 7/2) dry, silt loam; light brownish gray (2.5Y 6/2) moist; 35 percent sand; 50 percent silt; 15 percent clay; massive; friable, hard, moderately sticky, moderately plastic; electrical conductivity of 0.44 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; weathered sandstone; $CaCO_3$ 13 percent.

12AS010

Pedon ID: 12AS010

Description Date: 11/26/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 17% and 31% fine sand or coarser in control section.

Current Taxonomic Name: Bobknoll family
Current Taxonomic Class: Coarse-loamy, mixed, superactive, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370027E, 4142761N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Tread
Profile Pos: Summit
Slope: 4 percent
Elevation: 2100 meters (6889.8 feet)
Aspect: 170°
Shape: up/down: Linear; **across:** Linear
Surface Fragments: subrounded sandstone - 1 percent gravels.

Drainage: Somewhat poorly drained
Runoff: Medium
Erosion: None - deposition

Earth Cover: Shrub cover

Existing Vegetation: CHRYS9 - rabbitbrush (*Chrysothamnus*)

Parent Materials: alluvium derived from limestone and sandstone
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)
Diagnostic Features: Calcic horizon: 9 to 31 centimeters (3.5 to 12.2 inches)

A --- 0 to 9 centimeters (0 to 3.5 inches); very pale brown (10YR 7/3) dry, silty clay; yellowish brown (10YR 5/4) moist; 10 percent sand; 50 percent silt; 40 percent clay; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.56 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 47.6 percent.

Bk1 --- 9 to 31 centimeters (3.5 to 12.2 inches); very pale brown (10YR 8/2) dry, silt loam; grayish brown (10YR 5/2) moist; 8 percent sand; 68 percent silt; 24 percent clay; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 1 percent (few) fine masses of carbonate in matrix; electrical conductivity of 0.42 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear; CaCO3 57.6 percent.

Bk2 --- 31 to 67 centimeters (12.2 to 26.4 inches); very pale brown (10YR 8/3) dry, silty clay loam; very pale brown (10YR 7/4) moist; 16 percent sand; 50 percent silt; 34 percent clay; structure; very friable, slightly hard, slightly sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 12 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.37 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; clear; CaCO3 50.1 percent.

Bk3 --- 67 to 96 centimeters (26.4 to 37.8 inches); pale yellow (2.5Y 8/3) dry, sandy loam; pale yellow (2.5Y 7/4) moist; 66 percent sand; 18 percent silt; 16 percent clay; 4 percent fine prominent reddish yellow (7.5YR 6/8) mottles; weak medium subangular blocky structure; very friable, slightly hard, nonsticky, nonplastic; common very fine roots throughout; common very fine interstitial pores; 4 percent (common) fine reddish yellow (7.5YR 6/8), moist; 8 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.27 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.9, pH meter; abrupt; CaCO3 24.4 percent.

C1 --- 96 to 134 centimeters (37.8 to 52.8 inches); pale yellow (2.5Y 8/2) dry, loam; pale yellow (2.5Y 7/3) moist; 42 percent sand; 36 percent silt; 22 percent clay; 20 percent coarse prominent strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common very fine roots throughout; common very fine tubular pores; 20 percent (many) coarse strong brown (7.5YR 5/8), moist; 2 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.34 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 8.9, pH meter; clear; CaCO3 32.4 percent.

C2 --- 134 to 183 centimeters (52.8 to 72 inches); pale yellow (2.5Y 8/2) dry, silt loam; light gray (2.5Y 7/2) moist; 20 percent sand; 60 percent silt; 20 percent clay; 30 percent coarse prominent strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common very fine roots throughout; common very fine tubular pores; 30 percent (many) coarse strong brown (7.5YR 5/8), moist; electrical conductivity of 0.3 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; strongly alkaline, pH 8.9, pH meter; abrupt; CaCO3 37 percent.

2C --- 183 to 200 centimeters (72 to 78.7 inches); white (2.5Y 8/1) dry, sandy loam; light gray (2.5Y 7/2) moist; 60 percent sand; 28 percent silt; 12 percent clay; 2 percent medium prominent yellow (10YR 7/8) mottles; weak medium subangular blocky parting to single grain structure; very friable, slightly hard, nonsticky, nonplastic; many very fine interstitial pores; 2 percent (common) medium yellow (10YR 7/8), moist; electrical conductivity of 0.26 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; strongly alkaline, pH 9, pH meter; abrupt; CaCO3 25.8 percent.

3Cg --- 200 to 284 centimeters (78.7 to 111.8 inches); white (2.5Y 8/1) dry, silty clay; light gray (2.5Y 7/1) moist; 0 percent sand; 48 percent silt; 52 percent clay; 15 percent coarse prominent strong brown (7.5YR 5/6) and 15 percent medium prominent strong brown (7.5YR 5/6) mottles; medium structure; very firm, very hard, very sticky, very plastic; 5 percent (common) medium prominent bluish gray (5PB 6/1), moist, reduced matrix; electrical conductivity of 0.3 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; CaCO3 48 percent.

12AS011

Pedon ID: 12AS011

Description Date: 11/26/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 37% and 2% fine sand or coarser in control section.

Current Taxonomic Name: CCC family
Current Taxonomic Class: Fine, carbonatic, mesic Aridic Calciustepts
Current Taxon Kind: Family
County or Parish: UT025 - Kane
State or Territory: UT - Utah **:**
UTM: 370019E, 4142957N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Tread
Profile Pos: Summit
Slope: 3 percent
Elevation: 2104 meters (6902.9 feet)
Aspect: 121°
Shape: up/down: Linear; **across:** Linear
Surface Fragments: none.

Drainage: Somewhat poorly drained
Runoff: Medium**:**
Erosion: None - deposition

Earth Cover: Shrub cover

Existing Vegetation: AGCR - crested wheatgrass (*Agropyron cristatum*); CHRYS9 - rabbitbrush (*Chrysothamnus*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)
Diagnostic Features: Calcic horizon: 71 to 116 centimeters (28 to 45.7 inches) and Calcic horizon: 128 to 214 centimeters (50.4 to 84.3 inches)

A --- 0 to 10 centimeters (0 to 3.9 inches); grayish brown (10YR 5/2) dry, silty clay; dark brown (10YR 3/3) moist; 18 percent sand; 41 percent silt; 41 percent clay; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.54 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 39.8 percent.

Bk1 --- 10 to 32 centimeters (3.9 to 12.6 inches); light brownish gray (10YR 6/2) dry, silty clay; dark grayish brown (10YR 4/2) moist; 18 percent sand; 40 percent silt; 42 percent clay; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 3 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.46 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; gradual; CaCO3 43.3 percent.

Bk2 --- 32 to 71 centimeters (12.6 to 28 inches); pink (7.5YR 8/4) dry, silty clay loam; reddish yellow (7.5YR 7/6) moist; 0 percent sand; 61 percent silt; 39 percent clay; structure; very friable, hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 20 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.37 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; clear; CaCO3 41.4 percent.

Bk3 --- 71 to 116 centimeters (28 to 45.7 inches); very pale brown (10YR 8/2) dry, clay; light brownish gray (10YR 6/2) moist; 0 percent sand; 37 percent silt; 63 percent clay; 22 percent medium prominent reddish yellow (7.5YR 6/6) mottles; structure; friable, hard, very sticky, very plastic; common very fine roots throughout; common very fine tubular pores; 22 percent (many) medium reddish yellow (7.5YR 6/6), moist; 12 percent (common) fine masses of carbonate in cracks; electrical conductivity of 0.36 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; abrupt; CaCO3 55.2 percent.

2C --- 116 to 128 centimeters (45.7 to 50.4 inches); light gray (2.5Y 7/2) dry, sandy loam; light brownish gray (2.5Y 6/2) moist; 70 percent sand; 18 percent silt; 12 percent clay; single grain; loose, loose, nonsticky, nonplastic; common very fine roots throughout; many very fine interstitial pores; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 8.9, pH meter; (limited sample collected of this sand lens); abrupt; CaCO3 24.4 percent.

3Bk1 --- 128 to 154 centimeters (50.4 to 60.6 inches); white (2.5Y 8/1) dry, clay; light gray (2.5Y 7/2) moist; 0 percent sand; 25 percent silt; 75 percent clay; 10 percent medium prominent reddish yellow (7.5YR 6/8) and 10 percent fine prominent reddish yellow

(7.5YR 6/8) mottles; moderate medium subangular blocky structure; friable, hard, very sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; 10 percent (common) medium reddish yellow (7.5YR 6/8), moist and 10 percent (common) fine reddish yellow (7.5YR 6/8), moist; 3 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.35 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 8.8, pH meter; clear; CaCO3 51 percent.

3Bk2 --- 154 to 214 centimeters (60.6 to 84.3 inches); white (2.5Y 8/1) dry, clay; light gray (2.5Y 7/2) moist; 0 percent sand; 17 percent silt; 83 percent clay; 25 percent fine prominent reddish yellow (7.5YR 6/6) mottles; moderate medium subangular blocky structure; friable, hard, very sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; 25 percent (many) fine reddish yellow (7.5YR 6/6), moist; 2 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.5 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; CaCO3 49.5 percent.

12AS012

Pedon ID: 12AS012

Description Date: 11/26/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 37% and 1% fine sand or coarser in control section.

Current Taxonomic Name: CCC family
Current Taxonomic Class: Fine, carbonatic, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370063E, 4143126N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Tread
Profile Pos: Summit
Slope: 3 percent
Elevation: 2107 meters (6912.7 feet)
Aspect: 225°
Shape: up/down: Linear; **across:** Concave
Surface Fragments: none.

Drainage: Somewhat poorly drained
Runoff: Medium
Erosion: None - deposition

Earth Cover: Shrubby rangeland

Existing Vegetation: CHRYS9 - rabbitbrush (*Chrysothamnus*)

Parent Materials: alluvium
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Cambic horizon: 11 to 30 centimeters (4.3 to 11.8 inches) and Calcic horizon: 30 to 72 centimeters (11.8 to 28.3 inches)

A --- 0 to 11 centimeters (0 to 4.3 inches); light brownish gray (10YR 6/2) dry, clay; brown (10YR 4/3) moist; 0 percent sand; 37 percent silt; 63 percent clay; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.53 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 38.6 percent.

Bw --- 11 to 30 centimeters (4.3 to 11.8 inches); light brownish gray (10YR 6/2) dry, clay; dark grayish brown (10YR 4/2) moist; 0 percent sand; 25 percent silt; 75 percent clay; weak medium prismatic parting to moderate medium angular blocky structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.45 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 49 percent.

Bk1 --- 30 to 72 centimeters (11.8 to 28.3 inches); white (10YR 8/1) dry, clay; light brownish gray (10YR 6/2) moist; 0 percent sand; 37 percent silt; 63 percent clay; weak medium subangular blocky structure; friable, hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 20 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.4 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; gradual; CaCO3 61.7 percent.

Bk2 --- 72 to 116 centimeters (28.3 to 45.7 inches); yellow (2.5Y 8/6) dry, loam; olive yellow (2.5Y 6/6) moist; 42 percent sand; 33 percent silt; 25 percent clay; 15 percent medium prominent yellow (10YR 7/8) mottles; weak medium subangular blocky structure; very friable, hard, slightly sticky, slightly plastic; common very fine roots throughout; common very fine tubular pores; 15 percent (common) medium yellow (10YR 7/8), moist finely disseminated carbonates; electrical conductivity of 0.26 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 9, pH meter; gradual; CaCO3 28.9 percent.

Bk3 --- 116 to 160 centimeters (45.7 to 63 inches); pale yellow (2.5Y 8/2) dry, loam; light yellowish brown (2.5Y 6/3) moist; 50 percent sand; 32 percent silt; 18 percent clay; 10 percent medium distinct yellow (2.5Y 7/6) mottles; moderate medium subangular blocky structure; very friable, slightly hard, nonsticky, nonplastic; common very fine roots throughout; many very fine interstitial pores; 10 percent (common) medium yellow (2.5Y 7/6), moist; 3 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.35 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.8, pH meter; abrupt; CaCO3 25.5 percent.

C --- 160 to 181 centimeters (63 to 71.3 inches); white (10YR 8/1) dry, loam; light gray (10YR 7/2) moist; 50 percent sand; 33 percent silt; 17 percent clay; 2 percent fine prominent yellow (2.5Y 7/6) mottles; weak medium subangular blocky structure; very friable, slightly hard, nonsticky, nonplastic; common very fine roots throughout; many very fine interstitial pores; 2 percent (common) fine yellow (2.5Y 7/6), moist; electrical conductivity of 0.28 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; very strongly alkaline, pH 9.2, pH meter; abrupt; CaCO3 25.6 percent.

2Bk --- 181 to 187 centimeters (71.3 to 73.6 inches); white (10YR 8/1) dry, extremely gravelly loamy sand; light gray (10YR 7/2) moist; null percent sand; null percent silt; 3 percent clay; single grain; loose, loose, nonsticky, nonplastic; common very fine roots throughout; many very fine interstitial pores finely disseminated carbonates; 50 percent subrounded sandstone gravels; strongly effervescent by HCl, 1 normal; too thin to sample separately for analysis, included with overlying C horizon (field estimated texture and percent clay); clear; CaCO3 25.6 percent.

3Bk --- 187 to 230 centimeters (73.6 to 90.6 inches); white (10YR 8/1) dry, loam; light gray (10YR 7/2) moist; 50 percent sand; 33 percent silt; 17 percent clay; single grain; loose, loose, nonsticky, nonplastic; common very fine roots throughout; many very fine interstitial pores finely disseminated carbonates; electrical conductivity of 0.25 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 9, pH meter; CaCO3 18.1 percent.

12AS013

Pedon ID: 12AS013

Description Date: 11/27/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 55% and 0% fine sand or coarser in control section; . Bag sample of 0-12 cm
Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369813E, 4142684N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: hills
Landform: hillslope
Geomorphic Component: Side Slope
Profile Pos: Shoulder
Slope: 7 percent
Elevation: 2110 meters (6922.6 feet)
Aspect: 116°
Shape: up/down: Convex; **across:** Convex
Surface Fragments: subangular sandstone - 3 percent gravels and 2 percent channers.

Drainage: Well drained
Runoff: Very high
Erosion: Class 2 - Sheet erosion

Primary Earth Cover: shrub cover.

Parent Materials: residuum weathered from shale
Bedrock: Calcareous shale at 102 centimeters (40.2 inches)
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)
Diagnostic Features: Secondary carbonates: 16 to 114 centimeters (6.3 to 44.9 inches) and Paralithic contact: 102 to 114 centimeters (40.2 to 44.9 inches)
Restrictions: Paralithic bedrock: 102 to 114 centimeters (40.2 to 44.9 inches)

Ap --- 0 to 16 centimeters (0 to 6.3 inches); grayish brown (10YR 5/2) dry, clay; very dark grayish brown (10YR 3/2) moist; 0 percent sand; 28 percent silt; 72 percent clay; moderate medium platy parting to moderate medium granular structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.37 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 3.5 percent.

Bk1 --- 16 to 52 centimeters (6.3 to 20.5 inches); light gray (2.5Y 7/2) dry, very parachannery clay; grayish brown (2.5Y 5/2) moist; 0 percent sand; 39 percent silt; 61 percent clay; weak medium subangular blocky parting to moderate medium granular structure; very friable, slightly hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 8 percent (few) carbonate coats on bottom surfaces of rock fragments; 8 percent (common) fine threadlike masses of carbonate between peds; 45 percent angular shale parachanners; electrical conductivity of 0.3 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; gradual; CaCO3 10.7 percent.

Bk2 --- 52 to 102 centimeters (20.5 to 40.2 inches); light gray (2.5Y 7/2) dry, extremely parachannery clay; grayish brown (2.5Y 5/2) moist; 0 percent sand; 39 percent silt; 61 percent clay; weak fine subangular blocky structure; very friable, slightly hard, very sticky, very plastic; common very fine roots throughout; common very fine tubular pores; 15 percent (common) fine threadlike masses of carbonate on faces of peds; 70 percent angular shale parachanners; electrical conductivity of 0.27 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; gradual; CaCO3 14.9 percent.

Cr --- 102 to 114 centimeters (40.2 to 44.9 inches); 0 percent sand; 24 percent silt; 73 percent clay; 3 percent (common) fine threadlike masses of carbonate in cracks; electrical conductivity of 0.3 mmhos/cm by EC meter, saturated paste; by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; weathered Tropic shale; CaCO3 10.1 percent.

12AS014

Pedon ID: 12AS014

Description Date: 11/27/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 48% and 6% fine sand or coarser in control section.

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts:
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369703E, 4142594N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: hills
Landform: hillslope
Geomorphic Component: Side Slope
Profile Pos: Backslope
Slope: 9 percent
Elevation: 2103 meters (6899.6 feet)
Aspect: 267°
Shape: up/down: Linear; **across:** Concave
Surface Fragments: subangular sandstone - 1 percent channers.

Drainage: Well drained
Runoff: Very high
Erosion: Class 2 - Sheet erosion

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Shrubby rangeland

Existing Vegetation: SAME3 - black sage (*Artemisia nova*); BROMU - brome (*Bromus*)

Parent Materials: residuum weathered from calcareous shale
Bedrock: Calcareous shale at 88 centimeters (34.6 inches)
Particle Size Control Section: 25 to 88 centimeters (9.8 to 34.6 inches)
Diagnostic Features: Cambic horizon: 20 to 45 centimeters (7.9 to 17.7 inches) and Paralithic contact: 88 to 114 centimeters (34.6 to 44.9 inches)

Restrictions: Paralithic bedrock: 88 to 114 centimeters (34.6 to 44.9 inches)

Ap --- 0 to 20 centimeters (0 to 7.9 inches); light brownish gray (2.5Y 6/2) dry, silty clay; dark grayish brown (2.5Y 4/2) moist; 6 percent sand; 43 percent silt; 51 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; friable, hard, very sticky, very plastic; common fine roots throughout and many very fine roots throughout; common very fine tubular pores; 15 percent (few) pressure faces on all faces of peds; electrical conductivity of 0.34 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 4.1 percent.

Bw --- 20 to 45 centimeters (7.9 to 17.7 inches); light brownish gray (2.5Y 6/2) dry, silty clay; dark grayish brown (2.5Y 4/2) moist; 6 percent sand; 43 percent silt; 51 percent clay; moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; gradual; CaCO3 5.9 percent.

BC --- 45 to 66 centimeters (17.7 to 26 inches); light brownish gray (2.5Y 6/2) dry, silty clay; grayish brown (2.5Y 5/2) moist; 4 percent sand; 44 percent silt; 52 percent clay; moderate medium angular blocky structure; firm, very hard, very sticky, very plastic; common very fine roots throughout; 5 percent (few) pressure faces on all faces of peds; electrical conductivity of 0.39 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; gradual; CaCO3 6.4 percent.

C --- 66 to 88 centimeters (26 to 34.6 inches); light brownish gray (2.5Y 6/2) dry, clay; grayish brown (2.5Y 5/2) moist; 10 percent sand; 37 percent silt; 53 percent clay; medium structure; very firm, extremely hard, very sticky, very plastic; common very fine roots throughout; electrical conductivity of 0.8 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; gradual; CaCO3 6.3 percent.

Cr --- 88 to 114 centimeters (34.6 to 44.9 inches); 6 percent sand; 39 percent silt; 55 percent clay; electrical conductivity of 1.65 mmhos/cm by EC meter, saturated paste; moderately alkaline, pH 8.1, pH meter; weathered tropic shale; CaCO3 6.6 percent.

12AS015

Pedon ID: 12AS015

Description Date: 11/27/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 53% and 10% fine sand or coarser in control section.

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369733E, 4142889N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: hills
Landform: structural bench
Geomorphic Component: Base Slope
Profile Pos: Footslope
Slope: 2 percent
Elevation: 2113 meters (6932.4 feet)
Aspect: 344°
Shape: up/down: Concave; **across:** Concave
Surface Fragments: subangular sandstone - 4 percent channers.

Drainage: Well drained
Runoff: High
Erosion: Class 1 - Sheet erosion

Earth Cover: Grass/herbaceous cover

Existing Vegetation: ARNO4 - black sagebrush (*Artemisia nova*); BROMU - brome (*Bromus*); POA - bluegrass (*Poa*); LESAS - Salina wildrye (*Leymus salinus ssp. salinus*); MEDIC - alfalfa (*Medicago*)

Parent Materials: residuum weathered from calcareous shale
Bedrock: Calcareous shale at 110 centimeters (43.3 inches)
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Cambic horizon: 20 to 87 centimeters (7.9 to 34.3 inches), Gypsum accumulations: 87 to 119 centimeters (34.3 to 46.9 inches) and Paralithic contact: 119 to 132 centimeters (46.9 to 52 inches)

Restrictions: Paralithic bedrock: 119 to 132 centimeters (46.9 to 52 inches)

A --- 0 to 20 centimeters (0 to 7.9 inches); light brownish gray (10YR 6/2) dry, clay; dark grayish brown (10YR 4/2) moist; 10 percent sand; 39 percent silt; 51 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.47 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 5.3 percent.

Bw1 --- 20 to 54 centimeters (7.9 to 21.3 inches); light brownish gray (10YR 6/2) dry, silty clay; grayish brown (10YR 5/2) moist; 12 percent sand; 32 percent silt; 56 percent clay; strong medium angular blocky structure; very firm, very hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 30 percent (common) pressure faces on all faces of peds; electrical conductivity of 0.39 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; gradual; CaCO3 8.4 percent.

Bw2 --- 54 to 87 centimeters (21.3 to 34.3 inches); light brownish gray (10YR 6/2) dry, clay; grayish brown (10YR 5/2) moist; 10 percent sand; 30 percent silt; 60 percent clay; strong medium angular blocky structure; very firm, very hard, very sticky, very plastic; common very fine roots throughout; 20 percent (few) pressure faces on all faces of peds; electrical conductivity of 0.98 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; gradual; CaCO3 12.6 percent.

By --- 87 to 119 centimeters (34.3 to 46.9 inches); light brownish gray (2.5Y 6/2) dry, silty clay; grayish brown (2.5Y 5/2) moist; 10 percent sand; 31 percent silt; 59 percent clay; massive; very firm, extremely hard, very sticky, very plastic; common very fine roots throughout; 2 percent (common) medium masses of gypsum in cracks; electrical conductivity of 6.55 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; weathered Tropic shale; gradual; CaCO3 7.4 percent.

Cr --- 119 to 137 centimeters (46.9 to 53.9 inches); clay; 20 percent sand; 32 percent silt; 48 percent clay; 4 percent (common) medium masses of gypsum in cracks; electrical conductivity of 10.9 mmhos/cm by EC meter, saturated paste; by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; moderately hard tropic shale; CaCO3 11.9 percent.

12AS016

Pedon ID: 12AS016

Description Date: 11/27/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 31% and 18% fine sand or coarser in control section.

Current Taxonomic Name: Teromote family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Haplustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369561E, 4142715N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: hills
Landform: structural bench and hillslope
Geomorphic Component: Riser
Profile Pos: Summit
Slope: 10 percent
Elevation: 2108 meters (6916 feet)
Aspect: 144°
Shape: up/down: Convex; **across:** Convex
Surface Fragments: subangular sandstone - 4 percent gravels, 3 percent cobbles, 1 percent stones, and 7 percent channers; and cobble size Tropic concretions.

Drainage: Well drained
Runoff: High
Erosion: Class 1 - Rill erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland

Existing Vegetation: ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: residuum weathered from calcareous shale
Bedrock: Strongly cemented calcareous shale at 112 centimeters (44.1 inches)
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Secondary carbonates: 11 to 40 centimeters (4.3 to 15.7 inches), Secondary carbonates: 71 to 120 centimeters (28 to 47.2 inches) and Paralithic contact: 112 centimeters (44.1 inches)

Restrictions: Paralithic bedrock: 112 centimeters (44.1 inches)

A --- 0 to 11 centimeters (0 to 4.3 inches); light yellowish brown (2.5Y 6/3) dry, clay loam; light olive brown (2.5Y 5/3) moist; 22 percent sand; 46 percent silt; 32 percent clay; weak medium subangular blocky parting to moderate medium granular structure; very friable, slightly hard, slightly sticky, slightly plastic; common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.43 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; collected bag sample of 0-11 cm about 6 ft; clear; CaCO3 11.6 percent.

Bk --- 11 to 40 centimeters (4.3 to 15.7 inches); light gray (2.5Y 7/2) dry, silty clay loam; light yellowish brown (2.5Y 6/3) moist; 18 percent sand; 49 percent silt; 33 percent clay; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 2 percent (common) fine masses of carbonate on vertical faces of peds; electrical conductivity of 0.37 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; abrupt; CaCO3 13.9 percent.

2A --- 40 to 45 centimeters (15.7 to 17.7 inches); grayish brown (10YR 5/2) dry, clay; brown (10YR 4/3) moist; 22 percent sand; 37 percent silt; 41 percent clay; moderate medium granular structure; very friable, soft, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.78 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; This is a buried surface that appeared to have covered when the pinyons and junipers were recently removed and the surface smoothed.; abrupt; CaCO3 14.5 percent.

2Bk --- 45 to 71 centimeters (17.7 to 28 inches); light brownish gray (2.5Y 6/2) dry, gravelly clay; grayish brown (2.5Y 5/2) moist; 22 percent sand; 37 percent silt; 41 percent clay; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common very fine roots throughout; common very fine tubular pores; 5 percent (few) carbonate coats on bottom surfaces of rock fragments; 8 percent (common) fine masses of carbonate on vertical faces of peds; 20 percent subangular sandstone gravels; electrical conductivity of 0.78 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; abrupt; CaCO3 14.5 percent.

3Bk --- 71 to 120 centimeters (28 to 47.2 inches); light yellowish brown (2.5Y 6/3) dry, clay loam; light olive brown (2.5Y 5/3) moist; 22 percent sand; 47 percent silt; 31 percent clay; moderate medium angular blocky structure; firm, very hard, slightly sticky, slightly plastic; common very fine roots throughout; common very fine tubular pores; 12 percent (common) medium masses of carbonate on faces of peds; electrical conductivity of 0.38 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 17.8 percent.

3Cr --- 112 to 120 centimeters (44.1 to 47.2 inches); 22 percent sand; 47 percent silt; 31 percent clay; electrical conductivity of 0.38 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; Tropic shale; CaCO3 17.8 percent.

12AS017

Pedon ID: 12AS017

Description Date: 11/27/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 56% and 13% fine sand or coarser in control section.

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts:
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369423E, 4142655N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: hills
Landform: hillslope
Geomorphic Component: Side Slope
Profile Pos: Backslope
Slope: 12 percent
Elevation: 2100 meters (6889.8 feet)
Aspect: 292°
Shape: up/down: Convex; **across:** Convex
Surface Fragments: Tropic concretions - 2 percent gravels and 3 percent cobbles.

Drainage: Well drained
Runoff: Medium
Erosion: None - deposition

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Shrubby rangeland

Existing Vegetation: ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: residuum weathered from shale
Bedrock: Calcareous shale at 118 centimeters (46.5 inches)
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Cambic horizon: 13 to 57 centimeters (5.1 to 22.4 inches), Gypsum accumulations: 57 to 118 centimeters (22.4 to 46.5 inches), Secondary carbonates: 57 to

84 centimeters (22.4 to 33.1 inches) and Paralithic contact: 118 to 170 centimeters (46.5 to 66.9 inches)

Restrictions: Paralithic bedrock: 118 to 170 centimeters (46.5 to 66.9 inches)

Ap --- 0 to 13 centimeters (0 to 5.1 inches); pale brown (10YR 6/3) dry, silty clay; brown (10YR 4/3) moist; 14 percent sand; 31 percent silt; 55 percent clay; weak medium subangular blocky parting to moderate medium granular structure; firm, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.33 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 4 percent.

Bw --- 13 to 57 centimeters (5.1 to 22.4 inches); light brownish gray (2.5Y 6/2) dry, clay; dark grayish brown (2.5Y 4/2) moist; 10 percent sand; 23 percent silt; 67 percent clay; moderate medium angular blocky structure; firm, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.24 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; gradual; CaCO3 4.4 percent.

Bky --- 57 to 84 centimeters (22.4 to 33.1 inches); light brownish gray (2.5Y 6/2) dry, clay; dark grayish brown (2.5Y 4/2) moist; 16 percent sand; 31 percent silt; 53 percent clay; moderate medium angular blocky structure; very firm, very hard, very sticky, very plastic; common very fine roots throughout; common very fine tubular pores; 3 percent (common) fine masses of carbonate on horizontal faces of peds and 2 percent (common) fine masses of gypsum on horizontal faces of peds; electrical conductivity of 3.35 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; gradual; CaCO3 2.7 percent.

Cy --- 84 to 118 centimeters (33.1 to 46.5 inches); gray (2.5Y 5/1) dry, silty clay; very dark gray (2.5Y 3/1) moist; 18 percent sand; 24 percent silt; 58 percent clay; weak medium angular blocky structure; very firm, very hard, very sticky, very plastic; common very fine roots throughout; 4 percent (common) fine masses of gypsum on horizontal faces of peds; electrical conductivity of 4.64 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 1.6 percent.

Cr1 --- 118 to 161 centimeters (46.5 to 63.4 inches); 16 percent sand; 29 percent silt; 55 percent clay; moderate medium angular blocky structure; 4 percent (common) fine masses of gypsum in cracks; electrical conductivity of 6.14 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; strongly acid, pH 5.3, pH meter; weathered Tropic shale; gradual; CaCO3 1.3 percent.

Cr2 --- 161 to 170 centimeters (63.4 to 66.9 inches); weak medium subangular blocky structure; 2 percent (common) fine masses of gypsum in cracks; noneffervescent; Tropic shale.

12AS018

Pedon ID: 12AS018

Description Date: 11/27/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 24% and 17% fine sand or coarser in control section.

Current Taxonomic Name: AAA family
Current Taxonomic Class: Fine-loamy, carbonatic, mesic Aridic Haplustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
Lat/Long:
UTM: 369803E, 4143245N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Tread
Profile Pos: Summit
Slope: 1 percent
Elevation: 2106.8 meters (6912.2 feet)
Aspect: 45°
Shape: up/down: Linear; **across:** Linear
Surface Fragments: none.

Drainage: Somewhat poorly drained
Runoff: Negligible
Erosion: None - deposition

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: LESAS - Salina wildrye (*Leymus salinus ssp. salinus*); CHRYS9 - rabbitbrush (*Chrysothamnus*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features:, Secondary carbonates: 22 to 244 centimeters (8.7 to 96.1 inches) and Aquic conditions: 572 to 732 centimeters (225.2 to 288.2 inches)

BAkp --- 0 to 22 centimeters (0 to 8.7 inches); gray (2.5Y 6/1) dry, clay loam; dark gray (2.5Y 4/1) moist; 26 percent sand; 38 percent silt; 36 percent clay; weak medium subangular blocky parting to moderate medium granular structure; very friable, slightly hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.46 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 61.5 percent.

Bk1 --- 22 to 68 centimeters (8.7 to 26.8 inches); light gray (2.5Y 7/1) dry, clay loam; gray (2.5Y 5/1) moist; 26 percent sand; 42 percent silt; 32 percent clay; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 5 percent (common) fine masses of carbonate on vertical faces of peds; electrical conductivity of 0.24 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear; CaCO3 59.5 percent.

Bk2 --- 68 to 115 centimeters (26.8 to 45.3 inches); pale yellow (2.5Y 8/2) dry, silty clay; pale yellow (2.5Y 7/3) moist; 8 percent sand; 48 percent silt; 44 percent clay; 15 percent medium prominent strong brown (7.5YR 5/6) mottles; moderate medium angular blocky structure; friable, hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 15 percent (common) medium strong brown (7.5YR 5/6), moist; 15 percent (common) medium masses of carbonate on faces of peds; electrical conductivity of 0.25 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; clear; CaCO3 54.1 percent.

Ck --- 115 to 148 centimeters (45.3 to 58.3 inches); white (2.5Y 8/1) dry, silty clay; light gray (2.5Y 7/2) moist; 18 percent sand; 42 percent silt; 40 percent clay; 10 percent medium prominent reddish yellow (7.5YR 6/6) mottles; moderate medium angular blocky structure; firm, very hard, moderately sticky, moderately plastic; common very fine roots throughout; 10 percent (common) medium reddish yellow (7.5YR 6/6), moist; 2 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.26 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; Very dense layer; clear; CaCO3 55.4 percent.

2Bk --- 148 to 244 centimeters (58.3 to 96.1 inches); white (2.5Y 8/1) dry, sandy loam; light gray (2.5Y 7/2) moist; 60 percent sand; 28 percent silt; 12 percent clay; 3 percent medium prominent brownish yellow (10YR 6/6) mottles; weak medium subangular blocky structure; friable, very hard, nonsticky, nonplastic; common very fine tubular pores; 3 percent (common) medium brownish yellow (10YR 6/6), moist; 20 percent (many)

medium masses of carbonate in matrix; electrical conductivity of 0.21 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 9, pH meter; clear; CaCO3 27.9 percent.

3C --- 244 to 318 centimeters (96.1 to 125.2 inches); white (2.5Y 8/1) dry, loamy sand; light brownish gray (2.5Y 6/2) moist; 80 percent sand; 14 percent silt; 6 percent clay; 10 percent coarse prominent brownish yellow (10YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; electrical conductivity of 0.34 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; clear; CaCO3 18.3 percent.

4C --- 318 to 388 centimeters (125.2 to 152.8 inches); white (2.5Y 8/1) dry, silty clay; light gray (2.5Y 7/1) moist; 0 percent sand; 53 percent silt; 47 percent clay; 20 percent coarse prominent brownish yellow (10YR 6/6) mottles; massive; firm, very hard, very sticky, very plastic; electrical conductivity of 1.19 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; abrupt; CaCO3 42.9 percent.

5C --- 388 to 406 centimeters (152.8 to 159.8 inches); pale yellow (2.5Y 8/2) dry, sandy loam; light gray (2.5Y 7/2) moist; 74 percent sand; 15 percent silt; 11 percent clay; 8 percent coarse prominent brownish yellow (10YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; electrical conductivity of 1.73 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; abrupt; CaCO3 20 percent.

6C --- 406 to 572 centimeters (159.8 to 225.2 inches); pale yellow (2.5Y 8/3) dry, silt loam; light yellowish brown (2.5Y 6/3) moist; 28 percent sand; 51 percent silt; 21 percent clay; 30 percent coarse prominent brownish yellow (10YR 6/6) mottles; massive; firm, very hard, slightly sticky, slightly plastic; electrical conductivity of 2.62 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH indicator solutions; 4-10 cm LS lenses; abrupt; CaCO3 37.1 percent.

6Cg1 --- 572 to 640 centimeters (225.2 to 252 inches); gray (2.5Y 6/1) dry, silty clay loam; dark gray (2.5Y 4/1) moist; 14 percent sand; 54 percent silt; 32 percent clay; massive; firm, very hard, slightly sticky, slightly plastic; 60 percent (many) coarse prominent dark greenish gray (10Y 3/1), moist, reduced matrix; electrical conductivity of 2.37 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; neutral, pH 7.3, pH indicator solutions; very wet; clear; CaCO3 37.1 percent.

6Cg2 --- 640 to 732 centimeters (252 to 288.2 inches); gray (2.5Y 6/1) dry, silty clay; dark grayish brown (2.5Y 4/2) moist; 16 percent sand; 44 percent silt; 40 percent clay; 40 percent coarse prominent brownish yellow (10YR 6/6) mottles; massive; firm, very hard, moderately sticky, moderately plastic; 15 percent (common) coarse prominent dark greenish gray (10Y 3/1), moist, reduced matrix in matrix; 5 percent subrounded

mudstone gravels; electrical conductivity of 1.57 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH indicator solutions; alluvium from conglomerate; CaCO3 35.1 percent.

12AS019

Pedon ID: 12AS019

Description Date: 11/27/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 30% and 14% fine sand or coarser in control section.

Current Taxonomic Name: AAA similar
Current Taxonomic Class: Fine-silty, carbonatic, mesic Aridic Haplustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369866E, 4143060N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Tread
Profile Pos: Summit
Slope: 2 percent
Elevation: 2109 meters (6919.3 feet)
Aspect: 194°
Shape: up/down: Linear; **across:** Concave
Surface Fragments: none.

Drainage: Moderately well drained
Runoff: Low
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Shrubby rangeland

Existing Vegetation: LESAS - Salina wildrye (*Leymus salinus ssp. salinus*); CHRYS9 - rabbitbrush (*Chrysothamnus*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Secondary carbonates: 32 to 196 centimeters (12.6 to 77.2 inches) and Cambic horizon: 32 to 72 centimeters (12.6 to 28.3 inches)

BAkp1 --- 0 to 12 centimeters (0 to 4.7 inches); light brownish gray (2.5Y 6/2) dry, silty clay; dark grayish brown (2.5Y 4/2) moist; 16 percent sand; 41 percent silt; 43 percent clay; weak medium subangular blocky parting to moderate medium granular structure; very friable, slightly hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.6 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; gradual; CaCO3 56 percent.

BAkp2 --- 12 to 32 centimeters (4.7 to 12.6 inches); light brownish gray (2.5Y 6/2) dry, silty clay; dark grayish brown (2.5Y 4/2) moist; 12 percent sand; 41 percent silt; 47 percent clay; weak medium subangular blocky parting to moderate medium granular structure; very friable, slightly hard, very sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.4 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 57.2 percent.

Bk1 --- 32 to 72 centimeters (12.6 to 28.3 inches); light gray (2.5Y 7/1) dry, silty clay; gray (2.5Y 6/1) moist; 10 percent sand; 46 percent silt; 44 percent clay; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 1 percent (few) fine masses of carbonate in matrix; electrical conductivity of 0.33 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; abrupt; CaCO3 57.1 percent.

Bk2 --- 72 to 100 centimeters (28.3 to 39.4 inches); white (2.5Y 8/1) dry, clay; light gray (2.5Y 7/1) moist; 24 percent sand; 35 percent silt; 41 percent clay; 10 percent medium prominent reddish yellow (7.5YR 7/6) mottles; structure; friable, hard, moderately sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; 10 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.2 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; clear; CaCO3 50.8 percent.

Bk3 --- 100 to 147 centimeters (39.4 to 57.9 inches); white (2.5Y 8/1) dry, loam; light gray (2.5Y 7/1) moist; 46 percent sand; 35 percent silt; 19 percent clay; 12 percent fine prominent reddish yellow (7.5YR 7/6) mottles; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common very fine roots throughout; common very fine tubular pores; 20 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.27 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; gradual; CaCO3 32.1 percent.

2Bk --- 147 to 196 centimeters (57.9 to 77.2 inches); pale yellow (2.5Y 8/2) dry, loam; light gray (2.5Y 7/2) moist; 44 percent sand; 41 percent silt; 15 percent clay; 15 percent medium reddish yellow

(7.5YR 6/6) mottles; moderate medium platy structure; friable, hard, nonsticky, nonplastic; common very fine roots throughout; common very fine tubular pores; 15 percent (common) medium reddish yellow (7.5YR 7/6), moist; 30 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.7, pH meter; clear; CaCO3 32.4 percent.

C --- 196 to 240 centimeters (77.2 to 94.5 inches); pale yellow (2.5Y 8/2) dry, sandy loam; light gray (2.5Y 7/2) moist; 52 percent sand; 33 percent silt; 15 percent clay; 25 percent medium prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; very friable, slightly hard, nonsticky, nonplastic; many very fine interstitial pores; 25 percent (many) medium strong brown (7.5YR 5/6), moist; electrical conductivity of 0.44 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 8.7, pH meter; CaCO3 30.7 percent.

12AS019A

Pedon ID: 12AS019A

Description Date: 11/12/2013
Describer: Robert Long

Pedon Notes: Text: 12AS019 was sampled and examined to 8 feet; a piezometer was needed in this vicinity, so this new hole was sampled within 10 feet of 12AS019 and a piezometer installed.

Current Taxonomic Name: AAA family
Current Taxonomic Class: Fine-loamy, carbonatic, mesic Aridic Haplustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369866E, 4143060N -- Datum NAD83, Zone 12
Location Description:
Legal Description: Section 13, Township 39 South, Range 6 west of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Tread
Profile Pos: Summit
Slope: 2 percent
Elevation: 2109 meters (6919.3 feet)
Aspect: 194°
Shape: up/down: Linear; **across:** Linear
Surface Fragments: none.

Drainage: Moderately well drained
Runoff: Low
Erosion: None - deposition

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Shrubby rangeland
Existing Vegetation: CHRYS9 - rabbitbrush (*Chrysothamnus*); LESAS - Salina wildrye (*Leymus salinus ssp. salinus*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)
Diagnostic Features: Secondary carbonates: 22 to 154 centimeters (8.7 to 60.6 inches)

A --- 0 to 22 centimeters (0 to 8.7 inches); light gray (10YR 7/2) dry, silty clay; grayish brown (10YR 5/2) moist; 10 percent sand; 44 percent silt; 46 percent clay; moderate medium platy parting to weak medium subangular blocky structure; very friable, slightly hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores finely disseminated carbonates; electrical conductivity of 0.35 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; clear; CaCO3 47.9 percent.

Bk1 --- 22 to 43 centimeters (8.7 to 16.9 inches); very pale brown (10YR 7/3) dry, clay; grayish brown (10YR 5/2) moist; 9 percent sand; 39 percent silt; 53 percent clay; moderate medium prismatic parting to moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 5 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.37 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; gradual; CaCO3 50.4 percent.

Bk2 --- 43 to 67 centimeters (16.9 to 26.4 inches); white (2.5Y 8/1) dry, silty clay; light brownish gray (2.5Y 6/2) moist; 6 percent sand; 44 percent silt; 50 percent clay; 8 percent fine prominent strong brown (7.5YR 5/6) mottles; structure; friable, hard, very sticky, very plastic; common very fine roots throughout; common very fine tubular pores; 12 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.26 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; gradual; CaCO3 50.1 percent.

Bk3 --- 67 to 154 centimeters (26.4 to 60.6 inches); pale yellow (2.5Y 8/2) dry, loam; light gray (2.5Y 7/2) moist; 37 percent sand; 42 percent silt; 21 percent clay; 3 percent fine prominent strong brown (7.5YR 5/6) mottles; massive; friable, hard, slightly sticky, slightly plastic; many very fine interstitial pores; 10 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.35 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; gradual; CaCO3 45.9 percent.

2C1 --- 154 to 242 centimeters (60.6 to 95.3 inches); pale yellow (2.5Y 7/4) dry, sandy loam; light yellowish brown (2.5Y 6/3) moist; 63 percent sand; 28 percent silt; 9 percent clay; 3 percent fine prominent brownish yellow (10YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; electrical conductivity of 0.28 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; clear; CaCO3 32.4 percent.

2C2 --- 242 to 363 centimeters (95.3 to 142.9 inches); light gray (2.5Y 7/2) dry, sandy loam; light brownish gray (2.5Y 6/2) moist; 58 percent sand; 31 percent silt; 11 percent clay; single grain; loose, loose, nonsticky, nonplastic; common very fine interstitial pores; electrical

conductivity of 0.52 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; gradual; CaCO3 31.6 percent.

3C1 --- 363 to 408 centimeters (142.9 to 160.6 inches); pale yellow (2.5Y 8/4) dry, silty clay loam; light yellowish brown (2.5Y 6/4) moist; 18 percent sand; 43 percent silt; 39 percent clay; 15 percent medium distinct yellowish brown (10YR 5/6) mottles; massive; firm, very hard, moderately sticky, moderately plastic; 5 percent (common) fine masses of carbonate in matrix; electrical conductivity of 1.87 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; clear; CaCO3 42.8 percent.

3C2 --- 408 to 548 centimeters (160.6 to 215.7 inches); pale yellow (2.5Y 8/2) dry, loam; light gray (2.5Y 7/2) moist; 38 percent sand; 42 percent silt; 20 percent clay; 5 percent medium prominent brownish yellow (10YR 6/6) mottles; massive; friable, very hard, slightly sticky, nonplastic; 12 percent (common) medium masses of carbonate in matrix; electrical conductivity of 1.96 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 47 percent.

4C --- 548 to 610 centimeters (215.7 to 240.2 inches); pale yellow (2.5Y 8/3) dry, sandy loam; light yellowish brown (2.5Y 6/4) moist; 59 percent sand; 32 percent silt; 9 percent clay; 3 percent fine prominent brownish yellow (10YR 6/8) mottles; single grain and massive; very friable, slightly hard, nonsticky, nonplastic; many very fine interstitial pores; electrical conductivity of 2.2 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; box sample is similar to weathered Tropic sandstone; clear; CaCO3 32 percent.

5Ck --- 610 to 810 centimeters (240.2 to 318.9 inches); very pale brown (10YR 8/2) dry, clay loam; light brownish gray (10YR 6/2) moist; 26 percent sand; 40 percent silt; 34 percent clay; 8 percent medium prominent brownish yellow (10YR 6/8) mottles; massive; firm, very hard, moderately sticky, moderately plastic; 5 percent (common) medium masses of carbonate in matrix; electrical conductivity of 1.98 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; box sample is similar to weathered Tropic shale; clear; CaCO3 29.3 percent.

6C --- 810 to 852 centimeters (318.9 to 335.4 inches); pale yellow (2.5Y 8/2) dry, loamy sand; light yellowish brown (2.5Y 6/3) moist; 86 percent sand; 9 percent silt; 5 percent clay; 30 percent coarse distinct olive yellow (2.5Y 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; electrical conductivity of 1.69 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; box sample is similar to a mix of weathered Tropic sandstone and shale; CaCO3 19.4 percent.

12AS020

Pedon ID: 12AS020

Description Date: 11/27/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 26% and 9% fine sand or coarser in control section.

Current Taxonomic Name: CCC family
Current Taxonomic Class: Fine-silty, carbonatic, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369879E, 4143461N -- Datum NAD83, Zone 12
Legal Description: Section 12, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Tread
Profile Pos: Summit
Slope: 2 percent
Elevation: 2109.8 meters (6922 feet)
Aspect: 324°
Shape: up/down: Linear; **across:** Linear
Surface Fragments: none.

Drainage: Poorly drained
Runoff: Low
Erosion: None - deposition

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Secondary carbonates: 30 to 300 centimeters (11.8 to 118.1 inches), Calcic horizon: 30 to 140 centimeters (11.8 to 55.1 inches) and Aquic conditions: 300 to 610 centimeters (118.1 to 240.2 inches)

Ap --- 0 to 13 centimeters (0 to 5.1 inches); gray (2.5Y 6/1) dry, clay loam; dark grayish brown (2.5Y 4/2) moist; 20 percent sand; 49 percent silt; 31 percent clay; moderate medium

platy parting to moderate medium granular structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.59 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 38.2 percent.

BAkp --- 13 to 30 centimeters (5.1 to 11.8 inches); gray (2.5Y 6/1) dry, silty clay loam; dark grayish brown (2.5Y 4/2) moist; 12 percent sand; 51 percent silt; 37 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.29 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; clear; CaCO3 76.3 percent.

Bk1 --- 30 to 80 centimeters (11.8 to 31.5 inches); white (2.5Y 8/1) dry, silty clay; light brownish gray (2.5Y 6/2) moist; 10 percent sand; 50 percent silt; 40 percent clay; 2 percent fine prominent reddish yellow (7.5YR 6/6) mottles; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 2 percent (common) fine reddish yellow (7.5YR 6/6), moist; 20 percent (many) fine masses of carbonate in matrix; electrical conductivity of 0.3 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; clear; CaCO3 60.4 percent.

Bk2 --- 80 to 111 centimeters (31.5 to 43.7 inches); white (2.5Y 8/1) dry, silty clay; light brownish gray (2.5Y 6/2) moist; 8 percent sand; 51 percent silt; 41 percent clay; 5 percent fine prominent reddish yellow (7.5YR 6/6) mottles; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 5 percent (common) fine reddish yellow (7.5YR 6/6), moist; 25 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; clear; CaCO3 52.4 percent.

Ck --- 111 to 140 centimeters (43.7 to 55.1 inches); pale yellow (2.5Y 8/2) dry, silty clay loam; light yellowish brown (2.5Y 6/3) moist; 10 percent sand; 54 percent silt; 36 percent clay; 25 percent medium prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable, hard, slightly sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; 25 percent (many) medium strong brown (7.5YR 5/6), moist; 2 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.51 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; clear; CaCO3 44.9 percent.

2Ck1 --- 140 to 175 centimeters (55.1 to 68.9 inches); white (2.5Y 8/1) dry, silt loam; light gray (2.5Y 7/1) moist; 10 percent sand; 64 percent silt; 26 percent clay; 3 percent medium prominent reddish yellow (7.5YR 6/6) and 4 percent fine prominent reddish yellow (7.5YR 6/6) mottles; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common very fine roots throughout; 15 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.66 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.7, pH meter; clear; CaCO3 54.2 percent.

2Ck2 --- 175 to 300 centimeters (68.9 to 118.1 inches); white (2.5Y 8/1) dry, loam; light gray (2.5Y 7/1) moist; 38 percent sand; 40 percent silt; 22 percent clay; 20 percent coarse prominent olive yellow (2.5Y 6/6) mottles; massive; firm, very hard, slightly sticky, slightly plastic; 5 percent (common) medium masses of carbonate in matrix; electrical conductivity of 1.48 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; 2-8 cm LS Lenses; clear; CaCO3 35.4 percent.

2C1 --- 300 to 488 centimeters (118.1 to 192.1 inches); light gray (2.5Y 7/1) dry, sandy loam; gray (2.5Y 5/1) moist; 56 percent sand; 30 percent silt; 14 percent clay; 8 percent medium prominent olive yellow (2.5Y 6/6) mottles; massive; firm, very hard, slightly sticky, nonplastic; electrical conductivity of 2.57 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; gradual; CaCO3 28.2 percent.

2C2 --- 488 to 600 centimeters (192.1 to 236.2 inches); pale yellow (2.5Y 8/2) dry, loam; light gray (2.5Y 7/2) moist; 32 percent sand; 48 percent silt; 20 percent clay; 8 percent medium prominent brownish yellow (10YR 6/6) mottles; massive; firm, very hard, nonsticky, nonplastic; electrical conductivity of 1.63 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 34.8 percent.

3C --- 600 to 610 centimeters (236.2 to 240.2 inches); yellow (2.5Y 7/6) dry, sand; olive yellow (2.5Y 6/6) moist; 88 percent sand; 7 percent silt; 5 percent clay; 15 percent medium faint brownish yellow (10YR 6/6) mottles; single grain; loose, loose, slightly sticky, nonplastic; electrical conductivity of 1.86 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; CaCO3 18.6 percent.

12AS021

Pedon ID: 12AS021

Description Date: 11/28/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 12% and 25% fine sand or coarser in control section.

Current Taxonomic Name: Atlatl family
Current Taxonomic Class: Coarse-loamy, carbonatic, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370292E, 4143151N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Tread
Profile Pos: Summit
Slope: 2 percent
Elevation: 2109.1 meters (6919.8 feet)
Aspect: 243°
Shape: up/down: Linear; **across:** Linear
Surface Fragments: none.

Drainage: Somewhat poorly drained
Runoff: Low
Erosion: None - deposition

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Secondary carbonates: 32 to 374 centimeters (12.6 to 147.2 inches), Calcic horizon: 32 to 150 centimeters (12.6 to 59.1 inches), Calcic horizon: 260 to 374 centimeters (102.4 to 147.2 inches), Secondary carbonates: 448 to 742 centimeters (176.4 to 292.1 inches) and Aquic conditions: 570 to 853 centimeters (224.4 to 335.8 inches)

Ap --- 0 to 9 centimeters (0 to 3.5 inches); pale brown (10YR 6/3) dry, clay loam; brown (10YR 4/3) moist; 24 percent sand; 41 percent silt; 35 percent clay; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.48 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 19.7 percent.

Bw --- 9 to 32 centimeters (3.5 to 12.6 inches); grayish brown (10YR 5/2) dry, clay loam; dark grayish brown (10YR 4/2) moist; 22 percent sand; 45 percent silt; 33 percent clay; moderate medium prismatic parting to moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.43 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 30.7 percent.

Bk1 --- 32 to 65 centimeters (12.6 to 25.6 inches); pink (7.5YR 8/4) dry, clay loam; light yellowish brown (10YR 6/4) moist; 22 percent sand; 46 percent silt; 32 percent clay; structure; friable, hard, slightly sticky, slightly plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 10 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.39 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.7, pH meter; clear; CaCO3 56.3 percent.

Bk2 --- 65 to 95 centimeters (25.6 to 37.4 inches); very pale brown (10YR 8/3) dry, silt loam; very pale brown (10YR 7/4) moist; 32 percent sand; 56 percent silt; 12 percent clay; 15 percent medium distinct reddish yellow (7.5YR 6/6) mottles; moderate medium subangular blocky structure; very friable, slightly hard, nonsticky, nonplastic; common very fine roots throughout; common very fine tubular pores; 15 percent (common) medium reddish yellow (7.5YR 6/6), moist; 15 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.33 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; very strongly alkaline, pH 9.4, pH meter; gradual; CaCO3 60.8 percent.

2Ck1 --- 95 to 150 centimeters (37.4 to 59.1 inches); pale yellow (2.5Y 8/3) dry, sandy loam; pale yellow (2.5Y 7/3) moist; 52 percent sand; 36 percent silt; 12 percent clay; 20 percent coarse prominent strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; friable, hard, nonsticky, nonplastic; common very fine roots throughout; common very fine tubular pores; 20 percent (many) coarse strong brown (7.5YR 5/8), moist; 4 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.34 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 9, pH meter; gradual; CaCO3 45.9 percent.

2Ck2 --- 150 to 202 centimeters (59.1 to 79.5 inches); very pale brown (10YR 7/3) dry, loamy sand; light yellowish brown (10YR 6/4) moist; 82 percent sand; 15 percent silt; 3 percent clay; 40 percent coarse prominent brownish yellow (10YR 6/8) mottles; moderate medium subangular blocky structure; very friable, slightly hard, nonsticky, nonplastic; many very fine interstitial pores; 40 percent (many) coarse brownish yellow (10YR 6/8), moist finely disseminated carbonates; electrical conductivity of 0.23 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; very strongly alkaline, pH 9.1, pH meter; abrupt; CaCO3 26.1 percent.

3Ck --- 202 to 260 centimeters (79.5 to 102.4 inches); white (2.5Y 8/1) dry, loamy sand; light gray (2.5Y 7/1) moist; 82 percent sand; 16 percent silt; 2 percent clay; 15 percent medium prominent brownish yellow (10YR 6/6) mottles; moderate medium subangular blocky structure; very friable, hard, nonsticky, nonplastic finely disseminated carbonates; electrical conductivity of 0.23 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 9, pH meter; abrupt; CaCO3 22.5 percent.

4Ckg --- 260 to 374 centimeters (102.4 to 147.2 inches); pale yellow (2.5Y 8/2) dry, silty clay; gray (2.5Y 5/1) moist; 0 percent sand; 59 percent silt; 41 percent clay; 30 percent coarse yellow (10YR 7/6) mottles; massive; firm, very hard, very sticky, moderately plastic; 20 percent (many) coarse prominent dark greenish gray (10Y 3/1), moist, reduced matrix; 12 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.54 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; lenses of LS 2-4 m thick; abrupt; CaCO3 47.8 percent.

5C --- 374 to 448 centimeters (147.2 to 176.4 inches); pale yellow (2.5Y 7/4) dry, sandy loam; (2.5Y 4/6) moist; 73 percent sand; 21 percent silt; 6 percent clay; 10 percent medium distinct brownish yellow (10YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; electrical conductivity of 2.36 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; abrupt; CaCO3 19.4 percent.

6Ck --- 448 to 524 centimeters (176.4 to 206.3 inches); very pale brown (10YR 7/4) dry, gravelly sandy loam; yellowish brown (10YR 5/6) moist; 75 percent sand; 19 percent silt; 6 percent clay; single grain; loose, loose, nonsticky, nonplastic; 3 percent (very few) carbonate coats on bottom surfaces of rock fragments finely disseminated carbonates; 30 percent subrounded calcareous sandstone gravels; electrical conductivity of 2.41 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; abrupt; CaCO3 31 percent.

7Ck1 --- 524 to 570 centimeters (206.3 to 224.4 inches); pale yellow (2.5Y 7/4) dry, silt loam; light yellowish brown (2.5Y 6/4) moist; 31 percent sand; 52 percent silt; 17 percent clay; 10 percent medium distinct brownish yellow (10YR 6/6) mottles; massive; friable, very hard, slightly sticky, nonplastic finely disseminated carbonates; electrical conductivity of 2.75 mmhos/cm by EC

meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; abrupt; CaCO3 35.2 percent.

7Ckg2 --- 570 to 660 centimeters (224.4 to 259.8 inches); light gray (10YR 7/2) dry, loam; grayish brown (10YR 5/2) moist; 37 percent sand; 37 percent silt; 26 percent clay; 25 percent coarse prominent yellowish red (5YR 5/6) mottles; massive; friable, very hard, slightly sticky, slightly plastic; 15 percent (common) medium prominent dark greenish gray (5GY 4/1), moist, reduced matrix finely disseminated carbonates; electrical conductivity of 2.85 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.4, pH meter; clear; CaCO3 24.6 percent.

8Ck --- 660 to 742 centimeters (259.8 to 292.1 inches); pale yellow (2.5Y 7/4) dry, sandy loam; light olive brown (2.5Y 5/4) moist; 73 percent sand; 17 percent silt; 10 percent clay; 8 percent medium distinct brownish yellow (10YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic finely disseminated carbonates; electrical conductivity of 2.68 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 22.9 percent.

9C --- 742 to 853 centimeters (292.1 to 335.8 inches); very pale brown (10YR 7/4) dry, extremely gravelly loamy sand; yellowish brown (10YR 5/4) moist; 81 percent sand; 13 percent silt; 6 percent clay; 20 percent medium distinct reddish yellow (7.5YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; 25 percent (many) coarse prominent dark greenish gray (5GY 4/1), moist, reduced matrix; 61 percent subrounded calcareous sandstone gravels; electrical conductivity of 0.71 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; CaCO3 70.7 percent.

12AS022

Pedon ID: 12AS022

Description Date: 11/28/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 0% and 82% fine sand or coarser in control section.

Current Taxonomic Name: DDD
Current Taxonomic Class: Sandy-skeletal, carbonatic, mesic, Oxyaquic Ustifluvents
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370095E, 4142936N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: stream terrace
Geomorphic Component: Base Slope
Profile Pos: Toeslope
Slope: 6 percent
Elevation: 2095.1 meters (6873.6 feet)
Aspect: 272°
Shape: up/down: Linear; **across:** Convex
Surface Fragments: subrounded sandstone - 20 percent gravels, 3 cobbles, 2 percent stones, and 10 channers.

Drainage: Very poorly drained
Runoff: Low
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Native shrubs

Existing Vegetation: SALVI - sage (*Salvia*); JUSC2 - Rocky Mountain juniper (*Juniperus scopulorum*); LESAS - Salina wildrye (*Leymus salinus ssp. salinus*); ELAN - Russian olive (*Elaeagnus angustifolia*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

A --- 0 to 12 centimeters (0 to 4.7 inches); light olive brown (2.5Y 5/3) moist, very gravelly loamy sand; pale yellow (2.5Y 7/3) dry; 84 percent sand; 14 percent silt; 2 percent clay; weak medium subangular blocky parting to single grain structure; very friable, slightly hard, nonsticky, nonplastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; 40 percent subrounded sandstone gravels; electrical conductivity of 0.28 mmhos/cm by EC meter, saturated paste; by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; clear; CaCO3 53.1 percent.

C1 --- 12 to 50 centimeters (4.7 to 19.7 inches); light olive brown (2.5Y 5/3) moist, extremely gravelly sand; light yellowish brown (2.5Y 6/3) dry; 90 percent sand; 8 percent silt; 2 percent clay; 4 percent medium reddish yellow (5YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; common fine roots throughout and common very fine roots throughout; 4 percent (common) medium reddish yellow (5YR 6/6), moist; 33 percent subrounded limestone gravels and 33 percent subrounded sandstone gravels; electrical conductivity of 0.25 mmhos/cm by EC meter, saturated paste; by HCl, 1 normal; very strongly alkaline, pH 9.3, pH meter; clear; CaCO3 62.2 percent.

C2 --- 50 to 87 centimeters (19.7 to 34.3 inches); light yellowish brown (10YR 6/4) moist, extremely gravelly sand; very pale brown (10YR 7/4) dry; 86 percent sand; 12 percent silt; 2 percent clay; 12 percent medium reddish yellow (5YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; common very fine roots throughout; 2 percent (very few) faint carbonate coats on bottom faces of peds; 12 percent (common) medium reddish yellow (5YR 6/6), moist; 30 percent subrounded limestone gravels and 33 percent subrounded sandstone gravels; electrical conductivity of 0.36 mmhos/cm by EC meter, saturated paste; by HCl, 1 normal; very strongly alkaline, pH 9.2, pH meter; gradual; CaCO3 60.5 percent.

C3 --- 87 to 126 centimeters (34.3 to 49.6 inches); light yellowish brown (10YR 6/4) moist, extremely gravelly sand; very pale brown (10YR 7/4) dry; 90 percent sand; 9 percent silt; 1 percent clay; 10 percent medium reddish yellow (5YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; common very fine roots throughout; 10 percent (common) medium reddish yellow (5YR 6/6), moist; 33 percent limestone gravels and 33 percent subrounded sandstone gravels; electrical conductivity of 0.37 mmhos/cm by EC meter, saturated paste; by HCl, 1 normal; strongly alkaline, pH 9, pH meter; clear; CaCO3 61.9 percent.

C4 --- 126 to 160 centimeters (49.6 to 63 inches); gray (2.5Y 6/1) moist, extremely gravelly loamy sand; light gray (2.5Y 7/1) dry; 82 percent sand; 15 percent silt; 3 percent clay; 1 percent medium greenish gray (10Y 6/1) and 4 percent medium yellowish red (5YR 5/6) mottles; single grain; loose, loose, nonsticky, nonplastic; 20 percent (many) greenish gray (10Y 6/1), moist and 5 percent (common) medium yellowish red (5YR 5/6), moist; 35 percent subrounded limestone gravels and 35 percent subrounded sandstone gravels; electrical conductivity of 0.62 mmhos/cm by EC meter, saturated paste; by HCl, 1 normal; strongly alkaline, pH 8.8, pH meter; clear; CaCO3 68.2 percent.

C5 --- 160 to 210 centimeters (63 to 82.7 inches); pale brown (10YR 6/3) moist, extremely gravelly loamy sand; light gray (10YR 7/2) dry; 84 percent sand; 14 percent silt; 2 percent clay; 8 percent medium yellowish red (5YR 5/6) mottles; single grain; loose, loose, nonsticky, nonplastic; 8 percent (common) medium yellowish red (5YR 5/6), moist; 37 percent subrounded limestone gravels and 37 percent subrounded sandstone gravels; electrical conductivity of 0.59 mmhos/cm by EC meter, saturated paste; by HCl, 1 normal; very strongly alkaline, pH 9.2, pH meter; clear; CaCO3 68.6 percent.

2C --- 210 to 232 centimeters (82.7 to 91.3 inches); gray (N 5/) moist, loamy sand; light gray (N 7/) dry; 80 percent sand; 16 percent silt; 4 percent clay; single grain; loose, loose, nonsticky, nonplastic; 1 percent subrounded sandstone gravels; electrical conductivity of 2.01 mmhos/cm by EC meter, saturated paste; by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; CaCO3 22.9 percent.

12AS023

Pedon ID: 12AS023

Description Date: 11/28/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 14% and 56% fine sand or coarser in control section.

Current Taxonomic Name: Bobknoll family
Current Taxonomic Class: Coarse-loamy, mixed, superactive, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370303E, 4143404N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: fan apron, and terrace
Geomorphic Component: Tread
Profile Pos: Summit
Slope: 4 percent
Elevation: 2116 meters (6942.3 feet)
Aspect: 214°
Shape: up/down: Linear; **across:** Linear
Surface Fragments: subangular stone - 5 percent gravels.

Drainage: Well drained
Runoff: Low
Erosion: None - deposition

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland
Existing Vegetation: pasture grasses (not identifiable)

Parent Materials: slope alluvium derived from sandstone and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)
Diagnostic Features: Calcic horizon: 18 to 180 centimeters (7.1 to 70.9 inches)

Ap --- 0 to 18 centimeters (0 to 7.1 inches); yellowish brown (10YR 5/4) dry, sandy clay loam; dark brown (10YR 3/3) moist; 50 percent sand; 25 percent silt; 25 percent clay; moderate medium platy structure; friable, hard, slightly sticky, slightly plastic; common

medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; 3 percent subangular sandstone gravels; electrical conductivity of 0.41 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 16.7 percent.

Bk1 --- 18 to 47 centimeters (7.1 to 18.5 inches); pale brown (10YR 6/3) dry, sandy clay loam; brown (10YR 5/3) moist; 51 percent sand; 25 percent silt; 24 percent clay; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 2 percent (very few) carbonate coats on bottom surfaces of rock fragments; 5 percent (common) fine masses of carbonate in matrix; 10 percent subangular sandstone gravels; electrical conductivity of 0.32 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; gradual; CaCO3 22.9 percent.

Bk2 --- 47 to 78 centimeters (18.5 to 30.7 inches); light yellowish brown (10YR 6/4) dry, sandy loam; yellowish brown (10YR 5/4) moist; 64 percent sand; 18 percent silt; 18 percent clay; weak fine subangular blocky structure; very friable, slightly hard, nonsticky, nonplastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 5 percent (few) carbonate coats on bottom surfaces of rock fragments; 8 percent (common) fine masses of carbonate in matrix; 3 percent subangular sandstone gravels; electrical conductivity of 0.26 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; gradual; CaCO3 31.5 percent.

Bk3 --- 78 to 120 centimeters (30.7 to 47.2 inches); very pale brown (10YR 7/4) dry, sandy loam; light yellowish brown (10YR 6/4) moist; 60 percent sand; 26 percent silt; 14 percent clay; single grain; loose, loose, nonsticky, nonplastic; common fine roots throughout and common very fine roots throughout; common very fine interstitial pores; 2 percent (very few) carbonate coats on bottom surfaces of rock fragments finely disseminated carbonates; 6 percent subangular sandstone gravels; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; abrupt; CaCO3 22.2 percent.

2C --- 120 to 180 centimeters (47.2 to 70.9 inches); light gray (10YR 7/2) dry, extremely gravelly loamy sand; light brownish gray (10YR 6/2) moist; 84 percent sand; 8 percent silt; 8 percent clay; single grain; loose, loose, nonsticky, nonplastic; common very fine roots throughout; common very fine interstitial pores finely disseminated carbonates; 64 percent subangular sandstone gravels; electrical conductivity of 0.26 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.7, pH meter; no CO_3 coats on Rocks; clear; CaCO3 31.4 percent.

3C --- 180 to 230 centimeters (70.9 to 90.6 inches); very pale brown (10YR 7/3) dry, gravelly loamy sand; pale brown (10YR 6/3) moist; 80 percent sand; 14 percent silt; 6 percent clay; 10 percent medium distinct yellow (10YR 7/6) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; 18 percent subangular calcareous sandstone gravels; electrical conductivity of 0.2 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; CaCO3 19.2 percent.

12AS024

Pedon ID: 12AS024

Description Date: 11/28/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 0% and 76% fine sand or coarser in control section.

Current Taxonomic Name: Vigil taxadjunct
Current Taxonomic Class: Sandy-skeletal, carbonatic, mesic Oxyaquic Ustifluvents
Current Taxon Kind: Taxadjunct

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370261E, 4143588N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: stream terrace, and bar
Geomorphic Component: Tread
Profile Pos: Shoulder
Slope: 6 percent
Elevation: 2110.2 meters (6923.2 feet)
Aspect: 277°
Shape: up/down: Linear; **across:** Convex
Surface Fragments: subrounded sandstone and limestone - 40 percent gravels, 10 cobbles, 5 stones, and 15 percent channers.

Drainage: Poorly drained
Runoff: Low
Erosion: Class 2 - Sheet erosion

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Savanna rangeland

Existing Vegetation: SAME3 - black sage (*Salvia mellifera*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: alluvium derived from limestone and sandstone and/or alluvium derived from calcareous conglomerate

Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)
Diagnostic Features: Aquic conditions: 136 to 305 centimeters (53.5 to 120.1 inches)

A --- 0 to 18 centimeters (0 to 7.1 inches); pale brown (10YR 6/3) dry, extremely gravelly sandy loam; brown (10YR 5/3) moist; 74 percent sand; 20 percent silt; 6 percent clay; weak medium subangular blocky parting to single grain structure; very friable, slightly hard, nonsticky, nonplastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; many very fine interstitial pores; 31 percent subrounded limestone gravels and 32 percent subrounded sandstone gravels; electrical conductivity of 0.22 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; very strongly alkaline, pH 9.1, pH meter; clear; CaCO3 56.7 percent.

C1 --- 18 to 84 centimeters (7.1 to 33.1 inches); very pale brown (10YR 7/4) dry, extremely gravelly loamy sand; light yellowish brown (10YR 6/4) moist; 80 percent sand; 18 percent silt; 2 percent clay; 6 percent medium distinct reddish yellow (7.5YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; common very fine roots throughout; many very fine interstitial pores; 6 percent (common) medium reddish yellow (7.5YR 6/6), moist; 30 percent subrounded limestone gravels and 35 percent subrounded sandstone gravels; electrical conductivity of 0.2 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; very strongly alkaline, pH 9.3, pH meter; gradual; CaCO3 56.6 percent.

C2 --- 84 to 136 centimeters (33.1 to 53.5 inches); pale brown (10YR 6/3) dry, extremely gravelly sand; brown (10YR 5/3) moist; 88 percent sand; 10 percent silt; 2 percent clay; 10 percent medium prominent red (7.5R 5/6) mottles; single grain; loose, loose, nonsticky, nonplastic; common very fine roots throughout; many very fine interstitial pores; 10 percent (common) medium reddish yellow (7.5YR 6/6), moist; 30 percent subrounded 2 limestone gravels and 31 percent subrounded sandstone gravels; electrical conductivity of 0.18 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; very strongly alkaline, pH 9.4, pH meter; clear; CaCO3 55.7 percent.

C3 --- 136 to 186 centimeters (53.5 to 73.2 inches); very pale brown (10YR 7/4) dry, extremely gravelly loamy sand; yellowish brown (10YR 5/4) moist; 84 percent sand; 14 percent silt; 2 percent clay; 20 percent medium prominent reddish yellow (5YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; 20 percent (many) medium reddish yellow (5YR 6/6), moist; 30 percent subrounded limestone gravels and 30 percent subrounded sandstone gravels; electrical conductivity of 0.78 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; very strongly alkaline, pH 9.3, pH meter; gradual; CaCO3 54.7 percent.

C4 --- 186 to 243 centimeters (73.2 to 95.7 inches); light gray (10YR 7/2) dry, very gravelly sand; light brownish gray (10YR 6/2) moist; 88 percent sand; 11 percent silt; 1 percent clay; 15 percent medium prominent reddish yellow (5YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; 3 percent (common) fine prominent dark bluish gray (5B 4/1), moist, reduced matrix; 27 percent subrounded limestone gravels and 27 percent subrounded sandstone gravels; electrical conductivity

of 0.55 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; very strongly alkaline, pH 9.1, pH meter; clear; CaCO3 53.7 percent.

2C --- 243 to 305 centimeters (95.7 to 120.1 inches); pale yellow (2.5Y 7/3) dry, loamy sand; light yellowish brown (2.5Y 6/3) moist; 88 percent sand; 12 percent silt; 8 percent clay; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; electrical conductivity of 1.19 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; collection of sample from this horizon required tabs on end of collection tube to keep sample from flowing out.; CaCO3 20.2 percent.

12AS025

Pedon ID: 12AS025

Description Date: 11/29/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 16% and 16% fine sand or coarser in control section.

Current Taxonomic Name: Atlatl family
Current Taxonomic Class: Coarse-loamy, carbonatic, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370090E, 4143492N -- Datum NAD83, Zone 12
Location Description:
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Tread
Profile Pos: Summit
Slope: 2 percent
Elevation: 2091 meters (6860.2 feet)
Aspect: 236°
Shape: up/down: Linear; **across:** Linear
Surface Fragments: none.

Drainage: Poorly drained
Runoff: Low
Erosion: None - deposition

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: MEDIC - alfalfa (*Medicago*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Secondary carbonates: 30 to 101 centimeters (11.8 to 39.8 inches), Calcic horizon: 30 to 101 centimeters (11.8 to 39.8 inches), Secondary carbonates: 123 to 204

centimeters (48.4 to 80.3 inches) and Calcic horizon: 123 to 156 centimeters (48.4 to 61.4 inches)

Ap1 --- 0 to 12 centimeters (0 to 4.7 inches); light brownish gray (10YR 6/2) dry, silt loam; dark grayish brown (10YR 4/2) moist; 22 percent sand; 56 percent silt; 22 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.57 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 27.3 percent.

Ap2 --- 12 to 30 centimeters (4.7 to 11.8 inches); light brownish gray (10YR 6/2) dry, silty clay; dark grayish brown (10YR 4/2) moist; 16 percent sand; 41 percent silt; 43 percent clay; weak medium prismatic parting to moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.5 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; clear; CaCO3 45.3 percent.

Bk1 --- 30 to 70 centimeters (11.8 to 27.6 inches); very pale brown (10YR 8/3) dry, silty clay loam; very pale brown (10YR 7/3) moist; 12 percent sand; 56 percent silt; 32 percent clay; 5 percent fine very pale brown (10YR 7/4) mottles; moderate fine subangular blocky structure; very friable, slightly hard, slightly sticky, slightly plastic; common very fine roots throughout; common very fine tubular pores; 5 percent (common) fine very pale brown (10YR 7/4), moist; 15 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.36 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; gradual; CaCO3 55 percent.

Bk2 --- 70 to 101 centimeters (27.6 to 39.8 inches); white (2.5Y 8/1) dry, loam; light gray (2.5Y 7/2) moist; 32 percent sand; 49 percent silt; 19 percent clay; 15 percent medium very pale brown (10YR 7/4) mottles; moderate medium subangular blocky structure; very friable, slightly hard, slightly sticky, nonplastic; common fine roots throughout; common very fine tubular pores; 15 percent (common) medium very pale brown (10YR 7/4), moist; 25 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.7, pH meter; abrupt; CaCO3 53.3 percent.

2C --- 101 to 123 centimeters (39.8 to 48.4 inches); white (10YR 8/1) dry, loam; light gray (10YR 7/1) moist; 38 percent sand; 46 percent silt; 16 percent clay; 5 percent fine very pale brown (10YR 7/4) mottles; single grain; loose, loose, nonsticky, nonplastic; many very

fine interstitial pores; 5 percent (common) fine very pale brown (10YR 7/4), moist; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 8.8, pH meter; abrupt; CaCO3 44.6 percent.

4Ck --- 123 to 156 centimeters (48.4 to 61.4 inches); white (2.5Y 8/1) dry, clay loam; light gray (2.5Y 7/1) moist; 20 percent sand; 44 percent silt; 36 percent clay; 20 percent medium yellow (2.5Y 7/6) mottles; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common very fine tubular pores; 20 percent (many) medium yellow (2.5Y 7/6), moist; 20 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.33 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 8.8, pH meter; clear; CaCO3 50.1 percent.

5Ck1 --- 156 to 186 centimeters (61.4 to 73.2 inches); pale yellow (2.5Y 8/2) dry, sandy loam; light gray (2.5Y 7/2) moist; 58 percent sand; 26 percent silt; 16 percent clay; 10 percent medium yellow (2.5Y 7/6) mottles; moderate medium subangular blocky structure; very friable, slightly hard, nonsticky, nonplastic; many very fine interstitial pores; 10 percent (common) medium yellow (2.5Y 7/6), moist; 10 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 8.9, pH meter; gradual; CaCO3 30.1 percent.

5Ck2 --- 186 to 204 centimeters (73.2 to 80.3 inches); pale yellow (2.5Y 7/3) dry, sandy loam; light yellowish brown (2.5Y 6/3) moist; 60 percent sand; 32 percent silt; 8 percent clay; 20 percent medium yellow (2.5Y 7/6) mottles; moderate medium subangular blocky structure; very friable, slightly hard, nonsticky, nonplastic; many very fine interstitial pores; 20 percent (many) medium yellow (2.5Y 7/6), moist; 8 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.27 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 8.9, pH meter; CaCO3 30.6 percent.

12AS026

Pedon ID: 12AS026

Description Date: 11/29/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 28% and 23% fine sand or coarser in control section.

Current Taxonomic Name: Wimmer family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369892E, 4143755N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: fan apron, and terrace
Geomorphic Component: Tread
Profile Pos: Toeslope
Slope: 5 percent
Elevation: 2118 meters (6948.8 feet)
Aspect: 177°
Shape: up/down: Linear; **across:** Linear
Surface Fragments: none.

Drainage: Moderately well drained
Runoff: Medium
Erosion: None - deposition

Primary Earth Cover: Grass/herbaceous cover

Existing Vegetation: BROMU - brome (*Bromus*); LESA4 - saline wildrye (*Leymus salinus*); ROWO - Woods' rose (*Rosa woodsii*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Secondary carbonates: 3 to 202 centimeters (1.2 to 79.5 inches), Calcic horizon: 20 to 65 centimeters (7.9 to 25.6 inches) and Calcic horizon: 104 to 202 centimeters (40.9 to 79.5 inches)

Oi --- 0 to 3 centimeters (0 to 1.2 inches); decomposing grass and leaves.

Ap --- 3 to 20 centimeters (1.2 to 7.9 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 20 percent sand; 39 percent silt; 41 percent clay; moderate medium platy parting to moderate medium granular structure; very friable, slightly hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; 3 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.73 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 28.8 percent.

Bk1 --- 20 to 65 centimeters (7.9 to 25.6 inches); pale brown (10YR 6/3) dry, clay loam; brown (10YR 5/3) moist; 20 percent sand; 47 percent silt; 33 percent clay; moderate medium subangular blocky structure; friable, slightly hard, slightly sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; 10 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.65 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 33.6 percent.

Bk2 --- 65 to 104 centimeters (25.6 to 40.9 inches); light gray (10YR 7/1) dry, clay loam; gray (10YR 5/1) moist; 30 percent sand; 31 percent silt; 39 percent clay; moderate medium prismatic parting to moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 4 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.51 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 30.9 percent.

Bk3 --- 104 to 144 centimeters (40.9 to 56.7 inches); gray (10YR 6/1) dry, silty clay; gray (10YR 5/1) moist; 10 percent sand; 41 percent silt; 49 percent clay; 2 percent fine prominent reddish yellow (7.5YR 6/6) mottles; moderate medium prismatic parting to strong medium angular blocky structure; firm, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 2 percent (common) fine reddish yellow (7.5YR 6/6), moist; 4 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.51 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 48.8 percent.

Ck --- 144 to 202 centimeters (56.7 to 79.5 inches); white (2.5Y 8/1) dry, clay; light gray (2.5Y 7/2) moist; 20 percent sand; 37 percent silt; 43 percent clay; 15 percent medium prominent reddish yellow (7.5YR 6/6) mottles; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common very fine roots

throughout; common very fine tubular pores; 15 percent (common) medium reddish yellow (7.5YR 6/6), moist; 30 percent (many) coarse masses of carbonate in matrix; electrical conductivity of 0.36 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; $CaCO_3$ 53.8 percent.

12AS027

Pedon ID: 12AS027

Description Date: 11/29/2012
Describer: Robert Long

Pedon Notes: Text: Non-carbonate clay 30% and 23% fine sand and coarser in control section.

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 396896E, 4143931N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: fan apron, and terrace
Geomorphic Component: Tread
Profile Pos: Toeslope
Slope: 1 percent
Elevation: 2117.9 meters (6948.5 feet)
Aspect: 45°
Shape: up/down: Linear; **across:** Linear
Surface Fragments: subangular sandstone - 5 percent gravels.

Drainage: Moderately well drained
Runoff: Low
Erosion: None - deposition

Earth Cover: Grass/herbaceous cover

Existing Vegetation: BROMU - brome (*Bromus*); LESAS - Salina wildrye (*Leymus salinus ssp. salinus*); ROWO - Woods' rose (*Rosa woodsii*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 20 to 100 centimeters (7.9 to 39.4 inches), Secondary carbonates: 52 to 560 centimeters (20.5 to 220.5 inches), Calcic horizon: 52 to 100

centimeters (20.5 to 39.4 inches), Calcic horizon: 116 to 305 centimeters (45.7 to 120.1 inches) and Aquic conditions: 625 to 792 centimeters (246.1 to 311.8 inches)

Ap --- 0 to 20 centimeters (0 to 7.9 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 24 percent sand; 36 percent silt; 40 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.59 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; abrupt; CaCO3 26.4 percent.

Bss --- 20 to 52 centimeters (7.9 to 20.5 inches); light brownish gray (10YR 6/2) dry, clay loam; dark grayish brown (10YR 4/2) moist; 24 percent sand; 40 percent silt; 36 percent clay; moderate medium prismatic parting to moderate medium subangular blocky structure; friable, very hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 25 percent (common) pressure faces on all faces of peds; electrical conductivity of 0.44 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear; CaCO3 26.5 percent.

Bkss --- 52 to 100 centimeters (20.5 to 39.4 inches); pale brown (10YR 6/3) dry, clay loam; brown (10YR 5/3) moist; 26 percent sand; 36 percent silt; 38 percent clay; structure; friable, very hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 5 percent (few) pressure faces on all faces of peds; 3 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.45 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; 2 narrow bands of SL 3-4 cm thick; clear; CaCO3 33.4 percent.

Bk1 --- 100 to 116 centimeters (39.4 to 45.7 inches); light gray (2.5Y 7/1) dry, clay loam; gray (2.5Y 6/1) moist; 34 percent sand; 30 percent silt; 36 percent clay; 10 percent medium prominent brownish yellow (10YR 6/6) mottles; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 5 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.42 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; clear; CaCO3 29 percent.

Bk2 --- 116 to 156 centimeters (45.7 to 61.4 inches); gray (2.5Y 6/1) dry, silty clay loam; gray (2.5Y 5/1) moist; 12 percent sand; 50 percent silt; 38 percent clay; 5 percent medium prominent brownish yellow (10YR 6/6) mottles; moderate medium prismatic parting to strong medium angular blocky structure; firm, very hard, moderately sticky, moderately

plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 8 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.44 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; abrupt; CaCO3 46.6 percent.

2Bk1 --- 156 to 170 centimeters (61.4 to 66.9 inches); white (2.5Y 8/1) dry, silty clay; light gray (2.5Y 7/1) moist; 6 percent sand; 54 percent silt; 40 percent clay; 10 percent coarse prominent yellow (10YR 7/8) mottles; moderate medium prismatic parting to moderate medium angular blocky structure; friable, very hard, moderately sticky, moderately plastic; common fine roots throughout and many very fine roots throughout; common fine tubular pores; 30 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.45 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; gradual; CaCO3 51.6 percent.

2Bk2 --- 170 to 305 centimeters (66.9 to 120.1 inches); white (2.5Y 8/1) dry, silty clay; light gray (2.5Y 7/1) moist; 0 percent sand; 52 percent silt; 48 percent clay; 30 percent medium prominent reddish yellow (7.5YR 6/6) mottles; moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; 15 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.49 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear; CaCO3 46.2 percent.

2Bk3 --- 305 to 427 centimeters (120.1 to 168.1 inches); gray (2.5Y 6/1) dry, clay; gray (2.5Y 5/1) moist; 12 percent sand; 39 percent silt; 49 percent clay; 15 percent medium prominent brownish yellow (10YR 6/6) mottles; massive; firm, very hard, very sticky, very plastic; 3 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 0.59 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; clear; CaCO3 27.2 percent.

2Ck --- 427 to 560 centimeters (168.1 to 220.5 inches); gray (2.5Y 6/1) dry, silty clay; gray (2.5Y 5/1) moist; 4 percent sand; 37 percent silt; 59 percent clay; 15 percent medium prominent yellow (10YR 7/6) mottles; massive; firm, very hard, very sticky, very plastic finely disseminated carbonates; electrical conductivity of 0.6 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; gradual; CaCO3 29 percent.

3C1 --- 560 to 625 centimeters (220.5 to 246.1 inches); light yellowish brown (2.5Y 6/3) dry, loam; olive brown (2.5Y 4/3) moist; 46 percent sand; 32 percent silt; 22 percent clay; 15 percent coarse prominent brownish yellow (10YR 6/8) and 15 percent medium prominent brownish yellow (10YR 6/8) mottles; massive parting to single grain; friable, hard, slightly sticky, nonplastic; many very fine interstitial pores; electrical conductivity of 0.76 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear; CaCO3 26.5 percent.

3C2 --- 625 to 792 centimeters (246.1 to 311.8 inches); pale yellow (2.5Y 7/4) dry, sandy loam; light yellowish brown (2.5Y 6/4) moist; 64 percent sand; 26 percent silt; 10 percent clay; 35 percent coarse prominent brownish yellow (10YR 6/8) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; electrical conductivity of 0.88 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; CaCO3 24.9 percent.

12AS028

Pedon ID: 12AS028

Description Date: 11/29/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 20% and 24% fine sand and coarser in control section.

Current Taxonomic Name: CCC family similar
Current Taxonomic Class: Fine-loamy, carbonatic, mesic Aridic Haplustepts
Current Taxon Kind: Taxadjunct

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370260E, 4143851N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace
Anthropogenic Feature:
Geomorphic Component: Tread
Profile Pos: Toeslope
Slope: 4 percent
Elevation: 2121.1 meters (6959.1 feet)
Aspect: 263°
Shape: up/down: Linear; **across:** Linear
Surface Fragments: none.

Drainage: Poorly drained
Runoff: Low
Erosion: None - deposition

Earth Cover: Grass/herbaceous cover

Existing Vegetation: MEDIC - alfalfa (*Medicago*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 12 to 25 centimeters (4.7 to 9.8 inches), Secondary carbonates: 25 to 173 centimeters (9.8 to 68.1 inches), Secondary carbonates: 275 to

325 centimeters (108.3 to 128 inches) and Aquic conditions: 325 to 610 centimeters (128 to 240.2 inches)

Ap1 --- 0 to 12 centimeters (0 to 4.7 inches); light brownish gray (10YR 6/2) dry, clay; dark grayish brown (10YR 4/2) moist; 18 percent sand; 38 percent silt; 44 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.82 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 48.6 percent.

Bss --- 12 to 25 centimeters (4.7 to 9.8 inches); light brownish gray (2.5Y 6/2) dry, silty clay loam; dark grayish brown (2.5Y 4/2) moist; 18 percent sand; 43 percent silt; 39 percent clay; moderate medium subangular blocky parting to strong fine subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; 15 percent (few) pressure faces on vertical faces of peds; electrical conductivity of 0.63 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; abrupt; CaCO3 49.4 percent.

Bk1 --- 25 to 68 centimeters (9.8 to 26.8 inches); pale yellow (2.5Y 8/2) dry, silty clay; light gray (2.5Y 7/2) moist; 10 percent sand; 46 percent silt; 44 percent clay; 5 percent fine prominent pink (7.5YR 7/4) mottles; moderate medium subangular blocky structure; friable, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 5 percent (common) fine pink (7.5YR 7/4), moist; 10 percent (common) medium masses of carbonate on faces of peds; electrical conductivity of 0.36 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; abrupt; CaCO3 53.8 percent.

Bk2 --- 68 to 103 centimeters (26.8 to 40.6 inches); white (2.5Y 8/1) dry, sandy loam; light gray (2.5Y 7/1) moist; 52 percent sand; 36 percent silt; 12 percent clay; 5 percent medium reddish yellow (7.5YR 6/6) and 10 percent fine prominent reddish yellow (7.5YR 6/6) mottles; structure; friable, hard, nonsticky, nonplastic; common very fine roots throughout; common very fine tubular pores; 15 percent (common) fine reddish yellow (7.5YR 6/6), moist; 30 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.34 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; clear; CaCO3 42.6 percent.

Ck1 --- 103 to 128 centimeters (40.6 to 50.4 inches); white (2.5Y 8/1) dry, silty clay loam; light gray (2.5Y 7/1) moist; 12 percent sand; 56 percent silt; 32 percent clay; 25 percent

medium prominent reddish yellow (7.5YR 6/6) mottles; moderate medium subangular blocky structure; firm, very hard, slightly sticky, slightly plastic; common very fine roots throughout; 25 percent (many) medium reddish yellow (7.5YR 6/6), moist finely disseminated carbonates; electrical conductivity of 0.36 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; abrupt; CaCO3 47.1 percent.

Ck2 --- 128 to 157 centimeters (50.4 to 61.8 inches); pale yellow (2.5Y 8/2) dry, silty clay; light gray (2.5Y 7/2) moist; 12 percent sand; 46 percent silt; 42 percent clay; 35 percent medium prominent reddish yellow (7.5YR 6/6) mottles; weak medium subangular blocky structure; firm, very hard, very sticky, moderately plastic; common very fine roots throughout; 30 percent (common) clay films on all faces of peds; 35 percent (many) medium reddish yellow (7.5YR 6/6), moist finely disseminated carbonates; electrical conductivity of 0.38 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; abrupt; CaCO3 51.7 percent.

Ck3 --- 157 to 173 centimeters (61.8 to 68.1 inches); white (10YR 8/1) dry, loam; light gray (10YR 7/1) moist; 48 percent sand; 40 percent silt; 12 percent clay; 10 percent fine prominent reddish yellow (7.5YR 6/6) mottles; weak fine subangular blocky structure; friable, extremely hard, nonsticky, nonplastic; common very fine roots throughout finely disseminated carbonates; electrical conductivity of 0.35 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.8, pH meter; Stopped push probe; clear; CaCO3 46.7 percent.

C --- 173 to 235 centimeters (68.1 to 92.5 inches); pale yellow (2.5Y 8/2) dry, loam; light gray (2.5Y 7/1) moist; 50 percent sand; 38 percent silt; 12 percent clay; 40 percent coarse prominent yellow (10YR 7/8) mottles; massive parting to single grain; very friable, hard, nonsticky, nonplastic; common very fine roots throughout; many very fine interstitial pores; electrical conductivity of 0.52 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; abrupt; CaCO3 33.2 percent.

2C --- 235 to 275 centimeters (92.5 to 108.3 inches); grayish brown (2.5Y 5/2) dry, sandy loam; very dark grayish brown (2.5Y 3/2) moist; 72 percent sand; 18 percent silt; 10 percent clay; 5 percent fine prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky parting to single grain structure; very friable, hard, nonsticky, nonplastic; many very fine interstitial pores; electrical conductivity of 0.57 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; clear; CaCO3 18.7 percent.

2Ck --- 275 to 325 centimeters (108.3 to 128 inches); light gray (2.5Y 7/2) dry, sandy loam; light brownish gray (2.5Y 6/2) moist; 72 percent sand; 20 percent silt; 8 percent clay; 10 percent medium prominent reddish yellow (7.5YR 6/8) mottles; weak medium subangular blocky parting to single grain structure; very friable, hard, nonsticky,

nonplastic; many very fine interstitial pores finely disseminated carbonates; electrical conductivity of 0.77 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear; CaCO3 21.2 percent.

3C1 --- 325 to 460 centimeters (128 to 181.1 inches); light gray (2.5Y 7/2) dry, loam; light yellowish brown (2.5Y 6/3) moist; 28 percent sand; 46 percent silt; 26 percent clay; 15 percent medium prominent reddish yellow (7.5YR 6/8) mottles; massive; friable, extremely hard, slightly sticky, slightly plastic; common very fine tubular pores; 35 percent (many) coarse prominent light bluish gray (10B 7/1), moist, reduced matrix; electrical conductivity of 2.61 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 27.1 percent.

3C2 --- 460 to 610 centimeters (181.1 to 240.2 inches); light gray (2.5Y 7/2) dry, sandy loam; grayish brown (2.5Y 5/2) moist; 54 percent sand; 32 percent silt; 14 percent clay; 25 percent coarse brownish yellow (10YR 6/8) mottles; massive; friable, extremely hard, nonsticky, nonplastic; many very fine interstitial pores; 40 percent (many) coarse prominent light bluish gray (5PB 7/1), moist; electrical conductivity of 2.38 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; CaCO3 25.3 percent.

12AS029

Pedon ID: 12AS029

Description Date: 11/29/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 38%and 19% fine sand or coarser in control section; This profile appears to colluvium deposited over deep weathering Tropic shale and sandstone.; Aquic conditions determined to be from 244 to 610 cm based on saturated conditions and very gravelly sandy loam immediately above the saturated zone.

Current Taxonomic Name: Boxcanyon family
Current Taxonomic Class: Fine, smectitic, mesic Calcidic Haplustalfs
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370221E, 4144330N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: alluvial fan on terrace
Geomorphic Component: Tread
Profile Pos: Toeslope
Slope: 3 percent
Elevation: 2128.2 meters (6982.3 feet)
Aspect: 239°
Shape: up/down: Linear; **across:** Linear
Surface Fragments: subrounded sandstone - 1 percent gravels and 1 percent channers.

Drainage: Somewhat poorly drained
Runoff: Low
Site Ksat Class Upper:
Site Ksat Class Lower:
Erosion: None - deposition

Primary Earth Cover: Crop cover.
Existing Vegetation: MEDIC - alfalfa (*Medicago*)

Parent Materials: alluvium derived from limestone, sandstone, and shale and/or alluvium.

Particle Size Control Section: 14 to 64 centimeters (5.5 to 25.2 inches)
Diagnostic Features: Secondary carbonates: 14 to 58 centimeters (5.5 to 22.8 inches), Argillic horizon: 14 to 86 centimeters (5.5 to 33.9 inches), Calcic horizon: 36 to 58 centimeters (14.2 to 22.8 inches), Secondary carbonates: 86 to 244 centimeters (33.9 to 96.1 inches), Calcic horizon: 86 to 232 centimeters (33.9 to 91.3 inches) and Aquic conditions: 244 to 610 centimeters (96.1 to 240.2 inches).

Ap --- 0 to 14 centimeters (0 to 5.5 inches); light brownish gray (10YR 6/2) dry, sandy clay loam; dark grayish brown (10YR 4/2) moist; 46 percent sand; 24 percent silt; 30 percent clay; weak medium subangular blocky parting to moderate medium granular structure; very friable, slightly hard, slightly sticky, slightly plastic; common coarse roots throughout, common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 1.18 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; clear; CaCO3 25.6 percent.

Btk1 --- 14 to 36 centimeters (5.5 to 14.2 inches); light brownish gray (2.5Y 6/2) dry, clay loam; dark grayish brown (2.5Y 4/2) moist; 32 percent sand; 30 percent silt; 38 percent clay; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common coarse roots throughout, common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 10 percent (few) clay films between sand grains and 20 percent (few) clay films on all faces of peds; 1 percent (few) very fine masses of carbonate on vertical faces of peds; electrical conductivity of 0.4 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 16.5 percent.

Btk2 --- 36 to 58 centimeters (14.2 to 22.8 inches); light brownish gray (2.5Y 6/2) dry, silty clay; grayish brown (2.5Y 5/2) moist; 12 percent sand; 40 percent silt; 48 percent clay; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common coarse roots throughout, common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 40 percent (common) clay films on all faces of peds; 8 percent (common) very fine threadlike masses of carbonate on vertical faces of peds; electrical conductivity of 0.36 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; abrupt; CaCO3 24.1 percent.

2Btb --- 58 to 86 centimeters (22.8 to 33.9 inches); gray (2.5Y 6/1) dry, clay; dark gray (2.5Y 4/1) moist; 2 percent sand; 40 percent silt; 58 percent clay; strong medium angular blocky structure; firm, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 50 percent (many) clay films on all faces of peds; electrical conductivity of 0.45 mmhos/cm by EC meter, saturated paste; slightly effervescent by

HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; Buried surface; clear; CaCO3 39.2 percent.

2Bk1 --- 86 to 118 centimeters (33.9 to 46.5 inches); very pale brown (10YR 8/3) dry, silty clay; very pale brown (10YR 7/4) moist; 8 percent sand; 34 percent silt; 58 percent clay; 6 percent medium prominent reddish yellow (5YR 6/6) mottles; structure; friable, hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 6 percent (common) medium reddish yellow (5YR 6/6), moist; 25 percent (many) medium masses of carbonate on faces of peds; electrical conductivity of 0.36 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; gradual; CaCO3 51.2 percent.

2Bk2 --- 118 to 173 centimeters (46.5 to 68.1 inches); pale yellow (2.5Y 8/2) dry, silty clay loam; light gray (2.5Y 7/2) moist; 6 percent sand; 56 percent silt; 38 percent clay; 12 percent medium prominent reddish yellow (7.5YR 6/6) mottles; structure; very friable, slightly hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine interstitial pores; 12 percent (common) medium reddish yellow (7.5YR 6/6), moist; 35 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.38 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; clear; CaCO3 57.7 percent.

3Ck1 --- 173 to 232 centimeters (68.1 to 91.3 inches); white (2.5Y 8/1) dry, silty clay; light gray (2.5Y 7/1) moist; 8 percent sand; 40 percent silt; 52 percent clay; 10 percent medium prominent strong brown (7.5YR 5/6) and 15 percent fine prominent strong brown (7.5YR 5/6) mottles; strong medium platy structure; friable, very hard, very sticky, very plastic; common very fine roots throughout; 25 percent (many) fine strong brown (7.5YR 5/6), moist; 20 percent (many) medium masses of carbonate on faces of peds; electrical conductivity of 0.48 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; abrupt; CaCO3 47.1 percent.

3Ck2 --- 232 to 244 centimeters (91.3 to 96.1 inches); gray (2.5Y 6/1) dry, clay loam; gray (2.5Y 5/1) moist; 44 percent sand; 24 percent silt; 32 percent clay; 5 percent fine prominent strong brown (7.5YR 5/6) mottles; massive; very firm, extremely hard, slightly sticky, slightly plastic; 5 percent (common) fine strong brown (7.5YR 5/6), moist; 5 percent (common) medium masses of carbonate on faces of peds; 5 percent subrounded sandstone gravels; electrical conductivity of 4.85 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; compacted sediment; clear; CaCO3 24.9 percent.

4Ck --- 244 to 334 centimeters (96.1 to 131.5 inches); light gray (2.5Y 7/1) dry, very gravelly sandy loam; light brownish gray (2.5Y 6/2) moist; 62 percent sand; 24 percent silt; 14 percent clay; 20 percent coarse prominent brownish yellow (10YR 6/8) mottles; massive

parting to single grain; very friable, hard, nonsticky, nonplastic; many very fine interstitial pores; 2 percent (very few) carbonate coats on bottom surfaces of rock fragments; 40 percent subrounded sandstone gravels; electrical conductivity of 5.24 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; 4Ck rock fragments estimated; clear; CaCO3 25.6 percent.

4Cr --- 334 to 500 centimeters (131.5 to 196.9 inches); light yellowish brown (2.5Y 6/4) dry, clay; light olive brown (2.5Y 5/4) moist; 4 percent sand; 40 percent silt; 56 percent clay; 20 percent coarse prominent brownish yellow (10YR 6/6) mottles; massive parting to single grain; very friable, hard, very sticky, very plastic; electrical conductivity of 4.81 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; Box sample resembles Tropic sandstone; requires very strong pressure to break fragments. and contains a 4-6 cm sandy clay loam lens.; clear; CaCO3 23.2 percent.

5Cr --- 500 to 610 centimeters (196.9 to 240.2 inches); gray (5Y 6/1) dry, sandy clay loam; gray (5Y 5/1) moist; 64 percent sand; 16 percent silt; 20 percent clay; 3 percent very fine distinct yellow (2.5Y 7/6) mottles; massive; firm, very hard, slightly sticky, slightly plastic; electrical conductivity of 1.85 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; Resembles weathering Tropic shale and some sections are platy; CaCO3 26.6 percent.

12AS030

Pedon ID: 12AS030

Description Date: 11/29/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 48% and fine sand or coarser 10% in control section.

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370295E, 4144440N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: hills
Landform: hillslope
Geomorphic Component: Side Slope
Profile Pos: Backslope
Slope: 24 percent
Elevation: 2135 meters (7004.6 feet)
Aspect: 197°
Shape: up/down: Linear; **across:** Linear
Surface Fragments: none.

Drainage: Well drained
Runoff: High
Erosion: Class 3 - Sheet erosion

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Shrubby rangeland
Existing Vegetation: AGCR - crested wheatgrass (*Agropyron cristatum*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: residuum
Bedrock: Calcareous sandstone at 95 centimeters (37.4 inches)
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 15 to 42 centimeters (5.9 to 16.5 inches) and Paralithic contact: 95 centimeters (37.4 inches)

Restrictions: Paralithic bedrock: 95 centimeters (37.4 inches)

A1 --- 0 to 15 centimeters (0 to 5.9 inches); light yellowish brown (2.5Y 6/3) dry, clay; light olive brown (2.5Y 5/3) moist; 12 percent sand; 35 percent silt; 53 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; friable, hard, very sticky, very plastic; common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.39 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 21.6 percent.

Bss1 --- 15 to 30 centimeters (5.9 to 11.8 inches); light brownish gray (2.5Y 6/2) dry, clay; grayish brown (2.5Y 5/2) moist; 16 percent sand; 30 percent silt; 54 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; firm, very hard, very sticky, very plastic; common fine roots throughout and many very fine roots throughout; common very fine tubular pores; 40 percent (common) slickensides (pedogenic) on all faces of peds; electrical conductivity of 0.37 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 21.5 percent.

Bss2 --- 30 to 42 centimeters (11.8 to 16.5 inches); light gray (2.5Y 7/2) dry, clay; light brownish gray (2.5Y 6/2) moist; 14 percent sand; 32 percent silt; 54 percent clay; structure; very firm, extremely hard, very sticky, very plastic; common very fine roots throughout; 20 percent (few) slickensides (pedoogenic) on all faces of peds; electrical conductivity of 0.36 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 21.8 percent.

Ck --- 42 to 67 centimeters (16.5 to 26.4 inches); light gray (2.5Y 7/2) dry, clay; light brownish gray (2.5Y 6/2) moist; 10 percent sand; 36 percent silt; 54 percent clay; moderate medium platy structure; very firm, extremely hard, very sticky, very plastic; common very fine roots throughout; 2 percent (very few) carbonate coats on rock fragments; 70 percent angular shale parachanners; electrical conductivity of 0.69 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 21.3 percent.

C --- 67 to 95 centimeters (26.4 to 37.4 inches); light brownish gray (2.5Y 6/2) dry, silty clay; grayish brown (2.5Y 5/2) moist; 10 percent sand; 34 percent silt; 56 percent clay; structure; very firm, extremely hard, very sticky, very plastic; electrical conductivity of 1.57 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; CaCO3 21.6 percent.

Cr --- 95 centimeters (37.4 inches); weathering Tropic shale.

12AS031

Pedon ID: 12AS031

Description Date: 11/29/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 24% and fine sand or coarser 34% in control section.

Current Taxonomic Name: Wimmer family
Current Taxonomic Class: Fine-loamy, superactive, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370459E, 4143562N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace, and alluvial fan
Geomorphic Component: Tread
Profile Pos: Toeslope
Slope: 3 percent
Elevation: 2126 meters (6975.1 feet)
Aspect: 232°
Shape: up/down: Convex; **across:** Linear
Surface Fragments: subangular sandstone - 2 percent gravels and 1 percent channers.

Drainage: Well drained
Runoff: Low
Erosion: None - deposition

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: CHRYS9 - rabbitbrush (*Chrysothamnus*)

Parent Materials: alluvium
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 12 to 71 centimeters (4.7 to 28 inches), Secondary carbonates: 71 to 172 centimeters (28 to 67.7 inches) and Calcic horizon: 71 to 134 centimeters (28 to 52.8 inches)

Ap1 --- 0 to 12 centimeters (0 to 4.7 inches); light yellowish brown (2.5Y 6/3) dry, clay; olive brown (2.5Y 4/3) moist; 20 percent sand; 37 percent silt; 43 percent clay; moderate medium platy parting to moderate medium granular structure; very friable, slightly hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; 2 percent subangular sandstone gravels; electrical conductivity of 0.47 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear smooth boundary; CaCO3 23.3 percent.

ABss --- 12 to 26 centimeters (4.7 to 10.2 inches); light yellowish brown (2.5Y 6/3) dry, clay; olive brown (2.5Y 4/3) moist; 20 percent sand; 35 percent silt; 45 percent clay; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 5 percent (few) slickensides (pedogenic) on all faces of peds; electrical conductivity of 0.46 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear smooth boundary; CaCO3 23.4 percent.

Bss1 --- 26 to 44 centimeters (10.2 to 17.3 inches); light brownish gray (10YR 6/2) dry, clay; dark grayish brown (10YR 4/2) moist; 20 percent sand; 36 percent silt; 44 percent clay; moderate medium prismatic parting to moderate medium angular blocky structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; 40 percent (common) slickensides (pedogenic) on all faces of peds; 2 percent subangular sandstone gravels; electrical conductivity of 0.46 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear smooth boundary; CaCO3 18.4 percent.

Bss2 --- 44 to 71 centimeters (17.3 to 28 inches); pale brown (10YR 6/3) dry, sandy clay loam; brown (10YR 5/3) moist; 46 percent sand; 22 percent silt; 32 percent clay; strong medium prismatic parting to strong medium angular blocky structure; firm, very hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; 2 percent (very few) carbonate coats on bottom surfaces of rock fragments and 40 percent (common) slickensides (pedogenic) on all faces of peds; 5 percent subangular sandstone gravels; electrical conductivity of 0.37 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear smooth boundary; CaCO3 22.4 percent.

Bk1 --- 71 to 108 centimeters (28 to 42.5 inches); very pale brown (10YR 8/3) dry, loam; very pale brown (10YR 7/3) moist; 46 percent sand; 36 percent silt; 18 percent clay; weak medium prismatic parting to moderate medium subangular blocky structure; friable, very hard, nonsticky, slightly plastic; common very fine roots throughout; common very fine interstitial pores; 8 percent (common) fine masses of carbonate in matrix; electrical

conductivity of 0.29 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; abrupt smooth boundary; CaCO3 36.4 percent.

Bk2 --- 108 to 134 centimeters (42.5 to 52.8 inches); very pale brown (10YR 8/4) dry, sandy loam; very pale brown (10YR 7/4) moist; 68 percent sand; 20 percent silt; 12 percent clay; moderate medium subangular blocky structure; friable, hard, nonsticky, nonplastic; common fine roots throughout and common very fine roots throughout; common very fine interstitial pores; 3 percent (common) fine spherical masses of carbonate in matrix; electrical conductivity of 0.22 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear wavy boundary; CaCO3 35 percent.

Bk3 --- 134 to 172 centimeters (52.8 to 67.7 inches); very pale brown (10YR 7/4) dry, sandy loam; light yellowish brown (10YR 6/4) moist; 74 percent sand; 16 percent silt; 10 percent clay; weak medium subangular blocky parting to single grain structure; loose, soft, nonsticky, nonplastic; common fine roots throughout and common very fine roots throughout; many very fine interstitial pores; 3 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.24 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; CaCO3 24 percent.

12AS032

Pedon ID: 12AS032

Description Date: 11/29/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 52% and fine sand or coarser 14% in control section.

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369543E, 4142570N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: hills
Landform: fan apron
Anthropogenic Feature:
Geomorphic Component: Side Slope
Profile Pos: Backslope
Slope: 6 percent
Elevation: 2102 meters (6896.3 feet)
Aspect: 144°
Shape: up/down: Linear; **across:** Linear
Surface Fragments: Tropic concretions - 2 percent cobbles; subangular sandstone - 5 percent channers.

Drainage: Well drained
Runoff: Medium
Erosion: None - deposition

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Shrubby rangeland

Existing Vegetation: BROMU - brome (*Bromus*); BRTE - cheatgrass (*Bromus tectorum*); VICIA - vetch (*Vicia*); PLJA - galleta (*Pleuraphis jamesii*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: residuum weathered from calcareous shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Secondary carbonates: 10 to 24 centimeters (3.9 to 9.4 inches), Slickensides: 10 to 66 centimeters (3.9 to 26 inches) and Secondary carbonates: 66 to 165 centimeters (26 to 65 inches)

Ap --- 0 to 10 centimeters (0 to 3.9 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 26 percent sand; 31 percent silt; 43 percent clay; weak medium subangular blocky parting to moderate medium granular structure; very friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine interstitial pores; electrical conductivity of 0.59 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear smooth boundary; CaCO3 6.5 percent.

Bss1 --- 10 to 24 centimeters (3.9 to 9.4 inches); grayish brown (2.5Y 5/2) dry, clay; olive brown (2.5Y 4/3) moist; 20 percent sand; 31 percent silt; 49 percent clay; moderate medium subangular blocky structure; friable, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; 40 percent (common) slickensides (pedogenic) on all faces of peds; 8 percent (common) fine threadlike masses of carbonate on surfaces along root channels; electrical conductivity of 0.45 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear wavy boundary; CaCO3 7.6 percent.

Bss2 --- 24 to 66 centimeters (9.4 to 26 inches); gray (10YR 6/1) dry, silty clay; gray (10YR 5/1) moist; 16 percent sand; 28 percent silt; 56 percent clay; moderate coarse prismatic parting to strong medium angular blocky structure; firm, extremely hard, very sticky, slightly plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; 70 percent (many) slickensides (pedogenic) on all faces of peds; electrical conductivity of 0.79 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear smooth boundary; CaCO3 12.4 percent.

Bk1 --- 66 to 143 centimeters (26 to 56.3 inches); pale yellow (2.5Y 8/2) dry, clay; light gray (2.5Y 7/2) moist; 16 percent sand; 24 percent silt; 60 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; firm, extremely hard, very sticky, very plastic; common very fine roots throughout; 20 percent (few) very dark grayish brown (2.5Y 3/2), moist, skeletans on all faces of peds; 30 percent (many) medium threadlike masses of carbonate in matrix; electrical conductivity of 4.96 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear smooth boundary; CaCO3 9.1 percent.

Bk2 --- 143 to 165 centimeters (56.3 to 65 inches); light brownish gray (2.5Y 6/2) dry, clay; grayish brown (2.5Y 5/2) moist; 16 percent sand; 31 percent silt; 53 percent clay; weak

medium subangular blocky structure; friable, very hard, very sticky, very plastic; common very fine tubular pores; 10 percent (few) very dark grayish brown (2.5Y 3/2), moist, skeletans on all faces of peds; 10 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 6.16 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; CaCO3 9.3 percent.

13AS01

Pedon ID: 13AS01

Description Date: 11/12/2013
Describer: Robert Long

Current Taxonomic Name: AAA family
Current Taxonomic Class: Fine-loamy, carbonatic, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369815E, 4143018N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: hillslope
Geomorphic Component: Interfluve
Profile Pos: Summit
Slope: 6 percent
Elevation: 2085 meters (6840.6 feet)
Aspect: 222°
Shape: up/down: Convex; **across:** Linear
Surface Fragments: none.

Drainage: Well drained
Runoff: Medium
Erosion: Class 2 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland

Existing Vegetation: PASM - western wheatgrass (*Pascopyrum smithii*); AGCR - crested wheatgrass (*Agropyron cristatum*); CHRYS9 - rabbitbrush (*Chrysothamnus*); THIN6 - intermediate wheatgrass (*Thinopyrum intermedium*)

Parent Materials: residuum weathered from sandstone and shale
Bedrock: Moderately cemented calcareous shale at 475 centimeters (187 inches)
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Secondary carbonates: 18 to 180 centimeters (7.1 to 70.9 inches), Calcic horizon: 18 to 180 centimeters (7.1 to 70.9 inches), Paralithic contact: 180 to 580

centimeters (70.9 to 228.3 inches) and Secondary carbonates: 213 to 475 centimeters (83.9 to 187 inches)

Restrictions: Paralithic bedrock: 180 to 580 centimeters (70.9 to 228.3 inches)

A --- 0 to 18 centimeters (0 to 7.1 inches); brown (10YR 5/3) dry, clay; dark grayish brown (10YR 4/2) moist; 24 percent sand; 35 percent silt; 41 percent clay; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.45 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; clear; CaCO3 36.7 percent.

Bk1 --- 18 to 45 centimeters (7.1 to 17.7 inches); pink (7.5YR 7/3) dry, clay; light brown (7.5YR 6/3) moist; 24 percent sand; 33 percent silt; 43 percent clay; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 12 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.17 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 45.9 percent.

Bk2 --- 45 to 106 centimeters (17.7 to 41.7 inches); pale yellow (2.5Y 8/2) dry, clay loam; pale yellow (2.5Y 7/3) moist; 24 percent sand; 37 percent silt; 39 percent clay; structure; friable, hard, very sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; 20 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.24 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; gradual; CaCO3 49 percent.

Bk3 --- 106 to 180 centimeters (41.7 to 70.9 inches); pale yellow (2.5Y 8/2) dry, loam; pale yellow (2.5Y 7/3) moist; 39 percent sand; 40 percent silt; 21 percent clay; weak medium subangular blocky parting to moderate medium granular structure; friable, hard, slightly sticky, slightly plastic; common very fine roots throughout; 30 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; clear; CaCO3 39.9 percent.

Cr --- 180 to 213 centimeters (70.9 to 83.9 inches); sandy loam; 70 percent sand; 20 percent silt; 10 percent clay; by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; Soft weathered sandstone; clear; CaCO3 23.3 percent.

2Crk1 --- 213 to 320 centimeters (83.9 to 126 inches); clay; 36 percent sand; 24 percent silt; 40 percent clay; 15 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.59 mmhos/cm by EC meter, saturated paste; by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; Weathered Tropic shale; gradual; CaCO3 42.5 percent.

2Crk2 --- 320 to 475 centimeters (126 to 187 inches); loam; 44 percent sand; 32 percent silt; 24 percent clay; 10 percent (common) medium threadlike masses of carbonate in matrix; electrical conductivity of 0.65 mmhos/cm by EC meter, saturated paste; by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; Weathered Tropic shale; gradual; CaCO3 17.5 percent.

2Cr --- 475 to 580 centimeters (187 to 228.3 inches); Tropic shale.

13AS02

Pedon ID: 13AS02

Description Date: 11/13/2013
Describer: Robert Long

Current Taxonomic Name: Wimmer family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370234E, 4142449N -- Datum NAD83, Zone 12
Location Description:
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: hillslope
Geomorphic Component: Side Slope
Profile Pos: Backslope
Slope: 2 percent
Elevation: 2073 meters (6801.2 feet)
Aspect: 297°
Shape: up/down: Linear; **across:** Convex
Surface Fragments: none.

Drainage: Well drained
Runoff: Low
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Shrubby rangeland

Existing Vegetation: ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: residuum weathered from calcareous shale
Bedrock: at 76 centimeters (29.9 inches)
Particle Size Control Section: 25 to 76 centimeters (9.8 to 29.9 inches)

Diagnostic Features: Slickensides: 10 to 42 centimeters (3.9 to 16.5 inches), Calcic horizon: 42 to 76 centimeters (16.5 to 29.9 inches) and Paralithic contact: 76 centimeters (29.9

inches)

Restrictions: Paralithic bedrock: 76 centimeters (29.9 inches)

A --- 0 to 10 centimeters (0 to 3.9 inches); pale brown (10YR 6/3) dry, clay loam; grayish brown (10YR 5/2) moist; 38 percent sand; 31 percent silt; 31 percent clay; moderate medium platy structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.21 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 14.8 percent.

Bss --- 10 to 42 centimeters (3.9 to 16.5 inches); brown (10YR 5/3) dry, clay loam; dark grayish brown (10YR 4/2) moist; 32 percent sand; 36 percent silt; 32 percent clay; moderate medium prismatic parting to strong medium angular blocky structure; firm, very hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 30 percent (common) slickensides (pedoogenic) on all faces of peds; electrical conductivity of 0.18 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 21.3 percent.

Bk --- 42 to 76 centimeters (16.5 to 29.9 inches); light brownish gray (2.5Y 6/2) dry, clay loam; light olive brown (2.5Y 5/3) moist; 34 percent sand; 32 percent silt; 34 percent clay; strong medium angular blocky structure; firm, very hard, moderately sticky, moderately plastic; common very fine roots throughout; 3 percent (common) fine threadlike carbonate concretions in matrix; 10 percent shale parachanners; electrical conductivity of 0.19 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; gradual; CaCO3 23.9 percent.

Cr --- 76 to 80 centimeters (29.9 to 31.5 inches); Tropic shale.

13AS03

Pedon ID: 13AS03

Description Date: 11/13/2013
Describer: Robert Long

Current Taxonomic Name: Teromote family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Haplustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370414E, 4142444N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: hillslope
Geomorphic Component: Side Slope
Profile Pos: Backslope
Slope: 6 percent
Elevation: 2083 meters (6834 feet)
Aspect: 239°
Shape: up/down: Linear; **across:** Linear
Surface Fragments: subangular sandstone - 1 percent gravels.

Drainage: Well drained
Runoff: Medium
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Shrubby rangeland

Existing Vegetation: ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: residuum weathered from shale
Bedrock: Strongly cemented calcareous shale at 164 centimeters (64.6 inches)
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 18 to 135 centimeters (7.1 to 53.1 inches), Secondary carbonates: 44 to 164 centimeters (17.3 to 64.6 inches) and Paralithic contact: 164 centimeters (64.6 inches)

Restrictions: Paralithic bedrock: 164 centimeters (64.6 inches)

A --- 0 to 18 centimeters (0 to 7.1 inches); light olive brown (2.5Y 5/3) dry, clay loam; olive brown (2.5Y 4/3) moist; 36 percent sand; 31 percent silt; 33 percent clay; moderate fine subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.24 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; clear; CaCO3 18.6 percent.

Bss --- 18 to 44 centimeters (7.1 to 17.3 inches); light yellowish brown (2.5Y 6/3) dry, clay loam; olive brown (2.5Y 4/3) moist; 36 percent sand; 30 percent silt; 34 percent clay; moderate medium prismatic parting to strong medium angular blocky structure; firm, very hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 50 percent (many) slickensides (pedogenic) on all faces of peds; electrical conductivity of 0.24 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 21.4 percent.

Bkss1 --- 44 to 66 centimeters (17.3 to 26 inches); pale yellow (2.5Y 7/3) dry, clay loam; light olive brown (2.5Y 5/3) moist; 38 percent sand; 26 percent silt; 36 percent clay; strong medium prismatic parting to strong medium angular blocky structure; firm, very hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; 75 percent (many) slickensides (pedogenic) on all faces of peds; 3 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.2 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; gradual; CaCO3 21.3 percent.

Bkss2 --- 66 to 135 centimeters (26 to 53.1 inches); light yellowish brown (2.5Y 6/3) dry, clay loam; light olive brown (2.5Y 5/3) moist; 38 percent sand; 27 percent silt; 35 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; firm, very hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; 60 percent (many) slickensides (pedogenic) on all faces of peds; 7 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.95 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; clear; CaCO3 22.4 percent.

Bk --- 135 to 164 centimeters (53.1 to 64.6 inches); light brownish gray (2.5Y 6/2) dry, clay loam; grayish brown (2.5Y 5/2) moist; 38 percent sand; 26 percent silt; 36 percent clay; moderate medium subangular blocky structure; firm, very hard, moderately sticky, moderately plastic; common very fine roots throughout; 6 percent (common) fine

masses of carbonate in matrix; 10 percent angular calcareous sandstone gravels; electrical conductivity of 0.46 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; gradual; CaCO3 21.8 percent.

Cr --- 164 to 240 centimeters (64.6 to 94.5 inches); Weathered Tropic shale.

13AS04

Pedon ID: 13AS04

Description Date: 1/13/2013
Describer: Robert Long

Current Taxonomic Name: Brumley family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Calcidic Haplustalfs
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370429E, 4142621N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: hills
Landform: alluvial fan
Geomorphic Component: Side Slope
Profile Pos: Footslope
Slope: 12 percent
Elevation: 2090 meters (6857 feet)
Aspect: 178°
Shape: up/down: Linear; **across:** Linear
Surface Fragments: none.

Drainage: Well drained
Runoff: Medium
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Shrubby rangeland

Existing Vegetation: ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*); CHRYS9 - rabbitbrush (*Chrysothamnus*)

Parent Materials: slope alluvium derived from sandstone and shale
Particle Size Control Section: 13 to 63 centimeters (5.1 to 24.8 inches)

Diagnostic Features: Argillic horizon: 13 to 90 centimeters (5.1 to 35.4 inches), Secondary carbonates: 40 to 210 centimeters (15.7 to 82.7 inches) and Calcic horizon: 40 to 210 centimeters (15.7 to 82.7 inches)

A --- 0 to 13 centimeters (0 to 5.1 inches); brown (10YR 5/3) dry, sandy clay loam; dark grayish brown (10YR 4/2) moist; 50 percent sand; 27 percent silt; 23 percent clay; weak medium platy parting to moderate medium granular structure; friable, hard, slightly sticky, slightly plastic; common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.24 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 6.3 percent.

Bt1 --- 13 to 40 centimeters (5.1 to 15.7 inches); brown (10YR 5/3) dry, sandy clay loam; dark grayish brown (10YR 4/2) moist; 48 percent sand; 25 percent silt; 27 percent clay; moderate medium prismatic parting to moderate medium subangular blocky structure; firm, very hard, slightly sticky, slightly plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 65 percent (many) clay films on all faces of peds; electrical conductivity of 0.21 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 10.2 percent.

Btk --- 40 to 90 centimeters (15.7 to 35.4 inches); light yellowish brown (2.5Y 6/3) dry, clay loam; light olive brown (2.5Y 5/3) moist; 42 percent sand; 27 percent silt; 31 percent clay; moderate medium subangular blocky structure; firm, very hard, moderately sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; 65 percent (many) clay films on all faces of peds; 2 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.18 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; gradual; CaCO3 15.2 percent.

Bk1 --- 90 to 150 centimeters (35.4 to 59.1 inches); light yellowish brown (2.5Y 6/3) dry, clay loam; light olive brown (2.5Y 5/3) moist; 40 percent sand; 28 percent silt; 32 percent clay; moderate medium subangular blocky structure; firm, very hard, moderately sticky, moderately plastic; common very fine roots throughout; 5 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.2 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear; CaCO3 17.3 percent.

Bk2 --- 150 to 210 centimeters (59.1 to 82.7 inches); pale yellow (2.5Y 7/3) dry, sandy clay loam; light yellowish brown (2.5Y 6/3) moist; 46 percent sand; 24 percent silt; 30 percent clay; moderate medium subangular blocky structure; friable, very hard, moderately sticky, moderately plastic; 10 percent (common) fine threadlike masses of carbonate in matrix; 5 percent subangular sandstone gravels; electrical conductivity of 0.4 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; CaCO3 17.5 percent.

13AS05

Pedon ID: 13AS05

Description Date: 11/13/2013
Describer: Robert Long

Current Taxonomic Name: Teromote
Current Taxonomic Class: Fine-loamy, superactive, mesic Aridic Haplustepts:
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370234E, 4142501N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: hillslope
Geomorphic Component: Head Slope
Profile Pos: Backslope
Slope: 4 percent
Elevation: 2076 meters (6811 feet)
Aspect: 256°
Shape: up/down: Linear; **across:** Convex
Surface Fragments: subrounded sandstone - 3 percent gravels.

Drainage: Well drained
Runoff: High
Erosion: Class 2 - Sheet erosion

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Shrubby rangeland

Existing Vegetation: ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: alluvium derived from shale and/or residuum weathered from shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 10 to 300 centimeters (3.9 to 118.1 inches), Secondary carbonates: 49 to 153 centimeters (19.3 to 60.2 inches) and Gypsum accumulations: 153 to 516 centimeters (60.2 to 203.1 inches)

A --- 0 to 10 centimeters (0 to 3.9 inches); light olive brown (2.5Y 5/3) dry, clay loam; olive brown (2.5Y 4/3) moist; 34 percent sand; 31 percent silt; 35 percent clay; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.2 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear; CaCO3 17.1 percent.

Bss1 --- 10 to 24 centimeters (3.9 to 9.4 inches); light olive brown (2.5Y 5/3) dry, clay loam; olive brown (2.5Y 4/3) moist; 34 percent sand; 28 percent silt; 38 percent clay; moderate medium prismatic parting to moderate medium angular blocky structure; firm, very hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 40 percent (common) slickensides (pedogenic) on all faces of peds; electrical conductivity of 1.05 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; clear; CaCO3 18 percent.

Bss2 --- 24 to 49 centimeters (9.4 to 19.3 inches); light brownish gray (2.5Y 6/2) dry, clay loam; grayish brown (2.5Y 5/2) moist; 28 percent sand; 33 percent silt; 39 percent clay; moderate medium prismatic parting to strong medium angular blocky structure; firm, very hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; 65 percent (many) slickensides (pedogenic) on all faces of peds; electrical conductivity of 0.33 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; gradual; CaCO3 18.9 percent.

Bkss1 --- 49 to 90 centimeters (19.3 to 35.4 inches); light yellowish brown (2.5Y 6/3) dry, clay loam; light olive brown (2.5Y 5/3) moist; 32 percent sand; 29 percent silt; 39 percent clay; weak medium prismatic parting to moderate medium angular blocky structure; firm, very hard, moderately sticky, moderately plastic; common very fine roots throughout; 35 percent (common) slickensides (pedogenic) on all faces of peds; 2 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 0.92 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 19.4 percent.

Bkss2 --- 90 to 153 centimeters (35.4 to 60.2 inches); light brownish gray (2.5Y 6/2) dry, clay; light olive brown (2.5Y 5/3) moist; 10 percent sand; 37 percent silt; 53 percent clay; moderate medium angular blocky structure; firm, very hard, very sticky, very plastic; common very fine roots throughout; 30 percent (common) slickensides (pedogenic) on all faces of peds; 6 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 2.2 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; gradual; CaCO3 22.1 percent.

Bssy1 --- 153 to 242 centimeters (60.2 to 95.3 inches); light brownish gray (2.5Y 6/2) dry, clay; light olive brown (2.5Y 5/3) moist; 32 percent sand; 18 percent silt; 50 percent clay; moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; 10 percent (few) slickensides (pedogenic) on all faces of peds; 5 percent (common) medium spherical gypsum crystals in matrix and 15 percent (common) fine threadlike gypsum crystals in matrix; electrical conductivity of 2.63 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; gradual; CaCO3 22.8 percent.

Bssy2 --- 242 to 300 centimeters (95.3 to 118.1 inches); light yellowish brown (2.5Y 6/3) dry, clay; light olive brown (2.5Y 5/3) moist; 10 percent sand; 37 percent silt; 53 percent clay; moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; 10 percent (common) medium spherical gypsum crystals in matrix; electrical conductivity of 2.3 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 22.9 percent.

By --- 300 to 394 centimeters (118.1 to 155.1 inches); light gray (2.5Y 7/2) dry, clay; light olive brown (2.5Y 5/3) moist; 14 percent sand; 35 percent silt; 51 percent clay; weak medium subangular blocky structure; firm, very hard, very sticky, very plastic; 2 percent (common) fine threadlike gypsum crystals in matrix; 2 percent subangular sandstone gravels; electrical conductivity of 1.17 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 24.3 percent.

Cy --- 394 to 516 centimeters (155.1 to 203.1 inches); pale yellow (2.5Y 7/3) dry, clay; light olive brown (2.5Y 5/3) moist; 40 percent sand; 14 percent silt; 46 percent clay; weak medium subangular blocky structure; friable, very hard, very sticky, very plastic; 1 percent (few) fine spherical gypsum crystals in matrix; electrical conductivity of 1.06 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; CaCO3 23.8 percent.

13AS06

Pedon ID: 13AS06

Description Date: 11/13/2013
Describer: Robert Long

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370184E, 4142476N -- Datum NAD83, Zone 12
Location Description:
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Tread
Profile Pos: Toeslope
Slope: 4 percent
Elevation: 2073 meters (6801.2 feet)
Aspect: 248°
Shape: up/down: Linear; **across:** Linear
Surface Fragments: none.

Drainage: Well drained**:**
Erosion: Class 2 - Gully erosion

Earth Cover: Grassland rangeland

Existing Vegetation: ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*); CHRYS9 - rabbitbrush (*Chrysothamnus*)

Parent Materials: alluvium derived from calcareous shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 38 to 245 centimeters (15 to 96.5 inches) and Secondary carbonates: 68 to 632 centimeters (26.8 to 248.8 inches)

A --- 0 to 13 centimeters (0 to 5.1 inches); light olive brown (2.5Y 5/3) dry, clay loam; olive brown (2.5Y 4/3) moist; 23 percent sand; 38 percent silt; 39 percent clay; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.55 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear; CaCO3 16.1 percent.

BA --- 13 to 38 centimeters (5.1 to 15 inches); light olive brown (2.5Y 5/3) dry, sandy clay; olive brown (2.5Y 4/3) moist; 46 percent sand; 12 percent silt; 42 percent clay; moderate medium platy parting to moderate medium angular blocky structure; firm, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.37 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 18.9 percent.

Bss --- 38 to 68 centimeters (15 to 26.8 inches); light brownish gray (2.5Y 6/2) dry, clay; grayish brown (2.5Y 5/2) moist; 16 percent sand; 37 percent silt; 47 percent clay; moderate medium prismatic parting to strong medium angular blocky structure; firm, very hard, very sticky, very plastic; common very fine roots throughout; 30 percent (common) slickensides (pedogenic) on vertical faces of peds; electrical conductivity of 0.39 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; clear; CaCO3 20.8 percent.

Bkss1 --- 68 to 112 centimeters (26.8 to 44.1 inches); light brownish gray (2.5Y 6/2) dry, clay; light olive brown (2.5Y 5/3) moist; 16 percent sand; 33 percent silt; 51 percent clay; weak medium prismatic parting to moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; common very fine roots throughout; 35 percent (common) slickensides (pedogenic) on all faces of peds; 5 percent (common) medium lenticular masses of carbonate in matrix and 12 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 3.2 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; gradual; CaCO3 21.3 percent.

Bkss2 --- 112 to 170 centimeters (44.1 to 66.9 inches); light gray (2.5Y 7/2) dry, sandy clay; light olive brown (2.5Y 5/3) moist; 47 percent sand; 4 percent silt; 49 percent clay; moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; 20 percent (few) slickensides (pedogenic) on vertical faces of peds; 7 percent (common) fine threadlike masses of carbonate in matrix and 18 percent (common) medium lenticular masses of carbonate in matrix; electrical conductivity of 3.17 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear; CaCO3 24 percent.

Bkss3 --- 170 to 245 centimeters (66.9 to 96.5 inches); light yellowish brown (2.5Y 6/3) dry, clay; light olive brown (2.5Y 5/3) moist; 18 percent sand; 36 percent silt; 46 percent clay; moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; 15 percent (few) slickensides (pedogenic) on vertical faces of peds; 7 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 2.87 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 24 percent.

Bk1 --- 245 to 315 centimeters (96.5 to 124 inches); light brownish gray (2.5Y 6/2) dry, sandy clay; light olive brown (2.5Y 5/3) moist; 48 percent sand; 11 percent silt; 41 percent clay; 30 percent coarse light olive brown (2.5Y 5/6) mottles; moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; 3 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 2.4 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear; CaCO3 22.4 percent.

Bk2 --- 315 to 396 centimeters (124 to 155.9 inches); light brownish gray (2.5Y 6/2) dry, clay; light olive brown (2.5Y 5/3) moist; 12 percent sand; 35 percent silt; 53 percent clay; 20 percent coarse olive yellow (2.5Y 6/6) mottles; weak medium subangular blocky structure; firm, very hard, very sticky, very plastic; 10 percent (common) medium lenticular masses of carbonate in matrix; 5 percent subangular sandstone gravels; electrical conductivity of 2.93 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 24.1 percent.

Bk3 --- 396 to 457 centimeters (155.9 to 179.9 inches); light brownish gray (2.5Y 6/2) dry, sandy clay; light olive brown (2.5Y 5/3) moist; 56 percent sand; 8 percent silt; 36 percent clay; 20 percent coarse olive yellow (2.5Y 6/6) mottles; weak medium subangular blocky structure; firm, very hard, moderately sticky, moderately plastic; 3 percent (common) medium lenticular masses of carbonate in matrix and 7 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 1.67 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; gradual; CaCO3 23 percent.

Bk4 --- 457 to 579 centimeters (179.9 to 228 inches); light brownish gray (2.5Y 6/2) dry, clay; light olive brown (2.5Y 5/3) moist; 10 percent sand; 39 percent silt; 51 percent clay; 25 percent coarse olive yellow (2.5Y 6/6) mottles; massive; firm, very hard, very sticky, very plastic; 10 percent (common) medium lenticular masses of carbonate in matrix; electrical conductivity of 1.41 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; gradual; CaCO3 23.5 percent.

Bk5 --- 579 to 632 centimeters (228 to 248.8 inches); light gray (2.5Y 7/2) dry, clay; light olive brown (2.5Y 5/3) moist; 32 percent sand; 19 percent silt; 49 percent clay; 5 percent

medium yellowish brown (10YR 5/8) and 15 percent coarse olive yellow (2.5Y 6/6) mottles; massive; firm, very hard, very sticky, very plastic; 5 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.85 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; abrupt; CaCO3 25.3 percent.

2C1 --- 632 to 770 centimeters (248.8 to 303.1 inches); very pale brown (10YR 7/3) dry, loamy sand; (10Y 6/3) moist; 82 percent sand; 13 percent silt; 5 percent clay; 5 percent fine yellowish brown (10YR 5/8) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; 25 percent subangular sandstone gravels; electrical conductivity of 0.41 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.9, pH meter; gradual; CaCO3 51.9 percent.

2C2 --- 770 to 838 centimeters (303.1 to 329.9 inches); pale yellow (2.5Y 7/4) dry, loamy sand; light yellowish brown (2.5Y 6/4) moist; 86 percent sand; 6 percent silt; 8 percent clay; 20 percent medium brownish yellow (10YR 6/8) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; 10 percent subangular sandstone gravels; electrical conductivity of 0.6 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; abrupt; CaCO3 28.2 percent.

3C --- 838 to 884 centimeters (329.9 to 348 inches); pale yellow (2.5Y 7/3) dry, sandy loam; light yellowish brown (2.5Y 6/3) moist; 64 percent sand; 21 percent silt; 15 percent clay; 10 percent medium yellow (10YR 7/6) mottles; massive; firm, very hard, nonsticky, nonplastic; electrical conductivity of 0.57 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; CaCO3 26.1 percent.

13AS07

Pedon ID: 13AS07

Description Date: 11/13/2013
Describer: Robert Long

Current Taxonomic Name: Flugle
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Calcidic Haplustalfs
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369982E, 4142493N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: terrace and
Geomorphic Component: Tread
Profile Pos: Footslope
Slope: 10 percent
Elevation: 2067 meters (6781.5 feet)
Aspect: 125°
Shape: up/down: Concave; **across:** Concave
Surface Fragments: subrounded sandstone - 25 percent gravels.

Drainage: Well drained
Runoff: Medium
Erosion: Class 1 - Rill erosion

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Shrubby rangeland

Existing Vegetation: BRIN2 - smooth brome (*Bromus inermis*); CHRYS9 - rabbitbrush (*Chrysothamnus*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 19 to 67 centimeters (7.5 to 26.4 inches)

Diagnostic Features: Argillic horizon: 19 to 67 centimeters (7.5 to 26.4 inches), Secondary carbonates: 46 to 656 centimeters (18.1 to 258.3 inches), Calcic horizon: 67 to 183 centimeters (26.4 to 72 inches) and Aquic conditions: 532 to 732 centimeters (209.4 to 288.2 inches)

A --- 0 to 19 centimeters (0 to 7.5 inches); pale brown (10YR 6/3) dry, clay loam; yellowish brown (10YR 5/4) moist; 28 percent sand; 36 percent silt; 36 percent clay; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.62 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 20.5 percent.

Bt --- 19 to 46 centimeters (7.5 to 18.1 inches); very pale brown (10YR 7/4) dry, clay; yellowish brown (10YR 5/4) moist; 32 percent sand; 23 percent silt; 45 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; firm, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 60 percent (many) clay films on all faces of peds; electrical conductivity of 0.72 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 35.6 percent.

Btk --- 46 to 67 centimeters (18.1 to 26.4 inches); very pale brown (10YR 7/3) dry, clay; yellowish brown (10YR 5/4) moist; 22 percent sand; 37 percent silt; 41 percent clay; moderate medium prismatic parting to moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; 20 percent (few) clay films between sand grains and 40 percent (common) clay films on all faces of peds; 5 percent (common) fine threadlike masses of carbonate in matrix and 20 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.75 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; abrupt; CaCO3 30.9 percent.

Bk --- 67 to 183 centimeters (26.4 to 72 inches); light gray (10YR 7/2) dry, parachannery sandy clay loam; grayish brown (10YR 5/2) moist; 52 percent sand; 16 percent silt; 32 percent clay; moderate medium subangular blocky and moderate fine subangular blocky structure; loose, loose, moderately sticky, moderately plastic; common very fine roots throughout; many very fine interstitial pores; 15 percent (common) medium masses of carbonate in matrix; 25 percent angular calcareous shale parachanners; electrical conductivity of 0.29 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; gradual; CaCO3 43.1 percent.

2Bk --- 183 to 305 centimeters (72 to 120.1 inches); light yellowish brown (2.5Y 6/3) dry, sandy loam; light olive brown (2.5Y 5/3) moist; 76 percent sand; 15 percent silt; 9 percent clay; single grain; loose, loose, nonsticky, nonplastic; common very fine roots throughout; many very fine tubular pores finely disseminated carbonates; 5 percent subangular calcareous shale parachanners and 5 percent subrounded sandstone gravels; electrical conductivity of 0.27 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; gradual; CaCO3 18.7 percent.

3Bk1 --- 305 to 427 centimeters (120.1 to 168.1 inches); pale yellow (2.5Y 7/3) dry, very gravelly loamy sand; light yellowish brown (2.5Y 6/3) moist; 80 percent sand; 12 percent silt; 8 percent clay; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; 5 percent (few) faint carbonate coats on rock fragments finely disseminated carbonates; 20 percent subrounded sandstone gravels and 25 percent subrounded limestone gravels; electrical conductivity of 0.53 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; diffuse; CaCO3 56.7 percent.

3Bk2 --- 427 to 532 centimeters (168.1 to 209.4 inches); pale yellow (2.5Y 7/4) dry, extremely gravelly loamy sand; light yellowish brown (2.5Y 6/4) moist; 78 percent sand; 16 percent silt; 6 percent clay; 3 percent fine prominent reddish yellow (7.5YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; 3 percent (very few) faint carbonate coats on rock fragments finely disseminated carbonates; 35 percent subrounded limestone gravels and 40 percent subrounded calcareous sandstone gravels; electrical conductivity of 0.58 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; clear; CaCO3 68.8 percent.

3Ckg --- 532 to 656 centimeters (209.4 to 258.3 inches); light brownish gray (2.5Y 6/2) dry, extremely gravelly loamy sand; grayish brown (2.5Y 5/2) moist; 84 percent sand; 9 percent silt; 7 percent clay; 3 percent fine distinct light olive brown (2.5Y 5/4) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; 3 percent (very few) faint carbonate coats on rock fragments finely disseminated carbonates; 35 percent subrounded limestone gravels and 40 percent subrounded calcareous sandstone gravels; electrical conductivity of 1.47 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; abrupt; CaCO3 43.1 percent.

4Cg --- 656 to 732 centimeters (258.3 to 288.2 inches); gray (2.5Y 6/1) dry, clay; gray (2.5Y 5/1) moist; 26 percent sand; 28 percent silt; 46 percent clay; 10 percent medium distinct light yellowish brown (2.5Y 6/4) and 15 percent medium gray (N 6/) mottles; massive; firm, very hard, very sticky, very plastic; electrical conductivity of 0.63 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; CaCO3 12 percent.

13AS08

Pedon ID: 13AS08

Description Date: 11/13/2013
Describer: Robert Long

Current Taxonomic Name: similar to Sideslide
Current Taxonomic Class: not enough data for classification.
Current Taxon Kind: family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369119E, 4142470N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West

Landscape: valley
Landform: hillslope
Geomorphic Component: Side Slope
Profile Pos: Toeslope
Slope: 10 percent
Elevation: 2071 meters (6794.6 feet)
Aspect: 271°
Shape: up/down: Concave; **across:** Concave

Drainage: Very poorly drained
Runoff:
Erosion: None - deposition

Earth Cover: Grassland rangeland
Parent Materials: slope alluvium

N/A 0 to 122 centimeters (0 to 48 inches); No sample recovered.

N/A 122 to 244 centimeters (48 to 96.1 inches); (5/4) moist, silty clay; (7/4) dry; null percent sand; null percent silt; 48 percent clay; 50 percent coarse (7.5YR 6/) and 25 percent coarse prominent (2.5Y 4/6) mottles; massive; firm, very hard; 20 percent (few) clay films between sand grains finely disseminated carbonates; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; diffuse; CaCO3 20.4 percent.

N/A 244 to 366 centimeters (96.1 to 144.1 inches); light olive brown (2.5Y 5/4) moist, silty clay; pale yellow (2.5Y 7/4) dry; null percent sand; null percent silt; 41 percent clay; 50 percent medium gray (N 6/) and 35 percent coarse prominent light olive brown (2.5Y

5/6) mottles; massive; firm, very hard; 40 percent (common) clay films on all faces of peds finely disseminated carbonates; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; clear; CaCO3 24.3 percent.

N/A 366 to 488 centimeters (144.1 to 192.1 inches); light olive brown (2.5Y 5/4) moist, silty clay; light yellowish brown (2.5Y 6/4) dry; null percent sand; null percent silt; 52 percent clay; 40 percent medium gray (N 6/) and 30 percent coarse distinct light olive brown (2.5Y 5/6) mottles; massive; firm, very hard; 20 percent (few) clay films between sand grains and 45 percent (common) clay films on all faces of peds; 5 percent (common) medium salt crystals in matrix; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; CaCO3 22.8 percent.

N/A not enough data available for horizon designations.

13AS09

Pedon ID: 13AS09

Description Date: 11/13/2013
Describer: Robert Long

Current Taxonomic Name: Quezcan family shallow
Current Taxonomic Class: Clayey, smectitic, calcareous, mesic, shallow Aridic Ustorthents
Current Taxon Kind: Taxadjunct

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370469E, 4142786N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 6 West of the 29 Meridian

Landscape: hills
Landform: hillslope
Geomorphic Component: Side Slope
Profile Pos: Backslope
Slope: 31 percent
Elevation: 2113 meters (6932.4 feet)
Aspect: 161°
Shape: up/down: Concave; **across:** Concave

Drainage: Well drained
Runoff: High
Erosion: Class 3 - Sheet erosion

Primary Earth Cover: Tree cover; **Secondary Earth Cover:**

Existing Vegetation: PIED - twoneedle pinyon (*Pinus edulis*); JUOS - Utah juniper (*Juniperus osteosperma*); YUCCA - yucca (*Yucca*); POSE - Sandberg bluegrass (*Poa secunda*); GUSA2 - broom snakeweed (*Gutierrezia sarothrae*)

Parent Materials: colluvium derived from sandstone and shale over residuum weathered from shale

Bedrock: Moderately cemented calcareous shale at 46 centimeters (18.1 inches)
Particle Size Control Section: 25 to 46 centimeters (9.8 to 18.1 inches)
Diagnostic Features: Paralithic contact: 46 to 52 centimeters (18.1 to 20.5 inches)
Restrictions: Paralithic bedrock: 46 to 52 centimeters (18.1 to 20.5 inches)

A --- 0 to 14 centimeters (0 to 5.5 inches); grayish brown (10YR 5/2) dry, gravelly clay; brown (10YR 4/3) moist; 14 percent sand; 32 percent silt; 54 percent clay; weak fine subangular blocky parting to moderate medium granular structure; friable, hard, very sticky, very plastic; common medium roots, common fine roots and common very fine roots; common very fine interstitial pores finely disseminated carbonates; 5 percent subangular calcareous sandstone stones, 5 percent calcareous sandstone cobbles and 10 percent subangular calcareous shale gravels; electrical conductivity of 0.21 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear smooth boundary; CaCO3 17.8 percent.

2C --- 14 to 46 centimeters (5.5 to 18.1 inches); dark olive brown (2.5Y 3/3) dry, clay; light olive brown (2.5Y 5/4) moist; 28 percent sand; 23 percent silt; 49 percent clay; weak medium subangular blocky structure; firm, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores finely disseminated carbonates; electrical conductivity of 0.16 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; gradual smooth boundary; CaCO3 19.7 percent.

2Cr --- 46 to 52 centimeters (18.1 to 20.5 inches); weathered shale.

14AS01

Pedon ID: 14AS01

Description Date: 4/24/2014
Describer: Robert Long

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370219E, 4142245N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: alluvial fan
Geomorphic Component: Side Slope
Profile Pos: Backslope
Slope: 10 percent
Elevation: 2068 meters (6784.8 feet)
Aspect: 232°
Shape: up/down: linear; **across:** linear
Surface Fragments: none.

Drainage: Well drained
Runoff: Medium
Erosion: Class 3 - Gully erosion

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Shrubby rangeland

Existing Vegetation: ARNO4 - black sagebrush (*Artemisia nova*); BRIN2 - smooth brome (*Bromus inermis*); THIN6 - intermediate wheatgrass (*Thinopyrum intermedium*)

Parent Materials: alluvium derived from sandstone and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 8 to 118 centimeters (3.1 to 46.5 inches) and Secondary carbonates: 118 to 165 centimeters (46.5 to 65 inches)

A --- 0 to 8 centimeters (0 to 3.1 inches); light olive brown (2.5Y 5/3) dry, clay loam; olive brown (2.5Y 4/3) moist; null percent sand; null percent silt; 34 percent clay; weak medium platy parting to moderate medium granular structure; very friable, slightly hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; many very fine interstitial pores; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH indicator solutions; clear smooth boundary.

Bss1 --- 8 to 41 centimeters (3.1 to 16.1 inches); light yellowish brown (2.5Y 6/3) dry, clay loam; olive brown (2.5Y 4/3) moist; null percent sand; null percent silt; 39 percent clay; strong medium prismatic parting to strong medium angular blocky structure; friable, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 30 percent (common) slickensides (pedogenic) on vertical faces of peds; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH indicator solutions; gradual smooth boundary.

Bss2 --- 41 to 78 centimeters (16.1 to 30.7 inches); light yellowish brown (2.5Y 6/3) dry, clay; olive brown (2.5Y 4/3) moist; null percent sand; null percent silt; 40 percent clay; strong medium prismatic parting to strong medium angular blocky structure; firm, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 40 percent (common) slickensides (pedogenic) on vertical faces of peds; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH indicator solutions; gradual smooth boundary.

Bss3 --- 78 to 118 centimeters (30.7 to 46.5 inches); light yellowish brown (2.5Y 6/3) dry, clay loam; olive brown (2.5Y 4/3) moist; null percent sand; null percent silt; 36 percent clay; moderate medium prismatic parting to moderate medium subangular blocky structure; friable, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; 25 percent (common) slickensides (pedogenic) on vertical faces of peds; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH indicator solutions; gradual smooth boundary.

Bk1 --- 118 to 138 centimeters (46.5 to 54.3 inches); light yellowish brown (2.5Y 6/3) dry, clay loam; light olive brown (2.5Y 5/3) moist; null percent sand; null percent silt; 34 percent clay; moderate medium subangular blocky structure; friable, very hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; 3 percent (common) fine threadlike masses of carbonate in matrix; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH indicator solutions; gradual smooth boundary.

Bk2 --- 138 to 165 centimeters (54.3 to 65 inches); light yellowish brown (2.5Y 6/3) dry, clay loam; light olive brown (2.5Y 5/3) moist; null percent sand; null percent silt; 32 percent clay; moderate medium subangular blocky structure; friable, very hard, moderately sticky, moderately plastic; common very fine roots throughout; 2 percent (common) fine threadlike masses of carbonate in matrix and 3 percent (common) fine spherical masses of carbonate in matrix; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH indicator solutions.

DP-01

Pedon ID: DP-01

Description Date: 7/30/2012
Describer: Robert Long

Pedon Notes: Text: Sample tubes were not recovered from this hole, therefore no horizon descriptions or laboratory analysis.

Current Taxonomic Name: location and setting similar to BBB family.

County or Parish: Kane
State or Territory: Utah
UTM: 370550E, 4143588N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: hill
Geomorphic Component: Baseslope
Profile Pos: Toeslope
Slope: 9 percent
Elevation: 2120 meters (6,953.6 feet)
Aspect: 259°
Shape: up/down: concave ; **across:** linear

Drainage:
Runoff: medium
Erosion:

Earth Cover: shrub cover.

Existing Vegetation: smooth brome (*Bromus inermis*); AGCR - crested wheatgrass (*Agropyron cristatum*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*); CONVO - bindweed (*Convolvulus*); matchweed.

DP-02

Pedon ID: DP-02

Description Date: 7/30/2012
Describer: Robert Long

Pedon Notes: Text: There was 10 cm of GRX loamy sand between 2C1 and 2C2 horizons. The 3C horizon was not sampled (too small) for lab analysis; texture estimated by field method.

Current Taxonomic Name: Flugle family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Haplustalfs
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370522E, 4143600N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Riser
Profile Pos: Shoulder
Slope: 4 percent
Elevation: 2119 meters (6952.1 feet)
Aspect: 235°
Shape: up/down: Convex; **across:** Convex
Surface Fragments: subrounded and subangular sandstone - 2 percent gravels.

Drainage: Well drained
Runoff: Low
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland

Existing Vegetation: CHRYS9 - rabbitbrush (*Chrysothamnus*); AGCR - crested wheatgrass (*Agropyron cristatum*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*); MEDIC - alfalfa (*Medicago*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 35 to 85 centimeters (13.8 to 33.5 inches)

Diagnostic Features: Argillic horizon: 35 to 170 centimeters (13.8 to 66.9 inches) and Calcic horizon: 170 to 220 centimeters (66.9 to 86.6 inches)

Ap --- 0 to 13 centimeters (0 to 5.1 inches); brown (10YR 5/3) dry, loam; brown (10YR 4/3) moist; 44 percent sand; 32 percent silt; 24 percent clay; moderate medium platy parting to moderate medium granular structure; very friable, slightly hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 4.09 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; neutral, pH 7, pH meter; clear; CaCO3 21.2 percent.

BA --- 13 to 35 centimeters (5.1 to 13.8 inches); pale brown (10YR 6/3) dry, loam; brown (10YR 4/3) moist; 40 percent sand; 37 percent silt; 23 percent clay; structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.44 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; neutral, pH 7.3, pH meter; clear; CaCO3 22 percent.

Btk1 --- 35 to 68 centimeters (13.8 to 26.8 inches); pale brown (10YR 6/3) dry, clay loam; brown (10YR 4/3) moist; 30 percent sand; 40 percent silt; 30 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; friable, hard, slightly sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 50 percent (many) clay films on all faces of peds; 3 percent (common) fine masses of carbonate on faces of peds; electrical conductivity of 0.47 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; neutral, pH 7.3, pH meter; gradual; CaCO3 24.7 percent.

Btk2 --- 68 to 92 centimeters (26.8 to 36.2 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 24 percent sand; 36 percent silt; 30 percent clay; strong medium prismatic parting to strong medium subangular blocky structure; firm, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; 75 percent (many) clay films on all faces of peds; 3 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 0.45 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.4, pH meter; gradual; CaCO3 18.1 percent.

Btk3 --- 92 to 170 centimeters (36.2 to 66.9 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 26 percent sand; 28 percent silt; 46 percent clay; strong medium prismatic parting to strong medium angular blocky structure; firm, very hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; 80 percent (many) clay films on all faces of peds; 2 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 0.4 mmhos/cm by EC

meter, saturated paste; slightly effervescent by HCl, 1 normal; neutral, pH 7.3, pH meter; abrupt; CaCO3 17.6 percent.

Bk --- 170 to 220 centimeters (66.9 to 86.6 inches); very pale brown (10YR 7/4) dry, clay loam; light yellowish brown (10YR 6/4) moist; 22 percent sand; 46 percent silt; 32 percent clay; weak medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common very fine interstitial pores finely disseminated carbonates and 10 percent (common) medium masses of carbonate in matrix; electrical conductivity of 1.26 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.4, pH meter; clear; CaCO3 47.8 percent.

2C1 --- 220 to 261 centimeters (86.6 to 102.8 inches); pale brown (10YR 6/3) dry, sandy loam; brown (10YR 5/3) moist; 78 percent sand; 12 percent silt; 10 percent clay; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores finely disseminated carbonates; electrical conductivity of 1.77 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear; CaCO3 19.3 percent.

2C2 --- 261 to 407 centimeters (102.8 to 160.2 inches); very pale brown (10YR 8/4) dry, sandy loam; light yellowish brown (10YR 6/4) moist; 70 percent sand; 22 percent silt; 8 percent clay; 4 percent medium distinct reddish yellow (7.5YR 7/6) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; 15 percent subangular sandstone gravels; electrical conductivity of 1.13 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; abrupt; CaCO3 25 percent.

3C --- 407 to 412 centimeters (160.2 to 162.2 inches); light brownish gray (10YR 6/2) dry, clay; dark grayish brown (10YR 4/2) moist; null percent sand; null percent silt; 45 percent clay; massive; very firm, very hard, very sticky, very plastic; 75 percent (many) pressure faces on all faces of peds; EC meter, saturated paste electric conductivity method; strongly effervescent.

DP-03

Pedon ID: DP-03

Description Date: 7/30/2012
Describer: Robert Long

Pedon Notes: Text: Mottles in Bssk are most likely due to entrapment of water between peds and inability of water to drain out of profile due to underlying Tropic shale.

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370509E, 4143434N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: alluvial fan
Anthropogenic Feature:
Geomorphic Component: Nose Slope
Profile Pos: Footslope
Slope: 7 percent
Elevation: 2119 meters (6952.1 feet)
Aspect: 272°
Shape: up/down: Convex; **across:** Convex
Surface Fragments: angular sandstone - 4 percent channers.

Drainage: Moderately well drained
Runoff: High:
Erosion: Class 2 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover.

Existing Vegetation: PASM - western wheatgrass (*Pascopyrum smithii*); CONVO - bindweed (*Convolvulus*); LINUM - flax (*Linum*)

Parent Materials: residuum weathered from calcareous sandstone
Bedrock: Moderately cemented calcareous shale at 137 centimeters (53.9 inches)
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 24 to 87 centimeters (9.4 to 34.3 inches) and Paralithic contact: 137 centimeters (53.9 inches)

Restrictions: Paralithic bedrock: 137 centimeters (53.9 inches)

Ap --- 0 to 24 centimeters (0 to 9.4 inches); light brownish gray (2.5Y 6/2) dry, silty clay; dark grayish brown (2.5Y 4/2) moist; 10 percent sand; 42 percent silt; 48 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.57 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; neutral, pH 7.2, pH meter; clear; CaCO3 28.9 percent.

Bss1 --- 24 to 47 centimeters (9.4 to 18.5 inches); light brownish gray (2.5Y 6/2) dry, clay; dark grayish brown (2.5Y 4/2) moist; 10 percent sand; 39 percent silt; 51 percent clay; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; 45 percent (common) slickensides (pedogenic) on all faces of peds; electrical conductivity of 0.38 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; gradual; CaCO3 33.4 percent.

Bss2 --- 47 to 87 centimeters (18.5 to 34.3 inches); light yellowish brown (2.5Y 6/3) dry, silty clay; olive brown (2.5Y 4/3) moist; 4 percent sand; 42 percent silt; 54 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; firm, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; 60 percent (many) slickensides (pedogenic) on all faces of peds; electrical conductivity of 0.32 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; gradual; CaCO3 29.8 percent.

Bkss --- 87 to 137 centimeters (34.3 to 53.9 inches); light gray (10YR 7/1) dry, silty clay; grayish brown (10YR 5/2) moist; 6 percent sand; 45 percent silt; 49 percent clay; 7 percent fine prominent olive yellow (2.5Y 6/6) mottles; strong medium prismatic parting to strong medium subangular blocky structure; very firm, extremely hard, very sticky, very plastic; common very fine roots throughout; 40 percent (common) slickensides (pedogenic) on all faces of peds; 3 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 0.64 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; gradual; CaCO3 31.7 percent.

Cr --- 137 to 140 centimeters (53.9 to 55.1 inches); Weathered Tropic shale.

DP-04

Pedon ID: DP-04

Description Date: 7/30/2012
Describer: Robert Long

Pedon Notes: Text: This soil is very similar to Brumley, but the clay increase between the A and Bt is only 4% and 5.6% is required (1.2 times). The "t" suffix indicates illuvial accumulation of silicate clay. Clay films were observed and not slickensides.

Current Taxonomic Name: Wimmer family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370463E, 4143436N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace and alluvial fan
Geomorphic Component: Tread
Profile Pos: Toeslope
Slope: 5 percent
Elevation: 2117 meters (6945.5 feet)
Aspect: 257°
Shape: up/down: Concave; **across:** Linear
Surface Fragments: subrounded sandstone - 2 percent gravels.

Drainage: Well drained
Runoff: Low
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: BRIN2 - smooth brome (*Bromus inermis*); AGCR - crested wheatgrass (*Agropyron cristatum*); CHRYS9 - rabbitbrush (*Chrysothamnus*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*); CONVO - bindweed (*Convolvulus*); MEDIC - alfalfa (*Medicago*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 20 to 70 centimeters (7.9 to 27.6 inches)

Diagnostic Features: Cambic horizon: 20 to 153 centimeters (7.9 to 60.2 inches) and Calcic horizon: 90 to 232 centimeters (35.4 to 91.3 inches)

Ap --- 0 to 20 centimeters (0 to 7.9 inches); pale brown (10YR 6/3) dry, clay loam; brown (10YR 4/3) moist; 30 percent sand; 42 percent silt; 28 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; very friable, slightly hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine interstitial pores; electrical conductivity of 0.76 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 20 percent.

Bt1 --- 20 to 46 centimeters (7.9 to 18.1 inches); brown (10YR 5/3) dry, clay loam; brown (10YR 4/3) moist; 30 percent sand; 38 percent silt; 32 percent clay; moderate medium subangular blocky parting to strong fine angular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; 35 percent (common) clay films on all faces of peds; electrical conductivity of 0.41 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 24.4 percent.

Bt2 --- 46 to 90 centimeters (18.1 to 35.4 inches); brown (10YR 4/3) dry, clay loam; dark brown (10YR 3/3) moist; 36 percent sand; 32 percent silt; 32 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; firm, very hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 50 percent (many) clay films on all faces of peds; electrical conductivity of 0.38 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; abrupt; CaCO3 9.1 percent.

Btk --- 90 to 153 centimeters (35.4 to 60.2 inches); brown (10YR 5/3) dry, clay loam gravel; brown (10YR 4/3) moist; 38 percent sand; 34 percent silt; 28 percent clay; weak medium prismatic parting to moderate medium subangular blocky structure; firm, very hard, moderately sticky, slightly plastic; common very fine roots throughout; 35 percent (common) clay films on all faces of peds; 4 percent (common) fine masses of carbonate in matrix; 6 percent subrounded sandstone gravels; electrical conductivity of 0.39 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; abrupt; CaCO3 22.5 percent.

Bk --- 153 to 232 centimeters (60.2 to 91.3 inches); very pale brown (10YR 7/4) dry, sandy loam; light yellowish brown (10YR 6/4) moist; 66 percent sand; 24 percent silt; 10 percent clay; single grain; loose, loose, nonsticky, nonplastic; common very fine roots throughout; many very fine interstitial pores finely disseminated carbonates; 4 percent subrounded

sandstone gravels; electrical conductivity of 0.37 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; CaCO3 42.4 percent.

DP-05

Pedon ID: DP-05

Description Date: 7/30/2012
Print Date: 6/25/2014
Describer: Robert Long

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370506E, 4143319N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: structural bench and hill
Geomorphic Component: Nose Slope
Profile Pos: Footslope
Slope: 7 percent
Elevation: 2118 meters (6948.8 feet)
Aspect: 268°
Shape: up/down: Concave; **across:** Linear
Surface Fragments: subangular sandstone - 2 percent gravels.

Drainage: Well drained
Runoff: Medium

Existing Vegetation: BRIN2 - smooth brome (*Bromus inermis*); PASM - western wheatgrass (*Pascopyrum smithii*); AGCR - crested wheatgrass (*Agropyron cristatum*); CONVO - bindweed (*Convolvulus*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: residuum weathered from calcareous shale
Bedrock: Calcareous shale at 162 centimeters (63.8 inches)
Particle Size Control Section:

Diagnostic Features: Secondary carbonates: 35 to 162 centimeters (13.8 to 63.8 inches), Slickensides: 35 to 70 centimeters (13.8 to 27.6 inches) and Paralithic contact: 162 centimeters (63.8 inches)

Restrictions: Paralithic bedrock: 162 centimeters (63.8 inches)

Ap --- 0 to 35 centimeters (0 to 13.8 inches); grayish brown (10YR 5/2) dry, clay loam; dark grayish brown (10YR 4/2) moist; 20 percent sand; 42 percent silt; 38 percent clay; weak medium subangular blocky parting to moderate medium granular structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.65 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 20.8 percent.

Bkss --- 35 to 70 centimeters (13.8 to 27.6 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 18 percent sand; 39 percent silt; 43 percent clay; moderate medium subangular blocky structure; friable, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 35 percent (common) slickensides (pedogenic) on vertical faces of peds; 2 percent (common) fine masses of carbonate on vertical faces of peds; electrical conductivity of 0.39 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; gradual; CaCO3 22.7 percent.

Bk --- 70 to 162 centimeters (27.6 to 63.8 inches); light brownish gray (2.5Y 6/2) dry, clay; grayish brown (2.5Y 5/2) moist; 16 percent sand; 39 percent silt; 45 percent clay; moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; common very fine roots throughout finely disseminated carbonates; electrical conductivity of 1.01 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear; CaCO3 25.9 percent.

Cr --- 162 to 176 centimeters (63.8 to 69.3 inches); light brownish gray (10YR 6/2) dry; grayish brown (10YR 5/2) moist; common very fine roots throughout; weathered Tropic shale.

DP-06

Pedon ID: DP-06

Description Date: 7/30/2012
Describer: Robert Long

Pedon Notes: Text: the clay increase between the BA and Bt horizons is only 4% and 7.2% is required for an argillic. The "t" refers to an accumulation of silicate clay. This soil was correlated to Sideshow, because of the fine mineralogy and lack of a calcic horizon.

Current Taxonomic Name: Teromote family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Haplustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370506E, 4143319N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: valley-floor remnant and alluvial fan
Geomorphic Component: Base Slope
Profile Pos: Toeslope
Slope: 5 percent
Elevation: 2118 meters (6948.8 feet)
Aspect: 257°
Shape: up/down: Concave; **across:** Concave
Surface Fragments: subrounded sandstone - 3 percent gravels.

Drainage: Well drained
Erosion: Class 2 - Sheet erosion

Primary Earth Cover: ; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: PASM - western wheatgrass (*Pascopyrum smithii*); CHRYS9 - rabbitbrush (*Chrysothamnus*); CONVO - bindweed (*Convolvulus*); AGCR - crested wheatgrass (*Agropyron cristatum*)

Parent Materials: slope alluvium derived from sandstone and shale over alluvium derived from limestone, sandstone, and shale

Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Cambic horizon: 35 to 145 centimeters (13.8 to 57.1 inches), Secondary carbonates: 75 to 230 centimeters (29.5 to 90.6 inches) and Calcic horizon: 187 to 230 centimeters (73.6 to 90.6 inches)

Ap --- 0 to 18 centimeters (0 to 7.1 inches); light brownish gray (10YR 6/2) dry, clay loam; dark grayish brown (10YR 4/2) moist; 28 percent sand; 39 percent silt; 33 percent clay; moderate medium platy parting to moderate medium granular structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.63 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; neutral, pH 7.3, pH meter; gradual; CaCO3 19.8 percent.

BA --- 18 to 35 centimeters (7.1 to 13.8 inches); grayish brown (10YR 5/2) dry, clay loam; dark grayish brown (10YR 4/2) moist; 28 percent sand; 36 percent silt; 36 percent clay; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.4 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; neutral, pH 7.3, pH meter; clear; CaCO3 19.6 percent.

Bt --- 35 to 75 centimeters (13.8 to 29.5 inches); light brownish gray (10YR 6/2) dry, silty clay; dark grayish brown (10YR 4/2) moist; 20 percent sand; 40 percent silt; 40 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; firm, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 50 percent (many) clay films on all faces of peds; electrical conductivity of 0.33 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear; CaCO3 19.7 percent.

Btk --- 75 to 145 centimeters (29.5 to 57.1 inches); pale brown (10YR 6/3) dry, clay loam; dark grayish brown (10YR 4/2) moist; 24 percent sand; 38 percent silt; 38 percent clay; strong medium prismatic parting to strong medium subangular blocky structure; firm, very hard, moderately sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 35 percent (common) clay films on all faces of peds; 4 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; abrupt; CaCO3 24.1 percent.

2Bk1 --- 145 to 187 centimeters (57.1 to 73.6 inches); pale brown (10YR 6/3) dry, sandy loam; brown (10YR 5/3) moist; 64 percent sand; 22 percent silt; 14 percent clay; single grain;

loose, loose, nonsticky, nonplastic; common very fine roots throughout; many very fine interstitial pores; 5 percent (few) carbonate coats on bottom surfaces of rock fragments finely disseminated carbonates; 4 percent subrounded sandstone gravels; electrical conductivity of 0.3 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; gradual; CaCO3 27 percent.

2Bk2 --- 187 to 230 centimeters (73.6 to 90.6 inches); very pale brown (10YR 7/3) dry, loamy sand; pale brown (10YR 6/3) moist; 84 percent sand; 10 percent silt; 6 percent clay; single grain; loose, loose, nonsticky, nonplastic; common very fine roots throughout; many very fine interstitial pores; 10 percent (few) carbonate coats on bottom surfaces of rock fragments finely disseminated carbonates; 40 percent subrounded sandstone gravels; electrical conductivity of 0.34 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; CaCO3 52.2 percent.

DP-07

Pedon ID: DP-7

Description Date: 7/30/2012
Describer: Robert Long

Pedon Notes: Text: Textures and percent clay were estimated based on the field texture method; and pH was determined with indicator phenol red indicator dye.

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370483E, 4143244N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: alluvial fan
Geomorphic Component: Nose Slope
Profile Pos: Footslope
Slope: 5 percent
Elevation: 2116 meters (6942.3 feet)
Aspect: 241°
Shape: up/down: Convex; **across:** Convex
Surface Fragments: subangular sandstone - 8 percent channers.

Drainage: Well drained
Runoff: Medium
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland

Parent Materials: slope alluvium derived from sandstone and shale over alluvium derived from limestone, sandstone, and shale
Existing Vegetation: smooth brome (*Bromus inermis*); AGCR - crested wheatgrass (*Agropyron cristatum*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*); CONVO - bindweed (*Convolvulus*); matchweed.

N/A --- 0 to 122 centimeters (0 to 48 inches); sample unavailable for evaluation..

Bkss --- 122 to 165 centimeters (48 to 65 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; null percent sand; null percent silt; 45 percent clay; moderate medium subangular blocky structure; firm, extremely hard, very sticky, very plastic; 25 percent (common) slickensides (pedogenic) on all faces of peds; 3 percent (common) fine threadlike masses of carbonate in matrix; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH indicator solutions; abrupt.

Bk --- 165 to 200 centimeters (65 to 78.7 inches); grayish brown (10YR 5/2) dry, sandy clay loam; dark grayish brown (10YR 4/2) moist; null percent sand; null percent silt; 28 percent clay; structure; friable, hard, slightly sticky, moderately plastic; 15 percent (common) fine masses of carbonate in matrix; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH indicator solutions; clear.

2Bk --- 200 to 244 centimeters (78.7 to 96.1 inches); light yellowish brown (10YR 6/4) dry, loamy sand; dark yellowish brown (10YR 4/4) moist; null percent sand; null percent silt; 5 percent clay; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; 1 percent (very few) carbonate coats on bottom surfaces of rock fragments finely disseminated carbonates; 10 percent subrounded calcareous sandstone gravels; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH indicator solutions.

DP-08

Pedon ID: DP-03

Description Date: 8/1/2012
Describer: Robert Long

Pedon Notes: Text: encountered sandstone at 32 inches in new auger hole; soil was clayey (50 to 60% clay)

Current Taxonomic Name: setting similar to Sideshow family
Current Taxonomic Class: not enough data for full classification
Current Taxon Kind:

County or Parish: Kane
State or Territory: Utah
UTM: 3705073E, 41432454N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: alluvial fan
Geomorphic Component: nose
Profile Pos: footslope
Slope: 7 percent
Elevation: 2118 meters (6,947 feet)
Aspect: 245°
Shape: up/down: ; **across:**
Surface Fragments: subangular sandstone - 4 percent channers and 2 percent flags.

Earth Cover: shrub cover.

Existing Vegetation: smooth brome (*Bromus inermis*); AGCR - crested wheatgrass (*Agropyron cristatum*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*); CONVO - bindweed (*Convolvulus*); matchweed.

DP-09

Pedon ID: DP-09

Description Date: 7/30/2012
Describer: Robert Long

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370485E, 4143105N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: alluvial fan
Geomorphic Component: Side Slope
Profile Pos: Footslope
Slope: 6 percent
Elevation: 2115 meters (6939 feet)
Aspect: 297°
Shape: up/down: Linear; **across:** Convex
Surface Fragments: subangular sandstone - 3 percent gravel, 1 percent cobble, and 2 percent channers.

Drainage: Well drained
Runoff: Low
Erosion: Class 2 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: PASM - western wheatgrass (*Pascopyrum smithii*); BRIN2 - smooth brome (*Bromus inermis*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*); MEDIC - alfalfa (*Medicago*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 38 to 194 centimeters (15 to 76.4 inches) and Secondary carbonates: 68 to 244 centimeters (26.8 to 96.1 inches)

Ap --- 0 to 38 centimeters (0 to 15 inches); pale brown (10YR 6/3) dry, clay; brown (10YR 5/3) moist; 20 percent sand; 33 percent silt; 47 percent clay; weak medium subangular blocky parting to moderate medium granular structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.83 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; neutral, pH 7.3, pH meter; clear; CaCO3 20.9 percent.

Bss --- 38 to 68 centimeters (15 to 26.8 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 12 percent sand; 36 percent silt; 52 percent clay; moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 25 percent (common) slickensides (pedogenic) on all faces of peds; electrical conductivity of 0.54 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 22.2 percent.

Bkss1 --- 68 to 166 centimeters (26.8 to 65.4 inches); light brownish gray (10YR 6/2) dry, clay; grayish brown (10YR 5/2) moist; 10 percent sand; 38 percent silt; 52 percent clay; moderate medium prismatic parting to moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 15 percent (few) clay films and 30 percent (common) slickensides (pedogenic) on all faces of peds; 3 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 1.54 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; clear; CaCO3 22.2 percent.

Bkss2 --- 166 to 194 centimeters (65.4 to 76.4 inches); light brownish gray (10YR 6/2) dry, clay; grayish brown (10YR 5/2) moist; 10 percent sand; 36 percent silt; 54 percent clay; moderate medium prismatic parting to moderate medium subangular blocky structure; firm, extremely hard, very sticky, very plastic; common very fine roots throughout; common very fine tubular pores; 25 percent (common) slickensides (pedogenic) on all faces of peds; 7 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 6.01 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; gradual; CaCO3 23.1 percent.

Bk --- 194 to 244 centimeters (76.4 to 96.1 inches); light brownish gray (2.5Y 6/2) dry, clay; grayish brown (2.5Y 5/2) moist; 14 percent sand; 34 percent silt; 52 percent clay; weak fine prismatic parting to weak medium subangular blocky structure; firm, very hard, very

sticky, very plastic; common very fine roots throughout; 12 percent (common) medium spherical masses of carbonate on faces of peds; electrical conductivity of 6.15 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; CaCO3 23.7 percent.

DP-10

Pedon ID: DP-10

Description Date: 7/31/2012
Describer: Robert Long

Pedon Notes: Text: Textures and percent clay were estimated based on the field texture method; and pH was determined with indicator phenol red indicator dye.

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370474E, 4143121N -- Datum NAD83, Zone 11
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: alluvial fan
Geomorphic Component: Side Slope
Profile Pos: Toeslope
Slope: 5 percent
Elevation: 2114 meters (6935.7 feet)
Aspect: 302°
Shape: up/down: Linear; **across:** Concave
Surface Fragments: subangular sandstone - 4 percent gravel and 1 percent channers.

Drainage: Well drained
Runoff: Low
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland

Existing Vegetation: CONVO - bindweed (*Convolvulus*); PASM - western wheatgrass (*Pascopyrum smithii*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: clayey slope alluvium derived from calcareous shale over coarse-loamy slope alluvium derived from calcareous sandstone

Diagnostic Features: Secondary carbonates: 122 to 244 centimeters (48 to 96.1 inches)

N/A 0 to 122 centimeters (0 to 48 inches); sample unavailable for evaluation.

Bkss --- 122 to 172 centimeters (48 to 67.7 inches); light brownish gray (10YR 6/2) dry, clay; dark gray (10YR 4/1) moist; null percent sand; null percent silt; 50 percent clay; structure; firm, extremely hard, very sticky, very plastic; common medium tubular pores; 25 percent (common) slickensides (pedogenic) on all faces of peds; 12 percent (common) medium masses of carbonate in matrix; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH indicator solutions; clear.

2Bk --- 172 to 244 centimeters (67.7 to 96.1 inches); very pale brown (10YR 7/4) dry, sandy loam; yellowish brown (10YR 5/4) moist; null percent sand; null percent silt; 10 percent clay; single grain; loose, loose, nonsticky, nonplastic; common medium tubular and common fine tubular pores finely disseminated carbonates; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH indicator solutions.

DP-11

Pedon ID: DP-11

Description Date: 7/31/2012
Describer: Robert Long

Pedon Notes: Text: This soil is similar to Wimmer family. The weighted percent clay in the control section is 17%. This is 1% less than the amount of clay required for fine-loamy.

Current Taxonomic Name: Wimmer family similar
Current Taxonomic Class: Coarse-loamy, mixed, superactive, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370352E, 4143094N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace and fan apron
Geomorphic Component: Base Slope
Profile Pos: Toeslope
Slope: 5 percent
Elevation: 2107 meters (6912.7 feet)
Aspect: 11°
Shape: up/down: Concave; **across:** Linear
Surface Fragments: none.

Drainage: Somewhat poorly drained
Runoff: Low
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: BRIN2 - smooth brome (*Bromus inermis*)

Parent Materials: slope alluvium derived from sandstone over alluvium derived from limestone, sandstone, and shale

Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Secondary carbonates: 27 to 169 centimeters (10.6 to 66.5 inches) and Calcic horizon: 60 to 138 centimeters (23.6 to 54.3 inches)

A --- 0 to 27 centimeters (0 to 10.6 inches); grayish brown (10YR 5/2) dry, loam; very dark grayish brown (10YR 3/2) moist; 50 percent sand; 28 percent silt; 22 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; friable, hard, slightly sticky, slightly plastic; electrical conductivity of 1.15 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; neutral, pH 7.3, pH meter; clear; CaCO3 4.9 percent.

Bk --- 27 to 60 centimeters (10.6 to 23.6 inches); grayish brown (10YR 5/2) dry, sandy clay loam; dark grayish brown (10YR 4/2) moist; 50 percent sand; 26 percent silt; 24 percent clay; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 5 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.38 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear; CaCO3 13 percent.

2Bk --- 60 to 138 centimeters (23.6 to 54.3 inches); very pale brown (10YR 7/4) dry, sandy loam; yellowish brown (10YR 5/6) moist; 64 percent sand; 20 percent silt; 16 percent clay; 5 percent medium faint yellow (10YR 7/6) mottles; weak medium subangular blocky structure; friable, very hard, nonsticky, nonplastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; many very fine interstitial pores; 5 percent (common) medium yellow (10YR 7/6), moist, iron-manganese masses; 9 percent (common) fine masses of carbonate in matrix; 5 percent subrounded sandstone gravels; electrical conductivity of 0.64 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; abrupt; CaCO3 33.5 percent.

3Bk --- 138 to 169 centimeters (54.3 to 66.5 inches); olive yellow (2.5Y 6/6) dry, sandy loam; brown (10YR 5/3) moist; 60 percent sand; 22 percent silt; 18 percent clay; 3 percent fine faint brownish yellow (10YR 6/6) mottles; moderate medium subangular blocky structure; friable, hard, nonsticky, nonplastic; 3 percent (common) fine brownish yellow (10YR 6/6), moist, iron-manganese masses; 8 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.36 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 10.7 percent.

3C --- 169 to 243 centimeters (66.5 to 95.7 inches); very pale brown (10YR 8/2) dry, sandy loam; very pale brown (10YR 7/3) moist; 68 percent sand; 14 percent silt; 18 percent clay; 20 percent coarse faint brownish yellow (10YR 6/6) mottles; moderate medium subangular blocky structure; firm, hard, nonsticky, nonplastic; common very fine interstitial pores; 20 percent (many) coarse brownish yellow (10YR 6/6), moist, iron-manganese masses;

electrical conductivity of 0.32 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; $CaCO_3$ 11.6 percent.

DP-12

Pedon ID: DP-12

Description Date: 7/31/2012
Describer: Robert Long

Current Taxonomic Name: Flugle family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Haplustalfs
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370347E, 4143083N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: hillslope:
Geomorphic Component: Side Slope
Profile Pos: Backslope
Slope: 6 percent
Elevation: 2108 meters (6916 feet)
Aspect: 23°
Shape: up/down: Convex; **across:** Convex
Surface Fragments: subangular sandstone - 3 percent channers and 2 percent flags.

Drainage: Moderately well drained
Runoff: Low
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland

Existing Vegetation: BRIN2 - smooth brome (*Bromus inermis*); CHRYS9 - rabbitbrush (*Chrysothamnus*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: slope alluvium derived from sandstone
Particle Size Control Section: 62 to 112 centimeters (24.4 to 44.1 inches)

Diagnostic Features: Argillic horizon: 62 to 126 centimeters (24.4 to 49.6 inches) and Secondary carbonates: 126 to 183 centimeters (49.6 to 72 inches)

Ap --- 0 to 28 centimeters (0 to 11 inches); brown (10YR 5/3) dry, sandy loam; dark grayish brown (10YR 4/2) moist; 58 percent sand; 25 percent silt; 17 percent clay; weak medium subangular blocky parting to moderate medium granular structure; very friable, slightly hard, nonsticky, nonplastic; common fine roots throughout and common very fine roots throughout; common fine tubular pores; noneffervescent by HCl, 1 normal; slightly alkaline, pH 7.4, pH meter; clear; CaCO3 2.6 percent.

A --- 28 to 62 centimeters (11 to 24.4 inches); yellowish brown (10YR 5/4) dry, loam; brown (10YR 4/3) moist; 50 percent sand; 35 percent silt; 15 percent clay; moderate medium subangular blocky structure; very friable, hard, nonsticky, nonplastic; common fine roots throughout and common very fine roots throughout; common fine tubular pores; noneffervescent by HCl, 1 normal; neutral, pH 7.3, pH meter; clear; CaCO3 0.4 percent.

Bt --- 62 to 126 centimeters (24.4 to 49.6 inches); yellowish brown (10YR 5/4) dry, sandy clay loam; dark brown (10YR 3/3) moist; 66 percent sand; 12 percent silt; 22 percent clay; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 15 percent (few) clay films on all faces of peds and 20 percent (few) clay films between sand grains; noneffervescent by HCl, 1 normal; slightly alkaline, pH 7.4, pH meter; clear; CaCO3 0.4 percent.

Bk --- 126 to 183 centimeters (49.6 to 72 inches); brownish yellow (10YR 6/6) dry, sandy clay loam; yellowish brown (10YR 5/8) moist; 52 percent sand; 26 percent silt; 22 percent clay; 8 percent medium reddish yellow (7.5YR 6/8) mottles; moderate medium subangular blocky structure; very friable, slightly hard, slightly sticky, slightly plastic; common very fine roots throughout; 5 percent (common) fine masses of carbonate in matrix; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 0.3 percent.

2Ck --- 183 to 244 centimeters (72 to 96.1 inches); white (2.5Y 8/1) dry, loam; light yellowish brown (2.5Y 6/3) moist; 50 percent sand; 28 percent silt; 22 percent clay; 12 percent pale brown (10YR 6/3) mottles; moderate medium subangular blocky structure; firm, very hard, slightly sticky, slightly plastic finely disseminated carbonates; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; CaCO3 11.1 percent.

DP-13

Pedon ID: DP-13

Description Date: 7/31/2012
Describer: Robert Long

Pedon Notes: Text: This soil profile is similar to the Flugle family. No lab data is available for the A horizon. Field estimate of the texture is loam (23% clay). Box sample appears to have an argillic horizon. Argillics were identified in this area.; the physiographic setting of this location is similar to 12AS04 (Evpark or Flugle mod. deep) and may be moderately deep or deep to sandstone.

Soil Name As Correlated: Flugle family similar
Current Taxonomic Name: Flugle family similar
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Haplustalfs
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370297E, 4143072N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: structural bench and hill
Geomorphic Component: Side Slope
Profile Pos: Backslope
Slope: 13 percent
Elevation: 2107 meters (6912.7 feet)
Aspect: 282°
Shape: up/down: Convex; **across:** Convex
Surface Fragments: subangular sandstone - 5 percent gravels and 10 percent channers.

Drainage: Well drained
Runoff: Medium
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland
Existing Vegetation: BRIN2 - smooth brome (*Bromus inermis*); MEDIC - alfalfa (*Medicago*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*); ARNO4 -

black sagebrush (*Artemisia nova*)

Parent Materials: residuum weathered from sandstone
Particle Size Control Section: 25 to 88 centimeters (9.8 to 34.6 inches)
Diagnostic Features: Argillic horizon: 15 to 54 centimeters (5.9 to 21.3 inches) and Secondary carbonates: 54 to 88 centimeters (21.3 to 34.6 inches)

A --- 0 to 15 centimeters (0 to 5.9 inches); brown (10YR 5/3) dry, loam; brown (10YR 4/3) moist; null percent sand; null percent silt; 23 percent clay; moderate medium platy parting to moderate fine granular structure; very friable, slightly hard, slightly sticky, slightly plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 2 percent subrounded sandstone gravels; slightly effervescent; No sample, too small; clear.

Bt --- 15 to 54 centimeters (5.9 to 21.3 inches); grayish brown (10YR 5/2) dry, sandy clay loam; dark grayish brown (10YR 4/2) moist; 48 percent sand; 24 percent silt; 28 percent clay; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 30 percent (common) clay films on all faces of peds; 10 percent subrounded 2 sandstone gravels; electrical conductivity of 0.54 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; neutral, pH 7.1, pH meter; clear; CaCO3 17.9 percent.

Bk --- 54 to 88 centimeters (21.3 to 34.6 inches); light brownish gray (10YR 6/2) dry, sandy clay loam; yellowish brown (10YR 5/4) moist; 48 percent sand; 21 percent silt; 31 percent clay; strong medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common very fine roots throughout; common very fine tubular pores; 7 percent (common) fine masses of carbonate on faces of peds; 5 percent subrounded sandstone gravels; electrical conductivity of 0.34 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; CaCO3 15.8 percent.

DP-14

Pedon ID: DP-14

Description Date: 7/31/2013
Describer: Robert Long

Pedon Notes: Text: Horizon samples were too small for submission for lab analysis. Textures and percent clay are field estimates.

Current Taxonomic Name: Wimmer family
Current Taxonomic Class: Coarse-loamy, mixed, superactive, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370294E, 4143081N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West

Landscape: valley
Landform: structural bench
Geomorphic Component: Tread
Profile Pos: Toeslope
Slope: 8 percent
Elevation: 2107 meters (6912.7 feet)
Aspect: 292°
Shape: up/down: Concave; **across:** Convex
Surface Fragments: subrounded sandstone - 3 percent gravels.

Drainage: Well drained
Runoff: Medium
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: BRIN2 - smooth brome (*Bromus inermis*); PASM - western wheatgrass (*Pascopyrum smithii*); CONVO - bindweed (*Convolvulus*); MEDIC - alfalfa (*Medicago*)

Parent Materials: slope alluvium derived from sandstone and shale over residuum weathered from calcareous sandstone

Bedrock: Sandstone at 88 centimeters (34.6 inches)
Particle Size Control Section: 25 to 88 centimeters (9.8 to 34.6 inches)

Diagnostic Features: Secondary carbonates: 18 to 88 centimeters (7.1 to 34.6 inches), Calcic horizon: 46 to 88 centimeters (18.1 to 34.6 inches) and Lithic contact: 88 centimeters (34.6 inches)

Restrictions: Lithic bedrock: 88 centimeters (34.6 inches)

A --- 0 to 18 centimeters (0 to 7.1 inches); grayish brown (10YR 5/2) dry, clay loam; dark grayish brown (10YR 4/2) moist; null percent sand; null percent silt; 32 percent clay; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; slightly effervescent; abrupt.

Bk1 --- 18 to 46 centimeters (7.1 to 18.1 inches); very pale brown (10YR 7/3) dry, sandy loam; pale brown (10YR 6/3) moist; null percent sand; null percent silt; 18 percent clay; weak medium subangular blocky structure; very friable, slightly hard, slightly sticky, nonplastic; common very fine roots throughout; common very fine tubular pores; 20 percent (many) medium masses of carbonate in matrix; strongly effervescent; clear.

Bk2 --- 46 to 88 centimeters (18.1 to 34.6 inches); very pale brown (10YR 8/3) dry, loamy sand; very pale brown (10YR 7/3) moist; null percent sand; null percent silt; 2 percent clay; single grain; loose, loose, nonsticky, nonplastic; common very fine roots throughout; many very fine interstitial pores finely disseminated carbonates; violently effervescent.

R --- 88 centimeters (34.6 inches); sandstone.

DP-15

Pedon ID: DP-15

Description Date: 7/31/2012
Describer: Robert Long

Pedon Notes: Text: Calcic horizon is too deep to be diagnostic.

Current Taxonomic Name: Teromote family similar
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Haplustepts
Current Taxon Kind: Taxadjunct

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370212E, 4142932N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: hillslope
Geomorphic Component: Nose Slope
Profile Pos: Toeslope
Slope: 15 percent
Elevation: 2105 meters (6906.2 feet)
Aspect: 274°
Shape: up/down: Concave; **across:** Linear
Surface Fragments: subrounded sandstone - 2 percent and 2 percent channers.

Drainage: Well drained
Runoff: Medium
Erosion: Class 2 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: PASM - western wheatgrass (*Pascopyrum smithii*); CHRYS9 - rabbitbrush (*Chrysothamnus*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*); SYOR2 - mountain snowberry (*Symphoricarpos oreophilus*); CELE3 - curlleaf mountain mahogany (*Cercocarpus ledifolius*)

Parent Materials: alluvium derived from sandstone and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Cambic horizon: 24 to 56 centimeters (9.4 to 22 inches), Secondary carbonates: 56 to 362 centimeters (22 to 142.5 inches) and Calcic horizon: 156 to 250 centimeters (61.4 to 98.4 inches)

Ap --- 0 to 24 centimeters (0 to 9.4 inches); brown (10YR 5/3) dry, clay loam; brown (10YR 4/3) moist; 44 percent sand; 26 percent silt; 30 percent clay; moderate medium platy parting to moderate medium granular structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.84 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; neutral, pH 7, pH meter; clear; CaCO3 8.5 percent.

Bw --- 24 to 56 centimeters (9.4 to 22 inches); brown (10YR 4/3) dry, clay loam; dark brown (10YR 3/3) moist; 38 percent sand; 28 percent silt; 34 percent clay; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.43 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; neutral, pH 7.3, pH meter; gradual; CaCO3 8.4 percent.

Bk1 --- 56 to 152 centimeters (22 to 59.8 inches); brown (10YR 5/3) dry, clay loam; brown (10YR 4/3) moist; 36 percent sand; 30 percent silt; 34 percent clay; weak medium subangular blocky parting to moderate fine subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; 1 percent (few) fine threadlike masses of carbonate in matrix; electrical conductivity of 0.32 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.4, pH meter; gradual; CaCO3 10.9 percent.

Bk2 --- 152 to 207 centimeters (59.8 to 81.5 inches); brown (10YR 5/3) dry, clay; brown (10YR 4/3) moist; 22 percent sand; 38 percent silt; 40 percent clay; structure; friable, hard, very sticky, very plastic; common very fine roots throughout; common very fine tubular pores; 2 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; abrupt; CaCO3 18.5 percent.

Bk3 --- 207 to 250 centimeters (81.5 to 98.4 inches); very pale brown (10YR 7/3) dry, clay loam; pale brown (10YR 6/3) moist; 26 percent sand; 47 percent silt; 27 percent clay; massive; very friable, slightly hard, slightly sticky, slightly plastic; common very fine roots throughout; 12 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.32 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.4, pH meter; abrupt; CaCO3 43.9 percent.

2Bk --- 250 to 280 centimeters (98.4 to 110.2 inches); light gray (2.5Y 7/1) dry, clay loam; gray (2.5Y 6/1) moist; 36 percent sand; 34 percent silt; 30 percent clay; moderate fine

subangular blocky structure; firm, very hard, slightly sticky, slightly plastic; 5 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 0.51 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear; CaCO3 25.8 percent.

2C --- 280 to 362 centimeters (110.2 to 142.5 inches); white (2.5Y 8/1) dry, loam; light yellowish brown (2.5Y 6/3) moist; 42 percent sand; 33 percent silt; 25 percent clay; 20 percent medium yellow (10YR 7/8) mottles; massive; firm, very hard, slightly sticky, slightly plastic; 2 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.6 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; CaCO3 21.8 percent.

DP-16

Pedon ID: DP-16

Description Date: 7/31/2012
Describer: Robert Long

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370179E, 4142786N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: hillslope
Geomorphic Component: Base Slope
Profile Pos: Footslope
Slope: 9 percent
Elevation: 2098 meters (6883.2 feet)
Aspect: 256°
Shape: up/down: Concave; **across:** Linear
Surface Fragments: subangular sandstone - 4 percent gravel, 1 percent stone, and 6 percent channers.

Drainage: Well drained
Runoff: High
Erosion: Class 3 - Rill erosion

Primary Earth Cover: ; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: PASM - western wheatgrass (*Pascopyrum smithii*); MEDIC - alfalfa (*Medicago*); AGCR - crested wheatgrass (*Agropyron cristatum*); CHRYS9 - rabbitbrush (*Chrysothamnus*); BRIN2 - smooth brome (*Bromus inermis*); CIRSI - thistle (*Cirsium*)

Parent Materials: residuum weathered from calcareous shale
Bedrock: Calcareous shale at 102 centimeters (40.2 inches)
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 18 to 102 centimeters (7.1 to 40.2 inches), Gypsum accumulations: 43 to 102 centimeters (16.9 to 40.2 inches) and Paralithic contact: 102

centimeters (40.2 inches)

Restrictions: Paralithic bedrock: 102 centimeters (40.2 inches)

A --- 0 to 18 centimeters (0 to 7.1 inches); brown (10YR 5/3) dry, clay loam; brown (10YR 4/3) moist; 36 percent sand; 28 percent silt; 36 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; friable, hard, moderately sticky, moderately plastic; common coarse roots throughout, common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.84 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 12.1 percent.

Bss --- 18 to 43 centimeters (7.1 to 16.9 inches); light brownish gray (10YR 6/2) dry, clay; grayish brown (10YR 5/2) moist; 24 percent sand; 32 percent silt; 44 percent clay; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common coarse roots throughout, common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 20 percent (few) slickensides (pedogenic) on all faces of peds; electrical conductivity of 0.48 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 15.6 percent.

Bssy --- 43 to 70 centimeters (16.9 to 27.6 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 18 percent sand; 36 percent silt; 46 percent clay; moderate medium prismatic parting to moderate medium subangular blocky structure; firm, extremely hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; 30 percent (common) slickensides (pedogenic) on all faces of peds; 1 percent (few) fine masses of gypsum in matrix; electrical conductivity of 0.5 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; gradual; CaCO3 14.2 percent.

Bssy --- 70 to 102 centimeters (27.6 to 40.2 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 22 percent sand; 30 percent silt; 48 percent clay; moderate medium prismatic parting to moderate medium subangular blocky structure; firm, extremely hard, very sticky, very plastic; 50 percent (many) slickensides (pedogenic) on all faces of peds; 1 percent (few) fine threadlike masses of gypsum in matrix; electrical conductivity of 0.36 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; gradual; CaCO3 14.6 percent.

Cr --- 102 to 116 centimeters (40.2 to 45.7 inches); weathered Tropic shale.

DP-17

Pedon ID: DP-17

Description Date: 7/31/2012
Describer: Robert Long

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370215E, 4142570N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 west of the 29 Meridian

Landscape: valley
Landform: hillslope
Geomorphic Component: Side Slope
Profile Pos: Toeslope
Slope: 6 percent
Elevation: 2090 meters (6857 feet)
Aspect: 222°
Shape: up/down: Concave; **across:** Linear
Surface Fragments: subangular sandstone- 5 percent gravels, 2 percent cobbles, 10 channers, and 2 percent flags.

Runoff: Medium
Erosion: Class 2 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Shrubby rangeland

Existing Vegetation: PASM - western wheatgrass (*Pascopyrum smithii*); AGCR - crested wheatgrass (*Agropyron cristatum*); MEDIC - alfalfa (*Medicago*); ARTR2 - basin big sagebrush (*Artemisia tridentata*)

Parent Materials: slope alluvium derived from sandstone and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 32 to 170 centimeters (12.6 to 66.9 inches) and Gypsum accumulations: 54 to 170 centimeters (21.3 to 66.9 inches)

A --- 0 to 20 centimeters (0 to 7.9 inches); pale brown (10YR 6/3) dry, clay loam; brown (10YR 4/3) moist; 28 percent sand; 34 percent silt; 38 percent clay; moderate medium platy parting to moderate medium granular structure; very friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.68 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear; CaCO3 19.2 percent.

BA --- 20 to 32 centimeters (7.9 to 12.6 inches); brown (10YR 5/3) dry, clay; brown (10YR 4/3) moist; 30 percent sand; 29 percent silt; 41 percent clay; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.5 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 15.9 percent.

Bss --- 32 to 54 centimeters (12.6 to 21.3 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 28 percent sand; 28 percent silt; 44 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; firm, very hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 15 percent (few) pressure faces and 30 percent (common) slickensides (pedogenic); electrical conductivity of 0.42 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; gradual; CaCO3 15.1 percent.

Bssy1 --- 54 to 122 centimeters (21.3 to 48 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 22 percent sand; 32 percent silt; 46 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; firm, very hard, very sticky, very plastic; common very fine roots throughout; common very fine tubular pores; 10 percent (few) pressure faces on vertical faces of peds and 20 percent (few) slickensides (pedogenic) on all faces of peds; 2 percent (common) fine gypsum crystals in matrix; electrical conductivity of 1.58 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; gradual; CaCO3 16.9 percent.

Bssy2 --- 122 to 170 centimeters (48 to 66.9 inches); pale brown (10YR 6/3) dry, clay; brown (10YR 5/3) moist; 16 percent sand; 34 percent silt; 50 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; firm, extremely hard, very sticky, very plastic; common very fine roots throughout; common very fine tubular pores; 15 percent (few) pressure faces on vertical faces of peds and 25 percent (common) slickensides (pedogenic) on all faces of peds; 4 percent (common) fine gypsum crystals in matrix; electrical conductivity of 6.01 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; CaCO3 19.9 percent.

DP-18

Pedon ID: DP-18

Description Date: 7/31/2012
Describer: Robert Long

Current Taxonomic Name: Brumley family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Calcidic Haplustalfs
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370516E, 4143693N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Base Slope
Profile Pos: Toeslope
Slope: 3 percent
Elevation: 2122 meters (6961.9 feet)
Aspect: 270°
Shape: up/down: Convex; **across:** Linear
Surface Fragments: subrounded sandstone - 2 percent gravels.

Drainage: Moderately well drained
Runoff: Low
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: AGCR - crested wheatgrass (*Agropyron cristatum*); CHRYS9 - rabbitbrush (*Chrysothamnus*); ROWOU - Woods' rose (*Rosa woodsii*); SPHAE - globemallow (*Sphaeralcea*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 44 to 68 centimeters (17.3 to 26.8 inches)

Diagnostic Features: Argillic horizon: 44 to 68 centimeters (17.3 to 26.8 inches), Secondary carbonates: 68 to 184 centimeters (26.8 to 72.4 inches) and Calcic horizon: 68 to 184 centimeters (26.8 to 72.4 inches)

Ap --- 0 to 18 centimeters (0 to 7.1 inches); light brownish gray (10YR 6/2) dry, clay loam; dark grayish brown (10YR 4/2) moist; 30 percent sand; 36 percent silt; 34 percent clay; moderate medium subangular blocky parting to strong medium granular structure; very friable, slightly hard, moderately sticky, moderately plastic; common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 1.01 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; neutral, pH 6.9, pH meter; clear; CaCO3 17.8 percent.

BA --- 18 to 44 centimeters (7.1 to 17.3 inches); light brownish gray (10YR 6/2) dry, clay loam; dark grayish brown (10YR 4/2) moist; 40 percent sand; 31 percent silt; 29 percent clay; moderate medium subangular blocky structure; friable, slightly hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.39 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; neutral, pH 6.9, pH meter; gradual; CaCO3 23.1 percent.

Bt --- 44 to 68 centimeters (17.3 to 26.8 inches); grayish brown (10YR 5/2) dry, clay loam; dark grayish brown (10YR 4/2) moist; 22 percent sand; 42 percent silt; 36 percent clay; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 10 percent (few) clay films between sand grains and 25 percent (common) clay films on all faces of peds; electrical conductivity of 0.74 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; neutral, pH 7, pH meter; gradual; CaCO3 20.3 percent.

Bk1 --- 68 to 144 centimeters (26.8 to 56.7 inches); very pale brown (10YR 7/4) dry, clay loam; light yellowish brown (10YR 6/4) moist; 30 percent sand; 41 percent silt; 29 percent clay; moderate medium subangular blocky structure; very friable, slightly hard, moderately sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; 20 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.43 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; neutral, pH 7, pH meter; gradual; CaCO3 35.9 percent.

Bk2 --- 144 to 184 centimeters (56.7 to 72.4 inches); very pale brown (10YR 8/4) dry, loam; very pale brown (10YR 7/4) moist; 36 percent sand; 44 percent silt; 20 percent clay; 15 percent medium distinct reddish yellow (7.5YR 6/6) mottles; moderate medium subangular blocky structure; very friable, slightly hard, slightly sticky, slightly plastic; common very fine tubular pores; 15 percent (common) fine masses of carbonate; electrical conductivity of 0.35 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; neutral, pH 7.2, pH meter; gradual; CaCO3 43.1 percent.

2C --- 184 to 240 centimeters (72.4 to 94.5 inches); light gray (10YR 7/2) dry, loamy sand; light brownish gray (10YR 6/2) moist; 78 percent sand; 14 percent silt; 8 percent clay; 2 percent fine prominent strong brown (7.5YR 5/6) mottles; weak fine subangular blocky

parting to single grain structure; very friable, soft, nonsticky, nonplastic; many very fine interstitial pores; electrical conductivity of 0.28 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; neutral, pH 7.3, pH meter; $CaCO_3$ 17.3 percent.

DP-19

Pedon ID: DP-19

Description Date: 7/31/2012
Describer: Robert Long

Pedon Notes: Text: Textures and percent clay were estimated based on the field texture method; and pH was determined with indicator phenol red indicator dye.

Current Taxonomic Name: Boxcanyon family similar
Current Taxonomic Class: Mixed, mesic
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370537E, 4143693N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 west of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Base Slope
Profile Pos: Toeslope
Slope: 6 percent
Elevation: 2122 meters (6961.9 feet)
Aspect: 253°
Shape: up/down: Concave; **across:** Linear
Surface Fragments: subangular sandstone - 5 percent channers.

Drainage: Well drained
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland

Existing Vegetation: AGCR - crested wheatgrass (*Agropyron cristatum*); CHRYS9 - rabbitbrush (*Chrysothamnus*); CONVO - bindweed (*Convolvulus*); PASM - western wheatgrass (*Pascopyrum smithii*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section:

Diagnostic Features: Secondary carbonates: 122 to 244 centimeters (48 to 96.1 inches)

N/A --- 0 to 122 centimeters (0 to 48 inches); sample unavailable for evaluation.

Bk --- 122 to 225 centimeters (48 to 88.6 inches); yellowish brown (10YR 5/4) moist, loam; very pale brown (10YR 7/3) dry; null percent sand; null percent silt; 18 percent clay; structure; friable, hard, nonsticky, nonplastic; common very fine roots throughout; common very fine tubular pores; 15 percent (common) medium masses of carbonate in matrix; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH indicator solutions; abrupt.

2Ck --- 225 to 244 centimeters (88.6 to 96.1 inches); yellowish brown (10YR 5/4) moist, loamy sand; very pale brown (10YR 7/4) dry; null percent sand; null percent silt; 3 percent clay; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores finely disseminated carbonates; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.4, pH indicator solutions.

DP-20

Pedon ID: DP-20

Description Date: 7/31/2012
Describer: Robert Long

Pedon Notes: Text: the original surface appears to have been removed, possibly by mechanically leveling of the surface. Definitive clay films observed and not slickensides were observed in the Bat and Bt horizons.

Current Taxonomic Name: Boxcanyon family truncated
Current Taxonomic Class: Fine, smectitic, mesic Calcidic Haplustalfs
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370556E, 4143699N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace and alluvial fan
Geomorphic Component: Base Slope
Profile Pos: Toeslope
Slope: 5 percent
Elevation: 2124 meters (6968.5 feet)
Aspect: 267°
Shape: up/down: Concave; **across:** Linear
Surface Fragments: subangular sandstone - 2 percent gravels and 5 percent channers.

Drainage: Well drained
Runoff: Low
Erosion: Class 2 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland

Existing Vegetation: AGCR - crested wheatgrass (*Agropyron cristatum*); BRIN2 - smooth brome (*Bromus inermis*); CHRYS9 - rabbitbrush (*Chrysothamnus*); ARNO4 - black sagebrush (*Artemisia nova*)

Parent Materials: slope alluvium derived from sandstone and shale over alluvium derived from limestone, sandstone, and shale

Particle Size Control Section: 0 to 50 centimeters (0 to 19.7 inches)

Diagnostic Features: Argillic horizon: 0 to 170 centimeters (0 to 66.9 inches), Gypsum accumulations: 122 to 170 centimeters (48 to 66.9 inches), Calcic horizon: 122 to 310 centimeters (48 to 122 inches) and Secondary carbonates: 122 to 366 centimeters (48 to 144.1 inches)

BAtp --- 0 to 38 centimeters (0 to 15 inches); grayish brown (10YR 5/2) dry, silty clay; dark grayish brown (10YR 4/2) moist; 20 percent sand; 40 percent silt; 40 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; very friable, hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 15 percent (few) clay films on all faces of peds; electrical conductivity of 0.95 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 14.2 percent.

Bt --- 38 to 55 centimeters (15 to 21.7 inches); grayish brown (10YR 5/2) dry, clay; brown (10YR 4/3) moist; 18 percent sand; 40 percent silt; 42 percent clay; strong medium subangular blocky structure; friable, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 20 percent (few) clay films between sand grains and 40 percent (common) clay films on all faces of peds; electrical conductivity of 0.52 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 14.8 percent.

N/A 55 to 122 centimeters (21.7 to 48 inches); EC meter, saturated paste electric conductivity method; sample not recovered by push probe..

Btky --- 122 to 170 centimeters (48 to 66.9 inches); light brownish gray (10YR 6/2) dry, clay; brown (10YR 4/3) moist; 19 percent sand; 39 percent silt; 42 percent clay; strong medium subangular blocky structure; firm, very hard, very sticky, very plastic; common very fine roots throughout; 3 percent (common) medium lenticular gypsum crystals between peds and 5 percent (common) fine threadlike masses of carbonate in matrix; 3 percent subrounded calcareous sandstone gravels; electrical conductivity of 2.76 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 21.5 percent.

Bk --- 170 to 240 centimeters (66.9 to 94.5 inches); very pale brown (10YR 8/2) dry, silt loam; yellowish brown (10YR 5/4) moist; 24 percent sand; 50 percent silt; 26 percent clay; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common very fine roots throughout; 12 percent (common) medium spherical masses of carbonate in matrix; electrical conductivity of 3.9 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear; CaCO3 41.1 percent.

2Ck1 --- 240 to 310 centimeters (94.5 to 122 inches); yellow (10YR 7/6) dry, sandy loam; yellowish brown (10YR 5/4) moist; 52 percent sand; 40 percent silt; 8 percent clay; massive parting to single grain; very friable, slightly hard, nonsticky, nonplastic finely disseminated carbonates; electrical conductivity of 1.69 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; gradual; CaCO3 36.8 percent.

2Ck2 --- 310 to 366 centimeters (122 to 144.1 inches); yellow (10YR 7/6) dry, sandy loam; brownish yellow (10YR 6/6) moist; 52 percent sand; 38 percent silt; 10 percent clay; massive parting to single grain; very friable, hard, nonsticky, nonplastic finely disseminated carbonates; electrical conductivity of 1.84 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; CaCO3 15.1 percent.

DP-21

Pedon ID: DP-21

Description Date: 7/31/2012
Describer: Robert Long

Current Taxonomic Name: Teromote family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Haplustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370583E, 4143702N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: hillslope
Geomorphic Component: Base Slope
Profile Pos: Footslope
Slope: 5 percent
Elevation: 2126 meters (6975.1 feet)
Aspect: 268°
Shape: up/down: Concave; **across:** Linear
Surface Fragments: subangular sandstone - 5 percent channers.

Drainage: Well drained
Runoff: Low
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland
Existing Vegetation: PASM - western wheatgrass (*Pascopyrum smithii*); AGCR - crested wheatgrass (*Agropyron cristatum*); ARNO4 - black sagebrush (*Artemisia nova*)

Parent Materials: slope alluvium derived from limestone and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 33 to 360 centimeters (13 to 141.7 inches), Gypsum accumulations: 188 to 360 centimeters (74 to 141.7 inches) and Secondary carbonates: 188 to 360 centimeters (74 to 141.7 inches)

Ap --- 0 to 33 centimeters (0 to 13 inches); grayish brown (10YR 5/2) dry, clay loam; dark grayish brown (10YR 4/2) moist; 24 percent sand; 37 percent silt; 39 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; friable, hard, moderately sticky, moderately plastic; common very fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.12 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 13 percent.

Bss1 --- 33 to 140 centimeters (13 to 55.1 inches); brown (10YR 5/3) dry, clay loam; dark grayish brown (10YR 4/2) moist; 26 percent sand; 35 percent silt; 39 percent clay; strong medium subangular blocky structure; friable, very hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 20 percent (few) slickensides (pedogenic); 2 percent subrounded limestone gravels; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 15 percent.

Bss2 --- 140 to 188 centimeters (55.1 to 74 inches); brown (10YR 5/3) dry, silty clay; brown (10YR 4/3) moist; 11 percent sand; 41 percent silt; 48 percent clay; strong medium subangular blocky structure; firm, very hard, very sticky, very plastic; common very fine roots throughout; 25 percent (common) slickensides (pedogenic); electrical conductivity of 2.37 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 18.6 percent.

Bssy1 --- 188 to 260 centimeters (74 to 102.4 inches); brown (10YR 5/3) dry, silty clay; brown (10YR 4/3) moist; 11 percent sand; 40 percent silt; 49 percent clay; moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; common very fine roots throughout; 30 percent (common) slickensides (pedogenic); 2 percent (common) medium gypsum crystals on vertical faces of peds and finely disseminated carbonates; electrical conductivity of 2.29 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; gradual; CaCO3 19.3 percent.

Bssy2 --- 260 to 360 centimeters (102.4 to 141.7 inches); light olive brown (2.5Y 5/3) dry, clay; olive brown (2.5Y 4/3) moist; 7 percent sand; 39 percent silt; 54 percent clay; moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; 20 percent (few) slickensides (pedogenic); 2 percent (common) fine gypsum crystals in matrix and 5 percent (common) medium masses of carbonate in matrix; electrical conductivity of 1.81 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; CaCO3 18.7 percent.

DP-22

Pedon ID: DP-22

Description Date: 7/31/2012
Describer: Robert Long

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370608E, 4143806N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: alluvial fan
Geomorphic Component: Base Slope
Profile Pos: Footslope
Slope: 7 percent
Elevation: 2129 meters (6984.9 feet)
Aspect: 250°
Shape: up/down: Concave; **across:** Convex
Surface Fragments: subangular sandstone - 3 percent gravels, 5 percent channers, and 2 percent flags.

Drainage: Well drained
Runoff: Medium
Erosion: Class 2 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland

Existing Vegetation: PASM - western wheatgrass (*Pascopyrum smithii*); CONVO - bindweed (*Convolvulus*); ROWOU - Woods' rose (*Rosa woodsii var. ultramontana*); WYAM - mule-ears (*Wyethia amplexicaulis*); ASTRA - milkvetch (*Astragalus*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: slope alluvium derived from calcareous shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 28 to 240 centimeters (11 to 94.5 inches), Secondary carbonates: 50 to 240 centimeters (19.7 to 94.5 inches) and Calcic horizon: 120 to 240 centimeters (47.2 to 94.5 inches)

Ap --- 0 to 28 centimeters (0 to 11 inches); light brownish gray (10YR 6/2) dry, silty clay; grayish brown (10YR 5/2) moist; 8 percent sand; 40 percent silt; 52 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; friable, very hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; electrical conductivity of 0.65 mmhos/cm by EC meter, saturated paste; slightly effervescent; moderately alkaline, pH 8, pH meter; clear; CaCO3 16 percent.

Bss --- 28 to 50 centimeters (11 to 19.7 inches); grayish brown (10YR 5/2) dry, silty clay; dark grayish brown (10YR 4/2) moist; 9 percent sand; 34 percent silt; 57 percent clay; strong medium subangular blocky structure; firm, extremely hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; 20 percent (few) pressure faces and 20 percent (few) slickensides (pedogenic); electrical conductivity of 3.6 mmhos/cm by EC meter, saturated paste; slightly effervescent; moderately alkaline, pH 8, pH meter; gradual; CaCO3 14.2 percent.

Bkss1 --- 50 to 120 centimeters (19.7 to 47.2 inches); light brownish gray (10YR 6/2) dry, silty clay; brown (10YR 5/3) moist; 3 percent sand; 50 percent silt; 47 percent clay; strong medium subangular blocky structure; firm, extremely hard, very sticky, very plastic; common very fine roots throughout; 15 percent (few) pressure faces and 30 percent (common) slickensides (pedogenic); 8 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 6.68 mmhos/cm by EC meter, saturated paste; strongly effervescent; moderately alkaline, pH 8.4, pH meter; gradual; CaCO3 16.6 percent.

Bkss2 --- 120 to 180 centimeters (47.2 to 70.9 inches); light brownish gray (10YR 6/2) dry, clay; grayish brown (10YR 5/2) moist; 0 percent sand; 39 percent silt; 61 percent clay; moderate medium subangular blocky structure; friable, extremely hard, very sticky, very plastic; common very fine roots throughout; 30 percent (common) slickensides (pedogenic); 15 percent (common) medium lenticular masses of carbonate in matrix; electrical conductivity of 7.94 mmhos/cm by EC meter, saturated paste; strongly effervescent; strongly alkaline, pH 8.6, pH meter; gradual; CaCO3 22.2 percent.

Bkss3 --- 180 to 240 centimeters (70.9 to 94.5 inches); light brownish gray (10YR 6/2) dry, silty clay; grayish brown (10YR 5/2) moist; 5 percent sand; 39 percent silt; 56 percent clay; moderate medium subangular blocky structure; friable, very hard, very sticky, very plastic; 15 percent (few) slickensides (pedogenic); 20 percent (many) medium lenticular masses of carbonate in matrix; electrical conductivity of 6.22 mmhos/cm by EC meter, saturated paste; strongly effervescent; moderately alkaline, pH 8.3, pH meter; CaCO3 23 percent.

DP-23

Pedon ID: DP-23

Description Date: 7/31/2012
Describer: Robert Long

Current Taxonomic Name: Wimmer family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370577E, 4143819N -- Datum NAD83, Zone 12
Location Description:
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace and fan apron
Geomorphic Component: Tread
Profile Pos: Toeslope
Slope: 5 percent
Elevation: 2127 meters (6978.3 feet)
Aspect: 252°
Shape: up/down: Convex; **across:** Linear
Surface Fragments: subangular sandstone - 10 cobbles and 5 percent channers.

Drainage: Well drained
Runoff: Medium
Erosion: Class 2 - Rill erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland

Existing Vegetation: PASM - western wheatgrass (*Pascopyrum smithii*); CONVO - bindweed (*Convolvulus*); CHRYS9 - rabbitbrush (*Chrysothamnus*); ROWOU - Woods' rose (*Rosa woodsii var. ultramontana*)

Parent Materials: slope alluvium derived from sandstone and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Cambic horizon: 30 to 57 centimeters (11.8 to 22.4 inches), Secondary carbonates: 57 to 122 centimeters (22.4 to 48 inches) and Calcic horizon: 57 to 122 centimeters (22.4 to 48 inches)

Ap --- 0 to 30 centimeters (0 to 11.8 inches); brown (10YR 5/3) dry, silty clay; dark grayish brown (10YR 4/2) moist; 19 percent sand; 41 percent silt; 40 percent clay; weak medium subangular blocky parting to moderate medium granular structure; very friable, slightly hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; electrical conductivity of 0.87 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 16.8 percent.

Bw --- 30 to 57 centimeters (11.8 to 22.4 inches); brown (10YR 5/3) dry, clay; dark grayish brown (10YR 4/2) moist; 26 percent sand; 34 percent silt; 40 percent clay; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; electrical conductivity of 0.35 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 16.1 percent.

Bk1 --- 57 to 80 centimeters (22.4 to 31.5 inches); light yellowish brown (10YR 6/4) dry, clay loam; yellowish brown (10YR 5/4) moist; 25 percent sand; 36 percent silt; 39 percent clay; moderate medium subangular blocky parting to strong fine subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common very fine roots throughout; 8 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.47 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 30.9 percent.

Bk2 --- 80 to 122 centimeters (31.5 to 48 inches); brownish yellow (10YR 6/6) dry, sandy clay; yellowish brown (10YR 5/6) moist; 62 percent sand; 0 percent silt; 38 percent clay; weak fine subangular blocky parting to single grain structure; very friable, hard, moderately sticky, moderately plastic; 10 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.67 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; CaCO3 29.6 percent.

DP-24

Pedon ID: DP-24

Description Date: 8/1/2012
Describer: Robert Long

Pedon Notes: Text: Bk horizon 126 to 244 cm) developed from shale, but no evidence of parent material remains.

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370691E, 4143951N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: alluvial fan
Geomorphic Component: Base Slope
Profile Pos: Footslope
Slope: 8 percent
Elevation: 2134 meters (7001.3 feet)
Aspect: 268°
Shape: up/down: Convex; **across:** Linear
Surface Fragments: subangular sandstone - 5 percent gravels, 8 percent channers, and 2 percent flags.

Drainage: Well drained
Runoff: High
Erosion: Class 3 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland

Existing Vegetation: PASM - western wheatgrass (*Pascopyrum smithii*); CONVO - bindweed (*Convolvulus*); CHRYS9 - rabbitbrush (*Chrysothamnus*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: slope alluvium derived from sandstone and shale over residuum weathered from calcareous shale

Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 22 to 126 centimeters (8.7 to 49.6 inches), Secondary carbonates: 40 to 244 centimeters (15.7 to 96.1 inches) and Gypsum accumulations: 126 to 244 centimeters (49.6 to 96.1 inches)

Ap --- 0 to 22 centimeters (0 to 8.7 inches); light brownish gray (10YR 6/2) dry, silty clay loam; dark grayish brown (10YR 4/2) moist; 19 percent sand; 44 percent silt; 37 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; very friable, hard, moderately sticky, moderately plastic; common coarse roots throughout, common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.52 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 18.9 percent.

Bss --- 22 to 40 centimeters (8.7 to 15.7 inches); brown (10YR 5/3) dry, silty clay; dark grayish brown (10YR 4/2) moist; 15 percent sand; 41 percent silt; 44 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; friable, very hard, very sticky, very plastic; common coarse roots throughout, common medium roots throughout, common fine roots throughout and common very fine roots throughout; 30 percent (common) slickensides (pedogenic); electrical conductivity of 0.5 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 18.3 percent.

Bkss1 --- 40 to 65 centimeters (15.7 to 25.6 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 15 percent sand; 39 percent silt; 46 percent clay; moderate medium prismatic parting to strong medium angular blocky structure; firm, very hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; 65 percent (many) slickensides (pedogenic); 1 percent (few) fine masses of carbonate in matrix; electrical conductivity of 0.39 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; gradual; CaCO3 18.4 percent.

Bkss2 --- 65 to 126 centimeters (25.6 to 49.6 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 13 percent sand; 39 percent silt; 48 percent clay; moderate medium subangular blocky structure; firm, hard, very sticky, very plastic; common very fine roots throughout; 50 percent (many) slickensides (pedogenic); 3 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.86 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; abrupt; CaCO3 18.2 percent.

Bk --- 126 to 244 centimeters (49.6 to 96.1 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 15 percent sand; 35 percent silt; 50 percent clay; massive; firm, very hard, very sticky, very plastic; 2 percent (common) fine lenticular gypsum crystals in matrix and 8 percent (common) medium masses of carbonate in matrix; electrical conductivity of 4.35 mmhos/cm; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; CaCO3 20.9 percent.

DP-25

Pedon ID: DP-25

Description Date: 8/1/2012
Describer: Robert Long

Pedon Notes: Text: The 3Cr horizon appears to be the top of weathering sandstone.

Current Taxonomic Name: Boxcanyon family
Current Taxonomic Class: Fine, smectitic, mesic Calcidic Haplustalfs
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370633E, 4143969N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace and alluvial fan
Geomorphic Component: Base Slope
Profile Pos: Toeslope
Slope: 4 percent
Elevation: 2129 meters (6984.9 feet)
Aspect: 270°
Shape: up/down: Convex; **across:** Linear
Surface Fragments: subangular sandstone - 2 percent gravels and 3 percent channers.

Drainage: Well drained
Runoff: Medium
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland

Existing Vegetation: PASM - western wheatgrass (*Pascopyrum smithii*); CONVO - bindweed (*Convolvulus*); CHRYS9 - rabbitbrush (*Chrysothamnus*); SYOR2 - mountain snowberry (*Symphoricarpos oreophilus*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: slope alluvium derived from sandstone and shale over alluvium derived from limestone and sandstone over residuum weathered from calcareous sandstone

Bedrock: Calcareous sandstone at 208 centimeters (81.9 inches)
Particle Size Control Section: 28 to 75 centimeters (11 to 29.5 inches)

Diagnostic Features: Secondary carbonates: 28 to 208 centimeters (11 to 81.9 inches), Argillic horizon: 28 to 144 centimeters (11 to 56.7 inches), Calcic horizon: 75 to 208 centimeters (29.5 to 81.9 inches) and Paralithic contact: 208 centimeters (81.9 inches)

Restrictions: Paralithic bedrock: 208 centimeters (81.9 inches)

Ap --- 0 to 16 centimeters (0 to 6.3 inches); grayish brown (10YR 5/2) dry, silty clay; dark grayish brown (10YR 4/2) moist; 19 percent sand; 41 percent silt; 40 percent clay; moderate medium subangular blocky structure; very friable, hard, moderately sticky, moderately plastic; common coarse roots throughout, common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.83 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 18.2 percent.

Bt --- 16 to 28 centimeters (6.3 to 11 inches); brown (10YR 5/3) dry, silty clay; dark grayish brown (10YR 4/2) moist; 15 percent sand; 41 percent silt; 44 percent clay; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common coarse roots throughout, common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 25 percent (common) clay films on all faces of peds; electrical conductivity of 0.48 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 16.1 percent.

Btk1 --- 28 to 54 centimeters (11 to 21.3 inches); grayish brown (10YR 5/2) dry, silty clay; dark grayish brown (10YR 4/2) moist; 11 percent sand; 41 percent silt; 48 percent clay; weak medium prismatic parting to strong medium subangular blocky structure; friable, very hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; 40 percent (common) clay films on all faces of peds finely disseminated carbonates; electrical conductivity of 0.49 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; gradual; CaCO3 16.1 percent.

2Btk2 --- 54 to 75 centimeters (21.3 to 29.5 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 19 percent sand; 39 percent silt; 42 percent clay; weak medium prismatic parting to strong medium subangular blocky structure; friable, very hard, very sticky, very plastic; common very fine roots throughout; 15 percent (few) clay films between sand grains and 40 percent (common) clay films on all faces of peds finely disseminated carbonates; 10 percent subrounded limestone gravels; electrical

conductivity of 0.49 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 19.6 percent.

2Btk3 --- 75 to 144 centimeters (29.5 to 56.7 inches); grayish brown (10YR 5/2) dry, gravelly clay loam; dark grayish brown (10YR 4/2) moist; 36 percent sand; 31 percent silt; 33 percent clay; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common very fine roots throughout; 25 percent (common) clay films on all faces of peds and 2 percent (very few) carbonate coats on bottom surfaces of rock fragments; 2 percent (common) fine masses of carbonate in matrix; 25 percent subrounded limestone gravels; electrical conductivity of 0.44 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 27.1 percent.

2Bk2 --- 144 to 208 centimeters (56.7 to 81.9 inches); pale brown (10YR 6/3) dry, very gravelly sandy loam; brown (10YR 5/3) moist; 72 percent sand; 15 percent silt; 13 percent clay; moderate medium subangular blocky parting to single grain structure; very friable, slightly hard, nonsticky, nonplastic; common very fine roots throughout; 3 percent (very few) carbonate coats on bottom surfaces of rock fragments; 8 percent (common) medium masses of carbonate in matrix; 20 percent subrounded sandstone gravels and 25 percent subrounded limestone gravels; electrical conductivity of 0.35 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; abrupt; CaCO3 51.8 percent.

3Cr --- 208 to 244 centimeters (81.9 to 96.1 inches); very pale brown (10YR 7/3) dry, gravelly loamy sand; yellowish brown (10YR 5/6) moist; 87 percent sand; 5 percent silt; 8 percent clay; massive parting to single grain; friable, hard, nonsticky, nonplastic; 30 percent subangular calcareous sandstone gravels; electrical conductivity of 0.37 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; weathering sandstone; CaCO3 32.5 percent.

DP-26

Pedon ID: DP-26

Description Date: 8/1/2012
Describer: Robert Long

Pedon Notes: Text: Clay films are present in Bt, but there is not enough clay increase from A for an argillic.

Current Taxonomic Name: BBB family
Current Taxonomic Class: Fine-loamy, carbonatic, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370754E, 4144249N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Base Slope
Profile Pos: Toeslope
Slope: 4 percent
Elevation: 2136 meters (7007.9 feet)
Aspect: 240°
Shape: up/down: Linear; **across:** Linear
Surface Fragments: none.

Drainage: Somewhat poorly drained
Runoff: Low
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Shrubby rangeland

Existing Vegetation: CHRYS9 - rabbitbrush (*Chrysothamnus*); PASM - western wheatgrass (*Pascopyrum smithii*); CONVO - bindweed (*Convolvulus*); ROWOU - Woods' rose (*Rosa woodsii var. ultramontana*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Cambic horizon: 15 to 32 centimeters (5.9 to 12.6 inches), Secondary carbonates: 32 to 366 centimeters (12.6 to 144.1 inches) and Calcic horizon: 32 to 230 centimeters (12.6 to 90.6 inches)

Ap --- 0 to 15 centimeters (0 to 5.9 inches); brown (10YR 5/3) dry, silty clay; brown (10YR 4/3) moist; 15 percent sand; 43 percent silt; 42 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; very friable, slightly hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.55 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; gradual; CaCO3 18.7 percent.

Bt --- 15 to 32 centimeters (5.9 to 12.6 inches); brown (10YR 5/3) dry, silty clay; brown (10YR 4/3) moist; 9 percent sand; 47 percent silt; 44 percent clay; weak medium prismatic parting to moderate medium subangular blocky structure; friable, very hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 40 percent (common) clay films on all faces of peds; electrical conductivity of 0.33 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 25.1 percent.

Bk1 --- 32 to 59 centimeters (12.6 to 23.2 inches); pink (7.5YR 8/3) dry, silty clay; reddish yellow (7.5YR 6/6) moist; 3 percent sand; 49 percent silt; 48 percent clay; structure; friable, very hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 18 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.34 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; gradual; CaCO3 46.8 percent.

Bk2 --- 59 to 90 centimeters (23.2 to 35.4 inches); pink (7.5YR 8/3) dry, silty clay; reddish yellow (7.5YR 6/6) moist; 1 percent sand; 51 percent silt; 48 percent clay; structure; firm, extremely hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 20 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.28 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; abrupt; CaCO3 54.4 percent.

2Bk1 --- 90 to 148 centimeters (35.4 to 58.3 inches); very pale brown (10YR 8/2) dry, silty clay loam; light yellowish brown (10YR 6/4) moist; 0 percent sand; 64 percent silt; 36 percent clay; 12 percent medium distinct reddish yellow (7.5YR 6/6) mottles; weak medium subangular blocky structure; friable, very hard, moderately sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; 12 percent (common) medium reddish yellow (7.5YR 6/6), dry; 7 percent (common) medium masses of carbonate in matrix; 2 percent subrounded calcareous sandstone gravels;

electrical conductivity of 0.26 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; gradual; CaCO3 50.2 percent.

2Bk2 --- 148 to 230 centimeters (58.3 to 90.6 inches); very pale brown (10YR 8/2) dry, loam; yellow (10YR 7/6) moist; 35 percent sand; 45 percent silt; 20 percent clay; 20 percent medium distinct brownish yellow (10YR 6/8) mottles; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common very fine roots throughout; common very fine tubular pores; 20 percent (many) medium brownish yellow (10YR 6/8), dry; 10 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.26 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; gradual; CaCO3 43.8 percent.

3Ck1 --- 230 to 294 centimeters (90.6 to 115.7 inches); very pale brown (10YR 8/2) dry, sandy loam; pale brown (10YR 6/3) moist; 55 percent sand; 31 percent silt; 14 percent clay; 25 percent medium prominent brownish yellow (10YR 6/8) mottles; weak medium subangular blocky parting to single grain structure; very friable, slightly hard, moderately sticky, nonplastic; common very fine interstitial pores; 5 percent (common) coarse brownish yellow (10YR 6/8), dry and 25 percent (many) medium brownish yellow (10YR 6/8), dry finely disseminated carbonates; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; clear; CaCO3 24.6 percent.

3Ck2 --- 294 to 350 centimeters (115.7 to 137.8 inches); light gray (10YR 7/2) dry, sandy loam; light brownish gray (10YR 6/2) moist; 69 percent sand; 23 percent silt; 8 percent clay; 3 percent medium prominent brownish yellow (10YR 6/6) mottles; single grain; very friable, hard, nonsticky, nonplastic; common very fine interstitial pores; 3 percent (common) medium brownish yellow (10YR 6/6), dry finely disseminated carbonates; electrical conductivity of 0.34 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; abrupt; CaCO3 15.3 percent.

4Ck --- 350 to 366 centimeters (137.8 to 144.1 inches); light gray (2.5Y 7/2) dry, silt loam; grayish brown (2.5Y 5/2) moist; 25 percent sand; 55 percent silt; 20 percent clay; 8 percent coarse prominent (10YR) mottles; massive; friable, very hard, slightly sticky, slightly plastic; 8 percent (common) coarse brownish yellow (10YR 6/6), dry; 4 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.39 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; CaCO3 37 percent.

DP-27

Pedon ID: DP-27

Description Date: 8/1/2013
Describer: Robert Long

Pedon Notes: Text: There is not enough clay increase between the A and Btk1 horizons. Clay films are visible in the Btk1 and Btk2 horizons.

Current Taxonomic Name: AAA family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370791E, 4144251N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Base Slope
Profile Pos: Toeslope
Slope: 6 percent
Elevation: 2140 meters (7021 feet)
Aspect: 260°
Shape: up/down: Concave; **across:** Concave
Surface Fragments: subangular sandstone - 1 percent channers.

Drainage: Somewhat poorly drained
Runoff: Low
Erosion: Class 2 - Rill erosion

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Shrubby rangeland

Existing Vegetation: CHRYS9 - rabbitbrush (*Chrysothamnus*); BRIN2 - smooth brome (*Bromus inermis*); AGCR - crested wheatgrass (*Agropyron cristatum*); ARNO4 - black sagebrush (*Artemisia nova*)

Parent Materials: slope alluvium derived from sandstone and shale over alluvium derived from limestone, sandstone, and shale over residuum weathered from calcareous shale

Bedrock: Calcareous shale at 396 centimeters (155.9 inches)

Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Secondary carbonates: 22 to 488 centimeters (8.7 to 192.1 inches), Cambic horizon: 22 to 80 centimeters (8.7 to 31.5 inches) and Calcic horizon: 80 to 310 centimeters (31.5 to 122 inches)

A --- 0 to 22 centimeters (0 to 8.7 inches); grayish brown (10YR 5/2) dry, silty clay; dark grayish brown (10YR 4/2) moist; 14 percent sand; 44 percent silt; 42 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.63 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 17.8 percent.

Btk1 --- 22 to 40 centimeters (8.7 to 15.7 inches); grayish brown (10YR 5/2) dry, silty clay; dark grayish brown (10YR 4/2) moist; 4 percent sand; 47 percent silt; 49 percent clay; strong medium subangular blocky structure; firm, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 35 percent (common) clay films on all faces of peds; 2 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.32 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 17 percent.

Btk2 --- 40 to 80 centimeters (15.7 to 31.5 inches); grayish brown (10YR 5/2) dry, silty clay; dark grayish brown (10YR 4/2) moist; 9 percent sand; 46 percent silt; 45 percent clay; strong medium subangular blocky structure; firm, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 15 percent (few) clay films between sand grains and 40 percent (common) clay films on all faces of peds; 2 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.4 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 18.9 percent.

Bk1 --- 80 to 152 centimeters (31.5 to 59.8 inches); light gray (10YR 7/2) dry, silty clay; pale brown (10YR 6/3) moist; 0 percent sand; 53 percent silt; 47 percent clay; 10 percent medium distinct brownish yellow (10YR 6/6) mottles; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common very fine tubular pores; 5 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.39 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; gradual; CaCO3 38.1 percent.

Bk2 --- 152 to 224 centimeters (59.8 to 88.2 inches); very pale brown (10YR 8/2) dry, silty clay loam; light brownish gray (10YR 6/2) moist; 6 percent sand; 59 percent silt; 35 percent clay; 12 percent medium prominent yellow (2.5Y 7/6) mottles; weak medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; 12 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; gradual; CaCO3 53.4 percent.

Bk3 --- 224 to 310 centimeters (88.2 to 122 inches); very pale brown (10YR 8/2) dry, silty clay loam; very pale brown (10YR 7/3) moist; 6 percent sand; 61 percent silt; 33 percent clay; 2 percent medium prominent yellow (2.5Y 7/6) and 5 percent fine prominent yellow (2.5Y 7/6) mottles; massive; friable, very hard, moderately sticky, moderately plastic; 15 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.43 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.7, pH meter; clear; CaCO3 57.1 percent.

2Bk1 --- 310 to 350 centimeters (122 to 137.8 inches); light brownish gray (2.5Y 6/2) dry, clay loam; dark grayish brown (2.5Y 4/2) moist; 32 percent sand; 35 percent silt; 33 percent clay; 5 percent fine prominent strong brown (7.5YR 5/8) mottles; massive; firm, very hard, moderately sticky, moderately plastic; 2 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 0.59 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; clear; CaCO3 22.9 percent.

2Bk2 --- 350 to 396 centimeters (137.8 to 155.9 inches); light gray (2.5Y 7/2) dry, gravelly loam; light olive brown (2.5Y 5/3) moist; 46 percent sand; 31 percent silt; 23 percent clay; 8 percent medium prominent brownish yellow (10YR 6/8) mottles; massive; firm, very hard, slightly sticky, slightly plastic; 4 percent (very few) carbonate coats on bottom surfaces of rock fragments; 4 percent (common) medium masses of carbonate in matrix; 10 percent subrounded 2 calcareous sandstone gravels and 15 percent subrounded limestone gravels; electrical conductivity of 1.35 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; Weather perching on top of this horizon; gradual; CaCO3 35 percent.

3Ck --- 396 to 488 centimeters (155.9 to 192.1 inches); light gray (2.5Y 7/1) dry, clay; gray (2.5Y 5/1) moist; 8 percent sand; 25 percent silt; 67 percent clay; 8 percent medium prominent light yellowish brown (10YR 6/4) mottles; moderate fine platy structure; friable, hard, very sticky, very plastic; 7 percent (common) medium masses of carbonate in matrix; electrical conductivity of 3.38 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; weathering shale; water appears to be perching on top and in this horizon; CaCO3 22.9 percent.

DP-28

Pedon ID: DP-28

Description Date: 8/1/2012
Describer: Robert Long

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369655E, 4143668N -- Datum NAD83, Zone 12
Legal Description: Section 12, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: alluvial fan
Geomorphic Component: Tread
Profile Pos: Toeslope
Slope: 1 percent
Elevation: 2115 meters (6939 feet)
Aspect: 90°
Shape: up/down: Linear; **across:** Linear
Surface Fragments: subangular sandstone - 4 percent channers.

Drainage: Moderately well drained
Runoff: Negligible
Erosion: None - deposition

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: BRIN2 - smooth brome (*Bromus inermis*); ROWOU - Woods' rose (*Rosa woodsii var. ultramontana*); PASM - western wheatgrass (*Pascopyrum smithii*); ACHIL - yarrow (*Achillea*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 14 to 62 centimeters (5.5 to 24.4 inches), Secondary carbonates: 62 to 140 centimeters (24.4 to 55.1 inches), Gypsum accumulations: 100 to 140 centimeters (39.4 to 55.1 inches) and Slickensides: 100 to 140 centimeters (39.4 to 55.1 inches)

AB --- 0 to 14 centimeters (0 to 5.5 inches); light brownish gray (10YR 6/2) dry, clay; grayish brown (10YR 5/2) moist; 20 percent sand; 34 percent silt; 46 percent clay; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.8 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 17.3 percent.

Bss1 --- 14 to 38 centimeters (5.5 to 15 inches); light brownish gray (10YR 6/2) dry, clay; brown (10YR 4/3) moist; 10 percent sand; 38 percent silt; 52 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; firm, extremely hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; 35 percent (common) slickensides (pedogenic) on all faces of peds; electrical conductivity of 0.58 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; gradual; CaCO3 24.5 percent.

Bss2 --- 38 to 62 centimeters (15 to 24.4 inches); light brownish gray (10YR 6/2) dry, silty clay; grayish brown (10YR 5/2) moist; 10 percent sand; 35 percent silt; 55 percent clay; strong medium prismatic parting to strong medium angular blocky structure; firm, extremely hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; 65 percent (many) slickensides (pedogenic) on all faces of peds; electrical conductivity of 0.44 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 25.2 percent.

Bk --- 62 to 100 centimeters (24.4 to 39.4 inches); light yellowish brown (2.5Y 6/3) dry, clay loam; light olive brown (2.5Y 5/3) moist; 20 percent sand; 44 percent silt; 36 percent clay; moderate medium subangular blocky structure; friable, very hard, moderately sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; 25 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.46 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; gradual; CaCO3 29.2 percent.

Bkssy1 --- 100 to 120 centimeters (39.4 to 47.2 inches); light brownish gray (2.5Y 6/2) dry, silty clay; grayish brown (2.5Y 5/2) moist; 12 percent sand; 44 percent silt; 44 percent clay; 2 percent fine prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; common very fine tubular pores; 45 percent (common) slickensides (pedogenic) on all faces of peds; 3 percent (common) fine masses of gypsum in matrix and 5 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.43 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 29.4 percent.

Bkssy2 --- 120 to 140 centimeters (47.2 to 55.1 inches); light brownish gray (2.5Y 6/2) dry, clay; grayish brown (2.5Y 5/2) moist; 14 percent sand; 34 percent silt; 52 percent clay; 8 percent fine prominent yellow (10YR 7/6) mottles; moderate medium subangular blocky structure; firm, extremely hard, very sticky, very plastic; 25 percent (common) slickensides (pedogenic) on all faces of peds; 2 percent (common) fine gypsum crystals in matrix and 15 percent (common) medium masses of carbonate in matrix; 3 percent subrounded sandstone gravels; electrical conductivity of 0.45 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; CaCO3 33.3 percent.

DP-29

Pedon ID: DP-29

Description Date: 8/1/2012
Describer: Robert Long

Current Taxonomic Name: BBB family
Current Taxonomic Class: Fine-loamy, carbonatic, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369782E, 4143666N -- Datum NAD83, Zone 12
Legal Description: Section 12, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: terrace and fan apron
Geomorphic Component: Tread
Profile Pos: Toeslope
Slope: 3 percent
Elevation: 2114 meters (6935.7 feet)
Aspect: 180°
Shape: up/down: Linear; **across:** Linear
Surface Fragments: none.

Drainage: Moderately well drained
Runoff: Low
Erosion: None - deposition

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: BRIN2 - smooth brome (*Bromus inermis*); CONVO - bindweed (*Convolvulus*); ROWOU - Woods' rose (*Rosa woodsii var. ultramontana*)

Parent Materials: alluvium derived from limestone, sandstone, and shale

Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Cambic horizon: 24 to 52 centimeters (9.4 to 20.5 inches), Secondary carbonates: 52 to 365 centimeters (20.5 to 143.7 inches) and Secondary carbonates: 72 to 210 centimeters (28.3 to 82.7 inches)

A --- 0 to 24 centimeters (0 to 9.4 inches); gray (10YR 6/1) dry, clay; dark grayish brown (10YR 4/2) moist; 20 percent sand; 38 percent silt; 42 percent clay; moderate medium platy parting to moderate medium granular structure; very friable, slightly hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.87 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 45.3 percent.

Bw --- 24 to 52 centimeters (9.4 to 20.5 inches); light brownish gray (10YR 6/2) dry, clay; dark grayish brown (10YR 4/2) moist; 18 percent sand; 38 percent silt; 44 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; firm, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.62 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 43.2 percent.

Bk --- 52 to 72 centimeters (20.5 to 28.3 inches); white (10YR 8/1) dry, loam; pale brown (10YR 6/3) moist; 50 percent sand; 32 percent silt; 18 percent clay; moderate medium subangular blocky structure; friable, hard, slightly sticky, nonplastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores finely disseminated carbonates and 20 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.44 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; abrupt; CaCO3 28.4 percent.

2ABk --- 72 to 97 centimeters (28.3 to 38.2 inches); light gray (2.5Y 7/1) dry, silty clay; olive brown (2.5Y 4/3) moist; 10 percent sand; 46 percent silt; 44 percent clay; moderate medium subangular blocky structure; friable, very hard, very sticky, very plastic; common very fine roots throughout; common very fine tubular pores finely disseminated carbonates and 35 percent (many) coarse masses of carbonate in matrix; electrical conductivity of 0.44 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 61.6 percent.

2Bk1 --- 97 to 155 centimeters (38.2 to 61 inches); pale yellow (2.5Y 8/2) dry, silty clay; pale yellow (2.5Y 8/3) moist; 4 percent sand; 52 percent silt; 44 percent clay; 8 percent fine reddish yellow (5YR 7/6) mottles; structure; friable, hard, very sticky, very plastic finely disseminated carbonates and 25 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.4 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; abrupt; CaCO3 58.5 percent.

2Bk2 --- 155 to 210 centimeters (61 to 82.7 inches); white (2.5Y 8/1) dry, silty clay; light brownish gray (2.5Y 6/2) moist; 10 percent sand; 44 percent silt; 46 percent clay; 12

percent medium (5B 6/6) mottles; moderate medium subangular blocky structure; friable, extremely hard, very sticky, very plastic finely disseminated carbonates; electrical conductivity of 0.45 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; abrupt; CaCO3 57 percent.

3Bk1 --- 210 to 266 centimeters (82.7 to 104.7 inches); gray (2.5Y 6/1) dry, silty clay; dark grayish brown (2.5Y 4/2) moist; 14 percent sand; 40 percent silt; 46 percent clay; 2 percent fine light bluish gray (5PB 8/1) and 5 percent coarse reddish yellow (7.5YR 6/6) mottles; weak medium subangular blocky structure; firm, very hard, very sticky, very plastic; 4 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.53 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; clear; CaCO3 31 percent.

3Bk2 --- 266 to 345 centimeters (104.7 to 135.8 inches); light gray (2.5Y 7/1) dry, silty clay; gray (2.5Y 5/1) moist; 6 percent sand; 44 percent silt; 50 percent clay; 2 percent fine light bluish gray (5PB 8/1) and 10 percent medium light yellowish brown (10YR 6/4) mottles; weak medium subangular blocky structure; firm, very hard, very sticky, very plastic finely disseminated carbonates and 1 percent (few) fine threadlike masses of carbonate in matrix; electrical conductivity of 0.83 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear; CaCO3 37.2 percent.

3Bk3 --- 345 to 365 centimeters (135.8 to 143.7 inches); white (2.5Y 8/1) dry, clay; light brownish gray (2.5Y 6/2) moist; 18 percent sand; 37 percent silt; 45 percent clay; 15 percent coarse reddish yellow (7.5YR 6/6) mottles; moderate medium prismatic structure; very firm, extremely hard, very sticky, very plastic finely disseminated carbonates and 1 percent (few) fine threadlike masses of carbonate in matrix; electrical conductivity of 0.75 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; CaCO3 42.5 percent.

Appendix M

Water Laboratory Analysis

Laboratory Reporting Sheets

Chemtech-Ford Laboratories
9632 South 500 West
Sandy, UT 84070

For selected data from hydrologic monitoring in the
North Private Lease and adjacent area

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1110915-05

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 12/22/2011 6:00 PM
Sample Site:	SW-1		**Receipt Date:** 12/27/2011 10:00 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 29
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	11.9	0.01	meq/L	1/20/2012 7:45	MJB	SM 1030 E	
Cation/Anion Balance	-4.9		%	1/20/2012 7:45	MJB	SM 1030 E	
Cations, Total	10.8	0.01	meq/L	1/20/2012 7:45	MJB	SM 1030 E	
Hardness, Total as CaCO3	542	1	mg/L	1/20/2012 7:45	MJB	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	12/29/2011 14:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	526	1.0	mg/L	12/29/2011 7:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	12/29/2011 7:00	TSM	SM 2320 B	
Alkalinity - CO2	382	1.0	mg/L	12/29/2011 7:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	12/29/2011 7:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	431	1.0	mg/L	12/29/2011 7:00	TSM	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	12/30/2011 9:30	TSM	SM 4500 NH3-D	
Chloride	7	1	mg/L	12/28/2011 5:30	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	12/28/2011 5:30	TSM	EPA 300.0	
Nitrate as N	ND	0.1	mg/L	12/28/2011 5:30	TSM	EPA 300.0	SPH
Nitrite as N	ND	0.1	mg/L	12/28/2011 5:30	TSM	EPA 300.0	SPH
Oil & Grease (HEM)	ND	6	mg/L	12/30/2011 12:37	PM	EPA 1664A	
Phosphorus, Total	ND	0.01	mg/L	12/28/2011 9:30	TSM	SM 4500 PB5E	
Sulfate	150	10	mg/L	12/28/2011 5:30	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	634	10	mg/L	12/29/2011 10:16	JSH	SM 2540 C	
Total Suspended Solids (TSS)	5	4	mg/L	12/28/2011 10:10	JSH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	1.0	mg/L	1/13/2012 1:50	PNM	EPA 200.7	
Aluminum, Total	ND	0.05	mg/L	1/19/2012 11:58	PNM	EPA 200.7	
Arsenic, Dissolved	ND	1.00	mg/L	1/13/2012 1:50	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	1/19/2012 11:58	PNM	EPA 200.7	
Boron, Dissolved	ND	1.00	mg/L	1/13/2012 1:50	PNM	EPA 200.7	
Boron, Total	0.10	0.05	mg/L	1/19/2012 11:58	PNM	EPA 200.7	
Barium, Dissolved	0.223	0.100	mg/L	1/13/2012 1:50	PNM	EPA 200.7	
Calcium, Dissolved	90.5	4.0	mg/L	1/13/2012 1:50	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.100	mg/L	1/13/2012 1:50	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.100	mg/L	1/13/2012 1:50	PNM	EPA 200.7	
Copper, Dissolved	ND	0.100	mg/L	1/13/2012 1:50	PNM	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1110915-05

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	12/22/2011 6:00 PM
Sample Site:	SW-1			***Receipt Date:***	12/27/2011 10:00 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	29
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Dissolved	ND	0.40	mg/L	1/13/2012 1:50	PNM	EPA 200.7	
Iron, Total	0.13	0.02	mg/L	1/19/2012 11:58	PNM	EPA 200.7	
Lead, Dissolved	ND	0.40	mg/L	1/13/2012 1:50	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	1/19/2012 11:58	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	1/4/2012 11:30	AKL	EPA 245.1	
Magnesium, Dissolved	76.7	4.0	mg/L	1/13/2012 1:50	PNM	EPA 200.7	
Manganese, Dissolved	ND	0.100	mg/L	1/13/2012 1:50	PNM	EPA 200.7	
Manganese, Total	0.016	0.005	mg/L	1/19/2012 11:58	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.20	mg/L	1/13/2012 1:50	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.10	mg/L	1/13/2012 1:50	PNM	EPA 200.7	
Potassium, Dissolved	ND	10.0	mg/L	1/13/2012 1:50	PNM	EPA 200.7	
Selenium, Dissolved	ND	0.40	mg/L	1/13/2012 1:50	PNM	EPA 200.7	
Selenium, Total	0.02	0.02	mg/L	1/19/2012 11:58	PNM	EPA 200.7	
Sodium, Dissolved	ND	10.0	mg/L	1/13/2012 1:50	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.20	mg/L	1/13/2012 1:50	PNM	EPA 200.7	

6100 South Stratler
Murray, UT 84107
801-262-7299 Office

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Certificate of Analysis

Lab Sample No.: 1110915-08

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	12/23/2011 5:30 PM
Sample Site:	~~Y-103~~ Y-70			***Receipt Date:***	12/27/2011 10:00 AM
Comments:	ECP 2			***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	
Field pH:				***Field Temp. Deg. C :***	
Field Flow g/Min.:				***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	14.4	0.02	mg/L	1/19/2012 12:17	PNM	EPA 200.7	
Lead, Dissolved	ND	0.10	mg/L	1/19/2012 12:16	PNM	EPA 200.7	
Lead, Total	0.05	0.02	mg/L	1/19/2012 12:17	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	12/30/2011 13:00	AKL	EPA 245.1	
Magnesium, Dissolved	33.6	1.0	mg/L	1/19/2012 12:16	PNM	EPA 200.7	
Manganese, Dissolved	0.058	0.025	mg/L	1/19/2012 12:16	PNM	EPA 200.7	
Manganese, Total	0.740	0.005	mg/L	1/19/2012 12:17	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.05	mg/L	1/19/2012 12:16	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.02	mg/L	1/19/2012 12:16	PNM	EPA 200.7	
Potassium, Dissolved	11.9	2.5	mg/L	1/19/2012 12:16	PNM	EPA 200.7	
Selenium, Dissolved	ND	0.10	mg/L	1/19/2012 12:16	PNM	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	1/19/2012 12:17	PNM	EPA 200.7	
Sodium, Dissolved	200	2.5	mg/L	1/19/2012 12:16	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.05	mg/L	1/19/2012 12:16	PNM	EPA 200.7	

Abbreviations

ND = Not detected at the corresponding Minimum Reporting Limit.
1 mg/L = one milligram per liter or 1 mg/Kg = one milligram per kilogram = 1 part per million.
1 ug/L = one microgram per liter or 1 ug/Kg = one microgram per kilogram = 1 part per billion.
1 ng/L = one nanogram per liter or 1 ng/Kg = one nanogram per kilogram = 1 part per trillion.

Flag Descriptions

SPH = Sample submitted past method specified holding time.

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1110915-08

Name:	**Alton Coal Development, LLC**	***Mine Code:*** 41	***Sample Date:*** 12/23/2011 5:30 PM
Sample Site:	~~Y-103~~ Y-70		***Receipt Date:*** 12/27/2011 10:00 AM
Comments:	EQP 2		***Sampler:*** Erik Petersen
Sample Type:	Water		***Site No.:***
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	16.3	0.01	meq/L	1/20/2012 7:45	MJB	SM 1030 E	
Cation/Anion Balance	-6.1		%	1/20/2012 7:45	MJB	SM 1030 E	
Cations, Total	14.4	0.01	meq/L	1/20/2012 7:45	MJB	SM 1030 E	
Hardness, Total as CaCO3	269	1	mg/L	1/20/2012 7:45	MJB	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	12/29/2011 14:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	557	2.0	mg/L	12/29/2011 7:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	2.0	mg/L	12/29/2011 7:00	TSM	SM 2320 B	
Alkalinity - CO2	404	2.0	mg/L	12/29/2011 7:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	2.0	mg/L	12/29/2011 7:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	457	2.0	mg/L	12/29/2011 7:00	TSM	SM 2320 B	
Ammonia as N	1.0	0.4	mg/L	1/4/2012 11:30	JSH	SM 4500 NH3-D	
Chloride	9	1	mg/L	12/28/2011 5:30	TSM	EPA 300.0	
Fluoride	0.6	0.1	mg/L	12/28/2011 5:30	TSM	EPA 300.0	
Nitrate as N	ND	0.1	mg/L	12/28/2011 5:30	TSM	EPA 300.0	SPH
Nitrite as N	ND	0.1	mg/L	12/28/2011 5:30	TSM	EPA 300.0	SPH
Phosphorus, Total	0.77	0.02	mg/L	12/28/2011 9:30	TSM	SM 4500 PB5E	
Sulfate	350	10	mg/L	12/28/2011 5:30	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1050	10	mg/L	12/29/2011 10:22	JSH	SM 2540 C	
Total Suspended Solids (TSS)	1410	20	mg/L	12/28/2011 10:14	JSH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.2	mg/L	1/19/2012 12:16	PNM	EPA 200.7	
Aluminum, Total	6.6	0.05	mg/L	1/19/2012 12:17	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.25	mg/L	1/19/2012 12:16	PNM	EPA 200.7	
Arsenic, Total	0.05	0.05	mg/L	1/19/2012 12:17	PNM	EPA 200.7	
Boron, Dissolved	0.65	0.25	mg/L	1/19/2012 12:16	PNM	EPA 200.7	
Boron, Total	0.71	0.05	mg/L	1/19/2012 12:17	PNM	EPA 200.7	
Barium, Dissolved	0.090	0.025	mg/L	1/19/2012 12:16	PNM	EPA 200.7	
Calcium, Dissolved	52.3	1.0	mg/L	1/19/2012 12:16	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.025	mg/L	1/19/2012 12:16	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.025	mg/L	1/19/2012 12:16	PNM	EPA 200.7	
Copper, Dissolved	ND	0.025	mg/L	1/19/2012 12:16	PNM	EPA 200.7	
Iron, Dissolved	ND	0.10	mg/L	1/19/2012 12:16	PNM	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1201139-02

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 2/9/2012 10:50 AM
Sample Site:	SP7-1		**Receipt Date:** 2/13/2012 2:18 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:**
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	17.6	0.01	meq/L	2/28/2012 7:45	MJB	SM 1030 E	
Cation/Anion Balance	-2.2		%	2/28/2012 7:45	MJB	SM 1030 E	
Cations, Total	16.8	0.01	meq/L	2/28/2012 7:45	MJB	SM 1030 E	
Hardness, Total as CaCO3	790	1	mg/L	2/28/2012 7:45	MJB	SM 2340 B	
Inorganic							
Acidity	ND	15.0	mg/L	2/15/2012 8:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	557	1.0	mg/L	2/14/2012 12:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	2/14/2012 12:00	TSM	SM 2320 B	
Alkalinity - CO2	427	1.0	mg/L	2/14/2012 12:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	2/14/2012 12:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	457	1.0	mg/L	2/14/2012 12:00	TSM	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	2/17/2012 12:00	TSM	SM 4500 NH3-D	
Chloride	11	1	mg/L	2/14/2012 9:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	2/14/2012 9:00	TSM	EPA 300.0	
Nitrate as N	ND	0.1	mg/L	2/14/2012 9:00	TSM	EPA 300.0	SPH
Nitrite as N	ND	0.1	mg/L	2/14/2012 9:00	TSM	EPA 300.0	SPH
Phosphorus, Total	0.03	0.01	mg/L	2/21/2012 8:00	TSM	SM 4500 PB5E	
Sulfate	391	5	mg/L	2/14/2012 9:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1030	10	mg/L	2/15/2012 10:40	JSH	SM 2540 C	
Total Suspended Solids (TSS)	4	4	mg/L	2/15/2012 9:08	JSH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	2/23/2012 13:50	PNM	EPA 200.7	
Aluminum, Total	ND	0.05	mg/L	2/23/2012 13:54	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	2/23/2012 13:50	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	2/23/2012 13:54	PNM	EPA 200.7	
Boron, Dissolved	0.06	0.05	mg/L	2/23/2012 13:50	PNM	EPA 200.7	
Boron, Total	0.06	0.05	mg/L	2/23/2012 13:54	PNM	EPA 200.7	
Barium, Dissolved	0.046	0.005	mg/L	2/23/2012 13:50	PNM	EPA 200.7	
Calcium, Dissolved	150	0.2	mg/L	2/23/2012 13:50	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	2/23/2012 13:50	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	2/23/2012 13:50	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	2/23/2012 13:50	PNM	EPA 200.7	
Iron, Dissolved	0.10	0.02	mg/L	2/23/2012 13:50	PNM	EPA 200.7	

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LABORATORIES

Certificate of Analysis

Lab Sample No.: 1201139-02

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	2/9/2012 10:50 AM
Sample Site:	SP7-1			***Receipt Date:***	2/13/2012 2:18 PM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	
Field pH:				***Field Temp. Deg. C :***	
Field Flow g/Min.:				***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	0.86	0.02	mg/L	2/23/2012 13:54	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	2/23/2012 13:50	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	2/23/2012 13:54	PNM	EPA 200.7	
Mercury, Dissolved	0.0002	0.0002	mg/L	2/16/2012 10:30	AKL	EPA 245.1	
Magnesium, Dissolved	101	0.2	mg/L	2/23/2012 13:50	PNM	EPA 200.7	
Manganese, Dissolved	0.126	0.005	mg/L	2/23/2012 13:50	PNM	EPA 200.7	
Manganese, Total	0.128	0.005	mg/L	2/23/2012 13:54	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	2/23/2012 13:50	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	2/23/2012 13:50	PNM	EPA 200.7	
Potassium, Dissolved	4.5	0.5	mg/L	2/23/2012 13:50	PNM	EPA 200.7	
Selenium, Dissolved	0.03	0.02	mg/L	2/23/2012 13:50	PNM	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	2/23/2012 13:54	PNM	EPA 200.7	
Sodium, Dissolved	20.6	0.5	mg/L	2/23/2012 13:50	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	2/23/2012 13:50	PNM	EPA 200.7	

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Lab Sample No.: 1201139-03

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 2/9/2012 1:45 PM
Sample Site:	SW-11		**Receipt Date:** 2/13/2012 2:18 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:**
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	8.7	0.01	meq/L	2/28/2012 7:45	MJB	SM 1030 E	
Cation/Anion Balance	2.3		%	2/28/2012 7:45	MJB	SM 1030 E	
Cations, Total	9.1	0.01	meq/L	2/28/2012 7:45	MJB	SM 1030 E	
Hardness, Total as CaCO3	409	1	mg/L	2/28/2012 7:45	MJB	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	2/15/2012 8:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	156	1.0	mg/L	2/14/2012 12:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	2/14/2012 12:00	TSM	SM 2320 B	
Alkalinity - CO2	116	1.0	mg/L	2/14/2012 12:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	2/14/2012 12:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	128	1.0	mg/L	2/14/2012 12:00	TSM	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	2/17/2012 12:00	TSM	SM 4500 NH3-D	
Chloride	28	1	mg/L	2/14/2012 9:00	TSM	EPA 300.0	
Fluoride	ND	0.1	mg/L	2/14/2012 9:00	TSM	EPA 300.0	
Nitrate as N	ND	0.1	mg/L	2/14/2012 9:00	TSM	EPA 300.0	SPH
Nitrite as N	ND	0.1	mg/L	2/14/2012 9:00	TSM	EPA 300.0	SPH
Oil & Grease (HEM)	25	5	mg/L	2/16/2012 10:20	FAJ	EPA 1664A	
Phosphorus, Total	0.13	0.01	mg/L	2/21/2012 8:00	TSM	SM 4500 PB5E	
Sulfate	255	5	mg/L	2/14/2012 9:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	540	10	mg/L	2/15/2012 10:42	JSH	SM 2540 C	
Total Suspended Solids (TSS)	30	4	mg/L	2/15/2012 9:10	JSH	SM 2540 D	
Metals							
Aluminum, Dissolved	0.05	0.05	mg/L	2/23/2012 14:06	PNM	EPA 200.7	
Aluminum, Total	0.2	0.05	mg/L	2/21/2012 21:18	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	2/23/2012 14:06	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	2/21/2012 21:18	PNM	EPA 200.7	
Boron, Dissolved	0.07	0.05	mg/L	2/23/2012 14:06	PNM	EPA 200.7	
Boron, Total	0.07	0.05	mg/L	2/21/2012 21:18	PNM	EPA 200.7	
Barium, Dissolved	0.027	0.005	mg/L	2/23/2012 14:06	PNM	EPA 200.7	
Calcium, Dissolved	56.9	0.2	mg/L	2/23/2012 14:06	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	2/23/2012 14:06	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	2/23/2012 14:06	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	2/23/2012 14:06	PNM	EPA 200.7	

CHEMTECH-FORD
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Certificate of Analysis

Lab Sample No.: 1201139-03

Name:	**Alton Coal Development, LLC**	***Mine Code:*** 41	***Sample Date:*** 2/9/2012 1:45 PM
Sample Site:	SW-11		***Receipt Date:*** 2/13/2012 2:18 PM
Comments:			***Sampler:*** Erik Petersen
Sample Type:	Water		***Site No.:***
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Dissolved	0.06	0.02	mg/L	2/23/2012 14:06	PNM	EPA 200.7	
Iron, Total	0.34	0.02	mg/L	2/21/2012 21:18	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	2/23/2012 14:06	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	2/21/2012 21:18	PNM	EPA 200.7	
Mercury, Dissolved	0.0002	0.0002	mg/L	2/16/2012 10:30	AKL	EPA 245.1	
Magnesium, Dissolved	64.9	0.2	mg/L	2/23/2012 14:06	PNM	EPA 200.7	
Manganese, Dissolved	0.044	0.005	mg/L	2/23/2012 14:06	PNM	EPA 200.7	
Manganese, Total	0.052	0.005	mg/L	2/21/2012 21:18	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	2/23/2012 14:06	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	2/23/2012 14:06	PNM	EPA 200.7	
Potassium, Dissolved	8.9	0.5	mg/L	2/23/2012 14:06	PNM	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	2/23/2012 14:06	PNM	EPA 200.7	
Selenium, Total	0.02	0.02	mg/L	2/21/2012 21:18	PNM	EPA 200.7	
Sodium, Dissolved	14.8	0.5	mg/L	2/23/2012 14:06	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	2/23/2012 14:06	PNM	EPA 200.7	

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CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1201139-07

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 2/10/2012 10:20 AM
Sample Site:	SW-1A		**Receipt Date:** 2/13/2012 2:18 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:**
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	9.4	0.01	meq/L	2/28/2012 7:45	MJB	SM 1030 E	
Cation/Anion Balance	-1.1		%	2/28/2012 7:45	MJB	SM 1030 E	
Cations, Total	9.2	0.01	meq/L	2/28/2012 7:45	MJB	SM 1030 E	
Hardness, Total as CaCO3	441	1	mg/L	2/28/2012 7:45	MJB	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	2/15/2012 8:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	433	1.0	mg/L	2/14/2012 12:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	2.0	1.0	mg/L	2/14/2012 12:00	TSM	SM 2320 B	
Alkalinity - CO2	316	1.0	mg/L	2/14/2012 12:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	2/14/2012 12:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	359	1.0	mg/L	2/14/2012 12:00	TSM	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	2/17/2012 12:00	TSM	SM 4500 NH3-D	
Chloride	5	1	mg/L	2/14/2012 9:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	2/14/2012 9:00	TSM	EPA 300.0	
Nitrate as N	ND	0.1	mg/L	2/14/2012 9:00	TSM	EPA 300.0	SPH
Nitrite as N	ND	0.1	mg/L	2/14/2012 9:00	TSM	EPA 300.0	SPH
Oil & Grease (HEM)	8	5	mg/L	2/16/2012 10:20	FAJ	EPA 1664A	
Phosphorus, Total	0.05	0.01	mg/L	2/21/2012 8:00	TSM	SM 4500 PB5E	
Sulfate	100	1	mg/L	2/14/2012 9:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	500	10	mg/L	2/15/2012 10:50	JSH	SM 2540 C	
Total Suspended Solids (TSS)	63	4	mg/L	2/15/2012 9:18	JSH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	2/23/2012 14:22	PNM	EPA 200.7	
Aluminum, Total	0.4	0.05	mg/L	2/21/2012 21:34	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	2/23/2012 14:22	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	2/21/2012 21:34	PNM	EPA 200.7	
Boron, Dissolved	ND	0.05	mg/L	2/23/2012 14:22	PNM	EPA 200.7	
Boron, Total	ND	0.05	mg/L	2/21/2012 21:34	PNM	EPA 200.7	
Barium, Dissolved	0.224	0.005	mg/L	2/23/2012 14:22	PNM	EPA 200.7	
Calcium, Dissolved	70.9	0.2	mg/L	2/23/2012 14:22	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	2/23/2012 14:22	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	2/23/2012 14:22	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	2/23/2012 14:22	PNM	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1201139-07

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	2/10/2012 10:20 AM
Sample Site:	SW-1A			***Receipt Date:***	2/13/2012 2:18 PM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	
Field pH:				***Field Temp. Deg. C :***	
Field Flow g/Min.:				***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Dissolved	ND	0.02	mg/L	2/23/2012 14:22	PNM	EPA 200.7	
Iron, Total	1.01	0.02	mg/L	2/21/2012 21:34	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	2/23/2012 14:22	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	2/21/2012 21:34	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	2/16/2012 10:30	AKL	EPA 245.1	
Magnesium, Dissolved	64.0	0.2	mg/L	2/23/2012 14:22	PNM	EPA 200.7	
Manganese, Dissolved	0.013	0.005	mg/L	2/23/2012 14:22	PNM	EPA 200.7	
Manganese, Total	0.044	0.005	mg/L	2/21/2012 21:34	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	2/23/2012 14:22	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	2/23/2012 14:22	PNM	EPA 200.7	
Potassium, Dissolved	2.2	0.5	mg/L	2/23/2012 14:22	PNM	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	2/23/2012 14:22	PNM	EPA 200.7	
Selenium, Total	0.02	0.02	mg/L	2/21/2012 21:34	PNM	EPA 200.7	
Sodium, Dissolved	7.3	0.5	mg/L	2/23/2012 14:22	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	2/23/2012 14:22	PNM	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1201139-08

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 2/10/2012 11:45 AM
Sample Site:	Knob Spring		**Receipt Date:** 2/13/2012 2:18 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** na
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	45.9	0.01	meq/L	2/28/2012 7:45	MJB	SM 1030 E	
Cation/Anion Balance	5.7		%	2/28/2012 7:45	MJB	SM 1030 E	
Cations, Total	51.5	0.01	meq/L	2/28/2012 7:45	MJB	SM 1030 E	
Hardness, Total as CaCO3	2120	1	mg/L	2/28/2012 7:45	MJB	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	2/15/2012 8:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	399	1.0	mg/L	2/14/2012 12:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	2/14/2012 12:00	TSM	SM 2320 B	
Alkalinity - CO2	295	1.0	mg/L	2/14/2012 12:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	2/14/2012 12:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	327	1.0	mg/L	2/14/2012 12:00	TSM	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	2/17/2012 12:00	TSM	SM 4500 NH3-D	
Chloride	61	1	mg/L	2/14/2012 9:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	2/14/2012 9:00	TSM	EPA 300.0	
Nitrate as N	ND	0.1	mg/L	2/14/2012 9:00	TSM	EPA 300.0	SPH
Nitrite as N	ND	0.1	mg/L	2/14/2012 9:00	TSM	EPA 300.0	SPH
Phosphorus, Total	0.20	0.01	mg/L	2/21/2012 8:00	TSM	SM 4500 PB5E	
Sulfate	1810	10	mg/L	2/14/2012 9:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	2930	10	mg/L	2/15/2012 10:52	JSH	SM 2540 C	
Total Suspended Solids (TSS)	15	4	mg/L	2/15/2012 9:20	JSH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	2/23/2012 14:25	PNM	EPA 200.7	
Aluminum, Total	0.09	0.05	mg/L	2/21/2012 21:45	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	2/23/2012 14:25	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	2/21/2012 21:45	PNM	EPA 200.7	
Boron, Dissolved	0.08	0.05	mg/L	2/23/2012 14:25	PNM	EPA 200.7	
Boron, Total	0.09	0.05	mg/L	2/21/2012 21:45	PNM	EPA 200.7	
Barium, Dissolved	0.057	0.005	mg/L	2/23/2012 14:25	PNM	EPA 200.7	
Calcium, Dissolved	231	0.2	mg/L	2/23/2012 14:25	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	2/23/2012 14:25	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	2/23/2012 14:25	PNM	EPA 200.7	
Copper, Dissolved	0.005	0.005	mg/L	2/23/2012 14:25	PNM	EPA 200.7	
Iron, Dissolved	0.26	0.02	mg/L	2/23/2012 14:25	PNM	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1201139-08

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	2/10/2012 11:45 AM
Sample Site:	Knob Spring			***Receipt Date:***	2/13/2012 2:18 PM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	na
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	0.58	0.02	mg/L	2/21/2012 21:45	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	2/23/2012 14:25	PNM	EPA 200.7	
Lead, Total	0.02	0.02	mg/L	2/21/2012 21:45	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	2/16/2012 10:30	AKL	EPA 245.1	
Magnesium, Dissolved	374	0.2	mg/L	2/23/2012 14:25	PNM	EPA 200.7	
Manganese, Dissolved	0.776	0.005	mg/L	2/23/2012 14:25	PNM	EPA 200.7	
Manganese, Total	1.35	0.005	mg/L	2/21/2012 21:45	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	2/23/2012 14:25	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	2/23/2012 14:25	PNM	EPA 200.7	
Potassium, Dissolved	28.4	0.5	mg/L	2/23/2012 14:25	PNM	EPA 200.7	
Selenium, Dissolved	0.03	0.02	mg/L	2/23/2012 14:25	PNM	EPA 200.7	
Selenium, Total	0.04	0.02	mg/L	2/21/2012 21:45	PNM	EPA 200.7	
Sodium, Dissolved	195	0.5	mg/L	2/23/2012 14:25	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	2/23/2012 14:25	PNM	EPA 200.7	

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CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1201139-09

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 2/10/2012 12:25 PM
Sample Site:	Kanab Creek at County Road		**Receipt Date:** 2/13/2012 2:18 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:**
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	9.8	0.01	meq/L	2/28/2012 7:45	MJB	SM 1030 E	
Cation/Anion Balance	-4.8		%	2/28/2012 7:45	MJB	SM 1030 E	
Cations, Total	8.9	0.01	meq/L	2/28/2012 7:45	MJB	SM 1030 E	
Hardness, Total as CaCO3	427	1	mg/L	2/28/2012 7:45	MJB	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	2/15/2012 8:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	431	1.0	mg/L	2/14/2012 12:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	2.0	1.0	mg/L	2/14/2012 12:00	TSM	SM 2320 B	
Alkalinity - CO2	314	1.0	mg/L	2/14/2012 12:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	2/14/2012 12:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	357	1.0	mg/L	2/14/2012 12:00	TSM	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	2/17/2012 12:00	TSM	SM 4500 NH3-D	
Chloride	6	1	mg/L	2/14/2012 9:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	2/14/2012 9:00	TSM	EPA 300.0	
Nitrate as N	ND	0.1	mg/L	2/14/2012 9:00	TSM	EPA 300.0	SPH
Nitrite as N	ND	0.1	mg/L	2/14/2012 9:00	TSM	EPA 300.0	SPH
Oil & Grease (HEM)	ND	5	mg/L	2/16/2012 10:20	FAJ	EPA 1664A	
Phosphorus, Total	0.04	0.01	mg/L	2/21/2012 8:00	TSM	SM 4500 PB5E	
Sulfate	122	1	mg/L	2/14/2012 9:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	514	10	mg/L	2/15/2012 10:54	JSH	SM 2540 C	
Total Suspended Solids (TSS)	36	4	mg/L	2/15/2012 9:22	JSH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	2/23/2012 14:29	PNM	EPA 200.7	
Aluminum, Total	0.3	0.05	mg/L	2/21/2012 21:49	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	2/23/2012 14:29	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	2/21/2012 21:49	PNM	EPA 200.7	
Boron, Dissolved	ND	0.05	mg/L	2/23/2012 14:29	PNM	EPA 200.7	
Boron, Total	ND	0.05	mg/L	2/21/2012 21:49	PNM	EPA 200.7	
Barium, Dissolved	0.191	0.005	mg/L	2/23/2012 14:29	PNM	EPA 200.7	
Calcium, Dissolved	66.5	0.2	mg/L	2/23/2012 14:29	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	2/23/2012 14:29	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	2/23/2012 14:29	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	2/23/2012 14:29	PNM	EPA 200.7	

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LABORATORIES

Certificate of Analysis

Lab Sample No.: 1201139-09

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	2/10/2012 12:25 PM
Sample Site:	Kanab Creek at County Road			***Receipt Date:***	2/13/2012 2:18 PM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	
Field pH:				***Field Temp. Deg. C :***	
Field Flow g/Min.:				***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Dissolved	ND	0.02	mg/L	2/23/2012 14:29	PNM	EPA 200.7	
Iron, Total	0.69	0.02	mg/L	2/21/2012 21:49	PNM	EPA 200.7	
Lead, Dissolved	0.02	0.02	mg/L	2/23/2012 14:29	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	2/21/2012 21:49	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	2/16/2012 10:30	AKL	EPA 245.1	
Magnesium, Dissolved	63.3	0.2	mg/L	2/23/2012 14:29	PNM	EPA 200.7	
Manganese, Dissolved	0.014	0.005	mg/L	2/23/2012 14:29	PNM	EPA 200.7	
Manganese, Total	0.036	0.005	mg/L	2/21/2012 21:49	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	2/23/2012 14:29	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	2/23/2012 14:29	PNM	EPA 200.7	
Potassium, Dissolved	2.2	0.5	mg/L	2/23/2012 14:29	PNM	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	2/23/2012 14:29	PNM	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	2/21/2012 21:49	PNM	EPA 200.7	
Sodium, Dissolved	8.1	0.5	mg/L	2/23/2012 14:29	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	2/23/2012 14:29	PNM	EPA 200.7	

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Lab Sample No.: 1202642-07

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 3/31/2012 7:10 PM
Sample Site:	Kanab Creek at County Road		**Receipt Date:** 4/2/2012 2:53 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:**
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	15.2	0.01	meq/L	4/23/2012 14:02	DBH	SM 1030 E	
Cation/Anion Balance	3.5		%	4/23/2012 14:02	DBH	SM 1030 E	
Cations, Total	16.3	0.01	meq/L	4/23/2012 14:02	DBH	SM 1030 E	
Hardness, Total as CaCO3	758	1	mg/L	4/23/2012 14:00	DBH	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	4/4/2012 14:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	479	1.0	mg/L	4/4/2012 11:30	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	4/4/2012 11:30	TSM	SM 2320 B	
Alkalinity - CO2	347	1.0	mg/L	4/4/2012 11:30	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	4/4/2012 11:30	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	393	1.0	mg/L	4/4/2012 11:30	TSM	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	4/7/2012 11:00	TSM	SM 4500 NH3-D	
Chloride	13	1	mg/L	4/4/2012 7:30	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	4/4/2012 7:30	TSM	EPA 300.0	
Nitrate as N	ND	0.1	mg/L	4/4/2012 7:30	TSM	EPA 300.0	SPH
Nitrite as N	ND	0.1	mg/L	4/4/2012 7:30	TSM	EPA 300.0	SPH
Oil & Grease (HEM)	ND	5	mg/L	4/5/2012 11:38	FJ	EPA 1664A	
Phosphorus, Total	ND	0.01	mg/L	4/10/2012 12:30	TSM	SM 4500 PB5E	
Sulfate	335	5	mg/L	4/4/2012 7:30	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	890	10	mg/L	4/6/2012 11:54	JSH	SM 2540 C	
Total Suspended Solids (TSS)	ND	4	mg/L	4/4/2012 9:59	JSH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	4/13/2012 0:56	PNM	EPA 200.7	
Aluminum, Total	ND	0.05	mg/L	4/13/2012 1:00	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	4/13/2012 0:56	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	4/13/2012 1:00	PNM	EPA 200.7	
Boron, Dissolved	0.10	0.05	mg/L	4/13/2012 0:56	PNM	EPA 200.7	
Boron, Total	0.07	0.05	mg/L	4/13/2012 1:00	PNM	EPA 200.7	
Barium, Dissolved	0.221	0.005	mg/L	4/13/2012 0:56	PNM	EPA 200.7	
Calcium, Dissolved	92.5	0.2	mg/L	4/13/2012 0:56	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	4/13/2012 0:56	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	4/13/2012 0:56	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	4/13/2012 0:56	PNM	EPA 200.7	

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LABORATORIES

Certificate of Analysis

Lab Sample No.: 1202642-07

Name:	**Alton Coal Development, LLC**	***Mine Code:*** 41	***Sample Date:*** 3/31/2012 7:10 PM
Sample Site:	Kanab Creek at County Road		***Receipt Date:*** 4/2/2012 2:53 PM
Comments:			***Sampler:*** Erik Petersen
Sample Type:	Water		***Site No.:***
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Dissolved	ND	0.02	mg/L	4/13/2012 0:56	PNM	EPA 200.7	
Iron, Total	0.15	0.02	mg/L	4/13/2012 1:00	PNM	EPA 200.7	
Lead, Dissolved	0.02	0.02	mg/L	4/13/2012 0:56	PNM	EPA 200.7	
Lead, Total	0.02	0.02	mg/L	4/13/2012 1:00	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	4/18/2012 12:15	AKL	EPA 245.1	
Magnesium, Dissolved	128	0.2	mg/L	4/13/2012 0:56	PNM	EPA 200.7	
Manganese, Dissolved	ND	0.005	mg/L	4/13/2012 0:56	PNM	EPA 200.7	
Manganese, Total	0.034	0.005	mg/L	4/13/2012 1:00	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	4/13/2012 0:56	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	4/13/2012 0:56	PNM	EPA 200.7	
Potassium, Dissolved	4.3	0.5	mg/L	4/13/2012 0:56	PNM	EPA 200.7	
Selenium, Dissolved	0.03	0.02	mg/L	4/13/2012 0:56	PNM	EPA 200.7	
Selenium, Total	0.02	0.02	mg/L	4/13/2012 1:00	PNM	EPA 200.7	
Sodium, Dissolved	23.9	0.5	mg/L	4/13/2012 0:56	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	4/13/2012 0:56	PNM	EPA 200.7	

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CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1202642-08

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 3/31/2012 8:00 PM
Sample Site:	SW-1A		**Receipt Date:** 4/2/2012 2:53 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:**
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	13.6	0.01	meq/L	4/23/2012 14:02	DBH	SM 1030 E	
Cation/Anion Balance	3.4		%	4/23/2012 14:02	DBH	SM 1030 E	
Cations, Total	14.6	0.01	meq/L	4/23/2012 14:02	DBH	SM 1030 E	
Hardness, Total as CaCO3	679	1	mg/L	4/23/2012 14:00	DBH	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	4/4/2012 14:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	477	1.0	mg/L	4/4/2012 11:30	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	4/4/2012 11:30	TSM	SM 2320 B	
Alkalinity - CO2	345	1.0	mg/L	4/4/2012 11:30	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	4/4/2012 11:30	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	391	1.0	mg/L	4/4/2012 11:30	TSM	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	4/7/2012 11:00	TSM	SM 4500 NH3-D	
Chloride	12	1	mg/L	4/4/2012 7:30	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	4/4/2012 7:30	TSM	EPA 300.0	
Nitrate as N	ND	0.1	mg/L	4/4/2012 7:30	TSM	EPA 300.0	SPH
Nitrite as N	ND	0.1	mg/L	4/4/2012 7:30	TSM	EPA 300.0	SPH
Oil & Grease (HEM)	ND	5	mg/L	4/5/2012 11:38	FJ	EPA 1664A	
Phosphorus, Total	0.02	0.01	mg/L	4/10/2012 12:30	TSM	SM 4500 PB5E	
Sulfate	263	5	mg/L	4/4/2012 7:30	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	738	10	mg/L	4/6/2012 11:56	JSH	SM 2540 C	
Total Suspended Solids (TSS)	4	4	mg/L	4/4/2012 10:05	JSH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	4/13/2012 1:12	PNM	EPA 200.7	
Aluminum, Total	ND	0.05	mg/L	4/16/2012 12:23	PNM	EPA 200.7	
Arsenic, Dissolved	0.05	0.05	mg/L	4/13/2012 1:12	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	4/16/2012 12:23	PNM	EPA 200.7	
Boron, Dissolved	0.08	0.05	mg/L	4/13/2012 1:12	PNM	EPA 200.7	
Boron, Total	0.06	0.05	mg/L	4/18/2012 19:12	PNM	EPA 200.7	
Barium, Dissolved	0.254	0.005	mg/L	4/13/2012 1:12	PNM	EPA 200.7	
Calcium, Dissolved	82.3	0.2	mg/L	4/13/2012 1:12	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	4/13/2012 1:12	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	4/13/2012 1:12	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	4/13/2012 1:12	PNM	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1202642-08

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 3/31/2012 8:00 PM
Sample Site:	SW-1A		**Receipt Date:** 4/2/2012 2:53 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:**
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Dissolved	0.02	0.02	mg/L	4/13/2012 1:12	PNM	EPA 200.7	
Iron, Total	0.34	0.02	mg/L	4/16/2012 12:23	PNM	EPA 200.7	
Lead, Dissolved	0.02	0.02	mg/L	4/13/2012 1:12	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	4/16/2012 12:23	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	4/18/2012 12:15	AKL	EPA 245.1	
Magnesium, Dissolved	115	0.2	mg/L	4/13/2012 1:12	PNM	EPA 200.7	
Manganese, Dissolved	ND	0.005	mg/L	4/13/2012 1:12	PNM	EPA 200.7	
Manganese, Total	0.031	0.005	mg/L	4/16/2012 12:23	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	4/13/2012 1:12	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	4/13/2012 1:12	PNM	EPA 200.7	
Potassium, Dissolved	4.4	0.5	mg/L	4/13/2012 1:12	PNM	EPA 200.7	
Selenium, Dissolved	0.03	0.02	mg/L	4/13/2012 1:12	PNM	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	4/16/2012 12:23	PNM	EPA 200.7	
Sodium, Dissolved	21.1	0.5	mg/L	4/13/2012 1:12	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	4/13/2012 1:12	PNM	EPA 200.7	

Abbreviations

ND = Not detected at the corresponding Minimum Reporting Limit.
1 mg/L = one milligram per liter or 1 mg/Kg = one milligram per kilogram = 1 part per million.
1 ug/L = one microgram per liter or 1 ug/Kg = one microgram per kilogram = 1 part per billion.
1 ng/L = one nanogram per liter or 1 ng/Kg = one nanogram per kilogram = 1 part per trillion.

Flag Descriptions

SPH = Sample submitted past method specified holding time.

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CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1203401-02

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 4/24/2012 7:45 PM
Sample Site:	SW-3		**Receipt Date:** 4/26/2012 10:58 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 29
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	10.3	0.01	meq/L	5/15/2012 8:10	DBH	SM 1030 E	
Cation/Anion Balance	-2.0		%	5/15/2012 8:10	DBH	SM 1030 E	
Cations, Total	9.9	0.01	meq/L	5/15/2012 8:10	DBH	SM 1030 E	
Inorganic							
Alkalinity - Bicarbonate (HCO3)	388	1.0	mg/L	4/26/2012 10:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	4/26/2012 10:00	TSM	SM 2320 B	
Alkalinity - CO2	280	1.0	mg/L	4/26/2012 10:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	4/26/2012 10:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	318	1.0	mg/L	4/26/2012 10:00	TSM	SM 2320 B	
Chloride	7	1	mg/L	4/26/2012 12:00	TSM	EPA 300.0	
Nitrate as N	ND	0.1	mg/L	4/26/2012 12:00	TSM	EPA 300.0	
Nitrite as N	ND	0.1	mg/L	4/26/2012 12:00	TSM	EPA 300.0	
Oil & Grease (HEM)	ND	6	mg/L	4/30/2012 12:20	FAJ	EPA 1664A	
Phosphate, ortho	ND	0.01	mg/L	4/26/2012 13:00	TSM	SM 4500 P-E	
Sulfate	181	1	mg/L	4/26/2012 12:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	548	10	mg/L	5/1/2012 13:30	JSH	SM 2540 C	
Total Suspended Solids (TSS)	8	4	mg/L	4/27/2012 13:26	JSH	SM 2540 D	
Metals							
Boron, Dissolved	0.06	0.05	mg/L	5/13/2012 0:35	PNM	EPA 200.7	
Boron, Total	0.08	0.05	mg/L	5/3/2012 18:29	PNM	EPA 200.7	
Calcium, Dissolved	63.2	0.2	mg/L	5/13/2012 0:35	PNM	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	5/13/2012 0:35	PNM	EPA 200.7	
Iron, Total	0.26	0.02	mg/L	5/15/2012 19:19	PNM	EPA 200.7	
Magnesium, Dissolved	75.4	0.2	mg/L	5/13/2012 0:35	PNM	EPA 200.7	
Manganese, Dissolved	0.009	0.005	mg/L	5/13/2012 0:35	PNM	EPA 200.7	
Manganese, Total	0.016	0.005	mg/L	5/3/2012 18:29	PNM	EPA 200.7	
Potassium, Dissolved	2.7	0.5	mg/L	5/13/2012 0:35	PNM	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	5/13/2012 0:35	PNM	EPA 200.7	
Selenium, Total	ND	0.02	mg/L	5/3/2012 18:29	PNM	EPA 200.7	
Sodium, Dissolved	11.3	0.5	mg/L	5/13/2012 0:35	PNM	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1203401-03

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 4/25/2012 4:00 PM
Sample Site:	~~Y-18-1~~ Y-103		**Receipt Date:** 4/26/2012 10:58 AM
Comments:	ECP 2		**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:**
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	54.4	0.01	meq/L	5/15/2012 8:10	DBH	SM 1030 E	
Cation/Anion Balance	-1.2		%	5/15/2012 8:10	DBH	SM 1030 E	
Cations, Total	53.1	0.01	meq/L	5/15/2012 8:10	DBH	SM 1030 E	
Hardness, Total as CaCO3	2580	1	mg/L	5/15/2012 8:09	DBH	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	5/3/2012 9:30	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	906	2.0	mg/L	4/26/2012 10:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	2.0	mg/L	4/26/2012 10:00	TSM	SM 2320 B	
Alkalinity - CO2	687	2.0	mg/L	4/26/2012 10:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	2.0	mg/L	4/26/2012 10:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	743	2.0	mg/L	4/26/2012 10:00	TSM	SM 2320 B	
Ammonia as N	0.3	0.2	mg/L	4/27/2012 9:00	TSM	SM 4500 NH3-D	
Chloride	8	5	mg/L	4/27/2012 6:45	TSM	EPA 300.0	
Fluoride	ND	0.5	mg/L	4/27/2012 6:45	TSM	EPA 300.0	
Nitrate as N	ND	0.5	mg/L	4/27/2012 6:45	TSM	EPA 300.0	
Nitrite as N	ND	0.5	mg/L	4/27/2012 6:45	TSM	EPA 300.0	
Phosphate, ortho	ND	0.01	mg/L	4/26/2012 13:00	TSM	SM 4500 P-E	
Phosphorus, Total	1.3	0.10	mg/L	4/29/2012 19:00	TSM	SM 4500 PB5E	
Sulfate	1890	20	mg/L	5/1/2012 11:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	3560	10	mg/L	5/2/2012 16:30	JSH	SM 2540 C	
Total Suspended Solids (TSS)	10700	100	mg/L	4/27/2012 13:28	JSH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	5/13/2012 0:47	PNM	EPA 200.7	
Aluminum, Total	29.7	0.05	mg/L	5/3/2012 18:32	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	5/13/2012 0:47	PNM	EPA 200.7	
Arsenic, Total	0.10	0.05	mg/L	5/3/2012 18:32	PNM	EPA 200.7	
Boron, Dissolved	0.11	0.05	mg/L	5/13/2012 0:47	PNM	EPA 200.7	
Boron, Total	0.12	0.05	mg/L	5/3/2012 18:32	PNM	EPA 200.7	
Barium, Dissolved	0.013	0.005	mg/L	5/13/2012 0:47	PNM	EPA 200.7	
Calcium, Dissolved	316	0.2	mg/L	5/13/2012 0:47	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	5/13/2012 0:47	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	5/13/2012 0:47	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	5/13/2012 0:47	PNM	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1203401-03

Name:	Alton Coal Development, LLC	***Mine Code:***	41	***Sample Date:***	4/25/2012 4:00 PM
Sample Site:	~~Y-18-1~~ Y-103			***Receipt Date:***	4/26/2012 10:58 AM
Comments:	ECP			***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	
Field pH:				***Field Temp. Deg. C :***	
Field Flow g/Min.:				***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Dissolved	2.32	0.02	mg/L	5/13/2012 0:47	PNM	EPA 200.7	
Iron, Total	112	0.02	mg/L	5/15/2012 19:22	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	5/13/2012 0:47	PNM	EPA 200.7	
Lead, Total	0.23	0.02	mg/L	5/3/2012 18:32	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	5/2/2012 14:30	AKL	EPA 245.1	
Magnesium, Dissolved	435	0.2	mg/L	5/13/2012 0:47	PNM	EPA 200.7	
Manganese, Dissolved	0.099	0.005	mg/L	5/13/2012 0:47	PNM	EPA 200.7	
Manganese, Total	2.99	0.005	mg/L	5/3/2012 18:32	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	5/13/2012 0:47	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	5/13/2012 0:47	PNM	EPA 200.7	
Potassium, Dissolved	14.6	0.5	mg/L	5/13/2012 0:47	PNM	EPA 200.7	
Selenium, Dissolved	0.04	0.02	mg/L	5/13/2012 0:47	PNM	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	5/3/2012 18:32	PNM	EPA 200.7	
Sodium, Dissolved	23.0	0.5	mg/L	5/13/2012 0:47	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	5/13/2012 0:47	PNM	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1203401-04

Name:	Alton Coal Development, LLC	***Mine Code:*** 41	***Sample Date:***	4/25/2012 6:15 PM
Sample Site:	~~Y-103~~ Y-70		***Receipt Date:***	4/26/2012 10:58 AM
Comments:	ECP 5		***Sampler:***	Erik Petersen
Sample Type:	Water		***Site No.:***	
Field pH:		***Field Temp. Deg. C :***		
Field Flow g/Min.:		***Field Cond. umhos/cm:***		

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	44.2	0.01	meq/L	5/15/2012 8:10	DBH	SM 1030 E	
Cation/Anion Balance	3.1		%	5/15/2012 8:10	DBH	SM 1030 E	
Cations, Total	47.0	0.01	meq/L	5/15/2012 8:10	DBH	SM 1030 E	
Hardness, Total as CaCO3	1740	1	mg/L	5/15/2012 8:09	DBH	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	5/3/2012 9:30	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	735	2.0	mg/L	4/26/2012 10:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	2.0	mg/L	4/26/2012 10:00	TSM	SM 2320 B	
Alkalinity - CO2	565	2.0	mg/L	4/26/2012 10:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	2.0	mg/L	4/26/2012 10:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	603	2.0	mg/L	4/26/2012 10:00	TSM	SM 2320 B	
Ammonia as N	1.3	0.2	mg/L	4/27/2012 9:00	TSM	SM 4500 NH3-D	
Chloride	47	5	mg/L	4/27/2012 6:45	TSM	EPA 300.0	
Fluoride	0.6	0.5	mg/L	4/27/2012 6:45	TSM	EPA 300.0	
Nitrate as N	ND	0.5	mg/L	4/27/2012 6:45	TSM	EPA 300.0	
Nitrite as N	ND	0.5	mg/L	4/27/2012 6:45	TSM	EPA 300.0	
Phosphate, ortho	ND	0.01	mg/L	4/26/2012 13:00	TSM	SM 4500 P-E	
Phosphorus, Total	0.47	0.05	mg/L	4/29/2012 19:00	TSM	SM 4500 PB5E	
Sulfate	1480	20	mg/L	5/1/2012 11:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	2950	10	mg/L	5/2/2012 16:32	JSH	SM 2540 C	
Total Suspended Solids (TSS)	646	20	mg/L	4/27/2012 13:30	JSH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	5/13/2012 0:51	PNM	EPA 200.7	
Aluminum, Total	4.3	0.05	mg/L	5/3/2012 18:39	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	5/13/2012 0:51	PNM	EPA 200.7	
Arsenic, Total	0.05	0.05	mg/L	5/3/2012 18:39	PNM	EPA 200.7	
Boron, Dissolved	0.28	0.05	mg/L	5/13/2012 0:51	PNM	EPA 200.7	
Boron, Total	0.30	0.05	mg/L	5/3/2012 18:39	PNM	EPA 200.7	
Barium, Dissolved	0.065	0.005	mg/L	5/13/2012 0:51	PNM	EPA 200.7	
Calcium, Dissolved	319	0.2	mg/L	5/13/2012 0:51	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	5/13/2012 0:51	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	5/13/2012 0:51	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	5/13/2012 0:51	PNM	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1203401-04

Name:	Alton Coal Development, LLC	***Mine Code:*** 41	***Sample Date:***	4/25/2012 6:15 PM
Sample Site:	~~Y-103~~ Y-70		***Receipt Date:***	4/26/2012 10:58 AM
Comments:	ECP		***Sampler:***	Erik Petersen
Sample Type:	Water		***Site No.:***	
Field pH:			***Field Temp. Deg. C :***	
Field Flow g/Min.:			***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Dissolved	1.16	0.02	mg/L	5/13/2012 0:51	PNM	EPA 200.7	
Iron, Total	15.3	0.02	mg/L	5/15/2012 19:30	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	5/13/2012 0:51	PNM	EPA 200.7	
Lead, Total	0.03	0.02	mg/L	5/3/2012 18:39	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	5/2/2012 14:30	AKL	EPA 245.1	
Magnesium, Dissolved	230	0.2	mg/L	5/13/2012 0:51	PNM	EPA 200.7	
Manganese, Dissolved	0.651	0.005	mg/L	5/13/2012 0:51	PNM	EPA 200.7	
Manganese, Total	0.805	0.005	mg/L	5/3/2012 18:39	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	5/13/2012 0:51	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	5/13/2012 0:51	PNM	EPA 200.7	
Potassium, Dissolved	10.2	0.5	mg/L	5/13/2012 0:51	PNM	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	5/13/2012 0:51	PNM	EPA 200.7	
Selenium, Total	0.04	0.02	mg/L	5/3/2012 18:39	PNM	EPA 200.7	
Sodium, Dissolved	271	0.5	mg/L	5/13/2012 0:51	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	5/13/2012 0:51	PNM	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1203401-05

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 4/25/2012 5:35 PM
Sample Site:	Coyote Seep		**Receipt Date:** 4/26/2012 10:58 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:**
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	34.3	0.01	meq/L	5/15/2012 8:10	DBH	SM 1030 E	
Cation/Anion Balance	0.8		%	5/15/2012 8:10	DBH	SM 1030 E	
Cations, Total	34.9	0.01	meq/L	5/15/2012 8:10	DBH	SM 1030 E	
Hardness, Total as CaCO3	1660	1	mg/L	5/15/2012 8:09	DBH	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	5/3/2012 9:30	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	614	2.0	mg/L	4/26/2012 10:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	2.0	mg/L	4/26/2012 10:00	TSM	SM 2320 B	
Alkalinity - CO2	450	2.0	mg/L	4/26/2012 10:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	2.0	mg/L	4/26/2012 10:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	504	2.0	mg/L	4/26/2012 10:00	TSM	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	4/27/2012 9:00	TSM	SM 4500 NH3-D	
Chloride	20	5	mg/L	4/27/2012 6:45	TSM	EPA 300.0	
Fluoride	ND	0.5	mg/L	4/27/2012 6:45	TSM	EPA 300.0	
Nitrate as N	ND	0.5	mg/L	4/27/2012 6:45	TSM	EPA 300.0	
Nitrite as N	ND	0.5	mg/L	4/27/2012 6:45	TSM	EPA 300.0	
Oil & Grease (HEM)	ND	6	mg/L	4/30/2012 12:20	FAJ	EPA 1664A	
Phosphate, ortho	ND	0.01	mg/L	4/26/2012 13:00	TSM	SM 4500 P-E	
Phosphorus, Total	0.03	0.01	mg/L	4/29/2012 19:00	TSM	SM 4500 PB5E	
Sulfate	1140	20	mg/L	5/1/2012 11:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	2350	10	mg/L	5/2/2012 16:34	JSH	SM 2540 C	
Total Suspended Solids (TSS)	12	4	mg/L	4/27/2012 13:32	JSH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	5/13/2012 0:55	PNM	EPA 200.7	
Aluminum, Total	0.05	0.05	mg/L	5/3/2012 18:43	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	5/13/2012 0:55	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	5/3/2012 18:43	PNM	EPA 200.7	
Boron, Dissolved	0.08	0.05	mg/L	5/13/2012 0:55	PNM	EPA 200.7	
Boron, Total	0.11	0.05	mg/L	5/3/2012 18:43	PNM	EPA 200.7	
Barium, Dissolved	0.028	0.005	mg/L	5/13/2012 0:55	PNM	EPA 200.7	
Calcium, Dissolved	204	0.2	mg/L	5/13/2012 0:55	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	5/13/2012 0:55	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	5/13/2012 0:55	PNM	EPA 200.7	

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LABORATORIES

Certificate of Analysis

Lab Sample No.: 1203401-05

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	4/25/2012 5:35 PM
Sample Site:	Coyote Seep			***Receipt Date:***	4/26/2012 10:58 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Copper, Dissolved	ND	0.005	mg/L	5/13/2012 0:55	PNM	EPA 200.7	
Iron, Dissolved	0.02	0.02	mg/L	5/13/2012 0:55	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	5/13/2012 0:55	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	5/3/2012 18:43	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	5/2/2012 14:30	AKL	EPA 245.1	
Magnesium, Dissolved	279	0.2	mg/L	5/13/2012 0:55	PNM	EPA 200.7	
Manganese, Dissolved	0.021	0.005	mg/L	5/13/2012 0:55	PNM	EPA 200.7	
Manganese, Total	0.028	0.005	mg/L	5/3/2012 18:43	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	5/13/2012 0:55	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	5/13/2012 0:55	PNM	EPA 200.7	
Potassium, Dissolved	5.2	0.5	mg/L	5/13/2012 0:55	PNM	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	5/13/2012 0:55	PNM	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	5/3/2012 18:43	PNM	EPA 200.7	
Sodium, Dissolved	37.9	0.5	mg/L	5/13/2012 0:55	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	5/13/2012 0:55	PNM	EPA 200.7	

Abbreviations

ND = Not detected at the corresponding Minimum Reporting Limit.
1 mg/L = one milligram per liter or 1 mg/Kg = one milligram per kilogram = 1 part per million.
1 ug/L = one microgram per liter or 1 ug/Kg = one microgram per kilogram = 1 part per billion.
1 ng/L = one nanogram per liter or 1 ng/Kg = one nanogram per kilogram = 1 part per trillion.

Flag Descriptions

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Certificate of Analysis

Lab Sample No.: 1206198-02

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 7/10/2012 3:00 PM
Sample Site:	Y-103		**Receipt Date:** 7/12/2012 3:00 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 204
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	55.5	0.01	meq/L	7/30/2012 17:12	DBH	SM 1030 E	
Cation/Anion Balance	-0.7		%	7/30/2012 17:12	DBH	SM 1030 E	
Cations, Total	54.8	0.01	meq/L	7/30/2012 17:12	DBH	SM 1030 E	
Hardness, Total as CaCO3	2660	1	mg/L	7/30/2012 17:12	DBH	SM 2340 B	
Inorganic							
Acidity	ND	10.0	mg/L	7/13/2012 10:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	972	2.0	mg/L	7/15/2012 9:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	2.0	mg/L	7/15/2012 9:00	TSM	SM 2320 B	
Alkalinity - CO2	814	2.0	mg/L	7/15/2012 9:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	2.0	mg/L	7/15/2012 9:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	798	2.0	mg/L	7/15/2012 9:00	TSM	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	7/15/2012 9:30	TSM	SM 4500 NH3-D	
Chloride	9	2	mg/L	7/13/2012 17:00	TSM	EPA 300.0	
Fluoride	0.3	0.2	mg/L	7/13/2012 17:00	TSM	EPA 300.0	
Nitrate + Nitrite (Total)	ND	0.1	mg/L	7/16/2012 14:00	KSL	SM 4500 NO3-F	
Phosphorus, Total	0.08	0.01	mg/L	7/17/2012 11:00	TSM	SM 4500 PB5E	
Sulfate	1890	20	mg/L	7/13/2012 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	3560	10	mg/L	7/13/2012 16:00	JSH	SM 2540 C	
Total Suspended Solids (TSS)	179	10	mg/L	7/13/2012 17:00	JSH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	7/24/2012 22:20	PNM	EPA 200.7	
Aluminum, Total	2.7	0.05	mg/L	7/20/2012 20:36	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	7/24/2012 22:20	PNM	EPA 200.7	
Arsenic, Total	0.05	0.05	mg/L	7/20/2012 20:36	PNM	EPA 200.7	
Boron, Dissolved	0.10	0.05	mg/L	7/24/2012 22:20	PNM	EPA 200.7	
Boron, Total	0.11	0.05	mg/L	7/20/2012 20:36	PNM	EPA 200.7	
Barium, Dissolved	0.011	0.005	mg/L	7/24/2012 22:20	PNM	EPA 200.7	
Calcium, Dissolved	344	0.2	mg/L	7/24/2012 22:20	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	7/24/2012 22:20	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	7/24/2012 22:20	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	7/24/2012 22:20	PNM	EPA 200.7	
Iron, Dissolved	0.81	0.02	mg/L	7/24/2012 22:20	PNM	EPA 200.7	
Iron, Total	17.2	0.02	mg/L	7/24/2012 15:44	PNM	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1206198-02

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	7/10/2012 3:00 PM
Sample Site:	Y-103			***Receipt Date:***	7/12/2012 3:00 PM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	204
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Lead, Dissolved	ND	0.02	mg/L	7/24/2012 22:20	PNM	EPA 200.7	
Lead, Total	0.02	0.02	mg/L	7/20/2012 20:36	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	7/13/2012 16:30	AKL	EPA 245.1	
Magnesium, Dissolved	438	0.2	mg/L	7/24/2012 22:20	PNM	EPA 200.7	
Manganese, Dissolved	0.099	0.005	mg/L	7/24/2012 22:20	PNM	EPA 200.7	
Manganese, Total	0.151	0.005	mg/L	7/20/2012 20:36	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	7/24/2012 22:20	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	7/24/2012 22:20	PNM	EPA 200.7	
Potassium, Dissolved	16.3	0.5	mg/L	7/24/2012 22:20	PNM	EPA 200.7	
Selenium, Dissolved	0.04	0.02	mg/L	7/24/2012 22:20	PNM	EPA 200.7	
Selenium, Total	0.04	0.02	mg/L	7/20/2012 20:36	PNM	EPA 200.7	
Sodium, Dissolved	25.0	0.5	mg/L	7/24/2012 22:20	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	7/24/2012 22:20	PNM	EPA 200.7	

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LABORATORIES

Certificate of Analysis

Lab Sample No.: 1206198-03

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 7/10/2012 4:00 PM
Sample Site:	Y-70		**Receipt Date:** 7/12/2012 3:00 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 204
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	48.2	0.01	meq/L	7/30/2012 17:12	DBH	SM 1030 E	
Cation/Anion Balance	-1.3		%	7/30/2012 17:12	DBH	SM 1030 E	
Cations, Total	47.0	0.01	meq/L	7/30/2012 17:12	DBH	SM 1030 E	
Hardness, Total as CaCO3	1730	1	mg/L	7/30/2012 17:12	DBH	SM 2340 B	
Inorganic							
Acidity	ND	10.0	mg/L	7/13/2012 10:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	769	2.0	mg/L	7/15/2012 9:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	2.0	mg/L	7/15/2012 9:00	TSM	SM 2320 B	
Alkalinity - CO2	575	2.0	mg/L	7/15/2012 9:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	2.0	mg/L	7/15/2012 9:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	631	2.0	mg/L	7/15/2012 9:00	TSM	SM 2320 B	
Ammonia as N	1.0	0.2	mg/L	7/15/2012 9:30	TSM	SM 4500 NH3-D	
Chloride	53	2	mg/L	7/13/2012 17:00	TSM	EPA 300.0	
Fluoride	0.6	0.2	mg/L	7/13/2012 17:00	TSM	EPA 300.0	
Nitrate + Nitrite (Total)	ND	0.1	mg/L	7/16/2012 14:00	KSL	SM 4500 NO3-F	
Phosphorus, Total	0.07	0.01	mg/L	7/17/2012 11:00	TSM	SM 4500 PB5E	
Sulfate	1640	10	mg/L	7/13/2012 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	3740	10	mg/L	7/13/2012 16:00	JSH	SM 2540 C	
Total Suspended Solids (TSS)	93	7	mg/L	7/13/2012 17:00	JSH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	7/24/2012 22:24	PNM	EPA 200.7	
Aluminum, Total	1.0	0.05	mg/L	7/20/2012 20:40	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	7/24/2012 22:24	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	7/20/2012 20:40	PNM	EPA 200.7	
Boron, Dissolved	0.25	0.05	mg/L	7/24/2012 22:24	PNM	EPA 200.7	
Boron, Total	0.27	0.05	mg/L	7/20/2012 20:40	PNM	EPA 200.7	
Barium, Dissolved	0.013	0.005	mg/L	7/24/2012 22:24	PNM	EPA 200.7	
Calcium, Dissolved	318	0.2	mg/L	7/24/2012 22:24	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	7/24/2012 22:24	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	7/24/2012 22:24	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	7/24/2012 22:24	PNM	EPA 200.7	
Iron, Dissolved	0.78	0.02	mg/L	7/24/2012 22:24	PNM	EPA 200.7	
Iron, Total	8.21	0.02	mg/L	7/24/2012 15:48	PNM	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1206198-03

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	7/10/2012 4:00 PM
Sample Site:	Y-70			***Receipt Date:***	7/12/2012 3:00 PM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	204
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Lead, Dissolved	ND	0.02	mg/L	7/24/2012 22:24	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	7/20/2012 20:40	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	7/13/2012 16:30	AKL	EPA 245.1	
Magnesium, Dissolved	228	0.2	mg/L	7/24/2012 22:24	PNM	EPA 200.7	
Manganese, Dissolved	0.685	0.005	mg/L	7/24/2012 22:24	PNM	EPA 200.7	
Manganese, Total	0.714	0.005	mg/L	7/20/2012 20:40	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	7/24/2012 22:24	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	7/24/2012 22:24	PNM	EPA 200.7	
Potassium, Dissolved	10.2	0.5	mg/L	7/24/2012 22:24	PNM	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	7/24/2012 22:24	PNM	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	7/20/2012 20:40	PNM	EPA 200.7	
Sodium, Dissolved	277	0.5	mg/L	7/24/2012 22:24	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	7/24/2012 22:24	PNM	EPA 200.7	

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LABORATORIES

Certificate of Analysis

Lab Sample No.: 1211146-01

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 11/27/2012 3:45 PM
Sample Site:	Y-70		**Receipt Date:** 12/3/2012 9:30 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 225
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	46.2	0.01	meq/L	12/14/2012 16:00	DWG	SM 1030 E	
Cation/Anion Balance	0.3		%	12/14/2012 16:00	DWG	SM 1030 E	
Cations, Total	46.5	0.01	meq/L	12/14/2012 16:00	DWG	SM 1030 E	
Hardness, Total as CaCO3	1700	1	mg/L	12/14/2012 16:00	DWG	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	12/11/2012 10:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	735	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - CO2	552	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	603	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Ammonia as N	1.5	0.2	mg/L	12/9/2012 14:00	TSM	SM 4500 NH3-D	
Chloride	53	2	mg/L	12/3/2012 17:00	TSM	EPA 300.0	
Fluoride	0.6	0.2	mg/L	12/3/2012 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	12/7/2012 14:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.07	0.01	mg/L	12/5/2012 8:00	TSM	SM 4500 PB5E	
Sulfate	1570	20	mg/L	12/3/2012 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	3220	20	mg/L	12/4/2012 13:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	42	20	mg/L	12/4/2012 15:00	RMC	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	12/11/2012 19:04	PNM	EPA 200.7	
Aluminum, Total	0.1	0.05	mg/L	12/5/2012 18:45	PNM	EPA 200.7	
Arsenic, Dissolved	0.05	0.05	mg/L	12/11/2012 19:04	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	12/5/2012 18:45	PNM	EPA 200.7	
Boron, Dissolved	0.26	0.05	mg/L	12/11/2012 19:04	PNM	EPA 200.7	
Boron, Total	0.24	0.05	mg/L	12/5/2012 18:45	PNM	EPA 200.7	
Barium, Dissolved	0.016	0.005	mg/L	12/11/2012 19:04	PNM	EPA 200.7	
Calcium, Dissolved	307	0.2	mg/L	12/11/2012 19:04	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	12/11/2012 19:04	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	12/11/2012 19:04	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	12/11/2012 19:04	PNM	EPA 200.7	
Iron, Dissolved	7.27	0.02	mg/L	12/11/2012 19:04	PNM	EPA 200.7	
Iron, Total	7.62	0.02	mg/L	12/5/2012 18:45	PNM	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1211146-01

Name:	**Alton Coal Development, LLC**	***Mine Code:*** 41	***Sample Date:*** 11/27/2012 3:45 PM
Sample Site:	Y-70		***Receipt Date:*** 12/3/2012 9:30 AM
Comments:			***Sampler:*** Erik Petersen
Sample Type:	Water		***Site No.:*** 225
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Lead, Dissolved	ND	0.02	mg/L	12/11/2012 19:04	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	12/5/2012 18:45	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	12/5/2012 14:20	AKL	EPA 245.1	
Magnesium, Dissolved	226	0.2	mg/L	12/11/2012 19:04	PNM	EPA 200.7	
Manganese, Dissolved	0.633	0.005	mg/L	12/11/2012 19:04	PNM	EPA 200.7	
Manganese, Total	0.584	0.005	mg/L	12/5/2012 18:45	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	12/11/2012 19:04	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	12/11/2012 19:04	PNM	EPA 200.7	
Potassium, Dissolved	9.6	0.5	mg/L	12/11/2012 19:04	PNM	EPA 200.7	
Selenium, Dissolved	0.04	0.02	mg/L	12/11/2012 19:04	PNM	EPA 200.7	
Selenium, Total	0.02	0.02	mg/L	12/5/2012 18:45	PNM	EPA 200.7	
Sodium, Dissolved	274	0.5	mg/L	12/11/2012 19:04	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	12/11/2012 19:04	PNM	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1211146-03

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 11/28/2012 10:30 AM
Sample Site:	NLP-1		**Receipt Date:** 12/3/2012 9:30 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 229
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	43.5	0.01	meq/L	12/14/2012 16:00	DWG	SM 1030 E	
Cation/Anion Balance	-0.5		%	12/14/2012 16:00	DWG	SM 1030 E	
Cations, Total	43.1	0.01	meq/L	12/14/2012 16:00	DWG	SM 1030 E	
Hardness, Total as CaCO3	2030	1	mg/L	12/14/2012 16:00	DWG	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	12/11/2012 10:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	745	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - CO2	559	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	611	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Ammonia as N	0.5	0.2	mg/L	12/9/2012 14:00	TSM	SM 4500 NH3-D	
Chloride	34	2	mg/L	12/6/2012 10:30	TSM	EPA 300.0	
Fluoride	0.3	0.2	mg/L	12/6/2012 10:30	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	12/7/2012 14:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.05	0.01	mg/L	12/5/2012 8:00	TSM	SM 4500 PB5E	
Sulfate	1460	10	mg/L	12/3/2012 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	3020	20	mg/L	12/4/2012 13:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	104	20	mg/L	12/4/2012 14:00	RMC	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	12/11/2012 19:16	PNM	EPA 200.7	
Aluminum, Total	0.4	0.05	mg/L	12/5/2012 18:57	PNM	EPA 200.7	
Arsenic, Dissolved	0.05	0.05	mg/L	12/11/2012 19:16	PNM	EPA 200.7	
Arsenic, Total	0.06	0.05	mg/L	12/5/2012 18:57	PNM	EPA 200.7	
Boron, Dissolved	0.05	0.05	mg/L	12/11/2012 19:16	PNM	EPA 200.7	
Boron, Total	0.07	0.05	mg/L	12/5/2012 18:57	PNM	EPA 200.7	
Barium, Dissolved	0.020	0.005	mg/L	12/11/2012 19:16	PNM	EPA 200.7	
Calcium, Dissolved	292	0.2	mg/L	12/11/2012 19:16	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	12/11/2012 19:16	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	12/11/2012 19:16	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	12/11/2012 19:16	PNM	EPA 200.7	
Iron, Dissolved	6.98	0.02	mg/L	12/11/2012 19:16	PNM	EPA 200.7	
Iron, Total	12.9	0.02	mg/L	12/5/2012 18:57	PNM	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1211146-03

Name:	**Alton Coal Development, LLC**	***Mine Code:*** 41	***Sample Date:*** 11/28/2012 10:30 AM
Sample Site:	NLP-1		***Receipt Date:*** 12/3/2012 9:30 AM
Comments:			***Sampler:*** Erik Petersen
Sample Type:	Water		***Site No.:*** 229
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Lead, Dissolved	ND	0.02	mg/L	12/11/2012 19:16	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	12/5/2012 18:57	PNM	EPA 200.7	
Mercury, Dissolved	0.0002	0.0002	mg/L	12/5/2012 14:20	AKL	EPA 245.1	
Magnesium, Dissolved	316	0.2	mg/L	12/11/2012 19:16	PNM	EPA 200.7	
Manganese, Dissolved	0.081	0.005	mg/L	12/11/2012 19:16	PNM	EPA 200.7	
Manganese, Total	0.121	0.005	mg/L	12/5/2012 18:57	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	12/11/2012 19:16	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	12/11/2012 19:16	PNM	EPA 200.7	
Potassium, Dissolved	5.1	0.5	mg/L	12/11/2012 19:16	PNM	EPA 200.7	
Selenium, Dissolved	0.03	0.02	mg/L	12/11/2012 19:16	PNM	EPA 200.7	
Selenium, Total	0.04	0.02	mg/L	12/5/2012 18:57	PNM	EPA 200.7	
Sodium, Dissolved	46.2	0.5	mg/L	12/11/2012 19:16	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	12/11/2012 19:16	PNM	EPA 200.7	

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CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1211146-04

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 11/28/2012 10:00 AM
Sample Site:	Coyote Seep		**Receipt Date:** 12/3/2012 9:30 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 205
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	39.2	0.01	meq/L	12/14/2012 16:00	DWG	SM 1030 E	
Cation/Anion Balance	2.8		%	12/14/2012 16:00	DWG	SM 1030 E	
Cations, Total	41.4	0.01	meq/L	12/14/2012 16:00	DWG	SM 1030 E	
Hardness, Total as CaCO3	1970	1	mg/L	12/14/2012 16:00	DWG	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	12/11/2012 10:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	841	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - CO2	623	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	690	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	12/9/2012 14:00	TSM	SM 4500 NH3-D	
Chloride	24	1	mg/L	12/3/2012 17:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	12/3/2012 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	12/7/2012 14:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.02	0.01	mg/L	12/5/2012 8:00	TSM	SM 4500 PB5E	
Sulfate	1190	10	mg/L	12/3/2012 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	2640	20	mg/L	12/4/2012 13:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	7	4	mg/L	12/4/2012 14:00	RMC	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	12/11/2012 19:20	PNM	EPA 200.7	
Aluminum, Total	ND	0.05	mg/L	12/5/2012 14:27	PNM	EPA 200.7	
Arsenic, Dissolved	0.05	0.05	mg/L	12/11/2012 19:20	PNM	EPA 200.7	
Arsenic, Total	0.05	0.05	mg/L	12/5/2012 14:27	PNM	EPA 200.7	
Boron, Dissolved	0.07	0.05	mg/L	12/11/2012 19:20	PNM	EPA 200.7	
Boron, Total	0.06	0.05	mg/L	12/5/2012 14:27	PNM	EPA 200.7	
Barium, Dissolved	0.030	0.005	mg/L	12/11/2012 19:20	PNM	EPA 200.7	
Calcium, Dissolved	279	0.2	mg/L	12/11/2012 19:20	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	12/11/2012 19:20	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	12/11/2012 19:20	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	12/11/2012 19:20	PNM	EPA 200.7	
Iron, Dissolved	0.24	0.02	mg/L	12/11/2012 19:20	PNM	EPA 200.7	
Iron, Total	0.35	0.02	mg/L	12/5/2012 14:27	PNM	EPA 200.7	

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LABORATORIES

Certificate of Analysis

Lab Sample No.: 1211146-04

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	11/28/2012 10:00 AM
Sample Site:	Coyote Seep			***Receipt Date:***	12/3/2012 9:30 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	205
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Lead, Dissolved	ND	0.02	mg/L	12/11/2012 19:20	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	12/5/2012 14:27	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	12/5/2012 14:20	AKL	EPA 245.1	
Magnesium, Dissolved	309	0.2	mg/L	12/11/2012 19:20	PNM	EPA 200.7	
Manganese, Dissolved	0.098	0.005	mg/L	12/11/2012 19:20	PNM	EPA 200.7	
Manganese, Total	0.090	0.005	mg/L	12/5/2012 14:27	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	12/11/2012 19:20	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	12/11/2012 19:20	PNM	EPA 200.7	
Potassium, Dissolved	7.7	0.5	mg/L	12/11/2012 19:20	PNM	EPA 200.7	
Selenium, Dissolved	0.08	0.02	mg/L	12/11/2012 19:20	PNM	EPA 200.7	
Selenium, Total	0.02	0.02	mg/L	12/5/2012 14:27	PNM	EPA 200.7	
Sodium, Dissolved	43.2	0.5	mg/L	12/11/2012 19:20	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	12/11/2012 19:20	PNM	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1211146-05

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 11/28/2012 1:00 PM
Sample Site:	NLP-2		**Receipt Date:** 12/3/2012 9:30 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 230
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	51.6	0.01	meq/L	12/14/2012 16:00	DWG	SM 1030 E	
Cation/Anion Balance	1.1		%	12/14/2012 16:00	DWG	SM 1030 E	
Cations, Total	52.8	0.01	meq/L	12/14/2012 16:00	DWG	SM 1030 E	
Hardness, Total as CaCO3	2120	1	mg/L	12/14/2012 16:00	DWG	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	12/11/2012 10:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	724	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - CO2	539	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	594	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Ammonia as N	1.2	0.2	mg/L	12/9/2012 14:00	TSM	SM 4500 NH3-D	
Chloride	134	2	mg/L	12/7/2012 13:00	TSM	EPA 300.0	
Fluoride	0.4	0.2	mg/L	12/7/2012 13:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	12/7/2012 14:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.05	0.01	mg/L	12/5/2012 8:00	TSM	SM 4500 PB5E	
Sulfate	1730	10	mg/L	12/3/2012 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	3610	20	mg/L	12/4/2012 13:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	216	20	mg/L	12/4/2012 14:00	RMC	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	12/11/2012 19:24	PNM	EPA 200.7	
Aluminum, Total	0.2	0.05	mg/L	12/5/2012 19:09	PNM	EPA 200.7	
Arsenic, Dissolved	0.05	0.05	mg/L	12/11/2012 19:24	PNM	EPA 200.7	
Arsenic, Total	0.05	0.05	mg/L	12/5/2012 19:09	PNM	EPA 200.7	
Boron, Dissolved	0.14	0.05	mg/L	12/11/2012 19:24	PNM	EPA 200.7	
Boron, Total	0.16	0.05	mg/L	12/5/2012 19:09	PNM	EPA 200.7	
Barium, Dissolved	0.028	0.005	mg/L	12/11/2012 19:24	PNM	EPA 200.7	
Calcium, Dissolved	249	0.2	mg/L	12/11/2012 19:24	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	12/11/2012 19:24	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	12/11/2012 19:24	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	12/11/2012 19:24	PNM	EPA 200.7	
Iron, Dissolved	7.47	0.02	mg/L	12/11/2012 19:24	PNM	EPA 200.7	
Iron, Total	9.78	0.02	mg/L	12/5/2012 19:09	PNM	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1211146-05

Name:	**Alton Coal Development, LLC**	***Mine Code:*** 41	***Sample Date:*** 11/28/2012 1:00 PM
Sample Site:	NLP-2		***Receipt Date:*** 12/3/2012 9:30 AM
Comments:			***Sampler:*** Erik Petersen
Sample Type:	Water		***Site No.:*** 230
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Lead, Dissolved	ND	0.02	mg/L	12/11/2012 19:24	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	12/5/2012 19:09	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	12/5/2012 14:20	AKL	EPA 245.1	
Magnesium, Dissolved	364	0.2	mg/L	12/11/2012 19:24	PNM	EPA 200.7	
Manganese, Dissolved	0.050	0.005	mg/L	12/11/2012 19:24	PNM	EPA 200.7	
Manganese, Total	0.059	0.005	mg/L	12/5/2012 19:09	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	12/11/2012 19:24	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	12/11/2012 19:24	PNM	EPA 200.7	
Potassium, Dissolved	6.1	0.5	mg/L	12/11/2012 19:24	PNM	EPA 200.7	
Selenium, Dissolved	0.03	0.02	mg/L	12/11/2012 19:24	PNM	EPA 200.7	
Selenium, Total	ND	0.02	mg/L	12/5/2012 19:09	PNM	EPA 200.7	
Sodium, Dissolved	227	0.5	mg/L	12/11/2012 19:24	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	12/11/2012 19:24	PNM	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1211146-06

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 11/28/2012 6:00 PM
Sample Site:	Y-103		**Receipt Date:** 12/3/2012 9:30 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 204
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	55.3	0.01	meq/L	12/14/2012 16:00	DWG	SM 1030 E	
Cation/Anion Balance	-2.2		%	12/14/2012 16:00	DWG	SM 1030 E	
Cations, Total	53.0	0.01	meq/L	12/14/2012 16:00	DWG	SM 1030 E	
Hardness, Total as CaCO3	2580	1	mg/L	12/14/2012 16:00	DWG	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	12/11/2012 10:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	939	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - CO2	732	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	770	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Ammonia as N	0.4	0.2	mg/L	12/9/2012 14:00	TSM	SM 4500 NH3-D	
Chloride	8	2	mg/L	12/3/2012 17:00	TSM	EPA 300.0	
Fluoride	0.3	0.2	mg/L	12/3/2012 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	0.1	0.1	mg/L	12/7/2012 14:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.29	0.05	mg/L	12/5/2012 8:00	TSM	SM 4500 PB5E	
Sulfate	1910	20	mg/L	12/3/2012 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	3630	20	mg/L	12/4/2012 13:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	1040	33	mg/L	12/4/2012 14:00	RMC	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	12/11/2012 19:28	PNM	EPA 200.7	
Aluminum, Total	2.1	0.05	mg/L	12/5/2012 19:13	PNM	EPA 200.7	
Arsenic, Dissolved	0.05	0.05	mg/L	12/11/2012 19:28	PNM	EPA 200.7	
Arsenic, Total	0.07	0.05	mg/L	12/5/2012 19:13	PNM	EPA 200.7	
Boron, Dissolved	0.10	0.05	mg/L	12/11/2012 19:28	PNM	EPA 200.7	
Boron, Total	0.12	0.05	mg/L	12/5/2012 19:13	PNM	EPA 200.7	
Barium, Dissolved	0.012	0.005	mg/L	12/11/2012 19:28	PNM	EPA 200.7	
Calcium, Dissolved	328	0.2	mg/L	12/11/2012 19:28	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	12/11/2012 19:28	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	12/11/2012 19:28	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	12/11/2012 19:28	PNM	EPA 200.7	
Iron, Dissolved	0.25	0.02	mg/L	12/11/2012 19:28	PNM	EPA 200.7	
Iron, Total	20.3	0.02	mg/L	12/5/2012 19:13	PNM	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1211146-06

Name:	**Alton Coal Development, LLC**	***Mine Code:*** 41	***Sample Date:*** 11/28/2012 6:00 PM
Sample Site:	Y-103		***Receipt Date:*** 12/3/2012 9:30 AM
Comments:			***Sampler:*** Erik Petersen
Sample Type:	Water		***Site No.:*** 204
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Lead, Dissolved	0.02	0.02	mg/L	12/11/2012 19:28	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	12/5/2012 19:13	PNM	EPA 200.7	
Mercury, Dissolved	0.0002	0.0002	mg/L	12/5/2012 14:20	AKL	EPA 245.1	
Magnesium, Dissolved	427	0.2	mg/L	12/11/2012 19:28	PNM	EPA 200.7	
Manganese, Dissolved	0.085	0.005	mg/L	12/11/2012 19:28	PNM	EPA 200.7	
Manganese, Total	0.217	0.005	mg/L	12/5/2012 19:13	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	12/11/2012 19:28	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	12/11/2012 19:28	PNM	EPA 200.7	
Potassium, Dissolved	15.7	0.5	mg/L	12/11/2012 19:28	PNM	EPA 200.7	
Selenium, Dissolved	0.04	0.02	mg/L	12/11/2012 19:28	PNM	EPA 200.7	
Selenium, Total	ND	0.02	mg/L	12/5/2012 19:13	PNM	EPA 200.7	
Sodium, Dissolved	24.1	0.5	mg/L	12/11/2012 19:28	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	12/11/2012 19:28	PNM	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1211146-07

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 11/29/2012 10:30 AM
Sample Site:	SP7-1		**Receipt Date:** 12/3/2012 9:30 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 307
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	18.7	0.01	meq/L	12/17/2012 16:11	DWG	SM 1030 E	
Cation/Anion Balance	-46		%	12/17/2012 16:11	DWG	SM 1030 E	A-01
Cations, Total	6.9	0.01	meq/L	12/17/2012 16:11	DWG	SM 1030 E	
Hardness, Total as CaCO3	334	1	mg/L	12/17/2012 16:11	DWG	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	12/11/2012 10:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	586	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - CO2	443	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	481	2.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	A-01
Ammonia as N	ND	0.2	mg/L	12/9/2012 14:00	TSM	SM 4500 NH3-D	
Chloride	11	1	mg/L	12/3/2012 17:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	12/3/2012 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	12/7/2012 14:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.04	0.01	mg/L	12/5/2012 8:00	TSM	SM 4500 PB5E	
Sulfate	422	5	mg/L	12/3/2012 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1070	10	mg/L	12/6/2012 10:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	38	20	mg/L	12/6/2012 15:00	RMC	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	12/11/2012 19:32	PNM	EPA 200.7	
Aluminum, Total	0.1	0.05	mg/L	12/5/2012 19:17	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	12/11/2012 19:32	PNM	EPA 200.7	
Arsenic, Total	0.05	0.05	mg/L	12/5/2012 19:17	PNM	EPA 200.7	
Boron, Dissolved	ND	0.05	mg/L	12/11/2012 19:32	PNM	EPA 200.7	
Boron, Total	0.07	0.05	mg/L	12/5/2012 19:17	PNM	EPA 200.7	
Barium, Dissolved	0.215	0.005	mg/L	12/11/2012 19:32	PNM	EPA 200.7	
Calcium, Dissolved	56.4	0.2	mg/L	12/11/2012 19:32	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	12/11/2012 19:32	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	12/11/2012 19:32	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	12/11/2012 19:32	PNM	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	12/11/2012 19:32	PNM	EPA 200.7	
Iron, Total	7.22	0.02	mg/L	12/5/2012 19:17	PNM	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1211146-07

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	11/29/2012 10:30 AM
Sample Site:	SP7-1			***Receipt Date:***	12/3/2012 9:30 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	307
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Lead, Dissolved	ND	0.02	mg/L	12/11/2012 19:32	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	12/5/2012 19:17	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	12/5/2012 14:20	AKL	EPA 245.1	
Magnesium, Dissolved	46.8	0.2	mg/L	12/11/2012 19:32	PNM	EPA 200.7	
Manganese, Dissolved	0.006	0.005	mg/L	12/11/2012 19:32	PNM	EPA 200.7	
Manganese, Total	0.185	0.005	mg/L	12/5/2012 19:17	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	12/11/2012 19:32	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	12/11/2012 19:32	PNM	EPA 200.7	
Potassium, Dissolved	1.5	0.5	mg/L	12/11/2012 19:32	PNM	EPA 200.7	
Selenium, Dissolved	ND	0.02	mg/L	12/11/2012 19:32	PNM	EPA 200.7	
Selenium, Total	0.02	0.02	mg/L	12/5/2012 19:17	PNM	EPA 200.7	
Sodium, Dissolved	4.7	0.5	mg/L	12/11/2012 19:32	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	12/11/2012 19:32	PNM	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1211146-08

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 11/29/2012 11:00 AM
Sample Site:	SW-1A		**Receipt Date:** 12/3/2012 9:30 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 201
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	7.5	0.01	meq/L	12/14/2012 16:00	DWG	SM 1030 E	
Cation/Anion Balance	-1.5		%	12/14/2012 16:00	DWG	SM 1030 E	
Cations, Total	7.3	0.01	meq/L	12/14/2012 16:00	DWG	SM 1030 E	
Hardness, Total as CaCO3	353	1	mg/L	12/14/2012 16:00	DWG	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	12/11/2012 10:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	372	1.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - CO2	270	1.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	305	1.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	12/9/2012 14:00	TSM	SM 4500 NH3-D	
Chloride	3	1	mg/L	12/3/2012 17:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	12/3/2012 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	12/7/2012 14:00	KSL	SM 4500 NO3-F	
Oil & Grease (HEM)	ND	5	mg/L	12/11/2012 10:30	KSL	EPA 1664A	
Phosphorus, Total as P	ND	0.01	mg/L	12/5/2012 8:00	TSM	SM 4500 PB5E	
Sulfate	65	1	mg/L	12/3/2012 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	412	10	mg/L	12/6/2012 10:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	9	7	mg/L	12/6/2012 15:00	RMC	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	12/11/2012 19:35	PNM	EPA 200.7	
Aluminum, Total	0.07	0.05	mg/L	12/5/2012 19:21	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	12/11/2012 19:35	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	12/5/2012 19:21	PNM	EPA 200.7	
Boron, Dissolved	ND	0.05	mg/L	12/11/2012 19:35	PNM	EPA 200.7	
Boron, Total	ND	0.05	mg/L	12/5/2012 19:21	PNM	EPA 200.7	
Barium, Dissolved	0.227	0.005	mg/L	12/11/2012 19:35	PNM	EPA 200.7	
Calcium, Dissolved	58.5	0.2	mg/L	12/11/2012 19:35	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	12/11/2012 19:35	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	12/11/2012 19:35	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	12/11/2012 19:35	PNM	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	12/11/2012 19:35	PNM	EPA 200.7	

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LABORATORIES

Certificate of Analysis

Lab Sample No.: 1211146-08

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	11/29/2012 11:00 AM
Sample Site:	SW-1A			***Receipt Date:***	12/3/2012 9:30 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	201
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	0.15	0.02	mg/L	12/5/2012 19:21	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	12/11/2012 19:35	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	12/5/2012 19:21	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	12/5/2012 14:20	AKL	EPA 245.1	
Magnesium, Dissolved	50.3	0.2	mg/L	12/11/2012 19:35	PNM	EPA 200.7	
Manganese, Dissolved	0.005	0.005	mg/L	12/11/2012 19:35	PNM	EPA 200.7	
Manganese, Total	0.009	0.005	mg/L	12/5/2012 19:21	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	12/11/2012 19:35	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	12/11/2012 19:35	PNM	EPA 200.7	
Potassium, Dissolved	1.6	0.5	mg/L	12/11/2012 19:35	PNM	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	12/11/2012 19:35	PNM	EPA 200.7	
Selenium, Total	ND	0.02	mg/L	12/5/2012 19:21	PNM	EPA 200.7	
Sodium, Dissolved	5.0	0.5	mg/L	12/11/2012 19:35	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	12/11/2012 19:35	PNM	EPA 200.7	

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CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1211146-09

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 11/29/2012 3:00 PM
Sample Site:	Kanab Creek at County Road		**Receipt Date:** 12/3/2012 9:30 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 202
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	8.1	0.01	meq/L	12/14/2012 16:00	DWG	SM 1030 E	
Cation/Anion Balance	-3.7		%	12/14/2012 16:00	DWG	SM 1030 E	
Cations, Total	7.5	0.01	meq/L	12/14/2012 16:00	DWG	SM 1030 E	
Hardness, Total as CaCO3	360	1	mg/L	12/14/2012 16:00	DWG	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	12/11/2012 10:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	367	1.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - CO2	266	1.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	301	1.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	12/9/2012 14:00	TSM	SM 4500 NH3-D	
Chloride	4	1	mg/L	12/3/2012 17:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	12/3/2012 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	12/7/2012 14:00	KSL	SM 4500 NO3-F	
Oil & Grease (HEM)	ND	6	mg/L	12/11/2012 10:30	KSL	EPA 1664A	
Phosphorus, Total as P	ND	0.01	mg/L	12/5/2012 8:00	TSM	SM 4500 PB5E	
Sulfate	95	1	mg/L	12/3/2012 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	400	10	mg/L	12/6/2012 10:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	ND	4	mg/L	12/6/2012 15:00	RMC	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	12/11/2012 21:13	PNM	EPA 200.7	
Aluminum, Total	ND	0.05	mg/L	12/11/2012 21:13	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	12/11/2012 19:39	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	12/11/2012 21:13	PNM	EPA 200.7	
Boron, Dissolved	ND	0.05	mg/L	12/11/2012 19:39	PNM	EPA 200.7	
Boron, Total	0.05	0.05	mg/L	12/11/2012 21:13	PNM	EPA 200.7	
Barium, Dissolved	0.192	0.005	mg/L	12/11/2012 19:39	PNM	EPA 200.7	
Calcium, Dissolved	56.9	0.2	mg/L	12/11/2012 19:39	PNM	EPA 200.7	QM-010, QM-4X
Cadmium, Dissolved	ND	0.005	mg/L	12/11/2012 19:39	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	12/11/2012 19:39	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	12/11/2012 19:39	PNM	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1211146-09

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	11/29/2012 3:00 PM
Sample Site:	Kanab Creek at County Road			***Receipt Date:***	12/3/2012 9:30 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	202
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Dissolved	ND	0.02	mg/L	12/11/2012 19:39	PNM	EPA 200.7	
Iron, Total	0.06	0.02	mg/L	12/11/2012 21:13	PNM	EPA 200.7	
Lead, Dissolved	0.02	0.02	mg/L	12/11/2012 19:39	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	12/11/2012 21:13	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	12/5/2012 14:20	AKL	EPA 245.1	
Magnesium, Dissolved	53.0	0.2	mg/L	12/11/2012 19:39	PNM	EPA 200.7	QM-010, QM-4X
Manganese, Dissolved	ND	0.005	mg/L	12/11/2012 19:39	PNM	EPA 200.7	
Manganese, Total	0.007	0.005	mg/L	12/11/2012 21:13	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	12/11/2012 19:39	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	12/11/2012 19:39	PNM	EPA 200.7	
Potassium, Dissolved	1.7	0.5	mg/L	12/11/2012 19:39	PNM	EPA 200.7	
Selenium, Dissolved	ND	0.02	mg/L	12/11/2012 19:39	PNM	EPA 200.7	
Selenium, Total	ND	0.02	mg/L	12/11/2012 21:13	PNM	EPA 200.7	
Sodium, Dissolved	6.3	0.5	mg/L	12/11/2012 19:39	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	12/11/2012 19:39	PNM	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1211146-10

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 11/29/2012 3:30 PM
Sample Site:	SW-11		**Receipt Date:** 12/3/2012 9:30 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 214
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	33.4	0.01	meq/L	12/14/2012 16:00	DWG	SM 1030 E	
Cation/Anion Balance	2.0		%	12/14/2012 16:00	DWG	SM 1030 E	
Cations, Total	34.7	0.01	meq/L	12/14/2012 16:00	DWG	SM 1030 E	
Hardness, Total as CaCO3	1600	1	mg/L	12/14/2012 16:00	DWG	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	12/11/2012 10:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	491	1.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - CO2	356	1.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	403	1.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	12/9/2012 14:00	TSM	SM 4500 NH3-D	
Chloride	29	1	mg/L	12/3/2012 17:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	12/3/2012 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	12/7/2012 14:00	KSL	SM 4500 NO3-F	
Oil & Grease (HEM)	ND	5	mg/L	12/11/2012 10:30	KSL	EPA 1664A	
Phosphorus, Total as P	0.02	0.01	mg/L	12/5/2012 8:00	TSM	SM 4500 PB5E	
Sulfate	1180	10	mg/L	12/3/2012 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	2200	10	mg/L	12/6/2012 10:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	15	7	mg/L	12/6/2012 15:00	RMC	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	12/11/2012 19:51	PNM	EPA 200.7	
Aluminum, Total	0.1	0.05	mg/L	12/5/2012 19:25	PNM	EPA 200.7	
Arsenic, Dissolved	0.05	0.05	mg/L	12/11/2012 19:51	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	12/5/2012 19:25	PNM	EPA 200.7	
Boron, Dissolved	0.07	0.05	mg/L	12/11/2012 19:51	PNM	EPA 200.7	
Boron, Total	0.07	0.05	mg/L	12/5/2012 19:25	PNM	EPA 200.7	
Barium, Dissolved	0.026	0.005	mg/L	12/11/2012 19:51	PNM	EPA 200.7	
Calcium, Dissolved	150	0.2	mg/L	12/11/2012 19:51	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	12/11/2012 19:51	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	12/11/2012 19:51	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	12/11/2012 19:51	PNM	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	12/11/2012 19:51	PNM	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1211146-10

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	11/29/2012 3:30 PM
Sample Site:	SW-11			***Receipt Date:***	12/3/2012 9:30 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	214
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	0.16	0.02	mg/L	12/5/2012 19:25	PNM	EPA 200.7	
Lead, Dissolved	0.02	0.02	mg/L	12/11/2012 19:51	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	12/5/2012 19:25	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	12/5/2012 14:20	AKL	EPA 245.1	
Magnesium, Dissolved	298	0.2	mg/L	12/11/2012 19:51	PNM	EPA 200.7	
Manganese, Dissolved	ND	0.005	mg/L	12/11/2012 19:51	PNM	EPA 200.7	
Manganese, Total	0.005	0.005	mg/L	12/5/2012 19:25	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	12/11/2012 19:51	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	12/11/2012 19:51	PNM	EPA 200.7	
Potassium, Dissolved	6.5	0.5	mg/L	12/11/2012 19:51	PNM	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	12/11/2012 19:51	PNM	EPA 200.7	
Selenium, Total	ND	0.02	mg/L	12/5/2012 19:25	PNM	EPA 200.7	
Sodium, Dissolved	59.0	0.5	mg/L	12/11/2012 19:51	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	12/11/2012 19:51	PNM	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1211146-11

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 11/29/2012 6:00 PM
Sample Site:	SW-3		**Receipt Date:** 12/3/2012 9:30 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 30
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	8.1	0.01	meq/L	12/14/2012 16:00	DWG	SM 1030 E	
Cation/Anion Balance	2.0		%	12/14/2012 16:00	DWG	SM 1030 E	
Cations, Total	8.4	0.01	meq/L	12/14/2012 16:00	DWG	SM 1030 E	
Inorganic							
Alkalinity - Bicarbonate (HCO3)	361	1.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - CO2	261	1.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	296	1.0	mg/L	12/7/2012 20:00	TSM	SM 2320 B	
Chloride	4	1	mg/L	12/7/2012 13:00	TSM	EPA 300.0	
Oil & Grease (HEM)	ND	5	mg/L	12/11/2012 10:30	KSL	EPA 1664A	
Sulfate	100	1	mg/L	12/7/2012 13:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	452	10	mg/L	12/6/2012 10:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	ND	4	mg/L	12/6/2012 15:00	RMC	SM 2540 D	
Metals							
Boron, Dissolved	ND	0.05	mg/L	12/11/2012 20:03	PNM	EPA 200.7	
Boron, Total	ND	0.05	mg/L	12/11/2012 21:16	PNM	EPA 200.7	
Calcium, Dissolved	63.2	0.2	mg/L	12/11/2012 20:03	PNM	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	12/11/2012 20:03	PNM	EPA 200.7	
Iron, Total	0.07	0.02	mg/L	12/11/2012 21:16	PNM	EPA 200.7	
Magnesium, Dissolved	59.8	0.2	mg/L	12/11/2012 20:03	PNM	EPA 200.7	
Manganese, Dissolved	0.005	0.005	mg/L	12/11/2012 20:03	PNM	EPA 200.7	
Manganese, Total	0.006	0.005	mg/L	12/11/2012 21:16	PNM	EPA 200.7	
Potassium, Dissolved	2.0	0.5	mg/L	12/11/2012 20:03	PNM	EPA 200.7	
Selenium, Dissolved	ND	0.02	mg/L	12/11/2012 20:03	PNM	EPA 200.7	
Selenium, Total	ND	0.02	mg/L	12/11/2012 21:16	PNM	EPA 200.7	
Sodium, Dissolved	7.2	0.5	mg/L	12/11/2012 20:03	PNM	EPA 200.7	

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Abbreviations

ND = Not detected at the corresponding Minimum Reporting Limit.
1 mg/L = one milligram per liter or 1 mg/Kg = one milligram per kilogram = 1 part per million.
1 ug/L = one microgram per liter or 1 ug/Kg = one microgram per kilogram = 1 part per billion.
1 ng/L = one nanogram per liter or 1 ng/Kg = one nanogram per kilogram = 1 part per trillion.

Flag Descriptions

QM-4X = The spike recovery was outside of QC acceptance limits for the MS and/or MSD due to analyte concentration at 4 times or greater the spike concentration. The QC batch was accepted based on LCS and/or LCSD recoveries within the acceptance limits.

QM-010 = The MS recovery was outside acceptance limits but passed Duplicate Spike acceptance Limits. The batch was accepted based on the acceptability of the MSD as the batch Spike.

A-01 = This sample exhibited some interference for alkalinity, but the exact source is unknown. The net effect was an inflation of the alkalinity result, which also skewed the cation/anion balance high.

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Certificate of Analysis

Lab Sample No.: 1301610-03

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 2/26/2013 6:50 PM
Sample Site:	SW-11		**Receipt Date:** 3/1/2013 11:06 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 214
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	39.5	0.01	meq/L	3/18/2013 8:00	PNM	SM 1030 E	
Cation/Anion Balance	0.3		%	3/18/2013 8:00	PNM	SM 1030 E	
Cations, Total	39.8	0.01	meq/L	3/18/2013 8:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	1830	1	mg/L	3/18/2013 8:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	3/13/2013 17:00	RMC	SM 2310 B	APH
Alkalinity - Bicarbonate (HCO3)	614	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - CO2	445	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Total (as CaCO3)	504	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	3/5/2013 12:00	TSM	SM 4500 NH3-D	
Chloride	35	1	mg/L	3/2/2013 8:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	3/2/2013 8:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	3/21/2013 14:00	KSL	SM 4500 NO3-F	
Oil & Grease (HEM)	ND	6	mg/L	3/7/2013 9:00	SPH	EPA 1664A	
Phosphorus, Total as P	0.02	0.01	mg/L	3/5/2013 9:00	TSM	SM 4500 PB5E	
Sulfate	1370	10	mg/L	3/2/2013 8:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	2530	20	mg/L	3/4/2013 12:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	6	4	mg/L	3/1/2013 16:30	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	3/5/2013 12:57	PNM	EPA 200.7	
Aluminum, Total	ND	0.05	mg/L	3/8/2013 20:42	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	3/5/2013 12:57	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	3/8/2013 20:42	PNM	EPA 200.7	
Boron, Dissolved	0.08	0.05	mg/L	3/5/2013 12:57	PNM	EPA 200.7	
Boron, Total	0.07	0.05	mg/L	3/8/2013 20:42	PNM	EPA 200.7	
Barium, Dissolved	0.027	0.005	mg/L	3/5/2013 12:57	PNM	EPA 200.7	
Calcium, Dissolved	182	0.2	mg/L	3/5/2013 12:57	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	3/5/2013 12:57	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	3/5/2013 12:57	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	3/5/2013 12:57	PNM	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	3/5/2013 12:57	PNM	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1301610-03

Name:	**Alton Coal Development, LLC**	***Mine Code:*** 41	***Sample Date:*** 2/26/2013 6:50 PM
Sample Site:	SW-11		***Receipt Date:*** 3/1/2013 11:06 AM
Comments:			***Sampler:*** Erik Petersen
Sample Type:	Water		***Site No.:*** 214
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	0.06	0.02	mg/L	3/8/2013 20:42	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	3/5/2013 12:57	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	3/8/2013 20:42	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	3/5/2013 9:45	AKL	EPA 245.1	
Magnesium, Dissolved	335	0.2	mg/L	3/5/2013 12:57	PNM	EPA 200.7	
Manganese, Dissolved	ND	0.005	mg/L	3/5/2013 12:57	PNM	EPA 200.7	
Manganese, Total	0.011	0.005	mg/L	3/8/2013 20:42	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	3/5/2013 12:57	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	3/5/2013 12:57	PNM	EPA 200.7	
Potassium, Dissolved	8.4	0.5	mg/L	3/5/2013 12:57	PNM	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	3/5/2013 12:57	PNM	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	3/8/2013 20:42	PNM	EPA 200.7	
Sodium, Dissolved	67.4	0.5	mg/L	3/5/2013 12:57	PNM	EPA 200.7	QB-01
Zinc, Dissolved	ND	0.01	mg/L	3/5/2013 12:57	PNM	EPA 200.7	

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CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1301610-06

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 2/27/2013 4:30 PM
Sample Site:	Roadside Ditch		**Receipt Date:** 3/1/2013 11:06 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 242
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	6.1	0.01	meq/L	3/18/2013 8:00	PNM	SM 1030 E	
Cation/Anion Balance	-4.7		%	3/18/2013 8:00	PNM	SM 1030 E	
Cations, Total	5.6	0.01	meq/L	3/18/2013 8:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	254	1	mg/L	3/18/2013 8:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	3/13/2013 17:00	RMC	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	274	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - CO2	198	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Total (as CaCO3)	225	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	3/5/2013 12:00	TSM	SM 4500 NH3-D	
Chloride	7	1	mg/L	3/2/2013 8:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	3/2/2013 8:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	0.2	0.1	mg/L	3/21/2013 14:00	KSL	SM 4500 NO3-F	
Oil & Grease (HEM)	ND	5	mg/L	3/7/2013 9:00	SPH	EPA 1664A	
Phosphorus, Total as P	0.04	0.01	mg/L	3/5/2013 9:00	TSM	SM 4500 PB5E	
Sulfate	68	1	mg/L	3/2/2013 8:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	400	20	mg/L	3/4/2013 12:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	9	4	mg/L	3/1/2013 16:30	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	3/5/2013 13:13	PNM	EPA 200.7	
Aluminum, Total	0.1	0.05	mg/L	3/8/2013 20:57	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	3/5/2013 13:13	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	3/8/2013 20:57	PNM	EPA 200.7	
Boron, Dissolved	0.06	0.05	mg/L	3/5/2013 13:13	PNM	EPA 200.7	
Boron, Total	0.05	0.05	mg/L	3/8/2013 20:57	PNM	EPA 200.7	
Barium, Dissolved	0.036	0.005	mg/L	3/5/2013 13:13	PNM	EPA 200.7	
Calcium, Dissolved	59.3	0.2	mg/L	3/5/2013 13:13	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	3/5/2013 13:13	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	3/5/2013 13:13	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	3/5/2013 13:13	PNM	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	3/5/2013 13:13	PNM	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1301610-06

Name:	**Alton Coal Development, LLC**	***Mine Code:*** 41	***Sample Date:*** 2/27/2013 4:30 PM
Sample Site:	Roadside Ditch		***Receipt Date:*** 3/1/2013 11:06 AM
Comments:			***Sampler:*** Erik Petersen
Sample Type:	Water		***Site No.:*** 242
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	0.12	0.02	mg/L	3/8/2013 20:57	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	3/5/2013 13:13	PNM	EPA 200.7	
Lead, Total	0.02	0.02	mg/L	3/8/2013 20:57	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	3/5/2013 9:45	AKL	EPA 245.1	
Magnesium, Dissolved	25.6	0.2	mg/L	3/5/2013 13:13	PNM	EPA 200.7	
Manganese, Dissolved	ND	0.005	mg/L	3/5/2013 13:13	PNM	EPA 200.7	
Manganese, Total	ND	0.005	mg/L	3/8/2013 20:57	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	3/5/2013 13:13	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	3/5/2013 13:13	PNM	EPA 200.7	
Potassium, Dissolved	6.0	0.5	mg/L	3/5/2013 13:13	PNM	EPA 200.7	
Selenium, Dissolved	ND	0.02	mg/L	3/5/2013 13:13	PNM	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	3/8/2013 20:57	PNM	EPA 200.7	
Sodium, Dissolved	7.7	0.5	mg/L	3/5/2013 13:13	PNM	EPA 200.7	QB-01
Zinc, Dissolved	ND	0.01	mg/L	3/5/2013 13:13	PNM	EPA 200.7	

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CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1301610-08

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 2/27/2013 6:00 PM
Sample Site:	Kanab Creek at County Road		**Receipt Date:** 3/1/2013 11:06 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 202
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	7.4	0.01	meq/L	3/18/2013 8:00	PNM	SM 1030 E	
Cation/Anion Balance	-4.0		%	3/18/2013 8:00	PNM	SM 1030 E	
Cations, Total	6.9	0.01	meq/L	3/18/2013 8:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	331	1	mg/L	3/18/2013 8:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	3/13/2013 17:00	RMC	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	359	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Carbonate (CO3)	1.0	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - CO2	261	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Total (as CaCO3)	297	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	3/5/2013 12:00	TSM	SM 4500 NH3-D	
Chloride	3	1	mg/L	3/2/2013 8:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	3/2/2013 8:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	3/21/2013 14:00	KSL	SM 4500 NO3-F	
Oil & Grease (HEM)	ND	5	mg/L	3/7/2013 9:00	SPH	EPA 1664A	
Phosphorus, Total as P	0.08	0.01	mg/L	3/5/2013 9:00	TSM	SM 4500 PB5E	
Sulfate	72	1	mg/L	3/2/2013 8:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	476	20	mg/L	3/4/2013 12:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	147	10	mg/L	3/1/2013 16:30	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	3/5/2013 13:21	PNM	EPA 200.7	
Aluminum, Total	1.4	0.05	mg/L	3/8/2013 21:06	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	3/5/2013 13:21	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	3/8/2013 21:06	PNM	EPA 200.7	
Boron, Dissolved	ND	0.05	mg/L	3/5/2013 13:21	PNM	EPA 200.7	
Boron, Total	ND	0.05	mg/L	3/8/2013 21:06	PNM	EPA 200.7	
Barium, Dissolved	0.157	0.005	mg/L	3/5/2013 13:21	PNM	EPA 200.7	
Calcium, Dissolved	56.1	0.2	mg/L	3/5/2013 13:21	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	3/5/2013 13:21	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	3/5/2013 13:21	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	3/5/2013 13:21	PNM	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	3/5/2013 13:21	PNM	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1301610-08

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 2/27/2013 6:00 PM
Sample Site:	Kanab Creek at County Road		**Receipt Date:** 3/1/2013 11:06 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 202
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	2.38	0.02	mg/L	3/8/2013 21:06	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	3/5/2013 13:21	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	3/8/2013 21:06	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	3/5/2013 9:45	AKL	EPA 245.1	
Magnesium, Dissolved	46.4	0.2	mg/L	3/5/2013 13:21	PNM	EPA 200.7	
Manganese, Dissolved	ND	0.005	mg/L	3/5/2013 13:21	PNM	EPA 200.7	
Manganese, Total	0.063	0.005	mg/L	3/8/2013 21:06	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	3/5/2013 13:21	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	3/5/2013 13:21	PNM	EPA 200.7	
Potassium, Dissolved	1.7	0.5	mg/L	3/5/2013 13:21	PNM	EPA 200.7	
Selenium, Dissolved	ND	0.02	mg/L	3/5/2013 13:21	PNM	EPA 200.7	
Selenium, Total	0.02	0.02	mg/L	3/8/2013 21:06	PNM	EPA 200.7	
Sodium, Dissolved	5.3	0.5	mg/L	3/5/2013 13:21	PNM	EPA 200.7	QB-01
Zinc, Dissolved	ND	0.01	mg/L	3/5/2013 13:21	PNM	EPA 200.7	

Abbreviations

ND = Not detected at the corresponding Minimum Reporting Limit.
1 mg/L = one milligram per liter or 1 mg/Kg = one milligram per kilogram = 1 part per million.
1 ug/L = one microgram per liter or 1 ug/Kg = one microgram per kilogram = 1 part per billion.
1 ng/L = one nanogram per liter or 1 ng/Kg = one nanogram per kilogram = 1 part per trillion.

Flag Descriptions

QB-01 = The method blank contains analyte at a concentration above the MRL; however, concentration is less than 10% of the sample result, which is negligible according to method criteria.

APH = The analysis was performed past the EPA recommended holding time.

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CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1301611-01

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 2/28/2013 5:00 PM
Sample Site:	NLP-3		**Receipt Date:** 3/1/2013 11:06 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 233
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	17.2	0.01	meq/L	3/18/2013 8:00	PNM	SM 1030 E	
Cation/Anion Balance	1.4		%	3/18/2013 8:00	PNM	SM 1030 E	
Cations, Total	17.7	0.01	meq/L	3/18/2013 8:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	829	1	mg/L	3/18/2013 8:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	3/13/2013 17:00	RMC	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	1050	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - CO2	792	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Total (as CaCO3)	860	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	3/5/2013 12:00	TSM	SM 4500 NH3-D	
Chloride	ND	1	mg/L	3/1/2013 14:30	TSM	EPA 300.0	
Fluoride	ND	0.1	mg/L	3/1/2013 14:30	TSM	EPA 300.0	
Nitrate as N	ND	0.1	mg/L	3/1/2013 14:30	TSM	EPA 300.0	
Nitrite as N	ND	0.1	mg/L	3/1/2013 14:30	TSM	EPA 300.0	
Phosphorus, Total as P	1.0	0.05	mg/L	3/5/2013 9:00	TSM	SM 4500 PB5E	
Sulfate	ND	1	mg/L	3/2/2013 8:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1090	20	mg/L	3/6/2013 9:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	28300	100	mg/L	3/1/2013 16:30	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	3/5/2013 13:32	PNM	EPA 200.7	
Aluminum, Total	39.1	0.05	mg/L	3/8/2013 21:19	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	3/5/2013 13:32	PNM	EPA 200.7	
Arsenic, Total	0.07	0.05	mg/L	3/8/2013 21:19	PNM	EPA 200.7	
Boron, Dissolved	0.13	0.05	mg/L	3/5/2013 13:32	PNM	EPA 200.7	
Boron, Total	0.10	0.05	mg/L	3/8/2013 21:19	PNM	EPA 200.7	
Barium, Dissolved	0.028	0.005	mg/L	3/5/2013 13:32	PNM	EPA 200.7	
Calcium, Dissolved	139	0.2	mg/L	3/5/2013 13:32	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	3/5/2013 13:32	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	3/5/2013 13:32	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	3/5/2013 13:32	PNM	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	3/5/2013 13:32	PNM	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1301611-01

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	2/28/2013 5:00 PM
Sample Site:	NLP-3			***Receipt Date:***	3/1/2013 11:06 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	233
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	86.0	0.02	mg/L	3/8/2013 21:19	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	3/5/2013 13:32	PNM	EPA 200.7	
Lead, Total	0.18	0.02	mg/L	3/8/2013 21:19	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	3/5/2013 9:45	AKL	EPA 245.1	
Magnesium, Dissolved	117	0.2	mg/L	3/5/2013 13:32	PNM	EPA 200.7	
Manganese, Dissolved	0.011	0.005	mg/L	3/5/2013 13:32	PNM	EPA 200.7	
Manganese, Total	4.22	0.005	mg/L	3/8/2013 21:19	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	3/5/2013 13:32	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	3/5/2013 13:32	PNM	EPA 200.7	
Potassium, Dissolved	8.6	0.5	mg/L	3/5/2013 13:32	PNM	EPA 200.7	
Selenium, Dissolved	0.04	0.02	mg/L	3/5/2013 13:32	PNM	EPA 200.7	
Selenium, Total	0.02	0.02	mg/L	3/8/2013 21:19	PNM	EPA 200.7	
Sodium, Dissolved	21.1	0.5	mg/L	3/5/2013 13:32	PNM	EPA 200.7	QB-01
Zinc, Dissolved	ND	0.01	mg/L	3/5/2013 13:32	PNM	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1301611-02

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 2/28/2013 5:30 PM
Sample Site:	NLP-4		**Receipt Date:** 3/1/2013 11:06 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 234
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	30.8	0.01	meq/L	3/18/2013 8:00	PNM	SM 1030 E	
Cation/Anion Balance	-4.0		%	3/18/2013 8:00	PNM	SM 1030 E	
Cations, Total	28.5	0.01	meq/L	3/18/2013 8:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	1340	1	mg/L	3/18/2013 8:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	3/13/2013 17:00	RMC	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	778	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - CO2	593	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Total (as CaCO3)	638	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	3/5/2013 12:00	TSM	SM 4500 NH3-D	
Chloride	14	1	mg/L	3/1/2013 14:30	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	3/1/2013 14:30	TSM	EPA 300.0	
Nitrate as N	ND	0.1	mg/L	3/1/2013 14:30	TSM	EPA 300.0	
Nitrite as N	ND	0.1	mg/L	3/1/2013 14:30	TSM	EPA 300.0	
Phosphorus, Total as P	0.32	0.05	mg/L	3/5/2013 9:00	TSM	SM 4500 PB5E	
Sulfate	850	10	mg/L	3/2/2013 8:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1700	20	mg/L	3/6/2013 9:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	7790	100	mg/L	3/1/2013 16:30	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	3/5/2013 13:36	PNM	EPA 200.7	
Aluminum, Total	14.4	0.05	mg/L	3/8/2013 21:26	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	3/5/2013 13:36	PNM	EPA 200.7	
Arsenic, Total	0.08	0.05	mg/L	3/8/2013 21:26	PNM	EPA 200.7	
Boron, Dissolved	0.07	0.05	mg/L	3/5/2013 13:36	PNM	EPA 200.7	
Boron, Total	0.06	0.05	mg/L	3/8/2013 21:26	PNM	EPA 200.7	
Barium, Dissolved	0.021	0.005	mg/L	3/5/2013 13:36	PNM	EPA 200.7	
Calcium, Dissolved	207	0.2	mg/L	3/5/2013 13:36	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	3/5/2013 13:36	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	3/5/2013 13:36	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	3/5/2013 13:36	PNM	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	3/5/2013 13:36	PNM	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1301611-02

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	2/28/2013 5:30 PM
Sample Site:	NLP-4			***Receipt Date:***	3/1/2013 11:06 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	234
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	46.6	0.02	mg/L	3/8/2013 21:26	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	3/5/2013 13:36	PNM	EPA 200.7	
Lead, Total	0.07	0.02	mg/L	3/8/2013 21:26	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	3/5/2013 9:45	AKL	EPA 245.1	
Magnesium, Dissolved	201	0.2	mg/L	3/5/2013 13:36	PNM	EPA 200.7	
Manganese, Dissolved	0.067	0.005	mg/L	3/5/2013 13:36	PNM	EPA 200.7	
Manganese, Total	1.08	0.005	mg/L	3/8/2013 21:26	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	3/5/2013 13:36	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	3/5/2013 13:36	PNM	EPA 200.7	
Potassium, Dissolved	5.5	0.5	mg/L	3/5/2013 13:36	PNM	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	3/5/2013 13:36	PNM	EPA 200.7	
Selenium, Total	0.06	0.02	mg/L	3/8/2013 21:26	PNM	EPA 200.7	
Sodium, Dissolved	33.2	0.5	mg/L	3/5/2013 13:36	PNM	EPA 200.7	QB-01
Zinc, Dissolved	ND	0.01	mg/L	3/5/2013 13:36	PNM	EPA 200.7	

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CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1301611-03

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 2/28/2013 4:30 PM
Sample Site:	NLP-5		**Receipt Date:** 3/1/2013 11:06 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 235
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	29.4	0.01	meq/L	3/18/2013 8:00	PNM	SM 1030 E	
Cation/Anion Balance	-5.6		%	3/18/2013 8:00	PNM	SM 1030 E	
Cations, Total	26.3	0.01	meq/L	3/18/2013 8:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	1250	1	mg/L	3/18/2013 8:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	3/13/2013 17:00	RMC	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	613	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - CO2	456	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Total (as CaCO3)	503	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	3/5/2013 12:00	TSM	SM 4500 NH3-D	
Chloride	17	1	mg/L	3/1/2013 14:30	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	3/1/2013 14:30	TSM	EPA 300.0	
Nitrate as N	ND	0.1	mg/L	3/1/2013 14:30	TSM	EPA 300.0	
Nitrite as N	ND	0.1	mg/L	3/1/2013 14:30	TSM	EPA 300.0	
Phosphorus, Total as P	0.65	0.05	mg/L	3/5/2013 9:00	TSM	SM 4500 PB5E	
Sulfate	910	10	mg/L	3/2/2013 8:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1820	20	mg/L	3/6/2013 9:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	3010	100	mg/L	3/1/2013 16:30	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	3/5/2013 13:48	PNM	EPA 200.7	
Aluminum, Total	8.1	0.05	mg/L	3/8/2013 21:30	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	3/5/2013 13:48	PNM	EPA 200.7	
Arsenic, Total	0.06	0.05	mg/L	3/8/2013 21:30	PNM	EPA 200.7	
Boron, Dissolved	0.07	0.05	mg/L	3/5/2013 13:48	PNM	EPA 200.7	
Boron, Total	0.05	0.05	mg/L	3/8/2013 21:30	PNM	EPA 200.7	
Barium, Dissolved	0.022	0.005	mg/L	3/5/2013 13:48	PNM	EPA 200.7	
Calcium, Dissolved	203	0.2	mg/L	3/5/2013 13:48	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	3/5/2013 13:48	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	3/5/2013 13:48	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	3/5/2013 13:48	PNM	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	3/5/2013 13:48	PNM	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1301611-03

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	2/28/2013 4:30 PM
Sample Site:	NLP-5			***Receipt Date:***	3/1/2013 11:06 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	235
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	24.6	0.02	mg/L	3/8/2013 21:30	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	3/5/2013 13:48	PNM	EPA 200.7	
Lead, Total	0.05	0.02	mg/L	3/8/2013 21:30	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	3/5/2013 9:45	AKL	EPA 245.1	
Magnesium, Dissolved	180	0.2	mg/L	3/5/2013 13:48	PNM	EPA 200.7	
Manganese, Dissolved	ND	0.005	mg/L	3/5/2013 13:48	PNM	EPA 200.7	
Manganese, Total	1.39	0.005	mg/L	3/8/2013 21:30	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	3/5/2013 13:48	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	3/5/2013 13:48	PNM	EPA 200.7	
Potassium, Dissolved	4.1	0.5	mg/L	3/5/2013 13:48	PNM	EPA 200.7	
Selenium, Dissolved	0.04	0.02	mg/L	3/5/2013 13:48	PNM	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	3/8/2013 21:30	PNM	EPA 200.7	
Sodium, Dissolved	29.0	0.5	mg/L	3/5/2013 13:48	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	3/5/2013 13:48	PNM	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1301611-04

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 2/28/2013 3:45 PM
Sample Site:	NLP-6		**Receipt Date:** 3/1/2013 11:06 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 236
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	41.5	0.01	meq/L	3/18/2013 8:00	PNM	SM 1030 E	
Cation/Anion Balance	-0.4		%	3/18/2013 8:00	PNM	SM 1030 E	
Cations, Total	41.2	0.01	meq/L	3/18/2013 8:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	2010	1	mg/L	3/18/2013 8:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	3/13/2013 17:00	RMC	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	743	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - CO2	561	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Total (as CaCO3)	609	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Ammonia as N	0.3	0.2	mg/L	3/5/2013 12:00	TSM	SM 4500 NH3-D	
Chloride	8	1	mg/L	3/1/2013 14:30	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	3/1/2013 14:30	TSM	EPA 300.0	
Nitrate as N	ND	0.1	mg/L	3/1/2013 14:30	TSM	EPA 300.0	
Nitrite as N	ND	0.1	mg/L	3/1/2013 14:30	TSM	EPA 300.0	
Phosphorus, Total as P	0.06	0.01	mg/L	3/5/2013 9:00	TSM	SM 4500 PB5E	
Sulfate	1400	10	mg/L	3/2/2013 8:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	2380	20	mg/L	3/6/2013 9:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	21500	100	mg/L	3/1/2013 16:30	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	3/5/2013 14:00	PNM	EPA 200.7	
Aluminum, Total	0.8	0.05	mg/L	3/8/2013 21:42	PNM	EPA 200.7	
Arsenic, Dissolved	0.05	0.05	mg/L	3/5/2013 14:00	PNM	EPA 200.7	
Arsenic, Total	0.05	0.05	mg/L	3/8/2013 21:42	PNM	EPA 200.7	
Boron, Dissolved	0.09	0.05	mg/L	3/5/2013 14:00	PNM	EPA 200.7	
Boron, Total	0.06	0.05	mg/L	3/8/2013 21:42	PNM	EPA 200.7	
Barium, Dissolved	0.022	0.005	mg/L	3/5/2013 14:00	PNM	EPA 200.7	
Calcium, Dissolved	359	0.2	mg/L	3/5/2013 14:00	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	3/5/2013 14:00	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	3/5/2013 14:00	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	3/5/2013 14:00	PNM	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	3/5/2013 14:00	PNM	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1301611-04

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	2/28/2013 3:45 PM
Sample Site:	NLP-6			***Receipt Date:***	3/1/2013 11:06 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	236
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	21.5	0.02	mg/L	3/8/2013 21:42	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	3/5/2013 14:00	PNM	EPA 200.7	
Lead, Total	0.02	0.02	mg/L	3/8/2013 21:42	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	3/5/2013 9:45	AKL	EPA 245.1	
Magnesium, Dissolved	270	0.2	mg/L	3/5/2013 14:00	PNM	EPA 200.7	
Manganese, Dissolved	0.211	0.005	mg/L	3/5/2013 14:00	PNM	EPA 200.7	
Manganese, Total	0.484	0.005	mg/L	3/8/2013 21:42	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	3/5/2013 14:00	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	3/5/2013 14:00	PNM	EPA 200.7	
Potassium, Dissolved	5.8	0.5	mg/L	3/5/2013 14:00	PNM	EPA 200.7	
Selenium, Dissolved	0.04	0.02	mg/L	3/5/2013 14:00	PNM	EPA 200.7	
Selenium, Total	0.04	0.02	mg/L	3/8/2013 21:42	PNM	EPA 200.7	
Sodium, Dissolved	21.7	0.5	mg/L	3/5/2013 14:00	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	3/5/2013 14:00	PNM	EPA 200.7	

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Lab Sample No.: 1301611-05

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 2/28/2013 2:45 PM
Sample Site:	NLP-7		**Receipt Date:** 3/1/2013 11:06 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 237
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	15.3	0.01	meq/L	3/18/2013 8:00	PNM	SM 1030 E	
Cation/Anion Balance	23		%	3/18/2013 8:00	PNM	SM 1030 E	A-01
Cations, Total	24.4	0.01	meq/L	3/18/2013 8:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	920	1	mg/L	3/18/2013 8:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	3/13/2013 17:00	RMC	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	905	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - CO2	669	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Total (as CaCO3)	742	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	3/5/2013 12:00	TSM	SM 4500 NH3-D	
Chloride	ND	1	mg/L	3/1/2013 14:30	TSM	EPA 300.0	
Fluoride	ND	0.1	mg/L	3/1/2013 14:30	TSM	EPA 300.0	
Nitrate as N	ND	0.1	mg/L	3/1/2013 14:30	TSM	EPA 300.0	
Nitrite as N	ND	0.1	mg/L	3/1/2013 14:30	TSM	EPA 300.0	
Phosphorus, Total as P	2.6	0.05	mg/L	3/5/2013 9:00	TSM	SM 4500 PB5E	
Sulfate	21	1	mg/L	3/1/2013 14:30	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	2020	100	mg/L	3/6/2013 9:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	72500	100	mg/L	3/1/2013 16:30	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	3/5/2013 14:04	PNM	EPA 200.7	
Aluminum, Total	35.5	0.05	mg/L	3/8/2013 18:15	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	3/5/2013 14:04	PNM	EPA 200.7	
Arsenic, Total	0.08	0.05	mg/L	3/8/2013 18:15	PNM	EPA 200.7	QM-11
Boron, Dissolved	0.12	0.05	mg/L	3/5/2013 14:04	PNM	EPA 200.7	
Boron, Total	0.11	0.05	mg/L	3/8/2013 18:15	PNM	EPA 200.7	
Barium, Dissolved	0.023	0.005	mg/L	3/5/2013 14:04	PNM	EPA 200.7	
Calcium, Dissolved	75.0	0.2	mg/L	3/5/2013 14:04	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	3/5/2013 14:04	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	3/5/2013 14:04	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	3/5/2013 14:04	PNM	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	3/5/2013 14:04	PNM	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1301611-05

Name:	**Alton Coal Development, LLC**	***Mine Code:*** 41	***Sample Date:*** 2/28/2013 2:45 PM
Sample Site:	NLP-7		***Receipt Date:*** 3/1/2013 11:06 AM
Comments:			***Sampler:*** Erik Petersen
Sample Type:	Water		***Site No.:*** 237
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	37.5	0.02	mg/L	3/8/2013 18:15	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	3/5/2013 14:04	PNM	EPA 200.7	
Lead, Total	0.32	0.02	mg/L	3/19/2013 21:54	AWL	EPA 200.7	SL-01
Mercury, Dissolved	ND	0.0002	mg/L	3/5/2013 9:45	AKL	EPA 245.1	
Magnesium, Dissolved	178	0.2	mg/L	3/5/2013 14:04	PNM	EPA 200.7	
Manganese, Dissolved	0.129	0.005	mg/L	3/5/2013 14:04	PNM	EPA 200.7	
Manganese, Total	7.72	0.005	mg/L	3/8/2013 18:15	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	3/5/2013 14:04	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	3/5/2013 14:04	PNM	EPA 200.7	
Potassium, Dissolved	3.3	0.5	mg/L	3/5/2013 14:04	PNM	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	3/5/2013 14:04	PNM	EPA 200.7	
Selenium, Total	ND	0.02	mg/L	3/8/2013 18:15	PNM	EPA 200.7	QM-11
Sodium, Dissolved	139	0.5	mg/L	3/5/2013 14:04	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	3/5/2013 14:04	PNM	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1301611-06

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 2/28/2013 1:30 PM
Sample Site:	NLP-8		**Receipt Date:** 3/1/2013 11:06 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 238
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	139	0.01	meq/L	3/18/2013 8:00	PNM	SM 1030 E	
Cation/Anion Balance	-1.8		%	3/18/2013 8:00	PNM	SM 1030 E	
Cations, Total	134	0.01	meq/L	3/18/2013 8:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	5430	1	mg/L	3/18/2013 8:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	3/13/2013 17:00	RMC	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	1020	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - CO2	808	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Total (as CaCO3)	840	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Ammonia as N	0.8	0.2	mg/L	3/5/2013 12:00	TSM	SM 4500 NH3-D	
Chloride	1000	100	mg/L	3/1/2013 14:30	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	3/1/2013 14:30	TSM	EPA 300.0	
Nitrate as N	ND	0.1	mg/L	3/1/2013 14:30	TSM	EPA 300.0	
Nitrite as N	ND	0.1	mg/L	3/1/2013 14:30	TSM	EPA 300.0	
Phosphorus, Total as P	0.10	0.01	mg/L	3/5/2013 9:00	TSM	SM 4500 PB5E	
Sulfate	4510	100	mg/L	3/2/2013 8:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	9250	20	mg/L	3/6/2013 9:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	476	20	mg/L	3/1/2013 16:30	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	3/5/2013 14:08	PNM	EPA 200.7	
Aluminum, Total	0.3	0.05	mg/L	3/8/2013 18:23	PNM	EPA 200.7	
Arsenic, Dissolved	0.06	0.05	mg/L	3/5/2013 14:08	PNM	EPA 200.7	
Arsenic, Total	0.06	0.05	mg/L	3/8/2013 18:23	PNM	EPA 200.7	QM-11
Boron, Dissolved	0.25	0.05	mg/L	3/5/2013 14:08	PNM	EPA 200.7	
Boron, Total	0.24	0.05	mg/L	3/8/2013 18:23	PNM	EPA 200.7	
Barium, Dissolved	0.017	0.005	mg/L	3/5/2013 14:08	PNM	EPA 200.7	
Calcium, Dissolved	508	0.2	mg/L	3/5/2013 14:08	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	3/5/2013 14:08	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	3/5/2013 14:08	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	3/5/2013 14:08	PNM	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	3/5/2013 14:08	PNM	EPA 200.7	

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LABORATORIES

Certificate of Analysis

Lab Sample No.: 1301611-06

Name:	**Alton Coal Development, LLC**	***Mine Code:*** 41	***Sample Date:*** 2/28/2013 1:30 PM
Sample Site:	NLP-8		***Receipt Date:*** 3/1/2013 11:06 AM
Comments:			***Sampler:*** Erik Petersen
Sample Type:	Water		***Site No.:*** 238
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	10.6	0.02	mg/L	3/8/2013 18:23	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	3/5/2013 14:08	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	3/8/2013 18:23	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	3/5/2013 9:45	AKL	EPA 245.1	
Magnesium, Dissolved	1010	0.2	mg/L	3/5/2013 14:08	PNM	EPA 200.7	
Manganese, Dissolved	2.09	0.005	mg/L	3/5/2013 14:08	PNM	EPA 200.7	
Manganese, Total	2.22	0.005	mg/L	3/8/2013 18:23	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	3/5/2013 14:08	PNM	EPA 200.7	
Nickel, Dissolved	0.01	0.005	mg/L	3/5/2013 14:08	PNM	EPA 200.7	
Potassium, Dissolved	16.3	0.5	mg/L	3/5/2013 14:08	PNM	EPA 200.7	
Selenium, Dissolved	0.03	0.02	mg/L	3/5/2013 14:08	PNM	EPA 200.7	
Selenium, Total	0.04	0.02	mg/L	3/8/2013 18:23	PNM	EPA 200.7	QM-11
Sodium, Dissolved	572	0.5	mg/L	3/5/2013 14:08	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	3/5/2013 14:08	PNM	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1301611-07

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 2/26/2013 1:00 PM
Sample Site:	NLP-9		**Receipt Date:** 3/1/2013 11:06 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 239
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	72.4	0.01	meq/L	3/18/2013 8:00	PNM	SM 1030 E	
Cation/Anion Balance	-1.8		%	3/18/2013 8:00	PNM	SM 1030 E	
Cations, Total	69.8	0.01	meq/L	3/18/2013 8:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	2600	1	mg/L	3/18/2013 8:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	3/13/2013 17:00	RMC	SM 2310 B	APH
Alkalinity - Bicarbonate (HCO3)	536	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - CO2	391	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Alkalinity - Total (as CaCO3)	440	1.0	mg/L	3/4/2013 9:00	RMC	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	3/5/2013 12:00	TSM	SM 4500 NH3-D	
Chloride	360	10	mg/L	3/2/2013 8:00	TSM	EPA 300.0	
Fluoride	0.5	0.1	mg/L	3/2/2013 8:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	1.7	0.1	mg/L	3/21/2013 14:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.20	0.03	mg/L	3/5/2013 9:00	TSM	SM 4500 PB5E	
Sulfate	2570	20	mg/L	3/2/2013 8:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	4990	20	mg/L	3/4/2013 12:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	135	10	mg/L	3/1/2013 16:30	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	3/5/2013 14:16	PNM	EPA 200.7	
Aluminum, Total	0.7	0.05	mg/L	3/8/2013 18:30	PNM	EPA 200.7	
Arsenic, Dissolved	0.05	0.05	mg/L	3/5/2013 14:16	PNM	EPA 200.7	
Arsenic, Total	0.05	0.05	mg/L	3/8/2013 18:30	PNM	EPA 200.7	QM-11
Boron, Dissolved	0.20	0.05	mg/L	3/5/2013 14:16	PNM	EPA 200.7	
Boron, Total	0.21	0.05	mg/L	3/8/2013 18:30	PNM	EPA 200.7	
Barium, Dissolved	0.014	0.005	mg/L	3/5/2013 14:16	PNM	EPA 200.7	
Calcium, Dissolved	259	0.2	mg/L	3/5/2013 14:16	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	3/5/2013 14:16	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	3/5/2013 14:16	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	3/5/2013 14:16	PNM	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	3/5/2013 14:16	PNM	EPA 200.7	
Iron, Total	2.34	0.02	mg/L	3/8/2013 18:30	PNM	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1301611-07

Name:	**Alton Coal Development, LLC**	***Mine Code:*** 41	***Sample Date:*** 2/26/2013 1:00 PM
Sample Site:	NLP-9		***Receipt Date:*** 3/1/2013 11:06 AM
Comments:			***Sampler:*** Erik Petersen
Sample Type:	Water		***Site No.:*** 239
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Lead, Dissolved	ND	0.02	mg/L	3/5/2013 14:16	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	3/19/2013 21:54	AWL	EPA 200.7	SL-01
Mercury, Dissolved	ND	0.0002	mg/L	3/5/2013 9:45	AKL	EPA 245.1	
Magnesium, Dissolved	474	0.2	mg/L	3/5/2013 14:16	PNM	EPA 200.7	
Manganese, Dissolved	0.037	0.005	mg/L	3/5/2013 14:16	PNM	EPA 200.7	
Manganese, Total	0.056	0.005	mg/L	3/8/2013 18:30	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	3/5/2013 14:16	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	3/5/2013 14:16	PNM	EPA 200.7	
Potassium, Dissolved	7.7	0.5	mg/L	3/5/2013 14:16	PNM	EPA 200.7	
Selenium, Dissolved	0.05	0.02	mg/L	3/5/2013 14:16	PNM	EPA 200.7	
Selenium, Total	0.06	0.02	mg/L	3/8/2013 18:30	PNM	EPA 200.7	QM-11
Sodium, Dissolved	407	0.5	mg/L	3/5/2013 14:16	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	3/5/2013 14:16	PNM	EPA 200.7	

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CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1301611-10

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 2/28/2013 10:45 AM
Sample Site:	Pond Spring		**Receipt Date:** 3/1/2013 11:06 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 208
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	0.02	0.02	mg/L	3/8/2013 18:45	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	3/5/2013 12:06	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	3/19/2013 21:54	AWL	EPA 200.7	SL-01
Mercury, Dissolved	ND	0.0002	mg/L	3/5/2013 9:45	AKL	EPA 245.1	
Magnesium, Dissolved	246	0.2	mg/L	3/5/2013 12:06	PNM	EPA 200.7	
Manganese, Dissolved	ND	0.005	mg/L	3/5/2013 12:06	PNM	EPA 200.7	
Manganese, Total	ND	0.005	mg/L	3/8/2013 18:45	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	3/5/2013 12:06	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	3/5/2013 12:06	PNM	EPA 200.7	
Potassium, Dissolved	16.3	0.5	mg/L	3/5/2013 12:06	PNM	EPA 200.7	
Selenium, Dissolved	0.03	0.02	mg/L	3/5/2013 12:06	PNM	EPA 200.7	
Selenium, Total	0.04	0.02	mg/L	3/8/2013 18:45	PNM	EPA 200.7	QM-11
Sodium, Dissolved	66.4	0.5	mg/L	3/5/2013 12:06	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	3/5/2013 12:06	PNM	EPA 200.7	

Abbreviations

ND = Not detected at the corresponding Minimum Reporting Limit.
1 mg/L = one milligram per liter or 1 mg/Kg = one milligram per kilogram = 1 part per million.
1 ug/L = one microgram per liter or 1 ug/Kg = one microgram per kilogram = 1 part per billion.
1 ng/L = one nanogram per liter or 1 ng/Kg = one nanogram per kilogram = 1 part per trillion.

Flag Descriptions

SL-01 = Analysis performed by American West Analytical Labs, 463 W. 3600 S., Salt Lake City, UT 84115.

QM-11 = The Laboratory Control Sample recovery was outside acceptance limits. The analytical batch was accepted based on the recovery of the Method Spike.

QB-01 = The method blank contains analyte at a concentration above the MRL; however, concentration is less than 10% of the sample result, which is negligible according to method criteria.

APH = The analysis was performed past the EPA recommended holding time.

A-01 = The cation/anion balance is high. All analyses were re-run, and the original values were confirmed. The sediment composition may have affected some analyses, particularly metals.

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CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1302090-03

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 3/16/2013 5:30 PM
Sample Site:	Coyote Seep		**Receipt Date:** 3/18/2013 12:02 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 205
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	31.9	0.01	meq/L	4/19/2013 7:45	PNM	SM 1030 E	
Cation/Anion Balance	-0.4		%	4/19/2013 7:45	PNM	SM 1030 E	
Cations, Total	31.6	0.01	meq/L	4/19/2013 7:45	PNM	SM 1030 E	
Hardness, Total as CaCO3	1510	1	mg/L	4/19/2013 7:45	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	3/26/2013 10:00	RMC	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	606	1.0	mg/L	3/23/2013 10:30	RMC	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	3/23/2013 10:30	RMC	SM 2320 B	
Alkalinity - CO2	446	1.0	mg/L	3/23/2013 10:30	RMC	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	3/23/2013 10:30	RMC	SM 2320 B	
Alkalinity - Total (as CaCO3)	497	1.0	mg/L	3/23/2013 10:30	RMC	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	3/21/2013 9:00	TSM	SM 4500 NH3-D	
Chloride	18	2	mg/L	3/23/2013 12:00	TSM	EPA 300.0	
Fluoride	ND	0.2	mg/L	3/23/2013 12:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	3/21/2013 14:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	ND	0.05	mg/L	3/26/2013 14:48	AWL	SM 4500 PB5E	SL-01
Sulfate	1030	20	mg/L	3/22/2013 19:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	2040	20	mg/L	3/21/2013 0:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	62	7	mg/L	3/20/2013 14:00	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	4/6/2013 11:07	PNM	EPA 200.7	
Aluminum, Total	0.09	0.05	mg/L	4/16/2013 0:20	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	4/6/2013 11:07	PNM	EPA 200.7	
Arsenic, Total	0.05	0.05	mg/L	4/16/2013 0:20	PNM	EPA 200.7	
Boron, Dissolved	0.07	0.05	mg/L	4/6/2013 11:07	PNM	EPA 200.7	
Boron, Total	0.07	0.05	mg/L	4/16/2013 0:20	PNM	EPA 200.7	
Barium, Dissolved	0.036	0.005	mg/L	4/6/2013 11:07	PNM	EPA 200.7	
Calcium, Dissolved	229	0.2	mg/L	4/6/2013 11:07	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	4/6/2013 11:07	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	4/6/2013 11:07	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	4/6/2013 11:07	PNM	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	4/6/2013 11:07	PNM	EPA 200.7	
Iron, Total	0.54	0.02	mg/L	4/16/2013 0:20	PNM	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1302090-03

Name:	Alton Coal Development, LLC	**Mine Code:**	41	**Sample Date:**	3/16/2013 5:30 PM
Sample Site:	Coyote Seep			**Receipt Date:**	3/18/2013 12:02 PM
Comments:				**Sampler:**	Erik Petersen
Sample Type:	Water			**Site No.:**	205
Field pH:				**Field Temp. Deg. C :**	
Field Flow g/Min.:				**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Lead, Dissolved	ND	0.02	mg/L	4/6/2013 11:07	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	4/16/2013 0:20	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	4/26/2013 11:44	AWL	EPA 245.1	APH, SL-01
Magnesium, Dissolved	227	0.2	mg/L	4/6/2013 11:07	PNM	EPA 200.7	
Manganese, Dissolved	ND	0.005	mg/L	4/6/2013 11:07	PNM	EPA 200.7	
Manganese, Total	0.081	0.005	mg/L	4/16/2013 0:20	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	4/6/2013 11:07	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	4/6/2013 11:07	PNM	EPA 200.7	
Potassium, Dissolved	6.5	0.5	mg/L	4/6/2013 11:07	PNM	EPA 200.7	
Selenium, Dissolved	0.03	0.02	mg/L	4/6/2013 11:07	PNM	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	4/16/2013 0:20	PNM	EPA 200.7	
Sodium, Dissolved	31.1	0.5	mg/L	4/6/2013 11:07	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	4/6/2013 11:07	PNM	EPA 200.7	

Abbreviations

ND = Not detected at the corresponding Minimum Reporting Limit.
1 mg/L = one milligram per liter or 1 mg/Kg = one milligram per kilogram = 1 part per million.
1 ug/L = one microgram per liter or 1 ug/Kg = one microgram per kilogram = 1 part per billion.
1 ng/L = one nanogram per liter or 1 ng/Kg = one nanogram per kilogram = 1 part per trillion.

Flag Descriptions

SL-01 = Analysis performed by American West Analytical Labs, 463 W. 3600 S., Salt Lake City, UT 84115.

APH = The analysis was performed past the EPA recommended holding time.

A-01 = The balance is higher than normal. All cations and anions were re-run; the reported values have been reviewed and verified.

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CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1302099-07

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 3/16/2013 4:45 PM
Sample Site:	SW-1A		**Receipt Date:** 3/18/2013 12:02 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 201
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	7.7	0.01	meq/L	4/19/2013 7:45	PNM	SM 1030 E	
Cation/Anion Balance	-4.1		%	4/19/2013 7:45	PNM	SM 1030 E	
Cations, Total	7.1	0.01	meq/L	4/19/2013 7:45	PNM	SM 1030 E	
Hardness, Total as CaCO3	338	1	mg/L	4/19/2013 7:45	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	3/26/2013 10:00	RMC	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	354	1.0	mg/L	3/23/2013 10:30	RMC	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	3/23/2013 10:30	RMC	SM 2320 B	
Alkalinity - CO2	256	1.0	mg/L	3/23/2013 10:30	RMC	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	3/23/2013 10:30	RMC	SM 2320 B	
Alkalinity - Total (as CaCO3)	290	1.0	mg/L	3/23/2013 10:30	RMC	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	3/21/2013 9:00	TSM	SM 4500 NH3-D	
Chloride	4	1	mg/L	3/23/2013 12:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	3/23/2013 12:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	3/21/2013 14:00	KSL	SM 4500 NO3-F	
Oil & Grease (HEM)	ND	5	mg/L	4/4/2013 11:00	SPH	EPA 1664A	
Phosphorus, Total as P	ND	0.05	mg/L	3/22/2013 14:52	AWL	SM 4500 PB5E	SL-01
Sulfate	84	1	mg/L	3/23/2013 12:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	384	20	mg/L	3/21/2013 17:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	47	7	mg/L	3/20/2013 14:00	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	4/6/2013 13:25	PNM	EPA 200.7	
Aluminum, Total	0.5	0.05	mg/L	4/10/2013 1:34	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	4/6/2013 13:25	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	4/10/2013 1:34	PNM	EPA 200.7	
Boron, Dissolved	ND	0.05	mg/L	4/6/2013 13:25	PNM	EPA 200.7	
Boron, Total	ND	0.05	mg/L	4/10/2013 1:34	PNM	EPA 200.7	
Barium, Dissolved	0.171	0.005	mg/L	4/6/2013 13:25	PNM	EPA 200.7	
Calcium, Dissolved	50.8	0.2	mg/L	4/6/2013 13:25	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	4/6/2013 13:25	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	4/6/2013 13:25	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	4/6/2013 13:25	PNM	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	4/6/2013 13:25	PNM	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1302099-07

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	3/16/2013 4:45 PM
Sample Site:	SW-1A			***Receipt Date:***	3/18/2013 12:02 PM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	201
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	0.64	0.02	mg/L	4/10/2013 1:34	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	4/6/2013 13:25	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	4/10/2013 1:34	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	5/8/2013 10:34	AWL	EPA 245.1	APH, SL-01
Magnesium, Dissolved	51.2	0.2	mg/L	4/6/2013 13:25	PNM	EPA 200.7	
Manganese, Dissolved	ND	0.005	mg/L	4/6/2013 13:25	PNM	EPA 200.7	
Manganese, Total	0.024	0.005	mg/L	4/10/2013 1:34	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	4/6/2013 13:25	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	4/6/2013 13:25	PNM	EPA 200.7	
Potassium, Dissolved	1.9	0.5	mg/L	4/6/2013 13:25	PNM	EPA 200.7	
Selenium, Dissolved	ND	0.02	mg/L	4/6/2013 13:25	PNM	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	4/10/2013 1:34	PNM	EPA 200.7	
Sodium, Dissolved	6.1	0.5	mg/L	4/6/2013 13:25	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	4/6/2013 13:25	PNM	EPA 200.7	

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CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1302099-08

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 3/16/2013 6:00 PM
Sample Site:	Kanab Creek at County Road		**Receipt Date:** 3/18/2013 12:02 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 202
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	8.2	0.01	meq/L	4/19/2013 7:45	PNM	SM 1030 E	
Cation/Anion Balance	-5.2		%	4/19/2013 7:45	PNM	SM 1030 E	
Cations, Total	7.4	0.01	meq/L	4/19/2013 7:45	PNM	SM 1030 E	
Hardness, Total as CaCO3	351	1	mg/L	4/19/2013 7:45	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	3/26/2013 10:00	RMC	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	356	1.0	mg/L	3/23/2013 10:30	RMC	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	3/23/2013 10:30	RMC	SM 2320 B	
Alkalinity - CO2	257	1.0	mg/L	3/23/2013 10:30	RMC	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	3/23/2013 10:30	RMC	SM 2320 B	
Alkalinity - Total (as CaCO3)	292	1.0	mg/L	3/23/2013 10:30	RMC	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	3/21/2013 9:00	TSM	SM 4500 NH3-D	
Chloride	5	1	mg/L	3/23/2013 12:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	3/23/2013 12:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	3/21/2013 14:00	KSL	SM 4500 NO3-F	
Oil & Grease (HEM)	ND	5	mg/L	4/4/2013 11:00	SPH	EPA 1664A	
Phosphorus, Total as P	ND	0.05	mg/L	3/22/2013 14:52	AWL	SM 4500 PB5E	SL-01
Sulfate	105	1	mg/L	3/23/2013 12:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	416	20	mg/L	3/21/2013 17:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	34	10	mg/L	3/22/2013 16:00	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	4/6/2013 13:29	PNM	EPA 200.7	
Aluminum, Total	0.3	0.05	mg/L	4/10/2013 1:37	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	4/6/2013 13:29	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	4/10/2013 1:37	PNM	EPA 200.7	
Boron, Dissolved	ND	0.05	mg/L	4/6/2013 13:29	PNM	EPA 200.7	
Boron, Total	ND	0.05	mg/L	4/10/2013 1:37	PNM	EPA 200.7	
Barium, Dissolved	0.156	0.005	mg/L	4/6/2013 13:29	PNM	EPA 200.7	
Calcium, Dissolved	52.4	0.2	mg/L	4/6/2013 13:29	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	4/6/2013 13:29	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	4/6/2013 13:29	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	4/6/2013 13:29	PNM	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	4/6/2013 13:29	PNM	EPA 200.7	

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Lab Sample No.: 1302099-08

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 3/16/2013 6:00 PM
Sample Site:	Kanab Creek at County Road		**Receipt Date:** 3/18/2013 12:02 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 202
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	0.36	0.02	mg/L	4/10/2013 1:37	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	4/6/2013 13:29	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	4/10/2013 1:37	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	5/8/2013 10:34	AWL	EPA 245.1	APH, SL-01
Magnesium, Dissolved	53.4	0.2	mg/L	4/6/2013 13:29	PNM	EPA 200.7	
Manganese, Dissolved	ND	0.005	mg/L	4/6/2013 13:29	PNM	EPA 200.7	
Manganese, Total	0.022	0.005	mg/L	4/10/2013 1:37	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	4/6/2013 13:29	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	4/6/2013 13:29	PNM	EPA 200.7	
Potassium, Dissolved	2.0	0.5	mg/L	4/6/2013 13:29	PNM	EPA 200.7	
Selenium, Dissolved	ND	0.02	mg/L	4/6/2013 13:29	PNM	EPA 200.7	
Selenium, Total	0.02	0.02	mg/L	4/10/2013 1:37	PNM	EPA 200.7	
Sodium, Dissolved	6.8	0.5	mg/L	4/6/2013 13:29	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	4/6/2013 13:29	PNM	EPA 200.7	

Abbreviations

ND = Not detected at the corresponding Minimum Reporting Limit.
1 mg/L = one milligram per liter or 1 mg/Kg = one milligram per kilogram = 1 part per million.
1 ug/L = one microgram per liter or 1 ug/Kg = one microgram per kilogram = 1 part per billion.
1 ng/L = one nanogram per liter or 1 ng/Kg = one nanogram per kilogram = 1 part per trillion.

Flag Descriptions

SL-01 = Analysis performed by American West Analytical Labs, 463 W. 3600 S., Salt Lake City, UT 84115.

QM-4X = The spike recovery was outside of QC acceptance limits for the MS and/or MSD due to analyte concentration at 4 times or greater the spike concentration. The QC batch was accepted based on LCS and/or LCSD recoveries within the acceptance limits.

APH = The analysis was performed past the EPA recommended holding time.

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Lab Sample No.: 1303474-04

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	4/29/2013 12:30 PM
Sample Site:	SW-3			***Receipt Date:***	5/1/2013 2:00 PM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	30
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Inorganic							
Total Dissolved Solids (TDS)	996	20	mg/L	5/6/2013 9:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	ND	4	mg/L	5/6/2013 0:00	IJH	SM 2540 D	
Metals							
Iron, Total	0.17	0.02	mg/L	5/3/2013 18:55	PNM	EPA 200.7	
Manganese, Total	0.016	0.005	mg/L	5/3/2013 18:55	PNM	EPA 200.7	

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LABORATORIES

Certificate of Analysis

Lab Sample No.: 1303474-05

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	4/29/2013 4:10 PM
Sample Site:	Coyote Seep			***Receipt Date:***	5/1/2013 2:00 PM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	205
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Inorganic							
Total Dissolved Solids (TDS)	2260	20	mg/L	5/6/2013 9:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	69	4	mg/L	5/6/2013 0:00	IJH	SM 2540 D	
Metals							
Iron, Total	0.80	0.02	mg/L	5/7/2013 17:04	PNM	EPA 200.7	
Manganese, Total	0.043	0.005	mg/L	5/7/2013 17:04	PNM	EPA 200.7	

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Lab Sample No.: 1303474-06

Name:	**Alton Coal Development, LLC**	***Mine Code:*** 41	***Sample Date:*** 4/29/2013 7:00 PM
Sample Site:	SW-1A		***Receipt Date:*** 5/1/2013 2:00 PM
Comments:			***Sampler:*** Erik Petersen
Sample Type:	Water		***Site No.:*** 201
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Inorganic							
Total Dissolved Solids (TDS)	868	20	mg/L	5/6/2013 9:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	ND	4	mg/L	5/6/2013 0:00	IJH	SM 2540 D	
Metals							
Iron, Total	0.30	0.02	mg/L	5/3/2013 18:59	PNM	EPA 200.7	
Manganese, Total	0.016	0.005	mg/L	5/3/2013 18:59	PNM	EPA 200.7	

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LABORATORIES

Certificate of Analysis

Lab Sample No.: 1303474-07

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	4/29/2013 3:00 PM
Sample Site:	Kanab Creek at County Road			***Receipt Date:***	5/1/2013 2:00 PM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	202
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Inorganic							
Total Dissolved Solids (TDS)	988	20	mg/L	5/6/2013 9:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	ND	4	mg/L	5/6/2013 0:00	IJH	SM 2540 D	
Metals							
Iron, Total	0.30	0.02	mg/L	5/3/2013 19:03	PNM	EPA 200.7	
Manganese, Total	0.016	0.005	mg/L	5/3/2013 19:03	PNM	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1303475-03

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 4/29/2013 1:00 PM
Sample Site:	SW-11		**Receipt Date:** 5/1/2013 2:00 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 214
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	34.2	0.01	meq/L	5/14/2013 7:45	PNM	SM 1030 E	
Cation/Anion Balance	0.2		%	5/14/2013 7:45	PNM	SM 1030 E	
Cations, Total	34.4	0.01	meq/L	5/14/2013 7:45	PNM	SM 1030 E	
Hardness, Total as CaCO3	1560	1	mg/L	5/14/2013 7:45	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	5/13/2013 11:30	RMC	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	357	1.0	mg/L	5/13/2013 10:00	RMC	SM 2320 B	
Alkalinity - Carbonate (CO3)	2.0	1.0	mg/L	5/13/2013 10:00	RMC	SM 2320 B	
Alkalinity - CO2	256	1.0	mg/L	5/13/2013 10:00	RMC	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	5/13/2013 10:00	RMC	SM 2320 B	
Alkalinity - Total (as CaCO3)	297	1.0	mg/L	5/13/2013 10:00	RMC	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	5/4/2013 9:30	TSM	SM 4500 NH3-D	
Chloride	29.0	1.0	mg/L	5/2/2013 16:00	TSM	SM 4500 Cl C	
Fluoride	ND	0.5	mg/L	5/19/2013 14:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	5/2/2013 11:00	KSL	SM 4500 NO3-F	
Oil & Grease (HEM)	ND	5	mg/L	5/13/2013 0:00	FJ	EPA 1664A	
Phosphorus, Total as P	0.05	0.01	mg/L	5/6/2013 12:00	TSM	SM 4500 PB5E	
Sulfate	1320	250	mg/L	5/3/2013 11:00	TSM	SM 4500 SO4-E	
Total Dissolved Solids (TDS)	2300	20	mg/L	5/6/2013 9:00	SPH	SM 2540 C	
Total Suspended Solids (TSS)	31	4	mg/L	5/6/2013 0:00	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	5/3/2013 16:55	PNM	EPA 200.7	
Aluminum, Total	0.2	0.05	mg/L	5/7/2013 18:45	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	5/3/2013 16:55	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	5/7/2013 18:45	PNM	EPA 200.7	
Boron, Dissolved	0.11	0.05	mg/L	5/3/2013 16:55	PNM	EPA 200.7	
Boron, Total	0.14	0.05	mg/L	5/7/2013 18:45	PNM	EPA 200.7	
Barium, Dissolved	0.025	0.005	mg/L	5/3/2013 16:55	PNM	EPA 200.7	
Calcium, Dissolved	101	0.2	mg/L	5/3/2013 16:55	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	5/3/2013 16:55	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	5/3/2013 16:55	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	5/3/2013 16:55	PNM	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	5/3/2013 16:55	PNM	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1303475-03

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 4/29/2013 1:00 PM
Sample Site:	SW-11		**Receipt Date:** 5/1/2013 2:00 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 214
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	0.27	0.02	mg/L	5/7/2013 18:45	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	5/3/2013 16:55	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	5/7/2013 18:45	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	5/6/2013 8:39	AWL	EPA 245.1	SL-01
Magnesium, Dissolved	317	0.2	mg/L	5/3/2013 16:55	PNM	EPA 200.7	
Manganese, Dissolved	ND	0.005	mg/L	5/3/2013 16:55	PNM	EPA 200.7	
Manganese, Total	0.006	0.005	mg/L	5/7/2013 18:45	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	5/3/2013 16:55	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	5/3/2013 16:55	PNM	EPA 200.7	
Potassium, Dissolved	7.2	0.5	mg/L	5/3/2013 16:55	PNM	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	5/3/2013 16:55	PNM	EPA 200.7	
Selenium, Total	0.02	0.02	mg/L	5/7/2013 18:45	PNM	EPA 200.7	
Sodium, Dissolved	69.9	0.5	mg/L	5/3/2013 16:55	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	5/3/2013 16:55	PNM	EPA 200.7	

Abbreviations

ND = Not detected at the corresponding Minimum Reporting Limit.
1 mg/L = one milligram per liter or 1 mg/Kg = one milligram per kilogram = 1 part per million.
1 ug/L = one microgram per liter or 1 ug/Kg = one microgram per kilogram = 1 part per billion.
1 ng/L = one nanogram per liter or 1 ng/Kg = one nanogram per kilogram = 1 part per trillion.

Flag Descriptions

SL-01 = Analysis performed by American West Analytical Labs, 463 W. 3600 S., Salt Lake City, UT 84115.

QM-4X = The spike recovery was outside of QC acceptance limits for the MS and/or MSD due to analyte concentration at 4 times or greater the spike concentration. The QC batch was accepted based on LCS and/or LCSD recoveries within the acceptance limits.

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1304574-06

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 5/31/2013 9:30 PM
Sample Site:	Coyote Seep		**Receipt Date:** 6/4/2013 10:58 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 205
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	44.6	0.01	meq/L	7/2/2013 14:00	PNM	SM 1030 E	
Cation/Anion Balance	-6.7		%	7/2/2013 14:00	PNM	SM 1030 E	
Cations, Total	39.0	0.01	meq/L	7/2/2013 14:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	1840	1	mg/L	7/2/2013 14:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	6/13/2013 15:00	RMC	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	453	1.0	mg/L	6/13/2013 12:10	RMC	SM 2320 B	
Alkalinity - Carbonate (CO3)	2.0	1.0	mg/L	6/13/2013 12:10	RMC	SM 2320 B	
Alkalinity - CO2	329	1.0	mg/L	6/13/2013 12:10	RMC	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	6/13/2013 12:10	RMC	SM 2320 B	
Alkalinity - Total (as CaCO3)	375	1.0	mg/L	6/13/2013 12:10	RMC	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	6/11/2013 7:00	TSM	SM 4500 NH3-D	
Chloride	22	2	mg/L	6/4/2013 17:00	TSM	EPA 300.0	
Fluoride	ND	0.2	mg/L	6/4/2013 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	6/13/2013 14:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.02	0.01	mg/L	6/6/2013 7:00	TSM	SM 4500 PB5E	
Sulfate	1760	10	mg/L	6/4/2013 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	2590	20	mg/L	6/10/2013 0:00	JSH	SM 2540 C	APH
Total Suspended Solids (TSS)	16	4	mg/L	6/7/2013 0:00	JSH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	6/7/2013 17:50	PNM	EPA 200.7	
Aluminum, Total	0.2	0.05	mg/L	6/12/2013 18:19	PNM	EPA 200.7	
Arsenic, Dissolved	0.05	0.05	mg/L	6/7/2013 17:50	PNM	EPA 200.7	
Arsenic, Total	0.05	0.05	mg/L	6/12/2013 18:19	PNM	EPA 200.7	
Boron, Dissolved	0.10	0.05	mg/L	6/7/2013 17:50	PNM	EPA 200.7	
Boron, Total	0.11	0.05	mg/L	6/12/2013 18:19	PNM	EPA 200.7	
Barium, Dissolved	0.027	0.005	mg/L	6/7/2013 17:50	PNM	EPA 200.7	
Calcium, Dissolved	148	0.2	mg/L	6/7/2013 17:50	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	6/7/2013 17:50	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	6/7/2013 17:50	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	6/7/2013 17:50	PNM	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	6/7/2013 17:50	PNM	EPA 200.7	
Iron, Total	0.90	0.02	mg/L	6/12/2013 18:19	PNM	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1304574-06

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 5/31/2013 9:30 PM
Sample Site:	Coyote Seep		**Receipt Date:** 6/4/2013 10:58 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 205
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Lead, Dissolved	0.02	0.02	mg/L	6/7/2013 17:50	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	6/12/2013 18:19	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	6/8/2013 11:48	AWL	EPA 245.1	SL-01
Magnesium, Dissolved	356	0.2	mg/L	6/7/2013 17:50	PNM	EPA 200.7	
Manganese, Dissolved	0.041	0.005	mg/L	6/7/2013 17:50	PNM	EPA 200.7	
Manganese, Total	0.101	0.005	mg/L	6/12/2013 18:19	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	6/7/2013 17:50	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	6/7/2013 17:50	PNM	EPA 200.7	
Potassium, Dissolved	2.2	0.5	mg/L	6/7/2013 17:50	PNM	EPA 200.7	
Selenium, Dissolved	0.04	0.02	mg/L	6/7/2013 17:50	PNM	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	6/12/2013 18:19	PNM	EPA 200.7	
Sodium, Dissolved	52.3	0.5	mg/L	6/7/2013 17:50	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	6/7/2013 17:50	PNM	EPA 200.7	

Abbreviations

ND = Not detected at the corresponding Minimum Reporting Limit.
1 mg/L = one milligram per liter or 1 mg/Kg = one milligram per kilogram = 1 part per million.
1 ug/L = one microgram per liter or 1 ug/Kg = one microgram per kilogram = 1 part per billion.
1 ng/L = one nanogram per liter or 1 ng/Kg = one nanogram per kilogram = 1 part per trillion.

Flag Descriptions

SL-01 = Analysis performed by American West Analytical Labs, 463 W. 3600 S., Salt Lake City, UT 84115.

APH = The analysis was performed past the EPA recommended holding time.

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CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1304814-07

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 6/5/2013 9:00 PM
Sample Site:	DRAFT: Y-103		**Receipt Date:** 6/7/2013 10:37 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 203
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
DRAFT: Calculations							
Anions, Total	53.7	0.01	meq/L	7/2/2013 13:35	PNM	SM 1030 E	
Cation/Anion Balance	-2.0		%	7/2/2013 13:35	PNM	SM 1030 E	
Cations, Total	51.7	0.01	meq/L	7/2/2013 13:35	PNM	SM 1030 E	
Hardness, Total as CaCO3	2510	1	mg/L	7/2/2013 13:35	PNM	SM 2340 B	
DRAFT: Inorganic							
Acidity	ND	5.0	mg/L	6/19/2013 10:38	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	903	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - CO2	660	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	741	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	6/13/2013 8:00	TSM	SM 4500 NH3-D	
Chloride	10	2	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Fluoride	0.3	0.2	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	6/13/2013 14:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.02	0.01	mg/L	6/16/2013 11:00	TSM	SM 4500 PB5E	
Sulfate	1860	20	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	3240	20	mg/L	6/12/2013 11:00	JSH	SM 2540 C	
Total Suspended Solids (TSS)	170	20	mg/L	6/12/2013 11:00	IJH	SM 2540 D	
DRAFT: Metals							
Aluminum, Dissolved	ND	0.05	mg/L	6/26/2013 11:47	AKL	EPA 200.7	
Aluminum, Total	1.1	0.05	mg/L	6/19/2013 12:12	AKL	EPA 200.7	
Arsenic, Dissolved	0.06	0.05	mg/L	6/26/2013 11:47	AKL	EPA 200.7	
Arsenic, Total	0.06	0.05	mg/L	6/19/2013 12:12	AKL	EPA 200.7	
Boron, Dissolved	0.08	0.05	mg/L	6/26/2013 11:47	AKL	EPA 200.7	
Boron, Total	0.09	0.05	mg/L	6/19/2013 12:12	AKL	EPA 200.7	
Barium, Dissolved	0.011	0.005	mg/L	6/26/2013 11:47	AKL	EPA 200.7	
Calcium, Dissolved	324	0.2	mg/L	6/26/2013 11:47	AKL	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	6/26/2013 11:47	AKL	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	6/26/2013 11:47	AKL	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	6/26/2013 11:47	AKL	EPA 200.7	
Iron, Dissolved	2.35	0.02	mg/L	6/26/2013 11:47	AKL	EPA 200.7	
Iron, Total	15.5	0.02	mg/L	6/19/2013 12:12	AKL	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1304814-07

Name:	**Alton Coal Development, LLC**	***Mine Code:*** 41	***Sample Date:*** 6/5/2013 9:00 PM
Sample Site:	DRAFT: Y-103		***Receipt Date:*** 6/7/2013 10:37 AM
Comments:			***Sampler:*** Erik Petersen
Sample Type:	Water		***Site No.:*** 203
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
DRAFT: Metals							
Lead, Dissolved	ND	0.02	mg/L	6/26/2013 11:47	AKL	EPA 200.7	
Lead, Total	ND	0.02	mg/L	6/19/2013 12:12	AKL	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	7/1/2013 8:46	AWL	EPA 245.1	SL-01
Magnesium, Dissolved	413	0.2	mg/L	6/26/2013 11:47	AKL	EPA 200.7	
Manganese, Dissolved	0.083	0.005	mg/L	6/26/2013 11:47	AKL	EPA 200.7	
Manganese, Total	0.131	0.005	mg/L	6/19/2013 12:12	AKL	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	6/26/2013 11:47	AKL	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	6/26/2013 11:47	AKL	EPA 200.7	
Potassium, Dissolved	14.7	0.5	mg/L	6/26/2013 11:47	AKL	EPA 200.7	
Selenium, Dissolved	0.03	0.02	mg/L	6/26/2013 11:47	AKL	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	7/2/2013 13:54	AKL	EPA 200.7	
Sodium, Dissolved	22.9	0.5	mg/L	6/26/2013 11:47	AKL	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	6/26/2013 11:47	AKL	EPA 200.7	

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CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1304814-09

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 6/6/2013 11:50 AM
Sample Site:	DRAFT: Kanab Creek at County Road		**Receipt Date:** 6/7/2013 10:37 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 202
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
DRAFT: Calculations							
Anions, Total	14.8	0.01	meq/L	7/2/2013 13:35	PNM	SM 1030 E	
Cation/Anion Balance	-1.4		%	7/2/2013 13:35	PNM	SM 1030 E	
Cations, Total	14.4	0.01	meq/L	7/2/2013 13:35	PNM	SM 1030 E	
Hardness, Total as CaCO3	667	1	mg/L	7/2/2013 13:35	PNM	SM 2340 B	
DRAFT: Inorganic							
Acidity	ND	5.0	mg/L	6/20/2013 8:26	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	436	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	4.0	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - CO2	321	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	365	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	6/13/2013 8:00	TSM	SM 4500 NH3-D	
Chloride	12	1	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	6/13/2013 14:00	KSL	SM 4500 NO3-F	
Oil & Grease (HEM)	ND	5	mg/L	6/20/2013 15:05	QJP	EPA 1664A	
Phosphorus, Total as P	ND	0.01	mg/L	6/16/2013 11:00	TSM	SM 4500 PB5E	
Sulfate	353	5	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	796	20	mg/L	6/12/2013 11:00	JSH	SM 2540 C	
Total Suspended Solids (TSS)	ND	4	mg/L	6/12/2013 11:00	IJH	SM 2540 D	
DRAFT: Metals							
Aluminum, Dissolved	ND	0.05	mg/L	6/26/2013 11:56	AKL	EPA 200.7	
Aluminum, Total	ND	0.05	mg/L	6/19/2013 12:40	AKL	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	6/26/2013 11:56	AKL	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	6/19/2013 12:40	AKL	EPA 200.7	
Boron, Dissolved	0.07	0.05	mg/L	6/26/2013 11:56	AKL	EPA 200.7	
Boron, Total	0.08	0.05	mg/L	6/19/2013 12:40	AKL	EPA 200.7	
Barium, Dissolved	0.083	0.005	mg/L	6/26/2013 11:56	AKL	EPA 200.7	
Calcium, Dissolved	75.8	0.2	mg/L	6/26/2013 11:56	AKL	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	6/26/2013 11:56	AKL	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	6/26/2013 11:56	AKL	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	6/26/2013 11:56	AKL	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	6/26/2013 11:56	AKL	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1304814-09

Name:	**Alton Coal Development, LLC**	***Mine Code:*** 41	***Sample Date:*** 6/6/2013 11:50 AM
Sample Site:	DRAFT: Kanab Creek at County Road		***Receipt Date:*** 6/7/2013 10:37 AM
Comments:			***Sampler:*** Erik Petersen
Sample Type:	Water		***Site No.:*** 202
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
DRAFT: Metals							
Iron, Total	0.11	0.02	mg/L	6/19/2013 12:40	AKL	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	6/26/2013 11:56	AKL	EPA 200.7	
Lead, Total	ND	0.02	mg/L	6/19/2013 12:40	AKL	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	7/1/2013 8:46	AWL	EPA 245.1	SL-01
Magnesium, Dissolved	116	0.2	mg/L	6/26/2013 11:56	AKL	EPA 200.7	
Manganese, Dissolved	ND	0.005	mg/L	6/26/2013 11:56	AKL	EPA 200.7	
Manganese, Total	ND	0.005	mg/L	6/19/2013 12:40	AKL	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	6/26/2013 11:56	AKL	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	6/26/2013 11:56	AKL	EPA 200.7	
Potassium, Dissolved	3.6	0.5	mg/L	6/26/2013 11:56	AKL	EPA 200.7	
Selenium, Dissolved	0.03	0.02	mg/L	6/26/2013 11:56	AKL	EPA 200.7	
Selenium, Total	ND	0.02	mg/L	6/19/2013 12:40	AKL	EPA 200.7	
Sodium, Dissolved	23.0	0.5	mg/L	6/26/2013 11:56	AKL	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	6/26/2013 11:56	AKL	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1304814-10

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 6/6/2013 1:00 PM
Sample Site:	DRAFT: SP7-1		**Receipt Date:** 6/7/2013 10:37 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 203
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
DRAFT: Calculations							
Anions, Total	15.8	0.01	meq/L	7/2/2013 13:35	PNM	SM 1030 E	
Cation/Anion Balance	-1.0		%	7/2/2013 13:35	PNM	SM 1030 E	
Cations, Total	15.5	0.01	meq/L	7/2/2013 13:35	PNM	SM 1030 E	
Hardness, Total as CaCO3	317	1	mg/L	7/2/2013 13:35	PNM	SM 2340 B	
DRAFT: Inorganic							
Acidity	ND	5.0	mg/L	6/20/2013 8:26	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	413	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - CO2	302	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	339	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	6/13/2013 8:00	TSM	SM 4500 NH3-D	
Chloride	10	1	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	6/13/2013 14:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.09	0.01	mg/L	6/16/2013 11:00	TSM	SM 4500 PB5E	
Sulfate	420	5	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	936	20	mg/L	6/12/2013 11:00	JSH	SM 2540 C	
Total Suspended Solids (TSS)	122	20	mg/L	6/12/2013 11:00	IJH	SM 2540 D	
DRAFT: Metals							
Aluminum, Dissolved	ND	0.05	mg/L	6/26/2013 11:59	AKL	EPA 200.7	
Aluminum, Total	0.6	0.05	mg/L	6/19/2013 12:44	AKL	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	6/26/2013 11:59	AKL	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	6/19/2013 12:44	AKL	EPA 200.7	
Boron, Dissolved	0.05	0.05	mg/L	6/26/2013 11:59	AKL	EPA 200.7	
Boron, Total	0.07	0.05	mg/L	6/19/2013 12:44	AKL	EPA 200.7	
Barium, Dissolved	0.054	0.005	mg/L	6/26/2013 11:59	AKL	EPA 200.7	
Calcium, Dissolved	127	0.2	mg/L	6/26/2013 11:59	AKL	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	6/26/2013 11:59	AKL	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	6/26/2013 11:59	AKL	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	6/26/2013 11:59	AKL	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	6/26/2013 11:59	AKL	EPA 200.7	
Iron, Total	3.37	0.02	mg/L	6/19/2013 12:44	AKL	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1304814-10

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 6/6/2013 1:00 PM
Sample Site:	DRAFT: SP7-1		**Receipt Date:** 6/7/2013 10:37 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 203
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
DRAFT: Metals							
Lead, Dissolved	ND	0.02	mg/L	6/26/2013 11:59	AKL	EPA 200.7	
Lead, Total	ND	0.02	mg/L	6/19/2013 12:44	AKL	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	7/1/2013 8:46	AWL	EPA 245.1	SL-01
Magnesium, Dissolved	97.9	0.2	mg/L	6/26/2013 11:59	AKL	EPA 200.7	
Manganese, Dissolved	0.006	0.005	mg/L	6/26/2013 11:59	AKL	EPA 200.7	
Manganese, Total	0.157	0.005	mg/L	6/19/2013 12:44	AKL	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	6/26/2013 11:59	AKL	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	6/26/2013 11:59	AKL	EPA 200.7	
Potassium, Dissolved	3.5	0.5	mg/L	6/26/2013 11:59	AKL	EPA 200.7	
Selenium, Dissolved	0.05	0.02	mg/L	6/26/2013 11:59	AKL	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	6/19/2013 12:44	AKL	EPA 200.7	
Sodium, Dissolved	18.4	0.5	mg/L	6/26/2013 11:59	AKL	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	6/26/2013 11:59	AKL	EPA 200.7	

Abbreviations

ND = Not detected at the corresponding Minimum Reporting Limit.
1 mg/L = one milligram per liter or 1 mg/Kg = one milligram per kilogram = 1 part per million.
1 ug/L = one microgram per liter or 1 ug/Kg = one microgram per kilogram = 1 part per billion.
1 ng/L = one nanogram per liter or 1 ng/Kg = one nanogram per kilogram = 1 part per trillion.

Flag Descriptions

SL-01 = Analysis performed by American West Analytical Labs, 463 W. 3600 S., Salt Lake City, UT 84115.

QM-4X = The spike recovery was outside of QC acceptance limits for the MS and/or MSD due to analyte concentration at 4 times or greater the spike concentration. The QC batch was accepted based on LCS and/or LCSD recoveries within the acceptance limits.

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CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1304815-01

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	6/6/2013 1:30 PM
Sample Site:	SW-1A			***Receipt Date:***	6/7/2013 10:36 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	201
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	10.8	0.01	meq/L	7/5/2013 15:00	PNM	SM 1030 E	
Cation/Anion Balance	0.4		%	7/5/2013 15:00	PNM	SM 1030 E	
Cations, Total	10.9	0.01	meq/L	7/5/2013 15:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	505	1	mg/L	7/5/2013 15:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	6/20/2013 8:26	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	442	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	13.0	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - CO2	335	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	384	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	6/13/2013 8:00	TSM	SM 4500 NH3-D	
Chloride	7	1	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Fluoride	0.3	0.1	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	6/13/2013 14:00	KSL	SM 4500 NO3-F	
Oil & Grease (HEM)	ND	5	mg/L	6/20/2013 15:05	QJP	EPA 1664A	
Phosphorus, Total as P	0.01	0.01	mg/L	6/16/2013 11:00	TSM	SM 4500 PB5E	
Sulfate	160	1	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	544	20	mg/L	6/13/2013 0:00	JSH	SM 2540 C	
Total Suspended Solids (TSS)	ND	4	mg/L	6/13/2013 0:00	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	6/26/2013 12:03	AKL	EPA 200.7	
Aluminum, Total	ND	0.05	mg/L	6/19/2013 12:47	AKL	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	6/26/2013 12:03	AKL	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	6/19/2013 12:47	AKL	EPA 200.7	
Boron, Dissolved	0.06	0.05	mg/L	6/26/2013 12:03	AKL	EPA 200.7	
Boron, Total	0.07	0.05	mg/L	6/19/2013 12:47	AKL	EPA 200.7	
Barium, Dissolved	0.153	0.005	mg/L	6/26/2013 12:03	AKL	EPA 200.7	
Calcium, Dissolved	57.8	0.2	mg/L	6/26/2013 12:03	AKL	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	6/26/2013 12:03	AKL	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	6/26/2013 12:03	AKL	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	6/26/2013 12:03	AKL	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1304815-01

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	6/6/2013 1:30 PM
Sample Site:	SW-1A			***Receipt Date:***	6/7/2013 10:36 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	201
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Dissolved	ND	0.02	mg/L	6/26/2013 12:03	AKL	EPA 200.7	
Iron, Total	0.19	0.02	mg/L	6/19/2013 12:47	AKL	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	6/26/2013 12:03	AKL	EPA 200.7	
Lead, Total	ND	0.02	mg/L	6/19/2013 12:47	AKL	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	7/1/2013 8:46	AWL	EPA 245.1	SL-01
Magnesium, Dissolved	87.7	0.2	mg/L	6/26/2013 12:03	AKL	EPA 200.7	
Manganese, Dissolved	ND	0.005	mg/L	6/26/2013 12:03	AKL	EPA 200.7	
Manganese, Total	0.006	0.005	mg/L	6/19/2013 12:47	AKL	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	6/26/2013 12:03	AKL	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	6/26/2013 12:03	AKL	EPA 200.7	
Potassium, Dissolved	3.0	0.5	mg/L	6/26/2013 12:03	AKL	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	6/26/2013 12:03	AKL	EPA 200.7	
Selenium, Total	0.02	0.02	mg/L	6/19/2013 12:47	AKL	EPA 200.7	
Sodium, Dissolved	15.6	0.5	mg/L	6/26/2013 12:03	AKL	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	6/26/2013 12:03	AKL	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1304815-02

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 6/6/2013 3:00 PM
Sample Site:	Y-70		**Receipt Date:** 6/7/2013 10:36 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 225
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	45.2	0.01	meq/L	7/2/2013 13:35	PNM	SM 1030 E	
Cation/Anion Balance	-0.4		%	7/2/2013 13:35	PNM	SM 1030 E	
Cations, Total	44.9	0.01	meq/L	7/2/2013 13:35	PNM	SM 1030 E	
Hardness, Total as CaCO3	1690	1	mg/L	7/2/2013 13:35	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	6/20/2013 8:26	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	589	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - CO2	436	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	484	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Ammonia as N	1.4	0.2	mg/L	6/13/2013 8:00	TSM	SM 4500 NH3-D	
Chloride	59	2	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Fluoride	0.5	0.2	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	6/13/2013 14:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.14	0.01	mg/L	6/16/2013 11:00	TSM	SM 4500 PB5E	
Sulfate	1630	10	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	2940	20	mg/L	6/13/2013 0:00	JSH	SM 2540 C	
Total Suspended Solids (TSS)	130	20	mg/L	6/13/2013 0:00	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	6/26/2013 12:07	AKL	EPA 200.7	
Aluminum, Total	0.5	0.05	mg/L	6/19/2013 12:51	AKL	EPA 200.7	
Arsenic, Dissolved	0.06	0.05	mg/L	6/26/2013 12:07	AKL	EPA 200.7	
Arsenic, Total	0.05	0.05	mg/L	6/19/2013 12:51	AKL	EPA 200.7	
Boron, Dissolved	0.22	0.05	mg/L	6/26/2013 12:07	AKL	EPA 200.7	
Boron, Total	0.24	0.05	mg/L	6/19/2013 12:51	AKL	EPA 200.7	
Barium, Dissolved	0.017	0.005	mg/L	6/26/2013 12:07	AKL	EPA 200.7	
Calcium, Dissolved	301	0.2	mg/L	6/26/2013 12:07	AKL	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	6/26/2013 12:07	AKL	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	6/26/2013 12:07	AKL	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	6/26/2013 12:07	AKL	EPA 200.7	
Iron, Dissolved	0.48	0.02	mg/L	6/26/2013 12:07	AKL	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1304815-02

Name:	Alton Coal Development, LLC	**Mine Code:**	41	**Sample Date:**	6/6/2013 3:00 PM
Sample Site:	Y-70			**Receipt Date:**	6/7/2013 10:36 AM
Comments:				**Sampler:**	Erik Petersen
Sample Type:	Water			**Site No.:**	225
Field pH:		**Field Temp. Deg. C :**			
Field Flow g/Min.:		**Field Cond. umhos/cm:**			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	8.45	0.02	mg/L	6/19/2013 12:51	AKL	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	6/26/2013 12:07	AKL	EPA 200.7	
Lead, Total	ND	0.02	mg/L	6/19/2013 12:51	AKL	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	7/1/2013 8:46	AWL	EPA 245.1	SL-01
Magnesium, Dissolved	228	0.2	mg/L	6/26/2013 12:07	AKL	EPA 200.7	
Manganese, Dissolved	0.497	0.005	mg/L	6/26/2013 12:07	AKL	EPA 200.7	
Manganese, Total	0.542	0.005	mg/L	6/19/2013 12:51	AKL	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	6/26/2013 12:07	AKL	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	6/26/2013 12:07	AKL	EPA 200.7	
Potassium, Dissolved	8.8	0.5	mg/L	6/26/2013 12:07	AKL	EPA 200.7	
Selenium, Dissolved	0.04	0.02	mg/L	6/26/2013 12:07	AKL	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	6/19/2013 12:51	AKL	EPA 200.7	
Sodium, Dissolved	240	0.5	mg/L	6/26/2013 12:07	AKL	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	6/26/2013 12:07	AKL	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1304815-03

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 6/6/2013 3:30 PM
Sample Site:	NLP-4		**Receipt Date:** 6/7/2013 10:36 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 225
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	22.9	0.01	meq/L	7/2/2013 13:35	PNM	SM 1030 E	
Cation/Anion Balance	7.6		%	7/2/2013 13:35	PNM	SM 1030 E	
Cations, Total	26.7	0.01	meq/L	7/2/2013 13:35	PNM	SM 1030 E	
Hardness, Total as CaCO3	1260	1	mg/L	7/2/2013 13:35	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	6/20/2013 8:26	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	336	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - CO2	250	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	276	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	6/13/2013 8:00	TSM	SM 4500 NH3-D	
Chloride	14	1	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Fluoride	0.3	0.1	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	6/13/2013 14:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.25	0.05	mg/L	6/16/2013 11:00	TSM	SM 4500 PB5E	
Sulfate	817	5	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1480	100	mg/L	6/13/2013 0:00	JSH	SM 2540 C	
Total Suspended Solids (TSS)	3080	33	mg/L	6/13/2013 0:00	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	6/26/2013 12:11	AKL	EPA 200.7	
Aluminum, Total	5.1	0.05	mg/L	6/19/2013 12:55	AKL	EPA 200.7	
Arsenic, Dissolved	0.05	0.05	mg/L	6/26/2013 12:11	AKL	EPA 200.7	
Arsenic, Total	0.07	0.05	mg/L	6/19/2013 12:55	AKL	EPA 200.7	
Boron, Dissolved	0.09	0.05	mg/L	6/26/2013 12:11	AKL	EPA 200.7	
Boron, Total	0.10	0.05	mg/L	6/19/2013 12:55	AKL	EPA 200.7	
Barium, Dissolved	0.018	0.005	mg/L	6/26/2013 12:11	AKL	EPA 200.7	
Calcium, Dissolved	198	0.2	mg/L	6/26/2013 12:11	AKL	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	6/26/2013 12:11	AKL	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	6/26/2013 12:11	AKL	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	6/26/2013 12:11	AKL	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	6/26/2013 12:11	AKL	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1304815-03

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	6/6/2013 3:30 PM
Sample Site:	NLP-4			***Receipt Date:***	6/7/2013 10:36 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	225
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	20.4	0.02	mg/L	6/19/2013 12:55	AKL	EPA 200.7	
Lead, Dissolved	0.02	0.02	mg/L	6/26/2013 12:11	AKL	EPA 200.7	
Lead, Total	0.03	0.02	mg/L	6/19/2013 12:55	AKL	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	7/1/2013 8:46	AWL	EPA 245.1	SL-01
Magnesium, Dissolved	187	0.2	mg/L	6/26/2013 12:11	AKL	EPA 200.7	
Manganese, Dissolved	0.150	0.005	mg/L	6/26/2013 12:11	AKL	EPA 200.7	
Manganese, Total	0.465	0.005	mg/L	6/19/2013 12:55	AKL	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	6/26/2013 12:11	AKL	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	6/26/2013 12:11	AKL	EPA 200.7	
Potassium, Dissolved	6.0	0.5	mg/L	6/26/2013 12:11	AKL	EPA 200.7	
Selenium, Dissolved	0.04	0.02	mg/L	6/26/2013 12:11	AKL	EPA 200.7	
Selenium, Total	0.04	0.02	mg/L	6/19/2013 12:55	AKL	EPA 200.7	
Sodium, Dissolved	28.9	0.5	mg/L	6/26/2013 12:11	AKL	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	6/26/2013 12:11	AKL	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1304815-04

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 6/6/2013 4:15 PM
Sample Site:	NLP-3		**Receipt Date:** 6/7/2013 10:36 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 225
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	19.8	0.01	meq/L	7/2/2013 13:35	PNM	SM 1030 E	
Cation/Anion Balance	4.1		%	7/2/2013 13:35	PNM	SM 1030 E	
Cations, Total	21.5	0.01	meq/L	7/2/2013 13:35	PNM	SM 1030 E	
Hardness, Total as CaCO3	944	1	mg/L	7/2/2013 13:35	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	6/20/2013 8:26	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	718	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - CO2	527	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	589	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	6/13/2013 8:00	TSM	SM 4500 NH3-D	
Chloride	5	1	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	6/13/2013 14:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.14	0.05	mg/L	6/16/2013 11:00	TSM	SM 4500 PB5E	
Sulfate	380	5	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1200	100	mg/L	6/13/2013 0:00	JSH	SM 2540 C	
Total Suspended Solids (TSS)	6100	50	mg/L	6/13/2013 0:00	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	6/26/2013 12:15	AKL	EPA 200.7	
Aluminum, Total	7.6	0.05	mg/L	6/19/2013 12:59	AKL	EPA 200.7	
Arsenic, Dissolved	0.05	0.05	mg/L	6/26/2013 12:15	AKL	EPA 200.7	
Arsenic, Total	0.07	0.05	mg/L	6/19/2013 12:59	AKL	EPA 200.7	
Boron, Dissolved	0.10	0.05	mg/L	6/26/2013 12:15	AKL	EPA 200.7	
Boron, Total	0.11	0.05	mg/L	6/19/2013 12:59	AKL	EPA 200.7	
Barium, Dissolved	0.025	0.005	mg/L	6/26/2013 12:15	AKL	EPA 200.7	
Calcium, Dissolved	172	0.2	mg/L	6/26/2013 12:15	AKL	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	6/26/2013 12:15	AKL	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	6/26/2013 12:15	AKL	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	6/26/2013 12:15	AKL	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	6/26/2013 12:15	AKL	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1304815-04

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	6/6/2013 4:15 PM
Sample Site:	NLP-3			***Receipt Date:***	6/7/2013 10:36 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	225
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	28.5	0.02	mg/L	6/19/2013 12:59	AKL	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	6/26/2013 12:15	AKL	EPA 200.7	
Lead, Total	0.03	0.02	mg/L	6/19/2013 12:59	AKL	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	7/1/2013 8:46	AWL	EPA 245.1	SL-01
Magnesium, Dissolved	125	0.2	mg/L	6/26/2013 12:15	AKL	EPA 200.7	
Manganese, Dissolved	0.224	0.005	mg/L	6/26/2013 12:15	AKL	EPA 200.7	
Manganese, Total	0.650	0.005	mg/L	6/19/2013 12:59	AKL	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	6/26/2013 12:15	AKL	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	6/26/2013 12:15	AKL	EPA 200.7	
Potassium, Dissolved	7.7	0.5	mg/L	6/26/2013 12:15	AKL	EPA 200.7	
Selenium, Dissolved	0.03	0.02	mg/L	6/26/2013 12:15	AKL	EPA 200.7	
Selenium, Total	0.02	0.02	mg/L	6/19/2013 12:59	AKL	EPA 200.7	
Sodium, Dissolved	21.3	0.5	mg/L	6/26/2013 12:15	AKL	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	6/26/2013 12:15	AKL	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1304815-05

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 6/6/2013 5:00 PM
Sample Site:	NLP-2		**Receipt Date:** 6/7/2013 10:36 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 225
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	60.6	0.01	meq/L	7/2/2013 13:35	PNM	SM 1030 E	
Cation/Anion Balance	-4.9		%	7/2/2013 13:35	PNM	SM 1030 E	
Cations, Total	54.9	0.01	meq/L	7/2/2013 13:35	PNM	SM 1030 E	
Hardness, Total as CaCO3	2130	1	mg/L	7/2/2013 13:35	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	6/20/2013 8:26	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	966	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - CO2	708	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	792	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Ammonia as N	1.0	0.2	mg/L	6/13/2013 8:00	TSM	SM 4500 NH3-D	
Chloride	149	2	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Fluoride	0.5	0.2	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	0.1	0.1	mg/L	6/13/2013 14:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	1.2	0.05	mg/L	6/16/2013 11:00	TSM	SM 4500 PB5E	
Sulfate	1950	20	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	8740	100	mg/L	6/13/2013 0:00	JSH	SM 2540 C	
Total Suspended Solids (TSS)	7720	33	mg/L	6/13/2013 0:00	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	6/26/2013 12:19	AKL	EPA 200.7	
Aluminum, Total	16.9	0.05	mg/L	6/19/2013 13:03	AKL	EPA 200.7	
Arsenic, Dissolved	0.05	0.05	mg/L	6/26/2013 12:19	AKL	EPA 200.7	
Arsenic, Total	0.07	0.05	mg/L	6/19/2013 13:03	AKL	EPA 200.7	
Boron, Dissolved	0.12	0.05	mg/L	6/26/2013 12:19	AKL	EPA 200.7	
Boron, Total	0.14	0.05	mg/L	6/19/2013 13:03	AKL	EPA 200.7	
Barium, Dissolved	0.026	0.005	mg/L	6/26/2013 12:19	AKL	EPA 200.7	
Calcium, Dissolved	241	0.2	mg/L	6/26/2013 12:19	AKL	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	6/26/2013 12:19	AKL	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	6/26/2013 12:19	AKL	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	6/26/2013 12:19	AKL	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	6/26/2013 12:19	AKL	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1304815-05

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	6/6/2013 5:00 PM
Sample Site:	NLP-2			***Receipt Date:***	6/7/2013 10:36 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	225
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	47.0	0.02	mg/L	6/19/2013 13:03	AKL	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	6/26/2013 12:19	AKL	EPA 200.7	
Lead, Total	0.06	0.02	mg/L	6/19/2013 13:03	AKL	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	7/1/2013 8:46	AWL	EPA 245.1	SL-01
Magnesium, Dissolved	371	0.2	mg/L	6/26/2013 12:19	AKL	EPA 200.7	
Manganese, Dissolved	0.058	0.005	mg/L	6/26/2013 12:19	AKL	EPA 200.7	
Manganese, Total	0.984	0.005	mg/L	6/19/2013 13:03	AKL	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	6/26/2013 12:19	AKL	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	6/26/2013 12:19	AKL	EPA 200.7	
Potassium, Dissolved	5.0	0.5	mg/L	6/26/2013 12:19	AKL	EPA 200.7	
Selenium, Dissolved	0.03	0.02	mg/L	6/26/2013 12:19	AKL	EPA 200.7	
Selenium, Total	0.04	0.02	mg/L	6/19/2013 13:03	AKL	EPA 200.7	
Sodium, Dissolved	223	0.5	mg/L	6/26/2013 12:19	AKL	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	6/26/2013 12:19	AKL	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1304815-06

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 6/6/2013 5:45 PM
Sample Site:	NLP-1		**Receipt Date:** 6/7/2013 10:36 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 225
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	50.7	0.01	meq/L	7/2/2013 13:35	PNM	SM 1030 E	
Cation/Anion Balance	-4.6		%	7/2/2013 13:35	PNM	SM 1030 E	
Cations, Total	46.3	0.01	meq/L	7/2/2013 13:35	PNM	SM 1030 E	
Hardness, Total as CaCO3	2080	1	mg/L	7/2/2013 13:35	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	6/20/2013 8:26	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	986	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - CO2	734	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	809	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Ammonia as N	0.3	0.2	mg/L	6/13/2013 8:00	TSM	SM 4500 NH3-D	
Chloride	39	2	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Fluoride	0.4	0.2	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	6/13/2013 14:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.15	0.05	mg/L	6/16/2013 11:00	TSM	SM 4500 PB5E	
Sulfate	1610	10	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	2840	20	mg/L	6/13/2013 0:00	JSH	SM 2540 C	
Total Suspended Solids (TSS)	2680	33	mg/L	6/13/2013 0:00	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	6/26/2013 12:23	AKL	EPA 200.7	
Aluminum, Total	8.0	0.05	mg/L	6/19/2013 13:07	AKL	EPA 200.7	
Arsenic, Dissolved	0.06	0.05	mg/L	6/26/2013 12:23	AKL	EPA 200.7	
Arsenic, Total	0.08	0.05	mg/L	6/19/2013 13:07	AKL	EPA 200.7	
Boron, Dissolved	ND	0.05	mg/L	6/26/2013 12:23	AKL	EPA 200.7	
Boron, Total	ND	0.05	mg/L	6/19/2013 13:07	AKL	EPA 200.7	
Barium, Dissolved	0.025	0.005	mg/L	6/26/2013 12:23	AKL	EPA 200.7	
Calcium, Dissolved	297	0.2	mg/L	6/26/2013 12:23	AKL	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	6/26/2013 12:23	AKL	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	6/26/2013 12:23	AKL	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	6/26/2013 12:23	AKL	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	6/26/2013 12:23	AKL	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1304815-06

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	6/6/2013 5:45 PM
Sample Site:	NLP-1			***Receipt Date:***	6/7/2013 10:36 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	225
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	45.2	0.02	mg/L	6/19/2013 13:07	AKL	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	6/26/2013 12:23	AKL	EPA 200.7	
Lead, Total	0.05	0.02	mg/L	6/19/2013 13:07	AKL	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	7/1/2013 8:46	AWL	EPA 245.1	SL-01
Magnesium, Dissolved	326	0.2	mg/L	6/26/2013 12:23	AKL	EPA 200.7	
Manganese, Dissolved	0.076	0.005	mg/L	6/26/2013 12:23	AKL	EPA 200.7	
Manganese, Total	0.641	0.005	mg/L	6/19/2013 13:07	AKL	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	6/26/2013 12:23	AKL	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	6/26/2013 12:23	AKL	EPA 200.7	
Potassium, Dissolved	4.6	0.5	mg/L	6/26/2013 12:23	AKL	EPA 200.7	
Selenium, Dissolved	0.03	0.02	mg/L	6/26/2013 12:23	AKL	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	6/19/2013 13:07	AKL	EPA 200.7	
Sodium, Dissolved	49.1	0.5	mg/L	6/26/2013 12:23	AKL	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	6/26/2013 12:23	AKL	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1304815-07

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 6/6/2013 6:00 PM
Sample Site:	NLP-5		**Receipt Date:** 6/7/2013 10:36 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 225
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	32.3	0.01	meq/L	7/2/2013 13:35	PNM	SM 1030 E	
Cation/Anion Balance	-4.5		%	7/2/2013 13:35	PNM	SM 1030 E	
Cations, Total	29.6	0.01	meq/L	7/2/2013 13:35	PNM	SM 1030 E	
Hardness, Total as CaCO3	1400	1	mg/L	7/2/2013 13:35	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	6/20/2013 8:26	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	644	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - CO2	479	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	529	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	6/13/2013 8:00	TSM	SM 4500 NH3-D	
Chloride	14	1	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	6/13/2013 14:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.14	0.01	mg/L	6/16/2013 11:00	TSM	SM 4500 PB5E	
Sulfate	1030	10	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1950	20	mg/L	6/13/2013 0:00	JSH	SM 2540 C	
Total Suspended Solids (TSS)	392	20	mg/L	6/13/2013 0:00	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	6/26/2013 12:53	AKL	EPA 200.7	
Aluminum, Total	2.1	0.05	mg/L	6/19/2013 13:11	AKL	EPA 200.7	
Arsenic, Dissolved	0.06	0.05	mg/L	6/26/2013 12:53	AKL	EPA 200.7	
Arsenic, Total	0.05	0.05	mg/L	6/19/2013 13:11	AKL	EPA 200.7	
Boron, Dissolved	0.08	0.05	mg/L	6/26/2013 12:53	AKL	EPA 200.7	
Boron, Total	0.10	0.05	mg/L	6/19/2013 13:11	AKL	EPA 200.7	
Barium, Dissolved	0.020	0.005	mg/L	6/26/2013 12:53	AKL	EPA 200.7	
Calcium, Dissolved	224	0.2	mg/L	6/26/2013 12:53	AKL	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	6/26/2013 12:53	AKL	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	6/26/2013 12:53	AKL	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	6/26/2013 12:53	AKL	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	6/26/2013 12:53	AKL	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1304815-07

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	6/6/2013 6:00 PM
Sample Site:	NLP-5			***Receipt Date:***	6/7/2013 10:36 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	225
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	5.98	0.02	mg/L	6/19/2013 13:11	AKL	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	6/26/2013 12:53	AKL	EPA 200.7	
Lead, Total	ND	0.02	mg/L	6/19/2013 13:11	AKL	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	7/1/2013 8:46	AWL	EPA 245.1	SL-01
Magnesium, Dissolved	204	0.2	mg/L	6/26/2013 12:53	AKL	EPA 200.7	
Manganese, Dissolved	ND	0.005	mg/L	6/26/2013 12:53	AKL	EPA 200.7	
Manganese, Total	0.162	0.005	mg/L	6/19/2013 13:11	AKL	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	6/26/2013 12:53	AKL	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	6/26/2013 12:53	AKL	EPA 200.7	
Potassium, Dissolved	4.5	0.5	mg/L	6/26/2013 12:53	AKL	EPA 200.7	
Selenium, Dissolved	0.03	0.02	mg/L	6/26/2013 12:53	AKL	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	6/19/2013 13:11	AKL	EPA 200.7	
Sodium, Dissolved	26.6	0.5	mg/L	6/26/2013 12:53	AKL	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	6/26/2013 12:53	AKL	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1304815-08

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 6/6/2013 7:00 PM
Sample Site:	NLP-7		**Receipt Date:** 6/7/2013 10:36 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 225
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	42.0	0.01	meq/L	7/5/2013 15:00	PNM	SM 1030 E	
Cation/Anion Balance	-22		%	7/5/2013 15:00	PNM	SM 1030 E	A-01a
Cations, Total	27.0	0.01	meq/L	7/5/2013 15:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	936	1	mg/L	7/5/2013 15:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	6/20/2013 8:26	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	1900	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	A-01
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - CO2	1380	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	1560	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	6/13/2013 8:00	TSM	SM 4500 NH3-D	
Chloride	36	1	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Fluoride	0.6	0.1	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	0.7	0.1	mg/L	6/13/2013 14:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	1.6	0.05	mg/L	6/16/2013 11:00	TSM	SM 4500 PB5E	
Sulfate	476	5	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1120	100	mg/L	6/13/2013 0:00	JSH	SM 2540 C	
Total Suspended Solids (TSS)	30300	50	mg/L	6/13/2013 0:00	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	6/26/2013 12:57	AKL	EPA 200.7	
Aluminum, Total	37.5	0.05	mg/L	6/19/2013 13:24	AKL	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	6/26/2013 12:57	AKL	EPA 200.7	
Arsenic, Total	0.09	0.05	mg/L	6/19/2013 13:24	AKL	EPA 200.7	
Boron, Dissolved	0.07	0.05	mg/L	6/26/2013 12:57	AKL	EPA 200.7	
Boron, Total	0.07	0.05	mg/L	6/19/2013 13:24	AKL	EPA 200.7	
Barium, Dissolved	0.022	0.005	mg/L	6/26/2013 12:57	AKL	EPA 200.7	
Calcium, Dissolved	89.5	0.2	mg/L	6/26/2013 12:57	AKL	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	6/26/2013 12:57	AKL	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	6/26/2013 12:57	AKL	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	6/26/2013 12:57	AKL	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	6/26/2013 12:57	AKL	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1304815-08

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	6/6/2013 7:00 PM
Sample Site:	NLP-7			***Receipt Date:***	6/7/2013 10:36 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	225
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	83.0	0.02	mg/L	6/19/2013 13:24	AKL	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	6/26/2013 12:57	AKL	EPA 200.7	
Lead, Total	0.18	0.02	mg/L	6/19/2013 13:24	AKL	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	7/1/2013 8:46	AWL	EPA 245.1	SL-01
Magnesium, Dissolved	173	0.2	mg/L	6/26/2013 12:57	AKL	EPA 200.7	
Manganese, Dissolved	0.226	0.005	mg/L	6/26/2013 12:57	AKL	EPA 200.7	
Manganese, Total	4.75	0.005	mg/L	6/19/2013 13:24	AKL	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	6/26/2013 12:57	AKL	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	6/26/2013 12:57	AKL	EPA 200.7	
Potassium, Dissolved	3.4	0.5	mg/L	6/26/2013 12:57	AKL	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	6/26/2013 12:57	AKL	EPA 200.7	
Selenium, Total	0.02	0.02	mg/L	6/19/2013 13:24	AKL	EPA 200.7	
Sodium, Dissolved	87.3	0.5	mg/L	6/26/2013 12:57	AKL	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	6/26/2013 12:57	AKL	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1304815-09

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 6/6/2013 8:15 PM
Sample Site:	NLP-8		**Receipt Date:** 6/7/2013 10:36 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 225
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	126	0.01	meq/L	7/2/2013 13:35	PNM	SM 1030 E	
Cation/Anion Balance	-3.2		%	7/2/2013 13:35	PNM	SM 1030 E	
Cations, Total	118	0.01	meq/L	7/2/2013 13:35	PNM	SM 1030 E	
Hardness, Total as CaCO3	4580	1	mg/L	7/2/2013 13:35	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	6/20/2013 8:26	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	986	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - CO2	718	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	808	1.0	mg/L	6/18/2013 12:51	KRW	SM 2320 B	
Ammonia as N	0.5	0.2	mg/L	6/13/2013 8:00	TSM	SM 4500 NH3-D	
Chloride	775	25	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Fluoride	ND	0.5	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	0.8	0.1	mg/L	6/13/2013 14:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	1.1	0.05	mg/L	6/16/2013 11:00	TSM	SM 4500 PB5E	
Sulfate	4220	25	mg/L	6/11/2013 18:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	7740	20	mg/L	6/13/2013 0:00	JSH	SM 2540 C	
Total Suspended Solids (TSS)	17000	50	mg/L	6/13/2013 0:00	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	6/26/2013 13:01	AKL	EPA 200.7	
Aluminum, Total	26.7	0.05	mg/L	6/19/2013 13:42	AKL	EPA 200.7	
Arsenic, Dissolved	0.08	0.05	mg/L	6/26/2013 13:01	AKL	EPA 200.7	
Arsenic, Total	0.15	0.05	mg/L	6/19/2013 13:42	AKL	EPA 200.7	
Boron, Dissolved	0.21	0.05	mg/L	6/26/2013 13:01	AKL	EPA 200.7	
Boron, Total	0.16	0.05	mg/L	6/19/2013 13:42	AKL	EPA 200.7	
Barium, Dissolved	0.013	0.005	mg/L	6/26/2013 13:01	AKL	EPA 200.7	
Calcium, Dissolved	475	0.2	mg/L	6/26/2013 13:01	AKL	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	6/26/2013 13:01	AKL	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	6/26/2013 13:01	AKL	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	6/26/2013 13:01	AKL	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	6/26/2013 13:01	AKL	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1304815-09

Name:	Alton Coal Development, LLC	**Mine Code:**	41	**Sample Date:**	6/6/2013 8:15 PM
Sample Site:	NLP-8			**Receipt Date:**	6/7/2013 10:36 AM
Comments:				**Sampler:**	Erik Petersen
Sample Type:	Water			**Site No.:**	225
Field pH:				**Field Temp. Deg. C :**	
Field Flow g/Min.:				**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	122	0.02	mg/L	6/19/2013 13:42	AKL	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	6/26/2013 13:01	AKL	EPA 200.7	
Lead, Total	0.15	0.02	mg/L	6/19/2013 13:42	AKL	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	7/1/2013 8:46	AWL	EPA 245.1	SL-01
Magnesium, Dissolved	825	0.2	mg/L	6/26/2013 13:01	AKL	EPA 200.7	
Manganese, Dissolved	1.74	0.005	mg/L	6/26/2013 13:01	AKL	EPA 200.7	
Manganese, Total	4.76	0.005	mg/L	6/19/2013 13:42	AKL	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	6/26/2013 13:01	AKL	EPA 200.7	
Nickel, Dissolved	0.007	0.005	mg/L	6/26/2013 13:01	AKL	EPA 200.7	
Potassium, Dissolved	14.9	0.5	mg/L	6/26/2013 13:01	AKL	EPA 200.7	
Selenium, Dissolved	0.06	0.02	mg/L	6/26/2013 13:01	AKL	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	6/19/2013 13:42	AKL	EPA 200.7	
Sodium, Dissolved	450	0.5	mg/L	6/26/2013 13:01	AKL	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	6/26/2013 13:01	AKL	EPA 200.7	

Abbreviations

ND = Not detected at the corresponding Minimum Reporting Limit.
1 mg/L = one milligram per liter or 1 mg/Kg = one milligram per kilogram = 1 part per million.
1 ug/L = one microgram per liter or 1 ug/Kg = one microgram per kilogram = 1 part per billion.
1 ng/L = one nanogram per liter or 1 ng/Kg = one nanogram per kilogram = 1 part per trillion.

Flag Descriptions

SL-01 = Analysis performed by American West Analytical Labs, 463 W. 3600 S., Salt Lake City, UT 84115.

A-01a = See alkalinity comment.

A-01 = Because of the extreme amount of sediment in this sample, the alkalinity measurement could not be stabilized; therefore, the alkalinity values are estimates only. This has also created an inequity in the cation/anion balance.

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Certificate of Analysis

Lab Sample No.: 1309804-01

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 9/30/2013 3:50 PM
Sample Site:	SW-3		**Receipt Date:** 10/2/2013 2:10 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 30
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	17.8	0.01	meq/L	10/16/2013 15:00	PNM	SM 1030 E	
Cation/Anion Balance	-4.3		%	10/16/2013 15:00	PNM	SM 1030 E	
Cations, Total	16.3	0.01	meq/L	10/16/2013 15:00	PNM	SM 1030 E	
Inorganic							
Alkalinity - Bicarbonate (HCO3)	440	1.0	mg/L	10/10/2013 17:09	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	10/10/2013 17:09	KRW	SM 2320 B	
Alkalinity - CO2	318	1.0	mg/L	10/10/2013 17:09	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	10/10/2013 17:09	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	361	1.0	mg/L	10/10/2013 17:09	KRW	SM 2320 B	
Chloride	18	1	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	10/11/2013 9:00	KSL	SM 4500 NO3-F	
Oil & Grease (HEM)	ND	5	mg/L	10/8/2013 8:59	QJP	EPA 1664A	
Sulfate	485	5	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	992	20	mg/L	10/7/2013 5:30	JSH	SM 2540 C	
Total Suspended Solids (TSS)	31	4	mg/L	10/3/2013 15:17	IJH	SM 2540 D	
Metals							
Boron, Dissolved	0.09	0.05	mg/L	10/10/2013 22:45	TS	EPA 200.7	
Boron, Total	0.11	0.05	mg/L	10/7/2013 19:56	TS	EPA 200.7	
Calcium, Dissolved	74.6	0.2	mg/L	10/10/2013 22:45	TS	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	10/10/2013 22:45	TS	EPA 200.7	
Iron, Total	0.41	0.02	mg/L	10/7/2013 19:56	TS	EPA 200.7	
Magnesium, Dissolved	136	0.2	mg/L	10/10/2013 22:45	TS	EPA 200.7	
Manganese, Dissolved	ND	0.005	mg/L	10/10/2013 22:45	TS	EPA 200.7	
Manganese, Total	0.018	0.005	mg/L	10/7/2013 19:56	TS	EPA 200.7	
Potassium, Dissolved	6.2	0.5	mg/L	10/10/2013 22:45	TS	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	10/10/2013 22:45	TS	EPA 200.7	
Selenium, Total	0.02	0.02	mg/L	10/7/2013 19:56	TS	EPA 200.7	
Sodium, Dissolved	29.0	0.5	mg/L	10/10/2013 22:45	TS	EPA 200.7	

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Lab Sample No.: 1309804-03

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 9/30/2013 5:00 PM
Sample Site:	Kanab Creek at County Road		**Receipt Date:** 10/2/2013 2:10 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 202
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	17.5	0.01	meq/L	10/16/2013 15:00	PNM	SM 1030 E	
Cation/Anion Balance	-2.0		%	10/16/2013 15:00	PNM	SM 1030 E	
Cations, Total	16.8	0.01	meq/L	10/16/2013 15:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	775	1	mg/L	10/16/2013 15:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	10/14/2013 10:07	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	448	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - CO2	324	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	367	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	10/3/2013 12:30	TSM	SM 4500 NH3-D	
Chloride	17	1	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	10/9/2013 9:00	TJS	SM 4500 NO3-F	
Oil & Grease (HEM)	ND	6	mg/L	10/8/2013 8:59	QJP	EPA 1664A	
Phosphorus, Total as P	ND	0.01	mg/L	10/8/2013 7:00	TSM	SM 4500 PB5E	
Sulfate	467	5	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1020	20	mg/L	10/7/2013 5:30	JSH	SM 2540 C	
Total Suspended Solids (TSS)	ND	4	mg/L	10/5/2013 10:29	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	0.05	0.05	mg/L	10/10/2013 23:09	TS	EPA 200.7	
Aluminum, Total	ND	0.05	mg/L	10/7/2013 20:03	TS	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	10/10/2013 23:09	TS	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	10/7/2013 20:03	TS	EPA 200.7	
Boron, Dissolved	0.10	0.05	mg/L	10/10/2013 23:09	TS	EPA 200.7	
Boron, Total	0.10	0.05	mg/L	10/7/2013 20:03	TS	EPA 200.7	
Barium, Dissolved	0.067	0.005	mg/L	10/10/2013 23:09	TS	EPA 200.7	
Calcium, Dissolved	86.2	0.2	mg/L	10/10/2013 23:09	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	10/10/2013 23:09	TS	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	10/10/2013 23:09	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	10/10/2013 23:09	TS	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	10/10/2013 23:09	TS	EPA 200.7	

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Lab Sample No.: 1309804-03

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	9/30/2013 5:00 PM
Sample Site:	Kanab Creek at County Road			***Receipt Date:***	10/2/2013 2:10 PM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	202
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	0.06	0.02	mg/L	10/7/2013 20:03	TS	EPA 200.7	
Lead, Dissolved	0.03	0.02	mg/L	10/10/2013 23:09	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	10/7/2013 20:03	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	10/15/2013 14:43	AKL	EPA 245.1	
Magnesium, Dissolved	136	0.2	mg/L	10/10/2013 23:09	TS	EPA 200.7	
Manganese, Dissolved	0.005	0.005	mg/L	10/10/2013 23:09	TS	EPA 200.7	
Manganese, Total	0.007	0.005	mg/L	10/7/2013 20:03	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	10/10/2013 23:09	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	10/10/2013 23:09	TS	EPA 200.7	
Potassium, Dissolved	5.4	0.5	mg/L	10/10/2013 23:09	TS	EPA 200.7	
Selenium, Dissolved	ND	0.02	mg/L	10/10/2013 23:09	TS	EPA 200.7	
Selenium, Total	ND	0.02	mg/L	10/7/2013 20:03	TS	EPA 200.7	
Sodium, Dissolved	27.9	0.5	mg/L	10/10/2013 23:09	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	10/10/2013 23:09	TS	EPA 200.7	

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Lab Sample No.: 1309804-07

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 9/30/2013 7:30 PM
Sample Site:	SW-1A		**Receipt Date:** 10/2/2013 2:10 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 201
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	14.7	0.01	meq/L	10/16/2013 15:00	PNM	SM 1030 E	
Cation/Anion Balance	-1.5		%	10/16/2013 15:00	PNM	SM 1030 E	
Cations, Total	14.3	0.01	meq/L	10/16/2013 15:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	660	1	mg/L	10/16/2013 15:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	10/14/2013 10:07	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	490	1.0	mg/L	10/10/2013 17:09	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	10/10/2013 17:09	KRW	SM 2320 B	
Alkalinity - CO2	355	1.0	mg/L	10/10/2013 17:09	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	10/10/2013 17:09	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	402	1.0	mg/L	10/10/2013 17:09	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	10/3/2013 12:30	TSM	SM 4500 NH3-D	
Chloride	12	1	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Fluoride	0.3	0.1	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	10/9/2013 9:00	TJS	SM 4500 NO3-F	
Oil & Grease (HEM)	ND	6	mg/L	10/8/2013 8:59	QJP	EPA 1664A	
Phosphorus, Total as P	ND	0.01	mg/L	10/8/2013 7:00	TSM	SM 4500 PB5E	
Sulfate	306	2	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	876	20	mg/L	10/7/2013 5:30	JSH	SM 2540 C	
Total Suspended Solids (TSS)	ND	4	mg/L	10/5/2013 10:29	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	0.06	0.05	mg/L	10/10/2013 23:28	TS	EPA 200.7	
Aluminum, Total	ND	0.05	mg/L	10/16/2013 22:33	TS	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	10/10/2013 23:28	TS	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	10/16/2013 22:33	TS	EPA 200.7	
Boron, Dissolved	0.10	0.05	mg/L	10/10/2013 23:28	TS	EPA 200.7	
Boron, Total	ND	0.05	mg/L	10/16/2013 22:33	TS	EPA 200.7	
Barium, Dissolved	0.105	0.005	mg/L	10/10/2013 23:28	TS	EPA 200.7	
Calcium, Dissolved	78.1	0.2	mg/L	10/10/2013 23:28	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	10/10/2013 23:28	TS	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	10/10/2013 23:28	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	10/10/2013 23:28	TS	EPA 200.7	
Iron, Dissolved	0.02	0.02	mg/L	10/10/2013 23:28	TS	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1309804-07

Name:	**Alton Coal Development, LLC**	***Mine Code:*** 41	***Sample Date:*** 9/30/2013 7:30 PM
Sample Site:	SW-1A		***Receipt Date:*** 10/2/2013 2:10 PM
Comments:			***Sampler:*** Erik Petersen
Sample Type:	Water		***Site No.:*** 201
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	ND	0.02	mg/L	10/16/2013 22:33	TS	EPA 200.7	
Lead, Dissolved	0.02	0.02	mg/L	10/10/2013 23:28	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	10/16/2013 22:33	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	10/15/2013 14:43	AKL	EPA 245.1	
Magnesium, Dissolved	113	0.2	mg/L	10/10/2013 23:28	TS	EPA 200.7	
Manganese, Dissolved	0.006	0.005	mg/L	10/10/2013 23:28	TS	EPA 200.7	
Manganese, Total	ND	0.005	mg/L	10/16/2013 22:33	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	10/10/2013 23:28	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	10/10/2013 23:28	TS	EPA 200.7	
Potassium, Dissolved	5.2	0.5	mg/L	10/10/2013 23:28	TS	EPA 200.7	
Selenium, Dissolved	ND	0.02	mg/L	10/10/2013 23:28	TS	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	10/16/2013 22:33	TS	EPA 200.7	
Sodium, Dissolved	22.5	0.5	mg/L	10/10/2013 23:28	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	10/10/2013 23:28	TS	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1309804-08

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 9/30/2013 8:45 PM
Sample Site:	Coyote Seep		**Receipt Date:** 10/2/2013 2:10 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 205
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	32.9	0.01	meq/L	10/16/2013 15:00	PNM	SM 1030 E	
Cation/Anion Balance	-2.7		%	10/16/2013 15:00	PNM	SM 1030 E	
Cations, Total	31.2	0.01	meq/L	10/16/2013 15:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	1460	1	mg/L	10/16/2013 15:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	10/14/2013 10:07	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	435	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	16.0	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - CO2	336	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	383	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	10/3/2013 12:30	TSM	SM 4500 NH3-D	
Chloride	22	1	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Fluoride	ND	0.1	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	10/9/2013 9:00	TJS	SM 4500 NO3-F	
Phosphorus, Total as P	0.23	0.01	mg/L	10/8/2013 7:00	TSM	SM 4500 PB5E	
Sulfate	1210	10	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1910	20	mg/L	10/7/2013 5:30	JSH	SM 2540 C	
Total Suspended Solids (TSS)	147	10	mg/L	10/5/2013 10:29	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	0.06	0.05	mg/L	10/10/2013 23:32	TS	EPA 200.7	
Aluminum, Total	0.5	0.05	mg/L	10/7/2013 20:25	TS	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	10/10/2013 23:32	TS	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	10/7/2013 20:25	TS	EPA 200.7	
Boron, Dissolved	0.09	0.05	mg/L	10/10/2013 23:32	TS	EPA 200.7	
Boron, Total	0.10	0.05	mg/L	10/7/2013 20:25	TS	EPA 200.7	
Barium, Dissolved	0.056	0.005	mg/L	10/10/2013 23:32	TS	EPA 200.7	
Calcium, Dissolved	120	0.2	mg/L	10/10/2013 23:32	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	10/10/2013 23:32	TS	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	10/10/2013 23:32	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	10/10/2013 23:32	TS	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	10/10/2013 23:32	TS	EPA 200.7	
Iron, Total	1.93	0.02	mg/L	10/7/2013 20:25	TS	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1309804-08

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 9/30/2013 8:45 PM
Sample Site:	Coyote Seep		**Receipt Date:** 10/2/2013 2:10 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 205
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Lead, Dissolved	0.05	0.02	mg/L	10/10/2013 23:32	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	10/7/2013 20:25	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	10/15/2013 14:43	AKL	EPA 245.1	
Magnesium, Dissolved	282	0.2	mg/L	10/10/2013 23:32	TS	EPA 200.7	
Manganese, Dissolved	0.005	0.005	mg/L	10/10/2013 23:32	TS	EPA 200.7	
Manganese, Total	0.099	0.005	mg/L	10/7/2013 20:25	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	10/10/2013 23:32	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	10/10/2013 23:32	TS	EPA 200.7	
Potassium, Dissolved	6.0	0.5	mg/L	10/10/2013 23:32	TS	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	10/10/2013 23:32	TS	EPA 200.7	
Selenium, Total	ND	0.02	mg/L	10/7/2013 20:25	TS	EPA 200.7	
Sodium, Dissolved	42.0	0.5	mg/L	10/10/2013 23:32	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	10/10/2013 23:32	TS	EPA 200.7	

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Lab Sample No.: 1309804-09

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 9/30/2013 10:10 PM
Sample Site:	Well A Y-103 A6		**Receipt Date:** 10/2/2013 2:10 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:**
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	43.7	0.01	meq/L	10/16/2013 15:00	PNM	SM 1030 E	
Cation/Anion Balance	1.9		%	10/16/2013 15:00	PNM	SM 1030 E	
Cations, Total	45.4	0.01	meq/L	10/16/2013 15:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	2200	1	mg/L	10/16/2013 15:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	10/14/2013 10:07	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	718	1.0	mg/L	10/10/2013 17:09	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	10/10/2013 17:09	KRW	SM 2320 B	
Alkalinity - CO2	523	1.0	mg/L	10/10/2013 17:09	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	10/10/2013 17:09	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	589	1.0	mg/L	10/10/2013 17:09	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	10/3/2013 12:30	TSM	SM 4500 NH3-D	
Chloride	11	2	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Fluoride	0.3	0.2	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	0.1	0.1	mg/L	10/9/2013 9:00	TJS	SM 4500 NO3-F	
Phosphorus, Total as P	0.01	0.01	mg/L	10/8/2013 7:00	TSM	SM 4500 PB5E	
Sulfate	1520	50	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	2850	20	mg/L	10/7/2013 5:30	JSH	SM 2540 C	
Total Suspended Solids (TSS)	49	10	mg/L	10/5/2013 10:29	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	10/10/2013 23:35	TS	EPA 200.7	
Aluminum, Total	0.2	0.05	mg/L	10/7/2013 20:53	TS	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	10/10/2013 23:35	TS	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	10/7/2013 20:53	TS	EPA 200.7	
Boron, Dissolved	0.09	0.05	mg/L	10/10/2013 23:35	TS	EPA 200.7	
Boron, Total	0.11	0.05	mg/L	10/7/2013 20:53	TS	EPA 200.7	
Barium, Dissolved	0.011	0.005	mg/L	10/10/2013 23:35	TS	EPA 200.7	
Calcium, Dissolved	286	0.2	mg/L	10/10/2013 23:35	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	10/10/2013 23:35	TS	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	10/10/2013 23:35	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	10/10/2013 23:35	TS	EPA 200.7	
Iron, Dissolved	0.02	0.02	mg/L	10/10/2013 23:35	TS	EPA 200.7	
Iron, Total	10.8	0.02	mg/L	10/7/2013 20:53	TS	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1309804-09

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 9/30/2013 10:10 PM
Sample Site:	Well A Y-103 A6		**Receipt Date:** 10/2/2013 2:10 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:**
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Lead, Dissolved	0.04	0.02	mg/L	10/10/2013 23:35	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	10/7/2013 20:53	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	10/15/2013 14:43	AKL	EPA 245.1	
Magnesium, Dissolved	362	0.2	mg/L	10/10/2013 23:35	TS	EPA 200.7	
Manganese, Dissolved	0.102	0.005	mg/L	10/10/2013 23:35	TS	EPA 200.7	
Manganese, Total	0.114	0.005	mg/L	10/7/2013 20:53	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	10/10/2013 23:35	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	10/10/2013 23:35	TS	EPA 200.7	
Potassium, Dissolved	13.4	0.5	mg/L	10/10/2013 23:35	TS	EPA 200.7	
Selenium, Dissolved	0.03	0.02	mg/L	10/10/2013 23:35	TS	EPA 200.7	
Selenium, Total	0.02	0.02	mg/L	10/7/2013 20:53	TS	EPA 200.7	
Sodium, Dissolved	24.1	0.5	mg/L	10/10/2013 23:35	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	10/10/2013 23:35	TS	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1309806-01

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 10/1/2013 4:00 PM
Sample Site:	NLP-4		**Receipt Date:** 10/2/2013 2:10 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 225
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	30.1	0.01	meq/L	10/25/2013 9:00	PNM	SM 1030 E	
Cation/Anion Balance	-3.2		%	10/25/2013 9:00	PNM	SM 1030 E	
Cations, Total	28.2	0.01	meq/L	10/25/2013 9:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	1330	1	mg/L	10/21/2013 7:45	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	10/14/2013 10:07	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	648	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - CO2	485	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	531	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	10/6/2013 7:00	TSM	SM 4500 NH3-D	
Chloride	18	1	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Fluoride	0.3	0.1	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	10/11/2013 9:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.42	0.05	mg/L	10/8/2013 7:00	TSM	SM 4500 PB5E	
Sulfate	910	10	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1730	20	mg/L	10/7/2013 5:30	JSH	SM 2540 C	
Total Suspended Solids (TSS)	668	20	mg/L	10/5/2013 13:24	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	0.09	0.05	mg/L	10/11/2013 0:35	TS	EPA 200.7	
Aluminum, Total	2.5	0.05	mg/L	10/7/2013 21:27	TS	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	10/11/2013 0:35	TS	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	10/7/2013 21:27	TS	EPA 200.7	
Boron, Dissolved	0.11	0.05	mg/L	10/11/2013 0:35	TS	EPA 200.7	
Boron, Total	0.11	0.05	mg/L	10/7/2013 21:27	TS	EPA 200.7	
Barium, Dissolved	0.020	0.005	mg/L	10/11/2013 0:35	TS	EPA 200.7	
Calcium, Dissolved	202	0.2	mg/L	10/11/2013 0:35	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	10/11/2013 0:35	TS	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	10/11/2013 0:35	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	10/11/2013 0:35	TS	EPA 200.7	
Iron, Dissolved	0.03	0.02	mg/L	10/11/2013 0:35	TS	EPA 200.7	
Iron, Total	14.4	0.02	mg/L	10/7/2013 21:27	TS	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1309806-01

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	10/1/2013 4:00 PM
Sample Site:	NLP-4			***Receipt Date:***	10/2/2013 2:10 PM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	225
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Lead, Dissolved	0.04	0.02	mg/L	10/11/2013 0:35	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	10/7/2013 21:27	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	10/15/2013 14:43	AKL	EPA 245.1	
Magnesium, Dissolved	200	0.2	mg/L	10/11/2013 0:35	TS	EPA 200.7	
Manganese, Dissolved	0.236	0.005	mg/L	10/11/2013 0:35	TS	EPA 200.7	
Manganese, Total	0.485	0.005	mg/L	10/7/2013 21:27	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	10/11/2013 0:35	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	10/11/2013 0:35	TS	EPA 200.7	
Potassium, Dissolved	7.0	0.5	mg/L	10/11/2013 0:35	TS	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	10/11/2013 0:35	TS	EPA 200.7	
Selenium, Total	0.02	0.02	mg/L	10/7/2013 21:27	TS	EPA 200.7	
Sodium, Dissolved	34.4	0.5	mg/L	10/11/2013 0:35	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	10/11/2013 0:35	TS	EPA 200.7	

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Lab Sample No.: 1309806-02

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 10/1/2013 4:30 PM
Sample Site:	NLP-3		**Receipt Date:** 10/2/2013 2:10 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 225
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	16.8	0.01	meq/L	10/25/2013 9:00	PNM	SM 1030 E	
Cation/Anion Balance	-6.4		%	10/25/2013 9:00	PNM	SM 1030 E	
Cations, Total	14.8	0.01	meq/L	10/25/2013 9:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	677	1	mg/L	10/21/2013 7:45	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	10/14/2013 10:07	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	852	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - CO2	652	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	699	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	10/6/2013 7:00	TSM	SM 4500 NH3-D	
Chloride	5	1	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	0.1	0.1	mg/L	10/11/2013 9:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.22	0.05	mg/L	10/8/2013 7:00	TSM	SM 4500 PB5E	
Sulfate	386	5	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1080	20	mg/L	10/7/2013 5:30	RMC	SM 2540 C	
Total Suspended Solids (TSS)	2600	33	mg/L	10/5/2013 13:24	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	0.09	0.05	mg/L	10/11/2013 0:39	TS	EPA 200.7	
Aluminum, Total	7.9	0.05	mg/L	10/7/2013 21:31	TS	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	10/7/2013 21:31	TS	EPA 200.7	
Boron, Dissolved	0.13	0.05	mg/L	10/11/2013 0:39	TS	EPA 200.7	
Boron, Total	0.13	0.05	mg/L	10/7/2013 21:31	TS	EPA 200.7	
Barium, Dissolved	0.013	0.005	mg/L	10/11/2013 0:39	TS	EPA 200.7	
Calcium, Dissolved	65.1	0.2	mg/L	10/11/2013 0:39	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	10/11/2013 0:39	TS	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	10/11/2013 0:39	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	10/11/2013 0:39	TS	EPA 200.7	
Iron, Dissolved	0.04	0.02	mg/L	10/11/2013 0:39	TS	EPA 200.7	
Iron, Total	39.4	0.02	mg/L	10/7/2013 21:31	TS	EPA 200.7	
Lead, Dissolved	0.03	0.02	mg/L	10/11/2013 0:39	TS	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1309806-02

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	10/1/2013 4:30 PM
Sample Site:	NLP-3			***Receipt Date:***	10/2/2013 2:10 PM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	225
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Lead, Total	ND	0.02	mg/L	10/7/2013 21:31	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	10/15/2013 14:43	AKL	EPA 245.1	
Magnesium, Dissolved	125	0.2	mg/L	10/11/2013 0:39	TS	EPA 200.7	
Manganese, Dissolved	0.007	0.005	mg/L	10/11/2013 0:39	TS	EPA 200.7	
Manganese, Total	0.981	0.005	mg/L	10/7/2013 21:31	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	10/11/2013 0:39	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	10/11/2013 0:39	TS	EPA 200.7	
Potassium, Dissolved	8.3	0.5	mg/L	10/11/2013 0:39	TS	EPA 200.7	
Selenium, Dissolved	ND	0.02	mg/L	10/11/2013 0:39	TS	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	10/7/2013 21:31	TS	EPA 200.7	
Sodium, Dissolved	23.1	0.5	mg/L	10/11/2013 0:39	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	10/11/2013 0:39	TS	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1309806-03

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 10/1/2013 5:30 PM
Sample Site:	NLP-2		**Receipt Date:** 10/2/2013 2:10 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 225
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	53.6	0.01	meq/L	10/25/2013 9:00	PNM	SM 1030 E	
Cation/Anion Balance	-1.5		%	10/25/2013 9:00	PNM	SM 1030 E	
Cations, Total	52.0	0.01	meq/L	10/25/2013 9:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	2100	1	mg/L	10/21/2013 7:45	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	10/14/2013 10:07	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	565	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - CO2	414	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	463	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Ammonia as N	0.9	0.2	mg/L	10/6/2013 7:00	TSM	SM 4500 NH3-D	
Chloride	147	2	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Fluoride	0.4	0.2	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	0.1	0.1	mg/L	10/11/2013 9:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.37	0.05	mg/L	10/8/2013 7:00	TSM	SM 4500 PB5E	
Sulfate	1930	20	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	3130	20	mg/L	10/7/2013 5:30	RMC	SM 2540 C	
Total Suspended Solids (TSS)	3050	50	mg/L	10/5/2013 13:24	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	10/11/2013 0:43	TS	EPA 200.7	
Aluminum, Total	7.2	0.05	mg/L	10/7/2013 21:35	TS	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	10/11/2013 0:43	TS	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	10/7/2013 21:35	TS	EPA 200.7	
Boron, Dissolved	0.15	0.05	mg/L	10/11/2013 0:43	TS	EPA 200.7	
Boron, Total	0.15	0.05	mg/L	10/7/2013 21:35	TS	EPA 200.7	
Barium, Dissolved	0.016	0.005	mg/L	10/11/2013 0:43	TS	EPA 200.7	
Calcium, Dissolved	240	0.2	mg/L	10/11/2013 0:43	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	10/11/2013 0:43	TS	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	10/11/2013 0:43	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	10/11/2013 0:43	TS	EPA 200.7	
Iron, Dissolved	0.03	0.02	mg/L	10/11/2013 0:43	TS	EPA 200.7	
Iron, Total	34.3	0.02	mg/L	10/7/2013 21:35	TS	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1309806-03

Name:	**Alton Coal Development, LLC**	***Mine Code:*** 41	***Sample Date:*** 10/1/2013 5:30 PM
Sample Site:	NLP-2		***Receipt Date:*** 10/2/2013 2:10 PM
Comments:			***Sampler:*** Erik Petersen
Sample Type:	Water		***Site No.:*** 225
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Lead, Dissolved	0.05	0.02	mg/L	10/11/2013 0:43	TS	EPA 200.7	
Lead, Total	0.02	0.02	mg/L	10/7/2013 21:35	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	10/15/2013 14:43	AKL	EPA 245.1	
Magnesium, Dissolved	364	0.2	mg/L	10/11/2013 0:43	TS	EPA 200.7	
Manganese, Dissolved	0.043	0.005	mg/L	10/11/2013 0:43	TS	EPA 200.7	
Manganese, Total	0.427	0.005	mg/L	10/7/2013 21:35	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	10/11/2013 0:43	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	10/11/2013 0:43	TS	EPA 200.7	
Potassium, Dissolved	5.5	0.5	mg/L	10/11/2013 0:43	TS	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	10/11/2013 0:43	TS	EPA 200.7	
Selenium, Total	0.02	0.02	mg/L	10/7/2013 21:35	TS	EPA 200.7	
Sodium, Dissolved	228	0.5	mg/L	10/11/2013 0:43	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	10/11/2013 0:43	TS	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1309806-04

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 10/1/2013 6:10 PM
Sample Site:	Y-70		**Receipt Date:** 10/2/2013 2:10 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 225
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	42.7	0.01	meq/L	10/25/2013 9:00	PNM	SM 1030 E	
Cation/Anion Balance	-0.01		%	10/25/2013 9:00	PNM	SM 1030 E	
Cations, Total	42.7	0.01	meq/L	10/25/2013 9:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	1600	1	mg/L	10/21/2013 7:45	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	10/14/2013 10:07	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	574	1.0	mg/L	10/10/2013 17:09	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	10/10/2013 17:09	KRW	SM 2320 B	
Alkalinity - CO2	424	1.0	mg/L	10/10/2013 17:09	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	10/10/2013 17:09	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	471	1.0	mg/L	10/10/2013 17:09	KRW	SM 2320 B	
Ammonia as N	1.4	0.2	mg/L	10/6/2013 7:00	TSM	SM 4500 NH3-D	
Chloride	58	2	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Fluoride	0.5	0.2	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	0.2	0.1	mg/L	10/11/2013 9:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.10	0.01	mg/L	10/8/2013 7:00	TSM	SM 4500 PB5E	
Sulfate	1520	50	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	2840	20	mg/L	10/7/2013 5:30	RMC	SM 2540 C	
Total Suspended Solids (TSS)	116	7	mg/L	10/5/2013 13:24	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	10/11/2013 1:06	TS	EPA 200.7	
Aluminum, Total	0.5	0.05	mg/L	10/7/2013 21:47	TS	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	10/11/2013 1:06	TS	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	10/7/2013 21:47	TS	EPA 200.7	
Boron, Dissolved	0.23	0.05	mg/L	10/11/2013 1:06	TS	EPA 200.7	
Boron, Total	0.23	0.05	mg/L	10/7/2013 21:47	TS	EPA 200.7	
Barium, Dissolved	0.015	0.005	mg/L	10/11/2013 1:06	TS	EPA 200.7	
Calcium, Dissolved	286	0.2	mg/L	10/11/2013 1:06	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	10/11/2013 1:06	TS	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	10/11/2013 1:06	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	10/11/2013 1:06	TS	EPA 200.7	
Iron, Dissolved	0.06	0.02	mg/L	10/11/2013 1:06	TS	EPA 200.7	
Iron, Total	8.48	0.02	mg/L	10/7/2013 21:47	TS	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1309806-04

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	10/1/2013 6:10 PM
Sample Site:	Y-70			***Receipt Date:***	10/2/2013 2:10 PM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	225
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Lead, Dissolved	0.04	0.02	mg/L	10/11/2013 1:06	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	10/7/2013 21:47	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	10/15/2013 14:43	AKL	EPA 245.1	
Magnesium, Dissolved	215	0.2	mg/L	10/11/2013 1:06	TS	EPA 200.7	
Manganese, Dissolved	0.555	0.005	mg/L	10/11/2013 1:06	TS	EPA 200.7	
Manganese, Total	0.544	0.005	mg/L	10/7/2013 21:47	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	10/11/2013 1:06	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	10/11/2013 1:06	TS	EPA 200.7	
Potassium, Dissolved	9.5	0.5	mg/L	10/11/2013 1:06	TS	EPA 200.7	
Selenium, Dissolved	0.03	0.02	mg/L	10/11/2013 1:06	TS	EPA 200.7	
Selenium, Total	ND	0.02	mg/L	10/7/2013 21:47	TS	EPA 200.7	
Sodium, Dissolved	240	0.5	mg/L	10/11/2013 1:06	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	10/11/2013 1:06	TS	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1309806-05

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 10/1/2013 6:40 PM
Sample Site:	NLP-5		**Receipt Date:** 10/2/2013 2:10 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 225
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	30.2	0.01	meq/L	10/25/2013 9:00	PNM	SM 1030 E	
Cation/Anion Balance	-5.9		%	10/25/2013 9:00	PNM	SM 1030 E	
Cations, Total	26.8	0.01	meq/L	10/25/2013 9:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	1270	1	mg/L	10/21/2013 7:45	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	10/14/2013 10:07	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	598	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - CO2	449	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	490	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	10/6/2013 7:00	TSM	SM 4500 NH3-D	
Chloride	14	1	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	0.2	0.1	mg/L	10/11/2013 9:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.36	0.05	mg/L	10/8/2013 7:00	TSM	SM 4500 PB5E	
Sulfate	960	10	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1810	20	mg/L	10/7/2013 5:30	RMC	SM 2540 C	
Total Suspended Solids (TSS)	540	20	mg/L	10/8/2013 14:55	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	10/11/2013 1:10	TS	EPA 200.7	
Aluminum, Total	8.6	0.05	mg/L	10/7/2013 21:59	TS	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	10/11/2013 1:10	TS	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	10/7/2013 21:59	TS	EPA 200.7	
Boron, Dissolved	0.12	0.05	mg/L	10/11/2013 1:10	TS	EPA 200.7	
Boron, Total	0.13	0.05	mg/L	10/7/2013 21:59	TS	EPA 200.7	
Barium, Dissolved	0.022	0.005	mg/L	10/11/2013 1:10	TS	EPA 200.7	
Calcium, Dissolved	207	0.2	mg/L	10/11/2013 1:10	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	10/11/2013 1:10	TS	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	10/11/2013 1:10	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	10/11/2013 1:10	TS	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	10/11/2013 1:10	TS	EPA 200.7	
Iron, Total	27.4	0.02	mg/L	10/7/2013 21:59	TS	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1309806-05

Name:	**Alton Coal Development, LLC**	***Mine Code:*** 41	***Sample Date:*** 10/1/2013 6:40 PM
Sample Site:	NLP-5		***Receipt Date:*** 10/2/2013 2:10 PM
Comments:			***Sampler:*** Erik Petersen
Sample Type:	Water		***Site No.:*** 225
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Lead, Dissolved	0.04	0.02	mg/L	10/11/2013 1:10	TS	EPA 200.7	
Lead, Total	0.04	0.02	mg/L	10/7/2013 21:59	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	10/15/2013 14:43	AKL	EPA 245.1	
Magnesium, Dissolved	184	0.2	mg/L	10/11/2013 1:10	TS	EPA 200.7	
Manganese, Dissolved	ND	0.005	mg/L	10/11/2013 1:10	TS	EPA 200.7	
Manganese, Total	1.04	0.005	mg/L	10/7/2013 21:59	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	10/11/2013 1:10	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	10/11/2013 1:10	TS	EPA 200.7	
Potassium, Dissolved	5.4	0.5	mg/L	10/11/2013 1:10	TS	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	10/11/2013 1:10	TS	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	10/7/2013 21:59	TS	EPA 200.7	
Sodium, Dissolved	26.9	0.5	mg/L	10/11/2013 1:10	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	10/11/2013 1:10	TS	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1309806-06

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 10/1/2013 7:15 PM
Sample Site:	NLP-1		**Receipt Date:** 10/2/2013 2:10 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 225
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	45.9	0.01	meq/L	10/25/2013 9:00	PNM	SM 1030 E	
Cation/Anion Balance	-5.0		%	10/25/2013 9:00	PNM	SM 1030 E	
Cations, Total	41.5	0.01	meq/L	10/25/2013 9:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	1960	1	mg/L	10/21/2013 7:45	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	10/14/2013 10:07	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	752	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - CO2	569	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	617	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	10/6/2013 7:00	TSM	SM 4500 NH3-D	
Chloride	39	2	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Fluoride	0.3	0.2	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	10/11/2013 9:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.12	0.05	mg/L	10/8/2013 7:00	TSM	SM 4500 PB5E	
Sulfate	1560	20	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	2670	20	mg/L	10/7/2013 5:30	RMC	SM 2540 C	
Total Suspended Solids (TSS)	1090	20	mg/L	10/8/2013 14:55	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	10/11/2013 1:13	TS	EPA 200.7	
Aluminum, Total	5.0	0.05	mg/L	10/7/2013 22:02	TS	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	10/11/2013 1:13	TS	EPA 200.7	
Arsenic, Total	0.05	0.05	mg/L	10/7/2013 22:02	TS	EPA 200.7	
Boron, Dissolved	0.06	0.05	mg/L	10/11/2013 1:13	TS	EPA 200.7	
Boron, Total	0.06	0.05	mg/L	10/7/2013 22:02	TS	EPA 200.7	
Barium, Dissolved	0.014	0.005	mg/L	10/11/2013 1:13	TS	EPA 200.7	
Calcium, Dissolved	271	0.2	mg/L	10/11/2013 1:13	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	10/11/2013 1:13	TS	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	10/11/2013 1:13	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	10/11/2013 1:13	TS	EPA 200.7	
Iron, Dissolved	0.37	0.02	mg/L	10/11/2013 1:13	TS	EPA 200.7	
Iron, Total	42.2	0.02	mg/L	10/7/2013 22:02	TS	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1309806-06

Name:	**Alton Coal Development, LLC**	***Mine Code:*** 41	***Sample Date:*** 10/1/2013 7:15 PM
Sample Site:	NLP-1		***Receipt Date:*** 10/2/2013 2:10 PM
Comments:			***Sampler:*** Erik Petersen
Sample Type:	Water		***Site No.:*** 225
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Lead, Dissolved	0.04	0.02	mg/L	10/11/2013 1:13	TS	EPA 200.7	
Lead, Total	0.03	0.02	mg/L	10/7/2013 22:02	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	10/15/2013 14:43	AKL	EPA 245.1	
Magnesium, Dissolved	312	0.2	mg/L	10/11/2013 1:13	TS	EPA 200.7	
Manganese, Dissolved	0.060	0.005	mg/L	10/11/2013 1:13	TS	EPA 200.7	
Manganese, Total	0.480	0.005	mg/L	10/7/2013 22:02	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	10/11/2013 1:13	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	10/11/2013 1:13	TS	EPA 200.7	
Potassium, Dissolved	5.0	0.5	mg/L	10/11/2013 1:13	TS	EPA 200.7	
Selenium, Dissolved	ND	0.02	mg/L	10/11/2013 1:13	TS	EPA 200.7	
Selenium, Total	ND	0.02	mg/L	10/7/2013 22:02	TS	EPA 200.7	
Sodium, Dissolved	49.3	0.5	mg/L	10/11/2013 1:13	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	10/11/2013 1:13	TS	EPA 200.7	

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CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1309806-07

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 10/1/2013 8:00 PM
Sample Site:	NLP-7		**Receipt Date:** 10/2/2013 2:10 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 225
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	26.6	0.01	meq/L	10/25/2013 9:00	PNM	SM 1030 E	
Cation/Anion Balance	-4.4		%	10/25/2013 9:00	PNM	SM 1030 E	
Cations, Total	24.3	0.01	meq/L	10/25/2013 9:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	961	1	mg/L	10/21/2013 7:45	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	10/14/2013 10:07	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	2820	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - CO2	2080	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	2320	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	10/6/2013 7:00	TSM	SM 4500 NH3-D	
Chloride	34	1	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Fluoride	0.5	0.1	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	2.1	0.1	mg/L	10/11/2013 9:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.61	0.05	mg/L	10/8/2013 7:00	TSM	SM 4500 PB5E	
Sulfate	470	10	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1250	20	mg/L	10/7/2013 5:30	RMC	SM 2540 C	
Total Suspended Solids (TSS)	18800	33	mg/L	10/8/2013 14:55	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	0.09	0.05	mg/L	10/11/2013 1:17	TS	EPA 200.7	
Aluminum, Total	23.8	0.05	mg/L	10/7/2013 22:06	TS	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	10/11/2013 1:17	TS	EPA 200.7	
Arsenic, Total	0.06	0.05	mg/L	10/7/2013 22:06	TS	EPA 200.7	
Boron, Dissolved	0.11	0.05	mg/L	10/11/2013 1:17	TS	EPA 200.7	
Boron, Total	0.11	0.05	mg/L	10/7/2013 22:06	TS	EPA 200.7	
Barium, Dissolved	0.022	0.005	mg/L	10/11/2013 1:17	TS	EPA 200.7	
Calcium, Dissolved	86.5	0.2	mg/L	10/11/2013 1:17	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	10/11/2013 1:17	TS	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	10/11/2013 1:17	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	10/11/2013 1:17	TS	EPA 200.7	
Iron, Dissolved	0.02	0.02	mg/L	10/11/2013 1:17	TS	EPA 200.7	
Iron, Total	77.0	0.02	mg/L	10/7/2013 22:06	TS	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1309806-07

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	10/1/2013 8:00 PM
Sample Site:	NLP-7			***Receipt Date:***	10/2/2013 2:10 PM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	225
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Lead, Dissolved	0.02	0.02	mg/L	10/11/2013 1:17	TS	EPA 200.7	
Lead, Total	0.09	0.02	mg/L	10/7/2013 22:06	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	10/15/2013 14:43	AKL	EPA 245.1	
Magnesium, Dissolved	181	0.2	mg/L	10/11/2013 1:17	TS	EPA 200.7	
Manganese, Dissolved	0.184	0.005	mg/L	10/11/2013 1:17	TS	EPA 200.7	
Manganese, Total	3.18	0.005	mg/L	10/7/2013 22:06	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	10/11/2013 1:17	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	10/11/2013 1:17	TS	EPA 200.7	
Potassium, Dissolved	3.4	0.5	mg/L	10/11/2013 1:17	TS	EPA 200.7	
Selenium, Dissolved	0.03	0.02	mg/L	10/11/2013 1:17	TS	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	10/7/2013 22:06	TS	EPA 200.7	
Sodium, Dissolved	116	0.5	mg/L	10/11/2013 1:17	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	10/11/2013 1:17	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1309806-08

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 10/1/2013 8:45 PM
Sample Site:	NLP-8		**Receipt Date:** 10/2/2013 2:10 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 225
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	95.2	0.01	meq/L	10/25/2013 9:00	PNM	SM 1030 E	
Cation/Anion Balance	1.3		%	10/25/2013 9:00	PNM	SM 1030 E	
Cations, Total	97.6	0.01	meq/L	10/25/2013 9:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	4080	1	mg/L	10/21/2013 7:45	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	10/14/2013 10:07	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	696	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - CO2	518	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	571	1.0	mg/L	10/9/2013 14:30	KRW	SM 2320 B	
Ammonia as N	0.4	0.2	mg/L	10/6/2013 7:00	TSM	SM 4500 NH3-D	
Chloride	530	50	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Fluoride	ND	0.5	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	0.2	0.1	mg/L	10/11/2013 9:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.35	0.05	mg/L	10/8/2013 7:00	TSM	SM 4500 PB5E	
Sulfate	3310	50	mg/L	10/3/2013 6:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	6190	20	mg/L	10/7/2013 5:30	RMC	SM 2540 C	
Total Suspended Solids (TSS)	1370	20	mg/L	10/8/2013 14:55	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	10/11/2013 1:21	TS	EPA 200.7	
Aluminum, Total	8.6	0.05	mg/L	10/7/2013 22:10	TS	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	10/11/2013 1:21	TS	EPA 200.7	
Arsenic, Total	0.09	0.05	mg/L	10/7/2013 22:10	TS	EPA 200.7	
Boron, Dissolved	0.25	0.05	mg/L	10/11/2013 1:21	TS	EPA 200.7	
Boron, Total	0.24	0.05	mg/L	10/7/2013 22:10	TS	EPA 200.7	
Barium, Dissolved	0.018	0.005	mg/L	10/11/2013 1:21	TS	EPA 200.7	
Calcium, Dissolved	466	0.2	mg/L	10/11/2013 1:21	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	10/11/2013 1:21	TS	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	10/11/2013 1:21	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	10/11/2013 1:21	TS	EPA 200.7	
Iron, Dissolved	0.02	0.02	mg/L	10/11/2013 1:21	TS	EPA 200.7	
Iron, Total	78.5	0.02	mg/L	10/7/2013 22:10	TS	EPA 200.7	

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Lab Sample No.: 1309806-08

Name:	**Alton Coal Development, LLC**	***Mine Code:*** 41	***Sample Date:*** 10/1/2013 8:45 PM
Sample Site:	NLP-8		***Receipt Date:*** 10/2/2013 2:10 PM
Comments:			***Sampler:*** Erik Petersen
Sample Type:	Water		***Site No.:*** 225
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Lead, Dissolved	0.03	0.02	mg/L	10/11/2013 1:21	TS	EPA 200.7	
Lead, Total	0.05	0.02	mg/L	10/7/2013 22:10	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	10/15/2013 14:43	AKL	EPA 245.1	
Magnesium, Dissolved	708	0.2	mg/L	10/11/2013 1:21	TS	EPA 200.7	
Manganese, Dissolved	1.38	0.005	mg/L	10/11/2013 1:21	TS	EPA 200.7	
Manganese, Total	2.13	0.005	mg/L	10/7/2013 22:10	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	10/11/2013 1:21	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	10/11/2013 1:21	TS	EPA 200.7	
Potassium, Dissolved	18.1	0.5	mg/L	10/11/2013 1:21	TS	EPA 200.7	
Selenium, Dissolved	0.04	0.02	mg/L	10/11/2013 1:21	TS	EPA 200.7	
Selenium, Total	0.04	0.02	mg/L	10/7/2013 22:10	TS	EPA 200.7	
Sodium, Dissolved	360	0.5	mg/L	10/11/2013 1:21	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	10/11/2013 1:21	TS	EPA 200.7	

Abbreviations

ND = Not detected at the corresponding Minimum Reporting Limit.
1 mg/L = one milligram per liter or 1 mg/Kg = one milligram per kilogram = 1 part per million.
1 ug/L = one microgram per liter or 1 ug/Kg = one microgram per kilogram = 1 part per billion.
1 ng/L = one nanogram per liter or 1 ng/Kg = one nanogram per kilogram = 1 part per trillion.

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Lab Sample No.: 1310191-02

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 10/8/2013 4:45 PM
Sample Site:	SP7-1		**Receipt Date:** 10/11/2013 11:05 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 203
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	17.5	0.01	meq/L	10/23/2013 7:00	PNM	SM 1030 E	
Cation/Anion Balance	-0.1		%	10/23/2013 7:00	PNM	SM 1030 E	
Cations, Total	17.5	0.01	meq/L	10/23/2013 7:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	829	1	mg/L	10/21/2013 7:45	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	10/21/2013 21:38	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	532	1.0	mg/L	10/21/2013 21:32	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	10/21/2013 21:32	KRW	SM 2320 B	
Alkalinity - CO2	395	1.0	mg/L	10/21/2013 21:32	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	10/21/2013 21:32	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	437	1.0	mg/L	10/21/2013 21:32	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	10/14/2013 9:00	TSM	SM 4500 NH3-D	
Chloride	10	1	mg/L	10/11/2013 17:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	10/11/2013 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	10/22/2013 13:00	TJS	SM 4500 NO3-F	
Phosphorus, Total as P	0.02	0.01	mg/L	10/15/2013 11:00	TSM	SM 4500 PB5E	
Sulfate	410	10	mg/L	10/11/2013 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1030	20	mg/L	10/15/2013 7:30	RMC	SM 2540 C	
Total Suspended Solids (TSS)	61	4	mg/L	10/14/2013 14:21	JSH	SM 2540 D	
Metals							
Aluminum, Dissolved	0.08	0.05	mg/L	10/16/2013 21:41	TS	EPA 200.7	
Aluminum, Total	0.2	0.05	mg/L	10/16/2013 15:14	TS	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	10/16/2013 21:41	TS	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	10/16/2013 15:14	TS	EPA 200.7	
Boron, Dissolved	0.06	0.05	mg/L	10/16/2013 21:41	TS	EPA 200.7	
Boron, Total	0.07	0.05	mg/L	10/16/2013 15:14	TS	EPA 200.7	
Barium, Dissolved	0.051	0.005	mg/L	10/16/2013 21:41	TS	EPA 200.7	
Calcium, Dissolved	154	0.2	mg/L	10/16/2013 21:41	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	10/16/2013 21:41	TS	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	10/16/2013 21:41	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	10/16/2013 21:41	TS	EPA 200.7	
Iron, Dissolved	0.03	0.02	mg/L	10/16/2013 21:41	TS	EPA 200.7	
Iron, Total	1.26	0.02	mg/L	10/16/2013 15:14	TS	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1310191-02

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	10/8/2013 4:45 PM
Sample Site:	SP7-1			***Receipt Date:***	10/11/2013 11:05 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	203
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Lead, Dissolved	ND	0.02	mg/L	10/16/2013 21:41	TS	EPA 200.7	
Lead, Total	0.02	0.02	mg/L	10/16/2013 15:14	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	10/15/2013 14:54	AKL	EPA 245.1	
Magnesium, Dissolved	108	0.2	mg/L	10/16/2013 21:41	TS	EPA 200.7	
Manganese, Dissolved	0.082	0.005	mg/L	10/16/2013 21:41	TS	EPA 200.7	
Manganese, Total	0.138	0.005	mg/L	10/16/2013 15:14	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	10/16/2013 21:41	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	10/16/2013 21:41	TS	EPA 200.7	
Potassium, Dissolved	4.4	0.5	mg/L	10/16/2013 21:41	TS	EPA 200.7	
Selenium, Dissolved	0.03	0.02	mg/L	10/16/2013 21:41	TS	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	10/16/2013 15:14	TS	EPA 200.7	
Sodium, Dissolved	18.3	0.5	mg/L	10/16/2013 21:41	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	10/16/2013 21:41	TS	EPA 200.7	

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Lab Sample No.: 1310191-03

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 10/8/2013 5:45 PM
Sample Site:	NLP-9		**Receipt Date:** 10/11/2013 11:05 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 239
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	80.6	0.01	meq/L	10/23/2013 7:00	PNM	SM 1030 E	
Cation/Anion Balance	-2.8		%	10/23/2013 7:00	PNM	SM 1030 E	
Cations, Total	76.2	0.01	meq/L	10/23/2013 7:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	2880	1	mg/L	10/21/2013 7:45	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	10/21/2013 21:38	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	564	1.0	mg/L	10/21/2013 21:32	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	10/21/2013 21:32	KRW	SM 2320 B	
Alkalinity - CO2	415	1.0	mg/L	10/21/2013 21:32	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	10/21/2013 21:32	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	462	1.0	mg/L	10/21/2013 21:32	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	10/14/2013 9:00	TSM	SM 4500 NH3-D	
Chloride	443	5	mg/L	10/11/2013 17:00	TSM	EPA 300.0	
Fluoride	0.7	0.5	mg/L	10/11/2013 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	2.0	0.1	mg/L	10/22/2013 13:00	TJS	SM 4500 NO3-F	
Phosphorus, Total as P	0.36	0.03	mg/L	10/15/2013 11:00	TSM	SM 4500 PB5E	
Sulfate	2830	20	mg/L	10/11/2013 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	4720	20	mg/L	10/15/2013 7:30	RMC	SM 2540 C	
Total Suspended Solids (TSS)	294	10	mg/L	10/14/2013 14:21	JSH	SM 2540 D	
Metals							
Aluminum, Dissolved	0.07	0.05	mg/L	10/16/2013 21:45	TS	EPA 200.7	
Aluminum, Total	5.4	0.05	mg/L	10/16/2013 15:18	TS	EPA 200.7	
Arsenic, Dissolved	0.05	0.05	mg/L	10/16/2013 21:45	TS	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	10/16/2013 15:18	TS	EPA 200.7	
Boron, Dissolved	0.23	0.05	mg/L	10/16/2013 21:45	TS	EPA 200.7	
Boron, Total	0.25	0.05	mg/L	10/16/2013 15:18	TS	EPA 200.7	
Barium, Dissolved	0.024	0.005	mg/L	10/16/2013 21:45	TS	EPA 200.7	
Calcium, Dissolved	278	0.2	mg/L	10/16/2013 21:45	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	10/16/2013 21:45	TS	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	10/16/2013 21:45	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	10/16/2013 21:45	TS	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	10/16/2013 21:45	TS	EPA 200.7	
Iron, Total	14.9	0.02	mg/L	10/16/2013 15:18	TS	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1310191-03

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 10/8/2013 5:45 PM
Sample Site:	NLP-9		**Receipt Date:** 10/11/2013 11:05 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 239
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Lead, Dissolved	ND	0.02	mg/L	10/16/2013 21:45	TS	EPA 200.7	
Lead, Total	0.03	0.02	mg/L	10/16/2013 15:18	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	10/15/2013 14:54	AKL	EPA 245.1	
Magnesium, Dissolved	531	0.2	mg/L	10/16/2013 21:45	TS	EPA 200.7	
Manganese, Dissolved	0.012	0.005	mg/L	10/16/2013 21:45	TS	EPA 200.7	
Manganese, Total	0.181	0.005	mg/L	10/16/2013 15:18	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	10/16/2013 21:45	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	10/16/2013 21:45	TS	EPA 200.7	
Potassium, Dissolved	8.1	0.5	mg/L	10/16/2013 21:45	TS	EPA 200.7	
Selenium, Dissolved	0.07	0.02	mg/L	10/16/2013 21:45	TS	EPA 200.7	
Selenium, Total	0.04	0.02	mg/L	10/16/2013 15:18	TS	EPA 200.7	
Sodium, Dissolved	425	0.5	mg/L	10/16/2013 21:45	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	10/16/2013 21:45	TS	EPA 200.7	

Abbreviations

ND = Not detected at the corresponding Minimum Reporting Limit.
1 mg/L = one milligram per liter or 1 mg/Kg = one milligram per kilogram = 1 part per million.
1 ug/L = one microgram per liter or 1 ug/Kg = one microgram per kilogram = 1 part per billion.
1 ng/L = one nanogram per liter or 1 ng/Kg = one nanogram per kilogram = 1 part per trillion.

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Certificate of Analysis

Lab Sample No.: 1400015-05

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	12/31/2013 2:45 PM
Sample Site:	NLP-13			***Receipt Date:***	1/2/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	249
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	110	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Cation/Anion Balance	-3.1		%	1/15/2014 9:20	PNM	SM 1030 E	
Cations, Total	103	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Hardness, Total as CaCO3	3110	1	mg/L	1/15/2014 9:20	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	1/13/2014 7:41	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	813	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - CO2	600	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	667	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	1/5/2014 10:00	TSM	SM 4500 NH3-D	
Chloride	186	5	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Fluoride	0.9	0.5	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	0.1	0.1	mg/L	1/6/2014 10:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	1.5	0.10	mg/L	1/7/2014 4:00	TSM	SM 4500 PB5E	
Sulfate	4380	50	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	7040	20	mg/L	1/6/2014 8:00	MZ	SM 2540 C	
Total Suspended Solids (TSS)	7590	100	mg/L	1/6/2014 17:25	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	1/7/2014 16:48	TS	EPA 200.7	
Aluminum, Total	18.3	0.05	mg/L	1/6/2014 18:33	TS	EPA 200.7	
Arsenic, Dissolved	0.06	0.05	mg/L	1/7/2014 16:48	TS	EPA 200.7	
Arsenic, Total	0.09	0.05	mg/L	1/6/2014 18:33	TS	EPA 200.7	
Boron, Dissolved	0.92	0.05	mg/L	1/7/2014 16:48	TS	EPA 200.7	
Boron, Total	1.05	0.05	mg/L	1/6/2014 18:33	TS	EPA 200.7	
Barium, Dissolved	0.007	0.005	mg/L	1/7/2014 16:48	TS	EPA 200.7	
Calcium, Dissolved	301	0.2	mg/L	1/7/2014 16:48	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	1/7/2014 16:48	TS	EPA 200.7	
Chromium, Dissolved	0.018	0.005	mg/L	1/7/2014 16:48	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	1/7/2014 16:48	TS	EPA 200.7	
Iron, Dissolved	0.03	0.02	mg/L	1/7/2014 16:48	TS	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1400015-05

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	12/31/2013 2:45 PM
Sample Site:	NLP-13			***Receipt Date:***	1/2/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	249
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	26.1	0.02	mg/L	1/6/2014 18:33	TS	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	1/7/2014 16:48	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	1/6/2014 18:33	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	1/7/2014 13:00	AKL	EPA 245.1	
Magnesium, Dissolved	572	0.2	mg/L	1/7/2014 16:48	TS	EPA 200.7	
Manganese, Dissolved	0.190	0.005	mg/L	1/7/2014 16:48	TS	EPA 200.7	
Manganese, Total	0.898	0.005	mg/L	1/6/2014 18:33	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	1/7/2014 16:48	TS	EPA 200.7	
Nickel, Dissolved	0.007	0.005	mg/L	1/7/2014 16:48	TS	EPA 200.7	
Potassium, Dissolved	13.4	0.5	mg/L	1/7/2014 16:48	TS	EPA 200.7	
Selenium, Dissolved	0.16	0.02	mg/L	1/7/2014 16:48	TS	EPA 200.7	
Selenium, Total	0.10	0.02	mg/L	1/6/2014 18:33	TS	EPA 200.7	
Sodium, Dissolved	935	0.5	mg/L	1/7/2014 16:48	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	1/7/2014 16:48	TS	EPA 200.7	

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Lab Sample No.: 1400015-06

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 12/31/2013 4:15 PM
Sample Site:	Kanab Creek at County Road		**Receipt Date:** 1/2/2014 11:46 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 202
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	8.3	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Cation/Anion Balance	1.6		%	1/15/2014 9:20	PNM	SM 1030 E	
Cations, Total	8.6	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Hardness, Total as CaCO3	414	1	mg/L	1/15/2014 9:20	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	1/13/2014 7:41	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	363	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - CO2	263	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	297	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	1/5/2014 10:00	TSM	SM 4500 NH3-D	
Chloride	5	1	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	1/6/2014 10:00	KSL	SM 4500 NO3-F	
Oil & Grease (HEM)	ND	6	mg/L	1/6/2014 9:59	QJP	EPA 1664A	
Phosphorus, Total as P	0.02	0.01	mg/L	1/7/2014 4:00	TSM	SM 4500 PB5E	
Sulfate	108	1	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	520	20	mg/L	1/6/2014 8:00	MZ	SM 2540 C	
Total Suspended Solids (TSS)	35	4	mg/L	1/6/2014 17:25	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	1/7/2014 16:55	TS	EPA 200.7	
Aluminum, Total	0.1	0.05	mg/L	1/6/2014 18:40	TS	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	1/7/2014 16:55	TS	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	1/6/2014 18:40	TS	EPA 200.7	
Boron, Dissolved	ND	0.05	mg/L	1/7/2014 16:55	TS	EPA 200.7	
Boron, Total	ND	0.05	mg/L	1/6/2014 18:40	TS	EPA 200.7	
Barium, Dissolved	0.173	0.005	mg/L	1/7/2014 16:55	TS	EPA 200.7	
Calcium, Dissolved	67.0	0.2	mg/L	1/7/2014 16:55	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	1/7/2014 16:55	TS	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	1/7/2014 16:55	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	1/7/2014 16:55	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1400015-06

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	12/31/2013 4:15 PM
Sample Site:	Kanab Creek at County Road			***Receipt Date:***	1/2/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	202
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Dissolved	ND	0.02	mg/L	1/7/2014 16:55	TS	EPA 200.7	
Iron, Total	0.40	0.02	mg/L	1/6/2014 18:40	TS	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	1/7/2014 16:55	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	1/6/2014 18:40	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	1/7/2014 13:00	AKL	EPA 245.1	
Magnesium, Dissolved	59.9	0.2	mg/L	1/7/2014 16:55	TS	EPA 200.7	
Manganese, Dissolved	0.009	0.005	mg/L	1/7/2014 16:55	TS	EPA 200.7	
Manganese, Total	0.018	0.005	mg/L	1/6/2014 18:40	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	1/7/2014 16:55	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	1/7/2014 16:55	TS	EPA 200.7	
Potassium, Dissolved	2.1	0.5	mg/L	1/7/2014 16:55	TS	EPA 200.7	
Selenium, Dissolved	0.08	0.02	mg/L	1/7/2014 16:55	TS	EPA 200.7	
Selenium, Total	0.06	0.02	mg/L	1/6/2014 18:40	TS	EPA 200.7	
Sodium, Dissolved	6.7	0.5	mg/L	1/7/2014 16:55	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	1/7/2014 16:55	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1400015-07

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	12/31/2013 6:00 PM
Sample Site:	SW-1A			***Receipt Date:***	1/2/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	201
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	7.8	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Cation/Anion Balance	-2.2		%	1/15/2014 9:20	PNM	SM 1030 E	
Cations, Total	7.5	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Hardness, Total as CaCO3	362	1	mg/L	1/15/2014 9:20	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	1/13/2014 7:41	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	376	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	10.0	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - CO2	286	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	325	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	1/5/2014 10:00	TSM	SM 4500 NH3-D	
Chloride	4	1	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	1/6/2014 10:00	KSL	SM 4500 NO3-F	
Oil & Grease (HEM)	ND	6	mg/L	1/6/2014 9:59	QJP	EPA 1664A	
Phosphorus, Total as P	0.02	0.01	mg/L	1/7/2014 4:00	TSM	SM 4500 PB5E	
Sulfate	76	1	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	380	20	mg/L	1/6/2014 8:00	MZ	SM 2540 C	
Total Suspended Solids (TSS)	25	4	mg/L	1/6/2014 17:25	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	1/7/2014 16:59	TS	EPA 200.7	
Aluminum, Total	0.2	0.05	mg/L	1/6/2014 18:44	TS	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	1/7/2014 16:59	TS	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	1/6/2014 18:44	TS	EPA 200.7	
Boron, Dissolved	ND	0.05	mg/L	1/7/2014 16:59	TS	EPA 200.7	
Boron, Total	ND	0.05	mg/L	1/6/2014 18:44	TS	EPA 200.7	
Barium, Dissolved	0.186	0.005	mg/L	1/7/2014 16:59	TS	EPA 200.7	
Calcium, Dissolved	60.0	0.2	mg/L	1/7/2014 16:59	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	1/7/2014 16:59	TS	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	1/7/2014 16:59	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	1/7/2014 16:59	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1400015-07

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	12/31/2013 6:00 PM
Sample Site:	SW-1A			***Receipt Date:***	1/2/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	201
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Dissolved	ND	0.02	mg/L	1/7/2014 16:59	TS	EPA 200.7	
Iron, Total	0.42	0.02	mg/L	1/6/2014 18:44	TS	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	1/7/2014 16:59	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	1/6/2014 18:44	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	1/7/2014 13:00	AKL	EPA 245.1	
Magnesium, Dissolved	51.6	0.2	mg/L	1/7/2014 16:59	TS	EPA 200.7	
Manganese, Dissolved	0.007	0.005	mg/L	1/7/2014 16:59	TS	EPA 200.7	
Manganese, Total	0.016	0.005	mg/L	1/6/2014 18:44	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	1/7/2014 16:59	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	1/7/2014 16:59	TS	EPA 200.7	
Potassium, Dissolved	1.9	0.5	mg/L	1/7/2014 16:59	TS	EPA 200.7	
Selenium, Dissolved	0.07	0.02	mg/L	1/7/2014 16:59	TS	EPA 200.7	
Selenium, Total	0.06	0.02	mg/L	1/6/2014 18:44	TS	EPA 200.7	
Sodium, Dissolved	5.3	0.5	mg/L	1/7/2014 16:59	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	1/7/2014 16:59	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1400015-08

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	12/31/2013 7:15 PM
Sample Site:	NLP-1			***Receipt Date:***	1/2/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	229
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	45.9	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Cation/Anion Balance	-6.1		%	1/15/2014 9:20	PNM	SM 1030 E	
Cations, Total	40.6	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Hardness, Total as CaCO3	1900	1	mg/L	1/15/2014 9:20	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	1/13/2014 7:41	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	752	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - CO2	553	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	617	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Ammonia as N	0.3	0.2	mg/L	1/5/2014 10:00	TSM	SM 4500 NH3-D	
Chloride	40	2	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Fluoride	0.3	0.2	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	0.1	0.1	mg/L	1/6/2014 10:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	2.1	0.50	mg/L	1/7/2014 4:00	TSM	SM 4500 PB5E	
Sulfate	1560	20	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	2700	20	mg/L	1/6/2014 8:00	MZ	SM 2540 C	
Total Suspended Solids (TSS)	4210	100	mg/L	1/6/2014 17:25	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	1/7/2014 17:03	TS	EPA 200.7	
Aluminum, Total	2.8	0.05	mg/L	1/6/2014 18:48	TS	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	1/7/2014 17:03	TS	EPA 200.7	
Arsenic, Total	0.07	0.05	mg/L	1/6/2014 18:48	TS	EPA 200.7	
Boron, Dissolved	ND	0.05	mg/L	1/7/2014 17:03	TS	EPA 200.7	
Boron, Total	0.15	0.05	mg/L	1/6/2014 18:48	TS	EPA 200.7	
Barium, Dissolved	0.019	0.005	mg/L	1/7/2014 17:03	TS	EPA 200.7	
Calcium, Dissolved	267	0.2	mg/L	1/7/2014 17:03	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	1/7/2014 17:03	TS	EPA 200.7	
Chromium, Dissolved	0.012	0.005	mg/L	1/7/2014 17:03	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	1/7/2014 17:03	TS	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	1/7/2014 17:03	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1400015-08

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	12/31/2013 7:15 PM
Sample Site:	NLP-1			***Receipt Date:***	1/2/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	229
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	32.3	0.02	mg/L	1/6/2014 18:48	TS	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	1/7/2014 17:03	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	1/6/2014 18:48	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	1/7/2014 13:00	AKL	EPA 245.1	
Magnesium, Dissolved	300	0.2	mg/L	1/7/2014 17:03	TS	EPA 200.7	
Manganese, Dissolved	0.068	0.005	mg/L	1/7/2014 17:03	TS	EPA 200.7	
Manganese, Total	0.400	0.005	mg/L	1/6/2014 18:48	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	1/7/2014 17:03	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	1/7/2014 17:03	TS	EPA 200.7	
Potassium, Dissolved	4.6	0.5	mg/L	1/7/2014 17:03	TS	EPA 200.7	
Selenium, Dissolved	0.16	0.02	mg/L	1/7/2014 17:03	TS	EPA 200.7	
Selenium, Total	0.07	0.02	mg/L	1/6/2014 18:48	TS	EPA 200.7	
Sodium, Dissolved	57.7	0.5	mg/L	1/7/2014 17:03	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	1/7/2014 17:03	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1400015-09

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	12/31/2013 8:00 PM
Sample Site:	Y-103			***Receipt Date:***	1/2/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	204
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	52.5	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Cation/Anion Balance	-1.3		%	1/15/2014 9:20	PNM	SM 1030 E	
Cations, Total	51.1	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Hardness, Total as CaCO3	2490	1	mg/L	1/15/2014 9:20	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	1/13/2014 7:41	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	903	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - CO2	662	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	741	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	1/5/2014 10:00	TSM	SM 4500 NH3-D	
Chloride	10	2	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Fluoride	0.3	0.2	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	1/6/2014 10:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.04	0.03	mg/L	1/7/2014 4:00	TSM	SM 4500 PB5E	
Sulfate	1800	50	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	3120	20	mg/L	1/6/2014 8:00	MZ	SM 2540 C	
Total Suspended Solids (TSS)	130	20	mg/L	1/6/2014 17:25	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	0.6	0.05	mg/L	1/7/2014 17:07	TS	EPA 200.7	
Aluminum, Total	0.2	0.05	mg/L	1/6/2014 18:52	TS	EPA 200.7	
Arsenic, Dissolved	0.05	0.05	mg/L	1/7/2014 17:07	TS	EPA 200.7	
Arsenic, Total	0.05	0.05	mg/L	1/6/2014 18:52	TS	EPA 200.7	
Boron, Dissolved	0.08	0.05	mg/L	1/7/2014 17:07	TS	EPA 200.7	
Boron, Total	0.12	0.05	mg/L	1/6/2014 18:52	TS	EPA 200.7	
Barium, Dissolved	0.015	0.005	mg/L	1/7/2014 17:07	TS	EPA 200.7	
Calcium, Dissolved	315	0.2	mg/L	1/7/2014 17:07	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	1/7/2014 17:07	TS	EPA 200.7	
Chromium, Dissolved	0.016	0.005	mg/L	1/7/2014 17:07	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	1/7/2014 17:07	TS	EPA 200.7	
Iron, Dissolved	2.77	0.02	mg/L	1/7/2014 17:07	TS	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1400015-09

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	12/31/2013 8:00 PM
Sample Site:	Y-103			***Receipt Date:***	1/2/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	204
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	12.2	0.02	mg/L	1/6/2014 18:52	TS	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	1/7/2014 17:07	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	1/6/2014 18:52	TS	EPA 200.7	
Mercury, Dissolved	0.0004	0.0002	mg/L	1/7/2014 13:00	AKL	EPA 245.1	
Magnesium, Dissolved	414	0.2	mg/L	1/7/2014 17:07	TS	EPA 200.7	
Manganese, Dissolved	0.083	0.005	mg/L	1/7/2014 17:07	TS	EPA 200.7	
Manganese, Total	0.096	0.005	mg/L	1/6/2014 18:52	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	1/7/2014 17:07	TS	EPA 200.7	
Nickel, Dissolved	0.008	0.005	mg/L	1/7/2014 17:07	TS	EPA 200.7	
Potassium, Dissolved	14.2	0.5	mg/L	1/7/2014 17:07	TS	EPA 200.7	
Selenium, Dissolved	0.15	0.02	mg/L	1/7/2014 17:07	TS	EPA 200.7	
Selenium, Total	0.10	0.02	mg/L	1/6/2014 18:52	TS	EPA 200.7	
Sodium, Dissolved	22.7	0.5	mg/L	1/7/2014 17:07	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	1/7/2014 17:07	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1400015-10

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	12/31/2013 8:30 PM
Sample Site:	Y-70			***Receipt Date:***	1/2/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	225
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	46.0	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Cation/Anion Balance	-0.9		%	1/15/2014 9:20	PNM	SM 1030 E	
Cations, Total	45.2	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Hardness, Total as CaCO3	1710	1	mg/L	1/15/2014 9:20	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	1/13/2014 7:41	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	777	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - CO2	580	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	637	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Ammonia as N	1.4	0.2	mg/L	1/5/2014 10:00	TSM	SM 4500 NH3-D	
Chloride	58	2	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Fluoride	0.5	0.2	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	1/6/2014 10:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.04	0.03	mg/L	1/7/2014 4:00	TSM	SM 4500 PB5E	
Sulfate	1520	50	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	2920	20	mg/L	1/6/2014 8:00	MZ	SM 2540 C	
Total Suspended Solids (TSS)	32	20	mg/L	1/6/2014 17:25	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	1/7/2014 17:26	TS	EPA 200.7	
Aluminum, Total	ND	0.05	mg/L	1/7/2014 20:35	TS	EPA 200.7	
Arsenic, Dissolved	0.05	0.05	mg/L	1/7/2014 17:26	TS	EPA 200.7	
Arsenic, Total	0.05	0.05	mg/L	1/13/2014 15:31	TS	EPA 200.7	
Boron, Dissolved	0.22	0.05	mg/L	1/7/2014 17:26	TS	EPA 200.7	
Boron, Total	0.18	0.05	mg/L	1/13/2014 15:31	TS	EPA 200.7	
Barium, Dissolved	0.013	0.005	mg/L	1/7/2014 17:26	TS	EPA 200.7	
Calcium, Dissolved	294	0.2	mg/L	1/7/2014 17:26	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	1/7/2014 17:26	TS	EPA 200.7	
Chromium, Dissolved	0.010	0.005	mg/L	1/7/2014 17:26	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	1/7/2014 17:26	TS	EPA 200.7	
Iron, Dissolved	0.04	0.02	mg/L	1/7/2014 17:26	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1400015-10

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	12/31/2013 8:30 PM
Sample Site:	Y-70			***Receipt Date:***	1/2/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	225
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	8.35	0.02	mg/L	1/7/2014 20:35	TS	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	1/7/2014 17:26	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	1/7/2014 20:35	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	1/7/2014 13:00	AKL	EPA 245.1	
Magnesium, Dissolved	236	0.2	mg/L	1/7/2014 17:26	TS	EPA 200.7	
Manganese, Dissolved	0.593	0.005	mg/L	1/7/2014 17:26	TS	EPA 200.7	
Manganese, Total	0.592	0.005	mg/L	1/7/2014 20:35	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	1/7/2014 17:26	TS	EPA 200.7	
Nickel, Dissolved	0.008	0.005	mg/L	1/7/2014 17:26	TS	EPA 200.7	
Potassium, Dissolved	8.2	0.5	mg/L	1/7/2014 17:26	TS	EPA 200.7	
Selenium, Dissolved	0.15	0.02	mg/L	1/7/2014 17:26	TS	EPA 200.7	
Selenium, Total	0.13	0.02	mg/L	1/7/2014 20:35	TS	EPA 200.7	
Sodium, Dissolved	250	0.5	mg/L	1/7/2014 17:26	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	1/7/2014 17:26	TS	EPA 200.7	

Abbreviations

ND = Not detected at the corresponding Minimum Reporting Limit.
1 mg/L = one milligram per liter or 1 mg/Kg = one milligram per kilogram = 1 part per million.
1 ug/L = one microgram per liter or 1 ug/Kg = one microgram per kilogram = 1 part per billion.
1 ng/L = one nanogram per liter or 1 ng/Kg = one nanogram per kilogram = 1 part per trillion.

Flag Descriptions

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1400022-01

Name:	Alton Coal Development, LLC	**Mine Code:**	41	**Sample Date:**	12/31/2013 9:30 PM
Sample Site:	NLP-10			**Receipt Date:**	1/2/2014 11:46 AM
Comments:				**Sampler:**	Erik Petersen
Sample Type:	Water			**Site No.:**	246
Field pH:		**Field Temp. Deg. C :**			
Field Flow g/Min.:		**Field Cond. umhos/cm:**			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	62.9	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Cation/Anion Balance	-5.1		%	1/15/2014 9:20	PNM	SM 1030 E	
Cations, Total	56.7	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Hardness, Total as CaCO3	2400	1	mg/L	1/15/2014 9:20	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	1/13/2014 7:41	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	992	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - CO2	736	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	814	1.0	mg/L	1/6/2014 13:50	KRW	SM 2320 B	
Ammonia as N	2.4	0.2	mg/L	1/5/2014 10:00	TSM	SM 4500 NH3-D	
Chloride	134	2	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Fluoride	0.4	0.2	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	1/6/2014 10:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	14	2.0	mg/L	1/7/2014 4:00	TSM	SM 4500 PB5E	
Sulfate	2060	50	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	3150	20	mg/L	1/6/2014 8:00	MZ	SM 2540 C	
Total Suspended Solids (TSS)	325000	200	mg/L	1/6/2014 17:25	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	1/15/2014 14:58	TS	EPA 200.7	
Aluminum, Total	25.9	0.05	mg/L	1/6/2014 18:56	TS	EPA 200.7	
Arsenic, Dissolved	0.07	0.05	mg/L	1/15/2014 14:58	TS	EPA 200.7	
Arsenic, Total	0.15	0.05	mg/L	1/6/2014 18:56	TS	EPA 200.7	
Boron, Dissolved	0.15	0.05	mg/L	1/15/2014 14:58	TS	EPA 200.7	
Boron, Total	0.55	0.05	mg/L	1/6/2014 18:56	TS	EPA 200.7	
Barium, Dissolved	0.036	0.005	mg/L	1/15/2014 14:58	TS	EPA 200.7	
Calcium, Dissolved	309	0.2	mg/L	1/15/2014 14:58	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	1/15/2014 14:58	TS	EPA 200.7	
Chromium, Dissolved	0.015	0.005	mg/L	1/15/2014 14:58	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	1/15/2014 14:58	TS	EPA 200.7	
Iron, Dissolved	0.05	0.02	mg/L	1/15/2014 14:58	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1400022-01

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	12/31/2013 9:30 PM
Sample Site:	NLP-10			***Receipt Date:***	1/2/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	246
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	106	0.02	mg/L	1/6/2014 18:56	TS	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	1/15/2014 14:58	TS	EPA 200.7	
Lead, Total	0.06	0.02	mg/L	1/6/2014 18:56	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	1/7/2014 13:00	AKL	EPA 245.1	
Magnesium, Dissolved	396	0.2	mg/L	1/15/2014 14:58	TS	EPA 200.7	
Manganese, Dissolved	0.167	0.005	mg/L	1/15/2014 14:58	TS	EPA 200.7	
Manganese, Total	3.01	0.005	mg/L	1/6/2014 18:56	TS	EPA 200.7	
Molybdenum, Dissolved	0.02	0.01	mg/L	1/15/2014 14:58	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	1/15/2014 14:58	TS	EPA 200.7	
Potassium, Dissolved	9.6	0.5	mg/L	1/15/2014 14:58	TS	EPA 200.7	
Selenium, Dissolved	0.18	0.02	mg/L	1/15/2014 14:58	TS	EPA 200.7	
Selenium, Total	ND	0.02	mg/L	1/6/2014 18:56	TS	EPA 200.7	
Sodium, Dissolved	194	0.5	mg/L	1/15/2014 14:58	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	1/15/2014 14:58	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1400022-02

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	12/31/2013 10:20 PM
Sample Site:	Coyote Seep			***Receipt Date:***	1/2/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	205
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	36.9	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Cation/Anion Balance	-4.0		%	1/15/2014 9:20	PNM	SM 1030 E	
Cations, Total	34.1	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Hardness, Total as CaCO3	1620	1	mg/L	1/15/2014 9:20	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	1/13/2014 7:41	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	804	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - CO2	592	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	660	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Ammonia as N	0.5	0.2	mg/L	1/5/2014 10:00	TSM	SM 4500 NH3-D	
Chloride	24	1	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Fluoride	ND	0.1	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	1/6/2014 10:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.07	0.01	mg/L	1/7/2014 4:00	TSM	SM 4500 PB5E	
Sulfate	1110	10	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	2130	20	mg/L	1/6/2014 8:00	MZ	SM 2540 C	
Total Suspended Solids (TSS)	32	4	mg/L	1/6/2014 17:25	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	1/7/2014 17:34	TS	EPA 200.7	
Aluminum, Total	ND	0.05	mg/L	1/6/2014 19:03	TS	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	1/7/2014 17:34	TS	EPA 200.7	
Arsenic, Total	0.05	0.05	mg/L	1/6/2014 19:03	TS	EPA 200.7	
Boron, Dissolved	ND	0.05	mg/L	1/7/2014 17:34	TS	EPA 200.7	
Boron, Total	ND	0.05	mg/L	1/6/2014 19:03	TS	EPA 200.7	
Barium, Dissolved	0.044	0.005	mg/L	1/7/2014 17:34	TS	EPA 200.7	
Calcium, Dissolved	236	0.2	mg/L	1/7/2014 17:34	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	1/7/2014 17:34	TS	EPA 200.7	
Chromium, Dissolved	0.010	0.005	mg/L	1/7/2014 17:34	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	1/7/2014 17:34	TS	EPA 200.7	
Iron, Dissolved	0.18	0.02	mg/L	1/7/2014 17:34	TS	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1400022-02

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	12/31/2013 10:20 PM
Sample Site:	Coyote Seep			***Receipt Date:***	1/2/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	205
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	1.93	0.02	mg/L	1/6/2014 19:03	TS	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	1/7/2014 17:34	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	1/6/2014 19:03	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	1/7/2014 13:00	AKL	EPA 245.1	
Magnesium, Dissolved	250	0.2	mg/L	1/7/2014 17:34	TS	EPA 200.7	
Manganese, Dissolved	0.155	0.005	mg/L	1/7/2014 17:34	TS	EPA 200.7	
Manganese, Total	0.185	0.005	mg/L	1/6/2014 19:03	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	1/7/2014 17:34	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	1/7/2014 17:34	TS	EPA 200.7	
Potassium, Dissolved	6.8	0.5	mg/L	1/7/2014 17:34	TS	EPA 200.7	
Selenium, Dissolved	0.14	0.02	mg/L	1/7/2014 17:34	TS	EPA 200.7	
Selenium, Total	0.12	0.02	mg/L	1/6/2014 19:03	TS	EPA 200.7	
Sodium, Dissolved	36.2	0.5	mg/L	1/7/2014 17:34	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	1/7/2014 17:34	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1400022-03

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	12/31/2013 10:40 PM
Sample Site:	NLP-2			***Receipt Date:***	1/2/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	230
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	55.4	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Cation/Anion Balance	-5.4		%	1/15/2014 9:20	PNM	SM 1030 E	
Cations, Total	49.7	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Hardness, Total as CaCO3	2010	1	mg/L	1/15/2014 9:20	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	1/13/2014 7:41	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	664	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - CO2	486	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	544	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Ammonia as N	1.1	0.2	mg/L	1/5/2014 10:00	TSM	SM 4500 NH3-D	
Chloride	148	2	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Fluoride	0.4	0.2	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	0.1	0.1	mg/L	1/6/2014 10:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	1.7	0.50	mg/L	1/7/2014 4:00	TSM	SM 4500 PB5E	
Sulfate	1940	20	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	3670	20	mg/L	1/6/2014 8:00	MZ	SM 2540 C	
Total Suspended Solids (TSS)	5250	100	mg/L	1/6/2014 17:25	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	0.2	0.05	mg/L	1/7/2014 17:38	TS	EPA 200.7	
Aluminum, Total	20.9	0.05	mg/L	1/6/2014 19:22	TS	EPA 200.7	
Arsenic, Dissolved	0.05	0.05	mg/L	1/7/2014 17:38	TS	EPA 200.7	
Arsenic, Total	0.10	0.05	mg/L	1/6/2014 19:22	TS	EPA 200.7	
Boron, Dissolved	0.12	0.05	mg/L	1/7/2014 17:38	TS	EPA 200.7	
Boron, Total	0.41	0.05	mg/L	1/6/2014 19:22	TS	EPA 200.7	
Barium, Dissolved	0.024	0.005	mg/L	1/7/2014 17:38	TS	EPA 200.7	
Calcium, Dissolved	223	0.2	mg/L	1/7/2014 17:38	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	1/7/2014 17:38	TS	EPA 200.7	
Chromium, Dissolved	0.015	0.005	mg/L	1/7/2014 17:38	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	1/7/2014 17:38	TS	EPA 200.7	
Iron, Dissolved	0.24	0.02	mg/L	1/7/2014 17:38	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1400022-03

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	12/31/2013 10:40 PM
Sample Site:	NLP-2			***Receipt Date:***	1/2/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	230
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	67.9	0.02	mg/L	1/6/2014 19:22	TS	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	1/7/2014 17:38	TS	EPA 200.7	
Lead, Total	0.02	0.02	mg/L	1/6/2014 19:22	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	1/7/2014 13:00	AKL	EPA 245.1	
Magnesium, Dissolved	354	0.2	mg/L	1/7/2014 17:38	TS	EPA 200.7	
Manganese, Dissolved	0.044	0.005	mg/L	1/7/2014 17:38	TS	EPA 200.7	
Manganese, Total	1.47	0.005	mg/L	1/6/2014 19:22	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	1/7/2014 17:38	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	1/7/2014 17:38	TS	EPA 200.7	
Potassium, Dissolved	4.9	0.5	mg/L	1/7/2014 17:38	TS	EPA 200.7	
Selenium, Dissolved	0.13	0.02	mg/L	1/7/2014 17:38	TS	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	1/6/2014 19:22	TS	EPA 200.7	
Sodium, Dissolved	215	0.5	mg/L	1/7/2014 17:38	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	1/7/2014 17:38	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1400022-04

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	12/31/2013 11:00 PM
Sample Site:	NLP-12			***Receipt Date:***	1/2/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	248
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	42.8	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Cation/Anion Balance	-1.5		%	1/15/2014 9:20	PNM	SM 1030 E	
Cations, Total	41.6	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Hardness, Total as CaCO3	1820	1	mg/L	1/15/2014 9:20	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	1/13/2014 7:41	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	475	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - CO2	351	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	390	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Ammonia as N	0.3	0.2	mg/L	1/5/2014 10:00	TSM	SM 4500 NH3-D	
Chloride	55	2	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Fluoride	0.4	0.2	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	1/6/2014 10:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	4.8	0.50	mg/L	1/7/2014 4:00	TSM	SM 4500 PB5E	
Sulfate	1610	50	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	2250	20	mg/L	1/6/2014 8:00	MZ	SM 2540 C	
Total Suspended Solids (TSS)	278000	200	mg/L	1/6/2014 17:25	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	1/7/2014 17:41	TS	EPA 200.7	
Aluminum, Total	36.5	0.05	mg/L	1/6/2014 19:36	TS	EPA 200.7	
Arsenic, Dissolved	0.05	0.05	mg/L	1/7/2014 17:41	TS	EPA 200.7	
Arsenic, Total	0.41	0.05	mg/L	1/6/2014 19:36	TS	EPA 200.7	
Boron, Dissolved	0.13	0.05	mg/L	1/7/2014 17:41	TS	EPA 200.7	
Boron, Total	0.86	0.05	mg/L	1/6/2014 19:36	TS	EPA 200.7	
Barium, Dissolved	0.033	0.005	mg/L	1/7/2014 17:41	TS	EPA 200.7	
Calcium, Dissolved	327	0.2	mg/L	1/7/2014 17:41	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	1/7/2014 17:41	TS	EPA 200.7	
Chromium, Dissolved	0.010	0.005	mg/L	1/7/2014 17:41	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	1/7/2014 17:41	TS	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	1/7/2014 17:41	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1400022-04

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	12/31/2013 11:00 PM
Sample Site:	NLP-12			***Receipt Date:***	1/2/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	248
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	211	0.02	mg/L	1/6/2014 19:36	TS	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	1/7/2014 17:41	TS	EPA 200.7	
Lead, Total	0.15	0.02	mg/L	1/6/2014 19:36	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	1/7/2014 13:00	AKL	EPA 245.1	
Magnesium, Dissolved	243	0.2	mg/L	1/7/2014 17:41	TS	EPA 200.7	
Manganese, Dissolved	0.394	0.005	mg/L	1/7/2014 17:41	TS	EPA 200.7	
Manganese, Total	7.01	0.005	mg/L	1/6/2014 19:36	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	1/7/2014 17:41	TS	EPA 200.7	
Nickel, Dissolved	0.007	0.005	mg/L	1/7/2014 17:41	TS	EPA 200.7	
Potassium, Dissolved	8.1	0.5	mg/L	1/7/2014 17:41	TS	EPA 200.7	
Selenium, Dissolved	0.15	0.02	mg/L	1/7/2014 17:41	TS	EPA 200.7	
Selenium, Total	ND	0.02	mg/L	1/6/2014 19:36	TS	EPA 200.7	
Sodium, Dissolved	116	0.5	mg/L	1/7/2014 17:41	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	1/7/2014 17:41	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1400022-05

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	12/31/2013 11:40 PM
Sample Site:	NLP-4			***Receipt Date:***	1/2/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	234
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	27.3	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Cation/Anion Balance	2.5		%	1/15/2014 9:20	PNM	SM 1030 E	
Cations, Total	28.7	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Hardness, Total as CaCO3	1350	1	mg/L	1/15/2014 9:20	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	1/13/2014 7:41	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	580	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - CO2	424	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	476	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	1/5/2014 10:00	TSM	SM 4500 NH3-D	
Chloride	18	1	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	1/6/2014 10:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.50	0.20	mg/L	1/7/2014 4:00	TSM	SM 4500 PB5E	
Sulfate	830	10	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1750	20	mg/L	1/6/2014 8:00	MZ	SM 2540 C	
Total Suspended Solids (TSS)	6690	100	mg/L	1/6/2014 17:25	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	0.2	0.05	mg/L	1/7/2014 17:45	TS	EPA 200.7	
Aluminum, Total	10.4	0.05	mg/L	1/6/2014 19:43	TS	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	1/7/2014 17:45	TS	EPA 200.7	
Arsenic, Total	0.12	0.05	mg/L	1/6/2014 19:43	TS	EPA 200.7	
Boron, Dissolved	0.05	0.05	mg/L	1/7/2014 17:45	TS	EPA 200.7	
Boron, Total	0.34	0.05	mg/L	1/6/2014 19:43	TS	EPA 200.7	
Barium, Dissolved	0.018	0.005	mg/L	1/7/2014 17:45	TS	EPA 200.7	
Calcium, Dissolved	204	0.2	mg/L	1/7/2014 17:45	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	1/7/2014 17:45	TS	EPA 200.7	
Chromium, Dissolved	0.009	0.005	mg/L	1/7/2014 17:45	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	1/7/2014 17:45	TS	EPA 200.7	
Iron, Dissolved	0.18	0.02	mg/L	1/7/2014 17:45	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1400022-05

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	12/31/2013 11:40 PM
Sample Site:	NLP-4			***Receipt Date:***	1/2/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	234
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	75.8	0.02	mg/L	1/6/2014 19:43	TS	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	1/7/2014 17:45	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	1/6/2014 19:43	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	1/7/2014 13:00	AKL	EPA 245.1	
Magnesium, Dissolved	204	0.2	mg/L	1/7/2014 17:45	TS	EPA 200.7	
Manganese, Dissolved	0.148	0.005	mg/L	1/7/2014 17:45	TS	EPA 200.7	
Manganese, Total	2.61	0.005	mg/L	1/6/2014 19:43	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	1/7/2014 17:45	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	1/7/2014 17:45	TS	EPA 200.7	
Potassium, Dissolved	5.4	0.5	mg/L	1/7/2014 17:45	TS	EPA 200.7	
Selenium, Dissolved	0.12	0.02	mg/L	1/7/2014 17:45	TS	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	1/6/2014 19:43	TS	EPA 200.7	
Sodium, Dissolved	36.1	0.5	mg/L	1/7/2014 17:45	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	1/7/2014 17:45	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1400022-06

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	12/31/2013 11:55 PM
Sample Site:	NLP-3			***Receipt Date:***	1/2/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	233
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	19.2	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Cation/Anion Balance	3.0		%	1/15/2014 9:20	PNM	SM 1030 E	
Cations, Total	20.4	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Hardness, Total as CaCO3	956	1	mg/L	1/15/2014 9:20	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	1/13/2014 7:41	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	641	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - CO2	470	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	526	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	1/5/2014 10:00	TSM	SM 4500 NH3-D	
Chloride	6	1	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	0.2	0.1	mg/L	1/6/2014 10:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.22	0.05	mg/L	1/7/2014 4:00	TSM	SM 4500 PB5E	
Sulfate	410	10	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1090	20	mg/L	1/6/2014 8:00	MZ	SM 2540 C	
Total Suspended Solids (TSS)	15500	100	mg/L	1/6/2014 17:25	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	0.4	0.05	mg/L	1/7/2014 17:49	TS	EPA 200.7	
Aluminum, Total	10.0	0.05	mg/L	1/6/2014 19:47	TS	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	1/7/2014 17:49	TS	EPA 200.7	
Arsenic, Total	0.06	0.05	mg/L	1/6/2014 19:47	TS	EPA 200.7	
Boron, Dissolved	0.10	0.05	mg/L	1/7/2014 17:49	TS	EPA 200.7	
Boron, Total	0.24	0.05	mg/L	1/6/2014 19:47	TS	EPA 200.7	
Barium, Dissolved	0.033	0.005	mg/L	1/7/2014 17:49	TS	EPA 200.7	
Calcium, Dissolved	170	0.2	mg/L	1/7/2014 17:49	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	1/7/2014 17:49	TS	EPA 200.7	
Chromium, Dissolved	0.006	0.005	mg/L	1/7/2014 17:49	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	1/7/2014 17:49	TS	EPA 200.7	
Iron, Dissolved	0.25	0.02	mg/L	1/7/2014 17:49	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1400022-06

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	12/31/2013 11:55 PM
Sample Site:	NLP-3			***Receipt Date:***	1/2/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	233
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	30.2	0.02	mg/L	1/6/2014 19:47	TS	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	1/7/2014 17:49	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	1/6/2014 19:47	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	1/7/2014 13:00	AKL	EPA 245.1	
Magnesium, Dissolved	129	0.2	mg/L	1/7/2014 17:49	TS	EPA 200.7	
Manganese, Dissolved	0.206	0.005	mg/L	1/7/2014 17:49	TS	EPA 200.7	
Manganese, Total	0.892	0.005	mg/L	1/6/2014 19:47	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	1/7/2014 17:49	TS	EPA 200.7	
Nickel, Dissolved	0.006	0.005	mg/L	1/7/2014 17:49	TS	EPA 200.7	
Potassium, Dissolved	8.3	0.5	mg/L	1/7/2014 17:49	TS	EPA 200.7	
Selenium, Dissolved	0.12	0.02	mg/L	1/7/2014 17:49	TS	EPA 200.7	
Selenium, Total	0.08	0.02	mg/L	1/6/2014 19:47	TS	EPA 200.7	
Sodium, Dissolved	24.6	0.5	mg/L	1/7/2014 17:49	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	1/7/2014 17:49	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1400022-07

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	1/1/2014 4:30 PM
Sample Site:	NLP-5			***Receipt Date:***	1/2/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	235
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	27.9	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Cation/Anion Balance	2.1		%	1/15/2014 9:20	PNM	SM 1030 E	
Cations, Total	29.1	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Hardness, Total as CaCO3	1380	1	mg/L	1/15/2014 9:20	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	1/13/2014 7:41	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	478	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - CO2	349	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	392	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	1/5/2014 10:00	TSM	SM 4500 NH3-D	
Chloride	17	1	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	0.1	0.1	mg/L	1/6/2014 10:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.04	0.01	mg/L	1/7/2014 4:00	TSM	SM 4500 PB5E	
Sulfate	940	10	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1800	20	mg/L	1/6/2014 8:03	MZ	SM 2540 C	
Total Suspended Solids (TSS)	222	20	mg/L	1/7/2014 13:17	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	0.8	0.05	mg/L	1/7/2014 17:53	TS	EPA 200.7	
Aluminum, Total	0.6	0.05	mg/L	1/6/2014 19:51	TS	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	1/7/2014 17:53	TS	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	1/6/2014 19:51	TS	EPA 200.7	
Boron, Dissolved	0.05	0.05	mg/L	1/7/2014 17:53	TS	EPA 200.7	
Boron, Total	0.07	0.05	mg/L	1/6/2014 19:51	TS	EPA 200.7	
Barium, Dissolved	0.025	0.005	mg/L	1/7/2014 17:53	TS	EPA 200.7	
Calcium, Dissolved	226	0.2	mg/L	1/7/2014 17:53	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	1/7/2014 17:53	TS	EPA 200.7	
Chromium, Dissolved	0.009	0.005	mg/L	1/7/2014 17:53	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	1/7/2014 17:53	TS	EPA 200.7	
Iron, Dissolved	0.35	0.02	mg/L	1/7/2014 17:53	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1400022-07

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	1/1/2014 4:30 PM
Sample Site:	NLP-5			***Receipt Date:***	1/2/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	235
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	2.15	0.02	mg/L	1/6/2014 19:51	TS	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	1/7/2014 17:53	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	1/6/2014 19:51	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	1/7/2014 13:00	AKL	EPA 245.1	
Magnesium, Dissolved	199	0.2	mg/L	1/7/2014 17:53	TS	EPA 200.7	
Manganese, Dissolved	0.016	0.005	mg/L	1/7/2014 17:53	TS	EPA 200.7	
Manganese, Total	0.083	0.005	mg/L	1/6/2014 19:51	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	1/7/2014 17:53	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	1/7/2014 17:53	TS	EPA 200.7	
Potassium, Dissolved	4.7	0.5	mg/L	1/7/2014 17:53	TS	EPA 200.7	
Selenium, Dissolved	0.15	0.02	mg/L	1/7/2014 17:53	TS	EPA 200.7	
Selenium, Total	0.12	0.02	mg/L	1/6/2014 19:51	TS	EPA 200.7	
Sodium, Dissolved	29.6	0.5	mg/L	1/7/2014 17:53	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	1/7/2014 17:53	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1400022-08

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	1/1/2014 3:00 PM
Sample Site:	NLP-7			***Receipt Date:***	1/2/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	237
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	20.9	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Cation/Anion Balance	1.8		%	1/15/2014 9:20	PNM	SM 1030 E	
Cations, Total	21.6	0.01	meq/L	1/15/2014 9:20	PNM	SM 1030 E	
Hardness, Total as CaCO3	929	1	mg/L	1/15/2014 9:20	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	1/13/2014 7:41	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	780	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	11.0	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - CO2	578	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	657	1.0	mg/L	1/13/2014 8:00	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	1/5/2014 10:00	TSM	SM 4500 NH3-D	
Chloride	37	1	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Fluoride	0.5	0.1	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	1.2	0.1	mg/L	1/6/2014 10:00	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.50	0.10	mg/L	1/7/2014 4:00	TSM	SM 4500 PB5E	
Sulfate	339	5	mg/L	1/2/2014 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1140	20	mg/L	1/6/2014 8:03	MZ	SM 2540 C	
Total Suspended Solids (TSS)	7980	200	mg/L	1/7/2014 13:17	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	1.0	0.05	mg/L	1/7/2014 17:57	TS	EPA 200.7	
Aluminum, Total	10.8	0.05	mg/L	1/6/2014 19:55	TS	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	1/7/2014 17:57	TS	EPA 200.7	
Arsenic, Total	0.06	0.05	mg/L	1/6/2014 19:55	TS	EPA 200.7	
Boron, Dissolved	0.07	0.05	mg/L	1/7/2014 17:57	TS	EPA 200.7	
Boron, Total	0.22	0.05	mg/L	1/6/2014 19:55	TS	EPA 200.7	
Barium, Dissolved	0.030	0.005	mg/L	1/7/2014 17:57	TS	EPA 200.7	
Calcium, Dissolved	96.5	0.2	mg/L	1/7/2014 17:57	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	1/7/2014 17:57	TS	EPA 200.7	
Chromium, Dissolved	0.009	0.005	mg/L	1/7/2014 17:57	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	1/7/2014 17:57	TS	EPA 200.7	
Iron, Dissolved	0.55	0.02	mg/L	1/7/2014 17:57	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1400022-08

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	1/1/2014 3:00 PM
Sample Site:	NLP-7			***Receipt Date:***	1/2/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	237
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	37.5	0.02	mg/L	1/6/2014 19:55	TS	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	1/7/2014 17:57	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	1/6/2014 19:55	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	1/7/2014 13:00	AKL	EPA 245.1	
Magnesium, Dissolved	167	0.2	mg/L	1/7/2014 17:57	TS	EPA 200.7	
Manganese, Dissolved	0.177	0.005	mg/L	1/7/2014 17:57	TS	EPA 200.7	
Manganese, Total	1.80	0.005	mg/L	1/6/2014 19:55	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	1/7/2014 17:57	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	1/7/2014 17:57	TS	EPA 200.7	
Potassium, Dissolved	3.9	0.5	mg/L	1/7/2014 17:57	TS	EPA 200.7	
Selenium, Dissolved	0.09	0.02	mg/L	1/7/2014 17:57	TS	EPA 200.7	
Selenium, Total	0.08	0.02	mg/L	1/6/2014 19:55	TS	EPA 200.7	
Sodium, Dissolved	68.8	0.5	mg/L	1/7/2014 17:57	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	1/7/2014 17:57	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1401372-01

Name:	Alton Coal Development, LLC	**Mine Code:**	41	**Sample Date:**	2/11/2014 3:30 PM
Sample Site:	SW-11			**Receipt Date:**	2/12/2014 12:38 PM
Comments:				**Sampler:**	Erik Petersen
Sample Type:	Water			**Site No.:**	214
Field pH:		**Field Temp. Deg. C :**			
Field Flow g/Min.:		**Field Cond. umhos/cm:**			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	11.9	0.01	meq/L	2/24/2014 8:00	PNM	SM 1030 E	
Cation/Anion Balance	-2.3		%	2/24/2014 8:00	PNM	SM 1030 E	
Cations, Total	11.4	0.01	meq/L	2/24/2014 8:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	521	1	mg/L	2/24/2014 8:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	2/22/2014 1:31	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	249	1.0	mg/L	2/13/2014 16:18	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	2/13/2014 16:18	KRW	SM 2320 B	
Alkalinity - CO2	180	1.0	mg/L	2/13/2014 16:18	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	2/13/2014 16:18	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	204	1.0	mg/L	2/13/2014 16:18	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	2/13/2014 11:00	TSM	SM 4500 NH3-D	
Chloride	12	1	mg/L	2/13/2014 7:00	TSM	EPA 300.0	
Fluoride	ND	0.1	mg/L	2/13/2014 7:00	TSM	EPA 300.0	
Nitrate as N	ND	0.1	mg/L	2/13/2014 7:00	TSM	EPA 300.0	
Nitrite as N	ND	0.1	mg/L	2/13/2014 7:00	TSM	EPA 300.0	
Oil & Grease (HEM)	ND	6	mg/L	2/19/2014 0:00	QJP	EPA 1664A	
Phosphorus, Total as P	0.07	0.01	mg/L	2/14/2014 9:30	TSM	SM 4500 PB5E	
Sulfate	360	10	mg/L	2/13/2014 9:05	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	668	20	mg/L	2/13/2014 8:32	MZ	SM 2540 C	
Total Suspended Solids (TSS)	8	4	mg/L	2/18/2014 7:00	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	2/21/2014 12:14	TS	EPA 200.7	
Aluminum, Total	0.1	0.05	mg/L	2/20/2014 10:50	TS	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	2/21/2014 12:14	TS	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	2/19/2014 16:10	TS	EPA 200.7	
Boron, Dissolved	0.05	0.05	mg/L	2/21/2014 12:14	TS	EPA 200.7	
Boron, Total	ND	0.05	mg/L	2/19/2014 16:10	TS	EPA 200.7	
Barium, Dissolved	0.025	0.005	mg/L	2/21/2014 12:14	TS	EPA 200.7	
Calcium, Dissolved	54.3	0.2	mg/L	2/21/2014 12:14	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	2/21/2014 12:14	TS	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	2/21/2014 12:14	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1401372-01

Name:	Alton Coal Development, LLC	**Mine Code:**	41	**Sample Date:**	2/11/2014 3:30 PM
Sample Site:	SW-11			**Receipt Date:**	2/12/2014 12:38 PM
Comments:				**Sampler:**	Erik Petersen
Sample Type:	Water			**Site No.:**	214
Field pH:				**Field Temp. Deg. C :**	
Field Flow g/Min.:				**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Copper, Dissolved	ND	0.005	mg/L	2/21/2014 12:14	TS	EPA 200.7	
Iron, Dissolved	0.07	0.02	mg/L	2/21/2014 12:14	TS	EPA 200.7	
Iron, Total	0.20	0.02	mg/L	2/19/2014 16:10	TS	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	2/21/2014 12:14	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	2/19/2014 16:10	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	2/19/2014 15:57	AKL	EPA 245.1	
Magnesium, Dissolved	93.5	0.2	mg/L	2/21/2014 12:14	TS	EPA 200.7	
Manganese, Dissolved	0.010	0.005	mg/L	2/21/2014 12:14	TS	EPA 200.7	
Manganese, Total	ND	0.005	mg/L	2/19/2014 16:10	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	2/21/2014 12:14	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	2/21/2014 12:14	TS	EPA 200.7	
Potassium, Dissolved	5.6	0.5	mg/L	2/21/2014 12:14	TS	EPA 200.7	
Selenium, Dissolved	0.12	0.02	mg/L	2/21/2014 12:14	TS	EPA 200.7	
Selenium, Total	0.11	0.02	mg/L	2/19/2014 16:10	TS	EPA 200.7	
Sodium, Dissolved	18.7	0.5	mg/L	2/21/2014 12:14	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	2/21/2014 12:14	TS	EPA 200.7	

Abbreviations

ND = Not detected at the corresponding Minimum Reporting Limit.
1 mg/L = one milligram per liter or 1 mg/Kg = one milligram per kilogram = 1 part per million.
1 ug/L = one microgram per liter or 1 ug/Kg = one microgram per kilogram = 1 part per billion.
1 ng/L = one nanogram per liter or 1 ng/Kg = one nanogram per kilogram = 1 part per trillion.

Flag Descriptions

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1401922-01

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 2/28/2014 9:00 PM
Sample Site:	RSD-1		**Receipt Date:** 3/3/2014 10:32 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:**
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	6.3	0.01	meq/L	3/11/2014 7:45	PNM	SM 1030 E	
Cation/Anion Balance	-6.3		%	3/11/2014 7:45	PNM	SM 1030 E	
Cations, Total	5.6	0.01	meq/L	3/11/2014 7:45	PNM	SM 1030 E	
Hardness, Total as CaCO3	174	1	mg/L	3/11/2014 7:45	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	3/17/2014 13:24	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	73.0	1.0	mg/L	3/7/2014 23:01	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	3/7/2014 23:01	KRW	SM 2320 B	
Alkalinity - CO2	53.0	1.0	mg/L	3/7/2014 23:01	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	3/7/2014 23:01	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	60.0	1.0	mg/L	3/7/2014 23:01	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	3/5/2014 11:00	TSM	SM 4500 NH3-D	
Chloride	163	5	mg/L	3/4/2014 12:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	3/4/2014 12:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	1.3	0.1	mg/L	3/11/2014 12:00	KSL	SM 4500 NO3-F	
Oil & Grease (HEM)	ND	6	mg/L	3/10/2014 15:46	QJP	EPA 1664A	
Phosphorus, Total as P	4.0	1.2	mg/L	3/4/2014 11:30	TSM	SM 4500 P-E	
Settleable Solids	150	0.0002	mL/L	3/3/2014 14:45	JO	SM 2540 F	SPH
Sulfate	26	1	mg/L	3/4/2014 12:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	780	100	mg/L	3/4/2014 9:00	MZ	SM 2540 C	
Total Suspended Solids (TSS)	16200	200	mg/L	3/5/2014 13:51	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	3/10/2014 17:34	TS	EPA 200.7	
Aluminum, Total	65.1	0.05	mg/L	3/6/2014 12:37	TS	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	3/10/2014 17:34	TS	EPA 200.7	
Arsenic, Total	0.12	0.05	mg/L	3/6/2014 12:37	TS	EPA 200.7	
Boron, Dissolved	0.23	0.05	mg/L	3/11/2014 11:53	TS	EPA 200.7	
Boron, Total	0.41	0.05	mg/L	3/6/2014 12:37	TS	EPA 200.7	
Barium, Dissolved	0.073	0.005	mg/L	3/10/2014 17:34	TS	EPA 200.7	
Calcium, Dissolved	24.1	0.2	mg/L	3/10/2014 17:34	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	3/10/2014 17:34	TS	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	3/10/2014 17:34	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	3/10/2014 17:34	TS	EPA 200.7	

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LABORATORIES

Certificate of Analysis

Lab Sample No.: 1401922-01

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	2/28/2014 9:00 PM
Sample Site:	RSD-1			***Receipt Date:***	3/3/2014 10:32 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	
Field pH:				***Field Temp. Deg. C :***	
Field Flow g/Min.:				***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Dissolved	0.02	0.02	mg/L	3/10/2014 17:34	TS	EPA 200.7	
Iron, Total	43.1	0.02	mg/L	3/6/2014 12:37	TS	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	3/10/2014 17:34	TS	EPA 200.7	
Lead, Total	0.03	0.02	mg/L	3/6/2014 12:37	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	3/5/2014 15:37	AKL	EPA 245.1	
Magnesium, Dissolved	27.6	0.2	mg/L	3/10/2014 17:34	TS	EPA 200.7	
Manganese, Dissolved	0.024	0.005	mg/L	3/10/2014 17:34	TS	EPA 200.7	
Manganese, Total	3.83	0.005	mg/L	3/6/2014 12:37	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	3/10/2014 17:34	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	3/10/2014 17:34	TS	EPA 200.7	
Potassium, Dissolved	3.7	0.5	mg/L	3/10/2014 17:34	TS	EPA 200.7	
Selenium, Dissolved	0.07	0.02	mg/L	3/10/2014 17:34	TS	EPA 200.7	
Selenium, Total	0.14	0.02	mg/L	3/6/2014 12:37	TS	EPA 200.7	
Sodium, Dissolved	46.2	0.5	mg/L	3/10/2014 17:34	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	3/10/2014 17:34	TS	EPA 200.7	

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CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1401922-02

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 2/28/2014 9:45 PM
Sample Site:	SW-11		**Receipt Date:** 3/3/2014 10:32 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:**
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	25.3	0.01	meq/L	3/11/2014 7:45	PNM	SM 1030 E	
Cation/Anion Balance	0.3		%	3/11/2014 7:45	PNM	SM 1030 E	
Cations, Total	25.5	0.01	meq/L	3/11/2014 7:45	PNM	SM 1030 E	
Hardness, Total as CaCO3	1170	1	mg/L	3/11/2014 7:45	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	3/17/2014 13:24	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	258	1.0	mg/L	3/7/2014 23:01	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	3/7/2014 23:01	KRW	SM 2320 B	
Alkalinity - CO2	187	1.0	mg/L	3/7/2014 23:01	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	3/7/2014 23:01	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	211	1.0	mg/L	3/7/2014 23:01	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	3/5/2014 11:00	TSM	SM 4500 NH3-D	
Chloride	26	1	mg/L	3/4/2014 12:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	3/4/2014 12:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	3/11/2014 12:00	KSL	SM 4500 NO3-F	
Oil & Grease (HEM)	ND	5	mg/L	3/10/2014 15:46	QJP	EPA 1664A	
Phosphorus, Total as P	0.04	0.01	mg/L	3/4/2014 11:30	TSM	SM 4500 P-E	
Settleable Solids	ND	0.0002	mL/L	3/3/2014 14:45	JO	SM 2540 F	SPH
Sulfate	980	10	mg/L	3/4/2014 12:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1620	20	mg/L	3/4/2014 9:00	MZ	SM 2540 C	
Total Suspended Solids (TSS)	41	4	mg/L	3/5/2014 13:51	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	3/10/2014 17:38	TS	EPA 200.7	
Aluminum, Total	0.3	0.05	mg/L	3/6/2014 12:44	TS	EPA 200.7	
Arsenic, Dissolved	0.05	0.05	mg/L	3/10/2014 17:38	TS	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	3/6/2014 12:44	TS	EPA 200.7	
Boron, Dissolved	ND	0.05	mg/L	3/11/2014 11:57	TS	EPA 200.7	
Boron, Total	ND	0.05	mg/L	3/6/2014 12:44	TS	EPA 200.7	
Barium, Dissolved	0.030	0.005	mg/L	3/10/2014 17:38	TS	EPA 200.7	
Calcium, Dissolved	116	0.2	mg/L	3/10/2014 17:38	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	3/10/2014 17:38	TS	EPA 200.7	
Chromium, Dissolved	0.010	0.005	mg/L	3/10/2014 17:38	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	3/10/2014 17:38	TS	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1401922-02

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	2/28/2014 9:45 PM
Sample Site:	SW-11			***Receipt Date:***	3/3/2014 10:32 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	
Field pH:				***Field Temp. Deg. C :***	
Field Flow g/Min.:				***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Dissolved	ND	0.02	mg/L	3/10/2014 17:38	TS	EPA 200.7	
Iron, Total	0.51	0.02	mg/L	3/6/2014 12:44	TS	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	3/10/2014 17:38	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	3/6/2014 12:44	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	3/5/2014 15:37	AKL	EPA 245.1	
Magnesium, Dissolved	214	0.2	mg/L	3/10/2014 17:38	TS	EPA 200.7	
Manganese, Dissolved	ND	0.005	mg/L	3/10/2014 17:38	TS	EPA 200.7	
Manganese, Total	0.012	0.005	mg/L	3/6/2014 12:44	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	3/10/2014 17:38	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	3/10/2014 17:38	TS	EPA 200.7	
Potassium, Dissolved	5.9	0.5	mg/L	3/10/2014 17:38	TS	EPA 200.7	
Selenium, Dissolved	0.18	0.02	mg/L	3/10/2014 17:38	TS	EPA 200.7	
Selenium, Total	0.15	0.02	mg/L	3/6/2014 12:44	TS	EPA 200.7	
Sodium, Dissolved	44.3	0.5	mg/L	3/10/2014 17:38	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	3/10/2014 17:38	TS	EPA 200.7	

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Lab Sample No.: 1401922-06

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 2/28/2014 11:05 PM
Sample Site:	Kanab Creek at County Road		**Receipt Date:** 3/3/2014 10:32 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 202
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	10.1	0.01	meq/L	3/11/2014 7:45	PNM	SM 1030 E	
Cation/Anion Balance	-1.2		%	3/11/2014 7:45	PNM	SM 1030 E	
Cations, Total	9.9	0.01	meq/L	3/11/2014 7:45	PNM	SM 1030 E	
Hardness, Total as CaCO3	469	1	mg/L	3/11/2014 7:45	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	3/17/2014 13:24	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	393	1.0	mg/L	3/7/2014 23:01	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	3/7/2014 23:01	KRW	SM 2320 B	
Alkalinity - CO2	284	1.0	mg/L	3/7/2014 23:01	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	3/7/2014 23:01	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	322	1.0	mg/L	3/7/2014 23:01	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	3/5/2014 11:00	TSM	SM 4500 NH3-D	
Chloride	10	1	mg/L	3/4/2014 12:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	3/4/2014 12:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	3/11/2014 12:00	KSL	SM 4500 NO3-F	
Oil & Grease (HEM)	ND	6	mg/L	3/10/2014 15:46	QJP	EPA 1664A	
Phosphorus, Total as P	0.42	0.05	mg/L	3/4/2014 11:30	TSM	SM 4500 P-E	
Settleable Solids	1.0	0.0002	mL/L	3/3/2014 14:45	JO	SM 2540 F	SPH
Sulfate	165	5	mg/L	3/4/2014 12:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	536	20	mg/L	3/4/2014 9:00	MZ	SM 2540 C	
Total Suspended Solids (TSS)	613	33	mg/L	3/7/2014 17:37	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	0.07	0.05	mg/L	3/10/2014 18:09	TS	EPA 200.7	
Aluminum, Total	5.7	0.05	mg/L	3/6/2014 13:10	TS	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	3/10/2014 18:09	TS	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	3/6/2014 13:10	TS	EPA 200.7	
Boron, Dissolved	0.06	0.05	mg/L	3/11/2014 12:28	TS	EPA 200.7	
Boron, Total	0.09	0.05	mg/L	3/6/2014 13:10	TS	EPA 200.7	
Barium, Dissolved	0.165	0.005	mg/L	3/10/2014 18:09	TS	EPA 200.7	
Calcium, Dissolved	63.2	0.2	mg/L	3/10/2014 18:09	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	3/10/2014 18:09	TS	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	3/10/2014 18:09	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	3/10/2014 18:09	TS	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1401922-06

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	2/28/2014 11:05 PM
Sample Site:	Kanab Creek at County Road			***Receipt Date:***	3/3/2014 10:32 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	202
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Dissolved	0.06	0.02	mg/L	3/10/2014 18:09	TS	EPA 200.7	
Iron, Total	9.49	0.02	mg/L	3/6/2014 13:10	TS	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	3/10/2014 18:09	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	3/6/2014 13:10	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	3/5/2014 15:37	AKL	EPA 245.1	
Magnesium, Dissolved	75.6	0.2	mg/L	3/10/2014 18:09	TS	EPA 200.7	
Manganese, Dissolved	0.005	0.005	mg/L	3/10/2014 18:09	TS	EPA 200.7	
Manganese, Total	0.261	0.005	mg/L	3/6/2014 13:10	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	3/10/2014 18:09	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	3/10/2014 18:09	TS	EPA 200.7	
Potassium, Dissolved	3.3	0.5	mg/L	3/10/2014 18:09	TS	EPA 200.7	
Selenium, Dissolved	0.14	0.02	mg/L	3/10/2014 18:09	TS	EPA 200.7	
Selenium, Total	0.14	0.02	mg/L	3/6/2014 13:10	TS	EPA 200.7	
Sodium, Dissolved	10.2	0.5	mg/L	3/10/2014 18:09	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	3/10/2014 18:09	TS	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1403006-01

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 3/31/2014 5:30 PM
Sample Site:	SP1-7		**Receipt Date:** 4/2/2014 4:40 PM
Comments:			**Sampler:** Client
Sample Type:	Water		**Site No.:**
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	17.4	0.01	meq/L	4/9/2014 9:45	PNM	SM 1030 E	
Cation/Anion Balance	1.4		%	4/9/2014 9:45	PNM	SM 1030 E	
Cations, Total	17.9	0.01	meq/L	4/9/2014 9:45	PNM	SM 1030 E	
Hardness, Total as CaCO3	856	1	mg/L	4/9/2014 9:45	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	4/8/2014 1:55	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	552	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - CO2	405	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	453	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	4/7/2014 6:00	TM	SM 4500 NH3-D	
Chloride	9	1	mg/L	4/4/2014 7:30	TM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	4/4/2014 7:30	TM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	4/7/2014 14:54	JO	SM 4500 NO3-F	
Phosphorus, Total as P	0.02	0.01	mg/L	4/7/2014 3:00	TM	SM 4500 P-E	
Sulfate	390	20	mg/L	4/4/2014 7:30	TM	EPA 300.0	
Total Dissolved Solids (TDS)	1000	20	mg/L	4/4/2014 16:23	MZ	SM 2540 C	
Total Suspended Solids (TSS)	59	4	mg/L	4/4/2014 18:24	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	4/8/2014 18:37	TS	EPA 200.7	
Aluminum, Total	0.08	0.05	mg/L	4/10/2014 12:38	TS	EPA 200.7	
Arsenic, Dissolved	0.05	0.05	mg/L	4/9/2014 12:47	TS	EPA 200.7	
Arsenic, Total	0.05	0.05	mg/L	4/10/2014 12:38	TS	EPA 200.7	
Boron, Dissolved	0.05	0.05	mg/L	4/9/2014 12:47	TS	EPA 200.7	
Boron, Total	0.08	0.05	mg/L	4/10/2014 17:36	TS	EPA 200.7	
Barium, Dissolved	0.044	0.005	mg/L	4/8/2014 18:37	TS	EPA 200.7	
Calcium, Dissolved	158	0.2	mg/L	4/8/2014 18:37	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	4/9/2014 12:47	TS	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	4/8/2014 18:37	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	4/8/2014 18:37	TS	EPA 200.7	
Iron, Dissolved	0.09	0.02	mg/L	4/8/2014 18:37	TS	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1403006-01

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	3/31/2014 5:30 PM
Sample Site:	SP1-7			***Receipt Date:***	4/2/2014 4:40 PM
Comments:				***Sampler:***	Client
Sample Type:	Water			***Site No.:***	
Field pH:				***Field Temp. Deg. C :***	
Field Flow g/Min.:				***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	1.68	0.02	mg/L	4/10/2014 12:38	TS	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	4/8/2014 18:37	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	4/10/2014 12:38	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	4/9/2014 14:00	AKL	EPA 245.1	
Magnesium, Dissolved	112	0.2	mg/L	4/8/2014 18:37	TS	EPA 200.7	
Manganese, Dissolved	0.044	0.005	mg/L	4/8/2014 18:37	TS	EPA 200.7	
Manganese, Total	0.076	0.005	mg/L	4/10/2014 12:38	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	4/9/2014 12:47	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	4/8/2014 18:37	TS	EPA 200.7	
Potassium, Dissolved	4.3	0.5	mg/L	4/8/2014 18:37	TS	EPA 200.7	
Selenium, Dissolved	0.23	0.02	mg/L	4/9/2014 12:47	TS	EPA 200.7	
Selenium, Total	0.22	0.02	mg/L	4/10/2014 12:38	TS	EPA 200.7	
Sodium, Dissolved	16.2	0.5	mg/L	4/8/2014 18:37	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	4/8/2014 18:37	TS	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1403006-02

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	3/31/2014 8:30 PM
Sample Site:	Coyote Seep			***Receipt Date:***	4/2/2014 4:40 PM
Comments:				***Sampler:***	Client
Sample Type:	Water			***Site No.:***	205
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	35.5	0.01	meq/L	4/9/2014 9:45	PNM	SM 1030 E	
Cation/Anion Balance	-0.1		%	4/9/2014 9:45	PNM	SM 1030 E	
Cations, Total	35.4	0.01	meq/L	4/9/2014 9:45	PNM	SM 1030 E	
Hardness, Total as CaCO3	1660	1	mg/L	4/9/2014 9:45	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	4/8/2014 1:55	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	510	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - CO2	370	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	419	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	4/7/2014 6:00	TM	SM 4500 NH3-D	
Chloride	24	2	mg/L	4/4/2014 7:30	TM	EPA 300.0	
Fluoride	ND	0.2	mg/L	4/4/2014 7:30	TM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	4/7/2014 14:54	JO	SM 4500 NO3-F	
Phosphorus, Total as P	0.30	0.01	mg/L	4/7/2014 3:00	TM	SM 4500 P-E	
Sulfate	1270	10	mg/L	4/4/2014 7:30	TM	EPA 300.0	
Total Dissolved Solids (TDS)	2140	20	mg/L	4/4/2014 16:23	MZ	SM 2540 C	
Total Suspended Solids (TSS)	455	4	mg/L	4/7/2014 16:05	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	4/8/2014 18:56	TS	EPA 200.7	
Aluminum, Total	0.6	0.05	mg/L	4/10/2014 12:42	TS	EPA 200.7	
Arsenic, Dissolved	0.05	0.05	mg/L	4/9/2014 13:06	TS	EPA 200.7	
Arsenic, Total	0.07	0.05	mg/L	4/10/2014 12:42	TS	EPA 200.7	
Boron, Dissolved	0.05	0.05	mg/L	4/9/2014 13:06	TS	EPA 200.7	
Boron, Total	0.05	0.05	mg/L	4/10/2014 17:40	TS	EPA 200.7	
Barium, Dissolved	0.029	0.005	mg/L	4/8/2014 18:56	TS	EPA 200.7	
Calcium, Dissolved	170	0.2	mg/L	4/8/2014 18:56	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	4/9/2014 13:06	TS	EPA 200.7	
Chromium, Dissolved	0.011	0.005	mg/L	4/8/2014 18:56	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	4/8/2014 18:56	TS	EPA 200.7	
Iron, Dissolved	0.03	0.02	mg/L	4/8/2014 18:56	TS	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1403006-02

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	3/31/2014 8:30 PM
Sample Site:	Coyote Seep			***Receipt Date:***	4/2/2014 4:40 PM
Comments:				***Sampler:***	Client
Sample Type:	Water			***Site No.:***	205
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	3.74	0.02	mg/L	4/10/2014 12:42	TS	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	4/8/2014 18:56	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	4/10/2014 12:42	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	4/9/2014 14:00	AKL	EPA 245.1	
Magnesium, Dissolved	301	0.2	mg/L	4/8/2014 18:56	TS	EPA 200.7	
Manganese, Dissolved	ND	0.005	mg/L	4/8/2014 18:56	TS	EPA 200.7	
Manganese, Total	0.136	0.005	mg/L	4/10/2014 12:42	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	4/9/2014 13:06	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	4/8/2014 18:56	TS	EPA 200.7	
Potassium, Dissolved	6.0	0.5	mg/L	4/8/2014 18:56	TS	EPA 200.7	
Selenium, Dissolved	0.27	0.02	mg/L	4/9/2014 13:06	TS	EPA 200.7	
Selenium, Total	0.25	0.02	mg/L	4/10/2014 12:42	TS	EPA 200.7	
Sodium, Dissolved	45.4	0.5	mg/L	4/8/2014 18:56	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	4/8/2014 18:56	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1403006-03

Name:	Alton Coal Development, LLC	**Mine Code:**	41	**Sample Date:**	4/1/2014 3:00 PM
Sample Site:	Y-70			**Receipt Date:**	4/2/2014 4:40 PM
Comments:				**Sampler:**	Client
Sample Type:	Water			**Site No.:**	225
Field pH:		**Field Temp. Deg. C :**			
Field Flow g/Min.:		**Field Cond. umhos/cm:**			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	46.2	0.01	meq/L	4/9/2014 9:45	PNM	SM 1030 E	
Cation/Anion Balance	-3.1		%	4/9/2014 9:45	PNM	SM 1030 E	
Cations, Total	43.4	0.01	meq/L	4/9/2014 9:45	PNM	SM 1030 E	
Hardness, Total as CaCO3	1620	1	mg/L	4/9/2014 9:45	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	4/8/2014 1:55	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	766	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - CO2	589	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	629	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Ammonia as N	1.5	0.2	mg/L	4/7/2014 6:00	TM	SM 4500 NH3-D	
Chloride	58	2	mg/L	4/4/2014 7:30	TM	EPA 300.0	
Fluoride	0.5	0.2	mg/L	4/4/2014 7:30	TM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	4/7/2014 14:54	JO	SM 4500 NO3-F	
Phosphorus, Total as P	0.04	0.01	mg/L	4/7/2014 3:00	TM	SM 4500 P-E	
Sulfate	1540	20	mg/L	4/4/2014 7:30	TM	EPA 300.0	
Total Dissolved Solids (TDS)	2850	20	mg/L	4/4/2014 16:23	MZ	SM 2540 C	
Total Suspended Solids (TSS)	83	7	mg/L	4/7/2014 16:55	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	4/8/2014 19:00	TS	EPA 200.7	
Aluminum, Total	0.3	0.05	mg/L	4/10/2014 12:46	TS	EPA 200.7	
Arsenic, Dissolved	0.08	0.05	mg/L	4/9/2014 13:10	TS	EPA 200.7	
Arsenic, Total	0.09	0.05	mg/L	4/10/2014 12:46	TS	EPA 200.7	
Boron, Dissolved	0.23	0.05	mg/L	4/9/2014 13:10	TS	EPA 200.7	
Boron, Total	0.25	0.05	mg/L	4/10/2014 17:44	TS	EPA 200.7	
Barium, Dissolved	0.014	0.005	mg/L	4/8/2014 19:00	TS	EPA 200.7	
Calcium, Dissolved	280	0.2	mg/L	4/8/2014 19:00	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	4/9/2014 13:10	TS	EPA 200.7	
Chromium, Dissolved	0.009	0.005	mg/L	4/8/2014 19:00	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	4/8/2014 19:00	TS	EPA 200.7	
Iron, Dissolved	0.61	0.02	mg/L	4/8/2014 19:00	TS	EPA 200.7	

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Certificate of Analysis

Lab Sample No.: 1403006-03

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	4/1/2014 3:00 PM
Sample Site:	Y-70			***Receipt Date:***	4/2/2014 4:40 PM
Comments:				***Sampler:***	Client
Sample Type:	Water			***Site No.:***	225
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	8.59	0.02	mg/L	4/10/2014 12:46	TS	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	4/8/2014 19:00	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	4/10/2014 12:46	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	4/9/2014 14:00	AKL	EPA 245.1	
Magnesium, Dissolved	224	0.2	mg/L	4/8/2014 19:00	TS	EPA 200.7	
Manganese, Dissolved	0.481	0.005	mg/L	4/8/2014 19:00	TS	EPA 200.7	
Manganese, Total	0.540	0.005	mg/L	4/10/2014 12:46	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	4/9/2014 13:10	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	4/8/2014 19:00	TS	EPA 200.7	
Potassium, Dissolved	8.6	0.5	mg/L	4/8/2014 19:00	TS	EPA 200.7	
Selenium, Dissolved	0.28	0.02	mg/L	4/9/2014 13:10	TS	EPA 200.7	
Selenium, Total	0.28	0.02	mg/L	4/10/2014 12:46	TS	EPA 200.7	
Sodium, Dissolved	248	0.5	mg/L	4/8/2014 19:00	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	4/8/2014 19:00	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1403006-04

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 4/1/2014 6:20 PM
Sample Site:	Y-103		**Receipt Date:** 4/2/2014 4:40 PM
Comments:			**Sampler:** Client
Sample Type:	Water		**Site No.:** 204
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	44.7	0.01	meq/L	4/9/2014 9:45	PNM	SM 1030 E	
Cation/Anion Balance	-3.5		%	4/9/2014 9:45	PNM	SM 1030 E	
Cations, Total	41.7	0.01	meq/L	4/9/2014 9:45	PNM	SM 1030 E	
Hardness, Total as CaCO3	2020	1	mg/L	4/9/2014 9:45	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	4/8/2014 1:55	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	845	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - CO2	653	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	693	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	4/7/2014 6:00	TM	SM 4500 NH3-D	
Chloride	11	2	mg/L	4/4/2014 7:30	TM	EPA 300.0	
Fluoride	0.3	0.2	mg/L	4/4/2014 7:30	TM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	4/7/2014 14:54	JO	SM 4500 NO3-F	
Phosphorus, Total as P	ND	0.01	mg/L	4/7/2014 3:00	TM	SM 4500 P-E	
Sulfate	1470	10	mg/L	4/4/2014 7:30	TM	EPA 300.0	
Total Dissolved Solids (TDS)	2570	20	mg/L	4/4/2014 16:23	MZ	SM 2540 C	
Total Suspended Solids (TSS)	22	7	mg/L	4/7/2014 16:55	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	4/8/2014 19:04	TS	EPA 200.7	
Aluminum, Total	ND	0.05	mg/L	4/10/2014 12:50	TS	EPA 200.7	
Arsenic, Dissolved	0.07	0.05	mg/L	4/9/2014 13:14	TS	EPA 200.7	
Arsenic, Total	0.08	0.05	mg/L	4/10/2014 12:50	TS	EPA 200.7	
Boron, Dissolved	0.06	0.05	mg/L	4/9/2014 13:14	TS	EPA 200.7	
Boron, Total	0.07	0.05	mg/L	4/10/2014 17:48	TS	EPA 200.7	
Barium, Dissolved	0.010	0.005	mg/L	4/8/2014 19:04	TS	EPA 200.7	
Calcium, Dissolved	263	0.2	mg/L	4/8/2014 19:04	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	4/9/2014 13:14	TS	EPA 200.7	
Chromium, Dissolved	0.011	0.005	mg/L	4/8/2014 19:04	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	4/8/2014 19:04	TS	EPA 200.7	
Iron, Dissolved	0.45	0.02	mg/L	4/8/2014 19:04	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1403006-04

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	4/1/2014 6:20 PM
Sample Site:	Y-103			***Receipt Date:***	4/2/2014 4:40 PM
Comments:				***Sampler:***	Client
Sample Type:	Water			***Site No.:***	204
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	8.69	0.02	mg/L	4/10/2014 12:50	TS	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	4/8/2014 19:04	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	4/10/2014 12:50	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	4/9/2014 14:00	AKL	EPA 245.1	
Magnesium, Dissolved	331	0.2	mg/L	4/8/2014 19:04	TS	EPA 200.7	
Manganese, Dissolved	0.098	0.005	mg/L	4/8/2014 19:04	TS	EPA 200.7	
Manganese, Total	0.110	0.005	mg/L	4/10/2014 12:50	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	4/9/2014 13:14	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	4/8/2014 19:04	TS	EPA 200.7	
Potassium, Dissolved	11.8	0.5	mg/L	4/8/2014 19:04	TS	EPA 200.7	
Selenium, Dissolved	0.27	0.02	mg/L	4/9/2014 13:14	TS	EPA 200.7	
Selenium, Total	0.29	0.02	mg/L	4/10/2014 12:50	TS	EPA 200.7	
Sodium, Dissolved	24.2	0.5	mg/L	4/8/2014 19:04	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	4/8/2014 19:04	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1403006-06

Name:	Alton Coal Development, LLC	**Mine Code:**	41	**Sample Date:**	3/31/2014 5:00 PM
Sample Site:	SW-1A			**Receipt Date:**	4/2/2014 4:40 PM
Comments:				**Sampler:**	Client
Sample Type:	Water			**Site No.:**	201
Field pH:				**Field Temp. Deg. C :**	
Field Flow g/Min.:				**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	11.2	0.01	meq/L	4/9/2014 9:45	PNM	SM 1030 E	
Cation/Anion Balance	2.8		%	4/9/2014 9:45	PNM	SM 1030 E	
Cations, Total	11.9	0.01	meq/L	4/9/2014 9:45	PNM	SM 1030 E	
Hardness, Total as CaCO3	560	1	mg/L	4/9/2014 9:45	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	4/8/2014 1:55	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	427	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	22.0	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - CO2	340	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	388	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	4/7/2014 6:00	TM	SM 4500 NH3-D	
Chloride	8	1	mg/L	4/4/2014 7:30	TM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	4/4/2014 7:30	TM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	4/7/2014 14:54	JO	SM 4500 NO3-F	
Oil & Grease (HEM)	ND	5	mg/L	4/7/2014 14:08	QJP	EPA 1664A	
Phosphorus, Total as P	ND	0.01	mg/L	4/7/2014 3:00	TM	SM 4500 P-E	
Sulfate	193	2	mg/L	4/4/2014 7:30	TM	EPA 300.0	
Total Dissolved Solids (TDS)	584	20	mg/L	4/4/2014 16:23	MZ	SM 2540 C	
Total Suspended Solids (TSS)	5	4	mg/L	4/4/2014 18:24	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	4/8/2014 19:15	TS	EPA 200.7	
Aluminum, Total	ND	0.05	mg/L	4/10/2014 13:23	TS	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	4/9/2014 13:24	TS	EPA 200.7	
Arsenic, Total	0.05	0.05	mg/L	4/10/2014 13:23	TS	EPA 200.7	
Boron, Dissolved	0.05	0.05	mg/L	4/9/2014 13:24	TS	EPA 200.7	
Boron, Total	ND	0.05	mg/L	4/10/2014 18:22	TS	EPA 200.7	
Barium, Dissolved	0.120	0.005	mg/L	4/8/2014 19:15	TS	EPA 200.7	
Calcium, Dissolved	70.5	0.2	mg/L	4/8/2014 19:15	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	4/9/2014 13:24	TS	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	4/8/2014 19:15	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	4/8/2014 19:15	TS	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1403006-06

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	3/31/2014 5:00 PM
Sample Site:	SW-1A			***Receipt Date:***	4/2/2014 4:40 PM
Comments:				***Sampler:***	Client
Sample Type:	Water			***Site No.:***	201
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Dissolved	ND	0.02	mg/L	4/8/2014 19:15	TS	EPA 200.7	
Iron, Total	0.16	0.02	mg/L	4/10/2014 13:23	TS	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	4/8/2014 19:15	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	4/10/2014 13:23	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	4/9/2014 14:00	AKL	EPA 245.1	
Magnesium, Dissolved	93.2	0.2	mg/L	4/8/2014 19:15	TS	EPA 200.7	
Manganese, Dissolved	0.005	0.005	mg/L	4/8/2014 19:15	TS	EPA 200.7	
Manganese, Total	0.008	0.005	mg/L	4/10/2014 13:23	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	4/9/2014 13:24	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	4/8/2014 19:15	TS	EPA 200.7	
Potassium, Dissolved	3.8	0.5	mg/L	4/8/2014 19:15	TS	EPA 200.7	
Selenium, Dissolved	0.17	0.02	mg/L	4/9/2014 13:24	TS	EPA 200.7	
Selenium, Total	0.15	0.02	mg/L	4/10/2014 13:23	TS	EPA 200.7	
Sodium, Dissolved	13.9	0.5	mg/L	4/8/2014 19:15	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	4/8/2014 19:15	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1403006-07

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 3/31/2014 6:30 PM
Sample Site:	Kanab Creek at County Road		**Receipt Date:** 4/2/2014 4:40 PM
Comments:			**Sampler:** Client
Sample Type:	Water		**Site No.:** 202
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	14.2	0.01	meq/L	4/9/2014 9:45	PNM	SM 1030 E	
Cation/Anion Balance	-5.2		%	4/9/2014 9:45	PNM	SM 1030 E	
Cations, Total	12.8	0.01	meq/L	4/9/2014 9:45	PNM	SM 1030 E	
Hardness, Total as CaCO3	601	1	mg/L	4/9/2014 9:45	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	4/8/2014 1:55	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	473	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	14.0	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - CO2	361	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	410	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	4/7/2014 6:00	TM	SM 4500 NH3-D	
Chloride	12	1	mg/L	4/4/2014 7:30	TM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	4/4/2014 7:30	TM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	4/7/2014 14:54	JO	SM 4500 NO3-F	
Oil & Grease (HEM)	ND	5	mg/L	4/7/2014 14:08	QJP	EPA 1664A	
Phosphorus, Total as P	0.01	0.01	mg/L	4/7/2014 3:00	TM	SM 4500 P-E	
Sulfate	295	2	mg/L	4/4/2014 7:30	TM	EPA 300.0	
Total Dissolved Solids (TDS)	752	20	mg/L	4/4/2014 16:23	MZ	SM 2540 C	
Total Suspended Solids (TSS)	20	4	mg/L	4/4/2014 18:24	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	4/8/2014 19:19	TS	EPA 200.7	
Aluminum, Total	0.06	0.05	mg/L	4/10/2014 13:27	TS	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	4/9/2014 13:28	TS	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	4/10/2014 13:27	TS	EPA 200.7	
Boron, Dissolved	0.05	0.05	mg/L	4/9/2014 13:28	TS	EPA 200.7	
Boron, Total	ND	0.05	mg/L	4/10/2014 18:25	TS	EPA 200.7	
Barium, Dissolved	0.093	0.005	mg/L	4/8/2014 19:19	TS	EPA 200.7	
Calcium, Dissolved	70.8	0.2	mg/L	4/8/2014 19:19	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	4/9/2014 13:28	TS	EPA 200.7	
Chromium, Dissolved	0.005	0.005	mg/L	4/8/2014 19:19	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	4/8/2014 19:19	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1403006-07

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	3/31/2014 6:30 PM
Sample Site:	Kanab Creek at County Road			***Receipt Date:***	4/2/2014 4:40 PM
Comments:				***Sampler:***	Client
Sample Type:	Water			***Site No.:***	202
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Dissolved	ND	0.02	mg/L	4/8/2014 19:19	TS	EPA 200.7	
Iron, Total	0.30	0.02	mg/L	4/10/2014 13:27	TS	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	4/8/2014 19:19	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	4/10/2014 13:27	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	4/9/2014 14:00	AKL	EPA 245.1	
Magnesium, Dissolved	103	0.2	mg/L	4/8/2014 19:19	TS	EPA 200.7	
Manganese, Dissolved	0.006	0.005	mg/L	4/8/2014 19:19	TS	EPA 200.7	
Manganese, Total	0.017	0.005	mg/L	4/10/2014 13:27	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	4/9/2014 13:28	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	4/8/2014 19:19	TS	EPA 200.7	
Potassium, Dissolved	3.6	0.5	mg/L	4/8/2014 19:19	TS	EPA 200.7	
Selenium, Dissolved	0.14	0.02	mg/L	4/9/2014 13:28	TS	EPA 200.7	
Selenium, Total	0.16	0.02	mg/L	4/10/2014 13:27	TS	EPA 200.7	
Sodium, Dissolved	16.4	0.5	mg/L	4/8/2014 19:19	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	4/8/2014 19:19	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1403006-08

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 3/31/2014 7:15 PM
Sample Site:	SW-1		**Receipt Date:** 4/2/2014 4:40 PM
Comments:			**Sampler:** Client
Sample Type:	Water		**Site No.:** 29
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	12.1	0.01	meq/L	4/9/2014 9:45	PNM	SM 1030 E	
Cation/Anion Balance	-1.3		%	4/9/2014 9:45	PNM	SM 1030 E	
Cations, Total	11.7	0.01	meq/L	4/9/2014 9:45	PNM	SM 1030 E	
Hardness, Total as CaCO3	551	1	mg/L	4/9/2014 9:45	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	4/8/2014 1:55	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	454	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	13.0	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - CO2	346	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	395	1.0	mg/L	4/5/2014 2:37	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	4/7/2014 6:00	TM	SM 4500 NH3-D	
Chloride	9	1	mg/L	4/4/2014 7:30	TM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	4/4/2014 7:30	TM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	4/7/2014 14:54	JO	SM 4500 NO3-F	
Oil & Grease (HEM)	ND	6	mg/L	4/7/2014 14:08	QJP	EPA 1664A	
Phosphorus, Total as P	0.01	0.01	mg/L	4/7/2014 3:00	TM	SM 4500 P-E	
Sulfate	210	10	mg/L	4/4/2014 7:30	TM	EPA 300.0	
Total Dissolved Solids (TDS)	600	20	mg/L	4/4/2014 16:23	MZ	SM 2540 C	
Total Suspended Solids (TSS)	18	4	mg/L	4/4/2014 18:24	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	4/8/2014 19:23	TS	EPA 200.7	
Aluminum, Total	0.1	0.05	mg/L	4/10/2014 13:31	TS	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	4/9/2014 13:32	TS	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	4/10/2014 13:31	TS	EPA 200.7	
Boron, Dissolved	0.05	0.05	mg/L	4/9/2014 13:32	TS	EPA 200.7	
Boron, Total	ND	0.05	mg/L	4/10/2014 18:29	TS	EPA 200.7	
Barium, Dissolved	0.105	0.005	mg/L	4/8/2014 19:23	TS	EPA 200.7	
Calcium, Dissolved	72.7	0.2	mg/L	4/8/2014 19:23	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	4/9/2014 13:32	TS	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	4/8/2014 19:23	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	4/8/2014 19:23	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1403006-08

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	3/31/2014 7:15 PM
Sample Site:	SW-1			***Receipt Date:***	4/2/2014 4:40 PM
Comments:				***Sampler:***	Client
Sample Type:	Water			***Site No.:***	29
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Dissolved	ND	0.02	mg/L	4/8/2014 19:23	TS	EPA 200.7	
Iron, Total	0.42	0.02	mg/L	4/10/2014 13:31	TS	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	4/8/2014 19:23	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	4/10/2014 13:31	TS	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	4/9/2014 14:00	AKL	EPA 245.1	
Magnesium, Dissolved	89.7	0.2	mg/L	4/8/2014 19:23	TS	EPA 200.7	
Manganese, Dissolved	0.009	0.005	mg/L	4/8/2014 19:23	TS	EPA 200.7	
Manganese, Total	0.018	0.005	mg/L	4/10/2014 13:31	TS	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	4/9/2014 13:32	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	4/8/2014 19:23	TS	EPA 200.7	
Potassium, Dissolved	3.3	0.5	mg/L	4/8/2014 19:23	TS	EPA 200.7	
Selenium, Dissolved	0.17	0.02	mg/L	4/9/2014 13:32	TS	EPA 200.7	
Selenium, Total	0.15	0.02	mg/L	4/10/2014 13:31	TS	EPA 200.7	
Sodium, Dissolved	15.0	0.5	mg/L	4/8/2014 19:23	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	4/8/2014 19:23	TS	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1403754-01

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	4/24/2014 11:00 AM
Sample Site:	SW-1A			***Receipt Date:***	4/25/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	201
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Inorganic							
Total Dissolved Solids (TDS)	976	20	mg/L	4/30/2014 0:00	MZ	SM 2540 C	
Total Suspended Solids (TSS)	ND	4	mg/L	5/4/2014 7:00	IJH	SM 2540 D	
Metals							
Iron, Total	0.26	0.02	mg/L	5/5/2014 18:37	TS	EPA 200.7	
Manganese, Total	0.023	0.005	mg/L	5/12/2014 14:53	TS	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1403754-02

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	4/24/2014 2:40 PM
Sample Site:	Kanab Creek at County Road			***Receipt Date:***	4/25/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	202
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Inorganic							
Total Dissolved Solids (TDS)	1030	20	mg/L	4/30/2014 0:00	MZ	SM 2540 C	
Total Suspended Solids (TSS)	ND	4	mg/L	5/4/2014 7:00	IJH	SM 2540 D	
Metals							
Iron, Total	0.05	0.02	mg/L	5/5/2014 18:41	TS	EPA 200.7	
Manganese, Total	0.017	0.005	mg/L	5/12/2014 14:57	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1403754-03

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 4/24/2014 7:00 PM
Sample Site:	NLP-13		**Receipt Date:** 4/25/2014 11:46 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 249
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	108	0.01	meq/L	5/5/2014 7:00	PNM	SM 1030 E	
Cation/Anion Balance	3.1		%	5/5/2014 7:00	PNM	SM 1030 E	
Cations, Total	114	0.01	meq/L	5/5/2014 7:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	3530	1	mg/L	5/5/2014 7:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	5/9/2014 10:08	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	841	1.0	mg/L	5/2/2014 1:55	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	5/2/2014 1:55	KRW	SM 2320 B	
Alkalinity - CO2	644	1.0	mg/L	5/2/2014 1:55	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	5/2/2014 1:55	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	690	1.0	mg/L	5/2/2014 1:55	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	4/28/2014 12:30	TM	SM 4500 NH3-D	
Chloride	176	5	mg/L	4/25/2014 15:45	TM	EPA 300.0	
Fluoride	0.9	0.5	mg/L	4/25/2014 15:45	TM	EPA 300.0	
Nitrate as N	ND	0.5	mg/L	4/25/2014 15:45	TM	EPA 300.0	
Nitrite as N	ND	0.5	mg/L	4/25/2014 15:45	TM	EPA 300.0	
Phosphorus, Total as P	0.80	0.13	mg/L	4/28/2014 6:30	TM	SM 4500 P-E	
Sulfate	4270	50	mg/L	4/25/2014 15:45	TM	EPA 300.0	
Total Dissolved Solids (TDS)	7500	20	mg/L	4/30/2014 0:00	MZ	SM 2540 C	
Total Suspended Solids (TSS)	694	4	mg/L	5/4/2014 7:00	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	0.2	0.05	mg/L	5/5/2014 16:03	TS	EPA 200.7	
Aluminum, Total	15.6	0.05	mg/L	4/29/2014 14:25	KSL	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	5/5/2014 16:03	TS	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	4/29/2014 14:25	KSL	EPA 200.7	
Boron, Dissolved	0.99	0.05	mg/L	5/5/2014 16:03	TS	EPA 200.7	
Boron, Total	1.03	0.05	mg/L	4/29/2014 14:25	KSL	EPA 200.7	
Barium, Dissolved	0.007	0.005	mg/L	5/5/2014 16:03	TS	EPA 200.7	
Calcium, Dissolved	355	0.2	mg/L	5/5/2014 16:03	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	5/5/2014 16:03	TS	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	5/5/2014 16:03	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	5/5/2014 16:03	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1403754-03

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	4/24/2014 7:00 PM
Sample Site:	NLP-13			***Receipt Date:***	4/25/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	249
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Dissolved	0.02	0.02	mg/L	5/5/2014 16:03	TS	EPA 200.7	
Iron, Total	18.7	0.02	mg/L	4/29/2014 14:25	KSL	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	5/5/2014 16:03	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	4/29/2014 14:25	KSL	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	4/29/2014 11:00	AKL	EPA 245.1	
Magnesium, Dissolved	641	0.2	mg/L	5/5/2014 16:03	TS	EPA 200.7	
Manganese, Dissolved	0.188	0.005	mg/L	5/5/2014 16:03	TS	EPA 200.7	
Manganese, Total	0.705	0.005	mg/L	4/29/2014 14:25	KSL	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	5/5/2014 16:03	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	5/5/2014 16:03	TS	EPA 200.7	
Potassium, Dissolved	15.8	0.5	mg/L	5/5/2014 16:03	TS	EPA 200.7	
Selenium, Dissolved	ND	0.02	mg/L	5/5/2014 16:03	TS	EPA 200.7	
Selenium, Total	ND	0.02	mg/L	4/29/2014 14:25	KSL	EPA 200.7	
Sodium, Dissolved	1000	0.5	mg/L	5/5/2014 16:03	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	5/5/2014 16:03	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1403754-04

Name:	Alton Coal Development, LLC	**Mine Code:**	41	**Sample Date:**	4/24/2014 8:15 PM
Sample Site:	NLP-12			**Receipt Date:**	4/25/2014 11:46 AM
Comments:				**Sampler:**	Erik Petersen
Sample Type:	Water			**Site No.:**	248
Field pH:		**Field Temp. Deg. C :**			
Field Flow g/Min.:		**Field Cond. umhos/cm:**			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	45.9	0.01	meq/L	5/5/2014 7:00	PNM	SM 1030 E	
Cation/Anion Balance	4.1		%	5/5/2014 7:00	PNM	SM 1030 E	
Cations, Total	49.8	0.01	meq/L	5/5/2014 7:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	2190	1	mg/L	5/5/2014 7:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	5/9/2014 10:08	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	649	1.0	mg/L	5/2/2014 1:55	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	5/2/2014 1:55	KRW	SM 2320 B	
Alkalinity - CO2	485	1.0	mg/L	5/2/2014 1:55	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	5/2/2014 1:55	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	532	1.0	mg/L	5/2/2014 1:55	KRW	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	4/28/2014 12:30	TM	SM 4500 NH3-D	
Chloride	54	2	mg/L	4/25/2014 15:45	TM	EPA 300.0	
Fluoride	0.3	0.2	mg/L	4/25/2014 15:45	TM	EPA 300.0	
Nitrate as N	ND	0.2	mg/L	4/25/2014 15:45	TM	EPA 300.0	
Nitrite as N	ND	0.2	mg/L	4/25/2014 15:45	TM	EPA 300.0	
Phosphorus, Total as P	0.17	0.05	mg/L	4/28/2014 6:30	TM	SM 4500 P-E	
Sulfate	1620	10	mg/L	4/25/2014 15:45	TM	EPA 300.0	
Total Dissolved Solids (TDS)	2900	20	mg/L	4/30/2014 0:00	MZ	SM 2540 C	
Total Suspended Solids (TSS)	3530	20	mg/L	5/4/2014 7:00	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	0.4	0.05	mg/L	5/5/2014 16:11	TS	EPA 200.7	
Aluminum, Total	7.6	0.05	mg/L	4/29/2014 14:32	KSL	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	5/5/2014 16:11	TS	EPA 200.7	
Arsenic, Total	0.07	0.05	mg/L	4/29/2014 14:32	KSL	EPA 200.7	
Boron, Dissolved	0.14	0.05	mg/L	5/5/2014 16:11	TS	EPA 200.7	
Boron, Total	0.09	0.05	mg/L	4/29/2014 14:32	KSL	EPA 200.7	
Barium, Dissolved	0.024	0.005	mg/L	5/5/2014 16:11	TS	EPA 200.7	
Calcium, Dissolved	389	0.2	mg/L	5/5/2014 16:11	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	5/5/2014 16:11	TS	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	5/5/2014 16:11	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	5/5/2014 16:11	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1403754-04

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	4/24/2014 8:15 PM
Sample Site:	NLP-12			***Receipt Date:***	4/25/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	248
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Dissolved	0.32	0.02	mg/L	5/5/2014 16:11	TS	EPA 200.7	
Iron, Total	42.0	0.02	mg/L	4/29/2014 14:32	KSL	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	5/5/2014 16:11	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	4/29/2014 14:32	KSL	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	4/29/2014 11:00	AKL	EPA 245.1	
Magnesium, Dissolved	295	0.2	mg/L	5/5/2014 16:11	TS	EPA 200.7	
Manganese, Dissolved	0.528	0.005	mg/L	5/5/2014 16:11	TS	EPA 200.7	
Manganese, Total	0.933	0.005	mg/L	4/29/2014 14:32	KSL	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	5/5/2014 16:11	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	5/5/2014 16:11	TS	EPA 200.7	
Potassium, Dissolved	8.2	0.5	mg/L	5/5/2014 16:11	TS	EPA 200.7	
Selenium, Dissolved	ND	0.02	mg/L	5/5/2014 16:11	TS	EPA 200.7	
Selenium, Total	ND	0.02	mg/L	4/29/2014 14:32	KSL	EPA 200.7	
Sodium, Dissolved	136	0.5	mg/L	5/5/2014 16:11	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	5/5/2014 16:11	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1403754-05

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 4/24/2014 9:00 PM
Sample Site:	NLP-10		**Receipt Date:** 4/25/2014 11:46 AM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 246
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	61.7	0.01	meq/L	5/5/2014 7:00	PNM	SM 1030 E	
Cation/Anion Balance	2.5		%	5/5/2014 7:00	PNM	SM 1030 E	
Cations, Total	64.9	0.01	meq/L	5/5/2014 7:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	2800	1	mg/L	5/5/2014 7:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	5/9/2014 10:08	KRW	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	848	1.0	mg/L	5/2/2014 1:55	KRW	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	5/2/2014 1:55	KRW	SM 2320 B	
Alkalinity - CO2	634	1.0	mg/L	5/2/2014 1:55	KRW	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	5/2/2014 1:55	KRW	SM 2320 B	
Alkalinity - Total (as CaCO3)	696	1.0	mg/L	5/2/2014 1:55	KRW	SM 2320 B	
Ammonia as N	1.6	0.2	mg/L	4/28/2014 12:30	TM	SM 4500 NH3-D	
Chloride	133	5	mg/L	4/25/2014 15:45	TM	EPA 300.0	
Fluoride	ND	0.5	mg/L	4/25/2014 15:45	TM	EPA 300.0	
Nitrate as N	ND	0.5	mg/L	4/25/2014 15:45	TM	EPA 300.0	
Nitrite as N	ND	0.5	mg/L	4/25/2014 15:45	TM	EPA 300.0	
Phosphorus, Total as P	0.19	0.05	mg/L	4/28/2014 6:30	TM	SM 4500 P-E	
Sulfate	2120	20	mg/L	4/25/2014 15:45	TM	EPA 300.0	
Total Dissolved Solids (TDS)	3750	20	mg/L	4/30/2014 0:00	MZ	SM 2540 C	
Total Suspended Solids (TSS)	7160	33	mg/L	5/4/2014 7:00	IJH	SM 2540 D	
Metals							
Aluminum, Dissolved	0.8	0.05	mg/L	5/5/2014 16:15	TS	EPA 200.7	
Aluminum, Total	10.6	0.05	mg/L	4/29/2014 14:36	KSL	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	5/5/2014 16:15	TS	EPA 200.7	
Arsenic, Total	0.05	0.05	mg/L	4/29/2014 14:36	KSL	EPA 200.7	
Boron, Dissolved	0.17	0.05	mg/L	5/5/2014 16:15	TS	EPA 200.7	
Boron, Total	0.12	0.05	mg/L	4/29/2014 14:36	KSL	EPA 200.7	
Barium, Dissolved	0.028	0.005	mg/L	5/5/2014 16:15	TS	EPA 200.7	
Calcium, Dissolved	320	0.2	mg/L	5/5/2014 16:15	TS	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	5/5/2014 16:15	TS	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	5/5/2014 16:15	TS	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	5/5/2014 16:15	TS	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1403754-05

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	4/24/2014 9:00 PM
Sample Site:	NLP-10			***Receipt Date:***	4/25/2014 11:46 AM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	246
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Dissolved	1.76	0.02	mg/L	5/5/2014 16:15	TS	EPA 200.7	
Iron, Total	62.2	0.02	mg/L	4/29/2014 14:36	KSL	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	5/5/2014 16:15	TS	EPA 200.7	
Lead, Total	ND	0.02	mg/L	4/29/2014 14:36	KSL	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	4/29/2014 11:00	AKL	EPA 245.1	
Magnesium, Dissolved	486	0.2	mg/L	5/5/2014 16:15	TS	EPA 200.7	
Manganese, Dissolved	0.077	0.005	mg/L	5/5/2014 16:15	TS	EPA 200.7	
Manganese, Total	0.754	0.005	mg/L	4/29/2014 14:36	KSL	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	5/5/2014 16:15	TS	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	5/5/2014 16:15	TS	EPA 200.7	
Potassium, Dissolved	6.4	0.5	mg/L	5/5/2014 16:15	TS	EPA 200.7	
Selenium, Dissolved	ND	0.02	mg/L	5/5/2014 16:15	TS	EPA 200.7	
Selenium, Total	ND	0.02	mg/L	4/29/2014 14:36	KSL	EPA 200.7	
Sodium, Dissolved	202	0.5	mg/L	5/5/2014 16:15	TS	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	5/5/2014 16:15	TS	EPA 200.7	

Abbreviations

ND = Not detected at the corresponding Minimum Reporting Limit.

1 mg/L = one milligram per liter or 1 mg/Kg = one milligram per kilogram = 1 part per million.

1 ug/L = one microgram per liter or 1 ug/Kg = one microgram per kilogram = 1 part per billion.

1 ng/L = one nanogram per liter or 1 ng/Kg = one nanogram per kilogram = 1 part per trillion.

Flag Descriptions

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1205853-02

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 6/29/2012 3:40 PM
Sample Site:	Coyote Seep		**Receipt Date:** 7/3/2012 4:27 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 205
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	42.7	0.01	meq/L	7/25/2012 11:24	DBH	SM 1030 E	
Cation/Anion Balance	-1.6		%	7/25/2012 11:24	DBH	SM 1030 E	
Cations, Total	41.4	0.01	meq/L	7/25/2012 11:24	DBH	SM 1030 E	
Hardness, Total as CaCO3	1950	1	mg/L	7/25/2012 11:24	DBH	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	7/13/2012 10:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	345	1.0	mg/L	7/12/2012 7:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	7/12/2012 7:00	TSM	SM 2320 B	
Alkalinity - CO2	253	1.0	mg/L	7/12/2012 7:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	7/12/2012 7:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	283	1.0	mg/L	7/12/2012 7:00	TSM	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	7/11/2012 10:00	TSM	SM 4500 NH3-D	
Chloride	22	2	mg/L	7/6/2012 17:00	TSM	EPA 300.0	
Fluoride	ND	0.2	mg/L	7/6/2012 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	7/10/2012 15:16	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.04	0.01	mg/L	7/10/2012 13:00	TSM	SM 4500 P-E	
Sulfate	1750	10	mg/L	7/6/2012 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	2760	10	mg/L	7/5/2012 14:34	JSH	SM 2540 C	
Total Suspended Solids (TSS)	7	4	mg/L	7/5/2012 15:00	JSH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	7/19/2012 13:52	PNM	EPA 200.7	
Aluminum, Total	ND	0.05	mg/L	7/20/2012 15:28	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	7/19/2012 13:52	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	7/20/2012 15:28	PNM	EPA 200.7	
Boron, Dissolved	0.13	0.05	mg/L	7/19/2012 13:52	PNM	EPA 200.7	
Boron, Total	0.13	0.05	mg/L	7/20/2012 15:28	PNM	EPA 200.7	
Barium, Dissolved	0.023	0.005	mg/L	7/19/2012 13:52	PNM	EPA 200.7	
Calcium, Dissolved	116	0.2	mg/L	7/19/2012 13:52	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	7/19/2012 13:52	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	7/19/2012 13:52	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	7/19/2012 13:52	PNM	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	7/19/2012 13:52	PNM	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1205853-02

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	6/29/2012 3:40 PM
Sample Site:	Coyote Seep			***Receipt Date:***	7/3/2012 4:27 PM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	205
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	0.39	0.02	mg/L	7/24/2012 13:23	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	7/19/2012 13:52	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	7/20/2012 15:28	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	7/13/2012 16:30	AKL	EPA 245.1	
Magnesium, Dissolved	403	0.2	mg/L	7/19/2012 13:52	PNM	EPA 200.7	
Manganese, Dissolved	ND	0.005	mg/L	7/19/2012 13:52	PNM	EPA 200.7	
Manganese, Total	0.023	0.005	mg/L	7/20/2012 15:28	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	7/19/2012 13:52	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	7/19/2012 13:52	PNM	EPA 200.7	
Potassium, Dissolved	1.0	0.5	mg/L	7/19/2012 13:52	PNM	EPA 200.7	
Selenium, Dissolved	0.03	0.02	mg/L	7/19/2012 13:52	PNM	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	7/20/2012 15:28	PNM	EPA 200.7	
Sodium, Dissolved	54.8	0.5	mg/L	7/19/2012 13:52	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	7/19/2012 13:52	PNM	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1205853-03

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 6/29/2012 6:15 PM
Sample Site:	SP-7-1		**Receipt Date:** 7/3/2012 4:27 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 207
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	17.6	0.01	meq/L	7/25/2012 11:24	DBH	SM 1030 E	
Cation/Anion Balance	-11		%	7/25/2012 11:24	DBH	SM 1030 E	
Cations, Total	14.2	0.01	meq/L	7/25/2012 11:24	DBH	SM 1030 E	
Hardness, Total as CaCO3	663	1	mg/L	7/25/2012 11:24	DBH	SM 2340 B	
Inorganic							
Acidity	ND	10.0	mg/L	7/13/2012 10:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	542	1.0	mg/L	7/12/2012 7:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	7/12/2012 7:00	TSM	SM 2320 B	
Alkalinity - CO2	408	1.0	mg/L	7/12/2012 7:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	7/12/2012 7:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	444	1.0	mg/L	7/12/2012 7:00	TSM	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	7/11/2012 10:00	TSM	SM 4500 NH3-D	
Chloride	12	1	mg/L	7/6/2012 17:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	7/6/2012 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	7/10/2012 15:16	KSL	SM 4500 NO3-F	
Phosphorus, Total as P	0.04	0.01	mg/L	7/10/2012 13:00	TSM	SM 4500 P-E	
Sulfate	405	5	mg/L	7/6/2012 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1040	10	mg/L	7/5/2012 14:36	JSH	SM 2540 C	
Total Suspended Solids (TSS)	36	4	mg/L	7/5/2012 15:00	JSH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	7/19/2012 13:56	PNM	EPA 200.7	
Aluminum, Total	0.2	0.05	mg/L	7/20/2012 15:32	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	7/19/2012 13:56	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	7/20/2012 15:32	PNM	EPA 200.7	
Boron, Dissolved	0.07	0.05	mg/L	7/19/2012 13:56	PNM	EPA 200.7	
Boron, Total	0.08	0.05	mg/L	7/20/2012 15:32	PNM	EPA 200.7	
Barium, Dissolved	0.039	0.005	mg/L	7/19/2012 13:56	PNM	EPA 200.7	
Calcium, Dissolved	97.2	0.2	mg/L	7/19/2012 13:56	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	7/19/2012 13:56	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	7/19/2012 13:56	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	7/19/2012 13:56	PNM	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	7/19/2012 13:56	PNM	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1205853-03

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	6/29/2012 6:15 PM
Sample Site:	SP-7-1			***Receipt Date:***	7/3/2012 4:27 PM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	207
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Total	1.31	0.02	mg/L	7/24/2012 13:27	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	7/19/2012 13:56	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	7/20/2012 15:32	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	7/13/2012 16:30	AKL	EPA 245.1	
Magnesium, Dissolved	102	0.2	mg/L	7/19/2012 13:56	PNM	EPA 200.7	
Manganese, Dissolved	ND	0.005	mg/L	7/19/2012 13:56	PNM	EPA 200.7	
Manganese, Total	0.081	0.005	mg/L	7/20/2012 15:32	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	7/19/2012 13:56	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	7/19/2012 13:56	PNM	EPA 200.7	
Potassium, Dissolved	3.7	0.5	mg/L	7/19/2012 13:56	PNM	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	7/19/2012 13:56	PNM	EPA 200.7	
Selenium, Total	0.04	0.02	mg/L	7/20/2012 15:32	PNM	EPA 200.7	
Sodium, Dissolved	18.7	0.5	mg/L	7/19/2012 13:56	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	7/19/2012 13:56	PNM	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1205853-04

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 6/29/2012 6:45 PM
Sample Site:	SW-1A		**Receipt Date:** 7/3/2012 4:27 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 201
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	19.8	0.01	meq/L	7/25/2012 11:24	DBH	SM 1030 E	
Cation/Anion Balance	0.4		%	7/25/2012 11:24	DBH	SM 1030 E	
Cations, Total	20.0	0.01	meq/L	7/25/2012 11:24	DBH	SM 1030 E	
Hardness, Total as CaCO3	903	1	mg/L	7/25/2012 11:24	DBH	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	7/13/2012 10:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	503	1.0	mg/L	7/12/2012 7:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	7/12/2012 7:00	TSM	SM 2320 B	
Alkalinity - CO2	367	1.0	mg/L	7/12/2012 7:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	7/12/2012 7:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	413	1.0	mg/L	7/12/2012 7:00	TSM	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	7/11/2012 10:00	TSM	SM 4500 NH3-D	
Chloride	20	1	mg/L	7/6/2012 17:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	7/6/2012 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	7/10/2012 15:16	KSL	SM 4500 NO3-F	
Oil & Grease (HEM)	ND	5	mg/L	7/9/2012 12:00	KSL	EPA 1664A	
Phosphorus, Total as P	0.02	0.01	mg/L	7/10/2012 13:00	TSM	SM 4500 P-E	
Sulfate	530	5	mg/L	7/6/2012 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1180	10	mg/L	7/5/2012 14:38	JSH	SM 2540 C	
Total Suspended Solids (TSS)	ND	4	mg/L	7/5/2012 15:00	JSH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	7/19/2012 14:00	PNM	EPA 200.7	
Aluminum, Total	ND	0.05	mg/L	7/19/2012 18:42	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	7/19/2012 14:00	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	7/19/2012 18:42	PNM	EPA 200.7	
Boron, Dissolved	0.14	0.05	mg/L	7/19/2012 14:00	PNM	EPA 200.7	
Boron, Total	0.13	0.05	mg/L	7/19/2012 18:42	PNM	EPA 200.7	
Barium, Dissolved	0.083	0.005	mg/L	7/19/2012 14:00	PNM	EPA 200.7	
Calcium, Dissolved	79.9	0.2	mg/L	7/19/2012 14:00	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	7/19/2012 14:00	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	7/19/2012 14:00	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	7/19/2012 14:00	PNM	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1205853-04

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	6/29/2012 6:45 PM
Sample Site:	SW-1A			***Receipt Date:***	7/3/2012 4:27 PM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	201
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Dissolved	ND	0.02	mg/L	7/19/2012 14:00	PNM	EPA 200.7	
Iron, Total	0.31	0.02	mg/L	7/19/2012 18:42	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	7/19/2012 14:00	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	7/19/2012 18:42	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	7/13/2012 16:30	AKL	EPA 245.1	
Magnesium, Dissolved	171	0.2	mg/L	7/19/2012 14:00	PNM	EPA 200.7	
Manganese, Dissolved	ND	0.005	mg/L	7/19/2012 14:00	PNM	EPA 200.7	
Manganese, Total	0.009	0.005	mg/L	7/19/2012 18:42	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	7/19/2012 14:00	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	7/19/2012 14:00	PNM	EPA 200.7	
Potassium, Dissolved	6.4	0.5	mg/L	7/19/2012 14:00	PNM	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	7/19/2012 14:00	PNM	EPA 200.7	
Selenium, Total	0.02	0.02	mg/L	7/19/2012 18:42	PNM	EPA 200.7	
Sodium, Dissolved	40.4	0.5	mg/L	7/19/2012 14:00	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	7/19/2012 14:00	PNM	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1205853-05

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 6/29/2012 7:30 PM
Sample Site:	Kanab Creek at County Road		**Receipt Date:** 7/3/2012 4:27 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 202
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	21.9	0.01	meq/L	7/25/2012 11:24	DBH	SM 1030 E	
Cation/Anion Balance	-4.1		%	7/25/2012 11:24	DBH	SM 1030 E	
Cations, Total	20.1	0.01	meq/L	7/25/2012 11:24	DBH	SM 1030 E	
Hardness, Total as CaCO3	926	1	mg/L	7/25/2012 11:24	DBH	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	7/13/2012 10:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	392	1.0	mg/L	7/12/2012 7:00	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	7/12/2012 7:00	TSM	SM 2320 B	
Alkalinity - CO2	284	1.0	mg/L	7/12/2012 7:00	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	7/12/2012 7:00	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	322	1.0	mg/L	7/12/2012 7:00	TSM	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	7/11/2012 10:00	TSM	SM 4500 NH3-D	
Chloride	24	1	mg/L	7/6/2012 17:00	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	7/6/2012 17:00	TSM	EPA 300.0	
Nitrate + Nitrite, Total	ND	0.1	mg/L	7/10/2012 15:16	KSL	SM 4500 NO3-F	
Oil & Grease (HEM)	ND	6	mg/L	7/9/2012 12:00	KSL	EPA 1664A	
Phosphorus, Total as P	0.02	0.01	mg/L	7/10/2012 13:00	TSM	SM 4500 P-E	
Sulfate	710	10	mg/L	7/6/2012 17:00	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1360	10	mg/L	7/5/2012 14:40	JSH	SM 2540 C	
Total Suspended Solids (TSS)	ND	4	mg/L	7/5/2012 15:00	JSH	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	7/19/2012 14:04	PNM	EPA 200.7	
Aluminum, Total	ND	0.05	mg/L	7/19/2012 18:46	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	7/19/2012 14:04	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	7/19/2012 18:46	PNM	EPA 200.7	
Boron, Dissolved	0.09	0.05	mg/L	7/19/2012 14:04	PNM	EPA 200.7	
Boron, Total	0.11	0.05	mg/L	7/19/2012 18:46	PNM	EPA 200.7	
Barium, Dissolved	0.033	0.005	mg/L	7/19/2012 14:04	PNM	EPA 200.7	
Calcium, Dissolved	85.7	0.2	mg/L	7/19/2012 14:04	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	7/19/2012 14:04	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	7/19/2012 14:04	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	7/19/2012 14:04	PNM	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1205853-05

Name:	**Alton Coal Development, LLC**	***Mine Code:*** 41	***Sample Date:*** 6/29/2012 7:30 PM
Sample Site:	Kanab Creek at County Road		***Receipt Date:*** 7/3/2012 4:27 PM
Comments:			***Sampler:*** Erik Petersen
Sample Type:	Water		***Site No.:*** 202
Field pH:		***Field Temp. Deg. C :***	
Field Flow g/Min.:		***Field Cond. umhos/cm:***	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Dissolved	ND	0.02	mg/L	7/19/2012 14:04	PNM	EPA 200.7	
Iron, Total	0.05	0.02	mg/L	7/19/2012 18:46	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	7/19/2012 14:04	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	7/19/2012 18:46	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	7/13/2012 16:30	AKL	EPA 245.1	
Magnesium, Dissolved	173	0.2	mg/L	7/19/2012 14:04	PNM	EPA 200.7	
Manganese, Dissolved	ND	0.005	mg/L	7/19/2012 14:04	PNM	EPA 200.7	
Manganese, Total	0.010	0.005	mg/L	7/19/2012 18:46	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	7/19/2012 14:04	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	7/19/2012 14:04	PNM	EPA 200.7	
Potassium, Dissolved	5.2	0.5	mg/L	7/19/2012 14:04	PNM	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	7/19/2012 14:04	PNM	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	7/19/2012 18:46	PNM	EPA 200.7	
Sodium, Dissolved	34.5	0.5	mg/L	7/19/2012 14:04	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	7/19/2012 14:04	PNM	EPA 200.7	

CHEMTECH-FORD
LABORATORIES

Certificate of Analysis

Lab Sample No.: 1206197-01

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	7/11/2012 9:25 AM
Sample Site:	SW-1A			***Receipt Date:***	7/12/2012 3:00 PM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	201
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Inorganic							
Total Dissolved Solids (TDS)	1340	10	mg/L	7/13/2012 15:30	JSH	SM 2540 C	
Total Suspended Solids (TSS)	5	4	mg/L	7/13/2012 17:00	JSH	SM 2540 D	
Metals							
Iron, Total	0.38	0.02	mg/L	7/24/2012 15:13	PNM	EPA 200.7	
Manganese, Total	0.010	0.005	mg/L	7/20/2012 20:20	PNM	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1206197-02

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	7/11/2012 9:55 AM
Sample Site:	SW-1			***Receipt Date:***	7/12/2012 3:00 PM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	29
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Inorganic							
Total Dissolved Solids (TDS)	1520	10	mg/L	7/13/2012 16:00	JSH	SM 2540 C	
Total Suspended Solids (TSS)	ND	4	mg/L	7/13/2012 17:00	JSH	SM 2540 D	
Metals							
Iron, Total	0.63	0.02	mg/L	7/25/2012 0:52	PNM	EPA 200.7	
Manganese, Total	0.008	0.005	mg/L	7/25/2012 0:52	PNM	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1206197-03

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	7/11/2012 1:00 PM
Sample Site:	Kanab Creek at County Road			***Receipt Date:***	7/12/2012 3:00 PM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	202
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Inorganic							
Total Dissolved Solids (TDS)	198	10	mg/L	7/13/2012 16:00	JSH	SM 2540 C	
Total Suspended Solids (TSS)	5	4	mg/L	7/13/2012 17:00	JSH	SM 2540 D	
Metals							
Iron, Total	0.10	0.02	mg/L	7/25/2012 0:56	PNM	EPA 200.7	
Manganese, Total	0.009	0.005	mg/L	7/25/2012 0:56	PNM	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1206197-04

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 7/11/2012 1:45 PM
Sample Site:	SW-3		**Receipt Date:** 7/12/2012 3:00 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 29
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Inorganic							
Total Dissolved Solids (TDS)	1480	10	mg/L	7/13/2012 16:00	JSH	SM 2540 C	
Total Suspended Solids (TSS)	10	4	mg/L	7/13/2012 17:00	JSH	SM 2540 D	
Metals							
Iron, Total	0.32	0.02	mg/L	7/24/2012 15:17	PNM	EPA 200.7	
Manganese, Total	0.007	0.005	mg/L	7/20/2012 20:25	PNM	EPA 200.7	

Abbreviations

ND = Not detected at the corresponding Minimum Reporting Limit.
1 mg/L = one milligram per liter or 1 mg/Kg = one milligram per kilogram = 1 part per million.
1 ug/L = one microgram per liter or 1 ug/Kg = one microgram per kilogram = 1 part per billion.
1 ng/L = one nanogram per liter or 1 ng/Kg = one nanogram per kilogram = 1 part per trillion.

Flag Descriptions

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1209184-04

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 9/30/2012 12:15 PM
Sample Site:	SW-11		**Receipt Date:** 10/1/2012 1:30 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 214
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	37.6	0.01	meq/L	10/24/2012 9:00	PNM	SM 1030 E	
Cation/Anion Balance	1.2		%	10/24/2012 9:00	PNM	SM 1030 E	
Cations, Total	38.6	0.01	meq/L	10/24/2012 9:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	1750	1	mg/L	10/24/2012 9:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	10.0	mg/L	10/8/2012 13:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	450	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	2.0	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Alkalinity - CO2	325	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	372	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	10/9/2012 11:00	TSM	SM 4500 NH3-D	
Chloride	38	2	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Fluoride	ND	0.2	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Nitrate as N	ND	0.2	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Nitrite as N	ND	0.2	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Oil & Grease (HEM)	6	6	mg/L	10/8/2012 11:30	KSL	EPA 1664A	
Phosphorus, Total as P	0.02	0.01	mg/L	10/11/2012 10:00	TSM	SM 4500 P-F	
Sulfate	1400	10	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	2390	10	mg/L	10/5/2012 13:00	RMC	SM 2540 C	A-01
Total Suspended Solids (TSS)	14	4	mg/L	10/4/2012 9:59	RMC	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	10/3/2012 20:09	PNM	EPA 200.7	
Aluminum, Total	0.09	0.05	mg/L	10/9/2012 23:29	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	10/3/2012 20:09	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	10/9/2012 23:29	PNM	EPA 200.7	
Boron, Dissolved	0.11	0.05	mg/L	10/3/2012 20:09	PNM	EPA 200.7	
Boron, Total	0.23	0.05	mg/L	10/9/2012 23:29	PNM	EPA 200.7	
Barium, Dissolved	0.058	0.005	mg/L	10/3/2012 20:09	PNM	EPA 200.7	
Calcium, Dissolved	104	0.2	mg/L	10/3/2012 20:09	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	10/3/2012 20:09	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	10/3/2012 20:09	PNM	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1209184-04

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	9/30/2012 12:15 PM
Sample Site:	SW-11			***Receipt Date:***	10/1/2012 1:30 PM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	214
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Copper, Dissolved	ND	0.005	mg/L	10/3/2012 20:09	PNM	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	10/3/2012 20:09	PNM	EPA 200.7	
Iron, Total	0.13	0.02	mg/L	10/9/2012 23:29	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	10/3/2012 20:09	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	10/9/2012 23:29	PNM	EPA 200.7	
Mercury, Dissolved	ND	0.0002	mg/L	10/8/2012 9:30	AKL	EPA 245.1	
Magnesium, Dissolved	362	0.2	mg/L	10/3/2012 20:09	PNM	EPA 200.7	
Manganese, Dissolved	ND	0.005	mg/L	10/3/2012 20:09	PNM	EPA 200.7	
Manganese, Total	ND	0.005	mg/L	10/9/2012 23:29	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	10/3/2012 20:09	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	10/3/2012 20:09	PNM	EPA 200.7	
Potassium, Dissolved	6.8	0.5	mg/L	10/3/2012 20:09	PNM	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	10/3/2012 20:09	PNM	EPA 200.7	
Selenium, Total	ND	0.02	mg/L	10/9/2012 23:29	PNM	EPA 200.7	
Sodium, Dissolved	78.5	0.5	mg/L	10/3/2012 20:09	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	10/3/2012 20:09	PNM	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1209184-05

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 9/30/2012 1:00 PM
Sample Site:	Kanab Creek at County Road		**Receipt Date:** 10/1/2012 1:30 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 202
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	19.4	0.01	meq/L	10/24/2012 9:00	PNM	SM 1030 E	
Cation/Anion Balance	-2.3		%	10/24/2012 9:00	PNM	SM 1030 E	
Cations, Total	18.6	0.01	meq/L	10/24/2012 9:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	848	1	mg/L	10/24/2012 9:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	5.0	mg/L	10/8/2012 13:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	478	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Alkalinity - CO2	349	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	392	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	10/9/2012 11:00	TSM	SM 4500 NH3-D	
Chloride	20	1	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Nitrate as N	ND	0.1	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Nitrite as N	ND	0.1	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Oil & Grease (HEM)	ND	5	mg/L	10/8/2012 11:30	KSL	EPA 1664A	
Phosphorus, Total as P	ND	0.01	mg/L	10/11/2012 10:00	TSM	SM 4500 P-F	
Sulfate	530	10	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1220	10	mg/L	10/5/2012 13:00	RMC	SM 2540 C	A-01
Total Suspended Solids (TSS)	4	4	mg/L	10/4/2012 9:59	RMC	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	10/3/2012 20:13	PNM	EPA 200.7	
Aluminum, Total	ND	0.05	mg/L	10/4/2012 0:40	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	10/3/2012 20:13	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	10/4/2012 0:40	PNM	EPA 200.7	
Boron, Dissolved	0.09	0.05	mg/L	10/3/2012 20:13	PNM	EPA 200.7	
Boron, Total	0.09	0.05	mg/L	10/4/2012 0:40	PNM	EPA 200.7	
Barium, Dissolved	0.073	0.005	mg/L	10/3/2012 20:13	PNM	EPA 200.7	
Calcium, Dissolved	94.1	0.2	mg/L	10/3/2012 20:13	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	10/3/2012 20:13	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	10/3/2012 20:13	PNM	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1209184-05

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 9/30/2012 1:00 PM
Sample Site:	Kanab Creek at County Road		**Receipt Date:** 10/1/2012 1:30 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 202
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Copper, Dissolved	ND	0.005	mg/L	10/3/2012 20:13	PNM	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	10/3/2012 20:13	PNM	EPA 200.7	
Iron, Total	0.03	0.02	mg/L	10/4/2012 0:40	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	10/3/2012 20:13	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	10/4/2012 0:40	PNM	EPA 200.7	
Mercury, Dissolved	0.0002	0.0002	mg/L	10/8/2012 9:30	AKL	EPA 245.1	
Magnesium, Dissolved	149	0.2	mg/L	10/3/2012 20:13	PNM	EPA 200.7	
Manganese, Dissolved	ND	0.005	mg/L	10/3/2012 20:13	PNM	EPA 200.7	
Manganese, Total	ND	0.005	mg/L	10/4/2012 0:40	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	10/3/2012 20:13	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	10/3/2012 20:13	PNM	EPA 200.7	
Potassium, Dissolved	6.1	0.5	mg/L	10/3/2012 20:13	PNM	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	10/3/2012 20:13	PNM	EPA 200.7	
Selenium, Total	0.02	0.02	mg/L	10/4/2012 0:40	PNM	EPA 200.7	
Sodium, Dissolved	33.2	0.5	mg/L	10/3/2012 20:13	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	10/3/2012 20:13	PNM	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1209184-06

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 9/30/2012 2:45 PM
Sample Site:	SP7-1		**Receipt Date:** 10/1/2012 1:30 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 207
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	17.1	0.01	meq/L	10/24/2012 9:00	PNM	SM 1030 E	
Cation/Anion Balance	-2.6		%	10/24/2012 9:00	PNM	SM 1030 E	
Cations, Total	16.2	0.01	meq/L	10/24/2012 9:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	766	1	mg/L	10/24/2012 9:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	10.0	mg/L	10/8/2012 13:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	543	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Alkalinity - CO2	403	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	445	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	10/9/2012 11:00	TSM	SM 4500 NH3-D	
Chloride	10	1	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Nitrate as N	ND	0.1	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Nitrite as N	ND	0.1	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Phosphorus, Total as P	0.02	0.01	mg/L	10/11/2012 10:00	TSM	SM 4500 P-E	
Sulfate	380	10	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1050	10	mg/L	10/5/2012 13:00	RMC	SM 2540 C	A-01
Total Suspended Solids (TSS)	19	7	mg/L	10/4/2012 9:59	RMC	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	10/3/2012 20:17	PNM	EPA 200.7	
Aluminum, Total	0.05	0.05	mg/L	10/9/2012 23:33	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	10/3/2012 20:17	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	10/9/2012 23:33	PNM	EPA 200.7	
Boron, Dissolved	0.06	0.05	mg/L	10/3/2012 20:17	PNM	EPA 200.7	
Boron, Total	0.18	0.05	mg/L	10/9/2012 23:33	PNM	EPA 200.7	
Barium, Dissolved	0.061	0.005	mg/L	10/3/2012 20:17	PNM	EPA 200.7	
Calcium, Dissolved	142	0.2	mg/L	10/3/2012 20:17	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	10/3/2012 20:17	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	10/3/2012 20:17	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	10/3/2012 20:17	PNM	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1209184-06

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	9/30/2012 2:45 PM
Sample Site:	SP7-1			***Receipt Date:***	10/1/2012 1:30 PM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	207
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Dissolved	ND	0.02	mg/L	10/3/2012 20:17	PNM	EPA 200.7	
Iron, Total	1.69	0.02	mg/L	10/9/2012 23:33	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	10/3/2012 20:17	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	10/9/2012 23:33	PNM	EPA 200.7	
Mercury, Dissolved	0.0002	0.0002	mg/L	10/8/2012 9:30	AKL	EPA 245.1	
Magnesium, Dissolved	100	0.2	mg/L	10/3/2012 20:17	PNM	EPA 200.7	
Manganese, Dissolved	0.087	0.005	mg/L	10/3/2012 20:17	PNM	EPA 200.7	
Manganese, Total	0.131	0.005	mg/L	10/9/2012 23:33	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	10/3/2012 20:17	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	10/3/2012 20:17	PNM	EPA 200.7	
Potassium, Dissolved	4.5	0.5	mg/L	10/3/2012 20:17	PNM	EPA 200.7	
Selenium, Dissolved	ND	0.02	mg/L	10/3/2012 20:17	PNM	EPA 200.7	
Selenium, Total	0.02	0.02	mg/L	10/9/2012 23:33	PNM	EPA 200.7	
Sodium, Dissolved	18.4	0.5	mg/L	10/3/2012 20:17	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	10/3/2012 20:17	PNM	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1209184-07

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 9/30/2012 2:45 PM
Sample Site:	SW-1A		**Receipt Date:** 10/1/2012 1:30 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 201
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	16.8	0.01	meq/L	10/24/2012 9:00	PNM	SM 1030 E	
Cation/Anion Balance	-1.3		%	10/24/2012 9:00	PNM	SM 1030 E	
Cations, Total	16.4	0.01	meq/L	10/24/2012 9:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	752	1	mg/L	10/24/2012 9:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	10.0	mg/L	10/8/2012 13:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	543	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Alkalinity - CO2	398	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	445	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	10/9/2012 11:00	TSM	SM 4500 NH3-D	
Chloride	15	1	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Fluoride	0.3	0.1	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Nitrate as N	ND	0.1	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Nitrite as N	ND	0.1	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Oil & Grease (HEM)	ND	5	mg/L	10/8/2012 11:30	KSL	EPA 1664A	
Phosphorus, Total as P	ND	0.01	mg/L	10/11/2012 10:00	TSM	SM 4500 P-F	
Sulfate	360	10	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	974	10	mg/L	10/5/2012 13:00	RMC	SM 2540 C	A-01
Total Suspended Solids (TSS)	4	4	mg/L	10/5/2012 11:49	RMC	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	10/3/2012 20:21	PNM	EPA 200.7	
Aluminum, Total	ND	0.05	mg/L	10/4/2012 0:45	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	10/3/2012 20:21	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	10/4/2012 0:45	PNM	EPA 200.7	
Boron, Dissolved	0.10	0.05	mg/L	10/3/2012 20:21	PNM	EPA 200.7	
Boron, Total	0.10	0.05	mg/L	10/4/2012 0:45	PNM	EPA 200.7	
Barium, Dissolved	0.136	0.005	mg/L	10/3/2012 20:21	PNM	EPA 200.7	
Calcium, Dissolved	93.3	0.2	mg/L	10/3/2012 20:21	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	10/3/2012 20:21	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	10/3/2012 20:21	PNM	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1209184-07

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	9/30/2012 2:45 PM
Sample Site:	SW-1A			***Receipt Date:***	10/1/2012 1:30 PM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	201
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Copper, Dissolved	ND	0.005	mg/L	10/3/2012 20:21	PNM	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	10/3/2012 20:21	PNM	EPA 200.7	
Iron, Total	0.63	0.02	mg/L	10/4/2012 0:45	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	10/3/2012 20:21	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	10/4/2012 0:45	PNM	EPA 200.7	
Mercury, Dissolved	0.0002	0.0002	mg/L	10/8/2012 9:30	AKL	EPA 245.1	
Magnesium, Dissolved	126	0.2	mg/L	10/3/2012 20:21	PNM	EPA 200.7	
Manganese, Dissolved	0.009	0.005	mg/L	10/3/2012 20:21	PNM	EPA 200.7	
Manganese, Total	0.029	0.005	mg/L	10/4/2012 0:45	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	10/3/2012 20:21	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	10/3/2012 20:21	PNM	EPA 200.7	
Potassium, Dissolved	6.3	0.5	mg/L	10/3/2012 20:21	PNM	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	10/3/2012 20:21	PNM	EPA 200.7	
Selenium, Total	0.02	0.02	mg/L	10/4/2012 0:45	PNM	EPA 200.7	
Sodium, Dissolved	27.6	0.5	mg/L	10/3/2012 20:21	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	10/3/2012 20:21	PNM	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1209184-08

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 9/30/2012 4:00 PM
Sample Site:	Coyote Seep		**Receipt Date:** 10/1/2012 1:30 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 205
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	39.2	0.01	meq/L	10/24/2012 9:00	PNM	SM 1030 E	
Cation/Anion Balance	3.5		%	10/24/2012 9:00	PNM	SM 1030 E	
Cations, Total	42.1	0.01	meq/L	10/24/2012 9:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	1980	1	mg/L	10/24/2012 9:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	10.0	mg/L	10/8/2012 13:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	643	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Alkalinity - CO2	473	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	528	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	10/9/2012 11:00	TSM	SM 4500 NH3-D	
Chloride	29	2	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Fluoride	ND	0.2	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Nitrate as N	ND	0.2	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Nitrite as N	ND	0.2	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Phosphorus, Total as P	0.02	0.01	mg/L	10/11/2012 10:00	TSM	SM 4500 P-E	
Sulfate	1340	10	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	2370	10	mg/L	10/5/2012 13:00	RMC	SM 2540 C	A-01
Total Suspended Solids (TSS)	17	4	mg/L	10/5/2012 11:49	RMC	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	10/3/2012 20:25	PNM	EPA 200.7	
Aluminum, Total	ND	0.05	mg/L	10/9/2012 23:37	PNM	EPA 200.7	
Arsenic, Dissolved	0.05	0.05	mg/L	10/3/2012 20:25	PNM	EPA 200.7	
Arsenic, Total	0.05	0.05	mg/L	10/9/2012 23:37	PNM	EPA 200.7	
Boron, Dissolved	0.10	0.05	mg/L	10/3/2012 20:25	PNM	EPA 200.7	
Boron, Total	0.20	0.05	mg/L	10/9/2012 23:37	PNM	EPA 200.7	
Barium, Dissolved	0.046	0.005	mg/L	10/3/2012 20:25	PNM	EPA 200.7	
Calcium, Dissolved	212	0.2	mg/L	10/3/2012 20:25	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	10/3/2012 20:25	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	10/3/2012 20:25	PNM	EPA 200.7	
Copper, Dissolved	ND	0.005	mg/L	10/3/2012 20:25	PNM	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1209184-08

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	9/30/2012 4:00 PM
Sample Site:	Coyote Seep			***Receipt Date:***	10/1/2012 1:30 PM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	205
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Iron, Dissolved	0.02	0.02	mg/L	10/3/2012 20:25	PNM	EPA 200.7	
Iron, Total	0.27	0.02	mg/L	10/9/2012 23:37	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	10/3/2012 20:25	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	10/9/2012 23:37	PNM	EPA 200.7	
Mercury, Dissolved	0.0002	0.0002	mg/L	10/8/2012 9:30	AKL	EPA 245.1	
Magnesium, Dissolved	352	0.2	mg/L	10/3/2012 20:25	PNM	EPA 200.7	
Manganese, Dissolved	0.068	0.005	mg/L	10/3/2012 20:25	PNM	EPA 200.7	
Manganese, Total	0.068	0.005	mg/L	10/9/2012 23:37	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	10/3/2012 20:25	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	10/3/2012 20:25	PNM	EPA 200.7	
Potassium, Dissolved	7.5	0.5	mg/L	10/3/2012 20:25	PNM	EPA 200.7	
Selenium, Dissolved	0.03	0.02	mg/L	10/3/2012 20:25	PNM	EPA 200.7	
Selenium, Total	0.03	0.02	mg/L	10/9/2012 23:37	PNM	EPA 200.7	
Sodium, Dissolved	53.3	0.5	mg/L	10/3/2012 20:25	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	10/3/2012 20:25	PNM	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1209184-09

Name:	Alton Coal Development, LLC	**Mine Code:** 41	**Sample Date:** 9/30/2012 5:00 PM
Sample Site:	SW-1		**Receipt Date:** 10/1/2012 1:30 PM
Comments:			**Sampler:** Erik Petersen
Sample Type:	Water		**Site No.:** 29
Field pH:		**Field Temp. Deg. C :**	
Field Flow g/Min.:		**Field Cond. umhos/cm:**	

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Calculations							
Anions, Total	17.4	0.01	meq/L	10/24/2012 9:00	PNM	SM 1030 E	
Cation/Anion Balance	-2.4		%	10/24/2012 9:00	PNM	SM 1030 E	
Cations, Total	16.6	0.01	meq/L	10/24/2012 9:00	PNM	SM 1030 E	
Hardness, Total as CaCO3	755	1	mg/L	10/24/2012 9:00	PNM	SM 2340 B	
Inorganic							
Acidity	ND	10.0	mg/L	10/8/2012 13:00	TSM	SM 2310 B	
Alkalinity - Bicarbonate (HCO3)	500	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Alkalinity - Carbonate (CO3)	ND	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Alkalinity - CO2	363	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Alkalinity - Hydroxide (OH)	ND	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Alkalinity - Total (as CaCO3)	410	1.0	mg/L	10/8/2012 8:30	TSM	SM 2320 B	
Ammonia as N	ND	0.2	mg/L	10/9/2012 11:00	TSM	SM 4500 NH3-D	
Chloride	18	1	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Fluoride	0.2	0.1	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Nitrate as N	ND	0.1	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Nitrite as N	ND	0.1	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Oil & Grease (HEM)	ND	5	mg/L	10/8/2012 11:30	KSL	EPA 1664A	
Phosphorus, Total as P	ND	0.01	mg/L	10/11/2012 10:00	TSM	SM 4500 P-F	
Sulfate	418	5	mg/L	10/2/2012 7:30	TSM	EPA 300.0	
Total Dissolved Solids (TDS)	1110	10	mg/L	10/5/2012 13:00	RMC	SM 2540 C	A-01
Total Suspended Solids (TSS)	6	4	mg/L	10/5/2012 11:49	RMC	SM 2540 D	
Metals							
Aluminum, Dissolved	ND	0.05	mg/L	10/3/2012 20:29	PNM	EPA 200.7	
Aluminum, Total	0.07	0.05	mg/L	10/4/2012 0:48	PNM	EPA 200.7	
Arsenic, Dissolved	ND	0.05	mg/L	10/3/2012 20:29	PNM	EPA 200.7	
Arsenic, Total	ND	0.05	mg/L	10/4/2012 0:48	PNM	EPA 200.7	
Boron, Dissolved	0.08	0.05	mg/L	10/3/2012 20:29	PNM	EPA 200.7	
Boron, Total	0.08	0.05	mg/L	10/4/2012 0:48	PNM	EPA 200.7	
Barium, Dissolved	0.106	0.005	mg/L	10/3/2012 20:29	PNM	EPA 200.7	
Calcium, Dissolved	97.8	0.2	mg/L	10/3/2012 20:29	PNM	EPA 200.7	
Cadmium, Dissolved	ND	0.005	mg/L	10/3/2012 20:29	PNM	EPA 200.7	
Chromium, Dissolved	ND	0.005	mg/L	10/3/2012 20:29	PNM	EPA 200.7	

CHEMTECH-FORD LABORATORIES

Certificate of Analysis

Lab Sample No.: 1209184-09

Name:	**Alton Coal Development, LLC**	***Mine Code:***	41	***Sample Date:***	9/30/2012 5:00 PM
Sample Site:	SW-1			***Receipt Date:***	10/1/2012 1:30 PM
Comments:				***Sampler:***	Erik Petersen
Sample Type:	Water			***Site No.:***	29
Field pH:		***Field Temp. Deg. C :***			
Field Flow g/Min.:		***Field Cond. umhos/cm:***			

Parameter	Sample Result	Minimum Reporting Limit	Units	Analysis Date/Time	Analyst Initials	Analytical Method	Flag
Metals							
Copper, Dissolved	ND	0.005	mg/L	10/3/2012 20:29	PNM	EPA 200.7	
Iron, Dissolved	ND	0.02	mg/L	10/3/2012 20:29	PNM	EPA 200.7	
Iron, Total	0.18	0.02	mg/L	10/4/2012 0:48	PNM	EPA 200.7	
Lead, Dissolved	ND	0.02	mg/L	10/3/2012 20:29	PNM	EPA 200.7	
Lead, Total	ND	0.02	mg/L	10/4/2012 0:48	PNM	EPA 200.7	
Mercury, Dissolved	0.0002	0.0002	mg/L	10/8/2012 9:30	AKL	EPA 245.1	
Magnesium, Dissolved	124	0.2	mg/L	10/3/2012 20:29	PNM	EPA 200.7	
Manganese, Dissolved	0.005	0.005	mg/L	10/3/2012 20:29	PNM	EPA 200.7	
Manganese, Total	0.011	0.005	mg/L	10/4/2012 0:48	PNM	EPA 200.7	
Molybdenum, Dissolved	ND	0.01	mg/L	10/3/2012 20:29	PNM	EPA 200.7	
Nickel, Dissolved	ND	0.005	mg/L	10/3/2012 20:29	PNM	EPA 200.7	
Potassium, Dissolved	5.5	0.5	mg/L	10/3/2012 20:29	PNM	EPA 200.7	
Selenium, Dissolved	0.02	0.02	mg/L	10/3/2012 20:29	PNM	EPA 200.7	
Selenium, Total	ND	0.02	mg/L	10/4/2012 0:48	PNM	EPA 200.7	
Sodium, Dissolved	31.5	0.5	mg/L	10/3/2012 20:29	PNM	EPA 200.7	
Zinc, Dissolved	ND	0.01	mg/L	10/3/2012 20:29	PNM	EPA 200.7	

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R645-301-800

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R645-301-800

Bonding and Insurance

PHOTOGRAPHS	DESCRIPTION
None	

APPENDICES No.	DESCRIPTION
8-1	Cost Estimates and Calculations
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DRAWING No.	DESCRIPTION
None	

CHAPTER 8

R645-301-800. BONDING AND INSURANCE

820. REQUIREMENT TO FILE A BOND

820.100 The Operator Agrees to File a Bond.

After the permit application is approved, but before the permit is issued, the applicant will file with the Division, on a form prescribed and furnished by the Division, a bond or bonds conditioned upon performance of all requirements of the State Program, the permit and the reclamation bond.

820.110-~~111~~114 Area to be Covered by the Performance Bond and Incremental Bond

The disturbed areas at the Coal Hollow Project will be bonded. Bonding is representative of the full extent of current and expected disturbance for the Coal Hollow Mine permit area, and representative of discrete bond increments for the North Private Lease permit area. The areas to be bonded are -located, scheduled and identified on Drawings 5-19 and 5-74, respectively.

The permittee will file with the Division an additional bond or bonds to cover each increment of the North Private Lease permit in accordance with R645-301-830. Estimates for each permit area and each increment are provided in Appendices 8-1 and 8-2. North Private Lease increments are shown in Drawing 5-77.

The North Private Lease permit area bond increment areas average over 20 acres in size and are of sufficient configuration to provide for efficient reclamation operations should reclamation by the Division become necessary according to R645-301-880.900.

~~820.112-114 Incremental Bonding~~

~~Not applicable at this time.~~

820.120 Acceptance of Bond

The applicant agrees not to commence operations until the Division approves a performance bond for the Coal Hollow Project.

820.130 Coverage of Bond

The applicant will provide a performance bond for the disturbed area within the permit.

820.200 Form of the Performance Bond

820.223 Surety Bond

Alton Coal Development, LLC is proposing to submit a surety bond consistent with the requirements of R645-301-860.100 and any additional requirements in the State Program.

830. DETERMINATION OF BOND AMOUNT

830.100 Determined by the Division

The amount of the bond required will be determined by the Division.

830.140 Detailed Estimated Costs

The bonding amount for final reclamation will depend upon the approved permit and reclamation plan (R645-301-830.120).

For the Coal Hollow Mine permit area, ~~A~~an estimate has been completed for the mining and reclamation scenario shown in Drawings 5-17 through 5-19 that will generate the largest disturbance and require the largest bond. This scenario includes completion of surface mining through HWT 3, completion of highwall holes through the same, and full mining of the currently planned underground mine as entering through portals located in Pit 10. This scenario also accounts for all Coal Hollow Mine facilities and special reclamation areas. This estimate is provided as Appendix 8-1. These cost calculations are based on the specific details shown on these drawings, as well as the indicated plan and schedule for bond release application. The remaining liability bond estimate by release stage, escalated for 2017 (anticipated end of mining) is the following:

Ultimate Disturbance:	$32,028,705
Release 15_1:	$13,078,197
Release 15_2:	$11,248,253
Release 15_3:	$5,767,932
Release 16_1:	$5,131,946
Release 17_1:	$4,152,986
Release 26_1:	$3,818,982
End of UG Release:	$ 0

This bonding and release schedule anticipates the opportunity for mining to commence on the North Private Lease as well as the potential for additional mining area to become available under the BLM's adjacent LBA tract. In both cases, the underground portals, coal facilities, and thereby Pit 10 would remain open requiring the continued surety shown at the end of 2017. Should these additional leases not become available, reclamation of the remaining area would be performed and the bond would be released as shown. As part of the application process for these additional areas, updated estimates and calculations will be provided.

A summary and supporting calculations for these cost estimates is provided in Appendix 8-1.

For the North Private Lease permit area, a set of incremental estimates have been completed for the mining and reclamation scenario shown in Drawings 5-76A through 5-77 that describe the detailed areas and require the largest adequate bond. This scenario includes mining, backfilling, grading, and replacement of adequate soils and revegetation to restore all disturbed ground to approximate original contour and land use. This scenario also accounts for all North Private Lease facilities and special reclamation areas. This estimate is provided as Appendix 8-2. These cost calculations are based on the specific details shown on these drawings, as well as the indicated plan and schedule for bond posting and bond release application. The incremental bond to be posted and the remaining liability by yearly increment, escalated for 2017 (anticipated end of mining) is the following:

	Bond Liability (start)	Bond Release (-)	Additional Bond for Following Increment (+)	Bond Liability (end)	Bond Net Change (+/-)
Carryover from CHM	$11,248,253	$0	$965,652	$12,213,906	$965,652 +
Pre-Year 1	$12,213,906	$5,480,321	$4,365,523	$11,099,107	$1,114,799 -
Year 1	$11,099,107	$3,773,484	$4,622,575	$11,948,198	$849,091 +
Year 2	$11,948,198	$4,512,174	$6,399,183	$13,835,207	$1,887,009 +
Year 3	$13,835,207	$5,125,097	$3,998,247	$12,708,357	$1,126,850 -
Year 4	$12,708,357	$4,618,740	$5,995,744	$14,085,361	$1,377,004 +
Year 5	$14,085,361	$1,656,401	$0	$12,428,960	$1,656,401 -
Year 6	$12,428,960	$2,534,033	$0	$9,894,926	$2,534,033 -
Year 7	$9,894,926	$2,917,868	$0	$6,977,058	$2,917,868 -
Year 8	$6,977,058	$1,046,230	$0	$5,930,828	$1,046,230 -
Year 9	$5,930,828	$357,189	$0	$5,573,640	$357,189 -
Years 10-20	$5,573,640	$1,420,654	$0	$4,152,986	$1,420,654 -

This bonding and release schedule assumes a carryover of liability and posted bond from the Coal Hollow Mine permit area. The posted bond amount is $12,750,000, and the liability as shown in the table above. This schedule also anticipates the continued underground mining of the Coal Hollow Mine permit area, as well as the potential for additional mining area to become available under the BLM's adjacent LBA tract. In both cases, the underground portals, coal facilities, and thereby Coal Hollow Mine Pit 10 would remain open requiring the continued surety shown at the end of 2017 in Appendix 8-1. As part of the application process for these additional areas, updated estimates and calculations will be provided.

A summary and supporting calculations for these cost estimates is provided in Appendix 8-2.

840. GENERAL TERMS AND CONDITIONS OF THE BOND

General terms and conditions of the bond as stated at R645-301-840 through R645-301-840.520 will be met by Alton Coal Development, LLC

850. BOND REQUIREMENTS FOR UNDERGROUND COAL MINING

Not Applicable

860. FORM OF BOND

860.100 Surety Bond

The applicant will submit a surety bond as defined under R645-100-200 and meet all the requirements under R645-301-860.110 to .120.

870. REPLACEMENT OF BONDS

Equivalent bond coverage will be provided if Alton Coal Development, LLC replaces the surety bond.

880. REQUIREMENT TO RELEASE PERFORMANCE BONDS

Upon completion of reclamation operations, the applicant will apply for bond release and meet the requirements of R645-301-880.

890. TERMS AND CONDITIONS FOR LIABILITY INSURANCE

890.100 Certificate of Liability Insurance

A copy of the Certificate of Liability Insurance is provided in Appendix 1-3. Alton Coal Development, LLC will meet the requirements of R645-301-890 prior to commencing any mining operations.

APPENDIX 8-2

North Private Lease
Bond Calculations

BONDING

Introduction

The purpose of this appendix is to provide a reclamation bond estimate for the North Private Lease permit area as required by R645-301-830.140.

This estimate includes liability calculations for:

- All areas of surface disturbance requiring Phase 2 and Phase 3 reclamation
- All facilities and special areas requiring demolition, demobilization, etc.
- All excavated pits requiring Phase 1 through Phase 3 reclamation
- Surface areas of the long-term excess spoil structure that require Phase 1 through Phase 3 reclamation

This appendix includes the following details:

- Bond Estimate Summary and Release Application Plan
- Mine Facilities Line Item Reclamation Estimate
- Spoil Pile, Surface Disturbance Only, and Facility and Special Area surface reclamation Estimate
- Excavated Areas Reclamation Estimate
- Production Model and Cost Model Assumptions
- Pit Backfill - Truck/Shovel, Fleet Production and Cost Analysis (FPC)
- Subsoil - Truck/Shovel, Fleet Production and Cost Analysis (FPC)
- Topsoil - Truck/Shovel, Fleet Production and Cost Analysis (FPC)

All material volume and surface area calculations were performed utilizing Carlson Civil and Mining software.

Cost data sources include:

- RSMeans Heavy Cost Construction 2015
- RSMeans Construction Cost Data 2015
- CostMine Coal Cost Guide 2015
- CostMine Mine and Mill Equipment Cost Data, 2015

These sources are applied where appropriate in each of the cost estimates. Each line item in the estimate lists specifies which source is utilized for cost data.

Summary

The following is a brief summary of the information and methods used to calculate the costs for each category. The overall cost estimates below include total escalated costs applicable for all three phases of reclamation (where appropriate):

Bond Addition and Release Application Plan

This estimate considers the permit area on an incremental basis and applies successive bond additions and bond release applications as stepwise additions and subtractions from the ultimate disturbance liability. Each bond addition and release application potentially contain a combination of multiple pit & surface areas under different phases of disturbance or reclamation. These area polygons can be viewed on Drawing 5-77. The table below details this schedule:

	Bond Liability (start)	Bond Release (-)	Additional Bond for Following Increment (+)	Bond Liability (end)	Bond Net Change (+/-)
Carryover from CHM	$11,248,253	$0	$965,652	$12,213,906	$965,652 +
Pre-Year 1	$12,213,906	$5,480,321	$4,365,523	$11,099,107	$1,114,799 -
Year 1	$11,099,107	$3,773,484	$4,622,575	$11,948,198	$849,091 +
Year 2	$11,948,198	$4,512,174	$6,399,183	$13,835,207	$1,887,009 +
Year 3	$13,835,207	$5,125,097	$3,998,247	$12,708,357	$1,126,850 -
Year 4	$12,708,357	$4,618,740	$5,995,744	$14,085,361	$1,377,004 +
Year 5	$14,085,361	$1,656,401	$0	$12,428,960	$1,656,401 -
Year 6	$12,428,960	$2,534,033	$0	$9,894,926	$2,534,033 -
Year 7	$9,894,926	$2,917,868	$0	$6,977,058	$2,917,868 -
Year 8	$6,977,058	$1,046,230	$0	$5,930,828	$1,046,230 -
Year 9	$5,930,828	$357,189	$0	$5,573,640	$357,189 -
Years 10-20	$5,573,640	$1,420,654	$0	$4,152,986	$1,420,654 -

Mine Facilities

This section includes line items for the demolition, disposal, earthwork and specialized land reclamation costs for the entire facilities area, including ponds and ditches. The calculations for this section are based on the facilities and pond drawings in the current version of the Mining and Reclamation Plan. These drawings are all provided in Chapter 5 as Drawings 5-47 through 5-51B, and 5-58 through 5-77. The RSMeans Cost data is applied to this estimate. The overall escalated cost estimate for the facilities reclamation is approximately $1,088,563. This amount is separated into the years where the respective areas are disturbed.

Surface Disturbance Only Areas

These reclamation areas include areas that only require surface (Phase 2 and Phase3) reclamation, and include all ditches, ponds, roads, and other facilities that fall outside of the open pit boundaries shown on Drawing 5-77. The overall cost estimate for this category is $358,676. This amount is separated into the years where the respective areas are disturbed.

Excavated Areas

As shown on Drawings 5-74 through 5-77 and described in Chapter 5, Chapter 8, and the table above, the North Private Lease permit area will progress through eleven incremental stages of Bonding. Of these, excavation will occur in the first

six, with reclamation activities and bond releases occurring thereafter. The total liability for all excavated areas is $24,899,687.

Production Model and Cost Assumptions

Caterpillar's Fleet Production and Cost analysis software (v. 5.2.0.2) was utilized to establish a baseline cost model with inputs from the appropriate cost guides. This model provided unit costs on a $/BCY and $/LCY basis.

The following documentation provides the details for each section of this bond estimate.

Stage of Reclamation / Release Application	Pits/Areas Included in Bond		Phase 1 Bond Amount	Phase 2 Bond Amount	Phase 3 Bond Amount	Facilities Bond Amount	Total Bond Amount	Posted Bond Req'd	Addt'l Bond to Post / (-) for Bond Release	Current Bond Amount Held
Beginning Bond Liability (covering Coal Hollow Mine - Portals still open - Following Releases 15_1 & 15_2)							**$ 11,248,253**			**$ 12,750,000**
***All amounts escalated to 2017**										
Prior to Year 1: Construction and Startup Bond to Post										
All Phases & Area 1 Facilities	SURF 1			$ 78,171	$ 18,498		$ 96,669			
All Phases & Area 1 Facilities	Facilities Concrete Demolition					$ -	$ -			
All Phases & Area 1 Facilities	Facilities Structure Demolition					$ 37,589	$ 37,589			
All Phases & Area 1 Facilities	Facilities Earthwork					$ 188,781	$ 188,781			
All Phases & Area 1 Facilities	N Pit 01		$ 387,703	$ 18,267	$ 4,323		$ 410,293			
Phase 2&3 (Topsoil Removal & Site Preparation)	N Pit 02			$ 24,979	$ 5,911		$ 30,890			
Phase 2&3 (Topsoil Removal & Site Preparation)	N Pit 03			$ 33,224	$ 7,862		$ 41,086			
Phase 2&3 (Topsoil Removal & Site Preparation)	N Pit 04			$ 35,194	$ 8,328		$ 43,522			
Phase 2&3 (Topsoil Removal & Site Preparation)	N Pit 05			$ 36,004	$ 8,520		$ 44,524			
Phase 2&3 (Topsoil Removal & Site Preparation)	N Pit 06			$ 30,230	$ 7,153		$ 37,383			
Phase 2&3 (Topsoil Removal & Site Preparation)	N Pit 07			$ 28,235	$ 6,681		$ 34,916			
Subtotal			**$ 387,703**	**$ 284,304**	**$ 67,275**	**$ 226,370**	**$ 965,652**	**$ 12,213,906**	**$ (536,094)**	
Coal Hollow Release 15_3 Submission							**$ 5,480,321**			
Begin Year 1 Bond to Post										
Phase 1	N Pit 02		$ 695,067				$ 695,067			
Phase 1	N Pit 03		$ 767,321				$ 767,321			
Phase 1	N Pit 04		$ 678,079				$ 678,079			
Phase 1	N Pit 05		$ 609,328				$ 609,328			
Phase 1	N Pit 06		$ 816,642				$ 816,642			
Phase 1	N Pit 07		$ 799,085				$ 799,085			
Subtotal			**$ 4,365,523**	**$ -**	**$ -**	**$ -**	**$ 4,365,523**	**$ 11,099,107**	**$ (1,650,893)**	
End Year 1 Release Submission + CH Release 16_1							**$ 3,773,484**			
Begin Year 2 Bond to Post										
All Phases & Area 2 Facilities	SURF 2			$ 91,831	$ 21,730		$ 113,561			
All Phases & Area 2 Facilities	Facilities Concrete Demolition					$ -	$ -			
All Phases & Area 2 Facilities	Facilities Structure Demolition					$ 38,354	$ 38,354			
All Phases & Area 2 Facilities	Facilities Earthwork					$ 721,706	$ 721,706			
All Phases	N Pit 08		$ 701,601	$ 30,003	$ 7,100		$ 738,703			
All Phases	N Pit 09		$ 659,316	$ 37,021	$ 8,760		$ 705,098			
All Phases	N Pit 10		$ 556,569	$ 55,198	$ 13,062		$ 624,829			
All Phases	N Pit 11		$ 726,690	$ 32,752	$ 7,750		$ 767,193			
All Phases	N Pit 12		$ 867,566	$ 36,846	$ 8,719		$ 913,131			
Subtotal			**$ 3,511,743**	**$ 283,651**	**$ 67,121**	**$ 760,060**	**$ 4,622,575**	**$ 11,948,198**	**$ 849,091**	
End Year 2 Release Submission + CH Release 17_1							**$ 4,512,174**			
Begin Year 3 Bond to Post										
All Phases	N Pit 13		$ 1,077,255	$ 36,565	$ 8,652		$ 1,122,472			
All Phases	N Pit 14		$ 1,174,996	$ 44,428	$ 10,513		$ 1,229,936			
All Phases	N Pit 15		$ 1,278,589	$ 43,345	$ 10,257		$ 1,332,192			
All Phases	N Pit 16		$ 1,351,500	$ 48,689	$ 11,521		$ 1,411,710			
All Phases	N Pit 17		$ 1,241,167	$ 49,899	$ 11,808		$ 1,302,873			
Subtotal			**$ 6,123,506**	**$ 222,926**	**$ 52,751**		**$ 6,399,183**	**$ 13,835,207**	**$ 1,887,009**	
End Year 3 Release Submission							**$ 5,125,097**			
Begin Year 4 Bond to Post										
All Phases	N Pit 18		$ 1,077,634	$ 56,589	$ 13,391		$ 1,147,614			
All Phases	N Pit 19		$ 948,439	$ 46,817	$ 11,078		$ 1,006,335			
All Phases	N Pit 20		$ 847,509	$ 46,289	$ 10,953		$ 904,751			
All Phases	N Pit 21		$ 808,892	$ 105,653	$ 25,001		$ 939,546			
Subtotal			**$ 3,682,475**	**$ 255,348**	**$ 60,423**		**$ 3,998,247**	**$ 12,708,357**	**$ (1,126,850)**	
End Year 4 Release Submission							**$ 4,618,740**			
Begin Year 5 Bond to Post										
All Phases & Area 3 Facilities	SURF 3			$ 69,277	$ 16,393		$ 85,670			
All Phases & Area 3 Facilities	SURF 4			$ 50,763	$ 12,012		$ 62,775			
All Phases & Area 3 Facilities	Facilities Concrete Demolition					$ 24,736	$ 24,736			
All Phases & Area 3 Facilities	Facilities Structure Demolition					$ 7,657	$ 7,657			
All Phases & Area 3 Facilities	Facilities Earthwork					$ 69,739	$ 69,739			
All Phases	N HWT1		$ 2,534,033	$ 72,489	$ 17,153		$ 2,623,675			
All Phases	N HWT2		$ 2,917,868	$ 164,659	$ 38,963		$ 3,121,491			
Subtotal			**$ 5,451,902**	**$ 357,189**	**$ 84,522**	**$ 102,132**	**$ 5,995,744**	**$ 14,085,361**	**$ 1,377,004**	
End Year 5 Release Submission							**$ 1,656,401**	**$ 12,428,960**	**$ (1,656,401)**	
End Year 6 Release Submission							**$ 2,534,033**	**$ 9,894,926**	**$ (2,534,033)**	
End Year 7 Release Submission							**$ 2,917,868**	**$ 6,977,058**	**$ (2,917,868)**	
End Year 8 Release Submission							**$ 1,046,230**	**$ 5,930,828**	**$ (1,046,230)**	
End Year 9 Release Submission							**$ 357,189**	**$ 5,573,640**	**$ (357,189)**	
Year 10-20 Release Submissions							**$ 1,420,654**	**$ 4,152,986**	**$ (1,420,654)**	
		Check	$ 23,522,852	$ 1,403,418	$ 332,091	$ 1,088,563				

Stage of Reclamation / Release Application	Pits Included in Release Application	Phase 1 Bond Amount	Phase 1 Surface Area (acres)	Phase 2 Bond Amount	Phase 2 Surface Area (acres)	Phase 3 Bond Amount	Phase 3 Surface Area (acres)	Facilities Bond Amount	Total Bond Amount
Beginning Worst Case Scenario Bond Amount (all pits excavated)		**$ 23,522,852**	**178.4**	**$ 1,403,418**	**224.9**	**$ 332,091**	**224.9**	**$ 1,088,563**	**$ 26,346,925**
***All amounts escalated to 2017**									
Coal Hollow Release 15_3 Submission									
	Phase 1 Pits 1-B, 9-B, HWT 1-B & 2 & 3								**$ 5,480,321**
End Year 1 Release Submission									
	Phase 1 N Pit 01	$ 387,703	2.9						$ 387,703
	Phase 1 N Pit 02	$ 695,067	4.0						$ 695,067
	Phase 1 N Pit 03	$ 767,321	5.3						$ 767,321
	Phase 1 N Pit 04	$ 678,079	5.6						$ 678,079
	Phase 1 N Pit 05	$ 609,328	5.8						$ 609,328
	Subtotal	**$ 3,137,498**	**23.7**	**$ -**		**$ -**			**$ 3,137,498**
End Year 2 Release Submission									
	Phase 1 N Pit 06	$ 816,642	4.8						$ 816,642
	Phase 1 N Pit 07	$ 799,085	4.5						$ 799,085
	Phase 1 N Pit 08	$ 701,601	4.8						$ 701,601
	Phase 1 N Pit 09	$ 659,316	5.9						$ 659,316
	Phase 1 N Pit 10	$ 556,569	8.8						$ 556,569
	Subtotal	**$ 3,533,214**	**29.0**	**$ -**		**$ -**			**$ 3,533,214**
End Year 3 Release Submission									
	Phase 1 N Pit 11	$ 726,690	5.2						$ 726,690
	Phase 1 N Pit 12	$ 867,566	5.9						$ 867,566
	Phase 1 N Pit 13	$ 1,077,255	5.9						$ 1,077,255
	Phase 1 N Pit 14	$ 1,174,996	7.1						$ 1,174,996
	Phase 1 N Pit 15	$ 1,278,589	6.9						$ 1,278,589
	Subtotal	**$ 5,125,097**	**31.1**	**$ -**		**$ -**			**$ 5,125,097**
End Year 4 Release Submission									
	Phase 1 N Pit 16	$ 1,351,500	7.8						$ 1,351,500
	Phase 1 N Pit 17	$ 1,241,167	8.0						$ 1,241,167
	Phase 1 N Pit 18	$ 1,077,634	9.1						$ 1,077,634
	Phase 1 N Pit 19	$ 948,439	7.5						$ 948,439
	Subtotal	**$ 4,618,740**	**32.4**	**$ -**		**$ -**			**$ 4,618,740**
End Year 5 Release Submission									
	Phase 1 N Pit 20	$ 847,509	7.4						$ 847,509
	Phase 1 N Pit 21	$ 808,892	16.9						$ 808,892
	Subtotal	**$ 1,656,401**	**24.3**	**$ -**		**$ -**			**$ 1,656,401**
End Year 6 Release Submission									
	Phase 1 N HWT1	$ 2,534,033	11.6						$ 2,534,033
	Subtotal	**$ 2,534,033**	**11.6**	**$ -**		**$ -**			**$ 2,534,033**
End Year 7 Release Submission									
	Phase 1 N HWT2	$ 2,917,868	26.4						$ 2,917,868
	Subtotal	**$ 2,917,868**	**26.4**	**$ -**		**$ -**			**$ 2,917,868**
End Year 8 Release Submission									
	Phase 2 N Pit 01			$ 18,267	2.9				$ 18,267
	Phase 2 N Pit 02			$ 24,979	4.0				$ 24,979
	Phase 2 N Pit 03			$ 33,224	5.3				$ 33,224
	Phase 2 N Pit 04			$ 35,194	5.6				$ 35,194
	Phase 2 N Pit 05			$ 36,004	5.8				$ 36,004
	Phase 2 N Pit 06			$ 30,230	4.8				$ 30,230
	Phase 2 N Pit 07			$ 28,235	4.5				$ 28,235
	Phase 2 N Pit 08			$ 30,003	4.8				$ 30,003
	Phase 2 N Pit 09			$ 37,021	5.9				$ 37,021
	Phase 2 N Pit 10			$ 55,198	8.8				$ 55,198
	Phase 2 N Pit 11			$ 32,752	5.2				$ 32,752
	Phase 2 N Pit 12			$ 36,846	5.9				$ 36,846
	Phase 2 N Pit 13			$ 36,565	5.9				$ 36,565
	Phase 2 N Pit 14			$ 44,428	7.1				$ 44,428
	Phase 2 N Pit 15			$ 43,345	6.9				$ 43,345
	Phase 2 N Pit 16			$ 48,689	7.8				$ 48,689
	Phase 2 N Pit 17			$ 49,899	8.0				$ 49,899
	Phase 2 N Pit 18			$ 56,589	9.1				$ 56,589
	Phase 2 N Pit 19			$ 46,817	7.5				$ 46,817
	Phase 2 N Pit 20			$ 46,289	7.4				$ 46,289
	Phase 2 N Pit 21			$ 105,653	16.9				$ 105,653
	Phase 2 SURF 1			$ 78,171	12.5				$ 78,171
	Phase 2 SURF 2			$ 91,831	14.7				$ 91,831
	Subtotal	**$ -**		**$ 1,046,230**	**167.6**	**$ -**		**$ -**	**$ 1,046,230**
End Year 9 Release Submission									
	Phase 2 N HWT1			$ 72,489	11.6				$ 72,489
	Phase 2 N HWT2			$ 164,659	26.4				$ 164,659
	Phase 2 SURF 3			$ 69,277	11.1				$ 69,277
	Phase 2 SURF 4			$ 50,763	8.1				$ 50,763
		$ -		**$ 357,189**	**57.2**	**$ -**		**$ -**	**$ 357,189**
Year 10-20 Release Submissions									
	Phase 3 N Pit 01					$ 4,323	2.9		$ 4,323
	Phase 3 N Pit 02					$ 5,911	4.0		$ 5,911
	Phase 3 N Pit 03					$ 7,862	5.3		$ 7,862
	Phase 3 N Pit 04					$ 8,328	5.6		$ 8,328
	Phase 3 N Pit 05					$ 8,520	5.8		$ 8,520
	Phase 3 N Pit 06					$ 7,153	4.8		$ 7,153
	Phase 3 N Pit 07					$ 6,681	4.5		$ 6,681
	Phase 3 N Pit 08					$ 7,100	4.8		$ 7,100
	Phase 3 N Pit 09					$ 8,760	5.9		$ 8,760
	Phase 3 N Pit 10					$ 13,062	8.8		$ 13,062
	Phase 3 N Pit 11					$ 7,750	5.2		$ 7,750
	Phase 3 N Pit 12					$ 8,719	5.9		$ 8,719
	Phase 3 N Pit 13					$ 8,652	5.9		$ 8,652
	Phase 3 N Pit 14					$ 10,513	7.1		$ 10,513
	Phase 3 N Pit 15					$ 10,257	6.9		$ 10,257
	Phase 3 N Pit 16					$ 11,521	7.8		$ 11,521
	Phase 3 N Pit 17					$ 11,808	8.0		$ 11,808
	Phase 3 N Pit 18					$ 13,391	9.1		$ 13,391
	Phase 3 N Pit 19					$ 11,078	7.5		$ 11,078
	Phase 3 N Pit 20					$ 10,953	7.4		$ 10,953
	Phase 3 N Pit 21					$ 25,001	16.9		$ 25,001
	Phase 3 N HWT1					$ 17,153	11.6		$ 17,153
	Phase 3 N HWT2					$ 38,963	26.4		$ 38,963
	Phase 3 SURF 1					$ 18,498	12.5		$ 18,498
	Phase 3 SURF 2					$ 21,730	14.7		$ 21,730
	Phase 3 SURF 3					$ 16,393	11.1		$ 16,393
	Phase 3 SURF 4					$ 12,012	8.1		$ 12,012
	Phase 3 SURF CROSSING					$ -			$ -
	Phase 3 Facilities Concrete Demolition							$ 24,736	$ 24,736
	Phase 3 Facilities Structure Demolition							$ 83,601	$ 83,601
	Phase 3 Facilities Earthwork							$ 980,226	$ 980,226
	Subtotal	**$ -**		**$ -**		**$ 332,091**	**224.9**	**$ 1,088,563**	**$ 1,420,654**

Bond Cost Estimate

	Pit	BCF	BCY	Backfill LCY	Area (sf)	Area (acres)	Phase 1 Cost: Backfill Cost	Subsoil Quantity (LCY)	Subsoil Cost	Total Direct Cost	Indirect Cost	Total Phase 1 Cost	**Total Phase 1 Cost - Escalated**	Topsoil Quantity (LCY)	Topsoil Cost	Mulching Quantity (M.S.F)	Mulching Cost	Seeding Quantity (M.S.F)	Phase 2 Cost: Seeding Cost	Total Direct Cost	Indirect Cost	Total Phase 2 Cost	**Total Phase 2 Cost - Escalated**	Re-Seed Quantity	Phase 3 Cost: Re-Seed Cost	Total Direct Cost	Indirect Cost	Total Phase 3 Cost	**Total Phase 3 Cost - Escalated**	Facilities Cost: Area 1 Facilities Cost	Area 1 Facilities Cost - Escalated	Area 2 Facilities Cost	Area 2 Facilities Cost- Escalated	Area 3 Facilities Cost	Area 3 Facilities Cost - Escalated	Total Facilities Cost	**Total Facilities Cost - Escalated**	**Total Bonded Amount - Escalated**
North Area																																						
Excavated Areas	N Pit 01			317,219	127,498.2	2.9	$ 279,904	16,874	$ 14,560	$ 294,464	$ 78,916	$ 373,380	**$ 387,703**	3,375	$ 2,912	127	$ 7,679	127	$ 3,283	$ 13,874	$ 3,718	$ 17,593	**$ 18,267**	127	$ 3,283	$ 3,283	$ 880	$ 4,163	**$ 4,323**									**$ 410,293**
	N Pit 02			575,724	174,342.8	4.0	$ 507,999	23,074	$ 19,910	$ 527,909	$ 141,480	$ 669,388	**$ 695,067**	4,615	$ 3,982	174	$ 10,501	174	$ 4,489	$ 18,972	$ 5,084	$ 24,056	**$ 24,979**	174	$ 4,489	$ 4,489	$ 1,203	$ 5,692	**$ 5,911**									**$ 725,957**
	N Pit 03			630,470	231,889.1	5.3	$ 556,305	30,690	$ 26,481	$ 582,786	$ 156,187	$ 738,973	**$ 767,321**	6,138	$ 5,296	232	$ 13,967	232	$ 5,971	$ 25,234	$ 6,763	$ 31,997	**$ 33,224**	232	$ 5,971	$ 5,971	$ 1,600	$ 7,571	**$ 7,862**									**$ 808,407**
	N Pit 04			551,875	245,636.1	5.6	$ 486,955	32,509	$ 28,051	$ 515,007	$ 138,022	$ 653,028	**$ 678,079**	6,502	$ 5,610	246	$ 14,795	246	$ 6,325	$ 26,730	$ 7,164	$ 33,894	**$ 35,194**	246	$ 6,325	$ 6,325	$ 1,695	$ 8,020	**$ 8,328**									**$ 721,601**
	N Pit 05			491,965	251,290.3	5.8	$ 434,093	33,257	$ 28,697	$ 462,790	$ 124,028	$ 586,817	**$ 609,328**	6,651	$ 5,739	251	$ 15,135	251	$ 6,471	$ 27,345	$ 7,329	$ 34,674	**$ 36,004**	251	$ 6,471	$ 6,471	$ 1,734	$ 8,205	**$ 8,520**									**$ 653,852**
	N Pit 06			675,628	210,990.1	4.8	$ 596,152	27,924	$ 24,095	$ 620,246	$ 166,226	$ 786,472	**$ 816,642**	5,585	$ 4,819	211	$ 12,708	211	$ 5,433	$ 22,960	$ 6,153	$ 29,113	**$ 30,230**	211	$ 5,433	$ 5,433	$ 1,456	$ 6,889	**$ 7,153**									**$ 854,025**
	N Pit 07			662,319	197,063.8	4.5	$ 584,408	26,081	$ 22,504	$ 606,912	$ 162,652	$ 769,564	**$ 799,085**	5,216	$ 4,501	197	$ 11,869	197	$ 5,074	$ 21,444	$ 5,747	$ 27,191	**$ 28,235**	197	$ 5,074	$ 5,074	$ 1,360	$ 6,434	**$ 6,681**									**$ 834,001**
	N Pit 08			576,810	209,407.1	4.8	$ 508,958	27,714	$ 23,914	$ 532,871	$ 142,810	$ 675,681	**$ 701,601**	5,543	$ 4,783	209	$ 12,613	209	$ 5,392	$ 22,788	$ 6,107	$ 28,895	**$ 30,003**	209	$ 5,392	$ 5,392	$ 1,445	$ 6,837	**$ 7,100**									**$ 738,703**
	N Pit 09			534,073	258,391.9	5.9	$ 471,248	34,197	$ 29,508	$ 500,756	$ 134,203	$ 634,959	**$ 659,316**	6,839	$ 5,902	258	$ 15,563	258	$ 6,654	$ 28,118	$ 7,536	$ 35,654	**$ 37,021**	258	$ 6,654	$ 6,654	$ 1,783	$ 8,437	**$ 8,760**									**$ 705,098**
	N Pit 10			429,213	385,255.3	8.8	$ 378,723	50,987	$ 43,995	$ 422,719	$ 113,289	$ 536,007	**$ 556,569**	10,197	$ 8,799	385	$ 23,204	385	$ 9,920	$ 41,923	$ 11,235	$ 53,159	**$ 55,198**	385	$ 9,920	$ 9,920	$ 2,659	$ 12,579	**$ 13,062**									**$ 624,829**
	N Pit 11			595,923	228,593.2	5.2	$ 525,822	30,253	$ 26,105	$ 551,927	$ 147,917	$ 699,844	**$ 726,690**	6,051	$ 5,221	229	$ 13,768	229	$ 5,886	$ 24,875	$ 6,667	$ 31,542	**$ 32,752**	229	$ 5,886	$ 5,886	$ 1,578	$ 7,464	**$ 7,750**									**$ 767,193**
	N Pit 12			713,486	257,167.9	5.9	$ 629,556	34,035	$ 29,368	$ 658,924	$ 176,592	$ 835,515	**$ 867,566**	6,807	$ 5,874	257	$ 15,489	257	$ 6,622	$ 27,985	$ 7,500	$ 35,485	**$ 36,846**	257	$ 6,622	$ 6,622	$ 1,775	$ 8,397	**$ 8,719**									**$ 913,131**
	N Pit 13			894,232	255,204.9	5.9	$ 789,040	33,775	$ 29,144	$ 818,184	$ 219,273	$ 1,037,457	**$ 1,077,255**	6,755	$ 5,829	255	$ 15,371	255	$ 6,572	$ 27,771	$ 7,443	$ 35,214	**$ 36,565**	255	$ 6,572	$ 6,572	$ 1,761	$ 8,333	**$ 8,652**									**$ 1,122,472**
	N Pit 14			971,261	310,084.3	7.1	$ 857,008	41,038	$ 35,411	$ 892,419	$ 239,168	$ 1,131,587	**$ 1,174,996**	8,208	$ 7,082	310	$ 18,676	310	$ 7,985	$ 33,743	$ 9,043	$ 42,786	**$ 44,428**	310	$ 7,985	$ 7,985	$ 2,140	$ 10,125	**$ 10,513**									**$ 1,229,936**
	N Pit 15			1,061,408	302,530.8	6.9	$ 936,551	40,039	$ 34,548	$ 971,099	$ 260,254	$ 1,231,353	**$ 1,278,589**	8,008	$ 6,910	303	$ 18,221	303	$ 7,790	$ 32,921	$ 8,823	$ 41,744	**$ 43,345**	303	$ 7,790	$ 7,790	$ 2,088	$ 9,878	**$ 10,257**									**$ 1,332,192**
	N Pit 16			1,119,340	339,825.1	7.8	$ 987,668	44,974	$ 38,807	$ 1,026,475	$ 275,095	$ 1,301,570	**$ 1,351,500**	8,995	$ 7,761	340	$ 20,468	340	$ 8,750	$ 36,980	$ 9,911	$ 46,890	**$ 48,689**	340	$ 8,750	$ 8,750	$ 2,345	$ 11,096	**$ 11,521**									**$ 1,411,710**
	N Pit 17			1,023,276	348,270.0	8.0	$ 902,904	46,092	$ 39,772	$ 942,676	$ 252,637	$ 1,195,313	**$ 1,241,167**	9,218	$ 7,954	348	$ 20,976	348	$ 8,968	$ 37,899	$ 10,157	$ 48,055	**$ 49,899**	348	$ 8,968	$ 8,968	$ 2,403	$ 11,371	**$ 11,808**									**$ 1,302,873**
	N Pit 18			876,470	394,965.3	9.1	$ 773,368	52,272	$ 45,104	$ 818,472	$ 219,350	$ 1,037,822	**$ 1,077,634**	10,454	$ 9,021	395	$ 23,789	395	$ 10,170	$ 42,980	$ 11,519	$ 54,499	**$ 56,589**	395	$ 10,170	$ 10,170	$ 2,726	$ 12,896	**$ 13,391**									**$ 1,147,614**
	N Pit 19			774,091	326,762.4	7.5	$ 683,032	43,246	$ 37,315	$ 720,347	$ 193,053	$ 913,400	**$ 948,439**	8,649	$ 7,463	327	$ 19,681	327	$ 8,414	$ 35,558	$ 9,530	$ 45,088	**$ 46,817**	327	$ 8,414	$ 8,414	$ 2,255	$ 10,669	**$ 11,078**									**$ 1,006,335**
	N Pit 20			687,692	323,072.3	7.4	$ 606,796	42,757	$ 36,894	$ 643,690	$ 172,509	$ 816,199	**$ 847,509**	8,551	$ 7,379	323	$ 19,459	323	$ 8,319	$ 35,157	$ 9,422	$ 44,579	**$ 46,289**	323	$ 8,319	$ 8,319	$ 2,230	$ 10,549	**$ 10,953**									**$ 904,751**
	N Pit 21			600,828	737,409.2	16.9	$ 530,150	97,593	$ 84,210	$ 614,360	$ 164,649	$ 779,009	**$ 808,892**	19,519	$ 16,842	737	$ 44,414	737	$ 18,988	$ 80,245	$ 21,506	$ 101,750	**$ 105,653**	737	$ 18,988	$ 18,988	$ 5,089	$ 24,077	**$ 25,001**									**$ 939,546**
	N HWT1			2,115,723	505,935.4	11.6	$ 1,866,842	66,958	$ 57,777	$ 1,924,619	$ 515,798	$ 2,440,417	**$ 2,534,033**	13,392	$ 11,555	506	$ 30,472	506	$ 13,028	$ 55,056	$ 14,755	$ 69,811	**$ 72,489**	506	$ 13,028	$ 13,028	$ 3,491	$ 16,519	**$ 17,153**									**$ 2,623,675**
	N HWT2			2,362,855	1,149,244.4	26.4	$ 2,084,904	152,098	$ 131,241	$ 2,216,144	$ 593,927	$ 2,810,071	**$ 2,917,868**	30,420	$ 26,248	1,149	$ 69,219	1,149	$ 29,593	$ 125,060	$ 33,516	$ 158,576	**$ 164,659**	1,149	$ 29,593	$ 29,593	$ 7,931	$ 37,524	**$ 38,963**									**$ 3,121,491**
	Excavated Areas Totals	**0**	**0**	**19,241,881**	**7,770,830**	**178.4**	**$ 16,978,386**	**1,028,436**	**$ 887,410**	**$17,865,796**	**$ 4,788,033**	**$ 22,653,829**	**$ 23,522,852**	**205,687**	**$ 177,482**	**7,771**	**$ 468,037**	**7,771**	**$ 200,099**	**$ 845,618**	**$ 226,626**	**$ 1,072,243**	**$ 1,113,376**	**7,771**	**$ 200,099**	**$ 200,099**	**$ 53,626**	**$ 253,725**	**$ 263,459**									**$ 24,899,687**
Surface Disturbance Only Areas*	SURF 1				545,598	12.5								14,442	$ 12,461	546	$ 32,861	546	$ 14,049	$ 59,372	$ 15,912	$ 75,283	**$ 78,171**	546	$ 14,049	$ 14,049	$ 3,765	$ 17,814	**$ 18,498**									**$ 96,669**
**Includes all ditches, ponds, roads, etc. outside of pit areas	SURF 2				640,935	14.7								16,965	$ 14,639	641	$ 38,604	641	$ 16,504	$ 69,746	$ 18,692	$ 88,438	**$ 91,831**	641	$ 16,504	$ 16,504	$ 4,423	$ 20,927	**$ 21,730**									**$ 113,561**
	SURF 3				483,523	11.1								12,798	$ 11,043	484	$ 29,123	484	$ 12,451	$ 52,617	$ 14,101	$ 66,718	**$ 69,277**	484	$ 12,451	$ 12,451	$ 3,337	$ 15,787	**$ 16,393**									**$ 85,670**
	SURF 4				354,303	8.1								9,378	$ 8,092	354	$ 21,340	354	$ 9,123	$ 38,555	$ 10,333	$ 48,888	**$ 50,763**	354	$ 9,123	$ 9,123	$ 2,445	$ 11,568	**$ 12,012**									**$ 62,775**
	SURF CROSSING				-	-								-	$ -	-	$ -	-	$ -	$ -	$ -	$ -	**$ -**	-	$ -	$ -	$ -	$ -	**$ -**									**$ -**
	Surface Disturbance Only Areas Totals**				**2,024,359**	**46.5**								**53,583**	**$ 46,235**	**2,024**	**$ 121,927**	**2,024**	**$ 52,127**	**$ 220,290**	**$ 59,038**	**$ 279,327**	**$ 290,043**	**2,024**	**$ 52,127**	**$ 52,127**	**$ 13,970**	**$ 66,097**	**$ 68,633**									**$ 358,676**
Facilities & Special Areas*																																						
*All Topsoiling, Mulching & Seeding included in surface disturbance area calculations	Facilities Concrete Demolition																												$ -	$ -	$ -	$ -	$ 23,823	$ 24,736	**$ 23,823**	**$ 24,736**	**$ 24,736**
	Facilities Structure Demolition																												$ 36,200	$ 37,589	$ 36,938	$ 38,354	$ 7,375	$ 7,657	**$ 80,512**	**$ 83,601**	**$ 83,601**
	Facilities Earthwork																												$ 181,807	$ 188,781	$ 695,043	$ 721,706	$ 67,162	$ 69,739	**$ 944,012**	**$ 980,226**	**$ 980,226**
	Facilities & Special Areas* Totals																												**$ 218,007**	**$ 226,370**	**$ 731,981**	**$ 760,060**	**$ 98,359**	**$ 102,132**	**$ 1,048,347**	**$ 1,088,563**	**$ 1,088,563**
	South Area Totals	**0**	**0**	**19,241,881**	**9,795,189**	**224.9**	**$ 16,978,386**	**1,028,436**	**$ 887,410**	**$17,865,796**	**$ 4,788,033**	**$ 22,653,829**	**$ 23,522,852**	**259,270**	**$ 223,717**	**9,795**	**$ 589,964**	**9,795**	**$ 252,226**	**$ 1,065,908**	**$ 285,663**	**$ 1,351,571**	**$ 1,403,418**	**9,795**	**$ 252,226**	**$ 252,226**	**$ 67,597**	**$ 319,823**	**$ 332,091**							**$ 1,048,347**	**$ 1,088,563**	**$ 26,346,925**

North Area Facilities Reclamation Cost Estimate

Concrete Reclamation Cost Estimate

Concrete Demolition

Item	Unit	Quantity	Unit Cost ($)	Cost	**Cost Data Reference
New Kanab Creek Crossing (Box Culvert)	lft	450	$18.05	$8,123	RSMeans Building Constr., 02 41 13.43 0200

Concrete Disposal

*Concrete Disposal (All Facilities)	yd^3	1,000	$15.70	$15,700	RSMeans Building Constr., 02 41 16.17 4250
Subtotal Concrete Demolition & Disposal				**$23,823**	

*Concrete is disposed of on site (in pits) within five miles of facilities

**All cost data is from the 2015 editions of either the RS Means Heavy Construction or Building Construction Cost Data Manuals (Total Bare Cost)

Structures Reclamation Cost Estimate

Structure Demolition & Disposal

Item	Unit	Quantity	Unit Cost ($)	Cost	**Cost Data Reference
24" Drainage Culvert (demolition)	ft	260	$10.10	$2,626	RSMeans Heavy Constr., 02 41 13.40 0170
144" Drainage Culvert (demolition)	ft	215	$34.30	$7,375	RSMeans Heavy Constr., 02 41 13.40 0200
Culvert Excavation 6' - 10' Deep	yd^3	347	$3.82	$1,324	RSMeans Heavy Constr., 31 23 16.13 0510
Culvert Excavation 14' - 20' Deep	yd^3	5,000	$4.77	$23,850	RSMeans Heavy Constr., 31 23 16.13 1300
Perimeter Fencing (demolition)	ft	15,000	$2.15	$32,250	RSMeans Heavy Constr., 02 41 13.60 1650
Water Monitoring Wells - PVC (demolition)	VLF	1,500	$7.27	$10,905	RSMeans Heavy Constr., 02 41 13.76 0900
Water Monitoring Wells - Steel (demolition)	VLF	150	$14.55	$2,183	RSMeans Heavy Constr., 02 41 13.76 1000
Subtotal Structure Demolition & Disposal				**$80,512**	

**All cost data is from the 2015 editions of either the RS Means Heavy Construction or Building Construction Cost Data Manuals (Total Bare Cost)

RS Means does not have direct cost data references for some specific items. Where needed, reasonable substitutues are utilized.

Earthwork Reclamation Cost Estimate

Facilities Earthwork

Item	Unit	Quantity	Unit Cost ($)	Cost	**Cost Data Reference
Pond 5 backfill from embankment	yd^3	124	$1.95	$243	RSMeans Heavy Constr., 31 23 23.17 0020
Pond 5 backfill from subsoil pile	yd^3	7,765	$5.88	$45,660	RSMeans Heavy Constr., 31 23 23.20 3014 & 31 23 16.42 1300 & 31 23 23.17 0020
Pond 6 backfill from embankment	yd^3	242	$1.95	$472	RSMeans Heavy Constr., 31 23 23.17 0020
Pond 6 backfill from subsoil pile	yd^3	8,665	$5.88	$50,949	RSMeans Heavy Constr., 31 23 23.20 3014 & 31 23 16.42 1300 & 31 23 23.17 0020
Pond 7 backfill from embankment	yd^3	219	$1.95	$427	RSMeans Heavy Constr., 31 23 23.17 0020
Pond 7 backfill from subsoil pile	yd^3	118,132	$5.88	$694,616	RSMeans Heavy Constr., 31 23 23.20 3014 & 31 23 16.42 1300 & 31 23 23.17 0020
Pond 8 backfill from embankment	yd^3	5,467	$1.95	$10,660	RSMeans Heavy Constr., 31 23 23.17 0020
Pond 8 backfill from subsoil pile	yd^3	0	$5.88	$0	RSMeans Heavy Constr., 31 23 23.20 3014 & 31 23 16.42 1300 & 31 23 23.17 0020
Pond 9 backfill from embankment	yd^3	371	$1.95	$724	RSMeans Heavy Constr., 31 23 23.17 0020
Pond 9 backfill from subsoil pile	yd^3	9,486	$5.88	$55,778	RSMeans Heavy Constr., 31 23 23.20 3014 & 31 23 16.42 1300 & 31 23 23.17 0020
Ditch DD-05 TO DD-20 recontouring	yd^3	2,470	$1.95	$4,817	RSMeans Heavy Constr., 31 23 23.17 0020
Ripping of haul roads and compacted surfaces	yd^3	38,673	$2.06	$79,666	RSMeans Heavy Constr., 31 23 16.32 2310
Subtotal Facilities Earthwork				**$944,012**	

**All cost data is from the 2015 editions of either the RS Means Heavy Construction or Building Construction Cost Data Manuals (Total Bare Cost)

Total Facilities Reclamation Cost Estimate	**$1,048,347**

Equipment Cost Data

Equipment Description	Equipment Cost $/hr	Equip + Labor Cost $/hr
7 yd. Excavator (385C LME)	$78.26	$114.75
40 Ton (30 CY) Haul Truck (769C)	$48.26	$83.63
5,000 Gal. Water Truck	$30.09	$66.58
14 Grader	$46.35	$82.84
D10 Dozer	$88.29	$124.78
D7 Dozer	$49.81	$86.30

Sourced from Cost Mine 2015 Coal Cost Guide and 2015 Mine and Mill Equipment Costs

Labor Cost Data

Manpower Type	Base Wage ($/hr)	Labor Cost @ 36% burden ($/hr)
Heavy Equipment Operator	$26.83	$36.49
Truck Drivers	$26.01	$35.37

Labor Data from 2015 Coal Cost Guide Table LA-6 for Western Surface Coal Mines (Non-Union)

Unit Cost Data

Movement Type	Cost/BCY	Cost/LCY	Unit Swell Factor	
Rehandle with Truck/Shovel	$ 0.98	$ 0.88	10.7%	
Subsoil	$ 0.93	$ 0.86	7.2%	
Topsoil	$ 0.93	$ 0.86	7.2%	
		Cost/M.S.F		
Mulching		$ 60.23		RS Means Heavy Constr., 32 91 13.16 0350 (2015 Bare)
Seeding		$ 25.75		RS Means Heavy Constr., 32 92 19.14 3700 (2015 Bare)

Unit Costs calculated from Caterpillar Inc. FPC production model (v. 5.2.0.2) using 2015 cost data and updated GEM swell factors

Indirect Cost Factor
26.8%

Escalation Factor 2015 to 2017
1.038361

FPC_2015_November_Truck-Shovel_Backfill

Cycle Times

Hauler Cycle Time

	5 769C
Load with Exchange (min)	1.25
Haul (min)	1.2
Dump and Maneuver (min)	1.2
Return (min)	1.37
Potential Cycle Time (min)	5.02
Wait on Slow Hauler (min)	0
Wait to Load (min)	1.23
Additional Bunching (min)	0.42
Wait to Dump (min)	0
TMPH Wait (min)	
Total Cycle Time (min)	6.67
Bunching	Avg
Haul Start mph	0
Haul End mph	0
Return Start mph	0
Return End mph	0

Loader Cycle Time

	5 769C
Loader Model	385C LME
Loader Quantity	1
Bucket Capacity (CY)	7.25
Loader Fill Factor (%)	100
Loose Density (Lbs/LCY)	2,498
Tons per Pass	9.06
System Passes per Hauler	3
Hauler Payload (Tons)	27.17
% of Max GVW	103.52
Hauler Volume (LCY)	21.75
% of Body Fill	70
Loader Cycle Time (min)	0.25
First Bucket Dump (min)	0.05
Hauler Exchange Time (min)	0.7

Fleet Production

Fleet Estimates

Operating Schedule		
Operator Efficiency	90	%
Schedule Period	Shift	
Scheduled Hours	2,000.00	
Fleet Estimates		
Fleet Availability	87.87	%
Production per Sched Hr	691.02	BCY
Total Production	20,651,261	BCY
Sched Hrs Required	29,885.19	
Total Cost ($)	20,775,049	
Cost per BCY ($)	1.006	
Production per Shift	1,382,040	BCY
Shifts Required	14.94	

Theoretical Production

	Quantity	Model	BCY per Hour	Cycles per Hour
1	1	385C LME	932	
2	5	769C	1,161	12

Actual Production

	Quantity	Model	Cycles per Hour	Payload in Tons	Tons per Hour
1	5	769C	9	27.17	1,222.46
Fleet Tons per Operating Hour					1,222.46
x 90.00% Operator Efficiency =					1,100.21
x 87.87% Fleet Availability =					966.74

Cost

	Qty	Model	Machine Code	Hourly Cost Each Unit	Operating Hours	Total $	$ per BCY
Loaders	1	385C LME		124.78	26,897	3,356,167	0.163
Haulers:	5	769C	C202	95.18	131,298	0	0.605
Totals	5				131,298	0	0.605
Support	1	5,000 Gal. Water Truck		66.58	19,695	1,311,271	0.063
	1	14 Grader		82.84	13,130	1,087,671	0.053
	1	D7 Dozer		86.3	22,321	1,926,271	0.093
Totals	3				55,145	4,325,213	0.209
Fleet Totals	9				213,340	7,681,380	0.977

FPC_2015_November_Truck-Shovel_Subsoil

Cycle Times

Hauler Cycle Time

	5 769C
Load with Exchange (min)	1.25
Haul (min)	1.18
Dump and Maneuver (min)	1.2
Return (min)	1.37
Potential Cycle Time (min)	5
Wait on Slow Hauler (min)	0
Wait to Load (min)	1.25
Additional Bunching (min)	0.4
Wait to Dump (min)	0
TMPH Wait (min)	
Total Cycle Time (min)	6.65
Bunching	Avg
Haul Start mph	0
Haul End mph	0
Return Start mph	0
Return End mph	0

Loader Cycle Time

	5 769C
Loader Model	385C LME
Loader Quantity	1
Bucket Capacity (CY)	7.25
Loader Fill Factor (%)	100
Loose Density (Lbs/LCY)	2,143
Tons per Pass	7.77
System Passes per Hauler	3
Hauler Payload (Tons)	23.31
% of Max GVW	97.21
Hauler Volume (LCY)	21.75
% of Body Fill	70
Loader Cycle Time (min)	0.25
First Bucket Dump (min)	0.05
Hauler Exchange Time (min)	0.7

Fleet Production

Fleet Estimates

Operating Schedule		
Operator Efficiency	90	%
Schedule Period	Shift	
Scheduled Hours	2,000.00	
Fleet Estimates		
Fleet Availability	87.87	%
Production per Sched Hr	720.28	BCY
Total Production	1,190,524	BCY
Sched Hrs Required	1,652.87	
Total Cost ($)	1,134,089	
Cost per BCY ($)	0.953	
Production per Shift	1,440,558	BCY
Shifts Required	0.83	

Theoretical Production

Quantity	Model	BCY per Hour	Cycles per Hour
1	1 385C LME	969	
2	5 769C	1,212	12

Actual Production

Quantity	Model	Cycles per Hour	Payload in Tons	Tons per Hour
1	5 769C	9.02	23.31	1,051.53
Fleet Tons per Operating Hour				1,051.53
x 90.00% Operator Efficiency =				946.37
x 87.87% Fleet Availability =				831.56

Cost

	Qty	Model	Machine Code	Hourly Cost Each Unit	Operating Hours	Total $	$ per BCY
Loaders	1	385C LME		114.75	1,488	170,700	0.143
Haulers:	5	769C	C202	95.18	7,262	0	0.581
Totals	5				7,262	0	0.581
Support	1	5,000 Gal. Water Truck		66.58	1,089	72,523	0.061
	1	14 Grader		82.84	726	60,156	0.051
	1	D7 Dozer		86.3	1,234	106,537	0.089
Totals	3				3,050	239,215	0.201
Fleet Totals	9				11,799	409,915	0.925

FPC_2015_November_Truck-Shovel_Topsoil

Cycle Times

Hauler Cycle Time

	5 769C
Load with Exchange (min)	1.25
Haul (min)	1.18
Dump and Maneuver (min)	1.2
Return (min)	1.37
Potential Cycle Time (min)	5
Wait on Slow Hauler (min)	0
Wait to Load (min)	1.25
Additional Bunching (min)	0.4
Wait to Dump (min)	0
TMPH Wait (min)	
Total Cycle Time (min)	6.65
Bunching	Avg
Haul Start mph	0
Haul End mph	0
Return Start mph	0
Return End mph	0

Loader Cycle Time

	5 769C
Loader Model	385C LME
Loader Quantity	1
Bucket Capacity (CY)	7.25
Loader Fill Factor (%)	100
Loose Density (Lbs/LCY)	2,143
Tons per Pass	7.77
System Passes per Hauler	3
Hauler Payload (Tons)	23.31
% of Max GVW	97.21
Hauler Volume (LCY)	21.75
% of Body Fill	70
Loader Cycle Time (min)	0.25
First Bucket Dump (min)	0.05
Hauler Exchange Time (min)	0.7

Fleet Production

Fleet Estimates

Operating Schedule		
Operator Efficiency	90	%
Schedule Period	Shift	
Scheduled Hours	2,000.00	
Fleet Estimates		
Fleet Availability	87.87	%
Production per Sched Hr	720.28	BCY
Total Production	336,238	BCY
Sched Hrs Required	466.82	
Total Cost ($)	320,299	
Cost per BCY ($)	0.953	
Production per Shift	1,440,558	BCY
Shifts Required	0.23	

Theoretical Production

Quantity		Model	BCY per Hour	Cycles per Hour
1	1	385C LME	969	
2	5	769C	1,212	12

Actual Production

Quantity		Model	Cycles per Hour	Payload in Tons	Tons per Hour
1	5	769C	9.02	23.31	1,051.53
Fleet Tons per Operating Hour					1,051.53
x 90.00% Operator Efficiency =					946.37
x 87.87% Fleet Availability =					831.56

Cost

	Qty		Model	Machine Code	Hourly Cost Each Unit	Operating Hours	Total $	$ per BCY
Loaders		1	385C LME		114.75	420	48,210	0.143
Haulers:		5	769C	C202	95.18	2,051	0	0.581
Totals		5				2,051	0	0.581
Support		1	5,000 Gal. Water Truck		66.58	308	20,482	0.061
		1	14 Grader		82.84	205	16,990	0.051
		1	D7 Dozer		86.3	349	30,089	0.089
Totals		3				861	67,561	0.201
Fleet Totals		9				3,332	115,772	0.925

Wetland Delineations

&

Ordinary High Water Mark Identifications

Private Lease Area

Coal Hollow Project

Kane County, Utah

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INTRODUCTION

Study Rationale

A surface coal mine has been developed in northern Kane County, Utah. The company that permitted, constructed and currently operates the mine is Alton Coal Development, LLC; the mine is called the *Coal Hollow Mine*. The current mine site is located on private property about 2 miles south of the town of Alton. Plans have been made to expand the mine into private and federally owned property adjacent to the current mine site. This report delineates the wetlands and identifies Ordinary High Water Marks (OHWMs) on the privately owned property north of the mine (Private Lease area).

The United States Army Corps of Engineers (*Corps*) has the authority to permit the discharge of dredged or fill material in waters of the U.S. under Section 404 of the Clean Water Act (CWA). They are also charged with permitting work for the placement of structures in navigable "waters of the U.S." (USACE, May 2007). Waters of the U.S. have been strictly defined by the *Corps* and the U.S. Environmental Protection Agency (EPA), but may include wetlands if they are tributaries to Traditional Navigable Waters (TNW's) of the U.S. *or* have a significant nexus with them.

A definitive, official determination that there are or are not jurisdictional waters of the U.S. on a given site can only be made by the *Corps* with a document called an "Approved Jurisdictional Determination" (USACE, 2008a 2008b). The information herein has been prepared to assist the *Corps* in making that decision.

The *Corps Wetland Delineation Manual* (USACE, 1987) remains the current document for protocols to be used to identify and delineate "jurisdictional" wetlands, or those wetlands subject to regulation under Section 404. In 2008, a subsequent manual was published that is designed as a regional supplement to the *Corps Manual.* The manual is called *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region* (2008c), a region in which the Alton study area is located. This manual, referred to as *Regional Corps Manual*, was also used extensively in preparation of this document.

As described in Lichvar and McColley (2008), "*The Ordinary High Water Mark (OHWM) is a defining element for identifying the lateral limits of non-wetland waters. However, determining whether any non-wetland water is a jurisdictional 'Water of the United States' (WoUS) involves further assessment in accordance with the regulations, case law, and clarifying guidance. Federal jurisdiction over a non-wetland WoUS extends to the OHWM, defined in 33 CFR Part 328.3 as the line on the shore established by fluctuations of water and indicated by physical*

characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of the soil, destruction of terrestrial vegetation, or the presence of litter and debris."

In the Arid West, the region in which the study area lies, OHWMs are quite variable and can include evaluations in ephemeral, intermittent and perennial stream channels. This report identifies the OHWMs on the Private Lease area north of the existing mine.

General Site Description

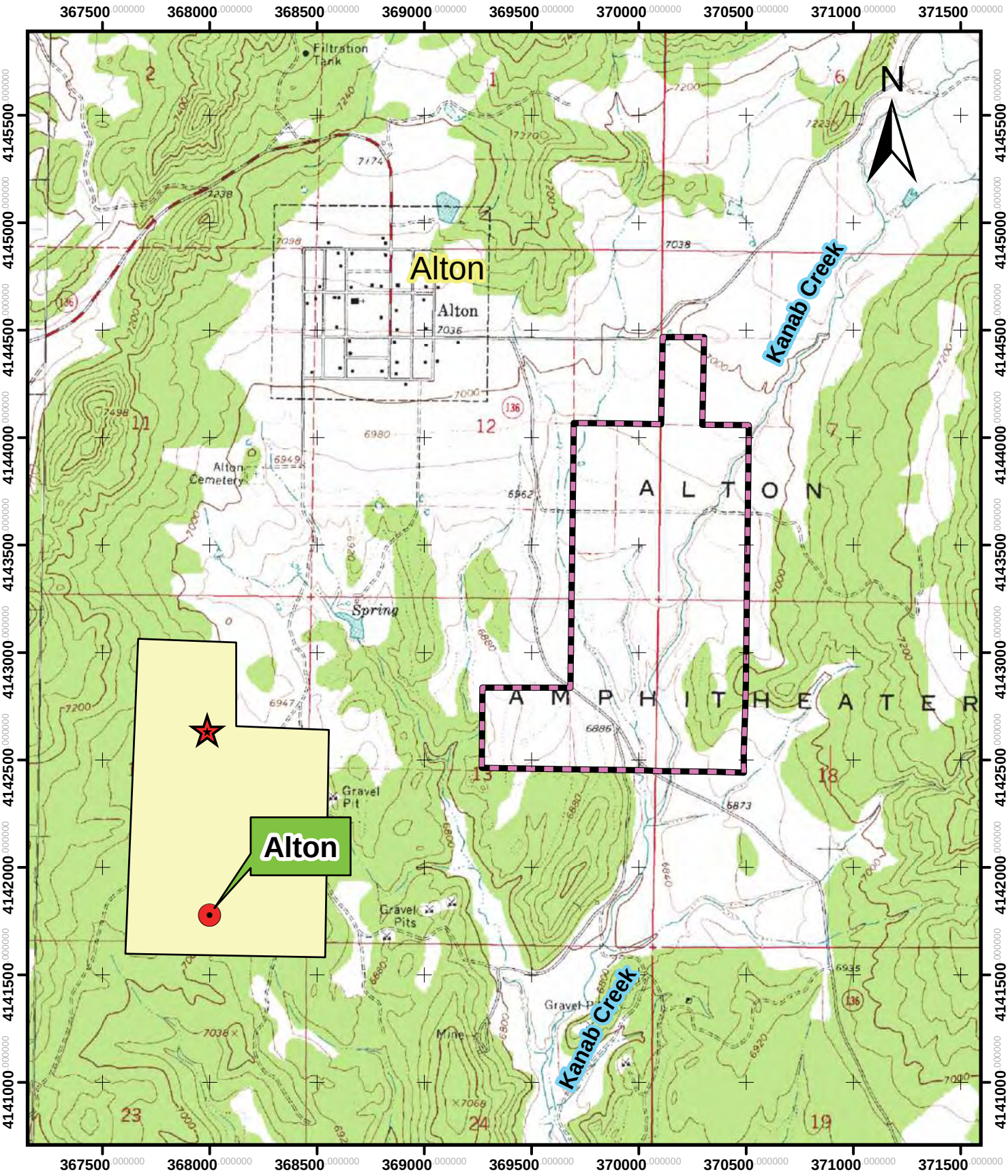
The Private Lease project area is located approximately one half mile southeast of Alton, Utah in the Alton Amphitheater, Figure 1. It includes portions of sections 12 and 13 in Township 39 South, Range 6 West and portions of sections 7 and 18 in Township 39 South, Range 5 West, Salt Lake Base and Meridian. The project area is bounded on the northeast and east by the precipitous Paunsaugunt Plateau and the northwest by the Markagunt Plateau; Black Mountain separates the Alton Amphitheater from Long Valley on the west; it is also bounded on the south by the Sink Valley and the Skutumpah Terrace. The Private Lease permit area is situated on an upland terrace within the Alton Amphitheater. The wetland areas are primarily along stream channels that are deeply incised into the terrace. Locations of the five stream channels that comprise the wetland and OHWM study areas are shown in Figure 2.

The Private Lease project area can be accessed from the town of Alton, Utah by three roads. The first road proceeds directly east from the southeast corner of Alton to the north end of the study area. The county road proceeds south along a ridge from the southeast corner of Alton paralleling the west boundary of the project before crossing the southwest part of the study and then exiting the southeast corner. A "farm road" crosses the northern half of the study area and Kanab Creek. The "farm road" is accessed from the main county road.

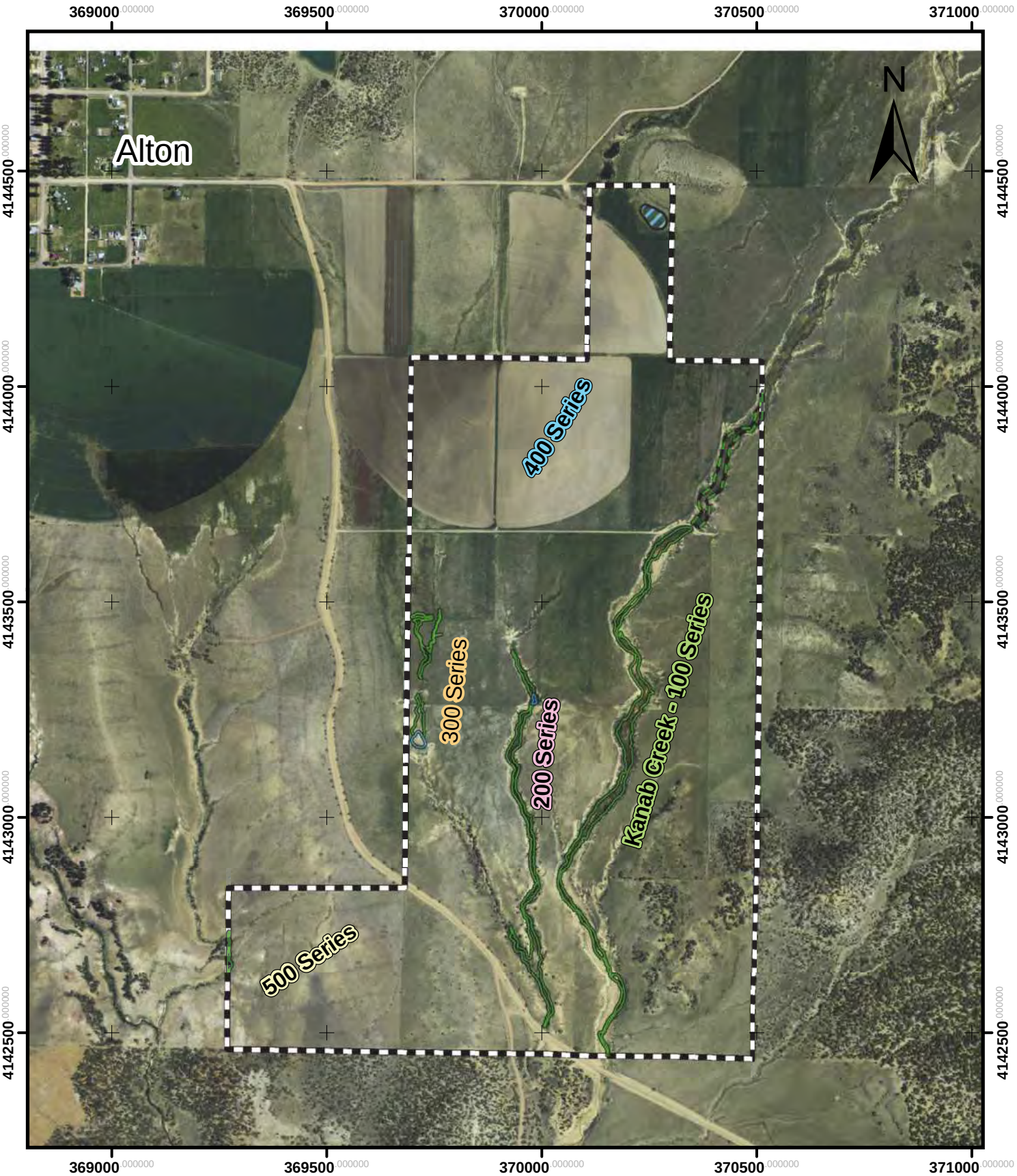
An "elk fence" crosses the middle of the study area from west to east. This fence has a significant impact on livestock and wildlife grazing, which affects the condition of the wetlands and adjacent upland pastures. The location of the elk fence is shown on Figures F-3 and F-7.

Elevation ranges from approximately 6,825 to 7,000 feet above sea level. Slopes range from 1 to 4 percent on the terrace, 5 to 10 percent on the southwest hillslopes, and from 30 to 60 percent or more on the very steep terrace sideslopes between the high terrace and the lower riparian zones. Plant communities adjacent to the study areas were primarily Sagebrush/Grass, Bitter-apple/Grass, croplands and pastures lands. Native plant communities in the general and surrounding areas included pinyon-juniper, oak brush, sagebrush/grass, and meadow types.

The Private Lease area is used for upland rangeland, irrigated cropland (alfalfa and small grains), and irrigated pastures. Irrigation is by wheel-line sprinkler systems, center pivot sprinklers, and some hand line sprinklers.



Wetland Survey of Alton Coal - Private Lease Area	Fig 1. Study Area Location Map
By: Long Resource Consultants, Inc. Morgan, Utah Mt. Nebo Scientific, Inc. Springville, Utah	General Location of Wetland Study Area southeast of Alton, Utah. Coordinate System: UTM, NAD 1983, Zone 12 North Alton, Utah USGS 7.5' Topographic Map — 1 inch = 2,000 feet August 11, 2012 — 0 500 1,000 2,000 3,000 4,000 Feet



Wetland Survey of Alton Coal - Private Lease Area	Figure 2. Stream Channels
By: Long Resource Consultants, Inc. Morgan, Utah Mt. Nebo Scientific, Inc. Springville, Utah	Note: Stream channel numbering system used for data points. Coordinate System: UTM, NAD 1983, Zone 12 North NAIP 2011 Aerial Photography 1 inch = 1,000 feet August 11, 2012 0 255 510 1,020 1,530 2,040 Feet

METHODS

The following materials, equipment, and methods were used in completion of wetland and OHWM inventories.

Aerial Photography

Natural color and CIR aerial photography from the United States Department of Agriculture, Farm Service Agency, National Agricultural Imagery Program NAIP) was used for this wetland inventory. Photography from 2009 (NAIP, 2009) and 2011 (NAIP, 2011) were used. The 2009 NAIP photography was taken on August 7, 2009. The 2011 NAIP photography was taken on June 22, 2011. These images were downloaded from the Utah Automated Geographic Reference Center (Utah AGRC, 2012). The projection of these aerial photos was UTM, NAD 1983, and Zone 12 North.

GIS Mapping

Pre-mapping and post-mapping of the wetland and OHWM data was done in a Geographic Information System (GIS) using ARCMap v. 9.3.1 (ARCMap) software. The post processed data points were projected on the NAIP aerial photography using the ARCMap software. The projection was done in UTM, NAD 1983, and Zone 12 North. The data was evaluated using both natural color and CIR color photography from both 2009 and 2011.

The ARCMap software was used to produce aspect, contours, elevation, hillshade, and slope GIS layers from the digital elevation model (DEM). The vertical datum is NGVD 29 (Utah AGRC, 2012). This data was used to: identify potential wetland areas; and to approximate the elevations for these areas.

GIS data (e.g. aerial photography, scanned USGS topographic map, DEM, roads, and streams, etc.) for the Private Lease study area were downloaded from the Utah Automated Geographic Reference Center (Utah AGRC, 2012).

Approximate elevations were obtained from the Digital Elevation Model (Utah AGRC, 2012) GIS layer.

Wetland acres were measured with ARCMap software on the horizontal plane.

GPS Data Collection

Wetland sample points, upland sample points, and OHWM points (left and right marks) were recorded with an *Ashtec MobileMapper 10*. The GPS (Global Position System) unit records field data with 1 to 2 meter accuracy. Post processing of the data with *MobileMapper Office v. 2.1.5,* by Ashtec, produces sub meter accuracy. The field data was post processed using reference data downloaded via the web from the Coconino County2, Arizona site. Table G-1 lists the coordinates (UTM NAD 1983 and lat/long) for each wetland and non-wetland data point. Table G-2 lists the coordinates (UTM NAD 1983 and lat/long) for the left and right high water marks for each OHWM cross-section.

Garmin GPSMAP® 60CSx and GPSMAP® 60CS GPS units were also used in the field to identify locations and record locations of general site photographs.

Geology

The Private Lease study area is primarily situated in Quaternary alluvium (Qa). Tropic shale (Kt) is mapped to the southwest and quaternary slumps, landslides, and colluvial deposits (Qmsc) are mapped to the east of the study area. Information was obtained from the Kanab, Utah 30'X60' Geologic GIS map (Doelling, 2008) and the Alton 7.5' Quadrangle (Tilton, 2001).

Hydrology

The National Hydrography Dataset (USGS-NHD, 2011) GIS layer was used for pre-mapping of potential wetland areas. This dataset included GIS layers for streams, ponds, and reservoirs. The *Spring and Seep Survey of the Coal Hollow Project Summary Report* (Petersen, 2008) was reviewed as part of the preliminary investigation.

Photographs

General photographs were taken for the entire study area (Appendix A) using a Nikon D70 digital camera. Locations of the general photos are shown in Figure A-1. Photographs of the wetland and upland data points (Appendix C) and OHWM marks (Appendix E) were also taken.

Precipitation Data

Precipitation data is available for the U.S. Weather Bureau station located in Alton, Utah which is less than one mile from the Private Lease study area. The period of available records for this station is January 1, 1915 through July 12, 2012 (Western Regional Climate Center, 2012).

Average annual precipitation is 16.43 inches and is nearly evenly distributed throughout the year. The average annual air temperature is 45.6^{o}F. The precipitation pattern is ustic and the temperature regime is mesic bordering on frigid C. Meir, 2006 in Long Resource Consultants, (Long, 2008).

Data from the WETS table for Alton, Utah was also evaluated as part of this inventory (USDA-NRCS, 2008).

Soil Survey Data

Soils data collected in the field was compared with existing Natural Resource Conservation Service (NRCS) soil survey data. Published NRCS soil survey data does not exist for the Alton, Utah area. A digital copy of unpublished in-progress soils spatial and tabular data was obtained from the Natural Resource Conservation Service (NRCS) field office in Richfield, Utah (USDA-NRCS, 2012). This in-progress work is subject to change as the survey data goes through the NRCS correlation process. *Keys to Soil Taxonomy* (USDA-NRCS 2010) was used as part of the evaluation process for soils in the Private Lease study area.

WETLANDS

The evaluation and recording of data for each wetland data point followed the procedures outlined in the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (Version 2.0)* (USACE, 2008c). This regional manual is a supplement to the *Corps of Engineers Wetlands Delineation Manual* (USACE 1987). The completed *Wetland Determination Data Forms* are in Appendix B. Photographs of the wetland sites are in Appendix C.

The location of each wetland and upland data point was recorded with the *Ashtec MobileMapper 10* GPS at the soil test pit locations. Vegetation and hydrology evaluations were done in the proximity of the soil test pit.

Vegetation

Qualitative and quantitative data for the vegetation in the study areas for this report were recorded in June and July, 2012. Vegetation sampling was conducted within representative wetland areas along the channels as well as the adjacent upland plant community. Sampling

was also conducted in non-wetland and upland plant communities in areas that appeared to be transitional to wetlands or showed actively growing plants in late in the season (or differential coloration by varying degrees of red) using CIR photography. GPS coordinates and color photographs were taken at each sample site.

S*ampling Design and Transect/Quadrat Placement*

The wetland sample areas varied in size and as such, sample sizes to record quantitative data also varied. In the larger areas more samples were taken when compared to the smaller areas. These data were summarized to provide averages of the parameters recorded. In all cases, the sample quadrats were randomly placed in the areas that appeared "most representative" of the site as a whole, using stratified random techniques. The data were recorded on the *Corps*' standard wetland datasheets as well as other raw data sheets used to summarize the data on spreadsheets for subsequent hydrophytic analyses. The quadrat placement technique was employed with the goal to adequately sample each site with an adequate number of samples to accurately represent the site.

Cover

Total cover (total living, bare ground, rock, and litter) estimates were made using ocular methods with one meter square quadrats. Sample sizes for each site have been provided on the Wetland Determination Data Forms. Plant nomenclature followed U.S. Army Corps of Engineers, National Wetland Plant List, Arid West Region (2012); if they were not listed here, nomenclature followed Welsh et al (2008).

Hydrophytic Vegetation Indicators

The *Corps Regional Supplement Manual* (2008c) cited above provides a section regarding hydrophytic vegetation indicators for wetland delineations. This section describes two procedures that may be used to test the presence of hydrophytic vegetation, which is one step in determining if a given area would be considered a "jurisdictional" wetland by definition. Both hydrophytic vegetation indicator procedures utilize quantitative cover data for their analyses.

The first test is called the "**Dominance Test**". The Dominance Test is the basic hydrophytic vegetation indicator and "*should be applied in every wetland determination in the arid west*". In this test the vegetation in a given community is *hydrophytic* if more that 50 percent of the dominant species across all strata are rated as:

1. OBL [Obligate Wetland: occurs almost always (estimated probability 99%) under natural condition in wetlands],

2. FACW [Facultative Wetland: usually occurs in wetlands (estimated probability 67%-99%), but occasionally found in non-wetlands], or

3. FAC [Facultative: equally likely to occur in wetland or non-wetland (estimated probability 34%-66%)].

This test employs the "50/20 Rule" to derive dominant species, meaning that dominant plants are those species that account for more than 50 percent of the total coverage of vegetation in each stratum (tree, sapling/shrub, herb, and woody vines) and also those single species that by themselves account for 20 percent or more of the living cover in each stratum. Once the dominant plants are identified, if 50 percent or more of them are classified as OBL, FACW or FAC, then the given community is considered to be *hydrophytic*.

The second *Corps* hydrophytic vegetation indicator procedure is called the **Prevalence Test**. This test can be employed on the vegetation in a community if it fails the Dominance Test described above, but meets those requirements for hydric soils and wetland hydrology in the wetland delineation process. The Prevalence Test considers all species in a plant community; however, the indicator categories assigned to the species (OBL, FACW, FAC, etc.) places a "weighted" value on them by using cover values of individual species. In other words, if a given plant species has more cover and is assigned OBL, FACW or FAC it is more likely that the community will be determined to be *hydrophytic*.

Soils

Hydric soils were evaluated in accordance with the guidelines listed in *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (Version 2.0)* (USACE 2008c). In-progress soil survey data was obtained from the NRCS and reviewed for potential hydric soil locations.

Small soil test pits were dug by hand at each wetland and non-wetland data point. The depth of these test pits had a typical depth of 16 to 21 inches. The following soils information was recorded on the wetland datasheets:

- Soil horizon (optional)
- Depth (inches)
- Matrix soil color (moist)
- Redox features, including color (moist), percent, type, and location
- Soil texture (with estimated percent clay)
- Other soil features (e.g. effervescence and lime masses or concretions)

Soil colors for the matrix and redox features were determined by using Munsell Soil Color Charts (Munsell 2000).

The applicable hydric soil indicators were selected and checked on wetland data sheet. Additional remarks on soil types were recorded along with depths to restrictive layers, if present. The final determination of whether or not it was a hydric soil was noted in the appropriate box on the wetland data sheet.

The same process was followed for representative upland soil locations adjacent to each wetland data point and for areas where documentation was recorded for documentation as 'non-wetland.'

Hydrology

Wetland hydrology was evaluated in accordance with the guidelines listed in *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (Version 2.0)* (USACE 2008c). The soil test pit was used to evaluate and note the presence of a high water table or saturated soils at each wetland and upland data point.

The following wetland hydrology was recorded:

- Depth of surface water, if present
- Depth to a high water table, if present
- Depth to saturated soils, if present

The applicable wetland hydrology indicators were selected and checked on the wetland data sheet. The final determination of whether or not wetland hydrology was present was noted in the appropriate box on the wetland data sheet. Additional remarks about the wetland hydrology were recorded on the wetland data sheet, as deemed appropriate.

ORDINARY HIGH WATER MARKS

The OHWM study follows those methods described in Lichvar and McColley (2008). Subsequent to that publication, an updated datasheet was created (Curtis and Lichvar, 2010) and was recommended to be used in conjunction with the 2008 Corps publication. The completed *Arid West Ephemeral and Intermittent Streams OHWM Datasheets* are appendix D. Photographs of the OHWM cross-sections are Appendix E.

Aerial Photographs & Topographic Maps

Available standard color and color CIR photographs were reviewed prior to and during the field investigations (NAIP 2009 and NAIP 2011). Additionally, the Alton, Utah USGS topographic (USGS, 1966) map, site specific soil maps and geologic maps were also employed for the studies. These map resources revealed channels, soil changes, geomorphology, geologic features and vegetation patterns.

Preliminary Field Evaluation

Once the maps were reviewed and the appropriate maps selected, notes were made on them to be used in the field for preliminary evaluation and identification. Using these marked maps, all drainages and channels were walked and preliminary data were recorded regarding the OHWM (and wetland) locations.

Final Field Identifications & Delineations

Following the preliminary work described above, field delineations were conducted. OHWM sample sites were chosen at representative reaches along all channels within the study area. These locations were sometimes located near the wetland and upland study sites described above. Once a given site was chosen, the sample channel was walked and observed for characteristics related to the OHWM and the following information was recorded:

- Investigators
- Date & Time of Day
- Site Number
- Brief Site Description
- Left and right OHWMs recorded by GPS

- Resources used at the site (maps, documents, etc)
- Location of Low-Flow Channel
- Location of Active Floodplain
- Location of Low Terrace
- Location of High Terrace (optional)

At each OHWM study site, the following indicators were initially noted:

- Changes in average sediment texture
- Changes in vegetation species
- Changes in vegetation cover
- Breaks in bank slopes
- Other changes
- Additional notes and comments

Also, in the Low-Flow, Active Flood Plain and Low Terrace areas, the following data were recorded:

- Average Sediment Texture
- Vegetation Cover
- Community Successional Stage
- Floodplain indicators (e.g. mud cracks, ripples, drift and/or debris, presence of bed and bank, benches, soil development, surface relief, other note and comments).

Once the above data and information were recorded, a measuring tape was placed across the entire channel (minimum left OHWM to right OHWM) and the lateral measurements were documented. A cross-section was then sketched on the datasheets that showed these measurements, along with the general channel topography and OHWM points [NOTE: “Right” (R) and “Left” (L) on the datasheets refer to “River-Right” and “River-Left” *as seen by looking downstream*].

Finally photographs were taken at the site and the locations of the OHWMs on both sides of the channel were recorded using the *Ashtec MobileMapper 10* GPS with sub-meter capabilities.

Results

In this report the wetland delineation and OHWM identification study areas have been divided into segments based primarily on different drainages or areas that appeared most likely to be hydrologically connected, at least on the ground surface. The drainages and the sample sites within them were given a series of numbers to differentiate between them from 100 to 500. For example, all sample sites in Kanab Creek were numbered in the 100s, the numbers in drainage west of Kanab Creek were in the 200s, west of that 300s, and so on, Figure 2.

Detailed data for each sample site within the wetlands, associated uplands, ephemeral drainages, and OHWMs have been provided on the summarized data sheets in the appendices. Summaries of the findings in these areas are provided below.

Riparian wet meadows, mixed riparian scrub/shrub wet meadows, ephemeral drainages, and upland areas were identified during this study. These areas are described in this section by drainage (e.g. Kanab Creek or 200 Drainage) starting at the downstream end and moving upstream and are shown on maps in Appendix F (Figures F-2 through F-10).

Representative active floodplain widths were measured in the field at the "Ordinary High Water Mark" (OHWM) using techniques described in the METHODS section of this report.

100 Drainage – Kanab Creek

General Description

Kanab Creek (100 Drainage) is a perennial stream with a long narrow floodplain situated in a stream valley that divides a "high terrace" that is part of the Alton Amphitheater (U.S. Geological Survey, 1966). The average "high terrace" elevation is approximately 20 feet higher than the average stream elevation. The elevation of Kanab Creek is about 6,827 feet at the study area boundary on the downstream end, 6,920 feet at the "farm road" crossing, and about 6,948 feet at the upstream end. The resulting average slope of Kanab Creek is approximately 0.5 percent over the reach that crosses the study area.

The south end of Kanab Creek is accessed from the main county road to the existing Coal Hollow Mine facility and by a "farm road" about 4,825 feet upstream. The stream extends

about 1,115 feet upstream from the "farm road" to the study area boundary. Consequently, the total length of Kanab Creek as it dissects the study area is approximately 5,940 feet.

Wetlands in the Kanab Creek drainage were separated into two distinct wetland areas. Wetland KL (Kanab Creek Lower) delineates the wetland along Kanab Creek from the south boundary upstream to the "farm road" crossing (Figures F-2, F-3, F-4 and F-5). The KL wetland was classified as a *Riparian Wet Meadow*. Wetland KU (Kanab Creek Upper) delineates the wetland along Kanab Creek from the "farm road" crossing upstream to the study area boundary (Figures F-5 and F-6). The KU wetland was classified as a *Mixed Riparian Scrub/Shrub Wet Meadow*.

Two ephemeral drainages (*Ephemeral Drainage 104 Non* and *Ephemeral Drainage 109 Non*) flow into Kanab Creek in the KL section (Figure F-2 and F-7, respectively).

CIR aerial photography shows areas of pink and red tones beyond the edges of the delineated wetlands along Kanab Creek. These tonal patterns are the result of Russian olive trees, willows, Wood's rose, and other large shrubs growing outside the delineated wetland with roots deep enough to reach the ground water along Kanab Creek. This situation was evaluated and documented at *Upland*110 (Figure F-2).

KL Riparian Wet Meadow

General Description

The KL *Riparian Wet Meadow* (KL wetland) encompasses the length of Kanab Creek from the south boundary of the study area upstream to the "farm road" crossing. The location of KL *Riparian Wet Meadow* is shown in Figures F-2, F-3, F-4, and F-5. The width of the active floodplain ranges from 14 to 83 feet at the OHWM data points. The width of the low flow channel ranges from 3 to 52 feet. The stream flow in Kanab Creek is shallow, but covers nearly the entire active floodplain at some locations (e.g. 12ALT_OHW105, 12ALT_OHW107, 12ALT_WET103, and 12ALT_WET106).

Livestock grazing has impacted the southern portion of the KL *Riparian Wet Meadow*. Trampling by cattle in the alluvial floodplain was observed at 12ALT_OHW102, 12ALT_OHW103, 12ALT_OHW105, 12ALT_WET102, and 12ALT_WET103. Grazing impacts were minimal at 12ALT_OHW106, 12ALT_OHW107, 12ALT_OHW108, and 12ALT_OHW109.

Class: Riparian Wet Meadow
Stream: Perennial Stream
Acres: 4.25
Length: approximately 4,825 feet
Width: 14 to 83 feet active floodplain (OHWM points)

Table 1. Field evaluation points within the *KL Riparian Wet Meado*w.

Wetland Evaluation Points	Associated Upland Evaluation Points	Ordinary High Water Mark Evaluation Points
12ALT_WET 101	12ALT_WET 101 Non	12ALT_OHW 102
12ALT_WET 102	12ALT_WET 102 Non	12ALT_OHW 103
12ALT_WET 103	12ALT_WET 103 Non	12ALT_OHW 105
12ALT_WET 105	12ALT_WET 105 Non	12ALT_OHW 106
12ALT_WET 106	12ALT_WET 106 Non	12ALT_OHW 107
		12ALT_OHW 108
		12ALT_OHW 109

Vegetation

Wetland KL, the most common wetland type of this perennial stream channel, is located in a significant portion of the Kanab Creek study area. When all samples sites of this type in Kanab Creek were considered, the total living cover ranged from 45.00% to 71.88%, with an average of 55.54%. Grasses and grass-like plants (e.g. rushes, sedges, etc.) dominated the cover and averaged nearly 80% of the species composition.

The dominant herbaceous plant by a wide margin in the Riparian Wet Meadows was arctic rush (*Juncus arcticus*). The most common woody plants were Booth's willow (*Salix boothii*) and narrow-leaf willow (*S. exigua*).

The upland plant communities adjacent to the Riparian Wet Meadows in Kanab Creek were comprised mostly of sagebrushes and grasses.

Soils

Hydric soil indicators observed in wetland KL were *Hydrogen Sulfide Odor (A4), Loamy Mucky Mineral (F1), Loamy Gleyed Matrix (F2), and Redox Depressions (F8)*. Diagnostic soil mottles

were observed throughout most of the KL wetland. Depleted soil conditions and the hydrogen sulfide odor were observed in the saturated and moist portions of the wetland.

Soils in the KL wetland are medium to coarse textured with loam, gravelly loam, extremely cobbly sandy loam, extremely cobbly sandy clay loam, and extremely gravelly loamy sand being common soil textures. The field estimated clay ranged from 3 to 30 percent.

Hydrology

Wetland hydrology indicators observed in the KL wetland were *Surface Water (A1), High Water Table (A2), Saturation (A3), Water Stained Leaves (B9), Hydrogen Sulfide (C1), and Oxidized Rhizospheres (C3)*.

Surface water from 2 to 3 inches deep was observed at 12ALT_WET103, 12ALT_WET106, 12ALT_OHW105, 12ALT_OHW107, 12ALT_OHW108, and12ALT_OHW109.

Hydrogen sulfide odors were detected at locations with surface, high water tables, or saturated soil. These areas included 12ALT_WET103, 12ALT_WET105, and 12ALT_WET106.

KU Mixed Scrub/Shrub Riparian Wet Meadow

General Description

The KU *Mixed Scrub/Shrub Riparian Wet Meadow* (wetland KU) encompasses the portion of Kanab Creek upstream from the "farm road" crossing to the upstream boundary of the study area. The location of KU *Riparian Wet Meadow* is shown in Figures F-4, and F-5. The wetland in this reach of Kanab Creek is characterized by a mixture of *Riparian Scrub/Shrub* and *Riparian Wet Meadow* communities. The width of the active floodplain ranges from less 19.0 to 47.5 feet at the OHWM points. The active floodplain is wider at the downstream end of the KU wetland. The low flow channel is narrow, ranging from 1.5 to 2.0 feet at the OHWM points.

There was evidence of livestock grazing in the KU wetland, but the impact appeared to be low to moderate. Dumping of trash in the "high terrace" side channels is common in the area outside of wetland KU.

Class: Mixed Riparian Scrub/Shrub Wet Meadow
Stream: Perennial Stream
Acres: 1.41
Length: approximately 1,115 feet
Width: 12 to 47 feet active floodplain (OHWM points)

Table 2. Field evaluation points within the *KU Mixed Riparian Scrub/Shrub Wet Meadow*.

Wetland Evaluation Points	Associated Upland Evaluation Points	Ordinary High Water Mark Evaluation Points
12ALT_WET 107 12ALT_WET 108	12ALT_WET 107 Non 12ALT_WET 108 Non	12ALT_OHW 110 12ALT_OHW 111

Vegetation

The KU *Mixed Riparian Scrub/Shrub Wet Meadow* was located in the upper reaches of the study area. Although more woody plants were present in the samples, which also resulted in more overstory cover, herbaceous plants continue to dominate the vegetative cover here. The total living cover ranged from 50.00% to 53.33%, with an average of 51.67%. Herbaceous plants consisted of more than 80% of the understory cover.

The most common herbaceous plants in these wetlands were arctic rush and three-square (*Schoenoplectus pungens*). The most common woody plants in this area were Booth's willow and Russian-olive (*Elaeagnus angustifolia*).

The upland vegetation types adjacent to the wetlands were primarily sagebrush/grass and Russian-olive/grass communities.

Soils

Hydric soil indicators observed in wetland KU were *Hydrogen Sulfide (A4), Depleted Matrix (F3), and Redox Depressions (F8)*. Diagnostic soil mottles were observed throughout most of the KU wetland. Depleted soil conditions and the hydrogen sulfide odor were observed in the saturated and moist portions of the wetland.

Soils in the KU wetland are medium textured with loam, sandy clay loam, and clay loam being common soil textures. Portions of this wetland have extremely cobbly horizons at a depth of 18 inches. The field estimated clay ranged from 20 to 30 percent.

Hydrology

Wetland hydrology indicators observed in the KU wetland were *Saturation (A3), Surface Soil Cracks (B6), Salt Crusts (B11), Hydrogen Sulfide (C1), and Oxidized Rhizospheres (C3)*.
Hydrogen sulfide odors were detected at locations with saturated soil (12ALT_WET108).

Ephemeral Drainage 104

General Description

There is not a wetland in *Ephemeral Drainage 104*. This narrow dry ephemeral drainage is a tributary of Kanab Creek. The low flow channel is 2 feet wide and incised within a gully. The active floodplain is limited to the low flow channel. Headcutting and soil erosion are active in this drainage. There was a 4 foot wide low terrace on both sides of the channel.

Elevations in *Ephemeral Drainage 104* are approximately 6,860 feet at the downstream end and 6,900 feet at the upstream end.

Class: Upland
Stream: Ephemeral Drainage
Length: approximately 1,000 feet
Width: 2.0 feet (OHWM points)

Table 3. Field evaluation points within *Ephemeral Drainage 104*.

Wetland Evaluation Points	Associated Upland Evaluation Points	Ordinary High Water Mark Evaluation Points
	12ALT_WET 104 Non	12ALT_OHW 104

Vegetation

This upland plant community had a total living cover of 53.33%. Its composition was comprised of only shrubs and grasses at 53.57% and 46.43%, respectively.

The dominant plant in this area was the grass, smooth brome (*Bromus inermis*) which had twice the cover of the other species. The three shrub species present in the sample quadrats were

nearly equally represented in the cover; these plants were Wyoming big sagebrush (*Artemisia tridentata* var. *wyomingensis*), snowberry (*Symphoricarpos oreophilus*) and rubber rabbitbrush (*Chrysothamnus nauseosus*).

Soils

Hydric soils were not observed in this ephemeral drainage.

Hydrology

Wetland hydrology was not observed in this ephemeral drainage.

Ephemeral Drainage 109

General Description

There is not a wetland in *Ephemeral Drainage 109*. This narrow dry ephemeral drainage is a tributary of Kanab Creek. There are a few very small patches (approximately 5 square feet up to 10 square feet) of wetlands within this drainage, but the cumulative total was estimated to be less than 0.1 acres and comprise less than 5 percent of the drainage. The combined low flow channel and active floodplain is approximately 5 feet wide.

Impacts from livestock grazing appeared to be less than along the water in Kanab Creek. But the impacts (e.g. hoof trampling of the soil surface) did make exact delineation of the active floodplain difficult.

Elevations in *Ephemeral Drainage 109* are approximately 6,870 feet at the downstream end and 6,900 feet at the upstream end.

Class: Upland
Stream: Ephemeral Drainage
Length: approximately 1,000 feet
Width: 5 feet (OHWM point)

Table 4. Field evaluation points within *Ephemeral Drainage 109*.

Wetland Evaluation Points	Associated Upland Evaluation Points	Ordinary High Water Mark Evaluation Points
	12ALT_WET 109 Non	12ALT_OHW 112

Vegetation

This ephemeral drainage supported an upland plant community with a total living cover of 51.67%. The composition consisted of nearly all shrubs and comprised 96.23% of the cover, with the remainder comprised of grasses at only 3.77%.

The dominant plant in this community was Wood's rose (*Rosa woodsii*) followed by rubber rabbitbrush. The only grass species present in the samples was crested wheatgrass (*Agropyron cristatum*).

Soils

Hydric soils were not observed in this ephemeral drainage. Mottles are prominent, but too deep to be diagnostic for a hydric soil. The soil mottles are most likely the result of moisture from snowbank accumulation. The soil texture is loam with 22 to 23 percent field estimated clay.

Hydrology

Wetland hydrology indicators were not observed in this ephemeral drainage. Heavy thunderstorms may result in short duration surface flow from localized runoff. The upstream watershed is very small.

Upland 110

General Description

This alluvial fan is situated at the location where *Ephemeral Drainage 109* empties onto a low terrace adjacent to Kanab Creek. Russian olive trees dominate this low terrace.

CIR aerial photography shows this area with red and pink color tones. It is outside of the delineated KL wetland. The deep rooted trees and shrubs are able to reach the deeper groundwater along Kanab Creek. The result is actively growing vegetation later in the growing season, but it is *not* a wetland.

Class: Upland

Table 5. Field evaluation points within *Upland 110*.

Wetland Evaluation Points	Associated Upland Evaluation Points	Ordinary High Water Mark Evaluation Points
	12ALT_WET 110 Non	

Vegetation

This area is an upland plant community. The site was dominated by Russian-olive trees that had a 90.00% cover. The only understory plant here was smooth brome which had a mean cover of 40.00%.

Soils

No hydric soil indicators were observed. No mottles were observed Soil texture is loam with 24 percent field estimated clay.

Hydrology

Wetland hydrology was not observed at this location.

200 Drainage

General Description

The *200 Drainage* is immediately west of Kanab Creek. This stream originates in the agricultural fields on the "high terrace" south of the "farm road." The stream flows south and exits the study area south of the main county road. A small stock pond (AA Pond, Figure F-7) is on the north side of the elk fence.

This area is a combination of ephemeral drainages and an intermittent stream. The reach from the south boundary to the main county road is an ephemeral drainage that does not contain a wetland. The middle reach is an intermittent stream from the main county road up past the elk fence. This middle reach is a long narrow *Riparian Wet Meadow* with surface water from seeps. The upper reach of the 200 drainage is an ephemeral drainage that transitions from the intermittent stream in the middle reach up onto the hay fields and pastures on the "high terrace."

The elevation difference between the active floodplain and the "high terrace" varies over the length of the 200 drainage. The difference is approximately 6 to 8 feet on the upstream side of the main county road. This elevation difference increases to approximately 23 feet in the middle reach (12ALT_WET201 and 12ALT_WET202) and continues upstream past the elk fence [12ALT_WET205). Near the upstream end of the intermittent stream portion (12ALT_OHW204) the elevation difference decreases to about 10 feet. The depth of the upper ephemeral drainage reach gradually decreases until it is the same elevation as the "high terrace" at the upstream end.

Ephemeral Drainage 204

General Description

Ephemeral Drainage 204 is not a wetland. Wetland hydrology was identified, but hydric soils and hydrophytic vegetation were *not* present.

This lower ephemeral drainage reach is located between the south boundary fence and the downstream end of the main county road culvert. It is a short reach that is impacted by discharges from the culvert. The active floodplain is wide at the culvert, similar to conditions on

the north side of the road (12ALT_OHW203), but it quickly necks down to about 5 feet at the south boundary fenceline.

The distinguishing feature of this reach of the 200 drainage is the channel scouring and deposition that has occurred as a result of discharges from the culvert. Some of the recent discharges appear to have been quite large, although no stream data is available (see *Ephemeral Drainage 301* description).

Livestock grazing has also impacted this drainage reach.

Elevations at *Ephemeral Drainage 204* are approximately 6,829 feet at the downstream end and 6,832 feet at the upstream end.

Class: Upland
Stream: Ephemeral Drainage
Length: approximately 140 feet

Table 6. Field evaluation points within *Ephemeral Drainage 204*.

Wetland Evaluation Points	Associated Upland Evaluation Points	Ordinary High Water Mark Evaluation Points
	12ALT_WET 204 Non	

Vegetation

The mean total living cover in this drainage area was 21.67%; its composition was comprised of 86.67% forbs and 13.33% grasses. No woody species were present in the sample quadrats.

The dominant plant in this area was field bindweed (*Convolvulus arvense*). The only other species present in the samples was foxtail barley (*Hordeum jubatum*).

Soils

Hydric soils were not identified in this reach of the 200 drainage. Prominent soil mottles were observed below 15 inches, but were too deep to be diagnostic. The drainage bottom was extremely cobbly and gravelly below 20 inches. The soil was moist below 15 inches. The field texture in the surface 20 inches was sandy clay loam with estimated 24 percent clay.

Hydrology

Surface soil cracks (B6) was the only wetland hydrology indicator observed in this area.

Surface water is likely present during periods of high runoff through this ephemeral drainage. The duration of these runoff periods is varied.

AA Riparian Wet Meadow

General Description

The *AA Riparian Wet Meadow* (wetland AA, Figures F-2, F-3, F-4) is situated in a long narrow valley bottom between the high terraces in the intermittent stream channel immediately west of Kanab Creek. The water source for this wetland is primarily groundwater seeps on the valley footslopes (lower 3 to 8 feet) just below and above the elk fence. Surface runoff from seasonal snowmelt and thunderstorms also contributes water to the wetland. Approximately 70 percent of this wetland had 2 to 4 inches of surface water and saturated soils at the time of the field evaluation.

The wetland begins at the main county road culvert (42 inch concrete) and continues upstream to a point approximately 370 feet beyond the small stock pond (AA Pond) at the elk fence. The lower 600 feet of this wetland was dry when it was evaluated on June 21, 2012. The soil was saturated and there was 2 to 4 inches of surface water from this point up to the elk fence. Soil in the AA wetland north of the elk fence was saturated at 17 inches.

Wetland AA extends approximately 320 feet up the *300 Drainage* to the northwest until that drainage becomes ephemeral.

The low flow channel is two feet wide in the lower “dry” area and ranges from 12 to 16 feet wide in the upstream portion. The active floodplain ranges in width from 48 feet at the lower end to 16 feet near the upper end of the wetland.

Livestock graze in this wetland and use it for a water source south of the elk fence. Evidence of cattle trampling in the riparian wet meadow was observed throughout the portion of the AA wetland south of the elk fence.

Elevations in wetland AA are approximately 6,840 feet at the main culvert at the downstream end and 6,905 feet at the upstream end.

Class: Riparian Wet Meadow
Stream: Intermittent Stream
Acres: 2.38 (including the small AA pond)
Length: approximately 3,130 feet
Width: 16 to 44 feet active floodplain (OHWM points)

Table 7. Field evaluation points within the *AA Riparian Wet Meadow*.

Wetland Evaluation Points	Associated Upland Evaluation Points	Ordinary High Water Mark Evaluation Points
12ALT_WET 201	12ALT_WET 201 Non	12ALT_OHW 201
12ALT_WET 202	12ALT_WET 202 Non	12ALT_OHW 202
12ALT_WET 203	12ALT_WET 203 Non	12ALT_OHW 203
12ALT_WET 205	12ALT_WET 205 Non	12ALT_OHW 204

Vegetation

The AA *Riparian Wet Meadows* had total living covers that ranged from 68.33% to 84.00%; the mean cover for all sample sites was 76.82%.

The most common plant for these wetlands by far was arctic rush. Other important species, however, were beaded sedge (*Carex utriculata)*, Douglas' sedge (*Carex douglassii*) and Missouri iris (*Iris missouriensis*).

The upland plant communities adjacent to the Riparian Wet Meadows in the 200 Drainage were either Sagebrush/Grass or Bitter-Apple/Wood's rose.

Soils

Hydric soils in wetland AA are characterized by a *Depleted Matrix (F3), Redox Depressions (F8),* and a strong *Hydrogen Sulfide Odor (A4)*. Diagnostic soil mottles were observed throughout the *AA Riparian Wet Meadow*. Depleted soil conditions and the hydrogen sulfide odor were observed in the saturated and moist portions of the wetland.

AA Riparian Wet Meadow soils are medium to heavy textured with loam, sandy clay loam, clay loam, and clay being common soil textures. The field estimated percent clay ranged from 14 to 42.

Hydrology

The dominant wetland hydrology indicators observed in wetland AA include *Surface Water (A1), Saturation (A3), Salt Crusts (B11), Hydrogen Sulfide odor (C1),* and *Oxidized Rhizospheres (C3)*. *Surface soil cracks (B6)* and *Water Stained Leaves (B9)* were also observed.

Ephemeral Drainage 206

General Description

No wetlands are present in this upper reach of the 200 drainage.

Ephemeral Drainage 206 is at the upper end of the 200 drainage, Figure F-4. It is the reach that transitions from the deeply incised intermittent stream up onto the agricultural fields and pastures on the "high terrace." The low flow channel is 10 feet wide with 2 additional feet of active floodplain on both sides. A small breached stock pond is located near the lower end of this reach. The drainage forks at the stock pond with one fork to the northwest and another to the northeast.

Elevations in *Ephemeral Drainage 206* are approximately 6,905 feet at the downstream end and 6,920 feet at the upstream end.

Class: Upland
Stream: Ephemeral Drainage
Length: approximately 1,000 feet

Table 8. Field evaluation points within *Ephemeral Drainage 206*.

Wetland Evaluation Points	Associated Upland Evaluation Points	Ordinary High Water Mark Evaluation Points
	12ALT_WET 206 Non	12ALT_OHW205

Vegetation

Although wetland plants were present, *Ephemeral Drainage 206* was an upland plant community based on its soils and hydrology. The total living cover here was 78.00%. The composition was comprised of 100% grasses and grass-like species.

The only two plants present in the sample quadrats were western wheatgrass (*Pascophyrum smithii*) and arctic rush.

Soils

No hydric soils were identified in this ephemeral drainage. Prominent soil mottles (1 percent) were observed below 14 inches, which is too deep and too few to be diagnostic.

Hydrology

No wetland hydrology indicators were observed in this ephemeral drainage.

300 Drainage

General Description

The *300 Drainage* is located west of the *200 Drainage* and drains the agricultural fields and pastures on the western side of the "high terrace", Figures F-2, F-7, and F-8 It is a tributary of the *200 Drainage.* The lower portion of this drainage system (*Ephemeral Drainage 301*) was severely affected by the breach of a stock pond (BB Pond) in the late winter or early spring of 2010-11. The middle reach of the 200 Drainage is dominated by an intermittent stream that transitions from the breached stock pond up onto the "high terrace." The upper reach is an ephemeral drainage that quickly becomes an indistinguishable part of the agricultural pastures.

Ephemeral Drainage 301

General Description

Wetlands were not identified in this lower reach of the *300 Drainage* under the existing conditions.

Ephemeral Drainage 301 was severely affected by the breach of a stock pond (BB Pond, Figure F-7) sometime during the late winter or early spring of 2010-11. Water was visible in the pond in the 2009 NAIP aerial photography (August), but the pond appeared to be dry in the 2011 NAIP photography (June). The Alton area received above average snowfall during the winter of 2010-11 followed by heavy rains on top of the snowpack. The exact date of the stock pond breach could not be determined.

Flood waters from the stock pond breach appeared to have had a severe impact on the *Ephemeral Drainage 301* reach. The bottom of the drainage has been scoured. Large juniper trees on the "high terrace" were undercut by bank erosion and fell into the drainage causing debris dams.

A few very small patches of riparian wet meadow remnants were observed in Ephemeral Drainage 301. These small patches ranged in size from approximately 5 square feet up to 10 square feet. The cumulative total of these riparian wet meadow remnants was estimated to be substantially less than 0.1 acres and less than 5 percent of the total area.

Elevations in *Ephemeral Drainage 301* are approximately 6,860 at the downstream end and 6,985 at the upstream end.

Class: Upland
Stream: Ephemeral drainage
Acres: N/A
Length: approximately 1,700 feet
Width: 11 feet (OHWM points)

Table 9. Field evaluation points within *Ephemeral Drainage 301*.

Wetland Evaluation Points	Associated Upland Evaluation Points	Ordinary High Water Mark Evaluation Points
	12ALT_WET 301 Non	12ALT_OHW301

Vegetation

This area supported an upland community within an ephemeral drainage. Total living cover here was estimated at 31.67%. The composition was comprised of 48.02% forbs, 32.54% grasses and 19.44% shrubs.

The dominant plants at this site were smooth brome, deep-root (*Iva axillaris*) and rubber rabbitbrush.

Soils

Hydric soils were not identified at the 12 ALT_WET301 Non location (Figure F-7). Prominent mottles (2 percent) were observed below 6 inches, but they were too deep and too few to be diagnostic. Tropic shale was present at 15 inches.

Hydrology

Wetland hydrology indicators were not observed under the current ephemeral drainage conditions. The drainage was scoured significantly in places when the stock pond failed. The rush of water, which came down the drainage when the pond failed, appeared to have been much higher than "normal high water" and removed hydrology indicators that may have been

present previously. Debris deposited high on the banks by the flood from the breached pond appeared much higher than would be attributed to the "Ordinary High Water."

BB Riparian Wet Meadow

General Description

The BB *Riparian Wet Meadow* (BB wetland) is located in the second ephemeral/intermittent drainage west of Kanab Creek, Figures F-7. The downstream end of this wetland begins at a point approximately 1,590 feet upstream from the main county road culvert in the *200 Drainage*. The BB wetland extends north 320 feet from its southern most point and terminates in the tailwater of a small breached stock pond approximately 80 feet north of the elk fence. The width ranges from about 90 feet in the southern portion to less than 20 feet north of the elk fence.

Wetland BB developed in the tailwater swale of a stock pond that breached in the winter or spring of 2010-2011. Water was present in the August 2009 NAIP aerial imagery, but not in the August 2011 aerial imagery. This wetland will most likely transition into an upland site over the next few years, if the stock pond is not rebuilt. The stock pond covered approximately 0.2 acres when full. A second much smaller stock pond located on the north side of the elk fence has also breached.

Elevations in wetland BB are approximately 6,888 feet at the downstream end and 6,895 at the upstream end.

Class: Riparian Wet Meadow
Stream: Intermittent Stream
Acres: 0.34 (does not include breached stock pond).
Length: approximately 324 feet
Width: approximately 20 to 90 feet

Table 10. Field evaluation points within the *BB Riparian Wet Meadow*.

Wetland Evaluation Points	Associated Upland Evaluation Points	Ordinary High Water Mark Evaluation Points
12ALT_WET 302	12ALT_WET 302 Non	12ALT_OHW 302

Vegetation

Wetland BB had a total living cover of 61.67%; this cover was comprised of over 90% grasses and grass-like species (rushes). The dominant plants at this wetland were wiregrass and foxtail barley.

The adjacent upland plant community was a pasture used primarily to graze domestic livestock. The dominant plant at the site was the introduced grass, crested wheatgrass.

Soils

The hydric soil indicators observed at wetland BB are *Thick dark surface (A12), Redox Dark Surface (F6), and Redox Depressions (F8)*.

Hydric soils in wetland BB developed in the sediments deposited upstream of the breached stock pond. The surface is deep and dark (thick mollic epipedon) with diagnostic soil mottles that begin at the surface and continue to a depth of at least 21 inches (depth of soil test pit). The majority of the mottles occur in the upper part of the argillic horizon (Bt1) from 3 to 11 inches below the surface. The upland soil profile has 18 percent prominent mottles below 13 inches.

The soil is medium textured loam and clay loam with field estimated 24 to 32 percent clay.

Hydrology

Existing hydrology at wetland BB was determined to be ”Problematic” due to the breached stock pond. The area will transition to upland conditions, if the dam is not rebuilt.

CC Riparian Wet Meadow

General Description

The CC Riparian Wet Meadow (CC wetland) wetland is located upstream from wetland BB. Wetland CC begins approximately 2,085 feet upstream from the main county road culvert, Figures F-7 and F-8. This wetland is part of the upstream end of the second ephemeral/intermittent drainage west of Kanab Creek. Wetland CC extends north

approximately 550 feet and terminates in a small stock pond. The average width of the wetland is 22 feet with an active floodplain of 25 feet (12ALT_OHW 302).

Wetland CC is an intermittent stream located in a swale that is 3 to 4 feet below the elevation of the high terrace. The adjacent "high terrace" area is used for irrigated and dryland hay or pasture.

There is approximately 180 feet of intermittent stream channel between wetlands BB and CC that does not meet the requirements for wetland delineation. Conversion of the adjacent agricultural fields to more efficient forms of sprinkler irrigation may result in the gradual transition of portions of wetlands BB, CC, and DD into an upland condition.

Wetland DD is a tributary to wetland CC Its shape is similar to wetland CC, but it has problematic vegetation due to management practices and subsequent erosion (see description for the DD *Riparian Wet Meadow*).

Elevations in wetland CC are approximately 6,897 feet at the downstream end and 6,910 feet at the upstream end.

Class: Riparian Wet Meadow
Stream: Intermittent Stream
Acres: 0.32
Length: approximately 550 feet
Width: 25 feet of active floodplain (OHWM points)

Table 11. Field evaluation points within the *CC Riparian Wet Meadow*.

Wetland Evaluation Points	Associated Upland Evaluation Points	Ordinary High Water Mark Evaluation Points
12ALT_WET 303	12ALT_WET 303 Non	12ALT_OHW 302

Vegetation

Wetland CC had a total living cover of 81.00%. The composition of that cover consisted of 89.71% grasses and grass-like species and 10.29% shrubs. No forbs were present in the sample quadrats.

The site was dominated by arctic rush, smooth brome and Wood's rose.

The upland vegetation adjacent to the wetland was a Sagebrush/Grass community and was dominated by Wyoming big sagebrush and western wheatgrass.

Soils

Soils in wetland CC barely meet the requirements for a hydric soil. There is a 6 inch thick band from 3 to 9 inches below the soil surface with 5 percent prominent mottles that meets the requirement for *Redox Depressions* (F8). The field estimated percent clay ranges from 24 to 30 percent. There are fine lime masses and threads in the soil horizon immediately below the horizon with mottles.

Hydrology

Hydrology appears to be short duration flooding resulting from off-site snow melt and thunderstorms. This intermittent stream may have developed from irrigation runoff prior to the implementation of sprinkler irrigation.

Wetland hydrology indicators observed in wetland CC are *Water-Stained Leaves (B9), Oxidized Rhizospheres (C3),* and *Drainage Patterns (B10, secondary)*.

DD Riparian Wet Meadow

General Description

The *DD Riparian Wet meadow* (DD wetland) is in an intermittent stream channel that flows into wetland CC, Figure F-8. It was separated from wetland CC, because of "problematic" vegetation in this wetland area that appeared to be the result of management practices. The channel configuration is very similar to wetland CC, but it has more erosion. The channel is about 3 to 4 feet below the elevation of the "high terrace." The adjacent "high terrace" area is used for sprinkler irrigated and dryland hay and pastures.

This area was determined to have "Problematic" vegetation due to management practices. The channel headcutting may have begun prior to the conversion to sprinkler irrigation. Trash (major appliances, tires, bicycles, motorcycle, and other discarded items) has been dumped in the headcut.

Elevations in wetland DD are approximately 6,900 feet at the downstream end and 6,910 feet at the upstream end.

Class: Riparian Wet Meadow
Stream: Intermittent Stream
Acres: 0.08
Length: approximately 345 feet
Width: approximately 25 feet active floodplain (based on OHWM points at 12ALT_OHW302)

Table 12. Field evaluation points within the *DD Riparian Wet Meadow*.

Wetland Evaluation Points	Associated Upland Evaluation Points	Ordinary High Water Mark Evaluation Points
12ALT_WET 304	12ALT_WET 304 Non	12ALT_OHW 302

Vegetation

Wetland DD had a total living cover of 71.67%. The composition was made up of 64.44% grasses and 26.03% forbs.

The dominant plant species at this site were smooth brome, deep-root, field bindweed and Wood's rose. Although soils and hydrology characteristics suggest wetland conditions, the "Problematic" vegetation described on the wetland data sheets showed the site did not have enough hydrophytic vegetation to be classified as such.

The adjacent upland plant community had a total living cover of 66.67%, of which was comprised of 69.96% grasses and 30.04% shrubs. The only two species present in the sample quadrats were foxtail barley and Wood's rose.

Soils

Hydric soils in this wetland have 8 to 18 percent prominent soil mottles from the surface to 13 inches with additional 6 percent mottles below 13 inches. These soils meet the requirements for *Redox Depressions (F8)*. The field estimated percent clay ranges from 24 in the surface to 43 in the subsurface (Bt, 3 to 13 inches).

Hydrology

The primary wetland hydrology indicator is *Oxidized Rhizospheres (F8)* along with *Drainage Patterns (B10)* as a secondary indicator. This wetland is in an intermittent stream channel that transitions to a very shallow ephemeral drainage upstream of this wetland.

Upland 305

General Description

Upland 305 (12ALT_WET305 Non) does not contain any wetlands, Figure F-8.

The *Upland 305* area was a mix of reddish pink and light blue colors on both the 2009 and 2011 NAIP CIR aerial photography. This area was checked for potential wetland areas, but none were identified.

The elevation at *Upland 305* is approximately 6,914 feet.

Class: Upland

Table 13. Field evaluation points within *Upland 305*.

Wetland Evaluation Points	Associated Upland Evaluation Points	Ordinary High Water Mark Evaluation Points
	12ALT_WET 305 Non	

Vegetation

The total living cover here was estimated at 75.83%. This cover had a composition of 61.61% grasses and grass-likes, 26.80% forbs and 11.59% shrubs.

Located in a pasture, this area had some wetland plants present and was therefore analyzed as to whether or not it would meet wetland criteria. The site was dominated by slender wheatgrass (*Elymus trachycaulus*), yarrow (*Achillea millefolium*), arctic rush and Kentucky bluegrass (*Poa pratensis*). Although some of these species are hydrophytic, the site did not meet the wetland criteria for vegetation.

Soils

Hydric soils are not present at this location. The soils are calcareous to the surface with 4 percent lime masses around soil peds below 7 inches. The soil is fine textured with estimated percent clay of 38. This soil appeared to have been plowed at some time in the past.

Hydrology

This area does not have any wetland hydrology.

Upland 306

General Description

Upland 306 (ALT12_WET306 Non) does not contain any wetlands, Figure F-8. Hydrophytic vegetation was present, but it did not meet hydric soil requirements. This area is less than 0.1 acres.

This location consisted of a very small stock pond that was dry. An ephemeral drainage forms south of this pond and flows toward the north end of wetland DD. However, there did not appear to be any significant source of surface water for this pond and it may be filled from an irrigation pipeline. The surrounding area was disturbed during pond construction.

The elevation at *Upland 306* is approximately 6,915 feet.

Class: Upland
Acres: Less than 0.1 acres

Table 14. Field evaluation points within *Upland 306*.

Wetland Evaluation Points	Associated Upland Evaluation Points	Ordinary High Water Mark Evaluation Points
	12ALT_WET 306 Non	

Vegetation

The total living cover for this site was estimated at 72.50%. The composition was comprised of 58.57% forbs and 27.86% grasses. No shrubs were present, at least in the sample quadrats.

This site was a dry stock pond located in a pasture. Hydrophytic vegetation was present. The site was dominated by "weedy" and introduced species such as knotweed (*Polygonum aviculare*), cocklebur (*Xanthium strumarium*) and smooth brome.

Soils

Hydric soils were not identified at this location. The soil was calcareous to the surface. The estimated clay ranged from 36 to 42 percent percent.

The very shallow ephemeral drainage between wetland CC and Upland 306 does not contain any hydric soils.

Hydrology

Wetland hydrology was not identified at this location. The pond did not appear to contain water on a consistent basis.

400 Drainage

General Description

The 400 Drainage consists mainly of agricultural fields on the "high terrace" where areas were evaluated to determine if any wetlands were present, Figures F-6 and F-9. There is one wetland (FF) at the very north end of the study area in conjunction with a small pond or reservoir, Figure F-6. These areas were evaluated as part of the study, because of either their appearance on NAIP CIR aerial photography or as delineations on the National Hydrography Dataset (NHD).

Upland 401

General Description

Upland 401 is not a wetland, Figure F-6. This area appeared bright pinkish red on the CIR aerial photography, but it is an irrigated alfalfa field. The area is irrigated by sprinklers. There are not any irrigation ditches in the vicinity. The pond for wetland FF is immediately north of this location, but no seepage or salt crusts were observed.

Elevation is approximately 6,970 feet.

Class: Upland
Stream: N/A

Table 15. Field evaluation points within *Upland 401*.

Wetland Evaluation Points	Associated Upland Evaluation Points	Ordinary High Water Mark Evaluation Points
	12ALT_WET 401 Non	

Vegetation

This upland site was an alfalfa field that had a total living cover of 70.00%. The composition of the living cover was comprised of 83.79% forbs and 16.21% grasses. No shrubs were present in

the sample quadrats. Consequently, the site was dominated by alfalfa (*Medicago sativa*) with some cheatgrass (*Bromus tectorum*).

Soils

No hydric soils were identified in this alfalfa field. The soil was calcareous to the surface. Soil textures were medium to fine with field estimated clay of 27 to 44 percent.

Hydrology

No wetland hydrology was identified at this location.

Ephemeral Drainage 402

General Description

Ephemeral Drainage 402 is not a wetland, Figure F-6. It is a drainage swale that may allow overflow water from small ponds north of the study area to flow onto the agricultural fields. Overflow from the ponds does not appear to have occurred very often in the past, since there was no evidence of hydric soils or flow patterns. The area has been plowed and planted with Timothy.

A small pond was delineated on the NHD GIS layer (USGS, 2011), but there was no evidence of a pond at this location.

Elevation at *Ephemeral Drainage 402* is approximately 6,973 feet.

Class: Upland
Stream: N/A

Table 16. Field evaluation points within *Ephemeral Drainage 402*.

Wetland Evaluation Points	Associated Upland Evaluation Points	Ordinary High Water Mark Evaluation Points
	12ALT_WET 402 Non	

Vegetation

This site was shown as a pond on the NHD GIS maps. There was no evidence of a pond during the time of the field work. The area had been plowed and seeded. The site had a total living cover of 80.00% and the composition was 100% grasses. The only grass present at the site, at least present in the sample quadrats, was Timothy (*Phleum pratensis*).

Soils

No hydric soils were identified at this location. The soil is a clay loam with estimated 30 percent clay.

Hydrology

No wetland hydrology was identified at this location. A road culvert empties into this area at the north fenceline.

Upland 403

General Description

Upland 403 is not a wetland, Figure F-9. The area appeared as a long narrow pinkish red stripe on the CIR aerial photography. This fenceline is in a large oat field that is irrigated by a center pivot. The bright pinkish red color on the CIR aerial photography is likely due to the actively growing grasses and Woods rose along the fenceline. There are not any ditches in this area.

The elevation at *Upland 403* is approximately 6,930 feet.

Class: Upland
Stream: N/A

Table 17. Field evaluation points within *Upland 403*.

Wetland Evaluation Points	Associated Upland Evaluation Points	Ordinary High Water Mark Evaluation Points
	12ALT_WET 403 Non	

Vegetation

The area consisted of a row of upland vegetation. The total living cover at the site was 91.67%. The composition was comprised of 92.79% grasses, 3.70% forbs and 3.51% shrubs.

The site was dominated smooth brome and western wheatgrass. There were also patches of Wood's rose along the fence-line.

Soils

No hydric soils were identified in this area. The soil consists of medium textured loam and sandy clay loam with estimated percent clay ranging from 24 to 29 percent. The soil is strongly calcareous to the surface and is violently calcareous below 14 inches. There are 15 percent lime masses in the soil matrix below 14 inches.

Hydrology

There is not any wetland hydrology at this location.

Upland 404

General Description

Upland 404 is not a wetland, Figure F-9. This area was evaluated because the NHD database (USGS, 2011) showed an ephemeral drainage and small pond at this location. No evidence of either a drainage or pond was found on the surface or in the soils of this harvested oat field.

The elevation at *Upland 404* is approximately 6,930 feet.

Class: Upland

Table 18. Field evaluation points within *Upland 404*.

Wetland Evaluation Points	Associated Upland Evaluation Points	Ordinary High Water Mark Evaluation Points
	12ALT_WET 404 Non	

Vegetation

This irrigated field had recently been cut and harvested. At the sample time, it had a total living cover of 65.00%. The composition of that cover was consisted of 81.75% grasses and 18.25% forbs. No shrubs were present.

Soils

No hydric soils were identified at this location. The soil is medium to fine textured with estimated percent clay of 26 to 36 percent. The soil is calcareous to the surface with 14 percent lime masses below 18 inches.

Hydrology

No wetland hydrology was identified at this location.

FF Riparian Wet Meadow

General Description

The FF *Riparian Wet Meadow* (FF wetland, Figure F-6) is located within the embankment of a small reservoir or pond near the north boundary of the study area. The delineated wetland area contains a riparian wet meadow (0.26 acres) and a mudflat (0.15 acres) between the wet meadow and the small pond (0.15 acres). These acres for the wetland parts are approximate, because the mud was too soft and deep to delineate the meadow-mudflat and mudflat-pond boundaries. The outer boundary of the riparian wet meadow was delineated. The total combined area of the three components is 0.56 acres.

The small reservoir does not appear to be used to store water to full capacity. This assumption is based on the amount of hydrophytic vegetation growing on the bottom of the pond at the upper end and the lower inner embankment sideslopes. If the pond was being used to store a full capacity amount of water, then the upstream end of the reservoir would be under 2 to 4 feet water. In addition, there was not a definitive spillway or outlet. It appeared that water entered the reservoir via a pipe at the north fenceline. This small reservoir may have been used before the center pivot was installed in the adjacent field.

A small ditch runs parallel to the northeast side of the reservoir about 50 feet northeast of the pond. The ditch was in disrepair and did not contain any wetlands.

Elevation of the riparian wet meadow is approximately 6,977 feet.

Class: Riparian Wet meadow
Stream: Irrigation Reservoir
Acres: 0.56 (total area of riparian wet meadow, mudflat, and pond)
Length: approximately 235 feet
Width: approximately 125 feet

Table 19. Field evaluation points within the *FF Riparian Wet Meadow*.

Wetland Evaluation Points	Associated Upland Evaluation Points	Ordinary High Water Mark Evaluation Points
12ALT_WET 405	12ALT_WET 405 Non	

Vegetation

This pond supported hydrophytic vegetation around it. As a result of changing water levels, the pond had concentric rings of varied vegetation that differed by species and composition. With random vegetation sampling conducted through these levels, the mean total living cover here was 50.00%. The composition of that cover was consisted of 67.23% grasses, 12.54% forbs and 10.61% shrubs.

The site was dominated by arctic rush with narrow-leaf willow, field bindweed and cocklebur as minor components.

Soils

Hydric soils were identified within the *Riparian Wet Meadow* portion of this wetland. *Redox Depressions (F8)* is the hydric soil indicator at this location. Prominent mottles were present from the surface down to 14 inches. The soil texture is clay with estimated 44 percent clay. This heavy soil texture is good for retaining water in the pond. Lime threads were present in the soil below the mottle layer (14 inches).

Native soils were disturbed during construction of this small reservoir.

Hydrology

Wetland hydrology is present at this location. Primary indicators observed at this site were *Surface Soil Cracks (B6), Inundation Visible on Aerial Imagery (B7), Salt Crust (B11),* and *Oxidized Rhizospheres (C3).*

There was no evidence of water seepage out of the pond (see *Upland 401* description for further information).

500 Drainage

General Description

This drainage area is in the southwest extension of the wetland study area, figure F-10. There is one riparian wet meadow and three ephemeral drainages in this area. Junipers have been removed from most of this area and the slash stacked in the ephemeral drainages.

EE Riparian Wet Meadow

General Description

The *EE Riparian Wet Meadow* (EE wetland) straddles the southwest boundary of the "Private Lease" study area, Figure F-10. Wetland EE is located approximately 1,300 feet west southwest from a gate on the main county road that accesses this part of the study area. This intermittent stream channel originates approximately 3,500 feet upstream in wet meadows on the south eastern edge of irrigated fields south of Alton, Utah. Wetland EE exits the study area to the southwest.

The wetland EE active floodplain is 17 feet wide (12ALT_OHW 501). The low flow channel is 1.5 feet wide and incised a few inches below the active floodplain. The wetland is approximately 325 feet long from south to north along the study area boundary.

There are numerous sandstone outcrops on the hill immediately west of this wetland area. This intermittent stream flows into Kanab Creek about 1.2 miles downstream.

Ephemeral drainages flow into wetland EE from the north and from the northeast (filled with juniper slash).

Elevation is approximately 6,820 feet at the downstream end and 6,830 feet at the upstream end.

Class: Riparian Wet Meadow
Stream: Intermittent Stream
Acres: 0.10 (portion of wetland within study area)
Length: approximately 325 feet
Width: 17 feet active floodplain (OHWM points, only left mark was in the study area)

Table 20. Field evaluation points within the *EE Riparian Wet Meadow*.

Wetland Evaluation Points	Associated Upland Evaluation Points	Ordinary High Water Mark Evaluation Points
12ALT_WET 501	12ALT_WET 501 Non	12ALT_OHW 501

Vegetation

The EE *Riparian Wet Meadow* had a total living cover of 80.00%. The composition of the cover consisted of nearly all grasses and grass-like species, or 98.96%. Forbs comprised only 1.04% of the cover and no shrubs were present in the sample quadrats.

The site was dominated by arctic rush and foxtail barley.

The upland adjacent to the wetland was a Sagebrush/Grass community and was dominated by big sagebrush *(Artemisia tridentata*) and western smooth brome.

Soils

Hydric soils are present are at this location. The soils are fine textured with 38 to 52 percent field estimated clay. Prominent soil mottles were observed from the surface down to a depth of 21 inches. Gleying was observed from a depth of 2 inches down to 21 inches. *Depleted Matrix (F3)* was the hydric soil indicator. Salt threads and masses (5 to 14 percent) were observed from the surface down to 21 inches.

Hydrology

Wetland hydrology was observed at this location. The primary wetland hydrology indicators were *Surface Soil Cracks (B6), Water-Stained Leaves (B9), Salt crust (B11)*, and *Oxidized Rhizospheres (C3)*. Surface water appeared to be perching on top of the heavy clay soil.

Ephemeral Drainage 502

General Description

Ephemeral Drainage 502 is not a wetland, Figure F-10. This ephemeral drainage is in the southwest part of the study area. The drainage is only a few feet wide. Junipers (slash) removed

from the adjacent hillslope have been stacked in the drainage. The watershed for this drainage is small.

Elevation in *Ephemeral Drainage 502* is approximately 6,855 feet where the ephemeral drainage crosses the south boundary of the study area and 6,880 feet at the upstream end.

Class: Upland
Stream: Ephemeral Drainage

Table 21. Field evaluation points within *Ephemeral Drainage 502*.

Wetland Evaluation Points	Associated Upland Evaluation Points	Ordinary High Water Mark Evaluation Points
	12ALT_WET 502 Non	

Vegetation

This upland community was located in an ephemeral drainage. The community had a total living cover of 60.00%; its composition consisted of 90.48% grasses and 9.52% shrubs. No forbs were present in the sample quadrats.

The site was dominated by smooth brome with Wood's rose as a minor component of the cover.

Soils

No hydric soil indicators were observed at this location. The soil is calcareous to the surface. The soil texture is clay loam with 33 to 36 percent clay. A limited amount of soil disturbance occurred when the juniper slash was stacked in the ephemeral drainage.

Hydrology

No primary wetland hydrology indicators were observed. Drainage patterns was the only secondary wetland hydrology indicator observed.

SUMMARY

Eight distinct wetland areas were delineated in the Private Lease study area. The wetlands were classified as Riparian Wet meadows and Mixed Riparian Scrub/Shrub Wet Meadows. Perennial streams, intermittent streams, and ephemeral drainages were identified. The type and size of each of these wetlands is listed in Table 22.

Table 22. Wetlands identified in the Private Lease study area.

Wetland	Plane Acres	Wetland Type	Stream type
Kanab Creek – 100 Drainage			
KL	4.25	Riparian Wet meadow	Perennial
KU	1.41	Mixed Riparian Scrub/Shrub Wet Meadow	Perennial
200 Drainage			
AA	2.38	Riparian Wet meadow	Intermittent
300 Drainage			
BB	0.34	Riparian Wet meadow	Intermittent
CC	0.32	Riparian Wet meadow	Intermittent
DD	0.08	Riparian Wet meadow	Intermittent
400 Drainage			
FF	0.56	Riparian Wet meadow	
500 Drainage			
EE	0.10	Riparian Wet meadow	Intermittent
TOTAL	9.44		

Ordinary High Water Marks were delineated at representative locations along the perennial streams, intermittent streams, and ephemeral drainages in the Private Lease study area. These delineations are discussed in the Results section of this report and shown on the maps in Appendix F.

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APPENDICES

A. **APPENDIX A** General Site Photographs

B. **APPENDIX B** Wetland Data Sheets

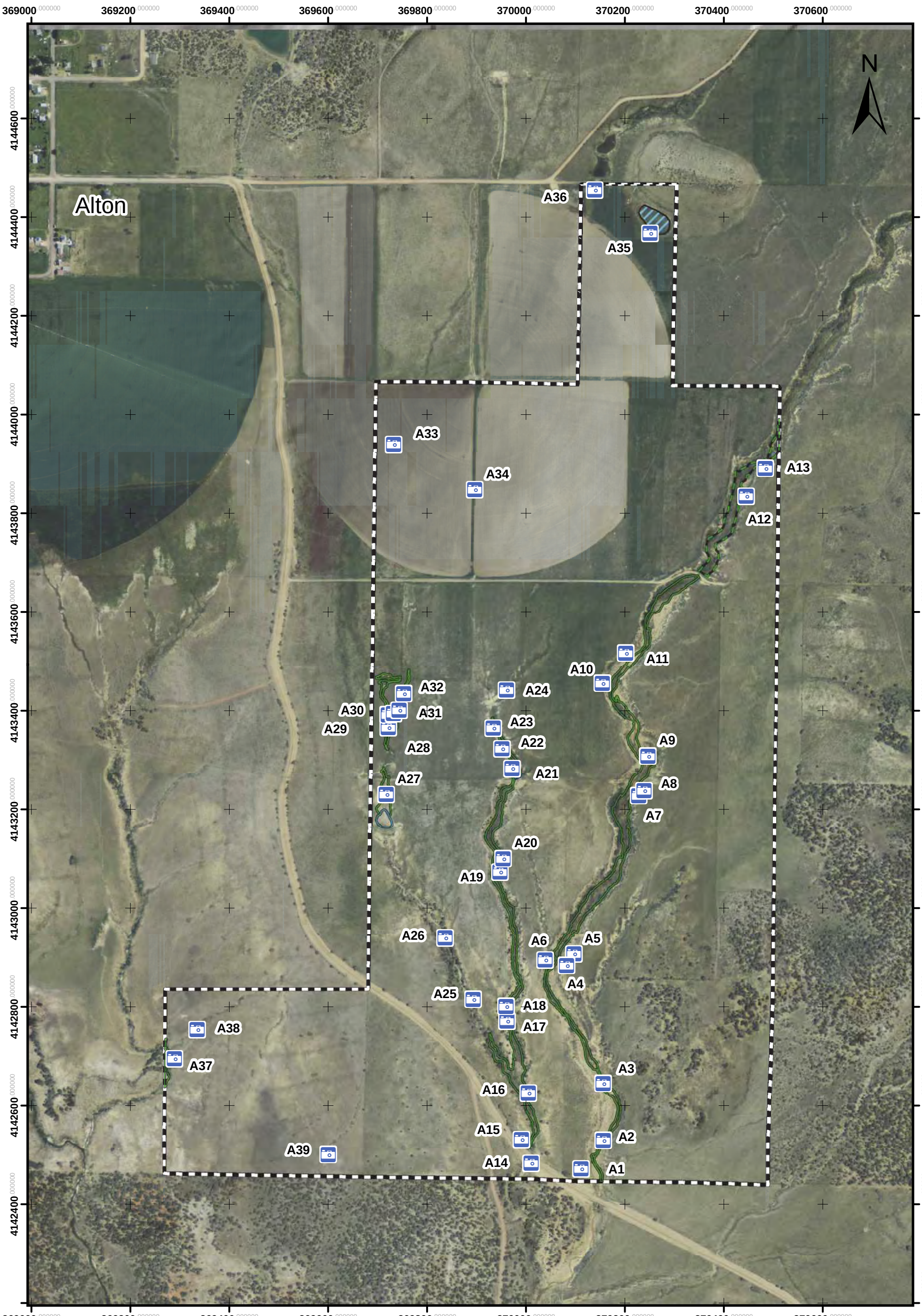
C. **APPENDIX C** Wetland Site Photographs

D. **APPENDIX D** Ordinary High Water Mark (OHWM) Data Sheets

E. **APPENDIX E** Ordinary High Water Mark (OHWM) Photographs

F. **APPENDIX F** Wetland Delineation Maps

G. **APPENDIX G** Wetland and OHWM GPS Data Points



Wetland Survey of Alton Coal - Private Lease Area		Fig A1. General Photos	Coordinate System: UTM, NAD 1983, Zone 12 North
By: Long Resource Consultants, Inc. Morgan, Utah Mt. Nebo Scientific, Inc. Springville, Utah	Photo Location Private Lease Bndy	Note: These photos show overall views of the wetland study area. Photo direction is detailed in the photo caption. Site specific photos are in appendixes C (wetlands) and E (OHWM).	
August 11, 2012	NAIP 2011 Aerial Photography	1 inch = 600 feet	0 150 300 600 900 1,200 Feet

Photo A1: (Direction = 8°)

Photo A2: (Direction = 40°)

Photo A3: (Direction = 50°)

Photo A4: (Direction = 15°)

Photo A5: (Direction = 15°)

Photo A6: (Direction = 120°)

Photo A7: (Direction = 270°)

Photo A8: (Direction = 350°)

Photo A9: (Direction = 220°)

Photo A10: (Direction = 160°)

Photo A11: (Direction = 300°)

Photo A12: (Direction = 210°)

Photo A13: (Direction = 340°)

Photo A14: (Direction = 270°)

Photo A15: (Direction = 5°)

Photo A16: (Direction = 330°)

Photo A17: (Direction = 170°)

Photo A18: (Direction = 330°)

Photo A19: (Direction = 210°)

Photo A20: (Direction = 340°)

Photo A21: (Direction = 180°)

Photo A22: (Direction = 150°)

Photo A23: (Direction = 180°)

Photo A24: (Direction = 230°)

Photo A25: (Direction = 230°)

Photo A26: (Direction = 160°)

Photo A27: (Direction = 190°)

Photo A28: (Direction = 155°)

Photo A29: (Direction = 335°)

Photo A30: (Direction = 30°)

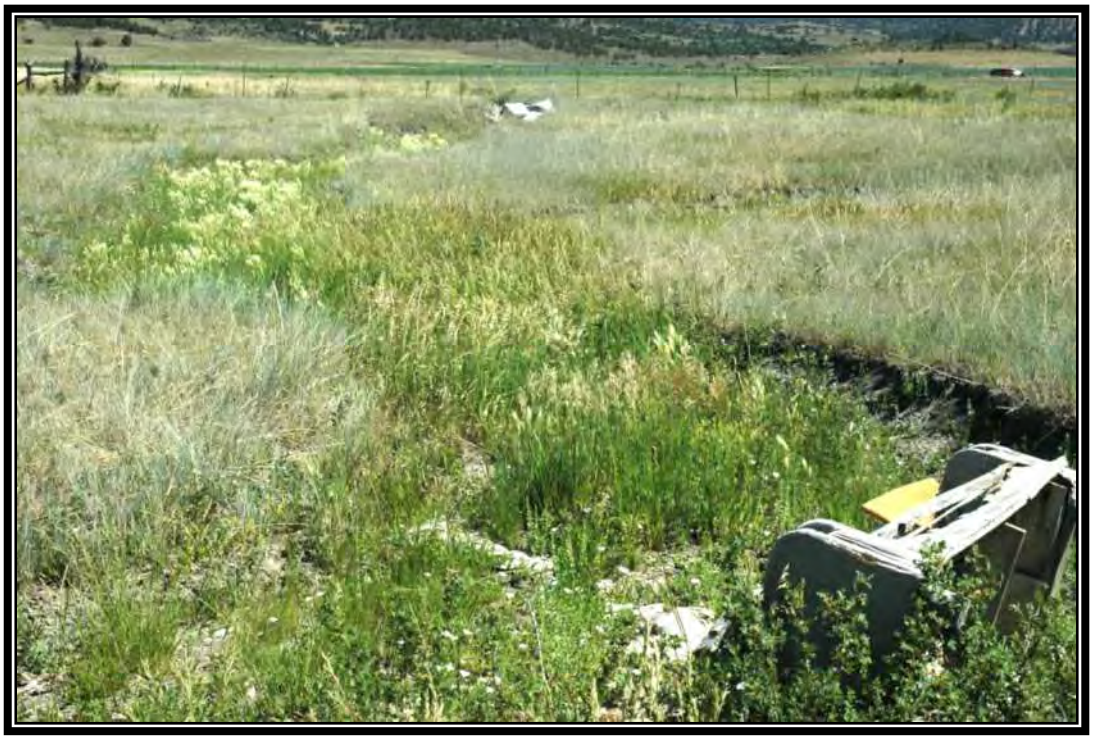


Photo A31: (Direction = 15°)

Photo A32: (Direction = 20°)

Photo A33 (Direction = 340°)

Photo A34: (Direction = 315°)

Photo A35: (Direction = 180°)

Photo A36: (Direction = 230°)

Photo A37: (Direction = 210°)

Photo A38: (Direction = 40°)

Photo A 39: (Direction = 15°)

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 12, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **101**

Investigator(s): P. Collins & R. Long Section, Township, Range: Section 18 Twp 39 S Range 5 W

Landform (hillslope, terrace, etc.): Alluvial floodplain Local relief (concave, convex, none): concave Slope (%): 2.7

Subregion (LRR): D -- MLRA 47B Lat: 37.420476 Long: -112.467398 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Riparian Wet Meadow

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:

This wetland area is part of a perennial stream channel.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 2)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 2)			
1. Salix boothii	5.00	Yes	FACW
2. Salix exigua	2.50	Yes	FACW
3.			
4.			
5.			
	7.50 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 2)			
1. Carex pellita	47.50	Yes	FACW
2. Juncus arcticus	12.50	Yes	FAC
3.			
4.			
5.			
6.			
7.			
8.			
	60.00 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 2)			
1.			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum 14.50 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species	55.00	x 2 =	110.00
FAC species	12.50	x 3 =	37.50
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	67.50 (A)		147.50 (B)

Prevalence Index = B/A = 2.19

Hydrophytic Vegetation Indicators:

X Dominance Test is >50%

X Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No _____

Remarks:

SOIL

Sampling Point: 12ALT_WET_101

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-3	10YR 4/4	85	7.5YR 6/6	10	C	M	SL (16)	
			7.5YR 6/6	5	C	M		Oxidized rhizospheres
3-17	G2 2.5/10B	25	G1 4/10Y	72	D	M	GR L (25)	5% fibers; 25% angular gravels
			7.5YR 6/6	3	C			Oxidized rhizospheres
17-24	2.5Y 4/2	80	G2 4/10B	20	D		CBX SL (17)	70% angular gravels

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- X Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- X Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes X No ___

Remarks:

Hydric soil conditions observed throughout profile to 24 inches. Soil shows signs of trampling by cattle. Estimated percent clay shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- X Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- X Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- X Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes X No ___ Depth (inches): 23

Saturation Present? (includes capillary fringe) Yes ___ No XJUIIIIIIIIII Depth (inches): ___

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Soil is very likely saturated to surface earlier in the growing season.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 12, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **101 Non**

Investigator(s): R. Long & P. Collins Section, Township, Range: Section 18 Twp 39 S Range 5 W

Landform (hillslope, terrace, etc.): Low Terrace Local relief (concave, convex, none): Concave Slope (%): 10

Subregion (LRR): D -- MLRA 47B Lat: 37.420441 Long: -112.467352 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

This is an upland area adjacent to wetland sample 101.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 2)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 2)			
1. Artemisia nova	10.00	Yes	UPL
2. Salix exigua	5.00	Yes	FACW
3.			
4.			
5.			
	15.00 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 2)			
1. Melilotus officinalis	17.50	Yes	FACU
2. Penstemon sp.	1.50	No	FACU
3.			
4.			
5.			
6.			
7.			
8.			
	19.00 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 2)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 37.50 % Cover of Biotic Crust 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33.33 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species	5.00	x 2 =	10.00
FAC species		x 3 =	
FACU species	19.00	x 4 =	76.00
UPL species	10.00	x 5 =	50.00
Column Totals:	34.00 (A)		136.00 (B)

Prevalence Index = B/A = 4.00

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

The Penstemon above was not in a state that could be positively identified to species, but it was not a dominant and would therefore not affect the wetland analyses. Most Penstemon's on the wetland Arid West plant list have been classified as "FACU".

SOIL

Sampling Point: **12ALT_WET_101 Non**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
A 0-3	10YR 5/2	100					CL (29)	Strong effervescence
Bk1 3-11	10YR 5/3	100					L (26)	Strong effervescence
								3% lime threads on vertical peds
Bk2 11-21	10YR 5/4	100					GRX LS (2)	Violent effervescence
								3% thin lime coats on rock bottoms

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): _____

Hydric Soil Present? Yes _____ No X

Remarks:

Estimated percent clay shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 12, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **102**

Investigator(s): R. Long & P. Collins Section, Township, Range: Section 18 Twp 39 S Range 5 W

Landform (hillslope, terrace, etc.): Alluvial floodplain Local relief (concave, convex, none): Concave Slope (%): 5

Subregion (LRR): D -- MLRA 47B Lat: 37.421458 Long: -112.467388 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Riparian Wet Meadow

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation Y, Soil Y, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:

This area differs from wetland areas 101 and 103 due to eroded surfaces within the perennial stream channel.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 3)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 3)			
1. Salix exigua	16.67	Yes	FACW
2. Salix boothii	6.67	Yes	FACW
3.			
4.			
5.			
	23.33 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 3)			
1. Juncus arcticus	6.67	Yes	FACW
2. Poa pratensis	6.67	Yes	FAC
3. Iva axillaris	5.00	Yes	FAC
4. Convolvulus arvense	3.33	No	FACU
5. Melilotus officinalis	1.67	No	FACU
6.			
7.			
8.			
	23.33 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 3)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 37.33 % Cover of Biotic Crust 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species 30.00	x 2 = 60.00
FAC species 11.67	x 3 = 35.00
FACU species 5.00	x 4 = 20.00
UPL species _____	x 5 = _____
Column Totals: 46.67 (A)	115.00 (B)

Prevalence Index = B/A = 2.46

Hydrophytic Vegetation Indicators:

X Dominance Test is >50%

X Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No _____

Remarks:

SOIL

Sampling Point: 12ALT_WET_102

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
A 0-3	10YR 5/2	95	10YR 7/6	5	C	M	GR SL (18)	
Bk1 3-8	10YR 4/3	85	7.5YR 5/6	15	C	M	CB SCL (20)	
Bk2 8-18	10YR 5/3	100					CBX SCL (21)	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- X Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes X No ___

Remarks:

Estimated percent clay shown in parentheses. Mottles in A and Bk horizons are prominent. Mottles in the Bk1 horizon meet the requirements of indicator F8 (Redox depressions).

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- X Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- X Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ___

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Wetland hydrology appears to be limited to runoff events in Kanab Creek.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 12, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **102 Non**

Investigator(s): R. Long & P. Collins Section, Township, Range: Section 18 Twp 39 S Range 5 W

Landform (hillslope, terrace, etc.): Terrace Local relief (concave, convex, none): Concave Slope (%): 12

Subregion (LRR): D -- MLRA 47B Lat: 37.421429 Long: -112.467443 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

Upland area adjacent to wetland 102. This area is above the floodplain.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 3)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 3)			
1. Artemisia tridentata wyomingensis	38.33	Yes	UPL
2.			
3.			
4.			
5.			
	38.33 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 3)			
1. Iva axillaris	4.33	Yes	FAC
2. Melilotus officinalis	2.33	Yes	FACU
3. Pascophyrum smithii	1.67	No	FAC
4. Hordeum jubatum	1.67	No	FAC
5.			
6.			
7.			
8.			
	10.00 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 3)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 41.00 % Cover of Biotic Crust 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33.33 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	_____	x 1 =	_____
FACW species	_____	x 2 =	_____
FAC species	7.67	x 3 =	23.00
FACU species	2.33	x 4 =	9.33
UPL species	38.33	x 5 =	191.67
Column Totals:	48.33 (A)		224.00 (B)

Prevalence Index = B/A = 4.63

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

Several "weedy" species were present in this area.

SOIL

Sampling Point: **12ALT_WET_102 Non**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
A 0-2	10YR 5/4	100					GR SCL (24)	
Bk 2-8	10YR 6/4	100					SiL (26)	
C 8-17	10YR 5/3	100					GRX SCL (23)	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes ___ No X

Remarks:

Estimated percent clay is shown in parentheses

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ___

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 13, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **103**

Investigator(s): P. Collins & R. Long Section, Township, Range: Section 13 Twp 39 S Range 6 W

Landform (hillslope, terrace, etc.): Valley, alluvial floodplain Local relief (concave, convex, none): Concave Slope (%): 3

Subregion (LRR): D -- MLRA 47B Lat: 37.423241 Long: -112.468724 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Riparian Wet Meadow

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N*, Soil N*, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:

* There are some isolated areas of moderate to heavy disturbance due to cattle use as a result of fence locations and trails to water (e.g. 30 to 100 feet of erosion on north side of fenceline).

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 3)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 3)			
1. Salix boothii	6.67	Yes	FACW
2.			
3.			
4.			
5.			
	6.67 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 3)			
1. Juncus arcticus	40.00	Yes	FACW
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	40.00 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 3)			
1.			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum 47.67 incl H20 % Cover of Biotic Crust 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species 46.67	x 2 = 93.33
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: 46.67 (A)	93.33 (B)

Prevalence Index = B/A = 2.00

Hydrophytic Vegetation Indicators:

X Dominance Test is >50%

X Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No _____

Remarks:

SOIL

Sampling Point: 12ALT_WET_103

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-1	10YR 6/4	100					L (23)	Very slight effervescence
1-14	2.5Y 5/3	55	G2 4/10B	30	D	M	CL (30)	Very slight effervescence
			G2 3/10B	15	D	M		
14							CBX	Stopped by cobbles

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- X Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes X No ___

Remarks:

Extensive trampling by cattle. Estimated percent clay shown in parentheses. This soil does not completely meet the requirements of "Loamy Gleyed Matrix" (F2), but there was a strong hydrogen sulfide odor when the hole was opened.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- X Surface Water (A1)
- X High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- X Hydrogen Sulfide Odor (C1)
- X Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes X No ___ Depth (inches): 2

Water Table Present? Yes X No ___ Depth (inches): 0-1

Saturation Present? (includes capillary fringe) Yes X No ___ Depth (inches): Surface

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Headcutting is present where grazing has impacted wetland that is part of perennial stream channel.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 13, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **103 Non**

Investigator(s): P. Collins & R. Long Section, Township, Range: Section 13 Twp 39 S Range 5 W

Landform (hillslope, terrace, etc.): Stream terrace Local relief (concave, convex, none): Clonvex Slope (%): 3

Subregion (LRR): D -- MLRA 47B Lat: 37.423247 Long: -112.468635 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 3)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 3)			
1. Gutierrezia sarothrae	6.67	Yes	FACU
2. Chrysothamnus nauseosus	3.33	Yes	FACU
3.			
4.			
5.			
	10.00 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 3)			
1. Melilotus officinalis	8.33	Yes	FACU
2. Iva axillaris	3.33	No	FAC
3.			
4.			
5.			
6.			
7.			
8.			
	11.67 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 3)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 45.67 % Cover of Biotic Crust 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:	
OBL species _____	x 1 =	_____
FACW species _____	x 2 =	_____
FAC species 3.33	x 3 =	10.00
FACU species 18.33	x 4 =	73.33
UPL species _____	x 5 =	_____
Column Totals: 21.67 (A)		83.33 (B)

Prevalence Index = B/A = 3.85

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

SOIL

Sampling Point: **12ALT_WET_103 Non**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-5	10YR 5/3	100					GRV L (24)	
5-21	10YR 5/4	100					GRX LS (2)	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? **Yes** ___ **No** X

Remarks:

Site is on an upland vegetated gravel bar/terrace. Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ___

Wetland Hydrology Present? **Yes** ___ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 12, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **104 Non**

Investigator(s): R. Long & P. Collins Section, Township, Range: Section 18 Twp 39 S Range 5 W

Landform (hillslope, terrace, etc.): Terrace sideslope drainage Local relief (concave, convex, none): Concave Slope (%): 5-8

Subregion (LRR): D -- MLRA 47B Lat: 37.423563 Long: -112.467523 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

This sample site confirms that there is not a wetland in the bottom of this ephemeral drainage. The drainage was walked from top to bottom where it enters Kanab Creek.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 3)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 3)			
1. Artemisia tridentata wyomingensis	11.67	Yes	UPL
2. Chrysothamnus nauseosus	10.00	Yes	FACU
3. Symphoricarpos oreophilus	10.00	Yes	FACU
4.			
5.			
	31.67 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 3)			
1. Bromus inermis	21.67	Yes	FACU
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	21.67 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 3)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 28.33 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:	
OBL species _____	x 1 =	_____
FACW species _____	x 2 =	_____
FAC species _____	x 3 =	_____
FACU species 41.67	x 4 =	166.67
UPL species 11.67	x 5 =	58.33
Column Totals: 53.33 (A)		225.00 (B)

Prevalence Index = B/A = 4.22

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

SOIL

Sampling Point: **12ALT_WET_104 Non**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
A 0-2	2.5Y 5/4	100					SCL (23)	
C 2-20	2.5Y 6/4	100					L (25)	
2C 20-36	2.5Y 5/4	100					GRX SCL(22)	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

This soil is an Ustic Torrifluvent and not a hydric soil. Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Flow confined to "Low Flow" channel (gully) during runoff events.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 13, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **105**

Investigator(s): P. Collins & R. Long Section, Township, Range: Section 18 Twp 39 S Range 5 W

Landform (hillslope, terrace, etc.): Alluvial floodplain Local relief (concave, convex, none): Concave Slope (%): 3

Subregion (LRR): D -- MLRA 47B Lat: 37.426598 Long: -112.467021 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Riparian Wet Meadow

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:

This wetland is part of a perennial stream channel (Kanab Creek).

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 8)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 8)			
1. Salix boothii	1.25	Yes	FACW
2.			
3.			
4.			
5.			
	1.25 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 8)			
1. Juncus arcticus	64.25	Yes	FACW
2. Carex douglasii	5.63	No	FAC
3. Triglochin maritima	0.75	No	OBL
4.			
5.			
6.			
7.			
8.			
	70.63 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 8)			
1.			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum 8.63 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0.75	x 1 =	0.75
FACW species	65.50	x 2 =	131.00
FAC species	5.63	x 3 =	16.88
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	71.88 (A)		140.63 (B)

Prevalence Index = B/A = 2.07

Hydrophytic Vegetation Indicators:

X Dominance Test is >50%

X Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No _____

Remarks:

SOIL

Sampling Point: 12ALT_WET_105

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-3	10YR 3/4	55	G2 4/10B	37	D	M	GRV SL (14)	10% Muck fibers
			7.5YR 6/8	8	C	M		
3-8	10YR 6/4	65	G2 4/10B	25	D	M	GRX SL (7)	
			7.5YR 6/6	10	C	M		
8-22	10YR 5/4	85	7.5YR 6/6	15	C	M	GRX LS (2)	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- X Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- X Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes X No ___

Remarks:

There is not enough gleyed matrix to use the " Loamy Gleyed Matrixc" hydric soil indicator (F2). The mucky surface is not thick enough to use the "Loamy Mucky Mineral" hydric soil indicator (F1). Soil is extremely gravelly below 3 inches. Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- X High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- X Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- X Hydrogen Sulfide Odor (C1)
- X Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes X No ___ Depth (inches): 9.5

Saturation Present? (includes capillary fringe) Yes X No ___ Depth (inches): 8

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 13, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **105 Non**

Investigator(s): P. Collins & R. Long Section, Township, Range: Section 18 Twp 39 S Range 5 W

Landform (hillslope, terrace, etc.): Terrace Local relief (concave, convex, none): Convex Slope (%): 25-50

Subregion (LRR): D -- MLRA 47B Lat: 37.42661 Long: -112.466893 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 4)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 4)			
1. Artemisia nova	21.25	Yes	UPL
2. Chrysothamnus nauseosus	8.75	Yes	UPL
3.			
4.			
5.			
	30.00 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 4)			
1. Agropyron cristatum	12.50	Yes	UPL
2. Poa pratensis	1.25	No	FAC
3. Bromus inermis	0.75	No	FACU
4. Carex douglasii	0.50	No	FAC
5.			
6.			
7.			
8.			
	15.00 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 4)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 26.75 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	_____	x 1 =	_____
FACW species	_____	x 2 =	_____
FAC species	1.75	x 3 =	5.25
FACU species	0.75	x 4 =	3.00
UPL species	42.50	x 5 =	212.50
Column Totals:	45.00 (A)		220.75 (B)

Prevalence Index = B/A = 4.91

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
A 0-6	2.5Y 5/3	100					GR SCL (23)	Strong effervescence
Bk 6-22	10YR 5/3	100					GRX SCL(25)	Strong effervescence

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

Thin lime coats on bottom of rocks in Bk horizon. Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 14, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **106**

Investigator(s): R. Long & P. Collins Section, Township, Range: Section 7 Twp 39 S Range 5 W

Landform (hillslope, terrace, etc.): Alluvial valley bottom between terraces Local relief (concave, convex, none): Concave Slope (%): 3

Subregion (LRR): D -- MLRA 47B Lat: 37.428909 Long: -112.467299 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Riparian Wet Meadow

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:

This wetland area is part of a perennial stream channel (Kanab Creek).

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 6)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 6)			
1. Salix boothii	2.50	Yes	FACW
2.			
3.			
4.			
5.			
	2.50 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 6)			
1. Scirpus pungens	25.83	Yes	OBL
2. Juncus arcticus	11.67	Yes	FACW
3. Juncus longistylis	5.00	No	FACW
4.			
5.			
6.			
7.			
8.			
	42.50 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 6)			
1.			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum 3.83 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	25.83	x 1 =	25.83
FACW species	19.17	x 2 =	38.33
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	45.00 (A)		64.17 (B)

Prevalence Index = B/A = 1.43

Hydrophytic Vegetation Indicators:

X Dominance Test is >50%

X Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No _____

Remarks:

SOIL

Sampling Point: 12ALT_WET_106

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
A 0-2	10YR 6/4	100					L (22)	
Bg 2-18	10YR 5/2	85	G2 3/10B	15	D	M	Pty LS (3)	15% Fibers

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- X Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- X Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes X No ___

Remarks:

Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- X Surface Water (A1)
- X High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- X Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes X No ___ Depth (inches): 3

Water Table Present? Yes X No ___ Depth (inches): Above surface

Saturation Present? (includes capillary fringe) Yes X No ___ Depth (inches): Above surface

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 14, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **106 Non**

Investigator(s): R. Long & P. Collins Section, Township, Range: Section 7 Twp 39 S Range 5 W

Landform (hillslope, terrace, etc.): Low stream terrace Local relief (concave, convex, none): None Slope (%): 14

Subregion (LRR): D -- MLRA 47B Lat: 37.428983 Long: -112.467373 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 6)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 6)			
1. Artemisia nova	15.83	Yes	UPL
2. Symphoricarpos oreophilus	10.83	Yes	FACU
3. Artemisia tridentata wyomingensis	1.67	No	UPL
4.			
5.			
	28.33 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 6)			
1. Agropyron cristatum	7.50	Yes	UPL
2. Bromus inermis	5.83	Yes	FACU
3. Equisetum arvensis	2.50	No	FAC
4. Stipa hymenoides	1.67	No	UPL
5. Melilotus officinalis	0.83	No	FACU
6.			
7.			
8.			
	18.33 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 6)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 20.00 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species 2.50	x 3 = 7.50
FACU species 17.50	x 4 = 70.00
UPL species 38.33	x 5 = 191.67
Column Totals: 46.67 (A)	269.17 (B)

Prevalence Index = B/A = 4.52

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

SOIL

Sampling Point: **12ALT_WET_106 Non**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
A 0-3	2.5Y 4/3	100					GRV SCL (22)	
Bk 3-10	2.5Y 5/3	100					GRX SCL (22)	
2Bk 10-21	10YR 3/4	100					GRV SL (5)	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ____

Hydric Soil Present? Yes ____ No X

Remarks:

Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ____ No X Depth (inches): ____

Water Table Present? Yes ____ No X Depth (inches): ____

Saturation Present? (includes capillary fringe) Yes ____ No X Depth (inches): ____

Wetland Hydrology Present? Yes ____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 14, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **107**

Investigator(s): P. Collins & R. Long Section, Township, Range: Section 7 Twp 39 S Range 5 W

Landform (hillslope, terrace, etc.): Alluvial valley bottom between terraces Local relief (concave, convex, none): Concave Slope (%): 3

Subregion (LRR): D -- MLRA 47B Lat: 37.43117 Long: -112.46501 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Mixed Riparian Scrub/Shrub Wet Meadow

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:

Trash has been dumped in high terrace ravines above wetland. This portion of the north Kanab Creek (perennial stream channel) wetland has areas of scrub/shrub wetland due to the concentration of willows and wild rose.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 5)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 5)			
1. Salix boothii	22.00	Yes	FACW
2. Rosa woodsii	4.00	No	FACU
3.			
4.			
5.			
	26.00 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 5)			
1. Juncus arcticus	28.00	Yes	FACW
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	28.00 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 5)			
1.			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum 37.20 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species 50.00	x 2 = 100.00
FAC species _____	x 3 = _____
FACU species 4.00	x 4 = 16.00
UPL species _____	x 5 = _____
Column Totals: 54.00 (A)	116.00 (B)

Prevalence Index = B/A = 2.15

Hydrophytic Vegetation Indicators:

X Dominance Test is >50%

X Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No _____

Remarks:

SOIL

Sampling Point: 12ALT_WET_107

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
A 0-3	10YR 6/4	90	7.5YR 6/8	10	C	M	SCL (22)	
BA 3-9	10YR 4/2	70	7.5YR 6/8	10	C	M	L (26)	Oxidized root channels
			G2 6/10B	20	D	M		
Bt 9-16	10YR 4/3	65	7.5YR 6/6	10	C	M	CL (30)	Oxidized root channels
			G2 6/10B	25	D	M		

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- X Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes X No ___

Remarks:

Soil is moist to 16 inches. The soil mottles are prominent. The "Depleted Matrix" hydric soil indicator applies to the BA horizon. Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- X Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- X Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- X Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ___

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Salt crust on soil surface.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 14, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **107 Non**

Investigator(s): P. Collins & R. Long Section, Township, Range: Section 7 Twp 39 S Range 5 W

Landform (hillslope, terrace, etc.): Valley sideslope Local relief (concave, convex, none): Concave Slope (%): 70

Subregion (LRR): D -- MLRA 47B Lat: 37.431075 Long: -112.464986 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 5)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 5)			
1. Artemisia tridentata	34.00	Yes	UPL
2. Chrysothamnus nauseosus	16.00	Yes	FACU
3. Rosa woodsii	3.00	No	FACU
4.			
5.			
	53.00 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 5)			
1. Elymus smithii	5.00	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	5.00 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 5)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 11.20 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33.33 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:	
OBL species _____	x 1 =	_____
FACW species _____	x 2 =	_____
FAC species 5.00	x 3 =	15.00
FACU species 19.00	x 4 =	76.00
UPL species 50.00	x 5 =	250.00
Column Totals: 74.00 (A)		341.00 (B)

Prevalence Index = B/A = 4.61

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
A 0-3	2.5Y 6/4	100					SCL (22)	
BA 3-15	2.5Y 6/4	100					SCL (22)	
Bk 15-20	2.5Y 6/4	98	10YR 5/8	2	C	M	SCL (22)	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): _____

Hydric Soil Present? Yes _____ No X

Remarks:

Not enough prominent mottles and not shallow enough to be a hydric soil. These mottles are probably the result of snowbank accumulations on the very steep slope. Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 14, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **108**

Investigator(s): R. Long & P. Collins Section, Township, Range: Section 7 Twp 39 S Range 5 W

Landform (hillslope, terrace, etc.): Valley bottom between terraces Local relief (concave, convex, none): Concave Slope (%): 3

Subregion (LRR): D -- MLRA 47B Lat: 37.433085 Long: -112.463864 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Mixed Riparian Scrub/Shrub Wet Meadow

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:

This wetland area is part of the perennial stream channel (Kanab Creek).

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 3)	Absolute % Cover	Dominant Species?	Indicator Status
1. Elaeagnus angustifolia	20.00	Yes	FAC
2.			
3.			
4.			
	20.00	= Total Cover	
Sapling/Shrub Stratum (Plot size: 1 m sq x 3)			
1.			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: 1 m sq x 3)			
1. Juncus arcticus	33.33	Yes	FACW
2. Scirpus pungens	18.33	Yes	OBL
3. Melilotus officinalis	1.67	No	FACU
4.			
5.			
6.			
7.			
8.			
	53.33	= Total Cover	
Woody Vine Stratum (Plot size: 1 m sq x 3)			
1.			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum 8.67 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	18.33	x 1 =	18.33
FACW species	33.33	x 2 =	66.67
FAC species	20.00	x 3 =	60.00
FACU species	1.67	x 4 =	6.67
UPL species		x 5 =	
Column Totals:	73.00 (A)		151.67 (B)

Prevalence Index = B/A = 2.07

Hydrophytic Vegetation Indicators:

X Dominance Test is >50%

X Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No _____

Remarks:

SOIL

Sampling Point: 12ALT_WET_108

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-3	10YR 4/3	80	7.5YR 6/6	12	C	M	SCL (20)	Oxidized root channels
			G2 4/10B	8	D	M		
3-10	10YR 5/3	60	7.5YR 6/8	15	C	M	SCL (28)	Oxidized root channels
			G2 6/10B	25	D	M		
10-18	10YR 5/3	85	7.5YR 6/8	8	C	M	SCL (28)	Oxidized root channels
			G2 5/10B	7	D	M		
18+							CBX	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- X Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- X Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes X No ___

Remarks:

Digging stopped by gravels and cobbles at 18 inches. Soil was very moist, but not saturated ABOVE 10 inches. Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- X Hydrogen Sulfide Odor (C1)
- X Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes X No ___ Depth (inches): 10

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Bottom of soil pit is about 10 inches above stream elevation.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 14, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **108 Non**

Investigator(s): R. Long & P. Collins Section, Township, Range: Section 7 Twp 39 S Range 5 W

Landform (hillslope, terrace, etc.): Valley stream terrace Local relief (concave, convex, none): convex Slope (%): 4

Subregion (LRR): D -- MLRA 47B Lat: 37.433085 Long: -112.463864 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No _____	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 3)	Absolute % Cover	Dominant Species?	Indicator Status
1. Elaeagnus angustifolia	13.33	Yes	FAC
2.			
3.			
4.			
	13.33	= Total Cover	
Sapling/Shrub Stratum (Plot size: 1 m sq x 3)			
1. Rosa woodsii	3.33	Yes	FACU
2.			
3.			
4.			
5.			
	3.33	= Total Cover	
Herb Stratum (Plot size: 1 m sq x 3)			
1. Elymus smithii	18.33	Yes	FAC
2. Poa pratensis	18.33	Yes	FAC
3. Scirpus pungens	11.67	Yes	OBL
4. Equisetum arvense	3.33	No	FAC
5. Bromus inermis	3.33	No	FACU
6.			
7.			
8.			
	55.00	= Total Cover	
Woody Vine Stratum (Plot size: 1 m sq x 3)			
1.			
2.			
		= Total Cover	

% Bare Ground in Herb Stratum 5.33 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 80.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	11.67	x 1 =	11.67
FACW species		x 2 =	
FAC species	53.33	x 3 =	160.00
FACU species	6.67	x 4 =	26.67
UPL species		x 5 =	
Column Totals:	71.67 (A)		198.33 (B)

Prevalence Index = B/A = 2.77

Hydrophytic Vegetation Indicators:

X Dominance Test is >50%

X Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No _____

Remarks:

Although hydrophytic vegetation was present, the soils and hydrologic conditions did not meet wetland criteria. Vegetation met criterion primarily due to western wheatgrass and bluegrass which can often occur in upland areas. The vegetation appears transitional between upland and wetland.

SOIL

Sampling Point: **12ALT_WET_108 Non**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
A 0-5	10YR 3/2	100					SCL (22)	Dry
Bw 5-14	10YR 4/3	100					CBV SCL(20)	Slightly moist
Bg 14-18	10YR 5/3	85	7.5YR 5/6	5	C	M	CBV SCL	Moist; oxidized root channels
			G2 7/10B	10	D	M		

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes ___ No X

Remarks:

Hydric soil conditions are too deep to be diagnostic for a wetland. Mottles in Bg horizon are distinct. Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ___

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No wetland hydrology indicators were observed.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 20, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **109 Non**

Investigator(s): P. Collins & R. Long Section, Township, Range: Section 13 Twp 39 S Range 6 W

Landform (hillslope, terrace, etc.): Incised ephemeral drainage Local relief (concave, convex, none): Concave Slope (%): 2-20

Subregion (LRR): D -- MLRA 47B Lat: 37.425081 Long: -112.469007 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

Snowbank accumulation area on west side of ephemeral drainage. A few very small patches of wetland areas are present in drainage, but cumulative total is less than 0.1 acres.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 6)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 6)			
1. Rosa woodsii	38.00	Yes	FACU
2. Chrysothamnus nauseosus	10.00	Yes	FACU
3. Artemisia nova	1.67	No	UPL
4.			
5.			
	49.67 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 6)			
1. Agropyron cristatum	2.00	Yes	UPL
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	2.00 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 6)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 27.00 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:	
OBL species _____	x 1 =	_____
FACW species _____	x 2 =	_____
FAC species _____	x 3 =	_____
FACU species 48.00	x 4 =	192.00
UPL species 13.67	x 5 =	68.33
Column Totals: 61.67 (A)		260.33 (B)

Prevalence Index = B/A = 4.22

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

SOIL

Sampling Point: **12ALT_WET_109 Non**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
A 0-6	10YR 4/3	100					L (22)	
Bw 6-19	10YR 4/3	100					L (23)	
C 19-32	2.5Y 5/4	85	10YR 7/8	15	C	M	L (22)	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes ___ No X

Remarks:

Mottles are prominent, but too deep to be diagnostic for a hydric soil. The soil mottles are most likely the result of moisture from snowbank accumulation. Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ___

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

It appears that most of the snowmelt soaks into the soil. Heavy thunderstorms may result in short duration surface flow from localized runoff (very small watershed).

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 20, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **110 Non**

Investigator(s): R. Long & P. Collins Section, Township, Range: Section 13 Twp 39 S Range 6 W

Landform (hillslope, terrace, etc.): Alluvial fan on low terrace Local relief (concave, convex, none): Convex Slope (%): 3-4

Subregion (LRR): D -- MLRA 47B Lat: 37.423809 Long: -112.468662 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

This area appears red on infrared aerial photography (2009 and 2011 NAIP) due to the mature Russian olive trees, but it is outside the Kanab Creek wetland (KL).

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 2 m sq x 1)	Absolute % Cover	Dominant Species?	Indicator Status
1. Elaeagnus angustifolia	90.00	Yes	FAC
2.			
3.			
4.			
	90.00	= Total Cover	
Sapling/Shrub Stratum (Plot size: 2 m sq x 1)			
1.			
2.			
3.			
4.			
5.			
		= Total Cover	
Herb Stratum (Plot size: 2 m sq x 1)			
1. Bromus inermis	40.00	Yes	FACU
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	40.00	= Total Cover	
Woody Vine Stratum (Plot size: 2 m sq x 1)			
1.			
2.			
		= Total Cover	

% Bare Ground in Herb Stratum 60.00 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:	
OBL species	x 1 =	
FACW species	x 2 =	
FAC species 90.00	x 3 =	270.00
FACU species 40.00	x 4 =	160.00
UPL species	x 5 =	
Column Totals: 130.00 (A)		430.00 (B)

Prevalence Index = B/A = 3.31

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

This area had some dominant hydrophytic vegetation only because of the overstory of the Russian olive trees; the trees themselves were outside the wetland area. The understory was in a non-wetland area. This was a non-wetland area.

SOIL

Sampling Point: **12ALT_WET_110 Non**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
0-8	2.5Y 5/4	100					L (24)	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

No mottles observed within 8 inches of the soil surface. Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No wetland hydrology conditions observed at this location on an alluvial fan at mouth of ephemeral drainage.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 15, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **201**

Investigator(s): P. Collins & R. Long Section, Township, Range: Section 13 Twp 39 S Range 6 W

Landform (hillslope, terrace, etc.): Valley bottom between terraces Local relief (concave, convex, none): Concave Slope (%): 2

Subregion (LRR): D -- MLRA 47B Lat: 37.424115 Long: -112.469446 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Riparian Wet Meadow

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:

This wetland area is part of an intermittent stream.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 3)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 3)			
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 1 m sq x 3)			
1. Juncus arcticus	78.33	Yes	FACW
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	78.33 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 3)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 10.00 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species 78.33	x 2 = 156.67
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: 78.33 (A)	156.67 (B)

Prevalence Index = B/A = 2.00

Hydrophytic Vegetation Indicators:

X Dominance Test is >50%

X Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No _____

Remarks:

Area receives heavy cattle use.

SOIL

Sampling Point: 12ALT_WET_201

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
A 0-1	10YR 6/3	96	10YR 5/8	4	C	M	Pty L (22)	Peaty loam, 25% fibers
2A 1-9	10 YR 2/1	85	G1 6/10Y	15	D	M	CL (29)	15% fibers
2Bw 9-21	2.5Y 6/3	88	10YR 6/6	12	C	M	CL (33)	1% fine FeMn concretions

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- X Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- X Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes X No ___

Remarks:

Mottles in A and 2Bw horizons are prominent. Estimated percent clay is shown in parentheses. Hydrogen sulfide order was very strong.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- X Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- X Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- X Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes X No ___ Depth (inches): 2-4

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes X No ___ Depth (inches): 0

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Salt crust was present on edge of wetland and on "high" spots within wetland where surface water was not present. Hydrologic conditions appear to be the result of surface water perching on top of clayey subsoil. Source of water appeared to be seeps in the northern end of this wetland. Some of the seeps (included in wetland delineation) were on the lower steep drainage sideslopes. This area receives heavy cattle use.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 15, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **201 Non**

Investigator(s): P. Collins & R. Long Section, Township, Range: Section 13 Twp 39 S Range 6 W

Landform (hillslope, terrace, etc.): Toeslope of high terrace sideslope Local relief (concave, convex, none): Concave Slope (%): 50

Subregion (LRR): D -- MLRA 47B Lat: 37.424106 Long: -112.469394 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 3)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 3)			
1. Artemisia tridentata wyomingensis	37.67	Yes	UPL
2. Symphoricarpos oreophilus	6.67	No	FACU
3. Rosa woodsii	0.67	No	FACU
4.			
5.			
	45.00 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 3)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	_____ = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 3)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 43.00 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:	
OBL species _____	x 1 =	_____
FACW species _____	x 2 =	_____
FAC species _____	x 3 =	_____
FACU species 7.33	x 4 =	29.33
UPL species 37.67	x 5 =	188.73
Column Totals: 45.00 (A)		217.67 (B)

Prevalence Index = B/A = 4.84

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

SOIL

Sampling Point: **12ALT_WET_201 Non**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
A 0-5	10YR 5/3	100					SCL (22)	
Bw 5-22	10YR 6/3	100					SL (14)	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): _____

Hydric Soil Present? Yes _____ **No** X

Remarks:

Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No _____ Depth (inches): _____

Water Table Present? Yes _____ No _____ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No _____ Depth (inches): _____

Wetland Hydrology Present? Yes _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 15, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **202**

Investigator(s): R. Long & P. Collins Section, Township, Range: Section 13 Twp 39 S Range 6 W

Landform (hillslope, terrace, etc.): Valley bottom between terraces Local relief (concave, convex, none): None Slope (%): 2

Subregion (LRR): D -- MLRA 47B Lat: 37.422055 Long: -112.469336 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Riparian Wet Meadow

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:

This wetland area is part of an intermittent stream.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 5)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 5)			
1.			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: 1 m sq x 5)			
1. Carex utriculata	46.00	Yes	OBL
2. Juncus arcticus	28.00	Yes	FACW
3. Poa pratensis	3.00	No	FAC
4.			
5.			
6.			
7.			
8.			
	77.00 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 5)			
1.			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum 10.40 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 66.67 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	46.00	x 1 =	46.00
FACW species	28.00	x 2 =	56.00
FAC species	3.00	x 3 =	9.00
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	77.00 (A)		111.00 (B)

Prevalence Index = B/A = 1.44

Hydrophytic Vegetation Indicators:

X Dominance Test is >50%

X Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No _____

Remarks:

Heavy cattle use was observed.

SOIL

Sampling Point: 12ALT_WET_202

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
A 0-3	2.5Y 5/3	75	10YR 6/8	15	C	M	CL (32)	Oxidized rhizospheres
			G1 5/10Y	10	D	M		
Bt 3-16	2.5Y 5/1	65	10YR 6/8	15	C	M	C (42)	Oxidized rhizospheres
			G1 5/10Y	20	D	M		

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- X Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes X No ___

Remarks:

Sand is filling voids between soil peds in Bt when the soil drys and cracks. Mottles in A and Bt are prominent. Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- X Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- X Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes X No ___ Depth (inches): 2

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes X No ___ Depth (inches): To surface

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Surface water appears to be perching on heavy clay subsoil. Water appears to be flowing from seeps at north end of wetland down to south end where it evaporates before reaching the road.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 15, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **202 Non**

Investigator(s): R. Long & P. Collins Section, Township, Range: Section 13 Twp 39 W Range 6 W

Landform (hillslope, terrace, etc.): High terrace toeslope Local relief (concave, convex, none): Concave Slope (%): 50

Subregion (LRR): D -- MLRA 47B Lat: 37.421993 Long: -112.469476 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes X	No _____	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

Hydric soils are present, but hydrophytic vegetation and wetland hydrology are not present. This site description was made a few feet outside the 202 wetland area.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 6)	Absolute % Cover	Dominant Species?	Indicator Status
1.	5.00	Yes	UPL
2.			
3.			
4.			
	5.00	= Total Cover	
Sapling/Shrub Stratum (Plot size: 1 m sq x 6)			
1. Artemisia tridentata wyomingensis	15.00	Yes	
2. Artemisia nova	13.33	Yes	
3. Gutierrezia sarothrae	8.00	No	
4. Juniperus osteosperma	6.67	No	
5. Peraphyllum ramosissimum	1.67	No	
	44.67	= Total Cover	
Herb Stratum (Plot size: 1 m sq x 6)			
1. Equisetum arvense	3.17	Yes	
2. Achillea millefolium	1.67	Yes	
3. Juncus arcticus	1.50	Yes	
4.			
5.			
6.			
7.			
8.			
	6.33	= Total Cover	
Woody Vine Stratum (Plot size: 1 m sq x 6)			
1.			
2.			
		= Total Cover	

% Bare Ground in Herb Stratum 29.83 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species	1.50	x 2 =	3.00
FAC species	3.17	x 3 =	9.50
FACU species	9.67	x 4 =	38.67
UPL species	41.67	x 5 =	208.33
Column Totals:	56.00 (A)		259.50 (B)

Prevalence Index = B/A = 4.63

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

SOIL

Sampling Point: **12ALT_WET_202 Non**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
A 0-3	2.5Y 6/4	100					L (20)	
C1 3-10	2.5Y 6/3	93	2.5Y 6/8	7	C	M	CL (34)	
C2 10-21	2.5Y 6/4	97	2.5Y 6/8	3	C	M	C (42)	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- X Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes X No ___

Remarks:

Mottles in C1 and C2 horizons are prominent and meet requirements of a hydric soil. Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ___

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No wetland hydrology indicators were observed at this upland site.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 19, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **203**

Investigator(s): P. Collins & R. Long Section, Township, Range: Section 13 Twp 39 S Range 6 W

Landform (hillslope, terrace, etc.): Valley between high terrace Local relief (concave, convex, none): Concave Slope (%): 2

Subregion (LRR): D -- MLRA 47B Lat: 37.421395 Long: -112.46927 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Riparian Wet Meadow

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:

Two intermittent streams converge in the northern part of this wetland area. The south end of this wetland is at the upstream end of the road culvert. This area lacked the surface water that was present in wetland areas 201 and 202.

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 1 m sq x 6)			
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 6)			
1. Salix exigua	20.84	Yes	FACW
2. Rosa woodsii	2.50	No	FACU
3.			
4.			
5.			
	23.34 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 6)			
1. Juncus arcticus	29.17	Yes	FACW
2. Iris missouriensis	18.33	Yes	FACW
3. Convolvulus arvense	0.83	No	FACU
4.			
5.			
6.			
7.			
8.			
	48.33 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 6)			
1.			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum 13.00 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:	
OBL species	x 1 =	
FACW species 68.34	x 2 =	136.68
FAC species	x 3 =	
FACU species 3.33	x 4 =	13.33
UPL species	x 5 =	
Column Totals: 71.67 (A)		150.01 (B)

Prevalence Index = B/A = 2.09

Hydrophytic Vegetation Indicators:

X Dominance Test is >50%

X Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No _____

Remarks:

SOIL

Sampling Point: 12ALT_WET_203

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
A 0-3	2.5Y 5/3	100					PCN SCL(24)	20% Shale parachanners
2Bw 3-18	2.5Y 5/3	93	7.5YR 6/6	7	C	M	CL (32)	5% Shale parachanners
								Oxidized rhizospheres

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- X Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes X No ___

Remarks:

The A horizon appears to be overwash deposition from the 2011 breach of stock pond at top of west fork ephemeral drainage (300 series). Mottles in 2Bw horizon are prominent. Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- X Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- X Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- X Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ___

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

There is not a distinct low flow channel. Water appears to concentrate in livestock trails. Salt crusts are in small patches on high spots and along edge of wetland area.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 19, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **203 Non**

Investigator(s): P. Collins & R. Long Section, Township, Range: Section 13 Twp 39 S Range 6 W

Landform (hillslope, terrace, etc.): Terrace sideslope Local relief (concave, convex, none): Concave Slope (%): 45

Subregion (LRR): D -- MLRA 47B Lat: 37.4213 Long: -112.469322 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

This site has upland vegetation. It is above the active floodplain. The soil contains prominent mottles, but they are too deep to be diagnostic for a hydric soil.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 5)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 5)			
1. Peraphyllum ramosissimum	49.00	Yes	UPL
2. Rosa woodsii	10.00	No	FACU
3. Chrysothamnus nauseosus	9.00	No	FACU
4. Gutierrezia sarothrae	1.00	No	FACU
5. Salix exigua	1.00	No	FACW
	70.00 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 5)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 5)			
1.			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum 18.00 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:	
OBL species	x 1 =	
FACW species 1.00	x 2 =	2.00
FAC species	x 3 =	
FACU species 20.00	x 4 =	80.00
UPL species 49.00	x 5 =	245.00
Column Totals: 70.00 (A)		327.00 (B)

Prevalence Index = B/A = 4.67

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

SOIL Sampling Point: **12ALT_WET_203 Non**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
A 0-9	2.5Y 4/3	100					CL (30)	
2A 9-17	2.5Y 5/3	85	7.5YR 6/6	15	C	M	SL (16)	Oxidized rhizospheres
2C 17-24	2.5Y4/3	85	7.5YR 6/6	15	C	M	CL (38)	40% shale parachanners
								Oxidized rhizospheres

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

Hydric soil indicators below 9 inches in 2A horizon are too deep to be diagnostic (requires 2 inches within 6 inches of soil surface). Mottles may be remnants of earlier conditions prior to channel downcutting. Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June , 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **204 Non**

Investigator(s): R. Long & P. Collins Section, Township, Range: Section 13 Twp 39 S Range 6 W

Landform (hillslope, terrace, etc.): Ephemeral stream channel Local relief (concave, convex, none): Concave Slope (%): 3

Subregion (LRR): D -- MLRA 47B Lat: 37.419815 Long: -112.469269 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation Y, Soil Y, or Hydrology Y significantly disturbed? Are "Normal Circumstances" present? Yes _____ No X

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes X	No _____	

Remarks:

This area between the road and fence is not a wetland based on the current conditions. The OHWM is similar to north side of road, but the channel necks down to 5 feet at property fenceline.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 3)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 3)			
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 1 m sq x 3)			
1. Convolvulus arvense	18.33	Yes	FACU
2. Hordeum jubatum	3.33	No	FAC
3.			
4.			
5.			
6.			
7.			
8.			
	21.67 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 3)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 71.67 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species 3.33	x 3 = 10.00
FACU species 18.33	x 4 = 73.33
UPL species _____	x 5 = _____
Column Totals: 21.67 (A)	83.33 (B)

Prevalence Index = B/A = 3.85

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

Vegetation in area has been disturbed by cattle use and high flows discharged from road culvert.

SOIL Sampling Point: **12ALT_WET_204 Non**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-15	2.5Y 4/3	100					SCL (24)	
15-20	2.5Y 4/3	92	10YR 5/8	8	C	M	SCL (24)	
20+								Too many cobbles & gravels to dig deeper.

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

Mottles are too deep to be diagnostic for a hydric soil. Soil was moist below 15". Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- X Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? **Yes** X **No** _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Surface water is likely present during periods of high runoff in this ephemeral drainage. The duration of these runoff periods is not known, but most are likely short and the result of thunderstorms.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 20, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **205**

Investigator(s): P. Collins & R. Long Section, Township, Range: Section 12 Twp 39 S Range 6 W

Landform (hillslope, terrace, etc.): Valley bottom between terraces Local relief (concave, convex, none): Concave Slope (%): 2

Subregion (LRR): D -- MLRA 47B Lat: 37.427665 Long: -112.469774 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Riparian Wet Meadow

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:

In some localized portions of the wetland, the delineation extends 3 to 8 feet up the toeslope to include seeps and other moist areas. This wetland area is part of an intermittent stream and is an extension of the area described by 201 and 202.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 5)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 5)			
1. Rosa woodsii	7.00	Yes	FACU
2.			
3.			
4.			
5.			
	7.00 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 5)			
1. Juncus arcticus	67.00	Yes	FACW
2. Carex douglasii	8.00	No	FAC
3. Poa pratensis	2.00	No	FAC
4.			
5.			
6.			
7.			
8.			
	77.00 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 5)			
1.			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum 1.40 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species 67.00	x 2 = 134.00
FAC species 10.00	x 3 = 30.00
FACU species 7.00	x 4 = 28.00
UPL species _____	x 5 = _____
Column Totals: 84.00 (A)	192.00 (B)

Prevalence Index = B/A = 2.29

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No _____

Remarks:

The Dominance Test suggested that this area did not have enough hydrophytic vegetation for wetland status, but the Prevalence Test indicates the vegetation is hydrophyic.

SOIL

Sampling Point: 12ALT_WET_205

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
A 0-2	10YR 5/3	85	7.5YR 5/8	15	C	M	Pty L (14)	Oxidized rhizospheres; 15% fibers
Bg1 2-9	2.5Y 5/2	80	7.5YR 5/8	10	C	M	CL (36)	Oxidized rhizospheres
			G1 4/10GY	10	D	M		
Bg2 9-21	2.5Y 5/2	68	G1 4/10GY	20	D	M	L (22)	Oxidized rhizospheres
			10YR 6/2	12	C	M		

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- X Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- X Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes X No ___

Remarks:

Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- X Water-Stained Leaves (B9)
- X Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- X Hydrogen Sulfide Odor (C1)
- X Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes X No ___ Depth (inches): 17

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Surface water is present about 30 yards downstream in the tailwater of the water impoundment.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 21, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **205 Non**

Investigator(s): P. Collins & R. Long Section, Township, Range: Section 12 Twp 39 S Range 6 W

Landform (hillslope, terrace, etc.): High terrace sideslope Local relief (concave, convex, none): None Slope (%): 50

Subregion (LRR): D -- MLRA 47B Lat: 37.427673 Long: -112.469718 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 5)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 5)			
1. Artemisia tridentata wyomingensis	17.00	Yes	UPL
2. Chrysothamnus nauseosus	10.00	Yes	FACU
3. Rosa woodsii	1.60	No	FACU
4.			
5.			
	28.60 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 5)			
1. Elymus smithii	32.00	Yes	FAC
2. Melilotus officinalis	2.00	No	FACU
3. Linum perenne	1.00	No	UPL
4. Juncus arcticus	0.40	No	FACW
5.			
6.			
7.			
8.			
	35.40 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 5)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 8.60 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	_____	x 1 =	_____
FACW species	0.40	x 2 =	0.80
FAC species	32.00	x 3 =	96.00
FACU species	13.60	x 4 =	54.40
UPL species	18.00	x 5 =	90.00
Column Totals:	64.00 (A)		241.20 (B)

Prevalence Index = B/A = 3.77

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

SOIL

Sampling Point: 12ALT_WET_205 Non

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
A 0-6	2.5Y 6/3	100					L (24)	Strong effervescence
Bk 6-21	2.5Y 7/3	100					L (22)	Violent effervescence

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No X

Remarks:

Estimated percent clay is shown in parentheses. This soil is in the Aridic Calciustept, fine-loamy, mixed, superactive, mesic family.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 21, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **206 Non**

Investigator(s): R. Long & P. Collins Section, Township, Range: Section 12 Twp 39 S Range 6 W

Landform (hillslope, terrace, etc.): Swale - upper ephemeral drainage Local relief (concave, convex, none): Concave Slope (%): 2

Subregion (LRR): D -- MLRA 47B Lat: 37.428686 Long: -112.469633 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No _____	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

This ephemeral drainage represents the upper end of the "200" channel system. It's depth below the surrounding agricultural fields ranges from less than two feet to a maximum depth of 8 to 10 feet.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 5)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 5)			
1.			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: 1 m sq x 5)			
1. Elymus smithii	39.00	Yes	FAC
2. Juncus arcticus	39.00	Yes	FACW
3.			
4.			
5.			
6.			
7.			
8.			
	78.00 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 5)			
1.			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum 3.80 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species	39.00	x 2 =	78.00
FAC species	39.00	x 3 =	117.00
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	78.00 (A)		195.00 (B)

Prevalence Index = B/A = 2.50

Hydrophytic Vegetation Indicators:

X Dominance Test is >50%

X Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No _____

Remarks:

Although the area tested favorably for hydrophytic plants, with the species present, it suggests the area is transitional between wetlands and uplands from a vegetation standpoint.

SOIL

Sampling Point: **12ALT_WET_206 Non**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
A 0-2	2.5Y 4/2	100					L (24)	Strong effervescence
AB 2-14	2.5Y5/2	100					L (24)	Strong effervescence
Bk 14-21	2.5Y 6/2	99	2.5Y 7/6	1	C	M	L (22)	Violent effervescence

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes ___ No X

Remarks:

The prominent mottles in the Bk horizon are too deep to be diagnostic for a hydric soil. Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ___

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

This is a dry ephemeral channel that appears to only receive localized surface runoff from the adjacent agricultural fields that are either dryland crops or sprinkler irrigated. There is no indication that it is influenced by groundwater. Hydrology indicators were not observed. There is a breached stock pond at the lower end of this area (above the 205 area).

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 19, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **301 Non**

Investigator(s): P. Collins & R. Long Section, Township, Range: Section 13 Twp 39 S Range 6 W

Landform (hillslope, terrace, etc.): Terrace in Arroyo-ephemeral channel Local relief (concave, convex, none): Concave Slope (%): 4

Subregion (LRR): D -- MLRA 47B Lat: 37.424829 Long: -112.471731 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation Y, Soil Y, or Hydrology Y significantly disturbed? Are "Normal Circumstances" present? Yes _____ No X

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

Existing conditions in this segment of the west ephemeral drainage are the result of the recent failure of a stock pond at the north end of the segment. The pond exists on the August 2009 NAIP photos, but not on the June 2011 NAIP. Based on recent weather conditions in the Alton area, it is estimated that failure occurred in the winter or spring of 2011. Extensive scouring of vegetation and soils in the drainage has recently occurred. Large debris piles with trees are present at several locations.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 6)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 6)			
1. Chrysothamnus nauseosus	5.00	Yes	FACU
2. Artemisia tridentata	1.67	Yes	UPL
3.			
4.			
5.			
	6.67 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 6)			
1. Bromus inermis	12.50	Yes	FACU
2. Iva axillaris	9.17	Yes	FAC
3. Melilotus officinalis	3.33	No	FACU
4.			
5.			
6.			
7.			
8.			
	25.00 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 6)			
1.			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum 44.17 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 25.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:	
OBL species	x 1 =	
FACW species	x 2 =	
FAC species 9.17	x 3 =	27.50
FACU species 20.83	x 4 =	83.33
UPL species 1.67	x 5 =	8.33
Column Totals: 31.67 (A)		119.17 (B)

Prevalence Index = B/A = 3.76

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

The cumulative amount of wetlands presently in this ephemeral drainage is estimated to be less than 0.1 acres or less than 5% of the drainage area between wetland 203 and the breached pond.

SOIL

Sampling Point: **12ALT_WET_301 Non**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
A 0-6	10YR 5/2	100					SiL (26)	
Bw 6-15	10YR 5/2	98	7.5YR 5/6	2	C	M	CL (29)	20% shale parachanners
Cr 15-18								Soft Tropic shale

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: Tropic shale

Depth (inches): 15

Hydric Soil Present? Yes _____ No X

Remarks:

Mottles in Bw are too deep to be diagnostic (F8). Wetlands in this drainage may not have developed to a point similar to Kanab Creek and the 200 drainage. There may not have been enough water for wetland development. This is the only soil description with shale bedrock in "Private Lease" wetland study. Estimated percent clay is shown in parentheses. Small patches of hydric soils may have been present prior to the pond failure.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

There were not any wetland hydrology indicators observed under the current ephemeral drainage conditions. The drainage was scoured significantly in places when the stock pond failed. The rush of water that came down the drainage when the pond failed appeared to have been much higher than "normal high water" and scoured out any typical hydrology indicators.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 20, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **302**

Investigator(s): R. Long & P. Collins Section, Township, Range: Section 13 Twp 39 S Range 6 W

Landform (hillslope, terrace, etc.): Swale sideslope in upper drainage Local relief (concave, convex, none): Concave Slope (%): 2

Subregion (LRR): D -- MLRA 47B Lat: 37.426803 Long: -112.472435 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Riparian Wet Meadow

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology Y significantly disturbed? Are "Normal Circumstances" present? Yes _____ No X

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes _____ No N	

Remarks:

This was the tailwater of failed stock pond described on 301 Non field sheet. Pond contained water in the August 2009 NAIP photo, but not in the June 2011 NAIP photo. Failure of the stock pond was most likely the result of a large precipitation event or high seasonal runoff. Wetland hydrology is no longer present and future wetland maintenance or development will not occur unless the dam is rebuilt. It is currently a wetland with problematic hydrology.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 6)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 6)			
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 1 m sq x 6)			
1. Juncus arcticus	50.00	Yes	FACW
2. Hordeum jubatum	5.83	No	FAC
3. Convolvulus arvensis	4.00	No	FACU
4. Erigeron sp.	1.83	No	FACU
5.			
6.			
7.			
8.			
	61.67 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 6)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 25.00 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species 50.00	x 2 = 100.00
FAC species 5.83	x 3 = 17.50
FACU species 5.83	x 4 = 23.33
UPL species _____	x 5 = _____
Column Totals: 61.67 (A)	140.83 (B)

Prevalence Index = B/A = 2.28

Hydrophytic Vegetation Indicators:

X Dominance Test is >50%

X Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No _____

Remarks:

Current vegetation is hydrophytic, but it will likely transition to an upland community if the stock pond is not rebuilt.

SOIL

Sampling Point: 12ALT_WET_302

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
A 0-3	10YR 3/2	94	10YR 6/6	6	C	M	L (24)	
Bt1 3-11	10YR 3/2	82	7.5YR 4/6	18	C	M	L (27)	Oxidized rhizospheres
Bt2 11-21	10YR 3/2	94	7.5YR 5/6	6	C	M	CL (32)	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- X Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- X Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- X Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes X No ___

Remarks:

Mottles are prominent in all three horizons. Hydric soil conditions are the result of conditions prior to the stock pond failure. Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ___

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Current hydrologic conditions were judged to be problematic due to the failure of the stock pond. Wetland hydrology will only return if the dam is rebuilt. The area will transition to upland, if the dam is not rebuilt,. A second smaller pond just north of the elk fence has also failed. This is an intermittent stream.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 20, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **302 Non**

Investigator(s): R. Long & P. Collins Section, Township, Range: Section 13 Twp 39 S Range 6 W

Landform (hillslope, terrace, etc.): Hillslope on high terrace Local relief (concave, convex, none): None Slope (%): 10

Subregion (LRR): D -- MLRA 47B Lat: 37.426761 Long: -112.472344 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 6)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 6)			
1. Rosa woodsii	4.50	Yes	FACU
2.			
3.			
4.			
5.			
	4.50 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 6)			
1. Agropyron cristatum	34.17	Yes	UPL
2. Bromus inermis	7.17	No	FACU
3. Iva axillaris	3.33	No	FAC
4.			
5.			
6.			
7.			
8.			
	44.67 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 6)			
1.			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum 23.33 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:	
OBL species	x 1 =	
FACW species	x 2 =	
FAC species 3.33	x 3 =	10.00
FACU species 11.67	x 4 =	46.67
UPL species 34.17	x 5 =	170.83
Column Totals: 49.17 (A)		227.50 (B)

Prevalence Index = B/A = 4.53

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

SOIL

Sampling Point: **12ALT_WET_302 Non**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
A 0-3	2.5Y 3/1	100					L (22)	
Bt 3-13	10YR 3/2	99	10YR 6/6	1	C	M	L (25)	Fine mottles on vertical ped faces
Btk 13-21	2.5Y 7/2	82	7.5YR 6/6	18	C	M	CL (38)	Coarse mottle on vertical ped faces

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

Mottles are prominent, but too deep to be diagnostic. There are not enough mottles above 13 inches to be diagnostic for a hydric soil. Mottles may be due to capillary fringe of groundwater when pond was full. Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 21, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **303**

Investigator(s): P. Collins & R. Long Section, Township, Range: Section 12 Twp 39 S Range 6 W

Landform (hillslope, terrace, etc.): Intermittent stream in swale Local relief (concave, convex, none): Concave Slope (%): 1.5

Subregion (LRR): D -- MLRA 47B Lat: 37.428108 Long: -112.47233 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Riparian Wet Meadow

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:

Conditions within this delineation just barely qualify as a wetland. This area likely receives much less runoff since the conversion to sprinkler irrigation. This is the upper end of the west intermittent stream. The drainage forks where wetland area 304 begins. There is an area of upland vegetation between the north end of 302 and the south end of 303. This delineation includes a small stock pond at the north end of the drainage.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 5)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 5)			
1. Rosa woodsii	8.00	Yes	FACU
2.			
3.			
4.			
5.			
	8.00 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 5)			
1. Juncus arcticus	45.00	Yes	FACW
2. Bromus inermis	24.00	Yes	FACU
3. Carex microptera	2.00	No	FAC
4. Poa pratensis	2.00	No	FAC
5.			
6.			
7.			
8.			
	73.00 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 5)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 3.80 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33.33 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species 45.00	x 2 = 90.00
FAC species 4.00	x 3 = 12.00
FACU species 32.00	x 4 = 128.00
UPL species _____	x 5 = _____
Column Totals: 81.00 (A)	230.00 (B)

Prevalence Index = B/A = 2.84

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

X Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No _____

Remarks:

The Dominance Test suggests the area is not hydrophytic, but the Prevalence Index puts it into the wetland status for vegetation.

SOIL

Sampling Point: 12ALT_WET_303

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
A 0-3	10YR 4/3	100					L (24)	Strong effervescence
Bw 3-9	2.5Y 4/3	94	7.5YR 6/8	5	C	M	CL (30	Oxidized rhizospheres
			5YR 5/8	1	C	M		Strong effervescence
Bk 9-16	2.5Y 4/3	100					CL (30)	Violent effervescence
								Common fine lime masses and
								threads on vertical ped faces

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- X Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes X No ___

Remarks:

This soil contains just enough mottles to be hydric. The soil is violently calcareous below the mottles (9 inches) with fine lime threads on the vertical ped faces. Estimated percent clay is shown in parentheses. Approximately 25 to 30 soil pits were dug in order to observe soil mottles and determine the wetland boundaries in this area.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- X Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- X Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- X Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ___

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Hydrology appears to be of short duration flooding in this intermittent stream due to surface flow from off-site snow melt and thunderstorms. No evidence of a high water table was observed.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 21, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **303 Non**

Investigator(s): P. Collins & R. Long Section, Township, Range: Section 12 Twp 39 S Range 6 W

Landform (hillslope, terrace, etc.): High Terrace Local relief (concave, convex, none): None Slope (%): 2.5

Subregion (LRR): D -- MLRA 47B Lat: 37.428067 Long: -112.472438 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

This location is outside the wetland in an upland setting.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 5)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 5)			
1. Artemisia tridentata wyomingensis	41.00	UPL	UPL
2. Rosa woodsii	3.00	Yes	FACU
3.			
4.			
5.			
	44.00 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 5)			
1. Elymus smithii	11.00	Yes	FAC
2. Iva axillaris	3.00	No	FAC
3. Juncus arcticus	3.00	No	FACW
4.			
5.			
6.			
7.			
8.			
	17.00 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 5)			
1.			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum 22.20 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species	3.00	x 2 =	6.00
FAC species	14.00	x 3 =	42.00
FACU species	3.00	x 4 =	12.00
UPL species	41.00	x 5 =	205.00
Column Totals:	61.00 (A)		265.00 (B)

Prevalence Index = B/A = 4.34

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

SOIL

Sampling Point: **12ALT_WET_303 Non**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
A 0-3	10YR 3/2	100					L (24)	Slight effervescence
BA 3-8	2.5Y 4/2	85					L (28)	Slight effervescence
	10YR 3/2	15						
Bt 8-15	2.5Y 4/2	100					CL (32)	Slight effervescence
Btk 15-21	2.5Y 4/2	100					CL (38)	Strong effervescence
								7% medium lime threads

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes ___ No X

Remarks:

This soil may qualify as a vertisol. The surface soil (A horizon) is mixing with the argillic (Bt horizon) when the soil drys and wide cracks develop. Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ___

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No wetland hydrology is present.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 21, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **304**

Investigator(s): R. Long & P. Collins Section, Township, Range: Section 12 Twp 39 S Range 6 W

Landform (hillslope, terrace, etc.): Eroded phemeral drainage in swale Local relief (concave, convex, none): concave Slope (%): 1 - 2

Subregion (LRR): D -- MLRA 47B Lat: 37.42828 Long: -112.472235 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Riparian Wet Meadow

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation Y, Soil Y, or Hydrology Y significantly disturbed? Are "Normal Circumstances" present? Yes _____ No X

Are Vegetation Y, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X	No _____	
Wetland Hydrology Present?	Yes X	No _____	

Remarks:

This area is not "naturally problematic." It is most likely a problematic area due to management practices. The channel headcutting may have begun prior to the conversion to sprinkler irrigation. Trash (major appliances, tires, bicycles, motorcycle, and other discarded items) has been dumped in the headcut. This area is similar to the 303 wetland description area, but extensive erosion (gully) has occurred. It was separated from 303, because of the "problematic" veg.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 3)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 3)			
1. Rosa woodsii	6.67	Yes	FACU
2.			
3.			
4.			
5.			
	6.67 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 3)			
1. Bromus inermis	36.67	Yes	FACU
2. Iva axillaris	11.67	No	FAC
3. Convolvulus arvense	6.67	No	FAC
4. Hordeum jubatum	5.00	No	FACU
5. Poa pratensis	4.00	No	FAC
6. Phleum pratensis	1.00	No	FACU
7.			
8.			
	65.00 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 3)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 20.00 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:	
OBL species	x 1 =	
FACW species	x 2 =	
FAC species 20.67	x 3 =	62.00
FACU species 51.00	x 4 =	204.00
UPL species	x 5 =	
Column Totals: 71.67 (A)		266.00 (B)

Prevalence Index = B/A = 3.71

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

X Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

This area had both wetland and upland plant species present, but the conditions described above have impacted the composition here. Most of the reach was dominated by smooth brome, but shorter sections of it was dominated by foxtail barley.

SOIL

Sampling Point: 12ALT_WET_304

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
A 0-3	2.5Y 4/3	92	10YR 7/6	8	C	M	L (24)	Strong effervescence
Bt 3-13	2.5Y 5/3	82	10YR 5/6	18	C	M	C (42)	Oxidized rhizospheres
								Strong effervescence
Bk 13-21	2.5Y 4/2	94	10YR 5/6	6	C	M	L (22)	Violent effervescence
								Finely disseminated lime

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- X Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes X No ___

Remarks:

The soil was moist below 3 inches. Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- X Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- X Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ___

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

This wetland is an intermittent stream channel that changes to an ephemeral drainage above this wetland delineation.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 21, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **304 Non**

Investigator(s): R. Long & P. Collins Section, Township, Range: Section 12 Twp 39 S Range 6 W

Landform (hillslope, terrace, etc.): High terrace Local relief (concave, convex, none): Concave Slope (%): 10

Subregion (LRR): D -- MLRA 47B Lat: 37.428278 Long: -112.472178 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 3)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 3)			
1. Rosa woodsii	20.00	Yes	FACU
2.			
3.			
4.			
5.			
	20.00 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 3)			
1. Hordeum jubatum	46.67	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	46.67 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 3)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 7.33 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species 46.67	x 3 = 140.00
FACU species 20.00	x 4 = 80.00
UPL species _____	x 5 = _____
Column Totals: 66.67 (A)	220.00 (B)

Prevalence Index = B/A = 3.30

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

SOIL

Sampling Point: **12ALT_WET_304 Non**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
A 0-2	2.5Y 3/1	100					L (24)	Slight effervescence
Bt 2-12	2.5Y 3/1	100					CL (29)	Slight effervescence
Bk 12-21	2.5Y 4/2	100					L (24)	Violent effervescence
								2% fine lime threads in peds

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes ___ No X

Remarks:

Soil is dry to 21 inches. Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ___

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 22, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **305 Non**

Investigator(s): P. Collins & R. Long Section, Township, Range: Section 12 Twp 39 S Range 6 W

Landform (hillslope, terrace, etc.): Terrace Local relief (concave, convex, none): None Slope (%): < 1

Subregion (LRR): D -- MLRA 47B Lat: 37.429324 Long: -112.472493 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

This area appeared pinkish red on the infrared aerial photography (2009 and 2011 NAIP), but close examination found that it did not meet the requirements for a wetland.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 6)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 6)			
1. Rosa woodsii	8.33	Yes	FACU
2.			
3.			
4.			
5.			
	8.33 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 6)			
1. Elymus trachycaulus	19.17	Yes	FACU
2. Achillea millefolium	18.33	Yes	FACU
3. Juncus arcticus	15.00	Yes	FACW
4. Poa pratensis	13.00	No	FAC
5. Iris missouriensis	1.67	No	FACW
6.			
7.			
8.			
	67.50 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 6)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 5.50 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 25.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	_____	x 1 =	_____
FACW species	16.67	x 2 =	33.33
FAC species	13.33	x 3 =	40.00
FACU species	45.83	x 4 =	183.33
UPL species	_____	x 5 =	_____
Column Totals:	75.83 (A)		256.67 (B)

Prevalence Index = B/A = 3.38

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

SOIL

Sampling Point: **12ALT_WET_305 Non**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
Ap 0-7	2.5Y 4/3	100					CL (38)	Very slight effervescence
Bk 7-21	2.5Y 5/3	100					CL (38)	Strong effervescence
								4% fine lime masses around peds

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes ___ No X

Remarks:

This soil is a fine textured Aridic Calciustept. Estimated percent clay is shown in parentheses. Several holes were dug in order to determine if hydric soils were present. The described soil profile is representative of the area. The soil appears to have been plowed at some point in the past. Approximately 15-20 holes were dug to determine if soils are hydric.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ___

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No wetland hydrology indicators were observed in this area.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 22, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **306 Non**

Investigator(s): R. Long & P. Collins Section, Township, Range: Section 12 Twp 39 S Range 6 W

Landform (hillslope, terrace, etc.): Small stock pond on high terrace Local relief (concave, convex, none): Concave Slope (%): _____

Subregion (LRR): D -- MLRA 47B Lat: 37.430184 Long: -112.472045 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No _____	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

This is a pond area with no water present. It is mostly a "weedy" area (approximately 0.06 acres). There is an ephemeral drainage that connects this stock pond to wetland 304 to the south. The drainage did meet hydrophytic vegetation requirements, but did not meet hydric soil requirements for a wetland. Soils and vegetation were evaluated further on July 24, 2012.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 2)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 2)			
1.			
2.			
3.			
4.			
5.			
	N/A = Total Cover		
Herb Stratum (Plot size: 1 m sq x 2)			
1. Polygonum aviculare	42.50	Yes	FACW
2. Bromus inermis	12.50	No	FACU
3. Xanthium strumarium	10.00	No	FAC
4. Hordeum jubatum	7.50	No	FAC
5.			
6.			
7.			
8.			
	72.50 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 2)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 18.00 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	_____	x 1 =	_____
FACW species	42.50	x 2 =	85.00
FAC species	17.50	x 3 =	52.50
FACU species	12.50	x 4 =	50.00
UPL species	_____	x 5 =	_____
Column Totals:	72.50 (A)		187.50 (B)

Prevalence Index = B/A = 2.59

Hydrophytic Vegetation Indicators:

X Dominance Test is >50%

X Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No _____

Remarks:

"Weedy" plant species were common at this site. Although these species suggest hydrophytic conditions, the soils and hydrology did not meet wetland conditions (see next page).

SOIL

Sampling Point: **12ALT_WET_306 Non**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
Ap 0-5	10YR 4/2	100					CL (36)	Slight effervescence
Bt 5-18	10YR 4/2	100					C (42)	Slight effervescence

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): _____

Hydric Soil Present? Yes _____ No X

Remarks:

No hydric soil indicators were observed. Estimated clay percentage is shown in parentheses. Soil test pit was dug on north side of small stock pond. Surface has been disturbed. The soil was described on July 24, 2012.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Hydrology limited to a dry stock pond. No wetland hydrology indicators were observed on either June 22, 2012 or July 24, 2012.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 20, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **401 Non**

Investigator(s): P. Collins & R. Long Section, Township, Range: Section 7 Twp 39 S Range 5 W

Landform (hillslope, terrace, etc.): Terrace Local relief (concave, convex, none): None Slope (%): 1.5

Subregion (LRR): D -- MLRA 47B Lat: 37.436856 Long: -112.466698 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Alfalfa field

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

This area appeared red on the infrared aerial photography (2009 and 2011 NAIP), so it was evaluated in the field. The photo pattern followed the outline of the field. The area is presently growing alfalfa and under sprinkler irrigation. This area is outside the center pivot. The red color on the aerial photo was most likely the result of irrigation. The purpose of this observation was to verify that the area is cultivated and irrigated.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 3)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 3)			
1.			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: 1 m sq x 3)			
1. Medicago sativa	58.33	Yes	FACU
2. Bromus tectorum	11.67	No	UPL
3.			
4.			
5.			
6.			
7.			
8.			
	70.00 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 3)			
1.			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum 8.67 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:	
OBL species	x 1 =	
FACW species	x 2 =	
FAC species	x 3 =	
FACU species 58.33	x 4 =	233.33
UPL species 11.67	x 5 =	350.00
Column Totals: 70.00 (A)		583.33 (B)

Prevalence Index = B/A = 4.55

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

This is a cultivated alfalfa field used for growing hay for livestock. Vegetation was evaluated on July 24, 2012.

SOIL

Sampling Point: **12ALT_WET_401 Non**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
Ap 0-7	2.5Y 4/2	100					L (27)	Slight effervescence
Bt 7-15	2.5Y 4/3	100					CL (34)	Slight effervescence
Btk 15-21	2.5Y 5/3	100					C (44)	Strong effervescence
								4% fine lime masses on verticle ped faces

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No X

Remarks:

This is an active alfalfa field that had been recently irrigated at the time of the first site evaluation on June 20, 2012. The perimeter of the area was walked on June 20, 2012. No evidence of seepage from the pond was observed. The soil was described on July 24, 2012.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No seepage from the pond or salt crusts were observed in the area. No wetland hydrology indicators were observed on either June 20, 2012 or July 24, 2012.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 20, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **402 Non**

Investigator(s): R. Long & P. Collins Section, Township, Range: Section 7 Twp 39 S Range 5 W

Landform (hillslope, terrace, etc.): Ephemeral drainage on terrace Local relief (concave, convex, none): Concave Slope (%): 3

Subregion (LRR): D -- MLRA 47B Lat: 37.437532 Long: -112.468051 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Ephemeral Drainage

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

This location was designated as a pond on the NHD GIS layer, but there is no evidence of a pond at the present time. The area has been plowed and Timothy planted.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 3)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 3)			
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 1 m sq x 3)			
1. Phleum pratense	80.00	Yes	FACU
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	80.00 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 3)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 7.00 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:	
OBL species	x 1 =	
FACW species	x 2 =	
FAC species	x 3 =	
FACU species 80.00	x 4 =	320.00
UPL species	x 5 =	
Column Totals: 80.00 (A)		320.00 (B)

Prevalence Index = B/A = 4.00

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

SOIL Sampling Point: **12ALT_WET_402 Non**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
Ap 0-16	10YR 5/2	100					CL (30)	2% fine sandstone gravels

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

This is not a hydric soil. A few (less than 3%) faint to very faint mottles were observed in a few soil test holes, but they were not the norm. Approximately ten soil test holes were dug in this ephemeral drainage to evaluate hydric soil potential. Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No signs of wetland hydrology were observed. There is a road culvert that empties into the area at the north fence.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 22, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **403 Non**

Investigator(s): P. Collins & R. Long Section, Township, Range: Section 12 Twp 39 S Range 6 W

Landform (hillslope, terrace, etc.): Terrace Local relief (concave, convex, none): None Slope (%): 2

Subregion (LRR): D -- MLRA 47B Lat: 37.43232 Long: -112.470608 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Upland - Agricultural Field

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

An observation was made at this location to verify that the infrared line along the fence was not a ditch or wetland. The red color is most likely due to the heavier grass growth along the fence, where it is not cultivated or harvested. No remnants of an abandoned irrigation ditch were observed. The area outside the fenceline is planted in small grain (oats). The grain field and fenceline are under center pivot irrigation.

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 1 m sq x 3)			
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 3)			
1. Rosa woodsii	3.33	Yes	FACU
2.			
3.			
4.			
5.			
	3.33 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 3)			
1. Bromus inermis	51.67	Yes	FACU
2. Pascopyrum smithii	33.33	Yes	FAC
3. Convolvulus arvense	3.33	No	FACU
4.			
5.			
6.			
7.			
8.			
	88.33 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 3)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 3.33 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 3.33 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species 33.33	x 3 = 100.00
FACU species 58.33	x 4 = 233.33
UPL species _____	x 5 = _____
Column Totals: 91.67 (A)	333.33 (B)

Prevalence Index = B/A = 3.64

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

Vegetation was evaluated on July 24, 2012.

SOIL

Sampling Point: **12ALT_WET_403 Non**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
Ap 0-6	10YR 4/2	100					L (24)	Strong effervescence
Btk1 6-14	10YR 4/3	100					SCL (29)	Strong effervescence
								3% fine lime masses on vertical ped faces
Btk2 14-21	2.5Y 4/3	100					L (26)	Violent effervescence
								15% fine lime masses in matrix

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): _____

Hydric Soil Present? Yes _____ No X

Remarks:

No indications of hydric soils were observed. Soil profile was evaluated on July 24, 2012.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No evidence of wetland hydrology was observed. There are no irrigation ditches along the fenceline.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: July 24 , 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **404 Non**

Investigator(s): P. Collins & R. Long Section, Township, Range: Section 12 Twp 39 S Range 6 W

Landform (hillslope, terrace, etc.): Terrace Local relief (concave, convex, none): None Slope (%): _____

Subregion (LRR): D -- MLRA 47B Lat: 37.433075 Long: -112.472458 Datum: NAD 1983

Soil Map Unit Name: 1111 Naplene family - Teromote - Arboles - Oxyaquic Ustifluvent complex, 2-8% NWI classification: Upland - Agricultural Field

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No _____ (If no, explain in Remarks.)

Are Vegetation Y, Soil Y, or Hydrology Y significantly disturbed? Are "Normal Circumstances" present? Yes _____ No N

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

NHD GIS map showed a drainage and a pond in this area, however, the native vegetation has been converted to a cultivated field (oats were recently harvested). There was not any visual evidence on the surface or in the soils of either a drainage or a pond in the area at the time of this evaluation. It is currently irrigated by a center pivot sprinkler system.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 3)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 3)			
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 1 m sq x 3)			
1. Avena fatua var. sativa	53.33	Yes	UPL
2. Convolvulus arvense	8.33	No	FACU
3. Lactuca serriola	3.33	No	FACU
4.			
5.			
6.			
7.			
8.			
	65.00 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 3)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 23.67 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:	
OBL species _____	x 1 =	_____
FACW species _____	x 2 =	_____
FAC species _____	x 3 =	_____
FACU species 11.67	x 4 =	46.67
UPL species 53.33	x 5 =	266.67
Column Totals: 65.00 (A)		313.33 (B)

Prevalence Index = B/A = 4.82

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

At sample time, this field had recently been harvested.

SOIL

Sampling Point: **12ALT_WET_404 Non**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
Ap 0-7	10YR 4/2	100					CL (33)	Slight effervescence
Bt 7-13	10YR 4/2	100					CL (36)	Slight effervescence
Btk2 13-18	10YR 4/2	100					CL (34)	Strong effervescence
								3% fine lime masses on vertical ped faces
Btk2 18-21	2.5Y 4/3	100					L (26)	Violent effervescence
								14% fine & medium limes masses in matrix

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes ___ No X

Remarks:

No hydric soil indicators were observed. Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ___

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No evidence of wetland hydrology was observed. No visual evidence of a surface drainage or pond were observed in the area.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: August 1, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **405**

Investigator(s): P. Collins & R. Long Section, Township, Range: Section 7 Twp 39 S Range 5 W

Landform (hillslope, terrace, etc.): Small reservoir sideslope Local relief (concave, convex, none): Concave Slope (%): 5

Subregion (LRR): D -- MLRA 47B Lat: 37.437343 Long: -112.466274 Datum: NAD 1983

Soil Map Unit Name: 1112 Quezcan family - Sideshow - Teromote family complex, 15 to 35% NWI classification: Riparian Wet Meadow

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation Y, Soil Y, or Hydrology Y significantly disturbed? * Are "Normal Circumstances" present? Yes X** No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:

This site was a pond or small reservoir. *This pond was a man-made disturbance to the natural landscape. **The circumstances are "normal" for its current function. This small pond/reservoir does not appear to be used to hold any more than local surface runoff at the present time. It did not appear to have been filled to capacity for some time, due to the amount of vegetation on portions of the pond/reservoir bottom and inner sideslopes.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 6)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 6)			
1. Salix exigua	5.83	Yes	FACW
2.			
3.			
4.			
5.			
	5.83 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 6)			
1. Juncus arcticus	35.00	Yes	FACW
2. Convolvulus arvense	4.50	No	FACU
3. Xanthium strumarium	3.83	No	FAC
4. Typha latifolia	0.83	No	OBL
5.			
6.			
7.			
8.			
	44.17 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 6)			
1.			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum 41.67 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0.83	x 1 =	0.83
FACW species	40.83	x 2 =	81.67
FAC species	3.83	x 3 =	11.50
FACU species	4.50	x 4 =	18.00
UPL species		x 5 =	
Column Totals:	50.00 (A)		112.00 (B)

Prevalence Index = B/A = 2.24

Hydrophytic Vegetation Indicators:

X ~~D~~ominance Test is >50%

X Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No _____

Remarks:

Due to fluctuating water levels, there were different zones of vegetation where the cover, composition and species varied.

SOIL

Sampling Point: 12ALT_WET_405

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
A 0-8	2.5Y 5/2	88	10YR 5/8	12	C	M	C (44)	Slight effervescence
								Oxidized rhizospheres
AB 8-14	2.5Y 5/2	94	10YR 5/8	6	C	M	C (44)	Slight effervescence
								Oxidized rhizospheres
Bk 14-18	2.5Y 6/2	100					C (44)	5% sandstone channers
								4% fine lime threads in matrix

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- X Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes X No ___

Remarks:

Area was disturbed to construct pond/reservoir embankment. Hydric soil conditions stop at 14 inches Heavy soil texture is good for holding water in pond. There was no evidence of water seeping out of pond (no salt crusts outside of pond or outer on embankment, see 12ALT_401Non). Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- X Surface Soil Cracks (B6)
- X Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- X Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- X Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes X No ___ Depth (inches): *

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): **

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Water levels fluctuate seasonally. Pond consisted of 46% (0.26 acres) riparian wet meadow on edge of pond bottom and on lower half of embankment sideslopes (inner slopes), 27% (0.15 acres) mud flat between wet meadow and pond, and 27% pond water surface (0.15 acres) on August 1, 2012. *Surface water present on pond only. **Saturation present in mud flat in close proximity to pond area.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: August 1, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **405 Non**

Investigator(s): R. Long, P. Collins Section, Township, Range: Section 7 Twp 39 S Range 5 W

Landform (hillslope, terrace, etc.): Top of small pond embankment Local relief (concave, convex, none): Convex Slope (%): 10

Subregion (LRR): D -- MLRA 47B Lat: 37.437392 Long: -112.466209 Datum: NAD 1983

Soil Map Unit Name: 1112 Quezcan family - Sideshow - Teromote family complex, 15 to 35% NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation Y, Soil Y, or Hydrology Y significantly disturbed? * Are "Normal Circumstances" present? Yes X** No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

This site was the upper banks of a pond or small reservoir. *The pond and banks were man-made disturbances to the natural landscape. **The circumstances are "normal" for its current function.

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 1 m sq x 6)			
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 6)			
1. Rosa woodsii	1.67	Yes	FACU
2.			
3.			
4.			
5.			
	1.67 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 6)			
1. Bromus inermis	38.33	Yes	FACU
2. Pascopyrum smithii	10.83	Yes	FAC
3. Convolvulus arvense	2.50	No	FACU
4. Medicago sativa	1.67	No	FACU
5.			
6.			
7.			
8.			
	53.33 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 6)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 45.00 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33.33 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:	
OBL species _____	x 1 =	_____
FACW species _____	x 2 =	_____
FAC species 10.83	x 3 =	32.50
FACU species 44.17	x 4 =	176.67
UPL species _____	x 5 =	_____
Column Totals: 55.00 (A)		209.17 (B)

Prevalence Index = B/A = 3.80

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

This area was most likely seeded to stabilize the pond banks.

SOIL

Sampling Point: **12ALT_WET_405 Non**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
A 0-5	2.5Y 5/2	100					CL (34)	Strong effervescence
Bk1 5-14	2.5Y 5/3	100					CL (32)	Strong effervescence
								2% fine lime threads in matrix
Bk2 14-18	2.5Y 5/3	100					CL (38)	Strong effervescence
								2% fine lime threads in matrix

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes ___ No X

Remarks:

Soil evaluation point was near top of embankment. Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ___

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 22, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **501**

Investigator(s): P. Collins & R. Long Section, Township, Range: Section 13 Twp 39 S Range 6 W

Landform (hillslope, terrace, etc.): Ephemeral drainage in valley bottom Local relief (concave, convex, none): Concave Slope (%): 6

Subregion (LRR): D -- MLRA 47B Lat: 37.421531 Long: -112.477354 Datum: NAD 1983

Soil Map Unit Name: Sili family - Sideshow - Redig family complex, 2 to 15 percent slopes NWI classification: Riparian Wet Meadow

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:

This wetland is in an intermittent stream channel that straddles the southwest boundary of the private lease study area. The wetland extends beyond the private lease area at both the upstream (north) and downstream (south) ends as well as to the west. Sandstone outcrops are present on the hill west of this wetland.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 6)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 6)			
1.			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: 1 m sq x 6)			
1. Juncus arcticus	67.50	Yes	FACW
2. Hordeum jubatum	11.67	No	FAC
3. Melilotus officinalis	0.83	No	FACU
4.			
5.			
6.			
7.			
8.			
	80.00 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 6)			
1.			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum 3.83 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species	67.50	x 2 =	135.00
FAC species	11.67	x 3 =	35.00
FACU species	0.83	x 4 =	0.33
UPL species		x 5 =	
Column Totals:	80.00 (A)		173.33 (B)

Prevalence Index = B/A = 2.17

Hydrophytic Vegetation Indicators:

X Dominance Test is >50%

X Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No _____

Remarks:

This stream reach was dominated by wiregrass, however, just down-drainage there was a shorter reach dominated by foxtail barley.

SOIL

Sampling Point: 12ALT_WET_501

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
A 0-2	2.5Y 5/2	92	10YR 6/4	3	C	M	CL (38)	5% 10YR 8/2 fine salt crystals
								very slight effervescence
								Oxidized rhizospheres
Bg1 2-7	2.5Y4/3	82	10YR 6/4 (fine)	5	C	M	C (42)	8% 10YR 8/2 fine salt threads
			G1 5/10Y (fine)	5	D	M		very slight effervescence
						M	C (52)	Oxidized rhizospheres
Bg2 7-21	2.5Y5/3	70	10YR 7/3 (fine)	8	C	M		14% 10YR 8/2 fine salt threads 7 masses
			G1 5/10Y (fine)	8	D	M		Oxidized rhizospheres; very slight eff.

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes X No ___

Remarks:

Salts accumulating in fine threads and masses on ped faces were included in soil color percents. Percent clay is so high that water infiltration is extremely slow. Hydric soil features are limited to cracks between soil peds. Digging was very difficult in this heavy clay soil. Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- X Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- X Water-Stained Leaves (B9)
- X Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- X Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ___

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Surface water would likely be present earlier in the year. The wetland is primarily due to perching of surface water on the heavy clay soil.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: June 22, 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **501 Non**

Investigator(s): R. Long & P. Collins Section, Township, Range: Section 13 Twp 39 S Range 6 W

Landform (hillslope, terrace, etc.): Hill footslope Local relief (concave, convex, none): Convex Slope (%): 25

Subregion (LRR): D -- MLRA 47B Lat: 37.421549 Long: -112.477279 Datum: NAD 1983

Soil Map Unit Name: Sili family - Sideshow - Redig family complex, 2 to 15 percent slopes NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

This footslope location is just above the wetland area.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 6)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 6)			
1. Artemisia tridentata	28.33	Yes	UPL
2.			
3.			
4.			
5.			
	28.33 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 6)			
1. Bromus inermis	27.50	Yes	FACU
2. Melilotus officinalis	3.33	No	FACU
3. Juncus arcticus	1.67	No	FACW
4.			
5.			
6.			
7.			
8.			
	32.50 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 6)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 23.33 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	_____	x 1 =	_____
FACW species	1.67	x 2 =	3.33
FAC species	_____	x 3 =	_____
FACU species	30.83	x 4 =	123.33
UPL species	28.33	x 5 =	141.67
Column Totals:	60.83 (A)		268.33 (B)

Prevalence Index = B/A = 4.41

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

The terraces here were dominated by big sagebrush; just up-slope was a field where the area adjacent to the non-wetland sample area was dominated yellow sweet-clover.

SOIL

Sampling Point: **12ALT_WET_501 Non**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
Ap 0-6	2.5Y 4/2	100					CL (37)	Very slight effervescence
Bt 6-20	2.5Y 4/3	100					C (46)	Very slight effervescence

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): ___

Hydric Soil Present? Yes ___ No X

Remarks:

Soil was dry. Vertical soil cracks were 1-2 inches wide and 6-8 inches deep. Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ___

Wetland Hydrology Present? Yes ___ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No evidence of wetland hydrology on this footslope.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Alton Coal - Private Lease Area City/County: Alton, Kane Sampling Date: July 24 , 2012

Applicant/Owner: Alton Coal Development State: Utah Sampling Point: **502 Non**

Investigator(s): P. Collins & R. Long Section, Township, Range: Section 13 Twp 39 S Range 6 W

Landform (hillslope, terrace, etc.): Ephemeral drainage on hill Local relief (concave, convex, none): Concave Slope (%): 8

Subregion (LRR): D -- MLRA 47B Lat: 37.420545 Long: -112.473288 Datum: NAD 1983

Soil Map Unit Name: 1103 Sili family - Sideshow - Redig family complex, 2 to 15 percent slopes NWI classification: Upland

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation Y, Soil Y, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes _____ No N

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

This ephemeral drainage in the southwest portion of the proposed private lease area was filled with juniper slash after it was removed from the adjacent hillslope.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 1 m sq x 3)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 1 m sq x 3)			
1. Rosa woodsii	6.67	Yes	FACU
2.			
3.			
4.			
5.			
	6.67 = Total Cover		
Herb Stratum (Plot size: 1 m sq x 3)			
1. Bromus inermis	53.33	YEs	FACU
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	53.33 = Total Cover		
Woody Vine Stratum (Plot size: 1 m sq x 3)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 23.33 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0.00 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:	
OBL species _____	x 1 =	_____
FACW species _____	x 2 =	_____
FAC species _____	x 3 =	_____
FACU species 60.00	x 4 =	240.00
UPL species _____	x 5 =	_____
Column Totals: 60.00 (A)		240.00 (B)

Prevalence Index = B/A = 4.00

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:

Trees and shrubs removed from the land adjacent to this ephemeral drainage have been placed within it, thus altered the native vegetation.

SOIL Sampling Point: **12ALT_WET_502 Non**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
Ap 0-7	10YR 4/2	100					CL (33)	Slight effervescence
Bt 7-13	10YR 4/2	100					CL (36)	Slight effervescence
Btk 13-18	10YR 4/2	100					CL (34)	Strong effervescence
								3% fine lime masses on vertical ped faces
Bk 18-21	2.5Y 4/3	100					L (26)	Violent effervescence
								14% fine & medium lime masses in matrix

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: None

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

No hydric soil indicators were observed. A limited amount of soil disturbance occured when the juniper brush was pushed into the ephemeral drainage. Estimated percent clay is shown in parentheses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- X Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No primary wetland hydrology indicators were observed. Drainage patterns were the only secondary wetland hydrology indicator that was observed.

Photo C1: 12ALT_WET 101

Photo C2: 12ALT_WET 101 Non

Photo C3: 12ALT_WET 102

Photo C4: 12ALT_WET 102 Non

Photo C5: 12ALT_WET 103

Photo C6: 12ALT_WET 103 Non

Photo C7: 12ALT_WET 104 Non

Photo C8: 12ALT_WET 105

Photo C9: 12ALT_WET 105 Non

Photo C10: 12ALT_WET 106

Photo C11: 12ALT_WET 106 Non

Photo C12: 12ALT_WET 107

Photo C13: 12ALT_WET 107 Non

Photo C14: 12ALT_WET 108

Photo C15: 12ALT_WET 108 Non

Photo C16: 12ALT_WET 109 Non

Photo C17: 12ALT_WET 110 Non

Photo C18: 12ALT_WET 201

Photo C19: 12ALT_WET 201 Non

Photo C20: 12ALT_WET 202

Photo C21: 12ALT_WET 202 Non

Photo C22: 12ALT_WET 203

Photo C23: 12ALT_WET 203 Non

Photo C24: 12ALT_WET 204 Non

Photo C25: 12ALT_WET 205

Photo C26: 12ALT_WET 205 Non

Photo C27: 12ALT_WET 206 Non

Photo C27: 12ALT_WET 301 Non

Photo C28: 12ALT_WET 302

Photo C29: 12ALT_WET 302 Non

Photo C30: 12ALT_WET 303

Photo C31: 12ALT_WET 303 Non

Photo C32: 12ALT_WET 304

Photo C33: 12ALT_WET 304 Non

Photo C34: 12ALT_WET 305 Non

Photo C35: 12ALT_WET 306 Non

Photo C36: 12ALT_WET 401 Non

Photo C37: 12ALT_WET 402 Non

Photo C38: 12ALT_WET 403 Non

Photo C40: 12ALT_WET 404 Non

Photo C39: 12ALT_WET 501

Photo C42: 12ALT_WET 501 Non

Photo C43: 12ALT_WET 502 Non

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Alton Private Lease
Project Number: 12ALT OHW 102
Stream: Kanab Creek
Investigator(s): P. Collins & R. Long

Date: June 12, 2012 **Time:** 11:34 AM
Town: Alton, Kane Co **State:** Utah
Photo begin file#: **Photo end file#:**

Y ■ / N ☐ Do normal circumstances exist on the site?

Y ☐ / N ■ Is the site significantly disturbed?

Location Details:
Kanab Creek

Projection: UTM **Datum:** 1983
Coordinates: E N/A N N/A

Potential anthropogenic influences on the channel system:

There is a downstream road culvert just beyond the southern edge of the wetland study area. Heavy livestock grazing use observed. Hoof prints in wetland zone.

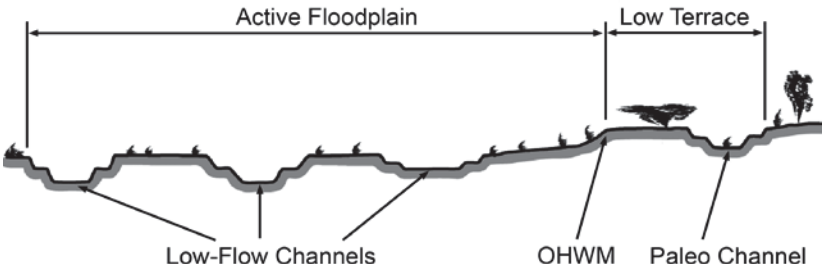
Brief site description:

This is a perennial stream located about 280 feet upstream from the south boundary. The low flow channel is 1 to 3 feet wide; and the active floodplain is 6 feet wide on each side of the stream.

Checklist of resources (if available):

- ■ Aerial photography
  Dates: August 2009 & August 2011
- ■ Topographic maps
- ■ Geologic maps
- ☐ Vegetation maps
- ■ Soils maps
- ■ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ■ Global positioning system (GPS)
- ☐ Other studies
- ☐ Stream gage data
  Gage number:
  Period of record:
- ☐ History of recent effective discharges
- ☐ Results of flood frequency analysis
- ☐ Most recent shift-adjusted rating
- ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

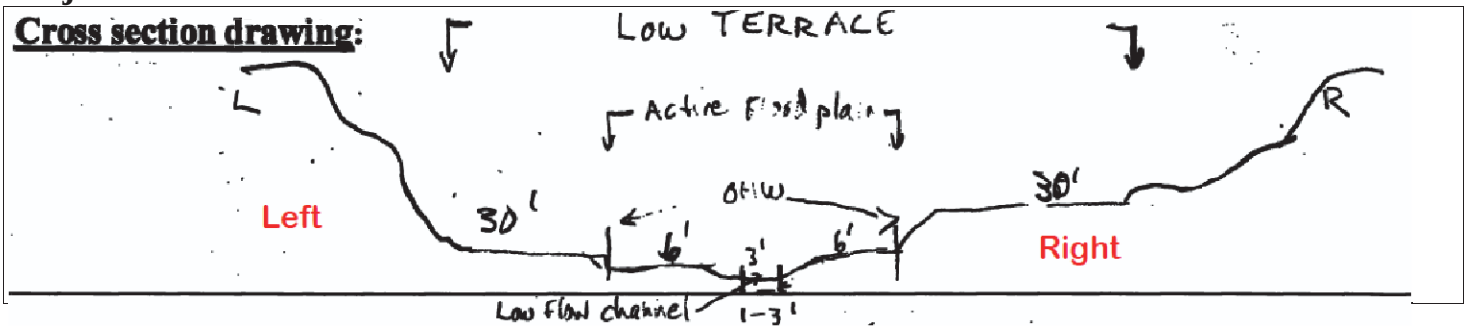


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ■ Mapping on aerial photograph
   - ■ Digitized on computer
   - ■ GPS
   - ☐ Other:

Project ID: June 12, 2018 **Cross section ID:** 12ALT_OHW 102 **Date:** June 12, 2018 **Time:** 11:34 AM

Cross section drawing:



OHWM UTM meters

	Left		Right	
	Easting	370152.0	Easting	370148.6
GPS point: NAD 1983, 12N	Northing	4142518.2	Northing	4142519.8

Indicators:

- [x] Change in average sediment texture
- [x] Change in vegetation species
- [x] Change in vegetation cover
- [ ] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Cross section sketch was drawn looking downstream. Left (L) and right (R) sides are labled in the sketch.

Floodplain unit: [x] Low-Flow Channel [ ] Active Floodplain [ ] Low Terrace

GPS point: See cross section drawing.

Characteristics of the floodplain unit:

Average sediment texture: Medium silt with 30% cobbles

Total veg cover: 10 % Tree: 0 % Shrub: 0 % Herb: 10 %

Community successional stage:

- [x] NA
- [ ] Early (herbaceous & seedlings)
- [ ] Mid (herbaceous, shrubs, saplings)
- [ ] Late (herbaceous, shrubs, mature trees)

Indicators:

- [ ] Mudcracks
- [ ] Ripples
- [ ] Drift and/or debris
- [ ] Presence of bed and bank
- [ ] Benches
- [x] Soil development
- [x] Surface relief
- [x] Other: Running water
- [ ] Other: _____
- [ ] Other: _____

Comments:

Project ID: **Cross section ID:** 12ALT_OHW 102 **Date:** June 12, 2012 **Time:**

Floodplain unit: ☐ Low-Flow Channel ☒ Active Floodplain ☐ Low Terrace

GPS point: See cross section drawing.

Characteristics of the floodplain unit:

Average sediment texture: Fine silt with 15% peggles & cobbles

Total veg cover: 70 % Tree: _____% Shrub: _____% Herb: 70 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☒ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☒ Drift and/or debris
- ☒ Presence of bed and bank
- ☒ Benches
- ☒ Soil development
- ☐ Surface relief
- ☒ Other: Mud
- ☐ Other: _____
- ☐ Other: _____

Comments:

The active floodplain is 6 feet wide on both sides of the low flow channel.

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☒ Low Terrace

GPS point: See cross section drawing.

Characteristics of the floodplain unit:

Average sediment texture: Cobble

Total veg cover: 40 % Tree: _____% Shrub: 25 % Herb: 15 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☒ Benches
- ☒ Soil development
- ☒ Surface relief
- ☒ Other: Upland Vegetation
- ☐ Other: _____
- ☐ Other: _____

Comments:

The low terrace is 30 feet wide on both the left and right sides.

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Alton Private Lease
Project Number: 12ALT OHW 103
Stream: Kanab Creek
Investigator(s): P. Collins & R. Long

Date: 06/12/2012 **Time:** 3:02 pm
Town: Alton, Kane Co **State:** Utah
Photo begin file#: **Photo end file#:**

Y ■ / N ☐ Do normal circumstances exist on the site?

Y ☐ / N ■ Is the site significantly disturbed?

Location Details:
Kanab Creek

Projection: UTM, 12N **Datum:** 1983
Coordinates: E see sketch N see sketch

Potential anthropogenic influences on the channel system:
Cattle grazing has impacted this section of Kanab Creek (perennial stream).

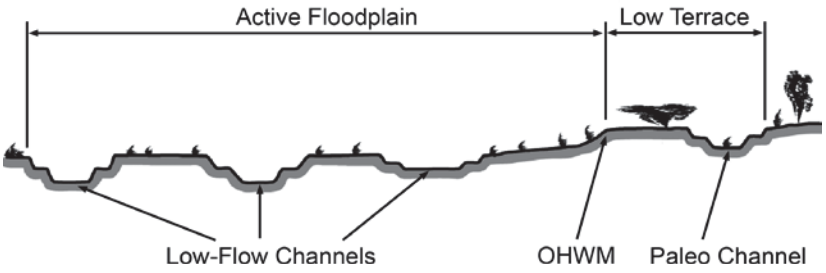
Brief site description:
This perennial channel represents a short reach of Kanab Creek. It consists of a broad wash out area that is significantly different than areas above and below. The wash out may be the result of the 2011 runoff events. The location is about 700 feet upstream from the south boundary.

Checklist of resources (if available):

- ■ Aerial photography
  Dates:
- ■ Topographic maps
- ■ Geologic maps
- ☐ Vegetation maps
- ■ Soils maps
- ■ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ■ Global positioning system (GPS)
- ☐ Other studies

- ☐ Stream gage data
  Gage number:
  Period of record:
- ☐ History of recent effective discharges
- ☐ Results of flood frequency analysis
- ☐ Most recent shift-adjusted rating
- ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

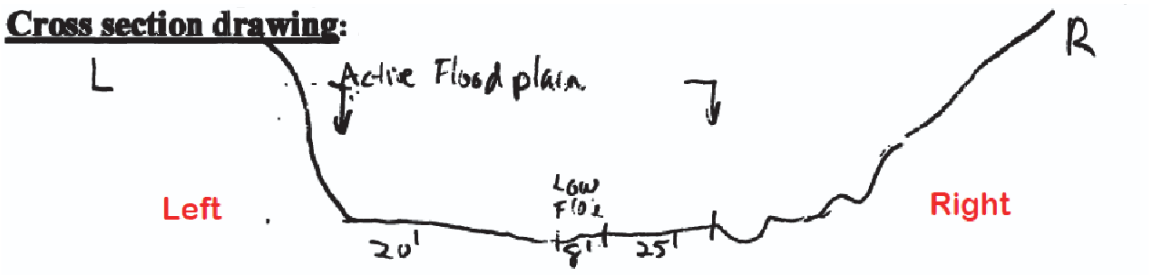


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ■ Mapping on aerial photograph
   - ■ Digitized on computer
   - ■ GPS
   - ☐ Other:

Project ID: 06/12/2012 **Cross section ID:** 12ALT_OHW 103 **Date:** 06/12/2012 **Time:** 3:02 pm

Cross section drawing:



OHWM

GPS point: UTM NAD 1983

Left Easting	370171.0	Right Easting	370157.2
Left Northing	4142642.0	Right Northing	4142634.0

Indicators:

- [x] Change in average sediment texture
- [x] Change in vegetation species
- [x] Change in vegetation cover
- [x] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Cross section sketch was drawn looking downstream. Left (L) and right (R) sides are labled in the sketch.

Floodplain unit: [x] Low-Flow Channel [ ] Active Floodplain [ ] Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Cobble with medium silt

Total veg cover: 1 % Tree: 0 % Shrub: 0 % Herb: 1 %

Community successional stage:

- [x] NA
- [ ] Early (herbaceous & seedlings)
- [ ] Mid (herbaceous, shrubs, saplings)
- [ ] Late (herbaceous, shrubs, mature trees)

Indicators:

- [ ] Mudcracks
- [ ] Ripples
- [ ] Drift and/or debris
- [x] Presence of bed and bank
- [ ] Benches
- [ ] Soil development
- [ ] Surface relief
- [x] Other: Water flow
- [ ] Other: _____
- [ ] Other: _____

Comments:

The low flow channel is 8 feet wide in this part of Kanab Creek.

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 103 **Date:** 06/12/2012 **Time:** 3:02 pm

Floodplain unit: ☐ Low-Flow Channel ■ Active Floodplain ☐ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Cobbly medium silt

Total veg cover: 25 % Tree: 0 % Shrub: 0 % Herb: 25 %

Community successional stage:

- ☐ NA
- ■ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ■ Drift and/or debris
- ■ Presence of bed and bank
- ☐ Benches
- ■ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Flood plain is quite active as indicated by lack of vegetation and deposition of debris. The active floodplain is 25 feet wide on the right side and 20 feet wide on the left side.

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ■ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Fine silt over pebbly coarse silt

Total veg cover: 65 % Tree: 15 % Shrub: 25 % Herb: 25 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ■ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ■ Benches
- ☐ Soil development
- ☐ Surface relief
- ■ Other: Upland mature vegetation
- ☐ Other: _____
- ☐ Other: _____

Comments:

There is not a low terrace on the left side of the stream, because it transitions from the active floodplain into the very steep high terrace sideslope. There is a paleo channel within the low terrace on the right side before it transitions onto the very steep high terrace sideslope.

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Alton Private Lease
Project Number: 12ALT OHW 104
Stream: Kanab Creek
Investigator(s): P. Collins & R. Long

Date: 6/12/2012 **Time:** 3:05 pm
Town: Alton, Kane Co **State:** Utah
Photo begin file#: **Photo end file#:**

Y ■ / N ☐ Do normal circumstances exist on the site?

Y ☐ / N ■ Is the site significantly disturbed?

Location Details:
Ephemeral drainage flowing into Kanab Creek

Projection: UTM, 12N **Datum:** 1983
Coordinates: E see sketch N see sketch

Potential anthropogenic influences on the channel system:

1. Cattle grazing
2. Trash has been dumped into top of drainage.

These impacts have probably not had any more impact on the overall condition compared to similar drainages.

Brief site description:

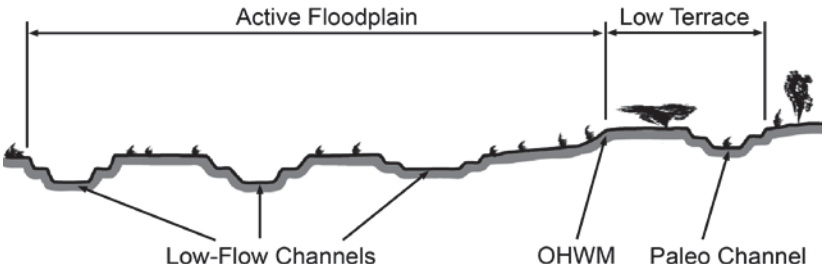
This is a narrow ephemeral drytributary of Kanab Creek. The sample location is about 420 feet north of Kanab Creek and about 1,530 feet upstream from the south boundary. The low flow channel is 2 feet wide with no active floodplain.

Checklist of resources (if available):

- ■ Aerial photography
  Dates:
- ■ Topographic maps
- ■ Geologic maps
- ☐ Vegetation maps
- ■ Soils maps
- ■ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ■ Global positioning system (GPS)
- ☐ Other studies

- ☐ Stream gage data
  Gage number:
  Period of record:
- ☐ History of recent effective discharges
- ☐ Results of flood frequency analysis
- ☐ Most recent shift-adjusted rating
- ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

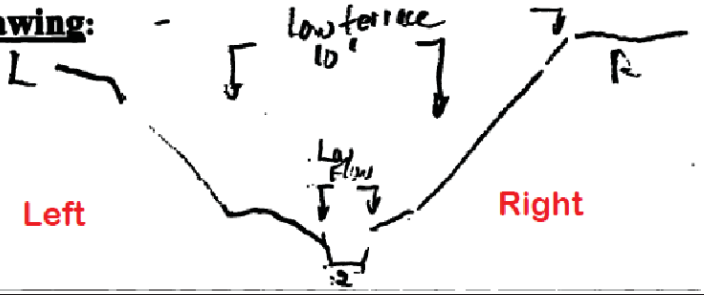


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ■ Mapping on aerial photograph
   - ■ Digitized on computer
   - ■ GPS
   - ☐ Other:

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 104 **Date:** 6/12/2012 **Time:** 3:05 pm

Cross section drawing:



OHWM

GPS point: UTM NAD 1983

	Left		Right	
	Easting	370150.8	Easting	370150.3
	Northing	4142871.3	Northing	4142870.9

Indicators:

- ☑ Change in average sediment texture
- ☑ Change in vegetation species
- ☑ Change in vegetation cover
- ☑ Break in bank slope
- ☐ Other: _____
- ☐ Other: _____

Comments:

Located at upper point where headcutting and erosion begin. No active floodplain; no riparian zone; walked from top to bottom where ephemeral channel enters Kanab Creek.

Cross section sketch was drawn looking downstream. Left (L) and right (R) sides are labled in the sketch.

Floodplain unit: ☑ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Pebbly mediium silt

Total veg cover: 5 % Tree: _____% Shrub: _____% Herb: 5 %

Community successional stage:

- ☐ NA
- ☑ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☑ Presence of bed and bank
- ☐ Benches
- ☑ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

The low flow channel is 2 feet wide in this dry ephemeral drainage.

Project ID: Private Lea **Cross section ID:** 12ALT_OHW 104 **Date:** 6/12/2012 **Time:** 3:05 pm

Floodplain unit: ☐ Low-Flow Channel ■ Active Floodplain ☐ Low Terrace

GPS point: N/A - See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: N/A

Total veg cover: _____ % Tree: _____% Shrub: _____% Herb: _____%

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ■ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Active floodplain was not present in this ephemeral drainage.

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ■ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Medium silt

Total veg cover: 70 % Tree: _____% Shrub: 35 % Herb: 35 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ■ Benches
- ■ Soil development
- ■ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

The low terrace is 4 feet wide on each side of the low flow channel.

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Alton Private Lease
Project Number: 12ALT OHW 105
Stream: Kanab Creek
Investigator(s): P. Collins & R. Long

Date: 6/13/2012 **Time:** 10:39 am
Town: Alton, Kane Co **State:** Utah
Photo begin file#: **Photo end file#:**

Y ■ / N ☐ Do normal circumstances exist on the site?

Y ☐ / N ■ Is the site significantly disturbed?

Location Details:
kanab Creek

Projection: UTM, 12N **Datum:** 1983
Coordinates: E see sketch N see sketch

Potential anthropogenic influences on the channel system:

Heavy cattle grazing use in some adjacent areas, but moderate grazing pressure has occurred in sample area. This site is in a different grazing area from sites 103, 104, and 106.

Brief site description:

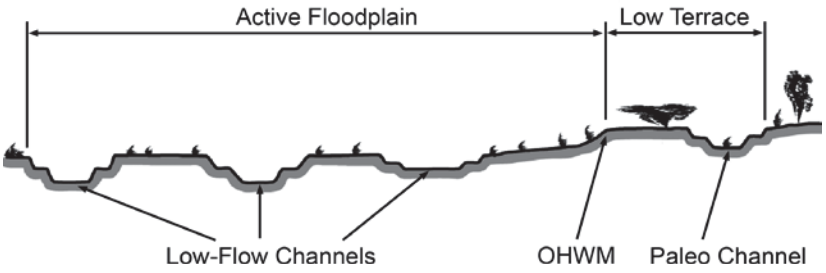
Valley bottom of Kanab Creek. Perennial stream channel location is about 1,590 feet upstream from south boundary. The low flow channel is 16 feet wide

Checklist of resources (if available):

- ■ Aerial photography
  Dates:
- ■ Topographic maps
- ■ Geologic maps
- ☐ Vegetation maps
- ■ Soils maps
- ■ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ■ Global positioning system (GPS)
- ☐ Other studies

- ☐ Stream gage data
  Gage number:
  Period of record:
- ☐ History of recent effective discharges
- ☐ Results of flood frequency analysis
- ☐ Most recent shift-adjusted rating
- ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

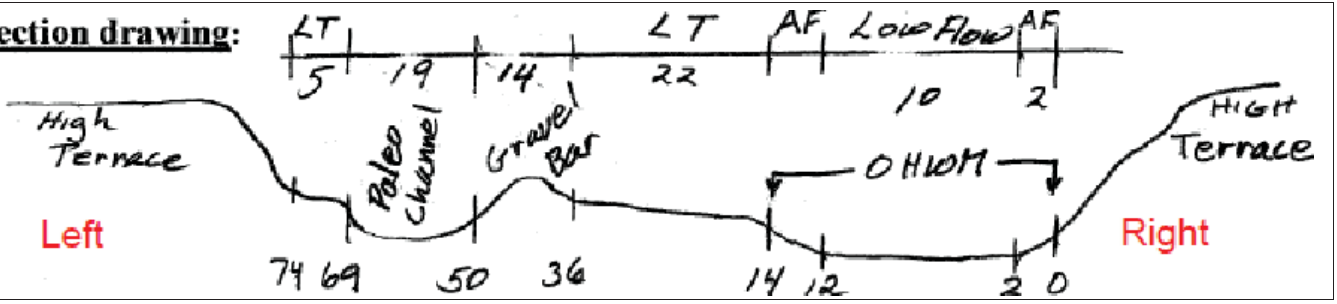


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ■ Mapping on aerial photograph
   - ■ Digitized on computer
   - ■ GPS
   - ☐ Other:

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 105 **Date:** 6/13/2012 **Time:** 10:39 am

Cross section drawing:



OHWM

GPS point: UTM NAD 1983

	Left		Right	
Easting	370042.9		Easting	370038.8
Northing	4142868.9		Northing	4142870.1

Indicators:

- [x] Change in average sediment texture
- [x] Change in vegetation species
- [x] Change in vegetation cover
- [x] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Cross section sketch was drawn looking downstream. Left (L) and right (R) sides are labled in the sketch.

Floodplain unit: [x] Low-Flow Channel [ ] Active Floodplain [ ] Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Fine silt

Total veg cover: 50 % Tree: 10 % Shrub: _____% Herb: 40 %

Community successional stage:

- [ ] NA
- [ ] Early (herbaceous & seedlings)
- [ ] Mid (herbaceous, shrubs, saplings)
- [ ] Late (herbaceous, shrubs, mature trees)

Indicators:

- [ ] Mudcracks
- [ ] Ripples
- [x] Drift and/or debris
- [ ] Presence of bed and bank
- [x] Benches
- [ ] Soil development
- [x] Surface relief
- [ ] Other: _____
- [ ] Other: _____
- [ ] Other: _____

Comments:

The low flow channel is 10 feet wide with water covering all of it at the time of evaluation.

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 105 **Date:** 6/13/2012 **Time:** 10:39 am

Floodplain unit: ☐ Low-Flow Channel ■ Active Floodplain ☐ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Very Pebbly Medium Silt

Total veg cover: 20 % Tree: _____% Shrub: 15 % Herb: 5 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ■ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ■ Benches
- ☐ Soil development
- ■ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

The active floodplain extends 2 feet beyond the low flow channel on both sides.

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ■ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Cobbles

Total veg cover: 25 % Tree: 0 % Shrub: 23 % Herb: 2 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ■ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ■ Benches
- ☐ Soil development
- ■ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

There is not a low terrace on the right side of the channel. The low terrace is 22 feet wide on the left side plus a 14 foot wide gravel bar, followed by a 19 foot wide paleo-channel, and then an additional 5 feet of low terrace before the very steep high terrace sideslope (see drawing and photos).

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Alton Private Lease
Project Number: 12ALT OHW 106
Stream: Kanab Creek
Investigator(s): P. Collins & R. Long

Date: 6/13/2012 **Time:** 1:49 pm
Town: Alton, Kane Co **State:** Utah
Photo begin file#: **Photo end file#:**

Y ■ / N ☐ Do normal circumstances exist on the site?

Y ☐ / N ■ Is the site significantly disturbed?

Location Details:
Kanab Creek

Projection: UTM, 12N **Datum:** 1983
Coordinates: E see sketch N see sketch

Potential anthropogenic influences on the channel system:
Cattle use in this area appears to be low to moderate.

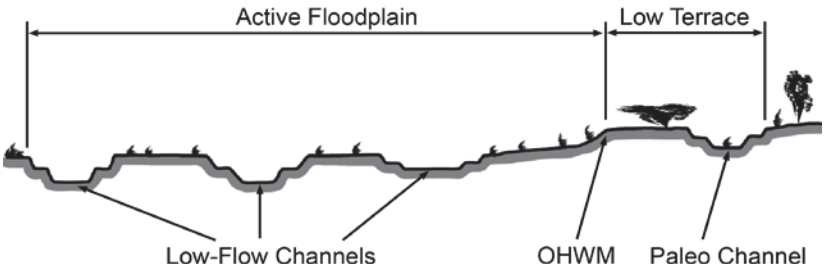
Brief site description:
The floodplain has relatively wider wetland areas at this location compared to sample areas on Kanab Creek south of this location. This perennial channel is about 2,165 feet upstream from south boundary.

Checklist of resources (if available):

- ■ Aerial photography
  Dates:
- ■ Topographic maps
- ■ Geologic maps
- ☐ Vegetation maps
- ■ Soils maps
- ■ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ■ Global positioning system (GPS)
- ☐ Other studies

- ☐ Stream gage data
  Gage number:
  Period of record:
- ☐ History of recent effective discharges
- ☐ Results of flood frequency analysis
- ☐ Most recent shift-adjusted rating
- ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

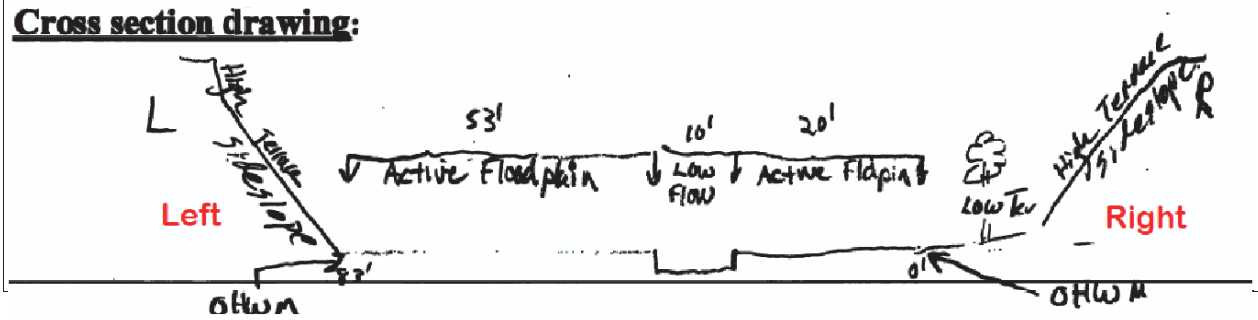


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ■ Mapping on aerial photograph
   - ■ Digitized on computer
   - ■ GPS
   - ☐ Other:

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 106 **Date:** 6/13/2012 **Time:** 1:49 pm

Cross section drawing:



OHWM

GPS point: NAD 1983

	Left		Right	
UTM	Easting	370141.7	Easting	370123.0
	Northing	4143010.0	Northing	4143025.6

Indicators:

- [x] Change in average sediment texture
- [x] Change in vegetation species
- [x] Change in vegetation cover
- [x] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Active floodplain is very wide at this location. Sides of active floodplain are just inside the Russian olive trees (see photos).

Cross section sketch was drawn looking downstream. Left (L) and right (R) sides are labled in the sketch.

Floodplain unit: [x] Low-Flow Channel [ ] Active Floodplain [ ] Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Fine silt

Total veg cover: 90 % Tree: _____% Shrub: _____% Herb: 90 %

Community successional stage:

- [ ] NA
- [ ] Early (herbaceous & seedlings)
- [ ] Mid (herbaceous, shrubs, saplings)
- [x] Late (herbaceous, shrubs, mature trees)

Indicators:

- [ ] Mudcracks
- [ ] Ripples
- [x] Drift and/or debris
- [x] Presence of bed and bank
- [x] Benches
- [x] Soil development
- [x] Surface relief
- [x] Other: Water surface
- [x] Other: Mud deposits
- [ ] Other: _____

Comments:

The low flow channel is 10 feet wide and about 1 foot below the level of the active floodplain. The low flow channel has a thick cover of herbaceous plants (see photos).

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 106 **Date:** 6/13/2012 **Time:** 1:49 pm

Floodplain unit: ☐ Low-Flow Channel ■ Active Floodplain ☐ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Medium silt

Total veg cover: 80 % Tree: 8 % Shrub: 7 % Herb: 65 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ■ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ■ Drift and/or debris
- ■ Presence of bed and bank
- ■ Benches
- ■ Soil development
- ■ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

The active floodplain is 20 feet wide on the right side and 53 feet wide on the left side. The active floodplain on the left side transitions into the very steep high terrace sideslope. The active floodplain has a thick cover of herbaceous plants (see photos) with encroaching shrubs and Russian olive trees on the edges.

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ■ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Medium silt

Total veg cover: 130 % Tree: 60 % Shrub: 0 % Herb: 70 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ■ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ■ Benches
- ■ Soil development
- ■ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

There is not any low terrace on the left side of the cross section. Russian olive trees are present on the right side low terrace. The total vegetative cover value is the sum of understory and overstory.

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Alton Private Lease
Project Number: 12ALT OHW 107
Stream: Kanab Creek
Investigator(s): P. Collins & R. Long

Date: 6/13/2012 **Time:** 4:15 pm
Town: Alton, Kane Co **State:** Utah
Photo begin file#: **Photo end file#:**

Y ■ / N ☐ Do normal circumstances exist on the site?

Y ☐ / N ■ Is the site significantly disturbed?

Location Details:
Kanab Creek

Projection: UTM, 12N **Datum:** 1983
Coordinates: E see sketch N see sketch

Potential anthropogenic influences on the channel system:
Cattle grazing impact is low in this area.

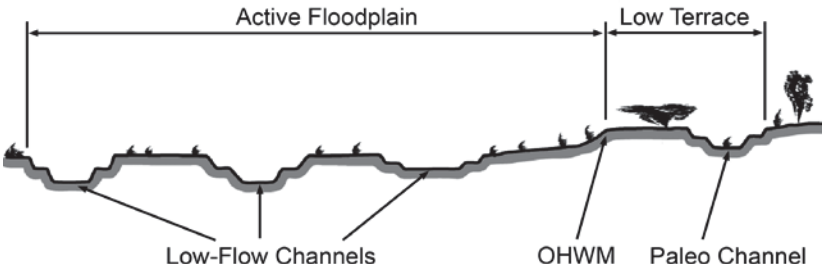
Brief site description:
Perennial channel is wide and the wetland area is also wide in this portion of Kanab Creek. Site is about 3,260 feet upstream from south boundary and 1,545 feet downstream from farm road crossing.

Checklist of resources (if available):

- ■ Aerial photography
  Dates:
- ■ Topographic maps
- ■ Geologic maps
- ☐ Vegetation maps
- ■ Soils maps
- ■ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ■ Global positioning system (GPS)
- ☐ Other studies

- ☐ Stream gage data
  Gage number:
  Period of record:
- ☐ History of recent effective discharges
- ☐ Results of flood frequency analysis
- ☐ Most recent shift-adjusted rating
- ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

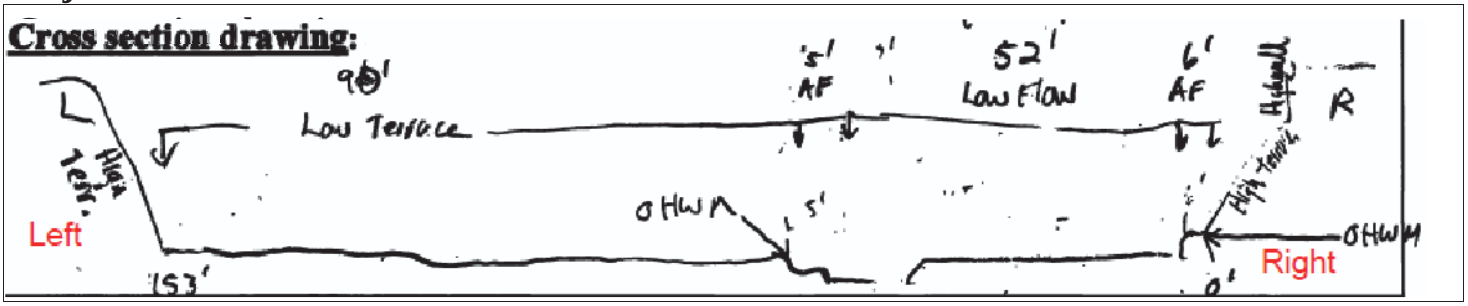


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ■ Mapping on aerial photograph
   - ■ Digitized on computer
   - ■ GPS
   - ☐ Other:

Project ID: **Cross section ID:** 12ALT_OHW 107 **Date:** 6/13/2012 **Time:** 4:15 pm

Cross section drawing:



OHWM **GPS point:** UTM NAD 1983

	Left		Right	
Easting	370243.0		Easting	370225.8
Northing	4143310.8		Northing	4143302.8

Indicators:

- [x] Change in average sediment texture
- [x] Change in vegetation species
- [ ] Change in vegetation cover
- [x] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Cross section sketch was drawn looking downstream. Left (L) and right (R) sides are labled in the sketch.
The low flow channel (52 feet) is nearly as wide as the active floodplain (5 feet wider on the left and 6 feet wider on the right. The low terrace is 90 feet wide on the left, but is not present on the right.

Floodplain unit: [x] Low-Flow Channel [ ] Active Floodplain [ ] Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Pebbly medium silt
Total veg cover: 80 % Tree: 0 % Shrub: 0 % Herb: 80 %
Community successional stage:

- [ ] NA
- [ ] Early (herbaceous & seedlings)
- [ ] Mid (herbaceous, shrubs, saplings)
- [x] Late (herbaceous, shrubs, mature trees)

Indicators:

- [ ] Mudcracks
- [ ] Ripples
- [x] Drift and/or debris
- [x] Presence of bed and bank
- [x] Benches
- [x] Soil development
- [x] Surface relief
- [ ] Other: _____
- [ ] Other: _____
- [ ] Other: _____

Comments:

The low flow area is very wide (52 feet) and does not resemble a "channel." It is entirely covered with 1 to 3 inches of water and has a thick cover of herbaceous plants.

Project ID: **Cross section ID:** 12ALT_OHW 107 **Date:** 6/13/2012 **Time:** 4:15 pm

Floodplain unit: ☐ Low-Flow Channel ■ Active Floodplain ☐ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Pebbly medium silt

Total veg cover: 50 % Tree: 0 % Shrub: 0 % Herb: 50 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ■ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ■ Drift and/or debris
- ☐ Presence of bed and bank
- ■ Benches
- ■ Soil development
- ■ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

The low flow floodplain extends 5 feet beyond the low flow channel on the left and 6 feet beyond it on the right. The edge of the active floodplain transitions directly into the very steep high terrace sideslope on the right.

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ■ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Cobbly medium silt

Total veg cover: 75 % Tree: 0 % Shrub: 30 % Herb: 45 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ■ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ■ Benches
- ■ Soil development
- ■ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

The low terrace is 90 feet wide on the left side of the stream cross section. It has a heavy cover of sagebrush and grasses. There is not any low terrace on the right side.

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Alton Private Lease
Project Number: 12ALT OHW 108
Stream: Kanab Creek
Investigator(s): P. Collins & R. Long

Date: 6/14/2012 **Time:** 9:42 am
Town: Alton, Kane Co **State:** Utah
Photo begin file#: **Photo end file#:**

Y ■ / N ☐ Do normal circumstances exist on the site?

Y ■ / N ☐ Is the site significantly disturbed?

Location Details:
Kanab Creek

Projection: UTM, 12N **Datum:** 1983
Coordinates: E see sketch N see sketch

Potential anthropogenic influences on the channel system:
Low impact from cattle grazing with less pressure than observed downstream.

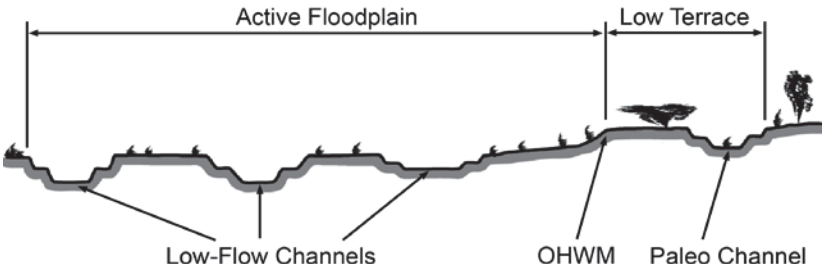
Brief site description:
This unique perennial channel (see notes in "Low Flow" and "Active Floodplain" sections) is located about 3,650 feet upstream from the south boundary and 1,150 feet downstream from the farm road crossing.

Checklist of resources (if available):

- ■ Aerial photography
  Dates:
- ■ Topographic maps
- ■ Geologic maps
- ☐ Vegetation maps
- ■ Soils maps
- ■ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ■ Global positioning system (GPS)
- ☐ Other studies

- ☐ Stream gage data
  Gage number:
  Period of record:
- ☐ History of recent effective discharges
- ☐ Results of flood frequency analysis
- ☐ Most recent shift-adjusted rating
- ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

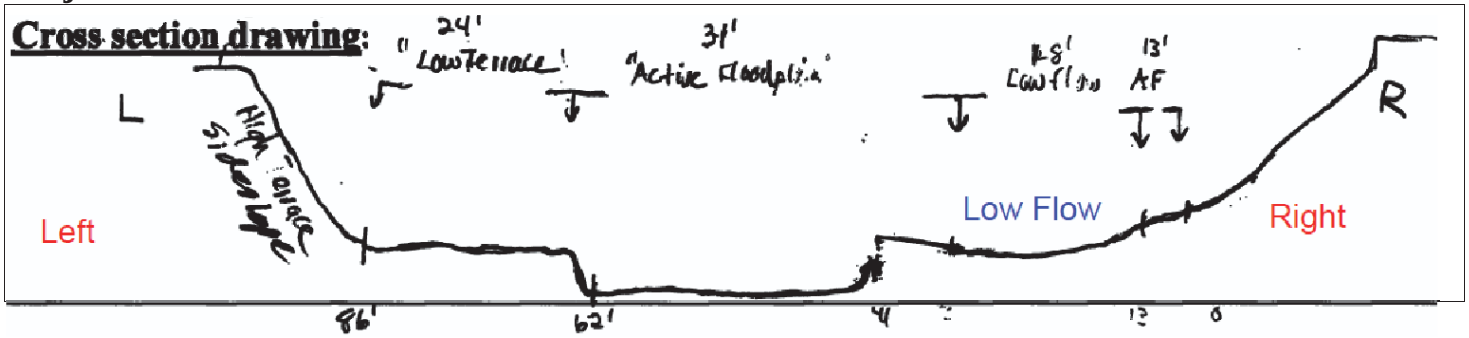


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ■ Mapping on aerial photograph
   - ■ Digitized on computer
   - ■ GPS
   - ☐ Other:

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 108 **Date:** 6/14/2012 **Time:** 9:42 am

Cross section drawing:



OHWM

GPS point: UTM NAD 1983

	Left		Right	
Easting	370199.9		Easting	370185.2
Northing	4143410.5		Northing	4143399.8

Indicators:

- [x] Change in average sediment texture
- [x] Change in vegetation species
- [ ] Change in vegetation cover
- [x] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Cross section sketch was drawn looking downstream. Left (L) and right (R) sides are labled in the sketch.

This is a unique area compared to previously sampled downstream areas (see site photos). The low flow channel is flowing in the concave portion of what is now a "stream terrace" on the right.

Floodplain unit: [x] Low-Flow Channel [ ] Active Floodplain [ ] Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Medium silt

Total veg cover: 90 % Tree: 0 % Shrub: 0 % Herb: 90 %

Community successional stage:

- [ ] NA
- [ ] Early (herbaceous & seedlings)
- [ ] Mid (herbaceous, shrubs, saplings)
- [x] Late (herbaceous, shrubs, mature trees)

Indicators:

- [ ] Mudcracks
- [ ] Ripples
- [x] Drift and/or debris
- [x] Presence of bed and bank
- [x] Benches
- [ ] Soil development
- [x] Surface relief
- [ ] Other: _____
- [ ] Other: _____
- [ ] Other: _____

Comments:

This is a very unique site, because the low flow channel is not in the lowest portion of the cross section. The low flow channel is on a slightly concave bench on the right side of the cross section. Runoff from a large storm or spring runoff (possibly late winter or early spring of 2011) has resulted in a 2 to 3 foot deep erosion channel with cobble bottom on the left side of the cross section. Water is presently confined to the elevated low flow channel (appears to be original channel location).

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 108 **Date:** 6/14/2012 **Time:** 9:42 am

Floodplain unit: ☐ Low-Flow Channel ■ Active Floodplain ☐ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Cobbles (left) and Medium silt (right)

Total veg cover: *____ % Tree: *____% Shrub: *____% Herb: *____% * See notes below.

Community successional stage:

- ☐ NA
- ■ Early (herbaceous & seedlings) Left
- ☐ Mid (herbaceous, shrubs, saplings)
- ■ Late (herbaceous, shrubs, mature trees) Right

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ■ Drift and/or debris
- ■ Presence of bed and bank
- ■ Benches
- ☐ Soil development
- ■ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Active floodplain includes the recent down cut channel described in the "Low Flow" comments (see photos).

* TOTAL VEG COVER

Left Total: 15% Tree: 0% Shrub: 0% Herb: 15%

Right Total: 75% Tree: 0% Shrub: 50% Herb: 25%

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ■ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Pebbly medium silt

Total veg cover: 65 % Tree: 0 % Shrub: 35 % Herb: 30 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

The new erosion channel appears to have been in an area that may have previously been part of the "Low Terrace." When this location was visited on July 25, 2012 the water was still flowing in the "low flow" channel", but the "high water" portion of the perrenial flow was flowing over the headcut and into the erosion channel (the overflow water was not making it to the downstream end). It appears to only be a matter of time until the active channel moves into the eroded cobble channel.

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Alton Private Lease
Project Number: 12ALT OHW 109
Stream: Kanab Creek
Investigator(s): P. Collins & R. Long

Date: 6/14/2012 **Time:** 11:20 am
Town: Alton, Kane Co **State:** Utah
Photo begin file#: **Photo end file#:**

Y ■ / N ☐ Do normal circumstances exist on the site?

Y ☐ / N ■ Is the site significantly disturbed?

Location Details:
Kanab Creek

Projection: UTM, 12N **Datum:** 1983
Coordinates: E see sketch N see sketch

Potential anthropogenic influences on the channel system:
Cattle grazing has been light compared to some downstream reaches.

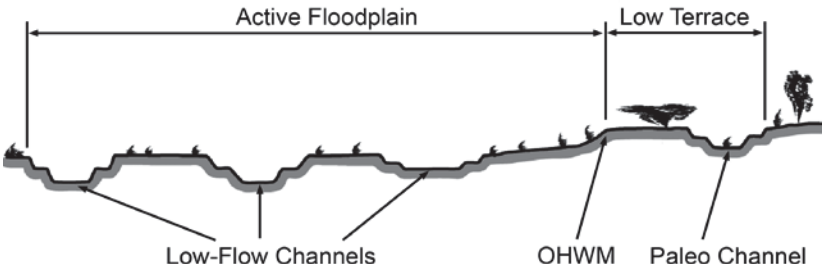
Brief site description:
Perennial stream channel about 560 feet downstream from the farm road crossing and about 4,240 feet upstream from the south boundary. The active floodplain is wide.

Checklist of resources (if available):

- ■ Aerial photography
  Dates:
- ■ Topographic maps
- ■ Geologic maps
- ☐ Vegetation maps
- ■ Soils maps
- ■ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ■ Global positioning system (GPS)
- ☐ Other studies

- ☐ Stream gage data
  Gage number:
  Period of record:
- ☐ History of recent effective discharges
- ☐ Results of flood frequency analysis
- ☐ Most recent shift-adjusted rating
- ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

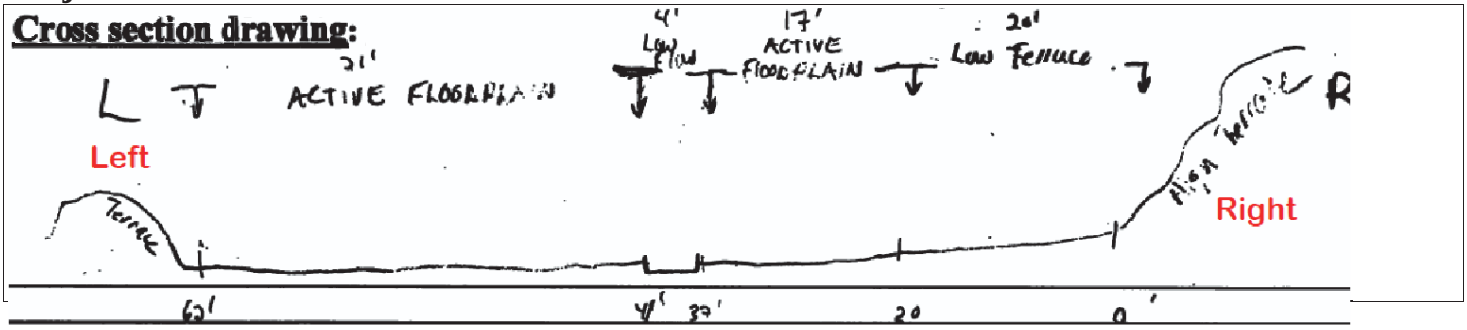


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ■ Mapping on aerial photograph
   - ■ Digitized on computer
   - ■ GPS
   - ☐ Other:

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 109 **Date:** 6/14/2012 **Time:** 11:20 am

Cross section drawing:



OHWM

GPS point: UTM NAD 1983

	Left		Right	
Easting	370237.8		Easting	370250.6
Northing	4143549.7		Northing	4143552.2

Indicators:

- [x] Change in average sediment texture
- [x] Change in vegetation species
- [x] Change in vegetation cover
- [x] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Cross section sketch was drawn looking downstream. Left (L) and right (R) sides are labeled in the sketch. The low flow channel is 4 feet wide. The active flood plain is 21 feet wide on the left and 17 feet wide on the right. There is a 20 foot wide low terrace on the right side.

Floodplain unit: [x] Low-Flow Channel [ ] Active Floodplain [ ] Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Medium silt

Total veg cover: 35 % Tree: 0 % Shrub: 0 % Herb: 35 %

Community successional stage:

- [ ] NA
- [ ] Early (herbaceous & seedlings)
- [ ] Mid (herbaceous, shrubs, saplings)
- [x] Late (herbaceous, shrubs, mature trees)

Indicators:

- [ ] Mudcracks
- [ ] Ripples
- [ ] Drift and/or debris
- [x] Presence of bed and bank
- [x] Benches
- [ ] Soil development
- [ ] Surface relief
- [ ] Other: _____
- [ ] Other: _____
- [ ] Other: _____

Comments:

The low flow channel is 4 feet wide. When this site was visited on July 25, 2012 the "low flow" channel was bank full with water spreading out across part of the active floodplain.

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 109 **Date:** 6/14/2012 **Time:** 11:20 am

Floodplain unit: ☐ Low-Flow Channel ■ Active Floodplain ☐ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Gravelly medium silt

Total veg cover: 45 % Tree: 0 % Shrub: 0 % Herb: 45 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ■ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ■ Drift and/or debris
- ☐ Presence of bed and bank
- ■ Benches
- ☐ Soil development
- ■ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

The active floodplain is 21 feet wide on the left and 17 feet wide on the right.

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ■ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Gravelly medium silt

Total veg cover: 50 % Tree: 0 % Shrub: 35 % Herb: 15 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ■ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ■ Benches
- ■ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

The low terraces transition into the very steep high terrace sideslopes.

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Alton Private Lease
Project Number: 12ALT OHW 110
Stream: Kanab Creek
Investigator(s): P. Collins & R. Long

Date: 6/14/2012 **Time:** 4:21 pm
Town: Alton, Kane Co **State:** Utah
Photo begin file#: **Photo end file#:**

Y ■ / N ☐ Do normal circumstances exist on the site?

Y ☐ / N ■ Is the site significantly disturbed?

Location Details:
Kanab Creek

Projection: UTM, 12N **Datum:** 1983
Coordinates: E see sketch N see sketch

Potential anthropogenic influences on the channel system:

Trash has been dumped at the top of the high terrace side channels. Grazing use appears to be limted in this area north of the farm road crossing.

Brief site description:

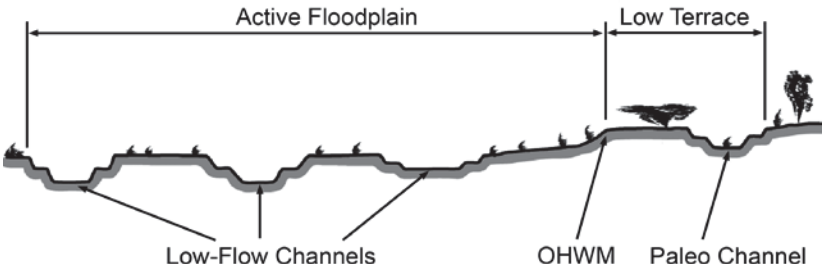
Perennial stream channel about 300 feet north of the farm road crossing and 5,120 feet upstream from the south boundary.

Checklist of resources (if available):

- ■ Aerial photography
  Dates:
- ■ Topographic maps
- ■ Geologic maps
- ☐ Vegetation maps
- ■ Soils maps
- ■ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ■ Global positioning system (GPS)
- ☐ Other studies

- ☐ Stream gage data
  Gage number:
  Period of record:
- ☐ History of recent effective discharges
- ☐ Results of flood frequency analysis
- ☐ Most recent shift-adjusted rating
- ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

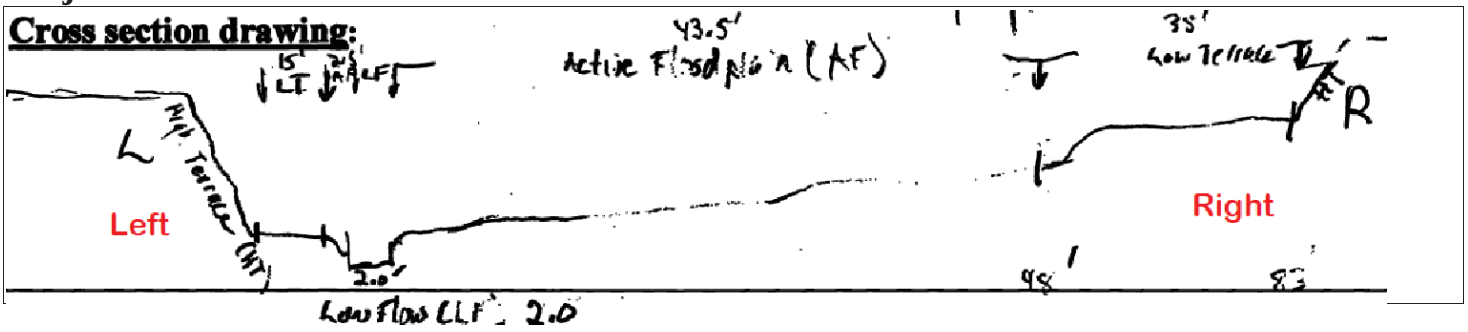


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ■ Mapping on aerial photograph
   - ■ Digitized on computer
   - ■ GPS
   - ☐ Other:

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 110 **Date:** 6/14/2012 **Time:** 4:21 pm

Cross section drawing:



OHWM

GPS point: UTM NAD 1983

Left Easting	370390.1	Right Easting	370382.0
Left Northing	4143746.2	Right Northing	4143757.8

Indicators:

- ☑ Change in average sediment texture
- ☑ Change in vegetation species
- ☑ Change in vegetation cover
- ☑ Break in bank slope
- ☐ Other: _____
- ☐ Other: _____

Comments:

Cross section sketch was drawn looking downstream. Left (L) and right (R) sides are labled in the sketch. The low flow channel is 2 feet wide. The active flood plain is 2.5 feet wide on the left and 43.5 feet wide on the right. There is a 15 foot wide low terrace on the left and a 35 foot wide low terrace on the right.

Floodplain unit: ☑ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Pebbles

Total veg cover: 0 % Tree: 0 % Shrub: 0 % Herb: 0 %

Community successional stage:

- ☑ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☑ Presence of bed and bank
- ☑ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

The low flow channel is 2 feet wide.

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 110 **Date:** 6/14/2012 **Time:** 4:21 pm

Floodplain unit: ☐ Low-Flow Channel ■ Active Floodplain ☐ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Medium silt

Total veg cover: 85 % Tree: 0 % Shrub: 20 % Herb: 65 %

Community successional stage:

- ☐ NA
- ■ Mid (herbaceous, shrubs, saplings)
- ☐ Early (herbaceous & seedlings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

The active floodplain is 2.5 feet wide on the left and 43.5 feet wide on the right. Vegetation on the active floodplain is a mix of willows, wild rose, and herbaceous plants. Russian olive trees are growing at the edge of the low terrace.

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ■ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Very cobbly medium silt

Total veg cover: 75 % Tree: 15 % Shrub: 15 % Herb: 45 %

Community successional stage:

- ☐ NA
- ■ Mid (herbaceous, shrubs, saplings)
- ☐ Early (herbaceous & seedlings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ■ Benches
- ■ Soil development
- ■ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

The low terrace is 15 feet wide on the left and 35 feet wide on the right. There is a significant amount of Russian olives growing on the low terraces.

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Alton Private Lease
Project Number: 12ALT OHW 111
Stream: Kanab Creek
Investigator(s): P. Collins & R. Long

Date: 6/14/2012 **Time:** 2:44 pm
Town: Alton, Kane Co **State:** Utah
Photo begin file#: **Photo end file#:**

Y ■ / N ☐ Do normal circumstances exist on the site?

Y ☐ / N ■ Is the site significantly disturbed?

Location Details:
Kanab Creek

Projection: UTM, 12N **Datum:** 1983
Coordinates: E see sketch N see sketch

Potential anthropogenic influences on the channel system:

This area is used for livestock grazing, but impact appears to be limited to moderate. Dumping of trash in high terrace side channels is common in this area.

Brief site description:

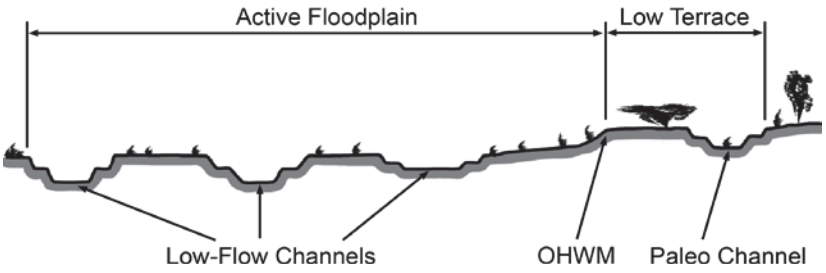
Perennial stream channel 1,065 feet upstream from the farm road crossing and 5,865 feet upstream from the south boundary. The low flow channel is 1.5 feet wide with 3.5 foot active floodplain on the left and 12 feet on the right. There is a low terrace on both sides of the cross section.

Checklist of resources (if available):

- ■ Aerial photography
  Dates:
- ■ Topographic maps
- ■ Geologic maps
- ☐ Vegetation maps
- ■ Soils maps
- ■ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ■ Global positioning system (GPS)
- ☐ Other studies

- ☐ Stream gage data
  Gage number:
  Period of record:
- ☐ History of recent effective discharges
- ☐ Results of flood frequency analysis
- ☐ Most recent shift-adjusted rating
- ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

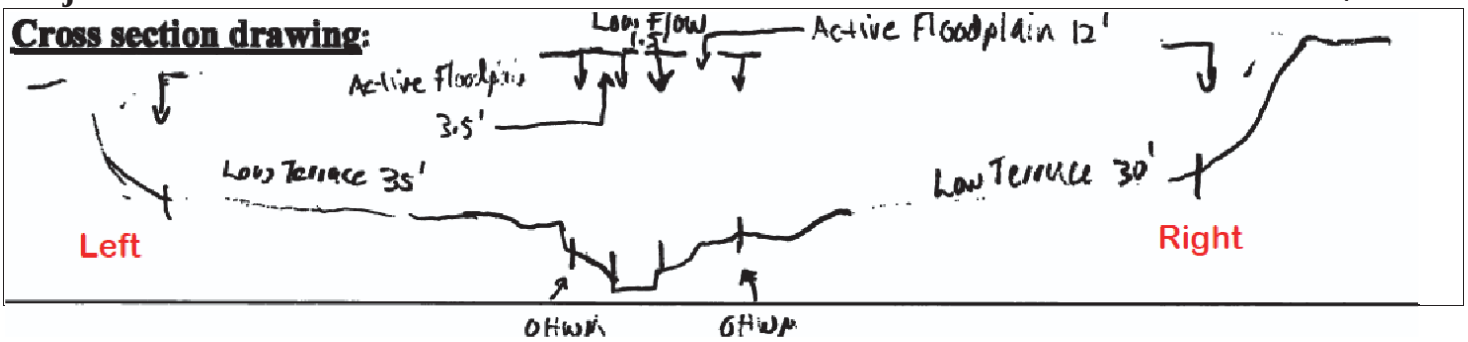


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ■ Mapping on aerial photograph
   - ■ Digitized on computer
   - ■ GPS
   - ☐ Other:

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 111 **Date:** 6/14/2012 **Time:** 2:44 pm

Cross section drawing:



OHWM

GPS point: UTM NAD 1983

	Left		Right	
	Easting	370498.6	Easting	370495.5
	Northing	4143928.8	Northing	4143930.6

Indicators:

- [x] Change in average sediment texture
- [x] Change in vegetation species
- [x] Change in vegetation cover
- [x] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Cross section sketch was drawn looking downstream. Left (L) and right (R) sides are labled in the sketch.
The low flow channel is 1.5 feet wide with a 3.5 feet active floodplain on the left and 12 feet on the right. There is a low terrace on both sides of the cross section.

Floodplain unit: [x] Low-Flow Channel [ ] Active Floodplain [ ] Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Pebbles
Total veg cover: 0 % Tree: 0 % Shrub: 0 % Herb: 0 %
Community successional stage:

- [x] NA
- [ ] Early (herbaceous & seedlings)
- [ ] Mid (herbaceous, shrubs, saplings)
- [ ] Late (herbaceous, shrubs, mature trees)

Indicators:

- [ ] Mudcracks
- [ ] Ripples
- [ ] Drift and/or debris
- [x] Presence of bed and bank
- [x] Benches
- [ ] Soil development
- [x] Surface relief
- [ ] Other: _____
- [ ] Other: _____
- [ ] Other: _____

Comments:

There is no vegetation in the low flow channel which is 1.5 feet wide.

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 111 **Date:** 6/14/2012 **Time:** 2:44 pm

Floodplain unit: ☐ Low-Flow Channel ■ Active Floodplain ☐ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Medium silt

Total veg cover: 35 % Tree: 0 % Shrub: 15 % Herb: 20 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ■ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ■ Drift and/or debris
- ■ Presence of bed and bank
- ■ Benches
- ■ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

The active floodplain is 3.5 feet wide on the left and 12 feet wide on the right. There are deposits of large debris at the OHWM.

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ■ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Very pebbly medium silt

Total veg cover: 60 % Tree: 20 % Shrub: 10 % Herb: 30 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ■ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ■ Drift and/or debris
- ☐ Presence of bed and bank
- ■ Benches
- ■ Soil development
- ■ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

The low terrace is 35 feet wide on the left and 30 feet wide on the right. Vegetation on the low terrace includes Russian olive, willows, and wild rose.

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Alton Private Lease
Project Number: 12ALT OHW 112
Stream: Kanab Creek
Investigator(s): P. Collins & R. Long

Date: 6/20/2012 **Time:** 4:05 pm
Town: Alton, Kane Co **State:** Utah
Photo begin file#: **Photo end file#:**

Y ■ / N ☐ Do normal circumstances exist on the site?

Y ☐ / N ■ Is the site significantly disturbed?

Location Details:
Kanab Creek

Projection: UTM, 12N **Datum:** 1983
Coordinates: E see sketch N see sketch

Potential anthropogenic influences on the channel system:
Cattle grazing in this area is less than along the water in Kanab Creek.

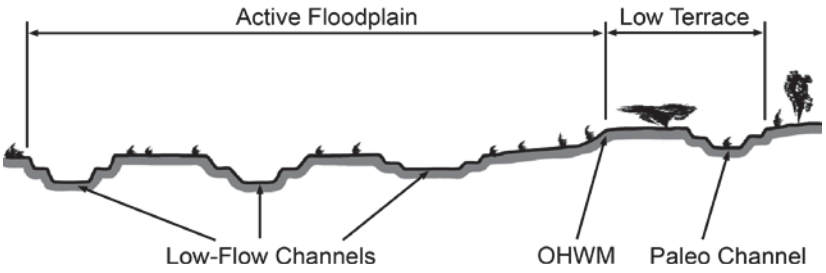
Brief site description:
This is a dry ephemeral drainage that flows into Kanab Creek from the north. This cross section is about 400 feet upstream from Kanab Creek and about 2,060 feet upstream from the south boundary. The low flow and active floodplain are the same (5 feet). There is a six foot wide low terrace on the left and the very steep high terrace sideslope on the right.

Checklist of resources (if available):

- ■ Aerial photography
  Dates:
- ■ Topographic maps
- ■ Geologic maps
- ☐ Vegetation maps
- ■ Soils maps
- ■ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ■ Global positioning system (GPS)
- ☐ Other studies

- ☐ Stream gage data
  Gage number:
  Period of record:
- ☐ History of recent effective discharges
- ☐ Results of flood frequency analysis
- ☐ Most recent shift-adjusted rating
- ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

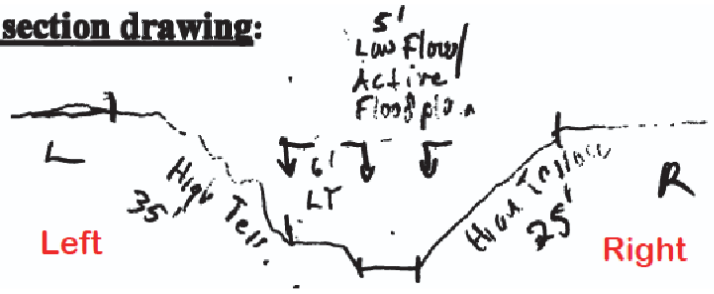


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ■ Mapping on aerial photograph
   - ■ Digitized on computer
   - ■ GPS
   - ☐ Other:

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 112 **Date:** 6/20/2012 **Time:** 4:05 pm

Cross section drawing:



OHWM

GPS point: UTM NAD 1983

	Left		Right	
Easting	370027.7		Easting	370026.0
Northing	4143007.9		Northing	4143007.6

Indicators:

- [x] Change in average sediment texture
- [x] Change in vegetation species
- [x] Change in vegetation cover
- [x] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Cross section sketch was drawn looking downstream. Left (L) and right (R) sides are labled in the sketch.
The low flow and active floodplain are the same (5 feet wide). There is a six foot wide low terrace on the left and the very steep high terrace sideslope on the right.

Floodplain unit: [x] Low-Flow Channel [x] Active Floodplain [ ] Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Medium silt
Total veg cover: 40 % Tree: 0 % Shrub: 15 % Herb: 25 %
Community successional stage:

- [ ] NA
- [ ] Early (herbaceous & seedlings)
- [x] Mid (herbaceous, shrubs, saplings)
- [ ] Late (herbaceous, shrubs, mature trees)

Indicators:

- [ ] Mudcracks
- [ ] Ripples
- [x] Drift and/or debris
- [ ] Presence of bed and bank
- [ ] Benches
- [x] Soil development
- [x] Surface relief
- [ ] Other: _____
- [ ] Other: _____
- [ ] Other: _____

Comments:

The low flow terrace and active floodplain are one and the same (5 feet wide)

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 112 **Date:** 6/20/2012 **Time:** 4:05 pm

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☒ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Medium silt

Total veg cover: 65 % Tree: 0 % Shrub: 60 % Herb: 5 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☒ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☒ Benches
- ☒ Soil development
- ☒ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

The low terrace is 6 feet wide and only on the left side.

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: _____

Total veg cover: _____ % Tree: _____% Shrub: _____% Herb: _____%

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Alton Private Lease
Project Number: 12ALT OHW 201
Stream: Kanab Creek
Investigator(s): P. Collins & R. Long

Date: 6/15/2012 **Time:** 11:30 am
Town: Alton, Kane Co **State:** Utah
Photo begin file#: **Photo end file#:**

Y ■ / N ☐ Do normal circumstances exist on the site?

Y ■ / N ☐ Is the site significantly disturbed?

Location Details:
Intermittent stream west of Kanab Creek

Projection: UTM, 12N **Datum:** 1983
Coordinates: E see sketch N see sketch

Potential anthropogenic influences on the channel system:
Heavy cattle use along and in this intermittent stream.

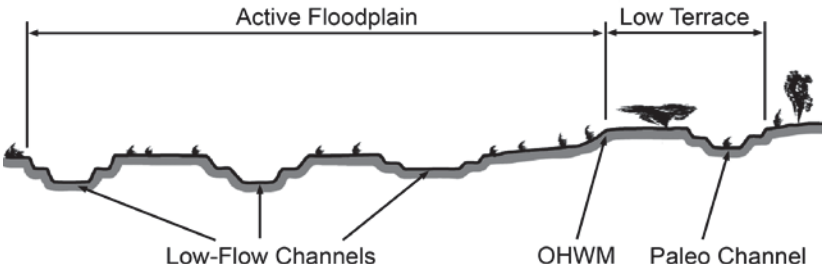
Brief site description:
Narrow intermittent stream immediately west of Kanab Creek. This drainage flows into Kanab Creek south of the main road. Sample location is 2,100 feet upstream from the main road and 575 feet downstream from the elk fence.

Checklist of resources (if available):

- ■ Aerial photography
  Dates:
- ■ Topographic maps
- ■ Geologic maps
- ☐ Vegetation maps
- ■ Soils maps
- ■ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ■ Global positioning system (GPS)
- ☐ Other studies

- ☐ Stream gage data
  Gage number:
  Period of record:
- ☐ History of recent effective discharges
- ☐ Results of flood frequency analysis
- ☐ Most recent shift-adjusted rating
- ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

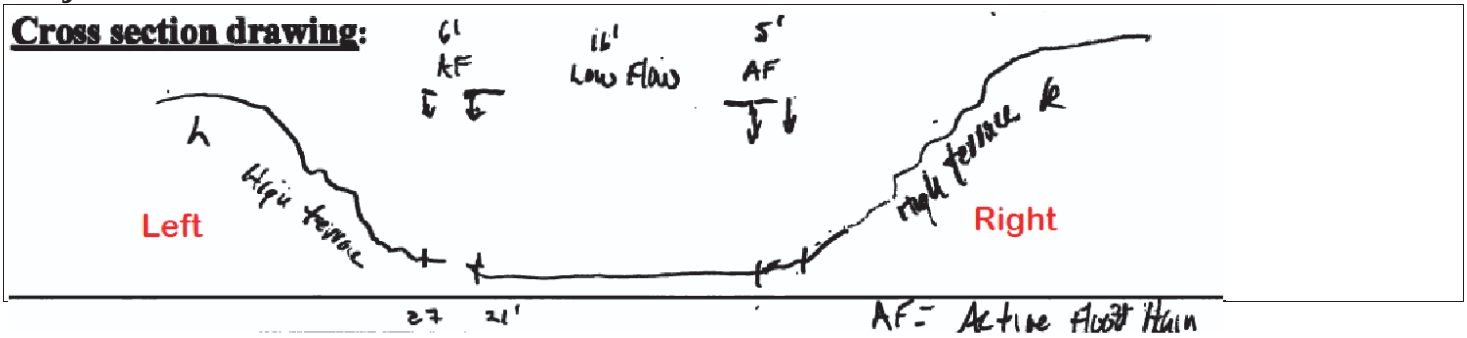


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ■ Mapping on aerial photograph
   - ■ Digitized on computer
   - ■ GPS
   - ☐ Other:

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 201 **Date:** 6/15/2012 **Time:** 11:30 am

Cross section drawing:



OHWM

GPS point: UTM NAD 1983

	Left		Right	
Easting	369942.5		Easting	369935.5
Northing	4143104.3		Northing	4143106.8

Indicators:

- ☑ Change in average sediment texture
- ☑ Change in vegetation species
- ☑ Change in vegetation cover
- ☑ Break in bank slope
- ☐ Other: _____
- ☐ Other: _____

Comments:

Cross section sketch was drawn looking downstream. Left (L) and right (R) sides are labeled in the sketch.
The low flow channel is 16 feet wide and the active floodplain extends 6 feet on the left and 5 feet on the right. The active floodplain transitions directly into the very steep high terrace sideslope on both sides.

Floodplain unit: ☑ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Medium silt
Total veg cover: 50 % Tree: 0 % Shrub: 0 % Herb: 50 %
Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☑ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☑ Drift and/or debris
- ☐ Presence of bed and bank
- ☑ Benches
- ☐ Soil development
- ☑ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

The low flow channel was covered with water 1 to 3 inches deep on about 90 to 95 percent of the area. The low flow channel is 16 feet wide and has a moderate to thick cover of herbaceous plants.

Project ID: Private Lease **Cross section ID:** 12ALT OHW **Date:** 6/15/2012 **Time:** 11:30 am

Floodplain unit: ☐ Low-Flow Channel ■ Active Floodplain ☐ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Medium silt

Total veg cover: 40 % Tree: 0 % Shrub: 10 % Herb: 30 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ■ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ■ Drift and/or debris
- ☐ Presence of bed and bank
- ■ Benches
- ■ Soil development
- ■ Surface relief
- ■ Other: Cattle trails
- ☐ Other: _____
- ☐ Other: _____

Comments:

The active floodplain extends beyond the low flow channel 6 feet on the left and 5 feet on the right. There are heavily used cattle trails just above the active flood plain on both sides cut into the very steep toe of the high terrace sideslope.

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: _____

Total veg cover: _____ % Tree: _____% Shrub: _____% Herb: _____%

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

There are no low terraces along this reach of the intermittent stream.

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Alton Private Lease
Project Number: 12ALT OHW 202
Stream: Kanab Creek
Investigator(s): P. Collins & R. Long

Date: 6/15/2012 **Time:** 12:57 pm
Town: Alton, Kane Co **State:** Utah
Photo begin file#: **Photo end file#:**

Y ■ / N ☐ Do normal circumstances exist on the site?

Y ☐ / N ■ Is the site significantly disturbed?

Location Details:
Intermittent stream west of Kanab Creek

Projection: UTM, 12N **Datum:** 1983
Coordinates: E see sketch N see sketch

Potential anthropogenic influences on the channel system:
Heavy pressure from cattle grazing along and in this reach of intermittent stream.

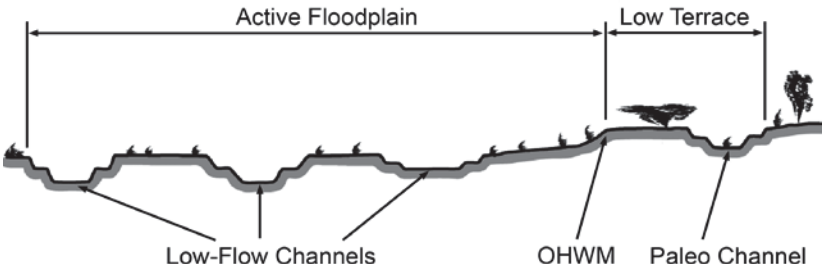
Brief site description:
Intermittent stream is in drainage just west of Kanab Creek. Sample location is 925 feet upstream from main road. This intermittent stream flows into Kanab Creek south of the main road.

Checklist of resources (if available):

- ■ Aerial photography
  Dates:
- ■ Topographic maps
- ■ Geologic maps
- ☐ Vegetation maps
- ■ Soils maps
- ■ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ■ Global positioning system (GPS)
- ☐ Other studies

- ☐ Stream gage data
  Gage number:
  Period of record:
- ☐ History of recent effective discharges
- ☐ Results of flood frequency analysis
- ☐ Most recent shift-adjusted rating
- ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

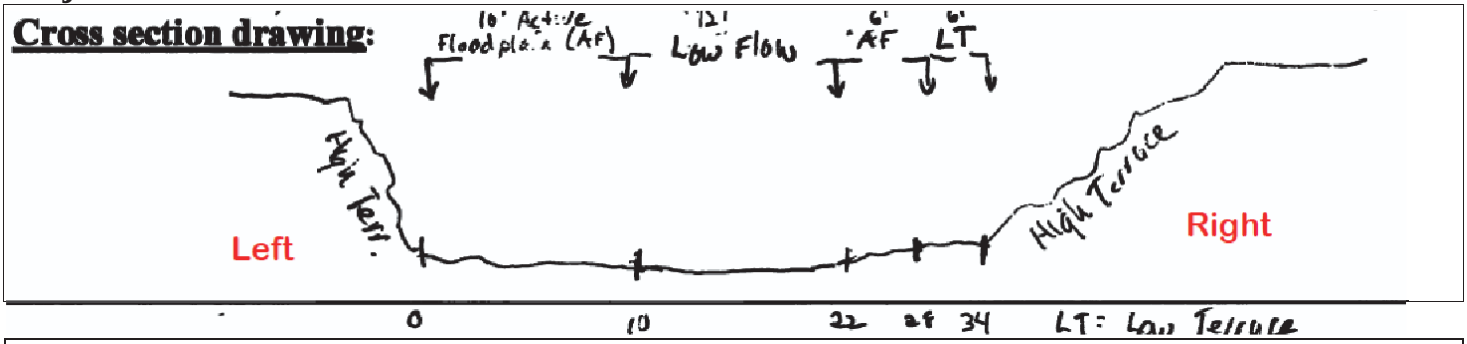


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ■ Mapping on aerial photograph
   - ■ Digitized on computer
   - ■ GPS
   - ☐ Other:

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 202 **Date:** 6/15/2012 **Time:** 12:57 pm

Cross section drawing:



OHWM

GPS point: UTM NAD 1983

	Left		Right	
Easting	369967.1		Easting	369960.4
Northing	4142771.4		Northing	4142765.2

Indicators:

- [x] Change in average sediment texture
- [x] Change in vegetation species
- [x] Change in vegetation cover
- [x] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Cross section sketch was drawn looking downstream. Left (L) and right (R) sides are labeled in the sketch. There is water in the low flow zone along with heavy vegetation cover.

Floodplain unit: [x] Low-Flow Channel [ ] Active Floodplain [ ] Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Fine silt

Total veg cover: 90 % Tree: 0 % Shrub: 0 % Herb: 90 %

Community successional stage:

- [ ] NA
- [ ] Early (herbaceous & seedlings)
- [ ] Mid (herbaceous, shrubs, saplings)
- [x] Late (herbaceous, shrubs, mature trees)

Indicators:

- [ ] Mudcracks
- [ ] Ripples
- [x] Drift and/or debris
- [ ] Presence of bed and bank
- [ ] Benches
- [x] Soil development
- [x] Surface relief
- [ ] Other: _____
- [ ] Other: _____
- [ ] Other: _____

Comments:

The low flow channel covers the bottom of the intermittent stream drainage. There was 1 to 3 inches of water on the surface. It is 12 feet wide with a thick cover of herbaceous plants. The surface water appears to be perching on a heavy clay subsoil horizon.

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 202 **Date:** 6/15/2012 **Time:** 12:57 pm

Floodplain unit: ☐ Low-Flow Channel ■ Active Floodplain ☐ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Medium silt

Total veg cover: _____ % Tree: _____% Shrub: _____% Herb: _____%

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ■ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ■ Drift and/or debris
- ☐ Presence of bed and bank
- ■ Benches
- ■ Soil development
- ■ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

A significant amount of large and small debris marks this location. There are cattle trails along both sides of the active floodplain zone which is 10 feet wide on the left and 6 feet wide on the right. There is thick cover of herbaceous plants.

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ■ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Medium silt

Total veg cover: 35 % Tree: 0 % Shrub: 25 % Herb: 10 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ■ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ■ Soil development
- ■ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Cattle trails affect vegetation cover in this zone. The low terrace is 6 feet wide on the right. There is not a low terrace on the left (see sketch above and photos).

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Alton Private Lease
Project Number: 12ALT OHW 203
Stream: Kanab Creek
Investigator(s): P. Collins & R. Long

Date: 6/19/2012 **Time:** 12:51 pm
Town: Alton, Kane Co **State:** Utah
Photo begin file#: **Photo end file#:**

Y ■ / N □ Do normal circumstances exist on the site?

Y □ / N ■ Is the site significantly disturbed?

Location Details:
Intermittent stream west of Kanab Creek

Projection: UTM, 12N **Datum:** 1983
Coordinates: E see sketch N see sketch

Potential anthropogenic influences on the channel system:
Cattle grazing has impacted this area with the low flow channel also serving as a cattle trail.

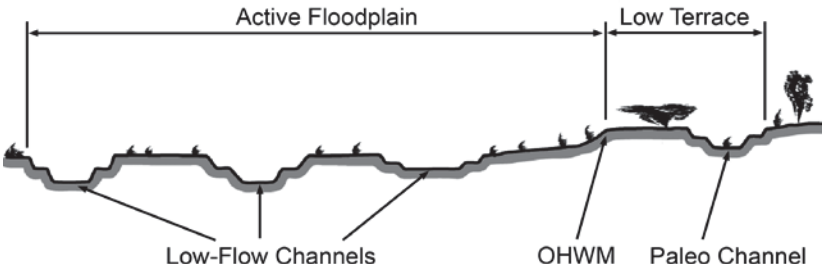
Brief site description:
This is an intermittent stream that was dry at the time it was evaluated, but it appears to be moist earlier in the year. Sample location is downstream from the convergence of an ephemeral drainage and intermittent stream just west of Kanab Creek. The low flow channel is 2 feet wide and the active floodplain extends 27.5 feet on the left and 24.5 feet on the right.

Checklist of resources (if available):

- ■ Aerial photography
  Dates:
- ■ Topographic maps
- ■ Geologic maps
- □ Vegetation maps
- ■ Soils maps
- ■ Rainfall/precipitation maps
- □ Existing delineation(s) for site
- ■ Global positioning system (GPS)
- □ Other studies

- □ Stream gage data
  Gage number:
  Period of record:
- □ History of recent effective discharges
- □ Results of flood frequency analysis
- □ Most recent shift-adjusted rating
- □ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

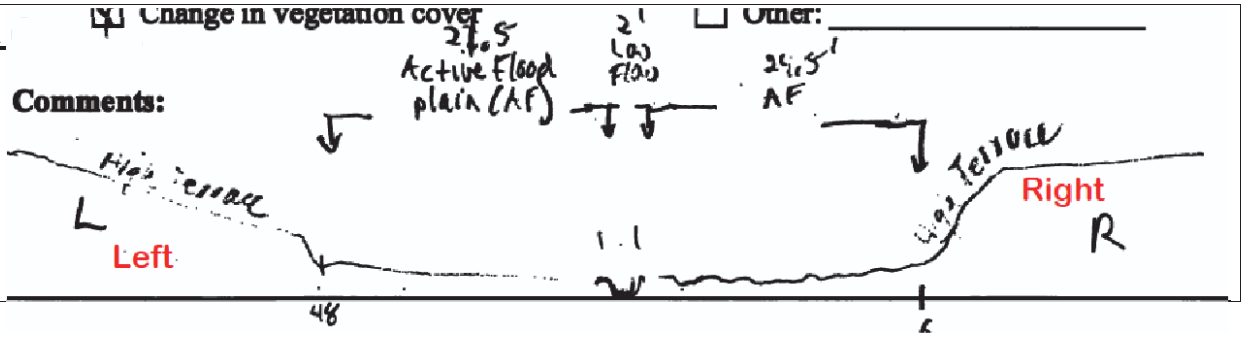


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ■ Mapping on aerial photograph
   - ■ Digitized on computer
   - ■ GPS
   - □ Other:

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 203 **Date:** 6/19/2012 **Time:** 12:51 pm

Cross section



OHWM

GPS point: UTM NAD 1983

	Left		Right	
	Easting	370009.8	Easting	369998.6
	Northing	4142601.7	Northing	4142594.2

Indicators:

- [x] Change in average sediment texture
- [x] Change in vegetation species
- [x] Change in vegetation cover
- [x] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Cross section sketch was drawn looking downstream. Left (L) and right (R) sides are labled in the sketch. The low flow channel is 2 feet wide and the active floodplain extends 27.5 feet on the left and 24.5 feet on the right. There is a heavy cover of herbaceous plants in this reach of the intermittent stream.

Floodplain unit: [x] Low-Flow Channel [ ] Active Floodplain [ ] Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Fine silt

Total veg cover: 50 % Tree: 0 % Shrub: 0 % Herb: 50 %

Community successional stage:

- [ ] NA
- [ ] Early (herbaceous & seedlings)
- [x] Mid (herbaceous, shrubs, saplings)
- [ ] Late (herbaceous, shrubs, mature trees)

Indicators:

- [ ] Mudcracks
- [ ] Ripples
- [x] Drift and/or debris
- [ ] Presence of bed and bank
- [x] Benches
- [ ] Soil development
- [x] Surface relief
- [ ] Other: _____
- [ ] Other: _____
- [ ] Other: _____

Comments:

The low flow channel is 2 feet wide and also serves as a cattle trail. This zone is bare in some areas.

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 203 **Date:** 6/19/2012 **Time:** 12:51 pm

Floodplain unit: ☐ Low-Flow Channel ■ Active Floodplain ☐ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Medium silt

Total veg cover: 65 % Tree: 0 % Shrub: 25 % Herb: 40 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ■ Drift and/or debris
- ☐ Presence of bed and bank
- ■ Benches
- ■ Soil development
- ■ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Willows, iris, and wiregrass dominate vegetation in this zone. The Active floodplain extends beyond the low flow channel for 27.5 feet on the left and 24.5 feet on the right.

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ■ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Medium silt

Total veg cover: 85 % Tree: _____% Shrub: 70 % Herb: 10 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ■ Benches
- ■ Soil development
- ■ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

The high terrace slopes down to become the 'low terrace' at this south end of the intermittent stream.

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Alton Private Lease
Project Number: 12ALT OHW 204
Stream: Kanab Creek
Investigator(s): P. Collins & R. Long

Date: 6/21/2012 **Time:** 4:59 pm
Town: Alton, Kane Co **State:** Utah
Photo begin file#: **Photo end file#:**

Y ■ / N ☐ Do normal circumstances exist on the site?

Y ☐ / N ■ Is the site significantly disturbed?

Location Details:
Intermittent stream west of Kanab Creek

Projection: UTM, 12N **Datum:** 1983
Coordinates: E see sketch N see sketch

Potential anthropogenic influences on the channel system:
There is some cattle use in this area due to the stock pond just north of the elk fence.

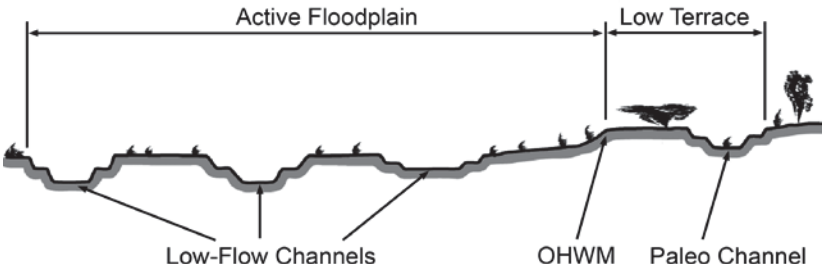
Brief site description:
This is the north end of an intermittent stream in the drainage just west of Kanab Creek. The sample location is 390 feet upstream from the elk fence and about 980 feet south of the farm road.

Checklist of resources (if available):

- ■ Aerial photography
  Dates:
- ■ Topographic maps
- ■ Geologic maps
- ☐ Vegetation maps
- ■ Soils maps
- ■ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ■ Global positioning system (GPS)
- ☐ Other studies

- ☐ Stream gage data
  Gage number:
  Period of record:
- ☐ History of recent effective discharges
- ☐ Results of flood frequency analysis
- ☐ Most recent shift-adjusted rating
- ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

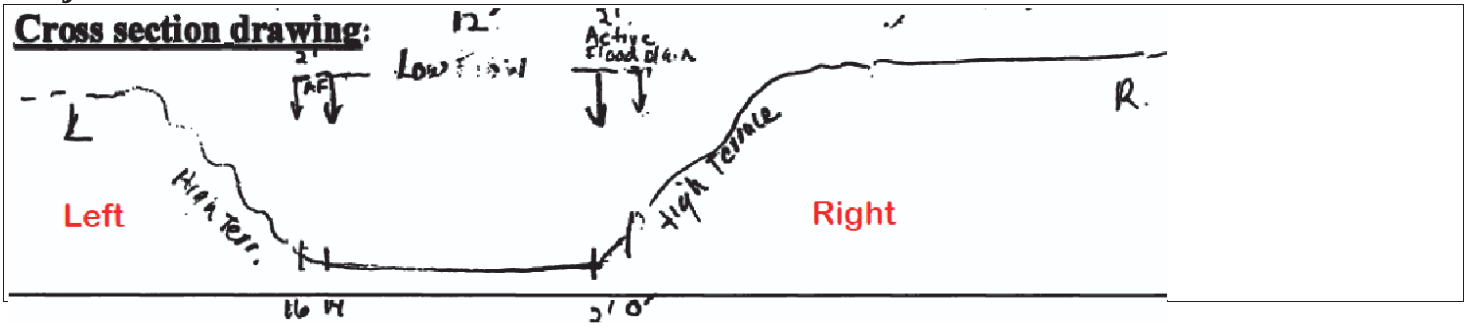


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ■ Mapping on aerial photograph
   - ■ Digitized on computer
   - ■ GPS
   - ☐ Other:

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 204 **Date:** 6/21/2012 **Time:** 4:59 pm

Cross section drawing:



OHWM

GPS point: UTM NAD 1983

	Left		Right	
Easting	369945.3		Easting	369940.4
Northing	4143362.8		Northing	4143362.5

Indicators:

- [x] Change in average sediment texture
- [x] Change in vegetation species
- [x] Change in vegetation cover
- [x] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Cross section sketch was drawn looking downstream. Left (L) and right (R) sides are labeled in the sketch. The low flow channel is 12 feet wide and the active floodplain extends 2 feet on each side. The active floodplain transitions directly into the very steep high terrace sideslope on both sides. There is a small stock pond on the north side of the elk fence that causes water to back up into the lower portion of the low flow channel.

Floodplain unit: [x] Low-Flow Channel [ ] Active Floodplain [ ] Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Fine silt

Total veg cover: 90 % Tree: 0 % Shrub: 0 % Herb: 90 %

Community successional stage:

- [ ] NA
- [ ] Early (herbaceous & seedlings)
- [ ] Mid (herbaceous, shrubs, saplings)
- [x] Late (herbaceous, shrubs, mature trees)

Indicators:

- [ ] Mudcracks
- [ ] Ripples
- [x] Drift and/or debris
- [ ] Presence of bed and bank
- [ ] Benches
- [x] Soil development
- [x] Surface relief
- [ ] Other: _____
- [ ] Other: _____
- [ ] Other: _____

Comments:

The stock pond is influencing low flow and wetland hydrology in this area. The low flow channel is 12 feet wide and comprises most of the active floodplain.

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 204 **Date:** 6/21/2012 **Time:** 4:59 pm

Floodplain unit: ☐ Low-Flow Channel ■ Active Floodplain ☐ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Medium silt

Total veg cover: 65 % Tree: 0 % Shrub: 0 % Herb: 65 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ■ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ■ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ■ Soil development
- ■ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

The active floodplain extends 2 feet beyond the low flow channel on each side. The active floodplain transitions directly into the very steep high terrace sideslope. There livestock/wildlife trails along both sides of the active floodplain.

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: _____

Total veg cover: _____ % Tree: _____% Shrub: _____% Herb: _____%

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

There are no low terraces in this reach of the intermittent stream, since the active floodplain transitions directly into the very steep high terrace sideslopes.

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Alton Private Lease
Project Number: 12ALT OHW 205
Stream: Kanab Creek
Investigator(s): P. Collins & R. Long

Date: 6/21/2012 **Time:** 5:44 pm
Town: Alton, Kane Co **State:** Utah
Photo begin file#: **Photo end file#:**

Y ■ / N ☐ Do normal circumstances exist on the site?

Y ☐ / N ■ Is the site significantly disturbed?

Location Details:
Ephemeral/intermittent drainage west of Kanab Creek

Projection: UTM, 12N **Datum:** 1983
Coordinates: E see sketch N see sketch

Potential anthropogenic influences on the channel system:

There is some cattle in this upper part of the drainage.
A breached stock pond separates this upper part of the drainage from the OHW 204 area.

Brief site description:

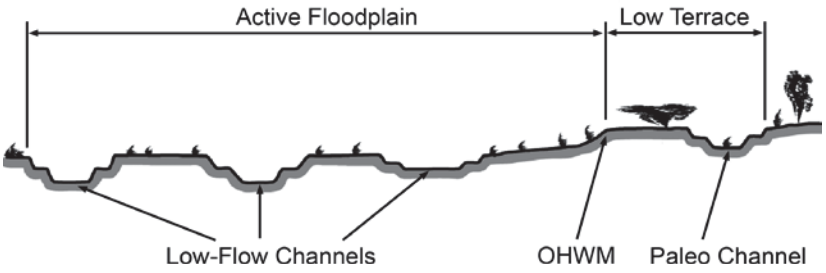
This is the upper end of the ephemeral/intermittent drainage just west of Kanab Creek. It is an ephemeral drainage in this reach and an intermittent stream below this area. The sample location is about 755 feet upstream from the elk fence and 660 feet south of the farm road. The upper end of this reach transitions into the high terrace irrigated and dryland farms.

Checklist of resources (if available):

- ■ Aerial photography
  Dates:
- ■ Topographic maps
- ■ Geologic maps
- ☐ Vegetation maps
- ■ Soils maps
- ■ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ■ Global positioning system (GPS)
- ☐ Other studies

- ☐ Stream gage data
  Gage number:
  Period of record:
- ☐ History of recent effective discharges
- ☐ Results of flood frequency analysis
- ☐ Most recent shift-adjusted rating
- ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

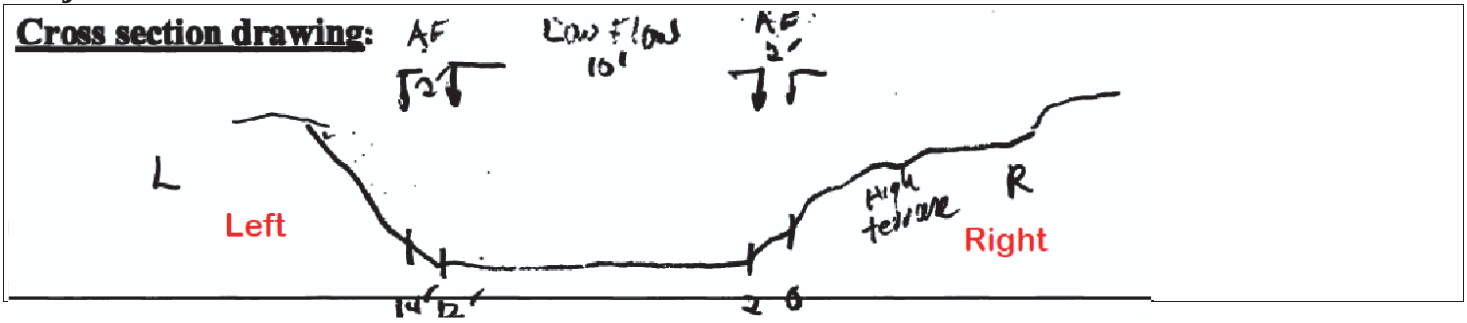


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ■ Mapping on aerial photograph
   - ■ Digitized on computer
   - ■ GPS
   - ☐ Other:

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 205 **Date:** 6/21/2012 **Time:** 5:44 pm

Cross section drawing:



OHWM

GPS point: UTM NAD 1983

	Left		Right	
Easting	369980.2		Easting	369979.2
Northing	4143460.3		Northing	4143464.0

Indicators:

- [x] Change in average sediment texture
- [x] Change in vegetation species
- [x] Change in vegetation cover
- [x] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Cross section sketch was drawn looking downstream. Left (L) and right (R) sides are labeled in the sketch. The ephemeral drainage is distinct at this sample location, but just upstream it widens and becomes less distinct as it transitions into the high terrace irrigated and dryland farm fields. The low flow channel is 10 feet wide and the active floodplain extends 2 feet on each side. There is not any low terraces.

Floodplain unit: [x] Low-Flow Channel [ ] Active Floodplain [ ] Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Medium silt

Total veg cover: 80 % Tree: 0 % Shrub: 0 % Herb: 80 %

Community successional stage:

- [ ] NA
- [ ] Early (herbaceous & seedlings)
- [ ] Mid (herbaceous, shrubs, saplings)
- [x] Late (herbaceous, shrubs, mature trees)

Indicators:

- [ ] Mudcracks
- [ ] Ripples
- [x] Drift and/or debris
- [ ] Presence of bed and bank
- [ ] Benches
- [x] Soil development
- [x] Surface relief
- [ ] Other: _____
- [ ] Other: _____
- [ ] Other: _____

Comments:

The low flow channel is 10 feet wide and has a heavy cover of herbaceous plants.

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 205 **Date:** 6/21/2012 **Time:** 5:44 pm

Floodplain unit: ☐ Low-Flow Channel ■ Active Floodplain ☐ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Medium silt

Total veg cover: 75 % Tree: 0 % Shrub: 0 % Herb: 75 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ■ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ■ Benches
- ■ Soil development
- ■ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

The active floodplain extends beyond the low flow channel two feet on both sides and has a heavy cover of herbaceous plants.

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ■ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Medium silt

Total veg cover: 60 % Tree: 0 % Shrub: 30 % Herb: 30 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ■ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ■ Benches
- ■ Soil development
- ■ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

The low terrace at this upper end of the ephemeral/intermittent drainage is the high terrace described in descriptions lower in the drainage and in Kanab Creek.

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Alton Private Lease
Project Number: 12ALT OHW 301
Stream: Kanab Creek
Investigator(s): P. Collins & R. Long

Date: June 19, 2012 **Time:** 3:34 pm
Town: Alton, Kane Co **State:** Utah
Photo begin file#: **Photo end file#:**

Y ☐ / N ■ Do normal circumstances exist on the site?

Y ■ / N ☐ Is the site significantly disturbed?

Location Details:
Second ephemeral drainage west of Kanab Creek

Projection: UTM, 12N **Datum:** 1983
Coordinates: E see sketch N see sketch

Potential anthropogenic influences on the channel system:

A stock pond just south of the elk fence on this ephemeral drainage breached during the winter or spring of 2010-2011 and sent a large wall of water down the channel, resulting in severe scouring. There is also heavy cattle use. Large trees have fallen into the channel causing debris dams.

Brief site description:

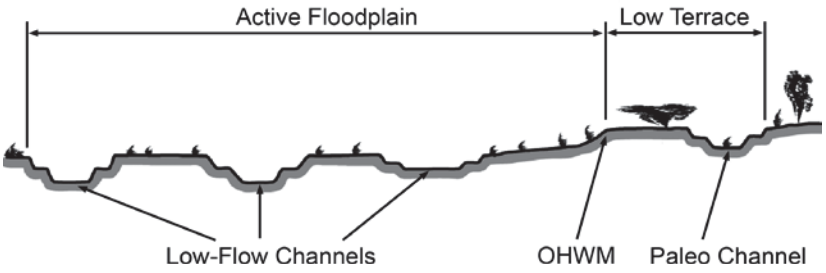
The flash flood has significantly changed the stream characteristics. Less than 5% of the stream reach contains very small (e.g. less than 10 sq ft) wetland areas with a cumulative total of less than 0.1 acres. The channel is sharply incised and most of the bottom is void of vegetation. Sample location is about 1,590 feet upstream from main road and about 1,220 feet south of elk fence.

Checklist of resources (if available):

- ■ Aerial photography
  Dates:
- ■ Topographic maps
- ■ Geologic maps
- ☐ Vegetation maps
- ■ Soils maps
- ■ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ■ Global positioning system (GPS)
- ☐ Other studies

- ☐ Stream gage data
  Gage number:
  Period of record:
- ☐ History of recent effective discharges
- ☐ Results of flood frequency analysis
- ☐ Most recent shift-adjusted rating
- ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

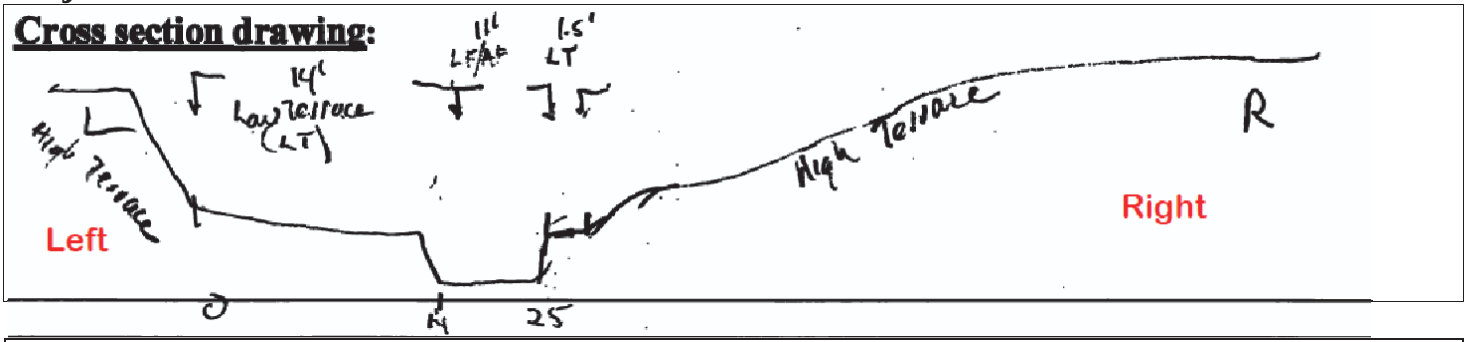


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ■ Mapping on aerial photograph
   - ■ Digitized on computer
   - ■ GPS
   - ☐ Other:

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 301 **Date:** June 19, 2012 **Time:** 3:34 pm

Cross section drawing:



OHWM

GPS point: UTM NAD 1983

	Left		Right	
Easting	369837.7		Easting	369832.9
Northing	4142941.0		Northing	4142936.6

Indicators:

- ☑ Change in average sediment texture
- ☑ Change in vegetation species
- ☑ Change in vegetation cover
- ☑ Break in bank slope
- ☐ Other: _____
- ☐ Other: _____

Comments:

Cross section sketch was drawn looking downstream. Left (L) and right (R) sides are labeled in the sketch. This channel reach was severely altered when the stock pond breached. Low flow channel and active floodplain are one and the same. The recent flash flood caused significant downcutting in many parts of the drainage. There is no available documentation on what the channel was like prior to the stock pond breach. Refer to site photos and 12ALT_WET301 Non description for additional information on this event. No springs or seeps were observed in this ephemeral drainage.

Floodplain unit: ☑ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Cobbles

Total veg cover: 5 % Tree: 0 % Shrub: 0 % Herb: 5 %

Community successional stage:

- ☐ NA
- ☑ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☑ Drift and/or debris
- ☑ Presence of bed and bank
- ☑ Benches
- ☐ Soil development
- ☑ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

The low flow channel is 11 feet wide at the sample location. It occupies the same zone as the active floodplain. Large cobbles are the primary feature of the sharply incised low flow channel. Vegetation is limited to very small patches that appear to have survived the flash flood.

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 301 **Date:** June 19, 2012 **Time:** 3:34 pm

Floodplain unit: ☐ Low-Flow Channel ■ Active Floodplain ☐ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Cobbles

Total veg cover: _____ % Tree: _____% Shrub: _____% Herb: _____%

Community successional stage:

- ☐ NA
- ☐ Mid (herbaceous, shrubs, saplings)
- ■ Early (herbaceous & seedlings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

The active floodplain occupies the same zone as the low flow channel (see low flow channel section for details).

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ■ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Medium silt

Total veg cover: 40 % Tree: 0 % Shrub: 15 % Herb: 25 %

Community successional stage:

- ☐ NA
- ■ Mid (herbaceous, shrubs, saplings)
- ☐ Early (herbaceous & seedlings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ■ Presence of bed and bank
- ■ Benches
- ■ Soil development
- ■ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

The low terrace zone represents the portions of the drainage that were least affected by the flash flood. The low terrace is 14 feet wide on the left side and only 1.5 feet wide on the right side. The flash flood cut into the bank enough to expose Tropic shale at some locations (see photos).

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Alton Private Lease
Project Number: 12ALT OHW 302
Stream: Kanab Creek
Investigator(s): P. Collins & R. Long

Date: 6/20/2012 **Time:** 1:03 pm
Town: Alton, Kane Co **State:** Utah
Photo begin file#: **Photo end file#:**

Y ■ / N ☐ Do normal circumstances exist on the site?

Y ☐ / N ■ Is the site significantly disturbed?

Location Details:
Second intermittent stream west of Kanab Creek

Projection: UTM, 12N **Datum:** 1983
Coordinates: E see sketch N see sketch

Potential anthropogenic influences on the channel system:

Conversion to center pivot irrigation appears to have reduced the amount of surface runoff that previously found it's way into this ephemeral drainage. Subsurface flow may have also been reduced by improved irrigation methods. No evidence of grazing was observed in this area, but it is used by wildlife (e.g. deer).

Brief site description:

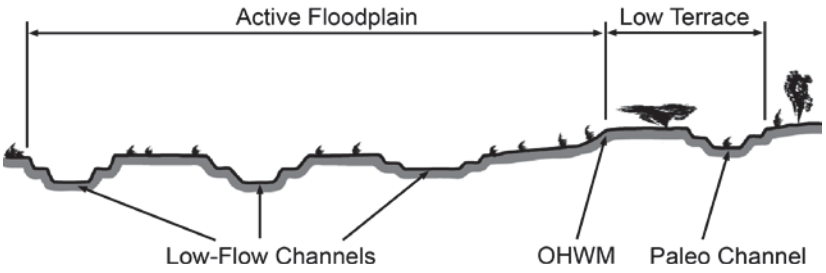
Sample location represents the upper portion of the second ephemeral/intermittent drainage west of Kanab Creek. It transitions into the high terrace about 400 feet north of this point. Low flow channel at this sample location is about 3-4 feet below elevation of high terrace. The sample location is 310 feet north of the elk fence and 1000 feet south of the farm road.

Checklist of resources (if available):

- ■ Aerial photography
  Dates:
- ■ Topographic maps
- ■ Geologic maps
- ☐ Vegetation maps
- ■ Soils maps
- ■ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ■ Global positioning system (GPS)
- ☐ Other studies

- ☐ Stream gage data
  Gage number:
  Period of record:
- ☐ History of recent effective discharges
- ☐ Results of flood frequency analysis
- ☐ Most recent shift-adjusted rating
- ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

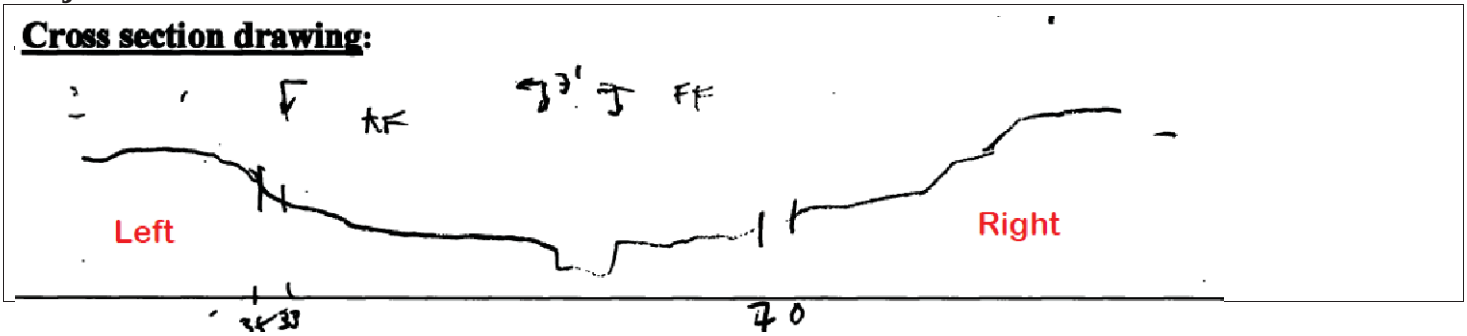


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ■ Mapping on aerial photograph
   - ■ Digitized on computer
   - ■ GPS
   - ☐ Other:

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 302 **Date:** 6/20/2012 **Time:** 1:03 pm

Cross section drawing:



OHWM

GPS point: UTM NAD 1983

	Left		Right	
	Easting	369725.1	Easting	369718.8
	Northing	4143352.9	Northing	4143356.9

Indicators:

- [x] Change in average sediment texture
- [x] Change in vegetation species
- [x] Change in vegetation cover
- [x] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Cross section sketch was drawn looking downstream. Left (L) and right (R) sides are labeled in the sketch.

Floodplain unit: [x] Low-Flow Channel [ ] Active Floodplain [ ] Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Medium silt

Total veg cover: 60 % Tree: 0 % Shrub: 0 % Herb: 60 %

Community successional stage:

- [ ] NA
- [ ] Early (herbaceous & seedlings)
- [ ] Mid (herbaceous, shrubs, saplings)
- [ ] Late (herbaceous, shrubs, mature trees)

Indicators:

- [ ] Mudcracks
- [ ] Ripples
- [ ] Drift and/or debris
- [x] Presence of bed and bank
- [x] Benches
- [x] Soil development
- [x] Surface relief
- [ ] Other: _____
- [ ] Other: _____
- [ ] Other: _____

Comments:

The low flow channel is 3 feet wide and incised about 6 to 12 inches below the active floodplain elevation. There is a heavy vegetative cover of herbaceous plants.

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 302 **Date:** 6/20/2012 **Time:** 1:03 pm

Floodplain unit: ☐ Low-Flow Channel ■ Active Floodplain ☐ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Medium silt

Total veg cover: 60 % Tree: 0 % Shrub: 0 % Herb: 60 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ■ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ■ Presence of bed and bank
- ■ Benches
- ■ Soil development
- ■ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

The active floodplain extends beyond the low flow channel There is a heavy vegetative cover of herbaceous plants.

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ■ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Medium silt

Total veg cover: 70 % Tree: 0 % Shrub: 0 % Herb: 70 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ■ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ■ Benches
- ■ Soil development
- ■ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

There is a heavy vegetative cover of herbaceous plants.

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Alton Private Lease
Project Number: 12ALT OHW 501
Stream: Kanab Creek
Investigator(s): P. Collins & R. Long

Date: 6/22/2012 **Time:** 9:41 am
Town: Alton, Kane Co **State:** Utah
Photo begin file#: **Photo end file#:**

Y ■ / N ☐ Do normal circumstances exist on the site?

Y ☐ / N ■ Is the site significantly disturbed?

Location Details:
Western most intermittent stream

Projection: UTM, 12N **Datum:** 1983
Coordinates: E see sketch N see sketch

Potential anthropogenic influences on the channel system:

There is potential for cattle grazing in this area, although no signs were observed. Pinyon and juniper trees have been removed and the areas on the north, east and south seeded.

Brief site description:

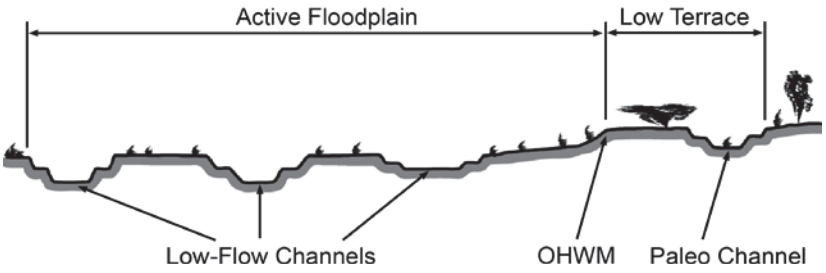
This intermittent stream channel drains from the irrigated fields and meadows south of Alton. The sample location is about 1,420 feet WSW of a fence corner on the south side of the main road. An ephemeral flows into this intermittent stream from the northwest (see general photos).

Checklist of resources (if available):

- ■ Aerial photography
  Dates:
- ■ Topographic maps
- ■ Geologic maps
- ☐ Vegetation maps
- ■ Soils maps
- ■ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ■ Global positioning system (GPS)
- ☐ Other studies

- ☐ Stream gage data
  Gage number:
  Period of record:
- ☐ History of recent effective discharges
- ☐ Results of flood frequency analysis
- ☐ Most recent shift-adjusted rating
- ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

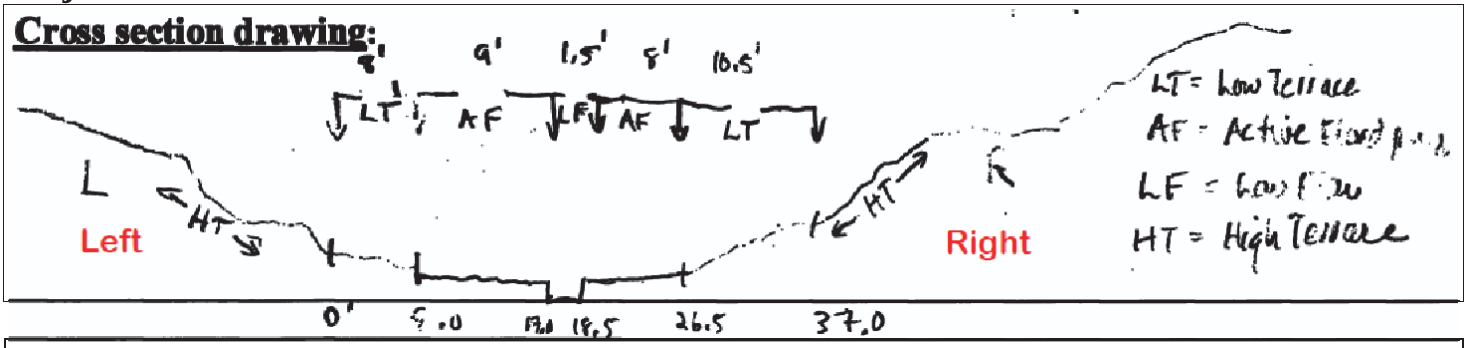


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ■ Mapping on aerial photograph
   - ■ Digitized on computer
   - ■ GPS
   - ☐ Other:

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 501 **Date:** 6/22/2012 **Time:** 9:41 am

Cross section drawing:



OHWM

GPS point: UTM NAD 1983

	Left		Right	
	Easting	369274.8	Easting	369269.6
	Northing	4142681.6	Northing	4142681.4

Indicators:

- ☐ Change in average sediment texture
- ☐ Change in vegetation species
- ☐ Change in vegetation cover
- ☐ Break in bank slope
- ☐ Other: _____
- ☐ Other: _____

Comments:

Cross section sketch was drawn looking downstream. Left (L) and right (R) sides are labeled in the sketch.

Floodplain unit: ☒ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Clay

Total veg cover: 30 % Tree: 0 % Shrub: 0 % Herb: 30 %

Community successional stage:

- ☐ NA
- ☒ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☒ Mudcracks
- ☐ Ripples
- ☒ Drift and/or debris
- ☒ Presence of bed and bank
- ☒ Benches
- ☐ Soil development
- ☒ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

The low flow channel is 1.5 feet wide and is incised a few inches below the elevation of the active floodplain.

Project ID: Private Lease **Cross section ID:** 12ALT_OHW 501 **Date:** 6/22/2012 **Time:** 9:41 am

Floodplain unit: ☐ Low-Flow Channel ■ Active Floodplain ☐ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Clay

Total veg cover: 95 % Tree: 0 % Shrub: 0 % Herb: 95 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ■ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ■ Presence of bed and bank
- ■ Benches
- ■ Soil development
- ■ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

The active floodplain extends beyond the low flow channel 9 feet on the left and 8 feet on the right. There is a thick cover of herbaceous plants.

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ■ Low Terrace

GPS point: See cross section sketch.

Characteristics of the floodplain unit:

Average sediment texture: Clay

Total veg cover: 70 % Tree: _____% Shrub: _____% Herb: 70 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ■ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ■ Benches
- ■ Soil development
- ■ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

the low terrace is 8 feet wide on the left side and 10.5 feet wide on the right side. There is a thick cover of herbaceous plants.

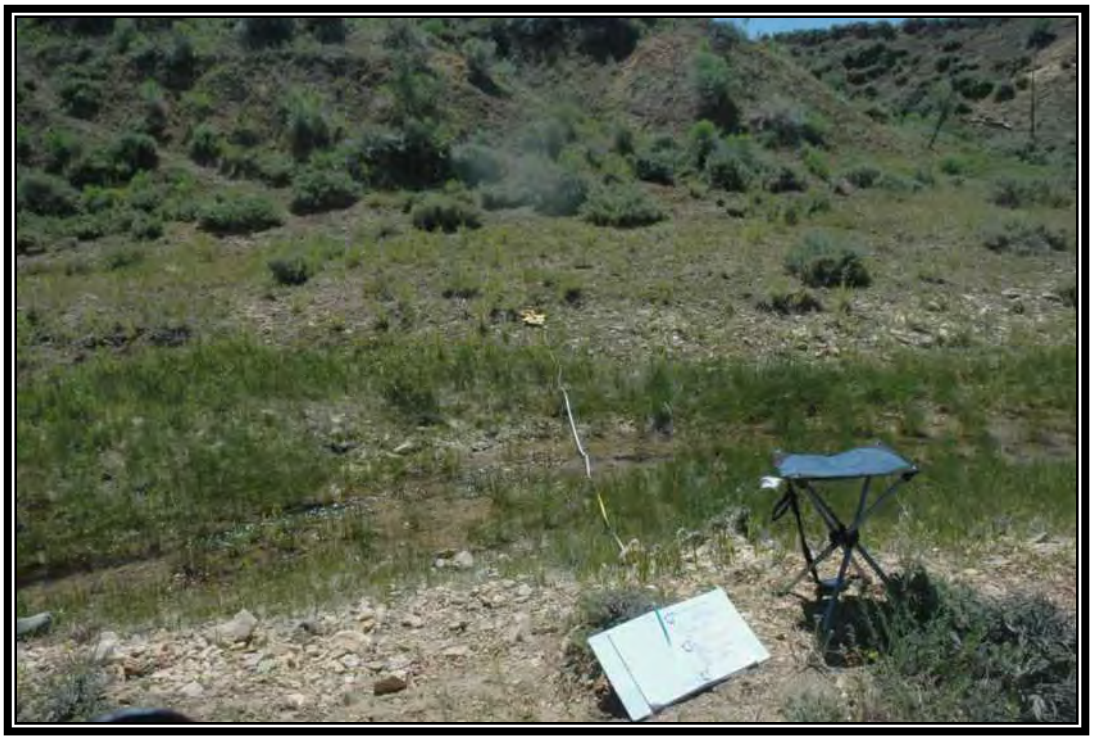


Photo E1: 12ALT_OHW 102

Photo E2: 12ALT_OHW 103

Photo E3: 12ALT_OHW 104

Photo E4: 12ALT_OHW 105

Photo E5: 12ALT_OHW 106

Photo E6: 12ALT_OHW 107

Photo E7: 12ALT_OHW 108 (new channel)

Photo E8: 12ALT_OHW 108 (existing channel)

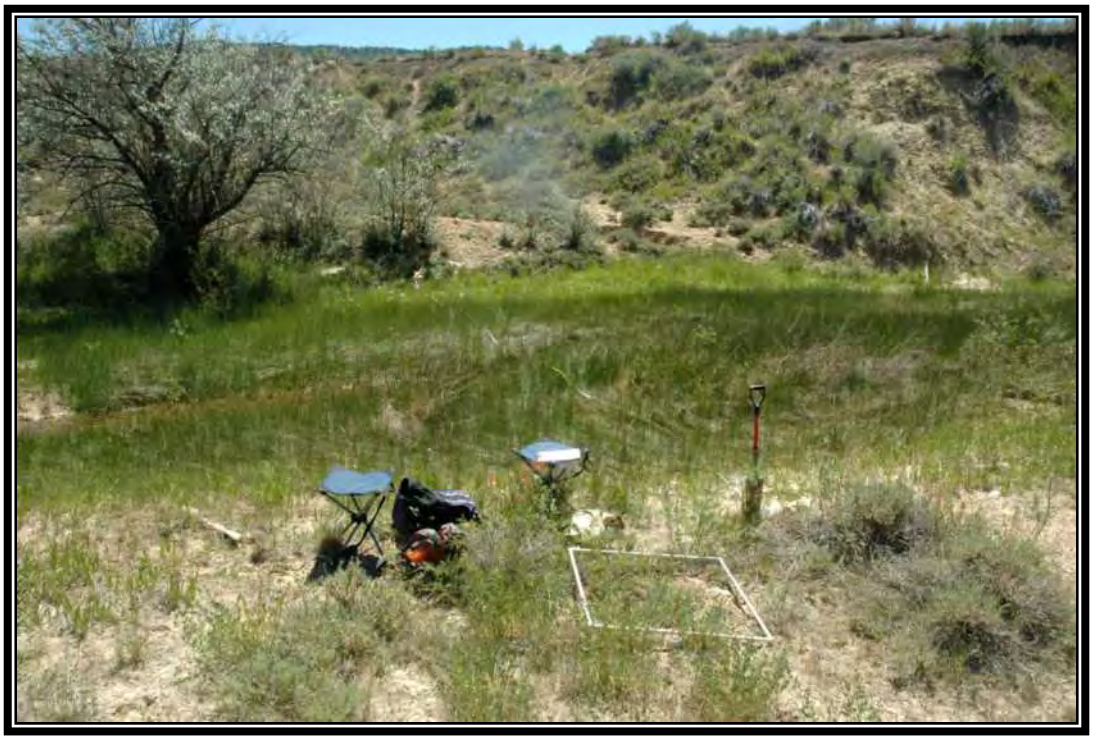


Photo E9: 12ALT_OHW 109

Photo E10: 12ALT_OHW 110

Photo E11: 12ALT_OHW 111

Photo E12: 12ALT_OHW 112

Photo E13: 12ALT_OHW 201

Photo E14: 12ALT_OHW 202

Photo E15: 12ALT_OHW 203

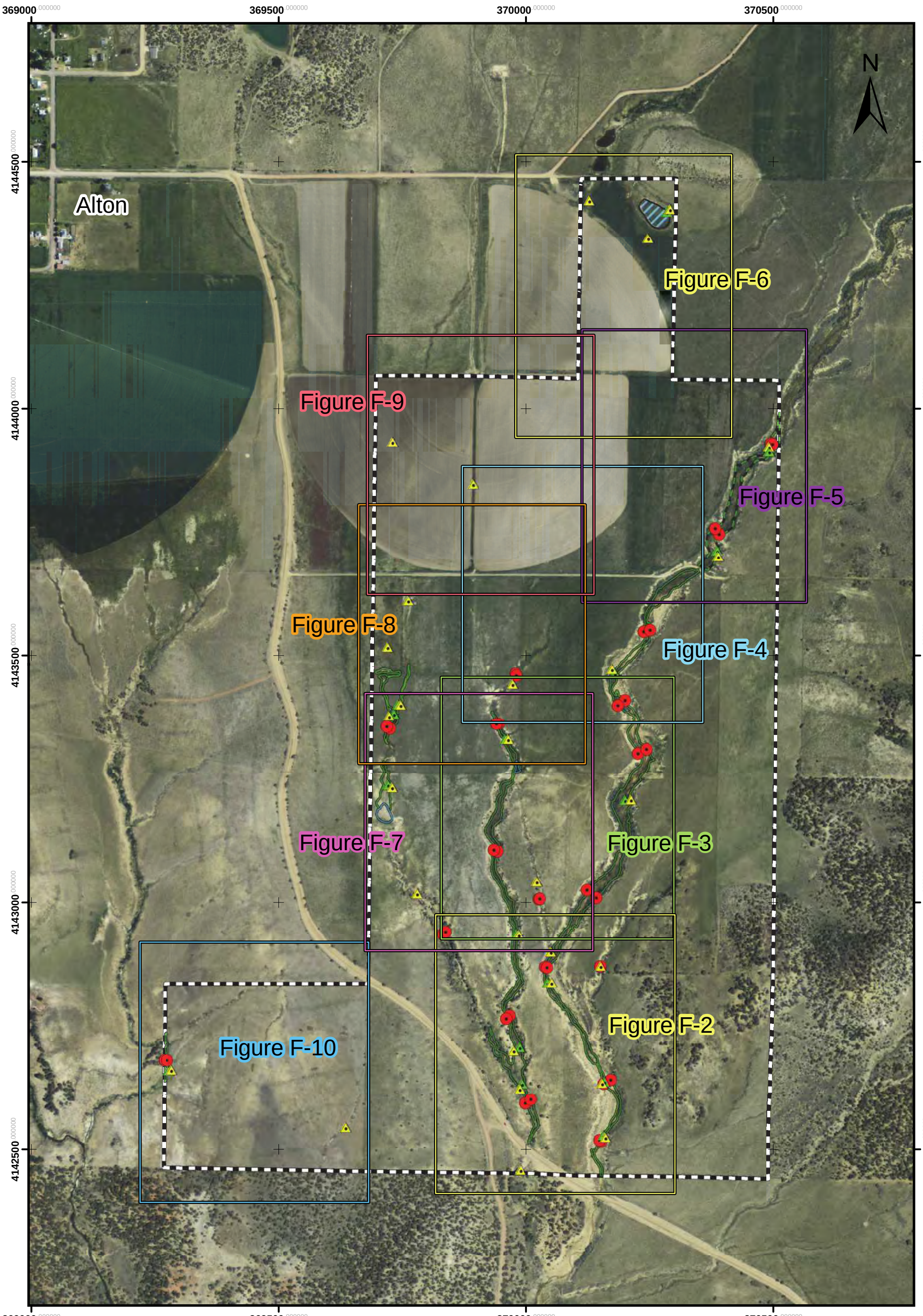
Photo E16: 12ALT_OHW 204

Photo E17: 12ALT_OHW 205

Photo E18: 12ALT_OHW 301

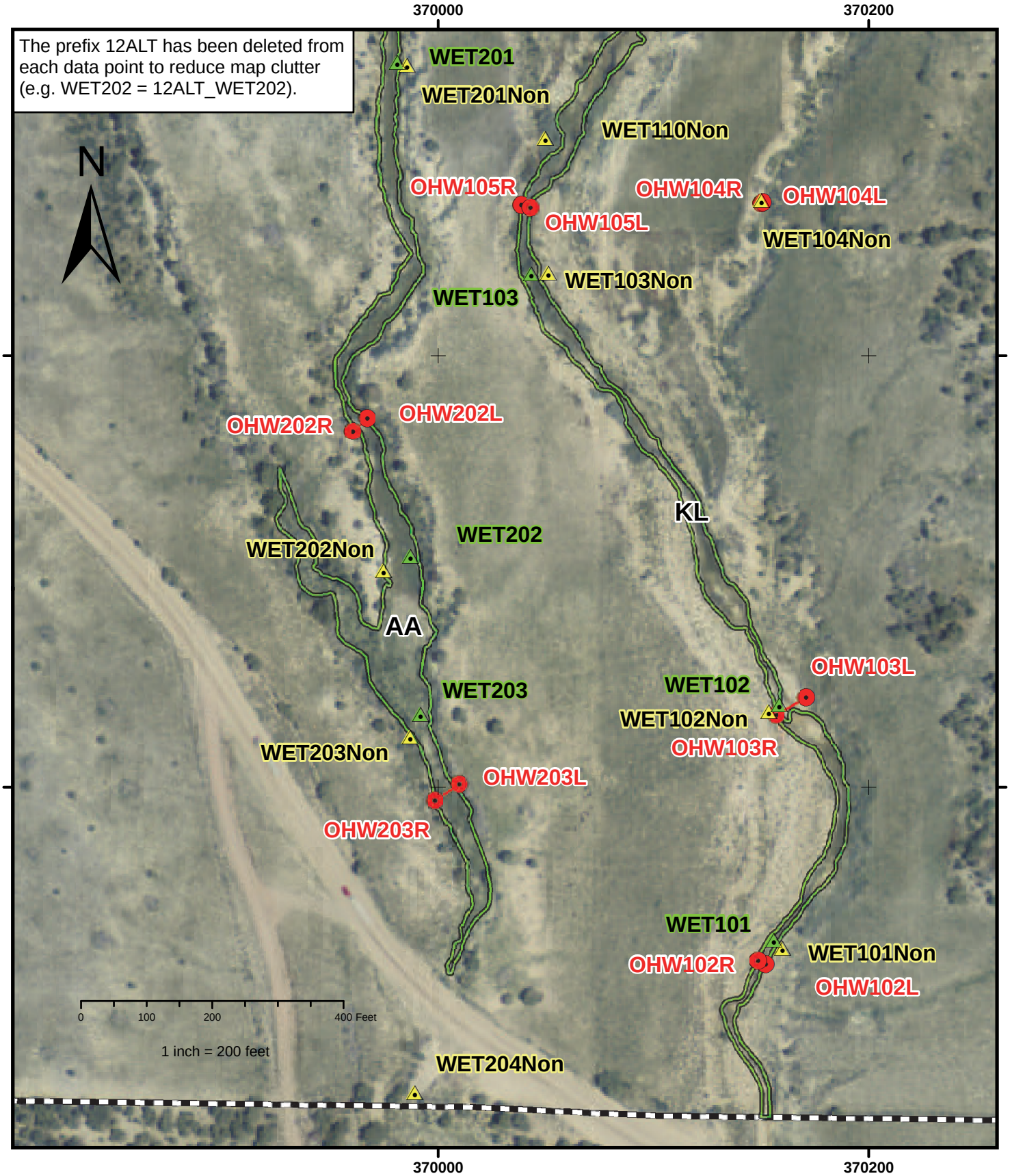
Photo E19: 12ALT_OHW 302

Photo E20: 12ALT_OHW 501

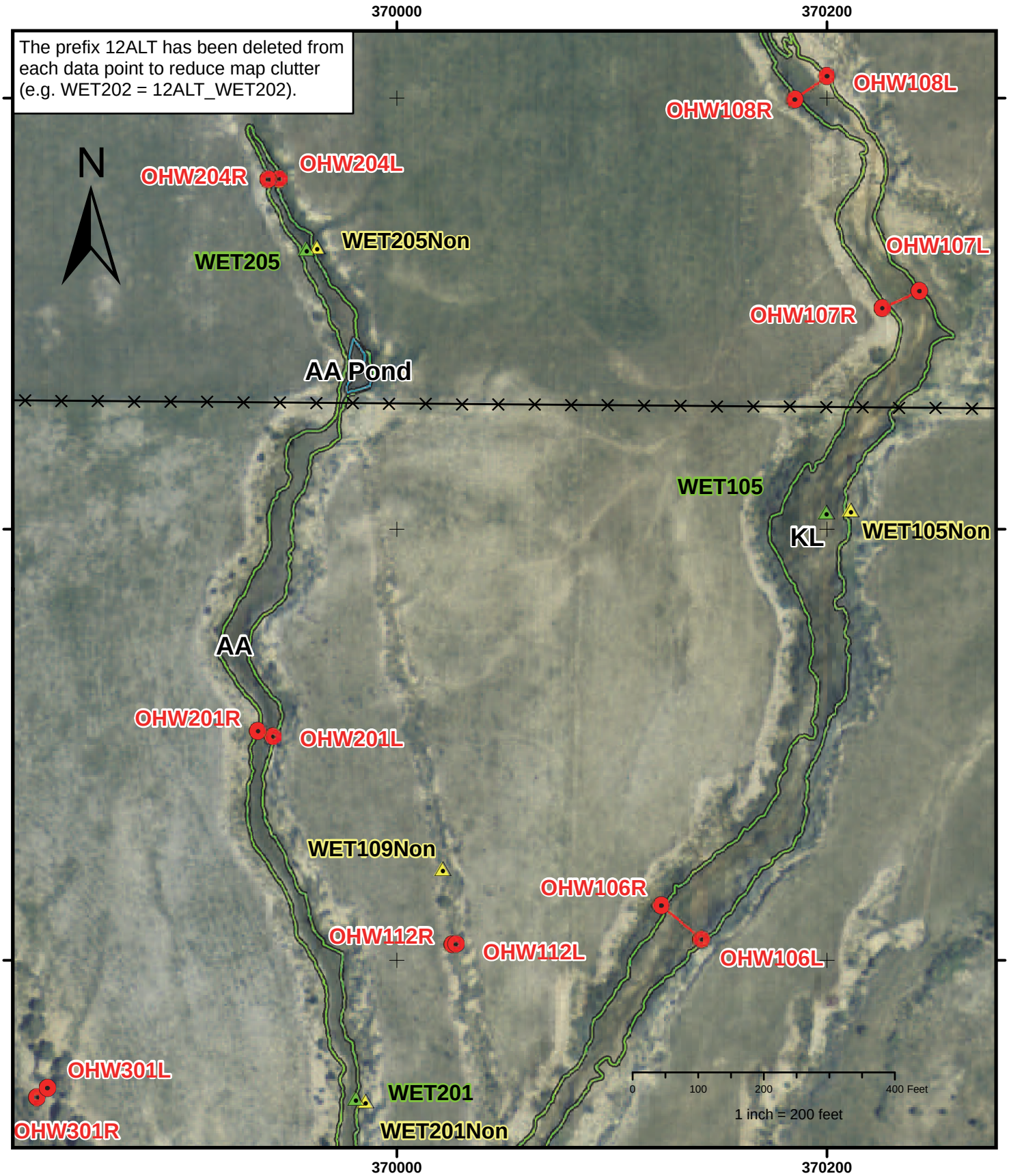


Wetland Survey of Alton Coal - Private Lease Area	Figure F-1	Coordinate System: UTM, NAD 1983, Zone 12 North
By: Long Resource Consultants, Inc. Morgan, Utah Mt. Nebo Scientific, Inc. Springville, Utah	Wetland · OHWM Points · Private Lease Upland	Note: Location of detailed maps is approximate and provided for informational purposes only.
August 11, 2012	NAIP 2011 Aerial Photography	1 inch = 600 feet

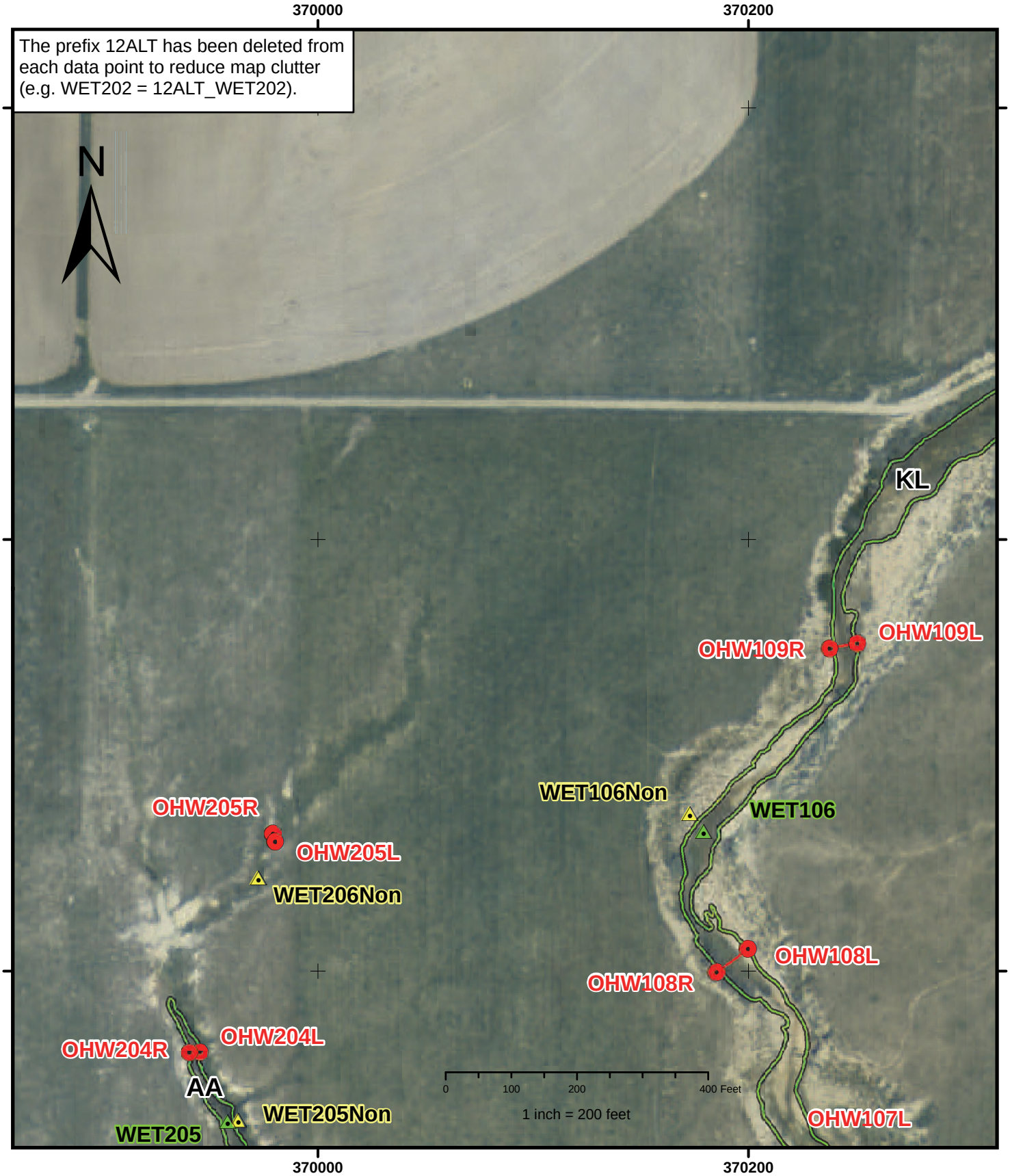
0 160 320 640 960 1,280 Feet



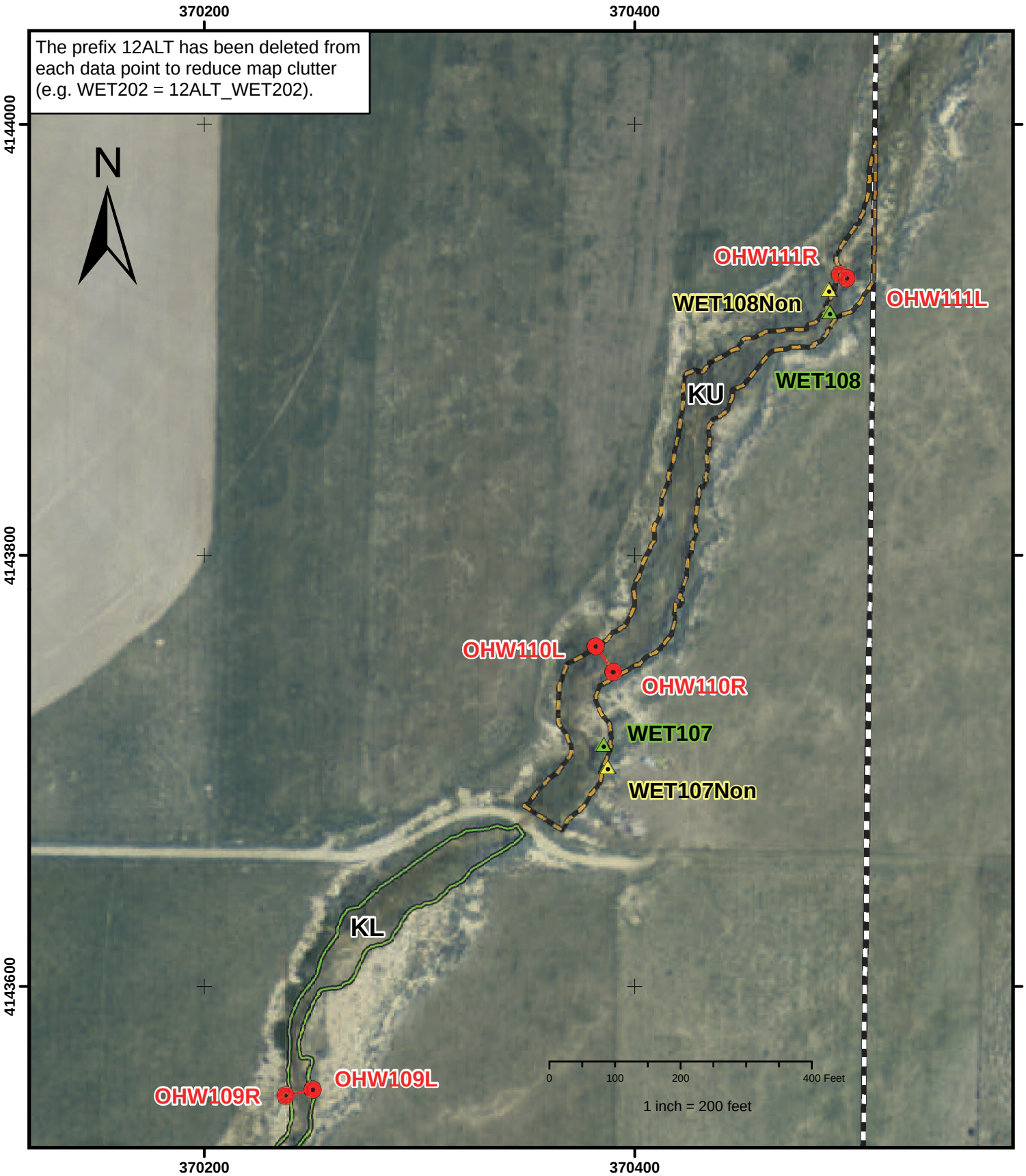
Wetland Survey of Alton Coal - Private Lease Area	Figure F-2		Cordinate System: UTM NAD 1983 Zone 12 North
By: Long Resource Consultants, Inc Morgan, Utah Mt. Nebo Scientific, Inc. Springville, Utah	Wetland Site Upland OHWM Points OHWM Evaluation	Riparian Wet Meadow Mixed Riparian Scrub/Shrub Wet Meadow Small Reservoir Wet Meadow Stock Pond	Private Lease Bndy Elk_Fence **KL** = Wetland Symbol
August 11, 2012	Completed in accordance with USACE Wetland Delineation (1987).		NAIP 2011 Aerial Photography



Wetland Survey of Alton Coal - Private Lease Area	Figure F-3		Cordinate System: UTM NAD 1983 Zone 12 North
By: Long Resource Consultants, Inc Morgan, Utah Mt. Nebo Scientific, Inc. Springville, Utah	Wetland Site Upland OHWM Points OHWM Evaluation	Riparian Wet Meadow Mixed Riparian Scrub/Shrub Wet Meadow Small Reservoir Wet Meadow Stock Pond	Private Lease Bndy Elk_Fence **KL** = Wetland Symbol
August 11, 2012	Completed in accordance with USACE Wetland Delineation (1987).		NAIP 2011 Aerial Photography



Wetland Survey of Alton Coal - Private Lease Area	Figure F-4		Cordinate System: UTM NAD 1983 Zone 12 North
By: Long Resource Consultants, Inc Morgan, Utah Mt. Nebo Scientific, Inc. Springville, Utah	Wetland Site Upland OHWM Points OHWM Evaluation	Riparian Wet Meadow Mixed Riparian Scrub/Shrub Wet Meadow Small Reservoir Wet Meadow Stock Pond	Private Lease Bndy Elk_Fence **KL** = Wetland Symbol
August 11, 2012	Completed in accordance with USACE Wetland Delineation (1987).		NAIP 2011 Aerial Photography



Wetland Survey of Alton Coal - Private Lease Area | Figure F-5 | Cordinate System: UTM NAD 1983 Zone 12 North

By: Long Resource Consultants, Inc
Morgan, Utah

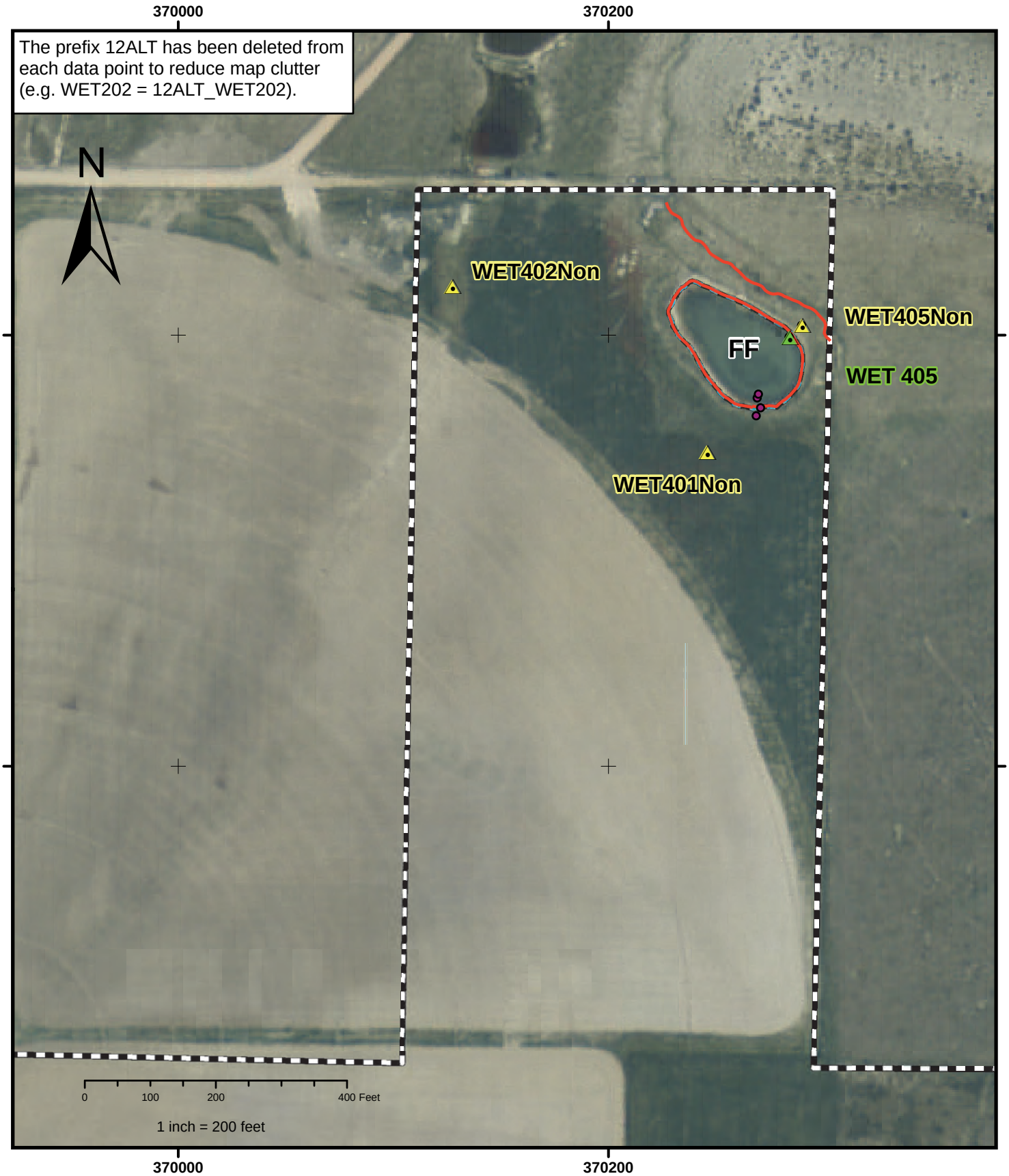
Mt. Nebo Scientific, Inc.
Springville, Utah

August 11, 2012

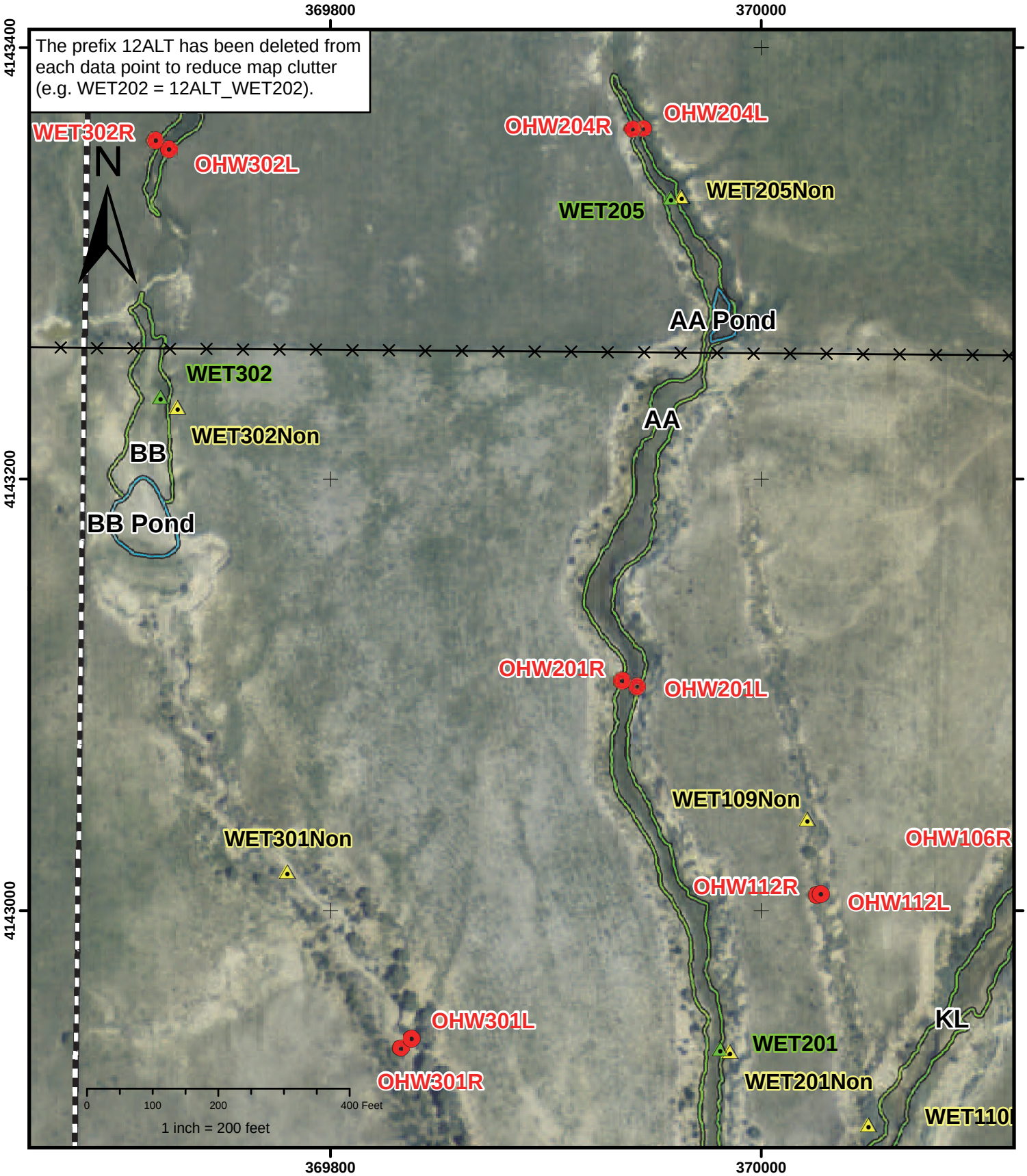
- Wetland Site
- Upland
- OHWM Points
- OHWM Evaluation
- Riparian Wet Meadow
- Mixed Riparian Scrub/Shrub Wet Meadow
- Small Reservoir Wet Meadow
- Stock Pond
- Private Lease Bndy
- Elk_Fence
- **KL** = Wetland Symbol

Completed in accordance with USACE Wetland Delineation (1987).

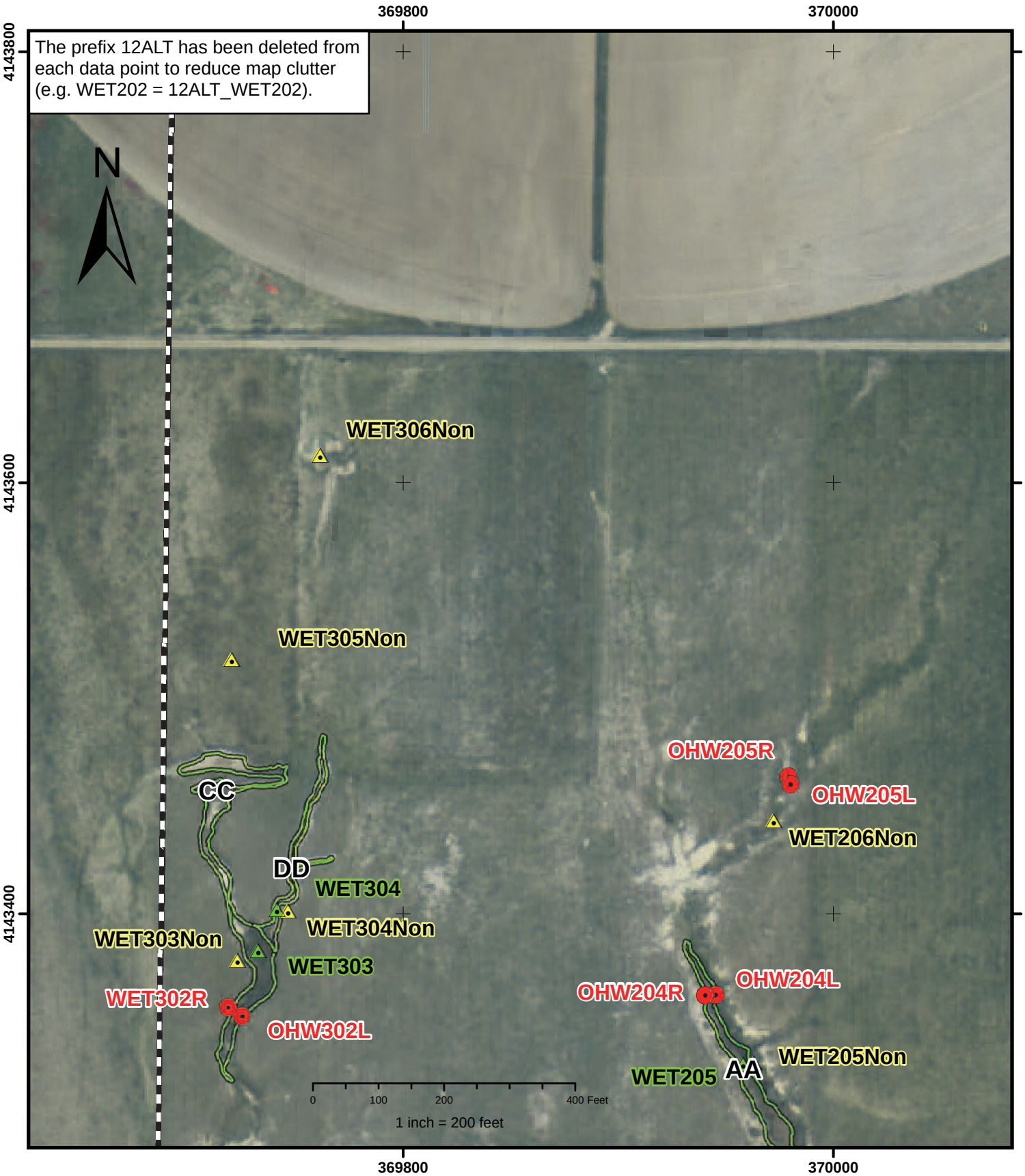
NAIP 2011 Aerial Photography



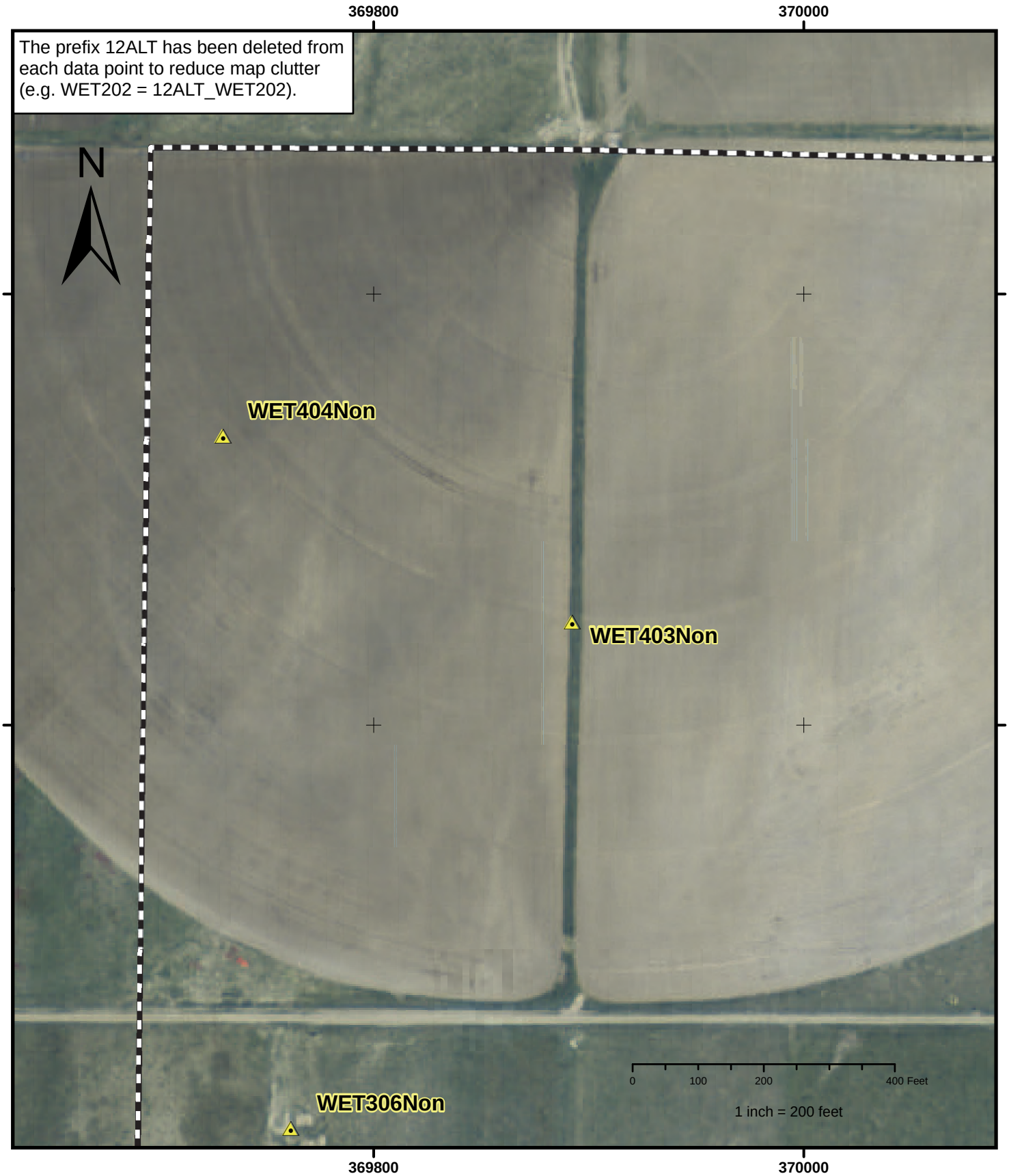
Wetland Survey of Alton Coal - Private Lease Area	Figure F-6		Cordinate System: UTM NAD 1983 Zone 12 North
By: Long Resource Consultants, Inc Morgan, Utah Mt. Nebo Scientific, Inc. Springville, Utah	Wetland Site Upland OHWM Points OHWM Evaluation	Riparian Wet Meadow Mixed Riparian Scrub/Shrub Wet Meadow Small Reservoir Wet Meadow Stock Pond	Private Lease Bndy Elk_Fence **KL** = Wetland Symbol
August 11, 2012	Completed in accordance with USACE Wetland Delineation (1987).		NAIP 2011 Aerial Photography



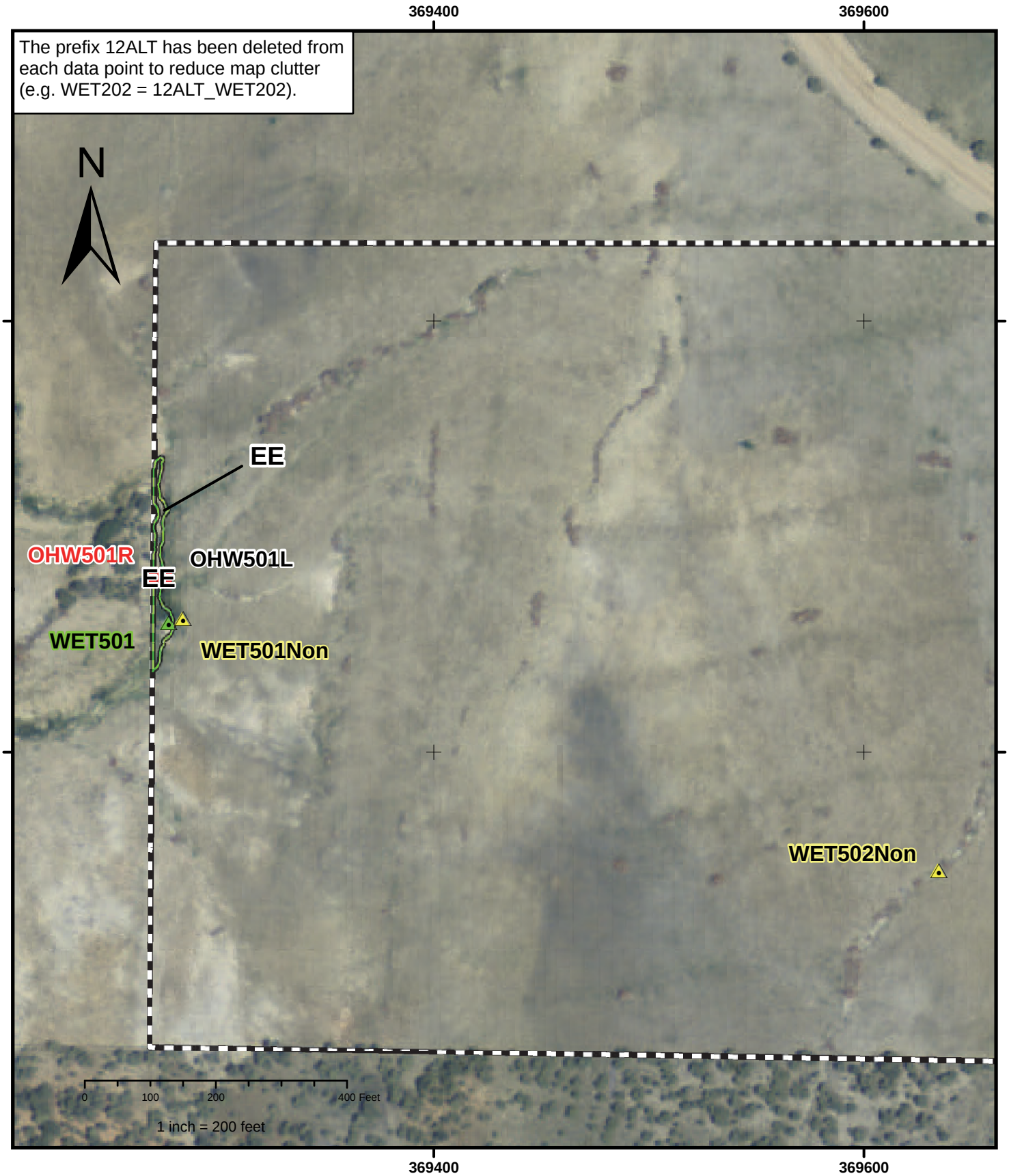
Wetland Survey of Alton Coal - Private Lease Area	Figure F-7		Cordinate System: UTM NAD 1983 Zone 12 North
By: Long Resource Consultants, Inc Morgan, Utah Mt. Nebo Scientific, Inc. Springville, Utah	Wetland Site Upland OHWM Points OHWM Evaluation	Riparian Wet Meadow Mixed Riparian Scrub/Shrub Wet Meadow Small Reservoir Wet Meadow Stock Pond	Private Lease Bndy Elk_Fence **KL** = Wetland Symbol
August 11, 2012	Completed in accordance with USACE Wetland Delineation (1987).		NAIP 2011 Aerial Photography



Wetland Survey of Alton Coal - Private Lease Area	Figure F-8		Cordinate System: UTM NAD 1983 Zone 12 North
By: Long Resource Consultants, Inc Morgan, Utah Mt. Nebo Scientific, Inc. Springville, Utah	Wetland Site Upland OHWM Points OHWM Evaluation	Riparian Wet Meadow Mixed Riparian Scrub/Shrub Wet Meadow Small Reservoir Wet Meadow Stock Pond	Private Lease Bndy Elk_Fence **KL** = Wetland Symbol
August 11, 2012	Completed in accordance with USACE Wetland Delineation (1987).		NAIP 2011 Aerial Photography



Wetland Survey of Alton Coal - Private Lease Area	Figure F-9		Cordinate System: UTM NAD 1983 Zone 12 North
By: Long Resource Consultants, Inc Morgan, Utah Mt. Nebo Scientific, Inc. Springville, Utah	Wetland Site Upland OHWM Points OHWM Evaluation	Riparian Wet Meadow Mixed Riparian Scrub/Shrub Wet Meadow Small Reservoir Wet Meadow Stock Pond	Private Lease Bndy Elk_Fence **KL** = Wetland Symbol
August 11, 2012	Completed in accordance with USACE Wetland Delineation (1987).		NAIP 2011 Aerial Photography



Wetland Survey of Alton Coal - Private Lease Area	Figure F-10		Cordinate System: UTM NAD 1983 Zone 12 North
By: Long Resource Consultants, Inc Morgan, Utah Mt. Nebo Scientific, Inc. Springville, Utah	Wetland Site Upland OHWM Points OHWM Evaluation	Riparian Wet Meadow Mixed Riparian Scrub/Shrub Wet Meadow Small Reservoir Wet Meadow Stock Pond	Private Lease Bndy Elk_Fence **KL** = Wetland Symbol
August 11, 2012	Completed in accordance with USACE Wetland Delineation (1987).		NAIP 2011 Aerial Photography

Table G-1. Wetland and non-wetland GPS data points.

	Section	Township	Range	UTM Easting NAD 1983	UTM Northing NAD 1983	Latitude	Longitude
				meters	meters	Degrees	Degrees
100 Drainage - Kanab Creek							
12ALT_WET 101	18	39 South	5 West	370155.4	4142529.3	37.42048	-112.4674
12ALT_WET 101 Non	18	39 South	5 West	370159.4	4142525.4	37.42044	-112.46735
12ALT_WET 102	18	39 South	5 West	370157.9	4142638.3	37.42146	-112.46739
12ALT_WET 102 Non	18	39 South	5 West	370153.1	4142635.2	37.42143	-112.46744
12ALT_WET 103	13	39 South	6 West	370042.8	4142838.0	37.42324	-112.46872
12ALT_WET 103 Non	13	39 South	6 West	370050.6	4142838.5	37.42325	-112.46864
12ALT_WET 104 Non	18	39 South	5 West	370149.6	4142872.1	37.42356	-112.46752
12ALT_WET 105	18	39 South	5 West	370199.3	4143208.0	37.4266	-112.46702
12ALT_WET 105 Non	18	39 South	5 West	370210.6	4143209.2	37.42661	-112.46689
12ALT_WET 106	7	39 South	5 West	370178.7	4143464.9	37.42891	-112.4673
12ALT_WET 106 Non	7	39 South	5 West	370172.2	4143473.2	37.42898	-112.46737
12ALT_WET 107	7	39 South	5 West	370385.1	4143712.6	37.43117	-112.46501
12ALT_WET 107 Non	7	39 South	5 West	370387.1	4143702.0	37.43108	-112.46499
12ALT_WET 108	7	39 South	5 West	370490.2	4143913.1	37.43299	-112.46386
12ALT_WET 108 Non	7	39 South	5 West	370489.8	4143923.5	37.43309	-112.46386
12ALT_WET 109 Non	13	39 South	6 West	370020.9	4143042.5	37.42508	-112.46901
12ALT_WET 110 Non	13	39 South	6 West	370049.3	4142900.9	37.42381	-112.46866
200 Drainage							
12ALT_WET 201	13	39 South	6 West	369980.4	4142936.0	37.42412	-112.46945
12ALT_WET 201 Non	13	39 South	6 West	369985.0	4142934.8	37.42411	-112.46939
12ALT_WET 202	13	39 South	6 West	369986.6	4142707.3	37.42206	-112.46934
12ALT_WET 202 Non	13	39 South	6 West	369974.1	4142700.6	37.42199	-112.46948
12ALT_WET 203	13	39 South	6 West	369991.3	4142633.9	37.4214	-112.46927
12ALT_WET 203 Non	13	39 South	6 West	369986.5	4142623.4	37.4213	-112.46932
12ALT_WET 204 Non	13	39 South	6 West	369988.6	4142458.6	37.41982	-112.46927
12ALT_WET 205	12	39 South	6 West	369957.6	4143330.3	37.42767	-112.46977
12ALT_WET 205 Non	12	39 South	6 West	369962.5	4143331.0	37.42767	-112.46972
12ALT_WET 206 Non	12	39 South	6 West	369971.8	4143443.3	37.42869	-112.46963

Table G-1. Wetland and non-wetland GPS data points.

	Section	Township	Range	UTM Easting NAD 1983	UTM Northing NAD 1983	Latitude	Longitude
				meters	meters	Degrees	Degrees
100 Drainage - Kanab Creek							
300 Drainage							
12ALT_WET 301 Non	13	39 South	6 West	369779.4	4143018.3	37.42483	-112.47173
12ALT_WET 302	13	39 South	6 West	369720.6	4143238.3	37.4268	-112.47244
12ALT_WET 302 Non	13	39 South	6 West	369728.5	4143233.5	37.42676	-112.47234
12ALT_WET 303	12	39 South	6 West	369732.1	4143383.0	37.42811	-112.47233
12ALT_WET 303 Non	12	39 South	6 West	369722.5	4143378.5	37.42807	-112.47244
12ALT_WET 304	12	39 South	6 West	369740.8	4143401.9	37.42828	-112.47224
12ALT_WET 304 Non	12	39 South	6 West	369745.9	4143401.6	37.42828	-112.47218
12ALT_WET 305 Non	12	39 South	6 West	369719.9	4143518.1	37.42932	-112.47249
12ALT_WET 306 Non	12	39 South	6 West	369761.0	4143612.9	37.43018	-112.47205
400 Drainage							
12ALT_WET 401 Non	7	39 South	5 West	370245.6	4144345.7	37.43686	-112.4667
12ALT_WET 402 Non	7	39 South	5 West	370127.1	4144422.6	37.43753	-112.46805
12ALT_WET 403 Non	12	39 South	6 West	369891.8	4143847.8	37.43232	-112.47061
12ALT_WET 404 Non	12	39 South	6 West	369729.5	4143934.2	37.43308	-112.47246
12ALT_WET 405	7	39 South	5 West	370284.0	4144399.0	37.43734	-112.46627
12ALT_WET 405 Non	7	39 South	5 West	370289.8	4144404.1	37.43739	-112.46621
500 Drainage							
12ALT_WET 501	13	39 South	6 West	369276.2	4142660.2	37.42153	-112.47735
12ALT_WET 501 Non	13	39 South	6 West	369282.8	4142662.0	37.42155	-112.47728
12ALT_WET 502 Non	13	39 South	6 West	369634.24	4142545.09	37.42055	-112.47329

Table G-2. Ordinary High Water Mark (OHWM) GPS data points.

Description	Township	Range	Section	UTM Easting NAD 1983	UTM Northing NAD 1983	Latitude	Longitude
				meters	meters	degrees	degrees
100 Drainage - Kanab Creek							
12ALT_OHW102R	39 South	5 West	18	370148.6	4142519.8	37.42039	-112.46747
12ALT_OHW102L	39 South	5 West	18	370152.0	4142518.2	37.42038	-112.46743
12ALT_OHW103R	39 South	5 West	18	370157.2	4142634.0	37.42142	-112.4674
12ALT_OHW103L	39 South	5 West	18	370171.0	4142642.0	37.42149	-112.46724
12ALT_OHW104R	39 South	5 West	18	370150.3	4142870.9	37.42355	-112.46752
12ALT_OHW104L	39 South	5 West	18	370150.8	4142871.3	37.42356	-112.46751
12ALT_OHW105R	39 South	6 West	13	370038.8	4142870.1	37.42353	-112.46878
12ALT_OHW105L	39 South	6 West	13	370042.9	4142868.9	37.4235	-112.46866
12ALT_OHW106R	39 South	5 West	18	370123.0	4143025.6	37.42494	-112.46785
12ALT_OHW106L	39 South	5 West	18	370141.7	4143010.0	37.42481	-112.46764
12ALT_OHW107R	39 South	5 West	7	370225.8	4143302.8	37.42746	-112.46674
12ALT_OHW107L	39 South	5 West	7	370243.0	4143310.8	37.42753	-112.46655
12ALT_OHW108R	39 South	5 West	7	370185.2	4143399.8	37.42832	-112.46721
12ALT_OHW108L	39 South	5 West	7	370199.9	4143410.5	37.42842	-112.46705
12ALT_OHW109R	39 South	5 West	7	370237.8	4143549.7	37.42968	-112.46665
12ALT_OHW109L	39 South	5 West	7	370250.6	4143552.2	37.42971	-112.4665
12ALT_OHW110R	39 South	5 West	7	370382.0	4143757.8	37.43158	-112.46505
12ALT_OHW110L	39 South	5 West	7	370390.1	4143746.2	37.43147	-112.46496
12ALT_OHW111R	39 South	5 West	7	370495.5	4143930.6	37.43315	-112.4638
12ALT_OHW111L	39 South	5 West	7	370498.6	4143928.8	37.43313	-112.46377
12ALT_OHW112R	39 South	6 West	13	370026.0	4143007.6	37.42477	-112.46894
12ALT_OHW112L	39 South	6 West	13	370027.7	4143007.9	37.42477	-112.46893
200 Drainage							
12ALT_OHW201R	39 South	6 West	13	369935.5	4143106.8	37.42565	-112.46998
12ALT_OHW201L	39 South	6 West	13	369942.5	4143104.3	37.42563	-112.4699
12ALT_OHW202R	39 South	6 West	13	369960.4	4142765.2	37.42257	-112.46964
12ALT_OHW202L	39 South	6 West	13	369967.1	4142771.4	37.42263	-112.46957
12ALT_OHW203R	39 South	6 West	13	369998.6	4142594.2	37.42104	-112.46918
12ALT_OHW203L	39 South	6 West	13	370009.8	4142601.7	37.42111	-112.46906
12ALT_OHW204R	39 South	6 West	12	369940.4	4143362.5	37.42795	-112.46997
12ALT_OHW204L	39 South	6 West	12	369945.3	4143362.8	37.42796	-112.46992

Table G-2. Ordinary High Water Mark (OHWM) GPS data points.

Description	Township	Range	Section	UTM Easting NAD 1983	UTM Northing NAD 1983	Latitude	Longitude
				meters	meters	degrees	degrees
200 Drainage, continued							
12ALT_OHW205R	39 South	6 West	12	369979.2	4143464.0	37.42887	-112.46955
12ALT_OHW205L	39 South	6 West	12	369980.2	4143460.3	37.42884	-112.46954
300 Drainage							
12ALT_OHW301R	39 South	6 West	13	369832.9	4142936.6	37.4241	-112.47111
12ALT_OHW301L	39 South	6 West	13	369837.7	4142941.0	37.42414	-112.47106
12ALT_OHW302R	39 South	6 West	12	369718.8	4143356.9	37.42787	-112.47248
12ALT_OHW302L	39 South	6 West	12	369725.1	4143352.9	37.42784	-112.4724
500 Drainage							
12ALT_OHW501R	39 South	6 West	13	369269.6	4142681.4	37.42172	-112.47743
12ALT_OHW501L	39 South	6 West	13	369274.8	4142681.6	37.42172	-112.47737

PRIMINARY JURISDICTIONAL DETERMINATION

SPK-2011-01248

November 2012

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, SACRAMENTO
CORPS OF ENGINEERS
1325 J STREET
SACRAMENTO CA 95814-2922

REPLY TO
ATTENTION OF

November 6, 2012

Regulatory Division SPK-2011-01248

Mr. Larry Johnson
Alton Coal Development, LLC
463 North 100 West, Suite 1
Cedar City, Utah 84720

Dear Mr. Johnson:

We are responding to your consultants August 30, 2012 request for a preliminary jurisdictional determination (JD), in accordance with our Regulatory Guidance Letter (RGL) 08-02, for the Alton Coal Private Lease Site. The approximately 1,296-acre site is located on or near Kanab Creek, Section 12 and 13, Township 39 S, Range 6 W, and Section 7 and 18, Township 39 South, Range 5 West, Salt Lake Meridian, Latitude 37.40757°, Longitude -112.46555°, Alton, Kane County, Utah.

Based on available information, **we concur with the amount and location of wetlands and/or other water bodies on the site as depicted on the enclosed Figures 1 and 2 from Long Resource Consultants, Inc. and Mt. Nebo Scientific, Inc. (Enclosure 1)**. The approximately 55.60 acres of wetlands and 56038 linear feet of other water bodies present within the survey area are potential waters of the United States regulated under Section 404 of the Clean Water Act.

A copy of our RGL 08-02 Preliminary Jurisdictional Determination Form (Enclosure 2) for this site is enclosed. Please sign and return a copy of the completed form to this office. Once we receive a copy of the form with your signature we can accept and process a Pre-Construction Notification or permit application for your proposed project.

You should not start any work in potentially jurisdictional waters of the United States unless you have Department of the Army permit authorization for the activity. You may request an approved JD for this site at any time prior to starting work within waters. In certain circumstances, as described in RGL 08-02, an approved JD may later be necessary.

You should provide a copy of this letter and notice to all other affected parties, including any individual who has an identifiable and substantial legal interest in the property.

This preliminary determination has been conducted to identify the potential limits of wetlands and other water bodies which may be subject to Corps of Engineers' jurisdiction for the

particular site identified in this request. A Notification of Appeal Process and Request for Appeal form is enclosed to notify you of your options with this determination (Enclosure 3). This determination may not be valid for the wetland conservation provisions of the Food Security Act of 1985. If you or your tenant are U.S. Department of Agriculture (USDA) program participants, or anticipate participation in USDA programs, you should request a certified wetland determination from the local office of the Natural Resources Conservation Service, prior to starting work.

We appreciate your feedback. At your earliest convenience, please tell us how we are doing by completing the customer survey on our website under *Customer Service Survey*.

Please refer to identification number SPK-2011-01248 in any correspondence concerning this project. If you have any questions, please contact me at 196 E Tabernacle St, Suite 30, St. George, UT 84770-3474, email *patricia.l.mcqueary@usace.army.mil*, or telephone 435-986-1961. For more information regarding our program, please visit our website at *www.spk.usace.army.mil/Missions/Regulatory.aspx*.

Sincerely,

MCQUEARY.PATRICIA.L.1369971936

Digitally signed by MCQUEARY.PATRICIA.L.1369971936
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=MCQUEARY.PATRICIA.L.1369971936
Date: 2012.11.06 08:36:06 -07'00'

Patricia L. McQueary
Senior Project Manager, St. George Office
Utah-Nevada Regulatory Branch

Enclosures
Enclosure 1: Figures of the Project Area
Enclosure 1: Preliminary JD Form for signature
Enclosure 3: Appeal Form

Copy Furnished without enclosures
Mr. Robert E. Long, Long Resource Consultants, Inc., 1960 West Deep Creek Road, Morgan, Utah 84050
Mr. Patrick D. Collins, Mt. Nebo Scientific, Inc., 330 East 400 South, Suite 6, P.O. Box 337, Springville, Utah 84663
Mr. Keith Rigtrup, Bureau of Land Management, Kanab Field Office, 319 North 100 East Kanab, Utah 84741
Mr. Dennis Wenger, Frontier Corporation, 221 North Gateway Drive, Suite B, Providence, Utah 84332
Mr. Benjamin Gaddis, SWCA, 257 East 200 South, Suite 200, Salt Lake City, Utah 84111

PRELIMINARY JURISDICTIONAL DETERMINATION FORM
Sacramento District

This preliminary JD finds that there *"may be"* waters of the United States on the subject project site, and identifies all aquatic features on the site that could be affected by the proposed activity, based on the following information:

Regulatory Branch: **Nevada-Utah** File/ORM #: **SPK-2011-01248** PJD Date: **November 6, 2012**

State: **UT** City/County: **Alton, Kane County**
Nearest Waterbody:

Location (Lat/Long): **37.4075°, -112.4655°**

Size of Review Area: **~1296** acres

Name/Address Of Property Owner/Potential Applicant
Mr. Larry Johnson
Alton Coal Development, LLC
463 North 100 West, Suite 1
Cedar City, Utah 84720

Identify (Estimate) Amount of Waters in the Review Area
Non-Wetland Waters:
linear feet **56038** ft wide acre(s)
Stream Flow: **Mixed**

Wetlands: **55.60** acre(s) Cowardin Class: **N/A**

Name of any Water Bodies on the site identified as Section 10 Waters: Tidal: Non-Tidal:

☒ Office (Desk) Determination
☒ Field Determination:
Date(s) of Site Visit(s): **June 19, July 25, August 30, 2012**

SUPPORTING DATA: Data reviewed for preliminary JD (check all that apply – checked items should be included in case file and, where checked and requested, appropriately reference sources below)

☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant:
☒ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
☐ Data sheets prepared by the Corps.
☐ Corps navigable waters' study.
☐ U.S. Geological Survey Hydrologic Atlas:
  ☐ USGS NHD data.
  ☐ USGS HUC maps.
☒ U.S. Geological Survey map(s). Cite scale & quad name: **1:24K; UT-BALD KNOLL**
☐ USDA Natural Resources Conservation Service Soil Survey.
☐ National wetlands inventory map(s).
☐ State/Local wetland inventory map(s).
☐ FEMA/FIRM maps.
☐ 100-year Floodplain Elevation (if known):
☒ Photographs: ☒ Aerial ☒ Other
☒ Previous determination(s). File no. and date of response letter: **SPK-2011-00216, June 30, 2011; SPK-2009-01008, September 27, 2010**
☐ Other information (please specify):

IMPORTANT NOTE: The information recorded on this form has not necessarily been verified by the Corps and should not be relied upon for later jurisdictional determinations.

MCQUEARY.PATRICIA.L.1369971936 Digitally signed by MCQUEARY.PATRICIA.L.1369971936 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=MCQUEARY.PATRICIA.L.1369971936 Date: 2012.11.06 08:36:35 -07'00'

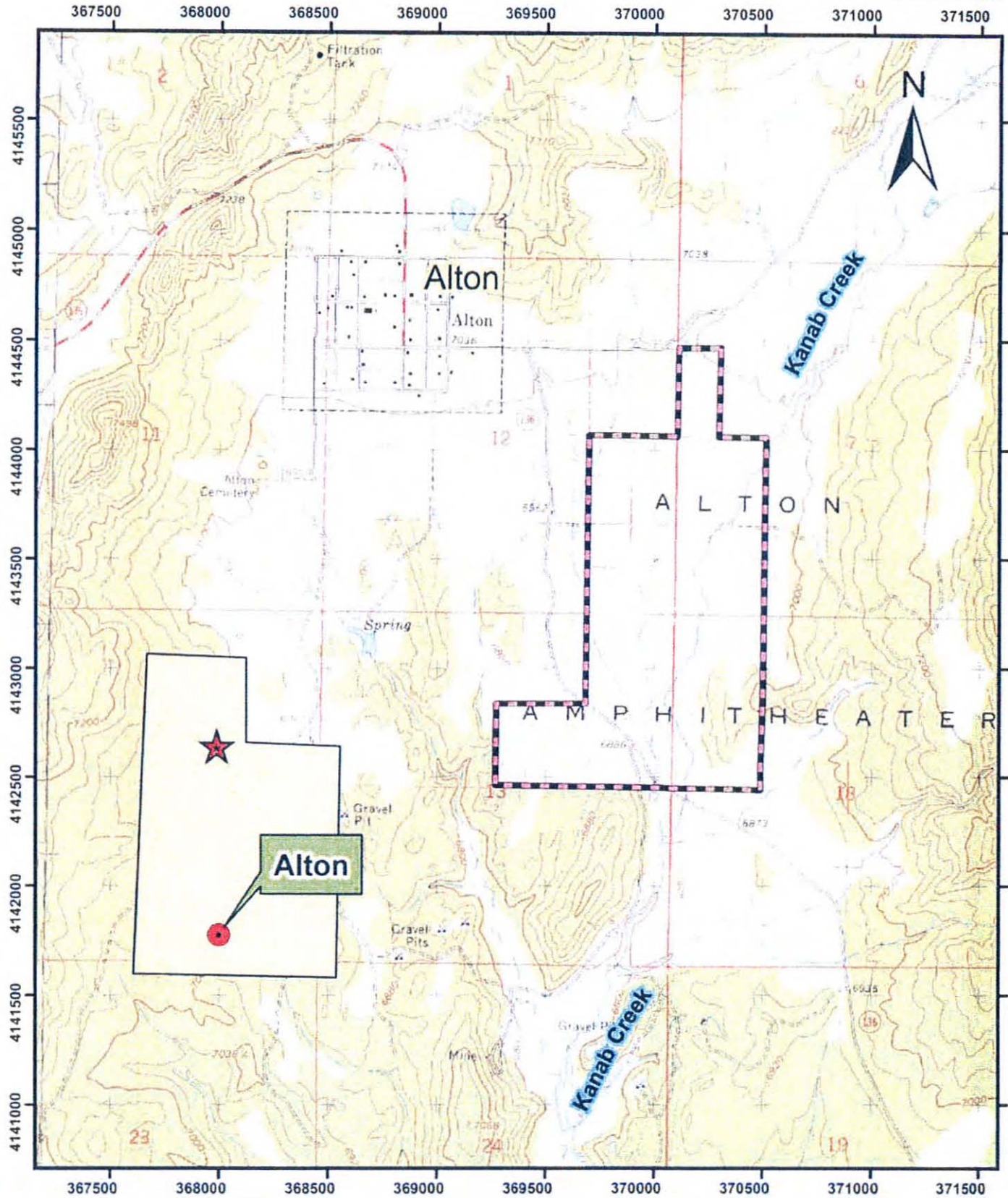
Signature and Date of Regulatory Project Manager (REQUIRED)

Signature and Date of Person Requesting Preliminary JD (REQUIRED, unless obtaining the signature is impracticable)

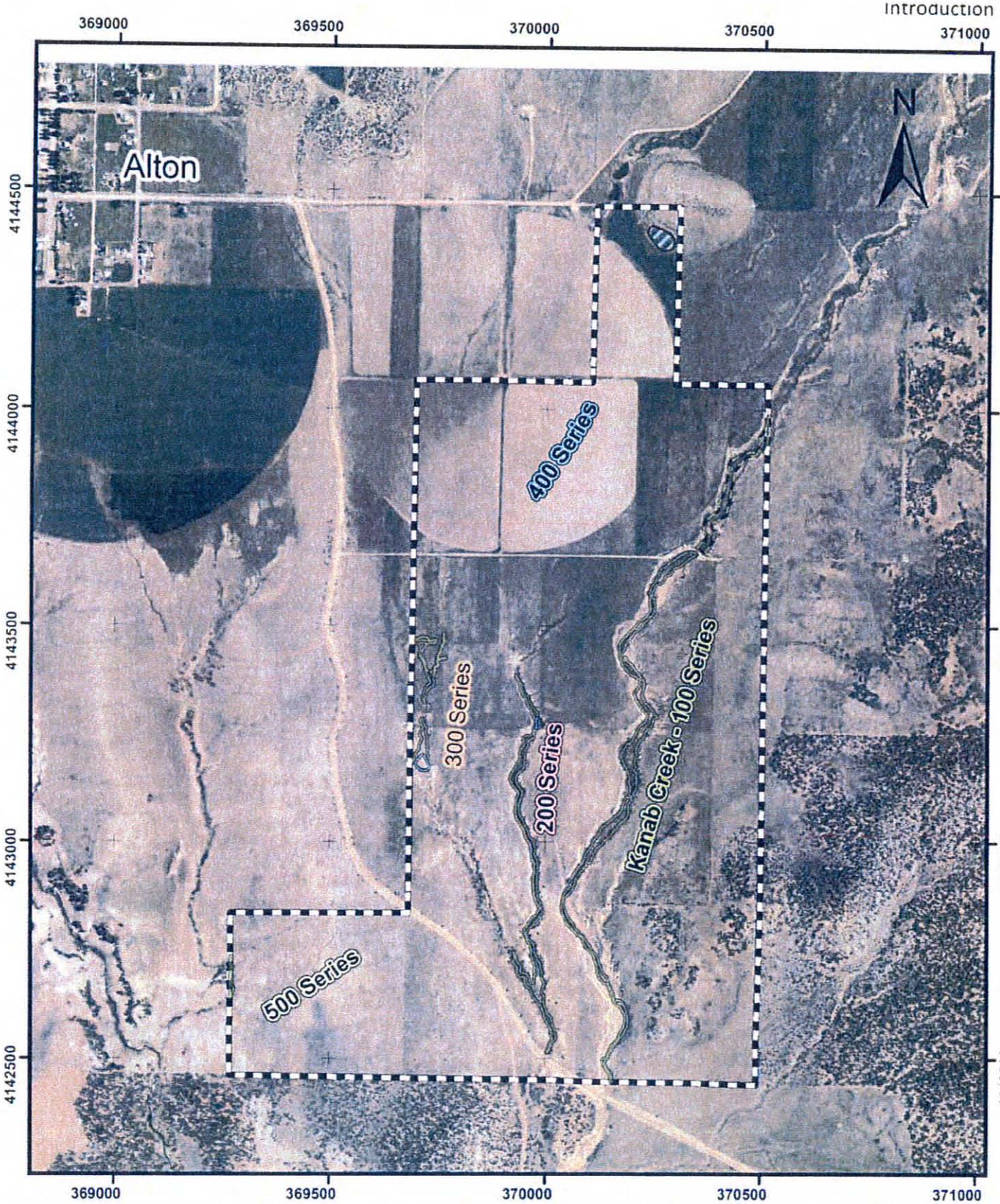
EXPLANATION OF PRELIMINARY AND APPROVED JURISDICTIONAL DETERMINATIONS:

1. The Corps of Engineers believes that there may be jurisdictional waters of the United States on the subject site, and the permit applicant or other affected party who requested this preliminary JD is hereby advised of his or her option to request and obtain an approved jurisdictional determination (JD) for that site. Nevertheless, the permit applicant or other person who requested this preliminary JD has declined to exercise the option to obtain an approved JD in this instance and at this time.

2. In any circumstance where a permit applicant obtains an individual permit, or a Nationwide General Permit (NWP) or other general permit verification requiring "preconstruction notification" (PCN), or requests verification for a non-reporting NWP or other general permit, and the permit applicant has not requested an approved JD for the activity, the permit applicant is hereby made aware of the following: (1) the permit applicant has elected to seek a permit authorization based on a preliminary JD, which does not make an official determination of jurisdictional waters; (2) that the applicant has the option to request an approved JD before accepting the terms and conditions of the permit authorization, and that basing a permit authorization on an approved JD could possibly result in less compensatory mitigation being required or different special conditions; (3) that the applicant has the right to request an individual permit rather than accepting the terms and conditions of the NWP or other general permit authorization; (4) that the applicant can accept a permit authorization and thereby agree to comply with all the terms and conditions of that permit, including whatever mitigation requirements the Corps has determined to be necessary; (5) that undertaking any activity in reliance upon the subject permit authorization without requesting an approved JD constitutes the applicant's acceptance of the use of the preliminary JD, but that either form of JD will be processed as soon as is practicable; (6) accepting a permit authorization (e.g., signing a proffered individual permit) or undertaking any activity in reliance on any form of Corps permit authorization based on a preliminary JD constitutes agreement that all wetlands and other water bodies on the site affected in any way by that activity are jurisdictional waters of the United States, and precludes any challenge to such jurisdiction in any administrative or judicial compliance or enforcement action, or in any administrative appeal or in any Federal court; and (7) whether the applicant elects to use either an approved JD or a preliminary JD, that JD will be processed as soon as is practicable. Further, an approved JD, a proffered individual permit (and all terms and conditions contained therein), or individual permit denial can be administratively appealed pursuant to 33 C.F.R. Part 331, and that in any administrative appeal, jurisdictional issues can be raised (see 33 C.F.R. 331.5(a)(2)). If, during that administrative appeal, it becomes necessary to make an official determination whether CWA jurisdiction exists over a site, or to provide an official delineation of jurisdictional waters on the site, the Corps will provide an approved JD to accomplish that result, as soon as is practicable.



Wetland Survey of Alton Coal - Private Lease Area	Fig 1. Study Area Location Map
By: Long Resource Consultants, Inc. Morgan, Utah Mt. Nebo Scientific, Inc. Springville, Utah	General Location of Wetland Study Area southeast of Alton, Utah.
	Coordinate System: UTM, NAD 1983, Zone 12 North
	Alton, Utah USGS 7.5' Topographic Map — 1 inch = 2,000 feet
	August 11, 2012 — 0 500 1,000 2,000 3,000 4,000 Feet



Wetland Survey of Alton Coal - Private Lease Area	Figure 2. Stream Channels
By: Long Resource Consultants, Inc. Morgan, Utah Mt. Nebo Scientific, Inc. Springville, Utah	Note: Stream channel numbering system used for data points. Coordinate System: UTM, NAD 1983, Zone 12 North NAIP 2011 Aerial Photography — 1 inch = 1,000 feet August 11, 2012 — 0 255 510 1,020 1,530 2,040 Feet

NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL

Applicant: Mr. Larry Johnson Alton Coal Development, LLC 463 North 100 West, Suite 1 Cedar City, Utah 84720	File No.: SPK-2011-01248	Date: October 29, 2012

Attached is:		See Section below
	INITIAL PROFFERED PERMIT (Standard Permit or Letter of permission)	A
	PROFFERED PERMIT (Standard Permit or Letter of permission)	B
	PERMIT DENIAL	C
	APPROVED JURISDICTIONAL DETERMINATION	D
X	PRELIMINARY JURISDICTIONAL DETERMINATION	E

SECTION I - The following identifies your rights and options regarding an administrative appeal of the above decision. Additional information may be found at *http://www.usace.army.mil/cecw/pages/reg_materials.aspx* or Corps regulations at 33 CFR Part 331.

A: INITIAL PROFFERED PERMIT: You may accept or object to the permit.

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- OBJECT: If you object to the permit (Standard or LOP) because of certain terms and conditions therein, you may request that the permit be modified accordingly. You must complete Section II of this form and return the form to the district engineer. Your objections must be received by the district engineer within 60 days of the date of this notice, or you will forfeit your right to appeal the permit in the future. Upon receipt of your letter, the district engineer will evaluate your objections and may: (a) modify the permit to address all of your concerns, (b) modify the permit to address some of your objections, or (c) not modify the permit having determined that the permit should be issued as previously written. After evaluating your objections, the district engineer will send you a proffered permit for your reconsideration, as indicated in Section B below.

B: PROFFERED PERMIT: You may accept or appeal the permit

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- APPEAL: If you choose to decline the proffered permit (Standard or LOP) because of certain terms and conditions therein, you may appeal the declined permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer (address on reverse). This form must be received by the division engineer within 60 days of the date of this notice.

C: PERMIT DENIAL: You may appeal the denial of a permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer (address on reverse). This form must be received by the division engineer within 60 days of the date of this notice.

D: APPROVED JURISDICTIONAL DETERMINATION: You may accept or appeal the approved JD or provide new information.

- ACCEPT: You do not need to notify the Corps to accept an approved JD. Failure to notify the Corps within 60 days of the date of this notice, means that you accept the approved JD in its entirety, and waive all rights to appeal the approved JD.
- APPEAL: If you disagree with the approved JD, you may appeal the approved JD under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer (address on reverse). This form must be received by the division engineer within 60 days of the date of this notice.

E: PRELIMINARY JURISDICTIONAL DETERMINATION: You do not need to respond to the Corps regarding the preliminary JD. The Preliminary JD is not appealable. If you wish, you may request an approved JD (which may be appealed), by contacting the Corps district for further instruction. Also you may provide new information for further consideration by the Corps to reevaluate the JD.

SECTION II - REQUEST FOR APPEAL or OBJECTIONS TO AN INITIAL PROFFERED PERMIT

REASONS FOR APPEAL OR OBJECTIONS: (Describe your reasons for appealing the decision or your objections to an initial proffered permit in clear concise statements. You may attach additional information to this form to clarify where your reasons or objections are addressed in the administrative record.)

ADDITIONAL INFORMATION: The appeal is limited to a review of the administrative record, the Corps memorandum for the record of the appeal conference or meeting, and any supplemental information that the review officer has determined is needed to clarify the administrative record. Neither the appellant nor the Corps may add new information or analyses to the record. However, you may provide additional information to clarify the location of information that is already in the administrative record.

POINT OF CONTACT FOR QUESTIONS OR INFORMATION:

If you have questions regarding this decision and/or the appeal process you may contact:
Karen Clementsen
Project Manager, St. George Office
Utah-Nevada Regulatory Branch
U.S. Army Corps of Engineers
196 E Tabernacle St. Suite 30, St. George, UT 84770-3474
Phone: 435-986-1961, FAX 435-986-3961
Email: Karen.L.Clementsen@usace.army.mil
(Use this address for submittals to the **district** engineer)

If you only have questions regarding the appeal process you may also contact:
Thomas J. Cavanaugh
Administrative Appeal Review Officer
U.S. Army Corps of Engineers
South Pacific Division, CESPD-PDO
1455 Market Street, 2052B
San Francisco, California 94103-1399
Phone: 415-503-6574, FAX 415-503-6646)
Email: Thomas.J.Cavanaugh@usace.army.mil
(Use this address for submittals to the **division** engineer)

RIGHT OF ENTRY: Your signature below grants the right of entry to Corps of Engineers personnel, and any government consultants, to conduct investigations of the project site during the course of the appeal process. You will be provided a 15 day notice of any site investigation, and will have the opportunity to participate in all site investigations.

	Date:	Telephone number:
_____ Signature of appellant or agent.		

PRELIMINARY JURSIDICTIONAL DETERMINATION

SPK-2011-01248

September 2015

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, SACRAMENTO DISTRICT
1325 J STREET
SACRAMENTO CA 95814-2922

REPLY TO
ATTENTION OF

September 4, 2015

Regulatory Division SPK-2011-01248

Alton Coal Development
Attn: Mr. Kirk Nicholes
463 North 100 West, Suite 1
Cedar City, Utah 84720

Dear Mr. Nicholes:

We are responding to your consultant's September 3, 2015 request for a preliminary jurisdictional determination (JD), in accordance with our Regulatory Guidance Letter (RGL) 08-02, for the Alton Coal North Private Lease Area. The approximately 296-acre project site is located near Alton on Kanab Creek, Latitude 37.40757°, Longitude -112.465557°, Alton, Kane County, Utah.

Based on available information, **we concur with the amount and location of wetlands and/or other water bodies on the site as depicted on the enclosed August 2015 Alton Coal NPLA Map prepared by Frontier Corporation**. The approximately 6.34 acres of palustrine emergent wet meadow wetlands, the 4,632-ft of Kanab Creek and the 0.04 acres of a stock pond – to the extent that is located within an active channel; are present within the survey area are potential waters of the United States regulated under Section 404 of the Clean Water Act.

We have enclosed a copy of the *Preliminary Jurisdictional Determination Form* for this site. Please sign and return a copy of the completed form to this office. Once we receive a copy of the form with your signature we can accept and process a Pre-Construction Notification or permit application for your proposed project.

You should not start any work in potentially jurisdictional waters of the United States unless you have Department of the Army permit authorization for the activity. You may request an approved JD for this site at any time prior to starting work within waters. In certain circumstances, as described in RGL 08-02, an approved JD may later be necessary.

You should provide a copy of this letter and notice to all other affected parties, including any individual who has an identifiable and substantial legal interest in the property.

We appreciate your feedback. At your earliest convenience, please tell us how we are doing by completing the customer survey on our website under *Customer Service Survey*. For more information regarding our program, please visit our website at *www.spk.usace.army.mil/Missions/Regulatory.aspx*.

Please refer to identification number SPK-2011-01248 in any correspondence concerning this project. If you have any questions, please contact Jason Deters at Saint George Regulatory Office, 196 E Tabernacle Street Room 30, St. George, Utah 84770, by email at *Jason.deters@usace.army.mil*, or telephone at 435-986-3979.

Sincerely,

Patricia L. McQueary
Senior Regulatory Project Manager
St. George Regulatory Office
Sacramento District

Enclosures

cc:
Mr. Dennis Wenger (electronically)

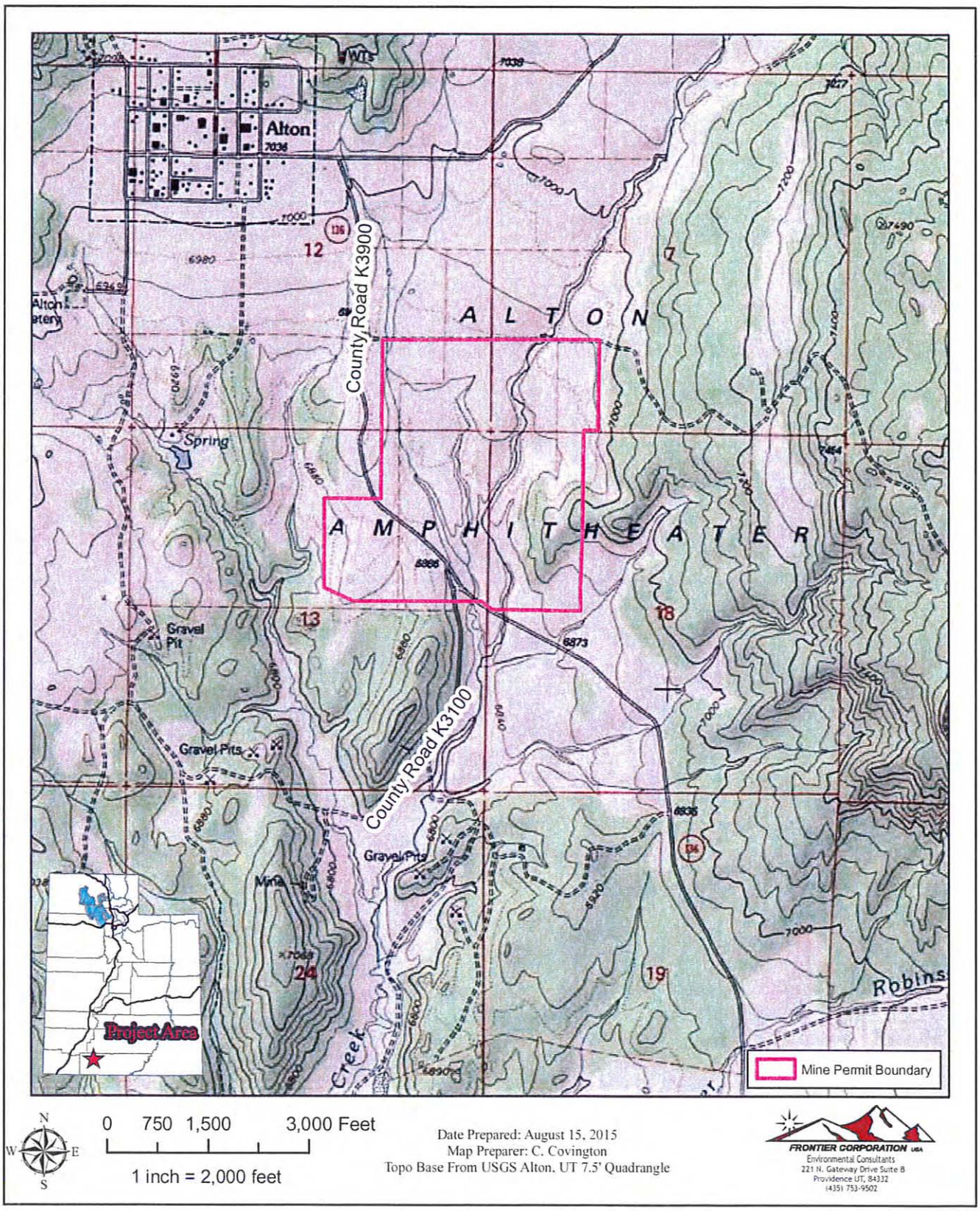


Figure 1. Site Location Map - 1:24,000 Scale 7.5' Topographic Map

Alton Coal NPLA, Kane County, UT
Update to Existing Delineation
SPK-2011-01248

Frontier Corporation USA
August 2015

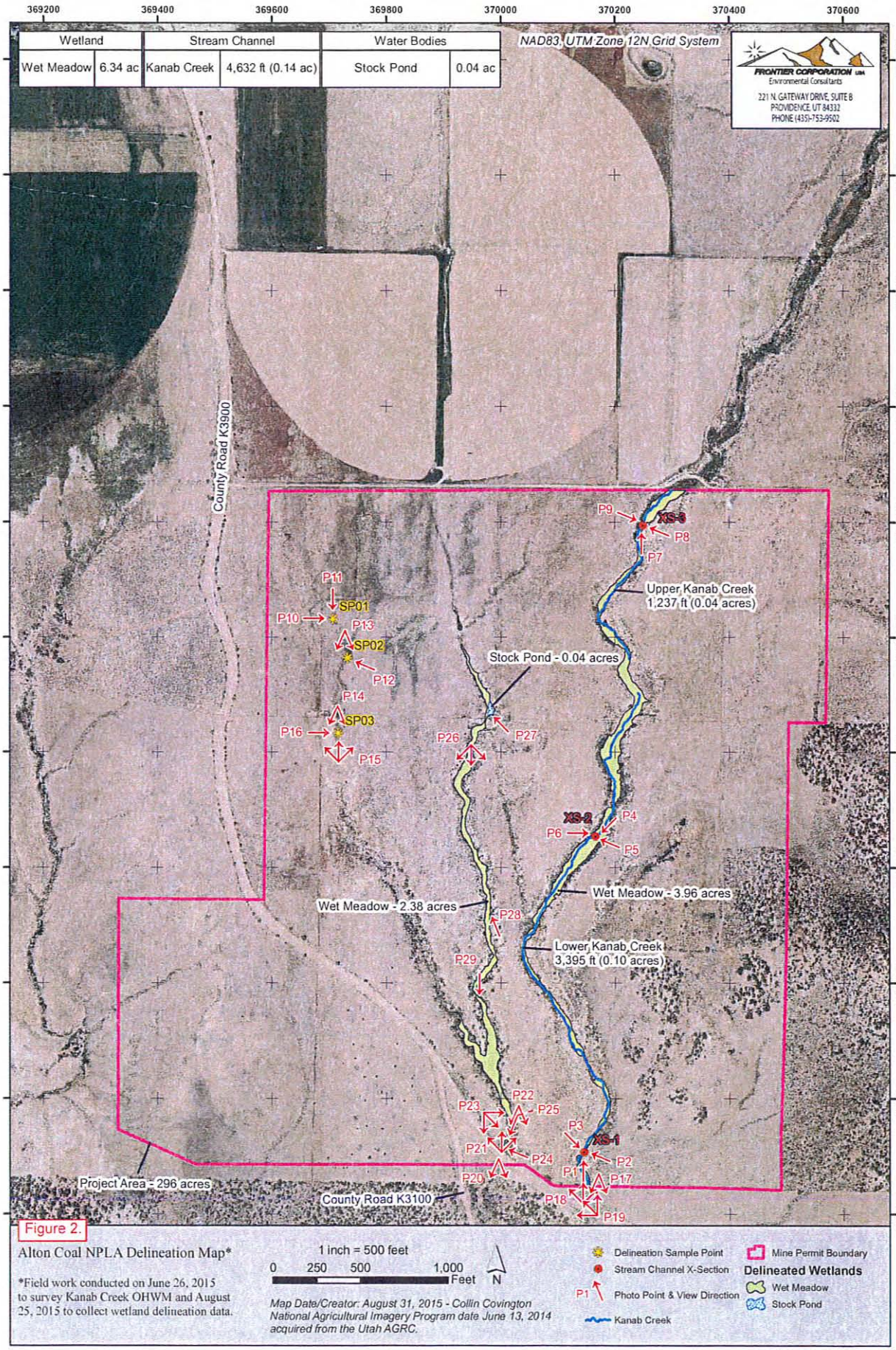


Figure 2.

Alton Coal NPLA Delineation Map*

*Field work conducted on June 26, 2015 to survey Kanab Creek OHWM and August 25, 2015 to collect wetland delineation data.

1 inch = 500 feet

0 250 500 1,000 Feet N

Map Date/Creator: August 31, 2015 - Collin Covington
National Agricultural Imagery Program date June 13, 2014 acquired from the Utah AGRC.

Delineation Sample Point
Stream Channel X-Section
P1 Photo Point & View Direction
Kanab Creek
Mine Permit Boundary
Delineated Wetlands
Wet Meadow
Stock Pond

Alton Coal NPLA, Kane County, UT
Update to Existing Delineation
SPK-2011-01248

Frontier Corporation, USA
August 2015

PRELIMINARY JURISDICTIONAL DETERMINATION FORM
Sacramento District

This preliminary JD finds that there *"may be"* waters of the United States on the subject project site, and identifies all aquatic features on the site that could be affected by the proposed activity, based on the following information:

Regulatory Branch: **Select** File/ORM #: **SPK-2011-01248** PJD Date: **September 4, 2015**

State: **UT** City/County: **, Kane County**
Nearest Waterbody:

Location (Lat/Long): **37.4075°, -112.46555°**

Size of Review Area: **296** acres

Name/Address Of Property Owner/ Potential Applicant: **Alton Coal Development**
Attn: Mr. Kirk Nicholes
463 North 100 West Suite 1
Cedar City, Utah 84721

Identify (Estimate) Amount of Waters in the Review Area

Non-Wetland Waters:
4632 linear feet ft wide **0.14** acre(s)
Stream Flow: **Perennial**
Other non-wetland waters: 0.04 acre stock pond

Wetlands: **6.34** acre(s)
Cowardin Class: **Palustrine, emergent**

Name of any Water Bodies Tidal:
on the site identified as
Section 10 Waters: Non-Tidal:

☒ Office (Desk) Determination
☐ Field Determination:
Date(s) of Site Visit(s):

SUPPORTING DATA: Data reviewed for preliminary JD (check all that apply – checked items should be included in case file and, where checked and requested, appropriately reference sources below)

☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant:
☒ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
☐ Data sheets prepared by the Corps.
☐ Corps navigable waters' study.
☒ U.S. Geological Survey Hydrologic Atlas:
  ☒ USGS NHD data.
  ☐ USGS HUC maps.
☒ U.S. Geological Survey map(s). Cite scale & quad name: **1:24K; UT-BALD KNOLL**
☐ USDA Natural Resources Conservation Service Soil Survey.
☐ National wetlands inventory map(s).
☐ State/Local wetland inventory map(s).
☐ FEMA/FIRM maps.
☐ 100-year Floodplain Elevation (if known):
☒ Photographs: ☒ Aerial
  ☒ Other
☒ Previous determination(s). File no. and date of response letter: **SPK-2010-00748; SPK-2011-01248; SPK-2011-000216**
☐ Other information (please specify):

IMPORTANT NOTE: The information recorded on this form has not necessarily been verified by the Corps and should not be relied upon for later jurisdictional determinations.

MCQUEARY.PATRICIA.L.1369971936 Digitally signed by MCQUEARY.PATRICIA.L.1369971936 DN: cn=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=MCQUEARY.PATRICIA.L.1369971936 Date: 2015.09.04 16:13:07 -06'00'

9/04/2015

Signature and Date of Regulatory Project Manager (REQUIRED)

Signature and Date of Person Requesting Preliminary JD (REQUIRED, unless obtaining the signature is impracticable)

EXPLANATION OF PRELIMINARY AND APPROVED JURISDICTIONAL DETERMINATIONS:

1. The Corps of Engineers believes that there may be jurisdictional waters of the United States on the subject site, and the permit applicant or other affected party who requested this preliminary JD is hereby advised of his or her option to request and obtain an approved jurisdictional determination (JD) for that site. Nevertheless, the permit applicant or other person who requested this preliminary JD has declined to exercise the option to obtain an approved JD in this instance and at this time.

2. In any circumstance where a permit applicant obtains an individual permit, or a Nationwide General Permit (NWP) or other general permit verification requiring "preconstruction notification" (PCN), or requests verification for a non-reporting NWP or other general permit, and the permit applicant has not requested an approved JD for the activity, the permit applicant is hereby made aware of the following: (1) the permit applicant has elected to seek a permit authorization based on a preliminary JD, which does not make an official determination of jurisdictional waters; (2) that the applicant has the option to request an approved JD before accepting the terms and conditions of the permit authorization, and that basing a permit authorization on an approved JD could possibly result in less compensatory mitigation being required or different special conditions; (3) that the applicant has the right to request an individual permit rather than accepting the terms and conditions of the NWP or other general permit authorization; (4) that the applicant can accept a permit authorization and thereby agree to comply with all the terms and conditions of that permit, including whatever mitigation requirements the Corps has determined to be necessary; (5) that undertaking any activity in reliance upon the subject permit authorization without requesting an approved JD constitutes the applicant's acceptance of the use of the preliminary JD, but that either form of JD will be processed as soon as is practicable; (6) accepting a permit authorization (e.g., signing a proffered individual permit) or undertaking any activity in reliance on any form of Corps permit authorization based on a preliminary JD constitutes agreement that all wetlands and other water bodies on the site affected in any way by that activity are jurisdictional waters of the United States, and precludes any challenge to such jurisdiction in any administrative or judicial compliance or enforcement action, or in any administrative appeal or in any Federal court; and (7) whether the applicant elects to use either an approved JD or a preliminary JD, that JD will be processed as soon as is practicable. Further, an approved JD, a proffered individual permit (and all terms and conditions contained therein), or individual permit denial can be administratively appealed pursuant to 33 C.F.R. Part 331, and that in any administrative appeal, jurisdictional issues can be raised (see 33 C.F.R. 331.5(a)(2)). If, during that administrative appeal, it becomes necessary to make an official determination whether CWA jurisdiction exists over a site, or to provide an official delineation of jurisdictional waters on the site, the Corps will provide an approved JD to accomplish that result, as soon as is practicable.

Supplemental Reports - Volume 11

Order 2 Soil Survey

for the

North Private Lease Expansion
of the
Coal Hollow Mine

Located Southeast of Alton, Utah

Prepared for

Alton Coal Development, LLC

by

Long Resource Consultants, Inc.
Morgan, Utah

~~November 18, 2014~~ October 2, 2015

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Section One

Purpose of Soil Survey

The purpose of this report is to summarize the results of an order 2 soils inventory conducted for Alton Coal Development, LLC (ACD) in the North Private Lease (NPL). This area is proposed for expansion of the existing Coal Hollow surface coal mine. The soil survey area is approximately one third mile southeast of Alton, Utah and comprises approximately 428 acres. This soil survey was prepared so that ACD could: 1) identify suitable sources of subsoil and topsoil; 2) determine topsoil and subsoil salvage depths and quantities; and, 3) develop a post mining reclamation plan using salvaged soil materials.

Project Area

The North Private Lease soil survey area is located in the Alton Amphitheater, Figure 1. It is bounded on the northeast and east by the Paunsaugunt Plateau and by the Markagunt Plateau on the northwest. Black Mountain separates the Alton Amphitheater from Long Valley on the west. It is bounded on the south by Sink Valley and the Skutumpah Terrace (Tilton 2001). The project area includes portions of the west half of section 7 and west half of section 18 in Township 39 south, Range 5 west, and the southwest quarter of section 12, northeast quarter of section 13, in Township 39 south, Range 6 west, Salt Lake Base meridian (Utah AGRC 2012d). Elevation ranges from approximately 6,839 to 7,036 feet (2,085 to 2,145 meters) based on digital elevation models (Utah AGRC 2012a).

The soil survey project area is approximately 428 acres.

The NPL is drained by Kanab Creek which is a tributary of the Colorado River.

Reference Points

Common reference points within the NPL soil survey area are shown in Figure 2. These areas include:

- County Road
- Farm Road
- Farm Road Crossing
- Elk fence
- Kanab Creek
- Kanab Creek Crossing
- North Hill

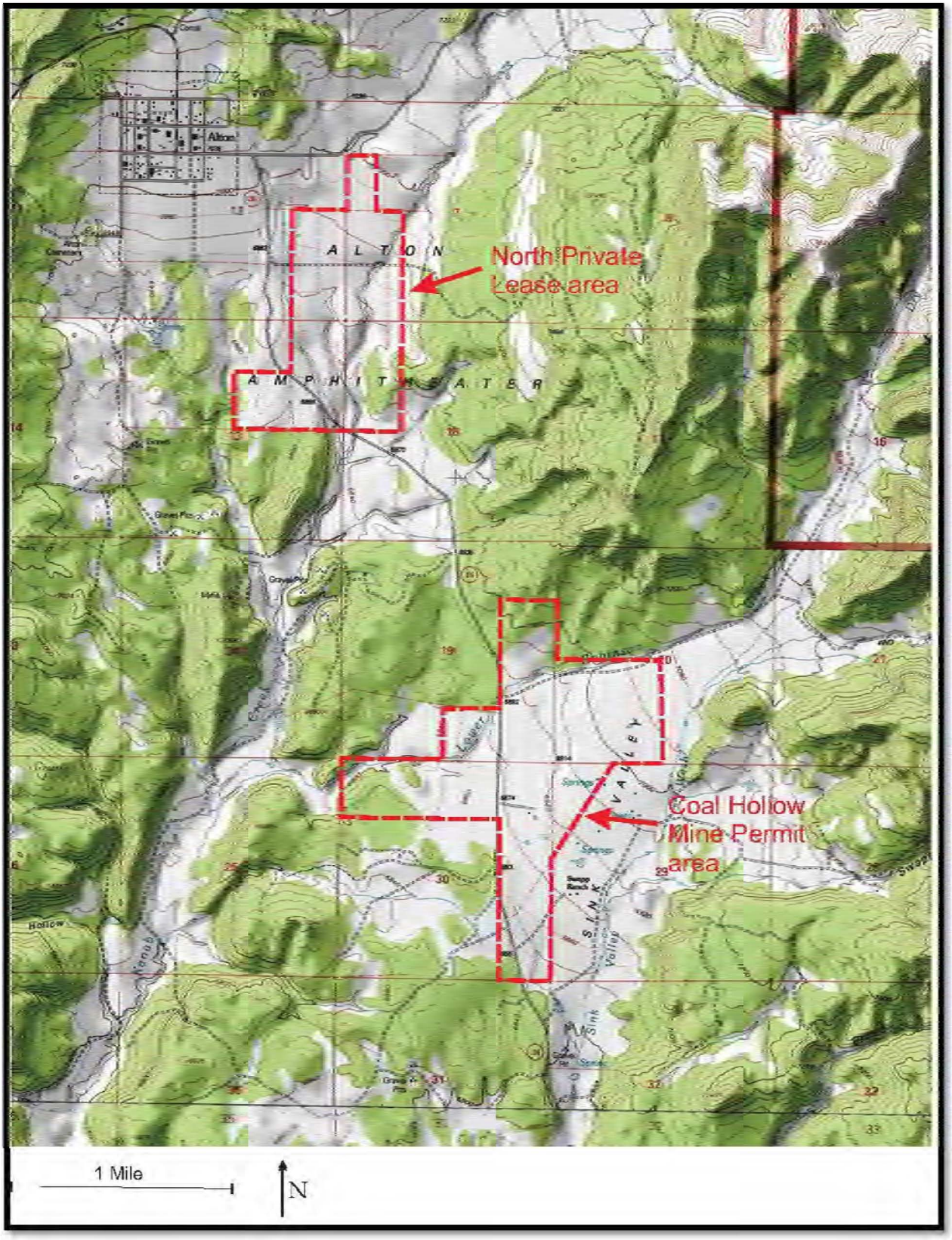

Figure 1. General location of Alton Coal's North Private Lease near Alton, Utah in Kane County.

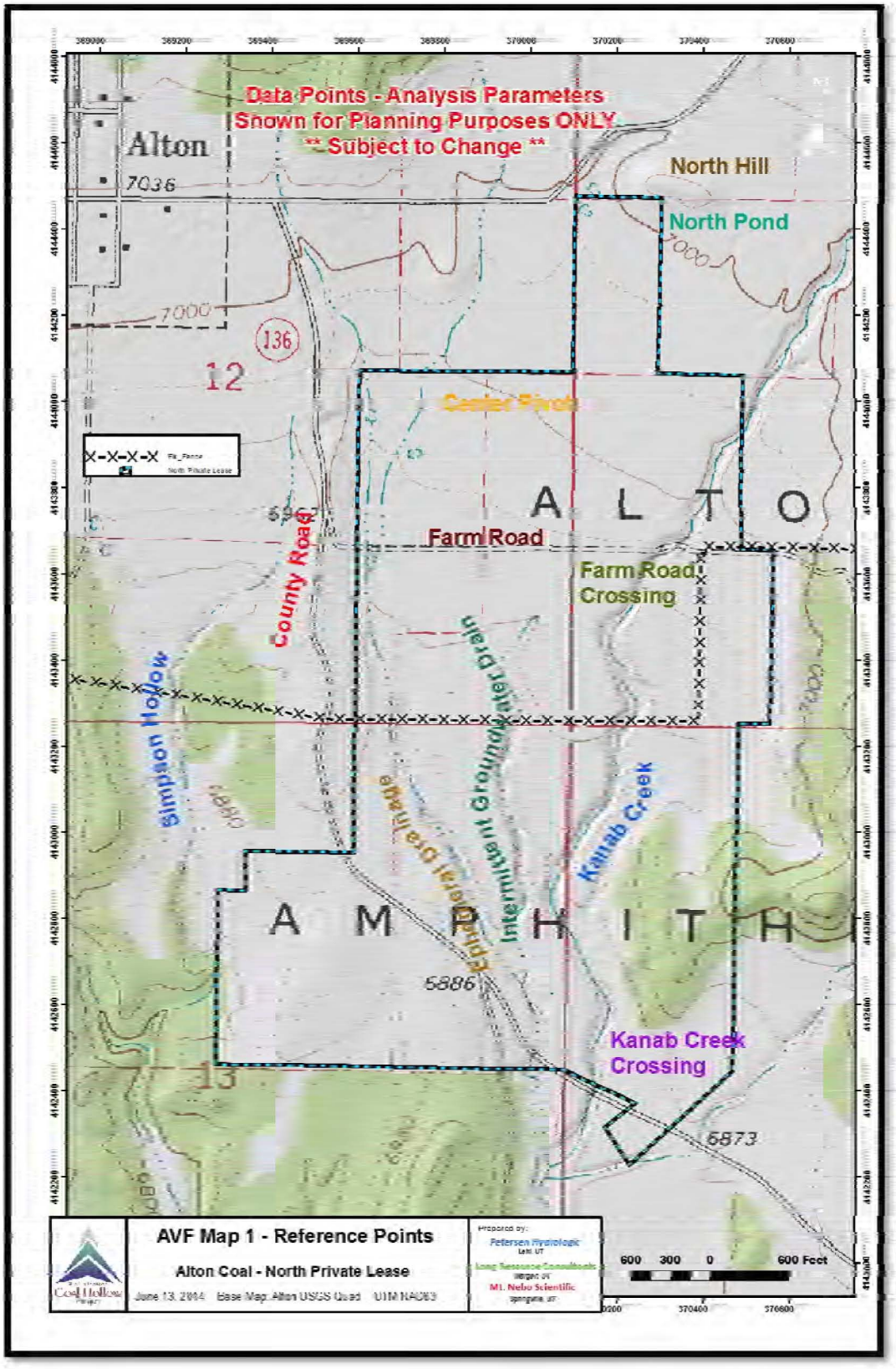

Figure 2. Reference points in the North Private Lease soil survey area (Petersen 2014).

Vegetation

Native vegetation in the NPL soil survey area consists of Utah juniper, pinyon pine, big sagebrush, and wet meadows. Portions of the project area were previously cleared of Utah juniper, pinyon pine, and sagebrush and planted to non-irrigated range grasses. Ecological sites were assigned to soil map unit components (Benson 2014a, Benson 2014b, and USDA NRCS 2014a).

Agriculture

The area north of the farm road and west of Kanab Creek is under active cultivation. Alfalfa and small grain crops are grown in this area.

The area south of the farm road, north of the elk fence, and west of Kanab Creek is dominated by irrigated and non-irrigated grass pastures. Some alfalfa has been grown in the eastern end of this area in the past as evidenced by scattered plants within the grass field.

Irrigation

The northern portion of the soil survey area is currently under irrigation as shown by Soils Map 5 in Appendix F. The estimated areas under irrigation were determined from aerial photography and are approximate. A center pivot irrigates 71.28 acres north of the farm road. Wheel-lines are used to irrigate 15.84 acres north of the farm road and 20.15 acres south of the farm road. An additional 21.56 acres south of the farm road is irrigated with hand lines on an intermittent basis.

Climate

An official U.S. Weather Bureau station is located in Alton, Utah. The period of available records for this station is May 1, 1915 through February 28, 2013 (Western Regional Climate Center, May 2014). Average annual precipitation is 16.71 inches. Monthly precipitation is fairly uniform from July through March, while less is received from April through June. The average annual air temperature is 45.6 ^{o}F. The precipitation pattern is ustic (V. Parslow, 2012) and typified by summer thunderstorms. Soil temperature regime is mesic (V. Parslow, 2012). Table 1. Summary of weather data for Alton, Utah. contains a summary of weather data for Alton, Utah. Summers are warm with cool nights.

Table 1. Summary of weather data for Alton, Utah.

	Ave Max Temp (F)	Ave Min Temp (F)	Ave Total Precip (in)	Ave. Total Snowfall (in)	Ave Total Snow Depth (in)
January	39.4	15.1	1.84	20.7	~~6~~7
February	42.1	17.6	1.81	19.5	8
March	47.8	21.9	1.60	13.8	6
April	57.5	28.0	1.06	4.8	1
May	67.1	34.9	0.82	0.6	0
June	76.8	42.2	0.53	0.1	0
July	82.3	50.1	1.43	0.0	0
August	80.0	48.9	1.73	0.0	0
September	73.5	41.8	1.47	0.0	0
October	62.6	32.9	1.49	1.2	0
November	50.0	23.1	1.26	6.4	1
December	41.5	16.8	1.68	16.4	3
Annual	60.0	31.1	16.71	83.6	2

Source: Western Regional Climate Center, May 2014.
Period of Record: May 1, 1915 to December 31, 2014

Geology

The North Private Lease soil survey area is located in Sink Valley in the Alton Amphitheater southwest of the Paunsaugunt Plateau. Quaternary alluvium (Qa), Tropic shale and (Kt), and Dakota sandstone (Kd) are the primary sources of parent material in the soil survey area. Figure 3Figure 3. General geology of areas within and near the North Private Lease soil survey area near Alton, Utah (Tilton 2001). illustrates geologic formations and features in the NPL soil survey area (Tilton, 2001). A site specific map of the geologic contacts in the North Private is shown in Figure 4 (Petersen 2014a). Quaternary alluvium (Qa) consists of unconsolidated clay, silt, sand, and gravel deposits located in fan alluvium and terrace deposits of Holocene age (Tilton, 2001). Parent materials based on the soil survey and geologic reconnaissance of the North Private Lease soil survey area are shown on Soils Map 3 in Appendix F.

The primary sources of the Quaternary alluvium is Claron limestone (Tcp), Tropic shale (Kt), Tibbet Canyon sandstone (Kst), Dakota sandstone (Kd)as well as other surrounding geologic units (Tilton 2001). Soils developed from Quaternary alluvium are situated on the terrace remnant (pediment) dissected by Kanab Creek and other ephemeral channels. The influence of alluvium from the Claron limestone is soils with greater than 40 percent calcium carbonate. Tropic shale alluvium is characterized by soils with clayey textures.

Tropic shale (Kt) is a member of the Upper Cretaceous formation and is also referred to as Mancos shale (Hintze, 1977) in Eastern Utah. It is a medium-brownish-gray to medium dark-gray, very thin-bedded, silty shale. Soils developed directly from Tropic shale are primarily along the eastern, western, and southeastern portion of the NPL (Tilton 2001). Shallow coarse textured soils have developed in the sandstone member of the Tropic formation in the southeastern portion of the NPL.

Tibbet Canyon sandstone is a member of the Straight Cliffs formation and overlies the Tropic shale. This formation is the result of "...beach and bar deposits, and possibly coastal dunes (Tilton 2001)."

Claron limestone (Tcp) consists of a lower pink member and an overlying white member. The Sunset Cliffs at the headwaters of Kanab Creek were formed in Claron limestone. The Claron formation was deposited in freshwater lakes. Claron limestone was formerly referred to as the Wasatch Formation (Tilton 2001).

Dakota sandstone (Kd) consists of interbeded yellowish-gray and brown sandstone, gray mudstone, black carbonaceous mudstone and coal, and some bentonite (Tilton 2001). Dakota sandstone is present in the extreme southwest portion of the soil survey area where it is intermingled with Tropic shale.

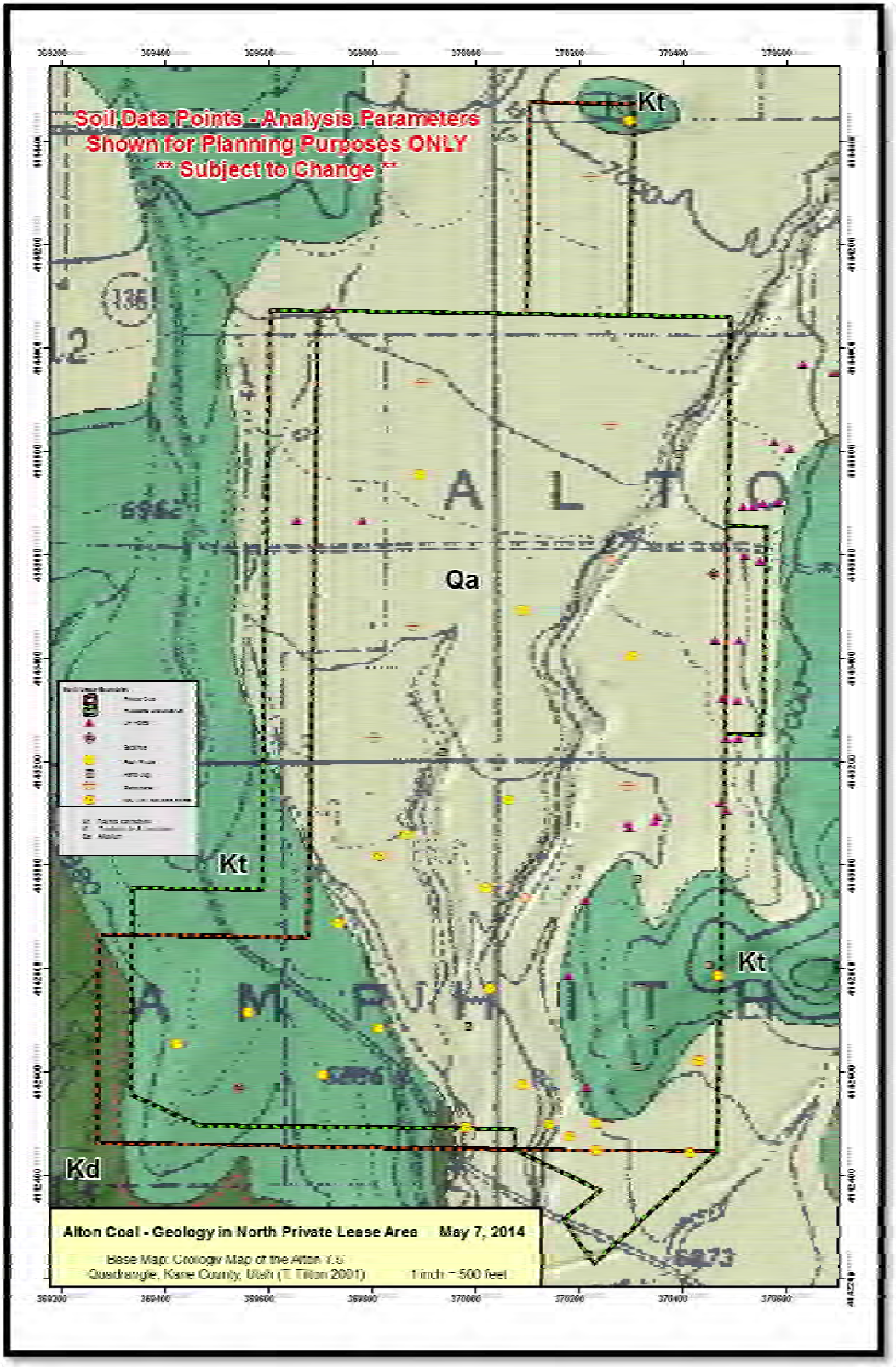

Figure 3. General geology of areas within and near the North Private Lease soil survey area near Alton, Utah (Tilton 2001).

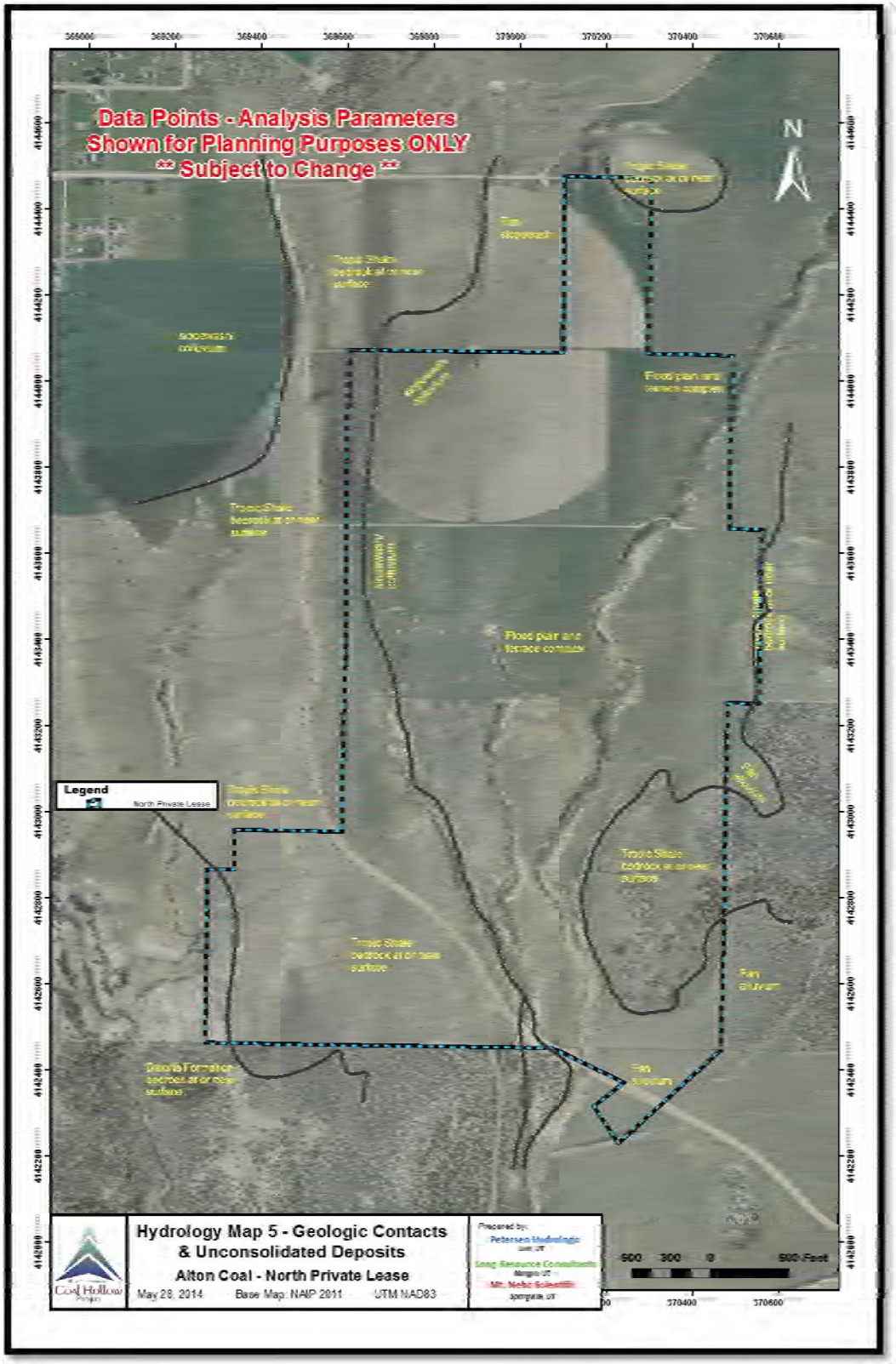

Figure 4. Geologic contacts within and near the North Private Lease soil survey area near Alton Utah (Petersen 2014a).

How this Soil Survey was Made

This soil survey was made in accordance with the guidelines for an order II soil survey as detailed in the *Soil Survey Manual* (USDA NRCS 1993) and *National Soil Survey Handbook* (2014b). Soils were classified using the *Keys to Soil Taxonomy, Twelfth Edition* (USDA NRCS 2014d). The dominant soil Great Groups identified in the NPL soil survey area are Calciustepts, Haplustalfs, Haplusterts, Endoaquepts, Ustifluvents, and Ustorthents.

Evaluation of Soils

Soils were examined, described, and sampled in hand dug pits (6), cutbanks (3), backhoe pits (2), and hydraulic push probe tubes (58). Access agreements between ACD and landowners limited soil examinations to non-destructive testing (minimal surface disturbance) within agricultural areas. Ten of the push probe locations were outside the soil survey boundary. Soil profile descriptions and samples were collected in July/August 2012, October 2012, November 2012, November 2013, and April 2014. Soils Map 1 in Appendix F details the locations of the soil profiles that were examined, sampled, and analyzed within and adjacent to the North Private Lease soil survey area.

Hydraulic Push Probe

The hydraulic push probe was classified as non-destructive testing, because of the very limited amount of surface disturbance that occurred when soil samples were collected. The upper 8 feet were collected in 2.75 inch diameter tubes and in 1.5 inch diameter tubes below 8 feet. Soil samples were collected in clear plastic liners that were 4 feet (122 cm) in length.

Use of the hydraulic push probe allowed more soils to be evaluated to deeper depths and at more frequent intervals compared to a typical order 2 soil survey. The number of sample locations averaged one per each 7.4 acres. The normal sampling interval for an order 2 soil survey of this type is one sample location per each 10 to 15 acres.

Soil characteristics normally seen in backhoe pits or cutbanks were also observed when the push probe tube liners were opened. These characteristics included: horizons; soil structure; dry and moist consistence; ped surface features (clay films, slickensides, and carbonate coats); root size and density; pore size and density; concentrations (secondary carbonates); rock fragment size, amount, shape, roundness, and kind; and qualitative soil moisture estimates. Soil horizon boundary descriptions were limited to vertical descriptions (abrupt, clear, gradual, and diffuse) for the push tubes.

Soil Profile Descriptions

Soil profile descriptions were completed for each soil sample location. This occurred in the field for the hand dug pits, cutbanks, and backhoe pits when they were sampled. Push probe holes were analyzed and described when the push tubes were opened in the office. Soil colors

(Munsell 2012) were evaluated in the office under natural lighting using the profile box samples collected for each location. Soil *Pedon Description Forms* (USDA - NRCS 1997) were completed for each soil pit using the methods detailed in the *Field Book for Describing and Sampling Soils*, version 3.0 (Schoeneberger et. al., 2012). All soil descriptions were completed by Robert E. Long, Certified Professional Soil Scientist. Soil profile descriptions are in Appendix B. Photographs of the soil profile locations are in Appendix D.

The geomorphic setting for each soil profile location was determined based on the Geomorphic Description System (USDA 2008)

Soil sample locations were coded by the year that the sample was collected. The 12AS samples were collected in 2012, 13AS samples in 2013, and the 14AS sample in 2014. The DP samples were collected in 2012.

Soil samples of each horizon were collected in new gallon size plastic freezer bags and in micromonolith boxes. The sealed sample bags were shipped to the Inter Mountain Laboratory in Sheridan, Wyoming for analysis. Box samples were used for further examination of soil profile characteristics and retained as a record of each soil profile. Photos of the soil profile boxes are in Appendix E.

Piezometers

Piezometers were installed at 13 of the soil profile locations sampled with the hydraulic push probe. Depths at these locations were increased to the depth of groundwater or approximately 29 feet, whichever occurred first. The results of the NPL piezometer study are detailed in the NPL geo-hydrology study (Petersen 2014b). Table 2 lists the soil profile description numbers and the corresponding piezometer study names.

Table 2. Soil profile names and corresponding piezometer study names.

Soil Survey Profile Identification	Piezometer Study Identification	Depth	Depth
		cm	feet
12AS018	NLP-2	732	24.0
12AS020	NLP-1	610	20.0
12AS021	NLP-3	853	28.0
12AS022	NLP-4	232	7.6
12AS024	NLP-5	305	10.0
12AS027	NLP-7	792	26.0
12AS028	NLP-6	610	20.0
12AS029	NLP-8	610	20.0
DP-30[1]	NLP-9		
12AS019A	NLP-10	852	28.0
13AS006	NLP-11	884	29.0
13AS007	NLP-12	732	24.0
13AS008	NLP-13	488	16.0

1. No soil description completed for DP-30.

Soil Profile Locations

The location of each soil sample location was determined with a hand-held GPS. The DP locations were recorded manually with a Garmin GPSMAp 60csx™ in the UTM NAD27 coordinate system. The 12AS, 13AS, and 14AS soil sample locations were recorded on an Ashtec MobilMapper 10™ in CORS96 NAD83. MobilMapper field data was post processed with MobilMapper Office 4.5© software (Trimble Navigation Limited 2013) and reference data from the Coconino County 2, Arizona base station (approximately 48 km or 30 miles from the NPL).

Elevations

Elevations for the piezometer location were determined with survey grade GPS units by ACD staff. The top of the piezometer casing (projecting above ground surface) was measured as the elevation.

The MobilMapper 10 provided post processed elevations for the 12AS, 13AS, and 14AS soil profile locations.

Elevations for the DP soil profile locations were obtained from the digital elevation model (Utah AGRC 2012a) using ARCMap software.

Permeability

Soil permeability estimates were derived from estimates of the saturated hydraulic conductivity, K_{sat}. The K_{sat} estimates were obtained from soil textural triangles in the *Guide for Estimating Ksat from Soil Properties* in section 618.88 of the National Soil Survey Handbook (USDA NRCS 2014c). The lab analysis percents sand, silt, and clay were used to estimate K_{sat}.

Digital Mapping

The soil survey map (Soils Map 2 in Appendix F) was produced using ARCMap software (version 10.2.1).

Digital natural color aerial photography, infrared aerial photography, Public Land Survey Sections (PLSS), and a Utah transportation layer were downloaded from the Utah Automated Geographic Reference Center (Utah AGRC 2012-14).

Slope (Soils Map 7 in Appendix F), aspect, contour, and hillshade shapefile layers were created from a 10 meter digital elevation model (DEM) downloaded from the AGRC web site (Utah AGRC 2012b). These shapefiles were used to determine the aspect and percent slope at each soil sample location. The slope file was used to determine slope ranges for the soil map units (Soils Map 7 in Appendix F). A contour file was produced by Alton Coal using 2007 land survey data.

Analysis of Soil Samples

Soil samples (430) from 69 representative soil profiles that were collected from within or immediately adjacent to the NPL soil survey area were collected by soil horizon and submitted for chemical and physical analysis. Results of the laboratory analysis of soil samples is in Appendix C.

Soil samples were analyzed for the parameters outlined by the Utah Division of Oil Gas and Mining's (DOGM) *Guidelines for Management of Topsoil and Overburden* (Utah DOGM~~, 2005~~ 2008) along with additional parameters, Table 3.

Table 3. Soil analysis parameters for topsoil and overburden (Utah DOGM~~, 2005~~ 2008).

Parameter	Unit	Full Analysis	Short Analysis	Limited Analysis
Paste pH	s.u.	X[1]	X[1]	X[1]
Saturation percent	%	X[1]	X[1]	
Electrical Conductivity (ECe)	dS/m	X[1]	X[1]	X[1]
Moisture percent	%	X[1]	X[1]	
Field Capacity	%	X	X	
Wilting Point	%	X	X	
Organic Matter Percent	%	X[1]	X[1]	X[1]
Soluble Na, K, Mg, and Ca	meq/l	X[1]	X[1]	X[1]
Sodium Adsorption Ratio		X[1]	X[1]	X[1]
Particle Size Analysis (report very fine sand, sand, silt, and clay)	%	X[1]	X[1]	X[1]
Boron, available	ppm	X[2]	X[2]	
Nitrate (as N)	ppm	X	X	
CaCO3 Percent	%	X[1]	X[1]	X[1]
Phosphorus, available	ppm	X	X[3]	
Selenium, available	ppm	X[2]	X[2]	X[2]
Total Organic Carbon	%	X[1]	X[1]	X[1]
Acid Base Potential	Tons/Kton	X[2]		
Arsenic, Total	mg/kg	X		
Barium, total	mg/kg	X		
Cadmium, total	mg/kg	X		
Chromium, total	mg/kg	X		
Copper, total	mg/kg	X		
Iron, total	mg/kg	X		
Lead, total	mg/kg	X		
Manganese, total	mg/kg	X		
Molybdenum, total	mg/kg	X		
Selenium, total	mg/kg	X		
Silver, total	mg/kg	X		
Zinc, total	mg/kg	X		
Bulk Density	g/cm^3	X		
Coarse Fragments, >2mm	%	As deemed necessary for the sample		
K factor calculation		X	X[4]	X[4]

1. Parameter listed in *Guidelines for Management of Topsoil and Overburden*, Table 4 for soil suitability evaluation (Utah DOGM 2008).
2. Parameter listed in *Guidelines for Management of Topsoil and Overburden*, Table 8 for substitute topsoil and overburden (Utah DOGM ~~2005~~ 2008).
3. Available phosphorus was not analyzed on all medium list samples.
4. K factors were calculated for medium and short list samples when the necessary data was available.

Calcium Carbonate

Calcium carbonate is a clay size soil particle that is included in the percent clay reported for soil texture, but it is subtracted from the percent clay when determining the taxonomic particle-size class (USDA NRCS 2010). The percent of carbonate clay was estimated by using the following equation (USDA NRCS 2007):

$$\text{Carbonate Clay \%} = (0.10 \times \text{Total Clay\%}) + (0.21 \times \text{CaCO3 equiv\%}) - 2.7$$

The amount of carbonate clay present was enough to change the taxonomic family particle-size class to a coarser family in three cases. The amount of carbonate clay in the AAA family control sections changed the particle-size class from fine to fine-loamy; and the Atlatl family changed from fine-loamy to coarse-loamy. Wimmer and Teromote family soils are not carbonatic, but the soil families changed from fine to fine-loamy after subtracting the carbonate clays.

Prime Farmland

The Natural Resource Conservation Service (NRCS) conducted a Prime Farmland determination in the NPL soil survey area (Domeir 2012). This determination found that map units 1111 (Naplene-Teromote-Arboles-Oxyaquic Ustifluvent complex, 2 to 8 percent slopes and 1113 (Flugle-Teromote-Plumasano complex, 2 to 15 percent slopes) are considered Prime Farmland, if irrigated. These soil map units are part of the unpublished (in-progress) Kane County Area, Utah order 2 and 3 soil survey (Parslow 2012).

The NRCS Prime Farmland determination found that 292 acres of map unit 1111 was under irrigation based on the Southwest Regional Gap Analysis Project (SWReGAP) and was within the proposed boundaries as of the date of the determination. Soil map units considered by the NRCS to be Prime Farmland, if irrigated, within the North Private Lease soil survey area and in adjacent areas are shown in Soils Map 8 in Appendix F.

The NRCS recommended that a site specific determination be made using more intensive field and lab data collected from the project area (Domeir 2014b).

A project specific evaluation of potential Prime Farmland map units was conducted using field and laboratory analysis data from the proposed project area and the criteria set forth in the *Code of Federal Regulations Title 7, Part 657.5 Identification of important farmlands* (Grow 2014). These criteria are listed in Table 4. Results of the site specific Prime Farmland evaluation are shown on Soils Map 9 in Appendix F.

"Soils map units are classified as *prime* where 50 percent of the components in the map unit are *Prime* (Domeier 2014)." This criteria was applied to each of the North Private Lease soil map units to determine which were *prime* map units.

Table 4. Basic criteria for Identification of important farmlands as set forth in the Code of Federal Regulations, Title 7, Part 657.5 (Grow 2014).

Soil Parameter	Criteria Limits
Moisture regime	Aquic, udic ustic, or xeric and sufficient available water capacity within 40 inches of surface or root zone if less than 40 inches.
Irrigation water supply	Developed irrigation system and enough water is available for irrigation in 8 out 10 years
Temperature regime	Frigid, mesic, thermic, or hyperthermic
Soil pH	Between 4.5 and 8.4 within 40 inches (1 meter) or root zone if less than 40 inches
Conductivity (ECe)	Less than 4 mmhos/cm
Exchangeable Sodium (ESP)	Less than 15 percent
Flooding	Soils are not flooded during the growing season (less often than once in 2 years).
Erodibility, water	K (erodibility factor[1]) X percent slope does not exceed 2.0
Erodibility, wind	I (soils erodibility[2]) X C (climatic factor[3]) does not exceed 60
Permeability	Rate of at least 0.06 inch (0.15 cm) per hour in the upper 20 inches
Surface rock	Less than 10 percent of the surface layer (upper 6 inches) in these soils consists of rock fragments coarser than 3 inches (7.6 cm).

1. K factor calculated by Inter Mountain Labs was used for erodibility factor.
2. Soil erodibility factor (I) from Part 618.95 Wind Erodibility Groups was used for calculation.
3. Climatic factor (C) obtained from National C-Factor Values for Utah, May 1987 (Domeier 2014a).

Section Two

Soil Families

Soils in the NPL were classified to the soil family level using the K*eys to Soil Taxonomy, Twelfth Edition* (USDA NRCS 2014d). Soil family names were selected from established soil series in each family when available for the major soils in the NPL soil survey, Table 5. The priority for soil family name selection was based on the following criteria:

1. Soil family name was previously used by the NRCS as part of the order 3 mapping being completed in the Alton, Utah area.
2. Soil family name is from a soil series that is similar to the soil mapped in the NPL.
3. Soil family name was previously used by the NRCS on another soil survey in Utah.
4. Soil family name was previously by the NRCS in a state adjacent to southern Utah.
5. Soil family name is from an established soil series (USDA 2013a).
6. If none of the above selections provided an established soil family name, then a name consisting of three letters was assigned (AAA, BBB, CCC, and DDD).

Table 5. Taxonomic classification and characteristics of soil families in the NPL soil survey.

Soil Family	Taxonomic Classification	pH >8.4 in upper 100 cm	Calcium Carbonate Equivalent > 30% in Upper 150 cm	Calcium Carbonate Equivalent > 40% in Upper 150 cm
AAA	Aridic Haplustepts fine-loamy, carbonatic, mesic		Yes	Yes
Atlatl	Aridic Calciustepts coarse-loamy, carbonatic, mesic	Yes	Yes	Yes
BBB	Aridic Calciustepts fine-loamy, carbonatic, mesic		Yes	Yes
Bobknoll	Aridic Calciustepts coarse-loamy, mixed, superactive, mesic		Yes	Yes
Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic		Yes	Yes
Brumley	Calcidic Haplustalfs fine-loamy, mixed, superactive, mesic			
CCC	Aridic Calciustepts fine, carbonatic, mesic	Yes	Yes	Yes
DDD	Oxyaquic Ustifluvent sandy-skeletal, carbonatic, mesic	Yes	Yes	Yes
Flugle	Aridic Haplustalfs fine-loamy, mixed, superactive, mesic			
Quezcan	Aridic Ustorthent fine, smectitic, superactive, mesic			
Sideshow	Aridic Haplusterts fine, smectitic, mesic			
Sideslide	Typic Endoaquepts fine-loamy, mixed, superactive, mesic		Yes	Yes
Teromote	Aridic Haplustepts fine-loamy, mixed, superactive, mesic			
Vessilla	Aridic Lithic Ustorthents loamy, mixed, calcareous, active, mesic			
Wimmer	Aridic Calciustepts fine-loamy, mixed, superactive, mesic		Yes	

Representative soil profile descriptions for each family are in Appendix B.

Soil Characteristics

The dominant soil characteristics in the NPL soils are carbonatic soils, fine textures, depth to bedrock, and aquic conditions. Soils map 4 in Appendix F illustrates the locations where limiting soil features are present.

Calcium Carbonate

Calcium carbonate is a clay size soil particle that is included in the percent clay reported for soil texture, but it is subtracted from the percent clay when determining the taxonomic particle-size class (USDA NRCS 2007 and 2014d). The amount of carbonate clay present was enough to change the particle-size class to a coarser family in some cases. The amount of carbonate clay in the AAA family control sections changed the particle-size class from fine to fine-loamy; and the Atlatl family changed from fine-loamy to coarse-loamy. Wimmer and Teromote family soils are not carbonatic, but the soil families changed from fine to fine-loamy after subtracting the carbonate clays.

Carbonatic Soils

Soils with greater than 40 percent calcium carbonate equivalent in the control section occur on the terrace remnants along both sides of Kanab Creek. Carbonatic soils are limiting to plant growth by raising the soil pH and making soil nutrients less available (Imas 2014).

Soil mineralogy is classified as carbonatic when there is greater than 40 percent calcium carbonate equivalent in the control section (USDA NRCS 2014d). This condition was identified in four of the fifteen soil families identified in the North Private Lease soil survey area.

Fine Textures

Clay, silty clay, and clay loam are dominant textures in the NPL survey area. Clay percentages in the fine textured soils range from 36 percent to more than 60 percent. Estimated carbonate clay in the carbonatic soils is as much as 10 to 17 percent. Carbonate clays are not included in the clay fraction when determining taxonomic family particle-size class.

Depth to Bedrock

The majority of the NPL soils are very deep, greater than 150 cm (60 inches) deep. Soils on the hills in the southern part of the soil survey area are either moderately deep (50 to 100 cm) to Tropic shale or shallow (less than 50 cm) to Tropic sandstone.

Aquic Conditions

Several of the NPL soil profiles contain redoximorphic mottles. Aquic soil conditions require continuous or periodic saturation and reduction (USDA NRCS 2014d). Piezometers were

installed in 13 of the push probe holes in order to determine the depth of groundwater and the seasonal fluctuation (Petersen 2014).

The only soil profiles that were determined to have diagnostic aquic soil conditions are in the active floodplains and stream terraces along Kanab Creek and in the intermittent drainage west of Kanab Creek. The extent of aquic soil conditions is described in *Wetland Delineations & Ordinary High Water Mark Determinations, Private Lease Area* (Long and Collins 2012). Subirrigated soils are shown on Map 6 in Appendix F.

Soils on the terrace remnants along Kanab Creek contain soil mottles. Typically, these mottles were identified well above the current saturated zone. While some of the mottles can be directly attributed to current groundwater levels, many can be attributed to either: relict groundwater conditions prior to when Kanab Creek became incised; or the result of water retention of soil moisture between the fine textured soil peds.

AAA family

Aridic Haplustepts fine-loamy, carbonatic, mesic

Representative soil profile: 12AS018

The AAA soil family is very deep and formed in alluvium from limestone and sandstone. They are situated on terrace remnants along Kanab Creek. The soil is carbonatic and has greater than 40 percent calcium carbonate in the control section (25 to 100 cm). The soil pH in horizons below 100 cm (40 inches) is greater than 8.4.

The representative soil profile contains 13 percent estimated carbonate clay in the control section (25 to 100 cm). The soil pH ranges from 7.7 to 8.4 in the upper 115 cm (45 inches) and from 8.6 to 9.0 in the 115 to 244 cm (45 to 96 inches) depth.

AAA family soils are a *Fair* to *Poor* source of topsoil (Utah DOGM ~~2005~~ 2008). These soils are limited by soil pH greater than 8.4 below 100 cm (40 inches), saturation percent greater than 80 and less than 25 in some horizons, low available water capacity, silty clay soil textures, and calcium carbonate greater than 40 percent.

Atlatl family

Aridic Calciustepts coarse-loamy, carbonatic, mesic

Representative soil profile: 12AS021

Atlatl family soils are very deep and formed in alluvium from limestone and sandstone. They are situated on terrace remnants along Kanab Creek. The soil is carbonatic and has soil pH greater

than 8.4 in soil horizons above 100 cm (40 inches). These soils are limiting to agricultural production.

The representative soil profile contains a weighted average of 9 percent estimated carbonate clay in the control section (25 to 100 cm). The soil pH ranges from 7.9 to 9.1 in the upper 100 cm.

Atlatl family soils are a *Poor* to *Unacceptable* source of topsoil (Utah DOGM ~~2005~~ 2008). They are limited by greater than 40 percent calcium carbonate in the control section, soil pH from 8.6 to 9.4, saturation percent greater than 80, and low available water capacity in some horizons.

BBB family

Aridic Calciustepts fine-loamy, carbonatic, mesic

Representative soil profile: 13AS01

BBB family soils are very deep and formed in alluvium from limestone and sandstone. They are situated on terrace remnants and sideslopes along Kanab Creek. The soil is carbonatic and contains greater than 40 percent calcium carbonate in the control section (25 to 100 cm).

The representative soil profile contains a weighted average 11 percent estimated carbonate clay in the control section (25 to 100 cm). Soil pH ranges from 7.6 to 8.4 in the upper 100 cm.

BBB family soils are a *Poor* source of topsoil (Utah DOGM ~~2005~~ 2008). They are limited by clayey textures on the surface and greater than 30 percent calcium carbonate.

Bobknoll family

Aridic Calciustepts coarse-loamy, mixed, superactive, mesic

Representative soil profile: 12AS023

Bobknoll family soils are very deep and formed in mixed local alluvium from limestone, shale, and sandstone. They are situated on fan aprons along Kanab Creek. The soil has less than 18 percent clay in the control section.

The representative soil profile contains a weighted average 5 percent estimated carbonate clay in the control section. Soil pH ranges from 7.8 to 8.2 in the upper 100 cm and 8.6 to 8.7 below 120 cm.

Bobknoll family soils are a *Fair* source of topsoil (Utah DOGM ~~2005~~ 2008). They are limited by low available water capacity.

Boxcanyon family

Calcidic Haplustalfs fine, smectitic, mesic

Representative soil profile: 12AS029

Boxcanyon family soils are very deep and formed in mixed alluvium from limestone, sandstone, and shale. They are situated on terrace remnants along Kanab Creek. They have clay and silty clay in the subsoil and permeability is moderately slow to slow in the upper 20 inches (50 cm).

The representative profile contains 7 percent estimated carbonate clay in the control section (25 to 100 cm). Soil pH ranges from 7.6 to 8.4 in the upper 100 cm.

Boxcanyon family soils are a *Poor* source of topsoil (Utah DOGM 2008) below 58 cm due to the clay and silty clay textures and calcium carbonate greater than 30 percent.

Brumley family

Calcidic Haplustalfs fine-loamy, mixed, superactive, mesic

Representative soil profile: 13AS04

Brumley family soils are very deep and formed in slope alluvium from Tropic shale and sandstone. They are situated on alluvial fans and hillslopes in the southeastern part of the soil survey area. These soils have a zone of illuvial clay accumulation (argillic horizon) above a zone of secondary carbonate accumulation (calcic horizon).

The representative soil profile contains a weighted average 3 percent estimated carbonate clay in the control section (25 to 100 cm). Soil pH ranges from 7.9 to 8.2 in the upper 100 cm.

Brumley soils are a *Fair* source of topsoil (Utah DOGM ~~2005~~ 2008). They are limited by a low available water capacity, clay loam soil textures, and saturation greater than 55 percent below 90 cm.

CCC family

Aridic Calciustepts fine, carbonatic, mesic

Representative soil profile: 12AS011

CCC family soils are very deep and formed in alluvium from limestone and sandstone. They are situated on terrace remnants along Kanab Creek. These soils are fine textured, have an accumulation of secondary calcium carbonates (calcic horizon) and carbonatic mineralogy.

The representative soil profile contains a weighted average 12 percent estimated carbonate clay in the control section (25 to 100 cm). Soil pH ranges from 7.9 to 8.0 in the surface (0 to 32 cm) and from 8.4 to 8.9 in the subsoil.

CCC family soils are a *Poor* source of topsoil (Utah DOGM 2008). They are limited by greater than 40 percent calcium carbonate in the control section, soil pH from 8.6 to 8.8, and fair to poor available water capacity in some horizons.

DDD family

Oxyaquic Ustifluvent sandy-skeletal, carbonatic, mesic

Representative soil profile: 12AS022

DDD family soils are very deep and formed in mixed stream alluvium. They are situated on recently formed stream terraces along Kanab Creek. These soils are a mixture of sand, loamy sand, and sandy clay loam with greater than 35 percent subrounded sandstone gravels and cobbles.

These soils have soil pH greater than 9.0 in the upper 100 cm and greater than 50 percent calcium carbonate. There is a shallow water table present for most of the growing season.

DDD family soils are a *Poor* source of topsoil (Utah DOGM ~~2005~~ 2008). They are limited by high soil pH, greater than 50 percent calcium carbonate, sandy textures, greater than 35 percent gravels, and the presence of a water table within 100 cm (3.28 feet) of the soil surface.

Soils similar to DDD family soils were described as non-wetland or upland soils in *Wetland Delineations & Ordinary High Water Mark Identifications, Private Lease Area* (Long and Collins 2012).

Flugle family

Aridic Haplustalfs fine-loamy, mixed, superactive, mesic

Representative soil profile: ~~DP-12~~ 12AS004

Flugle family soils are moderately deep to very deep and formed in Tropic sandstone residuum. They are situated on hillslopes and structural benches. These soils have a zone of illuvial clay accumulation (argillic horizon).

The representative soil profile contains 2~~2~~3 percent clay in the control section or argillic horizon (62 to 126 cm or 2.0 to 4.1 feet). Soil textures are sandy clay loam and loam on the surface, sandy clay loam in the subsurface, and sandy ~~clay~~ loam and clay loam in the subsoil.

Flugle family soils are a *Good* to *Fair* source of topsoil (Utah DOGM ~~2005~~ 2008). They are limited by clayey textures in some soil profiles, calcium carbonate ranging from 15 to 30 percent in some profiles, and the depth to sandstone bedrock.

Quezcan family

Aridic Ustorthent fine, smectitic, superactive, mesic

Representative soil profile: 12AS005

Quezcan family soils are moderately deep and formed in Tropic shale residuum. They are situated on hillslopes and structural benches. They have clayey soil textures.

The representative soil profile has a clay surface, silty clay subsurface, and clay subsoil. Weathering Tropic shale is present at 78 cm (2.5 feet).

Quezcan family soils are a *Fair* to *Poor* source of topsoil (Utah DOGM ~~2005~~ 2008). They are limited by low water holding capacities, clayey soil textures, and depth to Tropic shale bedrock.

Sideshow family

Aridic Haplusterts fine, smectitic, mesic

Representative soil profile: 12AS032

Sideshow family soils are moderately deep to very deep and formed in residuum and local slope wash from Tropic shale. They are situated on hillslopes and alluvial fans. Clay in these soils ranges from 36 to 73 percent with a dominant range of 38 to 61 percent. Calcium carbonate is generally less than 15 percent in most soil profiles. Wide cracks (2 to 4 cm) in the soil surface were observed at some locations.

Sideshow family soils were identified by the unpublished Soil Survey of the Kane County Area, Utah (Parslow 2012) as being present in the NPL soil survey are.

The representative soil profile for Sideshow family has clay and silty clay textures with the percent clay ranging from 43 to 60 percent. Slickensides are visible on the ped faces.

Sideshow family soils are a *Poor* source of topsoil (Utah DOGM ~~2005~~ 2008). They are limited by the clay textures, high saturation percents in some profiles, salinity greater than 4 dS/m in the subsoil, and depth to Tropic shale in some profiles.

Sideslide family

Typic Endoaquepts fine-loamy, mixed, superactive, mesic

Representative soil profile: 12AS002

Sideslide soils are very deep and formed in slope wash and mixed alluvium from limestone, sandstone, and shale. They are situated on the active floodplain of Kanab Creek and in an intermittent erosional drainage.

Water covered the surface (0 to 5 inches deep) the soil surface in the area of the representative soil profile when it was sampled in November 2012.

Sideslide soils are a *Fair* to *Poor* source of topsoil (Utah DOGM 2005 2008). They are limited by silty clay textures, calcium carbonate greater than 30 percent in the subsoil. Extended periods of flooding and a high water table that perches on the underlying silty clay are also limitations to topsoil salvage.

Soils similar to Sideslide family soils were described as hydric soils in *Wetland Delineations & Ordinary High Water Mark Identifications, Private Lease Area* (Long and Collins 2012).

Teromote family

Aridic Haplustepts fine-loamy, mixed, superactive, mesic

Representative soil profile: 13AS03

Teromote family soils are very deep and formed local in alluvium from Tropic shale and sandstone. They are situated on alluvial fans and hillslopes. These soils have a clay loam surface and clay subsoil. These soils are similar to Sideshow family, but there is less noncarbonate clay in the control section.

Teromote soils do not have any evidence of illuvial clay accumulation. Slickensides are present in the subsurface and subsoil.

The representative soil profile has clay loam soil textures. The weighted average percent total clay in the control section is 35 percent which includes an estimated 23 percent carbonate clay and 12 percent non-carbonate clay.

Teromote soils are a *Fair* source of topsoil in the upper 100 cm (Utah DOGM ~~2005~~ 2008). Limitations include clay loam textures, 5 to 30 percent calcium carbonate in some profiles, and clayey subsoil in some profiles.

Vessilla family

Aridic Lithic Ustorthents loamy, mixed, calcareous, active, mesic

Representative soil profile: 12AS008

Vessilla family soils are shallow (less than 50 cm or 20 inches) to Tropic sandstone. They are situated on structural benches and hillslopes. Textures are sandy loam. Calcium carbonate equivalent is 10 to 16 percent.

Vessilla family soils are a *Fair* source of topsoil (UTAH DOGM 2008). They are limited by low available water capacity and shallow depth to sandstone.

Wimmer family

Aridic Calciustepts fine-loamy, mixed, superactive, mesic

Representative soil profile: 12AS031

Wimmer family soils are very deep and formed in slope local alluvium from sandstone and shale. They are situated on alluvial fans and fan aprons on terrace remnants. Textures include clay loam, clay, sandy clay loam, and loam. The percent clay in the control section ranges from 24 to 33 with an estimated 4 to 8 percent carbonate clay. There is a zone of secondary carbonate accumulation (calcic horizon). These soils do not have horizons within 100 cm of the surface with carbonates in excess of 36 percent.

The representative soil profile has a clay surface with clay loam subsurface and loam and sandy loam subsoil. Percent clay in the control section is 24 percent noncarbonate clay and an estimated 6 percent carbonate clay.

Wimmer family soils are a *Fair* to *Poor* source of topsoil (Utah DOGM ~~2005~~ 2008). Limitations are clayey textures, low available water capacity, and the percent calcium carbonate.

Section Three

Soils Legend

Soil in the North Private Lease soil survey area were delineated with 12 soil map units and one miscellaneous landform. The composition of the soil map units is detailed in Table 6.

Table 6. Soil map unit composition in the North Private Lease.

Map Unit Symbol	Pct	Map Unit Soil Family	Taxonomic Classification	Physiographic Setting[1]
A1		**Sideshow family, 0-4% slopes**		
	85	Sideshow	Aridic Haplusterts fine, smectitic, mesic	Concave Footslope
	10	Teremote	Aridic Haplustepts fine-loamy, mixed, super, mesic	Convex Hillslope
	5	Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic	Concave Toeslope
A2		**Sideshow - Teromote families association, 4 to 8% slopes**		
	50	Sideshow	Aridic Haplusterts fine, smectitic, mesic	Hillslope
	35	Teromote	Aridic Haplustepts fine-loamy, mixed, super, mesic	Convex Hillslope
	10	Wimmer	Aridic Calciustepts fine-loamy, mixed, super, mesic	Hill Toeslope
	5	Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic	Concave Toeslope
A3		**Sideshow family, 8 to 18% slopes**		
	80	Sideshow	Aridic Haplusterts fine, smectitic, mesic	Convex Hillslope
	10	Teremote	Aridic Haplustepts fine-loamy, mixed, super, mesic	Linear Hillslope
	7	Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic	Concave Toeslope
	3	Quezcan	Aridic Ustorthent fine, smectitic, super, mesic	Convex Ridge
B		**Flugle - Brumley families association, 8 to 15% slopes**		
	60	Flugle	Aridic Haplustalfs fine-loamy, mixed, supere, mesic	Structural Bench
	30	Brumley	Calcidic Haplustalfs fine-loamy, mixed, super, mesic	Hillslope
	10	Bobknoll	Aridic Calciustepts coarse-loamy, mixed, super, mesic	Hill Toeslope
C		**Quezcan family - Vesilla family - Rock Outcrop complex, 20 to 45% slopes**		
	50	Quezcan	Aridic Ustorthent fine, smectitic, superactive, mesic	Structural Bench
	30	Vesilla	Aridic Lithic Ustorthents loamy, mix, calc, act, mesic	Structural Bench
	15	Rock Outcrop		Ridge
	5	Brumley	Calcidic Haplustalfs fine-loamy, mixed, super, mesic	Swale
D		**Wimmer - Teromote - Bobknoll families complex, 2 to 8% slopes**		
	50	Wimmer	Aridic Calciustepts fine-loamy, mixed, super, mesic	Fan Apron
	25	Teromote	Aridic Haplustepts fine-loamy, mixed, super, mesic	Alluvial Fan
	15	Bobknoll	Aridic Calciustepts coarse-loamy, mixed, super, mesic	Terrace Remnant
	10	Flugle	Aridic Haplustalfs fine-loamy, mixed, super, mesic	Terrace Remnant

Map Unit Symbol	Pct	Map Unit Soil Family	Taxonomic Classification	Physiographic Setting[1]
E		**Atlatl - CCC families complex, 0 to 4% slopes**		
	45	Atlatl	Aridic Calciustepts coarse-loamy, carbonatic, mesic	Terrace Remnant
	40	CCC	Aridic Haplustepts fine-loamy, carbonatic, mesic	Terrace Remnant
	10	Bobknoll	Aridic Calciustepts coarse-loamy, mixed, super, mesic	Terrace Remnant
	5	Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic	Terrace Remnant
F		**Boxcanyon family, 0 to 4% slopes**		
	85	Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic	Alluvial Fan
	10	Wimmer	Aridic Calciustepts fine-loamy, mixed, super, mesic	Fan Apron
	5	Bobknoll	Aridic Calciustepts coarse-loamy, mixed, super, mesic	Terrace Remnant
G		**AAA - BBB~~C~~ families complex, 0 to 5% slopes**		
	70	AAA	Aridic Haplustepts fine-loamy, carbonatic, mesic	Terrace Remnant
	15	BBB	Aridic Calciustepts fine-loamy, carbonatic, mesic	Terrace Remnant
	10	CCC	Aridic Calciustepts fine, carbonatic, mesic	Terrace Remnant
	5	Atlatl	Aridic Calciustepts coarse-loamy, carbonatic, mesic	Terrace Remnant
H		**BBB - Atlatl families complex, 15 to 70% slopes**		
	75	BBB	Aridic Calciustepts fine-loamy, carbonatic, mesic	Valley sideslope
	20	Atlatl	Aridic Calciustepts coarse-loamy, carbonatic, mesic	Valley sideslope
	5	AAA	Aridic Haplustepts fine-loamy, carbonatic, mesic	Hill Toeslope
J		**Sideslide - ~~Vigil taxadjunct~~ families association, 4 to 12% slopes**		
	50	Sideslide	Typic Endoaquepts fine-loamy, mixed, mesic	Floodplain
	40	DDD	Oxyaquic Ustifluvent sandy-skel, carbonatic, mesic	Stream Terrace
	10	Teromote	Aridic Haplustepts fine-loamy, mixed, super, mesic	Alluvial Fan
K		**BBB family, 15 to 70% slopes**		
	80	BBB	Aridic Calciustepts fine-loamy, carbonatic, mesic	Hillslope
	10	Quezcan	Aridic Ustorthent fine, smectitic, superactive, mesic	Arroyo sideslope
	10	Sideshow	Aridic Haplusterts fine, smectitic, mesic	Hillslope
P		**Pond**		

1. Dominant physiographic setting.

Soil Map Units

The following map unit descriptions describe the composition and physiographic settings of the soil components. Representative soil profile locations are shown in parentheses.

A1 Sideshow family, 0-4% slopes

The A1 soil map unit is dominated by clayey soils that formed in residuum and alluvium from Tropic shale. This map unit consists of 85 Sideshow family (12AS015) soils on concave footslopes. Also included are 10 percent Teromote family soils on convex hillslopes, 5 percent Boxcanyon family soils on concave toeslopes, and other similar soils.

Vegetation on Sideshow soils consists of black sagebrush, wheatgrasses, and Galleta grass. Pinyon pine and Utah juniper have been recently removed from some A1 map units were they had encroached.

A2 Sideshow - Teromote families association, 4 to 8% slopes

The A2 soil map unit is dominated by clayey soils in residuum and alluvium from Tropic shale. This map unit consists of 50 percent Sideshow family (12AS032) soils on hillslopes and 35 percent Teromote family (12AS016) soils on convex hillslopes. Also included are 10 percent Wimmer family soils on hill toeslopes, 5 percent Boxcanyon family soils on concave toeslopes, and other similar soils.

Vegetation on Sideshow family soils consists of black sagebrush, wheatgrasses, and Galleta grass. Pinyon pine and Utah juniper have been recently removed from some A2 map units were they had encroached.

Vegetation on Teromote soils is dominated by Wyoming big sagebrush.

A3 Sideshow family, 8 to 18% slopes

The A3 soil map unit is dominated by clayey soils that formed in residuum and alluvium from Tropic shale. This map unit consists of 80 Sideshow family (12AS017) soils on convex hillslopes. Also included are 10 percent Teromote family soils on linear hillslopes, 7 percent Boxcanyon family soils on concave toeslopes, 3 percent Quezcan family soils on convex ridges, and other similar soils.

Vegetation on Sideshow soils consists of black sagebrush, Wyoming big sagebrush, wheatgrasses, and Galleta grass. Pinyon pine and Utah juniper have been recently removed from some A3 map units were they had encroached.

B Flugle - Brumley families association, 8 to 15% slopes

The B soil map unit is dominated by fine-loamy soils that formed in residuum and alluvium from Tropic sandstone and shale. This map unit consists of 60 percent Flugle family (~~DP-12~~12AS004)

soils on structural benches and 30 percent Brumley family (13AS04) soils on hillslopes. Also included are 10 percent Bobknoll family soils on the toeslopes of hills and other similar soils.

Vegetation on the Flugle family soils is dominated by smooth brome, rabbitbrush, and sagebrush.

Vegetation on the Brumley family soils is dominated by Wyoming big sagebrush and rabbitbrush.

C Quezcan family - Vesilla family - Rock Outcrop complex, 20 to 45% slopes

The C soil map unit is dominated by shallow and moderately deep soils that formed in residuum from Tropic sandstone and shale. This map unit consists of 50 percent Quezcan family (12AS005) soils on structural benches, 30 percent Vesilla family (12AS008) soils on structural benches, and 15 percent sandstone outcrops (12AS006). Also included are 5 percent Brumley family soils and other similar soils.

Vegetation on Quezcan and Vesilla is dominated by pinyon pine and Utah juniper. Gambel oak and mountain snowberry are also present.

D Wimmer - Teromote - Bobknoll families complex, 2 to 8% slopes

The D soil map unit is dominated by fine-loamy soils that formed in mixed alluvium from sandstone and shale. This map unit consists of 50 percent Wimmer family (12AS031) soils on fan aprons, 25 percent Teromote family (13AS03) soils on alluvial fans, and 15 percent Bobknoll family (12AS023) soils on terrace remnants. Also included are 10 percent Flugle family (DP-02) soils on terrace remnants and other similar soils.

Existing vegetation on map unit D soils is dominated by rabbitbrush and Wyoming big sagebrush. Shrubs have been removed from most map unit D soils and planted to grasses that had been grazed too low for identification.

E Atlatl - CCC - AAA families complex, 0 to 4% slopes

The E soil map unit is dominated by soils with greater than 40 percent calcium carbonate in the control section (25 to 100 cm or 10 to 40 inches). These soils formed in mixed alluvium from limestone, sandstone, and shale on terrace remnants. This map unit consists of 45 percent Atlatl family (12AS021) soils on and 40 percent CCC family (12AS011) soils. Also included are 10 percent Bobknoll family (12AS010) soils, 5 percent Boxcanyon family soils, and other similar soils.

Existing vegetation on map unit E soils is dominated by rabbitbrush, sparse clumps of crested wheatgrass, and other grasses that had been grazed too low for identification.

F Boxcanyon family, 0 to 4% slopes

The F soil map unit is dominated by clayey soils that formed in slope alluvium from shale and sandstone. This map unit consists of 85 percent Boxcanyon family (12AS029) soils on alluvial fans. Also included are 10 percent Wimmer family soils, 5 percent Bobknoll family soils, and other similar soils.

Most native vegetation has been removed from Boxcanyon soils in map unit F. An area of Boxcanyon soils at the north end of the soil survey area is irrigated and growing alfalfa and small grains. Wyoming big sagebrush and rabbitbrush are the dominant shrubs in other map unit D delineations.

G AAA - BBB families complex, 0 to 5% slopes

The G soil map unit is dominated by fine-loamy soils with greater than 40 percent calcium carbonate in the control section (25 to 100 cm or 10 to 40 inches). These soils formed in mixed alluvium from limestone, sandstone, and shale on terrace remnants. This map unit consists of 70 percent AAA family (12AS018) soils and 15 percent BBB family (DP-29) soils. Also included are 10 percent CCC family soils, 5 percent Atlatl family soils, and other similar soils.

Existing vegetation on the AAA family soils is dominated by rabbitbrush and a variety of grasses and forbs. Rabbitbrush is also dominant on the BBB family soils.

H BBB - Atlatl families complex, 15 to 70% slopes

The H soil map unit is dominated by soils with greater than 40 percent calcium carbonate in the control section (25 to 100 cm or 10 to 40 inches). These soils formed in mixed alluvium from limestone, sandstone, and shale on very steep valley sideslopes and on the erosional edges of terrace remnants. This map unit consists of 75 percent BBB family (12AS001) soils and 20 percent Atlatl family (12AS003) soils. Also included are 5 percent AAA family soils and other similar soils.

This map unit is influenced by snowbanks on the steep sideslopes. Existing vegetation on the BBB family soils is dominated by rabbitbrush, smooth brome, Woods' rose, and scattered Utah junipers. Rabbitbrush and Wyoming big sagebrush are dominant on the Atlatl family soils. Russian olive is growing on the footslopes.

J Sideslide - DDD families association, 4 to 12% slopes

The J soil map unit is dominated by coarse and fine textured soils with water tables in the plant rooting zones. This map unit is located along Kanab Creek and in the bottom of an intermittent drainage west of Kanab Creek. It consists of 50 percent Sideslide family (12AS002) soils on floodplains and 40 percent DDD family (12AS022) soils on stream terraces. Also included are 10 percent Teromote family soils on alluvial fans and other similar soils.

Sedges, rushes, and Kentucky bluegrass dominate the wet meadows on the Sideslide family soils. Black sage, Wyoming big sagebrush, Rocky mountain junipers, and Russian olive dominate the DDD family soils.

K BBB family, 15 to 70% slopes

The K soil map unit is dominated by soils that formed in residuum from Tropic sandstone and shale on moderately steep to very steep ephemeral channel sideslopes. This map unit consists of 80 percent BBB family (13AS01) on hillslopes. Also included are 10 percent Quezcan family soils on arroyo sideslopes and structural benches, 10 percent Sideshow family soils on hillslopes, and other similar soils.

BBB family soils in map unit K are dominated by western wheatgrass, crested wheatgrass, rabbitbrush, and intermediate wheatgrass.

P Pond

Two small stock water ponds are located in the North Private Lease soil survey area. One pond (1.2 acres) is located at the far north end of the soil survey area at the base of the North hill. The second very small pond (0.2 acres) is located near the top of the western ephemeral drainage and has breached, possibly in February 2012 when heavy rains caused rapid melting of the snowpack.

Section Four

Prime Farmland Evaluation

Irrigated farmlands in the North Private Lease include both *Prime Farmlands, if irrigated* and *Farmlands of Statewide Importance, if irrigated*. Prime Farmlands have criteria established by the federal government. *Farmlands of Statewide Importance* do not meet the federal criteria, but do meet criteria established by ~~state~~ the State of Utah. Farmlands that meet either criteria are important "...for the production of food, feed, fiber, forage and oilseed crops (Domeier 2014c)."

An evaluation of potential Prime Farmland areas within the North Private Lease was conducted using field and lab data collected for the soil survey. The results found a difference between the soils mapped as part of the Kane County Area, Utah Soil Survey and those identified by the more intensive North Private Lease soil survey. The project specific evaluation of potential *Prime Farmland* map units was conducted using field and laboratory analysis data from the North Private Lease area and the criteria set forth in the *Code of Federal Regulations Title 7, Part 657.5 Identification of important farmlands* (Grow 2014). These Important farmland criteria were listed previously in table ~~3~~4.

Irrigated farmlands in the North Private Lease that do not meet the criteria for *Prime, if irrigated* do meet the criteria for *Farmlands of Statewide Importance, if irrigated*. The criteria for this second classification of farmlands has been established by the Utah Department of Agriculture and Utah State University in cooperation with the Natural Resources Conservation Service, United State Department of Agriculture (Domeier 2014).

Requirements for soils handling (R645-302-317.400) and soil replacement (R645-302-317.500) apply to both farmland classifications. Soils map 9 in Appendix F identifies the soils within the North Private Lease survey area that meet either the criteria of *Prime Farmland, if irrigated* or *Farmland of Statewide Importance, if irrigated*.

Prime Soil Families

Soil families that meet the Important farmland criteria, if irrigated are identified in table 6. Eight soil families meet the criteria for *prime, if irrigated*. Three of these families do not meet the criteria for *prime* when the slope increases and they become more susceptible to water erosion. Limiting soil features for the seven soil families which do not meet the criteria for *Prime Farmland* are listed in Table 7.

Table 7. Soil families that meet Important (prime) farmland criteria as set forth in the *Code of Federal Regulations Title 7, Part 657.5 Identification of important farmlands* (Grow 2014).

Soil Family	Prime Farmland, if Irrigated	Limiting Features
AAA	Yes	
Atlatl	No	pH > 8.4
BBB	Yes/No	K factor X slope
Bobknoll	Yes	
Boxcanyon	Yes	Permeability may be limiting in some profiles
Brumley	Yes/No	K factor X slope
CCC	No	pH > 8.4; permeability
DDD	No	Water table; surface cobbles
Flugle	Yes	
Quezcan	No	Very slow permeability; K factor X Slope
Sideshow	No	Very slow permeability; K factor X Slope; Ece > 4
Sideslide	No	Water table
Teromote	Yes/No	K factor X slope
Vesilla	No	Shallow to sandstone; limited available water capacity
Wimmer	Yes	

1. Based on map unit slope ranges when soil family is a major component.

Farmland Soils of Statewide Importance

The Utah Department of Agriculture in conjunction with Utah State University, and the Natural Resources Conservation Service has developed criteria for *Farmlands of Statewide Importance.* "This is land, in addition to prime and unique farmlands, that is of statewide importance for the production of food, feed, fiber, forage, and oilseed crops (Domeier 2014c)." These criteria are listed in Table 8. Soils meeting the criteria for *Farmland of Statewide Importance, if irrigated* are listed in Table 9.

Table 8. Criteria for Farmlands of Statewide Importance established by the Utah Department of Agriculture and Utah State University in conjunction with the Natural Resources Conservation Service (Domeier 2014c).

Parameter	Criteria
1	Soils have an adequate moisture supply.
a	Soil moisture sufficient to permit economic production in 5 out 10 years.
b	Soils have a water supplying potential of more than 11 inches or a developed irrigation system with a dependable water supply of suitable quality. Water supplying potential refers to the amount of water estimated to be available for plant growth from moisture stored in the soil plus precipitation during the plant growth period.
2	Soils at a depth of 20 inches (50 cm) have a mean summer temperature of above 59 degrees F. This includes soils in the frigid, mesic, and thermic temperature regimes.
3	Soils have a pH of 4.5 through 8.6 and exchangeable sodium saturation (ESP) is less than 15 percent above a depth of 20 inches.
4	Soils have no water table that prevents the production of food, feed, fiber, forage, and oilseed crops.
5	Soils can be managed so that the saturation extract of soil above 20 inches (50 cm) has an electrical conductivity less than 4 mmhos.
6	Soils are not flooded frequently. The statistical chance of flooding on soil of Statewide Importance is 0 to 50 percent any year during the growing season.
7	Soils have a product of K-factor times percent slope of 5 or more.

Soils in the North Private Lease do not provide enough soil moisture to meet the requirement of 11 inches or more. The soil family average available water capacity (AWC) ranges from 1.06 inches (Vessilla family) ~~inches~~ to ~~4.37~~ 3.66 inches (Teromote family) in the upper ~~48~~ 40 inches of soil or the rooting zone (whichever is shallow) in the North Private Lease permit area during the non-growing season based on laboratory analysis of Field Capacity (1/3 bar) and Wilting Point (15 bar), Table C-3. Precipitation during the growing season (May 21 ~~thru~~ to ~~September~~ October 8) is 5.79 inches, Table G-6. The greatest average soil family moisture supplying capacity is ~~10.39~~ 9.45 inches (maximum average family AWC plus average growing season

precipitation). The majority of the area north of the *Elk Fence* and west of Kanab Creek does have a developed sprinkler irrigation system. The need for a developed irrigation supply results in the classification *Farmland of Statewide Importance, if irrigated*.

Soil profiles 12AS020 and 12AS025 are within the Prime Farmland area. They have available water capacities in the upper 40 inches of 2.39 and 2.36 inches (Table C-2), respectively. Moisture supplying capacity of these profiles is 8.18 and 8.15 inches, respectively.

Approximation of the growing season was evaluated based on: median Spring and Fall freeze (32° F threshold) for Alton, Utah (Utah Climate Center); probability of 28.5° F Spring and Fall freeze dates for Alton, Utah (WRCC 2015); and the WETS Table 28° F freeze dates for Alton, Utah (NRCS 2015b). Information for these growing season approximation are in Appendix G.

Soils in North Private Lease soil survey area have a mesic temperature regime (Parslow 2012).

Table 9. Soils that meet criteria for *Farmland of Statewide Importance* and limitations. Soils that meet *Prime Farmland, if Irrigated* criteria not rated for *Farmland of Statewide Importance, if Irrigated*.

Soil Family	Prime Farmland, if Irrigated[1]	Farmland of Statewide Importance, if Irrigated	Limiting Features[2]
AAA	Yes		
Atlatl	No	Yes/No	pH > 8.6 above 20 inches in some profiles
BBB	Yes/No	Yes	K factor X slope (when slope less than 22 percent)
Bobknoll	Yes		
Boxcanyon	Yes		Permeability may be limiting in some profiles
Brumley[3, 4]	Yes/No	Yes	
CCC	No	Yes	
DDD	No	No	Water table
Flugle[3, 4]	Yes	Yes	
Quezcan[4]	No	Yes/No	K factor X slope (when slope less than 31 percent)
Sideshow[3]	No	Yes	
Sideslide	No	No	Water table, flooding
Teromote	Yes/No	Yes	
Vesilla[4]	No	Yes/No	Shallow to sandstone; limited available water capacity
Wimmer	Yes		

1. Designation from Table 7.
2. Based on slope when soil family is a major soil.
3. Some profiles of soil family may be limited by depths to bedrock of less than 40 inches.
4. Soil not irrigated.

Irrigation Areas

The portion of the soil survey area where irrigation systems are present is shown on Soils Map 5. The areas shown on this map are based on field observations and interviews with landowners by Alton Coal Development.

The area north of the farm road and west of Kanab Creek is irrigated with a center pivot system and wheel line systems.

The area south of the farm road and west of Kanab Creek is partially irrigated with sprinkler systems. The west boundary of this area is along an existing fenceline. No evidence of a developed irrigation system was observed west of the fenceline.

The extent of irrigation development in a small area (approximately 4.0 acres) in the southwest corner of the Dean R Heaton property (parcel 9-6-12-2) is unknown. This area is separated from the rest of the property by an erosion channel. No active irrigation was observed in this area. This area is assumed to be irrigated for the purpose of determining the extent of Prime Farmland and Farmland of Statewide Importance in the soil survey area.

Landowners informed Alton Coal Development that the area south of the farm road is only irrigated in the fall when there is extra water available and classified the area as not irrigated. They stated that in most years there is not any water available for irrigation south of the farm road (Johnson 2015).

The president of the irrigation company stated in a letter to Alton Coal Development, "I know of no flood irrigation south of the farm road, (we call it the lane going to the east bench)." He also indicated that he had "...researched the old records of water usage and maps of old ditches before my time (Raymond Heaton) and have not found any evidence of the ditch system going that far south (Heaton2014).

Prime Farmland Soil Map Units

Four of the twelve soil map units have at least 50 percent *prime* components as stipulated in Part 622.3 - Farmland Classification in the National Soils Handbook (Domeier 2014b) and are considered Prime Farmland soil map units. Four soil map units have at least 50 percent *Farmland of Statewide Importance* components and are also considered *Prime Farmland*. The other five soil map units contain less than 50 percent *prime* or *Farmland of Statewide Importance* components. Table 10 identifies the soil map units considered to be *Prime Farmland*, based on the federal and state criteria. Map units C, H, and K are not irrigated and have steep to very steep slopes. Map units J and P are subject to flooding and map unit J has a water table.

Table 10. North Private Lease soil map units that qualify as *Prime Farmland, if irrigated*.

	North Private Lease Soil Map Units												
	A1	A2	A3	B	C	D	E	F	G	H	J	K	P
Prime Farmland, if Irrigated	S	S	S[1]	P	No	P	S	P	P	No	No	No	No

P - map unit contains more than 50 percent *Prime Farmland* soils.
S - map unit contains more than 50 percent combined *Prime Farmland* and *Farmland of Statewide Importance* soils.

1. Portions of map unit have slopes that may qualify for *Farmland of Statewide Importance*.

Table 11 summarizes the areas of *Prime Farmlands* and *Farmlands of Statewide Importance* that are irrigated or non-irrigated. The irrigated areas include all areas where water is allocated for irrigation (Utah 2014). The results of this evaluation are shown on Soils Map 9 in Appendix F. The results of this evaluation of the field and lab data collected in the North Private Lease soil survey area found that there are ~~120.8~~ 102.7 acres of *Prime Farmland* and ~~65.1~~ 50.4 acres of *Farmland of Statewide Importance* ~~that is either under sprinkler~~ with a developed irrigation system ~~or has water allocated for irrigation~~ for a total of ~~185.9~~ 153.1 acres in the soil survey area.

The measured water allocation area is approximately 182.5 acres. The center pivot system is watering areas outside the allocated area. The area under irrigation is less than one half of the North Private Lease soil survey area (428.0 acres).

NRCS Prime Farmland Assessment

The NRCS conducted a Prime Farmland assessment based on in-progress NRCS soil survey data for Kane County, Utah. The results of this assessment are in Appendix A along with additional information received from the NRCS.

The NRCS determined that NRCS soil map units 1111 (Naplene-Termote-Arboles-Oxyaquic Ustifluvent complex, 2 to 8 percent slopes) and 1113 (Flugle-Termote-Pluasano complex, 2 to 15 percent slopes) were Prime Farmland. Only map unit 1111 was mapped within the North Private Lease soil survey area. The NRCS in-progress soil survey consisted of order 2 and 3 soil mapping.

When NRCS soil map unit 1111 is measured in the area that it is under irrigation or has water allocated for irrigation the area is approximately 196 acres in the soil survey area. This map unit delineation includes areas along Kanab Creek and ephemeral drainages where water is not allocated for irrigation and the sideslopes are very steep. The 292 acres reported by the NRCS (Domeier 2012) appears to be an over-estimate of the *Prime Farmland* area when irrigated.

Table 11. Summary of areas Prime Farmland and Farmland of Statewide Importance that is irrigated and non-irrigated in the North Private Lease soil survey area.

Map Unit	Prime Farmland Irrigated[1]	Prime Farmland Non Irrigated[2]	Statewide Farmland Irrigated[1]	Statewide Farmland Non Irrigated[2]	Other Lands Non Irrigated[2]
	acres	acres	acres	acres	acres
A1			27.0 ~~4.6~~	19.5	
A2				~~54.7~~ 59.3	
A3				28.2	
B		12.4			
C					21.2
D	~~53.8~~ 36.3	~~17.0~~ 34.5			
E			~~33.5~~ 23.4	~~27.2~~ 37.3	
F	13.1 ~~53.9~~ 53.3	5.5 ~~16.4~~ 17.0			
G					
H					20.1
J					14.6
K					4.0
P					1.5
Total	~~120.8~~ 102.7	~~51.2~~ 69.4	~~65.1~~ 50.4	~~129.6~~ 144.3	61.3
Survey Acres 428.1					

1. Areas either currently under sprinkler irrigation plus areas delineated as unknown irrigation on Soils Map 9.
2. No known irrigation development in these areas.

Section Five

Topsoil and Subsoil Salvage

Soil Limiting Features

Determination of *Good, Fair, Poor, or Unacceptable* ratings for topsoil, subsoil, and overburden is based on the Guidelines for Management of Topsoil and Overburden (Utah DOGM ~~2005~~ 2008).

Available Water Capacity

The available water capacity (AWC) was determined in the laboratory with pressure plates at field capacity (1/3 atmosphere) and wilting point (15 atmosphere). The difference between the two test results is the available water capacity.

AWC ranges from *Fair* to *Poor* in most of the soil horizons (Utah DOGM 2008). Soil horizons with *Poor* AWC are primarily associated with clay, silty clay, loamy sand soil textures, as well as greater than 40 percent carbonates.

Available water capacity depth was calculated for the upper 40 inches of the soil profile or to the depth of a limiting soil feature (ie. bedrock), whichever was shallower. These AWC depth calculations are detailed in Tables C-2 in Appendix C. Comparison of the AWC depth calculations for each soil family are shown in Table C-3.

Calcium Carbonate

The calcium carbonate equivalent was analyzed by the laboratory and reported as percent carbonate. Calcium carbonate levels ranged from less than 1 percent to as high as 76 percent. Measured calcium carbonate is greater than 30 percent in at least one soil horizon within 150 cm (5 feet) of the soil surface at 35 of the 69 soil profile locations. Soils with greater than 30 percent calcium carbonate are considered *Poor* in the *Guidelines for Topsoil and Overburden Management* (Utah DOGM ~~2005~~ 2008).

Calcium carbonate levels correlate with parent material and geomorphic setting. Soils that developed in alluvium from limestone and sandstone on terrace remnants have calcium carbonate levels greater than 30 percent in at least one soil horizon within 150 cm (5 feet) of the soil surface. Alluvial fan soils developed in mixed slope alluvium and colluvium with Tropic shale and sandstone as their primary source and typically have calcium carbonate levels ranging from 10 to approximately 25 percent. Soils that developed directly from the Tropic shale have low amounts of calcium carbonate.

Soil calcium carbonate levels were greater than 30 percent on the surface at 14 soil profile locations. Ten of these profiles had greater than 40 percent calcium carbonate at the surface. These conditions are typically associated with poor vegetative cover in the North Private Lease soil survey area.

Table 12. Calcium carbonate conditions for soil families in the North Private Lease soil survey.

Soil Family	Taxonomic Classification	Calcium Carbonate Equivalent > 30% in Upper 150 cm	Calcium Carbonate Equivalent > 40% in Upper 150 cm
AAA	Aridic Haplustepts fine-loamy, carbonatic, mesic	Yes	Yes
Atlatl	Aridic Calciustepts coarse-loamy, carbonatic, mesic	Yes	Yes
BBB	Aridic Calciustepts fine-loamy, carbonatic, mesic	Yes	Yes
Bobknoll	Aridic Calciustepts coarse-loamy, mixed, superactive, mesic	Yes	Yes
Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic	Yes	Yes
Brumley	Calcidic Haplustalfs fine-loamy, mixed, superactive, mesic		
CCC	Aridic Calciustepts fine, carbonatic, mesic	Yes	Yes
DDD	Oxyaquic Ustifluvent sandy-skeletal, carbonatic, mesic	Yes	Yes
Flugle	Aridic Haplustalfs fine-loamy, mixed, superactive, mesic		
Quezcan	Aridic Ustorthent fine, smectitic, superactive, mesic		
Sideshow	Aridic Haplusterts fine, smectitic, mesic		
Sideslide	Typic Endoaquepts fine-loamy, mixed, superactive, mesic	Yes	Yes
Teromote	Aridic Haplustepts fine-loamy, mixed, superactive, mesic		
Vessilla	Aridic Lithic Ustorthents loamy, mixed, calcareous, active, mesic		
Wimmer	Aridic Calciustepts fine-loamy, mixed, superactive, mesic	Yes	

Calcium carbonate contributes to plant nutrient deficiencies. The availability of phosphorus is reduced by the formation of insoluble Ca and Mg phosphates. "Iron, Zn, Mn, and Cu deficiencies are common in soils that have high calcium carbonate due to reduced solubility at alkaline pH values (Imas 2014).

K factor

The K factor is an estimate of the potential erodibility of a soil by water. Soils with a K factor greater than 0.37 are considered *Poor* and have an increased potential of being eroded by water (Utah DOGM ~~2005~~ 2008). Soils with K factors greater than 0.37 are of limited extent in the North Private Lease soil survey area.

Salinity

Soil salinity is not a significant problem in the North Private Lease soil survey area. Conductivities of 4 to 8 dS/m occur in the lower subsoil of the Sideshow family which develops from Tropic shale. A soil conductivity of 10.9 dS/m was measured in a Tropic shale bedrock sample at soil profile location 12AS015.

Soil profile 12AS029 is a Boxcanyon family soil with conductivities of 4.81 to 5.24 dS/m at a depth of 232 to 500 cm (7.6 to 16.4 feet) below the surface. Weathered Tropic sandstone is present at 334 to 500 cm (11.0 to 16.4 feet) and strongly weathered Tropic shale is present at (16.4 feet).

Sodicity

Sodium concentrations are not a significant problem in the North Private Lease soil survey area. Sodium adsorption ratios (SAR) levels were generally 4 or less for most of the soil horizons. The SAR increases to 5 to 10 in the lower subsoil of soils that developed from Tropic shale (Sideshow family) and in soils with groundwater along Kanab Creek.

The maximum measured SAR was 10.3. This SAR was detected at the bottom of two Sideshow family soil profiles that developed from Tropic shale residuum.

Soil pH

The soil pH is neutral to very strongly alkaline in the North Private Lease soil survey area. The pH measurements ranged from 6.9 to 9.4.

Soil pH has a direct effect on plant growth and development. Alfalfa and small grain production does well when the soil pH is between 5.7 and 8.1, but nutrient deficiency and growth reduction occur beyond this range (Gale et. al. 2001). Alfalfa seedlings establish and develop rapidly when the soil pH range is 6.5 to 7.0 (Dixon et. al. 2005). Research in Idaho, Oregon, and Washington has determined that 7.0 is the ideal soil pH for alfalfa with a tolerance range of 6.0 to 8.2 (Koenig et. al. 2009). The Alfalfa and Forage Systems Workgroup determined the ideal soil pH range to be 6.3 to 7.5 for alfalfa and that values greater than 8.2 are often associated with unproductive sites (Orloff 2007). High soil pH can contribute to reduced nutrient availability (Imas 2014).

Atlatl, CCC, and DDD families have soil pH greater than 8.4 in at least one horizon above 100 cm (3.28 feet) and the AAA and Bobknoll families have soil pH greater than 8.4 in at least one horizon above 150 cm (5 feet). The upper soil pH limit for *Prime Farmland* soils is no horizons greater than 8.4 within 100 cm (3.28 feet) of the surface (Grow 2014). Atlatl and CCC families are the major soils in map unit E.

DDD family soils have soil pH greater 9.0 at the surface ~~and are the dominant soil~~ in map unit J. Soil Profile 12AS024 with surface pH greater than 9.0 is within the no disturbance buffer area and will not be disturbed.

A soil pH of 5.3 was measured in weathered Tropic shale at soil profile location 12AS017. This was the only pH less than 6.9 identified in the soil survey area.

Topsoil and Subsoil Salvage Depths

Salvage of topsoil and subsoil in the North Private Lease soil survey area falls under the normal criteria for upland soils and the criteria for salvage from Prime Farmland soils. Requirements for Prime Farmland soils handling (R645-302-317.400) and soil replacement (R645-302-317.500) apply to both Prime Farmlands ~~classifications~~ and Farmlands of Statewide Importance. Soils Map 10 shows the estimated average salvage depths in Prime Farmland and Non Prime Farmland areas.

The following estimates for average topsoil and subsoil salvage depths are provided for planning purposes. Actual salvage depths will vary in the field and should be monitored. Salvage should be done in close consultation with a Certified Professional Soil Scientist.

Prime Farmlands

Soils in the Prime Farmland area south of the farm road have existing subsoil conditions that range from *Fair* to *Poor* based on the *Guidelines for Management of Topsoil and Overburden* (Utah DOGM 2008). These existing soil conditions are attributable to the amount of calcium carbonate and the soil pH.

Soil profiles (12AS020 and 12AS025) in the Prime Farmland area south of the farm road are characterized by greater than 30 percent calcium carbonate in both the B and C horizons. Calcium carbonate ranges from 45 to 76 percent in the B horizon and from 45 to 52 percent in the C horizon. Soil pH was lower in the B horizon (8.1 to 8.7) compared to the C horizon (8.5 to 8.8). The clayey textures in the Prime Farmland area are attributable to the amount of carbonate clays (calcium carbonate) in the soil.

Soil pH and percent calcium carbonate are generally lower in the soils north of the farm road (12AS026, 12AS027, 12AS028, and 12AS029) relative to the soils south of the farm road (12AS020 and12AS025).

Based on the existing conditions, subsoil with pH greater than 8.5 should be stockpiled as C horizon. Determination of B and C horizon materials should be based on the pH and then the percent carbonates.

Table 13contains the estimated average salvage depths for the A, B, and C horizons for the soil map units listed as Prime (*Prime Farmlands* and *Farmlands of Statewide Importance*) in Table 10. Total salvage do not total 4.0 feet in some map units due to component soils that have bedrock at less than 4.0 feet.

Soils in the Prime Farmland area south of the farm road have existing subsoil conditions that range from *Fair* to *Poor* based on the *Guidelines for Management of Topsoil and Overburden* (Utah DOGM 2008). These existing soil conditions are attributable to the amount of calcium carbonate and the soil pH.

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Soil pH and percent calcium carbonate are generally lower in the soils north of the farm road (12AS026, 12AS027, 12AS028, and 12AS029) relative to the soils south of the farm road (12AS020 and12AS025).

Based on the existing conditions, subsoil with pH greater than 8.5 should be stockpiled as C horizon. Determination of B and C horizon materials should be based on the pH and then the percent carbonates.

Table 13. Estimated average salvage depths by horizon for soil map units in areas ~~where they are~~ of Prime Farmland. Average depths should be expected to vary during salvage operations and should be monitored by a Certified Professional Soil Scientist.

Soil Map Unit	A Horizon[1]	B Horizon[1]	C Horizon[1]	Total Estimated Average Salvage Depth[2]
	feet	feet	feet	feet
A1	0.7	2.9	0.3	3.9
A2	0.7	3.0	0.1	3.8
A3	0.7	2.8	0.3	3.8
B	0.8	2.7	0.0	3.5
D	0.7	3.0	0.0	3.7
E	0.5	3.2	0.3	4.0
F	0.7	3.3	0.0	4.0
G	0.7	3.1	0.2	4.0
Average	0.7	3.0	0.2	3.9

1. Estimated average A, B, and C horizon salvage depth is based on weighted averages using soil family averages for all profiles examined as part of survey and percent occurrence in map unit.
2. Estimated average total salvage depth is sum of estimated topsoil and subsoil depths.

Salvage and stockpiling of all soils in the Prime Farmland area should be closely monitored by a Certified Professional Soil Scientist.

Non-Irrigated Lands

Table 14 contains the estimated average topsoil salvage depths for soil map units that are not irrigated or are not Prime Farmland. Total salvage does not total 4.0 feet in some map units due to component soils that have bedrock at less than 4.0 feet.

Table 14. Estimated average salvage depths by horizon for soil map units that are not irrigated and in areas ~~where they~~ that are not Prime Farmland. Average depths should be expected to vary during salvage operations and should be monitored by a Certified Professional Soil Scientist.

Soil Map Unit	Estimated Average Topsoil Salvage Depth[1]	Estimated Average Subsoil Salvage Depth[1]	Estimated Average Total Salvage Depth[2]
	feet	feet	feet
A1	1.2	2.6	3.8
A2	1.1	2.7	3.8
A3	1.2	2.6	3.8
B	1.4	2.1	3.5
C	0.5	1.0	1.5
D	1.2	2.6	3.8
E	1.1	2.9	4.0
F	1.6	2.4	4.0
G	0.9	3.1	4.0
H	1.0	3.0	4.0
J[3]	0.6	3.4	4.0
K	1.0	2.8	3.8
Average	1.1	2.6	3.7

3. Estimated average topsoil and subsoil salvage depth is based on weighted averages using soil family averages for all profiles examined as part of survey and percent occurrence in map unit.
4. Estimated average total salvage depth is sum of estimated topsoil and subsoil depths.
5. Estimated topsoil and subsoil salvage depths take into account that not all surface materials for DDD family will be salvaged as topsoil due to Unacceptable pH levels in some locations.

The pH is greater than 9.0 in the surface (topsoil) in one map unit J profile (12AS024). Soil pH greater than 9.0 is *Unacceptable* based on the *Guidelines for Management of Topsoil and Overburden* (Utah DOGM 2008). Material with pH greater than 9.0 should not be stockpiled with topsoil even if it is salvaged from the top of the soil profile. It is recommended that soil pH of 8.5 be the upper limit when salvaging topsoil. Removal of topsoil and subsoil should be monitored by a Certified Professional Soil Scientist.

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Appendix A

Soil Laboratory Analysis

Table of Contents

- Prime Farmland status from Mike Domeier to Alton Coal, December 5, 2012
- May 28, 2014 email from Mike Domeier, Utah State Soil Scientist with Prime Farmland status letter and copies of attachments
- October 1, 2014 email from Mike Domeier, Utah State Soil Scientist with Prime Farmland and Farmland of Statewide Importance attachments
- May 15-21, 2014 email exchange with Ray Grow, NRCS Utah State Office
- November 8, 2012 email exchange with Ray Grow, NRCS Utah State Office
- October 9, 2012 request from Alton Coal Development to NRCS State Office for Prime Farmland assessment.
- April 24, 2014 letter from Raymond Heaton to Alton Coal Development concerning historical irrigation.
- Tabulation of crop and livestock inquiry of permit area landowners received by Larry Johnson of Alton Coal Development, October 2, 2015.

May 28, 2014 email from Mike Domeier, Utah State Soil Scientist with Prime Farmland status letter and copies of attachments

United States Department of Agriculture

NRCS
Natural Resources Conservation Service
125 South State Street, Room 4402
Salt Lake City, UT 84138-1100
(801) 524-4550
FAX (801) 524-4403

December 5, 2012

Larry Johnson
Alton Coal Development LLC
463 N. 100 W. Suite 1
Cedar City, UT 84720

RE: Prime Farmland Status

Dear Mr. Johnson:

Please find attached Farmland Conversion Impact Rating (AD-1006), Farmland Classification Report, and Hydric Soil Rating for the proposed project in Kane County, Utah.

The proposed Alton coal mining lease Project will impact important farmland resources in Utah. Soil map units affected by this proposed project include 1111 – Naplene-Termote-Arboles-Oxyaquic Ustifluvent complex, 2 to 8 percent slopes and 1113 – Flugle-Termote-Plumasano complex, 2 to 15 percent slopes. Soil map units 1111 and 1113 are considered Prime Farmland, if irrigated. Based on the most current imagery available and the Southwest Regional Gap Analysis Project (SWReGAP) it was determined that this soil is being irrigated or that there is a reliable water source. The term "irrigated" means that there is an irrigation water supply that is dependable and of adequate quality. Based on project site information provided, approximately 292 acres of soil map unit 1111 will be converted.

The Soil Survey of Kane County Area, Utah does indicate the presence of hydric soils in the project area. The third component of map unit 1111 is on flood plains, is frequently flooded and has sedges on the plant list. However, on-site verification is necessary to establish the existence, size, shape, and type of wetlands. The NRCS cannot perform wetland determinations unless it is in support of USDA farm programs.

The U.S. Army Corps of Engineers administers the Section 404 program governing the discharge of dredge and fill material into waters in the U.S. as defined and guided by Section 404 of the Clean Water Act. The wetlands which fall within the Section 404 regulation are referred to as jurisdictional wetlands.

I hope you find this information helpful. Please don't hesitate to call (801.524.4574) or email (mike.domeier@ut.usda.gov) with any further questions.

Sincerely,

Mike Domeier
State Soil Scientist, NRCS, Utah

Enclosure: Form AD-1006, Farmland Classification Report, and Hydric Soil Rating for project area

Print Close

FW: Alton Coal request

From: Domeier, Michael - NRCS, Salt Lake City, UT (Mike.Domeier@ut.usda.gov)
Sent: Wed 5/28/14 10:09 AM
To: ROBERT LONG (lrcsoils@msn.com) (lrcsoils@msn.com); Parslow, Victor - NRCS, Richfield, UT (Vic.Parslow@ut.usda.gov); Grow, Raymond - NRCS, Salt Lake City, UT (raymond.grow@ut.usda.gov)

12 attachments

AD1006.pdf (80.2 KB) , AltonSoilsMap.docx (178.8 KB) , Alton Order 2 Soil Survey Legends and Maps May 18 2014 (2).pdf (3.3 MB) , AltonCoalEXPORT - prime components.xlsx (61.5 KB) , AltonCoalmapunits.xlsx (12.2 KB) , LetterSigned.pdf (140.0 KB) , SmallerArea.pdf (1301.0 KB) , Soils-w-Topog.docx (2.9 MB) , UtDivOilGas&Mining.jpg (968.1 KB) , UtDivOilGas&Mining2.jpg (777.6 KB) , UtDivOilGas&Mining.jpg (968.1 KB) , UtDivOilGas&Mining-5-27-2014.jpg (646.7 KB)

Bob, Vic, Ray –

Bob and I visited regarding the Alton Coal Request. Please let me know if there are any comments or corrections to this summary.

There is a south parcel where the current mine is operating. In 2006 an important farmland determination was completed by Corey Meier. This was done with an on-site investigation since the soil survey was not yet completed. In January 2014 a determination was made for an 80 acre expansion adjoining the south parcel. It was based on the draft soil survey. This was sent to Priscilla Burton at the Utah Division of Oil, Gas & Mining.

In January 2012 the NRCS completed an Important Farmland determination for the north parcel. It was based on the draft soil survey and was sent to Larry Johnson at Alton Coal. The information related to that determination is attached. In Bob's consultant report he will provide the more detailed information he has collected on the north parcel.

The NRCS determinations are based on map units in the soil survey. For farmland this would usually be an order 2 soil survey. Bob's work is order 1 soil survey that is utilized for on-site interpretations. The following definition is from part '622.03 – Farmland Classification' in the National Soil Survey Handbook.

Definition. The farmland classification designates map units as prime farmland, farmland of statewide importance, farmland of local importance, or farmland of unique importance. Soil map units with components of

prime farmland are classified as: prime where 50 percent or more of the components in the map unit composition are prime; of statewide importance where less than 50 percent of the components in the map unit are prime but a combination of lands of prime or statewide importance is 50 percent or more of the map unit composition; of local importance where less than 50 percent of the components in the map unit are of prime or statewide importance but the total of land of prime, statewide, and/or local importance is 50 percent or more of the map unit composition. All other soil map units are shown as not farmland unless they are designated as unique.

Mike Domeier

Utah NRCS - State Soil Scientist

801-524-4574 (work)

801-631-0713 (cell)

From: Grow, Raymond - NRCS, Salt Lake City, UT
Sent: Tuesday, May 27, 2014 5:02 PM
To: Domeier, Michael - NRCS, Salt Lake City, UT
Subject: Alton Coal request

Mike,

These are key files for the Alton Coal Prime Farmland.

Ray

This electronic message contains information generated by the USDA solely for the intended recipients. Any unauthorized interception of this message or the use or disclosure of the information it contains may violate the law and subject the violator to civil or criminal penalties. If you believe you have received this message in error, please notify the sender and delete the email immediately.

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request 10/9/12
Name Of Project Alton Coal Mining permit	Federal Agency Involved none (UT. Div. Oil, Gas, & Mining)
Proposed Land Use Coal Mining Lease	County And State Kane, Utah
PART II *(To be completed by NRCS)*	Date Request Received By NRCS 10/9/12

Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply – do not complete additional parts of this form).*	Yes ☑	No ☐	Acres Irrigated 3,433	Average Farm Size 1190

Major Crop(s) Hay, grain and pasture	Farmable Land In Govt. Jurisdiction Acres: 13452 %	Amount Of Farmland As Defined in FPPA Acres: 1 % 0
Name Of Land Evaluation System Used Utah NRCS LE	Name Of Local Site Assessment System None	Date Land Evaluation Returned By NRCS 11/8/12

PART III *(To be completed by Federal Agency)*	Alternative Site Rating Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly	292.0			
B. Total Acres To Be Converted Indirectly	8,603.0			
C. Total Acres In Site	8,895.0	0.0	0.0	0.0
PART IV *(To be completed by NRCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland	1,726.0			
B. Total Acres Statewide And Local Important Farmland	0.0			
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted	0.0			
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value	0.0			
PART V *(To be completed by NRCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	100	0	0	0

PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points				
1. Area In Nonurban Use					
2. Perimeter In Nonurban Use					
3. Percent Of Site Being Farmed					
4. Protection Provided By State And Local Government					
5. Distance From Urban Builtup Area					
6. Distance To Urban Support Services					
7. Size Of Present Farm Unit Compared To Average					
8. Creation Of Nonfarmable Farmland					
9. Availability Of Farm Support Services					
10. On-Farm Investments					
11. Effects Of Conversion On Farm Support Services					
12. Compatibility With Existing Agricultural Use					
TOTAL SITE ASSESSMENT POINTS	160	0	0	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	100	0	0	0
Total Site Assessment *(From Part VI above or a local site assessment)*	160	0	0	0	0
TOTAL POINTS *(Total of above 2 lines)*	260	100	0	0	0

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? Yes ☐ No ☐

Reason For Selection:

(See Instructions on reverse side)

This form was electronically produced by National Production Services Staff

Form AD-1006 (10-83)

This page and previous page from Alton AD1006.pdf attached to email from Mike Domeier on May 28, 2014.

STEPS IN THE PROCESSING THE FARMLAND AND CONVERSION IMPACT RATING FORM

Step 1 – Federal agencies involved in proposed projects that may convert farmland, as defined in the Farmland Protection Policy Act (FPPA) to nonagricultural uses, will initially complete Parts I and III of the form.

Step 2 – Originator will send copies A, B and C together with maps indicating locations of site(s), to the Natural Resources Conservation Service (NRCS) local field office and retain copy D for their files. (Note: NRCS has a field office in most counties in the U.S. The field office is usually located in the county seat. A list of field office locations are available from the NRCS State Conservationist in each state).

Step 3 – NRCS will, within 45 calendar days after receipt of form, make a determination as to whether the site(s) of the proposed project contains prime, unique, statewide or local important farmland.

Step '4 – In cases where farmland covered by the FPPA will be converted by the proposed project, NRCS field offices will complete Parts II, IV and V of the form.

Step 5 – NRCS will return copy A and B of the form to the Federal agency involved in the project. (Copy C will be retained for NRCS records).

Step 6 – The Federal agency involved in the proposed project will complete Parts VI and VII of the form.

Step 7 – The Federal agency involved in the proposed project will make a determination as to whether the proposed conversion is consistent with the FPPA and the agency's internal policies.

INSTRUCTIONS FOR COMPLETING THE FARMLAND CONVERSION IMPACT RATING FORM

Part I: In completing the "County And State" questions list all the local governments that are responsible for local land controls where site(s) are to be evaluated.

Part III: In completing item B (Total Acres To Be Converted Indirectly), include the following:

1. Acres not being directly converted but that would no longer be capable of being farmed after the conversion, because the conversion would restrict access to them.

2. Acres planned to receive services from an infrastructure project as indicated in the project justification (e.g. highways, utilities) that will cause a direct conversion.

Part VI: Do not complete Part VI if a local site assessment is used.

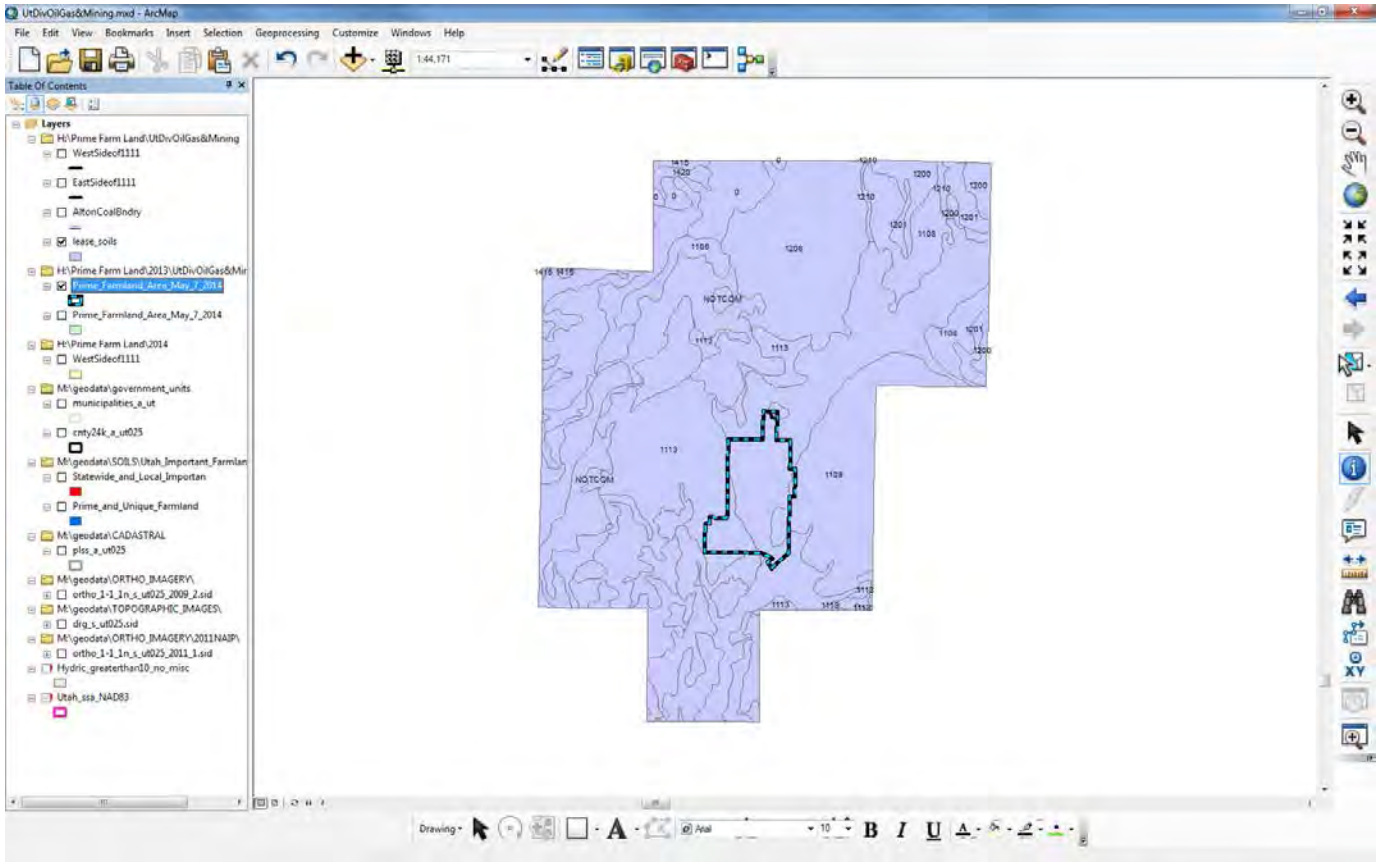
Assign the maximum points for each site assessment criterion as shown in § 658.5 (b) of CFR. In cases of corridor-type projects such as transportation, powerline and flood control, criteria #5 and #6 will not apply and will, be weighed zero, however, criterion #8 will be weighed a maximum of 25 points, and criterion #11 a maximum of 25 points.

Individual Federal agencies at the national level, may assign relative weights among the 12 site assessment criteria other than those shown in the FPPA rule. In all cases where other weights are assigned relative adjustments must be made to maintain the maximum total weight points at l60.

In rating alternative sites, Federal agencies shall consider each of the criteria and assign points within the limits established in the FPPA rule. Sites most suitable for protection under these criteria will receive the highest total scores, and sites least suitable, the lowest scores.

Part VII: In computing the "Total Site Assessment Points" where a State or local site assessment is used and the total maximum number of points is other than 160, adjust the site assessment points to a base of 160. Example: if the Site Assessment maximum is 200 points, and alternative Site "A" is rated 180 points:

$$\frac{\text{Total points assigned Site A}}{\text{Maximum points possible}} = \frac{180}{200} \times 160 = 144 \text{ points for Site "A."}$$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Data Points - Analysis Parameters
Shown for Planning Purposes ONLY
** Subject to Change **

North Private Lease

Carbonatic Map Unit

- A1 Sideshow family, 0-4% slopes
- A2 Sideshow-Terem... families, 4-8% slopes
- A3 Sideshow family, 8-18% slopes
- B Flugle-Brumley families, 8-15% slopes
- C Quezcan-Vesilla families-Rock Outcrop, 20-45% slopes
- D Wimmer-Teremote - Bobknoll families, 2-8% slopes
- E Atlatl - CCC - AAA families, 0-4% slopes
- F Boxcanyon family, 0-4% slopes
- G AAA-CCC-BBB families, 0-5% slopes
- H BBB-Atlatl families, 0-5% slopes
- J Wet Bottoms
- K 300 channel
- P Ponds
- DP Holes
- Backhoe
- Push Probe
- Hand Dug
- Piezometer
- Nov 2013 soil data points

1103 1111 1112 1115 1108 1111

A1 A2 A3 B D E F G H J K P

DP-30 DP-28 Sideshow > 140 DP-29 BBB 0 DP-01 Flugle DP-02 Flugle 170 DP-03 Sideshow 137 Rock DP-04 Wimmer 153 DP-05 Sideshow 162 Rock DP-06 Teromote 187 DP-07 Sideshow DP-08 Sideshow DP-09 Sideshow > 244 DP-10 Sideshow DP-11 Bobknoll > 243 DP-12 Flugle > 244 DP-13 Flugle > 88 DP-14 Bobknoll 88 Rock DP-15 Teromote 207 DP-16 Sideshow 102 Rock DP-17 Sideshow > 170 DP-18 Brumley 144 DP-19 Boxcanyon DP-21 Teromote > 360 DP-23 Wimmer > 122

12A S030 Sideshow 95 Rock
12A S029 Boxcanyon 86
12A S027 Wimmer 170
12A S028 AAA 0
12A S026 Wimmer 104
12A S024 DDD 0
12A S031 Wimmer > 172
12A S025 Atlatl 12
12A S020 CCC similar 13
12A S023 Bobknoll > 230
12A S018 AAA 0
12A S001 BBB BBB 0
12A S021 Atlatl 32
12A S012 CCC 11
12A S019 AAA similar 0
13A S01 BBB
12A S011 CCC 10
12A S022 DDD 0
12A S015 Sideshow mid 118 Rock
12A S016 Teromote 112 Rock
12A S017 Sideshow 118 Rock
12A S013 Sideshow 102 Rock
12A S010 BBB similar 0
12A S002 Sideslide 87
12A S014 Sideshow mid 88 Rock
12A S032 Sideshow > 165
12A S009 Boxcanyon 20
12A S003 Atlatl similar 0
12A S008 Vesilla 23 Rock
13A S09 Quezcan, shallow
12A S007 Brumley 83 Rock
12A S005 Quezcan 78 Rock
13A S04 Brumley
12A S006 sandstone
13A S08
13A S07 Boxcanyon similar
13A S06 Sideshow
13A S05 Teromote
13A S02 Wimmer
13A S03 Teromote
Kanab Creek 1
14A S001 Sideshow

4144400 4144200 4144000 4143800 4143600 4143400 4143200 4143000 4142800 4142600 4142400 4142200

369200 369400 369600 369800 370000 370200 370400 370600

N

500 250 0 500 Feet

Coal Hollow Project

Order 2 Soil Survey - Parent Materials

Alton Coal - North Private Lease

May 18, 2014 Base Map: NAIP 2011 UTM NAD83

Prepared by:

Long Resource Consultants

Morgan, UT

Page from Alton Order 2 Soil Survey Legends and Maps May 18 2014 (2).pdf attached to email from Mike Domeier on May 28, 2014. File originally sent to Ray Grow on May 18, 2014.

Data Points - Analysis Parameters
Shown for Planning Purposes ONLY
** Subject to Change **

Legend

North Private Lease

Soil Parent Materials Map Unit

- A1 Shale Residuum and Local Slopewash
- A2 Shale Residuum
- A3 Shale Residuum
- B Tropic Sandstone Residuum
- C Residuum
- D Local Slopewash over Alluvium
- E Depositional
- F Local Slopewash
- G Depositional
- H Depositional
- J Floodplain
- K Transition Residuum to Depositional
- P Pond
- DP Holes
- Backhoe
- Push Probe
- Hand Dug
- Piezometer
- Nov 2013 soil data points

1103 1111 1112 1108 1115 1115

Order 2 Soil Survey - Parent Materials

Alton Coal - North Private Lease

May 18, 2014 Base Map: NAIP 2011 UTM NAD83

Prepared by:

Long Resource Consultants

Morgan, UT

Coal Hollow Project

500 250 0 500 Feet

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Table 1. Taxonomic classification of soil families identified in the North Private Lease soil survey area.

Soil Family	Taxonomic Classification	pH >8.4 in upper 100 cm	Calcium Carbonate Equivalent > 30% in Upper 150 cm	Calcium Carbonate Equivalent > 40% in Upper 150 cm
AAA	Aridic Haplustepts fine-loamy, carbonatic, mesic	1	Yes	Yes
Atlatl	Aridic Calciustepts coarse-loamy, carbonatic, mesic	Yes	Yes	Yes
BBB	Aridic Calciustepts fine-loamy, carbonatic, mesic	2	Yes	Yes
Bobknoll	Aridic Calciustepts coarse-loamy, mixed, superactive, mesic	3	Yes	Yes
Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic	4	Yes	Yes
Brumley	Calcidic Haplustalfs fine-loamy, mixed, superactive, mesic	5		
CCC	Aridic Calciustepts fine, carbonatic, mesic	Yes	Yes	Yes
DDD	Oxyaquic Ustifluvent sandy-skeletal, carbonatic, mesic	Yes	Yes	Yes
Flugle	Aridic Haplustalfs fine-loamy, mixed, superactive, mesic			
Quezcan	Aridic Ustorthent fine, smectitic, superactive, mesic	6		
Sideshow	Aridic Haplusterts fine, smectitic, mesic			
Sideslide	Typic Endoaquepts fine-loamy, mixed, superactive, mesic	7	Yes	Yes
Teromote	Aridic Haplustepts fine-loamy, mixed, superactive, mesic			
Vessilla	Aridic Lithic Ustorthents loamy, mixed, calcareous, active, mesic	8		
Wimmer	Aridic Calciustepts fine-loamy, mixed, superactive, mesic		Yes	

1. AAA family soils have soil pH within 100 cm of the soil surface and pH greater than 8.4 below 100 cm.
2. Some BBB family soils have soil pH greater than 8.4 below 100 cm.
3. Some Bobknoll family soils have soil pH greater than 8.4 below 100 cm.
4. Some Boxcanyon family soils have soil pH greater than 8.4 below 100 cm.
5. Some Brumley family soils have soil pH greater than 8.4 below 100 cm.
6. Quezcan soils have Tropic shale between 50 and 75 cm (20 and 40 inches) below the surface.
7. Sideslide soils have soil pH greater than 8.4 below 100 cm.
8. Vessilla soils have sandstone within 50 cm (20 inches) of the soil surface.

Page from Alton Order 2 Soil Survey Legends and Maps May 18 2014 (2).pdf attached to email from Mike Domeier on May 28, 2014. File originally sent to Ray Grow on May 18, 2014.

Table 2. Soil survey legend for the North Privagte Lease area.

Map Unit Symbol	Pct	Map Unit Soil Family	Taxonomic Classification	Representive Pedon	Physiographic Setting
A1		**Sideshow family, 0-4% slopes**			
	85	Sideshow	Aridic Haplusterts fine, smectitic, mesic	12AS015	Concave Footslopes
	10	Teremote	Aridic Haplustepts fine-loamy, mixed, superactive, mesic		Convex Hillslopes
	5	Wimmer	Aridic Calciustepts fine-loamy, mixed, superactive, mesic		Concave Toeslopes
A2		**Sideshow - Teromote families, 4 to 8% slopes**			
	50	Sideshow	Aridic Haplusterts fine, smectitic, mesic	12AS032	Hillslopes
	35	Teromote	Aridic Haplustepts fine-loamy, mixed, superactive, mesic	12AS016	Convex Hillslopes
	10	Wimmer	Aridic Calciustepts fine-loamy, mixed, superactive, mesic		Toeslopes
	5	Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic		Concave Toeslopes
A3		**Sideshow family, 8 to 18% slopes**			
	80	Sideshow	Aridic Haplusterts fine, smectitic, mesic	12AS017	Convex Hillslopes
	10	Teremote	Aridic Haplustepts fine-loamy, mixed, superactive, mesic		Linear Hillslopes
	7	Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic		Concave Toeslopes
	3	Quezcan	Aridic Ustorthent fine, smectitic, superactive, mesic		Convex Ridges
B		**Flugle - Brumley families, 8 to 15% slopes**			
	60	Flugle	Aridic Haplustalfs fine-loamy, mixed, superactive, mesic	DP-12	Structural Benches
	30	Brumley	Calcidic Haplustalfs fine-loamy, mixed, superactive, mesic	13AS04	Hillslopes
	10	Bobknoll	Aridic Calciustepts coarse-loamy, mixed, superactive, mesic	DP-11	Alluvial Fans
C		**Quezcan family - Vesilla family - Rock Outcrop, 20 to 45% slopes**			
	50	Quezcan	Aridic Ustorthent fine, smectitic, superactive, mesic	12AS005	Structural Benches
	30	Vesilla	Aridic Lithic Ustorthents loamy, mixed, calcareous, active, mesic	12AS008	Structural Benches
	15	Rock Outcrop		12AS006	Ridges
	5	Brumley	Calcidic Haplustalfs fine-loamy, mixed, superactive, mesic		

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Table 2. Soil survey legend for the North Privagte Lease area.

Map Unit Symbol	Pct	Map Unit Soil Family	Taxonomic Classification	Representive Pedon	Physiographic Setting
D		**Wimmer - Teromote - Bobknoll families, 2 to 8% slopes**			
	50	Wimmer	Aridic Calciustepts fine-loamy, mixed, superactive, mesic	12AS031	Toe of Alluvial Fans
	25	Teromote	Aridic Haplustepts fine-loamy, mixed, superactive, mesic	13AS03	Alluvial Fans
	15	Bobknoll	Aridic Calciustepts coarse-loamy, mixed, superactive, mesic	12AS023	Fan Apron
	10	Flugle	Aridic Haplustalfs fine-loamy, mixed, superactive, mesic	DP-02	Alluvial Fans
E		**Atlatl - CCC - AAA families, 0 to 4% slopes**			
	45	Atlatl	Aridic Calciustepts coarse-loamy, carbonatic, mesic	12AS021	Terrace Remnants
	35	CCC	Aridic Haplustepts fine-loamy, carbonatic, mesic	12AS011	Terrace Remnants
	15	AAA	Aridic Haplustepts fine-loamy, carbonatic, mesic	12AS019A	Terrace Remnants
	5	Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic		Terrace Remnants
F		**Boxcanyon family, 0 to 4% slopes**			
	85	Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic	12AS029	Alluvial Fans
	10	Wimmer	Aridic Calciustepts fine-loamy, mixed, superactive, mesic		Toe of Alluvial fans
	5	Bobknoll	Aridic Calciustepts coarse-loamy, mixed, superactive, mesic		Terrace Remnants
G		**AAA - BBB families, 0 to 5% slopes**			
	70	AAA	Aridic Haplustepts fine-loamy, carbonatic, mesic	12AS018	Terrace Remnants
	15	BBB	Aridic Calciustepts fine-loamy, carbonatic, mesic	DP-29	Terrace Remnants
	10	CCC	Aridic Calciustepts fine, carbonatic, mesic		Terrace Remnants
	5	Atlatl	Aridic Calciustepts coarse-loamy, carbonatic, mesic		Terrace Remnants
H		**BBB family, 15 to 70% slopes**			
	80	BBB	Aridic Calciustepts fine-loamy, carbonatic, mesic	12AS001	Valley sideslopes
	10	Atlatl	Aridic Calciustepts coarse-loamy, carbonatic, mesic		Valley sideslopes
	10	AAA	Aridic Haplustepts fine-loamy, carbonatic, mesic		Toeslopes

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Table 2. Soil survey legend for the North Privagte Lease area.

Map Unit Symbol	Pct	Map Unit _____ Soil Family	Taxonomic Classification	Representive Pedon	Physiographic Setting
J		**Sideslide - DDD families**			
	50	DDD	Oxyaquic Ustifluvent sandy-skeletal, carbonatic, mesic	12AS024	Stream Terrace
	40	Sideslide	Typic Endoaquepts fine-loamy, mixed, mesic	12AS002	Floodplain
	10	Teromote	Aridic Haplustepts fine-loamy, mixed, superactive, mesic		Alluvial fans
K		**BBB family, 15 to 70% slopes**			
	80	BBB	Aridic Calciustepts fine-loamy, carbonatic, mesic	13AS01	Hillslopes
	10	Quezcan	Aridic Ustorthent fine, smectitic, superactive, mesic		Arroyo sideslopes
	10	Sideshow	Aridic Haplusterts fine, smectitic, mesic		Hillslopes
P		**Pond**			

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Table 3. Soil map units with components having a soil pH greater than 8.4 in at least one horizon within 40 inches (1 meter) of the surface (highlited in pink). Map units E and J have major compents with soil pH > 8.4 within 40 inches of soil surface. Map units G and H contain minor components with soil pH > 8.4 within 40 inches of soil surface.

Map Unit Symbol	Pct	Map Unit Soil Family	Taxonomic Classification	Representive Pedon	Physiographic Setting
A1		**Sideshow family, 0-4% slopes**			
	85	Sideshow	Aridic Haplusterts fine, smectitic, mesic	12AS015	Concave Footslopes
	10	Teremote	Aridic Haplustepts fine-loamy, mixed, superactive, mesic		Convex Hillslopes
	5	Wimmer	Aridic Calciustepts fine-loamy, mixed, superactive, mesic		Concave Toeslopes
A2		**Sideshow - Teromote families, 4 to 8% slopes**			
	50	Sideshow	Aridic Haplusterts fine, smectitic, mesic	12AS032	Hillslopes
	35	Teromote	Aridic Haplustepts fine-loamy, mixed, superactive, mesic	12AS016	Convex Hillslopes
	10	Wimmer	Aridic Calciustepts fine-loamy, mixed, superactive, mesic		Toeslopes
	5	Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic		Concave Toeslopes
A3		**Sideshow family, 8 to 18% slopes**			
	80	Sideshow	Aridic Haplusterts fine, smectitic, mesic	12AS017	Convex Hillslopes
	10	Teremote	Aridic Haplustepts fine-loamy, mixed, superactive, mesic		Linear Hillslopes
	7	Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic		Concave Toeslopes
	3	Quezcan	Aridic Ustorthent fine, smectitic, superactive, mesic		Convex Ridges
B		**Flugle - Brumley families, 8 to 15% slopes**			
	60	Flugle	Aridic Haplustalfs fine-loamy, mixed, superactive, mesic	DP-12	Structural Benches
	30	Brumley	Calcidic Haplustalfs fine-loamy, mixed, superactive, mesic	13AS04	Hillslopes
	10	Bobknoll	Aridic Calciustepts coarse-loamy, mixed, superactive, mesic	DP-11	Alluvial Fans
C		**Quezcan family - Vesilla family - Rock Outcrop, 20 to 45% slopes**			
	50	Quezcan	Aridic Ustorthent fine, smectitic, superactive, mesic	12AS005	Structural Benches
	30	Vesilla	Aridic Lithic Ustorthents loamy, mixed, calcareous, active, mesic	12AS008	Structural Benches
	15	Rock Outcrop		12AS006	Ridges
	5	Brumley	Calcidic Haplustalfs fine-loamy, mixed, superactive, mesic		

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Table 3. Soil map units with components having a soil pH greater than 8.4 in at least one horizon within 40 inches (1 meter) of the surface (highlited in pink). Map units E and J have major compents with soil pH > 8.4 within 40 inches of soil surface. Map units G and H contain minor components with soil pH > 8.4 within 40 inches of soil surface.

Map Unit Symbol	Pct	Map Unit Soil Family	Taxonomic Classification	Representive Pedon	Physiographic Setting
D		**Wimmer - Teromote - Bobknoll families, 2 to 8% slopes**			
	50	Wimmer	Aridic Calciustepts fine-loamy, mixed, superactive, mesic	12AS031	Toe of Alluvial Fans
	25	Teromote	Aridic Haplustepts fine-loamy, mixed, superactive, mesic	13AS03	Alluvial Fans
	15	Bobknoll	Aridic Calciustepts coarse-loamy, mixed, superactive, mesic	12AS023	Fan Apron
	10	Flugle	Aridic Haplustalfs fine-loamy, mixed, superactive, mesic	DP-02	Alluvial Fans
E		**Atlatl - CCC - AAA families, 0 to 4% slopes**			
	45	Atlatl	Aridic Calciustepts coarse-loamy, carbonatic, mesic	12AS021	Terrace Remnants
	35	CCC	Aridic Haplustepts fine-loamy, carbonatic, mesic	12AS011	Terrace Remnants
	15	AAA	Aridic Haplustepts fine-loamy, carbonatic, mesic	12AS019A	Terrace Remnants
	5	Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic		Terrace Remnants
F		**Boxcanyon family, 0 to 4% slopes**			
	85	Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic	12AS029	Alluvial Fans
	10	Wimmer	Aridic Calciustepts fine-loamy, mixed, superactive, mesic		Toe of Alluvial fans
	5	Bobknoll	Aridic Calciustepts coarse-loamy, mixed, superactive, mesic		Terrace Remnants
G		**AAA - BBB families, 0 to 5% slopes**			
	70	AAA	Aridic Haplustepts fine-loamy, carbonatic, mesic	12AS018	Terrace Remnants
	15	BBB	Aridic Calciustepts fine-loamy, carbonatic, mesic	DP-29	Terrace Remnants
	10	CCC	Aridic Calciustepts fine, carbonatic, mesic		Terrace Remnants
	5	Atlatl	Aridic Calciustepts coarse-loamy, carbonatic, mesic		Terrace Remnants
H		**BBB family, 15 to 70% slopes**			
	80	BBB	Aridic Calciustepts fine-loamy, carbonatic, mesic	12AS001	Valley sideslopes
	10	Atlatl	Aridic Calciustepts coarse-loamy, carbonatic, mesic		Valley sideslopes
	10	AAA	Aridic Haplustepts fine-loamy, carbonatic, mesic		Toeslopes

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Table 3. Soil map units with components having a soil pH greater than 8.4 in at least one horizon within 40 inches (1 meter) of the surface (highlited in pink). Map units E and J have major compents with soil pH > 8.4 within 40 inches of soil surface. Map units G and H contain minor components with soil pH > 8.4 within 40 inches of soil surface.

Map Unit Symbol	Pct	Map Unit Soil Family	Taxonomic Classification	Representive Pedon	Physiographic Setting
J		**Sideslide - DDD families**			
	50	DDD	Oxyaquic Ustifluvent sandy-skeletal, carbonatic, mesic	12AS024	Stream Terrace
	40	Sideslide	Typic Endoaquepts fine-loamy, mixed, mesic	12AS002	Floodplain
	10	Teromote	Aridic Haplustepts fine-loamy, mixed, superactive, mesic		Alluvial fans
K		**BBB family, 15 to 70% slopes**			
	80	BBB	Aridic Calciustepts fine-loamy, carbonatic, mesic	13AS01	Hillslopes
	10	Quezcan	Aridic Ustorthent fine, smectitic, superactive, mesic		Arroyo sideslopes
	10	Sideshow	Aridic Haplusterts fine, smectitic, mesic		Hillslopes
P		**Pond**			

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Table 4. Carbonatic soils identified within the North Private Lease area (highlited in yellow). Map units E, G, H, J and K have major components with carbonatic mineralogy (greater than 40 $CaCO_3$ percent in the control section).

Map Unit Symbol	Pct	Map Unit Soil Family	Taxonomic Classification	Representive Pedon	Physiographic Setting
A1		**Sideshow family, 0-4% slopes**			
	85	Sideshow	Aridic Haplusterts fine, smectitic, mesic	12AS015	Concave Footslopes
	10	Teremote	Aridic Haplustepts fine-loamy, mixed, superactive, mesic		Convex Hillslopes
	5	Wimmer	Aridic Calciustepts fine-loamy, mixed, superactive, mesic		Concave Toeslopes
A2		**Sideshow - Teromote families, 4 to 8% slopes**			
	50	Sideshow	Aridic Haplusterts fine, smectitic, mesic	12AS032	Hillslopes
	35	Teromote	Aridic Haplustepts fine-loamy, mixed, superactive, mesic	12AS016	Convex Hillslopes
	10	Wimmer	Aridic Calciustepts fine-loamy, mixed, superactive, mesic		Toeslopes
	5	Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic		Concave Toeslopes
A3		**Sideshow family, 8 to 18% slopes**			
	80	Sideshow	Aridic Haplusterts fine, smectitic, mesic	12AS017	Convex Hillslopes
	10	Teremote	Aridic Haplustepts fine-loamy, mixed, superactive, mesic		Linear Hillslopes
	7	Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic		Concave Toeslopes
	3	Quezcan	Aridic Ustorthent fine, smectitic, superactive, mesic		Convex Ridges
B		**Flugle - Brumley families, 8 to 15% slopes**			
	60	Flugle	Aridic Haplustalfs fine-loamy, mixed, superactive, mesic	DP-12	Structural Benches
	30	Brumley	Calcidic Haplustalfs fine-loamy, mixed, superactive, mesic	13AS04	Hillslopes
	10	Bobknoll	Aridic Calciustepts coarse-loamy, mixed, superactive, mesic	DP-11	Alluvial Fans
C		**Quezcan family - Vesilla family - Rock Outcrop, 20 to 45% slopes**			
	50	Quezcan	Aridic Ustorthent fine, smectitic, superactive, mesic	12AS005	Structural Benches
	30	Vesilla	Aridic Lithic Ustorthents loamy, mixed, calcareous, active, mesic	12AS008	Structural Benches
	15	Rock Outcrop		12AS006	Ridges
	5	Brumley	Calcidic Haplustalfs fine-loamy, mixed, superactive, mesic		

Page from Alton Order 2 Soil Survey Legends and Maps May 18 2014 (2).pdf attached to email from Mike Domeier on May 28, 2014.
File originally sent to Ray Grow on May 18, 2014.

Table 4. Carbonatic soils identified within the North Private Lease area (highlited in yellow). Map units E, G, H, J and K have major components with carbonatic mineralogy (greater than 40 $CaCO_3$ percent in the control section).

Map Unit Symbol	Pct	Map Unit Soil Family	Taxonomic Classification	Representive Pedon	Physiographic Setting
D		**Wimmer - Teromote - Bobknoll families, 2 to 8% slopes**			
	50	Wimmer	Aridic Calciustepts fine-loamy, mixed, superactive, mesic	12AS031	Toe of Alluvial Fans
	25	Teromote	Aridic Haplustepts fine-loamy, mixed, superactive, mesic	13AS03	Alluvial Fans
	15	Bobknoll	Aridic Calciustepts coarse-loamy, mixed, superactive, mesic	12AS023	Fan Apron
	10	Flugle	Aridic Haplustalfs fine-loamy, mixed, superactive, mesic	DP-02	Alluvial Fans
E		**Atlatl - CCC - AAA families, 0 to 4% slopes**			
	45	Atlatl	Aridic Calciustepts coarse-loamy, carbonatic, mesic	12AS021	Terrace Remnants
	35	CCC	Aridic Haplustepts fine-loamy, carbonatic, mesic	12AS011	Terrace Remnants
	15	AAA	Aridic Haplustepts fine-loamy, carbonatic, mesic	12AS019A	Terrace Remnants
	5	Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic		Terrace Remnants
F		**Boxcanyon family, 0 to 4% slopes**			
	85	Boxcanyon	Calcidic Haplustalfs fine, smectitic, mesic	12AS029	Alluvial Fans
	10	Wimmer	Aridic Calciustepts fine-loamy, mixed, superactive, mesic		Toe of Alluvial fans
	5	Bobknoll	Aridic Calciustepts coarse-loamy, mixed, superactive, mesic		Terrace Remnants
G		**AAA - BBB families, 0 to 5% slopes**			
	70	AAA	Aridic Haplustepts fine-loamy, carbonatic, mesic	12AS018	Terrace Remnants
	15	BBB	Aridic Calciustepts fine-loamy, carbonatic, mesic	DP-29	Terrace Remnants
	10	CCC	Aridic Calciustepts fine, carbonatic, mesic		Terrace Remnants
	5	Atlatl	Aridic Calciustepts coarse-loamy, carbonatic, mesic		Terrace Remnants
H		**BBB family, 15 to 70% slopes**			
	80	BBB	Aridic Calciustepts fine-loamy, carbonatic, mesic	12AS001	Valley sideslopes
	10	Atlatl	Aridic Calciustepts coarse-loamy, carbonatic, mesic		Valley sideslopes
	10	AAA	Aridic Haplustepts fine-loamy, carbonatic, mesic		Toeslopes

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Table 4. Carbonatic soils identified within the North Private Lease area (highlited in yellow). Map units E, G, H, J and K have major components with carbonatic mineralogy (greater than 40 $CaCO_3$ percent in the control section).

Map Unit Symbol	Pct	Map Unit Soil Family	Taxonomic Classification	Representive Pedon	Physiographic Setting
J		**Sideslide - DDD families**			
	50	DDD	Oxyaquic Ustifluvent sandy-skeletal, carbonatic, mesic	12AS024	Stream Terrace
	40	Sideslide	Typic Endoaquepts fine-loamy, mixed, mesic	12AS002	Floodplain
	10	Teromote	Aridic Haplustepts fine-loamy, mixed, superactive, mesic		Alluvial fans
K		**BBB family, 15 to 70% slopes**			
	80	BBB	Aridic Calciustepts fine-loamy, carbonatic, mesic	13AS01	Hillslopes
	10	Quezcan	Aridic Ustorthent fine, smectitic, superactive, mesic		Arroyo sideslopes
	10	Sideshow	Aridic Haplusterts fine, smectitic, mesic		Hillslopes
P		**Pond**			

Page from Alton Order 2 Soil Survey Legends and Maps May 18 2014 (2).pdf attached to email from Mike Domeier on May 28, 2014.
File originally sent to Ray Grow on May 18, 2014.

Capability Subclass

mapsymbol	soil	localphase	surffrags	comp%	map(in)	average slope	Kw	waterindex	minpH	maxpH	wei	noniirigatedLCC	nonirrigated subclass	irrigatedLCC	irrigatedsubclass
1103	Sideshow	--	--	35	16	3	0.32	1	8.2	8.2	86	4	e	3	e
1103	Sili	--	--	40	16	5	0.32	1.6	8.2	8.2	86	4	e	3	e
1108	Caval family	--	--	20	16	6	0.2	1.2	7.2	7.4	86	6	e	--	--
1108	Teromote family	--	--	45	16	5	0.32	1.6	7.2	8	86	6	e	--	--
1110	Teromote family	--	--	20	14	2	0.2	0.4	7.6	8.4	86	6	e	--	--
1110	Elpedro	--	--	30	14	2	0.49	1	8.4	8.6	86	6	e	--	--
1111	Arboles	--	--	15	16	2	0.28	0.6	8	8.4	86	4	e	2	e
1111	Naplene	--	--	45	16	2	0.49	1	8	8.4	86	4	e	2	e
1111	Teromote	--	--	20	16	3	0.43	1.3	8.2	8.2	86	4	e	2	e
1111	Oxyaquic Ustifluvents	--	--	10	16	3	0.43	1.3	8.2	8.4	86	4	e	2	e
1113	Flugle	--	--	35	16	4	0.17	0.7	7	7.6	56	4	e	2	e
1113	Teromote	--	0	30	16	4	0.28	1.1	6.6	7.8	48	4	e	2	e
1113	Plumasano	--	0	15	16	4	0.32	1.3	6.8	7	56	6	e	4	e
1415	Ess	--	--	30	18	8	0.1	0.8	7.2	7.6	38	6	e	--	--
1415	Diagulch	--	--	30	18	8	0.15	1.2	5.6	8.4	56	6	e	--	--
1415	Hereford family	--	--	30	18	17	0.28	4.8	6	8.2	48	6	e	--	--
1420	Brycan	moist	--	25	18	6	0.28	1.7	7.8	8.4	56	4	e	--	--
1420	Hereford family	--	--	30	18	7	0.28	2	7.8	8	86	4	e	--	--
1420	Mara family	--	--	45	18	11	0.2	2.2	8	8.4	86	4	e	--	--

Page from AltonCoalEXPORT - prime components.xlsx file attached to email from Mike Domeier on May 28, 2014.

awc(inches)	awc noduff	ec	sar	minimum watertabledepth	flooding frequency	ksat	surfacelayercoarsefrags	tempregime	primecode
7.9	7.87	0	0	--	none	0.92	--	mesic	4
6.7	6.74	0	0	--	none	0.92	--	mesic	4
4.9	4.92	0	0	--	none	28	--	mesic	--
5.9	5.91	0	0	--	none	9	--	mesic	--
6.9	6.89	0	0	--	none	9	--	mesic	--
8.3	8.31	0	0	--	none	3	--	mesic	--
6.7	6.72	0	0	--	none	0.92	--	mesic	4
8	8.02	0	0	--	none	9	--	mesic	4
7.3	7.34	0	0	--	none	3	--	mesic	4
8.1	8.15	0	0	--	rare	9	--	mesic	4
7	7.03	0	0	--	none	9	--	mesic	4
7.9	7.93	0	0	--	none	3	--	mesic	4
5.5	5.51	0	0	--	none	28	--	mesic	4
3.7	3.7	0	0	--	none	3	--	frigid	--
5.4	5.14	2	0	--	none	9	--	frigid	--
7.5	7.75	0	0	--	none	3	--	frigid	--
6.5	6.48	1	0	--	none	9	--	frigid	--
6.6	6.55	0	0	--	none	3	--	frigid	--
5.5	5.5	1	0	--	none	9	--	frigid	--

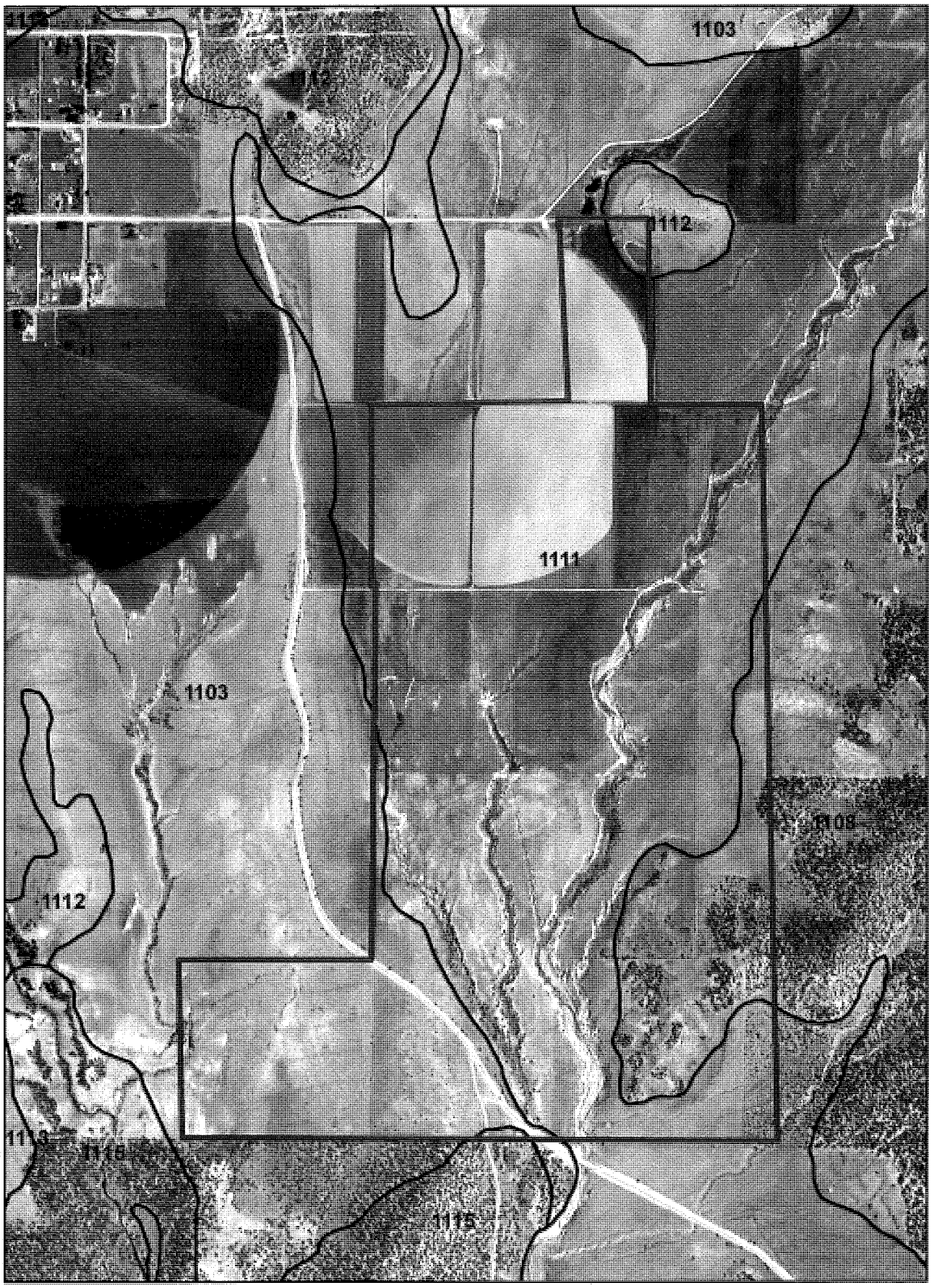
Page from AltonCoalEXPORT - prime components.xlsx file attached to email from Mike Domeier on May 28, 2014.

MUSYM	Cnt_MUSYM	Sum_Shape_
1103	6	2051.3047
1105	6	1196.4184
1108	4	3053.5091
1110	1	15.7675
1111	1	2985.6637
1112	10	677.1014
1113	7	638.2963
1115	4	774.3837
1200	3	3467.2968
1201	3	227.8141
1410	2	38.7014
1415	4	1780.1612
1418	2	232.3984
1419	3	927.3244
1420	6	1020.2465

Page from AltonCoalnOYBURA.xlsx file attached to email from Mike Domeier on May 28, 2014.

Page from SmallerArea.pdf file attached to email from Mike Domeier on May 28, 2014.

Alton Coal Lease

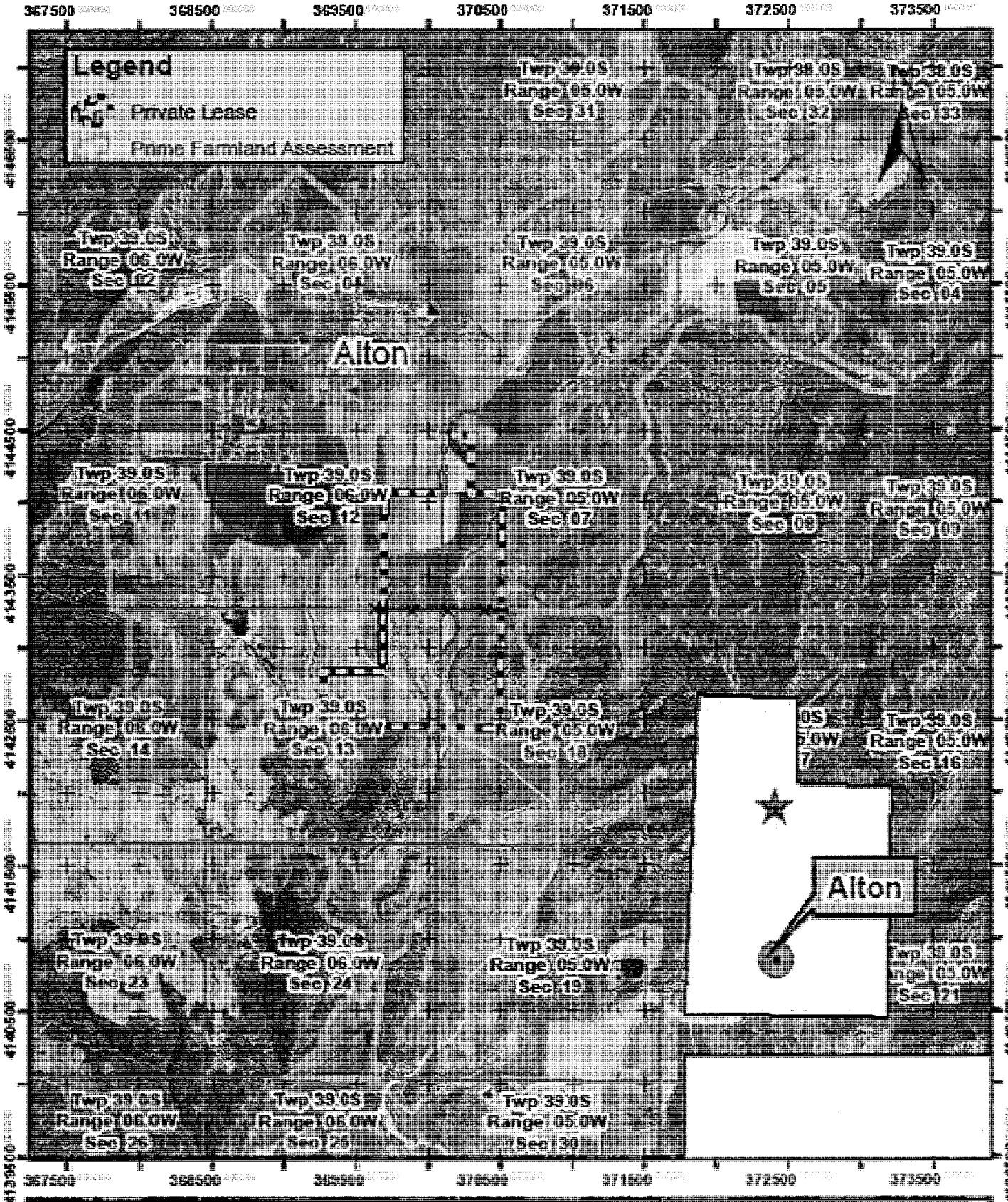


0 400 800 1,600 2,400 3,200 Feet

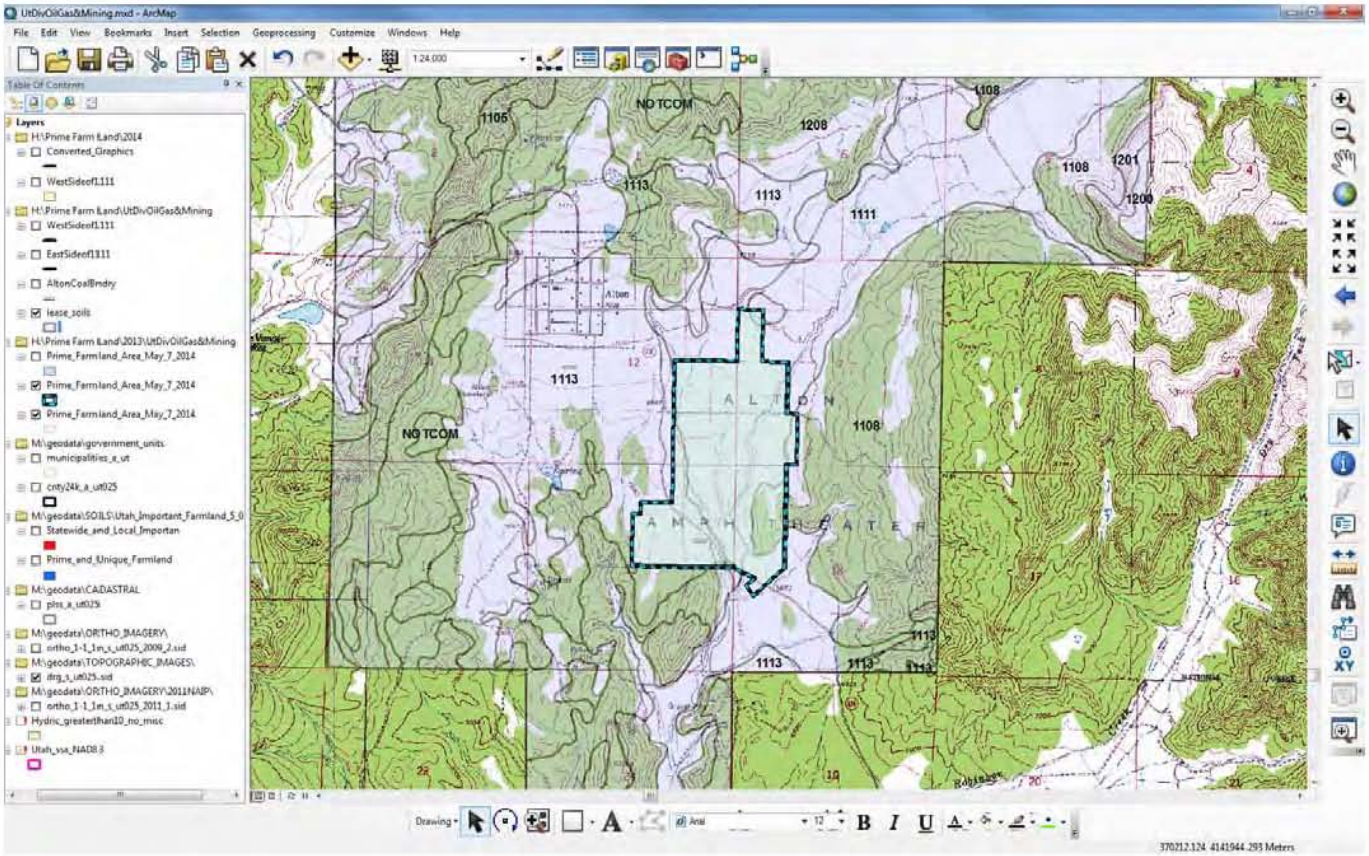
1:12,000

1 inch = 1,000 feet

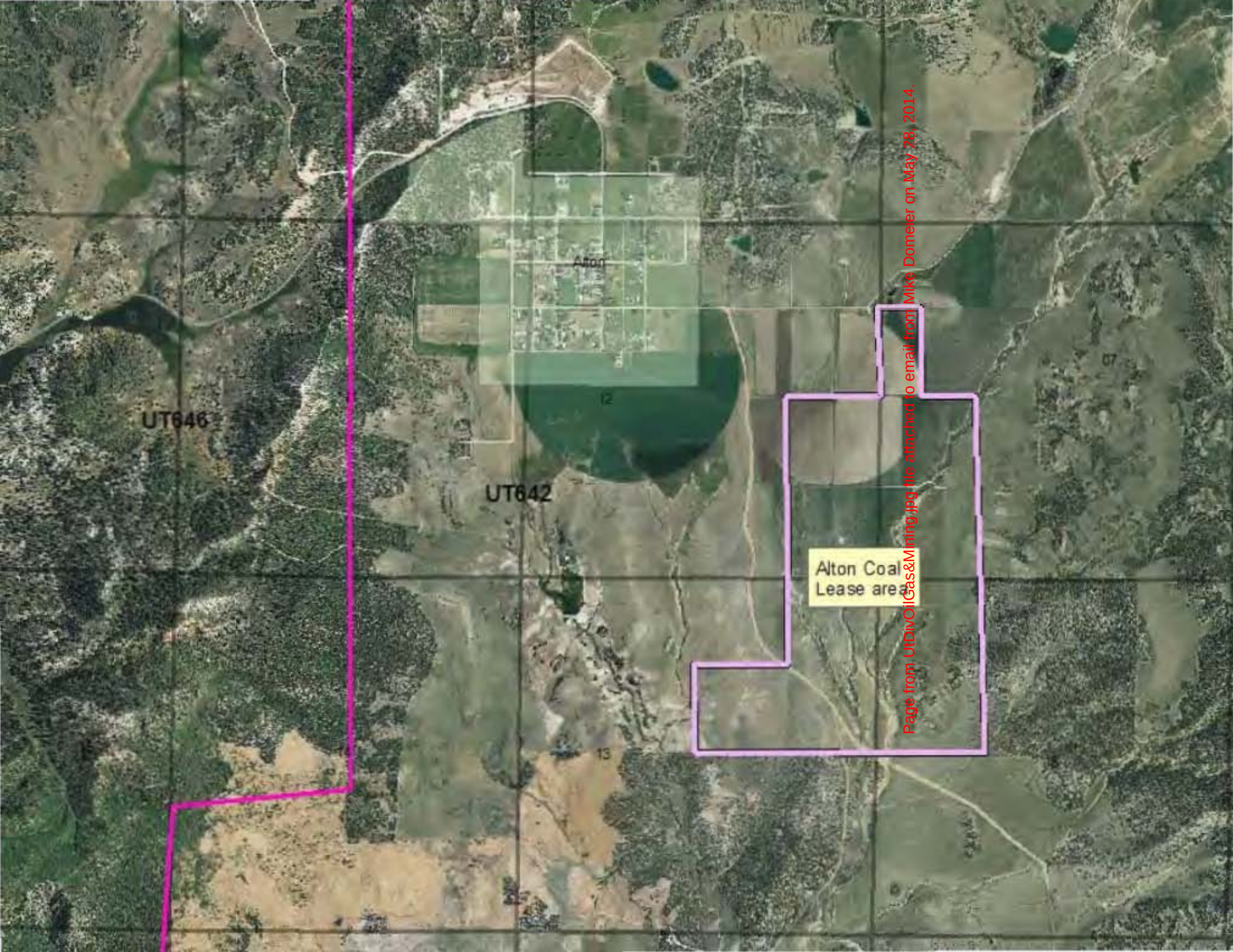
Page from SmallerArea.pdf file attached to email from Mike Domeier on May 28, 2014.

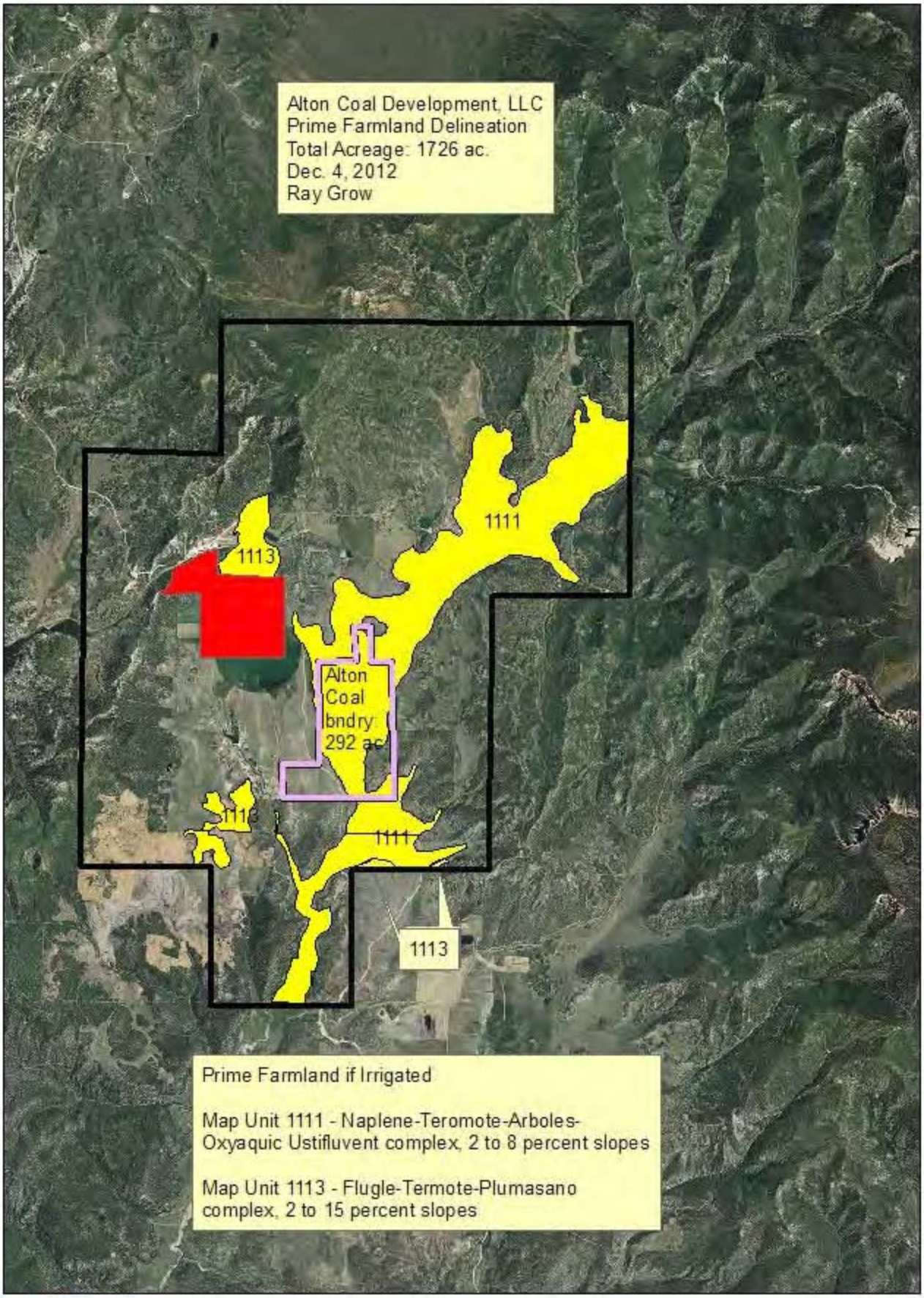


Alton Coal - Private Lease Area	Location Map
Alton Coal Development 463 N 100 W Cedar City, Utah	General Location of Private Lease Area southeast of Alton, Utah
	Coordinate System: UTM, NAD 1983, Zone 12 North
	Alton, Utah USGS 7.5' Topographic Map — 1 inch = 3,000 feet
	October 9, 2012 — 0 750 1,500 3,000 4,500 6,000 Feet



Page from Soils-w-Topo.docx file attached to email from Mike Domeier on May 28, 2014.


Alton
UT646
UT642
Alton Coal
Lease area
Page from UtDivOilGas&Mining.jpg file attached to email from Mike Domeier on May 28, 2014.

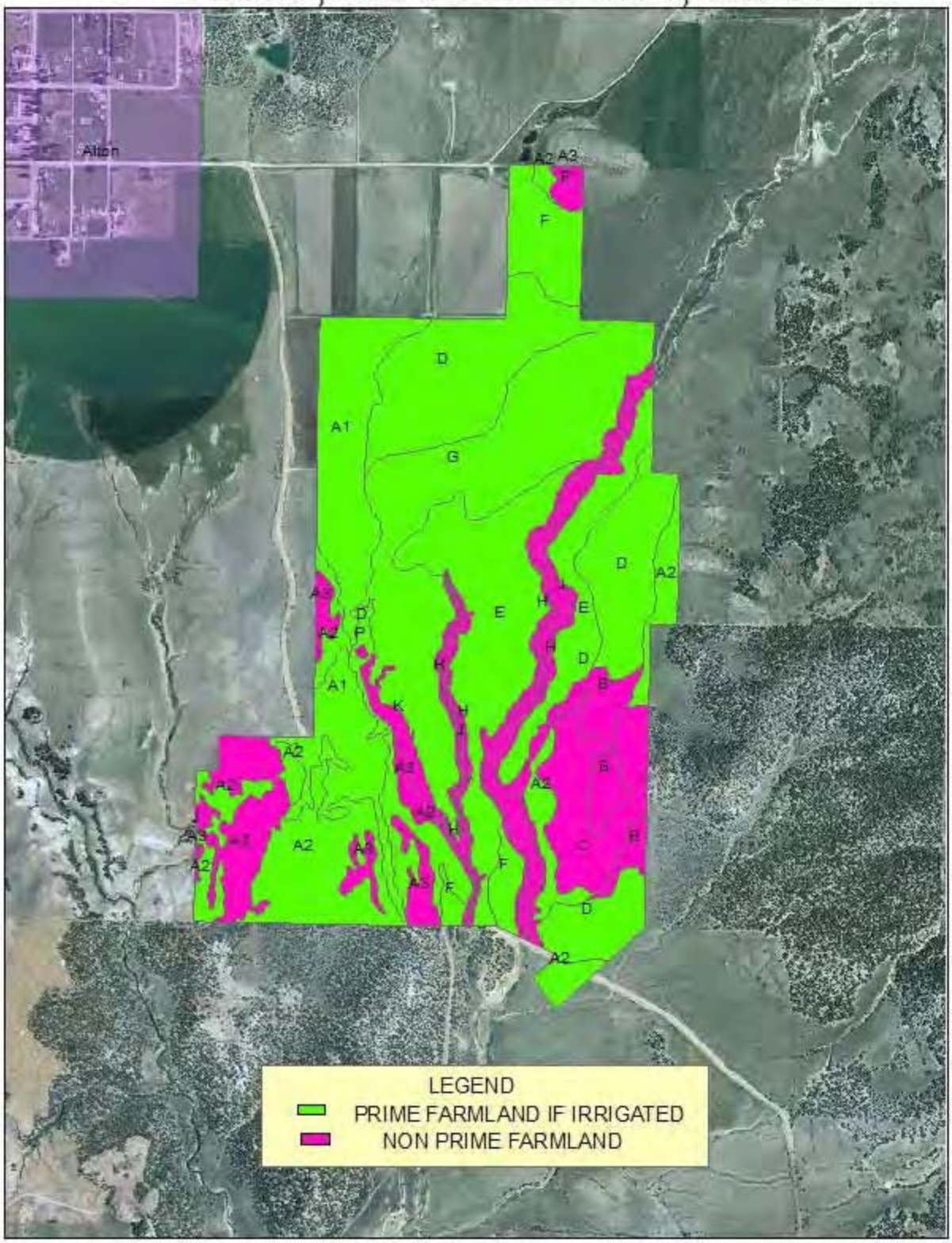


USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

Page from UtDivOilGas&Mining2.jpg file attached to email from Mike Doemeier on May 28, 2014.

Page from UtahOilGas&Mining-5-27-2014.jpg file attached to email from Mike Domeier on May 28, 2014.

UTAH DIVISION OF GAS AND MINING
PRIME FARMLAND DETERMINATION
MAY 28, 2014
RAY GROW
NRCS, SALT LAKE CITY, UTAH



NRCS

0 0.125 0.25 0.5 0.75 1 Miles

N W E S

October 1, 2014 email from Mike Domeier, Utah State Soil Scientist with Prime Farmland and Farmland of Statewide Importance Attachments

Print Close

statewide criteria

From: Domeier, Michael - NRCS, Salt Lake City, UT (Mike.Domeier@ut.usda.gov)
Sent: Wed 10/01/14 9:20 AM
To: ROBERT LONG (lrcsoils@msn.com) (lrcsoils@msn.com)
3 attachments
Farmland Definition.pdf (159.7 KB) , Prime Farmland Criteria.doc (26.7 KB) , Utah Statewide.doc (25.7 KB)

Bob,

As requested.

Mike Domeier

Utah NRCS - State Soil Scientist

801-524-4574 (work)

801-631-0713 (cell)

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TITLE 7--AGRICULTURE

CHAPTER VI--NATURAL RESOURCES CONSERVATION SERVICE, DEPARTMENT OF AGRICULTURE

PART 658--FARMLAND PROTECTION POLICY ACT--Table of Contents

Sec. 658.1 Purpose.

This part sets out the criteria developed by the Secretary of Agriculture, in cooperation with other Federal agencies, pursuant to section 1541(a) of the Farmland Protection Policy Act (FPPA or the Act) 7 U.S.C. 4202(a). As required by section 1541(b) of the Act, 7 U.S.C. 4202(b), Federal agencies are (a) to use the criteria to identify and take into account the adverse effects of their programs on the preservation of farmland, (b) to consider alternative actions, as appropriate, that could lessen adverse effects, and (c) to ensure that their programs, to the extent practicable, are compatible with State and units of local government and private programs and policies to protect farmland. Guidelines to assist agencies in using the criteria are included in this part. The Department of Agriculture (hereinafter USDA) may make available to States, units of local government, individuals, organizations, and other units of the Federal Government, information useful in restoring, maintaining, and improving the quantity and quality of farmland.

Sec. 658. 2 Definitions.

(a) Farmland means prime or unique farmlands as defined in section 1540(c)(1) of the Act or farmland that is determined by the appropriate state or unit of local government agency or agencies with concurrence of the Secretary to be farmland of statewide of local importance. ``Farmland'' does not include land already in or committed to urban development or water storage. Farmland ``already in'' urban development or water storage includes all such land with a density of 30 structures per 40-acre area. Farmland already in urban development also includes lands identified as ``urbanized area'' (UA) on the Census Bureau Map, or as urban area mapped with a ``tint overprint'' on the USGS topographical maps, or as ``urban-built-up'' on the USDA Important Farmland Maps. Areas shown as white on the USDA Important Farmland Maps are not ``farmland'' and, therefore, are not subject to the Act. Farmland ``committed to urban development or water storage'' includes all such land that receives a combined score of 160 points or less from the land evaluation and site assessment criteria.

(b) Federal agency means a department, agency, independent commission, or other unit of the Federal Government.

(c) Federal program means those activities or responsibilities of a Federal agency that involve undertaking, financing, or assisting construction or improvement projects or acquiring, managing, or disposing of Federal lands and facilities.

(1) The term ``Federal program'' does not include:

(i) Federal permitting, licensing, or rate approval programs for activities on private or non-Federal lands; and

(ii) Construction or improvement projects that were beyond the planning stage and were in either the active design or construction state on August 4, 1984.

2.For the purposes of this section, a project is considered to be ``beyond the planning stage and in either the active design or construction state on August 4, 1984'' if, on or before that date, actual construction of the project had commenced or:

(i) Acquisition of land or easements for the project had occurred or all required Federal agency planning documents and steps were completed and accepted, endorsed, or approved by the appropriate agency;

(ii) A final environmental impact statement was filed with the Environmental Protection Agency or an environmental assessment was completed and a finding of no significant impact was executed by the appropriate agency official; and

(iii) The engineering or architectural design had begun or such services had been secured by contract. The phrase ``undertaking, financing, or assisting construction or improvement projects'' includes providing loan guarantees or loan insurance for such projects and includes the acquisition, management and disposal of land or facilities that a Federal agency obtains as the result of foreclosure or other actions taken under a loan or other financial assistance provided by the agency directly and specifically for that property. For the purposes of this section, the

7/24/2000

1. The soils have:
a) Aquic, udic, ustic, or xeric moisture regimes and sufficient available water capacity within a depth of 40 inches (1 meter), or in the root zone if the root zone is less than 40 inches deep to produce the commonly grown crops in 7 or more years out of 10; or,

b) Xeric or ustic moisture regimes in which the available water capacity is limited, but the area has a developed irrigation water supply that is dependable (a dependable water supply is one in which enough water is available for irrigation in 8 out of 10 years for the crops commonly grown) and of adequate quality; or,

c) Aridic or torric moisture regimes and the area has a developed irrigation water supply that is dependable and of adequate quality; and,

2. The soils have a temperature regime that is frigid, mesic, thermic, or hyperthermic (pergelic and cryic regimes are excluded). These are soils that, at a depth of 20 inches (50 cm), have a mean annual temperature higher than 32°F (0°C). In addition, the mean summer temperature at this depth in soils with a 0 horizon is higher than 47°F (8°C); in soils that have no 0 horizon, the mean summer temperature is higher than 59°F (15°C); and,

3. The soils have a pH between 4.5 and 8.4 in all horizons within a depth of 40 inches (1 meter) or in the root zone if the root zone is less than 40 inches deep; and,

4. The soils either have no water table or have a water table that is maintained at a sufficient depth during the cropping season to allow cultivated crops common to the area to be grown; and,

5. The soils can be managed so that, in all horizons within a depth of 40 inches (1 meter) or in the root zone if the root zone is less than 40 inches deep, during part of each year the conductivity of the saturation extract is less than 4 mmhos/cm and the exchangeable sodium percentage (ESP) is less than 15; and,

6. The soils are not flooded frequently during the growing season (less often than once in 2 years); and,

7. The product of K (erodibility factor) x percent slope is less than 2.0, and the product of I (soil erodibility) x C (climatic factor) does not exceed 60; and,

8. The soils have a permeability rate of at least 0.06 inch (0.15 cm) per hour in the upper 20 inches (50 cm) and the mean annual soil temperature at a depth of 20 inches (50 cm) is less than 59°F (15°C); the permeability rate is not a limiting factor if the mean annual soil temperature is 59°F (15°C) or higher; and,

9. Less than 10 percent of the surface layer (upper 6 inches) in these soils consists of rock fragments coarser than 3 inches (7.6 cm).

Utah Farmland of Statewide Importance

The Farmland Protection Policy Act encourages states to develop criteria for Farmland of Statewide Importance. This is land, in addition to prime and unique farmlands, that is of statewide importance for the production of food, feed, fiber, forage, and oilseed crops. In the late 1970's the following criteria for Farmland of Statewide Importance were developed by the Utah Department of Agriculture and Utah State University in cooperation with the Natural Resources Conservation Service, United States Department of Agriculture.

1. The soils have an adequate moisture supply.
a. The soil moisture supply is sufficient to permit economic crop production in 5 out of 10 years.
b. The soils have a water supp1ing potential of more than 11 inches or a developed irrigation system with a dependable water supply of suitable quality. Water supplying potential refers to the amount of water estimated to be available for plant growth from moisture stored in the soil plus precipitation during the plant growth period.

2. The soils at a depth of 20 inches have a mean summer temperature above 59 degrees F. This includes soils in frigid, mesic, and thermic temperature regimes.

3. The soils have a pH of 4.5 through 8.6 and exchangeable sodium saturation is less than 15 percent above a depth of 20 inches.

4. The soil has no water table that prevents the production of food, feed, fiber, and forage and oilseed crops.

5. The soils can be managed so that the saturation extract of soil above 20 inches has an electrical conductivity less than 4 millimhos.

6. The soils are not flooded frequently. The statistical chance of flooding on soils of Statewide Importance is 0 to 50 percent in any year during the growing season.

7. The soils have a product of k-factor times percent slope of 5 or less.

May 15-21, 2014 email exchange with Ray Grow, NRCS Utah State Office

Print Close

RE: Alton Prime Farmland

From: Grow, Raymond - NRCS, Salt Lake City, UT (raymond.grow@ut.usda.gov)
Sent: Wed 5/21/14 12:14 PM
To: ROBERT E LONG (lrcsoils@msn.com)

Thanks Bob, This is working well.

Ray

From: ROBERT E LONG [mailto:lrcsoils@msn.com]
Sent: Wednesday, May 21, 2014 9:34 AM
To: Grow, Raymond - NRCS, Salt Lake City, UT
Subject: RE: Alton Prime Farmland

Ray,

Attached are the soil lines shapefile, associated layer files, and ARCMap map file.

Double clicking on *Alton_Soil_Lines_May_21_2014* ArcGIS document file should open up the full map set. If everything opens correctly, you should only need to add a link to your base maps.

Acres are already calculated in the *Alton_Soil_Lines_May_21_2014* shapefile. Let me know if you need shapefiles for the soil data points.

I hope this will help with your calculations. I appreciate your time and efforts to complete this assessment.

Thanks.

Robert E Long, CPSS
Long Resource Consultants, Inc.
801-791-3447 Cell / Office

From: lrcsoils@msn.com
To: raymond.grow@ut.usda.gov
Subject: RE: Alton Prime Farmland
Date: Wed, 21 May 2014 08:51:17 -0600

Ray,

I will send the shapefile for the soils map.

Robert E Long, CPSS
Long Resource Consultants, Inc.
801-791-3447 Cell / Office

From: raymond.grow@ut.usda.gov
To: lrcsoils@msn.com
Subject: RE: Alton Prime Farmland
Date: Wed, 21 May 2014 14:47:20 +0000

Hi Bob,

Files opened ok. Thanks for all the information. I hope to get the measurements on remaining Prime Farmland today and send this off. Previously we showed map unit 1111 as the home of the only Prime Farmland in the project. Your new findings indicate that some of that will not be prime.

I'm juggling NRI and Prime farmland this morning so things are a little slow but when I get back to the new info, I'd like to try and put the new map units in an Arc Map project so I can measure acreage for the units that are going to be non-prime. I could be overlooking the obvious but it appears that the maps are in a pdf format.

I hate to ask for more favors but is this something you can send as a shape file? I think that will allow for completion today.

Thanks Bob,

Ray Grow

NRCS Soil Scientist/ State Resource Inventory Coordinator

125 S. State St., Rm. 4010

Salt Lake City, UT 84138

801 524-4253 O

801 557-7079 C

From: ROBERT E LONG [mailto:lrcsoils@msn.com]
Sent: Tuesday, May 20, 2014 1:08 PM
To: Grow, Raymond - NRCS, Salt Lake City, UT
Subject: RE: Alton Prime Farmland

Ray,

Were you able to open the files sent yesterday?

Do you need anything else?

Robert E Long, CPSS
Long Resource Consultants, Inc.
801-791-3447 Cell / Office

From: lrcsoils@msn.com
To: raymond.grow@ut.usda.gov
Subject: RE: Alton Prime Farmland
Date: Mon, 19 May 2014 07:48:14 -0600

Ray,

I though of couple things after sending the previous email last night.

Soil family names AAA, BBB, CCC, and DDD were coined for this survey because no series have been established in those families.

Lab analysis has been done on each horizon at most of the soil profile locations (66). Most horizons were analyzed for the parameters needed for soil survey decisions, plus several additional parameters.

Profiles were examined to 8 feet or bedrock, whichever occurred first.

Piezometers were installed at 13 of the soil profile locations to just below the groundwater depth (at the time of installation) or 29 feet, whichever occurred first.

If this new survey data can be used for the Prime Farmland assessment, it would be good. Let me know if you would like to see any additional data.

Thanks.

Robert E Long, CPSS
Long Resource Consultants, Inc.
801-791-3447 Cell / Office

From: lrcsoils@msn.com
To: raymond.grow@ut.usda.gov
Subject: RE: Alton Prime Farmland
Date: Sun, 18 May 2014 23:04:14 -0600

Ray,

Good morning.

Attached is the soil survey legend for the Alton Coal North Private Lease soil survey. This attachement contains four tables:

1. List of soil families identified in the Alton Coal Order 2 soil survey for the North Private Lease.
2. Standard soil survey legend with no additional mark-ups.
3. Soil survey legend with soils and map units with pH > 8.4 in the upper 100cm highlited in pink/salmon.
4. Soil survey legend with carbonatic soils highlited in yellow.

The attachment also includes two soil survey maps. The NRCS in-progress soil map unit lines (orange) and MUSYM (yellow) are also on each map.

Map 1 highlights the carbonatic and soils with pH > 8.4.

1. Soil survey of the North Private Lease area with carbonatic soil map shaded. Map unit G (pale yellow) contains carbonatic soils but PH > 8.4 does not occur until below 100 cm.
2. Map unit E (medium brown) is on the terrace remnants above Kanab Creek. The creek is incised about 20 to 30 feet. These soils are carbonatic and have soil pH > 8.4 in at least 1 horizon above 100 cm.
3. Map unit h (tan) is the very steep terrace remnant sideslopes for the incised Kanab Creek floodplan. Soils are carbonatic with soil pH > 8.4 above 100 cm.
4. Map unit J (medium brown) consists of the active floodplain along Kanab Creek and an adjacent drainage as well as the stream terrace with oxyaquic ustifluvents (documented water table within 150 cm).

Map 2 identifies the parent material sources.

Hopefully this information is helpful.

Please let me know if you have any questions or would like any additional information. I will be near a phone all day/week.

Thanks for your help with this Prime Farmland assessment.

Robert E Long, CPSS

Long Resource Consultants, Inc.
801-791-3447 Cell / Office

From: raymond.grow@ut.usda.gov
To: lrcsoils@msn.com
Subject: RE: Alton Prime Farmland
Date: Thu, 15 May 2014 20:57:16 +0000

Hi Bob,

I get the impression that this is the legend that goes with the map you made of the Alton area. Would it be safe to say that your map is the one to use? I have one from Vic and some map unit data.

Do the units on the legend have soils in the project area which go over 8.4 pH?

It looks like the soils in the project are prime if irrigated unless they have the higher pH's.

Let me know and I can finish up the report.

Thanks,

Ray

From: ROBERT E LONG [mailto:lrcsoils@msn.com]
Sent: Thursday, May 15, 2014 10:55 AM
To: Grow, Raymond - NRCS, Salt Lake City, UT
Subject: RE: Alton Prime Farmland

Ray,

Sorry, I forgot to attach the map.

There is a comment on your map. The second page shows the soils data that I received from Vic.

Robert E Long, CPSS
Long Resource Consultants, Inc.
801-791-3447 Cell / Office

From: lrcsoils@msn.com
To: raymond.grow@ut.usda.gov
Subject: RE: Alton Prime Farmland
Date: Thu, 15 May 2014 10:49:30 -0600

Ray,

Thanks for sending the information.

The placement of the project area on the topo map appears to be correct.

It appears that the polygons labels on your map are for MUSYM_int rather than MUSYM. But the 1111 and the 1108 appear to be the MUSYM. There is a large polygon that ocurrs in the southwest portion of the project area and then extends northwest to the town of Alton. The polygon is labeled 1113 on your map, but the MUSYM is 1103. My field data matches 1103 (Sili-Sideshow-Redig families 2-15%) with several Sideshow descriptions.

The OSD for Sideshow lists it as an Aridic Haplustert, but the legend that I received from Vic lists is as a Gypsic Haplustert.

The area in the center of the project area (1111 map symbol) is where several carbonatic soil descriptions were collected.

Robert E Long, CPSS
Long Resource Consultants, Inc.
801-791-3447 Cell / Office

From: raymond.grow@ut.usda.gov
To: lrcsoils@msn.com

CC: Vic.Parslow@ut.usda.gov
Subject: Alton Prime Farmland
Date: Thu, 15 May 2014 14:44:41 +0000

Hi Bob,

Attached are a couple of screen prints of the Alton Project so far. Also attached are references for Prime Farmland identifiers and farmland definition.

Do you see a need to change any soil lines in the project area?

Are there specific map units where the soil pH will be over 8.4 in all horizons within a depth of 40 inches or in the root zone if the root zone is less than 40 inches deep?

Other than possible influence from pH and map unit boundary changes, I don't see anything that will change ratings yet. If you spot something, let me know and I'll make adjustments accordingly.

Thanks,

Ray

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November 8, 2012 email exchange with Ray Grow, NRCS Utah State Office

Print Close

RE: Soils info for Alton Coal Development

From: Robert Long (lrcsoils@msn.com)
Sent: Thu 11/08/12 8:46 AM
To: 'Grow, Raymond - NRCS, Salt Lake City, UT' (raymond.grow@ut.usda.gov)
Cc: 'Larry Johnson' (ljohnson@altoncoal.com)
3 attachments
Alton_Private_Lease_Permit_Area_April_2012.shp.zip (584.7 KB) , Prime_Farmland_Assessment_Area_Oct_9_2012.zip (5.0 KB) , farmland soils.zip (48.2 KB)

Ray,

Attached are three shapefiles:

1. Alton Private Lease Permit Area - this is the area where the formal prime farmland assessment is needed for inclusion with the Utah DOGM permit application.

2. Prime Farmland Assessment Area Oct 9 2012 - prime farmland information is needed for this area as part of the alluvial valley floor assessment for adjacent lands.

3. Farmland Soils - this is the NRCS soil survey information that I received from Vic Parslow last spring.

Hopefully, this information will be helpful.

I am headed to the basin in a few minutes, but I will be back in the office Friday morning.

Thanks for your help with this assessment.

Robert Long, CPSS
Long Resource Consultants, Inc.
801.791.3447

-----Original Message-----

From: Grow, Raymond - NRCS, Salt Lake City, UT
[mailto:raymond.grow@ut.usda.gov]
Sent: Tuesday, November 06, 2012 3:10 PM
To: Robert Long (lrcsoils@msn.com)
Subject: Soils info for Alton Coal Development

Hi Bob,

A request came in recently for a prime farmland request for Alton Coal Development. They indicated you were working on an order 2 survey for the project area and that I might bug you for info.

The attached map has a humongous area delineated in a faint gray line for the area of concern. The request is for any cropland or potential cropland inside that area that might be prime.

Do you have any information on the soils or Prime Farmland status of soils in this area? I the status of the area inside the dashed line. Vic sent me a map and soil descriptions for map units 1111, which was the only prime farmland inside the dashed line, as well as 1103,1108 and 1112.

I'd be interested in knowing if there are there other map units in that larger delineation and if they might be prime or statewide important? The prime farmland form requires acreages so I'd need the map unit polygons if available.

Thanks,

Ray

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October 9, 2012 request from Alton Coal Development

to

NRCS State Office for Prime Farmland Assessment

October 9, 2012

Mr. Michael Domeier, State Soil Scientist
USDA / Natural Resource Conservation Service
Wallace F. Bennett Federal Bldg.
125 South State Street, Room 4010
Salt Lake City, UT 84138

Dear Mr. Domeier,
Alton Coal Development is in the process of revising our mining permit with the Utah Division of Oil, Gas, and Mining (DOGM) to include a private lease area southeast of Alton, Utah. Part of this process includes having a *Prime Farmland* assessment completed by the Natural Resource Conservation Service.
The location of the private lease area is shown on the attached drawing (pink and black line). The area is in portions of the following sections:

Township	Range	Section
39 South	5 West	7 and 18
39 South	6 West	12 and 13
Salt Lake Base Meridian		

Due to the requirements of the *Alluvial Valley Floor* analysis that is part of this project, we also need to look at potential farmlands areas adjacent to the project area. This larger area is also shown on the attached map (blue dashed line). This area is in portions of the following sections:

Township	Range	Section
38 South	5 West	31 and 32
39 South	5 West	5, 6, 7, 8, 18, and 19
39 South	6 West	1, 2, 11, 12, 12, 14, 23, and 24
Salt Lake Base Meridian		

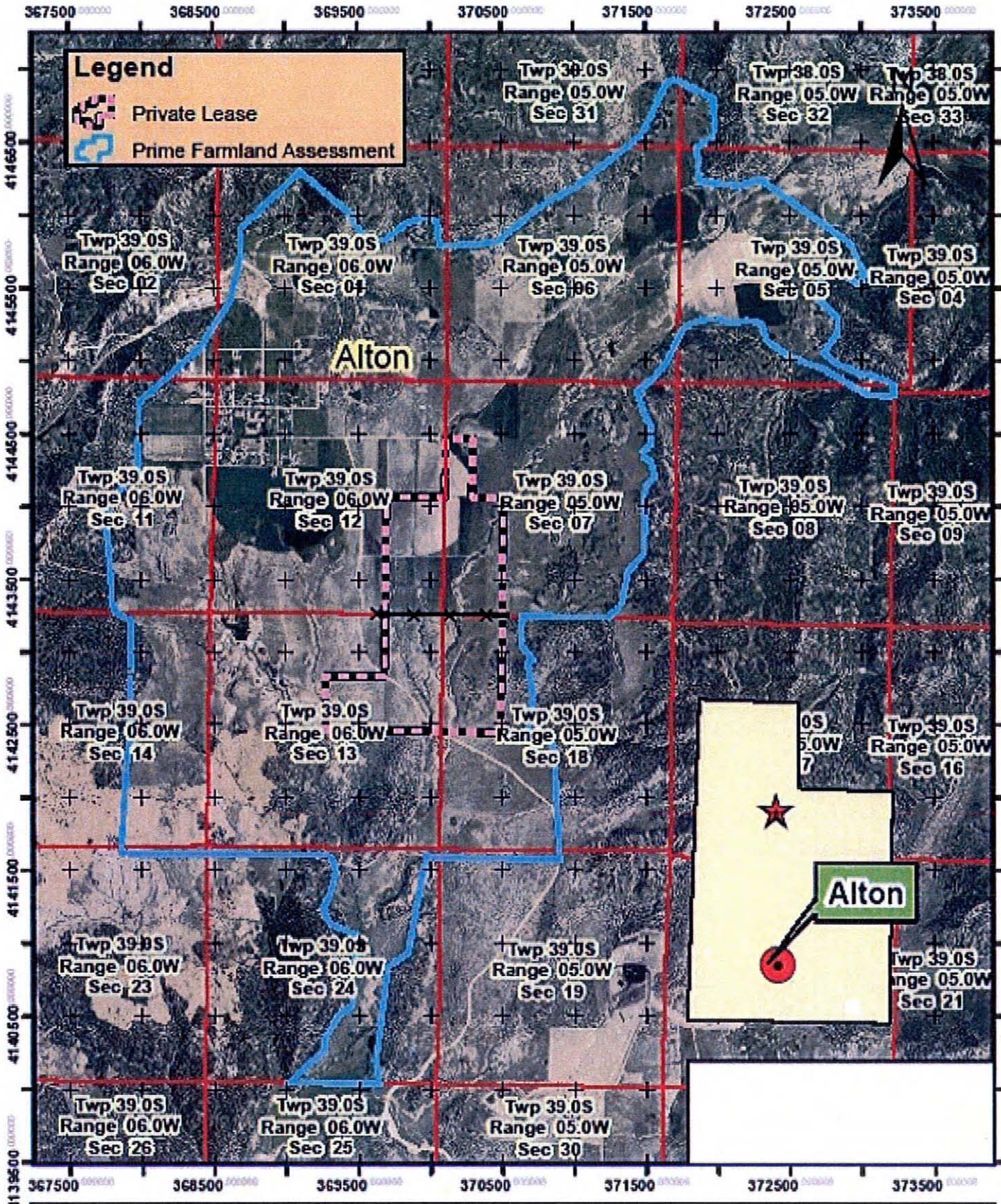
We will email a shapefile of the Private Lease permit boundary and the *Prime Farmland* assessment area. The shapefile coordinate system is UTM NAD 1983, Zone 12N.

Thank you very much for your assistance. If you have any questions or need any additional information please contact me at either 435-867-5331 or 435-691-2983.

Robert Long is conducting an order 2 soil survey of the permit area for Alton Coal. You may also contact him with any questions.

Sincerely,

Larry Johnson
Alton Coal Development, LLC



Alton Coal - Private Lease Area	Location Map
Alton Coal Development 463 N 100 W Cedar City, Utah	General Location of Private Lease Area southeast of Alton, Utah
	Coordinate System: UTM, NAD 1983, Zone 12 North
	Alton, Utah USGS 7.5' Topographic Map | 1 inch = 3,000 feet
	October 9, 2012 | 0 750 1,500 3,000 4,500 6,000 Feet

April 24, 2014 letter from Raymond Heaton
to
Alton Coal Development concerning Historical Irrigation

April 23, 2014

Dear Larry,

As pertaining to our conversation of the flood irrigation in the valley, I know of no flood irrigation that took place below south of the farm road, (we call it the lane going to the east bench). I have been the president of the irrigation co for many years and have researched the old records of water usage and maps of old ditches before my time and have not found evidence of the ditch system going that far south. There was some flood irrigation on the fields north of the farm road but those supply ditches came to the fields ½ mile to the north.

Sincerely

Raymond Heaton

Raymond Heaton

Tabulation of Crop and Livestock Inquiry of Permit Area Landowners received by Larry Johnson of Alton Coal Development, October 2, 2015

MANAGEMENT PLAN FOR THE NORTH PRIVATE LEASE PROPERTIES

Property ownership is shown on Drawing 1-3 of the Coal Hollow Mining and Reclamation Plan. Representatives from Alton Coal Development met with the landowners of the North Private Lease area to ascertain current land use information prior to mining in the area. The following information was provided to Larry Johnson by each landowner (personal communications, September 2015). The landowners expect reclamation and revegetation will provide as good as or better than the follow production.

PARCEL: 9-6-13-1, 9-6-12-5
LANDOWNER: Heaton Bros.
ACRES: 120
LIVESTOCK USE: 1.67 animal/acre; 30 days/year (June)
HAY PRODUCTION: None
IRRIGATION: No

PARCELS: 9-6-12-2; 9-5-7-4A; 9-5-18-3
LANDOWNER: Dean Heaton
ACRES: 45
LIVESTOCK USE: 1.33 animals/acre; 60 days/year (September and October)
HAY PRODUCTION: 1 crop/year (9 of 10 years); 2,000 pounds/acre
IRRIGATION: No

PARCELS: 9-5-7-3A, 9-5-18-5, 9-5-18-3A, 9-6-12-1
LANDOWNER: Ferril Heaton
ACRES: 108.34
LIVESTOCK USE: 0.69 animals/acre (with supplemental feed); 60 days/year (September and October)
HAY PRODUCTION: 1 crop/year (9 of 10 years); 2,000 pounds/acre
IRRIGATION: No

PARCEL: 9-6-12-3
LANDOWNER: Orvil Palmer
ACRES: 7
LIVESTOCK USE:1.43 animals/year; 60 days/year (July and August)
HAY PRODUCTION: None
IRRIGATION: No

Source: Johnson, L. 2015. Tabulation of information received from landowners in September 2015.

Appendix B

Soil Profile Descriptions

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12AS001

Pedon ID: 12AS001

Description Date: 10/24/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 29% and 15% fine sand or coarser in control section.

Current Taxonomic Name: BBB
Current Taxonomic Class: Fine-loamy, carbonatic, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369936E, 4143218N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: terrace, valley side and hillslope
Geomorphic Component: Riser
Profile Pos: Backslope
Slope: 45 percent
Elevation: 2106 meters (6909.4 feet)
Aspect: 101°
Shape: up/down: Convex; **across:** Convex

Surface Fragments: none.

Drainage: Well drained
Runoff: Very high
Erosion: Class 2 - Rill erosion

Earth Cover: Shrubby rangeland

Existing Vegetation: CHRYS9 - rabbitbrush (*Chrysothamnus*); BROMU - brome (*Bromus*); PASM - western wheatgrass (Pascopyrum smithii) ; ROWO - Woods' rose (*Rosa woodsii*); JUOS - Utah juniper (*Juniperus osteosperma*)

Parent Materials: alluvium derived from limestone, sandstone, and shale

Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)
Diagnostic Features: Calcic horizon: 90 to 122 centimeters (35.4 to 48 inches)

A --- 0 to 12 centimeters (0 to 4.7 inches); light brownish gray (10YR 6/2) dry, clay loam; brown (10YR 5/3) moist; 30 percent sand; 39 percent silt; 31 percent clay; weak medium platy parting to moderate medium granular structure; very friable, slightly hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.67 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear smooth boundary; CaCO3 46.2 percent.

Bw --- 12 to 28 centimeters (4.7 to 11 inches); light brownish gray (10YR 6/2) dry, clay loam; brown (10YR 5/3) moist; 24 percent sand; 41 percent silt; 35 percent clay; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common fine roots throughout, common medium roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.53 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; clear wavy boundary; CaCO3 47.9 percent.

Bk --- 28 to 56 centimeters (11 to 22 inches); 80 percent light brownish gray (2.5Y 6/2) dry, 15 percent pale yellow (2.5Y 8/2) dry and 5 percent yellow (10YR 7/6) dry, silty clay; 80 percent dark grayish brown (2.5Y 4/2) moist, 15 percent light brownish gray (2.5Y 6/2) moist and 5 percent brownish yellow (10YR 6/6) moist; 10 percent sand; 49 percent silt; 41 percent clay; moderate medium subangular blocky structure; friable, hard, moderately sticky, slightly plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 6 percent (common) fine finely disseminated carbonates and 2 percent (common) fine masses of carbonate in matrix; 30 percent shale parachanners; electrical conductivity of 0.5 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; varied colors in Bk due to decomposing shale and sandstone.; clear smooth boundary; CaCO3 52.2 percent.

2Bw --- 56 to 90 centimeters (22 to 35.4 inches); dark grayish brown (10YR 4/2) dry, silty clay; very dark grayish brown (10YR 3/2) moist; 16 percent sand; 40 percent silt; 44 percent clay; strong medium subangular blocky structure; firm, very hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.67 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; 2Bw is buried surface.; abrupt smooth boundary; CaCO3 42.9 percent.

2Bk --- 90 to 122 centimeters (35.4 to 48 inches); light gray (2.5Y 7/2) dry, clay loam; light yellowish brown (2.5Y 6/3) moist; 26 percent sand; 42 percent silt; 32 percent clay; weak medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common very fine roots throughout; common very fine tubular pores finely disseminated carbonates; 2 percent sandstone parachanners; electrical conductivity of 1 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; Varied colors in 2Bk due to parachanners.; gradual smooth boundary; $CaCO_3$ 51.8 percent.

2BCk --- 122 to 160 centimeters (48 to 63 inches); pale yellow (2.5Y 7/3) dry, paragravelly sandy loam; light olive brown (2.5Y 5/3) moist; 64 percent sand; 24 percent silt; 12 percent clay; massive parting to single grain; friable, hard, nonsticky, nonplastic; common very fine roots throughout; common very fine interstitial pores finely disseminated carbonates; 25 percent sandstone paragravels; electrical conductivity of 0.81 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; $CaCO_3$ 30.4 percent.

12AS002

Pedon ID: 12AS002

Description Date: 10/24/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 31% and 17% fine sand or coarser in control section.

Current Taxonomic Name: Sideslide family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Typic Endoaquepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369987E, 4142687N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: flood plain
Geomorphic Component: Base Slope
Profile Pos: Toeslope
Slope: 3 percent
Elevation: 2092 meters (6863.5 feet)
Aspect: 161°
Shape: up/down: Linear; **across:** Linear

Surface Fragments: none.

Drainage: Very poorly drained
Runoff: Very low
Erosion: None - deposition

Earth Cover: Grassland rangeland

Existing Vegetation: CAUT - Northwest Territory sedge (*Carex utriculata*); JUARL - Baltic rush (*Juncus arcticus ssp. littoralis*); POPR - Kentucky bluegrass (*Poa pratensis*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Aquic conditions: 0 to 110 centimeters (0 to 43.3 inches) and Calcic horizon: 55 to 110 centimeters (21.7 to 43.3 inches)

A --- 0 to 9 centimeters (0 to 3.5 inches); light olive brown (2.5Y 5/3) moist, clay loam; light brownish gray (2.5Y 6/2) dry; 30 percent sand; 41 percent silt; 29 percent clay; 20 percent medium strong brown (7.5YR 5/6) mottles; moderate medium platy structure; friable, hard, slightly sticky, slightly plastic; common fine roots throughout, common medium roots throughout and many very fine roots throughout; common very fine tubular pores; 20 percent (many) medium strong brown (7.5YR 5/6), moist; electrical conductivity of 1.79 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; neutral, pH 7.3, pH meter; abrupt smooth boundary; CaCO3 27.3 percent.

Bg1 --- 9 to 26 centimeters (3.5 to 10.2 inches); grayish brown (2.5Y 5/2) moist, clay loam; light yellowish brown (2.5Y 6/3) dry; 20 percent sand; 46 percent silt; 34 percent clay; 5 percent fine strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm, very hard, slightly sticky, slightly plastic; common fine roots throughout, common medium roots throughout and common very fine roots throughout; common very fine tubular pores; 10 percent (common) medium prominent light greenish gray (10Y 7/1), moist, reduced matrix; electrical conductivity of 1.45 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; clear smooth boundary; CaCO3 23.8 percent.

Bg2 --- 26 to 55 centimeters (10.2 to 21.7 inches); grayish brown (2.5Y 5/2) moist, clay loam; pale yellow (2.5Y 7/3) dry; 24 percent sand; 39 percent silt; 37 percent clay; 12 percent fine brownish yellow (10YR 6/6) mottles; moderate medium subangular blocky structure; firm, very hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; 3 percent (common) fine prominent greenish gray (10Y 5/1), moist, reduced matrix; electrical conductivity of 1.28 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear smooth boundary; CaCO3 22.2 percent.

Bg3 --- 55 to 87 centimeters (21.7 to 34.3 inches); light olive brown (2.5Y 5/3) moist, silty clay; pale yellow (2.5Y 7/3) dry; 18 percent sand; 42 percent silt; 40 percent clay; 25 percent medium brownish yellow (10YR 6/6) mottles; strong medium subangular blocky parting to moderate medium prismatic structure; firm, very hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; 10 percent (common) fine prominent greenish gray (10Y 5/1), moist, reduced matrix; 2 percent (common) fine masses of carbonate in matrix; electrical conductivity of 1.45 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; abrupt smooth boundary; CaCO3 33.2 percent.

Bg4 --- 87 to 110 centimeters (34.3 to 43.3 inches); light brownish gray (2.5Y 6/2) moist, silty clay loam; light gray (2.5Y 7/2) dry; 10 percent sand; 52 percent silt; 38 percent clay; 15 percent medium light greenish gray (10Y 7/1) and 30 percent coarse yellow (10YR 7/6) mottles; strong medium subangular blocky parting to moderate coarse prismatic structure; firm, very hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; 15 percent (common) medium prominent light greenish gray (10Y 7/1), moist, reduced matrix; 5 percent (common) fine masses of carbonate in matrix; electrical conductivity of 1.91 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear smooth boundary; $CaCO_3$ 47.9 percent.

Bg5 --- 110 centimeters (43.3 inches); Hit large cobble.

12AS003

Pedon ID: 12AS003

Description Date: 10/24/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 15% and 22% fine sand or coarser in control section.

Current Taxonomic Name: Atlatl family similar
Current Taxonomic Class: Coarse-loamy, carbonatic, mesic Aridic Haplustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370393E, 4143794N -- Datum NAD83, Zone 13
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace, valley side, and hillslope
Geomorphic Component: Side Slope
Profile Pos: Backslope
Slope: 40 percent
Elevation: 2127 meters (6978.3 feet)
Aspect: 93°
Shape: up/down: Concave; **across:** Linear

Surface Fragments: none.

Drainage: Poorly drained
Runoff: High
Erosion: Class 2 - Rill erosion

Earth Cover: Shrubby rangeland

Existing Vegetation: CHRYS9 - rabbitbrush (*Chrysothamnus*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: alluvium
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)
Diagnostic Features: Cambic horizon: 8 to 34 centimeters (3.1 to 13.4 inches)

A --- 0 to 8 centimeters (0 to 3.1 inches); light brownish gray (2.5Y 6/2) dry, clay loam; olive brown (2.5Y 4/3) moist; 24 percent sand; 39 percent silt; 37 percent clay; moderate medium platy parting to moderate medium granular structure; very friable, slightly hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; electrical conductivity of 0.64 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear smooth boundary; CaCO3 46.4 percent.

Bw --- 8 to 34 centimeters (3.1 to 13.4 inches); light brownish gray (2.5Y 6/2) dry, clay; light olive brown (2.5Y 5/3) moist; 25 percent sand; 33 percent silt; 42 percent clay; moderate medium prismatic parting to moderate medium subangular blocky structure; friable, hard, very sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; electrical conductivity of 0.61 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; abrupt smooth boundary; CaCO3 50.8 percent.

Bk1 --- 34 to 88 centimeters (13.4 to 34.6 inches); pale yellow (2.5Y 8/2) dry, silt loam; pale yellow (2.5Y 7/3) moist; 25 percent sand; 53 percent silt; 22 percent clay; 12 percent medium distinct yellow (10YR 7/6) mottles; moderate medium subangular blocky and moderate fine subangular blocky structure; friable, very hard, slightly sticky, slightly plastic; common fine roots throughout and common very fine roots throughout; 12 percent (common) fine distinct yellow (10YR 7/6), moist; 8 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.38 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; gradual smooth boundary; CaCO3 45.4 percent.

Bk2 --- 88 to 122 centimeters (34.6 to 48 inches); pale yellow (2.5Y 7/3) dry, silt loam; light yellowish brown (2.5Y 6/3) moist; 27 percent sand; 50 percent silt; 23 percent clay; 8 percent fine prominent yellow (10YR 7/6) mottles; weak medium subangular blocky structure; very friable, hard, slightly sticky, slightly plastic; common very fine roots throughout; 10 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.42 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; clear smooth boundary; CaCO3 41.1 percent.

Bk3 --- 122 to 155 centimeters (48 to 61 inches); 75 percent light gray (2.5Y 7/2) dry and 25 percent pale yellow (2.5Y 7/4) dry, paragravelly loam; 75 percent light brownish gray (2.5Y 6/2) moist and 25 percent light olive brown (2.5Y 5/4) moist; 43 percent sand; 41 percent silt; 16 percent clay; 5 percent medium prominent yellow (10YR 7/6) mottles; medium structure; very friable, slightly hard, nonsticky, nonplastic; common very fine roots throughout; 7 percent (common) medium masses of carbonate in matrix; 20 percent sandstone paragravels; electrical conductivity of 0.45 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; dual colors are result of weathering shale and sand stone (75/25); CaCO3 33.4 percent.

12AS004

Pedon ID: 12AS004

Description Date: 10/25/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 23% and 56% fine sand or coarser in control section.

Current Taxonomic Name: Flugle family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Haplustalfs

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370313E, 4142972N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: hills
Landform: structural bench
Geomorphic Component: Side Slope
Profile Pos: Backslope
Slope: 13 percent
Elevation: 2124 meters (6968.5 feet)
Aspect: 58°
Shape: up/down: Convex; **across:** Linear

Surface Fragments: none.

Drainage: Well drained
Runoff: Medium
Erosion: Class 2 - Sheet erosion

Earth Cover: Shrub cover

Existing Vegetation: PUTR2 - antelope bitterbrush (*Purshia tridentata*); CHRYS9 - rabbitbrush (*Chrysothamnus*)

Parent Materials: residuum weathered from sandstone
Bedrock: Sandstone at 78 centimeters (30.7 inches)
Particle Size Control Section: 8 to 22 centimeters (3.1 to 8.7 inches)

Diagnostic Features: Argillic horizon: 8 to 22 centimeters (3.1 to 8.7 inches), Secondary carbonates: 48 to 78 centimeters (18.9 to 30.7 inches) and Lithic contact: 78 centimeters (30.7 inches)

Restrictions: Lithic bedrock: 78 centimeters (30.7 inches)

A --- 0 to 8 centimeters (0 to 3.1 inches); pale brown (10YR 6/3) dry, sandy clay loam; brown (10YR 4/3) moist; 65 percent sand; 15 percent silt; 20 percent clay; moderate medium platy structure; very friable, hard, slightly sticky, nonplastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.61 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear smooth boundary; CaCO3 4.1 percent.

Bt --- 8 to 22 centimeters (3.1 to 8.7 inches); brownish yellow (10YR 6/6) dry, sandy clay loam; yellowish brown (10YR 5/6) moist; 67 percent sand; 10 percent silt; 23 percent clay; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 35 percent (common) clay films between sand grains; 5 percent subangular sandstone gravels; electrical conductivity of 0.35 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; slightly alkaline, pH 7.4, pH meter; clear smooth boundary; CaCO3 1.8 percent.

Bk1 --- 22 to 48 centimeters (8.7 to 18.9 inches); brownish yellow (10YR 6/6) dry, silt loam; yellowish brown (10YR 5/6) moist; 77 percent sand; 14 percent silt; 9 percent clay; weak medium subangular blocky structure; very friable, slightly hard, nonsticky, nonplastic; common fine roots throughout and common very fine roots throughout; common very fine interstitial pores; 3 percent (common) fine masses of carbonate on vertical faces of peds; electrical conductivity of 0.26 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; gradual smooth boundary; CaCO3 5.9 percent.

Bk2 --- 48 to 78 centimeters (18.9 to 30.7 inches); pale yellow (2.5Y 7/3) dry, clay loam; light yellowish brown (2.5Y 6/3) moist; 39 percent sand; 34 percent silt; 27 percent clay; moderate medium subangular blocky structure; friable, very hard, slightly sticky, slightly plastic; common very fine roots throughout; 20 percent (many) medium masses of carbonate on faces of peds; electrical conductivity of 0.33 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; abrupt smooth boundary; CaCO3 14.4 percent.

R --- 78 centimeters (30.7 inches); sandstone.

12AS005

Pedon ID: 12AS005

Description Date: 10/25/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 54% and 7% fine sand or coarser in control section.

Current Taxonomic Name: Quezcan family
Current Taxonomic Class: Fine, smectitic, calcareous, mesic Aridic Ustorthents
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370339E, 4142683N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: hills
Landform: structural bench
Geomorphic Component: Side Slope
Profile Pos: Shoulder
Slope: 11 percent
Elevation: 2124 meters (6968.5 feet)
Aspect: 215°
Shape: up/down: Convex; **across:** Convex

Surface Fragments: subangular sandstone - 15 percent gravels, 20 percent cobbles, 10 percent channers, and 5 percent flags.

Drainage: Well drained
Runoff: Very high
Erosion: Class 3 - Sheet erosion

Earth Cover: Other tree cover

Existing Vegetation: PIED - twoneedle pinyon (*Pinus edulis*); JUOS - Utah juniper (*Juniperus osteosperma*); SYMPH - snowberry (*Symphoricarpos*); POA - bluegrass (*Poa*)

Parent Materials: residuum weathered from shale
Bedrock: Calcareous shale at 78 centimeters (30.7 inches)
Particle Size Control Section: 25 to 78 centimeters (9.8 to 30.7 inches)

Diagnostic Features: Paralithic contact: 78 centimeters (30.7 inches)
Restrictions: Paralithic bedrock: 78 centimeters (30.7 inches)

A --- 0 to 5 centimeters (0 to 2 inches); light yellowish brown (2.5Y 6/3) dry, cobbly clay; light olive brown (2.5Y 5/3) moist; 17 percent sand; 33 percent silt; 50 percent clay; moderate coarse platy parting to moderate medium granular structure; firm, very hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; common fine tubular pores; 5 percent subangular sandstone flags, 10 percent subangular sandstone cobbles and 5 percent sandstone gravels; electrical conductivity of 0.45 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear smooth boundary; CaCO3 23.1 percent.

C1 --- 5 to 35 centimeters (2 to 13.8 inches); light gray (2.5Y 7/2) dry, parachannery silty clay; light yellowish brown (2.5Y 6/3) moist; 9 percent sand; 33 percent silt; 58 percent clay; weak medium subangular blocky structure; firm, very hard, very sticky, very plastic; common coarse roots throughout, common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; 15 percent angular shale parachanners and 10 percent subangular sandstone gravels; electrical conductivity of 0.33 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; clear smooth boundary; CaCO3 23.5 percent.

C2 --- 35 to 78 centimeters (13.8 to 30.7 inches); light gray (2.5Y 7/2) dry, very parachannery clay; light yellowish brown (2.5Y 6/3) moist; 7 percent sand; 29 percent silt; 64 percent clay; massive; firm, very hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; 45 percent angular parachanners; shale electrical conductivity of 0.44 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; gradual smooth boundary; CaCO3 24.4 percent.

Cr --- 78 centimeters (30.7 inches); weathering Tropic shale.

12AS006

Pedon ID: 12AS006

Description Date: 10/25/2012
Describer: Robert Long

Pedon Notes: Text: Sandstone outcrop

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370311E, 4142608N -- Datum NAD83, Zone 12
Location Description:
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: hills
Landform: ledge
Slope: 8 percent
Elevation: 2123 meters (6965.2 feet)
Aspect: 172°

12AS007

Pedon ID: 12AS007

Description Date: 10/25/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 35% and 35% fine sand or coarser in control section.

Current Taxonomic Name: Brumley family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Calcidic Haplustalfs
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370318E, 4142763N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: hills
Landform: structural bench
Geomorphic Component: Side Slope
Profile Pos: Shoulder
Slope: 19 percent
Elevation: 2131 meters (6991.5 feet)
Aspect: 258°
Shape: up/down: Convex; **across:** Linear

Surface Fragments: subangular sandstone - 15 percent gravels, 3 percent cobbles, 5 percent stones, 1 percent boulders, 20 percent channers, and 6 percent flags.

Drainage: Well drained
Runoff: High
Erosion: Class 3 - Sheet erosion

Earth Cover: Shrubby rangeland

Existing Vegetation: PASM - western wheatgrass (Pascopyrum smithii) ; CHRYS9 - rabbitbrush (*Chrysothamnus*); QUGA - Gambel oak (*Quercus gambelii*); SYOR2 - mountain snowberry (*Symphoricarpos oreophilus*); PIED - twoneedle pinyon (*Pinus edulis*); JUOS - Utah juniper (*Juniperus osteosperma*)

Parent Materials: residuum weathered from sandstone
Bedrock: Sandstone at 83 centimeters (32.7 inches)

Particle Size Control Section: 7 to 44 centimeters (2.8 to 17.3 inches)

Diagnostic Features: Argillic horizon: 7 centimeters (2.8 inches), Calcic horizon: 44 centimeters (17.3 inches) and Lithic contact: 83 centimeters (32.7 inches)

Restrictions: Lithic bedrock: 83 centimeters (32.7 inches)

A --- 0 to 7 centimeters (0 to 2.8 inches); brown (10YR 4/3) dry, channery sandy clay loam; dark brown (10YR 3/3) moist; 47 percent sand; 24 percent silt; 29 percent clay; moderate medium platy structure; very friable, slightly hard, slightly sticky, slightly plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 12 percent subangular sandstone channers, 1 percent subangular sandstone boulders, 3 percent subangular sandstone cobbles and 10 percent subangular sandstone gravels; electrical conductivity of 0.4 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear smooth boundary; CaCO3 3 percent.

Bt --- 7 to 44 centimeters (2.8 to 17.3 inches); light yellowish brown (10YR 6/4) dry, clay loam; yellowish brown (10YR 5/4) moist; 37 percent sand; 27 percent silt; 36 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 40 percent (common) clay films on all faces of peds; 1 percent subangular sandstone boulders; electrical conductivity of 0.34 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; slightly alkaline, pH 7.4, pH meter; abrupt smooth boundary; CaCO3 1.4 percent.

Bk --- 44 to 83 centimeters (17.3 to 32.7 inches); pale yellow (2.5Y 7/4) dry, sandy clay loam; light yellowish brown (2.5Y 6/4) moist; 67 percent sand; 11 percent silt; 22 percent clay; weak medium subangular blocky structure; loose, loose, slightly sticky, slightly plastic; common fine roots throughout and common very fine roots throughout; common very fine interstitial pores; 8 percent (few) carbonate coats on bottom surfaces of rock fragments; 25 percent (many) medium masses of carbonate on faces of peds; electrical conductivity of 0.32 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; abrupt smooth boundary; CaCO3 19.9 percent.

R --- 83 centimeters (32.7 inches); Tropic sandstone.

12AS008

Pedon ID: 12AS008

Description Date: 10/25/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 12% and 63% fine sand or coarser in control section.

Current Taxonomic Name: Vessilla family
Current Taxonomic Class: Loamy, mixed, active, calcareous, mesic Aridic Lithic Ustorthents
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370452E, 4142806N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: hills
Landform: structural bench
Geomorphic Component: Side Slope
Profile Pos: Backslope
Slope: 18 percent
Elevation: 2114 meters (6935.7 feet)
Aspect: 250°
Shape: up/down: Linear; **across:** Convex

Surface Fragments: subangular sandstone - 10 percent gravels, 5 percent cobbles, 15 percent channers, and 5 percent flags.

Drainage: Somewhat excessively drained
Runoff: Medium
Erosion: Class 1 - Sheet erosion

Earth Cover: Tree cover

Existing Vegetation: PIED - twoneedle pinyon (*Pinus edulis*); JUOS - Utah juniper (*Juniperus osteosperma*); QUGA - Gambel oak (*Quercus gambelii*); SYOR2 - mountain snowberry (*Symphoricarpos oreophilus*)

Parent Materials: residuum weathered from sandstone
Bedrock: Sandstone at 23 centimeters (9.1 inches)
Particle Size Control Section: 0 to 23 centimeters (0 to 9.1 inches)

Diagnostic Features: Secondary carbonates: 9 to 23 centimeters (3.5 to 9.1 inches) and Lithic contact: 23 centimeters (9.1 inches)

Restrictions: Lithic bedrock: 23 centimeters (9.1 inches)

A --- 0 to 9 centimeters (0 to 3.5 inches); light yellowish brown (2.5Y 6/4) dry, channery sandy loam; olive brown (2.5Y 4/4) moist; 63 percent sand; 20 percent silt; 17 percent clay; moderate medium platy structure; very friable, slightly hard, slightly sticky, slightly plastic; common very fine roots throughout; common very fine interstitial pores; 2 percent subangular sandstone flags, 10 percent subangular sandstone channers, 3 percent subangular sandstone cobbles and 5 percent subangular sandstone gravels; electrical conductivity of 0.43 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear smooth boundary; CaCO3 11.8 percent.

Ck --- 9 to 23 centimeters (3.5 to 9.1 inches); light yellowish brown (2.5Y 6/4) dry, sandy loam; light olive brown (2.5Y 5/4) moist; 77 percent sand; 11 percent silt; 12 percent clay; weak medium subangular blocky parting to single grain structure; loose, soft, nonsticky, nonplastic; common coarse roots throughout, common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine interstitial pores; 2 percent (very few) carbonate coats on bottom surfaces of rock fragments; 5 percent subangular sandstone gravels; electrical conductivity of 0.48 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; abrupt smooth boundary; CaCO3 15.7 percent.

R --- 23 centimeters (9.1 inches); Tropic sandstone.

12AS009

Pedon ID: 12AS009

Description Date: 11/26/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 40% and 3% fine sand or coarser in control section.

Current Taxonomic Name: Boxcanyon family
Current Taxonomic Class: Fine, smectitic, superactive, mesic Calcidic Haplustalfs
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370090E, 4142575N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Tread
Profile Pos: Summit
Slope: 2 percent
Elevation: 2095 meters (6873.4 feet)
Aspect: 225°
Shape: up/down: Linear; **across:** Linear

Surface Fragments: none.

Drainage: Moderately well drained
Runoff: Medium
Erosion: None - deposition

Earth Cover: Shrub cover

Existing Vegetation: CHRYS9 - rabbitbrush (*Chrysothamnus*); JUOS - Utah juniper (*Juniperus osteosperma*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Bedrock: Sandstone at 514 centimeters (202.4 inches)
Particle Size Control Section: 7 to 57 centimeters (2.8 to 22.4 inches)

Diagnostic Features: Argillic horizon: 7 to 62 centimeters (2.8 to 24.4 inches) and Calcic horizon: 20 to 232 centimeters (7.9 to 91.3 inches)

A --- 0 to 7 centimeters (0 to 2.8 inches); brown (10YR 5/3) dry, clay loam; (10Y 4/3) moist; 26 percent sand; 35 percent silt; 39 percent clay; moderate medium platy parting to moderate medium granular structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.59 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 22.2 percent.

Bt --- 7 to 20 centimeters (2.8 to 7.9 inches); pale brown (10YR 6/3) dry, silty clay; brown (10YR 4/3) moist; 10 percent sand; 46 percent silt; 44 percent clay; moderate medium prismatic parting to strong medium angular blocky structure; friable, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; 20 percent (few) clay films between sand grains and 25 percent (common) clay films on all faces of peds; electrical conductivity of 0.45 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; clear; CaCO3 25.4 percent.

Btk --- 20 to 62 centimeters (7.9 to 24.4 inches); very pale brown (10YR 7/4) dry, silty clay; light yellowish brown (10YR 6/4) moist; 0 percent sand; 47 percent silt; 53 percent clay; moderate medium prismatic parting to moderate medium subangular blocky structure; friable, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 15 percent (few) clay films on all faces of peds; 8 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.33 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; gradual; CaCO3 42.4 percent.

Bk1 --- 62 to 99 centimeters (24.4 to 39 inches); pink (7.5YR 8/3) dry, silty clay; pink (7.5YR 7/4) moist; 0 percent sand; 48 percent silt; 52 percent clay; moderate medium prismatic parting to moderate fine subangular blocky structure; friable, very hard, very sticky, very plastic; common very fine roots throughout; common very fine tubular pores; 15 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.26 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; gradual; CaCO3 52.6 percent.

Bk2 --- 99 to 137 centimeters (39 to 53.9 inches); very pale brown (10YR 8/3) dry, silty clay; very pale brown (10YR 7/4) moist; 0 percent sand; 53 percent silt; 47 percent clay; 8 percent medium distinct strong brown (7.5YR 5/6) mottles; moderate medium prismatic parting to moderate medium subangular blocky structure; friable, hard, very sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; 8 percent (common) medium strong brown (7.5YR 5/6), moist; 15 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.25 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; gradual; CaCO3 51.8 percent.

Bk3 --- 137 to 183 centimeters (53.9 to 72 inches); pale yellow (2.5Y 8/2) dry, silty clay; light gray (2.5Y 7/2) moist; 0 percent sand; 49 percent silt; 51 percent clay; 10 percent coarse reddish yellow (7.5YR 6/6) and 10 percent medium prominent reddish yellow (7.5YR 6/6) mottles; moderate medium subangular blocky structure; friable, hard, very sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; 10 percent (common) coarse reddish yellow (7.5YR 6/6), moist and 10 percent (common) medium reddish yellow (7.5YR 6/6), moist; 20 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.28 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; gradual; CaCO3 49.2 percent.

Bk4 --- 183 to 232 centimeters (72 to 91.3 inches); pale yellow (2.5Y 8/2) dry, silty clay loam; light gray (2.5Y 7/2) moist; 6 percent sand; 58 percent silt; 36 percent clay; 5 percent medium prominent strong brown (7.5YR 5/6) mottles; weak medium angular blocky structure; friable, hard, very sticky, moderately plastic; 5 percent (common) medium strong brown (7.5YR 5/6), moist; 15 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.32 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; clear; CaCO3 45.2 percent.

2C --- 232 to 320 centimeters (91.3 to 126 inches); white (2.5Y 8/1) dry, sandy loam; light gray (2.5Y 7/1) moist; 60 percent sand; 30 percent silt; 10 percent clay; 25 percent coarse prominent brownish yellow (10YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; electrical conductivity of 0.38 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear; CaCO3 25.7 percent.

3C --- 320 to 366 centimeters (126 to 144.1 inches); white (2.5Y 8/1) dry, sandy loam; light gray (2.5Y 7/1) moist; 56 percent sand; 32 percent silt; 12 percent clay; 15 percent coarse prominent brownish yellow (10YR 6/6) mottles; massive; friable, very hard, nonsticky, nonplastic; electrical conductivity of 0.44 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; water is perching on this horizon; clear; CaCO3 25.6 percent.

4C --- 366 to 514 centimeters (144.1 to 202.4 inches); white (2.5Y 8/1) dry, sandy loam; light gray (2.5Y 7/2) moist; 55 percent sand; 26 percent silt; 8 percent clay; 20 percent coarse prominent brownish yellow (10YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; electrical conductivity of 0.35 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; diffuse; CaCO3 20.5 percent.

4Cr --- 514 to 610 centimeters (202.4 to 240.2 inches); light gray (2.5Y 7/2) dry, silt loam; light brownish gray (2.5Y 6/2) moist; 35 percent sand; 50 percent silt; 15 percent clay; massive; friable, hard, moderately sticky, moderately plastic; electrical conductivity of 0.44 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; weathered sandstone; CaCO3 13 percent.

12AS010

Pedon ID: 12AS010

Description Date: 11/26/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 17% and 31% fine sand or coarser in control section.

Current Taxonomic Name: Bobknoll family
Current Taxonomic Class: Coarse-loamy, mixed, superactive, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370027E, 4142761N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Tread
Profile Pos: Summit
Slope: 4 percent
Elevation: 2100 meters (6889.8 feet)
Aspect: 170°
Shape: up/down: Linear; **across:** Linear

Surface Fragments: subrounded sandstone - 1 percent gravels.

Drainage: Somewhat poorly drained
Runoff: Medium
Erosion: None - deposition

Earth Cover: Shrub cover

Existing Vegetation: CHRYS9 - rabbitbrush (*Chrysothamnus*)

Parent Materials: alluvium derived from limestone and sandstone
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)
Diagnostic Features: Calcic horizon: 9 to 31 centimeters (3.5 to 12.2 inches)

A --- 0 to 9 centimeters (0 to 3.5 inches); very pale brown (10YR 7/3) dry, silty clay; yellowish brown (10YR 5/4) moist; 10 percent sand; 50 percent silt; 40 percent clay; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.56 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 47.6 percent.

Bk1 --- 9 to 31 centimeters (3.5 to 12.2 inches); very pale brown (10YR 8/2) dry, silt loam; grayish brown (10YR 5/2) moist; 8 percent sand; 68 percent silt; 24 percent clay; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 1 percent (few) fine masses of carbonate in matrix; electrical conductivity of 0.42 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear; CaCO3 57.6 percent.

Bk2 --- 31 to 67 centimeters (12.2 to 26.4 inches); very pale brown (10YR 8/3) dry, silty clay loam; very pale brown (10YR 7/4) moist; 16 percent sand; 50 percent silt; 34 percent clay; structure; very friable, slightly hard, slightly sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 12 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.37 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; clear; CaCO3 50.1 percent.

Bk3 --- 67 to 96 centimeters (26.4 to 37.8 inches); pale yellow (2.5Y 8/3) dry, sandy loam; pale yellow (2.5Y 7/4) moist; 66 percent sand; 18 percent silt; 16 percent clay; 4 percent fine prominent reddish yellow (7.5YR 6/8) mottles; weak medium subangular blocky structure; very friable, slightly hard, nonsticky, nonplastic; common very fine roots throughout; common very fine interstitial pores; 4 percent (common) fine reddish yellow (7.5YR 6/8), moist; 8 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.27 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.9, pH meter; abrupt; CaCO3 24.4 percent.

C1 --- 96 to 134 centimeters (37.8 to 52.8 inches); pale yellow (2.5Y 8/2) dry, loam; pale yellow (2.5Y 7/3) moist; 42 percent sand; 36 percent silt; 22 percent clay; 20 percent coarse prominent strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common very fine roots throughout; common very fine tubular pores; 20 percent (many) coarse strong brown (7.5YR 5/8), moist; 2 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.34 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 8.9, pH meter; clear; CaCO3 32.4 percent.

C2 --- 134 to 183 centimeters (52.8 to 72 inches); pale yellow (2.5Y 8/2) dry, silt loam; light gray (2.5Y 7/2) moist; 20 percent sand; 60 percent silt; 20 percent clay; 30 percent coarse prominent strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common very fine roots throughout; common very fine tubular pores; 30 percent (many) coarse strong brown (7.5YR 5/8), moist; electrical conductivity of 0.3 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; strongly alkaline, pH 8.9, pH meter; abrupt; CaCO3 37 percent.

2C --- 183 to 200 centimeters (72 to 78.7 inches); white (2.5Y 8/1) dry, sandy loam; light gray (2.5Y 7/2) moist; 60 percent sand; 28 percent silt; 12 percent clay; 2 percent medium prominent yellow (10YR 7/8) mottles; weak medium subangular blocky parting to single grain structure; very friable, slightly hard, nonsticky, nonplastic; many very fine interstitial pores; 2 percent (common) medium yellow (10YR 7/8), moist; electrical conductivity of 0.26 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; strongly alkaline, pH 9, pH meter; abrupt; CaCO3 25.8 percent.

3Cg --- 200 to 284 centimeters (78.7 to 111.8 inches); white (2.5Y 8/1) dry, silty clay; light gray (2.5Y 7/1) moist; 0 percent sand; 48 percent silt; 52 percent clay; 15 percent coarse prominent strong brown (7.5YR 5/6) and 15 percent medium prominent strong brown (7.5YR 5/6) mottles; medium structure; very firm, very hard, very sticky, very plastic; 5 percent (common) medium prominent bluish gray (5PB 6/1), moist, reduced matrix; electrical conductivity of 0.3 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; CaCO3 48 percent.

12AS011

Pedon ID: 12AS011

Description Date: 11/26/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 37% and 2% fine sand or coarser in control section.

Current Taxonomic Name: CCC family
Current Taxonomic Class: Fine, carbonatic, mesic Aridic Calciustepts
Current Taxon Kind: Family
County or Parish: UT025 - Kane
State or Territory: UT - Utah **:**
UTM: 370019E, 4142957N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Tread
Profile Pos: Summit
Slope: 3 percent
Elevation: 2104 meters (6902.9 feet)
Aspect: 121°
Shape: up/down: Linear; **across:** Linear

Surface Fragments: none.

Drainage: Somewhat poorly drained
Runoff: Medium**:**
Erosion: None - deposition

Earth Cover: Shrub cover

Existing Vegetation: AGCR - crested wheatgrass (*Agropyron cristatum*); CHRYS9 - rabbitbrush (*Chrysothamnus*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)
Diagnostic Features: Calcic horizon: 71 to 116 centimeters (28 to 45.7 inches) and Calcic horizon: 128 to 214 centimeters (50.4 to 84.3 inches)

A --- 0 to 10 centimeters (0 to 3.9 inches); grayish brown (10YR 5/2) dry, silty clay; dark brown (10YR 3/3) moist; 18 percent sand; 41 percent silt; 41 percent clay; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.54 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 39.8 percent.

Bk1 --- 10 to 32 centimeters (3.9 to 12.6 inches); light brownish gray (10YR 6/2) dry, silty clay; dark grayish brown (10YR 4/2) moist; 18 percent sand; 40 percent silt; 42 percent clay; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 3 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.46 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; gradual; CaCO3 43.3 percent.

Bk2 --- 32 to 71 centimeters (12.6 to 28 inches); pink (7.5YR 8/4) dry, silty clay loam; reddish yellow (7.5YR 7/6) moist; 0 percent sand; 61 percent silt; 39 percent clay; structure; very friable, hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 20 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.37 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; clear; CaCO3 41.4 percent.

Bk3 --- 71 to 116 centimeters (28 to 45.7 inches); very pale brown (10YR 8/2) dry, clay; light brownish gray (10YR 6/2) moist; 0 percent sand; 37 percent silt; 63 percent clay; 22 percent medium prominent reddish yellow (7.5YR 6/6) mottles; structure; friable, hard, very sticky, very plastic; common very fine roots throughout; common very fine tubular pores; 22 percent (many) medium reddish yellow (7.5YR 6/6), moist; 12 percent (common) fine masses of carbonate in cracks; electrical conductivity of 0.36 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; abrupt; CaCO3 55.2 percent.

2C --- 116 to 128 centimeters (45.7 to 50.4 inches); light gray (2.5Y 7/2) dry, sandy loam; light brownish gray (2.5Y 6/2) moist; 70 percent sand; 18 percent silt; 12 percent clay; single grain; loose, loose, nonsticky, nonplastic; common very fine roots throughout; many very fine interstitial pores; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 8.9, pH meter; (limited sample collected of this sand lens); abrupt; CaCO3 24.4 percent.

3Bk1 --- 128 to 154 centimeters (50.4 to 60.6 inches); white (2.5Y 8/1) dry, clay; light gray (2.5Y 7/2) moist; 0 percent sand; 25 percent silt; 75 percent clay; 10 percent medium prominent reddish yellow (7.5YR 6/8) and 10 percent fine prominent reddish yellow (7.5YR 6/8) mottles; moderate medium subangular blocky structure; friable, hard, very sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; 10 percent (common) medium reddish yellow (7.5YR 6/8), moist and 10 percent (common) fine reddish yellow (7.5YR 6/8), moist; 3 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.35 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 8.8, pH meter; clear; CaCO3 51 percent.

3Bk2 --- 154 to 214 centimeters (60.6 to 84.3 inches); white (2.5Y 8/1) dry, clay; light gray (2.5Y 7/2) moist; 0 percent sand; 17 percent silt; 83 percent clay; 25 percent fine prominent reddish yellow (7.5YR 6/6) mottles; moderate medium subangular blocky structure; friable, hard, very sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; 25 percent (many) fine reddish yellow (7.5YR 6/6), moist; 2 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.5 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; CaCO3 49.5 percent.

12AS012

Pedon ID: 12AS012

Description Date: 11/26/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 37% and 1% fine sand or coarser in control section.

Current Taxonomic Name: CCC family
Current Taxonomic Class: Fine, carbonatic, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370063E, 4143126N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Tread
Profile Pos: Summit
Slope: 3 percent
Elevation: 2107 meters (6912.7 feet)
Aspect: 225°
Shape: up/down: Linear; **across:** Concave

Surface Fragments: none.

Drainage: Somewhat poorly drained
Runoff: Medium
Erosion: None - deposition

Earth Cover: Shrubby rangeland

Existing Vegetation: CHRYS9 - rabbitbrush (*Chrysothamnus*)

Parent Materials: alluvium
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Cambic horizon: 11 to 30 centimeters (4.3 to 11.8 inches) and Calcic horizon: 30 to 72 centimeters (11.8 to 28.3 inches)

A --- 0 to 11 centimeters (0 to 4.3 inches); light brownish gray (10YR 6/2) dry, clay; brown (10YR 4/3) moist; 0 percent sand; 37 percent silt; 63 percent clay; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.53 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 38.6 percent.

Bw --- 11 to 30 centimeters (4.3 to 11.8 inches); light brownish gray (10YR 6/2) dry, clay; dark grayish brown (10YR 4/2) moist; 0 percent sand; 25 percent silt; 75 percent clay; weak medium prismatic parting to moderate medium angular blocky structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.45 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 49 percent.

Bk1 --- 30 to 72 centimeters (11.8 to 28.3 inches); white (10YR 8/1) dry, clay; light brownish gray (10YR 6/2) moist; 0 percent sand; 37 percent silt; 63 percent clay; weak medium subangular blocky structure; friable, hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 20 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.4 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; gradual; CaCO3 61.7 percent.

Bk2 --- 72 to 116 centimeters (28.3 to 45.7 inches); yellow (2.5Y 8/6) dry, loam; olive yellow (2.5Y 6/6) moist; 42 percent sand; 33 percent silt; 25 percent clay; 15 percent medium prominent yellow (10YR 7/8) mottles; weak medium subangular blocky structure; very friable, hard, slightly sticky, slightly plastic; common very fine roots throughout; common very fine tubular pores; 15 percent (common) medium yellow (10YR 7/8), moist finely disseminated carbonates; electrical conductivity of 0.26 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 9, pH meter; gradual; CaCO3 28.9 percent.

Bk3 --- 116 to 160 centimeters (45.7 to 63 inches); pale yellow (2.5Y 8/2) dry, loam; light yellowish brown (2.5Y 6/3) moist; 50 percent sand; 32 percent silt; 18 percent clay; 10 percent medium distinct yellow (2.5Y 7/6) mottles; moderate medium subangular blocky structure; very friable, slightly hard, nonsticky, nonplastic; common very fine roots throughout; many very fine interstitial pores; 10 percent (common) medium yellow (2.5Y 7/6), moist; 3 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.35 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.8, pH meter; abrupt; CaCO3 25.5 percent.

C --- 160 to 181 centimeters (63 to 71.3 inches); white (10YR 8/1) dry, loam; light gray (10YR 7/2) moist; 50 percent sand; 33 percent silt; 17 percent clay; 2 percent fine prominent yellow (2.5Y 7/6) mottles; weak medium subangular blocky structure; very friable, slightly hard, nonsticky, nonplastic; common very fine roots throughout; many very fine interstitial pores; 2 percent (common) fine yellow (2.5Y 7/6), moist; electrical conductivity of 0.28 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; very strongly alkaline, pH 9.2, pH meter; abrupt; CaCO3 25.6 percent.

2Bk --- 181 to 187 centimeters (71.3 to 73.6 inches); white (10YR 8/1) dry, extremely gravelly loamy sand; light gray (10YR 7/2) moist; null percent sand; null percent silt; 3 percent clay; single grain; loose, loose, nonsticky, nonplastic; common very fine roots throughout; many very fine interstitial pores finely disseminated carbonates; 50 percent subrounded sandstone gravels; strongly effervescent by HCl, 1 normal; too thin to sample separately for analysis, included with overlying C horizon (field estimated texture and percent clay); clear; CaCO3 25.6 percent.

3Bk --- 187 to 230 centimeters (73.6 to 90.6 inches); white (10YR 8/1) dry, loam; light gray (10YR 7/2) moist; 50 percent sand; 33 percent silt; 17 percent clay; single grain; loose, loose, nonsticky, nonplastic; common very fine roots throughout; many very fine interstitial pores finely disseminated carbonates; electrical conductivity of 0.25 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 9, pH meter; CaCO3 18.1 percent.

12AS013

Pedon ID: 12AS013

Description Date: 11/27/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 55% and 0% fine sand or coarser in control section; . Bag sample of 0-12 cm
Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369813E, 4142684N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: hills
Landform: hillslope
Geomorphic Component: Side Slope
Profile Pos: Shoulder
Slope: 7 percent
Elevation: 2110 meters (6922.6 feet)
Aspect: 116°
Shape: up/down: Convex; **across:** Convex

Surface Fragments: subangular sandstone - 3 percent gravels and 2 percent channers.

Drainage: Well drained
Runoff: Very high
Erosion: Class 2 - Sheet erosion

Primary Earth Cover: shrub cover.

Parent Materials: residuum weathered from shale
Bedrock: Calcareous shale at 102 centimeters (40.2 inches)
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)
Diagnostic Features: Secondary carbonates: 16 to 114 centimeters (6.3 to 44.9 inches) and Paralithic contact: 102 to 114 centimeters (40.2 to 44.9 inches)
Restrictions: Paralithic bedrock: 102 to 114 centimeters (40.2 to 44.9 inches)

Ap --- 0 to 16 centimeters (0 to 6.3 inches); grayish brown (10YR 5/2) dry, clay; very dark grayish brown (10YR 3/2) moist; 0 percent sand; 28 percent silt; 72 percent clay; moderate medium platy parting to moderate medium granular structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.37 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; $CaCO_3$ 3.5 percent.

Bk1 --- 16 to 52 centimeters (6.3 to 20.5 inches); light gray (2.5Y 7/2) dry, very parachannery clay; grayish brown (2.5Y 5/2) moist; 0 percent sand; 39 percent silt; 61 percent clay; weak medium subangular blocky parting to moderate medium granular structure; very friable, slightly hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 8 percent (few) carbonate coats on bottom surfaces of rock fragments; 8 percent (common) fine threadlike masses of carbonate between peds; 45 percent angular shale parachanners; electrical conductivity of 0.3 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; gradual; $CaCO_3$ 10.7 percent.

Bk2 --- 52 to 102 centimeters (20.5 to 40.2 inches); light gray (2.5Y 7/2) dry, extremely parachannery clay; grayish brown (2.5Y 5/2) moist; 0 percent sand; 39 percent silt; 61 percent clay; weak fine subangular blocky structure; very friable, slightly hard, very sticky, very plastic; common very fine roots throughout; common very fine tubular pores; 15 percent (common) fine threadlike masses of carbonate on faces of peds; 70 percent angular shale parachanners; electrical conductivity of 0.27 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; gradual; $CaCO_3$ 14.9 percent.

Cr --- 102 to 114 centimeters (40.2 to 44.9 inches); 0 percent sand; 24 percent silt; 73 percent clay; 3 percent (common) fine threadlike masses of carbonate in cracks; electrical conductivity of 0.3 mmhos/cm by EC meter, saturated paste; by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; weathered Tropic shale; $CaCO_3$ 10.1 percent.

12AS014

Pedon ID: 12AS014

Description Date: 11/27/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 48% and 6% fine sand or coarser in control section.

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts**:**
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369703E, 4142594N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: hills
Landform: hillslope
Geomorphic Component: Side Slope
Profile Pos: Backslope
Slope: 9 percent
Elevation: 2103 meters (6899.6 feet)
Aspect: 267°
Shape: up/down: Linear; **across:** Concave

Surface Fragments: subangular sandstone - 1 percent channers.

Drainage: Well drained
Runoff: Very high
Erosion: Class 2 - Sheet erosion

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Shrubby rangeland

Existing Vegetation: SAME3 - black sage (*Artemisia nova*); BROMU - brome (*Bromus*)

Parent Materials: residuum weathered from calcareous shale
Bedrock: Calcareous shale at 88 centimeters (34.6 inches)
Particle Size Control Section: 25 to 88 centimeters (9.8 to 34.6 inches)
Diagnostic Features: Cambic horizon: 20 to 45 centimeters (7.9 to 17.7 inches) and Paralithic contact: 88 to 114 centimeters (34.6 to 44.9 inches)

Restrictions: Paralithic bedrock: 88 to 114 centimeters (34.6 to 44.9 inches)

Ap --- 0 to 20 centimeters (0 to 7.9 inches); light brownish gray (2.5Y 6/2) dry, silty clay; dark grayish brown (2.5Y 4/2) moist; 6 percent sand; 43 percent silt; 51 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; friable, hard, very sticky, very plastic; common fine roots throughout and many very fine roots throughout; common very fine tubular pores; 15 percent (few) pressure faces on all faces of peds; electrical conductivity of 0.34 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 4.1 percent.

Bw --- 20 to 45 centimeters (7.9 to 17.7 inches); light brownish gray (2.5Y 6/2) dry, silty clay; dark grayish brown (2.5Y 4/2) moist; 6 percent sand; 43 percent silt; 51 percent clay; moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; gradual; CaCO3 5.9 percent.

BC --- 45 to 66 centimeters (17.7 to 26 inches); light brownish gray (2.5Y 6/2) dry, silty clay; grayish brown (2.5Y 5/2) moist; 4 percent sand; 44 percent silt; 52 percent clay; moderate medium angular blocky structure; firm, very hard, very sticky, very plastic; common very fine roots throughout; 5 percent (few) pressure faces on all faces of peds; electrical conductivity of 0.39 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; gradual; CaCO3 6.4 percent.

C --- 66 to 88 centimeters (26 to 34.6 inches); light brownish gray (2.5Y 6/2) dry, clay; grayish brown (2.5Y 5/2) moist; 10 percent sand; 37 percent silt; 53 percent clay; medium structure; very firm, extremely hard, very sticky, very plastic; common very fine roots throughout; electrical conductivity of 0.8 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; gradual; CaCO3 6.3 percent.

Cr --- 88 to 114 centimeters (34.6 to 44.9 inches); 6 percent sand; 39 percent silt; 55 percent clay; electrical conductivity of 1.65 mmhos/cm by EC meter, saturated paste; moderately alkaline, pH 8.1, pH meter; weathered tropic shale; CaCO3 6.6 percent.

12AS015

Pedon ID: 12AS015

Description Date: 11/27/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 53% and 10% fine sand or coarser in control section.

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369733E, 4142889N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: hills
Landform: structural bench
Geomorphic Component: Base Slope
Profile Pos: Footslope
Slope: 2 percent
Elevation: 2113 meters (6932.4 feet)
Aspect: 344°
Shape: up/down: Concave; **across:** Concave

Surface Fragments: subangular sandstone - 4 percent channers.

Drainage: Well drained
Runoff: High
Erosion: Class 1 - Sheet erosion

Earth Cover: Grass/herbaceous cover

Existing Vegetation: ARNO4 - black sagebrush (*Artemisia nova*); BROMU - brome (*Bromus*); POA - bluegrass (*Poa*); PASM - western wheatgrass (Pascopyrum smithii) ; MEDIC - alfalfa (*Medicago*)

Parent Materials: residuum weathered from calcareous shale
Bedrock: Calcareous shale at 110 centimeters (43.3 inches)
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Cambic horizon: 20 to 87 centimeters (7.9 to 34.3 inches), Gypsum accumulations: 87 to 119 centimeters (34.3 to 46.9 inches) and Paralithic contact: 119 to 132 centimeters (46.9 to 52 inches)

Restrictions: Paralithic bedrock: 119 to 132 centimeters (46.9 to 52 inches)

A --- 0 to 20 centimeters (0 to 7.9 inches); light brownish gray (10YR 6/2) dry, clay; dark grayish brown (10YR 4/2) moist; 10 percent sand; 39 percent silt; 51 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.47 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 5.3 percent.

Bw1 --- 20 to 54 centimeters (7.9 to 21.3 inches); light brownish gray (10YR 6/2) dry, silty clay; grayish brown (10YR 5/2) moist; 12 percent sand; 32 percent silt; 56 percent clay; strong medium angular blocky structure; very firm, very hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 30 percent (common) pressure faces on all faces of peds; electrical conductivity of 0.39 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; gradual; CaCO3 8.4 percent.

Bw2 --- 54 to 87 centimeters (21.3 to 34.3 inches); light brownish gray (10YR 6/2) dry, clay; grayish brown (10YR 5/2) moist; 10 percent sand; 30 percent silt; 60 percent clay; strong medium angular blocky structure; very firm, very hard, very sticky, very plastic; common very fine roots throughout; 20 percent (few) pressure faces on all faces of peds; electrical conductivity of 0.98 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; gradual; CaCO3 12.6 percent.

By --- 87 to 119 centimeters (34.3 to 46.9 inches); light brownish gray (2.5Y 6/2) dry, silty clay; grayish brown (2.5Y 5/2) moist; 10 percent sand; 31 percent silt; 59 percent clay; massive; very firm, extremely hard, very sticky, very plastic; common very fine roots throughout; 2 percent (common) medium masses of gypsum in cracks; electrical conductivity of 6.55 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; weathered Tropic shale; gradual; CaCO3 7.4 percent.

Cr --- 119 to 137 centimeters (46.9 to 53.9 inches); clay; 20 percent sand; 32 percent silt; 48 percent clay; 4 percent (common) medium masses of gypsum in cracks; electrical conductivity of 10.9 mmhos/cm by EC meter, saturated paste; by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; moderately hard tropic shale; CaCO3 11.9 percent.

12AS016

Pedon ID: 12AS016

Description Date: 11/27/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 31% and 18% fine sand or coarser in control section.

Current Taxonomic Name: Teromote family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Haplustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369561E, 4142715N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: hills
Landform: hillslope
Geomorphic Component: rise
Profile Pos: Summit
Slope: 10 percent
Elevation: 2108 meters (6916 feet)
Aspect: 144°
Shape: up/down: Convex; **across:** Convex

Surface Fragments: subangular sandstone - 4 percent gravels, 3 percent cobbles, 1 percent stones, and 7 percent channers; and cobble size Tropic concretions.

Drainage: Well drained
Runoff: High
Erosion: Class 1 - Rill erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland

Existing Vegetation: ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: residuum weathered from calcareous shale
Bedrock: Strongly cemented calcareous shale at 112 centimeters (44.1 inches)
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Secondary carbonates: 11 to 40 centimeters (4.3 to 15.7 inches), Secondary carbonates: 71 to 120 centimeters (28 to 47.2 inches) and Paralithic contact: 112 centimeters (44.1 inches)

Restrictions: Paralithic bedrock: 112 centimeters (44.1 inches)

A --- 0 to 11 centimeters (0 to 4.3 inches); light yellowish brown (2.5Y 6/3) dry, clay loam; light olive brown (2.5Y 5/3) moist; 22 percent sand; 46 percent silt; 32 percent clay; weak medium subangular blocky parting to moderate medium granular structure; very friable, slightly hard, slightly sticky, slightly plastic; common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.43 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; collected bag sample of 0-11 cm about 6 ft; clear; CaCO3 11.6 percent.

Bk --- 11 to 40 centimeters (4.3 to 15.7 inches); light gray (2.5Y 7/2) dry, silty clay loam; light yellowish brown (2.5Y 6/3) moist; 18 percent sand; 49 percent silt; 33 percent clay; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 2 percent (common) fine masses of carbonate on vertical faces of peds; electrical conductivity of 0.37 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; abrupt; CaCO3 13.9 percent.

2A --- 40 to 45 centimeters (15.7 to 17.7 inches); grayish brown (10YR 5/2) dry, clay; brown (10YR 4/3) moist; 22 percent sand; 37 percent silt; 41 percent clay; moderate medium granular structure; very friable, soft, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.78 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; This is a buried surface that appeared to have covered when the pinyons and junipers were recently removed and the surface smoothed.; abrupt; CaCO3 14.5 percent.

2Bk --- 45 to 71 centimeters (17.7 to 28 inches); light brownish gray (2.5Y 6/2) dry, gravelly clay; grayish brown (2.5Y 5/2) moist; 22 percent sand; 37 percent silt; 41 percent clay; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common very fine roots throughout; common very fine tubular pores; 5 percent (few) carbonate coats on bottom surfaces of rock fragments; 8 percent (common) fine masses of carbonate on vertical faces of peds; 20 percent subangular sandstone gravels; electrical conductivity of 0.78 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; abrupt; CaCO3 14.5 percent.

3Bk --- 71 to 120 centimeters (28 to 47.2 inches); light yellowish brown (2.5Y 6/3) dry, clay loam; light olive brown (2.5Y 5/3) moist; 22 percent sand; 47 percent silt; 31 percent clay; moderate medium angular blocky structure; firm, very hard, slightly sticky, slightly plastic; common very fine roots throughout; common very fine tubular pores; 12 percent (common) medium masses of carbonate on faces of peds; electrical conductivity of 0.38 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 17.8 percent.

3Cr --- 112 to 120 centimeters (44.1 to 47.2 inches); 22 percent sand; 47 percent silt; 31 percent clay; electrical conductivity of 0.38 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; Tropic shale; CaCO3 17.8 percent.

12AS017

Pedon ID: 12AS017

Description Date: 11/27/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 56% and 13% fine sand or coarser in control section.

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts**:**
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369423E, 4142655N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: hills
Landform: hillslope
Geomorphic Component: Side Slope
Profile Pos: Backslope
Slope: 12 percent
Elevation: 2100 meters (6889.8 feet)
Aspect: 292°
Shape: up/down: Convex; **across:** Convex

Surface Fragments: Tropic concretions - 2 percent gravels and 3 percent cobbles.

Drainage: Well drained
Runoff: Medium
Erosion: None - deposition

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Shrubby rangeland

Existing Vegetation: ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: residuum weathered from shale
Bedrock: Calcareous shale at 118 centimeters (46.5 inches)
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Cambic horizon: 13 to 57 centimeters (5.1 to 22.4 inches), Gypsum accumulations: 57 to 118 centimeters (22.4 to 46.5 inches), Secondary carbonates: 57 to 84 centimeters (22.4 to 33.1 inches) and Paralithic contact: 118 to 170 centimeters (46.5 to 66.9 inches)

Restrictions: Paralithic bedrock: 118 to 170 centimeters (46.5 to 66.9 inches)

Ap --- 0 to 13 centimeters (0 to 5.1 inches); pale brown (10YR 6/3) dry, silty clay; brown (10YR 4/3) moist; 14 percent sand; 31 percent silt; 55 percent clay; weak medium subangular blocky parting to moderate medium granular structure; firm, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.33 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; $CaCO_3$ 4 percent.

Bw --- 13 to 57 centimeters (5.1 to 22.4 inches); light brownish gray (2.5Y 6/2) dry, clay; dark grayish brown (2.5Y 4/2) moist; 10 percent sand; 23 percent silt; 67 percent clay; moderate medium angular blocky structure; firm, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.24 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; gradual; $CaCO_3$ 4.4 percent.

Bky --- 57 to 84 centimeters (22.4 to 33.1 inches); light brownish gray (2.5Y 6/2) dry, clay; dark grayish brown (2.5Y 4/2) moist; 16 percent sand; 31 percent silt; 53 percent clay; moderate medium angular blocky structure; very firm, very hard, very sticky, very plastic; common very fine roots throughout; common very fine tubular pores; 3 percent (common) fine masses of carbonate on horizontal faces of peds and 2 percent (common) fine masses of gypsum on horizontal faces of peds; electrical conductivity of 3.35 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; gradual; $CaCO_3$ 2.7 percent.

Cy --- 84 to 118 centimeters (33.1 to 46.5 inches); gray (2.5Y 5/1) dry, silty clay; very dark gray (2.5Y 3/1) moist; 18 percent sand; 24 percent silt; 58 percent clay; weak medium angular blocky structure; very firm, very hard, very sticky, very plastic; common very fine roots throughout; 4 percent (common) fine masses of gypsum on horizontal faces of peds; electrical conductivity of 4.64 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; $CaCO_3$ 1.6 percent.

Cr1 --- 118 to 161 centimeters (46.5 to 63.4 inches); 16 percent sand; 29 percent silt; 55 percent clay; moderate medium angular blocky structure; 4 percent (common) fine masses of gypsum in cracks; electrical conductivity of 6.14 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; strongly acid, pH 5.3, pH meter; weathered Tropic shale; gradual; CaCO3 1.3 percent.

Cr2 --- 161 to 170 centimeters (63.4 to 66.9 inches); weak medium subangular blocky structure; 2 percent (common) fine masses of gypsum in cracks; noneffervescent; Tropic shale.

12AS018

Pedon ID: 12AS018

Description Date: 11/27/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 24% and 17% fine sand or coarser in control section.

Current Taxonomic Name: AAA family
Current Taxonomic Class: Fine-loamy, carbonatic, mesic Aridic Haplustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
Lat/Long:
UTM: 369803E, 4143245N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Tread
Profile Pos: Summit
Slope: 1 percent
Elevation: 2106.8 meters (6912.2 feet)
Aspect: 45°
Shape: up/down: Linear; **across:** Linear

Surface Fragments: none.

Drainage: Somewhat poorly drained
Runoff: Negligible
Erosion: None - deposition

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: PASM - western wheatgrass (Pascopyrum smithii) ; CHRYS9 - rabbitbrush (*Chrysothamnus*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features:, Secondary carbonates: 22 to 244 centimeters (8.7 to 96.1 inches) and Aquic conditions: 572 to 732 centimeters (225.2 to 288.2 inches)

BAkp --- 0 to 22 centimeters (0 to 8.7 inches); gray (2.5Y 6/1) dry, clay loam; dark gray (2.5Y 4/1) moist; 26 percent sand; 38 percent silt; 36 percent clay; weak medium subangular blocky parting to moderate medium granular structure; very friable, slightly hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.46 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 61.5 percent.

Bk1 --- 22 to 68 centimeters (8.7 to 26.8 inches); light gray (2.5Y 7/1) dry, clay loam; gray (2.5Y 5/1) moist; 26 percent sand; 42 percent silt; 32 percent clay; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 5 percent (common) fine masses of carbonate on vertical faces of peds; electrical conductivity of 0.24 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear; CaCO3 59.5 percent.

Bk2 --- 68 to 115 centimeters (26.8 to 45.3 inches); pale yellow (2.5Y 8/2) dry, silty clay; pale yellow (2.5Y 7/3) moist; 8 percent sand; 48 percent silt; 44 percent clay; 15 percent medium prominent strong brown (7.5YR 5/6) mottles; moderate medium angular blocky structure; friable, hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 15 percent (common) medium strong brown (7.5YR 5/6), moist; 15 percent (common) medium masses of carbonate on faces of peds; electrical conductivity of 0.25 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; clear; CaCO3 54.1 percent.

Ck --- 115 to 148 centimeters (45.3 to 58.3 inches); white (2.5Y 8/1) dry, silty clay; light gray (2.5Y 7/2) moist; 18 percent sand; 42 percent silt; 40 percent clay; 10 percent medium prominent reddish yellow (7.5YR 6/6) mottles; moderate medium angular blocky structure; firm, very hard, moderately sticky, moderately plastic; common very fine roots throughout; 10 percent (common) medium reddish yellow (7.5YR 6/6), moist; 2 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.26 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; Very dense layer; clear; CaCO3 55.4 percent.

2Bk --- 148 to 244 centimeters (58.3 to 96.1 inches); white (2.5Y 8/1) dry, sandy loam; light gray (2.5Y 7/2) moist; 60 percent sand; 28 percent silt; 12 percent clay; 3 percent medium prominent brownish yellow (10YR 6/6) mottles; weak medium subangular blocky structure; friable, very hard, nonsticky, nonplastic; common very fine tubular pores; 3 percent (common) medium brownish yellow (10YR 6/6), moist; 20 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.21 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 9, pH meter; clear; CaCO3 27.9 percent.

3C --- 244 to 318 centimeters (96.1 to 125.2 inches); white (2.5Y 8/1) dry, loamy sand; light brownish gray (2.5Y 6/2) moist; 80 percent sand; 14 percent silt; 6 percent clay; 10 percent coarse prominent brownish yellow (10YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; electrical conductivity of 0.34 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; clear; CaCO3 18.3 percent.

4C --- 318 to 388 centimeters (125.2 to 152.8 inches); white (2.5Y 8/1) dry, silty clay; light gray (2.5Y 7/1) moist; 0 percent sand; 53 percent silt; 47 percent clay; 20 percent coarse prominent brownish yellow (10YR 6/6) mottles; massive; firm, very hard, very sticky, very plastic; electrical conductivity of 1.19 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; abrupt; CaCO3 42.9 percent.

5C --- 388 to 406 centimeters (152.8 to 159.8 inches); pale yellow (2.5Y 8/2) dry, sandy loam; light gray (2.5Y 7/2) moist; 74 percent sand; 15 percent silt; 11 percent clay; 8 percent coarse prominent brownish yellow (10YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; electrical conductivity of 1.73 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; abrupt; CaCO3 20 percent.

6C --- 406 to 572 centimeters (159.8 to 225.2 inches); pale yellow (2.5Y 8/3) dry, silt loam; light yellowish brown (2.5Y 6/3) moist; 28 percent sand; 51 percent silt; 21 percent clay; 30 percent coarse prominent brownish yellow (10YR 6/6) mottles; massive; firm, very hard, slightly sticky, slightly plastic; electrical conductivity of 2.62 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH indicator solutions; 4-10 cm LS lenses; abrupt; CaCO3 37.1 percent.

6Cg1 --- 572 to 640 centimeters (225.2 to 252 inches); gray (2.5Y 6/1) dry, silty clay loam; dark gray (2.5Y 4/1) moist; 14 percent sand; 54 percent silt; 32 percent clay; massive; firm, very hard, slightly sticky, slightly plastic; 60 percent (many) coarse prominent dark greenish gray (10Y 3/1), moist, reduced matrix; electrical conductivity of 2.37 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; neutral, pH 7.3, pH indicator solutions; very wet; clear; CaCO3 37.1 percent.

6Cg2 --- 640 to 732 centimeters (252 to 288.2 inches); gray (2.5Y 6/1) dry, silty clay; dark grayish brown (2.5Y 4/2) moist; 16 percent sand; 44 percent silt; 40 percent clay; 40 percent coarse prominent brownish yellow (10YR 6/6) mottles; massive; firm, very hard, moderately sticky, moderately plastic; 15 percent (common) coarse prominent dark greenish gray (10Y 3/1), moist, reduced matrix in matrix; 5 percent subrounded mudstone gravels; electrical conductivity of 1.57 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH indicator solutions; alluvium from conglomerate; $CaCO_3$ 35.1 percent.

12AS019

Pedon ID: 12AS019

Description Date: 11/27/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 30% and 14% fine sand or coarser in control section.

Current Taxonomic Name: AAA similar
Current Taxonomic Class: Fine-silty, carbonatic, mesic Aridic Haplustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369866E, 4143060N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Tread
Profile Pos: Summit
Slope: 2 percent
Elevation: 2109 meters (6919.3 feet)
Aspect: 194°
Shape: up/down: Linear; **across:** Concave

Surface Fragments: none.

Drainage: Moderately well drained
Runoff: Low
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Shrubby rangeland

Surface Fragments: None.

Existing Vegetation: PASM - western wheatgrass (Pascopyrum smithii) ; CHRYS9 - rabbitbrush (*Chrysothamnus*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Secondary carbonates: 32 to 196 centimeters (12.6 to 77.2 inches) and Cambic horizon: 32 to 72 centimeters (12.6 to 28.3 inches)

BAkp1 --- 0 to 12 centimeters (0 to 4.7 inches); light brownish gray (2.5Y 6/2) dry, silty clay; dark grayish brown (2.5Y 4/2) moist; 16 percent sand; 41 percent silt; 43 percent clay; weak medium subangular blocky parting to moderate medium granular structure; very friable, slightly hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.6 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; gradual; $CaCO_3$ 56 percent.

BAkp2 --- 12 to 32 centimeters (4.7 to 12.6 inches); light brownish gray (2.5Y 6/2) dry, silty clay; dark grayish brown (2.5Y 4/2) moist; 12 percent sand; 41 percent silt; 47 percent clay; weak medium subangular blocky parting to moderate medium granular structure; very friable, slightly hard, very sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.4 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; $CaCO_3$ 57.2 percent.

Bk1 --- 32 to 72 centimeters (12.6 to 28.3 inches); light gray (2.5Y 7/1) dry, silty clay; gray (2.5Y 6/1) moist; 10 percent sand; 46 percent silt; 44 percent clay; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 1 percent (few) fine masses of carbonate in matrix; electrical conductivity of 0.33 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; abrupt; $CaCO_3$ 57.1 percent.

Bk2 --- 72 to 100 centimeters (28.3 to 39.4 inches); white (2.5Y 8/1) dry, clay; light gray (2.5Y 7/1) moist; 24 percent sand; 35 percent silt; 41 percent clay; 10 percent medium prominent reddish yellow (7.5YR 7/6) mottles; structure; friable, hard, moderately sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; 10 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.2 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; clear; $CaCO_3$ 50.8 percent.

Bk3 --- 100 to 147 centimeters (39.4 to 57.9 inches); white (2.5Y 8/1) dry, loam; light gray (2.5Y 7/1) moist; 46 percent sand; 35 percent silt; 19 percent clay; 12 percent fine prominent reddish yellow (7.5YR 7/6) mottles; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common very fine roots throughout; common very fine tubular pores; 20 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.27 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; gradual; $CaCO_3$ 32.1 percent.

2Bk --- 147 to 196 centimeters (57.9 to 77.2 inches); pale yellow (2.5Y 8/2) dry, loam; light gray (2.5Y 7/2) moist; 44 percent sand; 41 percent silt; 15 percent clay; 15 percent medium reddish yellow (7.5YR 6/6) mottles; moderate medium platy structure; friable, hard, nonsticky, nonplastic; common very fine roots throughout; common very fine tubular pores; 15 percent (common) medium reddish yellow (7.5YR 7/6), moist; 30 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.7, pH meter; clear; CaCO3 32.4 percent.

C --- 196 to 240 centimeters (77.2 to 94.5 inches); pale yellow (2.5Y 8/2) dry, sandy loam; light gray (2.5Y 7/2) moist; 52 percent sand; 33 percent silt; 15 percent clay; 25 percent medium prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; very friable, slightly hard, nonsticky, nonplastic; many very fine interstitial pores; 25 percent (many) medium strong brown (7.5YR 5/6), moist; electrical conductivity of 0.44 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 8.7, pH meter; CaCO3 30.7 percent.

12AS019A

Pedon ID: 12AS019A

Description Date: 11/12/2013
Describer: Robert Long

Pedon Notes: Text: 12AS019 was sampled and examined to 8 feet; a piezometer was needed in this vicinity, so this new hole was sampled within 10 feet of 12AS019 and a piezometer installed.

Current Taxonomic Name: AAA family
Current Taxonomic Class: Fine-loamy, carbonatic, mesic Aridic Haplustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369866E, 4143060N -- Datum NAD83, Zone 12
Location Description:
Legal Description: Section 13, Township 39 South, Range 6 west of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Tread
Profile Pos: Summit
Slope: 2 percent
Elevation: 2109 meters (6919.3 feet)
Aspect: 194°
Shape: up/down: Linear; **across:** Linear

Surface Fragments: none.

Drainage: Moderately well drained
Runoff: Low
Erosion: None - deposition

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Shrubby rangeland
Existing Vegetation: CHRYS9 - rabbitbrush (*Chrysothamnus*); PASM - western wheatgrass (Pascopyrum smithii)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)
Diagnostic Features: Secondary carbonates: 22 to 154 centimeters (8.7 to 60.6 inches)

A --- 0 to 22 centimeters (0 to 8.7 inches); light gray (10YR 7/2) dry, silty clay; grayish brown (10YR 5/2) moist; 10 percent sand; 44 percent silt; 46 percent clay; moderate medium platy parting to weak medium subangular blocky structure; very friable, slightly hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores finely disseminated carbonates; electrical conductivity of 0.35 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; clear; CaCO3 47.9 percent.

Bk1 --- 22 to 43 centimeters (8.7 to 16.9 inches); very pale brown (10YR 7/3) dry, clay; grayish brown (10YR 5/2) moist; 9 percent sand; 39 percent silt; 53 percent clay; moderate medium prismatic parting to moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 5 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.37 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; gradual; CaCO3 50.4 percent.

Bk2 --- 43 to 67 centimeters (16.9 to 26.4 inches); white (2.5Y 8/1) dry, silty clay; light brownish gray (2.5Y 6/2) moist; 6 percent sand; 44 percent silt; 50 percent clay; 8 percent fine prominent strong brown (7.5YR 5/6) mottles; structure; friable, hard, very sticky, very plastic; common very fine roots throughout; common very fine tubular pores; 12 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.26 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; gradual; CaCO3 50.1 percent.

Bk3 --- 67 to 154 centimeters (26.4 to 60.6 inches); pale yellow (2.5Y 8/2) dry, loam; light gray (2.5Y 7/2) moist; 37 percent sand; 42 percent silt; 21 percent clay; 3 percent fine prominent strong brown (7.5YR 5/6) mottles; massive; friable, hard, slightly sticky, slightly plastic; many very fine interstitial pores; 10 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.35 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; gradual; CaCO3 45.9 percent.

2C1 --- 154 to 242 centimeters (60.6 to 95.3 inches); pale yellow (2.5Y 7/4) dry, sandy loam; light yellowish brown (2.5Y 6/3) moist; 63 percent sand; 28 percent silt; 9 percent clay; 3 percent fine prominent brownish yellow (10YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; electrical conductivity of 0.28 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; clear; CaCO3 32.4 percent.

2C2 --- 242 to 363 centimeters (95.3 to 142.9 inches); light gray (2.5Y 7/2) dry, sandy loam; light brownish gray (2.5Y 6/2) moist; 58 percent sand; 31 percent silt; 11 percent clay; single grain; loose, loose, nonsticky, nonplastic; common very fine interstitial pores; electrical

conductivity of 0.52 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; gradual; $CaCO_3$ 31.6 percent.

3C1 --- 363 to 408 centimeters (142.9 to 160.6 inches); pale yellow (2.5Y 8/4) dry, silty clay loam; light yellowish brown (2.5Y 6/4) moist; 18 percent sand; 43 percent silt; 39 percent clay; 15 percent medium distinct yellowish brown (10YR 5/6) mottles; massive; firm, very hard, moderately sticky, moderately plastic; 5 percent (common) fine masses of carbonate in matrix; electrical conductivity of 1.87 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; clear; $CaCO_3$ 42.8 percent.

3C2 --- 408 to 548 centimeters (160.6 to 215.7 inches); pale yellow (2.5Y 8/2) dry, loam; light gray (2.5Y 7/2) moist; 38 percent sand; 42 percent silt; 20 percent clay; 5 percent medium prominent brownish yellow (10YR 6/6) mottles; massive; friable, very hard, slightly sticky, nonplastic; 12 percent (common) medium masses of carbonate in matrix; electrical conductivity of 1.96 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; $CaCO_3$ 47 percent.

4C --- 548 to 610 centimeters (215.7 to 240.2 inches); pale yellow (2.5Y 8/3) dry, sandy loam; light yellowish brown (2.5Y 6/4) moist; 59 percent sand; 32 percent silt; 9 percent clay; 3 percent fine prominent brownish yellow (10YR 6/8) mottles; single grain and massive; very friable, slightly hard, nonsticky, nonplastic; many very fine interstitial pores; electrical conductivity of 2.2 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; box sample is similar to weathered Tropic sandstone; clear; $CaCO_3$ 32 percent.

5Ck --- 610 to 810 centimeters (240.2 to 318.9 inches); very pale brown (10YR 8/2) dry, clay loam; light brownish gray (10YR 6/2) moist; 26 percent sand; 40 percent silt; 34 percent clay; 8 percent medium prominent brownish yellow (10YR 6/8) mottles; massive; firm, very hard, moderately sticky, moderately plastic; 5 percent (common) medium masses of carbonate in matrix; electrical conductivity of 1.98 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; box sample is similar to weathered Tropic shale; clear; $CaCO_3$ 29.3 percent.

6C --- 810 to 852 centimeters (318.9 to 335.4 inches); pale yellow (2.5Y 8/2) dry, loamy sand; light yellowish brown (2.5Y 6/3) moist; 86 percent sand; 9 percent silt; 5 percent clay; 30 percent coarse distinct olive yellow (2.5Y 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; electrical conductivity of 1.69 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; box sample is similar to a mix of weathered Tropic sandstone and shale; $CaCO_3$ 19.4 percent.

12AS020

Pedon ID: 12AS020

Description Date: 11/27/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 26% and 9% fine sand or coarser in control section.

Current Taxonomic Name: CCC family similar
Current Taxonomic Class: Fine-silty, carbonatic, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369879E, 4143461N -- Datum NAD83, Zone 12
Legal Description: Section 12, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Tread
Profile Pos: Summit
Slope: 2 percent
Elevation: 2109.8 meters (6922 feet)
Aspect: 324°
Shape: up/down: Linear; **across:** Linear

Surface Fragments: none.

Drainage: Poorly drained
Runoff: Low
Erosion: None - deposition

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Secondary carbonates: 30 to 300 centimeters (11.8 to 118.1 inches), Calcic horizon: 30 to 140 centimeters (11.8 to 55.1 inches) and Aquic conditions: 300 to 610 centimeters (118.1 to 240.2 inches)

Ap --- 0 to 13 centimeters (0 to 5.1 inches); gray (2.5Y 6/1) dry, clay loam; dark grayish brown (2.5Y 4/2) moist; 20 percent sand; 49 percent silt; 31 percent clay; moderate medium platy parting to moderate medium granular structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.59 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 38.2 percent.

BAkp --- 13 to 30 centimeters (5.1 to 11.8 inches); gray (2.5Y 6/1) dry, silty clay loam; dark grayish brown (2.5Y 4/2) moist; 12 percent sand; 51 percent silt; 37 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.29 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; clear; CaCO3 76.3 percent.

Bk1 --- 30 to 80 centimeters (11.8 to 31.5 inches); white (2.5Y 8/1) dry, silty clay; light brownish gray (2.5Y 6/2) moist; 10 percent sand; 50 percent silt; 40 percent clay; 2 percent fine prominent reddish yellow (7.5YR 6/6) mottles; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 2 percent (common) fine reddish yellow (7.5YR 6/6), moist; 20 percent (many) fine masses of carbonate in matrix; electrical conductivity of 0.3 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; clear; CaCO3 60.4 percent.

Bk2 --- 80 to 111 centimeters (31.5 to 43.7 inches); white (2.5Y 8/1) dry, silty clay; light brownish gray (2.5Y 6/2) moist; 8 percent sand; 51 percent silt; 41 percent clay; 5 percent fine prominent reddish yellow (7.5YR 6/6) mottles; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 5 percent (common) fine reddish yellow (7.5YR 6/6), moist; 25 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; clear; CaCO3 52.4 percent.

Ck --- 111 to 140 centimeters (43.7 to 55.1 inches); pale yellow (2.5Y 8/2) dry, silty clay loam; light yellowish brown (2.5Y 6/3) moist; 10 percent sand; 54 percent silt; 36 percent clay; 25 percent medium prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable, hard, slightly sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; 25 percent (many) medium strong brown (7.5YR 5/6), moist; 2 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.51 mmhos/cm by EC meter, saturated paste; slightly

effervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; clear; CaCO3 44.9 percent.

2Ck1 --- 140 to 175 centimeters (55.1 to 68.9 inches); white (2.5Y 8/1) dry, silt loam; light gray (2.5Y 7/1) moist; 10 percent sand; 64 percent silt; 26 percent clay; 3 percent medium prominent reddish yellow (7.5YR 6/6) and 4 percent fine prominent reddish yellow (7.5YR 6/6) mottles; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common very fine roots throughout; 15 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.66 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.7, pH meter; clear; CaCO3 54.2 percent.

2Ck2 --- 175 to 300 centimeters (68.9 to 118.1 inches); white (2.5Y 8/1) dry, loam; light gray (2.5Y 7/1) moist; 38 percent sand; 40 percent silt; 22 percent clay; 20 percent coarse prominent olive yellow (2.5Y 6/6) mottles; massive; firm, very hard, slightly sticky, slightly plastic; 5 percent (common) medium masses of carbonate in matrix; electrical conductivity of 1.48 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; 2-8 cm LS Lenses; clear; CaCO3 35.4 percent.

2C1 --- 300 to 488 centimeters (118.1 to 192.1 inches); light gray (2.5Y 7/1) dry, sandy loam; gray (2.5Y 5/1) moist; 56 percent sand; 30 percent silt; 14 percent clay; 8 percent medium prominent olive yellow (2.5Y 6/6) mottles; massive; firm, very hard, slightly sticky, nonplastic; electrical conductivity of 2.57 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; gradual; CaCO3 28.2 percent.

2C2 --- 488 to 600 centimeters (192.1 to 236.2 inches); pale yellow (2.5Y 8/2) dry, loam; light gray (2.5Y 7/2) moist; 32 percent sand; 48 percent silt; 20 percent clay; 8 percent medium prominent brownish yellow (10YR 6/6) mottles; massive; firm, very hard, nonsticky, nonplastic; electrical conductivity of 1.63 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 34.8 percent.

3C --- 600 to 610 centimeters (236.2 to 240.2 inches); yellow (2.5Y 7/6) dry, sand; olive yellow (2.5Y 6/6) moist; 88 percent sand; 7 percent silt; 5 percent clay; 15 percent medium faint brownish yellow (10YR 6/6) mottles; single grain; loose, loose, slightly sticky, nonplastic; electrical conductivity of 1.86 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; CaCO3 18.6 percent.

12AS021

Pedon ID: 12AS021

Description Date: 11/28/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 12% and 25% fine sand or coarser in control section.

Current Taxonomic Name: Atlatl family
Current Taxonomic Class: Coarse-loamy, carbonatic, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370292E, 4143151N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Tread
Profile Pos: Summit
Slope: 2 percent
Elevation: 2109.1 meters (6919.8 feet)
Aspect: 243°
Shape: up/down: Linear; **across:** Linear

Surface Fragments: none.

Drainage: Somewhat poorly drained
Runoff: Low
Erosion: None - deposition

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Secondary carbonates: 32 to 374 centimeters (12.6 to 147.2 inches), Calcic horizon: 32 to 150 centimeters (12.6 to 59.1 inches), Calcic horizon: 260 to 374 centimeters (102.4 to 147.2 inches), Secondary carbonates: 448 to 742 centimeters (176.4 to 292.1 inches) and Aquic conditions: 570 to 853 centimeters (224.4 to 335.8 inches)

Ap --- 0 to 9 centimeters (0 to 3.5 inches); pale brown (10YR 6/3) dry, clay loam; brown (10YR 4/3) moist; 24 percent sand; 41 percent silt; 35 percent clay; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.48 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 19.7 percent.

Bw --- 9 to 32 centimeters (3.5 to 12.6 inches); grayish brown (10YR 5/2) dry, clay loam; dark grayish brown (10YR 4/2) moist; 22 percent sand; 45 percent silt; 33 percent clay; moderate medium prismatic parting to moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.43 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 30.7 percent.

Bk1 --- 32 to 65 centimeters (12.6 to 25.6 inches); pink (7.5YR 8/4) dry, clay loam; light yellowish brown (10YR 6/4) moist; 22 percent sand; 46 percent silt; 32 percent clay; structure; friable, hard, slightly sticky, slightly plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 10 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.39 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.7, pH meter; clear; CaCO3 56.3 percent.

Bk2 --- 65 to 95 centimeters (25.6 to 37.4 inches); very pale brown (10YR 8/3) dry, silt loam; very pale brown (10YR 7/4) moist; 32 percent sand; 56 percent silt; 12 percent clay; 15 percent medium distinct reddish yellow (7.5YR 6/6) mottles; moderate medium subangular blocky structure; very friable, slightly hard, nonsticky, nonplastic; common very fine roots throughout; common very fine tubular pores; 15 percent (common) medium reddish yellow (7.5YR 6/6), moist; 15 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.33 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; very strongly alkaline, pH 9.4, pH meter; gradual; CaCO3 60.8 percent.

2Ck1 --- 95 to 150 centimeters (37.4 to 59.1 inches); pale yellow (2.5Y 8/3) dry, sandy loam; pale yellow (2.5Y 7/3) moist; 52 percent sand; 36 percent silt; 12 percent clay; 20 percent coarse prominent strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; friable, hard, nonsticky, nonplastic; common very fine roots throughout; common very fine tubular pores; 20 percent (many) coarse strong brown (7.5YR 5/8), moist; 4 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.34 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 9, pH meter; gradual; CaCO3 45.9 percent.

2Ck2 --- 150 to 202 centimeters (59.1 to 79.5 inches); very pale brown (10YR 7/3) dry, loamy sand; light yellowish brown (10YR 6/4) moist; 82 percent sand; 15 percent silt; 3 percent clay; 40 percent coarse prominent brownish yellow (10YR 6/8) mottles; moderate medium subangular blocky structure; very friable, slightly hard, nonsticky, nonplastic; many very fine interstitial pores; 40 percent (many) coarse brownish yellow (10YR 6/8), moist finely disseminated carbonates; electrical conductivity of 0.23 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; very strongly alkaline, pH 9.1, pH meter; abrupt; CaCO3 26.1 percent.

3Ck --- 202 to 260 centimeters (79.5 to 102.4 inches); white (2.5Y 8/1) dry, loamy sand; light gray (2.5Y 7/1) moist; 82 percent sand; 16 percent silt; 2 percent clay; 15 percent medium prominent brownish yellow (10YR 6/6) mottles; moderate medium subangular blocky structure; very friable, hard, nonsticky, nonplastic finely disseminated carbonates; electrical conductivity of 0.23 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 9, pH meter; abrupt; CaCO3 22.5 percent.

4Ckg --- 260 to 374 centimeters (102.4 to 147.2 inches); pale yellow (2.5Y 8/2) dry, silty clay; gray (2.5Y 5/1) moist; 0 percent sand; 59 percent silt; 41 percent clay; 30 percent coarse yellow (10YR 7/6) mottles; massive; firm, very hard, very sticky, moderately plastic; 20 percent (many) coarse prominent dark greenish gray (10Y 3/1), moist, reduced matrix; 12 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.54 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; lenses of LS 2-4 m thick; abrupt; CaCO3 47.8 percent.

5C --- 374 to 448 centimeters (147.2 to 176.4 inches); pale yellow (2.5Y 7/4) dry, sandy loam; (2.5Y 4/6) moist; 73 percent sand; 21 percent silt; 6 percent clay; 10 percent medium distinct brownish yellow (10YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; electrical conductivity of 2.36 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; abrupt; CaCO3 19.4 percent.

6Ck --- 448 to 524 centimeters (176.4 to 206.3 inches); very pale brown (10YR 7/4) dry, gravelly sandy loam; yellowish brown (10YR 5/6) moist; 75 percent sand; 19 percent silt; 6 percent clay; single grain; loose, loose, nonsticky, nonplastic; 3 percent (very few) carbonate coats on bottom surfaces of rock fragments finely disseminated carbonates; 30 percent subrounded calcareous sandstone gravels; electrical conductivity of 2.41 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; abrupt; CaCO3 31 percent.

7Ck1 --- 524 to 570 centimeters (206.3 to 224.4 inches); pale yellow (2.5Y 7/4) dry, silt loam; light yellowish brown (2.5Y 6/4) moist; 31 percent sand; 52 percent silt; 17 percent clay; 10 percent medium distinct brownish yellow (10YR 6/6) mottles; massive; friable, very hard, slightly sticky, nonplastic finely disseminated carbonates; electrical conductivity of 2.75 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; abrupt; CaCO3 35.2 percent.

7Ckg2 --- 570 to 660 centimeters (224.4 to 259.8 inches); light gray (10YR 7/2) dry, loam; grayish brown (10YR 5/2) moist; 37 percent sand; 37 percent silt; 26 percent clay; 25 percent coarse prominent yellowish red (5YR 5/6) mottles; massive; friable, very hard, slightly sticky, slightly plastic; 15 percent (common) medium prominent dark greenish gray (5GY 4/1), moist, reduced matrix finely disseminated carbonates; electrical conductivity of 2.85 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.4, pH meter; clear; CaCO3 24.6 percent.

8Ck --- 660 to 742 centimeters (259.8 to 292.1 inches); pale yellow (2.5Y 7/4) dry, sandy loam; light olive brown (2.5Y 5/4) moist; 73 percent sand; 17 percent silt; 10 percent clay; 8 percent medium distinct brownish yellow (10YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic finely disseminated carbonates; electrical conductivity of 2.68 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 22.9 percent.

9C --- 742 to 853 centimeters (292.1 to 335.8 inches); very pale brown (10YR 7/4) dry, extremely gravelly loamy sand; yellowish brown (10YR 5/4) moist; 81 percent sand; 13 percent silt; 6 percent clay; 20 percent medium distinct reddish yellow (7.5YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; 25 percent (many) coarse prominent dark greenish gray (5GY 4/1), moist, reduced matrix; 61 percent subrounded calcareous sandstone gravels; electrical conductivity of 0.71 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; CaCO3 70.7 percent.

12AS022

Pedon ID: 12AS022

Description Date: 11/28/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 0% and 82% fine sand or coarser in control section.

Current Taxonomic Name: DDD family
Current Taxonomic Class: Sandy-skeletal, carbonatic, mesic, Oxyaquic Ustifluvents
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370095E, 4142936N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: stream terrace
Geomorphic Component: Base Slope
Profile Pos: Toeslope
Slope: 6 percent
Elevation: 2095.1 meters (6873.6 feet)
Aspect: 272°
Shape: up/down: Linear; **across:** Convex

Surface Fragments: subrounded sandstone - 20 percent gravels, 3 cobbles, 2 percent stones, and 10 channers.

Drainage: Very poorly drained
Runoff: Low
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Native shrubs

Existing Vegetation: SALVI - sage (*Salvia*); JUSC2 - Rocky Mountain juniper (*Juniperus scopulorum*); PASM - western wheatgrass (Pascopyrum smithii); ELAN - Russian olive (*Elaeagnus angustifolia*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

A --- 0 to 12 centimeters (0 to 4.7 inches); light olive brown (2.5Y 5/3) moist, very gravelly loamy sand; pale yellow (2.5Y 7/3) dry; 84 percent sand; 14 percent silt; 2 percent clay; weak medium subangular blocky parting to single grain structure; very friable, slightly hard, nonsticky, nonplastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; 40 percent subrounded sandstone gravels; electrical conductivity of 0.28 mmhos/cm by EC meter, saturated paste; by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; clear; CaCO3 53.1 percent.

C1 --- 12 to 50 centimeters (4.7 to 19.7 inches); light olive brown (2.5Y 5/3) moist, extremely gravelly sand; light yellowish brown (2.5Y 6/3) dry; 90 percent sand; 8 percent silt; 2 percent clay; 4 percent medium reddish yellow (5YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; common fine roots throughout and common very fine roots throughout; 4 percent (common) medium reddish yellow (5YR 6/6), moist; 33 percent subrounded limestone gravels and 33 percent subrounded sandstone gravels; electrical conductivity of 0.25 mmhos/cm by EC meter, saturated paste; by HCl, 1 normal; very strongly alkaline, pH 9.3, pH meter; clear; CaCO3 62.2 percent.

C2 --- 50 to 87 centimeters (19.7 to 34.3 inches); light yellowish brown (10YR 6/4) moist, extremely gravelly sand; very pale brown (10YR 7/4) dry; 86 percent sand; 12 percent silt; 2 percent clay; 12 percent medium reddish yellow (5YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; common very fine roots throughout; 2 percent (very few) faint carbonate coats on bottom faces of peds; 12 percent (common) medium reddish yellow (5YR 6/6), moist; 30 percent subrounded limestone gravels and 33 percent subrounded sandstone gravels; electrical conductivity of 0.36 mmhos/cm by EC meter, saturated paste; by HCl, 1 normal; very strongly alkaline, pH 9.2, pH meter; gradual; CaCO3 60.5 percent.

C3 --- 87 to 126 centimeters (34.3 to 49.6 inches); light yellowish brown (10YR 6/4) moist, extremely gravelly sand; very pale brown (10YR 7/4) dry; 90 percent sand; 9 percent silt; 1 percent clay; 10 percent medium reddish yellow (5YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; common very fine roots throughout; 10 percent (common) medium reddish yellow (5YR 6/6), moist; 33 percent limestone gravels and 33 percent subrounded sandstone gravels; electrical conductivity of 0.37 mmhos/cm by EC meter, saturated paste; by HCl, 1 normal; strongly alkaline, pH 9, pH meter; clear; CaCO3 61.9 percent.

C4 --- 126 to 160 centimeters (49.6 to 63 inches); gray (2.5Y 6/1) moist, extremely gravelly loamy sand; light gray (2.5Y 7/1) dry; 82 percent sand; 15 percent silt; 3 percent clay; 1 percent medium greenish gray (10Y 6/1) and 4 percent medium yellowish red (5YR 5/6) mottles; single grain; loose, loose, nonsticky, nonplastic; 20 percent (many) greenish gray (10Y 6/1), moist and 5 percent (common) medium yellowish red (5YR 5/6), moist; 35 percent subrounded limestone gravels and 35 percent subrounded sandstone gravels; electrical conductivity of 0.62 mmhos/cm by EC meter, saturated paste; by HCl, 1 normal; strongly alkaline, pH 8.8, pH meter; clear; CaCO3 68.2 percent.

C5 --- 160 to 210 centimeters (63 to 82.7 inches); pale brown (10YR 6/3) moist, extremely gravelly loamy sand; light gray (10YR 7/2) dry; 84 percent sand; 14 percent silt; 2 percent clay; 8 percent medium yellowish red (5YR 5/6) mottles; single grain; loose, loose, nonsticky, nonplastic; 8 percent (common) medium yellowish red (5YR 5/6), moist; 37 percent subrounded limestone gravels and 37 percent subrounded sandstone gravels; electrical conductivity of 0.59 mmhos/cm by EC meter, saturated paste; by HCl, 1 normal; very strongly alkaline, pH 9.2, pH meter; clear; CaCO3 68.6 percent.

2C --- 210 to 232 centimeters (82.7 to 91.3 inches); gray (N 5/) moist, loamy sand; light gray (N 7/) dry; 80 percent sand; 16 percent silt; 4 percent clay; single grain; loose, loose, nonsticky, nonplastic; 1 percent subrounded sandstone gravels; electrical conductivity of 2.01 mmhos/cm by EC meter, saturated paste; by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; CaCO3 22.9 percent.

12AS023

Pedon ID: 12AS023

Description Date: 11/28/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 14% and 56% fine sand or coarser in control section.

Current Taxonomic Name: Bobknoll family
Current Taxonomic Class: Coarse-loamy, mixed, superactive, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370303E, 4143404N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: fan apron, and terrace
Geomorphic Component: Tread
Profile Pos: Summit
Slope: 4 percent
Elevation: 2116 meters (6942.3 feet)
Aspect: 214°
Shape: up/down: Linear; **across:** Linear

Surface Fragments: subangular stone - 5 percent gravels.

Drainage: Well drained
Runoff: Low
Erosion: None - deposition

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: pasture grasses (not identifiable)

Parent Materials: slope alluvium derived from sandstone and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)
Diagnostic Features: Calcic horizon: 18 to 180 centimeters (7.1 to 70.9 inches)

Ap --- 0 to 18 centimeters (0 to 7.1 inches); yellowish brown (10YR 5/4) dry, sandy clay loam; dark brown (10YR 3/3) moist; 50 percent sand; 25 percent silt; 25 percent clay; moderate medium platy structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; 3 percent subangular sandstone gravels; electrical conductivity of 0.41 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 16.7 percent.

Bk1 --- 18 to 47 centimeters (7.1 to 18.5 inches); pale brown (10YR 6/3) dry, sandy clay loam; brown (10YR 5/3) moist; 51 percent sand; 25 percent silt; 24 percent clay; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 2 percent (very few) carbonate coats on bottom surfaces of rock fragments; 5 percent (common) fine masses of carbonate in matrix; 10 percent subangular sandstone gravels; electrical conductivity of 0.32 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; gradual; CaCO3 22.9 percent.

Bk2 --- 47 to 78 centimeters (18.5 to 30.7 inches); light yellowish brown (10YR 6/4) dry, sandy loam; yellowish brown (10YR 5/4) moist; 64 percent sand; 18 percent silt; 18 percent clay; weak fine subangular blocky structure; very friable, slightly hard, nonsticky, nonplastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 5 percent (few) carbonate coats on bottom surfaces of rock fragments; 8 percent (common) fine masses of carbonate in matrix; 3 percent subangular sandstone gravels; electrical conductivity of 0.26 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; gradual; CaCO3 31.5 percent.

Bk3 --- 78 to 120 centimeters (30.7 to 47.2 inches); very pale brown (10YR 7/4) dry, sandy loam; light yellowish brown (10YR 6/4) moist; 60 percent sand; 26 percent silt; 14 percent clay; single grain; loose, loose, nonsticky, nonplastic; common fine roots throughout and common very fine roots throughout; common very fine interstitial pores; 2 percent (very few) carbonate coats on bottom surfaces of rock fragments finely disseminated carbonates; 6 percent subangular sandstone gravels; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; abrupt; CaCO3 22.2 percent.

2C --- 120 to 180 centimeters (47.2 to 70.9 inches); light gray (10YR 7/2) dry, extremely gravelly loamy sand; light brownish gray (10YR 6/2) moist; 84 percent sand; 8 percent silt; 8 percent clay; single grain; loose, loose, nonsticky, nonplastic; common very fine roots throughout; common very fine interstitial pores finely disseminated carbonates; 64 percent subangular sandstone gravels; electrical conductivity of 0.26 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.7, pH meter; no CO_3 coats on Rocks; clear; CaCO3 31.4 percent.

3C --- 180 to 230 centimeters (70.9 to 90.6 inches); very pale brown (10YR 7/3) dry, gravelly loamy sand; pale brown (10YR 6/3) moist; 80 percent sand; 14 percent silt; 6 percent clay; 10 percent medium distinct yellow (10YR 7/6) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; 18 percent subangular calcareous sandstone gravels; electrical conductivity of 0.2 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; CaCO3 19.2 percent.

12AS024

Pedon ID: 12AS024

Description Date: 11/28/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 0% and 76% fine sand or coarser in control section.

Current Taxonomic Name: DDD family
Current Taxonomic Class: Sandy-skeletal, carbonatic, mesic Oxyaquic Ustifluvents
Current Taxon Kind: Taxadjunct

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370261E, 4143588N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: stream terrace, and bar
Geomorphic Component: Tread
Profile Pos: Shoulder
Slope: 6 percent
Elevation: 2110.2 meters (6923.2 feet)
Aspect: 277°
Shape: up/down: Linear; **across:** Convex

Surface Fragments: subrounded sandstone and limestone - 40 percent gravels, 10 cobbles, 5 stones, and 15 percent channers.

Drainage: Poorly drained
Runoff: Low
Erosion: Class 2 - Sheet erosion

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Savanna rangeland

Existing Vegetation: SAME3 - black sage (*Salvia mellifera*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: alluvium derived from limestone and sandstone and/or alluvium derived from calcareous conglomerate

Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)
Diagnostic Features: Aquic conditions: 136 to 305 centimeters (53.5 to 120.1 inches)

A --- 0 to 18 centimeters (0 to 7.1 inches); pale brown (10YR 6/3) dry, extremely gravelly sandy loam; brown (10YR 5/3) moist; 74 percent sand; 20 percent silt; 6 percent clay; weak medium subangular blocky parting to single grain structure; very friable, slightly hard, nonsticky, nonplastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; many very fine interstitial pores; 31 percent subrounded limestone gravels and 32 percent subrounded sandstone gravels; electrical conductivity of 0.22 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; very strongly alkaline, pH 9.1, pH meter; clear; CaCO3 56.7 percent.

C1 --- 18 to 84 centimeters (7.1 to 33.1 inches); very pale brown (10YR 7/4) dry, extremely gravelly loamy sand; light yellowish brown (10YR 6/4) moist; 80 percent sand; 18 percent silt; 2 percent clay; 6 percent medium distinct reddish yellow (7.5YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; common very fine roots throughout; many very fine interstitial pores; 6 percent (common) medium reddish yellow (7.5YR 6/6), moist; 30 percent subrounded limestone gravels and 35 percent subrounded sandstone gravels; electrical conductivity of 0.2 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; very strongly alkaline, pH 9.3, pH meter; gradual; CaCO3 56.6 percent.

C2 --- 84 to 136 centimeters (33.1 to 53.5 inches); pale brown (10YR 6/3) dry, extremely gravelly sand; brown (10YR 5/3) moist; 88 percent sand; 10 percent silt; 2 percent clay; 10 percent medium prominent red (7.5R 5/6) mottles; single grain; loose, loose, nonsticky, nonplastic; common very fine roots throughout; many very fine interstitial pores; 10 percent (common) medium reddish yellow (7.5YR 6/6), moist; 30 percent subrounded 2 limestone gravels and 31 percent subrounded sandstone gravels; electrical conductivity of 0.18 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; very strongly alkaline, pH 9.4, pH meter; clear; CaCO3 55.7 percent.

C3 --- 136 to 186 centimeters (53.5 to 73.2 inches); very pale brown (10YR 7/4) dry, extremely gravelly loamy sand; yellowish brown (10YR 5/4) moist; 84 percent sand; 14 percent silt; 2 percent clay; 20 percent medium prominent reddish yellow (5YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; 20 percent (many) medium reddish yellow (5YR 6/6), moist; 30 percent subrounded limestone gravels and 30 percent subrounded sandstone gravels; electrical conductivity of 0.78 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; very strongly alkaline, pH 9.3, pH meter; gradual; CaCO3 54.7 percent.

C4 --- 186 to 243 centimeters (73.2 to 95.7 inches); light gray (10YR 7/2) dry, very gravelly sand; light brownish gray (10YR 6/2) moist; 88 percent sand; 11 percent silt; 1 percent clay; 15

percent medium prominent reddish yellow (5YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; 3 percent (common) fine prominent dark bluish gray (5B 4/1), moist, reduced matrix; 27 percent subrounded limestone gravels and 27 percent subrounded sandstone gravels; electrical conductivity of 0.55 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; very strongly alkaline, pH 9.1, pH meter; clear; CaCO3 53.7 percent.

2C --- 243 to 305 centimeters (95.7 to 120.1 inches); pale yellow (2.5Y 7/3) dry, loamy sand; light yellowish brown (2.5Y 6/3) moist; 88 percent sand; 12 percent silt; 8 percent clay; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; electrical conductivity of 1.19 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; collection of sample from this horizon required tabs on end of collection tube to keep sample from flowing out.; CaCO3 20.2 percent.

12AS025

Pedon ID: 12AS025

Description Date: 11/29/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 16% and 16% fine sand or coarser in control section.

Current Taxonomic Name: Atlatl family
Current Taxonomic Class: Coarse-loamy, carbonatic, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370090E, 4143492N -- Datum NAD83, Zone 12
Location Description:
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Tread
Profile Pos: Summit
Slope: 2 percent
Elevation: 2091 meters (6860.2 feet)
Aspect: 236°
Shape: up/down: Linear; **across:** Linear

Surface Fragments: none.

Drainage: Poorly drained
Runoff: Low
Erosion: None - deposition

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: MEDIC - alfalfa (*Medicago*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Secondary carbonates: 30 to 101 centimeters (11.8 to 39.8 inches), Calcic horizon: 30 to 101 centimeters (11.8 to 39.8 inches), Secondary carbonates: 123 to 204 centimeters (48.4 to 80.3 inches) and Calcic horizon: 123 to 156 centimeters (48.4 to 61.4 inches)

Ap1 --- 0 to 12 centimeters (0 to 4.7 inches); light brownish gray (10YR 6/2) dry, silt loam; dark grayish brown (10YR 4/2) moist; 22 percent sand; 56 percent silt; 22 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.57 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 27.3 percent.

Ap2 --- 12 to 30 centimeters (4.7 to 11.8 inches); light brownish gray (10YR 6/2) dry, silty clay; dark grayish brown (10YR 4/2) moist; 16 percent sand; 41 percent silt; 43 percent clay; weak medium prismatic parting to moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.5 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; clear; CaCO3 45.3 percent.

Bk1 --- 30 to 70 centimeters (11.8 to 27.6 inches); very pale brown (10YR 8/3) dry, silty clay loam; very pale brown (10YR 7/3) moist; 12 percent sand; 56 percent silt; 32 percent clay; 5 percent fine very pale brown (10YR 7/4) mottles; moderate fine subangular blocky structure; very friable, slightly hard, slightly sticky, slightly plastic; common very fine roots throughout; common very fine tubular pores; 5 percent (common) fine very pale brown (10YR 7/4), moist; 15 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.36 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; gradual; CaCO3 55 percent.

Bk2 --- 70 to 101 centimeters (27.6 to 39.8 inches); white (2.5Y 8/1) dry, loam; light gray (2.5Y 7/2) moist; 32 percent sand; 49 percent silt; 19 percent clay; 15 percent medium very pale brown (10YR 7/4) mottles; moderate medium subangular blocky structure; very friable, slightly hard, slightly sticky, nonplastic; common fine roots throughout; common very fine tubular pores; 15 percent (common) medium very pale brown (10YR 7/4), moist; 25 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.7, pH meter; abrupt; CaCO3 53.3 percent.

2C --- 101 to 123 centimeters (39.8 to 48.4 inches); white (10YR 8/1) dry, loam; light gray (10YR 7/1) moist; 38 percent sand; 46 percent silt; 16 percent clay; 5 percent fine very pale brown (10YR 7/4) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; 5 percent (common) fine very pale brown (10YR 7/4), moist; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 8.8, pH meter; abrupt; CaCO3 44.6 percent.

4Ck --- 123 to 156 centimeters (48.4 to 61.4 inches); white (2.5Y 8/1) dry, clay loam; light gray (2.5Y 7/1) moist; 20 percent sand; 44 percent silt; 36 percent clay; 20 percent medium yellow (2.5Y 7/6) mottles; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common very fine tubular pores; 20 percent (many) medium yellow (2.5Y 7/6), moist; 20 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.33 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 8.8, pH meter; clear; CaCO3 50.1 percent.

5Ck1 --- 156 to 186 centimeters (61.4 to 73.2 inches); pale yellow (2.5Y 8/2) dry, sandy loam; light gray (2.5Y 7/2) moist; 58 percent sand; 26 percent silt; 16 percent clay; 10 percent medium yellow (2.5Y 7/6) mottles; moderate medium subangular blocky structure; very friable, slightly hard, nonsticky, nonplastic; many very fine interstitial pores; 10 percent (common) medium yellow (2.5Y 7/6), moist; 10 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 8.9, pH meter; gradual; CaCO3 30.1 percent.

5Ck2 --- 186 to 204 centimeters (73.2 to 80.3 inches); pale yellow (2.5Y 7/3) dry, sandy loam; light yellowish brown (2.5Y 6/3) moist; 60 percent sand; 32 percent silt; 8 percent clay; 20 percent medium yellow (2.5Y 7/6) mottles; moderate medium subangular blocky structure; very friable, slightly hard, nonsticky, nonplastic; many very fine interstitial pores; 20 percent (many) medium yellow (2.5Y 7/6), moist; 8 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.27 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 8.9, pH meter; CaCO3 30.6 percent.

12AS026

Pedon ID: 12AS026

Description Date: 11/29/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 28% and 23% fine sand or coarser in control section.

Current Taxonomic Name: Wimmer family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369892E, 4143755N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: fan apron, and terrace
Geomorphic Component: Tread
Profile Pos: Toeslope
Slope: 5 percent
Elevation: 2118 meters (6948.8 feet)
Aspect: 177°
Shape: up/down: Linear; **across:** Linear

Surface Fragments: none.

Drainage: Moderately well drained
Runoff: Medium
Erosion: None - deposition

Primary Earth Cover: Grass/herbaceous cover

Existing Vegetation: BROMU - brome (*Bromus*); PASM - western wheatgrass (Pascopyrum smithii) ; ROWO - Woods' rose (*Rosa woodsii*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Secondary carbonates: 3 to 202 centimeters (1.2 to 79.5 inches), Calcic horizon: 20 to 65 centimeters (7.9 to 25.6 inches) and Calcic horizon: 104 to 202 centimeters (40.9 to 79.5 inches)

Oi --- 0 to 3 centimeters (0 to 1.2 inches); decomposing grass and leaves.

Ap --- 3 to 20 centimeters (1.2 to 7.9 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 20 percent sand; 39 percent silt; 41 percent clay; moderate medium platy parting to moderate medium granular structure; very friable, slightly hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; 3 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.73 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 28.8 percent.

Bk1 --- 20 to 65 centimeters (7.9 to 25.6 inches); pale brown (10YR 6/3) dry, clay loam; brown (10YR 5/3) moist; 20 percent sand; 47 percent silt; 33 percent clay; moderate medium subangular blocky structure; friable, slightly hard, slightly sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; 10 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.65 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 33.6 percent.

Bk2 --- 65 to 104 centimeters (25.6 to 40.9 inches); light gray (10YR 7/1) dry, clay loam; gray (10YR 5/1) moist; 30 percent sand; 31 percent silt; 39 percent clay; moderate medium prismatic parting to moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 4 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.51 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 30.9 percent.

Bk3 --- 104 to 144 centimeters (40.9 to 56.7 inches); gray (10YR 6/1) dry, silty clay; gray (10YR 5/1) moist; 10 percent sand; 41 percent silt; 49 percent clay; 2 percent fine prominent reddish yellow (7.5YR 6/6) mottles; moderate medium prismatic parting to strong medium angular blocky structure; firm, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 2 percent (common) fine reddish yellow (7.5YR 6/6), moist; 4 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.51 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 48.8 percent.

Ck --- 144 to 202 centimeters (56.7 to 79.5 inches); white (2.5Y 8/1) dry, clay; light gray (2.5Y 7/2) moist; 20 percent sand; 37 percent silt; 43 percent clay; 15 percent medium prominent reddish yellow (7.5YR 6/6) mottles; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; 15 percent (common) medium reddish yellow (7.5YR 6/6), moist; 30 percent (many) coarse masses of carbonate in matrix; electrical conductivity of 0.36 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; CaCO3 53.8 percent.

12AS027

Pedon ID: 12AS027

Description Date: 11/29/2012
Describer: Robert Long

Pedon Notes: Text: Non-carbonate clay 30% and 23% fine sand and coarser in control section.

Current Taxonomic Name: Wimmer family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 396896E, 4143931N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: fan apron, and terrace
Geomorphic Component: Tread
Profile Pos: Toeslope
Slope: 1 percent
Elevation: 2117.9 meters (6948.5 feet)
Aspect: 45°
Shape: up/down: Linear; **across:** Linear

Surface Fragments: subangular sandstone - 5 percent gravels.

Drainage: Moderately well drained
Runoff: Low
Erosion: None - deposition

Earth Cover: Grass/herbaceous cover

Existing Vegetation: BROMU - brome (*Bromus*); PASM - western wheatgrass (Pascopyrum smithii) ; ROWO - Woods' rose (*Rosa woodsii*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 20 to 100 centimeters (7.9 to 39.4 inches), Secondary carbonates: 52 to 560 centimeters (20.5 to 220.5 inches), Calcic horizon: 52 to 100 centimeters (20.5 to 39.4 inches), Calcic horizon: 116 to 305 centimeters (45.7 to 120.1 inches) and Aquic conditions: 625 to 792 centimeters (246.1 to 311.8 inches)

Ap --- 0 to 20 centimeters (0 to 7.9 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 24 percent sand; 36 percent silt; 40 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.59 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; abrupt; CaCO3 26.4 percent.

Bss --- 20 to 52 centimeters (7.9 to 20.5 inches); light brownish gray (10YR 6/2) dry, clay loam; dark grayish brown (10YR 4/2) moist; 24 percent sand; 40 percent silt; 36 percent clay; moderate medium prismatic parting to moderate medium subangular blocky structure; friable, very hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 25 percent (common) pressure faces on all faces of peds; electrical conductivity of 0.44 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear; CaCO3 26.5 percent.

Bkss --- 52 to 100 centimeters (20.5 to 39.4 inches); pale brown (10YR 6/3) dry, clay loam; brown (10YR 5/3) moist; 26 percent sand; 36 percent silt; 38 percent clay; structure; friable, very hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 5 percent (few) pressure faces on all faces of peds; 3 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.45 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; 2 narrow bands of SL 3-4 cm thick; clear; CaCO3 33.4 percent.

Bk1 --- 100 to 116 centimeters (39.4 to 45.7 inches); light gray (2.5Y 7/1) dry, clay loam; gray (2.5Y 6/1) moist; 34 percent sand; 30 percent silt; 36 percent clay; 10 percent medium prominent brownish yellow (10YR 6/6) mottles; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 5 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.42 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; clear; CaCO3 29 percent.

Bk2 --- 116 to 156 centimeters (45.7 to 61.4 inches); gray (2.5Y 6/1) dry, silty clay loam; gray (2.5Y 5/1) moist; 12 percent sand; 50 percent silt; 38 percent clay; 5 percent medium prominent brownish yellow (10YR 6/6) mottles; moderate medium prismatic parting to strong medium angular blocky structure; firm, very hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 8 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.44 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; abrupt; CaCO3 46.6 percent.

2Bk1 --- 156 to 170 centimeters (61.4 to 66.9 inches); white (2.5Y 8/1) dry, silty clay; light gray (2.5Y 7/1) moist; 6 percent sand; 54 percent silt; 40 percent clay; 10 percent coarse prominent yellow (10YR 7/8) mottles; moderate medium prismatic parting to moderate medium angular blocky structure; friable, very hard, moderately sticky, moderately plastic; common fine roots throughout and many very fine roots throughout; common fine tubular pores; 30 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.45 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; gradual; CaCO3 51.6 percent.

2Bk2 --- 170 to 305 centimeters (66.9 to 120.1 inches); white (2.5Y 8/1) dry, silty clay; light gray (2.5Y 7/1) moist; 0 percent sand; 52 percent silt; 48 percent clay; 30 percent medium prominent reddish yellow (7.5YR 6/6) mottles; moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; 15 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.49 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear; CaCO3 46.2 percent.

2Bk3 --- 305 to 427 centimeters (120.1 to 168.1 inches); gray (2.5Y 6/1) dry, clay; gray (2.5Y 5/1) moist; 12 percent sand; 39 percent silt; 49 percent clay; 15 percent medium prominent brownish yellow (10YR 6/6) mottles; massive; firm, very hard, very sticky, very plastic; 3 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 0.59 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; clear; CaCO3 27.2 percent.

2Ck --- 427 to 560 centimeters (168.1 to 220.5 inches); gray (2.5Y 6/1) dry, silty clay; gray (2.5Y 5/1) moist; 4 percent sand; 37 percent silt; 59 percent clay; 15 percent medium prominent yellow (10YR 7/6) mottles; massive; firm, very hard, very sticky, very plastic finely disseminated carbonates; electrical conductivity of 0.6 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; gradual; CaCO3 29 percent.

3C1 --- 560 to 625 centimeters (220.5 to 246.1 inches); light yellowish brown (2.5Y 6/3) dry, loam; olive brown (2.5Y 4/3) moist; 46 percent sand; 32 percent silt; 22 percent clay; 15 percent coarse prominent brownish yellow (10YR 6/8) and 15 percent medium prominent brownish yellow (10YR 6/8) mottles; massive parting to single grain; friable, hard, slightly sticky, nonplastic; many very fine interstitial pores; electrical conductivity of 0.76 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear; CaCO3 26.5 percent.

3C2 --- 625 to 792 centimeters (246.1 to 311.8 inches); pale yellow (2.5Y 7/4) dry, sandy loam; light yellowish brown (2.5Y 6/4) moist; 64 percent sand; 26 percent silt; 10 percent clay; 35 percent coarse prominent brownish yellow (10YR 6/8) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; electrical conductivity of 0.88 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; CaCO3 24.9 percent.

12AS028

Pedon ID: 12AS028

Description Date: 11/29/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 20% and 24% fine sand and coarser in control section.

Current Taxonomic Name: AAA family
Current Taxonomic Class: Fine-loamy, carbonatic, mesic Aridic Haplustepts
Current Taxon Kind: Taxadjunct

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370260E, 4143851N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace
Anthropogenic Feature:
Geomorphic Component: Tread
Profile Pos: Toeslope
Slope: 4 percent
Elevation: 2121.1 meters (6959.1 feet)
Aspect: 263°
Shape: up/down: Linear; **across:** Linear

Surface Fragments: none.

Drainage: Poorly drained
Runoff: Low
Erosion: None - deposition

Earth Cover: Grass/herbaceous cover

Existing Vegetation: MEDIC - alfalfa (*Medicago*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 12 to 25 centimeters (4.7 to 9.8 inches), Secondary carbonates: 25 to 173 centimeters (9.8 to 68.1 inches), Secondary carbonates: 275 to 325 centimeters (108.3 to 128 inches) and Aquic conditions: 325 to 610 centimeters (128 to 240.2 inches)

Ap1 --- 0 to 12 centimeters (0 to 4.7 inches); light brownish gray (10YR 6/2) dry, clay; dark grayish brown (10YR 4/2) moist; 18 percent sand; 38 percent silt; 44 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.82 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 48.6 percent.

Bss --- 12 to 25 centimeters (4.7 to 9.8 inches); light brownish gray (2.5Y 6/2) dry, silty clay loam; dark grayish brown (2.5Y 4/2) moist; 18 percent sand; 43 percent silt; 39 percent clay; moderate medium subangular blocky parting to strong fine subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; 15 percent (few) pressure faces on vertical faces of peds; electrical conductivity of 0.63 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; abrupt; CaCO3 49.4 percent.

Bk1 --- 25 to 68 centimeters (9.8 to 26.8 inches); pale yellow (2.5Y 8/2) dry, silty clay; light gray (2.5Y 7/2) moist; 10 percent sand; 46 percent silt; 44 percent clay; 5 percent fine prominent pink (7.5YR 7/4) mottles; moderate medium subangular blocky structure; friable, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 5 percent (common) fine pink (7.5YR 7/4), moist; 10 percent (common) medium masses of carbonate on faces of peds; electrical conductivity of 0.36 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; abrupt; CaCO3 53.8 percent.

Bk2 --- 68 to 103 centimeters (26.8 to 40.6 inches); white (2.5Y 8/1) dry, sandy loam; light gray (2.5Y 7/1) moist; 52 percent sand; 36 percent silt; 12 percent clay; 5 percent medium reddish yellow (7.5YR 6/6) and 10 percent fine prominent reddish yellow (7.5YR 6/6) mottles; structure; friable, hard, nonsticky, nonplastic; common very fine roots throughout; common very fine tubular pores; 15 percent (common) fine reddish yellow (7.5YR 6/6), moist; 30 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.34 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; clear; CaCO3 42.6 percent.

Ck1 --- 103 to 128 centimeters (40.6 to 50.4 inches); white (2.5Y 8/1) dry, silty clay loam; light gray (2.5Y 7/1) moist; 12 percent sand; 56 percent silt; 32 percent clay; 25 percent medium prominent reddish yellow (7.5YR 6/6) mottles; moderate medium subangular blocky structure; firm, very hard, slightly sticky, slightly plastic; common very fine roots throughout; 25 percent (many) medium reddish yellow (7.5YR 6/6), moist finely disseminated carbonates; electrical conductivity of 0.36 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; abrupt; CaCO3 47.1 percent.

Ck2 --- 128 to 157 centimeters (50.4 to 61.8 inches); pale yellow (2.5Y 8/2) dry, silty clay; light gray (2.5Y 7/2) moist; 12 percent sand; 46 percent silt; 42 percent clay; 35 percent medium prominent reddish yellow (7.5YR 6/6) mottles; weak medium subangular blocky structure; firm, very hard, very sticky, moderately plastic; common very fine roots throughout; 30 percent (common) clay films on all faces of peds; 35 percent (many) medium reddish yellow (7.5YR 6/6), moist finely disseminated carbonates; electrical conductivity of 0.38 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; abrupt; CaCO3 51.7 percent.

Ck3 --- 157 to 173 centimeters (61.8 to 68.1 inches); white (10YR 8/1) dry, loam; light gray (10YR 7/1) moist; 48 percent sand; 40 percent silt; 12 percent clay; 10 percent fine prominent reddish yellow (7.5YR 6/6) mottles; weak fine subangular blocky structure; friable, extremely hard, nonsticky, nonplastic; common very fine roots throughout finely disseminated carbonates; electrical conductivity of 0.35 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.8, pH meter; Stopped push probe; clear; CaCO3 46.7 percent.

C --- 173 to 235 centimeters (68.1 to 92.5 inches); pale yellow (2.5Y 8/2) dry, loam; light gray (2.5Y 7/1) moist; 50 percent sand; 38 percent silt; 12 percent clay; 40 percent coarse prominent yellow (10YR 7/8) mottles; massive parting to single grain; very friable, hard, nonsticky, nonplastic; common very fine roots throughout; many very fine interstitial pores; electrical conductivity of 0.52 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; abrupt; CaCO3 33.2 percent.

2C --- 235 to 275 centimeters (92.5 to 108.3 inches); grayish brown (2.5Y 5/2) dry, sandy loam; very dark grayish brown (2.5Y 3/2) moist; 72 percent sand; 18 percent silt; 10 percent clay; 5 percent fine prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky parting to single grain structure; very friable, hard, nonsticky, nonplastic; many very fine interstitial pores; electrical conductivity of 0.57 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; clear; CaCO3 18.7 percent.

2Ck --- 275 to 325 centimeters (108.3 to 128 inches); light gray (2.5Y 7/2) dry, sandy loam; light brownish gray (2.5Y 6/2) moist; 72 percent sand; 20 percent silt; 8 percent clay; 10 percent medium prominent reddish yellow (7.5YR 6/8) mottles; weak medium subangular blocky parting to single grain structure; very friable, hard, nonsticky, nonplastic; many very fine interstitial pores finely disseminated carbonates; electrical conductivity of 0.77 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear; CaCO3 21.2 percent.

3C1 --- 325 to 460 centimeters (128 to 181.1 inches); light gray (2.5Y 7/2) dry, loam; light yellowish brown (2.5Y 6/3) moist; 28 percent sand; 46 percent silt; 26 percent clay; 15 percent medium prominent reddish yellow (7.5YR 6/8) mottles; massive; friable, extremely hard, slightly sticky, slightly plastic; common very fine tubular pores; 35 percent (many) coarse prominent light bluish gray (10B 7/1), moist, reduced matrix; electrical conductivity of 2.61 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 27.1 percent.

3C2 --- 460 to 610 centimeters (181.1 to 240.2 inches); light gray (2.5Y 7/2) dry, sandy loam; grayish brown (2.5Y 5/2) moist; 54 percent sand; 32 percent silt; 14 percent clay; 25 percent coarse brownish yellow (10YR 6/8) mottles; massive; friable, extremely hard, nonsticky, nonplastic; many very fine interstitial pores; 40 percent (many) coarse prominent light bluish gray (5PB 7/1), moist; electrical conductivity of 2.38 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; CaCO3 25.3 percent.

12AS029

Pedon ID: 12AS029

Description Date: 11/29/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 38%and 19% fine sand or coarser in control section; This profile appears to colluvium deposited over deep weathering Tropic shale and sandstone.**;** Aquic conditions determined to be from 244 to 610 cm based on saturated conditions and very gravelly sandy loam immediately above the saturated zone.

Current Taxonomic Name: Boxcanyon family
Current Taxonomic Class: Fine, smectitic, mesic Calcidic Haplustalfs
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370221E, 4144330N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: alluvial fan on terrace
Geomorphic Component: Tread
Profile Pos: Toeslope
Slope: 3 percent
Elevation: 2128.2 meters (6982.3 feet)
Aspect: 239°
Shape: up/down: Linear; **across:** Linear

Surface Fragments: subrounded sandstone - 1 percent gravels and 1 percent channers.

Drainage: Somewhat poorly drained
Runoff: Low
Site Ksat Class Upper:
Site Ksat Class Lower:
Erosion: None - deposition

Primary Earth Cover: Crop cover.

Existing Vegetation: MEDIC - alfalfa (*Medicago*)

Parent Materials: alluvium derived from limestone, sandstone, and shale and/or alluvium.

Particle Size Control Section: 14 to 64 centimeters (5.5 to 25.2 inches)
Diagnostic Features: Secondary carbonates: 14 to 58 centimeters (5.5 to 22.8 inches), Argillic horizon: 14 to 86 centimeters (5.5 to 33.9 inches), Calcic horizon: 36 to 58 centimeters (14.2 to 22.8 inches), Secondary carbonates: 86 to 244 centimeters (33.9 to 96.1 inches), Calcic horizon: 86 to 232 centimeters (33.9 to 91.3 inches) and Aquic conditions: 244 to 610 centimeters (96.1 to 240.2 inches).

Ap --- 0 to 14 centimeters (0 to 5.5 inches); light brownish gray (10YR 6/2) dry, sandy clay loam; dark grayish brown (10YR 4/2) moist; 46 percent sand; 24 percent silt; 30 percent clay; weak medium subangular blocky parting to moderate medium granular structure; very friable, slightly hard, slightly sticky, slightly plastic; common coarse roots throughout, common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 1.18 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; clear; CaCO3 25.6 percent.

Btk1 --- 14 to 36 centimeters (5.5 to 14.2 inches); light brownish gray (2.5Y 6/2) dry, clay loam; dark grayish brown (2.5Y 4/2) moist; 32 percent sand; 30 percent silt; 38 percent clay; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common coarse roots throughout, common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 10 percent (few) clay films between sand grains and 20 percent (few) clay films on all faces of peds; 1 percent (few) very fine masses of carbonate on vertical faces of peds; electrical conductivity of 0.4 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 16.5 percent.

Btk2 --- 36 to 58 centimeters (14.2 to 22.8 inches); light brownish gray (2.5Y 6/2) dry, silty clay; grayish brown (2.5Y 5/2) moist; 12 percent sand; 40 percent silt; 48 percent clay; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common coarse roots throughout, common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 40 percent (common) clay films on all faces of peds; 8 percent (common) very fine threadlike masses of carbonate on vertical faces of peds; electrical conductivity of 0.36 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; abrupt; CaCO3 24.1 percent.

2Btb --- 58 to 86 centimeters (22.8 to 33.9 inches); gray (2.5Y 6/1) dry, clay; dark gray (2.5Y 4/1) moist; 2 percent sand; 40 percent silt; 58 percent clay; strong medium angular blocky structure; firm, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 50 percent (many) clay films on all faces of peds; electrical conductivity of 0.45 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; Buried surface; clear; CaCO3 39.2 percent.

2Bk1 --- 86 to 118 centimeters (33.9 to 46.5 inches); very pale brown (10YR 8/3) dry, silty clay; very pale brown (10YR 7/4) moist; 8 percent sand; 34 percent silt; 58 percent clay; 6 percent medium prominent reddish yellow (5YR 6/6) mottles; structure; friable, hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 6 percent (common) medium reddish yellow (5YR 6/6), moist; 25 percent (many) medium masses of carbonate on faces of peds; electrical conductivity of 0.36 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; gradual; CaCO3 51.2 percent.

2Bk2 --- 118 to 173 centimeters (46.5 to 68.1 inches); pale yellow (2.5Y 8/2) dry, silty clay loam; light gray (2.5Y 7/2) moist; 6 percent sand; 56 percent silt; 38 percent clay; 12 percent medium prominent reddish yellow (7.5YR 6/6) mottles; structure; very friable, slightly hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine interstitial pores; 12 percent (common) medium reddish yellow (7.5YR 6/6), moist; 35 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.38 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; clear; CaCO3 57.7 percent.

3Ck1 --- 173 to 232 centimeters (68.1 to 91.3 inches); white (2.5Y 8/1) dry, silty clay; light gray (2.5Y 7/1) moist; 8 percent sand; 40 percent silt; 52 percent clay; 10 percent medium prominent strong brown (7.5YR 5/6) and 15 percent fine prominent strong brown (7.5YR 5/6) mottles; strong medium platy structure; friable, very hard, very sticky, very plastic; common very fine roots throughout; 25 percent (many) fine strong brown (7.5YR 5/6), moist; 20 percent (many) medium masses of carbonate on faces of peds; electrical conductivity of 0.48 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; abrupt; CaCO3 47.1 percent.

3Ck2 --- 232 to 244 centimeters (91.3 to 96.1 inches); gray (2.5Y 6/1) dry, clay loam; gray (2.5Y 5/1) moist; 44 percent sand; 24 percent silt; 32 percent clay; 5 percent fine prominent strong brown (7.5YR 5/6) mottles; massive; very firm, extremely hard, slightly sticky, slightly plastic; 5 percent (common) fine strong brown (7.5YR 5/6), moist; 5 percent (common) medium masses of carbonate on faces of peds; 5 percent subrounded sandstone gravels; electrical conductivity of 4.85 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; compacted sediment; clear; CaCO3 24.9 percent.

4Ck --- 244 to 334 centimeters (96.1 to 131.5 inches); light gray (2.5Y 7/1) dry, very gravelly sandy loam; light brownish gray (2.5Y 6/2) moist; 62 percent sand; 24 percent silt; 14 percent clay; 20 percent coarse prominent brownish yellow (10YR 6/8) mottles; massive parting to single grain; very friable, hard, nonsticky, nonplastic; many very fine interstitial pores; 2 percent (very few) carbonate coats on bottom surfaces of rock fragments; 40 percent subrounded sandstone gravels; electrical conductivity of 5.24 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; 4Ck rock fragments estimated; clear; CaCO3 25.6 percent.

4Cr --- 334 to 500 centimeters (131.5 to 196.9 inches); light yellowish brown (2.5Y 6/4) dry, clay; light olive brown (2.5Y 5/4) moist; 4 percent sand; 40 percent silt; 56 percent clay; 20 percent coarse prominent brownish yellow (10YR 6/6) mottles; massive parting to single grain; very friable, hard, very sticky, very plastic; electrical conductivity of 4.81 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; Box sample resembles Tropic sandstone; requires very strong pressure to break fragments. and contains a 4-6 cm sandy clay loam lens.; clear; CaCO3 23.2 percent.

5Cr --- 500 to 610 centimeters (196.9 to 240.2 inches); gray (5Y 6/1) dry, sandy clay loam; gray (5Y 5/1) moist; 64 percent sand; 16 percent silt; 20 percent clay; 3 percent very fine distinct yellow (2.5Y 7/6) mottles; massive; firm, very hard, slightly sticky, slightly plastic; electrical conductivity of 1.85 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; Resembles weathering Tropic shale and some sections are platy; CaCO3 26.6 percent.

12AS030

Pedon ID: 12AS030

Description Date: 11/29/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 48% and fine sand or coarser 10% in control section.

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370295E, 4144440N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: hills
Landform: hillslope
Geomorphic Component: Side Slope
Profile Pos: Backslope
Slope: 24 percent
Elevation: 2135 meters (7004.6 feet)
Aspect: 197°
Shape: up/down: Linear; **across:** Linear

Surface Fragments: none.

Drainage: Well drained
Runoff: High
Erosion: Class 3 - Sheet erosion

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Shrubby rangeland

Existing Vegetation: AGCR - crested wheatgrass (*Agropyron cristatum*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: residuum
Bedrock: Calcareous sandstone at 95 centimeters (37.4 inches)
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 15 to 42 centimeters (5.9 to 16.5 inches) and Paralithic contact: 95 centimeters (37.4 inches)

Restrictions: Paralithic bedrock: 95 centimeters (37.4 inches)

A1 --- 0 to 15 centimeters (0 to 5.9 inches); light yellowish brown (2.5Y 6/3) dry, clay; light olive brown (2.5Y 5/3) moist; 12 percent sand; 35 percent silt; 53 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; friable, hard, very sticky, very plastic; common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.39 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 21.6 percent.

Bss1 --- 15 to 30 centimeters (5.9 to 11.8 inches); light brownish gray (2.5Y 6/2) dry, clay; grayish brown (2.5Y 5/2) moist; 16 percent sand; 30 percent silt; 54 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; firm, very hard, very sticky, very plastic; common fine roots throughout and many very fine roots throughout; common very fine tubular pores; 40 percent (common) slickensides (pedogenic) on all faces of peds; electrical conductivity of 0.37 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 21.5 percent.

Bss2 --- 30 to 42 centimeters (11.8 to 16.5 inches); light gray (2.5Y 7/2) dry, clay; light brownish gray (2.5Y 6/2) moist; 14 percent sand; 32 percent silt; 54 percent clay; structure; very firm, extremely hard, very sticky, very plastic; common very fine roots throughout; 20 percent (few) slickensides (pedoogenic) on all faces of peds; electrical conductivity of 0.36 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 21.8 percent.

Ck --- 42 to 67 centimeters (16.5 to 26.4 inches); light gray (2.5Y 7/2) dry, clay; light brownish gray (2.5Y 6/2) moist; 10 percent sand; 36 percent silt; 54 percent clay; moderate medium platy structure; very firm, extremely hard, very sticky, very plastic; common very fine roots throughout; 2 percent (very few) carbonate coats on rock fragments; 70 percent angular shale parachanners; electrical conductivity of 0.69 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 21.3 percent.

C --- 67 to 95 centimeters (26.4 to 37.4 inches); light brownish gray (2.5Y 6/2) dry, silty clay; grayish brown (2.5Y 5/2) moist; 10 percent sand; 34 percent silt; 56 percent clay; structure; very firm, extremely hard, very sticky, very plastic; electrical conductivity of 1.57 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; CaCO3 21.6 percent.

Cr --- 95 centimeters (37.4 inches); weathering Tropic shale.

12AS031

Pedon ID: 12AS031

Description Date: 11/29/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 24% and fine sand or coarser 34% in control section.

Current Taxonomic Name: Wimmer family
Current Taxonomic Class: Fine-loamy, superactive, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370459E, 4143562N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace, and alluvial fan
Geomorphic Component: Tread
Profile Pos: Toeslope
Slope: 3 percent
Elevation: 2126 meters (6975.1 feet)
Aspect: 232°
Shape: up/down: Convex; **across:** Linear

Surface Fragments: subangular sandstone - 2 percent gravels and 1 percent channers.

Drainage: Well drained
Runoff: Low
Erosion: None - deposition

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: CHRYS9 - rabbitbrush (*Chrysothamnus*)

Parent Materials: alluvium
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 12 to 71 centimeters (4.7 to 28 inches), Secondary carbonates: 71 to 172 centimeters (28 to 67.7 inches) and Calcic horizon: 71 to 134 centimeters (28 to 52.8 inches)

Ap1 --- 0 to 12 centimeters (0 to 4.7 inches); light yellowish brown (2.5Y 6/3) dry, clay; olive brown (2.5Y 4/3) moist; 20 percent sand; 37 percent silt; 43 percent clay; moderate medium platy parting to moderate medium granular structure; very friable, slightly hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; 2 percent subangular sandstone gravels; electrical conductivity of 0.47 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear smooth boundary; CaCO3 23.3 percent.

ABss --- 12 to 26 centimeters (4.7 to 10.2 inches); light yellowish brown (2.5Y 6/3) dry, clay; olive brown (2.5Y 4/3) moist; 20 percent sand; 35 percent silt; 45 percent clay; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 5 percent (few) slickensides (pedogenic) on all faces of peds; electrical conductivity of 0.46 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear smooth boundary; CaCO3 23.4 percent.

Bss1 --- 26 to 44 centimeters (10.2 to 17.3 inches); light brownish gray (10YR 6/2) dry, clay; dark grayish brown (10YR 4/2) moist; 20 percent sand; 36 percent silt; 44 percent clay; moderate medium prismatic parting to moderate medium angular blocky structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; 40 percent (common) slickensides (pedogenic) on all faces of peds; 2 percent subangular sandstone gravels; electrical conductivity of 0.46 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear smooth boundary; CaCO3 18.4 percent.

Bss2 --- 44 to 71 centimeters (17.3 to 28 inches); pale brown (10YR 6/3) dry, sandy clay loam; brown (10YR 5/3) moist; 46 percent sand; 22 percent silt; 32 percent clay; strong medium prismatic parting to strong medium angular blocky structure; firm, very hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; 2 percent (very few) carbonate coats on bottom surfaces of rock fragments and 40 percent (common) slickensides (pedogenic) on all faces of peds; 5 percent subangular sandstone gravels; electrical conductivity of 0.37 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear smooth boundary; CaCO3 22.4 percent.

Bk1 --- 71 to 108 centimeters (28 to 42.5 inches); very pale brown (10YR 8/3) dry, loam; very pale brown (10YR 7/3) moist; 46 percent sand; 36 percent silt; 18 percent clay; weak medium prismatic parting to moderate medium subangular blocky structure; friable, very hard, nonsticky, slightly plastic; common very fine roots throughout; common very fine interstitial pores; 8 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.29 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; abrupt smooth boundary; CaCO3 36.4 percent.

Bk2 --- 108 to 134 centimeters (42.5 to 52.8 inches); very pale brown (10YR 8/4) dry, sandy loam; very pale brown (10YR 7/4) moist; 68 percent sand; 20 percent silt; 12 percent clay; moderate medium subangular blocky structure; friable, hard, nonsticky, nonplastic; common fine roots throughout and common very fine roots throughout; common very fine interstitial pores; 3 percent (common) fine spherical masses of carbonate in matrix; electrical conductivity of 0.22 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear wavy boundary; CaCO3 35 percent.

Bk3 --- 134 to 172 centimeters (52.8 to 67.7 inches); very pale brown (10YR 7/4) dry, sandy loam; light yellowish brown (10YR 6/4) moist; 74 percent sand; 16 percent silt; 10 percent clay; weak medium subangular blocky parting to single grain structure; loose, soft, nonsticky, nonplastic; common fine roots throughout and common very fine roots throughout; many very fine interstitial pores; 3 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.24 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; CaCO3 24 percent.

12AS032

Pedon ID: 12AS032

Description Date: 11/29/2012
Describer: Robert Long

Pedon Notes: Text: Non carbonate clay 52% and fine sand or coarser 14% in control section.

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369543E, 4142570N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: hills
Landform: fan apron
Anthropogenic Feature:
Geomorphic Component: Side Slope
Profile Pos: Backslope
Slope: 6 percent
Elevation: 2102 meters (6896.3 feet)
Aspect: 144°
Shape: up/down: Linear; **across:** Linear
Surface Fragments: Tropic concretions - 2 percent subangular sandstone cobbles; 5 percent subangular sandstone channers.

Drainage: Well drained
Runoff: Medium
Erosion: None - deposition

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Shrubby rangeland

Surface Fragments: 2 percent subangular sandstone cobbles; and 5 percent subangular sandstone channers.

Existing Vegetation: BROMU - brome (*Bromus*); BRTE - cheatgrass (*Bromus tectorum*); VICIA - vetch (*Vicia*); PLJA - galleta (*Pleuraphis jamesii*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: residuum weathered from calcareous shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Secondary carbonates: 10 to 24 centimeters (3.9 to 9.4 inches), Slickensides: 10 to 66 centimeters (3.9 to 26 inches) and Secondary carbonates: 66 to 165 centimeters (26 to 65 inches)

Ap --- 0 to 10 centimeters (0 to 3.9 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 26 percent sand; 31 percent silt; 43 percent clay; weak medium subangular blocky parting to moderate medium granular structure; very friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine interstitial pores; electrical conductivity of 0.59 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear smooth boundary; $CaCO_3$ 6.5 percent.

Bss1 --- 10 to 24 centimeters (3.9 to 9.4 inches); grayish brown (2.5Y 5/2) dry, clay; olive brown (2.5Y 4/3) moist; 20 percent sand; 31 percent silt; 49 percent clay; moderate medium subangular blocky structure; friable, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; 40 percent (common) slickensides (pedogenic) on all faces of peds; 8 percent (common) fine threadlike masses of carbonate on surfaces along root channels; electrical conductivity of 0.45 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear wavy boundary; $CaCO_3$ 7.6 percent.

Bss2 --- 24 to 66 centimeters (9.4 to 26 inches); gray (10YR 6/1) dry, silty clay; gray (10YR 5/1) moist; 16 percent sand; 28 percent silt; 56 percent clay; moderate coarse prismatic parting to strong medium angular blocky structure; firm, extremely hard, very sticky, slightly plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; 70 percent (many) slickensides (pedogenic) on all faces of peds; electrical conductivity of 0.79 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear smooth boundary; $CaCO_3$ 12.4 percent.

Bk1 --- 66 to 143 centimeters (26 to 56.3 inches); pale yellow (2.5Y 8/2) dry, clay; light gray (2.5Y 7/2) moist; 16 percent sand; 24 percent silt; 60 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; firm, extremely hard, very sticky, very plastic; common very fine roots throughout; 20 percent (few) very dark grayish brown (2.5Y 3/2), moist, skeletans on all faces of peds; 30 percent (many) medium threadlike masses of carbonate in matrix; electrical conductivity of 4.96 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear smooth boundary; $CaCO_3$ 9.1 percent.

Bk2 --- 143 to 165 centimeters (56.3 to 65 inches); light brownish gray (2.5Y 6/2) dry, clay; grayish brown (2.5Y 5/2) moist; 16 percent sand; 31 percent silt; 53 percent clay; weak medium subangular blocky structure; friable, very hard, very sticky, very plastic; common very fine tubular pores; 10 percent (few) very dark grayish brown (2.5Y 3/2), moist, skeletans on all faces of peds; 10 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 6.16 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; $CaCO_3$ 9.3 percent.

13AS01

Pedon ID: 13AS01

Description Date: 11/12/2013
Describer: Robert Long

Current Taxonomic Name: BBB family
Current Taxonomic Class: Fine-loamy, carbonatic, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369815E, 4143018N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: hillslope
Geomorphic Component: Interfluve
Profile Pos: Summit
Slope: 6 percent
Elevation: 2085 meters (6840.6 feet)
Aspect: 222°
Shape: up/down: Convex; **across:** Linear
Surface Fragments: none.

Drainage: Well drained
Runoff: Medium
Erosion: Class 2 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland

Existing Vegetation: PASM - western wheatgrass (*Pascopyrum smithii*); AGCR - crested wheatgrass (*Agropyron cristatum*); CHRYS9 - rabbitbrush (*Chrysothamnus*); THIN6 - intermediate wheatgrass (*Thinopyrum intermedium*)

Parent Materials: residuum weathered from sandstone and shale
Bedrock: Moderately cemented calcareous shale at 475 centimeters (187 inches)
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Secondary carbonates: 18 to 180 centimeters (7.1 to 70.9 inches), Calcic horizon: 18 to 180 centimeters (7.1 to 70.9 inches), Paralithic contact: 180 to 580 centimeters (70.9 to 228.3 inches) and Secondary carbonates: 213 to 475 centimeters (83.9 to 187 inches)

Restrictions: Paralithic bedrock: 180 to 580 centimeters (70.9 to 228.3 inches)

A --- 0 to 18 centimeters (0 to 7.1 inches); brown (10YR 5/3) dry, clay; dark grayish brown (10YR 4/2) moist; 24 percent sand; 35 percent silt; 41 percent clay; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.45 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; clear; CaCO3 36.7 percent.

Bk1 --- 18 to 45 centimeters (7.1 to 17.7 inches); pink (7.5YR 7/3) dry, clay; light brown (7.5YR 6/3) moist; 24 percent sand; 33 percent silt; 43 percent clay; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 12 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.17 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 45.9 percent.

Bk2 --- 45 to 106 centimeters (17.7 to 41.7 inches); pale yellow (2.5Y 8/2) dry, clay loam; pale yellow (2.5Y 7/3) moist; 24 percent sand; 37 percent silt; 39 percent clay; structure; friable, hard, very sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; 20 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.24 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; gradual; CaCO3 49 percent.

Bk3 --- 106 to 180 centimeters (41.7 to 70.9 inches); pale yellow (2.5Y 8/2) dry, loam; pale yellow (2.5Y 7/3) moist; 39 percent sand; 40 percent silt; 21 percent clay; weak medium subangular blocky parting to moderate medium granular structure; friable, hard, slightly sticky, slightly plastic; common very fine roots throughout; 30 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; clear; CaCO3 39.9 percent.

Cr --- 180 to 213 centimeters (70.9 to 83.9 inches); sandy loam; 70 percent sand; 20 percent silt; 10 percent clay; by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; Soft weathered sandstone; clear; CaCO3 23.3 percent.

2Crk1 --- 213 to 320 centimeters (83.9 to 126 inches); clay; 36 percent sand; 24 percent silt; 40 percent clay; 15 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.59 mmhos/cm by EC meter, saturated paste; by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; Weathered Tropic shale; gradual; CaCO3 42.5 percent.

2Crk2 --- 320 to 475 centimeters (126 to 187 inches); loam; 44 percent sand; 32 percent silt; 24 percent clay; 10 percent (common) medium threadlike masses of carbonate in matrix; electrical conductivity of 0.65 mmhos/cm by EC meter, saturated paste; by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; Weathered Tropic shale; gradual; CaCO3 17.5 percent.

2Cr --- 475 to 580 centimeters (187 to 228.3 inches); Tropic shale.

13AS02

Pedon ID: 13AS02

Description Date: 11/13/2013
Describer: Robert Long

Current Taxonomic Name: Wimmer family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370234E, 4142449N -- Datum NAD83, Zone 12
Location Description:
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: hillslope
Geomorphic Component: Side Slope
Profile Pos: Backslope
Slope: 2 percent
Elevation: 2073 meters (6801.2 feet)
Aspect: 297°
Shape: up/down: Linear; **across:** Convex

Surface Fragments: none.

Drainage: Well drained
Runoff: Low
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Shrubby rangeland

Existing Vegetation: ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: residuum weathered from calcareous shale
Bedrock: at 76 centimeters (29.9 inches)
Particle Size Control Section: 25 to 76 centimeters (9.8 to 29.9 inches)

Diagnostic Features: Slickensides: 10 to 42 centimeters (3.9 to 16.5 inches), Calcic horizon: 42 to 76 centimeters (16.5 to 29.9 inches) and Paralithic contact: 76 centimeters (29.9 inches)

Restrictions: Paralithic bedrock: 76 centimeters (29.9 inches)

A --- 0 to 10 centimeters (0 to 3.9 inches); pale brown (10YR 6/3) dry, clay loam; grayish brown (10YR 5/2) moist; 38 percent sand; 31 percent silt; 31 percent clay; moderate medium platy structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.21 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 14.8 percent.

Bss --- 10 to 42 centimeters (3.9 to 16.5 inches); brown (10YR 5/3) dry, clay loam; dark grayish brown (10YR 4/2) moist; 32 percent sand; 36 percent silt; 32 percent clay; moderate medium prismatic parting to strong medium angular blocky structure; firm, very hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 30 percent (common) slickensides (pedoogenic) on all faces of peds; electrical conductivity of 0.18 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 21.3 percent.

Bk --- 42 to 76 centimeters (16.5 to 29.9 inches); light brownish gray (2.5Y 6/2) dry, clay loam; light olive brown (2.5Y 5/3) moist; 34 percent sand; 32 percent silt; 34 percent clay; strong medium angular blocky structure; firm, very hard, moderately sticky, moderately plastic; common very fine roots throughout; 3 percent (common) fine threadlike carbonate concretions in matrix; 10 percent shale parachanners; electrical conductivity of 0.19 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; gradual; CaCO3 23.9 percent.

Cr --- 76 to 80 centimeters (29.9 to 31.5 inches); Tropic shale.

13AS03

Pedon ID: 13AS03

Description Date: 11/13/2013
Describer: Robert Long

Current Taxonomic Name: Teromote family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Haplustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370414E, 4142444N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: hillslope
Geomorphic Component: Side Slope
Profile Pos: Backslope
Slope: 6 percent
Elevation: 2083 meters (6834 feet)
Aspect: 239°
Shape: up/down: Linear; **across:** Linear

Surface Fragments: subangular sandstone - 1 percent gravels.

Drainage: Well drained
Runoff: Medium
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Shrubby rangeland

Existing Vegetation: ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: residuum weathered from shale
Bedrock: Strongly cemented calcareous shale at 164 centimeters (64.6 inches)
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 18 to 135 centimeters (7.1 to 53.1 inches), Secondary carbonates: 44 to 164 centimeters (17.3 to 64.6 inches) and Paralithic contact: 164 centimeters (64.6 inches)

Restrictions: Paralithic bedrock: 164 centimeters (64.6 inches)

A --- 0 to 18 centimeters (0 to 7.1 inches); light olive brown (2.5Y 5/3) dry, clay loam; olive brown (2.5Y 4/3) moist; 36 percent sand; 31 percent silt; 33 percent clay; moderate fine subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.24 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; clear; CaCO3 18.6 percent.

Bss --- 18 to 44 centimeters (7.1 to 17.3 inches); light yellowish brown (2.5Y 6/3) dry, clay loam; olive brown (2.5Y 4/3) moist; 36 percent sand; 30 percent silt; 34 percent clay; moderate medium prismatic parting to strong medium angular blocky structure; firm, very hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 50 percent (many) slickensides (pedogenic) on all faces of peds; electrical conductivity of 0.24 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 21.4 percent.

Bkss1 --- 44 to 66 centimeters (17.3 to 26 inches); pale yellow (2.5Y 7/3) dry, clay loam; light olive brown (2.5Y 5/3) moist; 38 percent sand; 26 percent silt; 36 percent clay; strong medium prismatic parting to strong medium angular blocky structure; firm, very hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; 75 percent (many) slickensides (pedogenic) on all faces of peds; 3 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.2 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; gradual; CaCO3 21.3 percent.

Bkss2 --- 66 to 135 centimeters (26 to 53.1 inches); light yellowish brown (2.5Y 6/3) dry, clay loam; light olive brown (2.5Y 5/3) moist; 38 percent sand; 27 percent silt; 35 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; firm, very hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; 60 percent (many) slickensides (pedogenic) on all faces of peds; 7 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.95 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; clear; CaCO3 22.4 percent.

Bk --- 135 to 164 centimeters (53.1 to 64.6 inches); light brownish gray (2.5Y 6/2) dry, clay loam; grayish brown (2.5Y 5/2) moist; 38 percent sand; 26 percent silt; 36 percent clay; moderate medium subangular blocky structure; firm, very hard, moderately sticky, moderately plastic; common very fine roots throughout; 6 percent (common) fine masses of carbonate in matrix; 10 percent angular calcareous sandstone gravels; electrical conductivity of 0.46 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; gradual; CaCO3 21.8 percent.

Cr --- 164 to 240 centimeters (64.6 to 94.5 inches); Weathered Tropic shale.

13AS04

Pedon ID: 13AS04

Description Date: 1/13/2013
Describer: Robert Long

Current Taxonomic Name: Brumley family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Calcidic Haplustalfs
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370429E, 4142621N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: hills
Landform: alluvial fan
Geomorphic Component: Side Slope
Profile Pos: Footslope
Slope: 12 percent
Elevation: 2090 meters (6857 feet)
Aspect: 178°
Shape: up/down: Linear; **across:** Linear

Surface Fragments: none.

Drainage: Well drained
Runoff: Medium
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Shrubby rangeland

Existing Vegetation: ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*); CHRYS9 - rabbitbrush (*Chrysothamnus*)

Parent Materials: slope alluvium derived from sandstone and shale
Particle Size Control Section: 13 to 63 centimeters (5.1 to 24.8 inches)

Diagnostic Features: Argillic horizon: 13 to 90 centimeters (5.1 to 35.4 inches), Secondary carbonates: 40 to 210 centimeters (15.7 to 82.7 inches) and Calcic horizon: 40 to 210 centimeters (15.7 to 82.7 inches)

A --- 0 to 13 centimeters (0 to 5.1 inches); brown (10YR 5/3) dry, sandy clay loam; dark grayish brown (10YR 4/2) moist; 50 percent sand; 27 percent silt; 23 percent clay; weak medium platy parting to moderate medium granular structure; friable, hard, slightly sticky, slightly plastic; common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.24 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 6.3 percent.

Bt1 --- 13 to 40 centimeters (5.1 to 15.7 inches); brown (10YR 5/3) dry, sandy clay loam; dark grayish brown (10YR 4/2) moist; 48 percent sand; 25 percent silt; 27 percent clay; moderate medium prismatic parting to moderate medium subangular blocky structure; firm, very hard, slightly sticky, slightly plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 65 percent (many) clay films on all faces of peds; electrical conductivity of 0.21 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 10.2 percent.

Btk --- 40 to 90 centimeters (15.7 to 35.4 inches); light yellowish brown (2.5Y 6/3) dry, clay loam; light olive brown (2.5Y 5/3) moist; 42 percent sand; 27 percent silt; 31 percent clay; moderate medium subangular blocky structure; firm, very hard, moderately sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; 65 percent (many) clay films on all faces of peds; 2 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.18 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; gradual; CaCO3 15.2 percent.

Bk1 --- 90 to 150 centimeters (35.4 to 59.1 inches); light yellowish brown (2.5Y 6/3) dry, clay loam; light olive brown (2.5Y 5/3) moist; 40 percent sand; 28 percent silt; 32 percent clay; moderate medium subangular blocky structure; firm, very hard, moderately sticky, moderately plastic; common very fine roots throughout; 5 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.2 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear; CaCO3 17.3 percent.

Bk2 --- 150 to 210 centimeters (59.1 to 82.7 inches); pale yellow (2.5Y 7/3) dry, sandy clay loam; light yellowish brown (2.5Y 6/3) moist; 46 percent sand; 24 percent silt; 30 percent clay; moderate medium subangular blocky structure; friable, very hard, moderately sticky, moderately plastic; 10 percent (common) fine threadlike masses of carbonate in matrix; 5 percent subangular sandstone gravels; electrical conductivity of 0.4 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; CaCO3 17.5 percent.

13AS05

Pedon ID: 13AS05

Description Date: 11/13/2013
Describer: Robert Long

Current Taxonomic Name: Teromote
Current Taxonomic Class: Fine-loamy, superactive, mesic Aridic Haplustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370234E, 4142501N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: hillslope
Geomorphic Component: Head Slope
Profile Pos: Backslope
Slope: 4 percent
Elevation: 2076 meters (6811 feet)
Aspect: 256°
Shape: up/down: Linear; **across:** Convex

Surface Fragments: subrounded sandstone - 3 percent gravels.

Drainage: Well drained
Runoff: High
Erosion: Class 2 - Sheet erosion

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Shrubby rangeland

Existing Vegetation: ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: alluvium derived from shale and/or residuum weathered from shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 10 to 300 centimeters (3.9 to 118.1 inches), Secondary carbonates: 49 to 153 centimeters (19.3 to 60.2 inches) and Gypsum accumulations: 153 to 516 centimeters (60.2 to 203.1 inches)

A --- 0 to 10 centimeters (0 to 3.9 inches); light olive brown (2.5Y 5/3) dry, clay loam; olive brown (2.5Y 4/3) moist; 34 percent sand; 31 percent silt; 35 percent clay; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.2 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear; $CaCO_3$ 17.1 percent.

Bss1 --- 10 to 24 centimeters (3.9 to 9.4 inches); light olive brown (2.5Y 5/3) dry, clay loam; olive brown (2.5Y 4/3) moist; 34 percent sand; 28 percent silt; 38 percent clay; moderate medium prismatic parting to moderate medium angular blocky structure; firm, very hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 40 percent (common) slickensides (pedogenic) on all faces of peds; electrical conductivity of 1.05 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; clear; $CaCO_3$ 18 percent.

Bss2 --- 24 to 49 centimeters (9.4 to 19.3 inches); light brownish gray (2.5Y 6/2) dry, clay loam; grayish brown (2.5Y 5/2) moist; 28 percent sand; 33 percent silt; 39 percent clay; moderate medium prismatic parting to strong medium angular blocky structure; firm, very hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; 65 percent (many) slickensides (pedogenic) on all faces of peds; electrical conductivity of 0.33 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; gradual; $CaCO_3$ 18.9 percent.

Bkss1 --- 49 to 90 centimeters (19.3 to 35.4 inches); light yellowish brown (2.5Y 6/3) dry, clay loam; light olive brown (2.5Y 5/3) moist; 32 percent sand; 29 percent silt; 39 percent clay; weak medium prismatic parting to moderate medium angular blocky structure; firm, very hard, moderately sticky, moderately plastic; common very fine roots throughout; 35 percent (common) slickensides (pedogenic) on all faces of peds; 2 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 0.92 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; $CaCO_3$ 19.4 percent.

Bkss2 --- 90 to 153 centimeters (35.4 to 60.2 inches); light brownish gray (2.5Y 6/2) dry, clay; light olive brown (2.5Y 5/3) moist; 10 percent sand; 37 percent silt; 53 percent clay; moderate medium angular blocky structure; firm, very hard, very sticky, very plastic; common very fine roots throughout; 30 percent (common) slickensides (pedogenic) on all faces of peds; 6 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 2.2 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; gradual; $CaCO_3$ 22.1 percent.

Bssy1 --- 153 to 242 centimeters (60.2 to 95.3 inches); light brownish gray (2.5Y 6/2) dry, clay; light olive brown (2.5Y 5/3) moist; 32 percent sand; 18 percent silt; 50 percent clay; moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; 10 percent (few) slickensides (pedogenic) on all faces of peds; 5 percent (common) medium spherical gypsum crystals in matrix and 15 percent (common) fine threadlike gypsum crystals in matrix; electrical conductivity of 2.63 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; gradual; CaCO3 22.8 percent.

Bssy2 --- 242 to 300 centimeters (95.3 to 118.1 inches); light yellowish brown (2.5Y 6/3) dry, clay; light olive brown (2.5Y 5/3) moist; 10 percent sand; 37 percent silt; 53 percent clay; moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; 10 percent (common) medium spherical gypsum crystals in matrix; electrical conductivity of 2.3 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 22.9 percent.

By --- 300 to 394 centimeters (118.1 to 155.1 inches); light gray (2.5Y 7/2) dry, clay; light olive brown (2.5Y 5/3) moist; 14 percent sand; 35 percent silt; 51 percent clay; weak medium subangular blocky structure; firm, very hard, very sticky, very plastic; 2 percent (common) fine threadlike gypsum crystals in matrix; 2 percent subangular sandstone gravels; electrical conductivity of 1.17 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 24.3 percent.

Cy --- 394 to 516 centimeters (155.1 to 203.1 inches); pale yellow (2.5Y 7/3) dry, clay; light olive brown (2.5Y 5/3) moist; 40 percent sand; 14 percent silt; 46 percent clay; weak medium subangular blocky structure; friable, very hard, very sticky, very plastic; 1 percent (few) fine spherical gypsum crystals in matrix; electrical conductivity of 1.06 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; CaCO3 23.8 percent.

13AS06

Pedon ID: 13AS06

Description Date: 11/13/2013
Describer: Robert Long

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370184E, 4142476N -- Datum NAD83, Zone 12
Location Description:
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Tread
Profile Pos: Toeslope
Slope: 4 percent
Elevation: 2073 meters (6801.2 feet)
Aspect: 248°
Shape: up/down: Linear; **across:** Linear

Surface Fragments: none.

Drainage: Well drained**:**
Erosion: Class 2 - Gully erosion

Earth Cover: Grassland rangeland

Existing Vegetation: ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*); CHRYS9 - rabbitbrush (*Chrysothamnus*)

Parent Materials: alluvium derived from calcareous shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 38 to 245 centimeters (15 to 96.5 inches) and Secondary carbonates: 68 to 632 centimeters (26.8 to 248.8 inches)

A --- 0 to 13 centimeters (0 to 5.1 inches); light olive brown (2.5Y 5/3) dry, clay loam; olive brown (2.5Y 4/3) moist; 23 percent sand; 38 percent silt; 39 percent clay; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.55 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear; CaCO3 16.1 percent.

BA --- 13 to 38 centimeters (5.1 to 15 inches); light olive brown (2.5Y 5/3) dry, sandy clay; olive brown (2.5Y 4/3) moist; 46 percent sand; 12 percent silt; 42 percent clay; moderate medium platy parting to moderate medium angular blocky structure; firm, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.37 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 18.9 percent.

Bss --- 38 to 68 centimeters (15 to 26.8 inches); light brownish gray (2.5Y 6/2) dry, clay; grayish brown (2.5Y 5/2) moist; 16 percent sand; 37 percent silt; 47 percent clay; moderate medium prismatic parting to strong medium angular blocky structure; firm, very hard, very sticky, very plastic; common very fine roots throughout; 30 percent (common) slickensides (pedogenic) on vertical faces of peds; electrical conductivity of 0.39 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; clear; CaCO3 20.8 percent.

Bkss1 --- 68 to 112 centimeters (26.8 to 44.1 inches); light brownish gray (2.5Y 6/2) dry, clay; light olive brown (2.5Y 5/3) moist; 16 percent sand; 33 percent silt; 51 percent clay; weak medium prismatic parting to moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; common very fine roots throughout; 35 percent (common) slickensides (pedogenic) on all faces of peds; 5 percent (common) medium lenticular masses of carbonate in matrix and 12 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 3.2 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; gradual; CaCO3 21.3 percent.

Bkss2 --- 112 to 170 centimeters (44.1 to 66.9 inches); light gray (2.5Y 7/2) dry, sandy clay; light olive brown (2.5Y 5/3) moist; 47 percent sand; 4 percent silt; 49 percent clay; moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; 20 percent (few) slickensides (pedogenic) on vertical faces of peds; 7 percent (common) fine threadlike masses of carbonate in matrix and 18 percent (common) medium lenticular masses of carbonate in matrix; electrical conductivity of 3.17 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear; CaCO3 24 percent.

Bkss3 --- 170 to 245 centimeters (66.9 to 96.5 inches); light yellowish brown (2.5Y 6/3) dry, clay; light olive brown (2.5Y 5/3) moist; 18 percent sand; 36 percent silt; 46 percent clay; moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; 15 percent (few) slickensides (pedogenic) on vertical faces of peds; 7 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 2.87 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 24 percent.

Bk1 --- 245 to 315 centimeters (96.5 to 124 inches); light brownish gray (2.5Y 6/2) dry, sandy clay; light olive brown (2.5Y 5/3) moist; 48 percent sand; 11 percent silt; 41 percent clay; 30 percent coarse light olive brown (2.5Y 5/6) mottles; moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; 3 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 2.4 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear; CaCO3 22.4 percent.

Bk2 --- 315 to 396 centimeters (124 to 155.9 inches); light brownish gray (2.5Y 6/2) dry, clay; light olive brown (2.5Y 5/3) moist; 12 percent sand; 35 percent silt; 53 percent clay; 20 percent coarse olive yellow (2.5Y 6/6) mottles; weak medium subangular blocky structure; firm, very hard, very sticky, very plastic; 10 percent (common) medium lenticular masses of carbonate in matrix; 5 percent subangular sandstone gravels; electrical conductivity of 2.93 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 24.1 percent.

Bk3 --- 396 to 457 centimeters (155.9 to 179.9 inches); light brownish gray (2.5Y 6/2) dry, sandy clay; light olive brown (2.5Y 5/3) moist; 56 percent sand; 8 percent silt; 36 percent clay; 20 percent coarse olive yellow (2.5Y 6/6) mottles; weak medium subangular blocky structure; firm, very hard, moderately sticky, moderately plastic; 3 percent (common) medium lenticular masses of carbonate in matrix and 7 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 1.67 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; gradual; CaCO3 23 percent.

Bk4 --- 457 to 579 centimeters (179.9 to 228 inches); light brownish gray (2.5Y 6/2) dry, clay; light olive brown (2.5Y 5/3) moist; 10 percent sand; 39 percent silt; 51 percent clay; 25 percent coarse olive yellow (2.5Y 6/6) mottles; massive; firm, very hard, very sticky, very plastic; 10 percent (common) medium lenticular masses of carbonate in matrix; electrical conductivity of 1.41 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; gradual; CaCO3 23.5 percent.

Bk5 --- 579 to 632 centimeters (228 to 248.8 inches); light gray (2.5Y 7/2) dry, clay; light olive brown (2.5Y 5/3) moist; 32 percent sand; 19 percent silt; 49 percent clay; 5 percent medium yellowish brown (10YR 5/8) and 15 percent coarse olive yellow (2.5Y 6/6) mottles; massive; firm, very hard, very sticky, very plastic; 5 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.85 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; abrupt; CaCO3 25.3 percent.

2C1 --- 632 to 770 centimeters (248.8 to 303.1 inches); very pale brown (10YR 7/3) dry, loamy sand; (10Y 6/3) moist; 82 percent sand; 13 percent silt; 5 percent clay; 5 percent fine yellowish brown (10YR 5/8) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; 25 percent subangular sandstone gravels; electrical conductivity of 0.41 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.9, pH meter; gradual; CaCO3 51.9 percent.

2C2 --- 770 to 838 centimeters (303.1 to 329.9 inches); pale yellow (2.5Y 7/4) dry, loamy sand; light yellowish brown (2.5Y 6/4) moist; 86 percent sand; 6 percent silt; 8 percent clay; 20 percent medium brownish yellow (10YR 6/8) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; 10 percent subangular sandstone gravels; electrical conductivity of 0.6 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; abrupt; CaCO3 28.2 percent.

3C --- 838 to 884 centimeters (329.9 to 348 inches); pale yellow (2.5Y 7/3) dry, sandy loam; light yellowish brown (2.5Y 6/3) moist; 64 percent sand; 21 percent silt; 15 percent clay; 10 percent medium yellow (10YR 7/6) mottles; massive; firm, very hard, nonsticky, nonplastic; electrical conductivity of 0.57 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; CaCO3 26.1 percent.

13AS07

Pedon ID: 13AS07

Description Date: 11/13/2013
Describer: Robert Long

Current Taxonomic Name: Boxcanyon family similar
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Calcidic Haplustalfs
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369982E, 4142493N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: terrace and
Geomorphic Component: Tread
Profile Pos: Footslope
Slope: 10 percent
Elevation: 2067 meters (6781.5 feet)
Aspect: 125°
Shape: up/down: Concave; **across:** Concave

Surface Fragments: subrounded sandstone - 25 percent gravels.

Drainage: Well drained
Runoff: Medium
Erosion: Class 1 - Rill erosion

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Shrubby rangeland

Existing Vegetation: BRIN2 - smooth brome (*Bromus inermis*); CHRYS9 - rabbitbrush (*Chrysothamnus*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 19 to 67 centimeters (7.5 to 26.4 inches)

Diagnostic Features: Argillic horizon: 19 to 67 centimeters (7.5 to 26.4 inches), Secondary carbonates: 46 to 656 centimeters (18.1 to 258.3 inches), Calcic horizon: 67 to 183 centimeters (26.4 to 72 inches) and Aquic conditions: 532 to 732 centimeters (209.4 to 288.2 inches)

A --- 0 to 19 centimeters (0 to 7.5 inches); pale brown (10YR 6/3) dry, clay loam; yellowish brown (10YR 5/4) moist; 28 percent sand; 36 percent silt; 36 percent clay; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.62 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; $CaCO_3$ 20.5 percent.

Bt --- 19 to 46 centimeters (7.5 to 18.1 inches); very pale brown (10YR 7/4) dry, clay; yellowish brown (10YR 5/4) moist; 32 percent sand; 23 percent silt; 45 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; firm, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 60 percent (many) clay films on all faces of peds; electrical conductivity of 0.72 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; $CaCO_3$ 35.6 percent.

Btk --- 46 to 67 centimeters (18.1 to 26.4 inches); very pale brown (10YR 7/3) dry, clay; yellowish brown (10YR 5/4) moist; 22 percent sand; 37 percent silt; 41 percent clay; moderate medium prismatic parting to moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; 20 percent (few) clay films between sand grains and 40 percent (common) clay films on all faces of peds; 5 percent (common) fine threadlike masses of carbonate in matrix and 20 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.75 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; abrupt; $CaCO_3$ 30.9 percent.

Bk --- 67 to 183 centimeters (26.4 to 72 inches); light gray (10YR 7/2) dry, parachannery sandy clay loam; grayish brown (10YR 5/2) moist; 52 percent sand; 16 percent silt; 32 percent clay; moderate medium subangular blocky and moderate fine subangular blocky structure; loose, loose, moderately sticky, moderately plastic; common very fine roots throughout; many very fine interstitial pores; 15 percent (common) medium masses of carbonate in matrix; 25 percent angular calcareous shale parachanners; electrical conductivity of 0.29 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; gradual; $CaCO_3$ 43.1 percent.

2Bk --- 183 to 305 centimeters (72 to 120.1 inches); light yellowish brown (2.5Y 6/3) dry, sandy loam; light olive brown (2.5Y 5/3) moist; 76 percent sand; 15 percent silt; 9 percent clay; single grain; loose, loose, nonsticky, nonplastic; common very fine roots throughout; many very fine tubular pores finely disseminated carbonates; 5 percent subangular calcareous shale parachanners and 5 percent subrounded sandstone gravels; electrical conductivity of 0.27 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; gradual; CaCO3 18.7 percent.

3Bk1 --- 305 to 427 centimeters (120.1 to 168.1 inches); pale yellow (2.5Y 7/3) dry, very gravelly loamy sand; light yellowish brown (2.5Y 6/3) moist; 80 percent sand; 12 percent silt; 8 percent clay; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; 5 percent (few) faint carbonate coats on rock fragments finely disseminated carbonates; 20 percent subrounded sandstone gravels and 25 percent subrounded limestone gravels; electrical conductivity of 0.53 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; diffuse; CaCO3 56.7 percent.

3Bk2 --- 427 to 532 centimeters (168.1 to 209.4 inches); pale yellow (2.5Y 7/4) dry, extremely gravelly loamy sand; light yellowish brown (2.5Y 6/4) moist; 78 percent sand; 16 percent silt; 6 percent clay; 3 percent fine prominent reddish yellow (7.5YR 6/6) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; 3 percent (very few) faint carbonate coats on rock fragments finely disseminated carbonates; 35 percent subrounded limestone gravels and 40 percent subrounded calcareous sandstone gravels; electrical conductivity of 0.58 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; clear; CaCO3 68.8 percent.

3Ckg --- 532 to 656 centimeters (209.4 to 258.3 inches); light brownish gray (2.5Y 6/2) dry, extremely gravelly loamy sand; grayish brown (2.5Y 5/2) moist; 84 percent sand; 9 percent silt; 7 percent clay; 3 percent fine distinct light olive brown (2.5Y 5/4) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; 3 percent (very few) faint carbonate coats on rock fragments finely disseminated carbonates; 35 percent subrounded limestone gravels and 40 percent subrounded calcareous sandstone gravels; electrical conductivity of 1.47 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; abrupt; CaCO3 43.1 percent.

4Cg --- 656 to 732 centimeters (258.3 to 288.2 inches); gray (2.5Y 6/1) dry, clay; gray (2.5Y 5/1) moist; 26 percent sand; 28 percent silt; 46 percent clay; 10 percent medium distinct light yellowish brown (2.5Y 6/4) and 15 percent medium gray (N 6/) mottles; massive; firm, very hard, very sticky, very plastic; electrical conductivity of 0.63 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; CaCO3 12 percent.

13AS08

Pedon ID: 13AS08

Description Date: 11/13/2013
Describer: Robert Long

Current Taxonomic Name: similar to Sideslide
Current Taxonomic Class: not enough data for classification.
Current Taxon Kind: family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369119E, 4142470N -- Datum NAD83, Zone 12
Legal Description: Section 13, Township 39 South, Range 6 West

Landscape: valley
Landform: hillslope
Geomorphic Component: Side Slope
Profile Pos: Toeslope
Slope: 10 percent
Elevation: 2071 meters (6794.6 feet)
Aspect: 271°
Shape: up/down: Concave; **across:** Concave

Surface Fragments: none.

Drainage: Very poorly drained
Runoff:
Erosion: None - deposition

Earth Cover: Grassland rangeland
Parent Materials: slope alluvium

N/A 0 to 122 centimeters (0 to 48 inches); No sample recovered.

N/A 122 to 244 centimeters (48 to 96.1 inches); (5/4) moist, silty clay; (7/4) dry; null percent sand; null percent silt; 48 percent clay; 50 percent coarse (7.5YR 6/) and 25 percent coarse prominent (2.5Y 4/6) mottles; massive; firm, very hard; 20 percent (few) clay films between sand grains finely disseminated carbonates; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; diffuse; $CaCO_3$ 20.4 percent.

N/A 244 to 366 centimeters (96.1 to 144.1 inches); light olive brown (2.5Y 5/4) moist, silty clay; pale yellow (2.5Y 7/4) dry; null percent sand; null percent silt; 41 percent clay; 50 percent medium gray (N 6/) and 35 percent coarse prominent light olive brown (2.5Y 5/6) mottles; massive; firm, very hard; 40 percent (common) clay films on all faces of peds finely disseminated carbonates; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; clear; CaCO3 24.3 percent.

N/A 366 to 488 centimeters (144.1 to 192.1 inches); light olive brown (2.5Y 5/4) moist, silty clay; light yellowish brown (2.5Y 6/4) dry; null percent sand; null percent silt; 52 percent clay; 40 percent medium gray (N 6/) and 30 percent coarse distinct light olive brown (2.5Y 5/6) mottles; massive; firm, very hard; 20 percent (few) clay films between sand grains and 45 percent (common) clay films on all faces of peds; 5 percent (common) medium salt crystals in matrix; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; CaCO3 22.8 percent.

N/A not enough data available for horizon designations.

13AS09

Pedon ID: 13AS09

Description Date: 11/13/2013
Describer: Robert Long

Current Taxonomic Name: Quezcan family shallow
Current Taxonomic Class: Clayey, smectitic, calcareous, mesic, shallow Aridic Ustorthents
Current Taxon Kind: Taxadjunct

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370469E, 4142786N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 6 West of the 29 Meridian

Landscape: hills
Landform: hillslope
Geomorphic Component: Side Slope
Profile Pos: Backslope
Slope: 31 percent
Elevation: 2113 meters (6932.4 feet)
Aspect: 161°
Shape: up/down: Concave; **across:** Concave

Surface Fragments: 25 percent subangular sandstone gravels; 15 percent subangular sandstone cobbles; 15 percent subangular sandstone stones; 5 percent subangular sandstone boulders; and 10 percent subangular sandstone gravels.

Drainage: Well drained
Runoff: High
Erosion: Class 3 - Sheet erosion

Primary Earth Cover: Tree cover; **Secondary Earth Cover:**

Existing Vegetation: PIED - twoneedle pinyon (*Pinus edulis*); JUOS - Utah juniper (*Juniperus osteosperma*); YUCCA - yucca (*Yucca*); POSE - Sandberg bluegrass (*Poa secunda*); GUSA2 - broom snakeweed (*Gutierrezia sarothrae*)

Parent Materials: colluvium derived from sandstone and shale over residuum weathered from shale

Bedrock: Moderately cemented calcareous shale at 46 centimeters (18.1 inches)
Particle Size Control Section: 25 to 46 centimeters (9.8 to 18.1 inches)
Diagnostic Features: Paralithic contact: 46 to 52 centimeters (18.1 to 20.5 inches)
Restrictions: Paralithic bedrock: 46 to 52 centimeters (18.1 to 20.5 inches)

A --- 0 to 14 centimeters (0 to 5.5 inches); grayish brown (10YR 5/2) dry, gravelly clay; brown (10YR 4/3) moist; 14 percent sand; 32 percent silt; 54 percent clay; weak fine subangular blocky parting to moderate medium granular structure; friable, hard, very sticky, very plastic; common medium roots, common fine roots and common very fine roots; common very fine interstitial pores finely disseminated carbonates; 5 percent subangular calcareous sandstone stones, 5 percent calcareous sandstone cobbles and 10 percent subangular calcareous shale gravels; electrical conductivity of 0.21 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear smooth boundary; CaCO3 17.8 percent.

2C --- 14 to 46 centimeters (5.5 to 18.1 inches); dark olive brown (2.5Y 3/3) dry, clay; light olive brown (2.5Y 5/4) moist; 28 percent sand; 23 percent silt; 49 percent clay; weak medium subangular blocky structure; firm, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores finely disseminated carbonates; electrical conductivity of 0.16 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; gradual smooth boundary; CaCO3 19.7 percent.

2Cr --- 46 to 52 centimeters (18.1 to 20.5 inches); weathered shale.

14AS01

Pedon ID: 14AS01

Description Date: 4/24/2014
Describer: Robert Long

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370219E, 4142245N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: alluvial fan
Geomorphic Component: Side Slope
Profile Pos: Backslope
Slope: 10 percent
Elevation: 2068 meters (6784.8 feet)
Aspect: 232°
Shape: up/down: linear; **across:** linear

Surface Fragments: none.

Drainage: Well drained
Runoff: Medium
Erosion: Class 3 - Gully erosion

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Shrubby rangeland

Existing Vegetation: ARNO4 - black sagebrush (*Artemisia nova*); BRIN2 - smooth brome (*Bromus inermis*); THIN6 - intermediate wheatgrass (*Thinopyrum intermedium*)

Parent Materials: alluvium derived from sandstone and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 8 to 118 centimeters (3.1 to 46.5 inches) and Secondary carbonates: 118 to 165 centimeters (46.5 to 65 inches)

A --- 0 to 8 centimeters (0 to 3.1 inches); light olive brown (2.5Y 5/3) dry, clay loam; olive brown (2.5Y 4/3) moist; null percent sand; null percent silt; 34 percent clay; weak medium platy parting to moderate medium granular structure; very friable, slightly hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; many very fine interstitial pores; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH indicator solutions; clear smooth boundary.

Bss1 --- 8 to 41 centimeters (3.1 to 16.1 inches); light yellowish brown (2.5Y 6/3) dry, clay loam; olive brown (2.5Y 4/3) moist; null percent sand; null percent silt; 39 percent clay; strong medium prismatic parting to strong medium angular blocky structure; friable, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 30 percent (common) slickensides (pedogenic) on vertical faces of peds; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH indicator solutions; gradual smooth boundary.

Bss2 --- 41 to 78 centimeters (16.1 to 30.7 inches); light yellowish brown (2.5Y 6/3) dry, clay; olive brown (2.5Y 4/3) moist; null percent sand; null percent silt; 40 percent clay; strong medium prismatic parting to strong medium angular blocky structure; firm, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 40 percent (common) slickensides (pedogenic) on vertical faces of peds; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH indicator solutions; gradual smooth boundary.

Bss3 --- 78 to 118 centimeters (30.7 to 46.5 inches); light yellowish brown (2.5Y 6/3) dry, clay loam; olive brown (2.5Y 4/3) moist; null percent sand; null percent silt; 36 percent clay; moderate medium prismatic parting to moderate medium subangular blocky structure; friable, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; 25 percent (common) slickensides (pedogenic) on vertical faces of peds; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH indicator solutions; gradual smooth boundary.

Bk1 --- 118 to 138 centimeters (46.5 to 54.3 inches); light yellowish brown (2.5Y 6/3) dry, clay loam; light olive brown (2.5Y 5/3) moist; null percent sand; null percent silt; 34 percent clay; moderate medium subangular blocky structure; friable, very hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; 3 percent (common) fine threadlike masses of carbonate in matrix; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH indicator solutions; gradual smooth boundary.

Bk2 --- 138 to 165 centimeters (54.3 to 65 inches); light yellowish brown (2.5Y 6/3) dry, clay loam; light olive brown (2.5Y 5/3) moist; null percent sand; null percent silt; 32 percent clay; moderate medium subangular blocky structure; friable, very hard, moderately sticky, moderately plastic; common very fine roots throughout; 2 percent (common) fine threadlike masses of carbonate in matrix and 3 percent (common) fine spherical masses of carbonate in matrix; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH indicator solutions.

DP-01

Pedon ID: DP-01

Description Date: 7/30/2012
Describer: Robert Long

Pedon Notes: Text: Sample tubes were not recovered from this hole, therefore no horizon descriptions or laboratory analysis.

Current Taxonomic Name: location and setting similar to BBB family.

County or Parish: Kane
State or Territory: Utah
UTM: 370550E, 4143588N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: hill
Geomorphic Component: Baseslope
Profile Pos: Toeslope
Slope: 9 percent
Elevation: 2120 meters (6,953.6 feet)
Aspect: 259°
Shape: up/down: concave ; **across:** linear

Drainage:
Runoff: medium
Erosion:

Earth Cover: shrub cover.

Existing Vegetation: smooth brome (*Bromus inermis*); AGCR - crested wheatgrass (*Agropyron cristatum*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*); CONVO - bindweed (*Convolvulus*); matchweed.

DP-02

Pedon ID: DP-02

Description Date: 7/30/2012
Describer: Robert Long

Pedon Notes: Text: There was 10 cm of GRX loamy sand between 2C1 and 2C2 horizons. The 3C horizon was not sampled (too small) for lab analysis; texture estimated by field method.

Current Taxonomic Name: Flugle family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Haplustalfs
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370522E, 4143600N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Riser
Profile Pos: Shoulder
Slope: 4 percent
Elevation: 2119 meters (6952.1 feet)
Aspect: 235°
Shape: up/down: Convex; **across:** Convex

Surface Fragments: subrounded and subangular sandstone - 2 percent gravels.

Drainage: Well drained
Runoff: Low
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland

Existing Vegetation: CHRYS9 - rabbitbrush (*Chrysothamnus*); AGCR - crested wheatgrass (*Agropyron cristatum*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*); MEDIC - alfalfa (*Medicago*)

Parent Materials: alluvium derived from limestone, sandstone, and shale

Particle Size Control Section: 35 to 85 centimeters (13.8 to 33.5 inches)

Diagnostic Features: Argillic horizon: 35 to 170 centimeters (13.8 to 66.9 inches) and Calcic horizon: 170 to 220 centimeters (66.9 to 86.6 inches)

Ap --- 0 to 13 centimeters (0 to 5.1 inches); brown (10YR 5/3) dry, loam; brown (10YR 4/3) moist; 44 percent sand; 32 percent silt; 24 percent clay; moderate medium platy parting to moderate medium granular structure; very friable, slightly hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 4.09 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; neutral, pH 7, pH meter; clear; CaCO3 21.2 percent.

BA --- 13 to 35 centimeters (5.1 to 13.8 inches); pale brown (10YR 6/3) dry, loam; brown (10YR 4/3) moist; 40 percent sand; 37 percent silt; 23 percent clay; structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.44 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; neutral, pH 7.3, pH meter; clear; CaCO3 22 percent.

Btk1 --- 35 to 68 centimeters (13.8 to 26.8 inches); pale brown (10YR 6/3) dry, clay loam; brown (10YR 4/3) moist; 30 percent sand; 40 percent silt; 30 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; friable, hard, slightly sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 50 percent (many) clay films on all faces of peds; 3 percent (common) fine masses of carbonate on faces of peds; electrical conductivity of 0.47 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; neutral, pH 7.3, pH meter; gradual; CaCO3 24.7 percent.

Btk2 --- 68 to 92 centimeters (26.8 to 36.2 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 24 percent sand; 36 percent silt; 30 percent clay; strong medium prismatic parting to strong medium subangular blocky structure; firm, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; 75 percent (many) clay films on all faces of peds; 3 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 0.45 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.4, pH meter; gradual; CaCO3 18.1 percent.

Btk3 --- 92 to 170 centimeters (36.2 to 66.9 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 26 percent sand; 28 percent silt; 46 percent clay; strong medium prismatic parting to strong medium angular blocky structure; firm, very hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; 80 percent (many) clay films on all faces of peds; 2 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 0.4 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; neutral, pH 7.3, pH meter; abrupt; CaCO3 17.6 percent.

Bk --- 170 to 220 centimeters (66.9 to 86.6 inches); very pale brown (10YR 7/4) dry, clay loam; light yellowish brown (10YR 6/4) moist; 22 percent sand; 46 percent silt; 32 percent clay; weak medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common very fine interstitial pores finely disseminated carbonates and 10 percent (common) medium masses of carbonate in matrix; electrical conductivity of 1.26 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.4, pH meter; clear; CaCO3 47.8 percent.

2C1 --- 220 to 261 centimeters (86.6 to 102.8 inches); pale brown (10YR 6/3) dry, sandy loam; brown (10YR 5/3) moist; 78 percent sand; 12 percent silt; 10 percent clay; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores finely disseminated carbonates; electrical conductivity of 1.77 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear; CaCO3 19.3 percent.

2C2 --- 261 to 407 centimeters (102.8 to 160.2 inches); very pale brown (10YR 8/4) dry, sandy loam; light yellowish brown (10YR 6/4) moist; 70 percent sand; 22 percent silt; 8 percent clay; 4 percent medium distinct reddish yellow (7.5YR 7/6) mottles; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; 15 percent subangular sandstone gravels; electrical conductivity of 1.13 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; abrupt; CaCO3 25 percent.

3C --- 407 to 412 centimeters (160.2 to 162.2 inches); light brownish gray (10YR 6/2) dry, clay; dark grayish brown (10YR 4/2) moist; null percent sand; null percent silt; 45 percent clay; massive; very firm, very hard, very sticky, very plastic; 75 percent (many) pressure faces on all faces of peds; EC meter, saturated paste electric conductivity method; strongly effervescent.

DP-03

Pedon ID: DP-03

Description Date: 7/30/2012
Describer: Robert Long

Pedon Notes: Text: Mottles in Bssk are most likely due to entrapment of water between peds and inability of water to drain out of profile due to underlying Tropic shale.

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370509E, 4143434N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: alluvial fan
Anthropogenic Feature:
Geomorphic Component: Nose Slope
Profile Pos: Footslope
Slope: 7 percent
Elevation: 2119 meters (6952.1 feet)
Aspect: 272°
Shape: up/down: Convex; **across:** Convex

Surface Fragments: angular sandstone - 4 percent channers.

Drainage: Moderately well drained
Runoff: High**:**
Erosion: Class 2 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover.

Existing Vegetation: PASM - western wheatgrass (*Pascopyrum smithii*); CONVO - bindweed (*Convolvulus*); LINUM - flax (*Linum*)

Parent Materials: residuum weathered from calcareous sandstone
Bedrock: Moderately cemented calcareous shale at 137 centimeters (53.9 inches)

Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 24 to 87 centimeters (9.4 to 34.3 inches) and Paralithic contact: 137 centimeters (53.9 inches)

Restrictions: Paralithic bedrock: 137 centimeters (53.9 inches)

Ap --- 0 to 24 centimeters (0 to 9.4 inches); light brownish gray (2.5Y 6/2) dry, silty clay; dark grayish brown (2.5Y 4/2) moist; 10 percent sand; 42 percent silt; 48 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.57 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; neutral, pH 7.2, pH meter; clear; CaCO3 28.9 percent.

Bss1 --- 24 to 47 centimeters (9.4 to 18.5 inches); light brownish gray (2.5Y 6/2) dry, clay; dark grayish brown (2.5Y 4/2) moist; 10 percent sand; 39 percent silt; 51 percent clay; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; 45 percent (common) slickensides (pedogenic) on all faces of peds; electrical conductivity of 0.38 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; gradual; CaCO3 33.4 percent.

Bss2 --- 47 to 87 centimeters (18.5 to 34.3 inches); light yellowish brown (2.5Y 6/3) dry, silty clay; olive brown (2.5Y 4/3) moist; 4 percent sand; 42 percent silt; 54 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; firm, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; 60 percent (many) slickensides (pedogenic) on all faces of peds; electrical conductivity of 0.32 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; gradual; CaCO3 29.8 percent.

Bkss --- 87 to 137 centimeters (34.3 to 53.9 inches); light gray (10YR 7/1) dry, silty clay; grayish brown (10YR 5/2) moist; 6 percent sand; 45 percent silt; 49 percent clay; 7 percent fine prominent olive yellow (2.5Y 6/6) mottles; strong medium prismatic parting to strong medium subangular blocky structure; very firm, extremely hard, very sticky, very plastic; common very fine roots throughout; 40 percent (common) slickensides (pedogenic) on all faces of peds; 3 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 0.64 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; gradual; CaCO3 31.7 percent.

Cr --- 137 to 140 centimeters (53.9 to 55.1 inches); Weathered Tropic shale.

DP-04

Pedon ID: DP-04

Description Date: 7/30/2012
Describer: Robert Long

Pedon Notes: Text: This soil is very similar to Brumley, but the clay increase between the A and Bt is only 4% and 5.6% is required (1.2 times). The "t" suffix indicates illuvial accumulation of silicate clay. Clay films were observed and not slickensides.

Current Taxonomic Name: Wimmer family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370463E, 4143436N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace and alluvial fan
Geomorphic Component: Tread
Profile Pos: Toeslope
Slope: 5 percent
Elevation: 2117 meters (6945.5 feet)
Aspect: 257°
Shape: up/down: Concave; **across:** Linear

Surface Fragments: subrounded sandstone - 2 percent gravels.

Drainage: Well drained
Runoff: Low
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: BRIN2 - smooth brome (*Bromus inermis*); AGCR - crested wheatgrass (*Agropyron cristatum*); CHRYS9 - rabbitbrush (*Chrysothamnus*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*); CONVO - bindweed (*Convolvulus*); MEDIC - alfalfa (*Medicago*)

Parent Materials: alluvium derived from limestone, sandstone, and shale

Particle Size Control Section: 20 to 70 centimeters (7.9 to 27.6 inches)

Diagnostic Features: Cambic horizon: 20 to 153 centimeters (7.9 to 60.2 inches) and Calcic horizon: 90 to 232 centimeters (35.4 to 91.3 inches)

Ap --- 0 to 20 centimeters (0 to 7.9 inches); pale brown (10YR 6/3) dry, clay loam; brown (10YR 4/3) moist; 30 percent sand; 42 percent silt; 28 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; very friable, slightly hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine interstitial pores; electrical conductivity of 0.76 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 20 percent.

Bt1 --- 20 to 46 centimeters (7.9 to 18.1 inches); brown (10YR 5/3) dry, clay loam; brown (10YR 4/3) moist; 30 percent sand; 38 percent silt; 32 percent clay; moderate medium subangular blocky parting to strong fine angular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; 35 percent (common) clay films on all faces of peds; electrical conductivity of 0.41 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 24.4 percent.

Bt2 --- 46 to 90 centimeters (18.1 to 35.4 inches); brown (10YR 4/3) dry, clay loam; dark brown (10YR 3/3) moist; 36 percent sand; 32 percent silt; 32 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; firm, very hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 50 percent (many) clay films on all faces of peds; electrical conductivity of 0.38 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; abrupt; CaCO3 9.1 percent.

Btk --- 90 to 153 centimeters (35.4 to 60.2 inches); brown (10YR 5/3) dry, clay loam gravel; brown (10YR 4/3) moist; 38 percent sand; 34 percent silt; 28 percent clay; weak medium prismatic parting to moderate medium subangular blocky structure; firm, very hard, moderately sticky, slightly plastic; common very fine roots throughout; 35 percent (common) clay films on all faces of peds; 4 percent (common) fine masses of carbonate in matrix; 6 percent subrounded sandstone gravels; electrical conductivity of 0.39 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; abrupt; CaCO3 22.5 percent.

Bk --- 153 to 232 centimeters (60.2 to 91.3 inches); very pale brown (10YR 7/4) dry, sandy loam; light yellowish brown (10YR 6/4) moist; 66 percent sand; 24 percent silt; 10 percent clay; single grain; loose, loose, nonsticky, nonplastic; common very fine roots throughout; many very fine interstitial pores finely disseminated carbonates; 4 percent subrounded sandstone gravels; electrical conductivity of 0.37 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; CaCO3 42.4 percent.

DP-05

Pedon ID: DP-05

Description Date: 7/30/2012
Print Date: 6/25/2014
Describer: Robert Long

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370506E, 4143319N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: structural bench and hill
Geomorphic Component: Nose Slope
Profile Pos: Footslope
Slope: 7 percent
Elevation: 2118 meters (6948.8 feet)
Aspect: 268°
Shape: up/down: Concave; **across:** Linear

Surface Fragments: subangular sandstone - 2 percent gravels.

Drainage: Well drained
Runoff: Medium

Existing Vegetation: BRIN2 - smooth brome (*Bromus inermis*); PASM - western wheatgrass (*Pascopyrum smithii*); AGCR - crested wheatgrass (*Agropyron cristatum*); CONVO - bindweed (*Convolvulus*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: residuum weathered from calcareous shale
Bedrock: Calcareous shale at 162 centimeters (63.8 inches)
Particle Size Control Section:

Diagnostic Features: Secondary carbonates: 35 to 162 centimeters (13.8 to 63.8 inches), Slickensides: 35 to 70 centimeters (13.8 to 27.6 inches) and Paralithic contact: 162 centimeters (63.8 inches)

Restrictions: Paralithic bedrock: 162 centimeters (63.8 inches)

Ap --- 0 to 35 centimeters (0 to 13.8 inches); grayish brown (10YR 5/2) dry, clay loam; dark grayish brown (10YR 4/2) moist; 20 percent sand; 42 percent silt; 38 percent clay; weak medium subangular blocky parting to moderate medium granular structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.65 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 20.8 percent.

Bkss --- 35 to 70 centimeters (13.8 to 27.6 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 18 percent sand; 39 percent silt; 43 percent clay; moderate medium subangular blocky structure; friable, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 35 percent (common) slickensides (pedogenic) on vertical faces of peds; 2 percent (common) fine masses of carbonate on vertical faces of peds; electrical conductivity of 0.39 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; gradual; CaCO3 22.7 percent.

Bk --- 70 to 162 centimeters (27.6 to 63.8 inches); light brownish gray (2.5Y 6/2) dry, clay; grayish brown (2.5Y 5/2) moist; 16 percent sand; 39 percent silt; 45 percent clay; moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; common very fine roots throughout finely disseminated carbonates; electrical conductivity of 1.01 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear; CaCO3 25.9 percent.

Cr --- 162 to 176 centimeters (63.8 to 69.3 inches); light brownish gray (10YR 6/2) dry; grayish brown (10YR 5/2) moist; common very fine roots throughout; weathered Tropic shale.

DP-06

Pedon ID: DP-06

Description Date: 7/30/2012
Describer: Robert Long

Pedon Notes: Text: the clay increase between the BA and Bt horizons is only 4% and 7.2% is required for an argillic. The "t" refers to an accumulation of silicate clay. This soil was correlated to Sideshow, because of the fine mineralogy and lack of a calcic horizon.

Current Taxonomic Name: Teromote family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Haplustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370506E, 4143319N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: valley-floor remnant and alluvial fan
Geomorphic Component: Base Slope
Profile Pos: Toeslope
Slope: 5 percent
Elevation: 2118 meters (6948.8 feet)
Aspect: 257°
Shape: up/down: Concave; **across:** Concave

Surface Fragments: subrounded sandstone - 3 percent gravels.

Drainage: Well drained
Erosion: Class 2 - Sheet erosion

Primary Earth Cover: ; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: PASM - western wheatgrass (*Pascopyrum smithii*); CHRYS9 - rabbitbrush (*Chrysothamnus*); CONVO - bindweed (*Convolvulus*); AGCR - crested wheatgrass (*Agropyron cristatum*)

Parent Materials: slope alluvium derived from sandstone and shale over alluvium derived from limestone, sandstone, and shale

Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Cambic horizon: 35 to 145 centimeters (13.8 to 57.1 inches), Secondary carbonates: 75 to 230 centimeters (29.5 to 90.6 inches) and Calcic horizon: 187 to 230 centimeters (73.6 to 90.6 inches)

Ap --- 0 to 18 centimeters (0 to 7.1 inches); light brownish gray (10YR 6/2) dry, clay loam; dark grayish brown (10YR 4/2) moist; 28 percent sand; 39 percent silt; 33 percent clay; moderate medium platy parting to moderate medium granular structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.63 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; neutral, pH 7.3, pH meter; gradual; $CaCO_3$ 19.8 percent.

BA --- 18 to 35 centimeters (7.1 to 13.8 inches); grayish brown (10YR 5/2) dry, clay loam; dark grayish brown (10YR 4/2) moist; 28 percent sand; 36 percent silt; 36 percent clay; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.4 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; neutral, pH 7.3, pH meter; clear; $CaCO_3$ 19.6 percent.

Bt --- 35 to 75 centimeters (13.8 to 29.5 inches); light brownish gray (10YR 6/2) dry, silty clay; dark grayish brown (10YR 4/2) moist; 20 percent sand; 40 percent silt; 40 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; firm, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 50 percent (many) clay films on all faces of peds; electrical conductivity of 0.33 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear; $CaCO_3$ 19.7 percent.

Btk --- 75 to 145 centimeters (29.5 to 57.1 inches); pale brown (10YR 6/3) dry, clay loam; dark grayish brown (10YR 4/2) moist; 24 percent sand; 38 percent silt; 38 percent clay; strong medium prismatic parting to strong medium subangular blocky structure; firm, very hard, moderately sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 35 percent (common) clay films on all faces of peds; 4 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; abrupt; $CaCO_3$ 24.1 percent.

2Bk1 --- 145 to 187 centimeters (57.1 to 73.6 inches); pale brown (10YR 6/3) dry, sandy loam; brown (10YR 5/3) moist; 64 percent sand; 22 percent silt; 14 percent clay; single grain; loose, loose, nonsticky, nonplastic; common very fine roots throughout; many very fine interstitial pores; 5 percent (few) carbonate coats on bottom surfaces of rock fragments finely disseminated carbonates; 4 percent subrounded sandstone gravels; electrical conductivity of 0.3 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; gradual; CaCO3 27 percent.

2Bk2 --- 187 to 230 centimeters (73.6 to 90.6 inches); very pale brown (10YR 7/3) dry, loamy sand; pale brown (10YR 6/3) moist; 84 percent sand; 10 percent silt; 6 percent clay; single grain; loose, loose, nonsticky, nonplastic; common very fine roots throughout; many very fine interstitial pores; 10 percent (few) carbonate coats on bottom surfaces of rock fragments finely disseminated carbonates; 40 percent subrounded sandstone gravels; electrical conductivity of 0.34 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; CaCO3 52.2 percent.

DP-07

Pedon ID: DP-7

Description Date: 7/30/2012
Describer: Robert Long

Pedon Notes: Text: Textures and percent clay were estimated based on the field texture method; and pH was determined with indicator phenol red indicator dye. Correlated to Sideshow family based on physiographic setting, surface conditions, and subsoil.

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370483E, 4143244N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: alluvial fan
Geomorphic Component: Nose Slope
Profile Pos: Footslope
Slope: 5 percent
Elevation: 2116 meters (6942.3 feet)
Aspect: 241°
Shape: up/down: Convex; **across:** Convex
Surface Fragments: subangular sandstone - 8 percent channers.

Drainage: Well drained
Runoff: Medium
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland

Parent Materials: slope alluvium derived from sandstone and shale over alluvium derived from limestone, sandstone, and shale
Existing Vegetation: smooth brome (*Bromus inermis*); AGCR - crested wheatgrass (*Agropyron cristatum*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*); CONVO - bindweed (*Convolvulus*); matchweed.

N/A --- 0 to 122 centimeters (0 to 48 inches); sample unavailable for evaluation..

Bkss --- 122 to 165 centimeters (48 to 65 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; null percent sand; null percent silt; 45 percent clay; moderate medium subangular blocky structure; firm, extremely hard, very sticky, very plastic; 25 percent (common) slickensides (pedogenic) on all faces of peds; 3 percent (common) fine threadlike masses of carbonate in matrix; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH indicator solutions; abrupt.

Bk --- 165 to 200 centimeters (65 to 78.7 inches); grayish brown (10YR 5/2) dry, sandy clay loam; dark grayish brown (10YR 4/2) moist; null percent sand; null percent silt; 28 percent clay; structure; friable, hard, slightly sticky, moderately plastic; 15 percent (common) fine masses of carbonate in matrix; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH indicator solutions; clear.

2Bk --- 200 to 244 centimeters (78.7 to 96.1 inches); light yellowish brown (10YR 6/4) dry, loamy sand; dark yellowish brown (10YR 4/4) moist; null percent sand; null percent silt; 5 percent clay; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores; 1 percent (very few) carbonate coats on bottom surfaces of rock fragments finely disseminated carbonates; 10 percent subrounded calcareous sandstone gravels; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH indicator solutions.

DP-08

Pedon ID: DP-03

Description Date: 8/1/2012
Describer: Robert Long

Pedon Notes: Text: encountered sandstone at 32 inches in new auger hole; soil was clayey (50 to 60% clay)

Current Taxonomic Name: setting similar to Sideshow family
Current Taxonomic Class: not enough data for full classification
Current Taxon Kind:

County or Parish: Kane
State or Territory: Utah
UTM: 3705073E, 41432454N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: alluvial fan
Geomorphic Component: nose
Profile Pos: footslope
Slope: 7 percent
Elevation: 2118 meters (6,947 feet)
Aspect: 245°
Shape: up/down: ; **across:**
Surface Fragments: subangular sandstone - 4 percent channers and 2 percent flags.

Earth Cover: shrub cover.

Existing Vegetation: smooth brome (*Bromus inermis*); AGCR - crested wheatgrass (*Agropyron cristatum*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*); CONVO - bindweed (*Convolvulus*); matchweed.

DP-09

Pedon ID: DP-09

Description Date: 7/30/2012
Describer: Robert Long

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370485E, 4143105N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: alluvial fan
Geomorphic Component: Side Slope
Profile Pos: Footslope
Slope: 6 percent
Elevation: 2115 meters (6939 feet)
Aspect: 297°
Shape: up/down: Linear; **across:** Convex

Surface Fragments: subangular sandstone - 3 percent gravel, 1 percent cobble, and 2 percent channers.

Drainage: Well drained
Runoff: Low
Erosion: Class 2 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: PASM - western wheatgrass (*Pascopyrum smithii*); BRIN2 - smooth brome (*Bromus inermis*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*); MEDIC - alfalfa (*Medicago*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 38 to 194 centimeters (15 to 76.4 inches) and Secondary carbonates: 68 to 244 centimeters (26.8 to 96.1 inches)

Ap --- 0 to 38 centimeters (0 to 15 inches); pale brown (10YR 6/3) dry, clay; brown (10YR 5/3) moist; 20 percent sand; 33 percent silt; 47 percent clay; weak medium subangular blocky parting to moderate medium granular structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.83 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; neutral, pH 7.3, pH meter; clear; CaCO3 20.9 percent.

Bss --- 38 to 68 centimeters (15 to 26.8 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 12 percent sand; 36 percent silt; 52 percent clay; moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 25 percent (common) slickensides (pedogenic) on all faces of peds; electrical conductivity of 0.54 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 22.2 percent.

Bkss1 --- 68 to 166 centimeters (26.8 to 65.4 inches); light brownish gray (10YR 6/2) dry, clay; grayish brown (10YR 5/2) moist; 10 percent sand; 38 percent silt; 52 percent clay; moderate medium prismatic parting to moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 15 percent (few) clay films and 30 percent (common) slickensides (pedogenic) on all faces of peds; 3 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 1.54 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; clear; CaCO3 22.2 percent.

Bkss2 --- 166 to 194 centimeters (65.4 to 76.4 inches); light brownish gray (10YR 6/2) dry, clay; grayish brown (10YR 5/2) moist; 10 percent sand; 36 percent silt; 54 percent clay; moderate medium prismatic parting to moderate medium subangular blocky structure; firm, extremely hard, very sticky, very plastic; common very fine roots throughout; common very fine tubular pores; 25 percent (common) slickensides (pedogenic) on all faces of peds; 7 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 6.01 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; gradual; CaCO3 23.1 percent.

Bk --- 194 to 244 centimeters (76.4 to 96.1 inches); light brownish gray (2.5Y 6/2) dry, clay; grayish brown (2.5Y 5/2) moist; 14 percent sand; 34 percent silt; 52 percent clay; weak fine prismatic parting to weak medium subangular blocky structure; firm, very hard, very sticky, very plastic; common very fine roots throughout; 12 percent (common) medium spherical masses of carbonate on faces of peds; electrical conductivity of 6.15 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; $CaCO_3$ 23.7 percent.

DP-10

Pedon ID: DP-10

Description Date: 7/31/2012
Describer: Robert Long

Pedon Notes: Text: Textures and percent clay were estimated based on the field texture method; and pH was determined with indicator phenol red indicator dye. Correlated to Sideshow family based on physiographic setting, surface conditions, and subsoil.

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370474E, 4143121N -- Datum NAD83, Zone 11
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: alluvial fan
Geomorphic Component: Side Slope
Profile Pos: Toeslope
Slope: 5 percent
Elevation: 2114 meters (6935.7 feet)
Aspect: 302°
Shape: up/down: Linear; **across:** Concave

Surface Fragments: subangular sandstone - 4 percent gravel and 1 percent channers.

Drainage: Well drained
Runoff: Low
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland

Existing Vegetation: CONVO - bindweed (*Convolvulus*); PASM - western wheatgrass (*Pascopyrum smithii*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: clayey slope alluvium derived from calcareous shale over coarse-loamy slope alluvium derived from calcareous sandstone

Diagnostic Features: Secondary carbonates: 122 to 244 centimeters (48 to 96.1 inches)

N/A 0 to 122 centimeters (0 to 48 inches); sample unavailable for evaluation.

Bkss --- 122 to 172 centimeters (48 to 67.7 inches); light brownish gray (10YR 6/2) dry, clay; dark gray (10YR 4/1) moist; null percent sand; null percent silt; 50 percent clay; structure; firm, extremely hard, very sticky, very plastic; common medium tubular pores; 25 percent (common) slickensides (pedogenic) on all faces of peds; 12 percent (common) medium masses of carbonate in matrix; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH indicator solutions; clear.

2Bk --- 172 to 244 centimeters (67.7 to 96.1 inches); very pale brown (10YR 7/4) dry, sandy loam; yellowish brown (10YR 5/4) moist; null percent sand; null percent silt; 10 percent clay; single grain; loose, loose, nonsticky, nonplastic; common medium tubular and common fine tubular pores finely disseminated carbonates; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH indicator solutions.

DP-11

Pedon ID: DP-11

Description Date: 7/31/2012
Describer: Robert Long

Pedon Notes: Text: This soil is similar to Wimmer family. The weighted percent clay in the control section is 17%. This is 1% less than the amount of clay required for fine-loamy.

Current Taxonomic Name: Bobknoll family
Current Taxonomic Class: Coarse-loamy, mixed, superactive, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370352E, 4143094N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace and fan apron
Geomorphic Component: Base Slope
Profile Pos: Toeslope
Slope: 5 percent
Elevation: 2107 meters (6912.7 feet)
Aspect: 11°
Shape: up/down: Concave; **across:** Linear

Surface Fragments: none.

Drainage: Somewhat poorly drained
Runoff: Low
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: BRIN2 - smooth brome (*Bromus inermis*)

Parent Materials: slope alluvium derived from sandstone over alluvium derived from limestone, sandstone, and shale

Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Secondary carbonates: 27 to 169 centimeters (10.6 to 66.5 inches) and Calcic horizon: 60 to 138 centimeters (23.6 to 54.3 inches)

A --- 0 to 27 centimeters (0 to 10.6 inches); grayish brown (10YR 5/2) dry, loam; very dark grayish brown (10YR 3/2) moist; 50 percent sand; 28 percent silt; 22 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; friable, hard, slightly sticky, slightly plastic; electrical conductivity of 1.15 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; neutral, pH 7.3, pH meter; clear; CaCO3 4.9 percent.

Bk --- 27 to 60 centimeters (10.6 to 23.6 inches); grayish brown (10YR 5/2) dry, sandy clay loam; dark grayish brown (10YR 4/2) moist; 50 percent sand; 26 percent silt; 24 percent clay; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 5 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.38 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear; CaCO3 13 percent.

2Bk --- 60 to 138 centimeters (23.6 to 54.3 inches); very pale brown (10YR 7/4) dry, sandy loam; yellowish brown (10YR 5/6) moist; 64 percent sand; 20 percent silt; 16 percent clay; 5 percent medium faint yellow (10YR 7/6) mottles; weak medium subangular blocky structure; friable, very hard, nonsticky, nonplastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; many very fine interstitial pores; 5 percent (common) medium yellow (10YR 7/6), moist, iron-manganese masses; 9 percent (common) fine masses of carbonate in matrix; 5 percent subrounded sandstone gravels; electrical conductivity of 0.64 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.6, pH meter; abrupt; CaCO3 33.5 percent.

3Bk --- 138 to 169 centimeters (54.3 to 66.5 inches); olive yellow (2.5Y 6/6) dry, sandy loam; brown (10YR 5/3) moist; 60 percent sand; 22 percent silt; 18 percent clay; 3 percent fine faint brownish yellow (10YR 6/6) mottles; moderate medium subangular blocky structure; friable, hard, nonsticky, nonplastic; 3 percent (common) fine brownish yellow (10YR 6/6), moist, iron-manganese masses; 8 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.36 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 10.7 percent.

3C --- 169 to 243 centimeters (66.5 to 95.7 inches); very pale brown (10YR 8/2) dry, sandy loam; very pale brown (10YR 7/3) moist; 68 percent sand; 14 percent silt; 18 percent clay; 20 percent coarse faint brownish yellow (10YR 6/6) mottles; moderate medium subangular blocky structure; firm, hard, nonsticky, nonplastic; common very fine interstitial pores; 20 percent (many) coarse brownish yellow (10YR 6/6), moist, iron-manganese masses; electrical conductivity of 0.32 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; $CaCO_3$ 11.6 percent.

DP-12

Pedon ID: DP-12

Description Date: 7/31/2012
Describer: Robert Long

Current Taxonomic Name: Flugle family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Haplustalfs
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370347E, 4143083N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: hillslope**:**
Geomorphic Component: Side Slope
Profile Pos: Backslope
Slope: 6 percent
Elevation: 2108 meters (6916 feet)
Aspect: 23°
Shape: up/down: Convex; **across:** Convex

Surface Fragments: subangular sandstone - 3 percent channers and 2 percent flags.

Drainage: Moderately well drained
Runoff: Low
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland

Existing Vegetation: BRIN2 - smooth brome (*Bromus inermis*); CHRYS9 - rabbitbrush (*Chrysothamnus*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: slope alluvium derived from sandstone
Particle Size Control Section: 62 to 112 centimeters (24.4 to 44.1 inches)

Diagnostic Features: Argillic horizon: 62 to 126 centimeters (24.4 to 49.6 inches) and Secondary carbonates: 126 to 183 centimeters (49.6 to 72 inches)

Ap --- 0 to 28 centimeters (0 to 11 inches); brown (10YR 5/3) dry, sandy loam; dark grayish brown (10YR 4/2) moist; 58 percent sand; 25 percent silt; 17 percent clay; weak medium subangular blocky parting to moderate medium granular structure; very friable, slightly hard, nonsticky, nonplastic; common fine roots throughout and common very fine roots throughout; common fine tubular pores; noneffervescent by HCl, 1 normal; slightly alkaline, pH 7.4, pH meter; clear; CaCO3 2.6 percent.

A --- 28 to 62 centimeters (11 to 24.4 inches); yellowish brown (10YR 5/4) dry, loam; brown (10YR 4/3) moist; 50 percent sand; 35 percent silt; 15 percent clay; moderate medium subangular blocky structure; very friable, hard, nonsticky, nonplastic; common fine roots throughout and common very fine roots throughout; common fine tubular pores; noneffervescent by HCl, 1 normal; neutral, pH 7.3, pH meter; clear; CaCO3 0.4 percent.

Bt --- 62 to 126 centimeters (24.4 to 49.6 inches); yellowish brown (10YR 5/4) dry, sandy clay loam; dark brown (10YR 3/3) moist; 66 percent sand; 12 percent silt; 22 percent clay; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 15 percent (few) clay films on all faces of peds and 20 percent (few) clay films between sand grains; noneffervescent by HCl, 1 normal; slightly alkaline, pH 7.4, pH meter; clear; CaCO3 0.4 percent.

Bk --- 126 to 183 centimeters (49.6 to 72 inches); brownish yellow (10YR 6/6) dry, sandy clay loam; yellowish brown (10YR 5/8) moist; 52 percent sand; 26 percent silt; 22 percent clay; 8 percent medium reddish yellow (7.5YR 6/8) mottles; moderate medium subangular blocky structure; very friable, slightly hard, slightly sticky, slightly plastic; common very fine roots throughout; 5 percent (common) fine masses of carbonate in matrix; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 0.3 percent.

2Ck --- 183 to 244 centimeters (72 to 96.1 inches); white (2.5Y 8/1) dry, loam; light yellowish brown (2.5Y 6/3) moist; 50 percent sand; 28 percent silt; 22 percent clay; 12 percent pale brown (10YR 6/3) mottles; moderate medium subangular blocky structure; firm, very hard, slightly sticky, slightly plastic finely disseminated carbonates; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; CaCO3 11.1 percent.

DP-13

Pedon ID: DP-13

Description Date: 7/31/2012
Describer: Robert Long

Pedon Notes: Text: This soil profile is similar to the Flugle family. No lab data is available for the A horizon. Field estimate of the texture is loam (23% clay). Box sample appears to have an argillic horizon. Argillics were identified in this area.; the physiographic setting of this location is similar to 12AS04 (Evpark or Flugle mod. deep) and may be moderately deep or deep to sandstone.

Current Taxonomic Name: Flugle family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Haplustalfs
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370297E, 4143072N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: structural bench and hill
Geomorphic Component: Side Slope
Profile Pos: Backslope
Slope: 13 percent
Elevation: 2107 meters (6912.7 feet)
Aspect: 282°
Shape: up/down: Convex; **across:** Convex

Surface Fragments: subangular sandstone - 5 percent gravels and 10 percent channers.

Drainage: Well drained
Runoff: Medium
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland
Existing Vegetation: BRIN2 - smooth brome (*Bromus inermis*); MEDIC - alfalfa (*Medicago*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*); ARNO4 -

black sagebrush (*Artemisia nova*)

Parent Materials: residuum weathered from sandstone
Particle Size Control Section: 25 to 88 centimeters (9.8 to 34.6 inches)
Diagnostic Features: Argillic horizon: 15 to 54 centimeters (5.9 to 21.3 inches) and Secondary carbonates: 54 to 88 centimeters (21.3 to 34.6 inches)

A --- 0 to 15 centimeters (0 to 5.9 inches); brown (10YR 5/3) dry, loam; brown (10YR 4/3) moist; null percent sand; null percent silt; 23 percent clay; moderate medium platy parting to moderate fine granular structure; very friable, slightly hard, slightly sticky, slightly plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 2 percent subrounded sandstone gravels; slightly effervescent; No sample, too small; clear.

Bt --- 15 to 54 centimeters (5.9 to 21.3 inches); grayish brown (10YR 5/2) dry, sandy clay loam; dark grayish brown (10YR 4/2) moist; 48 percent sand; 24 percent silt; 28 percent clay; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 30 percent (common) clay films on all faces of peds; 10 percent subrounded 2 sandstone gravels; electrical conductivity of 0.54 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; neutral, pH 7.1, pH meter; clear; $CaCO_3$ 17.9 percent.

Bk --- 54 to 88 centimeters (21.3 to 34.6 inches); light brownish gray (10YR 6/2) dry, sandy clay loam; yellowish brown (10YR 5/4) moist; 48 percent sand; 21 percent silt; 31 percent clay; strong medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common very fine roots throughout; common very fine tubular pores; 7 percent (common) fine masses of carbonate on faces of peds; 5 percent subrounded sandstone gravels; electrical conductivity of 0.34 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; $CaCO_3$ 15.8 percent.

DP-14

Pedon ID: DP-14

Description Date: 7/31/2013
Describer: Robert Long

Pedon Notes: Text: Horizon samples were too small for submission for lab analysis. Textures and percent clay are field estimates.

Current Taxonomic Name: Bobknoll family
Current Taxonomic Class: Coarse-loamy, mixed, superactive, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370294E, 4143081N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West

Landscape: valley
Landform: structural bench
Geomorphic Component: Tread
Profile Pos: Toeslope
Slope: 8 percent
Elevation: 2107 meters (6912.7 feet)
Aspect: 292°
Shape: up/down: Concave; **across:** Convex

Surface Fragments: subrounded sandstone - 3 percent gravels.

Drainage: Well drained
Runoff: Medium
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: BRIN2 - smooth brome (*Bromus inermis*); PASM - western wheatgrass (*Pascopyrum smithii*); CONVO - bindweed (*Convolvulus*); MEDIC - alfalfa (*Medicago*)

Parent Materials: slope alluvium derived from sandstone and shale over residuum weathered from calcareous sandstone

Bedrock: Sandstone at 88 centimeters (34.6 inches)
Particle Size Control Section: 25 to 88 centimeters (9.8 to 34.6 inches)

Diagnostic Features: Secondary carbonates: 18 to 88 centimeters (7.1 to 34.6 inches), Calcic horizon: 46 to 88 centimeters (18.1 to 34.6 inches) and Lithic contact: 88 centimeters (34.6 inches)

Restrictions: Lithic bedrock: 88 centimeters (34.6 inches)

A --- 0 to 18 centimeters (0 to 7.1 inches); grayish brown (10YR 5/2) dry, clay loam; dark grayish brown (10YR 4/2) moist; null percent sand; null percent silt; 32 percent clay; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; slightly effervescent; abrupt.

Bk1 --- 18 to 46 centimeters (7.1 to 18.1 inches); very pale brown (10YR 7/3) dry, sandy loam; pale brown (10YR 6/3) moist; null percent sand; null percent silt; 18 percent clay; weak medium subangular blocky structure; very friable, slightly hard, slightly sticky, nonplastic; common very fine roots throughout; common very fine tubular pores; 20 percent (many) medium masses of carbonate in matrix; strongly effervescent; clear.

Bk2 --- 46 to 88 centimeters (18.1 to 34.6 inches); very pale brown (10YR 8/3) dry, loamy sand; very pale brown (10YR 7/3) moist; null percent sand; null percent silt; 2 percent clay; single grain; loose, loose, nonsticky, nonplastic; common very fine roots throughout; many very fine interstitial pores finely disseminated carbonates; violently effervescent.

R --- 88 centimeters (34.6 inches); sandstone.

DP-15

Pedon ID: DP-15

Description Date: 7/31/2012
Describer: Robert Long

Pedon Notes: Text: Calcic horizon is too deep to be diagnostic.

Current Taxonomic Name: Teromote family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Haplustepts
Current Taxon Kind: Taxadjunct

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370212E, 4142932N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: hillslope
Geomorphic Component: Nose Slope
Profile Pos: Toeslope
Slope: 15 percent
Elevation: 2105 meters (6906.2 feet)
Aspect: 274°
Shape: up/down: Concave; **across:** Linear

Surface Fragments: subrounded sandstone - 2 percent and 2 percent channers.

Drainage: Well drained
Runoff: Medium
Erosion: Class 2 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: PASM - western wheatgrass (*Pascopyrum smithii*); CHRYS9 - rabbitbrush (*Chrysothamnus*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*); SYOR2 - mountain snowberry (*Symphoricarpos oreophilus*); CELE3 - curlleaf mountain mahogany (*Cercocarpus ledifolius*)

Parent Materials: alluvium derived from sandstone and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Cambic horizon: 24 to 56 centimeters (9.4 to 22 inches), Secondary carbonates: 56 to 362 centimeters (22 to 142.5 inches) and Calcic horizon: 156 to 250 centimeters (61.4 to 98.4 inches)

Ap --- 0 to 24 centimeters (0 to 9.4 inches); brown (10YR 5/3) dry, clay loam; brown (10YR 4/3) moist; 44 percent sand; 26 percent silt; 30 percent clay; moderate medium platy parting to moderate medium granular structure; friable, hard, slightly sticky, slightly plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.84 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; neutral, pH 7, pH meter; clear; CaCO3 8.5 percent.

Bw --- 24 to 56 centimeters (9.4 to 22 inches); brown (10YR 4/3) dry, clay loam; dark brown (10YR 3/3) moist; 38 percent sand; 28 percent silt; 34 percent clay; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.43 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; neutral, pH 7.3, pH meter; gradual; CaCO3 8.4 percent.

Bk1 --- 56 to 152 centimeters (22 to 59.8 inches); brown (10YR 5/3) dry, clay loam; brown (10YR 4/3) moist; 36 percent sand; 30 percent silt; 34 percent clay; weak medium subangular blocky parting to moderate fine subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; 1 percent (few) fine threadlike masses of carbonate in matrix; electrical conductivity of 0.32 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.4, pH meter; gradual; CaCO3 10.9 percent.

Bk2 --- 152 to 207 centimeters (59.8 to 81.5 inches); brown (10YR 5/3) dry, clay; brown (10YR 4/3) moist; 22 percent sand; 38 percent silt; 40 percent clay; structure; friable, hard, very sticky, very plastic; common very fine roots throughout; common very fine tubular pores; 2 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; abrupt; CaCO3 18.5 percent.

Bk3 --- 207 to 250 centimeters (81.5 to 98.4 inches); very pale brown (10YR 7/3) dry, clay loam; pale brown (10YR 6/3) moist; 26 percent sand; 47 percent silt; 27 percent clay; massive; very friable, slightly hard, slightly sticky, slightly plastic; common very fine roots throughout; 12 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.32 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.4, pH meter; abrupt; CaCO3 43.9 percent.

2Bk --- 250 to 280 centimeters (98.4 to 110.2 inches); light gray (2.5Y 7/1) dry, clay loam; gray (2.5Y 6/1) moist; 36 percent sand; 34 percent silt; 30 percent clay; moderate fine subangular blocky structure; firm, very hard, slightly sticky, slightly plastic; 5 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 0.51 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear; CaCO3 25.8 percent.

2C --- 280 to 362 centimeters (110.2 to 142.5 inches); white (2.5Y 8/1) dry, loam; light yellowish brown (2.5Y 6/3) moist; 42 percent sand; 33 percent silt; 25 percent clay; 20 percent medium yellow (10YR 7/8) mottles; massive; firm, very hard, slightly sticky, slightly plastic; 2 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.6 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; CaCO3 21.8 percent.

DP-16

Pedon ID: DP-16

Description Date: 7/31/2012
Describer: Robert Long

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370179E, 4142786N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: hillslope
Geomorphic Component: Base Slope
Profile Pos: Footslope
Slope: 9 percent
Elevation: 2098 meters (6883.2 feet)
Aspect: 256°
Shape: up/down: Concave; **across:** Linear

Surface Fragments: subangular sandstone - 4 percent gravel, 1 percent stone, and 6 percent channers.

Drainage: Well drained
Runoff: High
Erosion: Class 3 - Rill erosion

Primary Earth Cover: ; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: PASM - western wheatgrass (*Pascopyrum smithii*); MEDIC - alfalfa (*Medicago*); AGCR - crested wheatgrass (*Agropyron cristatum*); CHRYS9 - rabbitbrush (*Chrysothamnus*); BRIN2 - smooth brome (*Bromus inermis*); CIRSI - thistle (*Cirsium*)

Parent Materials: residuum weathered from calcareous shale
Bedrock: Calcareous shale at 102 centimeters (40.2 inches)
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 18 to 102 centimeters (7.1 to 40.2 inches), Gypsum accumulations: 43 to 102 centimeters (16.9 to 40.2 inches) and Paralithic contact: 102 centimeters (40.2 inches)

Restrictions: Paralithic bedrock: 102 centimeters (40.2 inches)

A --- 0 to 18 centimeters (0 to 7.1 inches); brown (10YR 5/3) dry, clay loam; brown (10YR 4/3) moist; 36 percent sand; 28 percent silt; 36 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; friable, hard, moderately sticky, moderately plastic; common coarse roots throughout, common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.84 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 12.1 percent.

Bss --- 18 to 43 centimeters (7.1 to 16.9 inches); light brownish gray (10YR 6/2) dry, clay; grayish brown (10YR 5/2) moist; 24 percent sand; 32 percent silt; 44 percent clay; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common coarse roots throughout, common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 20 percent (few) slickensides (pedogenic) on all faces of peds; electrical conductivity of 0.48 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 15.6 percent.

Bssy --- 43 to 70 centimeters (16.9 to 27.6 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 18 percent sand; 36 percent silt; 46 percent clay; moderate medium prismatic parting to moderate medium subangular blocky structure; firm, extremely hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; 30 percent (common) slickensides (pedogenic) on all faces of peds; 1 percent (few) fine masses of gypsum in matrix; electrical conductivity of 0.5 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; gradual; CaCO3 14.2 percent.

Bssy --- 70 to 102 centimeters (27.6 to 40.2 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 22 percent sand; 30 percent silt; 48 percent clay; moderate medium prismatic parting to moderate medium subangular blocky structure; firm, extremely hard, very sticky, very plastic; 50 percent (many) slickensides (pedogenic) on all faces of peds; 1 percent (few) fine threadlike masses of gypsum in matrix; electrical conductivity of 0.36 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; gradual; CaCO3 14.6 percent.

Cr --- 102 to 116 centimeters (40.2 to 45.7 inches); weathered Tropic shale.

DP-17

Pedon ID: DP-17

Description Date: 7/31/2012
Describer: Robert Long

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370215E, 4142570N -- Datum NAD83, Zone 12
Legal Description: Section 18, Township 39 South, Range 5 west of the 29 Meridian

Landscape: valley
Landform: hillslope
Geomorphic Component: Side Slope
Profile Pos: Toeslope
Slope: 6 percent
Elevation: 2090 meters (6857 feet)
Aspect: 222°
Shape: up/down: Concave; **across:** Linear

Surface Fragments: subangular sandstone- 5 percent gravels, 2 percent cobbles, 10 channers, and 2 percent flags.

Runoff: Medium
Erosion: Class 2 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Shrubby rangeland

Existing Vegetation: PASM - western wheatgrass (*Pascopyrum smithii*); AGCR - crested wheatgrass (*Agropyron cristatum*); MEDIC - alfalfa (*Medicago*); ARTR2 - basin big sagebrush (*Artemisia tridentata*)

Parent Materials: slope alluvium derived from sandstone and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 32 to 170 centimeters (12.6 to 66.9 inches) and Gypsum accumulations: 54 to 170 centimeters (21.3 to 66.9 inches)

A --- 0 to 20 centimeters (0 to 7.9 inches); pale brown (10YR 6/3) dry, clay loam; brown (10YR 4/3) moist; 28 percent sand; 34 percent silt; 38 percent clay; moderate medium platy parting to moderate medium granular structure; very friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.68 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.5, pH meter; clear; CaCO3 19.2 percent.

BA --- 20 to 32 centimeters (7.9 to 12.6 inches); brown (10YR 5/3) dry, clay; brown (10YR 4/3) moist; 30 percent sand; 29 percent silt; 41 percent clay; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.5 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 15.9 percent.

Bss --- 32 to 54 centimeters (12.6 to 21.3 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 28 percent sand; 28 percent silt; 44 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; firm, very hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 15 percent (few) pressure faces and 30 percent (common) slickensides (pedogenic); electrical conductivity of 0.42 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; gradual; CaCO3 15.1 percent.

Bssy1 --- 54 to 122 centimeters (21.3 to 48 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 22 percent sand; 32 percent silt; 46 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; firm, very hard, very sticky, very plastic; common very fine roots throughout; common very fine tubular pores; 10 percent (few) pressure faces on vertical faces of peds and 20 percent (few) slickensides (pedogenic) on all faces of peds; 2 percent (common) fine gypsum crystals in matrix; electrical conductivity of 1.58 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; gradual; CaCO3 16.9 percent.

Bssy2 --- 122 to 170 centimeters (48 to 66.9 inches); pale brown (10YR 6/3) dry, clay; brown (10YR 5/3) moist; 16 percent sand; 34 percent silt; 50 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; firm, extremely hard, very sticky, very plastic; common very fine roots throughout; common very fine tubular pores; 15 percent (few) pressure faces on vertical faces of peds and 25 percent (common) slickensides (pedogenic) on all faces of peds; 4 percent (common) fine gypsum crystals in matrix; electrical conductivity of 6.01 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; CaCO3 19.9 percent.

DP-18

Pedon ID: DP-18

Description Date: 7/31/2012
Describer: Robert Long

Current Taxonomic Name: Brumley family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Calcidic Haplustalfs
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370516E, 4143693N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Base Slope
Profile Pos: Toeslope
Slope: 3 percent
Elevation: 2122 meters (6961.9 feet)
Aspect: 270°
Shape: up/down: Convex; **across:** Linear

Surface Fragments: subrounded sandstone - 2 percent gravels.

Drainage: Moderately well drained
Runoff: Low
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: AGCR - crested wheatgrass (*Agropyron cristatum*); CHRYS9 - rabbitbrush (*Chrysothamnus*); ROWOU - Woods' rose (*Rosa woodsii*); SPHAE - globemallow (*Sphaeralcea*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 44 to 68 centimeters (17.3 to 26.8 inches)

Diagnostic Features: Argillic horizon: 44 to 68 centimeters (17.3 to 26.8 inches), Secondary carbonates: 68 to 184 centimeters (26.8 to 72.4 inches) and Calcic horizon: 68 to 184 centimeters (26.8 to 72.4 inches)

Ap --- 0 to 18 centimeters (0 to 7.1 inches); light brownish gray (10YR 6/2) dry, clay loam; dark grayish brown (10YR 4/2) moist; 30 percent sand; 36 percent silt; 34 percent clay; moderate medium subangular blocky parting to strong medium granular structure; very friable, slightly hard, moderately sticky, moderately plastic; common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 1.01 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; neutral, pH 6.9, pH meter; clear; CaCO3 17.8 percent.

BA --- 18 to 44 centimeters (7.1 to 17.3 inches); light brownish gray (10YR 6/2) dry, clay loam; dark grayish brown (10YR 4/2) moist; 40 percent sand; 31 percent silt; 29 percent clay; moderate medium subangular blocky structure; friable, slightly hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.39 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; neutral, pH 6.9, pH meter; gradual; CaCO3 23.1 percent.

Bt --- 44 to 68 centimeters (17.3 to 26.8 inches); grayish brown (10YR 5/2) dry, clay loam; dark grayish brown (10YR 4/2) moist; 22 percent sand; 42 percent silt; 36 percent clay; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 10 percent (few) clay films between sand grains and 25 percent (common) clay films on all faces of peds; electrical conductivity of 0.74 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; neutral, pH 7, pH meter; gradual; CaCO3 20.3 percent.

Bk1 --- 68 to 144 centimeters (26.8 to 56.7 inches); very pale brown (10YR 7/4) dry, clay loam; light yellowish brown (10YR 6/4) moist; 30 percent sand; 41 percent silt; 29 percent clay; moderate medium subangular blocky structure; very friable, slightly hard, moderately sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; 20 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.43 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; neutral, pH 7, pH meter; gradual; CaCO3 35.9 percent.

Bk2 --- 144 to 184 centimeters (56.7 to 72.4 inches); very pale brown (10YR 8/4) dry, loam; very pale brown (10YR 7/4) moist; 36 percent sand; 44 percent silt; 20 percent clay; 15 percent medium distinct reddish yellow (7.5YR 6/6) mottles; moderate medium subangular blocky structure; very friable, slightly hard, slightly sticky, slightly plastic; common very fine tubular pores; 15 percent (common) fine masses of carbonate; electrical conductivity of 0.35 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; neutral, pH 7.2, pH meter; gradual; CaCO3 43.1 percent.

2C --- 184 to 240 centimeters (72.4 to 94.5 inches); light gray (10YR 7/2) dry, loamy sand; light brownish gray (10YR 6/2) moist; 78 percent sand; 14 percent silt; 8 percent clay; 2 percent fine prominent strong brown (7.5YR 5/6) mottles; weak fine subangular blocky parting to single grain structure; very friable, soft, nonsticky, nonplastic; many very fine interstitial pores; electrical conductivity of 0.28 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; neutral, pH 7.3, pH meter; $CaCO_3$ 17.3 percent.

DP-19

Pedon ID: DP-19

Description Date: 7/31/2012
Describer: Robert Long

Pedon Notes: Text: Textures and percent clay were estimated based on the field texture method; and pH was determined with indicator phenol red indicator dye.

Current Taxonomic Name: Boxcanyon family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Calcidic Haplustalfs
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370537E, 4143693N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 west of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Base Slope
Profile Pos: Toeslope
Slope: 6 percent
Elevation: 2122 meters (6961.9 feet)
Aspect: 253°
Shape: up/down: Concave; **across:** Linear

Surface Fragments: subangular sandstone - 5 percent channers.

Drainage: Well drained
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland

Existing Vegetation: AGCR - crested wheatgrass (*Agropyron cristatum*); CHRYS9 - rabbitbrush (*Chrysothamnus*); CONVO - bindweed (*Convolvulus*); PASM - western wheatgrass (*Pascopyrum smithii*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section:

Diagnostic Features: Secondary carbonates: 122 to 244 centimeters (48 to 96.1 inches)

N/A --- 0 to 122 centimeters (0 to 48 inches); sample unavailable for evaluation.

Bk --- 122 to 225 centimeters (48 to 88.6 inches); yellowish brown (10YR 5/4) moist, loam; very pale brown (10YR 7/3) dry; null percent sand; null percent silt; 18 percent clay; structure; friable, hard, nonsticky, nonplastic; common very fine roots throughout; common very fine tubular pores; 15 percent (common) medium masses of carbonate in matrix; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH indicator solutions; abrupt.

2Ck --- 225 to 244 centimeters (88.6 to 96.1 inches); yellowish brown (10YR 5/4) moist, loamy sand; very pale brown (10YR 7/4) dry; null percent sand; null percent silt; 3 percent clay; single grain; loose, loose, nonsticky, nonplastic; many very fine interstitial pores finely disseminated carbonates; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.4, pH indicator solutions.

DP-20

Pedon ID: DP-20

Description Date: 7/31/2012
Describer: Robert Long

Pedon Notes: Text: the original surface appears to have been removed, possibly by mechanically leveling of the surface. Definitive clay films observed and not slickensides were observed in the Bat and Bt horizons.

Current Taxonomic Name: Boxcanyon family truncated
Current Taxonomic Class: Fine, smectitic, mesic Calcidic Haplustalfs
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370556E, 4143699N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace and alluvial fan
Geomorphic Component: Base Slope
Profile Pos: Toeslope
Slope: 5 percent
Elevation: 2124 meters (6968.5 feet)
Aspect: 267°
Shape: up/down: Concave; **across:** Linear

Surface Fragments: subangular sandstone - 2 percent gravels and 5 percent channers.

Drainage: Well drained
Runoff: Low
Erosion: Class 2 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland

Existing Vegetation: AGCR - crested wheatgrass (*Agropyron cristatum*); BRIN2 - smooth brome (*Bromus inermis*); CHRYS9 - rabbitbrush (*Chrysothamnus*); ARNO4 - black sagebrush (*Artemisia nova*)

Parent Materials: slope alluvium derived from sandstone and shale over alluvium derived from limestone, sandstone, and shale

Particle Size Control Section: 0 to 50 centimeters (0 to 19.7 inches)

Diagnostic Features: Argillic horizon: 0 to 170 centimeters (0 to 66.9 inches), Gypsum accumulations: 122 to 170 centimeters (48 to 66.9 inches), Calcic horizon: 122 to 310 centimeters (48 to 122 inches) and Secondary carbonates: 122 to 366 centimeters (48 to 144.1 inches)

BAtp --- 0 to 38 centimeters (0 to 15 inches); grayish brown (10YR 5/2) dry, silty clay; dark grayish brown (10YR 4/2) moist; 20 percent sand; 40 percent silt; 40 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; very friable, hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 15 percent (few) clay films on all faces of peds; electrical conductivity of 0.95 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 14.2 percent.

Bt --- 38 to 55 centimeters (15 to 21.7 inches); grayish brown (10YR 5/2) dry, clay; brown (10YR 4/3) moist; 18 percent sand; 40 percent silt; 42 percent clay; strong medium subangular blocky structure; friable, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 20 percent (few) clay films between sand grains and 40 percent (common) clay films on all faces of peds; electrical conductivity of 0.52 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 14.8 percent.

N/A 55 to 122 centimeters (21.7 to 48 inches); EC meter, saturated paste electric conductivity method; sample not recovered by push probe..

Btky --- 122 to 170 centimeters (48 to 66.9 inches); light brownish gray (10YR 6/2) dry, clay; brown (10YR 4/3) moist; 19 percent sand; 39 percent silt; 42 percent clay; strong medium subangular blocky structure; firm, very hard, very sticky, very plastic; common very fine roots throughout; 3 percent (common) medium lenticular gypsum crystals between peds and 5 percent (common) fine threadlike masses of carbonate in matrix; 3 percent subrounded calcareous sandstone gravels; electrical conductivity of 2.76 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 21.5 percent.

Bk --- 170 to 240 centimeters (66.9 to 94.5 inches); very pale brown (10YR 8/2) dry, silt loam; yellowish brown (10YR 5/4) moist; 24 percent sand; 50 percent silt; 26 percent clay; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common very fine roots throughout; 12 percent (common) medium spherical masses of carbonate in matrix; electrical conductivity of 3.9 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear; CaCO3 41.1 percent.

2Ck1 --- 240 to 310 centimeters (94.5 to 122 inches); yellow (10YR 7/6) dry, sandy loam; yellowish brown (10YR 5/4) moist; 52 percent sand; 40 percent silt; 8 percent clay; massive parting to single grain; very friable, slightly hard, nonsticky, nonplastic finely disseminated carbonates; electrical conductivity of 1.69 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; gradual; CaCO3 36.8 percent.

2Ck2 --- 310 to 366 centimeters (122 to 144.1 inches); yellow (10YR 7/6) dry, sandy loam; brownish yellow (10YR 6/6) moist; 52 percent sand; 38 percent silt; 10 percent clay; massive parting to single grain; very friable, hard, nonsticky, nonplastic finely disseminated carbonates; electrical conductivity of 1.84 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; CaCO3 15.1 percent.

DP-21

Pedon ID: DP-21

Description Date: 7/31/2012
Describer: Robert Long

Current Taxonomic Name: Teromote family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Haplustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370583E, 4143702N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: hillslope
Geomorphic Component: Base Slope
Profile Pos: Footslope
Slope: 5 percent
Elevation: 2126 meters (6975.1 feet)
Aspect: 268°
Shape: up/down: Concave; **across:** Linear

Surface Fragments: subangular sandstone - 5 percent channers.

Drainage: Well drained
Runoff: Low
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland
Existing Vegetation: PASM - western wheatgrass (*Pascopyrum smithii*); AGCR - crested wheatgrass (*Agropyron cristatum*); ARNO4 - black sagebrush (*Artemisia nova*)

Parent Materials: slope alluvium derived from limestone and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 33 to 360 centimeters (13 to 141.7 inches), Gypsum accumulations: 188 to 360 centimeters (74 to 141.7 inches) and Secondary carbonates: 188 to 360 centimeters (74 to 141.7 inches)

Ap --- 0 to 33 centimeters (0 to 13 inches); grayish brown (10YR 5/2) dry, clay loam; dark grayish brown (10YR 4/2) moist; 24 percent sand; 37 percent silt; 39 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; friable, hard, moderately sticky, moderately plastic; common very fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.12 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 13 percent.

Bss1 --- 33 to 140 centimeters (13 to 55.1 inches); brown (10YR 5/3) dry, clay loam; dark grayish brown (10YR 4/2) moist; 26 percent sand; 35 percent silt; 39 percent clay; strong medium subangular blocky structure; friable, very hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 20 percent (few) slickensides (pedogenic); 2 percent subrounded limestone gravels; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 15 percent.

Bss2 --- 140 to 188 centimeters (55.1 to 74 inches); brown (10YR 5/3) dry, silty clay; brown (10YR 4/3) moist; 11 percent sand; 41 percent silt; 48 percent clay; strong medium subangular blocky structure; firm, very hard, very sticky, very plastic; common very fine roots throughout; 25 percent (common) slickensides (pedogenic); electrical conductivity of 2.37 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 18.6 percent.

Bssy1 --- 188 to 260 centimeters (74 to 102.4 inches); brown (10YR 5/3) dry, silty clay; brown (10YR 4/3) moist; 11 percent sand; 40 percent silt; 49 percent clay; moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; common very fine roots throughout; 30 percent (common) slickensides (pedogenic); 2 percent (common) medium gypsum crystals on vertical faces of peds and finely disseminated carbonates; electrical conductivity of 2.29 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; gradual; CaCO3 19.3 percent.

Bssy2 --- 260 to 360 centimeters (102.4 to 141.7 inches); light olive brown (2.5Y 5/3) dry, clay; olive brown (2.5Y 4/3) moist; 7 percent sand; 39 percent silt; 54 percent clay; moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; 20 percent (few) slickensides (pedogenic); 2 percent (common) fine gypsum crystals in matrix and 5 percent (common) medium masses of carbonate in matrix; electrical conductivity of 1.81 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; CaCO3 18.7 percent.

DP-22

Pedon ID: DP-22

Description Date: 7/31/2012
Describer: Robert Long

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370608E, 4143806N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: alluvial fan
Geomorphic Component: Base Slope
Profile Pos: Footslope
Slope: 7 percent
Elevation: 2129 meters (6984.9 feet)
Aspect: 250°
Shape: up/down: Concave; **across:** Convex

Surface Fragments: subangular sandstone - 3 percent gravels, 5 percent channers, and 2 percent flags.

Drainage: Well drained
Runoff: Medium
Erosion: Class 2 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland

Existing Vegetation: PASM - western wheatgrass (*Pascopyrum smithii*); CONVO - bindweed (*Convolvulus*); ROWOU - Woods' rose (*Rosa woodsii var. ultramontana*); WYAM - mule-ears (*Wyethia amplexicaulis*); ASTRA - milkvetch (*Astragalus*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: slope alluvium derived from calcareous shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 28 to 240 centimeters (11 to 94.5 inches), Secondary carbonates: 50 to 240 centimeters (19.7 to 94.5 inches) and Calcic horizon: 120 to 240 centimeters (47.2 to 94.5 inches)

Ap --- 0 to 28 centimeters (0 to 11 inches); light brownish gray (10YR 6/2) dry, silty clay; grayish brown (10YR 5/2) moist; 8 percent sand; 40 percent silt; 52 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; friable, very hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; electrical conductivity of 0.65 mmhos/cm by EC meter, saturated paste; slightly effervescent; moderately alkaline, pH 8, pH meter; clear; CaCO3 16 percent.

Bss --- 28 to 50 centimeters (11 to 19.7 inches); grayish brown (10YR 5/2) dry, silty clay; dark grayish brown (10YR 4/2) moist; 9 percent sand; 34 percent silt; 57 percent clay; strong medium subangular blocky structure; firm, extremely hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; 20 percent (few) pressure faces and 20 percent (few) slickensides (pedogenic); electrical conductivity of 3.6 mmhos/cm by EC meter, saturated paste; slightly effervescent; moderately alkaline, pH 8, pH meter; gradual; CaCO3 14.2 percent.

Bkss1 --- 50 to 120 centimeters (19.7 to 47.2 inches); light brownish gray (10YR 6/2) dry, silty clay; brown (10YR 5/3) moist; 3 percent sand; 50 percent silt; 47 percent clay; strong medium subangular blocky structure; firm, extremely hard, very sticky, very plastic; common very fine roots throughout; 15 percent (few) pressure faces and 30 percent (common) slickensides (pedogenic); 8 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 6.68 mmhos/cm by EC meter, saturated paste; strongly effervescent; moderately alkaline, pH 8.4, pH meter; gradual; CaCO3 16.6 percent.

Bkss2 --- 120 to 180 centimeters (47.2 to 70.9 inches); light brownish gray (10YR 6/2) dry, clay; grayish brown (10YR 5/2) moist; 0 percent sand; 39 percent silt; 61 percent clay; moderate medium subangular blocky structure; friable, extremely hard, very sticky, very plastic; common very fine roots throughout; 30 percent (common) slickensides (pedogenic); 15 percent (common) medium lenticular masses of carbonate in matrix; electrical conductivity of 7.94 mmhos/cm by EC meter, saturated paste; strongly effervescent; strongly alkaline, pH 8.6, pH meter; gradual; CaCO3 22.2 percent.

Bkss3 --- 180 to 240 centimeters (70.9 to 94.5 inches); light brownish gray (10YR 6/2) dry, silty clay; grayish brown (10YR 5/2) moist; 5 percent sand; 39 percent silt; 56 percent clay; moderate medium subangular blocky structure; friable, very hard, very sticky, very plastic; 15 percent (few) slickensides (pedogenic); 20 percent (many) medium lenticular masses of carbonate in matrix; electrical conductivity of 6.22 mmhos/cm by EC meter, saturated paste; strongly effervescent; moderately alkaline, pH 8.3, pH meter; CaCO3 23 percent.

DP-23

Pedon ID: DP-23

Description Date: 7/31/2012
Describer: Robert Long

Current Taxonomic Name: Wimmer family
Current Taxonomic Class: Fine-loamy, mixed, superactive, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370577E, 4143819N -- Datum NAD83, Zone 12
Location Description:
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace and fan apron
Geomorphic Component: Tread
Profile Pos: Toeslope
Slope: 5 percent
Elevation: 2127 meters (6978.3 feet)
Aspect: 252°
Shape: up/down: Convex; **across:** Linear

Surface Fragments: subangular sandstone - 10 cobbles and 5 percent channers.

Drainage: Well drained
Runoff: Medium
Erosion: Class 2 - Rill erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland

Existing Vegetation: PASM - western wheatgrass (*Pascopyrum smithii*); CONVO - bindweed (*Convolvulus*); CHRYS9 - rabbitbrush (*Chrysothamnus*); ROWOU - Woods' rose (*Rosa woodsii var. ultramontana*)

Parent Materials: slope alluvium derived from sandstone and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Cambic horizon: 30 to 57 centimeters (11.8 to 22.4 inches), Secondary carbonates: 57 to 122 centimeters (22.4 to 48 inches) and Calcic horizon: 57 to 122 centimeters (22.4 to 48 inches)

Ap --- 0 to 30 centimeters (0 to 11.8 inches); brown (10YR 5/3) dry, silty clay; dark grayish brown (10YR 4/2) moist; 19 percent sand; 41 percent silt; 40 percent clay; weak medium subangular blocky parting to moderate medium granular structure; very friable, slightly hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; electrical conductivity of 0.87 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 16.8 percent.

Bw --- 30 to 57 centimeters (11.8 to 22.4 inches); brown (10YR 5/3) dry, clay; dark grayish brown (10YR 4/2) moist; 26 percent sand; 34 percent silt; 40 percent clay; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; electrical conductivity of 0.35 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 16.1 percent.

Bk1 --- 57 to 80 centimeters (22.4 to 31.5 inches); light yellowish brown (10YR 6/4) dry, clay loam; yellowish brown (10YR 5/4) moist; 25 percent sand; 36 percent silt; 39 percent clay; moderate medium subangular blocky parting to strong fine subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common very fine roots throughout; 8 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.47 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 30.9 percent.

Bk2 --- 80 to 122 centimeters (31.5 to 48 inches); brownish yellow (10YR 6/6) dry, sandy clay; yellowish brown (10YR 5/6) moist; 62 percent sand; 0 percent silt; 38 percent clay; weak fine subangular blocky parting to single grain structure; very friable, hard, moderately sticky, moderately plastic; 10 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.67 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; CaCO3 29.6 percent.

DP-24

Pedon ID: DP-24

Description Date: 8/1/2012
Describer: Robert Long

Pedon Notes: Text: Bk horizon 126 to 244 cm) developed from shale, but no evidence of parent material remains.

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370691E, 4143951N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: alluvial fan
Geomorphic Component: Base Slope
Profile Pos: Footslope
Slope: 8 percent
Elevation: 2134 meters (7001.3 feet)
Aspect: 268°
Shape: up/down: Convex; **across:** Linear

Surface Fragments: subangular sandstone - 5 percent gravels, 8 percent channers, and 2 percent flags.

Drainage: Well drained
Runoff: High
Erosion: Class 3 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland

Existing Vegetation: PASM - western wheatgrass (*Pascopyrum smithii*); CONVO - bindweed (*Convolvulus*); CHRYS9 - rabbitbrush (*Chrysothamnus*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: slope alluvium derived from sandstone and shale over residuum weathered from calcareous shale

Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 22 to 126 centimeters (8.7 to 49.6 inches), Secondary carbonates: 40 to 244 centimeters (15.7 to 96.1 inches) and Gypsum accumulations: 126 to 244 centimeters (49.6 to 96.1 inches)

Ap --- 0 to 22 centimeters (0 to 8.7 inches); light brownish gray (10YR 6/2) dry, silty clay loam; dark grayish brown (10YR 4/2) moist; 19 percent sand; 44 percent silt; 37 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; very friable, hard, moderately sticky, moderately plastic; common coarse roots throughout, common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.52 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 18.9 percent.

Bss --- 22 to 40 centimeters (8.7 to 15.7 inches); brown (10YR 5/3) dry, silty clay; dark grayish brown (10YR 4/2) moist; 15 percent sand; 41 percent silt; 44 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; friable, very hard, very sticky, very plastic; common coarse roots throughout, common medium roots throughout, common fine roots throughout and common very fine roots throughout; 30 percent (common) slickensides (pedogenic); electrical conductivity of 0.5 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 18.3 percent.

Bkss1 --- 40 to 65 centimeters (15.7 to 25.6 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 15 percent sand; 39 percent silt; 46 percent clay; moderate medium prismatic parting to strong medium angular blocky structure; firm, very hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; 65 percent (many) slickensides (pedogenic); 1 percent (few) fine masses of carbonate in matrix; electrical conductivity of 0.39 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; gradual; CaCO3 18.4 percent.

Bkss2 --- 65 to 126 centimeters (25.6 to 49.6 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 13 percent sand; 39 percent silt; 48 percent clay; moderate medium subangular blocky structure; firm, hard, very sticky, very plastic; common very fine roots throughout; 50 percent (many) slickensides (pedogenic); 3 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.86 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; abrupt; CaCO3 18.2 percent.

Bk --- 126 to 244 centimeters (49.6 to 96.1 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 15 percent sand; 35 percent silt; 50 percent clay; massive; firm, very hard, very sticky, very plastic; 2 percent (common) fine lenticular gypsum crystals in matrix and 8 percent (common) medium masses of carbonate in matrix; electrical conductivity of 4.35 mmhos/cm; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; CaCO3 20.9 percent.

DP-25

Pedon ID: DP-25

Description Date: 8/1/2012
Describer: Robert Long

Pedon Notes: Text: The 3Cr horizon appears to be the top of weathering sandstone.

Current Taxonomic Name: Boxcanyon family
Current Taxonomic Class: Fine, smectitic, mesic Calcidic Haplustalfs
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370633E, 4143969N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace and alluvial fan
Geomorphic Component: Base Slope
Profile Pos: Toeslope
Slope: 4 percent
Elevation: 2129 meters (6984.9 feet)
Aspect: 270°
Shape: up/down: Convex; **across:** Linear

Surface Fragments: subangular sandstone - 2 percent gravels and 3 percent channers.

Drainage: Well drained
Runoff: Medium
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Grassland rangeland

Existing Vegetation: PASM - western wheatgrass (*Pascopyrum smithii*); CONVO - bindweed (*Convolvulus*); CHRYS9 - rabbitbrush (*Chrysothamnus*); SYOR2 - mountain snowberry (*Symphoricarpos oreophilus*); ARTRW8 - Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*)

Parent Materials: slope alluvium derived from sandstone and shale over alluvium derived from limestone and sandstone over residuum weathered from calcareous sandstone

Bedrock: Calcareous sandstone at 208 centimeters (81.9 inches)
Particle Size Control Section: 28 to 75 centimeters (11 to 29.5 inches)

Diagnostic Features: Secondary carbonates: 28 to 208 centimeters (11 to 81.9 inches), Argillic horizon: 28 to 144 centimeters (11 to 56.7 inches), Calcic horizon: 75 to 208 centimeters (29.5 to 81.9 inches) and Paralithic contact: 208 centimeters (81.9 inches)

Restrictions: Paralithic bedrock: 208 centimeters (81.9 inches)

Ap --- 0 to 16 centimeters (0 to 6.3 inches); grayish brown (10YR 5/2) dry, silty clay; dark grayish brown (10YR 4/2) moist; 19 percent sand; 41 percent silt; 40 percent clay; moderate medium subangular blocky structure; very friable, hard, moderately sticky, moderately plastic; common coarse roots throughout, common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.83 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 18.2 percent.

Bt --- 16 to 28 centimeters (6.3 to 11 inches); brown (10YR 5/3) dry, silty clay; dark grayish brown (10YR 4/2) moist; 15 percent sand; 41 percent silt; 44 percent clay; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common coarse roots throughout, common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 25 percent (common) clay films on all faces of peds; electrical conductivity of 0.48 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 16.1 percent.

Btk1 --- 28 to 54 centimeters (11 to 21.3 inches); grayish brown (10YR 5/2) dry, silty clay; dark grayish brown (10YR 4/2) moist; 11 percent sand; 41 percent silt; 48 percent clay; weak medium prismatic parting to strong medium subangular blocky structure; friable, very hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; 40 percent (common) clay films on all faces of peds finely disseminated carbonates; electrical conductivity of 0.49 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; gradual; CaCO3 16.1 percent.

2Btk2 --- 54 to 75 centimeters (21.3 to 29.5 inches); grayish brown (10YR 5/2) dry, clay; dark grayish brown (10YR 4/2) moist; 19 percent sand; 39 percent silt; 42 percent clay; weak medium prismatic parting to strong medium subangular blocky structure; friable, very hard, very sticky, very plastic; common very fine roots throughout; 15 percent (few) clay films between sand grains and 40 percent (common) clay films on all faces of peds finely disseminated carbonates; 10 percent subrounded limestone gravels; electrical conductivity of 0.49 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 19.6 percent.

2Btk3 --- 75 to 144 centimeters (29.5 to 56.7 inches); grayish brown (10YR 5/2) dry, gravelly clay loam; dark grayish brown (10YR 4/2) moist; 36 percent sand; 31 percent silt; 33 percent clay; moderate medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; common very fine roots throughout; 25 percent (common) clay films on all faces of peds and 2 percent (very few) carbonate coats on bottom surfaces of rock fragments; 2 percent (common) fine masses of carbonate in matrix; 25 percent subrounded limestone gravels; electrical conductivity of 0.44 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 27.1 percent.

2Bk2 --- 144 to 208 centimeters (56.7 to 81.9 inches); pale brown (10YR 6/3) dry, very gravelly sandy loam; brown (10YR 5/3) moist; 72 percent sand; 15 percent silt; 13 percent clay; moderate medium subangular blocky parting to single grain structure; very friable, slightly hard, nonsticky, nonplastic; common very fine roots throughout; 3 percent (very few) carbonate coats on bottom surfaces of rock fragments; 8 percent (common) medium masses of carbonate in matrix; 20 percent subrounded sandstone gravels and 25 percent subrounded limestone gravels; electrical conductivity of 0.35 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; abrupt; CaCO3 51.8 percent.

3Cr --- 208 to 244 centimeters (81.9 to 96.1 inches); very pale brown (10YR 7/3) dry, gravelly loamy sand; yellowish brown (10YR 5/6) moist; 87 percent sand; 5 percent silt; 8 percent clay; massive parting to single grain; friable, hard, nonsticky, nonplastic; 30 percent subangular calcareous sandstone gravels; electrical conductivity of 0.37 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; weathering sandstone; CaCO3 32.5 percent.

DP-26

Pedon ID: DP-26

Description Date: 8/1/2012
Describer: Robert Long

Pedon Notes: Text: Clay films are present in Bt, but there is not enough clay increase from A for an argillic.

Current Taxonomic Name: BBB family
Current Taxonomic Class: Fine-loamy, carbonatic, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370754E, 4144249N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Base Slope
Profile Pos: Toeslope
Slope: 4 percent
Elevation: 2136 meters (7007.9 feet)
Aspect: 240°
Shape: up/down: Linear; **across:** Linear

Surface Fragments: none.

Drainage: Somewhat poorly drained
Runoff: Low
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Shrubby rangeland

Existing Vegetation: CHRYS9 - rabbitbrush (*Chrysothamnus*); PASM - western wheatgrass (*Pascopyrum smithii*); CONVO - bindweed (*Convolvulus*); ROWOU - Woods' rose (*Rosa woodsii var. ultramontana*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Cambic horizon: 15 to 32 centimeters (5.9 to 12.6 inches), Secondary carbonates: 32 to 366 centimeters (12.6 to 144.1 inches) and Calcic horizon: 32 to 230 centimeters (12.6 to 90.6 inches)

Ap --- 0 to 15 centimeters (0 to 5.9 inches); brown (10YR 5/3) dry, silty clay; brown (10YR 4/3) moist; 15 percent sand; 43 percent silt; 42 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; very friable, slightly hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.55 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; gradual; CaCO3 18.7 percent.

Bt --- 15 to 32 centimeters (5.9 to 12.6 inches); brown (10YR 5/3) dry, silty clay; brown (10YR 4/3) moist; 9 percent sand; 47 percent silt; 44 percent clay; weak medium prismatic parting to moderate medium subangular blocky structure; friable, very hard, moderately sticky, moderately plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 40 percent (common) clay films on all faces of peds; electrical conductivity of 0.33 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; clear; CaCO3 25.1 percent.

Bk1 --- 32 to 59 centimeters (12.6 to 23.2 inches); pink (7.5YR 8/3) dry, silty clay; reddish yellow (7.5YR 6/6) moist; 3 percent sand; 49 percent silt; 48 percent clay; structure; friable, very hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 18 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.34 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; gradual; CaCO3 46.8 percent.

Bk2 --- 59 to 90 centimeters (23.2 to 35.4 inches); pink (7.5YR 8/3) dry, silty clay; reddish yellow (7.5YR 6/6) moist; 1 percent sand; 51 percent silt; 48 percent clay; structure; firm, extremely hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 20 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.28 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; abrupt; CaCO3 54.4 percent.

2Bk1 --- 90 to 148 centimeters (35.4 to 58.3 inches); very pale brown (10YR 8/2) dry, silty clay loam; light yellowish brown (10YR 6/4) moist; 0 percent sand; 64 percent silt; 36 percent clay; 12 percent medium distinct reddish yellow (7.5YR 6/6) mottles; weak medium subangular blocky structure; friable, very hard, moderately sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; 12 percent (common) medium reddish yellow (7.5YR 6/6), dry; 7 percent (common) medium masses of carbonate in matrix; 2 percent subrounded calcareous sandstone gravels;

electrical conductivity of 0.26 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; gradual; CaCO3 50.2 percent.

2Bk2 --- 148 to 230 centimeters (58.3 to 90.6 inches); very pale brown (10YR 8/2) dry, loam; yellow (10YR 7/6) moist; 35 percent sand; 45 percent silt; 20 percent clay; 20 percent medium distinct brownish yellow (10YR 6/8) mottles; moderate medium subangular blocky structure; friable, hard, slightly sticky, slightly plastic; common very fine roots throughout; common very fine tubular pores; 20 percent (many) medium brownish yellow (10YR 6/8), dry; 10 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.26 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; gradual; CaCO3 43.8 percent.

3Ck1 --- 230 to 294 centimeters (90.6 to 115.7 inches); very pale brown (10YR 8/2) dry, sandy loam; pale brown (10YR 6/3) moist; 55 percent sand; 31 percent silt; 14 percent clay; 25 percent medium prominent brownish yellow (10YR 6/8) mottles; weak medium subangular blocky parting to single grain structure; very friable, slightly hard, moderately sticky, nonplastic; common very fine interstitial pores; 5 percent (common) coarse brownish yellow (10YR 6/8), dry and 25 percent (many) medium brownish yellow (10YR 6/8), dry finely disseminated carbonates; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; clear; CaCO3 24.6 percent.

3Ck2 --- 294 to 350 centimeters (115.7 to 137.8 inches); light gray (10YR 7/2) dry, sandy loam; light brownish gray (10YR 6/2) moist; 69 percent sand; 23 percent silt; 8 percent clay; 3 percent medium prominent brownish yellow (10YR 6/6) mottles; single grain; very friable, hard, nonsticky, nonplastic; common very fine interstitial pores; 3 percent (common) medium brownish yellow (10YR 6/6), dry finely disseminated carbonates; electrical conductivity of 0.34 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; abrupt; CaCO3 15.3 percent.

4Ck --- 350 to 366 centimeters (137.8 to 144.1 inches); light gray (2.5Y 7/2) dry, silt loam; grayish brown (2.5Y 5/2) moist; 25 percent sand; 55 percent silt; 20 percent clay; 8 percent coarse prominent (10YR) mottles; massive; friable, very hard, slightly sticky, slightly plastic; 8 percent (common) coarse brownish yellow (10YR 6/6), dry; 4 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.39 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; CaCO3 37 percent.

DP-27

Pedon ID: DP-27

Description Date: 8/1/2013
Describer: Robert Long

Pedon Notes: Text: There is not enough clay increase between the A and Btk1 horizons. Clay films are visible in the Btk1 and Btk2 horizons.

Current Taxonomic Name: CCC family similar
Current Taxonomic Class: Fine, smectitic, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 370791E, 4144251N -- Datum NAD83, Zone 12
Legal Description: Section 7, Township 39 South, Range 5 West of the 29 Meridian

Landscape: valley
Landform: terrace
Geomorphic Component: Base Slope
Profile Pos: Toeslope
Slope: 6 percent
Elevation: 2140 meters (7021 feet)
Aspect: 260°
Shape: up/down: Concave; **across:** Concave

Surface Fragments: subangular sandstone - 1 percent channers.

Drainage: Somewhat poorly drained
Runoff: Low
Erosion: Class 2 - Rill erosion

Primary Earth Cover: Shrub cover; **Secondary Earth Cover:** Shrubby rangeland

Existing Vegetation: CHRYS9 - rabbitbrush (*Chrysothamnus*); BRIN2 - smooth brome (*Bromus inermis*); AGCR - crested wheatgrass (*Agropyron cristatum*); ARNO4 - black sagebrush (*Artemisia nova*)

Parent Materials: slope alluvium derived from sandstone and shale over alluvium derived from limestone, sandstone, and shale over residuum weathered from calcareous shale

Bedrock: Calcareous shale at 396 centimeters (155.9 inches)
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Secondary carbonates: 22 to 488 centimeters (8.7 to 192.1 inches), Cambic horizon: 22 to 80 centimeters (8.7 to 31.5 inches) and Calcic horizon: 80 to 310 centimeters (31.5 to 122 inches)

A --- 0 to 22 centimeters (0 to 8.7 inches); grayish brown (10YR 5/2) dry, silty clay; dark grayish brown (10YR 4/2) moist; 14 percent sand; 44 percent silt; 42 percent clay; moderate medium subangular blocky parting to moderate medium granular structure; friable, hard, moderately sticky, moderately plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.63 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 17.8 percent.

Btk1 --- 22 to 40 centimeters (8.7 to 15.7 inches); grayish brown (10YR 5/2) dry, silty clay; dark grayish brown (10YR 4/2) moist; 4 percent sand; 47 percent silt; 49 percent clay; strong medium subangular blocky structure; firm, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 35 percent (common) clay films on all faces of peds; 2 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.32 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 17 percent.

Btk2 --- 40 to 80 centimeters (15.7 to 31.5 inches); grayish brown (10YR 5/2) dry, silty clay; dark grayish brown (10YR 4/2) moist; 9 percent sand; 46 percent silt; 45 percent clay; strong medium subangular blocky structure; firm, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; 15 percent (few) clay films between sand grains and 40 percent (common) clay films on all faces of peds; 2 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.4 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.8, pH meter; clear; CaCO3 18.9 percent.

Bk1 --- 80 to 152 centimeters (31.5 to 59.8 inches); light gray (10YR 7/2) dry, silty clay; pale brown (10YR 6/3) moist; 0 percent sand; 53 percent silt; 47 percent clay; 10 percent medium distinct brownish yellow (10YR 6/6) mottles; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common very fine tubular pores; 5 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.39 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; gradual; CaCO3 38.1 percent.

Bk2 --- 152 to 224 centimeters (59.8 to 88.2 inches); very pale brown (10YR 8/2) dry, silty clay loam; light brownish gray (10YR 6/2) moist; 6 percent sand; 59 percent silt; 35 percent clay; 12 percent medium prominent yellow (2.5Y 7/6) mottles; weak medium subangular blocky structure; friable, hard, moderately sticky, moderately plastic; 12 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.31 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.5, pH meter; gradual; CaCO3 53.4 percent.

Bk3 --- 224 to 310 centimeters (88.2 to 122 inches); very pale brown (10YR 8/2) dry, silty clay loam; very pale brown (10YR 7/3) moist; 6 percent sand; 61 percent silt; 33 percent clay; 2 percent medium prominent yellow (2.5Y 7/6) and 5 percent fine prominent yellow (2.5Y 7/6) mottles; massive; friable, very hard, moderately sticky, moderately plastic; 15 percent (common) medium masses of carbonate in matrix; electrical conductivity of 0.43 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; strongly alkaline, pH 8.7, pH meter; clear; CaCO3 57.1 percent.

2Bk1 --- 310 to 350 centimeters (122 to 137.8 inches); light brownish gray (2.5Y 6/2) dry, clay loam; dark grayish brown (2.5Y 4/2) moist; 32 percent sand; 35 percent silt; 33 percent clay; 5 percent fine prominent strong brown (7.5YR 5/8) mottles; massive; firm, very hard, moderately sticky, moderately plastic; 2 percent (common) fine threadlike masses of carbonate in matrix; electrical conductivity of 0.59 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; strongly alkaline, pH 8.6, pH meter; clear; CaCO3 22.9 percent.

2Bk2 --- 350 to 396 centimeters (137.8 to 155.9 inches); light gray (2.5Y 7/2) dry, gravelly loam; light olive brown (2.5Y 5/3) moist; 46 percent sand; 31 percent silt; 23 percent clay; 8 percent medium prominent brownish yellow (10YR 6/8) mottles; massive; firm, very hard, slightly sticky, slightly plastic; 4 percent (very few) carbonate coats on bottom surfaces of rock fragments; 4 percent (common) medium masses of carbonate in matrix; 10 percent subrounded 2 calcareous sandstone gravels and 15 percent subrounded limestone gravels; electrical conductivity of 1.35 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; Weather perching on top of this horizon; gradual; CaCO3 35 percent.

3Ck --- 396 to 488 centimeters (155.9 to 192.1 inches); light gray (2.5Y 7/1) dry, clay; gray (2.5Y 5/1) moist; 8 percent sand; 25 percent silt; 67 percent clay; 8 percent medium prominent light yellowish brown (10YR 6/4) mottles; moderate fine platy structure; friable, hard, very sticky, very plastic; 7 percent (common) medium masses of carbonate in matrix; electrical conductivity of 3.38 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.4, pH meter; weathering shale; water appears to be perching on top and in this horizon; CaCO3 22.9 percent.

DP-28

Pedon ID: DP-28

Description Date: 8/1/2012
Describer: Robert Long

Current Taxonomic Name: Sideshow family
Current Taxonomic Class: Fine, smectitic, mesic Aridic Haplusterts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369655E, 4143668N -- Datum NAD83, Zone 12
Legal Description: Section 12, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: alluvial fan
Geomorphic Component: Tread
Profile Pos: Toeslope
Slope: 1 percent
Elevation: 2115 meters (6939 feet)
Aspect: 90°
Shape: up/down: Linear; **across:** Linear

Surface Fragments: subangular sandstone - 4 percent channers.

Drainage: Moderately well drained
Runoff: Negligible
Erosion: None - deposition

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: BRIN2 - smooth brome (*Bromus inermis*); ROWOU - Woods' rose (*Rosa woodsii var. ultramontana*); PASM - western wheatgrass (*Pascopyrum smithii*); ACHIL - yarrow (*Achillea*)

Parent Materials: alluvium derived from limestone, sandstone, and shale
Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Slickensides: 14 to 62 centimeters (5.5 to 24.4 inches), Secondary carbonates: 62 to 140 centimeters (24.4 to 55.1 inches), Gypsum accumulations: 100 to 140 centimeters (39.4 to 55.1 inches) and Slickensides: 100 to 140 centimeters (39.4 to 55.1 inches)

AB --- 0 to 14 centimeters (0 to 5.5 inches); light brownish gray (10YR 6/2) dry, clay; grayish brown (10YR 5/2) moist; 20 percent sand; 34 percent silt; 46 percent clay; moderate medium subangular blocky structure; friable, hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.8 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 17.3 percent.

Bss1 --- 14 to 38 centimeters (5.5 to 15 inches); light brownish gray (10YR 6/2) dry, clay; brown (10YR 4/3) moist; 10 percent sand; 38 percent silt; 52 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; firm, extremely hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; 35 percent (common) slickensides (pedogenic) on all faces of peds; electrical conductivity of 0.58 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; gradual; CaCO3 24.5 percent.

Bss2 --- 38 to 62 centimeters (15 to 24.4 inches); light brownish gray (10YR 6/2) dry, silty clay; grayish brown (10YR 5/2) moist; 10 percent sand; 35 percent silt; 55 percent clay; strong medium prismatic parting to strong medium angular blocky structure; firm, extremely hard, very sticky, very plastic; common fine roots throughout and common very fine roots throughout; 65 percent (many) slickensides (pedogenic) on all faces of peds; electrical conductivity of 0.44 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 25.2 percent.

Bk --- 62 to 100 centimeters (24.4 to 39.4 inches); light yellowish brown (2.5Y 6/3) dry, clay loam; light olive brown (2.5Y 5/3) moist; 20 percent sand; 44 percent silt; 36 percent clay; moderate medium subangular blocky structure; friable, very hard, moderately sticky, moderately plastic; common very fine roots throughout; common very fine tubular pores; 25 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.46 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 7.9, pH meter; gradual; CaCO3 29.2 percent.

Bkssy1 --- 100 to 120 centimeters (39.4 to 47.2 inches); light brownish gray (2.5Y 6/2) dry, silty clay; grayish brown (2.5Y 5/2) moist; 12 percent sand; 44 percent silt; 44 percent clay; 2 percent fine prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm, very hard, very sticky, very plastic; common very fine tubular pores; 45 percent (common) slickensides (pedogenic) on all faces of peds; 3 percent (common) fine masses of gypsum in matrix and 5 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.43 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 29.4 percent.

Bkssy2 --- 120 to 140 centimeters (47.2 to 55.1 inches); light brownish gray (2.5Y 6/2) dry, clay; grayish brown (2.5Y 5/2) moist; 14 percent sand; 34 percent silt; 52 percent clay; 8 percent fine prominent yellow (10YR 7/6) mottles; moderate medium subangular blocky structure; firm, extremely hard, very sticky, very plastic; 25 percent (common) slickensides (pedogenic) on all faces of peds; 2 percent (common) fine gypsum crystals in matrix and 15 percent (common) medium masses of carbonate in matrix; 3 percent subrounded sandstone gravels; electrical conductivity of 0.45 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; CaCO3 33.3 percent.

DP-29

Pedon ID: DP-29

Description Date: 8/1/2012
Describer: Robert Long

Current Taxonomic Name: BBB family
Current Taxonomic Class: Fine-loamy, carbonatic, mesic Aridic Calciustepts
Current Taxon Kind: Family

County or Parish: UT025 - Kane
State or Territory: UT - Utah
UTM: 369782E, 4143666N -- Datum NAD83, Zone 12
Legal Description: Section 12, Township 39 South, Range 6 West of the 29 Meridian

Landscape: valley
Landform: terrace and fan apron
Geomorphic Component: Tread
Profile Pos: Toeslope
Slope: 3 percent
Elevation: 2114 meters (6935.7 feet)
Aspect: 180°
Shape: up/down: Linear; **across:** Linear

Surface Fragments: none.

Drainage: Moderately well drained
Runoff: Low
Erosion: None - deposition

Primary Earth Cover: Grass/herbaceous cover; **Secondary Earth Cover:** Tame pastureland

Existing Vegetation: BRIN2 - smooth brome (*Bromus inermis*); CONVO - bindweed (*Convolvulus*); ROWOU - Woods' rose (*Rosa woodsii var. ultramontana*)

Parent Materials: alluvium derived from limestone, sandstone, and shale

Particle Size Control Section: 25 to 100 centimeters (9.8 to 39.4 inches)

Diagnostic Features: Cambic horizon: 24 to 52 centimeters (9.4 to 20.5 inches), Secondary carbonates: 52 to 365 centimeters (20.5 to 143.7 inches) and Secondary carbonates: 72 to 210 centimeters (28.3 to 82.7 inches)

A --- 0 to 24 centimeters (0 to 9.4 inches); gray (10YR 6/1) dry, clay; dark grayish brown (10YR 4/2) moist; 20 percent sand; 38 percent silt; 42 percent clay; moderate medium platy parting to moderate medium granular structure; very friable, slightly hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and many very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.87 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; slightly alkaline, pH 7.7, pH meter; clear; CaCO3 45.3 percent.

Bw --- 24 to 52 centimeters (9.4 to 20.5 inches); light brownish gray (10YR 6/2) dry, clay; dark grayish brown (10YR 4/2) moist; 18 percent sand; 38 percent silt; 44 percent clay; moderate medium prismatic parting to strong medium subangular blocky structure; firm, very hard, very sticky, very plastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; common very fine tubular pores; electrical conductivity of 0.62 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 43.2 percent.

Bk --- 52 to 72 centimeters (20.5 to 28.3 inches); white (10YR 8/1) dry, loam; pale brown (10YR 6/3) moist; 50 percent sand; 32 percent silt; 18 percent clay; moderate medium subangular blocky structure; friable, hard, slightly sticky, nonplastic; common fine roots throughout and common very fine roots throughout; common very fine tubular pores finely disseminated carbonates and 20 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.44 mmhos/cm by EC meter, saturated paste; violently effervescent by HCl, 1 normal; moderately alkaline, pH 8.1, pH meter; abrupt; CaCO3 28.4 percent.

2ABk --- 72 to 97 centimeters (28.3 to 38.2 inches); light gray (2.5Y 7/1) dry, silty clay; olive brown (2.5Y 4/3) moist; 10 percent sand; 46 percent silt; 44 percent clay; moderate medium subangular blocky structure; friable, very hard, very sticky, very plastic; common very fine roots throughout; common very fine tubular pores finely disseminated carbonates and 35 percent (many) coarse masses of carbonate in matrix; electrical conductivity of 0.44 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8, pH meter; clear; CaCO3 61.6 percent.

2Bk1 --- 97 to 155 centimeters (38.2 to 61 inches); pale yellow (2.5Y 8/2) dry, silty clay; pale yellow (2.5Y 8/3) moist; 4 percent sand; 52 percent silt; 44 percent clay; 8 percent fine reddish yellow (5YR 7/6) mottles; structure; friable, hard, very sticky, very plastic finely disseminated carbonates and 25 percent (many) medium masses of carbonate in matrix; electrical conductivity of 0.4 mmhos/cm by EC meter, saturated paste; strongly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; abrupt; CaCO3 58.5 percent.

2Bk2 --- 155 to 210 centimeters (61 to 82.7 inches); white (2.5Y 8/1) dry, silty clay; light brownish gray (2.5Y 6/2) moist; 10 percent sand; 44 percent silt; 46 percent clay; 12 percent medium (5B 6/6) mottles; moderate medium subangular blocky structure; friable, extremely hard, very sticky, very plastic finely disseminated carbonates; electrical conductivity of 0.45 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; abrupt; $CaCO_3$ 57 percent.

3Bk1 --- 210 to 266 centimeters (82.7 to 104.7 inches); gray (2.5Y 6/1) dry, silty clay; dark grayish brown (2.5Y 4/2) moist; 14 percent sand; 40 percent silt; 46 percent clay; 2 percent fine light bluish gray (5PB 8/1) and 5 percent coarse reddish yellow (7.5YR 6/6) mottles; weak medium subangular blocky structure; firm, very hard, very sticky, very plastic; 4 percent (common) fine masses of carbonate in matrix; electrical conductivity of 0.53 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; clear; $CaCO_3$ 31 percent.

3Bk2 --- 266 to 345 centimeters (104.7 to 135.8 inches); light gray (2.5Y 7/1) dry, silty clay; gray (2.5Y 5/1) moist; 6 percent sand; 44 percent silt; 50 percent clay; 2 percent fine light bluish gray (5PB 8/1) and 10 percent medium light yellowish brown (10YR 6/4) mottles; weak medium subangular blocky structure; firm, very hard, very sticky, very plastic finely disseminated carbonates and 1 percent (few) fine threadlike masses of carbonate in matrix; electrical conductivity of 0.83 mmhos/cm by EC meter, saturated paste; slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.2, pH meter; clear; $CaCO_3$ 37.2 percent.

3Bk3 --- 345 to 365 centimeters (135.8 to 143.7 inches); white (2.5Y 8/1) dry, clay; light brownish gray (2.5Y 6/2) moist; 18 percent sand; 37 percent silt; 45 percent clay; 15 percent coarse reddish yellow (7.5YR 6/6) mottles; moderate medium prismatic structure; very firm, extremely hard, very sticky, very plastic finely disseminated carbonates and 1 percent (few) fine threadlike masses of carbonate in matrix; electrical conductivity of 0.75 mmhos/cm by EC meter, saturated paste; very slightly effervescent by HCl, 1 normal; moderately alkaline, pH 8.3, pH meter; $CaCO_3$ 42.5 percent.

Appendix C

Soil Laboratory Analysis

Table of Contents

- Summary pages of laboratory analysis results
- Laboratory analysis reports
- K factors calculated by laboratory

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Date: 1/30/2013

CLIENT: Alton Coal Development, LLC
Project: Private Lease Soils
Lab Order: S1211393

CASE NARRATIVE

Report ID: S1211393001

Samples 12AS001, 12AS002, 12AS003, 12AS004, 12AS005, 12AS007, and 12AS008 were received on November 26, 2012.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1211393001

Project: Private Lease Soils
Date Received: 11/26/2012

Date Reported: 1/30/2013
Work Order: S1211393

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1211393-001	12AS001	0-12	7.5	56.7	0.67	8.6	29.8	21.8	4.9
S1211393-002	12AS001	12-28	7.6	54.2	0.53	8.2	29.1	22.3	3.9
S1211393-003	12AS001	28-56	7.8	62.5	0.50	10.0	31.7	23.9	3.3
S1211393-004	12AS001	56-90	7.9	66.7	0.67	14.7	37.1	29.6	4.2
S1211393-005	12AS001	90-122	8.2	55.4	1.00	9.0	27.7	20.7	1.1
S1211393-006	12AS001	122-160	8.2	31.7	0.81	5.0	17.8	7.6	0.6
S1211393-007	12AS002	0-9	7.3	63.2	1.79	24.6	29.0	20.4	2.2
S1211393-008	12AS002	9-26	7.6	74.3	1.45	22.7	32.8	24.3	3.3
S1211393-009	12AS002	26-55	7.9	78.1	1.28	24.2	32.4	26.2	2.6
S1211393-010	12AS002	55-87	7.9	73.2	1.45	26.6	33.1	26.9	2.5
S1211393-011	12AS002	87-110	7.8	70.9	1.91	31.2	35.3	27.4	2.7
S1211393-012	12AS003	0-8	7.9	61.6	0.64	4.5	31.2	22.8	4.4
S1211393-013	12AS003	8-34	7.9	57.9	0.61	5.9	30.3	22.2	2.7
S1211393-014	12AS003	34-88	8.3	45.4	0.38	5.1	24.2	14.7	0.5
S1211393-015	12AS003	88-122	8.3	48.0	0.42	6.8	24.6	15.3	0.9
S1211393-016	12AS003	122-155	8.5	40.2	0.45	4.0	22.3	11.9	1.1
S1211393-017	12AS004	0-8	7.5	63.6	0.61	5.6	28.6	19.8	6.4
S1211393-018	12AS004	8-22	7.4	46.8	0.35	5.9	21.7	11.4	1.4
S1211393-019	12AS004	22-48	7.6	34.8	0.26	2.6	9.5	5.3	0.6
S1211393-020	12AS004	48-788	7.8	49.7	0.33	6.6	23.2	16.2	1.3

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

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Karen Secor, Soil Lab Supervisor

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Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1211393-021	12AS005	0-5	7.5	62.6	0.45	11.1	32.1	27.3	3.9
S1211393-022	12AS005	5-35	7.6	74.9	0.33	15.1	37.2	29.6	2.3
S1211393-023	12AS005	35-78	8.1	82.1	0.44	18.1	44.7	37.7	1.1
S1211393-024	12AS007	0-7	7.5	50.3	0.40	3.8	22.8	15.4	1.9
S1211393-025	12AS007	7-44	7.4	51.5	0.34	11.3	25.1	19.0	1.8
S1211393-026	12AS007	44-83	7.7	42.5	0.32	5.3	15.3	15.9	1.3
S1211393-027	12AS008	0-9	7.5	46.4	0.43	4.8	22.9	12.7	4.0
S1211393-028	12AS008	9-23	7.5	44.3	0.48	4.9	21.6	9.0	2.5

These results apply only to the samples tested.

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Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1211393-001	12AS001	0-12	4.46	1.87	0.97	0.10	0.06
S1211393-002	12AS001	12-28	3.78	2.07	0.51	0.13	0.08
S1211393-003	12AS001	28-56	3.08	2.00	0.23	0.40	0.25
S1211393-004	12AS001	56-90	2.84	3.11	0.14	1.35	0.79
S1211393-005	12AS001	90-122	3.26	8.52	0.12	0.46	0.19
S1211393-006	12AS001	122-160	4.01	5.16	0.15	0.22	0.10
S1211393-007	12AS002	0-9	5.96	16.7	0.64	1.87	0.56
S1211393-008	12AS002	9-26	4.77	11.2	0.45	1.50	0.53
S1211393-009	12AS002	26-55	3.52	9.73	0.37	1.68	0.65
S1211393-010	12AS002	55-87	4.58	12.3	0.36	1.96	0.67
S1211393-011	12AS002	87-110	6.95	16.3	0.37	2.35	0.69
S1211393-012	12AS003	0-8	3.74	2.53	0.99	0.20	0.11
S1211393-013	12AS003	8-34	3.15	3.52	0.17	0.13	0.07
S1211393-014	12AS003	34-88	1.47	2.48	0.09	0.15	0.11
S1211393-015	12AS003	88-122	1.41	3.17	0.08	0.21	0.14
S1211393-016	12AS003	122-155	0.90	3.64	0.11	0.38	0.25
S1211393-017	12AS004	0-8	5.74	0.94	0.59	0.07	0.04
S1211393-018	12AS004	8-22	3.28	0.61	0.23	0.07	0.05
S1211393-019	12AS004	22-48	2.24	0.51	0.13	0.08	0.07
S1211393-020	12AS004	48-788	2.56	0.92	0.06	0.12	0.09

These results apply only to the samples tested.

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

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Karen Secor, Soil Lab Supervisor

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Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1211393-021	12AS005	0-5	4.24	1.10	0.21	0.15	0.09
S1211393-022	12AS005	5-35	2.54	1.25	0.15	0.19	0.14
S1211393-023	12AS005	35-78	1.83	1.98	0.16	1.24	0.90
S1211393-024	12AS007	0-7	3.32	1.00	0.30	0.07	0.05
S1211393-025	12AS007	7-44	2.76	0.87	0.19	0.09	0.07
S1211393-026	12AS007	44-83	2.83	0.87	0.08	0.12	0.09
S1211393-027	12AS008	0-9	4.30	0.57	0.18	0.07	0.05
S1211393-028	12AS008	9-23	4.45	0.75	0.24	0.06	0.04

These results apply only to the samples tested.

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Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
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Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Boron	Nitrate (as N)	CO3	Selenium
		cm	%	%	%		%	ppm	ppm	%	ppm
S1211393-001	12AS001	0-12	30.0	39.0	31.0	Clay Loam	8.0	0.58	1.2	46.2	<0.02
S1211393-002	12AS001	12-28	24.0	41.0	35.0	Clay Loam	5.4	0.60	0.8	47.9	<0.02
S1211393-003	12AS001	28-56	10.0	49.0	41.0	Silty Clay	<0.1	0.63	0.3	52.2	<0.02
S1211393-004	12AS001	56-90	16.0	40.0	44.0	Silty Clay	6.9	0.71	<0.1	42.9	<0.02
S1211393-005	12AS001	90-122	26.0	42.0	32.0	Clay Loam	6.4	0.40	0.4	51.8	<0.02
S1211393-006	12AS001	122-160	64.0	24.0	12.0	Sandy Loam	14.4	0.17	0.7	30.4	<0.02
S1211393-007	12AS002	0-9	30.0	41.0	29.0	Clay Loam	10.4	0.34	0.6	27.3	<0.02
S1211393-008	12AS002	9-26	20.0	46.0	34.0	Clay Loam	11.2	0.43	1.1	23.8	<0.02
S1211393-009	12AS002	26-55	24.0	39.0	37.0	Clay Loam	13.9	0.25	1.4	22.2	<0.02
S1211393-010	12AS002	55-87	18.0	42.0	40.0	Silty Clay	7.7	0.26	2.2	33.2	<0.02
S1211393-011	12AS002	87-110	10.0	52.0	38.0	Silty Clay Loam	0.6	0.47	1.4	47.9	<0.02
S1211393-012	12AS003	0-8	24.0	39.0	37.0	Clay Loam	5.9	0.79	11.9	46.4	<0.02
S1211393-013	12AS003	8-34	25.0	33.0	42.0	Clay	10.5	0.72	15.8	50.8	<0.02
S1211393-014	12AS003	34-88	25.0	53.0	22.0	Silty Loam	12.5	0.37	4.5	45.4	<0.02
S1211393-015	12AS003	88-122	27.0	50.0	23.0	Silty Loam	10.1	0.34	4.7	41.1	<0.02
S1211393-016	12AS003	122-155	43.0	41.0	16.0	Loam	7.0	0.39	4.4	33.4	<0.02
S1211393-017	12AS004	0-8	65.0	15.0	20.0	Sandy Clay Loam	15.9	0.37	0.3	4.1	<0.02
S1211393-018	12AS004	8-22	67.0	10.0	23.0	Sandy Clay Loam	16.7	0.25	0.2	1.8	<0.02
S1211393-019	12AS004	22-48	77.0	14.0	9.0	Sandy Loam	10.2	0.15	0.5	5.9	<0.02
S1211393-020	12AS004	48-788	39.0	34.0	27.0	Clay Loam	9.9	0.25	0.3	14.4	<0.02

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1211393001

Project: Private Lease Soils

Date Received: 11/26/2012

Date Reported: 1/30/2013

Work Order: S1211393

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Boron	Nitrate (as N)	CO3	Selenium
		cm	%	%	%		%	ppm	ppm	%	ppm
S1211393-021	12AS005	0-5	17.0	33.0	50.0	Clay	5.0	0.45	0.2	23.1	<0.02
S1211393-022	12AS005	5-35	9.0	33.0	58.0	Silty Clay	4.5	0.22	0.2	23.5	<0.02
S1211393-023	12AS005	35-78	7.0	29.0	64.0	Clay	3.3	0.54	0.6	24.4	<0.02
S1211393-024	12AS007	0-7	47.0	24.0	29.0	Sandy Clay Loam	11.5	0.30	0.3	3.0	<0.02
S1211393-025	12AS007	7-44	37.0	27.0	36.0	Clay Loam	4.2	0.36	0.9	1.4	<0.02
S1211393-026	12AS007	44-83	67.0	11.0	22.0	Sandy Clay Loam	16.6	0.25	0.5	19.9	<0.02
S1211393-027	12AS008	0-9	63.0	20.0	17.0	Sandy Loam	12.2	0.19	0.7	11.8	<0.02
S1211393-028	12AS008	9-23	77.0	11.0	12.0	Sandy Loam	11.4	0.13	0.2	15.7	<0.02

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Lab ID	Sample ID	Depths	Total Carbon	TOC	Total Sulfur	T.S. AB	Neutral. Potential	T.S. ABP	Total Mercury
		cm	%	%	%	t/1000t	t/1000t	t/1000t	mg/Kg
S1211393-001	12AS001	0-12	8.5	3.0	0.03	0.83	462	461	<0.2
S1211393-002	12AS001	12-28	8.5	2.7	<0.01	<0.01	479	479	<0.2
S1211393-003	12AS001	28-56	8.6	2.4	<0.01	<0.01	522	522	<0.2
S1211393-004	12AS001	56-90	9.2	4.1	0.02	0.72	429	428	<0.2
S1211393-005	12AS001	90-122	7.5	1.3	<0.01	<0.01	518	518	<0.2
S1211393-006	12AS001	122-160	4.4	0.7	<0.01	<0.01	304	304	<0.2
S1211393-007	12AS002	0-9	4.8	1.6	0.02	0.54	273	273	<0.2
S1211393-008	12AS002	9-26	4.5	1.6	<0.01	<0.01	239	239	<0.2
S1211393-009	12AS002	26-55	3.7	1.1	<0.01	<0.01	222	222	<0.2
S1211393-010	12AS002	55-87	5.4	1.5	<0.01	<0.01	332	332	<0.2
S1211393-011	12AS002	87-110	7.8	2.0	<0.01	<0.01	479	479	<0.2
S1211393-012	12AS003	0-8	8.8	3.2	0.02	0.50	464	463	<0.2
S1211393-013	12AS003	8-34	8.5	2.4	<0.01	<0.01	508	508	<0.2
S1211393-014	12AS003	34-88	6.6	1.1	<0.01	<0.01	454	454	<0.2
S1211393-015	12AS003	88-122	6.3	1.3	0.01	0.40	411	410	<0.2
S1211393-016	12AS003	122-155	4.7	0.7	<0.01	<0.01	334	334	<0.2
S1211393-017	12AS004	0-8	5.1	4.6	0.03	0.85	41.3	40.4	<0.2
S1211393-018	12AS004	8-22	0.8	0.6	<0.01	<0.01	18.0	18.0	<0.2
S1211393-019	12AS004	22-48	1.0	0.3	<0.01	<0.01	59.0	59.0	<0.2
S1211393-020	12AS004	48-788	3.0	1.3	<0.01	<0.01	144	144	<0.2

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Soil Analysis Report

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Lab ID	Sample ID	Depths cm	Total Carbon %	TOC %	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t	Total Mercury mg/Kg
S1211393-021	12AS005	0-5	5.4	2.6	<0.01	<0.01	231	231	<0.2
S1211393-022	12AS005	5-35	4.9	2.1	<0.01	<0.01	235	235	<0.2
S1211393-023	12AS005	35-78	3.6	0.6	<0.01	<0.01	244	244	<0.2
S1211393-024	12AS007	0-7	1.5	1.2	<0.01	<0.01	29.6	29.6	<0.2
S1211393-025	12AS007	7-44	1.2	1.0	<0.01	<0.01	13.7	13.7	<0.2
S1211393-026	12AS007	44-83	3.2	0.8	<0.01	<0.01	199	199	<0.2
S1211393-027	12AS008	0-9	4.0	2.6	0.01	0.32	118	117	<0.2
S1211393-028	12AS008	9-23	3.4	1.5	0.02	0.70	157	156	<0.2

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Lab ID	Sample ID	Depths cm	Total Arsenic mg/Kg	Total Barium mg/Kg	Total Cadmium mg/Kg	Total Chromium mg/Kg	Total Copper mg/Kg	Total Iron mg/Kg	Total Lead mg/Kg	Total Manganese mg/Kg	Total Molybdenum mg/Kg
S1211393-001	12AS001	0-12	6.5	449	0.81	15.2	12.1	11100	7.2	291	<0.7
S1211393-002	12AS001	12-28	6.9	611	0.58	21.1	17.5	15200	10.2	398	<0.7
S1211393-003	12AS001	28-56	6.5	821	0.75	28.2	19.4	17700	10.4	469	<0.7
S1211393-004	12AS001	56-90	4.1	911	0.60	25.2	23.7	17300	8.9	538	<0.7
S1211393-005	12AS001	90-122	10.5	653	0.65	26.2	11.8	16600	10.2	337	<0.7
S1211393-006	12AS001	122-160	5.6	346	0.41	13.1	8.44	7570	6.5	195	<0.7
S1211393-007	12AS002	0-9	8.0	295	0.51	17.1	13.9	13700	10.5	329	<0.7
S1211393-008	12AS002	9-26	6.1	197	0.46	21.3	14.2	14100	10.8	237	<0.7
S1211393-009	12AS002	26-55	8.5	266	0.41	24.8	17.9	18100	13.0	336	<0.7
S1211393-010	12AS002	55-87	6.3	207	0.52	19.6	11.3	12700	9.6	254	<0.7
S1211393-011	12AS002	87-110	7.6	204	0.54	18.8	10.9	13300	9.5	268	0.8
S1211393-012	12AS003	0-8	7.5	565	0.76	26.0	17.6	16200	10.4	550	<0.7
S1211393-013	12AS003	8-34	8.8	658	0.68	28.7	18.3	19500	10.6	594	<0.7
S1211393-014	12AS003	34-88	5.0	281	0.56	19.5	8.23	10200	8.3	269	<0.7
S1211393-015	12AS003	88-122	9.0	358	0.71	23.9	13.6	17300	12.0	340	<0.7
S1211393-016	12AS003	122-155	3.8	131	0.55	12.9	10.1	6890	7.0	202	<0.7
S1211393-017	12AS004	0-8	3.1	64.9	0.55	17.7	11.9	13700	12.2	234	<0.7
S1211393-018	12AS004	8-22	4.2	36.7	0.27	17.7	8.41	13200	8.6	161	<0.7
S1211393-019	12AS004	22-48	2.9	17.3	0.26	10.7	6.48	7730	4.6	150	<0.7
S1211393-020	12AS004	48-788	3.4	44.9	0.49	12.8	10.4	11400	8.6	315	<0.7

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Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

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Lab ID	Sample ID	Depths	Total Arsenic	Total Barium	Total Cadmium	Total Chromium	Total Copper	Total Iron	Total Lead	Total Manganese	Total Molybdenum
		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
S1211393-021	12AS005	0-5	7.6	147	0.71	19.1	14.2	32000	17.4	577	1.3
S1211393-022	12AS005	5-35	3.1	115	0.39	15.7	11.8	15300	12.2	263	0.9
S1211393-023	12AS005	35-78	6.1	107	0.37	14.4	10.9	13600	13.7	146	<0.7
S1211393-024	12AS007	0-7	5.9	68.6	0.37	21.4	8.97	17500	11.1	239	<0.7
S1211393-025	12AS007	7-44	6.0	79.0	0.25	25.6	9.12	19000	11.6	209	<0.7
S1211393-026	12AS007	44-83	2.9	63.6	0.31	10.9	7.12	8180	5.0	142	<0.7
S1211393-027	12AS008	0-9	3.2	52.1	0.45	15.0	11.0	12600	12.2	266	<0.7
S1211393-028	12AS008	9-23	3.5	27.3	0.16	7.33	6.90	6270	3.7	144	<0.7

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Karen Secor, Soil Lab Supervisor

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Lab ID	Sample ID	Depths cm	Total Selenium mg/Kg	Total Silver mg/Kg	Total Zinc mg/Kg	Bulk Density g/cm³
S1211393-001	12AS001	0-12	<0.96	<0.5	43.4	3.4
S1211393-002	12AS001	12-28	<0.96	<0.5	58.8	3.0
S1211393-003	12AS001	28-56	1.09	<0.5	65.3	3.2
S1211393-004	12AS001	56-90	<0.96	<0.5	70.9	2.4
S1211393-005	12AS001	90-122	<0.96	<0.5	45.5	2.6
S1211393-006	12AS001	122-160	<0.96	<0.5	27.9	2.9
S1211393-007	12AS002	0-9	<0.96	<0.5	44.7	2.4
S1211393-008	12AS002	9-26	<0.96	<0.5	49.7	2.7
S1211393-009	12AS002	26-55	<0.96	<0.5	54.7	2.3
S1211393-010	12AS002	55-87	<0.96	<0.5	43.7	2.2
S1211393-011	12AS002	87-110	<0.96	<0.5	40.2	2.2
S1211393-012	12AS003	0-8	<0.96	<0.5	66.5	4.1
S1211393-013	12AS003	8-34	<0.96	<0.5	64.0	7.4
S1211393-014	12AS003	34-88	<0.96	<0.5	33.4	2.7
S1211393-015	12AS003	88-122	<0.96	<0.5	50.4	2.6
S1211393-016	12AS003	122-155	<0.96	<0.5	28.5	3.2
S1211393-017	12AS004	0-8	<0.96	<0.5	46.9	3.5
S1211393-018	12AS004	8-22	<0.96	<0.5	34.4	2.7
S1211393-019	12AS004	22-48	<0.96	<0.5	18.2	2.7
S1211393-020	12AS004	48-788	<0.96	<0.5	28.6	2.7

These results apply only to the samples tested.

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Karen Secor, Soil Lab Supervisor

Soil Analysis Report

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Lab ID	Sample ID	Depths cm	Total Selenium mg/Kg	Total Silver mg/Kg	Total Zinc mg/Kg	Bulk Density g/cm³
S1211393-021	12AS005	0-5	<0.96	<0.5	74.5	3.2
S1211393-022	12AS005	5-35	<0.96	<0.5	47.8	2.5
S1211393-023	12AS005	35-78	<0.96	<0.5	50.2	2.6
S1211393-024	12AS007	0-7	<0.96	<0.5	45.5	2.9
S1211393-025	12AS007	7-44	<0.96	<0.5	49.5	2.6
S1211393-026	12AS007	44-83	<0.96	<0.5	19.6	2.5
S1211393-027	12AS008	0-9	<0.96	<0.5	39.0	3.5
S1211393-028	12AS008	9-23	<0.96	<0.5	14.6	3.4

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Lab ID	Sample ID	Organic Matter %	Sand %	Silt %	Clay %	Very Fine Sand %	Texture	K-factor (t.ac.h/100acft.tf.in)	Structure s	Permeability p	M
S1211393-001	12AS001 (1-12)	4.9	30.0	39.0	31.0	8.0	Clay Loam	0.17	2	4	3243.0
S1211393-002	12AS001 (12-28)	3.9	24.0	41.0	35.0	5.4	Clay Loam	0.18	2	4	3016.0
S1211393-003	12AS001 (28-56)	3.3	10.0	49.0	41.0	0	Silty Clay	0.24	2	6	2891.0
S1211393-004	12AS001 (56-90)	4.2	16.0	40.0	44.0	6.9	Silty Clay	0.20	2	6	2626.4
S1211393-005	12AS001 (90-122)	1.1	26.0	42.0	32.0	6.4	Clay Loam	0.26	2	4	3291.2
S1211393-006	12AS001 (122-160)	0.6	64.0	24.0	12.0	14.4	Sandy Loam	0.23	2	2	3379.2
S1211393-007	12AS002 (0-9)	2.2	30.0	41.0	29.0	10.4	Clay Loam	0.29	3	4	3649.4
S1211393-008	12AS002 (9-26)	3.3	20.0	46.0	34.0	11.2	Clay Loam	0.28	3	4	3775.2
S1211393-009	12AS002 (26-55)	2.6	24.0	39.0	37.0	13.9	Clay Loam	0.26	3	4	3332.7
S1211393-010	12AS002 (55-87)	2.5	18.0	42.0	40.0	7.7	Silty Clay	0.29	3	6	2982.0
S1211393-011	12AS002 (87-110)	2.7	10.0	52.0	38.0	0.6	Silty Clay Loam	0.28	3	5	3261.2
S1211393-012	12AS003 (0-8)	4.4	24.0	39.0	37.0	5.9	Clay Loam	0.16	2	4	2828.7
S1211393-013	12AS003 (8-34)	2.7	25.0	33.0	42.0	10.5	Clay	0.22	2	6	2523.0
S1211393-014	12AS003 (34-88)	0.5	25.0	53.0	22.0	12.5	Silty Loam	0.41	2	3	5109.0
S1211393-015	12AS003 (88-122)	0.9	27.0	50.0	23.0	10.1	Silty Loam	0.35	2	3	4627.7
S1211393-016	12AS003 (122-155)	1.1	43.0	41.0	16.0	7.0	Loam	0.30	2	3	4032.0
S1211393-017	12AS004 (0-8)	6.4	65.0	15.0	20.0	15.9	Sandy Clay Loam	0.11	2	4	2472.0
S1211393-018	12AS004 (8-22)	1.4	67.0	10.0	23.0	16.7	Sandy Clay Loam	0.16	2	4	2055.9
S1211393-019	12AS004 (22-48)	0.6	77.0	14.0	9.0	10.2	Sandy Loam	0.13	2	2	2202.2
S1211393-020	12AS004 (48-78)	1.3	39.0	34.0	27.0	9.9	Clay Loam	0.25	2	4	3204.7
S1211393-021	12AS005 (0-5)	3.9	17.0	33.0	50.0	5.0	Clay	0.17	2	6	1900.0
S1211393-022	12AS005 (5-35)	2.3	9.0	33.0	58.0	4.5	Silty Clay	0.16	2	6	1575.0
S1211393-023	12AS005 (35-78)	1.1	7.0	29.0	64.0	3.3	Clay	0.15	2	6	1162.8
S1211393-024	12AS007 (0-7)	1.9	47.0	24.0	29.0	11.5	Sandy Clay Loam	0.19	2	4	2520.5
S1211393-025	12AS007 (7-44)	1.8	37.0	27.0	36.0	4.2	Clay Loam	0.15	2	4	1996.8
S1211393-026	12AS007 (44-83)	1.3	67.0	11.0	22.0	16.6	Sandy Clay Loam	0.17	2	4	2152.8
S1211393-027	12AS008 (0-9)	4.0	63.0	20.0	17.0	12.2	Sandy Loam	0.11	2	2	2672.6
S1211393-028	12AS008 (9-23)	2.5	77.0	11.0	12.0	11.4	Sandy Loam	0.09	2	2	1971.2

These Results apply only to the samples tested.

Reviewed by: Karen Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Date: 1/30/2013

CLIENT: Alton Coal Development, LLC
Project: Private Lease Soils
Lab Order: S1301063

CASE NARRATIVE

Report ID: S1301063001

Samples 12AS031, and 12AS032 were received on December 31, 2012.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

Bulk density analysis could not be performed on sample 12AS031 (26-44cm) due to lack of appropriate sample (no clods).

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301063001

Project: Private Lease Soils
Date Received: 12/31/2012

Date Reported: 1/30/2013
Work Order: S1301063

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1301063-001	12AS031	0-12	7.5	65.4	0.47	13.8	32.3	22.6	3.7
S1301063-002	12AS031	12-26	7.5	67.1	0.46	13.3	32.1	24.8	3.4
S1301063-003	12AS031	26-44	7.5	60.8	0.46	12.2	32.2	25.2	3.7
S1301063-004	12AS031	44-71	7.9	60.2	0.37	8.7	24.4	17.6	2.2
S1301063-005	12AS031	71-108	8.2	39.8	0.29	4.7	20.5	11.3	0.9
S1301063-006	12AS031	108-134	8.2	39.4	0.22	3.8	13.6	5.8	0.7
S1301063-007	12AS031	134-172	8.2	32.9	0.24	3.9	14.4	7.2	0.7
S1301063-008	12AS032	0-10	7.7	84.2	0.59	17.7	41.5	27.9	4.5
S1301063-009	12AS032	10-24	7.8	75.7	0.45	15.1	38.7	33.1	1.9
S1301063-010	12AS032	24-66	7.9	83.7	0.79	16.4	41.3	30.3	3.0
S1301063-011	12AS032	66-143	7.8	82.9	4.96	18.7	43.9	29.1	3.0
S1301063-012	12AS032	143-165	7.9	79.7	6.16	18.0	39.2	28.1	3.0

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301063001

Project: Private Lease Soils

Date Received: 12/31/2012

Date Reported: 1/30/2013

Work Order: S1301063

Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1301063-001	12AS031	0-12	3.71	1.11	0.45	0.13	0.08
S1301063-002	12AS031	12-26	3.60	1.35	0.31	0.18	0.12
S1301063-003	12AS031	26-44	3.84	2.40	0.16	0.14	0.08
S1301063-004	12AS031	44-71	2.19	1.97	0.11	0.21	0.15
S1301063-005	12AS031	71-108	1.39	1.68	0.07	0.20	0.16
S1301063-006	12AS031	108-134	1.30	1.20	0.07	0.20	0.18
S1301063-007	12AS031	134-172	1.19	1.30	0.07	0.25	0.23
S1301063-008	12AS032	0-10	4.49	1.15	0.38	0.75	0.44
S1301063-009	12AS032	10-24	2.52	0.79	0.13	1.91	1.49
S1301063-010	12AS032	24-66	2.57	1.05	0.11	5.08	3.77
S1301063-011	12AS032	66-143	21.8	15.5	0.35	32.6	7.56
S1301063-012	12AS032	143-165	20.5	20.2	0.51	46.5	10.3

These results apply only to the samples tested.

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Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301063001

Project: Private Lease Soils
Date Received: 12/31/2012

Date Reported: 1/30/2013
Work Order: S1301063

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Boron	Nitrate (as N)	CO3	Selenium
		cm	%	%	%		%	ppm	ppm	%	ppm
S1301063-001	12AS031	0-12	20.0	37.0	43.0	Clay	10.6	0.26	2.8	23.3	<0.02
S1301063-002	12AS031	12-26	20.0	35.0	45.0	Clay	11.2	0.32	1.1	23.4	<0.02
S1301063-003	12AS031	26-44	20.0	36.0	44.0	Clay	5.8	0.51	0.6	18.4	<0.02
S1301063-004	12AS031	44-71	46.0	22.0	32.0	Sandy Clay Loam	16.8	0.29	0.5	22.4	<0.02
S1301063-005	12AS031	71-108	46.0	36.0	18.0	Loam	13.1	0.21	0.6	36.4	<0.02
S1301063-006	12AS031	108-134	68.0	20.0	12.0	Sandy Loam	7.8	0.14	0.5	35.0	<0.02
S1301063-007	12AS031	134-172	74.0	16.0	10.0	Sandy Loam	13.3	0.14	<0.1	24.0	<0.02
S1301063-008	12AS032	0-10	26.0	31.0	43.0	Clay	19.3	0.67	1.7	6.5	<0.02
S1301063-009	12AS032	10-24	20.0	31.0	49.0	Clay	15.6	0.66	0.6	7.6	<0.02
S1301063-010	12AS032	24-66	16.0	28.0	56.0	Silty Clay	11.8	1.11	<0.1	12.4	<0.02
S1301063-011	12AS032	66-143	16.0	24.0	60.0	Clay	10.4	3.04	0.5	9.1	<0.02
S1301063-012	12AS032	143-165	16.0	31.0	53.0	Clay	11.2	2.62	0.7	9.3	<0.02

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301063001

Project: Private Lease Soils
Date Received: 12/31/2012

Date Reported: 1/30/2013
Work Order: S1301063

Lab ID	Sample ID	Depths	Total Carbon	TOC	Total Sulfur	T.S. AB	Neutral. Potential	T.S. ABP	Total Mercury
		cm	%	%	%	t/1000t	t/1000t	t/1000t	mg/Kg
S1301063-001	12AS031	0-12	4.4	1.6	0.13	4.19	233	229	<0.2
S1301063-002	12AS031	12-26	4.2	1.4	0.09	2.87	234	231	<0.2
S1301063-003	12AS031	26-44	3.1	0.9	0.06	2.00	184	182	<0.2
S1301063-004	12AS031	44-71	3.9	1.2	0.09	2.87	224	221	<0.2
S1301063-005	12AS031	71-108	4.8	0.4	0.08	2.61	364	361	<0.2
S1301063-006	12AS031	108-134	4.0	<0.1	0.08	2.46	350	347	<0.2
S1301063-007	12AS031	134-172	2.3	<0.1	0.07	2.21	240	238	<0.2
S1301063-008	12AS032	0-10	3.0	2.2	0.10	3.13	64.8	61.6	<0.2
S1301063-009	12AS032	10-24	1.8	0.9	0.12	3.69	76.3	72.6	<0.2
S1301063-010	12AS032	24-66	2.8	1.3	0.07	2.29	124	122	<0.2
S1301063-011	12AS032	66-143	2.9	1.8	1.13	35.5	91.0	55.5	<0.2
S1301063-012	12AS032	143-165	2.3	1.2	0.33	10.4	93.4	83.0	<0.2

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301063001

Project: Private Lease Soils
Date Received: 12/31/2012

Date Reported: 1/30/2013
Work Order: S1301063

Lab ID	Sample ID	Depths cm	Total Arsenic mg/Kg	Total Barium mg/Kg	Total Cadmium mg/Kg	Total Chromium mg/Kg	Total Copper mg/Kg	Total Iron mg/Kg	Total Lead mg/Kg	Total Manganese mg/Kg	Total Molybdenum mg/Kg
S1301063-001	12AS031	0-12	6.7	20.3	0.12	7.45	128	5340	16.5	90.6	14.6
S1301063-002	12AS031	12-26	10.3	138	0.81	33.4	18.6	20800	16.4	350	3.3
S1301063-003	12AS031	26-44	7.8	109	1.06	26.1	14.3	16200	12.2	277	2.5
S1301063-004	12AS031	44-71	8.8	137	0.68	30.1	15.9	16900	12.3	321	2.6
S1301063-005	12AS031	71-108	7.7	123	0.49	17.4	7.61	9630	8.5	200	1.7
S1301063-006	12AS031	108-134	8.7	111	0.43	22.2	13.7	17100	16.3	180	3.9
S1301063-007	12AS031	134-172	7.6	103	0.40	12.3	5.46	8630	6.8	173	1.4
S1301063-008	12AS032	0-10	5.8	149	0.37	11.3	4.99	6250	5.8	123	0.9
S1301063-009	12AS032	10-24	7.5	107	0.41	31.4	16.5	19500	14.5	300	1.7
S1301063-010	12AS032	24-66	7.8	116	0.41	37.8	16.4	22100	13.9	218	2.9
S1301063-011	12AS032	66-143	8.5	127	0.43	27.9	15.4	19600	16.3	147	2.1
S1301063-012	12AS032	143-165	5.8	71.4	0.21	13.8	8.30	12100	11.6	105	2.3

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301063001

Project: Private Lease Soils

Date Received: 12/31/2012

Date Reported: 1/30/2013

Work Order: S1301063

Lab ID	Sample ID	Depths cm	Total Selenium mg/Kg	Total Silver mg/Kg	Total Zinc mg/Kg	Bulk Density g/cm³
S1301063-001	12AS031	0-12	43.5	0.5	7.84	2.9
S1301063-002	12AS031	12-26	1.15	<0.5	98.2	2.9
S1301063-003	12AS031	26-44	1.58	<0.5	79.4	
S1301063-004	12AS031	44-71	1.98	<0.5	91.8	2.3
S1301063-005	12AS031	71-108	<0.96	<0.5	43.4	2.5
S1301063-006	12AS031	108-134	2.59	<0.5	65.8	2.6
S1301063-007	12AS031	134-172	<0.96	<0.5	30.9	2.6
S1301063-008	12AS032	0-10	1.93	<0.5	29.4	3.4
S1301063-009	12AS032	10-24	<0.96	<0.5	69.1	2.3
S1301063-010	12AS032	24-66	<0.96	<0.5	64.9	2.3
S1301063-011	12AS032	66-143	<0.96	0.6	69.0	2.3
S1301063-012	12AS032	143-165	<0.96	<0.5	44.5	2.7

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

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Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 12/31/2012

Report ID: S1301063001
Date Reported: 1/30/2013
Work Order: S1301063

Lab ID	Sample ID	Organic Matter %	Sand %	Silt %	Clay %	Very Fine Sand %	Texture	K-factor (t.ac.h/100acft.tf.in)	Structure s	Permeability p	M
S1301063-001	12AS031 (0-12)	3.7	20.0	37.0	43.0	10.6	Clay	0.25	3	6	2713.2
S1301063-002	12AS031 (12-26)	3.4	20.0	35.0	45.0	11.2	Clay	0.25	3	6	2541.0
S1301063-003	12AS031 (26-44)	3.7	20.0	36.0	44.0	5.8	Clay	0.23	3	6	2340.8
S1301063-004	12AS031 (44-71)	2.2	46.0	22.0	32.0	16.8	Sandy Clay Loam	0.22	3	4	2638.4
S1301063-005	12AS031 (71-108)	0.9	46.0	36.0	18.0	13.1	Loam	0.30	2	3	4026.2
S1301063-006	12AS031 (108-134)	0.7	68.0	20.0	12.0	7.8	Sandy Loam	0.15	2	2	2446.4
S1301063-007	12AS031 (134-172)	0.7	74.0	16.0	10.0	13.3	Sandy Loam	0.16	2	2	2637.0
S1301063-008	12AS032 (1-10)	4.5	26.0	31.0	43.0	19.3	Clay	0.25	3	6	2867.1
S1301063-009	12AS032 (10-24)	1.9	20.0	31.0	49.0	15.6	Clay	0.26	3	6	2376.6
S1301063-010	12AS032 (24-66)	3.0	16.0	28.0	56.0	11.8	Silty Clay	0.23	4	6	1751.2
S1301063-011	12AS032 (66-143)	3.0	16.0	24.0	60.0	10.4	Clay	0.21	4	6	1376.0
S1301063-012	12AS032 (143-165)	3.0	16.0	31.0	53.0	11.2	Clay	0.22	3	6	1983.4

These Results apply only to the samples tested.

Reviewed by: Karen Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Date: 4/3/2013

CLIENT: Alton Coal Development, LLC
Project: Private Lease Soils - Full List
Lab Order: S1301363

CASE NARRATIVE

Report ID: S1301363001

Samples 12AS018, 12AS020, 12AS021, 12AS022, 12AS024, 12AS027, 12AS028, and 12AS029 were received on January 22, 2013.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301363001

Project: Private Lease Soils - Full List
Date Received: 1/22/2013

Date Reported: 4/3/2013
Work Order: S1301363

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1301363-001	12AS018	0-22	7.7	72.1	0.46	15.4	40.8	30.8	5.6
S1301363-002	12AS018	22-68	8.2	63.2	0.24	18.8	34.2	22.2	1.9
S1301363-003	12AS018	68-115	8.4	65.5	0.25	13.9	27.2	23.6	1.3
S1301363-004	12AS018	115-148	8.6	70.9	0.26	11.5	27.3	22.7	1.2
S1301363-005	12AS018	148-244	9.0	40.7	0.21	10.9	14.6	8.3	0.5
S1301363-006	12AS020	0-13	7.8	87.7	0.59	13.1	38.8	32.4	7.4
S1301363-007	12AS020	13-30	8.1	84.9	0.29	10.6	35.2	29.5	4.2
S1301363-008	12AS020	30-80	8.3	81.2	0.30	22.9	36.7	29.3	2.8
S1301363-009	12AS020	80-111	8.6	67.0	0.31	11.7	27.4	24.6	0.9
S1301363-010	12AS020	111-140	8.5	61.4	0.51	10.6	26.6	22.8	1.2
S1301363-011	12AS020	140-175	8.7	51.1	0.66	26.2	23.3	18.3	1.1
S1301363-012	12AS021	0-9	7.8	75.3	0.48	11.2	32.5	24.2	5.1
S1301363-013	12AS021	9-32	7.9	70.1	0.43	8.9	36.1	25.0	3.9
S1301363-014	12AS021	32-65	8.7	68.7	0.39	10.8	38.8	25.6	2.7
S1301363-015	12AS021	65-95	9.4	47.4	0.33	7.6	29.4	14.6	0.7
S1301363-016	12AS021	95-150	9.0	34.3	0.34	13.9	20.8	12.4	1.1
S1301363-017	12AS021	150-202	9.1	34.4	0.23	18.2	9.3	4.7	0.9
S1301363-018	12AS021	202-230	9.0	26.4	0.23	15.0	8.5	3.4	0.4
S1301363-019	12AS022	0-12	8.6	23.9	0.28	3.6	12.3	6.1	0.7
S1301363-020	12AS022	12-50	9.3	27.2	0.25	2.7	11.8	5.1	0.3

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301363001

Project: Private Lease Soils - Full List
Date Received: 1/22/2013

Date Reported: 4/3/2013
Work Order: S1301363

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1301363-021	12AS022	50-87	9.2	29.2	0.36	8.4	11.4	5.8	0.4
S1301363-022	12AS022	87-126	9.0	26.5	0.37	9.6	15.1	4.7	0.3
S1301363-023	12AS022	126-160	8.8	26.8	0.62	14.6	15.6	5.9	1.0
S1301363-024	12AS022	160-210	9.2	27.6	0.59	13.3	16.3	6.0	0.5
S1301363-025	12AS022	210-232	7.7	30.1	2.01	23.7	20.5	7.3	2.5
S1301363-026	12AS024	0-18	9.1	25.6	0.22	5.1	15.1	6.7	0.3
S1301363-027	12AS024	18-84	9.3	33.1	0.20	2.3	16.0	5.6	0.3
S1301363-028	12AS024	84-136	9.4	27.9	0.18	2.6	15.6	5.0	0.3
S1301363-029	12AS024	136-186	9.3	27.5	0.78	5.7	16.0	5.2	1.3
S1301363-030	12AS024	186-233	9.1	30.3	0.55	13.9	15.0	5.2	0.4
S1301363-031	12AS027	0-20	7.7	75.5	0.59	18.1	37.7	34.4	5.5
S1301363-032	12AS027	20-52	7.5	75.0	0.44	13.5	33.6	30.3	5.0
S1301363-033	12AS027	52-100	7.8	65.4	0.45	8.1	30.7	26.0	3.6
S1301363-034	12AS027	100-116	8.1	58.2	0.42	9.0	28.2	21.5	2.1
S1301363-035	12AS027	116-156	8.2	78.6	0.44	14.5	35.2	30.0	1.7
S1301363-036	12AS027	156-170	8.3	57.8	0.45	9.0	27.8	23.5	1.2
S1301363-037	12AS028	0-12	7.7	71.5	0.82	12.9	34.2	30.3	5.9
S1301363-038	12AS028	12-25	7.8	71.5	0.63	12.2	33.0	28.3	4.0
S1301363-039	12AS028	25-68	8.1	63.3	0.36	12.9	31.0	25.6	1.6
S1301363-040	12AS028	68-103	8.4	39.5	0.34	4.1	20.8	13.5	0.4

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301363001

Project: Private Lease Soils - Full List

Date Received: 1/22/2013

Date Reported: 4/3/2013

Work Order: S1301363

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1301363-041	12AS028	103-128	8.4	61.4	0.36	12.5	28.0	22.6	1.0
S1301363-042	12AS028	128-157	8.5	68.2	0.38	13.9	30.9	25.6	1.4
S1301363-043	12AS028	157-173	8.8	38.8	0.35	5.5	20.1	13.7	0.9
S1301363-044	12AS029	0-14	7.6	60.7	1.18	10.5	30.8	22.8	5.0
S1301363-045	12AS029	14-36	7.9	60.2	0.40	6.9	29.3	18.7	2.4
S1301363-046	12AS029	36-58	8.0	68.2	0.36	10.6	31.6	25.2	2.1
S1301363-047	12AS029	58-86	7.9	72.4	0.45	15.1	39.7	33.1	5.1
S1301363-048	12AS029	86-118	8.4	60.8	0.36	12.0	34.8	27.9	1.6
S1301363-049	12AS029	118-173	8.5	52.5	0.38	7.2	29.2	23.4	1.0
S1301363-050	12AS029	173-232	8.4	67.4	0.48	12.6	33.2	25.4	1.1
S1301363-051	12AS029	232-244	8.1	53.6	4.85	7.1	27.5	17.1	1.1

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301363001

Project: Private Lease Soils - Full List

Date Received: 1/22/2013

Date Reported: 4/3/2013

Work Order: S1301363

Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1301363-001	12AS018	0-22	3.10	1.57	0.49	0.09	0.06
S1301363-002	12AS018	22-68	1.84	0.96	0.12	0.08	0.07
S1301363-003	12AS018	68-115	1.17	1.84	0.07	0.17	0.14
S1301363-004	12AS018	115-148	0.93	2.00	0.06	0.23	0.19
S1301363-005	12AS018	148-244	1.01	1.57	0.08	0.15	0.14
S1301363-006	12AS020	0-13	4.09	1.46	1.06	0.06	0.04
S1301363-007	12AS020	13-30	2.37	0.96	0.43	0.07	0.05
S1301363-008	12AS020	30-80	1.88	1.52	0.27	0.13	0.10
S1301363-009	12AS020	80-111	0.97	2.23	0.07	0.37	0.29
S1301363-010	12AS020	111-140	1.32	3.73	0.09	0.63	0.40
S1301363-011	12AS020	140-175	1.26	5.80	0.11	0.82	0.43
S1301363-012	12AS021	0-9	2.76	1.70	1.02	0.08	0.05
S1301363-013	12AS021	9-32	2.50	2.66	0.18	0.07	0.04
S1301363-014	12AS021	32-65	1.04	3.40	0.10	0.15	0.10
S1301363-015	12AS021	65-95	0.83	2.94	0.09	0.16	0.11
S1301363-016	12AS021	95-150	0.95	3.02	0.10	0.17	0.12
S1301363-017	12AS021	150-202	0.81	1.71	0.06	0.14	0.12
S1301363-018	12AS021	202-230	0.87	1.85	0.07	0.15	0.13
S1301363-019	12AS022	0-12	2.05	1.03	0.26	0.13	0.11
S1301363-020	12AS022	12-50	1.37	1.16	0.18	0.14	0.12

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301363001

Project: Private Lease Soils - Full List

Date Received: 1/22/2013

Date Reported: 4/3/2013

Work Order: S1301363

Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1301363-021	12AS022	50-87	1.24	2.28	0.12	0.24	0.18
S1301363-022	12AS022	87-126	1.38	2.40	0.13	0.22	0.16
S1301363-023	12AS022	126-160	2.50	4.48	0.17	0.31	0.17
S1301363-024	12AS022	160-210	1.89	4.04	0.14	0.29	0.17
S1301363-025	12AS022	210-232	12.0	15.1	0.36	0.92	0.25
S1301363-026	12AS024	0-18	1.29	1.16	0.13	0.12	0.11
S1301363-027	12AS024	18-84	1.04	1.25	0.09	0.11	0.10
S1301363-028	12AS024	84-136	0.89	1.23	0.08	0.09	0.09
S1301363-029	12AS024	136-186	1.24	1.98	0.10	0.17	0.14
S1301363-030	12AS024	186-233	1.68	4.25	0.13	0.32	0.19
S1301363-031	12AS027	0-20	3.52	2.55	0.46	0.58	0.33
S1301363-032	12AS027	20-52	3.03	1.52	0.48	0.19	0.13
S1301363-033	12AS027	52-100	2.61	1.88	0.22	0.39	0.26
S1301363-034	12AS027	100-116	1.61	1.83	0.07	1.39	1.06
S1301363-035	12AS027	116-156	1.63	1.74	0.06	1.78	1.37
S1301363-036	12AS027	156-170	1.53	1.75	0.04	1.89	1.48
S1301363-037	12AS028	0-12	4.67	4.40	0.65	0.36	0.17
S1301363-038	12AS028	12-25	3.67	3.59	0.17	0.33	0.17
S1301363-039	12AS028	25-68	1.97	2.13	0.13	0.28	0.19
S1301363-040	12AS028	68-103	1.48	2.13	0.08	0.26	0.19

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301363001

Project: Private Lease Soils - Full List
Date Received: 1/22/2013

Date Reported: 4/3/2013
Work Order: S1301363

Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1301363-041	12AS028	103-128	1.76	2.52	0.09	0.36	0.24
S1301363-042	12AS028	128-157	1.62	3.04	0.08	0.46	0.30
S1301363-043	12AS028	157-173	1.36	2.64	0.08	0.41	0.29
S1301363-044	12AS029	0-14	7.07	5.16	1.19	0.22	0.09
S1301363-045	12AS029	14-36	2.70	2.19	0.12	0.14	0.09
S1301363-046	12AS029	36-58	2.22	2.26	0.10	0.22	0.15
S1301363-047	12AS029	58-86	2.73	2.83	0.09	0.32	0.19
S1301363-048	12AS029	86-118	2.05	2.53	0.07	0.41	0.27
S1301363-049	12AS029	118-173	1.75	2.82	0.07	0.59	0.39
S1301363-050	12AS029	173-232	1.76	3.06	0.07	1.00	0.64
S1301363-051	12AS029	232-244	12.2	57.4	0.42	9.96	1.69

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301363001

Project: Private Lease Soils - Full List

Date Received: 1/22/2013

Date Reported: 4/3/2013

Work Order: S1301363

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment
		cm	%	%	%		%	%
S1301363-001	12AS018	0-22	26.0	38.0	36.0	Clay Loam	9.4	
S1301363-002	12AS018	22-68	26.0	42.0	32.0	Clay Loam	7.3	
S1301363-003	12AS018	68-115	8.0	48.0	44.0	Silty Clay	4.0	
S1301363-004	12AS018	115-148	18.0	42.0	40.0	Silty Clay	12.3	
S1301363-005	12AS018	148-244	60.0	28.0	12.0	Sandy Loam	17.2	
S1301363-006	12AS020	0-13	20.0	49.0	31.0	Clay Loam	3.3	
S1301363-007	12AS020	13-30	12.0	51.0	37.0	Silty Clay Loam	2.1	
S1301363-008	12AS020	30-80	10.0	50.0	40.0	Silty Clay	1.8	
S1301363-009	12AS020	80-111	8.0	51.0	41.0	Silty Clay	2.4	
S1301363-010	12AS020	111-140	10.0	54.0	36.0	Silty Clay Loam	5.2	
S1301363-011	12AS020	140-175	10.0	64.0	26.0	Silty Loam	4.8	
S1301363-012	12AS021	0-9	24.0	41.0	35.0	Clay Loam	10.9	
S1301363-013	12AS021	9-32	22.0	45.0	33.0	Clay Loam	10.7	
S1301363-014	12AS021	32-65	22.0	46.0	32.0	Clay Loam	8.3	
S1301363-015	12AS021	65-95	32.0	56.0	12.0	Silty Loam	15.5	
S1301363-016	12AS021	95-150	52.0	36.0	12.0	Sandy Loam	9.6	
S1301363-017	12AS021	150-202	82.0	15.0	3.0	Loamy Sand	18.3	
S1301363-018	12AS021	202-230	82.0	16.0	2.0	Loamy Sand	12.5	
S1301363-019	12AS022	0-12	84.0	14.0	2.0	Loamy Sand	12.5	
S1301363-020	12AS022	12-50	90.0	8.0	2.0	Sand	8.5	65.9

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301363001

Project: Private Lease Soils - Full List
Date Received: 1/22/2013

Date Reported: 4/3/2013
Work Order: S1301363

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment
		cm	%	%	%		%	%
S1301363-021	12AS022	50-87	86.0	12.0	2.0	Sand	6.9	63.1
S1301363-022	12AS022	87-126	90.0	9.0	1.0	Sand	4.9	65.9
S1301363-023	12AS022	126-160	82.0	15.0	3.0	Loamy Sand	9.9	70.2
S1301363-024	12AS022	160-210	84.0	14.0	2.0	Loamy Sand	11.3	73.8
S1301363-025	12AS022	210-232	80.0	16.0	4.0	Loamy Sand	17.2	1.1
S1301363-026	12AS024	0-18	74.0	20.0	6.0	Sandy Loam	2.2	62.6
S1301363-027	12AS024	18-84	80.0	18.0	2.0	Loamy Sand	6.4	64.5
S1301363-028	12AS024	84-136	88.0	10.0	2.0	Sand	9.5	60.5
S1301363-029	12AS024	136-186	84.0	14.0	2.0	Loamy Sand	8.3	60.0
S1301363-030	12AS024	186-233	88.0	11.0	1.0	Sand	8.8	54.4
S1301363-031	12AS027	0-20	24.0	36.0	40.0	Clay	13.6	
S1301363-032	12AS027	20-52	24.0	40.0	36.0	Clay Loam	10.0	
S1301363-033	12AS027	52-100	26.0	36.0	38.0	Clay Loam	7.4	
S1301363-034	12AS027	100-116	34.0	30.0	36.0	Clay Loam	12.0	
S1301363-035	12AS027	116-156	12.0	50.0	38.0	Silty Clay Loam	5.7	
S1301363-036	12AS027	156-170	6.0	54.0	40.0	Silty Clay	2.5	
S1301363-037	12AS028	0-12	18.0	38.0	44.0	Clay	5.8	
S1301363-038	12AS028	12-25	18.0	43.0	39.0	Silty Clay Loam	7.9	
S1301363-039	12AS028	25-68	10.0	46.0	44.0	Silty Clay	4.8	
S1301363-040	12AS028	68-103	52.0	36.0	12.0	Sandy Loam	17.2	

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
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Report ID: S1301363001

Project: Private Lease Soils - Full List

Date Received: 1/22/2013

Date Reported: 4/3/2013

Work Order: S1301363

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment
		cm	%	%	%		%	%
S1301363-041	12AS028	103-128	12.0	56.0	32.0	Silty Clay Loam	6.3	
S1301363-042	12AS028	128-157	12.0	46.0	42.0	Silty Clay	2.4	
S1301363-043	12AS028	157-173	48.0	40.0	12.0	Loam	11.7	
S1301363-044	12AS029	0-14	46.0	24.0	30.0	Sandy Clay Loam	27.5	
S1301363-045	12AS029	14-36	32.0	30.0	38.0	Clay Loam	7.1	
S1301363-046	12AS029	36-58	12.0	40.0	48.0	Silty Clay	<0.1	
S1301363-047	12AS029	58-86	2.0	40.0	58.0	Clay	<0.1	
S1301363-048	12AS029	86-118	8.0	34.0	58.0	Silty Clay	3.3	
S1301363-049	12AS029	118-173	6.0	56.0	38.0	Silty Clay Loam	0.7	
S1301363-050	12AS029	173-232	8.0	40.0	52.0	Silty Clay	4.1	
S1301363-051	12AS029	232-244	44.0	24.0	32.0	Clay Loam	3.1	

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301363001

Project: Private Lease Soils - Full List
Date Received: 1/22/2013

Date Reported: 4/3/2013
Work Order: S1301363

Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1301363-001	12AS018	0-22	1.03	0.4	61.5	9.9	<0.02	10.5	3.1
S1301363-002	12AS018	22-68	0.31	<0.1	59.5	2.1	<0.02	8.0	0.9
S1301363-003	12AS018	68-115	0.45	<0.1	54.1	1.8	<0.02	6.9	0.4
S1301363-004	12AS018	115-148	0.31	<0.1	55.4	1.7	<0.02	6.8	0.2
S1301363-005	12AS018	148-244	0.12	<0.1	27.9	1.2	<0.02	3.8	0.4
S1301363-006	12AS020	0-13	0.52	4.7	38.2	10.1	<0.02	11.2	6.6
S1301363-007	12AS020	13-30	0.75	<0.1	76.3	4.1	<0.02	9.3	0.2
S1301363-008	12AS020	30-80	0.64	<0.1	60.4	2.5	<0.02	9.1	1.8
S1301363-009	12AS020	80-111	0.33	<0.1	52.4	3.4	<0.02	7.2	0.9
S1301363-010	12AS020	111-140	0.29	<0.1	44.9	2.0	<0.02	6.1	0.8
S1301363-011	12AS020	140-175	0.28	<0.1	54.2	2.3	<0.02	7.1	0.6
S1301363-012	12AS021	0-9	1.07	<0.1	19.7	8.4	<0.02	5.4	3.0
S1301363-013	12AS021	9-32	1.37	<0.1	30.7	6.5	<0.02	5.2	1.6
S1301363-014	12AS021	32-65	1.42	<0.1	56.3	4.0	<0.02	7.8	1.1
S1301363-015	12AS021	65-95	0.31	<0.1	60.8	1.8	<0.02	7.7	0.4
S1301363-016	12AS021	95-150	0.31	<0.1	45.9	1.5	<0.02	6.1	0.6
S1301363-017	12AS021	150-202	0.16	<0.1	26.1	1.3	<0.02	3.3	0.2
S1301363-018	12AS021	202-230	0.10	<0.1	22.5	4.2	<0.02	2.6	<0.1
S1301363-019	12AS022	0-12	0.08	<0.1	53.1	2.9	<0.02	7.3	0.9
S1301363-020	12AS022	12-50	0.08	<0.1	62.2	2.6	<0.02	8.0	0.6

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301363001

Project: Private Lease Soils - Full List
Date Received: 1/22/2013

Date Reported: 4/3/2013
Work Order: S1301363

Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1301363-021	12AS022	50-87	0.11	<0.1	60.5	1.7	<0.02	8.0	0.8
S1301363-022	12AS022	87-126	0.06	<0.1	61.9	1.9	<0.02	7.8	0.3
S1301363-023	12AS022	126-160	0.13	<0.1	68.2	1.6	<0.02	8.9	0.8
S1301363-024	12AS022	160-210	0.08	<0.1	68.6	1.7	<0.02	8.8	0.6
S1301363-025	12AS022	210-232	0.41	<0.1	22.9	1.9	<0.02	3.5	0.7
S1301363-026	12AS024	0-18	0.12	<0.1	56.7	2.1	<0.02	7.3	0.5
S1301363-027	12AS024	18-84	0.08	<0.1	56.6	3.3	<0.02	7.0	0.2
S1301363-028	12AS024	84-136	0.06	<0.1	55.7	1.8	<0.02	7.0	0.3
S1301363-029	12AS024	136-186	0.08	<0.1	54.7	1.9	<0.02	7.4	0.8
S1301363-030	12AS024	186-233	0.08	<0.1	53.7	1.6	<0.02	6.8	0.3
S1301363-031	12AS027	0-20	0.07	8.4	26.4	19.3	<0.02	5.4	2.2
S1301363-032	12AS027	20-52	0.48	<0.1	26.5	11.9	<0.02	5.0	1.8
S1301363-033	12AS027	52-100	0.68	2.0	33.4	6.3	<0.02	5.2	1.2
S1301363-034	12AS027	100-116	0.21	<0.1	29.0	2.1	<0.02	3.8	0.4
S1301363-035	12AS027	116-156	0.25	<0.1	46.6	2.0	<0.02	6.2	0.6
S1301363-036	12AS027	156-170	0.37	<0.1	51.6	4.3	<0.02	6.7	0.5
S1301363-037	12AS028	0-12	1.01	23.9	48.6	11.0	<0.02	8.5	2.7
S1301363-038	12AS028	12-25	0.79	7.2	49.4	11.1	<0.02	7.7	1.7
S1301363-039	12AS028	25-68	0.38	0.4	53.8	2.8	<0.02	6.8	0.3
S1301363-040	12AS028	68-103	0.17	<0.1	42.6	1.7	<0.02	4.4	<0.1

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301363001

Project: Private Lease Soils - Full List

Date Received: 1/22/2013

Date Reported: 4/3/2013

Work Order: S1301363

Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1301363-041	12AS028	103-128	0.29	<0.1	47.1	1.4	<0.02	5.8	0.2
S1301363-042	12AS028	128-157	0.28	<0.1	51.7	1.5	<0.02	6.7	0.4
S1301363-043	12AS028	157-173	0.12	<0.1	46.7	1.6	<0.02	5.3	<0.1
S1301363-044	12AS029	0-14	0.71	56.5	25.6	41.2	<0.02	5.1	2.0
S1301363-045	12AS029	14-36	0.26	6.5	16.5	8.7	<0.02	3.2	1.2
S1301363-046	12AS029	36-58	0.45	0.9	24.1	4.0	<0.02	3.3	0.4
S1301363-047	12AS029	58-86	0.33	1.2	39.2	5.1	<0.02	6.5	1.8
S1301363-048	12AS029	86-118	0.21	1.2	51.2	2.2	<0.02	6.7	0.5
S1301363-049	12AS029	118-173	0.27	0.7	57.7	2.6	<0.02	7.5	0.6
S1301363-050	12AS029	173-232	0.39	0.9	47.1	2.7	<0.02	6.2	0.5
S1301363-051	12AS029	232-244	0.35	0.4	24.9	2.4	<0.02	3.1	0.1

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301363001

Project: Private Lease Soils - Full List

Date Received: 1/22/2013

Date Reported: 4/3/2013

Work Order: S1301363

Lab ID	Sample ID	Depths cm	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t
S1301363-001	12AS018	0-22	0.09	2.69	615	612
S1301363-002	12AS018	22-68	0.06	1.98	595	593
S1301363-003	12AS018	68-115	0.04	1.19	541	540
S1301363-004	12AS018	115-148	0.03	0.92	554	553
S1301363-005	12AS018	148-244	0.01	0.44	279	279
S1301363-006	12AS020	0-13	0.49	15.4	382	367
S1301363-007	12AS020	13-30	0.04	1.23	763	761
S1301363-008	12AS020	30-80	0.06	1.98	604	602
S1301363-009	12AS020	80-111	0.04	1.20	524	523
S1301363-010	12AS020	111-140	0.04	1.13	449	448
S1301363-011	12AS020	140-175	0.01	0.41	542	541
S1301363-012	12AS021	0-9	0.15	4.61	197	192
S1301363-013	12AS021	9-32	0.74	23.1	307	284
S1301363-014	12AS021	32-65	1.29	40.3	563	523
S1301363-015	12AS021	65-95	0.02	0.48	608	608
S1301363-016	12AS021	95-150	0.03	0.79	459	458
S1301363-017	12AS021	150-202	0.02	0.73	261	261
S1301363-018	12AS021	202-230	0.19	5.81	225	219
S1301363-019	12AS022	0-12	0.02	0.47	531	530
S1301363-020	12AS022	12-50	0.03	0.87	622	621

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301363001

Project: Private Lease Soils - Full List

Date Received: 1/22/2013

Date Reported: 4/3/2013

Work Order: S1301363

Lab ID	Sample ID	Depths	Total Sulfur	T.S. AB	Neutral. Potential	T.S. ABP
		cm	%	t/1000t	t/1000t	t/1000t
S1301363-021	12AS022	50-87	0.02	0.70	605	604
S1301363-022	12AS022	87-126	0.02	0.55	619	618
S1301363-023	12AS022	126-160	0.07	2.09	682	680
S1301363-024	12AS022	160-210	0.07	2.03	686	684
S1301363-025	12AS022	210-232	0.68	21.2	229	208
S1301363-026	12AS024	0-18	0.02	0.74	567	566
S1301363-027	12AS024	18-84	0.03	0.80	566	565
S1301363-028	12AS024	84-136	0.02	0.53	557	557
S1301363-029	12AS024	136-186	0.03	0.82	547	546
S1301363-030	12AS024	186-233	0.02	0.72	537	537
S1301363-031	12AS027	0-20	0.04	1.13	264	262
S1301363-032	12AS027	20-52	0.04	1.21	265	264
S1301363-033	12AS027	52-100	0.03	1.02	334	333
S1301363-034	12AS027	100-116	0.02	0.52	290	290
S1301363-035	12AS027	116-156	0.05	1.60	466	465
S1301363-036	12AS027	156-170	0.16	5.02	516	511
S1301363-037	12AS028	0-12	0.05	1.65	486	485
S1301363-038	12AS028	12-25	0.05	1.65	494	493
S1301363-039	12AS028	25-68	0.03	1.02	538	537
S1301363-040	12AS028	68-103	0.01	0.37	426	426

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301363001

Project: Private Lease Soils - Full List

Date Received: 1/22/2013

Date Reported: 4/3/2013

Work Order: S1301363

Lab ID	Sample ID	Depths cm	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t
S1301363-041	12AS028	103-128	0.02	0.77	471	470
S1301363-042	12AS028	128-157	0.03	0.84	517	516
S1301363-043	12AS028	157-173	0.02	0.71	467	466
S1301363-044	12AS029	0-14	0.03	0.95	256	255
S1301363-045	12AS029	14-36	0.02	0.65	165	165
S1301363-046	12AS029	36-58	0.01	0.46	241	241
S1301363-047	12AS029	58-86	0.04	1.11	392	391
S1301363-048	12AS029	86-118	0.02	0.53	512	511
S1301363-049	12AS029	118-173	0.03	0.91	577	576
S1301363-050	12AS029	173-232	0.04	1.13	471	470
S1301363-051	12AS029	232-244	0.08	2.64	249	247

C - 50

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301363001

Project: Private Lease Soils - Full List

Date Received: 1/22/2013

Date Reported: 4/3/2013

Work Order: S1301363

Lab ID	Sample ID	Depths	Total Arsenic	Total Barium	Total Cadmium	Total Chromium	Total Copper	Total Iron	Total Lead	Total Manganese	Total Molybdenum
		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
S1301363-001	12AS018	0-22	6.6	681	0.30	15.5	12.8	8980	7.0	303	<0.7
S1301363-002	12AS018	22-68	9.7	750	0.38	21.0	12.4	12800	7.4	570	<0.7
S1301363-003	12AS018	68-115	24.0	392	0.76	27.7	9.33	31100	10.9	398	1.0
S1301363-004	12AS018	115-148	13.8	498	0.65	29.1	11.0	18800	11.3	284	<0.7
S1301363-005	12AS018	148-244	3.6	96.0	0.26	11.7	6.81	4630	5.9	119	<0.7
S1301363-006	12AS020	0-13	6.7	596	0.37	18.4	14.2	10800	9.3	388	<0.7
S1301363-007	12AS020	13-30	7.4	544	0.35	18.6	12.3	10300	7.7	309	<0.7
S1301363-008	12AS020	30-80	9.6	546	0.34	16.0	10.7	10800	6.3	449	<0.7
S1301363-009	12AS020	80-111	26.3	309	0.63	19.6	6.75	27400	7.9	316	0.8
S1301363-010	12AS020	111-140	34.9	353	0.72	20.9	11.6	31400	9.0	201	1.0
S1301363-011	12AS020	140-175	5.3	224	0.37	17.6	7.50	6490	7.9	172	<0.7
S1301363-012	12AS021	0-9	6.3	103	0.43	20.1	12.7	14400	10.2	287	<0.7
S1301363-013	12AS021	9-32	7.6	153	0.50	27.6	15.6	18200	11.0	396	<0.7
S1301363-014	12AS021	32-65	6.2	331	0.36	17.2	9.14	13400	6.5	373	<0.7
S1301363-015	12AS021	65-95	7.4	215	0.33	12.3	4.94	10700	6.1	217	<0.7
S1301363-016	12AS021	95-150	4.8	201	0.33	11.5	5.13	8610	5.7	163	<0.7
S1301363-017	12AS021	150-202	12.8	123	0.29	5.74	2.58	11600	3.5	196	<0.7
S1301363-018	12AS021	202-230	2.7	75.6	0.21	5.61	2.86	3240	3.8	89.4	<0.7
S1301363-019	12AS022	0-12	5.0	134	0.26	7.35	3.05	6880	4.7	187	<0.7
S1301363-020	12AS022	12-50	5.6	127	0.24	6.40	2.70	6740	3.7	231	<0.7

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301363001

Project: Private Lease Soils - Full List
Date Received: 1/22/2013

Date Reported: 4/3/2013
Work Order: S1301363

Lab ID	Sample ID	Depths	Total Arsenic	Total Barium	Total Cadmium	Total Chromium	Total Copper	Total Iron	Total Lead	Total Manganese	Total Molybdenum
		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
S1301363-021	12AS022	50-87	5.9	139	0.20	6.26	2.65	7320	3.4	250	<0.7
S1301363-022	12AS022	87-126	5.6	130	0.25	6.32	2.64	7440	3.6	231	<0.7
S1301363-023	12AS022	126-160	6.6	149	0.28	8.80	3.48	7370	4.1	226	<0.7
S1301363-024	12AS022	160-210	5.5	180	0.32	7.71	2.99	6780	4.1	251	0.8
S1301363-025	12AS022	210-232	8.7	96.5	0.26	9.63	5.46	8660	5.5	105	1.5
S1301363-026	12AS024	0-18	6.6	169	0.30	8.03	3.31	8890	4.3	252	<0.7
S1301363-027	12AS024	18-84	6.7	120	0.26	6.58	2.61	7640	3.7	219	0.7
S1301363-028	12AS024	84-136	4.6	167	0.29	7.19	2.80	6770	4.3	246	<0.7
S1301363-029	12AS024	136-186	3.9	142	0.34	6.46	2.54	7080	3.9	236	<0.7
S1301363-030	12AS024	186-233	5.6	174	0.25	6.49	2.51	6510	3.7	208	<0.7
S1301363-031	12AS027	0-20	6.2	118	0.38	22.4	12.3	14000	10.7	219	1.3
S1301363-032	12AS027	20-52	7.7	148	0.46	23.1	14.2	16200	12.9	272	1.0
S1301363-033	12AS027	52-100	9.3	272	0.50	27.7	13.2	15100	11.2	262	<0.7
S1301363-034	12AS027	100-116	8.7	300	0.38	28.4	13.5	17600	11.2	239	1.3
S1301363-035	12AS027	116-156	8.7	562	0.58	36.6	16.6	21200	12.7	456	<0.7
S1301363-036	12AS027	156-170	16.4	332	0.58	35.2	9.92	22900	12.4	308	2.6
S1301363-037	12AS028	0-12	9.5	453	0.53	27.7	15.0	15300	10.8	456	1.6
S1301363-038	12AS028	12-25	9.9	476	0.52	32.6	15.2	16700	11.5	456	1.9
S1301363-039	12AS028	25-68	13.5	441	0.60	36.7	12.6	18900	12.7	334	<0.7
S1301363-040	12AS028	68-103	3.5	170	0.30	13.9	4.06	4940	6.6	164	<0.7

These results apply only to the samples tested.

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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
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Report ID: S1301363001

Project: Private Lease Soils - Full List
Date Received: 1/22/2013

Date Reported: 4/3/2013
Work Order: S1301363

Lab ID	Sample ID	Depths cm	Total Arsenic mg/Kg	Total Barium mg/Kg	Total Cadmium mg/Kg	Total Chromium mg/Kg	Total Copper mg/Kg	Total Iron mg/Kg	Total Lead mg/Kg	Total Manganese mg/Kg	Total Molybdenum mg/Kg
S1301363-041	12AS028	103-128	8.3	270	0.39	19.6	9.97	10600	9.4	177	1.5
S1301363-042	12AS028	128-157	9.3	362	0.50	25.8	12.5	13400	11.0	253	2.9
S1301363-043	12AS028	157-173	3.5	173	0.32	12.2	5.28	4240	6.7	188	1.2
S1301363-044	12AS029	0-14	5.7	131	0.43	18.2	12.0	12700	10.8	219	2.1
S1301363-045	12AS029	14-36	5.7	116	0.22	15.7	9.32	11800	9.7	202	2.2
S1301363-046	12AS029	36-58	6.2	117	0.24	19.2	12.0	14000	11.8	217	1.7
S1301363-047	12AS029	58-86	6.4	317	0.39	25.2	19.1	14800	10.6	433	3.1
S1301363-048	12AS029	86-118	9.5	271	0.40	27.9	9.51	12600	10.4	261	3.6
S1301363-049	12AS029	118-173	8.6	195	0.37	20.8	8.02	10400	9.7	236	2.1
S1301363-050	12AS029	173-232	11.6	261	0.39	23.0	10.6	14200	9.4	192	1.9
S1301363-051	12AS029	232-244	11.2	202	0.36	16.7	11.2	18300	8.2	125	1.8

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301363001

Project: Private Lease Soils - Full List
Date Received: 1/22/2013

Date Reported: 4/3/2013
Work Order: S1301363

Lab ID	Sample ID	Depths	Total Selenium	Total Silver	Total Zinc	Total Mercury	Bulk Density
		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	g/cm³
S1301363-001	12AS018	0-22	1.12	<0.5	59.6	<0.2	6.2
S1301363-002	12AS018	22-68	<0.96	<0.5	52.3	<0.2	2.6
S1301363-003	12AS018	68-115	1.68	<0.5	45.4	<0.2	2.4
S1301363-004	12AS018	115-148	1.18	<0.5	46.5	<0.2	
S1301363-005	12AS018	148-244	<0.96	<0.5	25.2	<0.2	2.4
S1301363-006	12AS020	0-13	1.48	<0.5	68.1	<0.2	5.2
S1301363-007	12AS020	13-30	1.78	<0.5	50.8	<0.2	
S1301363-008	12AS020	30-80	1.56	<0.5	41.2	<0.2	
S1301363-009	12AS020	80-111	1.81	<0.5	37.0	<0.2	2.6
S1301363-010	12AS020	111-140	<0.96	<0.5	50.1	<0.2	2.2
S1301363-011	12AS020	140-175	<0.96	<0.5	25.8	<0.2	2.2
S1301363-012	12AS021	0-9	<0.96	<0.5	61.0	<0.2	2.3
S1301363-013	12AS021	9-32	1.84	<0.5	76.3	<0.2	2.8
S1301363-014	12AS021	32-65	<0.96	<0.5	43.8	<0.2	7.3
S1301363-015	12AS021	65-95	1.53	<0.5	27.4	<0.2	3.4
S1301363-016	12AS021	95-150	1.53	<0.5	26.6	<0.2	2.5
S1301363-017	12AS021	150-202	<0.96	<0.5	15.6	<0.2	2.3
S1301363-018	12AS021	202-230	<0.96	<0.5	12.6	<0.2	2.6
S1301363-019	12AS022	0-12	<0.96	<0.5	17.0	<0.2	
S1301363-020	12AS022	12-50	1.58	<0.5	13.7	<0.2	

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301363001

Project: Private Lease Soils - Full List
Date Received: 1/22/2013

Date Reported: 4/3/2013
Work Order: S1301363

Lab ID	Sample ID	Depths cm	Total Selenium mg/Kg	Total Silver mg/Kg	Total Zinc mg/Kg	Total Mercury mg/Kg	Bulk Density g/cm³
S1301363-021	12AS022	50-87	<0.96	<0.5	14.4	<0.2	2.4
S1301363-022	12AS022	87-126	<0.96	<0.5	14.8	<0.2	
S1301363-023	12AS022	126-160	2.15	<0.5	16.6	<0.2	2.0
S1301363-024	12AS022	160-210	<0.96	<0.5	19.5	<0.2	2.0
S1301363-025	12AS022	210-232	1.54	<0.5	25.5	<0.2	2.1
S1301363-026	12AS024	0-18	<0.96	<0.5	19.3	<0.2	2.1
S1301363-027	12AS024	18-84	<0.96	<0.5	15.4	<0.2	
S1301363-028	12AS024	84-136	<0.96	<0.5	13.6	<0.2	
S1301363-029	12AS024	136-186	<0.96	<0.5	19.2	<0.2	2.1
S1301363-030	12AS024	186-233	<0.96	<0.5	13.6	<0.2	2.2
S1301363-031	12AS027	0-20	<0.96	<0.5	63.4	<0.2	2.7
S1301363-032	12AS027	20-52	<0.96	<0.5	72.4	<0.2	2.5
S1301363-033	12AS027	52-100	<0.96	<0.5	73.3	<0.2	2.1
S1301363-034	12AS027	100-116	<0.96	<0.5	62.5	<0.2	2.5
S1301363-035	12AS027	116-156	1.57	<0.5	73.1	<0.2	2.4
S1301363-036	12AS027	156-170	<0.96	<0.5	56.8	<0.2	2.2
S1301363-037	12AS028	0-12	1.41	<0.5	75.1	<0.2	4.0
S1301363-038	12AS028	12-25	1.37	<0.5	75.8	<0.2	3.0
S1301363-039	12AS028	25-68	<0.96	<0.5	59.1	<0.2	2.5
S1301363-040	12AS028	68-103	<0.96	<0.5	22.9	<0.2	2.5

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301363001

Project: Private Lease Soils - Full List
Date Received: 1/22/2013

Date Reported: 4/3/2013
Work Order: S1301363

Lab ID	Sample ID	Depths cm	Total Selenium mg/Kg	Total Silver mg/Kg	Total Zinc mg/Kg	Total Mercury mg/Kg	Bulk Density g/cm³
S1301363-041	12AS028	103-128	<0.96	<0.5	41.0	<0.2	2.2
S1301363-042	12AS028	128-157	<0.96	<0.5	50.9	<0.2	2.1
S1301363-043	12AS028	157-173	<0.96	<0.5	25.3	<0.2	2.4
S1301363-044	12AS029	0-14	<0.96	<0.5	58.1	<0.2	4.3
S1301363-045	12AS029	14-36	<0.96	<0.5	47.3	<0.2	2.4
S1301363-046	12AS029	36-58	<0.96	<0.5	60.1	<0.2	2.2
S1301363-047	12AS029	58-86	1.04	<0.5	89.9	<0.2	2.3
S1301363-048	12AS029	86-118	1.43	<0.5	47.1	<0.2	2.6
S1301363-049	12AS029	118-173	<0.96	<0.5	41.2	<0.2	2.7
S1301363-050	12AS029	173-232	1.20	<0.5	48.2	<0.2	2.3
S1301363-051	12AS029	232-244	<0.96	<0.5	68.2	<0.2	2.0

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Date: 4/1/2013

CLIENT: Alton Coal Development, LLC
Project: Private Lease Soils - Short List
Lab Order: S1301365

CASE NARRATIVE

Report ID: S1301365001

Samples 12AS009, 12AS010, 12AS011, 12AS012, 12AS013, 12AS014, 12AS015, 12AS016, 12AS017, 12AS019, 12AS023, 12AS025, 12AS026, and 12AS030 were received on January 22, 2013.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301365001

Project: Private Lease Soils - Short List
Date Received: 1/22/2013

Date Reported: 4/1/2013
Work Order: S1301365

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1301365-001	12AS009	0-7	7.7	65.2	0.59	11.4	29.6	24.5	4.8
S1301365-002	12AS009	7-20	7.6	60.7	0.45	8.8	28.2	21.1	3.4
S1301365-003	12AS009	20-62	7.9	64.1	0.33	9.9	30.9	23.9	1.8
S1301365-004	12AS009	62-99	8.1	62.9	0.26	9.1	27.7	22.9	1.3
S1301365-005	12AS009	99-137	8.4	55.8	0.25	9.0	26.7	22.2	0.9
S1301365-006	12AS009	137-183	8.5	64.0	0.28	10.8	27.7	23.7	1.0
S1301365-007	12AS009	183-232	8.6	52.7	0.32	6.8	25.7	20.3	2.3
S1301365-008	12AS010	0-9	7.9	72.5	0.56	15.4	41.6	28.7	5.7
S1301365-009	12AS010	9-31	8.2	65.2	0.42	13.5	43.3	26.9	2.4
S1301365-010	12AS010	31-67	8.6	52.0	0.37	9.1	31.1	20.5	2.1
S1301365-011	12AS010	67-96	8.9	32.5	0.27	6.6	22.3	7.4	0.5
S1301365-012	12AS010	96-134	8.9	40.2	0.34	15.0	23.0	15.9	0.5
S1301365-013	12AS010	134-183	8.9	49.3	0.30	16.2	24.2	13.0	1.1
S1301365-014	12AS010	183-200	9.0	31.3	0.26	9.9	16.9	6.0	0.5
S1301365-015	12AS010	200-284	8.5	80.4	0.30	19.1	30.4	25.4	0.9
S1301365-016	12AS011	0-10	7.9	66.5	0.54	14.2	35.7	25.7	6.1
S1301365-017	12AS011	10-32	8.0	65.8	0.46	10.1	32.8	23.3	4.5
S1301365-018	12AS011	32-71	8.4	39.4	0.37	3.9	22.7	14.2	1.3
S1301365-019	12AS011	71-116	8.6	51.0	0.36	5.8	30.9	24.4	0.6
S1301365-020	12AS011	116-128	8.9	31.3	0.31	2.3			1.0

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301365001

Project: Private Lease Soils - Short List
Date Received: 1/22/2013

Date Reported: 4/1/2013
Work Order: S1301365

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1301365-021	12AS011	128-154	8.8	66.4	0.35	13.3	29.8	25.0	1.0
S1301365-022	12AS011	154-214	8.6	65.7	0.50	13.0	26.5	22.2	1.3
S1301365-023	12AS012	0-11	7.9	66.4	0.53	12.6	34.1	23.2	6.0
S1301365-024	12AS012	11-30	8.0	73.3	0.45	13.3	35.8	28.1	4.1
S1301365-025	12AS012	30-72	8.4	49.5	0.40	7.0	27.6	19.8	0.8
S1301365-026	12AS012	72-116	9.0	30.9	0.26	3.0	13.3	7.7	0.3
S1301365-027	12AS012	116-160	8.8	29.0	0.35	3.5	10.3	5.2	0.3
S1301365-028	12AS012	160-187	9.2	29.3	0.28	5.3	12.3	4.9	0.6
S1301365-029	12AS012	187-230	9.0	31.9	0.25	4.5	7.3	3.2	0.3
S1301365-030	12AS013	0-16	7.7	97.3	0.37	13.1	28.4	22.5	4.4
S1301365-031	12AS013	16-52	7.8	29.3	0.30	6.8	22.3	15.2	1.6
S1301365-032	12AS013	52-102	8.1	51.8	0.27	6.8	21.4	15.9	0.9
S1301365-033	12AS013	102-114	8.2	53.8	0.30	8.7	25.9	22.3	0.8
S1301365-034	12AS014	0-20	7.8	65.9	0.34	46.5	35.4	27.0	2.5
S1301365-035	12AS014	20-45	7.9	69.1	0.31	30.4	34.3	28.0	1.8
S1301365-036	12AS014	45-66	8.4	75.8	0.39	18.8	35.5	30.2	1.1
S1301365-037	12AS014	66-88	8.2	76.7	0.80	12.6	36.0	29.8	2.0
S1301365-038	12AS014	88-114	8.1	82.7	1.65	12.3	37.9	31.1	1.0
S1301365-039	12AS015	0-20	7.9	72.1	0.47	14.0	39.8	30.8	3.7
S1301365-040	12AS015	20-54	8.0	76.7	0.39	13.7	39.4	34.0	2.4

These results apply only to the samples tested.

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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

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Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301365001

Project: Private Lease Soils - Short List
Date Received: 1/22/2013

Date Reported: 4/1/2013
Work Order: S1301365

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1301365-041	12AS015	54-87	8.4	84.0	0.98	14.0	42.4	37.2	1.7
S1301365-042	12AS015	87-119	8.2	52.7	6.55	16.5	44.2	39.2	1.0
S1301365-083	12AS015	119-132	8.2	72.5	10.9	13.9	36.8	32.0	0.8
S1301365-043	12AS016	0-11	7.7	50.7	0.43	9.9	28.0	17.6	2.9
S1301365-044	12AS016	11-40	7.7	51.6	0.37	6.7	26.8	16.8	1.9
S1301365-045	12AS016	40-71	8.1	57.2	0.78	7.1	25.5	18.0	1.3
S1301365-046	12AS016	71-120	7.7	47.8	0.38	5.2	26.0	16.8	1.7
S1301365-047	12AS017	0-13	7.7	84.5	0.33	20.7	47.8	38.8	3.5
S1301365-048	12AS017	13-57	7.9	186	0.24	20.0	99.0	96.6	1.9
S1301365-049	12AS017	57-84	7.8	87.9	3.35	20.7	47.8	42.8	0.3
S1301365-050	12AS017	84-118	7.7	83.7	4.64	19.5	44.6	40.0	0.6
S1301365-051	12AS017	118-161	5.3	80.2	6.14	17.3	44.6	38.9	0.2
S1301365-052	12AS019	0-12	7.7	67.6	0.60	13.9	40.7	33.0	5.5
S1301365-053	12AS019	12-32	7.8	72.6	0.40	11.8	40.2	33.3	5.8
S1301365-054	12AS019	32-72	8.0	62.8	0.33	11.3	42.0	31.2	3.9
S1301365-055	12AS019	72-100	8.3	61.1	0.20	8.8	26.8	23.5	1.1
S1301365-056	12AS019	100-147	8.4	36.6	0.27	5.9	19.1	11.7	0.4
S1301365-057	12AS019	147-196	8.7	35.0	0.31	5.7	20.8	10.6	2.8
S1301365-058	12AS019	196-240	8.7	33.0	0.44	8.2	20.1	10.9	0.2
S1301365-059	12AS023	0-18	7.8	43.9	0.41	9.0	19.0	13.6	0.3

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301365001

Project: Private Lease Soils - Short List
Date Received: 1/22/2013

Date Reported: 4/1/2013
Work Order: S1301365

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1301365-060	12AS023	18-47	7.8	38.3	0.32	3.5	16.6	11.3	2.9
S1301365-061	12AS023	47-78	8.1	32.5	0.26	2.0	15.1	10.3	3.0
S1301365-062	12AS023	78-120	8.2	28.7	0.31	1.5	12.5	7.1	1.9
S1301365-063	12AS023	120-180	8.7	29.0	0.26	1.6	10.2	5.8	0.7
S1301365-064	12AS023	180-230	8.6	28.8	0.20	3.8	8.6	3.0	0.2
S1301365-065	12AS025	0-12	7.8	69.0	0.57	12.5	35.4	28.7	6.4
S1301365-066	12AS025	12-30	8.1	60.0	0.50	10.6	31.6	26.7	3.8
S1301365-067	12AS025	30-70	8.5	49.6	0.36	4.8	30.4	24.0	0.7
S1301365-068	12AS025	70-101	8.7	43.8	0.31	6.5	27.5	21.7	0.5
S1301365-069	12AS025	101-123	8.8	35.2	0.31	2.9	23.2	13.2	0.2
S1301365-070	12AS025	123-156	8.8	56.2	0.33	11.4	27.2	23.6	0.7
S1301365-071	12AS025	156-186	8.9	30.9	0.31	8.1	18.5	10.6	0.2
S1301365-072	12AS025	186-204	8.9	28.1	0.27	8.0	19.0	6.3	<0.1
S1301365-073	12AS026	3-20	7.7	68.4	0.73	18.9	34.8	29.8	7.0
S1301365-074	12AS026	20-65	7.7	55.2	0.65	9.2	28.9	21.6	1.9
S1301365-075	12AS026	65-104	7.9	56.2	0.51	9.5	31.3	23.0	2.0
S1301365-076	12AS026	104-144	8.0	58.3	0.51	12.7	34.2	29.4	2.3
S1301365-077	12AS026	144-202	8.0	61.2	0.36	9.2	27.8	23.6	1.2
S1301365-078	12AS030	0-15	7.7	65.1	0.39	12.6	32.0	26.9	2.5
S1301365-079	12AS030	15-30	7.7	66.5	0.37	11.0	32.7	28.5	1.9

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301365001

Project: Private Lease Soils - Short List
Date Received: 1/22/2013

Date Reported: 4/1/2013
Work Order: S1301365

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1301365-080	12AS030	30-42	7.9	69.5	0.36	10.1	32.8	29.2	1.8
S1301365-081	12AS030	42-67	7.9	59.7	0.69	11.2	33.7	29.9	1.9
S1301365-082	12AS030	67-95	7.9	82.2	1.57	12.8	36.1	31.0	1.9

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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
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Report ID: S1301365001

Project: Private Lease Soils - Short List

Date Received: 1/22/2013

Date Reported: 4/1/2013

Work Order: S1301365

Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1301365-001	12AS009	0-7	3.75	1.40	0.98	0.11	0.07
S1301365-002	12AS009	7-20	3.51	1.26	0.55	0.10	0.06
S1301365-003	12AS009	20-62	2.50	1.06	0.17	0.17	0.13
S1301365-004	12AS009	62-99	1.62	1.06	0.12	0.15	0.13
S1301365-005	12AS009	99-137	1.39	1.19	0.10	0.13	0.11
S1301365-006	12AS009	137-183	1.23	1.66	0.10	0.18	0.15
S1301365-007	12AS009	183-232	1.23	1.92	0.13	0.27	0.22
S1301365-008	12AS010	0-9	3.42	2.43	0.30	0.21	0.12
S1301365-009	12AS010	9-31	2.30	2.07	0.16	0.09	0.06
S1301365-010	12AS010	31-67	1.16	2.40	0.16	0.16	0.12
S1301365-011	12AS010	67-96	0.93	2.12	0.09	0.09	0.07
S1301365-012	12AS010	96-134	0.89	3.05	0.11	0.14	0.10
S1301365-013	12AS010	134-183	0.75	2.50	0.12	0.10	0.08
S1301365-014	12AS010	183-200	0.67	2.27	0.11	0.15	0.12
S1301365-015	12AS010	200-284	1.06	2.14	0.10	0.27	0.21
S1301365-016	12AS011	0-10	3.04	2.04	0.81	0.07	0.05
S1301365-017	12AS011	10-32	2.64	2.42	0.31	0.07	0.04
S1301365-018	12AS011	32-71	1.37	2.22	0.12	0.09	0.07
S1301365-019	12AS011	71-116	1.16	3.13	0.09	0.16	0.11
S1301365-020	12AS011	116-128	0.85	2.15	0.08	0.50	0.41

These results apply only to the samples tested.

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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301365001

Project: Private Lease Soils - Short List

Date Received: 1/22/2013

Date Reported: 4/1/2013

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Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1301365-021	12AS011	128-154	0.88	3.07	0.09	0.16	0.11
S1301365-022	12AS011	154-214	1.39	3.89	0.11	0.35	0.21
S1301365-023	12AS012	0-11	3.54	2.01	0.74	0.06	0.04
S1301365-024	12AS012	11-30	2.97	2.26	0.21	0.06	0.04
S1301365-025	12AS012	30-72	1.17	2.41	0.12	0.11	0.08
S1301365-026	12AS012	72-116	0.85	1.84	0.07	0.10	0.09
S1301365-027	12AS012	116-160	0.98	1.77	0.08	0.98	0.83
S1301365-028	12AS012	160-187	0.88	2.02	0.08	0.11	0.09
S1301365-029	12AS012	187-230	0.96	1.97	0.06	0.09	0.08
S1301365-030	12AS013	0-16	3.34	0.68	0.35	0.08	0.06
S1301365-031	12AS013	16-52	2.69	0.62	0.21	0.14	0.11
S1301365-032	12AS013	52-102	1.34	0.65	0.11	1.10	1.11
S1301365-033	12AS013	102-114	1.01	0.48	0.07	2.20	2.54
S1301365-034	12AS014	0-20	2.23	1.18	0.12	0.35	0.26
S1301365-035	12AS014	20-45	1.69	0.91	0.05	1.24	1.09
S1301365-036	12AS014	45-66	1.01	0.56	0.04	3.02	3.41
S1301365-037	12AS014	66-88	1.52	0.96	0.06	6.21	5.57
S1301365-038	12AS014	88-114	2.90	2.72	0.10	12.5	7.44
S1301365-039	12AS015	0-20	3.15	1.83	0.13	0.54	0.34
S1301365-040	12AS015	20-54	1.91	1.63	0.05	1.43	1.08

These results apply only to the samples tested.

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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301365001

Project: Private Lease Soils - Short List

Date Received: 1/22/2013

Date Reported: 4/1/2013

Work Order: S1301365

Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1301365-041	12AS015	54-87	1.54	2.88	0.04	6.60	4.44
S1301365-042	12AS015	87-119	7.10	55.1	0.30	38.2	6.85
S1301365-083	12AS015	119-132	24.2	115	0.47	60.8	7.29
S1301365-043	12AS016	0-11	3.86	0.66	0.34	0.25	0.17
S1301365-044	12AS016	11-40	3.06	0.80	0.29	0.13	0.09
S1301365-045	12AS016	40-71	1.95	1.65	0.14	4.73	3.53
S1301365-046	12AS016	71-120	2.82	0.75	0.19	0.59	0.44
S1301365-047	12AS017	0-13	2.52	0.57	0.22	0.71	0.57
S1301365-048	12AS017	13-57	1.41	0.27	0.11	1.23	1.30
S1301365-049	12AS017	57-84	22.3	6.99	0.34	17.4	4.55
S1301365-050	12AS017	84-118	22.4	11.3	0.51	27.1	6.60
S1301365-051	12AS017	118-161	16.9	20.0	0.65	44.1	10.3
S1301365-052	12AS019	0-12	4.14	1.03	0.71	0.34	0.21
S1301365-053	12AS019	12-32	3.52	1.05	0.37	0.06	0.04
S1301365-054	12AS019	32-72	2.64	1.41	0.09	0.12	0.09
S1301365-055	12AS019	72-100	1.45	0.90	0.05	0.08	0.07
S1301365-056	12AS019	100-147	1.42	1.47	0.07	0.19	0.16
S1301365-057	12AS019	147-196	1.20	1.96	0.06	0.13	0.11
S1301365-058	12AS019	196-240	1.63	2.74	0.09	0.46	0.31
S1301365-059	12AS023	0-18	3.68	0.90	0.32	0.05	0.03

These results apply only to the samples tested.

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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301365001

Project: Private Lease Soils - Short List

Date Received: 1/22/2013

Date Reported: 4/1/2013

Work Order: S1301365

Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1301365-060	12AS023	18-47	2.94	0.84	0.07	0.10	0.07
S1301365-061	12AS023	47-78	2.09	0.80	0.06	0.05	0.05
S1301365-062	12AS023	78-120	2.17	1.29	0.06	0.47	0.36
S1301365-063	12AS023	120-180	1.48	1.24	0.10	0.22	0.19
S1301365-064	12AS023	180-230	1.26	0.98	0.06	0.08	0.07
S1301365-065	12AS025	0-12	3.88	2.92	0.20	0.18	0.10
S1301365-066	12AS025	12-30	2.44	2.16	0.05	0.15	0.10
S1301365-067	12AS025	30-70	1.35	3.11	0.05	0.13	0.09
S1301365-068	12AS025	70-101	1.12	2.44	0.08	0.13	0.10
S1301365-069	12AS025	101-123	1.05	2.56	0.09	0.13	0.10
S1301365-070	12AS025	123-156	1.25	2.54	0.14	0.20	0.15
S1301365-071	12AS025	156-186	0.93	2.19	0.16	0.22	0.18
S1301365-072	12AS025	186-204	0.95	2.04	0.17	0.13	0.11
S1301365-073	12AS026	3-20	4.37	3.22	0.44	0.47	0.24
S1301365-074	12AS026	20-65	3.53	2.19	0.54	1.12	0.66
S1301365-075	12AS026	65-104	3.51	2.05	0.18	0.53	0.32
S1301365-076	12AS026	104-144	3.45	2.05	0.08	0.58	0.35
S1301365-077	12AS026	144-202	2.11	1.55	0.03	0.79	0.58
S1301365-078	12AS030	0-15	3.02	0.60	0.22	0.59	0.44
S1301365-079	12AS030	15-30	2.67	0.60	0.17	1.50	1.17

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301365001

Project: Private Lease Soils - Short List

Date Received: 1/22/2013

Date Reported: 4/1/2013

Work Order: S1301365

Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1301365-080	12AS030	30-42	1.80	0.45	0.09	2.56	2.42
S1301365-081	12AS030	42-67	1.96	0.60	0.09	5.26	4.65
S1301365-082	12AS030	67-95	3.47	1.11	0.14	12.1	8.03

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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
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Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment
		cm	%	%	%		%	%
S1301365-001	12AS009	0-7	26.0	35.0	39.0	Clay Loam	7.1	
S1301365-002	12AS009	7-20	10.0	46.0	44.0	Silty Clay	<0.1	
S1301365-003	12AS009	20-62	<0.1	47.0	53.0	Silty Clay	<0.1	
S1301365-004	12AS009	62-99	<0.1	48.0	52.0	Silty Clay	<0.1	
S1301365-005	12AS009	99-137	<0.1	53.0	47.0	Silty Clay	<0.1	
S1301365-006	12AS009	137-183	<0.1	49.0	51.0	Silty Clay	<0.1	
S1301365-007	12AS009	183-232	6.0	58.0	36.0	Silty Clay Loam	<0.1	
S1301365-008	12AS010	0-9	10.0	50.0	40.0	Silty Clay	<0.1	
S1301365-009	12AS010	9-31	8.0	68.0	24.0	Silty Loam	<0.1	
S1301365-010	12AS010	31-67	16.0	50.0	34.0	Silty Clay Loam	<0.1	
S1301365-011	12AS010	67-96	66.0	18.0	16.0	Sandy Loam	17.7	
S1301365-012	12AS010	96-134	42.0	36.0	22.0	Loam	9.8	
S1301365-013	12AS010	134-183	20.0	60.0	20.0	Silty Loam	10.5	
S1301365-014	12AS010	183-200	60.0	28.0	12.0	Sandy Loam	8.8	
S1301365-015	12AS010	200-284	<0.1	48.0	52.0	Silty Clay	<0.1	
S1301365-016	12AS011	0-10	18.0	41.0	41.0	Silty Clay	<0.1	
S1301365-017	12AS011	10-32	18.0	40.0	42.0	Silty Clay	0.5	
S1301365-018	12AS011	32-71	<0.1	61.0	39.0	Silty Clay Loam	<0.1	
S1301365-019	12AS011	71-116	<0.1	37.0	63.0	Clay	<0.1	
S1301365-020	12AS011	116-128	70.0	18.0	12.0	Sandy Loam	3.6	

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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

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Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment
		cm	%	%	%		%	%
S1301365-021	12AS011	128-154	<0.1	25.0	75.0	Clay	<0.1	
S1301365-022	12AS011	154-214	<0.1	17.0	83.0	Clay	<0.1	
S1301365-023	12AS012	0-11	<0.1	37.0	63.0	Clay	<0.1	
S1301365-024	12AS012	11-30	<0.1	25.0	75.0	Clay	<0.1	
S1301365-025	12AS012	30-72	<0.1	37.0	63.0	Clay	<0.1	
S1301365-026	12AS012	72-116	42.0	33.0	25.0	Loam	<0.1	
S1301365-027	12AS012	116-160	50.0	32.0	18.0	Loam	<0.1	
S1301365-028	12AS012	160-187	50.0	33.0	17.0	Loam	<0.1	
S1301365-029	12AS012	187-230	50.0	33.0	17.0	Loam	<0.1	
S1301365-030	12AS013	0-16	<0.1	28.0	72.0	Clay	<0.1	
S1301365-031	12AS013	16-52	<0.1	39.0	61.0	Clay	<0.1	
S1301365-032	12AS013	52-102	<0.1	39.0	61.0	Clay	<0.1	
S1301365-033	12AS013	102-114	<0.1	27.0	73.0	Clay	<0.1	
S1301365-034	12AS014	0-20	6.0	43.0	51.0	Silty Clay	1.7	
S1301365-035	12AS014	20-45	6.0	43.0	51.0	Silty Clay	2.2	
S1301365-036	12AS014	45-66	4.0	44.0	52.0	Silty Clay	0.3	
S1301365-037	12AS014	66-88	10.0	37.0	53.0	Clay	6.3	
S1301365-038	12AS014	88-114	6.0	39.0	55.0	Silty Clay	2.4	
S1301365-039	12AS015	0-20	10.0	39.0	51.0	Clay	4.4	
S1301365-040	12AS015	20-54	12.0	32.0	56.0	Silty Clay	7.2	

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Karen Secor, Soil Lab Supervisor

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Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment
		cm	%	%	%		%	%
S1301365-041	12AS015	54-87	10.0	30.0	60.0	Clay	5.6	
S1301365-042	12AS015	87-119	10.0	31.0	59.0	Silty Clay	6.1	
S1301365-083	12AS015	119-132	20.0	32.0	48.0	Clay	15.6	
S1301365-043	12AS016	0-11	22.0	46.0	32.0	Clay Loam	13.9	
S1301365-044	12AS016	11-40	18.0	49.0	33.0	Silty Clay Loam	10.2	
S1301365-045	12AS016	40-71	22.0	37.0	41.0	Clay	15.5	
S1301365-046	12AS016	71-120	22.0	47.0	31.0	Clay Loam	13.0	
S1301365-047	12AS017	0-13	14.0	31.0	55.0	Silty Clay	9.2	
S1301365-048	12AS017	13-57	10.0	23.0	67.0	Clay	6.6	
S1301365-049	12AS017	57-84	16.0	31.0	53.0	Clay	6.3	
S1301365-050	12AS017	84-118	18.0	24.0	58.0	Silty Clay	4.5	
S1301365-051	12AS017	118-161	16.0	29.0	55.0	Silty Clay	8.5	
S1301365-052	12AS019	0-12	16.0	41.0	43.0	Silty Clay	2.3	
S1301365-053	12AS019	12-32	12.0	41.0	47.0	Silty Clay	0.2	
S1301365-054	12AS019	32-72	10.0	46.0	44.0	Silty Clay	<0.1	
S1301365-055	12AS019	72-100	24.0	35.0	41.0	Clay	19.1	
S1301365-056	12AS019	100-147	46.0	35.0	19.0	Loam	10.5	
S1301365-057	12AS019	147-196	44.0	41.0	15.0	Loam	11.5	
S1301365-058	12AS019	196-240	52.0	33.0	15.0	Sandy Loam	11.1	
S1301365-059	12AS023	0-18	50.0	25.0	25.0	Sandy Clay Loam	5.9	

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1301365001

Project: Private Lease Soils - Short List
Date Received: 1/22/2013

Date Reported: 4/1/2013
Work Order: S1301365

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment
		cm	%	%	%		%	%
S1301365-060	12AS023	18-47	51.0	25.0	24.0	Sandy Clay Loam	2.0	9.6
S1301365-061	12AS023	47-78	64.0	18.0	18.0	Sandy Loam	10.7	2.7
S1301365-062	12AS023	78-120	60.0	26.0	14.0	Sandy Loam	<0.1	6.1
S1301365-063	12AS023	120-180	84.0	8.0	8.0	Loamy Sand	10.6	63.5
S1301365-064	12AS023	180-230	80.0	14.0	6.0	Loamy Sand	6.8	17.9
S1301365-065	12AS025	0-12	22.0	56.0	22.0	Silty Loam	7.5	0.2
S1301365-066	12AS025	12-30	16.0	41.0	43.0	Silty Clay	8.1	<0.1
S1301365-067	12AS025	30-70	12.0	56.0	32.0	Silty Clay Loam	6.9	
S1301365-068	12AS025	70-101	32.0	49.0	19.0	Loam	27.3	
S1301365-069	12AS025	101-123	38.0	46.0	16.0	Loam	13.8	
S1301365-070	12AS025	123-156	20.0	44.0	36.0	Clay Loam	13.3	
S1301365-071	12AS025	156-186	58.0	26.0	16.0	Sandy Loam	16.2	
S1301365-072	12AS025	186-204	60.0	32.0	8.0	Sandy Loam	17.0	
S1301365-073	12AS026	3-20	20.0	39.0	41.0	Clay	7.7	
S1301365-074	12AS026	20-65	20.0	47.0	33.0	Clay Loam	3.9	
S1301365-075	12AS026	65-104	34.0	27.0	39.0	Clay Loam	6.3	
S1301365-076	12AS026	104-144	10.0	41.0	49.0	Silty Clay	2.2	
S1301365-077	12AS026	144-202	20.0	37.0	43.0	Clay	15.5	
S1301365-078	12AS030	0-15	12.0	35.0	53.0	Clay	7.9	
S1301365-079	12AS030	15-30	16.0	30.0	54.0	Clay	11.9	

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
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Report ID: S1301365001

Project: Private Lease Soils - Short List

Date Received: 1/22/2013

Date Reported: 4/1/2013

Work Order: S1301365

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment
		cm	%	%	%		%	%
S1301365-080	12AS030	30-42	14.0	32.0	54.0	Clay	10.0	
S1301365-081	12AS030	42-67	10.0	36.0	54.0	Clay	6.2	
S1301365-082	12AS030	67-95	10.0	34.0	56.0	Silty Clay	6.2	

These results apply only to the samples tested.

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Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

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Cedar City, UT 84721

Report ID: S1301365001

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Work Order: S1301365

Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1301365-001	12AS009	0-7	0.65	3.5	22.2	11.0	<0.02	5.0	2.3
S1301365-002	12AS009	7-20	0.51	0.5	25.4	6.0	<0.02	4.4	1.4
S1301365-003	12AS009	20-62	0.34	0.5	42.4	3.8	<0.02	6.0	0.9
S1301365-004	12AS009	62-99	0.49	0.6	52.6	1.7	<0.02	6.8	0.5
S1301365-005	12AS009	99-137	0.36	0.5	51.8	2.2	<0.02	6.8	0.7
S1301365-006	12AS009	137-183	0.33	0.4	49.2	20.4	<0.02	6.5	0.7
S1301365-007	12AS009	183-232	0.25	0.5	45.2	1120	<0.02	5.8	0.3
S1301365-008	12AS010	0-9	0.68	1.9	47.6	38.7	<0.02	8.5	2.8
S1301365-009	12AS010	9-31	0.63	0.5	57.6	3.3	<0.02	8.1	1.2
S1301365-010	12AS010	31-67	0.22	0.4	50.1	1.4	<0.02	6.3	0.3
S1301365-011	12AS010	67-96	0.18	0.3	24.4	2.3	<0.02	3.0	<0.1
S1301365-012	12AS010	96-134	0.25	0.4	32.4	2.0	<0.02	4.3	0.4
S1301365-013	12AS010	134-183	0.29	<0.1	37.0	2.3	<0.02	4.8	0.3
S1301365-014	12AS010	183-200	0.18	0.4	25.8	0.3	<0.02	3.5	0.4
S1301365-015	12AS010	200-284	0.57	0.8	48.0	0.5	<0.02	6.4	0.7
S1301365-016	12AS011	0-10	0.83	0.9	39.8	8.5	<0.02	7.2	2.4
S1301365-017	12AS011	10-32	1.06	0.8	43.3	5.0	<0.02	6.7	1.5
S1301365-018	12AS011	32-71	0.27	0.4	41.4	1.7	<0.02	5.3	0.4
S1301365-019	12AS011	71-116	0.25	0.4	55.2	1.4	<0.02	7.2	0.6
S1301365-020	12AS011	116-128	0.17	0.3	24.4	0.7	<0.02	3.2	0.2

These results apply only to the samples tested.

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Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

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Report ID: S1301365001

Project: Private Lease Soils - Short List
Date Received: 1/22/2013

Date Reported: 4/1/2013
Work Order: S1301365

Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1301365-021	12AS011	128-154	0.64	0.5	51.0	<0.1	<0.02	6.7	0.5
S1301365-022	12AS011	154-214	0.34	1.1	49.5	0.8	<0.02	6.6	0.6
S1301365-023	12AS012	0-11	0.50	1.2	38.6	8.9	<0.02	7.0	2.3
S1301365-024	12AS012	11-30	0.95	0.7	49.0	4.8	<0.02	7.4	1.5
S1301365-025	12AS012	30-72	0.45	0.5	61.7	1.0	<0.02	8.0	0.6
S1301365-026	12AS012	72-116	0.20	0.3	28.9	0.7	<0.02	3.6	0.1
S1301365-027	12AS012	116-160	0.14	0.4	25.5	0.6	<0.02	3.1	<0.1
S1301365-028	12AS012	160-187	0.13	0.6	25.6	0.7	<0.02	3.4	0.3
S1301365-029	12AS012	187-230	0.13	0.4	18.1	0.3	<0.02	2.5	0.3
S1301365-030	12AS013	0-16	0.44	1.0	3.5	4.2	<0.02	2.8	2.3
S1301365-031	12AS013	16-52	0.18	0.9	10.7	1.2	<0.02	1.9	0.6
S1301365-032	12AS013	52-102	0.17	0.3	14.9	<0.1	<0.02	2.0	0.3
S1301365-033	12AS013	102-114	0.45	0.4	10.1	0.3	<0.02	1.5	0.2
S1301365-034	12AS014	0-20	0.55	2.3	4.1	3.6	<0.02	1.6	1.1
S1301365-035	12AS014	20-45	0.28	0.2	5.9	2.1	<0.02	1.4	0.6
S1301365-036	12AS014	45-66	0.40	0.1	6.4	1.9	<0.02	1.3	0.6
S1301365-037	12AS014	66-88	0.76	<0.1	6.3	1.8	<0.02	1.3	0.5
S1301365-038	12AS014	88-114	0.93	0.2	6.6	1.2	0.04	1.2	0.5
S1301365-039	12AS015	0-20	0.71	3.4	5.3	5.6	<0.02	2.0	1.4
S1301365-040	12AS015	20-54	0.55	1.1	8.4	2.3	<0.02	1.9	0.9

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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
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Report ID: S1301365001

Project: Private Lease Soils - Short List
Date Received: 1/22/2013

Date Reported: 4/1/2013
Work Order: S1301365

Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1301365-041	12AS015	54-87	1.01	1.1	12.6	1.0	<0.02	1.9	0.5
S1301365-042	12AS015	87-119	3.35	0.9	7.4	2.3	0.02	1.1	0.3
S1301365-083	12AS015	119-132	2.47	0.9	11.9	3.1	0.02	1.7	0.3
S1301365-043	12AS016	0-11	0.40	1.5	11.6	3.7	<0.02	2.8	1.4
S1301365-044	12AS016	11-40	0.32	0.4	13.9	2.1	<0.02	2.6	0.9
S1301365-045	12AS016	40-71	0.37	0.3	14.5	0.2	<0.02	2.2	0.4
S1301365-046	12AS016	71-120	0.34	0.5	17.8	1.2	<0.02	3.1	0.9
S1301365-047	12AS017	0-13	0.62	3.0	4.0	4.3	<0.02	2.2	1.7
S1301365-048	12AS017	13-57	0.43	0.3	4.4	2.3	<0.02	0.9	0.3
S1301365-049	12AS017	57-84	0.93	0.4	2.7	2.9	<0.02	0.6	0.3
S1301365-050	12AS017	84-118	0.76	0.7	1.6	1.3	<0.02	0.4	0.2
S1301365-051	12AS017	118-161	0.62	0.2	1.3	4.0	<0.02	0.4	0.2
S1301365-052	12AS019	0-12	0.70	2.6	56.0	12.8	<0.02	10.2	3.5
S1301365-053	12AS019	12-32	0.76	1.5	57.2	5.2	<0.02	9.9	3.1
S1301365-054	12AS019	32-72	0.70	0.7	57.1	2.1	<0.02	9.2	2.4
S1301365-055	12AS019	72-100	0.56	0.4	50.8	0.5	<0.02	6.7	0.6
S1301365-056	12AS019	100-147	0.28	0.4	32.1	0.6	<0.02	4.2	0.4
S1301365-057	12AS019	147-196	0.22	0.3	32.4	0.8	<0.02	4.4	0.5
S1301365-058	12AS019	196-240	0.20	0.3	30.7	0.8	<0.02	3.8	<0.1
S1301365-059	12AS023	0-18	0.32	2.2	16.7	5.9	<0.02	3.0	1.0

These results apply only to the samples tested.

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Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

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Suite 1
Cedar City, UT 84721

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Project: Private Lease Soils - Short List

Date Received: 1/22/2013

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Work Order: S1301365

Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1301365-060	12AS023	18-47	0.26	0.5	22.9	2.1	<0.02	3.3	0.5
S1301365-061	12AS023	47-78	0.18	0.4	31.5	1.5	<0.02	4.3	0.5
S1301365-062	12AS023	78-120	0.26	0.3	22.2	0.9	<0.02	2.9	<0.1
S1301365-063	12AS023	120-180	0.15	0.3	31.4	0.8	<0.02	5.9	2.2
S1301365-064	12AS023	180-230	0.09	0.3	19.2	0.5	<0.02	2.8	0.5
S1301365-065	12AS025	0-12	0.98	5.0	27.3	11.9	<0.02	8.4	5.1
S1301365-066	12AS025	12-30	0.66	0.3	45.3	3.1	<0.02	7.1	1.7
S1301365-067	12AS025	30-70	0.39	0.2	55.0	1.1	<0.02	7.3	0.8
S1301365-068	12AS025	70-101	0.38	0.2	53.3	1.2	<0.02	7.2	0.7
S1301365-069	12AS025	101-123	0.24	0.2	44.6	<0.1	<0.02	6.2	0.8
S1301365-070	12AS025	123-156	0.49	0.3	50.1	1.8	<0.02	6.7	0.9
S1301365-071	12AS025	156-186	0.38	0.2	30.1	0.6	<0.02	4.3	0.6
S1301365-072	12AS025	186-204	0.29	0.3	30.6	0.8	<0.02	3.8	<0.1
S1301365-073	12AS026	3-20	0.53	23.0	28.8	31.9	<0.02	6.6	3.1
S1301365-074	12AS026	20-65	0.34	1.4	33.6	5.6	<0.02	5.3	1.3
S1301365-075	12AS026	65-104	0.39	1.0	30.9	3.7	<0.02	4.3	0.6
S1301365-076	12AS026	104-144	0.49	1.1	48.8	2.7	<0.02	7.5	1.6
S1301365-077	12AS026	144-202	0.29	0.6	53.8	1.2	<0.02	7.2	0.8
S1301365-078	12AS030	0-15	0.65	1.1	21.6	9.3	<0.02	3.5	0.9
S1301365-079	12AS030	15-30	0.71	0.6	21.5	4.5	<0.02	3.5	0.9

These results apply only to the samples tested.

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Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

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Report ID: S1301365001

Project: Private Lease Soils - Short List
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Date Reported: 4/1/2013
Work Order: S1301365

Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1301365-080	12AS030	30-42	0.94	<0.1	21.8	3.1	<0.02	3.4	0.8
S1301365-081	12AS030	42-67	1.05	<0.1	21.3	2.8	<0.02	3.3	0.8
S1301365-082	12AS030	67-95	1.35	0.2	21.6	3.1	0.03	3.3	0.7

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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Date: 5/31/2013

CLIENT: Alton Coal Development, LLC
Project: Private Lease Soils - Full List
Lab Order: S1304177

CASE NARRATIVE

Report ID: S1304177001

Samples DP-17, and DP-29 were received on April 11, 2013.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1304177001

Project: Private Lease Soils - Full List
Date Received: 4/11/2013

Date Reported: 5/31/2013
Work Order: S1304177

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1304177-001	DP-17	0-20	7.5	62.7	0.68	18.7	31.3	20.8	2.9
S1304177-002	DP-17	20-32	7.7	63.0	0.50	21.0	30.1	22.4	2.3
S1304177-003	DP-17	32-54	7.9	63.7	0.42	21.5	33.7	25.0	2.0
S1304177-004	DP-17	54-122	8.1	76.4	1.58	22.4	35.7	27.4	2.3
S1304177-005	DP-17	122-170	7.9	75.0	6.01	24.7	35.8	26.4	1.9
S1304177-006	DP-29	0-24	7.7	69.0	0.87	16.4	33.3	24.3	5.2
S1304177-007	DP-29	24-52	8.0	62.3	0.62	22.7	33.6	25.4	4.1
S1304177-008	DP-29	52-72	8.1	46.3	0.44	13.2	21.1	11.1	1.4
S1304177-009	DP-29	72-97	8.0	75.1	0.44	21.7	33.6	27.2	2.4
S1304177-010	DP-29	97-155	8.2	67.5	0.40	25.6	28.5	23.6	1.3
S1304177-011	DP-29	155-210	8.3	63.2	0.45	25.1	29.2	24.8	1.2
S1304177-012	DP-29	210-266	8.3	62.4	0.53	26.1	33.4	27.2	1.0
S1304177-013	DP-29	266-345	8.2	78.4	0.83	32.4	34.9	28.8	1.5
S1304177-014	DP-29	345-365	8.3	94.6	0.75	22.8			1.0

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These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1304177001

Project: Private Lease Soils - Full List
Date Received: 4/11/2013

Date Reported: 5/31/2013
Work Order: S1304177

Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1304177-001	DP-17	0-20	4.94	0.95	0.20	0.19	0.11
S1304177-002	DP-17	20-32	3.37	0.88	0.12	0.31	0.21
S1304177-003	DP-17	32-54	2.09	0.70	0.09	1.08	0.91
S1304177-004	DP-17	54-122	2.78	2.77	0.10	8.13	4.88
S1304177-005	DP-17	122-170	19.8	32.8	0.28	23.2	4.53
S1304177-006	DP-29	0-24	4.25	3.33	0.40	0.40	0.21
S1304177-007	DP-29	24-52	2.90	2.37	0.18	0.43	0.26
S1304177-008	DP-29	52-72	2.22	1.68	0.11	0.28	0.20
S1304177-009	DP-29	72-97	2.02	1.91	0.09	0.38	0.27
S1304177-010	DP-29	97-155	1.72	1.59	0.05	0.47	0.37
S1304177-011	DP-29	155-210	1.44	2.12	0.05	0.88	0.66
S1304177-012	DP-29	210-266	1.47	2.68	0.12	1.36	0.94
S1304177-013	DP-29	266-345	1.67	4.14	0.19	1.86	1.09
S1304177-014	DP-29	345-365	1.91	3.36	0.20	1.32	0.81

C - 80

These results apply only to the samples tested.

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1304177001

Project: Private Lease Soils - Full List

Date Received: 4/11/2013

Date Reported: 5/31/2013

Work Order: S1304177

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand
		cm	%	%	%		%
S1304177-001	DP-17	0-20	28.0	34.0	38.0	Clay Loam	11.1
S1304177-002	DP-17	20-32	30.0	29.0	41.0	Clay	10.8
S1304177-003	DP-17	32-54	28.0	28.0	44.0	Clay	11.7
S1304177-004	DP-17	54-122	22.0	32.0	46.0	Clay	10.0
S1304177-005	DP-17	122-170	16.0	34.0	50.0	Clay	4.7
S1304177-006	DP-29	0-24	20.0	38.0	42.0	Clay	3.3
S1304177-007	DP-29	24-52	18.0	38.0	44.0	Clay	6.0
S1304177-008	DP-29	52-72	50.0	32.0	18.0	Loam	10.4
S1304177-009	DP-29	72-97	10.0	46.0	44.0	Silty Clay	<0.1
S1304177-010	DP-29	97-155	4.0	52.0	44.0	Silty Clay	<0.1
S1304177-011	DP-29	155-210	10.0	44.0	46.0	Silty Clay	6.7
S1304177-012	DP-29	210-266	14.0	40.0	46.0	Silty Clay	3.3
S1304177-013	DP-29	266-345	6.0	44.0	50.0	Silty Clay	2.5
S1304177-014	DP-29	345-365	17.5	37.5	45.0	Clay	13.2

These results apply only to the samples tested.

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

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Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

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Suite 1
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Project: Private Lease Soils - Full List
Date Received: 4/11/2013

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Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1304177-001	DP-17	0-20	0.68	28.0	19.2	5.3	<0.02	3.4	1.1
S1304177-002	DP-17	20-32	0.51	13.6	15.9	4.0	<0.02	2.6	0.7
S1304177-003	DP-17	32-54	0.42	12.0	15.1	3.3	<0.02	2.6	0.8
S1304177-004	DP-17	54-122	0.99	6.4	16.9	4.8	<0.02	2.5	0.5
S1304177-005	DP-17	122-170	1.34	12.9	19.9	3.4	<0.02	2.8	0.4
S1304177-006	DP-29	0-24	0.42	25.5	45.3	14.6	<0.02	7.3	1.8
S1304177-007	DP-29	24-52	0.33	12.7	43.2	6.4	<0.02	6.0	0.9
S1304177-008	DP-29	52-72	0.24	0.9	28.4	1.0	<0.02	3.4	<0.1
S1304177-009	DP-29	72-97	0.46	<0.1	61.6	0.8	<0.02	7.8	0.4
S1304177-010	DP-29	97-155	0.23	<0.1	58.5	1.4	<0.02	6.7	<0.1
S1304177-011	DP-29	155-210	0.37	0.7	57.0	1.6	<0.02	6.4	<0.1
S1304177-012	DP-29	210-266	0.39	0.5	31.0	2.1	<0.02	3.5	<0.1
S1304177-013	DP-29	266-345	0.39	0.7	37.2	1.9	0.04	4.2	<0.1
S1304177-014	DP-29	345-365			42.5			4.9	<0.1

These results apply only to the samples tested.

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Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1304177001

Project: Private Lease Soils - Full List
Date Received: 4/11/2013

Date Reported: 5/31/2013
Work Order: S1304177

Lab ID	Sample ID	Depths cm	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t
S1304177-001	DP-17	0-20	0.05	1.69	192	190
S1304177-002	DP-17	20-32	0.05	1.54	159	157
S1304177-003	DP-17	32-54	0.05	1.48	151	149
S1304177-004	DP-17	54-122	0.06	1.93	169	167
S1304177-005	DP-17	122-170	0.20	6.34	199	193
S1304177-006	DP-29	0-24	0.10	3.07	453	450
S1304177-007	DP-29	24-52	0.07	2.05	432	430
S1304177-008	DP-29	52-72	0.05	1.59	284	282
S1304177-009	DP-29	72-97	0.10	3.07	616	613
S1304177-010	DP-29	97-155	0.08	2.36	585	583
S1304177-011	DP-29	155-210	0.08	2.53	570	567
S1304177-012	DP-29	210-266	0.08	2.45	310	307
S1304177-013	DP-29	266-345	0.08	2.50	372	370
S1304177-014	DP-29	345-365	0.07	2.05	425	423

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1304177001

Project: Private Lease Soils - Full List
Date Received: 4/11/2013

Date Reported: 5/31/2013
Work Order: S1304177

Lab ID	Sample ID	Depths cm	Total Arsenic mg/Kg	Total Barium mg/Kg	Total Cadmium mg/Kg	Total Chromium mg/Kg	Total Copper mg/Kg	Total Iron mg/Kg	Total Lead mg/Kg	Total Manganese mg/Kg	Total Molybdenum mg/Kg
S1304177-001	DP-17	0-20	4.8	80.5	0.30	16.4	9.01	12200	13.3	177	1.5
S1304177-002	DP-17	20-32	6.1	100	0.34	18.6	10.9	14400	15.2	226	2.8
S1304177-003	DP-17	32-54	5.9	98.4	0.41	20.8	11.0	15900	15.5	228	2.6
S1304177-004	DP-17	54-122	5.8	130	0.50	22.6	11.9	17700	17.1	239	2.7
S1304177-005	DP-17	122-170	5.5	125	0.40	26.2	12.4	16200	15.3	211	3.7
S1304177-006	DP-29	0-24	8.7	460	0.54	22.9	14.3	13900	14.6	353	2.9
S1304177-007	DP-29	24-52	9.1	384	0.52	27.2	14.4	15100	15.5	319	2.3
S1304177-008	DP-29	52-72	5.1	174	0.27	15.0	5.81	7630	10.1	147	1.5
S1304177-009	DP-29	72-97	8.7	630	0.40	22.7	12.0	14600	11.8	630	2.9
S1304177-010	DP-29	97-155	24.0	508	0.79	28.3	10.1	27000	17.4	310	3.1
S1304177-011	DP-29	155-210	10.4	205	0.47	31.0	12.2	12700	15.0	209	2.6
S1304177-012	DP-29	210-266	8.0	150	0.56	32.3	15.9	17000	17.1	220	3.4
S1304177-013	DP-29	266-345	7.9	115	0.61	29.4	13.7	17800	16.5	235	3.6
S1304177-014	DP-29	345-365	8.6	97.4	0.62	30.4	13.8	18000	17.4	256	2.8

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1304177001

Project: Private Lease Soils - Full List

Date Received: 4/11/2013

Date Reported: 5/31/2013

Work Order: S1304177

Lab ID	Sample ID	Depths	Total Selenium	Total Silver	Total Zinc	Total Mercury	Bulk Density
		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	g/cm³
S1304177-001	DP-17	0-20	<0.96	<0.5	45.7	<0.2	2.7
S1304177-002	DP-17	20-32	<0.96	<0.5	61.4	<0.2	2.5
S1304177-003	DP-17	32-54	<0.96	<0.5	58.5	<0.2	2.7
S1304177-004	DP-17	54-122	<0.96	<0.5	68.1	<0.2	2.2
S1304177-005	DP-17	122-170	<0.96	<0.5	58.7	<0.2	2.1
S1304177-006	DP-29	0-24	<0.96	<0.5	72.4	<0.2	3.9
S1304177-007	DP-29	24-52	<0.96	<0.5	72.8	<0.2	2.4
S1304177-008	DP-29	52-72	<0.96	<0.5	34.9	<0.2	2.3
S1304177-009	DP-29	72-97	<0.96	<0.5	53.1	<0.2	3.1
S1304177-010	DP-29	97-155	<0.96	<0.5	50.2	<0.2	2.5
S1304177-011	DP-29	155-210	<0.96	<0.5	51.6	<0.2	2.1
S1304177-012	DP-29	210-266	<0.96	<0.5	77.6	<0.2	2.1
S1304177-013	DP-29	266-345	<0.96	<0.5	65.4	<0.2	2.2
S1304177-014	DP-29	345-365	<0.96	<0.5	68.1	<0.2	2.3

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

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1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1307417002
(Replaces S1307417001)
Date Reported: 10/15/2013
Work Order: S1307417

Project: Private Lease Soils - Full List
Date Received: 7/30/2013

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1307417-001	12AS009	232-320	8.2	26.4	0.38	2.8	17.6	5.1	1.0
S1307417-002	12AS009	320-366	8.3	29.6	0.44	4.9	19.1	6.3	1.2
S1307417-003	12AS009	366-514	8.2	31.3	0.35	3.2	19.8	4.9	1.1
S1307417-004	12AS018	244-318	8.1	20.1	0.34	1.8	12.6	3.0	0.2
S1307417-006	12AS018	318-388	7.7	77.4	1.19	17.0	29.3	24.9	2.2
S1307417-007	12AS018	406-572	7.6	45.2	2.62	14.9	19.8	12.7	1.4
S1307417-008	12AS018	572-640	7.3	70.1	2.37	31.0	27.3	21.1	3.0
S1307417-009	12AS018	640-732	7.7	87.1	1.57	13.6	25.6	20.8	1.8
S1307417-010	12AS020	175-300	7.8	51.8	1.48	8.1	18.8	10.7	1.1
S1307417-011	12AS020	300-488	7.5	35.4	2.57	16.4	19.0	8.6	1.0
S1307417-012	12AS020	488-600	7.7	45.2	1.63	16.1	20.3	14.3	1.1
S1307417-013	12AS021	260-374	8.1	86.2	0.54	18.0	26.1	22.2	1.9
S1307417-014	12AS021	374-448	7.6	30.1	2.36	4.2	18.7	4.4	1.4
S1307417-015	12AS021	448-524	7.5	31.7	2.41	7.3	18.2	5.6	1.5
S1307417-016	12AS021	524-570	7.5	54.2	2.75	17.7	27.2	15.0	2.3
S1307417-017	12AS021	570-660	7.4	46.1	2.85	13.4	26.4	16.9	2.6
S1307417-018	12AS021	660-742	7.7	30.5	2.68	12.5	20.5	6.8	1.2
S1307417-019	12AS021	742-853	8.3	23.5	0.71	5.9	12.3	5.6	0.8
S1307417-020	12AS024	243-305	8.0	26.7	1.19	15.0	17.6	4.6	0.7
S1307417-021	12AS027	170-305	8.2	80.4	0.49	13.0	27.0	22.1	1.7

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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1307417002
(Replaces S1307417001)

Project: Private Lease Soils - Full List

Date Received: 7/30/2013

Date Reported: 10/15/2013

Work Order: S1307417

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1307417-022	12AS027	305-427	8.1	66.7	0.59	14.2	31.0	23.0	1.5
S1307417-023	12AS027	427-560	8.2	88.6	0.60	18.6	35.6	29.0	1.4
S1307417-024	12AS027	560-625	8.2	38.6	0.76	15.0	23.6	11.6	0.9
S1307417-025	12AS027	625-792	8.3	31.6	0.88	14.1	21.7	5.7	0.6
S1307417-026	12AS028	173-235	8.4	30.7	0.52	6.4	22.8	8.0	0.6
S1307417-027	12AS028	235-275	8.1	33.4	0.57	5.7			1.0
S1307417-028	12AS028	275-325	8.2	25.9	0.77	6.3	20.9	5.0	3.3
S1307417-029	12AS028	325-460	7.7	56.3	2.61	15.1	29.4	18.3	1.7
S1307417-030	12AS028	460-610	7.5	33.9	2.38	17.1	21.8	8.8	1.1
S1307417-031	12AS029	244-334	8.4	25.9	5.24	7.4	21.4	7.5	0.6
S1307417-032	12AS029	334-500	8.1	29.8	4.81	15.3	21.1	6.0	0.6
S1307417-033	12AS029	500-610	8.1	114	1.85	23.2			1.5
S1307417-034	DP-12	0-28	7.4		0.87	4.8			4.6
S1307417-035	DP-12	28-62	7.3	34.8	0.41	3.4			1.6
S1307417-036	DP-12	62-126	7.4	36.9	0.30	4.4	27.1	11.3	0.8
S1307417-037	DP-12	126-183	7.8	36.3	0.27	6.8	26.5	11.1	0.1
S1307417-038	DP-12	183-244	8.2	48.8	0.40	7.9	27.2	13.1	0.9
S1307417-039	DP-21	140-188	7.9	73.7	2.52	11.8	40.8	29.1	2.7
S1307417-040	DP-21	188-260	7.9	70.8	3.66	11.2	39.3	29.9	2.2
S1307417-041	DP-21	260-360	7.9	82.5	3.02	14.3	39.5	30.5	1.9

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1307417002
(Replaces S1307417001)
Date Reported: 10/15/2013
Work Order: S1307417

Project: Private Lease Soils - Full List
Date Received: 7/30/2013

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1307417-042	DP-22	120-180	8.6	93.4	7.94	18.0	47.1	36.1	1.6
S1307417-043	DP-22	180-240	8.3	89.8	6.22	17.1	48.2	35.1	1.2
S1307417-044	DP-24	22-40	7.9	58.6	0.50	9.2	40.5	25.0	4.4
S1307417-045	DP-24	40-65	8.0	58.9	0.39	10.6	40.6	26.8	3.5
S1307417-046	DP-24	65-126	8.3	64.0	0.86	11.1	39.0	27.3	3.6
S1307417-047	DP-24	126-244	8.1	81.1	4.35	17.3	38.7	31.0	2.3
S1307417-048	DP-26	0-15	7.7	55.5	0.55	9.4	35.7	26.4	4.9
S1307417-049	DP-26	15-32	7.9	55.7	0.33	11.5	33.2	25.7	4.4
S1307417-050	DP-26	32-59	8.0	61.2	0.34	11.1	37.3	28.0	2.0
S1307417-051	DP-26	59-90	8.2	57.3	0.28	9.1	33.7	27.2	1.7
S1307417-052	DP-26	90-148	8.5	57.2	0.26	9.2	28.0	23.3	1.2
S1307417-053	DP-26	148-230	8.4	35.1	0.26	5.6	22.1	14.1	0.5
S1307417-054	DP-26	230-294	8.5	31.4	0.31	7.0	22.5	8.1	0.5
S1307417-055	DP-26	294-350	8.5	25.6	0.34	7.6	22.0	5.5	0.6

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1307417002
(Replaces S1307417001)
Date Reported: 10/15/2013
Work Order: S1307417

Project: Private Lease Soils - Full List
Date Received: 7/30/2013

Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1307417-001	12AS009	232-320	1.57	2.66	0.15	0.60	0.41
S1307417-002	12AS009	320-366	1.39	3.63	0.17	0.33	0.21
S1307417-003	12AS009	366-514	1.42	2.67	0.16	0.28	0.20
S1307417-004	12AS018	244-318	1.73	2.23	0.12	0.30	0.21
S1307417-006	12AS018	318-388	5.06	8.91	0.17	1.53	0.58
S1307417-007	12AS018	406-572	16.4	22.8	0.29	5.56	1.26
S1307417-008	12AS018	572-640	13.9	18.2	0.41	4.93	1.23
S1307417-009	12AS018	640-732	6.31	10.6	0.39	3.87	1.33
S1307417-010	12AS020	175-300	5.88	10.4	0.29	2.56	0.90
S1307417-011	12AS020	300-488	25.6	20.7	0.38	0.88	0.18
S1307417-012	12AS020	488-600	10.5	12.8	0.31	0.76	0.22
S1307417-013	12AS021	260-374	2.19	3.88	0.15	0.31	0.18
S1307417-014	12AS021	374-448	25.5	12.0	0.34	0.38	0.09
S1307417-015	12AS021	448-524	26.6	15.1	0.40	0.62	0.14
S1307417-016	12AS021	524-570	24.8	21.9	0.59	0.57	0.12
S1307417-017	12AS021	570-660	22.4	29.8	0.67	0.74	0.15
S1307417-018	12AS021	660-742	24.7	24.1	0.50	0.72	0.15
S1307417-019	12AS021	742-853	3.23	4.81	0.22	0.38	0.19
S1307417-020	12AS024	243-305	6.27	8.23	0.23	0.77	0.29
S1307417-021	12AS027	170-305	1.93	2.09	0.03	1.80	1.27

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1307417002
(Replaces S1307417001)
Date Reported: 10/15/2013
Work Order: S1307417

Project: Private Lease Soils - Full List
Date Received: 7/30/2013

Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1307417-022	12AS027	305-427	2.21	2.91	0.08	1.74	1.09
S1307417-023	12AS027	427-560	1.93	3.20	0.14	1.67	1.04
S1307417-024	12AS027	560-625	2.21	4.10	0.16	2.57	1.45
S1307417-025	12AS027	625-792	2.54	4.77	0.11	3.21	1.68
S1307417-026	12AS028	173-235	1.95	3.86	0.10	0.59	0.35
S1307417-027	12AS028	235-275	1.97	4.19	0.10	0.70	0.40
S1307417-028	12AS028	275-325	2.40	5.90	0.11	0.84	0.41
S1307417-029	12AS028	325-460	23.9	21.6	0.47	0.97	0.20
S1307417-030	12AS028	460-610	21.9	15.8	0.34	0.58	0.13
S1307417-031	12AS029	244-334	14.2	71.8	0.38	20.3	3.10
S1307417-032	12AS029	334-500	25.0	51.7	0.46	15.8	2.56
S1307417-033	12AS029	500-610	6.02	15.9	0.67	3.39	1.03
S1307417-034	DP-12	0-28	5.38	2.88	1.17	0.14	0.07
S1307417-035	DP-12	28-62	3.33	1.50	0.23	0.12	0.07
S1307417-036	DP-12	62-126	2.18	1.61	0.07	0.19	0.14
S1307417-037	DP-12	126-183	1.94	1.55	0.06	0.31	0.23
S1307417-038	DP-12	183-244	2.31	1.99	0.06	0.46	0.31
S1307417-039	DP-21	140-188	13.4	13.3	0.21	8.67	2.37
S1307417-040	DP-21	188-260	28.4	24.7	0.30	11.8	2.29
S1307417-041	DP-21	260-360	24.3	19.2	0.27	8.47	1.81

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1307417002
(Replaces S1307417001)
Date Reported: 10/15/2013
Work Order: S1307417

Project: Private Lease Soils - Full List
Date Received: 7/30/2013

Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1307417-042	DP-22	120-180	22.8	83.1	0.57	63.8	8.77
S1307417-043	DP-22	180-240	21.9	51.1	0.63	44.0	7.28
S1307417-044	DP-24	22-40	4.35	1.16	0.22	0.38	0.23
S1307417-045	DP-24	40-65	2.85	1.05	0.10	1.05	0.75
S1307417-046	DP-24	65-126	2.92	1.79	0.09	5.39	3.52
S1307417-047	DP-24	126-244	22.5	30.7	0.33	22.2	4.30
S1307417-048	DP-26	0-15	5.02	1.09	0.41	0.13	0.08
S1307417-049	DP-26	15-32	3.00	0.97	0.19	0.16	0.11
S1307417-050	DP-26	32-59	3.04	1.20	0.17	0.17	0.11
S1307417-051	DP-26	59-90	2.40	1.24	0.11	0.14	0.11
S1307417-052	DP-26	90-148	2.13	1.59	0.11	0.13	0.10
S1307417-053	DP-26	148-230	1.72	1.61	0.08	0.17	0.13
S1307417-054	DP-26	230-294	1.81	1.99	0.09	0.18	0.13
S1307417-055	DP-26	294-350	1.87	1.94	0.09	0.38	0.28

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1307417002
(Replaces S1307417001)
Date Reported: 10/15/2013
Work Order: S1307417

Project: Private Lease Soils - Full List
Date Received: 7/30/2013

Lab ID	Sample ID	Depths cm	Sand %	Silt %	Clay %	Texture	Very Fine Sand %	Coarse Fragment %
S1307417-001	12AS009	232-320	60.0	30.0	10.0	Sandy Loam	2.7	
S1307417-002	12AS009	320-366	56.0	32.4	11.6	Sandy Loam	7.3	
S1307417-003	12AS009	366-514	66.0	26.0	8.0	Sandy Loam	7.5	
S1307417-004	12AS018	244-318	80.0	14.0	6.0	Loamy Sand	6.5	
S1307417-006	12AS018	318-388	<0.1	53.0	47.0	Silty Clay	<0.1	
S1307417-007	12AS018	406-572	28.0	51.0	21.0	Silty Loam	2.0	
S1307417-008	12AS018	572-640	14.0	54.0	32.0	Silty Clay Loam	3.9	
S1307417-009	12AS018	640-732	16.0	44.0	40.0	Silty Clay	<0.1	1.8
S1307417-010	12AS020	175-300	38.0	40.0	22.0	Loam	2.2	
S1307417-011	12AS020	300-488	56.0	30.0	14.0	Sandy Loam	5.9	
S1307417-012	12AS020	488-600	32.0	48.0	20.0	Loam	10.2	
S1307417-013	12AS021	260-374	<0.1	59.0	41.0	Silty Clay	<0.1	
S1307417-014	12AS021	374-448	73.0	21.0	6.0	Sandy Loam	4.7	
S1307417-015	12AS021	448-524	75.0	19.0	6.0	Sandy Loam	<0.1	22.8
S1307417-016	12AS021	524-570	31.0	52.0	17.0	Silty Loam	9.5	
S1307417-017	12AS021	570-660	37.0	37.0	26.0	Loam	3.3	
S1307417-018	12AS021	660-742	73.0	17.0	10.0	Sandy Loam	5.9	
S1307417-019	12AS021	742-853	81.0	13.0	6.0	Loamy Sand	2.5	60.7
S1307417-020	12AS024	243-305	80.0	12.0	8.0	Loamy Sand	7.0	
S1307417-021	12AS027	170-305	<0.1	52.0	48.0	Silty Clay	<0.1	

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
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Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
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Cedar City, UT 84721

Report ID: S1307417002
(Replaces S1307417001)
Date Reported: 10/15/2013
Work Order: S1307417

Project: Private Lease Soils - Full List
Date Received: 7/30/2013

Lab ID	Sample ID	Depths cm	Sand %	Silt %	Clay %	Texture	Very Fine Sand %	Coarse Fragment %
S1307417-022	12AS027	305-427	12.0	39.0	49.0	Clay	<0.1	
S1307417-023	12AS027	427-560	4.0	37.0	59.0	Silty Clay	<0.1	
S1307417-024	12AS027	560-625	46.0	32.0	22.0	Loam	8.3	
S1307417-025	12AS027	625-792	64.0	26.0	10.0	Sandy Loam	7.2	
S1307417-026	12AS028	173-235	50.0	38.0	12.0	Loam	10.2	
S1307417-027	12AS028	235-275	72.0	18.0	10.0	Sandy Loam	7.4	
S1307417-028	12AS028	275-325	72.0	20.0	8.0	Sandy Loam	7.0	
S1307417-029	12AS028	325-460	28.0	46.0	26.0	Loam	5.6	
S1307417-030	12AS028	460-610	54.0	32.0	14.0	Sandy Loam	4.9	
S1307417-031	12AS029	244-334	62.0	24.0	14.0	Sandy Loam	1.9	8.0
S1307417-032	12AS029	334-500	4.0	40.0	56.0	Clay	<0.1	
S1307417-033	12AS029	500-610	64.0	16.0	20.0	Sandy Clay Loam	59.6	
S1307417-034	DP-12	0-28	58.0	25.0	17.0	Sandy Loam	11.1	
S1307417-035	DP-12	28-62	50.0	35.0	15.0	Loam	2.4	
S1307417-036	DP-12	62-126	66.0	12.0	22.0	Sandy Clay Loam	23.9	
S1307417-037	DP-12	126-183	52.0	26.0	22.0	Sandy Clay Loam	<0.1	
S1307417-038	DP-12	183-244	50.0	28.0	22.0	Loam	18.4	
S1307417-039	DP-21	140-188	11.0	41.0	48.0	Silty Clay	0.9	
S1307417-040	DP-21	188-260	11.0	40.0	49.0	Silty Clay	2.2	
S1307417-041	DP-21	260-360	7.0	39.0	54.0	Clay	<0.1	

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
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Report ID: S1307417002
(Replaces S1307417001)
Date Reported: 10/15/2013
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Project: Private Lease Soils - Full List
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Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment
		cm	%	%	%		%	%
S1307417-042	DP-22	120-180	<0.1	39.0	61.0	Clay	<0.1	
S1307417-043	DP-22	180-240	5.0	39.0	56.0	Silty Clay	0.6	
S1307417-044	DP-24	22-40	15.0	41.0	44.0	Silty Clay	3.4	
S1307417-045	DP-24	40-65	15.0	39.0	46.0	Clay	4.9	
S1307417-046	DP-24	65-126	13.0	39.0	48.0	Clay	3.0	
S1307417-047	DP-24	126-244	15.0	35.0	50.0	Clay	6.7	
S1307417-048	DP-26	0-15	15.0	43.0	42.0	Silty Clay	3.9	
S1307417-049	DP-26	15-32	9.0	47.0	44.0	Silty Clay	0.9	
S1307417-050	DP-26	32-59	3.0	49.0	48.0	Silty Clay	<0.1	
S1307417-051	DP-26	59-90	1.0	51.0	48.0	Silty Clay	<0.1	
S1307417-052	DP-26	90-148	<0.1	64.0	36.0	Silty Clay Loam	<0.1	
S1307417-053	DP-26	148-230	35.0	45.0	20.0	Loam	6.8	
S1307417-054	DP-26	230-294	55.0	31.0	14.0	Sandy Loam	15.2	
S1307417-055	DP-26	294-350	69.0	23.0	8.0	Sandy Loam	10.4	

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Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1307417-001	12AS009	232-320	0.11	0.2	25.7	2.9	<0.02	3.4	0.3
S1307417-002	12AS009	320-366	0.15	0.2	25.6	3.3	<0.02	3.4	0.4
S1307417-003	12AS009	366-514	0.11	0.2	20.5	3.0	<0.02	2.7	0.2
S1307417-004	12AS018	244-318	0.09	0.8	18.3	2.6	<0.02	2.4	0.2
S1307417-006	12AS018	318-388	0.34	3.6	42.9	3.3	<0.02	6.2	1.1
S1307417-007	12AS018	406-572	0.21	1.4	37.1	2.7	<0.02	4.6	0.2
S1307417-008	12AS018	572-640	0.47	0.2	37.1	6.3	<0.02	5.3	0.9
S1307417-009	12AS018	640-732	0.30	0.2	35.1	3.4	<0.02	4.8	0.6
S1307417-010	12AS020	175-300	0.09	1.4	35.4	2.1	<0.02	4.2	<0.1
S1307417-011	12AS020	300-488	0.09	0.2	28.2	3.1	<0.02	3.8	0.4
S1307417-012	12AS020	488-600	0.06	0.1	34.8	2.7	<0.02	4.4	0.2
S1307417-013	12AS021	260-374	0.46	2.3	47.8	2.5	0.03	6.4	0.7
S1307417-014	12AS021	374-448	0.12	2.7	19.4	2.2	<0.02	2.6	0.3
S1307417-015	12AS021	448-524	0.09	2.3	31.0	2.3	<0.02	4.3	0.6
S1307417-016	12AS021	524-570	0.24	1.5	35.2	3.1	<0.02	5.4	1.2
S1307417-017	12AS021	570-660	0.37	0.2	24.6	4.5	<0.02	4.0	1.1
S1307417-018	12AS021	660-742	0.16	0.4	22.9	2.7	<0.02	2.7	<0.1
S1307417-019	12AS021	742-853	0.08	0.2	70.7	2.5	<0.02	8.3	<0.1
S1307417-020	12AS024	243-305	0.08	0.1	20.2	3.5	<0.02	2.3	<0.1
S1307417-021	12AS027	170-305	0.13	0.9	46.2	3.7	<0.02	5.9	0.3

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1307417002
(Replaces S1307417001)
Date Reported: 10/15/2013
Work Order: S1307417

Project: Private Lease Soils - Full List
Date Received: 7/30/2013

Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1307417-022	12AS027	305-427	0.11	0.6	27.2	3.6	<0.02	3.5	0.2
S1307417-023	12AS027	427-560	0.21	0.4	29.0	3.2	<0.02	3.8	0.4
S1307417-024	12AS027	560-625	0.17	0.3	26.5	3.0	<0.02	3.5	0.3
S1307417-025	12AS027	625-792	0.13	0.4	24.9	2.9	<0.02	3.2	0.2
S1307417-026	12AS028	173-235	0.07	1.7	33.2	3.2	<0.02	4.4	0.4
S1307417-027	12AS028	235-275	0.11	2.0	18.7	3.0	<0.02	2.6	0.4
S1307417-028	12AS028	275-325	0.07	1.6	21.2	3.4	<0.02	2.8	0.3
S1307417-029	12AS028	325-460	0.10	1.6	27.1	2.1	<0.02	3.7	0.5
S1307417-030	12AS028	460-610	0.09	0.2	25.3	3.6	<0.02	3.0	<0.1
S1307417-031	12AS029	244-334	0.09	0.9	25.6	3.8	<0.02	3.7	0.6
S1307417-032	12AS029	334-500	0.11	0.1	23.2	2.3	<0.02	2.8	<0.1
S1307417-033	12AS029	500-610	0.36	0.2	26.6	3.1	<0.02	3.8	0.6
S1307417-034	DP-12	0-28	0.31	3.7	2.6	1.3	<0.02	2.0	1.7
S1307417-035	DP-12	28-62	0.18	1.0	0.4	10.0	<0.02	0.8	0.7
S1307417-036	DP-12	62-126	0.12	0.6	0.4	8.2	<0.02	0.8	0.8
S1307417-037	DP-12	126-183	0.10	0.3	0.3	3.2	<0.02	0.4	0.3
S1307417-038	DP-12	183-244	0.12	0.3	11.1	2.5	<0.02	1.5	0.1
S1307417-039	DP-21	140-188	0.92	1.5	18.6	4.5	<0.02	2.9	0.6
S1307417-040	DP-21	188-260	0.68	3.8	19.3	5.5	0.03	2.9	0.6
S1307417-041	DP-21	260-360	0.75	7.3	18.7	5.3	<0.02	2.8	0.5

These results apply only to the samples tested.

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Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

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Report ID: S1307417002
(Replaces S1307417001)
Date Reported: 10/15/2013
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Project: Private Lease Soils - Full List
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Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1307417-042	DP-22	120-180	0.91	0.4	22.2	2.6	<0.02	3.1	0.4
S1307417-043	DP-22	180-240	0.89	0.5	23.0	2.0	<0.02	3.2	0.5
S1307417-044	DP-24	22-40	0.41	1.6	18.3	6.5	<0.02	3.4	1.2
S1307417-045	DP-24	40-65	0.43	2.0	18.4	6.5	<0.02	3.3	1.1
S1307417-046	DP-24	65-126	0.55	1.9	18.2	5.8	<0.02	3.2	1.0
S1307417-047	DP-24	126-244	0.87	1.7	20.9	5.8	<0.02	3.2	0.7
S1307417-048	DP-26	0-15	0.32	0.8	18.7	18.0	<0.02	4.1	1.9
S1307417-049	DP-26	15-32	0.25	3.3	25.1	8.0	<0.02	4.5	1.5
S1307417-050	DP-26	32-59	0.22	2.0	46.8	5.7	<0.02	6.6	0.9
S1307417-051	DP-26	59-90	0.24	0.8	54.4	3.8	<0.02	7.2	0.6
S1307417-052	DP-26	90-148	0.20	0.9	50.2	3.9	<0.02	6.3	0.2
S1307417-053	DP-26	148-230	0.13	2.5	43.8	3.6	<0.02	5.4	0.2
S1307417-054	DP-26	230-294	0.10	0.2	24.6	2.8	<0.02	3.2	0.3
S1307417-055	DP-26	294-350	0.08	0.2	15.3	2.9	<0.02	1.9	<0.1

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

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Suite 1
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(Replaces S1307417001)
Date Reported: 10/15/2013
Work Order: S1307417

Project: Private Lease Soils - Full List
Date Received: 7/30/2013

Lab ID	Sample ID	Depths	Total Sulfur	T.S. AB	Neutral. Potential	T.S. ABP
		cm	%	t/1000t	t/1000t	t/1000t
S1307417-001	12AS009	232-320	<0.01	<0.01	257	257
S1307417-002	12AS009	320-366	<0.01	<0.01	256	256
S1307417-003	12AS009	366-514	<0.01	<0.01	205	205
S1307417-004	12AS018	244-318	<0.01	<0.01	183	183
S1307417-006	12AS018	318-388	0.03	0.93	429	428
S1307417-007	12AS018	406-572	0.03	1.07	371	370
S1307417-008	12AS018	572-640	0.32	10.0	371	361
S1307417-009	12AS018	640-732	0.09	2.84	351	348
S1307417-010	12AS020	175-300	0.01	0.35	354	354
S1307417-011	12AS020	300-488	0.13	4.16	282	278
S1307417-012	12AS020	488-600	0.04	1.33	348	347
S1307417-013	12AS021	260-374	0.04	1.16	478	476
S1307417-014	12AS021	374-448	0.03	1.08	194	193
S1307417-015	12AS021	448-524	0.23	7.25	310	303
S1307417-016	12AS021	524-570	0.21	6.47	352	345
S1307417-017	12AS021	570-660	0.22	7.01	246	239
S1307417-018	12AS021	660-742	0.05	1.54	229	228
S1307417-019	12AS021	742-853	0.01	0.39	707	707
S1307417-020	12AS024	243-305	0.01	0.34	202	202
S1307417-021	12AS027	170-305	<0.01	<0.01	462	462

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

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Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

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(Replaces S1307417001)
Date Reported: 10/15/2013
Work Order: S1307417

Project: Private Lease Soils - Full List
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Lab ID	Sample ID	Depths cm	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t
S1307417-022	12AS027	305-427	<0.01	<0.01	272	272
S1307417-023	12AS027	427-560	<0.01	<0.01	290	290
S1307417-024	12AS027	560-625	0.01	0.33	265	264
S1307417-025	12AS027	625-792	0.01	0.36	249	248
S1307417-026	12AS028	173-235	<0.01	<0.01	332	332
S1307417-027	12AS028	235-275	<0.01	<0.01	187	187
S1307417-028	12AS028	275-325	<0.01	<0.01	212	212
S1307417-029	12AS028	325-460	0.35	10.9	271	260
S1307417-030	12AS028	460-610	0.08	2.56	253	250
S1307417-031	12AS029	244-334	0.03	1.06	256	255
S1307417-032	12AS029	334-500	0.08	2.64	232	229
S1307417-033	12AS029	500-610	0.16	5.12	266	261
S1307417-034	DP-12	0-28	0.02	0.53	26.5	26.0
S1307417-035	DP-12	28-62	<0.01	<0.01	4.04	4.04
S1307417-036	DP-12	62-126	<0.01	<0.01	3.65	3.65
S1307417-037	DP-12	126-183	<0.01	<0.01	2.73	2.73
S1307417-038	DP-12	183-244	<0.01	<0.01	111	111
S1307417-039	DP-21	140-188	0.03	1.00	186	185
S1307417-040	DP-21	188-260	0.19	5.77	193	187
S1307417-041	DP-21	260-360	0.04	1.40	187	185

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

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(Replaces S1307417001)
Date Reported: 10/15/2013
Work Order: S1307417

Project: Private Lease Soils - Full List
Date Received: 7/30/2013

Lab ID	Sample ID	Depths	Total Sulfur	T.S. AB	Neutral. Potential	T.S. ABP
		cm	%	t/1000t	t/1000t	t/1000t
S1307417-042	DP-22	120-180	1.09	34.1	222	187
S1307417-043	DP-22	180-240	0.86	26.7	230	203
S1307417-044	DP-24	22-40	0.01	0.37	183	183
S1307417-045	DP-24	40-65	<0.01	<0.01	184	184
S1307417-046	DP-24	65-126	<0.01	<0.01	182	182
S1307417-047	DP-24	126-244	0.27	8.29	209	201
S1307417-048	DP-26	0-15	0.02	0.52	187	187
S1307417-049	DP-26	15-32	0.02	0.48	251	251
S1307417-050	DP-26	32-59	0.02	0.48	468	467
S1307417-051	DP-26	59-90	0.02	0.48	544	543
S1307417-052	DP-26	90-148	<0.01	<0.01	502	502
S1307417-053	DP-26	148-230	<0.01	<0.01	438	438
S1307417-054	DP-26	230-294	<0.01	<0.01	246	246
S1307417-055	DP-26	294-350	<0.01	<0.01	153	153

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
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Karen Secor, Soil Lab Supervisor

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Lab ID	Sample ID	Depths cm	Total Arsenic mg/Kg	Total Barium mg/Kg	Total Cadmium mg/Kg	Total Chromium mg/Kg	Total Copper mg/Kg	Total Iron mg/Kg	Total Lead mg/Kg	Total Manganese mg/Kg	Total Molybdenum mg/Kg
S1307417-001	12AS009	232-320	4.2	64.1	0.46	8.85	4.89	4930	5.2	108	1.1
S1307417-002	12AS009	320-366	6.6	167	0.64	15.5	11.1	6590	10.3	156	2.3
S1307417-003	12AS009	366-514	4.4	214	0.71	12.6	6.88	9360	7.2	244	1.2
S1307417-004	12AS018	244-318	3.4	76.9	0.33	8.10	4.65	3320	5.5	118	0.8
S1307417-006	12AS018	318-388	14.3	269	1.64	32.2	16.0	24700	15.9	426	3.9
S1307417-007	12AS018	406-572	9.2	159	0.83	18.3	10.9	10600	13.2	257	2.5
S1307417-008	12AS018	572-640	6.3	161	1.03	24.1	13.0	13900	12.7	285	2.1
S1307417-009	12AS018	640-732	10.7	173	1.20	26.8	14.4	18000	13.1	337	2.7
S1307417-010	12AS020	175-300	6.2	107	0.71	23.0	11.8	7690	15.0	211	2.6
S1307417-011	12AS020	300-488	6.2	62.4	0.59	9.98	5.69	8920	5.7	151	1.2
S1307417-012	12AS020	488-600	10.0	166	1.01	19.3	11.2	14200	11.9	327	2.1
S1307417-013	12AS021	260-374	15.3	194	1.16	32.9	16.1	15100	17.4	360	3.8
S1307417-014	12AS021	374-448	5.8	84.5	0.53	10.1	6.08	6160	7.3	165	1.0
S1307417-015	12AS021	448-524	14.4	122	0.79	8.28	3.15	12000	4.9	237	1.5
S1307417-016	12AS021	524-570	8.6	100	1.16	20.5	14.2	15000	13.2	410	3.0
S1307417-017	12AS021	570-660	7.2	88.3	1.02	19.5	11.5	14800	11.4	220	1.9
S1307417-018	12AS021	660-742	10.2	106	0.55	10.2	5.31	7670	6.3	132	0.9
S1307417-019	12AS021	742-853	5.9	184	0.67	8.89	3.67	9020	8.0	416	1.3
S1307417-020	12AS024	243-305	2.3	157	0.43	8.29	4.63	5180	6.2	121	0.9
S1307417-021	12AS027	170-305	6.8	199	0.91	25.8	10.9	12200	28.5	177	<0.7

These results apply only to the samples tested.

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Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
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Report ID: S1307417002
(Replaces S1307417001)
Date Reported: 10/15/2013
Work Order: S1307417

Project: Private Lease Soils - Full List
Date Received: 7/30/2013

Lab ID	Sample ID	Depths	Total Arsenic	Total Barium	Total Cadmium	Total Chromium	Total Copper	Total Iron	Total Lead	Total Manganese	Total Molybdenum
		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
S1307417-022	12AS027	305-427	5.0	130	1.27	32.0	16.1	18700	51.1	323	<0.7
S1307417-023	12AS027	427-560	3.9	108	1.24	30.0	15.0	19000	47.6	236	<0.7
S1307417-024	12AS027	560-625	4.6	203	0.98	18.6	10.7	12400	33.4	254	<0.7
S1307417-025	12AS027	625-792	4.0	202	0.64	11.8	6.56	7330	18.1	234	<0.7
S1307417-026	12AS028	173-235	5.2	131	0.72	14.1	7.16	9060	18.0	200	<0.7
S1307417-027	12AS028	235-275	3.1	65.4	0.38	11.9	8.01	3780	13.3	107	<0.7
S1307417-028	12AS028	275-325	3.6	51.8	0.37	9.96	5.46	3100	12.6	129	<0.7
S1307417-029	12AS028	325-460	8.5	123	1.26	23.7	13.2	16800	41.9	417	0.7
S1307417-030	12AS028	460-610	10.0	262	1.02	18.8	10.7	12700	31.6	245	<0.7
S1307417-031	12AS029	244-334	4.6	101	0.55	9.09	5.15	7640	13.6	115	<0.7
S1307417-032	12AS029	334-500	9.1	178	0.79	10.7	6.33	10600	16.5	205	0.8
S1307417-033	12AS029	500-610	3.5	114	1.19	34.8	17.6	18600	56.6	302	<0.7
S1307417-034	DP-12	0-28	5.7	59.2	1.16	16.6	13.2	15600	10.7	321	0.8
S1307417-035	DP-12	28-62	2.5	33.7	0.65	12.9	8.94	11700	20.8	210	<0.7
S1307417-036	DP-12	62-126	5.2	58.0	1.23	24.4	14.9	21100	48.2	334	<0.7
S1307417-037	DP-12	126-183	6.5	37.7	1.09	22.7	6.57	20800	36.6	228	<0.7
S1307417-038	DP-12	183-244	2.9	47.2	0.83	17.9	8.78	13800	27.3	217	<0.7
S1307417-039	DP-21	140-188	6.3	117	1.47	30.9	19.1	21700	48.2	335	1.5
S1307417-040	DP-21	188-260	6.8	104	1.49	31.9	19.5	21800	57.8	320	1.7
S1307417-041	DP-21	260-360	8.9	103	1.51	30.3	19.6	22200	48.1	317	1.4

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Karen Secor, Soil Lab Supervisor

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Lab ID	Sample ID	Depths	Total Arsenic	Total Barium	Total Cadmium	Total Chromium	Total Copper	Total Iron	Total Lead	Total Manganese	Total Molybdenum
		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
S1307417-042	DP-22	120-180	6.6	56.3	0.41	18.1	15.6	15300	10.4	170	<0.7
S1307417-043	DP-22	180-240	11.3	84.7	0.89	26.8	26.6	24100	17.2	260	2.8
S1307417-044	DP-24	22-40	7.0	93.5	0.61	25.5	16.3	18300	12.8	299	<0.7
S1307417-045	DP-24	40-65	8.0	107	0.55	32.2	19.0	21400	14.9	337	<0.7
S1307417-046	DP-24	65-126	6.9	90.7	0.61	27.8	17.0	19200	13.4	320	<0.7
S1307417-047	DP-24	126-244	7.9	95.2	0.72	27.0	17.7	19700	13.7	307	<0.7
S1307417-048	DP-26	0-15	10.6	127	0.69	35.4	22.3	21800	16.2	426	<0.7
S1307417-049	DP-26	15-32	12.9	173	0.81	39.8	24.0	23300	16.8	494	<0.7
S1307417-050	DP-26	32-59	11.5	224	0.53	32.8	13.7	16600	12.5	317	<0.7
S1307417-051	DP-26	59-90	13.2	372	0.62	33.6	14.5	17300	13.1	290	<0.7
S1307417-052	DP-26	90-148	6.4	147	0.34	19.0	8.32	8260	7.8	183	<0.7
S1307417-053	DP-26	148-230	7.7	152	0.53	14.4	8.70	8990	7.7	185	<0.7
S1307417-054	DP-26	230-294	5.0	112	0.39	13.0	7.90	7010	6.1	151	<0.7
S1307417-055	DP-26	294-350	3.5	142	0.43	9.52	6.60	5070	6.3	173	<0.7

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1307417002
(Replaces S1307417001)
Date Reported: 10/15/2013
Work Order: S1307417

Project: Private Lease Soils - Full List
Date Received: 7/30/2013

Lab ID	Sample ID	Depths cm	Total Selenium mg/Kg	Total Silver mg/Kg	Total Zinc mg/Kg	Total Mercury mg/Kg	Bulk Density g/cm³
S1307417-001	12AS009	232-320	<0.96	1.1	23.6	<0.2	2.20
S1307417-002	12AS009	320-366	<0.96	1.7	44.8	<0.2	2.44
S1307417-003	12AS009	366-514	<0.96	1.0	34.9	<0.2	3.09
S1307417-004	12AS018	244-318	<0.96	1.6	22.5	<0.2	3.38
S1307417-006	12AS018	318-388	<0.96	2.0	64.8	<0.2	2.31
S1307417-007	12AS018	406-572	<0.96	1.7	44.6	<0.2	2.24
S1307417-008	12AS018	572-640	<0.96	1.5	61.8	<0.2	2.20
S1307417-009	12AS018	640-732	<0.96	1.5	68.4	<0.2	2.09
S1307417-010	12AS020	175-300	<0.96	1.1	52.7	<0.2	2.21
S1307417-011	12AS020	300-488	<0.96	1.7	30.3	<0.2	1.96
S1307417-012	12AS020	488-600	1.22	2.0	52.9	<0.2	2.11
S1307417-013	12AS021	260-374	<0.96	1.8	68.3	<0.2	2.07
S1307417-014	12AS021	374-448	<0.96	2.0	33.8	<0.2	2.63
S1307417-015	12AS021	448-524	<0.96	1.9	24.1	<0.2	
S1307417-016	12AS021	524-570	<0.96	2.0	59.6	<0.2	2.50
S1307417-017	12AS021	570-660	<0.96	1.1	56.0	<0.2	2.26
S1307417-018	12AS021	660-742	<0.96	1.4	32.7	<0.2	2.28
S1307417-019	12AS021	742-853	<0.96	3.7	24.6	<0.2	
S1307417-020	12AS024	243-305	<0.96	1.3	24.2	<0.2	2.28
S1307417-021	12AS027	170-305	<0.96	<0.5	44.7	<0.2	2.05

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
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Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
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Report ID: S1307417002
(Replaces S1307417001)
Date Reported: 10/15/2013
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Project: Private Lease Soils - Full List
Date Received: 7/30/2013

Lab ID	Sample ID	Depths cm	Total Selenium mg/Kg	Total Silver mg/Kg	Total Zinc mg/Kg	Total Mercury mg/Kg	Bulk Density g/cm³
S1307417-022	12AS027	305-427	1.20	0.8	74.5	<0.2	2.12
S1307417-023	12AS027	427-560	1.29	0.8	67.7	<0.2	2.19
S1307417-024	12AS027	560-625	1.46	0.6	53.0	<0.2	2.24
S1307417-025	12AS027	625-792	1.21	1.0	27.6	<0.2	2.46
S1307417-026	12AS028	173-235	<0.96	0.8	30.2	<0.2	2.46
S1307417-027	12AS028	235-275	1.57	0.5	34.1	<0.2	3.16
S1307417-028	12AS028	275-325	<0.96	1.2	27.6	<0.2	2.18
S1307417-029	12AS028	325-460	1.53	0.6	60.6	<0.2	2.26
S1307417-030	12AS028	460-610	1.37	0.9	46.7	<0.2	2.40
S1307417-031	12AS029	244-334	1.12	<0.5	26.3	<0.2	2.35
S1307417-032	12AS029	334-500	<0.96	0.8	33.0	<0.2	2.43
S1307417-033	12AS029	500-610	1.22	<0.5	80.1	<0.2	2.28
S1307417-034	DP-12	0-28	<0.96	<0.5	62.1	<0.2	
S1307417-035	DP-12	28-62	<0.96	<0.5	38.9	<0.2	
S1307417-036	DP-12	62-126	<0.96	<0.5	71.4	<0.2	
S1307417-037	DP-12	126-183	<0.96	<0.5	63.3	<0.2	2.51
S1307417-038	DP-12	183-244	<0.96	<0.5	39.0	<0.2	2.10
S1307417-039	DP-21	140-188	<0.96	0.8	80.8	<0.2	2.09
S1307417-040	DP-21	188-260	<0.96	<0.5	82.1	<0.2	2.08
S1307417-041	DP-21	260-360	<0.96	<0.5	84.2	<0.2	2.05

These results apply only to the samples tested.

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Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
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Report ID: S1307417002
(Replaces S1307417001)
Date Reported: 10/15/2013
Work Order: S1307417

Project: Private Lease Soils - Full List
Date Received: 7/30/2013

Lab ID	Sample ID	Depths cm	Total Selenium mg/Kg	Total Silver mg/Kg	Total Zinc mg/Kg	Total Mercury mg/Kg	Bulk Density g/cm³
S1307417-042	DP-22	120-180	<0.96	<0.5	59.2	<0.2	2.24
S1307417-043	DP-22	180-240	<0.96	<0.5	94.6	<0.2	2.20
S1307417-044	DP-24	22-40	<0.96	<0.5	70.1	<0.2	2.61
S1307417-045	DP-24	40-65	<0.96	<0.5	80.0	<0.2	2.51
S1307417-046	DP-24	65-126	<0.96	<0.5	71.2	<0.2	2.30
S1307417-047	DP-24	126-244	<0.96	<0.5	73.8	<0.2	2.62
S1307417-048	DP-26	0-15	<0.96	<0.5	95.5	<0.2	2.84
S1307417-049	DP-26	15-32	<0.96	<0.5	105	<0.2	3.34
S1307417-050	DP-26	32-59	<0.96	<0.5	63.1	<0.2	3.69
S1307417-051	DP-26	59-90	<0.96	<0.5	52.3	<0.2	
S1307417-052	DP-26	90-148	<0.96	<0.5	31.9	<0.2	
S1307417-053	DP-26	148-230	<0.96	<0.5	33.6	<0.2	2.64
S1307417-054	DP-26	230-294	<0.96	<0.5	33.2	<0.2	2.74
S1307417-055	DP-26	294-350	<0.96	<0.5	34.9	<0.2	2.55

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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Date: 5/28/2013

CLIENT: Alton Coal Development, LLC
Project: Private Lease Soils - Short List
Lab Order: S1304178

CASE NARRATIVE

Report ID: S1304178001

Samples DP-04, DP-05, DP-16, and DP-28 were received on April 11, 2013.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1304178001

Project: Private Lease Soils - Short List
Date Received: 4/11/2013

Date Reported: 5/28/2013
Work Order: S1304178

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1304178-001	DP-16	0-18	7.7	54.4	0.84	8.5	35.6	22.0	2.9
S1304178-002	DP-16	18-43	7.9	59.7	0.48	11.9	35.0	25.8	1.8
S1304178-003	DP-16	43-70	7.9	58.7	0.50	12.2	35.3	29.8	2.1
S1304178-004	DP-16	70-102	8.1	63.1	0.36	15.2	37.1	31.8	2.9
S1304178-005	DP-28	0-14	7.7	61.1	0.80	12.4	34.6	28.5	3.6
S1304178-006	DP-28	14-38	8.1	64.3	0.58	13.9	36.4	28.2	2.3
S1304178-007	DP-28	38-62	8.0	66.9	0.44	13.4	36.8	31.0	1.7
S1304178-008	DP-28	62-100	7.9	53.3	0.46	12.2	31.6	25.2	2.0
S1304178-009	DP-28	100-120	8.0	59.1	0.43	11.6	34.1	26.9	2.3
S1304178-010	DP-28	120-140	8.2	68.5	0.45	6.6	36.0	28.3	1.7
S1304178-011	DP-04	0-20	7.7	46.5	0.76	6.6	30.6	18.1	2.7
S1304178-012	DP-04	20-46	7.8	48.1	0.41	7.3	28.1	20.1	2.3
S1304178-013	DP-04	46-90	7.9	47.4	0.38	10.1	28.6	20.6	2.4
S1304178-014	DP-04	90-153	8.1	41.2	0.39	8.4	26.0	17.8	2.3
S1304178-015	DP-04	153-232	8.4	25.6	0.37	5.0	19.7	8.8	0.9
S1304178-016	DP-05	0-35	7.8	48.3	0.65	9.6	31.0	23.4	2.6
S1304178-017	DP-05	35-70	7.8	51.7	0.39	11.0	32.3	25.1	2.5
S1304178-018	DP-05	70-162	8.2	62.2	1.01	11.3	34.3	28.1	1.8

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

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Report ID: S1304178001

Project: Private Lease Soils - Short List

Date Received: 4/11/2013

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Work Order: S1304178

Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1304178-001	DP-16	0-18	5.38	1.28	0.26	0.41	0.23
S1304178-002	DP-16	18-43	3.17	1.07	0.12	0.84	0.58
S1304178-003	DP-16	43-70	1.67	0.85	0.09	1.80	1.61
S1304178-004	DP-16	70-102	1.55	0.96	0.13	1.26	1.12
S1304178-005	DP-28	0-14	4.63	2.71	0.41	0.69	0.36
S1304178-006	DP-28	14-38	2.76	2.26	0.21	0.83	0.53
S1304178-007	DP-28	38-62	2.21	1.74	0.10	0.54	0.38
S1304178-008	DP-28	62-100	2.04	1.95	0.13	0.66	0.47
S1304178-009	DP-28	100-120	1.64	1.80	0.08	0.89	0.68
S1304178-010	DP-28	120-140	1.83	1.82	0.11	1.41	1.05
S1304178-011	DP-04	0-20	4.94	1.70	0.48	0.18	0.10
S1304178-012	DP-04	20-46	2.56	1.35	0.15	0.24	0.17
S1304178-013	DP-04	46-90	1.91	1.79	0.09	0.28	0.21
S1304178-014	DP-04	90-153	1.84	1.99	0.11	0.26	0.19
S1304178-015	DP-04	153-232	1.65	1.69	0.10	0.27	0.21
S1304178-016	DP-05	0-35	4.20	1.06	0.34	0.16	0.10
S1304178-017	DP-05	35-70	2.62	0.88	0.15	0.32	0.24
S1304178-018	DP-05	70-162	2.58	2.20	0.12	3.72	2.41

These results apply only to the samples tested.

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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
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Report ID: S1304178001

Project: Private Lease Soils - Short List

Date Received: 4/11/2013

Date Reported: 5/28/2013

Work Order: S1304178

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment
		cm	%	%	%		%	%
S1304178-001	DP-16	0-18	36.0	28.0	36.0	Clay Loam	18.2	
S1304178-002	DP-16	18-43	24.0	32.0	44.0	Clay	13.4	
S1304178-003	DP-16	43-70	18.0	36.0	46.0	Clay	9.0	
S1304178-004	DP-16	70-102	22.0	30.0	48.0	Clay	14.4	
S1304178-005	DP-28	0-14	20.0	34.0	46.0	Clay	10.3	
S1304178-006	DP-28	14-38	10.0	38.0	52.0	Clay	5.0	
S1304178-007	DP-28	38-62	10.0	35.0	55.0	Silty Clay	5.8	
S1304178-008	DP-28	62-100	20.0	44.0	36.0	Clay Loam	10.6	
S1304178-009	DP-28	100-120	12.0	44.0	44.0	Silty Clay	1.1	
S1304178-010	DP-28	120-140	14.0	34.0	52.0	Clay	4.6	
S1304178-011	DP-04	0-20	30.0	42.0	28.0	Clay Loam	6.6	
S1304178-012	DP-04	20-46	30.0	38.0	32.0	Clay Loam	10.3	
S1304178-013	DP-04	46-90	36.0	32.0	32.0	Clay Loam	12.3	
S1304178-014	DP-04	90-153	38.0	34.0	28.0	Clay Loam	8.0	5.9
S1304178-015	DP-04	153-232	66.0	24.0	10.0	Sandy Loam	11.0	4.2
S1304178-016	DP-05	0-35	20.0	42.0	38.0	Clay Loam	8.4	
S1304178-017	DP-05	35-70	18.0	39.0	43.0	Clay	9.5	
S1304178-018	DP-05	70-162	16.0	39.0	45.0	Clay	9.1	

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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

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Work Order: S1304178

Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1304178-001	DP-16	0-18	0.64	24.1	12.1	4.9	<0.02	2.8	1.4
S1304178-002	DP-16	18-43	0.37	2.5	15.6	4.0	<0.02	2.5	0.7
S1304178-003	DP-16	43-70	0.49	6.8	14.2	4.1	<0.02	2.4	0.7
S1304178-004	DP-16	70-102	0.82	8.3	14.6	5.3	<0.02	2.3	0.5
S1304178-005	DP-28	0-14	0.57	12.2	17.3	15.1	<0.02	3.2	1.2
S1304178-006	DP-28	14-38	0.35	7.6	24.5	5.8	<0.02	3.5	0.6
S1304178-007	DP-28	38-62	0.55	5.5	25.2	5.3	<0.02	3.5	0.4
S1304178-008	DP-28	62-100	0.72	8.1	29.2	5.9	<0.02	4.0	0.5
S1304178-009	DP-28	100-120	0.38	7.3	29.4	6.1	<0.02	3.9	0.4
S1304178-010	DP-28	120-140	0.26	1.7	33.3	3.5	<0.02	4.0	<0.1
S1304178-011	DP-04	0-20	0.48	21.8	20.0	13.6	<0.02	3.4	1.0
S1304178-012	DP-04	20-46	0.53	8.6	24.4	5.9	<0.02	3.8	0.9
S1304178-013	DP-04	46-90	0.67	7.2	9.1	6.0	<0.02	2.0	0.9
S1304178-014	DP-04	90-153	0.34	2.6	22.5	5.1	<0.02	3.3	0.6
S1304178-015	DP-04	153-232	0.15	0.4	42.4	3.5	<0.02	4.7	<0.1
S1304178-016	DP-05	0-35	0.38	15.2	20.8	10.8	<0.02	3.4	0.9
S1304178-017	DP-05	35-70	0.38	6.8	22.7	5.5	<0.02	3.5	0.7
S1304178-018	DP-05	70-162	0.78	0.5	25.9	4.5	0.04	3.6	0.4

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Date: 5/29/2013

CLIENT: Alton Coal Development, LLC
Project: Private Lease Soils - Limited List
Lab Order: S1304179

CASE NARRATIVE

Report ID: S1304179001

Samples DP-02, DP-03, DP-06, DP-09, DP-11, DP-13, DP-15, and DP-18 were received on April 11, 2013.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1304179001

Project: Private Lease Soils - Limited List
Date Received: 4/11/2013

Date Reported: 5/29/2013
Work Order: S1304179

Lab ID	Sample ID	Depths	pH	Electrical Conductivity	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	s.u.	dS/m	meq/L	meq/L	meq/L	meq/L	
S1304179-004	DP-18	0-18	6.9	1.01	6.90	1.94	0.56	0.10	0.05
S1304179-005	DP-18	18-44	6.9	0.39	2.87	1.02	0.29	0.11	0.08
S1304179-006	DP-18	44-68	7.0	0.74	4.56	2.39	0.27	0.19	0.10
S1304179-007	DP-18	68-144	7.0	0.43	2.88	1.50	0.19	0.24	0.16
S1304179-008	DP-18	144-184	7.2	0.35	2.21	1.16	0.13	0.20	0.16
S1304179-009	DP-18	184-240	7.3	0.28	1.90	0.91	0.11	0.16	0.14
S1304179-010	DP-02	0-13	7.0	4.09	25.7	7.25	4.55	0.40	0.10
S1304179-011	DP-02	13-35	7.3	0.44	3.05	1.24	0.39	0.11	0.07
S1304179-012	DP-02	35-68	7.3	0.47	2.84	2.12	0.16	0.14	0.09
S1304179-013	DP-02	68-92	7.4	0.45	2.46	2.22	0.09	0.36	0.24
S1304179-014	DP-02	92-170	7.3	0.40	1.99	1.87	0.11	0.41	0.29
S1304179-015	DP-02	170-220	7.4	1.26	5.84	4.65	0.14	2.51	1.10
S1304179-016	DP-02	220-261	7.5	1.77	8.25	7.45	0.26	2.95	1.05
S1304179-017	DP-02	261-412	7.7	1.13	4.52	4.47	0.23	2.34	1.10
S1304179-018	DP-03	0-24	7.2	0.57	3.95	0.96	0.28	0.14	0.09
S1304179-019	DP-03	24-47	7.7	0.38	2.52	0.92	0.15	0.26	0.20
S1304179-020	DP-03	47-87	7.6	0.32	1.88	1.16	0.08	0.63	0.51
S1304179-021	DP-03	87-137	7.9	0.64	1.54	2.07	0.10	2.86	2.13
S1304179-022	DP-06	0-18	7.3	0.63	4.72	1.07	0.74	0.16	0.09
S1304179-023	DP-06	18-35	7.3	0.40	3.20	0.83	0.37	0.14	0.10

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1304179001

Project: Private Lease Soils - Limited List
Date Received: 4/11/2013

Date Reported: 5/29/2013
Work Order: S1304179

Lab ID	Sample ID	Depths	pH	Electrical Conductivity	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	s.u.	dS/m	meq/L	meq/L	meq/L	meq/L	
S1304179-024	DP-06	35-75	7.5	0.33	2.69	0.76	0.18	0.17	0.13
S1304179-025	DP-06	75-145	7.5	0.31	2.29	0.72	0.14	0.21	0.17
S1304179-026	DP-06	145-187	7.7	0.30	2.05	0.73	0.15	0.28	0.24
S1304179-027	DP-06	187-230	7.9	0.34	1.84	1.18	0.18	0.39	0.31
S1304179-028	DP-09	0-38	7.3	0.83	5.58	1.24	0.37	0.59	0.32
S1304179-029	DP-09	38-68	7.7	0.54	1.96	0.99	0.07	2.77	2.28
S1304179-030	DP-09	68-166	7.6	1.54	3.29	2.02	0.22	9.07	5.57
S1304179-031	DP-09	166-194	7.8	6.01	19.1	24.0	0.30	32.7	7.05
S1304179-032	DP-09	194-244	7.8	6.15	19.9	23.6	0.32	31.4	6.73
S1304179-033	DP-11	0-27	7.3	1.15	5.58	3.08	1.27	0.32	0.15
S1304179-034	DP-11	27-60	7.5	0.38	2.24	1.40	0.19	0.17	0.13
S1304179-035	DP-11	60-138	7.6	0.64	2.75	3.80	0.17	0.27	0.15
S1304179-036	DP-11	138-169	7.7	0.36	1.64	1.97	0.13	0.20	0.15
S1304179-037	DP-11	169-243	7.8	0.32	1.23	1.92	0.09	0.20	0.16
S1304179-038	DP-13	15-54	7.1	0.54	4.12	1.16	0.22	0.28	0.17
S1304179-039	DP-13	54-88	7.5	0.34	2.30	1.10	0.15	0.22	0.17
S1304179-040	DP-15	0-24	7.0	0.84	6.78	1.35	0.49	0.13	0.06
S1304179-041	DP-15	24-56	7.3	0.43	3.60	0.89	0.27	0.12	0.08
S1304179-042	DP-15	56-152	7.4	0.32	2.43	0.72	0.21	0.11	0.09
S1304179-043	DP-15	152-207	7.5	0.31	2.15	0.94	0.16	0.17	0.14

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1304179001

Project: Private Lease Soils - Limited List
Date Received: 4/11/2013

Date Reported: 5/29/2013
Work Order: S1304179

Lab ID	Sample ID	Depths	pH	Electrical Conductivity	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	s.u.	dS/m	meq/L	meq/L	meq/L	meq/L	
S1304179-001	DP-15	207-250	7.4	0.32	2.03	1.66	0.14	0.23	0.17
S1304179-002	DP-15	250-280	7.5	0.51	1.73	2.99	0.18	0.28	0.18
S1304179-003	DP-15	280-362	7.5	0.60	1.67	4.00	0.15	0.50	0.30

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1304179001

Project: Private Lease Soils - Limited List
Date Received: 4/11/2013

Date Reported: 5/29/2013
Work Order: S1304179

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment	Boron	CO3	Selenium
		cm	%	%	%		%	%	ppm	%	ppm
S1304179-004	DP-18	0-18	30.0	36.0	34.0	Clay Loam	11.9			17.8	
S1304179-005	DP-18	18-44	40.0	31.0	29.0	Clay Loam	10.2			23.1	
S1304179-006	DP-18	44-68	22.0	42.0	36.0	Clay Loam	3.1		0.33	20.3	<0.02
S1304179-007	DP-18	68-144	30.0	41.0	29.0	Clay Loam	1.9		0.26	35.9	<0.02
S1304179-008	DP-18	144-184	36.0	44.0	20.0	Loam	6.7		0.14	43.1	<0.02
S1304179-009	DP-18	184-240	78.0	14.0	8.0	Loamy Sand	7.4		0.08	17.3	<0.02
S1304179-010	DP-02	0-13	44.0	32.0	24.0	Loam	9.4		0.28	21.2	<0.02
S1304179-011	DP-02	13-35	40.0	37.0	23.0	Loam	5.7		0.24	22.0	<0.02
S1304179-012	DP-02	35-68	30.0	40.0	30.0	Clay Loam	4.5		0.28	24.7	<0.02
S1304179-013	DP-02	68-92	24.0	36.0	40.0	Clay	8.8		0.44	18.1	<0.02
S1304179-014	DP-02	92-170	26.0	28.0	46.0	Clay	12.5		0.38	17.6	<0.02
S1304179-015	DP-02	170-220	22.0	46.0	32.0	Clay Loam	1.8		0.36	47.8	<0.02
S1304179-016	DP-02	220-261	78.0	12.0	10.0	Sandy Loam	9.8		0.14	19.3	<0.02
S1304179-017	DP-02	261-412	70.0	22.0	8.0	Sandy Loam	12.4		0.11	25.0	<0.02
S1304179-018	DP-03	0-24	10.0	42.0	48.0	Silty Clay	4.0		0.49	28.9	<0.02
S1304179-019	DP-03	24-47	10.0	39.0	51.0	Clay	6.2		0.32	33.4	<0.02
S1304179-020	DP-03	47-87	4.0	42.0	54.0	Silty Clay	0.4		0.30	29.8	<0.02
S1304179-021	DP-03	87-137	6.0	45.0	49.0	Silty Clay	2.4		0.73	31.7	<0.02
S1304179-022	DP-06	0-18	28.0	39.0	33.0	Clay Loam	5.6		0.54	19.8	<0.02
S1304179-023	DP-06	18-35	28.0	36.0	36.0	Clay Loam	6.8		0.32	19.6	<0.02

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1304179001

Project: Private Lease Soils - Limited List
Date Received: 4/11/2013

Date Reported: 5/29/2013
Work Order: S1304179

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment	Boron	CO3	Selenium
		cm	%	%	%		%	%	ppm	%	ppm
S1304179-024	DP-06	35-75	20.0	40.0	40.0	Silty Clay	9.3		0.27	19.7	<0.02
S1304179-025	DP-06	75-145	24.0	38.0	38.0	Clay Loam	8.4		0.39	24.1	<0.02
S1304179-026	DP-06	145-187	64.0	22.0	14.0	Sandy Loam	7.3	4.3	0.21	27.0	<0.02
S1304179-027	DP-06	187-230	84.0	10.0	6.0	Loamy Sand	3.9	40.6	0.10	52.2	<0.02
S1304179-028	DP-09	0-38	20.0	33.0	47.0	Clay	9.5		0.40	20.9	<0.02
S1304179-029	DP-09	38-68	12.0	36.0	52.0	Clay	4.3		0.45	22.2	<0.02
S1304179-030	DP-09	68-166	10.0	38.0	52.0	Clay	1.9		0.71	22.2	<0.02
S1304179-031	DP-09	166-194	10.0	36.0	54.0	Clay	2.3		1.16	23.1	0.11
S1304179-032	DP-09	194-244	14.0	34.0	52.0	Clay	4.4	0.5	1.09	23.7	0.07
S1304179-033	DP-11	0-27	50.0	28.0	22.0	Loam	12.2		0.39	4.9	<0.02
S1304179-034	DP-11	27-60	50.0	26.0	24.0	Sandy Clay Loam	8.2		0.32	13.0	<0.02
S1304179-035	DP-11	60-138	64.0	20.0	16.0	Sandy Loam	12.8	0.5	0.27	33.5	<0.02
S1304179-036	DP-11	138-169	60.0	22.0	18.0	Sandy Loam	10.3		0.19	10.7	<0.02
S1304179-037	DP-11	169-243	68.0	14.0	18.0	Sandy Loam	5.9		0.18	11.6	<0.02
S1304179-038	DP-13	15-54	48.0	24.0	28.0	Sandy Clay Loam	11.3	2.4	0.38	17.9	<0.02
S1304179-039	DP-13	54-88	48.0	21.0	31.0	Sandy Clay Loam	16.4	5.3		15.8	
S1304179-040	DP-15	0-24	44.0	26.0	30.0	Clay Loam	19.5			8.5	
S1304179-041	DP-15	24-56	38.0	28.0	34.0	Clay Loam	12.4			8.4	
S1304179-042	DP-15	56-152	36.0	30.0	34.0	Clay Loam	10.8		0.33	10.9	<0.02
S1304179-043	DP-15	152-207	22.0	38.0	40.0	Clay	9.1		0.40	18.5	<0.02

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1304179001

Project: Private Lease Soils - Limited List

Date Received: 4/11/2013

Date Reported: 5/29/2013

Work Order: S1304179

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment	Boron	CO3	Selenium
		cm	%	%	%		%	%	ppm	%	ppm
S1304179-001	DP-15	207-250	26.0	47.0	27.0	Clay Loam	9.0		0.25	43.9	<0.02
S1304179-002	DP-15	250-280	36.0	34.0	30.0	Clay Loam	16.9		0.30	25.8	<0.02
S1304179-003	DP-15	280-362	42.0	33.0	25.0	Loam	10.9		0.24	21.8	<0.02

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Date: 10/11/2013

CLIENT: Alton Coal Development, LLC
Project: Private Lease Soils - Short List
Lab Order: S1307425

CASE NARRATIVE

Report ID: S1307425001

Samples 12AS009, 12AS018, DP-21, DP-22, DP-25, and DP-27 were received on July 30, 2013.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1307425001

Project: Private Lease Soils - Short List
Date Received: 7/30/2013

Date Reported: 10/11/2013
Work Order: S1307425

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1307425-001	12AS009	514-610	8.6	38.9	0.44	4.9			1.2
S1307425-002	12AS018	388-406	8.1	30.1	1.73	7.1	14.3	6.4	0.9
S1307425-003	DP-21	0-33	7.8	58.8	0.45	8.5			4.0
S1307425-004	DP-21	33-140	7.9	61.9	0.41	10.1	33.3	24.7	2.6
S1307425-005	DP-22	0-28	8.0		0.65	10.9			3.3
S1307425-006	DP-22	28-50	8.0		3.60	14.9			2.2
S1307425-007	DP-22	50-120	8.4	126	6.68	16.0			1.8
S1307425-008	DP-25	0-16	7.7	59.2	0.83	8.2	35.3	23.9	6.2
S1307425-009	DP-25	16-28	7.8	59.1	0.48	10.2	34.8	25.7	4.0
S1307425-010	DP-25	28-54	7.8	63.7	0.49	11.7	35.1	27.8	3.3
S1307425-011	DP-25	54-75	7.8	57.0	0.49	11.0	31.7	25.6	3.7
S1307425-012	DP-25	75-144	8.0	44.3	0.44	7.6	25.8	18.3	2.0
S1307425-013	DP-25	144-208	8.6	27.6	0.35	3.1	16.2	8.2	1.0
S1307425-014	DP-27	0-22	7.7	55.5	0.63	9.2	33.1	23.7	5.3
S1307425-015	DP-27	22-40	7.8	58.2	0.32	12.2	33.9	27.9	3.9
S1307425-016	DP-27	40-80	7.8	56.1	0.40	10.7	36.3	25.7	4.1
S1307425-017	DP-27	80-152	8.0	59.0	0.39	10.4	32.8	26.7	2.4
S1307425-018	DP-27	152-224	8.5	48.9	0.31	8.3	26.7	21.6	1.1
S1307425-019	DP-27	224-310	8.7	57.0	0.43	9.4			1.2
S1307425-020	DP-27	310-350	8.6	54.9	0.59	10.3	28.2	19.5	1.6

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1307425001

Project: Private Lease Soils - Short List
Date Received: 7/30/2013

Date Reported: 10/11/2013
Work Order: S1307425

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1307425-021	DP-27	350-396	8.3	44.2	1.35	10.5	24.7	19.0	1.2
S1307425-022	DP-27	396-488	8.4	78.9	3.38	16.0	39.8	28.1	1.6

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These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Appendix C

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1307425001

Project: Private Lease Soils - Short List
Date Received: 7/30/2013

Date Reported: 10/11/2013
Work Order: S1307425

Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1307425-001	12AS009	514-610	1.07	3.29	0.15	0.49	0.33
S1307425-002	12AS018	388-406	7.55	13.5	0.22	2.42	0.75
S1307425-003	DP-21	0-33	3.44	1.07	0.52	0.19	0.12
S1307425-004	DP-21	33-140	2.50	1.34	0.27	0.43	0.31
S1307425-005	DP-22	0-28	3.09	2.24	0.17	2.02	1.24
S1307425-006	DP-22	28-50	20.8	21.3	0.23	15.2	3.31
S1307425-007	DP-22	50-120	23.8	64.2	0.38	42.0	6.34
S1307425-008	DP-25	0-16	6.52	1.80	0.63	0.30	0.15
S1307425-009	DP-25	16-28	4.08	1.06	0.40	0.13	0.08
S1307425-010	DP-25	28-54	3.79	1.03	0.35	0.17	0.11
S1307425-011	DP-25	54-75	3.92	1.13	0.30	0.20	0.13
S1307425-012	DP-25	75-144	3.27	1.11	0.20	0.33	0.22
S1307425-013	DP-25	144-208	2.17	1.33	0.15	0.19	0.15
S1307425-014	DP-27	0-22	5.41	1.13	0.59	0.12	0.06
S1307425-015	DP-27	22-40	2.56	0.81	0.20	0.13	0.10
S1307425-016	DP-27	40-80	3.03	1.02	0.26	0.18	0.13
S1307425-017	DP-27	80-152	2.65	1.07	0.16	0.15	0.11
S1307425-018	DP-27	152-224	1.51	1.45	0.11	0.31	0.26
S1307425-019	DP-27	224-310	1.16	2.55	0.10	0.68	0.50
S1307425-020	DP-27	310-350	1.45	4.04	0.17	1.65	0.99

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1307425001

Project: Private Lease Soils - Short List

Date Received: 7/30/2013

Date Reported: 10/11/2013

Work Order: S1307425

Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1307425-021	DP-27	350-396	3.15	8.40	0.29	4.13	1.72
S1307425-022	DP-27	396-488	5.76	34.7	0.43	12.9	2.88

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
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Report ID: S1307425001

Project: Private Lease Soils - Short List

Date Received: 7/30/2013

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Work Order: S1307425

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment
		cm	%	%	%		%	%
S1307425-001	12AS009	514-610	35.0	50.0	15.0	Silty Loam	16.5	
S1307425-002	12AS018	388-406	73.8	15.0	11.3	Sandy Loam	6.8	
S1307425-003	DP-21	0-33	23.8	37.5	38.8	Clay Loam	6.5	
S1307425-004	DP-21	33-140	26.3	35.0	38.8	Clay Loam	12.5	<0.1
S1307425-005	DP-22	0-28	7.5	40.0	52.5	Silty Clay	<0.1	
S1307425-006	DP-22	28-50	8.8	33.8	57.5	Silty Clay	1.5	
S1307425-007	DP-22	50-120	2.5	50.0	47.5	Silty Clay	<0.1	
S1307425-008	DP-25	0-16	18.8	41.3	40.0	Silty Clay	5.7	
S1307425-009	DP-25	16-28	15.0	41.3	43.8	Silty Clay	2.5	
S1307425-010	DP-25	28-54	11.3	41.3	47.5	Silty Clay	1.6	
S1307425-011	DP-25	54-75	18.8	38.8	42.5	Clay	<0.1	7.4
S1307425-012	DP-25	75-144	36.3	31.3	32.5	Clay Loam	3.2	13.8
S1307425-013	DP-25	144-208	72.5	15.0	12.5	Sandy Loam	4.0	41.0
S1307425-014	DP-27	0-22	13.8	43.8	42.5	Silty Clay	2.2	
S1307425-015	DP-27	22-40	3.8	47.5	48.8	Silty Clay	<0.1	
S1307425-016	DP-27	40-80	8.8	46.3	45.0	Silty Clay	1.3	
S1307425-017	DP-27	80-152	<0.1	52.5	47.5	Silty Clay	<0.1	
S1307425-018	DP-27	152-224	6.3	58.8	35.0	Silty Clay Loam	<0.1	
S1307425-019	DP-27	224-310	6.3	61.3	32.5	Silty Clay Loam	<0.1	
S1307425-020	DP-27	310-350	32.5	35.0	32.5	Clay Loam	7.1	

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1307425001

Project: Private Lease Soils - Short List
Date Received: 7/30/2013

Date Reported: 10/11/2013
Work Order: S1307425

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment
		cm	%	%	%		%	%
S1307425-021	DP-27	350-396	46.3	31.3	22.5	Loam	4.8	
S1307425-022	DP-27	396-488	7.5	25.0	67.5	Clay	2.6	

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These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Appendix C

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1307425001

Project: Private Lease Soils - Short List
Date Received: 7/30/2013

Date Reported: 10/11/2013
Work Order: S1307425

Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1307425-001	12AS009	514-610	0.21	0.2	25.0	1.9	<0.02	3.1	0.1
S1307425-002	12AS018	388-406	0.11	0.9	20.0	1.8	<0.02	2.8	0.4
S1307425-003	DP-21	0-33	0.41	4.2	13.0	14.8	<0.02	2.9	1.3
S1307425-004	DP-21	33-140	0.40	1.6	15.0	4.9	<0.02	2.7	0.9
S1307425-005	DP-22	0-28	0.69	7.5	16.0	9.4	<0.02	2.8	0.9
S1307425-006	DP-22	28-50	0.80	4.5	14.2	3.2	<0.02	2.3	0.6
S1307425-007	DP-22	50-120	0.90	2.9	16.6	3.3	<0.02	2.4	0.4
S1307425-008	DP-25	0-16	0.23	7.7	18.2	16.5	<0.02	3.9	1.7
S1307425-009	DP-25	16-28	0.32	5.5	16.1	6.2	<0.02	3.3	1.3
S1307425-010	DP-25	28-54	0.38	4.3	16.1	6.7	<0.02	3.3	1.4
S1307425-011	DP-25	54-75	0.28	1.9	19.6	6.3	<0.02	3.5	1.2
S1307425-012	DP-25	75-144	0.25	0.9	27.1	4.5	<0.02	4.3	1.0
S1307425-013	DP-25	144-208	0.12	0.4	51.8	4.7	<0.02	6.7	0.5
S1307425-014	DP-27	0-22	0.33	9.7	17.8	14.8	<0.02	3.9	1.8
S1307425-015	DP-27	22-40	0.42	2.1	17.0	6.8	<0.02	3.5	1.5
S1307425-016	DP-27	40-80	0.37	2.5	18.9	6.9	<0.02	3.9	1.6
S1307425-017	DP-27	80-152	0.27	3.0	38.1	5.5	<0.02	5.4	0.9
S1307425-018	DP-27	152-224	0.15	0.6	53.4	2.3	<0.02	5.8	<0.1
S1307425-019	DP-27	224-310	0.27	0.3	57.1	2.8	<0.02	7.0	0.1
S1307425-020	DP-27	310-350	0.45	0.4	22.9	2.7	<0.02	2.9	0.2

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
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Report ID: S1307425001

Project: Private Lease Soils - Short List

Date Received: 7/30/2013

Date Reported: 10/11/2013

Work Order: S1307425

Lab ID	Sample ID	Depths	Boron	Nitrate (as N)	CO3	Phosphorus	Selenium	Total Carbon	TOC
		cm	ppm	ppm	%	ppm	ppm	%	%
S1307425-021	DP-27	350-396	0.36	1.3	35.0	4.1	<0.02	4.5	0.3
S1307425-022	DP-27	396-488	0.45	0.5	22.9	1.8	<0.02	3.2	0.4

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Date: 10/4/2013

CLIENT: Alton Coal Development, LLC
Project: Private Lease Soils - Limited List
Lab Order: S1307426

CASE NARRATIVE

Report ID: S1307426001

Samples 12AS020, DP-20, DP-23, DP-24, DP-25, and DP-26 were received on July 30, 2013.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Your Environmental Monitoring Partner

Soil Analysis Report

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Report ID: S1307426001

Project: Private Lease Soils - Limited List

Date Received: 7/30/2013

Date Reported: 10/4/2013

Work Order: S1307426

Lab ID	Sample ID	Depths	pH	Electrical Conductivity	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	s.u.	dS/m	meq/L	meq/L	meq/L	meq/L	
S1307426-001	12AS020	600-610	7.9	1.86	12.4	14.3	0.29	1.09	0.30
S1307426-002	DP-20	0-38	7.7	0.95	7.06	2.99	0.56	0.16	0.07
S1307426-004	DP-20	38-55	8.0	0.52	3.47	2.13	0.18	0.43	0.26
S1307426-005	DP-20	122-170	8.0	2.76	15.4	20.2	0.36	8.49	2.01
S1307426-006	DP-20	170-240	8.2	3.90	19.9	39.0	0.21	13.0	2.39
S1307426-008	DP-20	240-310	8.4	1.69	3.32	12.1	0.14	6.74	2.43
S1307426-009	DP-20	310-366	8.4	1.84	3.57	12.2	0.13	6.95	2.48
S1307426-010	DP-23	0-30	7.8	0.87	7.04	2.31	0.60	0.41	0.19
S1307426-011	DP-23	30-57	7.9	0.35	2.90	1.40	0.22	0.20	0.14
S1307426-012	DP-23	57-80	7.8	0.47	3.21	1.70	0.23	0.39	0.25
S1307426-013	DP-23	80-122	7.8	0.67	4.73	2.39	0.23	0.32	0.17
S1307426-014	DP-24	0-22	7.8	0.52	3.79	1.48	0.30	0.38	0.23
S1307426-015	DP-25	208-244	8.5	0.37	2.05	1.74	0.13	0.19	0.14
S1307426-016	DP-26	350-366	8.2	0.39	1.74	2.60	0.14	0.23	0.15

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

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Report ID: S1307426001

Project: Private Lease Soils - Limited List

Date Received: 7/30/2013

Date Reported: 10/4/2013

Work Order: S1307426

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Coarse Fragment	Boron	CO3	Selenium
		cm	%	%	%		%	%	ppm	%	ppm
S1307426-001	12AS020	600-610	87.5	7.5	5.0	Sand	12.6		0.24	18.6	<0.02
S1307426-002	DP-20	0-38	20.0	40.0	40.0	Silty Clay	6.0		0.64	14.5	<0.02
S1307426-004	DP-20	38-55	17.5	40.0	42.5	Silty Clay	3.6			14.8	
S1307426-005	DP-20	122-170	18.8	38.8	42.5	Clay	3.4	<0.1		21.5	
S1307426-006	DP-20	170-240	23.8	50.0	26.3	Silty Loam	3.6		0.29	41.1	0.02
S1307426-008	DP-20	240-310	52.5	40.0	7.5	Sandy Loam	23.1		0.14	36.8	<0.02
S1307426-009	DP-20	310-366	52.5	37.5	10.0	Sandy Loam	18.9		0.13	15.1	<0.02
S1307426-010	DP-23	0-30	18.8	41.3	40.0	Silty Clay	4.1		0.58	16.8	<0.02
S1307426-011	DP-23	30-57	26.3	33.8	40.0	Clay	14.8		0.32	16.1	<0.02
S1307426-012	DP-23	57-80	25.0	36.3	38.8	Clay Loam	3.7		0.38	30.9	<0.02
S1307426-013	DP-23	80-122	62.5	<0.1	37.5	Sandy Clay	6.2		0.18	29.6	<0.02
S1307426-014	DP-24	0-22	18.8	43.8	37.5	Silty Clay Loam	4.8		0.47	18.9	<0.02
S1307426-015	DP-25	208-244	87.5	5.0	7.5	Loamy Sand	19.5	1.8	0.13	32.5	<0.02
S1307426-016	DP-26	350-366	25.0	55.0	20.0	Silty Loam	13.5		0.34	37.0	<0.02

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Date: 3/31/2014

CLIENT: Alton Coal Development, LLC
Project: Private Lease Soils - Full List
Lab Order: S1312084

CASE NARRATIVE

Report ID: S1312084001

Samples 12AS019A, 13AS01, 13AS02, 13AS03, 13AS04, 13AS05, 13AS06, 13AS07, and 13AS09 were received on December 2, 2013.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

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Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1312084001

Project: Private Lease Soils - Full List
Date Received: 12/2/2013

Date Reported: 3/31/2014
Work Order: S1312084

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1312084-001	12AS019A	0-22	8.3		0.35	17.6			3.6
S1312084-002	12AS019A	22-43	8.1	68.9	0.37	13.0			1.1
S1312084-003	12AS019A	43-67	8.2	64.9	0.26	11.7			1.0
S1312084-004	12AS019A	67-154	8.4	43.6	0.35	5.9	26.9	17.4	0.6
S1312084-005	12AS019A	154-242	8.6	29.9	0.28	6.8	22.6	8.0	0.4
S1312084-006	12AS019A	242-363	8.2	31.7	0.52	4.3	22.3	8.9	1.2
S1312084-007	12AS019A	363-408	7.6	72.1	1.87	17.6	36.7	28.0	2.6
S1312084-008	12AS019A	408-548	7.7	46.3	1.96	7.4	26.6	16.1	1.0
S1312084-009	12AS019A	548-610	7.7	29.7	2.20	8.1	24.6	9.1	1.1
S1312084-010	12AS019A	610-810	7.6	66.1	1.98	19.6	40.2	26.0	2.9
S1312084-011	12AS019A	810-852	7.8	27.4	1.69	15.4	24.0	5.0	0.5
S1312084-012	13AS01	0-18	7.6	60.5	0.45	17.0	39.8	27.1	6.0
S1312084-013	13AS01	18-45	7.9	56.9	0.17	12.0	36.2	24.8	2.3
S1312084-014	13AS01	45-106	8.4	58.3	0.24	9.5	35.1	25.2	1.4
S1312084-015	13AS01	106-180	8.6	40.1	0.31	5.3	26.2	15.9	0.5
S1312084-016	13AS01	180-213	8.5			1.4			0.4
S1312084-017	13AS01	213-320	8.4	72.0	0.59	12.2	32.2	24.7	0.9
S1312084-018	13AS01	320-475	8.3	51.9	0.65	6.3	26.7	18.4	0.6
S1312084-019	13AS02	0-10	7.9	56.4	0.21	17.4	35.4	25.2	2.4
S1312084-020	13AS02	10-42	8.0	58.6	0.18	17.2	35.5	25.6	1.8

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

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Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

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Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1312084-021	13AS02	42-76	8.3	54.8	0.19	10.4	36.5	25.9	1.9
S1312084-022	13AS03	0-18	7.6	60.2	0.24	13.0	36.3	27.6	2.6
S1312084-023	13AS03	18-44	7.8	54.8	0.24	10.9	34.8	23.0	1.6
S1312084-024	13AS03	44-66	7.9	56.0	0.20	9.5	37.6	23.2	1.4
S1312084-025	13AS03	66-135	8.5	53.2	0.95	9.3	34.0	22.8	1.3
S1312084-026	13AS03	135-164	8.2	63.2	0.46	9.8	33.4	25.8	1.0
S1312084-027	13AS04	0-13	8.0	51.4	0.24	13.4	35.9	17.8	2.7
S1312084-028	13AS04	13-40	7.9	54.5	0.21	15.4	35.4	21.7	2.3
S1312084-029	13AS04	40-90	7.9	57.0	0.18	13.0	34.4	21.7	1.8
S1312084-030	13AS04	90-150	8.2	62.9	0.20	10.8	33.6	24.4	1.4
S1312084-031	13AS04	150-210	8.3	59.1	0.40	9.6	31.8	24.1	1.0
S1312084-032	13AS05	0-10	8.2	60.5	0.20	11.6			2.5
S1312084-033	13AS05	10-24	8.1	64.6	1.05	16.8	34.4	27.8	2.4
S1312084-034	13AS05	24-49	7.9	63.2	0.33	10.6	34.8	26.5	2.4
S1312084-035	13AS05	49-90	8.0	73.1	0.92	11.0	37.0	29.1	2.8
S1312084-036	13AS05	90-153	7.9	76.3	2.20	11.5	38.1	28.4	1.7
S1312084-037	13AS05	153-242	7.8	73.0	2.63	10.6	35.0	26.0	1.4
S1312084-038	13AS05	242-300	7.7	78.9	2.30	13.7	37.5	25.9	1.4
S1312084-039	13AS05	300-394	8.0	76.0	1.17	13.7	35.4	27.3	1.2
S1312084-040	13AS05	394-516	8.0	72.4	1.06	14.9	34.3	26.1	1.1

These results apply only to the samples tested.

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Karen Secor, Soil Lab Supervisor

Soil Analysis Report

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Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1312084-041	13AS06	0-13	7.5	72.8	0.55	16.3	33.4	25.5	4.6
S1312084-042	13AS06	13-38	7.9	61.7	0.37	17.0	34.3	25.5	2.7
S1312084-043	13AS06	38-68	8.1	62.3	0.39	15.5	34.7	26.8	1.7
S1312084-044	13AS06	68-112	8.0	74.9	3.20	12.2	37.8	28.6	1.8
S1312084-045	13AS06	112-170	8.2	73.8	3.17	12.0	37.8	27.5	1.4
S1312084-046	13AS06	170-245	8.0	65.5	2.87	10.5	36.1	25.0	1.3
S1312084-047	13AS06	245-315	8.2	72.7	2.40	12.8	37.8	28.4	1.4
S1312084-048	13AS06	315-396	8.0	79.7	2.93	14.2	40.6	28.6	1.1
S1312084-049	13AS06	396-457	8.2	79.7	1.67	13.7	39.2	27.8	1.1
S1312084-050	13AS06	457-579	8.2	69.8	1.41	13.2	39.2	27.2	1.1
S1312084-051	13AS06	579-632	8.5	65.5	0.85	13.2	38.3	26.0	1.1
S1312084-052	13AS06	632-770	8.9	22.9	0.41	2.5	17.7	4.6	0.4
S1312084-053	13AS06	770-838	8.4	22.8	0.60	6.8	20.1	6.1	0.7
S1312084-054	13AS06	838-884	8.0	34.0	0.57	13.2	20.5	11.1	1.0
S1312084-055	13AS07	0-19	7.7	53.2	0.62	12.1	31.6	20.7	3.3
S1312084-056	13AS07	19-46	7.8	54.4	0.72	17.0	33.9	24.1	2.6
S1312084-057	13AS07	46-67	7.9	56.7	0.75	15.5	34.1	23.3	1.9
S1312084-058	13AS07	67-183	8.1	49.5	0.29	10.3	32.7	20.2	1.3
S1312084-059	13AS07	183-305	8.2	26.1	0.27	2.5	21.8	5.4	0.9
S1312084-060	13AS07	305-427	8.4	22.5	0.53	3.2	19.6	6.6	0.6

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Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1312084-061	13AS07	427-532	8.6	23.2	0.58	5.4	18.3	6.0	0.5
S1312084-062	13AS07	532-656	7.7	24.1	1.47	13.2	20.9	6.1	1.8
S1312084-063	13AS07	656-732	8.1	71.2	0.63	21.0	40.9	30.1	1.4
S1312084-064	13AS09	0-14	8.0	61.0	0.21	14.0	38.5	27.0	3.2
S1312084-065	13AS09	14-46	7.9	61.9	0.16	13.3	39.7	29.8	1.4

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Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1312084-001	12AS019A	0-22	2.83	1.30	0.17	0.19	0.13
S1312084-002	12AS019A	22-43	1.53	1.59	0.11	0.22	0.17
S1312084-003	12AS019A	43-67	1.03	1.52	0.08	0.18	0.16
S1312084-004	12AS019A	67-154	1.03	2.64	0.13	0.27	0.20
S1312084-005	12AS019A	154-242	0.79	2.31	0.12	0.14	0.12
S1312084-006	12AS019A	242-363	1.58	4.93	0.20	0.37	0.20
S1312084-007	12AS019A	363-408	17.3	18.6	0.51	0.63	0.15
S1312084-008	12AS019A	408-548	19.7	19.2	0.50	0.79	0.18
S1312084-009	12AS019A	548-610	23.3	23.4	0.46	1.77	0.37
S1312084-010	12AS019A	610-810	15.3	18.8	0.64	2.75	0.67
S1312084-011	12AS019A	810-852	9.40	14.8	0.35	4.08	1.17
S1312084-012	13AS01	0-18	3.61	1.12	0.40	0.12	0.08
S1312084-013	13AS01	18-45	1.42	0.75	0.15	0.13	0.13
S1312084-014	13AS01	45-106	1.94	1.41	0.17	0.15	0.11
S1312084-015	13AS01	106-180	0.74	2.39	0.16	0.32	0.26
S1312084-016	13AS01	180-213					
S1312084-017	13AS01	213-320	1.30	4.16	0.15	1.89	1.14
S1312084-018	13AS01	320-475	2.07	3.81	0.19	1.94	1.13
S1312084-019	13AS02	0-10	2.00	0.38	0.30	0.16	0.15
S1312084-020	13AS02	10-42	1.68	0.57	0.10	0.69	0.65

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

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Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1312084-021	13AS02	42-76	0.91	0.61	0.06	1.53	1.76
S1312084-022	13AS03	0-18	2.73	0.78	0.36	0.17	0.13
S1312084-023	13AS03	18-44	2.58	0.78	0.17	0.21	0.16
S1312084-024	13AS03	44-66	1.76	0.59	0.11	0.40	0.37
S1312084-025	13AS03	66-135	6.31	6.02	0.26	3.44	1.39
S1312084-026	13AS03	135-164	1.65	0.89	0.12	5.87	5.21
S1312084-027	13AS04	0-13	2.29	0.58	0.20	0.10	0.09
S1312084-028	13AS04	13-40	2.12	0.80	0.12	0.17	0.14
S1312084-029	13AS04	40-90	1.41	0.68	0.11	0.15	0.15
S1312084-030	13AS04	90-150	1.28	0.91	0.10	0.62	0.59
S1312084-031	13AS04	150-210	1.63	1.80	0.12	2.11	1.61
S1312084-032	13AS05	0-10	2.06	0.42	0.22	0.22	0.20
S1312084-033	13AS05	10-24	6.18	8.21	0.27	3.03	1.13
S1312084-034	13AS05	24-49	2.16	0.73	0.12	2.27	1.88
S1312084-035	13AS05	49-90	2.69	1.38	0.11	8.30	5.82
S1312084-036	13AS05	90-153	10.7	7.76	0.31	19.3	6.35
S1312084-037	13AS05	153-242	19.7	14.4	0.50	19.5	4.73
S1312084-038	13AS05	242-300	20.0	13.1	0.58	15.5	3.80
S1312084-039	13AS05	300-394	3.98	2.72	0.29	9.55	5.22
S1312084-040	13AS05	394-516	4.05	2.92	0.28	8.29	4.44

These results apply only to the samples tested.

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Karen Secor, Soil Lab Supervisor

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Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1312084-041	13AS06	0-13	5.01	1.26	0.55	0.38	0.21
S1312084-042	13AS06	13-38	2.35	1.06	0.20	0.95	0.73
S1312084-043	13AS06	38-68	1.34	0.92	0.09	2.95	2.78
S1312084-044	13AS06	68-112	20.4	45.9	0.45	22.1	3.83
S1312084-045	13AS06	112-170	16.0	50.6	0.62	20.9	3.61
S1312084-046	13AS06	170-245	16.1	36.2	0.64	19.3	3.78
S1312084-047	13AS06	245-315	6.11	26.8	0.66	17.0	4.19
S1312084-048	13AS06	315-396	17.8	45.1	0.82	17.4	3.10
S1312084-049	13AS06	396-457	4.29	14.4	0.48	10.7	3.52
S1312084-050	13AS06	457-579	2.72	11.2	0.48	7.98	3.02
S1312084-051	13AS06	579-632	1.54	5.18	0.28	4.19	2.29
S1312084-052	13AS06	632-770	1.09	3.25	0.19	1.02	0.69
S1312084-053	13AS06	770-838	2.39	3.15	0.15	0.93	0.56
S1312084-054	13AS06	838-884	3.56	3.88	0.23	0.73	0.38
S1312084-055	13AS07	0-19	4.60	2.03	0.45	1.10	0.60
S1312084-056	13AS07	19-46	4.86	2.71	0.29	1.18	0.61
S1312084-057	13AS07	46-67	3.92	4.39	0.23	1.16	0.57
S1312084-058	13AS07	67-183	1.40	1.69	0.12	0.66	0.53
S1312084-059	13AS07	183-305	1.18	1.54	0.07	0.59	0.51
S1312084-060	13AS07	305-427	2.47	4.02	0.17	1.06	0.59

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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		cm	meq/L	meq/L	meq/L	meq/L	
S1312084-061	13AS07	427-532	2.10	4.73	0.20	1.15	0.62
S1312084-062	13AS07	532-656	14.5	14.2	0.44	2.92	0.77
S1312084-063	13AS07	656-732	3.84	2.99	0.27	1.38	0.75
S1312084-064	13AS09	0-14	1.66	0.64	0.24	0.15	0.14
S1312084-065	13AS09	14-46	1.25	0.46	0.18	0.20	0.22

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1312084001

Project: Private Lease Soils - Full List
Date Received: 12/2/2013

Date Reported: 3/31/2014
Work Order: S1312084

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Boron	Nitrate(as N)	CO3	Selenium
		cm	%	%	%		%	ppm	ppm	%	ppm
S1312084-001	12AS019A	0-22	10.0	43.8	46.3	Silty Clay	<0.1	0.33	1.9	47.9	<0.02
S1312084-002	12AS019A	22-43	8.8	38.8	52.5	Clay	2.7			50.4	
S1312084-003	12AS019A	43-67	6.3	43.8	50.0	Silty Clay	0.3	0.21	0.5	50.1	<0.02
S1312084-004	12AS019A	67-154	37.0	42.0	21.0	Loam	26.5	0.24	0.8	45.9	<0.02
S1312084-005	12AS019A	154-242	63.0	28.0	9.0	Sandy Loam	34.6	0.16	0.3	32.4	<0.02
S1312084-006	12AS019A	242-363	58.0	31.0	11.0	Sandy Loam	26.3	0.17	3.3	31.6	0.03
S1312084-007	12AS019A	363-408	18.0	43.0	39.0	Silty Clay Loam	13.2	0.31	54.1	42.8	0.05
S1312084-008	12AS019A	408-548	38.0	42.0	20.0	Loam	29.0	0.10	11.4	47.0	<0.02
S1312084-009	12AS019A	548-610	59.0	32.0	9.0	Sandy Loam	34.5	0.16	4.8	32.0	<0.02
S1312084-010	12AS019A	610-810	26.0	40.0	34.0	Clay Loam	21.3	0.48	0.5	29.3	<0.02
S1312084-011	12AS019A	810-852	86.0	9.0	5.0	Loamy Sand	28.2	0.17	<0.1	19.4	<0.02
S1312084-012	13AS01	0-18	24.0	35.0	41.0	Clay	17.9	0.56	1.5	36.7	<0.02
S1312084-013	13AS01	18-45	24.0	33.0	43.0	Clay	19.6	0.47	0.6	45.9	<0.02
S1312084-014	13AS01	45-106	24.0	37.0	39.0	Clay Loam	19.1	0.46	0.6	49.0	<0.02
S1312084-015	13AS01	106-180	39.0	40.0	21.0	Loam	25.0	0.45	0.3	39.9	<0.02
S1312084-016	13AS01	180-213	70.0	20.0	10.0	Sandy Loam	11.5			23.3	
S1312084-017	13AS01	213-320	36.0	24.0	40.0	Clay	32.2	0.37	0.6	42.5	<0.02
S1312084-018	13AS01	320-475	44.0	32.0	24.0	Loam	34.5	0.29	0.5	17.5	0.06
S1312084-019	13AS02	0-10	38.0	31.0	31.0	Clay Loam	25.7	0.47	<0.1	14.8	<0.02
S1312084-020	13AS02	10-42	32.0	36.0	32.0	Clay Loam	22.7	0.26	0.7	21.3	<0.02

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1312084001

Project: Private Lease Soils - Full List
Date Received: 12/2/2013

Date Reported: 3/31/2014
Work Order: S1312084

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Boron	Nitrate(as N)	CO3	Selenium
		cm	%	%	%		%	ppm	ppm	%	ppm
S1312084-021	13AS02	42-76	34.0	32.0	34.0	Clay Loam	28.9	0.42	0.4	23.9	<0.02
S1312084-022	13AS03	0-18	36.0	31.0	33.0	Clay Loam	27.2	0.52	<0.1	18.6	<0.02
S1312084-023	13AS03	18-44	36.0	30.0	34.0	Clay Loam	25.1	0.28	0.6	21.4	<0.02
S1312084-024	13AS03	44-66	38.0	26.0	36.0	Clay Loam	27.5	0.42	0.6	21.3	<0.02
S1312084-025	13AS03	66-135	38.0	27.0	35.0	Clay Loam	25.3	0.62	0.2	22.4	<0.02
S1312084-026	13AS03	135-164	38.0	26.0	36.0	Clay Loam	26.3	0.92	1.5	21.8	<0.02
S1312084-027	13AS04	0-13	50.0	27.0	23.0	Sandy Clay Loam	25.5	0.30	0.6	6.3	<0.02
S1312084-028	13AS04	13-40	48.0	25.0	27.0	Sandy Clay Loam	28.6	0.29	0.2	10.2	<0.02
S1312084-029	13AS04	40-90	42.0	27.0	31.0	Clay Loam	28.7	0.41	1.6	15.2	<0.02
S1312084-030	13AS04	90-150	40.0	28.0	32.0	Clay Loam	28.6	0.60	0.6	17.3	<0.02
S1312084-031	13AS04	150-210	46.0	24.0	30.0	Sandy Clay Loam	31.3	0.67	0.1	17.5	<0.02
S1312084-032	13AS05	0-10	34.0	31.0	35.0	Clay Loam	24.9	0.29	2.8	17.1	<0.02
S1312084-033	13AS05	10-24	34.0	28.0	38.0	Clay Loam	26.5	0.34	3.6	18.0	<0.02
S1312084-034	13AS05	24-49	28.0	33.0	39.0	Clay Loam	21.0	0.54	2.2	18.9	<0.02
S1312084-035	13AS05	49-90	32.0	29.0	39.0	Clay Loam	25.5	0.75	0.8	19.4	<0.02
S1312084-036	13AS05	90-153	10.0	37.0	53.0	Clay	4.5	0.94	1.0	22.1	0.08
S1312084-037	13AS05	153-242	32.0	18.0	50.0	Clay	24.2	1.18	3.6	22.8	0.07
S1312084-038	13AS05	242-300	10.0	37.0	53.0	Clay	5.3	0.93	7.4	22.9	0.02
S1312084-039	13AS05	300-394	14.0	35.0	51.0	Clay	8.4	0.94	5.7	24.3	0.02
S1312084-040	13AS05	394-516	40.0	14.0	46.0	Clay	34.7	0.93	4.0	23.8	<0.02

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1312084001

Project: Private Lease Soils - Full List
Date Received: 12/2/2013

Date Reported: 3/31/2014
Work Order: S1312084

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Boron	Nitrate(as N)	CO3	Selenium
		cm	%	%	%		%	ppm	ppm	%	ppm
S1312084-041	13AS06	0-13	23.0	38.0	39.0	Clay Loam	8.5	0.58	2.1	16.1	<0.02
S1312084-042	13AS06	13-38	46.0	12.0	42.0	Sandy Clay	36.3	0.57	0.3	18.9	<0.02
S1312084-043	13AS06	38-68	16.0	37.0	47.0	Clay	8.7	0.51	<0.1	20.8	<0.02
S1312084-044	13AS06	68-112	16.0	33.0	51.0	Clay	10.5	0.84	<0.1	21.3	<0.02
S1312084-045	13AS06	112-170	47.0	4.0	49.0	Sandy Clay	41.2	1.38	0.9	24.0	0.06
S1312084-046	13AS06	170-245	18.0	36.0	46.0	Clay	6.3	0.97	1.3	24.0	0.03
S1312084-047	13AS06	245-315	48.0	11.0	41.0	Sandy Clay	41.5	1.03	0.3	22.4	0.03
S1312084-048	13AS06	315-396	12.0	35.0	53.0	Clay	5.6	1.06	0.3	24.1	0.03
S1312084-049	13AS06	396-457	56.0	8.0	36.0	Sandy Clay	50.4	0.70	0.3	23.0	<0.02
S1312084-050	13AS06	457-579	10.0	39.0	51.0	Clay	3.8	0.53	0.7	23.5	<0.02
S1312084-051	13AS06	579-632	32.0	19.0	49.0	Clay	23.1	0.41	0.2	25.3	<0.02
S1312084-052	13AS06	632-770	82.0	13.0	5.0	Loamy Sand	3.7	0.10	0.3	51.9	<0.02
S1312084-053	13AS06	770-838	86.0	6.0	8.0	Loamy Sand	27.3	0.11	0.3	28.2	<0.02
S1312084-054	13AS06	838-884	64.0	21.0	15.0	Sandy Loam	31.8	0.15	0.4	26.1	<0.02
S1312084-055	13AS07	0-19	28.0	36.0	36.0	Clay Loam	12.0	0.69	<0.1	20.5	<0.02
S1312084-056	13AS07	19-46	32.0	23.0	45.0	Clay	21.9	0.40	0.5	35.6	<0.02
S1312084-057	13AS07	46-67	22.0	37.0	41.0	Clay	8.0	0.37	0.1	30.9	<0.02
S1312084-058	13AS07	67-183	52.0	16.0	32.0	Sandy Clay Loam	30.5	0.26	1.4	43.1	<0.02
S1312084-059	13AS07	183-305	76.0	15.0	9.0	Sandy Loam	14.3	0.12	0.2	18.7	<0.02
S1312084-060	13AS07	305-427	80.0	12.0	8.0	Loamy Sand	13.7	0.11	0.2	56.7	<0.02

These results apply only to the samples tested.

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1312084001

Project: Private Lease Soils - Full List

Date Received: 12/2/2013

Date Reported: 3/31/2014

Work Order: S1312084

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Boron	Nitrate(as N)	CO3	Selenium
		cm	%	%	%		%	ppm	ppm	%	ppm
S1312084-061	13AS07	427-532	78.0	16.0	6.0	Loamy Sand	4.2	0.07	0.1	68.8	<0.02
S1312084-062	13AS07	532-656	84.0	9.0	7.0	Loamy Sand	21.4	0.19	0.1	43.1	<0.02
S1312084-063	13AS07	656-732	26.0	28.0	46.0	Clay	20.6	0.32	1.2	12.0	<0.02
S1312084-064	13AS09	0-14	14.0	32.0	54.0	Clay	8.0	0.53	<0.1	17.8	<0.02
S1312084-065	13AS09	14-46	28.0	23.0	49.0	Clay	24.1	0.50	1.0	19.7	<0.02

These results apply only to the samples tested.

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Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
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Project: Private Lease Soils - Full List
Date Received: 12/2/2013

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Lab ID	Sample ID	Depths	Total Carbon	TOC	Total Sulfur	T.S. AB	Neutral. Potential	T.S. ABP
		cm	%	%	%	t/1000t	t/1000t	t/1000t
S1312084-001	12AS019A	0-22	8.0	2.2	<0.01	<0.01	479	479
S1312084-002	12AS019A	22-43	7.0	0.9	0.18	5.74	504	499
S1312084-003	12AS019A	43-67	6.6	0.6	<0.01	<0.01	501	501
S1312084-004	12AS019A	67-154	5.8	0.3	<0.01	<0.01	459	459
S1312084-005	12AS019A	154-242	4.2	0.3	<0.01	<0.01	324	324
S1312084-006	12AS019A	242-363	4.2	0.4	<0.01	<0.01	316	316
S1312084-007	12AS019A	363-408	6.7	1.6	0.21	6.61	428	422
S1312084-008	12AS019A	408-548	6.4	0.7	0.07	2.11	470	468
S1312084-009	12AS019A	548-610	3.9	<0.1	0.18	5.50	320	314
S1312084-010	12AS019A	610-810	5.2	1.7	0.37	11.6	293	282
S1312084-011	12AS019A	810-852	2.6	0.3	0.02	0.74	194	194
S1312084-012	13AS01	0-18	7.2	2.8	0.02	0.58	367	366
S1312084-013	13AS01	18-45	6.7	1.2	<0.01	<0.01	459	459
S1312084-014	13AS01	45-106	6.7	0.8	<0.01	<0.01	490	490
S1312084-015	13AS01	106-180	5.3	0.5	<0.01	<0.01	399	399
S1312084-016	13AS01	180-213	3.0	0.2	<0.01	<0.01	233	233
S1312084-017	13AS01	213-320	5.7	0.6	<0.01	<0.01	425	425
S1312084-018	13AS01	320-475	2.3	0.2	<0.01	<0.01	175	175
S1312084-019	13AS02	0-10	3.3	1.5	0.07	2.09	148	146
S1312084-020	13AS02	10-42	3.5	1.0	<0.01	<0.01	213	213

These results apply only to the samples tested.

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Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
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Report ID: S1312084001

Project: Private Lease Soils - Full List
Date Received: 12/2/2013

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Work Order: S1312084

Lab ID	Sample ID	Depths cm	Total Carbon %	TOC %	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t
S1312084-021	13AS02	42-76	3.8	1.0	<0.01	<0.01	239	239
S1312084-022	13AS03	0-18	3.9	1.6	<0.01	<0.01	186	186
S1312084-023	13AS03	18-44	3.5	0.9	<0.01	<0.01	214	214
S1312084-024	13AS03	44-66	3.4	0.8	<0.01	<0.01	213	213
S1312084-025	13AS03	66-135	3.5	0.8	<0.01	<0.01	224	224
S1312084-026	13AS03	135-164	3.3	0.7	<0.01	<0.01	218	218
S1312084-027	13AS04	0-13	2.1	1.4	<0.01	<0.01	62.9	62.9
S1312084-028	13AS04	13-40	2.4	1.2	<0.01	<0.01	102	102
S1312084-029	13AS04	40-90	2.9	1.1	<0.01	<0.01	152	152
S1312084-030	13AS04	90-150	2.8	0.7	<0.01	<0.01	173	173
S1312084-031	13AS04	150-210	2.7	0.6	<0.01	<0.01	175	175
S1312084-032	13AS05	0-10	3.3	1.2	<0.01	<0.01	171	171
S1312084-033	13AS05	10-24	3.3	1.1	<0.01	<0.01	180	180
S1312084-034	13AS05	24-49	3.3	1.0	<0.01	<0.01	189	189
S1312084-035	13AS05	49-90	3.3	1.0	<0.01	<0.01	194	194
S1312084-036	13AS05	90-153	3.3	0.7	0.02	0.61	221	220
S1312084-037	13AS05	153-242	3.4	0.7	0.27	8.26	228	220
S1312084-038	13AS05	242-300	3.4	0.7	0.26	8.04	229	221
S1312084-039	13AS05	300-394	3.5	0.6	<0.01	<0.01	243	243
S1312084-040	13AS05	394-516	3.5	0.6	<0.01	<0.01	238	238

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
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Report ID: S1312084001

Project: Private Lease Soils - Full List
Date Received: 12/2/2013

Date Reported: 3/31/2014
Work Order: S1312084

Lab ID	Sample ID	Depths	Total Carbon	TOC	Total Sulfur	T.S. AB	Neutral. Potential	T.S. ABP
		cm	%	%	%	t/1000t	t/1000t	t/1000t
S1312084-041	13AS06	0-13	3.5	1.6	0.01	0.32	161	160
S1312084-042	13AS06	13-38	3.3	1.1	<0.01	<0.01	189	189
S1312084-043	13AS06	38-68	3.4	0.9	<0.01	<0.01	208	208
S1312084-044	13AS06	68-112	3.3	0.8	0.35	10.8	213	202
S1312084-045	13AS06	112-170	3.6	0.7	0.41	12.8	240	227
S1312084-046	13AS06	170-245	3.5	0.6	0.23	7.27	240	233
S1312084-047	13AS06	245-315	3.1	0.4	0.05	1.65	224	223
S1312084-048	13AS06	315-396	3.4	0.5	0.14	4.26	241	236
S1312084-049	13AS06	396-457	3.4	0.7	0.01	0.44	230	229
S1312084-050	13AS06	457-579	3.2	0.4	<0.01	<0.01	235	235
S1312084-051	13AS06	579-632	3.6	0.5	<0.01	<0.01	253	253
S1312084-052	13AS06	632-770	6.2	<0.1	<0.01	<0.01	519	519
S1312084-053	13AS06	770-838	3.6	0.2	<0.01	<0.01	282	282
S1312084-054	13AS06	838-884	3.5	0.4	<0.01	<0.01	261	261
S1312084-055	13AS07	0-19	3.9	1.5	<0.01	<0.01	205	205
S1312084-056	13AS07	19-46	5.4	1.2	<0.01	<0.01	356	356
S1312084-057	13AS07	46-67	4.8	1.1	<0.01	<0.01	309	309
S1312084-058	13AS07	67-183	5.9	0.7	<0.01	<0.01	431	431
S1312084-059	13AS07	183-305	2.7	0.4	0.02	0.54	187	187
S1312084-060	13AS07	305-427	7.3	0.5	0.02	0.49	567	567

These results apply only to the samples tested.

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Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1312084001

Project: Private Lease Soils - Full List
Date Received: 12/2/2013

Date Reported: 3/31/2014
Work Order: S1312084

Lab ID	Sample ID	Depths	Total Carbon	TOC	Total Sulfur	T.S. AB	Neutral. Potential	T.S. ABP
		cm	%	%	%	t/1000t	t/1000t	t/1000t
S1312084-061	13AS07	427-532	8.6	0.4	<0.01	<0.01	687	687
S1312084-062	13AS07	532-656	5.4	0.2	0.20	6.28	431	425
S1312084-063	13AS07	656-732	2.0	0.6	0.06	1.95	120	118
S1312084-064	13AS09	0-14	3.9	1.7	<0.01	<0.01	178	178
S1312084-065	13AS09	14-46	3.1	0.7	<0.01	<0.01	197	197

These results apply only to the samples tested.

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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
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Report ID: S1312084001

Project: Private Lease Soils - Full List
Date Received: 12/2/2013

Date Reported: 3/31/2014
Work Order: S1312084

Lab ID	Sample ID	Depths	Total Arsenic	Total Barium	Total Cadmium	Total Chromium	Total Copper	Total Iron	Total Lead	Total Manganese	Total Molybdenum
		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
S1312084-001	12AS019A	0-22	5.8	470	0.27	18.6	9.68	11900	5.8	300	<0.7
S1312084-002	12AS019A	22-43	5.6	277	0.50	25.5	6.18	11600	8.9	206	<0.7
S1312084-003	12AS019A	43-67	8.5	253	0.60	25.0	6.43	13800	8.6	234	<0.7
S1312084-004	12AS019A	67-154	2.5	170	0.34	16.2	4.99	6420	7.0	151	<0.7
S1312084-005	12AS019A	154-242	1.9	116	0.31	8.62	4.04	4160	4.3	99.5	<0.7
S1312084-006	12AS019A	242-363	3.0	72.8	0.35	8.07	5.15	3690	4.7	91.9	<0.7
S1312084-007	12AS019A	363-408	7.3	191	0.72	21.2	10.4	20700	8.9	290	1.1
S1312084-008	12AS019A	408-548	6.8	115	0.40	16.0	8.63	9340	8.0	179	<0.7
S1312084-009	12AS019A	548-610	6.1	60.7	0.42	9.18	5.95	7450	5.7	163	<0.7
S1312084-010	12AS019A	610-810	6.6	99.9	0.42	17.9	10.6	13300	8.5	191	0.9
S1312084-011	12AS019A	810-852	3.0	115	0.33	5.68	2.96	5220	3.7	94.5	<0.7
S1312084-012	13AS01	0-18	7.6	241	0.58	22.0	13.5	13500	9.3	391	<0.7
S1312084-013	13AS01	18-45	6.8	208	0.43	23.5	8.48	11100	9.8	310	1.4
S1312084-014	13AS01	45-106	8.2	399	0.43	21.9	8.84	12200	9.0	199	0.7
S1312084-015	13AS01	106-180	2.8	265	0.40	13.9	5.66	6710	7.1	153	0.8
S1312084-016	13AS01	180-213	4.5	128	0.26	5.71	3.41	5610	3.7	189	<0.7
S1312084-017	13AS01	213-320	10.5	119	0.53	21.5	9.97	16200	9.6	242	1.3
S1312084-018	13AS01	320-475	3.9	72.7	0.19	10.2	5.79	8150	5.1	141	<0.7
S1312084-019	13AS02	0-10	3.3	63.6	0.43	16.2	11.5	12700	9.7	171	<0.7
S1312084-020	13AS02	10-42	3.5	56.5	0.39	14.8	8.52	11400	8.2	134	<0.7

These results apply only to the samples tested.

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1312084001

Project: Private Lease Soils - Full List
Date Received: 12/2/2013

Date Reported: 3/31/2014
Work Order: S1312084

Lab ID	Sample ID	Depths	Total Arsenic	Total Barium	Total Cadmium	Total Chromium	Total Copper	Total Iron	Total Lead	Total Manganese	Total Molybdenum
		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
S1312084-021	13AS02	42-76	3.5	60.6	0.38	16.0	9.30	12600	9.8	142	<0.7
S1312084-022	13AS03	0-18	3.3	63.6	0.38	16.7	11.8	13400	10.7	170	<0.7
S1312084-023	13AS03	18-44	3.2	62.3	0.39	14.4	9.32	12400	9.4	161	<0.7
S1312084-024	13AS03	44-66	2.0	51.8	0.21	13.0	7.52	10200	7.4	117	<0.7
S1312084-025	13AS03	66-135	2.9	63.7	0.31	15.9	9.85	13600	9.6	156	<0.7
S1312084-026	13AS03	135-164	4.4	65.9	0.37	17.4	9.75	13400	10.2	169	<0.7
S1312084-027	13AS04	0-13	3.8	71.6	0.37	16.8	9.58	12800	7.7	219	<0.7
S1312084-028	13AS04	13-40	3.4	75.4	0.33	16.7	9.53	13000	8.5	217	<0.7
S1312084-029	13AS04	40-90	4.5	78.3	0.33	16.3	9.14	12800	8.5	191	<0.7
S1312084-030	13AS04	90-150	3.8	85.5	0.35	15.7	9.07	12800	8.6	185	<0.7
S1312084-031	13AS04	150-210	2.8	89.8	0.32	14.2	8.02	11800	7.8	178	<0.7
S1312084-032	13AS05	0-10	4.0	65.6	0.27	13.5	10.6	12300	10.1	162	<0.7
S1312084-033	13AS05	10-24	3.1	60.3	0.28	13.5	8.67	11000	8.3	139	<0.7
S1312084-034	13AS05	24-49	2.9	65.5	0.37	15.7	9.89	12800	9.5	159	<0.7
S1312084-035	13AS05	49-90	2.6	63.5	0.29	15.3	9.88	12700	9.8	152	<0.7
S1312084-036	13AS05	90-153	4.2	76.6	0.27	16.3	9.86	13300	10.0	151	<0.7
S1312084-037	13AS05	153-242	3.6	82.0	0.32	13.8	9.21	12300	9.6	134	<0.7
S1312084-038	13AS05	242-300	3.9	66.7	0.34	15.5	10.0	13000	9.9	140	<0.7
S1312084-039	13AS05	300-394	4.5	73.0	0.40	16.9	10.3	13600	10.6	150	<0.7
S1312084-040	13AS05	394-516	3.2	65.8	0.49	16.6	10.3	13700	10.4	143	<0.7

These results apply only to the samples tested.

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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1312084001

Project: Private Lease Soils - Full List
Date Received: 12/2/2013

Date Reported: 3/31/2014
Work Order: S1312084

Lab ID	Sample ID	Depths cm	Total Arsenic mg/Kg	Total Barium mg/Kg	Total Cadmium mg/Kg	Total Chromium mg/Kg	Total Copper mg/Kg	Total Iron mg/Kg	Total Lead mg/Kg	Total Manganese mg/Kg	Total Molybdenum mg/Kg
S1312084-041	13AS06	0-13	3.9	75.4	0.31	19.0	10.9	12500	14.7	168	<0.7
S1312084-042	13AS06	13-38	4.1	65.8	0.35	15.7	10.7	13100	10.5	166	<0.7
S1312084-043	13AS06	38-68	2.2	61.3	0.33	15.4	9.94	12700	9.3	155	<0.7
S1312084-044	13AS06	68-112	1.9	70.5	0.34	19.4	10.7	14300	10.9	168	<0.7
S1312084-045	13AS06	112-170	1.0	64.2	0.41	15.7	9.71	12600	9.7	152	<0.7
S1312084-046	13AS06	170-245	0.7	65.4	0.36	14.3	9.25	12300	9.3	137	<0.7
S1312084-047	13AS06	245-315	1.3	64.3	0.18	15.7	10.2	13100	10.1	142	<0.7
S1312084-048	13AS06	315-396	<0.6	62.1	0.34	13.3	9.26	12100	9.8	121	<0.7
S1312084-049	13AS06	396-457	1.9	60.2	0.37	12.8	9.70	12700	10.5	141	<0.7
S1312084-050	13AS06	457-579	0.9	66.3	0.25	14.6	9.69	12900	10.0	132	<0.7
S1312084-051	13AS06	579-632	2.0	122	0.30	13.9	9.43	13400	9.9	120	<0.7
S1312084-052	13AS06	632-770	1.1	149	0.15	4.65	1.86	5120	3.7	192	<0.7
S1312084-053	13AS06	770-838	2.4	204	0.40	6.88	3.64	7970	4.3	128	<0.7
S1312084-054	13AS06	838-884	2.0	122	0.39	10.9	6.70	6250	6.2	143	<0.7
S1312084-055	13AS07	0-19	2.1	83.3	0.30	15.5	9.20	10700	7.2	166	<0.7
S1312084-056	13AS07	19-46	4.1	136	0.37	20.9	10.2	13500	8.9	272	<0.7
S1312084-057	13AS07	46-67	3.7	197	0.28	18.4	8.24	12000	7.7	296	<0.7
S1312084-058	13AS07	67-183	2.7	361	0.38	15.6	7.48	11100	6.5	355	<0.7
S1312084-059	13AS07	183-305	0.8	67.4	0.28	7.27	3.83	4600	4.6	77.1	<0.7
S1312084-060	13AS07	305-427	1.1	121	0.17	6.42	2.40	4880	3.3	152	<0.7

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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1312084001

Project: Private Lease Soils - Full List
Date Received: 12/2/2013

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Work Order: S1312084

Lab ID	Sample ID	Depths	Total Arsenic	Total Barium	Total Cadmium	Total Chromium	Total Copper	Total Iron	Total Lead	Total Manganese	Total Molybdenum
		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
S1312084-061	13AS07	427-532	1.8	125	0.21	5.08	2.03	4740	3.5	265	<0.7
S1312084-062	13AS07	532-656	3.0	69.1	0.35	6.40	3.17	6810	3.9	149	<0.7
S1312084-063	13AS07	656-732	2.3	69.9	0.34	13.8	8.60	11400	9.2	145	<0.7
S1312084-064	13AS09	0-14	1.4	79.1	0.26	14.2	10.1	11300	8.5	81.4	<0.7
S1312084-065	13AS09	14-46	<0.6	175	0.20	10.2	9.11	10100	8.3	97.0	<0.7

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Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

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Report ID: S1312084001

Project: Private Lease Soils - Full List

Date Received: 12/2/2013

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Lab ID	Sample ID	Depths cm	Total Selenium mg/Kg	Total Silver mg/Kg	Total Zinc mg/Kg	Total Mercury mg/Kg	Bulk Density g/cm³
S1312084-001	12AS019A	0-22	<0.96	<0.5	57.5	<0.2	6.18
S1312084-002	12AS019A	22-43	<0.96	<0.5	37.5	<0.2	2.83
S1312084-003	12AS019A	43-67	<0.96	<0.5	36.9	<0.2	4.05
S1312084-004	12AS019A	67-154	<0.96	<0.5	23.6	<0.2	3.58
S1312084-005	12AS019A	154-242	<0.96	<0.5	17.9	<0.2	2.78
S1312084-006	12AS019A	242-363	<0.96	<0.5	23.7	<0.2	2.98
S1312084-007	12AS019A	363-408	<0.96	<0.5	49.4	<0.2	2.98
S1312084-008	12AS019A	408-548	<0.96	<0.5	36.8	<0.2	3.18
S1312084-009	12AS019A	548-610	<0.96	<0.5	27.9	<0.2	2.64
S1312084-010	12AS019A	610-810	<0.96	<0.5	53.5	<0.2	3.80
S1312084-011	12AS019A	810-852	<0.96	<0.5	19.7	<0.2	3.81
S1312084-012	13AS01	0-18	<0.96	<0.5	91.2	<0.2	6.65
S1312084-013	13AS01	18-45	<0.96	<0.5	48.2	<0.2	4.46
S1312084-014	13AS01	45-106	<0.96	<0.5	46.5	<0.2	
S1312084-015	13AS01	106-180	<0.96	<0.5	29.7	<0.2	
S1312084-016	13AS01	180-213	<0.96	<0.5	19.9	<0.2	
S1312084-017	13AS01	213-320	<0.96	<0.5	45.9	<0.2	2.47
S1312084-018	13AS01	320-475	<0.96	<0.5	23.1	<0.2	2.64
S1312084-019	13AS02	0-10	<0.96	<0.5	52.8	<0.2	3.94
S1312084-020	13AS02	10-42	<0.96	<0.5	43.3	<0.2	2.43

These results apply only to the samples tested.

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Lab ID	Sample ID	Depths cm	Total Selenium mg/Kg	Total Silver mg/Kg	Total Zinc mg/Kg	Total Mercury mg/Kg	Bulk Density g/cm³
S1312084-021	13AS02	42-76	<0.96	<0.5	48.4	<0.2	2.72
S1312084-022	13AS03	0-18	<0.96	<0.5	58.8	<0.2	2.42
S1312084-023	13AS03	18-44	<0.96	<0.5	47.6	<0.2	2.69
S1312084-024	13AS03	44-66	<0.96	<0.5	37.8	<0.2	2.72
S1312084-025	13AS03	66-135	<0.96	<0.5	49.4	<0.2	2.76
S1312084-026	13AS03	135-164	<0.96	<0.5	49.8	<0.2	2.72
S1312084-027	13AS04	0-13	<0.96	<0.5	43.9	<0.2	2.84
S1312084-028	13AS04	13-40	<0.96	<0.5	43.0	<0.2	2.35
S1312084-029	13AS04	40-90	<0.96	<0.5	43.0	<0.2	2.19
S1312084-030	13AS04	90-150	<0.96	<0.5	41.4	<0.2	2.43
S1312084-031	13AS04	150-210	<0.96	<0.5	36.4	<0.2	2.26
S1312084-032	13AS05	0-10	<0.96	<0.5	49.8	<0.2	2.58
S1312084-033	13AS05	10-24	<0.96	<0.5	42.7	<0.2	2.22
S1312084-034	13AS05	24-49	<0.96	<0.5	49.0	<0.2	2.43
S1312084-035	13AS05	49-90	<0.96	<0.5	49.1	<0.2	2.19
S1312084-036	13AS05	90-153	<0.96	<0.5	49.8	<0.2	2.19
S1312084-037	13AS05	153-242	<0.96	<0.5	46.8	<0.2	2.32
S1312084-038	13AS05	242-300	<0.96	<0.5	50.1	<0.2	2.13
S1312084-039	13AS05	300-394	<0.96	<0.5	51.6	<0.2	2.15
S1312084-040	13AS05	394-516	<0.96	<0.5	52.0	<0.2	2.26

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Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Karen Secor, Soil Lab Supervisor

Soil Analysis Report

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Report ID: S1312084001

Project: Private Lease Soils - Full List
Date Received: 12/2/2013

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Work Order: S1312084

Lab ID	Sample ID	Depths	Total Selenium	Total Silver	Total Zinc	Total Mercury	Bulk Density
		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	g/cm³
S1312084-041	13AS06	0-13	<0.96	<0.5	51.7	<0.2	3.20
S1312084-042	13AS06	13-38	<0.96	<0.5	49.3	<0.2	2.21
S1312084-043	13AS06	38-68	<0.96	<0.5	48.8	<0.2	2.24
S1312084-044	13AS06	68-112	<0.96	<0.5	57.1	<0.2	2.16
S1312084-045	13AS06	112-170	<0.96	<0.5	49.8	<0.2	2.25
S1312084-046	13AS06	170-245	<0.96	<0.5	47.2	<0.2	2.17
S1312084-047	13AS06	245-315	<0.96	<0.5	57.2	<0.2	2.21
S1312084-048	13AS06	315-396	<0.96	<0.5	48.6	<0.2	2.25
S1312084-049	13AS06	396-457	<0.96	<0.5	51.4	<0.2	2.20
S1312084-050	13AS06	457-579	<0.96	<0.5	50.3	<0.2	2.42
S1312084-051	13AS06	579-632	<0.96	<0.5	48.4	<0.2	2.29
S1312084-052	13AS06	632-770	<0.96	<0.5	12.5	<0.2	
S1312084-053	13AS06	770-838	<0.96	<0.5	20.5	<0.2	2.60
S1312084-054	13AS06	838-884	<0.96	<0.5	30.9	<0.2	2.49
S1312084-055	13AS07	0-19	<0.96	<0.5	40.9	<0.2	2.60
S1312084-056	13AS07	19-46	<0.96	<0.5	51.1	<0.2	2.29
S1312084-057	13AS07	46-67	<0.96	<0.5	42.5	<0.2	2.42
S1312084-058	13AS07	67-183	<0.96	<0.5	30.5	<0.2	3.07
S1312084-059	13AS07	183-305	<0.96	<0.5	19.8	<0.2	5.43
S1312084-060	13AS07	305-427	<0.96	<0.5	15.0	<0.2	2.90

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1312084001

Project: Private Lease Soils - Full List
Date Received: 12/2/2013

Date Reported: 3/31/2014
Work Order: S1312084

Lab ID	Sample ID	Depths	Total Selenium	Total Silver	Total Zinc	Total Mercury	Bulk Density
		cm	mg/Kg	mg/Kg	mg/Kg	mg/Kg	g/cm³
S1312084-061	13AS07	427-532	<0.96	<0.5	11.7	<0.2	
S1312084-062	13AS07	532-656	<0.96	<0.5	19.4	<0.2	2.71
S1312084-063	13AS07	656-732	<0.96	<0.5	38.6	<0.2	2.69
S1312084-064	13AS09	0-14	<0.96	<0.5	45.5	<0.2	4.55
S1312084-065	13AS09	14-46	<0.96	<0.5	39.1	<0.2	2.68

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Date: 3/11/2014

CLIENT: Alton Coal Development, LLC
Project: Private Lease Soils - Short List
Lab Order: S1312086

CASE NARRATIVE

Report ID: S1312086001

Samples 13AS08, DP-10, DP-19, and DP-7 were received on December 2, 2013.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1312086001

Project: Private Lease Soils - Short List
Date Received: 12/2/2013

Date Reported: 3/11/2014
Work Order: S1312086

Lab ID	Sample ID	Depths	pH	Saturation	Electrical Conductivity	Percent Moisture	Field Capacity	Wilt Point	Organic Matter
		cm	s.u.	%	dS/m	%	%	%	%
S1312086-001	DP-7	122-165	7.8	61.8	1.43	10.6	35.6	28.4	3.0
S1312086-002	DP-7	165-200	7.7	52.5	2.96	7.9	34.5	22.0	2.5
S1312086-003	DP-7	200-244	7.9	24.1	1.81	1.2			0.7
S1312086-004	DP-10	122-172	8.0	63.3	4.06	11.5	38.2	27.2	2.6
S1312086-005	DP-10	172-244	8.4	23.8	2.52	1.5	20.1	7.7	0.6
S1312086-006	DP-19	122-225	8.2	25.6	0.37	2.1	21.1	7.9	0.8
S1312086-007	DP-19	225-244				0.3			0.4
S1312086-008	13AS08	122-244	8.1	75.8	4.06	19.0	34.9	27.5	1.7
S1312086-009	13AS08	244-366	8.1	66.9	2.27	18.5	31.2	23.8	1.6
S1312086-010	13AS08	366-488	8.0	79.6	4.22	19.2	37.1	28.7	1.7

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1312086001

Project: Private Lease Soils - Short List
Date Received: 12/2/2013

Date Reported: 3/11/2014
Work Order: S1312086

Lab ID	Sample ID	Depths	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		cm	meq/L	meq/L	meq/L	meq/L	
S1312086-001	DP-7	122-165	22.0	13.5	1.30	12.8	3.04
S1312086-002	DP-7	165-200	23.0	21.2	0.46	10.2	2.16
S1312086-003	DP-7	200-244	11.6	10.7	0.33	5.21	1.56
S1312086-004	DP-10	122-172	15.9	37.2	0.45	15.5	3.01
S1312086-005	DP-10	172-244	4.30	18.1	0.22	9.82	2.93
S1312086-006	DP-19	122-225	1.62	1.35	0.12	0.45	0.37
S1312086-007	DP-19	225-244					
S1312086-008	13AS08	122-244	11.4	23.1	0.54	24.4	5.87
S1312086-009	13AS08	244-366	4.96	8.62	0.44	14.1	5.41
S1312086-010	13AS08	366-488	15.7	26.6	0.59	28.0	6.09

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1312086001

Project: Private Lease Soils - Short List

Date Received: 12/2/2013

Date Reported: 3/11/2014

Work Order: S1312086

Lab ID	Sample ID	Depths	Sand	Silt	Clay	Texture	Very Fine Sand	Boron	Nitrate(as N)	CO3	Selenium
		cm	%	%	%		%	ppm	ppm	%	ppm
S1312086-001	DP-7	122-165	14.0	36.0	50.0	Clay	5.6	1.00	4.9	18.9	<0.02
S1312086-002	DP-7	165-200	22.0	35.0	43.0	Clay	4.4	0.68	0.5	20.1	<0.02
S1312086-003	DP-7	200-244	78.0	10.0	12.0	Sandy Loam	9.6	0.16	0.3	20.6	<0.02
S1312086-004	DP-10	122-172	20.0	32.0	48.0	Clay	5.0	1.43	11.4	22.2	0.06
S1312086-005	DP-10	172-244	66.0	22.0	12.0	Sandy Loam	13.0	0.40	1.1	31.6	<0.02
S1312086-006	DP-19	122-225	54.0	32.0	14.0	Sandy Loam	8.5	0.20	2.1	34.2	<0.02
S1312086-007	DP-19	225-244	82.5	10.0	7.5	Loamy Sand	12.0			18.8	
S1312086-008	13AS08	122-244	10.0	42.0	48.0	Silty Clay	<0.1	1.64	0.9	20.4	<0.02
S1312086-009	13AS08	244-366	16.0	43.0	41.0	Silty Clay	8.0	1.19	2.0	24.3	<0.02
S1312086-010	13AS08	366-488	6.0	37.0	57.0	Silty Clay	0.9	1.12	0.6	22.8	<0.02

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Soil Analysis Report

Alton Coal Development, LLC

463 North 100 West
Suite 1
Cedar City, UT 84721

Report ID: S1312086001

Project: Private Lease Soils - Short List

Date Received: 12/2/2013

Date Reported: 3/11/2014

Work Order: S1312086

Lab ID	Sample ID	Depths cm	Total Carbon %	TOC %
S1312086-001	DP-7	122-165	3.3	1.1
S1312086-002	DP-7	165-200	3.1	0.7
S1312086-003	DP-7	200-244	3.0	0.5
S1312086-004	DP-10	122-172	3.7	1.0
S1312086-005	DP-10	172-244	4.7	0.9
S1312086-006	DP-19	122-225	4.7	0.6
S1312086-007	DP-19	225-244	2.5	0.2
S1312086-008	13AS08	122-244	3.2	0.7
S1312086-009	13AS08	244-366	3.5	0.6
S1312086-010	13AS08	366-488	3.6	0.8

C - 160

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs, Inc
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(307) 672-8945

Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 11/26/2012

Report ID: S1211393001
Date Reported: 1/30/2013
Work Order: S1211393

Lab ID	Sample ID	Organic Matter %	Sand %	Silt %	Clay %	Very Fine Sand %	Texture	K-factor (t.ac.h/100acft.tf.in)	Structure s	Permeability p	M
S1211393-001	12AS001 (1-12)	4.9	30.0	39.0	31.0	8.0	Clay Loam	0.17	2	4	3243.0
S1211393-002	12AS001 (12-28)	3.9	24.0	41.0	35.0	5.4	Clay Loam	0.18	2	4	3016.0
S1211393-003	12AS001 (28-56)	3.3	10.0	49.0	41.0	0	Silty Clay	0.24	2	6	2891.0
S1211393-004	12AS001 (56-90)	4.2	16.0	40.0	44.0	6.9	Silty Clay	0.20	2	6	2626.4
S1211393-005	12AS001 (90-122)	1.1	26.0	42.0	32.0	6.4	Clay Loam	0.26	2	4	3291.2
S1211393-006	12AS001 (122-160)	0.6	64.0	24.0	12.0	14.4	Sandy Loam	0.23	2	2	3379.2
S1211393-007	12AS002 (0-9)	2.2	30.0	41.0	29.0	10.4	Clay Loam	0.29	3	4	3649.4
S1211393-008	12AS002 (9-26)	3.3	20.0	46.0	34.0	11.2	Clay Loam	0.28	3	4	3775.2
S1211393-009	12AS002 (26-55)	2.6	24.0	39.0	37.0	13.9	Clay Loam	0.26	3	4	3332.7
S1211393-010	12AS002 (55-87)	2.5	18.0	42.0	40.0	7.7	Silty Clay	0.29	3	6	2982.0
S1211393-011	12AS002 (87-110)	2.7	10.0	52.0	38.0	0.6	Silty Clay Loam	0.28	3	5	3261.2
S1211393-012	12AS003 (0-8)	4.4	24.0	39.0	37.0	5.9	Clay Loam	0.16	2	4	2828.7
S1211393-013	12AS003 (8-34)	2.7	25.0	33.0	42.0	10.5	Clay	0.22	2	6	2523.0
S1211393-014	12AS003 (34-88)	0.5	25.0	53.0	22.0	12.5	Silty Loam	0.41	2	3	5109.0
S1211393-015	12AS003 (88-122)	0.9	27.0	50.0	23.0	10.1	Silty Loam	0.35	2	3	4627.7
S1211393-016	12AS003 (122-155)	1.1	43.0	41.0	16.0	7.0	Loam	0.30	2	3	4032.0
S1211393-017	12AS004 (0-8)	6.4	65.0	15.0	20.0	15.9	Sandy Clay Loam	0.11	2	4	2472.0
S1211393-018	12AS004 (8-22)	1.4	67.0	10.0	23.0	16.7	Sandy Clay Loam	0.16	2	4	2055.9
S1211393-019	12AS004 (22-48)	0.6	77.0	14.0	9.0	10.2	Sandy Loam	0.13	2	2	2202.2
S1211393-020	12AS004 (48-78)	1.3	39.0	34.0	27.0	9.9	Clay Loam	0.25	2	4	3204.7
S1211393-021	12AS005 (0-5)	3.9	17.0	33.0	50.0	5.0	Clay	0.17	2	6	1900.0
S1211393-022	12AS005 (5-35)	2.3	9.0	33.0	58.0	4.5	Silty Clay	0.16	2	6	1575.0
S1211393-023	12AS005 (35-78)	1.1	7.0	29.0	64.0	3.3	Clay	0.15	2	6	1162.8
S1211393-024	12AS007 (0-7)	1.9	47.0	24.0	29.0	11.5	Sandy Clay Loam	0.19	2	4	2520.5
S1211393-025	12AS007 (7-44)	1.8	37.0	27.0	36.0	4.2	Clay Loam	0.15	2	4	1996.8
S1211393-026	12AS007 (44-83)	1.3	67.0	11.0	22.0	16.6	Sandy Clay Loam	0.17	2	4	2152.8
S1211393-027	12AS008 (0-9)	4.0	63.0	20.0	17.0	12.2	Sandy Loam	0.11	2	2	2672.6
S1211393-028	12AS008 (9-23)	2.5	77.0	11.0	12.0	11.4	Sandy Loam	0.09	2	2	1971.2

These Results apply only to the samples tested.

Reviewed by:

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs, Inc
1673 Terra Ave, Sheridan, Wyoming, 82801
(307) 672-8945

Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 1/22/2013

Report ID: S1301365001
Date Reported: 4/9/2013
Work Order: S1301365

Lab ID	Sample ID	Organic Matter %	Sand %	Silt %	Clay %	Very Fine Sand %	Texture	K-factor (t.ac.h/100acft.tf.in)	Structure s	Permeability p	M
S1301365-001	12AS009 (0-7)	4.8	26.0	35.0	39.0	7.1	Clay Loam	0.17	3	4	2568.1
S1301365-002	12AS009 (7-20)	3.4	10.0	46.0	44.0	0.1	Silty Clay	0.25	3	6	2581.6
S1301365-003	12AS009 (20-62)	1.8	<0.1	47.0	53.0	0.1	Silty Clay	0.25	3	6	2213.7
S1301365-004	12AS009 (62-99)	1.3	<0.1	48.0	52.0	0.1	Silty Clay	0.26	3	6	2308.8
S1301365-005	12AS009 (99-137)	0.9	<0.1	53.0	47.0	0.1	Silty Clay	0.27	2	6	2814.3
S1301365-006	12AS009 (137-183)	1.0	<0.1	49.0	51.0	0.1	Silty Clay	0.24	2	6	2405.9
S1301365-007	12AS009 (183-232)	2.3	6.0	58.0	36.0	0.1	Silty Clay Loam	0.32	3	5	3718.4
S1301365-008	12AS010 (0-9)	5.7	10.0	50.0	40.0	0.1	Silty Clay	0.23	3	6	3006.0
S1301365-009	12AS010 (9-31)	2.4	8.0	68.0	24.0	0.1	Silty Loam	0.35	2	3	5175.6
S1301365-010	12AS010 (31-67)	2.1	16.0	50.0	34.0	0.1	Silty Clay Loam	0.26	2	5	3306.6
S1301365-011	12AS010 (67-96)	0.5	66.0	18.0	16.0	17.7	Sandy Loam	0.20	2	2	2998.8
S1301365-012	12AS010 (96-134)	0.5	42.0	36.0	22.0	9.8	Loam	0.27	2	3	3572.4
S1301365-013	12AS010 (134-183)	1.1	20.0	60.0	20.0	10.5	Silty Loam	0.43	2	3	5640.0
S1301365-014	12AS010 (183-200)	0.5	60.0	28.0	12.0	8.8	Sandy Loam	0.22	2	2	3238.4
S1301365-015	12AS010 (200-284)	0.9	<0.1	48.0	52.0	0.1	Silty Clay	0.27	3	6	2308.8
S1301365-016	12AS011 (0-10)	6.1	18.0	41.0	41.0	0.1	Silty Clay	0.16	2	6	2424.9
S1301365-017	12AS011 (10-32)	4.5	18.0	40.0	42.0	0.5	Silty Clay	0.18	2	6	2349.0
S1301365-018	12AS011 (32-71)	1.3	<0.1	61.0	39.0	0.1	Silty Clay Loam	0.31	2	5	3727.1
S1301365-019	12AS011 (71-116)	0.6	<0.1	37.0	63.0	0.1	Clay	0.20	3	6	1372.7
S1301365-020	12AS011 (116-128)	1.0	70.0	18.0	12.0	3.6	Sandy Loam	0.10	2	2	1900.8
S1301365-021	12AS011 (128-154)	1.0	<0.1	25.0	75.0	0.1	Clay	0.14	3	6	627.5
S1301365-022	12AS011 (154-214)	1.3	<0.1	17.0	83.0	0.1	Clay	0.12	3	6	290.7
S1301365-023	12AS012 (0-11)	6.0	<0.1	37.0	63.0	0.1	Clay	0.16	3	6	1372.7
S1301365-024	12AS012 (11-30)	4.1	<0.1	25.0	75.0	0.1	Clay	0.13	3	6	627.5
S1301365-025	12AS012 (30-72)	0.8	<0.1	37.0	63.0	0.1	Clay	0.20	3	6	1372.7

These Results apply only to the samples tested.

Reviewed by: Karen Secor

Karen Secor, Soil Lab Supervisor

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Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 1/22/2013

Report ID: S1301365001
Date Reported: 4/9/2013
Work Order: S1301365

Lab ID	Sample ID	Organic Matter	Sand	Silt	Clay	Very Fine Sand	Texture	K-factor	Structure	Permeability	M
		%	%	%	%	%		(t.ac.h/100acft.tf.in)	s	p	
S1301365-026	12AS012 (72-116)	0.3	42.0	33.0	25.0	0.1	Loam	0.18	2	3	2482.5
S1301365-027	12AS012 (116-160)	0.3	50.0	32.0	18.0	0.1	Loam	0.19	2	3	2632.2
S1301365-028	12AS012 (160-187)	0.6	50.0	33.0	17.0	0.1	Loam	0.20	2	3	2747.3
S1301365-029	12AS012 (187-230)	0.3	50.0	33.0	17.0	0.1	Loam	0.20	2	3	2747.3
S1301365-030	12AS013 (0-16)	4.4	<0.1	28.0	72.0	0.1	Clay	0.14	3	6	786.8
S1301365-031	12AS013 (16-52)	1.6	<0.1	39.0	61.0	0.1	Clay	0.20	3	6	1524.9
S1301365-032	12AS013 (52-102)	0.9	<0.1	39.0	61.0	0.1	Clay	0.21	3	6	1524.9
S1301365-033	12AS013 (102-114)	0.8	<0.1	27.0	73.0	0.1	Clay	0.18	4	6	731.7
S1301365-034	12AS014 (0-20)	2.5	6.0	43.0	51.0	1.7	Silty Clay	0.24	3	6	2190.3
S1301365-035	12AS014 (20-45)	1.8	6.0	43.0	51.0	2.2	Silty Clay	0.25	3	6	2214.8
S1301365-036	12AS014 (45-66)	1.1	4.0	44.0	52.0	0.3	Silty Clay	0.25	3	6	2126.4
S1301365-037	12AS014 (66-88)	2.0	10.0	37.0	53.0	6.3	Clay	0.23	3	6	2035.1
S1301365-038	12AS014 (88-114)	1.0	6.0	39.0	55.0	2.4	Silty Clay	0.23	3	6	1863.0
S1301365-039	12AS015 (0-20)	3.7	10.0	39.0	51.0	4.4	Clay	0.22	3	6	2126.6
S1301365-040	12AS015 (20-54)	2.4	12.0	32.0	56.0	7.2	Silty Clay	0.21	3	6	1724.8
S1301365-041	12AS015 (54-87)	1.7	10.0	30.0	60.0	5.6	Clay	0.19	3	6	1424.0
S1301365-042	12AS015 (87-119)	1.0	10.0	31.0	59.0	6.1	Silty Clay	0.17	2	6	1521.1
S1301365-083	12AS015 (119-132)	0.8	20.0	32.0	48.0	15.6	Clay	0.28	3	6	2475.2
S1301365-043	12AS016 (0-11)	2.9	22.0	46.0	32.0	13.9	Clay Loam	0.27	2	4	4073.2
S1301365-044	12AS016 (11-40)	1.9	18.0	49.0	33.0	10.2	Silty Clay Loam	0.32	2	5	3966.4
S1301365-045	12AS016 (40-71)	1.3	22.0	37.0	41.0	15.5	Clay	0.32	3	6	3097.5
S1301365-046	12AS016 (71-120)	1.7	22.0	47.0	31.0	13.0	Clay Loam	0.34	3	4	4140.0
S1301365-047	12AS017 (0-13)	3.5	14.0	31.0	55.0	9.2	Silty Clay	0.17	2	6	1809.0
S1301365-048	12AS017 (13-57)	1.9	10.0	23.0	67.0	6.6	Clay	0.19	4	6	976.8
S1301365-049	12AS017 (57-84)	0.3	16.0	31.0	53.0	6.3	Clay	0.23	3	6	1753.1
S1301365-050	12AS017 (84-118)	0.6	18.0	24.0	58.0	4.5	Silty Clay	0.22	4	6	1197.0

These Results apply only to the samples tested.

Reviewed by: Karen Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs, Inc
1673 Terra Ave, Sheridan, Wyoming, 82801
(307) 672-8945

Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 1/22/2013

Report ID: S1301365001
Date Reported: 4/9/2013
Work Order: S1301365

Lab ID	Sample ID	Organic Matter	Sand	Silt	Clay	Very Fine Sand	Texture	K-factor	Structure	Permeability	M
		%	%	%	%	%		(t.ac.h/100acft.tf.in)	s	p	
S1301365-051	12AS017 (118-161)	0.2	16.0	29.0	55.0	8.5	Silty Clay	0.23	3	6	1687.5
S1301365-052	12AS019 (0-12)	5.5	16.0	41.0	43.0	2.3	Silty Clay	0.21	3	6	2468.1
S1301365-053	12AS019 (12-32)	5.8	12.0	41.0	47.0	0.2	Silty Clay	0.19	3	6	2183.6
S1301365-054	12AS019 (32-72)	3.9	10.0	46.0	44.0	0.1	Silty Clay	0.24	3	6	2581.6
S1301365-055	12AS019 (72-100)	1.1	24.0	35.0	41.0	19.1	Clay	0.33	3	6	3191.9
S1301365-056	12AS019 (100-147)	0.4	46.0	35.0	19.0	10.5	Loam	0.28	2	3	3685.5
S1301365-057	12AS019 (147-196)	2.8	44.0	41.0	15.0	11.5	Loam	0.28	2	3	4462.5
S1301365-058	12AS019 (196-240)	0.2	52.0	33.0	15.0	11.1	Sandy Loam	0.27	2	2	3748.5
S1301365-059	12AS023 (0-18)	0.3	50.0	25.0	25.0	5.9	Sandy Clay Loam	0.23	3	4	2317.5
S1301365-060	12AS023 (18-47)	2.9	51.0	25.0	24.0	2.0	Sandy Clay Loam	0.14	2	4	2052.0
S1301365-061	12AS023 (47-78)	3.0	64.0	18.0	18.0	10.7	Sandy Loam	0.11	2	2	2353.4
S1301365-062	12AS023 (78-120)	1.9	60.0	26.0	14.0	0.1	Sandy Loam	0.12	2	2	2244.6
S1301365-063	12AS023 (120-180)	0.7	84.0	8.0	8.0	10.6	Loamy Sand	0.09	2	2	1711.2
S1301365-064	12AS023 (180-230)	0.2	80.0	14.0	6.0	6.8	Loamy Sand	0.11	2	2	1955.2
S1301365-065	12AS025 (0-12)	6.4	22.0	56.0	22.0	7.5	Silty Loam	0.19	2	3	4953.0
S1301365-066	12AS025 (12-30)	3.8	16.0	41.0	43.0	8.1	Silty Clay	0.25	3	6	2798.7
S1301365-067	12AS025 (30-70)	0.7	12.0	56.0	32.0	6.9	Silty Clay Loam	0.38	2	5	4277.2
S1301365-068	12AS025 (70-101)	0.5	32.0	49.0	19.0	27.3	Loam	0.51	2	3	6180.3
S1301365-069	12AS025 (101-123)	0.2	38.0	46.0	16.0	13.8	Loam	0.41	2	3	5023.2
S1301365-070	12AS025 (123-156)	0.7	20.0	44.0	36.0	13.3	Clay Loam	0.33	3	4	3667.2
S1301365-071	12AS025 (156-186)	0.2	58.0	26.0	16.0	16.2	Sandy Loam	0.25	2	2	3544.8
S1301365-072	12AS025 (186-204)	0.1	60.0	32.0	8.0	17.0	Sandy Loam	0.34	2	2	4508.0
S1301365-073	12AS026 (3-20)	7.0	20.0	39.0	41.0	7.7	Clay	0.20	3	6	2755.3
S1301365-074	12AS026 (20-65)	1.9	20.0	47.0	33.0	3.9	Clay Loam	0.28	3	4	3410.3
S1301365-075	12AS026 (65-104)	2.0	30.0	31.0	39.0	6.4	Clay Loam	0.17	2	4	2281.4
S1301365-076	12AS026 (104-144)	2.3	10.0	41.0	49.0	2.2	Silty Clay	0.24	3	6	2203.2

These Results apply only to the samples tested.

Reviewed by: Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs, Inc
1673 Terra Ave, Sheridan, Wyoming, 82801
(307) 672-8945

Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 1/22/2013

Report ID: S1301365001
Date Reported: 4/9/2013
Work Order: S1301365

Lab ID	Sample ID	Organic Matter	Sand	Silt	Clay	Very Fine Sand	Texture	K-factor	Structure	Permeability	M
		%	%	%	%	%		(t.ac.h/100acft.tf.in)	s	p	
S1301365-077	12AS026 (144-202)	1.2	20.0	37.0	43.0	15.5	Clay	0.32	3	6	2992.5
S1301365-078	12AS030 (0-15)	2.5	12.0	35.0	53.0	7.9	Clay	0.22	3	6	2016.3
S1301365-079	12AS030 (15-30)	1.9	16.0	30.0	54.0	11.9	Clay	0.23	3	6	1927.4
S1301365-080	12AS030 (30-42)	1.8	14.0	32.0	54.0	10.0	Clay	0.26	4	6	1932.0
S1301365-081	12AS030 (42-67)	1.9	10.0	36.0	54.0	6.2	Clay	0.26	4	6	1941.2
S1301365-082	12AS030 (67-95)	1.9	10.0	34.0	56.0	6.2	Silty Clay	0.21	3	6	1768.8

These Results apply only to the samples tested.

Reviewed by: Karen Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs, Inc
1673 Terra Ave, Sheridan, Wyoming, 82801
(307) 672-8945

Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 1/22/2013

Report ID: S1301363001
Date Reported: 4/9/2013
Work Order: S1301363

Lab ID	Sample ID	Organic Matter %	Sand %	Silt %	Clay %	Very Fine Sand %	Texture	K-factor (t.ac.h/100acft.tf.in)	Structure s	Permeability p	M
S1301363-001	12AS018 (0-22)	5.6	26.0	38.0	36.0	9.4	Clay Loam	0.18	3	4	3033.6
S1301363-002	12AS018 (22-68)	1.9	26.0	42.0	32.0	7.3	Clay Loam	0.28	3	4	3352.4
S1301363-003	12AS018 (68-115)	1.3	8.0	48.0	44.0	4.0	Silty Clay	0.31	3	6	2912.0
S1301363-004	12AS018 (115-148)	1.2	18.0	42.0	40.0	12.3	Silty Clay	0.34	3	6	3258.0
S1301363-005	12AS018 (148-244)	0.5	60.0	28.0	12.0	17.2	Sandy Loam	0.28	2	2	3977.6
S1301363-006	12AS020 (0-13)	7.4	20.0	49.0	31.0	3.3	Clay Loam	0.13	2	4	3608.7
S1301363-007	12AS020 (13-30)	4.2	12.0	51.0	37.0	2.1	Silty Clay Loam	0.25	3	5	3345.3
S1301363-008	12AS020 (30-80)	2.8	10.0	50.0	40.0	1.8	Silty Clay	0.29	3	6	3108.0
S1301363-009	12AS020 (80-11)	0.9	8.0	51.0	41.0	2.4	Silty Clay	0.30	2	6	3150.6
S1301363-010	12AS020 (111-140)	1.2	10.0	54.0	36.0	5.2	Silty Clay Loam	0.32	2	5	3788.8
S1301363-011	12AS020 (140-175)	1.1	10.0	64.0	26.0	4.8	Silty Loam	0.42	3	3	5091.2
S1301363-012	12AS021 (0-9)	5.1	24.0	41.0	35.0	10.9	Clay Loam	0.21	3	4	3373.5
S1301363-013	12AS021 (9-32)	3.9	22.0	45.0	33.0	10.7	Clay Loam	0.26	3	4	3731.9
S1301363-014	12AS021 (32-65)	2.7	22.0	46.0	32.0	8.3	Clay Loam	0.29	3	4	3692.4
S1301363-015	12AS021 (65-95)	0.7	32.0	56.0	12.0	15.5	Silty Loam	0.54	3	3	6292.0
S1301363-016	12AS021 (95-150)	1.1	52.0	36.0	12.0	9.6	Sandy Loam	0.27	2	2	4012.8
S1301363-017	12AS021 (150-202)	0.9	82.0	15.0	3.0	18.3	Loamy Sand	0.21	2	2	3230.1
S1301363-018	12AS021 (202-230)	0.4	82.0	16.0	2.0	12.5	Loamy Sand	0.18	2	2	2793.0
S1301363-019	12AS022 (0-12)	0.7	84.0	14.0	2.0	12.5	Loamy Sand	0.19	3	2	2597.0
S1301363-020	12AS022 (12-50)	0.3	90.0	8.0	2.0	8.5	Sand	0.09	3	1	1617.0
S1301363-021	12AS022 (50-87)	0.4	86.0	12.0	2.0	6.9	Sand	0.08	2	1	1852.2
S1301363-022	12AS022 (87-126)	0.3	90.0	9.0	1.0	4.9	Sand	0.04	2	1	1376.1
S1301363-023	12AS022 (126-160)	1.0	82.0	15.0	3.0	9.9	Loamy Sand	0.17	3	2	2415.3
S1301363-024	12AS022 (160-210)	0.5	84.0	14.0	2.0	11.3	Loamy Sand	0.15	2	2	2479.4
S1301363-025	12AS022 (210-232)	2.5	80.0	16.0	4.0	17.2	Loamy Sand	0.15	2	1	3187.2

These Results apply only to the samples tested.

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs, Inc
1673 Terra Ave, Sheridan, Wyoming, 82801
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Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 1/22/2013

Report ID: S1301363001
Date Reported: 4/9/2013
Work Order: S1301363

Lab ID	Sample ID	Organic Matter	Sand	Silt	Clay	Very Fine Sand	Texture	K-factor	Structure	Permeability	M
		%	%	%	%	%		(t.ac.h/100acft.tf.in)	s	p	
S1301363-026	12AS024 (0-18)	0.3	74.0	20.0	6.0	2.2	Sandy Loam	0.16	3	2	2086.8
S1301363-027	12AS024 (18-84)	0.3	80.0	18.0	2.0	6.4	Loamy Sand	0.18	3	2	2391.2
S1301363-028	12AS024 (84-136)	0.3	88.0	10.0	2.0	9.5	Sand	0.12	3	1	1911.0
S1301363-029	12AS024 (136-186)	1.3	84.0	14.0	2.0	8.3	Loamy Sand	0.15	3	2	2185.4
S1301363-030	12AS024 (186-233)	0.4	88.0	11.0	1.0	8.8	Sand	0.09	2	1	1960.2
S1301363-031	12AS027 (0-20)	5.5	24.0	36.0	40.0	13.6	Clay	0.20	2	6	2976.0
S1301363-032	12AS027 (20-52)	5.0	24.0	40.0	36.0	10.0	Clay Loam	0.17	2	4	3200.0
S1301363-033	12AS027 (52-100)	3.6	26.0	36.0	38.0	7.4	Clay Loam	0.20	3	4	2690.8
S1301363-034	12AS027 (100-116)	2.1	34.0	30.0	36.0	12.0	Clay Loam	0.23	3	4	2688.0
S1301363-035	12AS027 (116-156)	1.7	12.0	50.0	38.0	5.7	Silty Clay Loam	0.28	2	5	3453.4
S1301363-036	12AS027 (156-170)	1.2	6.0	54.0	40.0	2.5	Silty Clay	0.31	2	6	3390.0
S1301363-037	12AS028 (0-12)	5.9	18.0	38.0	44.0	5.8	Clay	0.20	3	6	2452.8
S1301363-038	12AS028 (12-25)	4.0	18.0	43.0	39.0	7.9	Silty Clay Loam	0.24	3	5	3104.9
S1301363-039	12AS028 (25-68)	1.6	10.0	46.0	44.0	4.8	Silty Clay	0.30	3	6	2844.8
S1301363-040	12AS028 (68-103)	0.4	52.0	36.0	12.0	17.2	Sandy Loam	0.38	3	2	4681.6
S1301363-041	12AS028 (103-128)	1.0	12.0	56.0	32.0	6.3	Silty Clay Loam	0.40	3	5	4236.4
S1301363-042	12AS028 (128-157)	1.4	12.0	46.0	42.0	2.4	Silty Clay	0.26	2	6	2807.2
S1301363-043	12AS028 (157-173)	0.9	48.0	40.0	12.0	11.7	Loam	0.34	2	3	4549.6
S1301363-044	12AS029 (0-14)	5.0	46.0	24.0	30.0	27.5	Sandy Clay Loam	0.19	2	4	3605.0
S1301363-045	12AS029 (14-36)	2.4	32.0	30.0	38.0	7.1	Clay Loam	0.19	3	4	2300.2
S1301363-046	12AS029 (36-58)	2.1	12.0	40.0	48.0	0.1	Silty Clay	0.23	3	6	2085.2
S1301363-047	12AS029 (58-86)	5.1	2.0	40.0	58.0	0.1	Clay	0.14	2	6	1684.2
S1301363-048	12AS029 (86-118)	1.6	8.0	34.0	58.0	3.3	Silty Clay	0.17	2	6	1566.6
S1301363-049	12AS029 (118-173)	1.0	6.0	56.0	38.0	0.7	Silty Clay Loam	0.34	3	5	3515.4
S1301363-050	12AS029 (173-232)	1.1	8.0	40.0	52.0	4.1	Silty Clay	0.22	2	6	2116.8
S1301363-051	12AS029 (232-244)	1.1	44.0	24.0	32.0	3.1	Clay Loam	0.15	2	4	1842.8

These Results apply only to the samples tested.

Reviewed by: Karen Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs, Inc
1673 Terra Ave, Sheridan, Wyoming, 82801
(307) 672-8945

Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 4/11/2013

Report ID: S1304177001
Date Reported: 5/31/2013
Work Order: S1304177

Lab ID	Sample ID	Organic Matter %	Sand %	Silt %	Clay %	Very Fine Sand %	Texture	K-factor (t.ac.h/100acft.tf.in)	Structure s	Permeability p	M
S1304177-001	DP-17 (0-20)	2.9	28.0	34.0	38.0	11.1	Clay Loam	0.15	1	4	2796.2
S1304177-002	DP-17 (20-32)	2.3	30.0	29.0	41.0	10.8	Clay	0.22	2	6	2348.2
S1304177-003	DP-17 (32-54)	2.0	28.0	28.0	44.0	11.7	Clay	0.21	2	6	2223.2
S1304177-004	DP-17 (54-122)	2.3	22.0	32.0	46.0	10.0	Clay	0.21	2	6	2268.0
S1304177-005	DP-17 (122-170)	1.9	16.0	34.0	50.0	4.7	Clay	0.23	3	6	1935.0
S1304177-006	DP-29 (0-24)	5.2	20.0	38.0	42.0	3.3	Clay	0.18	2	6	2395.4
S1304177-007	DP-29 (24-52)	4.1	18.0	38.0	44.0	6.0	Clay	0.23	3	6	2464.0
S1304177-008	DP-29 (52-72)	1.4	50.0	32.0	18.0	10.4	Loam	0.27	3	3	3476.8
S1304177-009	DP-29 (72-97)	2.4	10.0	46.0	44.0	0.1	Silty Clay	0.26	3	6	2581.6
S1304177-010	DP-29 (97-155)	1.3	4.0	52.0	44.0	0.1	Silty Clay	0.31	3	6	2917.6
S1304177-011	DP-29 (155-210)	1.2	10.0	44.0	46.0	6.7	Silty Clay	0.30	3	6	2737.8
S1304177-012	DP-29 (210-266)	1.0	14.0	40.0	46.0	3.3	Silty Clay	0.30	4	6	2338.2
S1304177-013	DP-29 (266-345)	1.5	6.0	44.0	50.0	2.5	Silty Clay	0.29	4	6	2325.0
S1304177-014	DP-29 (345-365)	1.0	17.5	37.5	45.0	13.2	Clay	0.34	4	6	2788.5

These Results apply only to the samples tested.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs, Inc
1673 Terra Ave, Sheridan, Wyoming, 82801
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Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 4/11/2013

Report ID: S1304178001
Date Reported: 5/29/2013
Work Order: S1304178

Lab ID	Sample ID	Organic Matter %	Sand %	Silt %	Clay %	Very Fine Sand %	Texture	K-factor (t.ac.h/100acft.tf.in)	Structure s	Permeability p	M
S1304178-001	DP-16 (0-18)	2.9	36.0	28.0	36.0	18.2	Clay Loam	0.20	2	4	2956.8
S1304178-002	DP-16 (18-43)	1.8	24.0	32.0	44.0	13.4	Clay	0.24	2	6	2542.4
S1304178-003	DP-16 (43-70)	2.1	18.0	36.0	46.0	9.0	Clay	0.23	2	6	2430.0
S1304178-004	DP-16 (70-102)	2.9	22.0	30.0	48.0	14.4	Clay	0.21	2	6	2308.8
S1304178-005	DP-28 (0-14)	3.6	20.0	34.0	46.0	10.3	Clay	0.20	2	6	2392.2
S1304178-006	DP-28 (14-38)	2.3	10.0	38.0	52.0	5.0	Clay	0.20	2	6	2064.0
S1304178-007	DP-28 (38-62)	1.7	10.0	35.0	55.0	5.8	Silty Clay	0.22	3	6	1836.0
S1304178-008	DP-28 (62-100)	2.0	20.0	44.0	36.0	10.6	Clay Loam	0.29	3	4	3494.4
S1304178-009	DP-28 (100-120)	2.3	12.0	44.0	44.0	1.1	Silty Clay	0.26	3	6	2525.6
S1304178-010	DP-28 (120-140)	1.7	14.0	34.0	52.0	4.6	Clay	0.22	3	6	1852.8
S1304178-011	DP-04 (0-20)	2.7	30.0	42.0	28.0	6.6	Clay Loam	0.24	2	4	3499.2
S1304178-012	DP-04 (20-46)	2.3	30.0	38.0	32.0	10.3	Clay Loam	0.23	2	4	3284.4
S1304178-013	DP-04 (46-90)	2.4	36.0	32.0	32.0	12.3	Clay Loam	0.21	2	4	3012.4
S1304178-014	DP-04 (90-153)	2.3	38.0	34.0	28.0	8.0	Clay Loam	0.21	2	4	3024.0
S1304178-015	DP-04 (153-232)	0.9	66.0	24.0	10.0	11.0	Sandy Loam	0.17	1	2	3150.0
S1304178-016	DP-05 (0-35)	2.6	20.0	42.0	38.0	8.4	Clay Loam	0.22	2	4	3124.8
S1304178-017	DP-05 (35-70)	2.5	18.0	39.0	43.0	9.5	Clay	0.27	3	6	2764.5
S1304178-018	DP-05 (70-162)	1.8	16.0	39.0	45.0	9.1	Clay	0.28	3	6	2645.5

These Results apply only to the samples tested.

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs, Inc
1673 Terra Ave, Sheridan, Wyoming, 82801
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Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 7/30/2013

Report ID: S1307417001
Date Reported: 10/15/2013
Work Order: S1307417

Lab ID	Sample ID	Organic Matter %	Sand %	Silt %	Clay %	Very Fine Sand %	Texture	K-factor (t.ac.h/100acft.tf.in)	Structure s	Permeability p	M
S1307417-001	12AS009 (232-230)	1.0	60.0	30.0	10.0	2.7	Sandy Loam	0.15	1	2	2943.0
S1307417-002	12AS009 (320-366)	1.2	56.0	32.4	11.6	7.3	Sandy Loam	0.22	2	2	3509.5
S1307417-003	12AS009 (366-514)	1.1	66.0	26.0	8.0	7.5	Sandy Loam	0.16	1	2	3082.0
S1307417-004	12AS018 (244-318)	0.2	80.0	14.0	6.0	6.5	Loamy Sand	0.08	1	2	1927.0
S1307417-006	12AS018 (318-388)	2.2	<0.1	53.0	47.0	0.1	Silty Clay	0.28	3	6	2814.3
S1307417-007	12AS018 (406-572)	1.4	28.0	51.0	21.0	2.0	Silty Loam	0.30	2	3	4187.0
S1307417-008	12AS018 (572-640)	3.0	14.0	54.0	32.0	3.9	Silty Clay Loam	0.32	3	5	3937.2
S1307417-009	12AS018 (640-732)	1.8	16.0	44.0	40.0	0.1	Silty Clay	0.28	3	6	2646.0
S1307417-010	12AS020 (175-300)	1.1	38.0	40.0	22.0	2.2	Loam	0.23	2	3	3291.6
S1307417-011	12AS020 (300-488)	1.0	56.0	30.0	14.0	5.9	Sandy Loam	0.23	3	2	3087.4
S1307417-012	12AS020 (488-600)	1.1	32.0	48.0	20.0	10.2	Loam	0.38	3	3	4656.0
S1307417-013	12AS021 (260-374)	1.9	<0.1	59.0	41.0	0.1	Silty Clay	0.37	4	6	3486.9
S1307417-014	12AS021 (374-448)	1.4	73.0	21.0	6.0	4.7	Sandy Loam	0.14	2	2	2415.8
S1307417-015	12AS021 (448-524)	1.5	75.0	19.0	6.0	0.1	Sandy Loam	0.09	2	2	1795.4
S1307417-016	12AS021 (524-570)	2.3	31.0	52.0	17.0	9.5	Silty Loam	0.38	3	3	5104.5
S1307417-017	12AS021 (570-660)	2.6	37.0	37.0	26.0	3.3	Loam	0.21	3	3	2982.2
S1307417-018	12AS021 (660-742)	1.2	73.0	17.0	10.0	5.9	Sandy Loam	0.11	2	2	2061.0
S1307417-019	12AS021 (742-853)	0.8	81.0	13.0	6.0	2.5	Loamy Sand	0.07	2	2	1457.0
S1307417-020	12AS024 (243-305)	0.7	80.0	12.0	8.0	7.0	Loamy Sand	0.13	3	2	1748.0
S1307417-021	12AS027 (170-305)	1.7	<0.1	52.0	48.0	0.1	Silty Clay	0.32	4	6	2709.2
S1307417-022	12AS027 (305-427)	1.5	12.0	39.0	49.0	0.1	Clay	0.27	4	6	1994.1
S1307417-023	12AS027 (427-560)	1.4	4.0	37.0	59.0	0.1	Silty Clay	0.20	3	6	1521.1
S1307417-024	12AS027 (560-625)	0.9	46.0	32.0	22.0	8.3	Loam	0.26	3	3	3143.4
S1307417-025	12AS027 (625-792)	0.6	64.0	26.0	10.0	7.2	Sandy Loam	0.19	2	2	2988.0
S1307417-026	12AS028 (173-235)	0.6	50.0	38.0	12.0	10.2	Loam	0.29	1	3	4241.6
S1307417-027	12AS028 (235-275)	1.0	72.0	18.0	10.0	7.4	Sandy Loam	0.10	1	2	2286.0
S1307417-028	12AS028 (275-325)	3.3	72.0	20.0	8.0	7.0	Sandy Loam	0.11	2	2	2484.0

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Reviewed by: Karen Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs, Inc
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Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 7/30/2013

Report ID: S1307417001
Date Reported: 10/15/2013
Work Order: S1307417

Lab ID	Sample ID	Organic Matter	Sand	Silt	Clay	Very Fine Sand	Texture	K-factor	Structure	Permeability	M
		%	%	%	%	%		(t.ac.h/100acft.tf.in)	s	p	
S1307417-029	12AS028 (325-460)	3.3	28.0	46.0	26.0	5.6	Loam	0.25	3	3	3818.4
S1307417-030	12AS028 (460-610)	1.7	54.0	32.0	14.0	4.9	Sandy Loam	0.22	3	2	3173.4
S1307417-031	12AS029 (244-334)	1.1	62.0	24.0	14.0	1.9	Sandy Loam	0.13	2	2	2227.4
S1307417-032	12AS029 (334-500)	0.6	4.0	40.0	56.0	0.1	Clay	0.20	2	6	1764.4
S1307417-033	12AS029 (500-610)	0.6	64.0	16.0	20.0	59.6	Sandy Clay Loam	0.55	3	4	6048.0
S1307417-034	DP-12 (0-28)	1.5	58.0	25.0	17.0	11.1	Sandy Loam	0.15	1	2	2996.3
S1307417-035	DP-12 (28-62)	4.6	50.0	35.0	15.0	2.4	Loam	0.12	1	3	3179.0
S1307417-036	DP-12 (62-126)	1.6	66.0	12.0	22.0	23.9	Sandy Clay Loam	0.21	2	4	2800.2
S1307417-037	DP-12 (126-183)	0.8	52.0	26.0	22.0	0.1	Sandy Clay Loam	0.20	3	4	2035.8
S1307417-038	DP-12 (183-244)	0.1	50.0	28.0	22.0	18.4	Loam	0.35	4	3	3619.2
S1307417-039	DP-21 (140-188)	0.9	11.0	41.0	48.0	0.9	Silty Clay	0.29	4	6	2178.8
S1307417-040	DP-21 (188-260)	2.7	11.0	40.0	49.0	2.2	Silty Clay	0.26	4	6	2152.2
S1307417-041	DP-21 (260-360)	2.2	7.0	39.0	54.0	0.1	Clay	0.25	4	6	1798.6
S1307417-042	DP-22 (120-180)	1.9	<0.1	39.0	61.0	0.1	Clay	0.23	4	6	1524.9
S1307417-043	DP-22 (180-240)	1.6	5.0	39.0	56.0	0.6	Silty Clay	0.25	4	6	1742.4
S1307417-044	DP-24 (22-40)	1.2	15.0	41.0	44.0	3.4	Silty Clay	0.28	3	6	2486.4
S1307417-045	DP-24 (40-65)	4.4	15.0	39.0	46.0	4.9	Clay	0.22	3	6	2370.6
S1307417-046	DP-24 (65-126)	3.5	13.0	39.0	48.0	3.0	Clay	0.22	3	6	2184.0
S1307417-047	DP-24 (126-244)	3.6	15.0	35.0	50.0	6.7	Clay	0.25	4	6	2085.0
S1307417-048	DP-26 (0-15)	2.3	15.0	43.0	42.0	3.9	Silty Clay	0.28	3	6	2720.2
S1307417-049	DP-26 (15-32)	4.9	9.0	47.0	44.0	0.9	Silty Clay	0.23	3	6	2682.4
S1307417-050	DP-26 (32-59)	4.4	3.0	49.0	48.0	0.1	Silty Clay	0.20	2	6	2553.2
S1307417-051	DP-26 (59-90)	2.0	1.0	51.0	48.0	0.1	Silty Clay	0.24	2	6	2657.2
S1307417-052	DP-26 (90-148)	1.7	<0.1	64.0	36.0	0.1	Silty Clay Loam	0.33	2	5	4102.4
S1307417-053	DP-26 (148-230)	1.2	35.0	45.0	20.0	6.8	Loam	0.30	2	3	4144.0
S1307417-054	DP-26 (230-294)	0.5	55.0	31.0	14.0	15.2	Sandy Loam	0.25	1	2	3973.2
S1307417-055	DP-26 (294-350)	0.5	69.0	23.0	8.0	10.4	Sandy Loam	0.20	2	2	3072.8

These Results apply only to the samples tested.

Reviewed by: Karen Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs, Inc
1673 Terra Ave, Sheridan, Wyoming, 82801
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Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 7/30/2013

Report ID: S1307425001
Date Reported: 10/15/2013
Work Order: S1307425

Lab ID	Sample ID	Organic Matter %	Sand %	Silt %	Clay %	Very Fine Sand %	Texture	K-factor (t.ac.h/100acft.tf.in)	Structure s	Permeability p	M
S1307425-001	12AS009 (514-610)	1.2	35.0	50.0	15.0	16.5	Silty Loam	0.43	2	3	5652.5
S1307425-002	12AS018 (388-406)	0.9	73.8	15.0	11.3	6.8	Sandy Loam	0.11	2	2	1933.7
S1307425-003	DP-21 (0-33)	4.0	23.8	37.5	38.8	6.5	Clay Loam	0.16	2	4	2692.8
S1307425-004	DP-21 (33-140)	2.6	26.3	35.0	38.8	12.5	Clay Loam	0.20	2	4	2907.0
S1307425-005	DP-22 (0-28)	3.3	7.5	40.0	52.5	0.1	Silty Clay	0.21	3	6	1904.8
S1307425-006	DP-22 (28-50)	2.2	8.8	33.8	57.5	1.5	Silty Clay	0.19	3	6	1500.3
S1307425-007	DP-22 (50-120)	1.8	2.5	50.0	47.5	0.1	Silty Clay	0.28	3	6	2630.3
S1307425-008	DP-25 (0-16)	6.2	18.8	41.3	40.0	5.7	Silty Clay	0.21	3	6	2820.0
S1307425-009	DP-25 (16-28)	4.0	15.0	41.3	43.8	2.5	Silty Clay	0.23	3	6	2461.6
S1307425-010	DP-25 (28-54)	3.3	11.3	41.3	47.5	1.6	Silty Clay	0.23	3	6	2252.3
S1307425-011	DP-25 (54-75)	3.7	18.8	38.8	42.5	0.1	Clay	0.22	3	6	2236.8
S1307425-012	DP-25 (75-144)	2.0	36.3	31.3	32.5	3.2	Clay Loam	0.17	2	4	2328.8
S1307425-013	DP-25 (144-208)	1.0	72.5	15.0	12.5	4.0	Sandy Loam	0.08	2	2	1662.5
S1307425-014	DP-27 (0-22)	5.3	13.8	43.8	42.5	2.2	Silty Clay	0.22	3	6	2645.0
S1307425-015	DP-27 (22-40)	3.9	3.8	47.5	48.8	0.1	Silty Clay	0.20	2	6	2437.1
S1307425-016	DP-27 (40-80)	4.1	8.8	46.3	45.0	1.3	Silty Clay	0.24	3	6	2618.0
S1307425-017	DP-27 (80-152)	2.4	<0.1	52.5	47.5	0.1	Silty Clay	0.28	3	6	2761.5
S1307425-018	DP-27 (152-224)	1.1	6.3	58.8	35.0	0.1	Silty Clay Loam	0.33	2	5	3828.5
S1307425-019	DP-27 (224-310)	1.2	6.3	61.3	32.5	0.1	Silty Clay Loam	0.35	2	5	4144.5
S1307425-020	DP-27 (310-350)	1.6	32.5	35.0	32.5	7.1	Clay Loam	0.25	3	4	2841.8
S1307425-021	DP-27 (350-396)	1.2	46.3	31.3	22.5	4.8	Loam	0.19	2	3	2797.8
S1307425-022	DP-27 (396-488)	1.6	7.5	25.0	67.5	2.6	Clay	0.19	4	6	897.0

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Reviewed by: Karen Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs, Inc
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Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 12/2/2013

Report ID: S1312084001
Date Reported: 4/3/2014
Work Order: S1312084

Lab ID	Sample ID	Organic Matter %	Sand %	Silt %	Clay %	Very Fine Sand %	Texture	K-factor (t.ac.h/100acft.tf.in)	Structure s	Permeability p	M
S1312084-001	12AS019A(0-22)	3.6	10.0	43.8	46.3	0.1	Silty Clay	0.20	2	6	2357.4
S1312084-002	12AS019 (22-43)	1.1	8.8	38.8	52.5	2.7	Clay	0.21	2	6	1971.3
S1312084-003	12AS019A(43-67)	1.0	6.3	43.8	50.0	0.3	Silty Clay	0.22	2	6	2205.0
S1312084-004	12AS019A(67-154)	0.6	37.0	42.0	21.0	26.5	Loam	0.40	1	3	5411.5
S1312084-005	12AS019A(154-242)	0.4	63.0	28.0	9.0	34.6	Sandy Loam	0.41	1	2	5696.6
S1312084-006	12AS019A(242-363)	1.2	58.0	31.0	11.0	26.3	Sandy Loam	0.32	1	2	5099.7
S1312084-007	12AS019A(363-408)	2.6	18.0	43.0	39.0	13.2	Silty Clay Loam	0.29	3	5	3428.2
S1312084-008	12AS019A(408-548)	1.0	38.0	42.0	20.0	29.0	Loam	0.44	2	3	5680.0
S1312084-009	12AS019A(548-610)	1.1	59.0	32.0	9.0	34.5	Sandy Loam	0.41	1	2	6051.5
S1312084-010	12AS019A(610-810)	2.9	26.0	40.0	34.0	21.3	Clay Loam	0.30	3	4	4045.8
S1312084-011	12AS019A(810-852)	0.5	86.0	9.0	5.0	28.2	Loamy Sand	0.21	1	2	3534.0
S1312084-012	13AS01(0-18)	6.0	24.0	35.0	41.0	17.9	Clay	0.20	2	6	3121.1
S1312084-013	13AS01(18-45)	2.3	24.0	33.0	43.0	19.6	Clay	0.26	2	6	2998.2
S1312084-014	13AS01(45-106)	1.4	24.0	37.0	39.0	19.1	Clay Loam	0.26	2	4	3422.1
S1312084-015	13AS01(106-180)	0.5	39.0	40.0	21.0	25.0	Loam	0.38	1	3	5135.0
S1312084-016	13AS01(180-213)	0.4	70.0	20.0	10.0	11.5	Sandy Loam	0.15	1	2	2835.0
S1312084-017	13AS01(213-320)	0.9	36.0	24.0	40.0	32.2	Clay	0.32	2	6	3372.0
S1312084-018	13AS01(320-475)	0.6	44.0	32.0	24.0	34.5	Loam	0.40	2	3	5054.0
S1312084-019	13AS02(0-10)	2.4	38.0	31.0	31.0	25.7	Clay Loam	0.28	2	4	3912.3
S1312084-020	13AS02(10-42)	1.8	32.0	36.0	32.0	22.7	Clay Loam	0.33	3	4	3991.6
S1312084-021	13AS02(42-76)	1.9	34.0	32.0	34.0	28.9	Clay Loam	0.33	3	4	4019.4
S1312084-022	13AS03(0-18)	2.6	36.0	31.0	33.0	27.2	Clay Loam	0.30	3	4	3899.4
S1312084-023	13AS03(18-44)	1.6	36.0	30.0	34.0	25.1	Clay Loam	0.31	3	4	3636.6
S1312084-024	13AS03(44-66)	1.4	38.0	26.0	36.0	27.5	Clay Loam	0.30	3	4	3424.0
S1312084-025	13AS03(66-135)	1.3	38.0	27.0	35.0	25.3	Clay Loam	0.30	3	4	3399.5

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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
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Project ID: Private Lease Soils
Date Received: 12/2/2013

Report ID: S1312084001
Date Reported: 4/3/2014
Work Order: S1312084

Lab ID	Sample ID	Organic Matter	Sand	Silt	Clay	Very Fine Sand	Texture	K-factor	Structure	Permeability	M
		%	%	%	%	%		(t.ac.h/100acft.tf.in)	s	p	
S1312084-026	13AS03(135-164)	1.0	38.0	26.0	36.0	26.3	Clay Loam	0.30	3	4	3347.2
S1312084-027	13AS04(0-13)	2.7	50.0	27.0	23.0	25.5	Sandy Clay Loam	0.28	2	4	4042.5
S1312084-028	13AS04(13-40)	2.3	48.0	25.0	27.0	28.6	Sandy Clay Loam	0.31	3	4	3912.8
S1312084-029	13AS04(40-90)	1.8	42.0	27.0	31.0	28.7	Clay Loam	0.32	3	4	3843.3
S1312084-030	13AS04(90-150)	1.4	40.0	28.0	32.0	28.6	Clay Loam	0.33	3	4	3848.8
S1312084-031	13AS04(150-210)	1.0	46.0	24.0	30.0	31.3	Sandy Clay Loam	0.34	3	4	3871.0
S1312084-032	13AS05(0-10)	2.5	34.0	31.0	35.0	24.9	Clay Loam	0.25	2	4	3633.5
S1312084-033	13AS05(10-24)	2.4	34.0	28.0	38.0	26.5	Clay Loam	0.27	3	4	3379.0
S1312084-034	13AS05(24-49)	2.4	28.0	33.0	39.0	21.0	Clay Loam	0.26	3	4	3294.0
S1312084-035	13AS05(49-90)	2.8	32.0	29.0	39.0	25.5	Clay Loam	0.26	3	4	3324.5
S1312084-036	13AS05(90-153)	1.7	10.0	37.0	53.0	4.5	Clay	0.23	3	6	1950.5
S1312084-037	13AS05(153-242)	1.4	32.0	18.0	50.0	24.2	Clay	0.21	2	6	2110.0
S1312084-038	13AS05(242-300)	1.4	10.0	37.0	53.0	5.3	Clay	0.24	3	6	1988.1
S1312084-039	13AS05(300-394)	1.2	14.0	35.0	51.0	8.4	Clay	0.25	3	6	2126.6
S1312084-040	13AS05(394-516)	1.1	40.0	14.0	46.0	34.7	Clay	0.29	3	6	2629.8
S1312084-041	13AS06(0-13)	4.6	23.0	38.0	39.0	8.5	Clay Loam	0.19	3	4	2836.5
S1312084-042	13AS06(13-38)	2.7	46.0	12.0	42.0	36.3	Sandy Clay	0.25	3	5	2801.4
S1312084-043	13AS06(38-68)	1.7	16.0	37.0	47.0	8.7	Clay	0.26	3	6	2422.1
S1312084-044	13AS06(68-112)	1.8	16.0	33.0	51.0	10.5	Clay	0.24	3	6	2131.5
S1312084-045	13AS06(112-170)	1.4	47.0	4.0	49.0	41.2	Sandy Clay	0.23	3	5	2305.2
S1312084-046	13AS06(170-245)	1.3	18.0	36.0	46.0	6.3	Clay	0.23	2	6	2284.2
S1312084-047	13AS06(245-315)	1.4	48.0	11.0	41.0	41.5	Sandy Clay	0.29	3	5	3097.5
S1312084-048	13AS06(315-396)	1.1	12.0	35.0	53.0	5.6	Clay	0.23	3	6	1908.2
S1312084-049	13AS06(396-457)	1.1	56.0	8.0	36.0	50.4	Sandy Clay	0.35	3	5	3737.6
S1312084-050	13AS06(457-579)	1.1	10.0	39.0	51.0	3.8	Clay	0.25	3	6	2097.2

These Results apply only to the samples tested.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 12/2/2013

Report ID: S1312084001
Date Reported: 4/3/2014
Work Order: S1312084

Lab ID	Sample ID	Organic Matter	Sand	Silt	Clay	Very Fine Sand	Texture	K-factor	Structure	Permeability	M
		%	%	%	%	%		(t.ac.h/100acft.tf.in)	s	p	
S1312084-051	13AS06(579-632)	1.1	32.0	19.0	49.0	23.1	Clay	0.22	2	6	2147.1
S1312084-052	13AS06(632-770)	0.4	82.0	13.0	5.0	3.7	Loamy Sand	0.05	1	2	1586.5
S1312084-053	13AS06(770-838)	0.7	86.0	6.0	8.0	27.3	Loamy Sand	0.20	2	2	3063.6
S1312084-054	13AS06(838-884)	1.0	64.0	21.0	15.0	31.8	Sandy Loam	0.34	3	2	4488.0
S1312084-055	13AS07(0-19)	3.3	28.0	36.0	36.0	12.0	Clay Loam	0.23	3	4	3072.0
S1312084-056	13AS07(19-46)	2.6	32.0	23.0	45.0	21.9	Clay	0.25	3	6	2469.5
S1312084-057	13AS07(46-67)	1.9	22.0	37.0	41.0	8.0	Clay	0.28	3	6	2655.0
S1312084-058	13AS07(67-183)	1.3	52.0	16.0	32.0	30.5	Sandy Clay Loam	0.21	1	4	3162.0
S1312084-059	13AS07(183-305)	0.9	76.0	15.0	9.0	14.3	Sandy Loam	0.13	1	2	2666.3
S1312084-060	13AS07(305-427)	0.6	80.0	12.0	8.0	13.7	Loamy Sand	0.14	2	2	2364.4
S1312084-061	13AS07(427-532)	0.5	78.0	16.0	6.0	4.2	Loamy Sand	0.11	2	2	1898.8
S1312084-062	13AS07(532-656)	1.8	84.0	9.0	7.0	21.4	Loamy Sand	0.19	3	2	2827.2
S1312084-063	13AS07(656-732)	1.4	26.0	28.0	46.0	20.6	Clay	0.28	3	6	2624.4
S1312084-064	13AS09(0-14)	3.2	14.0	32.0	54.0	8.0	Clay	0.17	2	6	1840.0
S1312084-065	13AS09(14-46)	1.4	28.0	23.0	49.0	24.1	Clay	0.27	3	6	2402.1

These Results apply only to the samples tested.

Reviewed by: Karen Secor

Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs, Inc
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Soil Analysis Report
Alton Coal Development
463 North 100 West, Suite 1
Cedar City, UT 84721

Project ID: Private Lease Soils
Date Received: 12/6/2013

Report ID: S1312086001
Date Reported: 4/3/2014
Work Order: S1312086

Lab ID	Sample ID	Organic Matter %	Sand %	Silt %	Clay %	Very Fine Sand %	Texture	K-factor (t.ac.h/100acft.tf.in)	Structure s	Permeability p	M
S1312086-001	DP-7(122-165)	3.0	14.0	36.0	50.0	5.6	Clay	0.19	2	6	2080.0
S1312086-002	DP-7(165-200)	2.5	22.0	35.0	43.0	4.4	Clay	0.21	2	6	2245.8
S1312086-003	DP-7(200-244)	0.7	78.0	10.0	12.0	9.6	Sandy Loam	0.06	1	2	1724.8
S1312086-004	DP-10(122-172)	2.6	20.0	32.0	48.0	5.0	Clay	0.22	3	6	1924.0
S1312086-005	DP-10(172-244)	0.6	66.0	22.0	12.0	13.0	Sandy Loam	0.17	1	2	3080.0
S1312086-006	DP-19(122-225)	0.8	54.0	32.0	14.0	8.5	Sandy Loam	0.20	1	2	3483.0
S1312086-007	DP-19(225-244)	0.4	82.5	10.0	7.5	12.0	Loamy Sand	0.09	1	2	2035.0
S1312086-008	13AS08(122-244)	1.7	10.0	42.0	48.0	0.1	Silty Clay	0.25	3	6	2189.2
S1312086-009	13AS08(244-366)	1.6	16.0	43.0	41.0	8.0	Silty Clay	0.31	3	6	3009.0
S1312086-010	13AS08(366-488)	1.7	6.0	37.0	57.0	0.9	Silty Clay	0.21	3	6	1629.7

These Results apply only to the samples tested.

Reviewed by: Karen Secor

Karen Secor, Soil Lab Supervisor

Appendix D
Soil Profile Location Photos

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12AS001

Photo D - 1. Soil profile 12AS001, BBB family, fine-loamy, carbonatic, mesic Aridic Calciustepts. Looking northwest across map unit J (wet meadow) at map unit H on steep (45 percent slope) terrace sideslope. Profile is located near orange number card on slope. Vegetation on the BBB family soil is dominated by rubber rabbitbrush, brome grass, wheatgrass, Woods' rose, and widely scattered Utah junipers.

Photo D - 2. 12AS001, BBB family, fine-loamy, carbonatic, mesic Aridic Calciustepts.

12AS002

Photo D - 3. Soil profile 12AS002, Sideslide family, fine-loamy, mixed, superactive, mesic Typic Endoaquepts. Looking north across wet meadow on bottom of incised intermittent drainage. Profile was located near edge of wet area where surface water was up to 5 inches (13 cm) deep. Soil gleying was observed below 3.5 inches (9 cm). Vegetation is dominated by Baltic rush and Kentucky bluegrass.

12AS003

Photo D - 4. Soil profile 12AS003, Atlatl family similar, **c**oarse-loamy, carbonatic, mesic Aridic Haplustepts. Looking north northeast along steep (40 percent) slope on terrace sideslope. Kanab Creek is in bottom of drainage on right of photo. Agricultural field is on terrace on left of photo. Profile location is north of 'Farm Road' crossing of Kanab Creek. Vegetation is dominated by rabbitbrush and Wyoming big sagebrush.

12AS004

Photo D - 5. Soil profile 12AS004, Flugle family, fine-loamy, mixed, superactive, mesic Aridic Haplustalfs. Looking northwest from sandstone structural bench on east side of Kanab Creek. Tropic sandstone was at 31 inches (78 cm). Vegetation is dominated by antelope bitterbrush and rabbitbrush.

12AS005

Photo D - 6. Soil profile 12AS005, Quezcan family, fine, smectitic, calcareous, mesic Aridic Ustorthents. Tropic shale was at 31 inches (78 cm). Vegetation is dominated by pinyon pine, Utah juniper, snowberry, and bluegrass.

12AS006

Photo D - 7. Soil profile location 12AS006, Tropic sandstone outcrop. The outcrop is surrounded by Vessilla family soils, loamy, mixed, active, calcareous, mesic Aridic Lithic Ustorthents. Vegetation near the sandstone outcrop is dominated by pinyon pine and Utah juniper.

12AS007

Photo D - 8. Soil profile 12AS007, Brumley family, fine-loamy, mixed, superactive, mesic Calcidic Haplustalfs. Looking north across structural bench. Tropic sandstone was at 33 inches (83 cm). Vegetation is dominated by wheatgrass, rabbitbrush, Gambel oak (low growth height), snowberry, and a few scattered pinyon pine and Utah juniper.

12AS008

Photo D - 9. Soil profile location 12AS008, Vessilla family, loamy, mixed, active, calcareous, mesic Aridic Lithic Ustorthents. Looking north across west facing structural bench. Tropic sandstone was at 9 inches (23 cm). Vegetation is dominated by pinyon pine, Utah juniper, Gambel oak in swales, and snowberry. Weathered sandstone outcrops are in the area.

12AS009

Photo D - 10. Soil profile location 12AS009, Boxcanyon family, fine, smectitic, mesic Calcidic Haplustalfs. Looking east across terrace west of Kanab Creek. Vegetation consists of rabbitbrush and widely scattered Utah junipers. Grasses were grazed to low for identification. This push-tube profile was examined to 20 feet (240.2 inches or 610 cm). weathered sandstone was encountered at 16.9 feet (202.4 inches or 610 cm).

12AS010

Photo D - 11. Soil profile location 12AS010, Bobknoll family, coarse-loamy, mixed, superactive, mesic Aridic Calciustepts. Looking east northeast across terrace west of Kanab Creek. Vegetation is dominated by rabbitbrush and grasses that were grazed too low for identification. This push-tube profile was examined to 9.3 feet (111.8 inches or 284 cm).

12AS011

Photo D - 12. Soil profile location 12AS011, CCC family, fine, carbonatic mesic Aridic Calciustepts. Looking southeast across terrace west of Kanab Creek. Vegetation is dominated by crested wheatgrass and rabbitbrush. This push-tube profile was examined to 7 feet (84.3 inches or 214 cm).

12AS012

Photo D - 13. Soil profile location 12AS012, CCC family, fine, carbonatic mesic Aridic Calciustepts. Located on terrace west of Kanab Creek. Vegetation is dominated by rabbitbrush and grasses grazed too low for identification. This push-tube profile was examined to 7.6 feet (90.6 inches or 230 cm).

12AS013

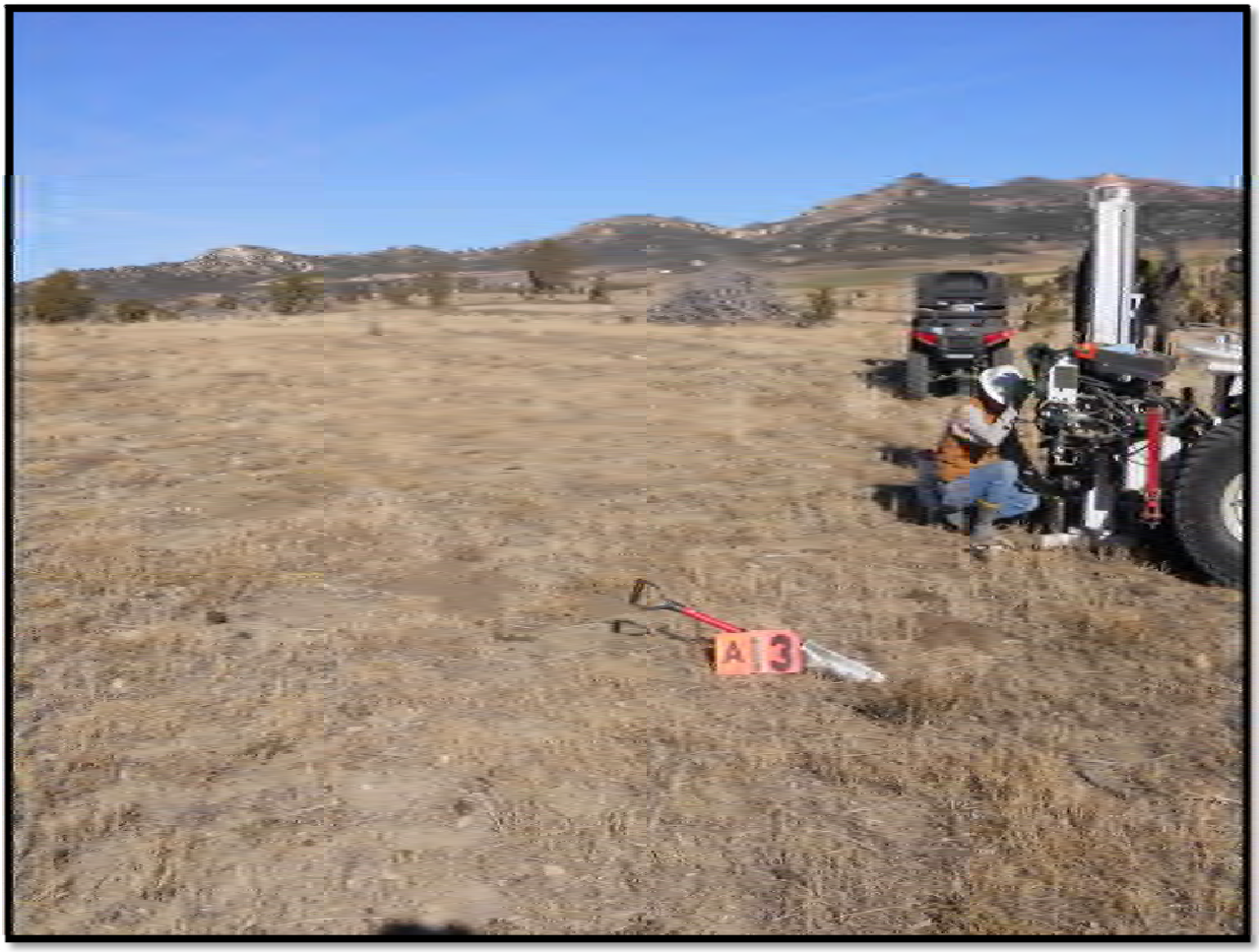

Photo D - 14. Soil profile 12AS013, Sideshow family, fine, smectitic, mesic Aridic Haplusterts. Looking north across hillslope. Tropic shale was at 40 inches (102 cm) in this push-tube hole.

12AS014

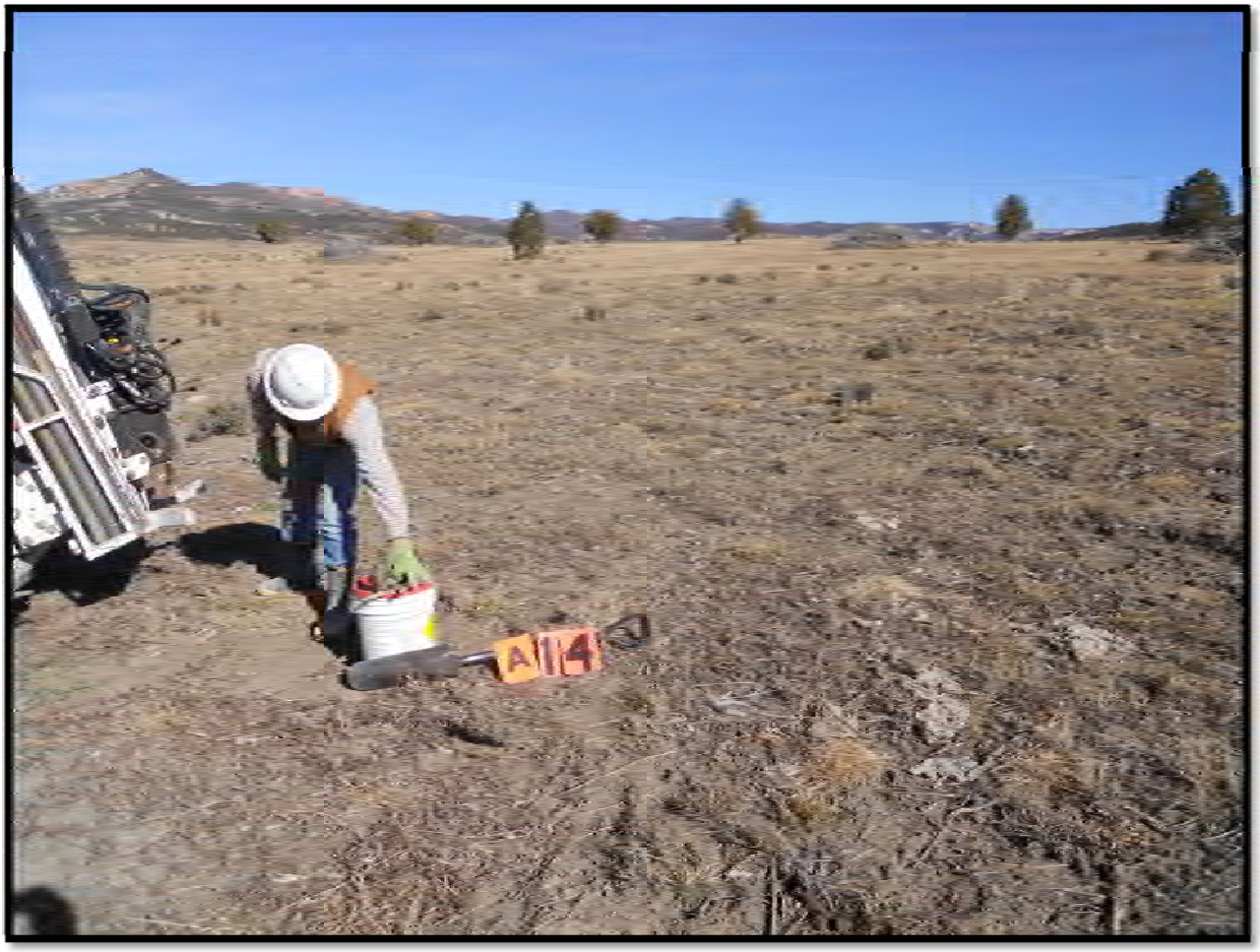

Photo D - 15. Soil profile 12AS014, Sideshow family, fine, smectitic, mesic Aridic Haplusterts. Looking north across hillslope. Tropic shale was at 34.6 inches (88 cm) in this push-tube hole. Vegetation is dominated by scattered young black sagebrush and brome grass. Pinyon pine and Utah juniper recently removed from this area.

12AS015

Photo D - 16. Soil profile 12AS015, Sideshow family, fine, smectitic, mesic Aridic Haplusterts. Looking north across structural bench. Tropic shale was at 47 inches (119 cm) in this push-tube hole. Vegetation is dominated by brome grass, wheatgrass, bluegrass, and alfalfa.

12AS016

Photo D - 17. Soil profile location 12AS016, Teromote family, fine-loamy, mixed, superactive, mesic Aridic Haplustepts. Looking north across hillslope summit. Tropic shale was at 44 inches (112 cm) in this push-tube hole. Vegetation is dominated by young Wyoming big sagebrush and grasses. Pinyon pine and Utah juniper recently removed from this area.

12AS017

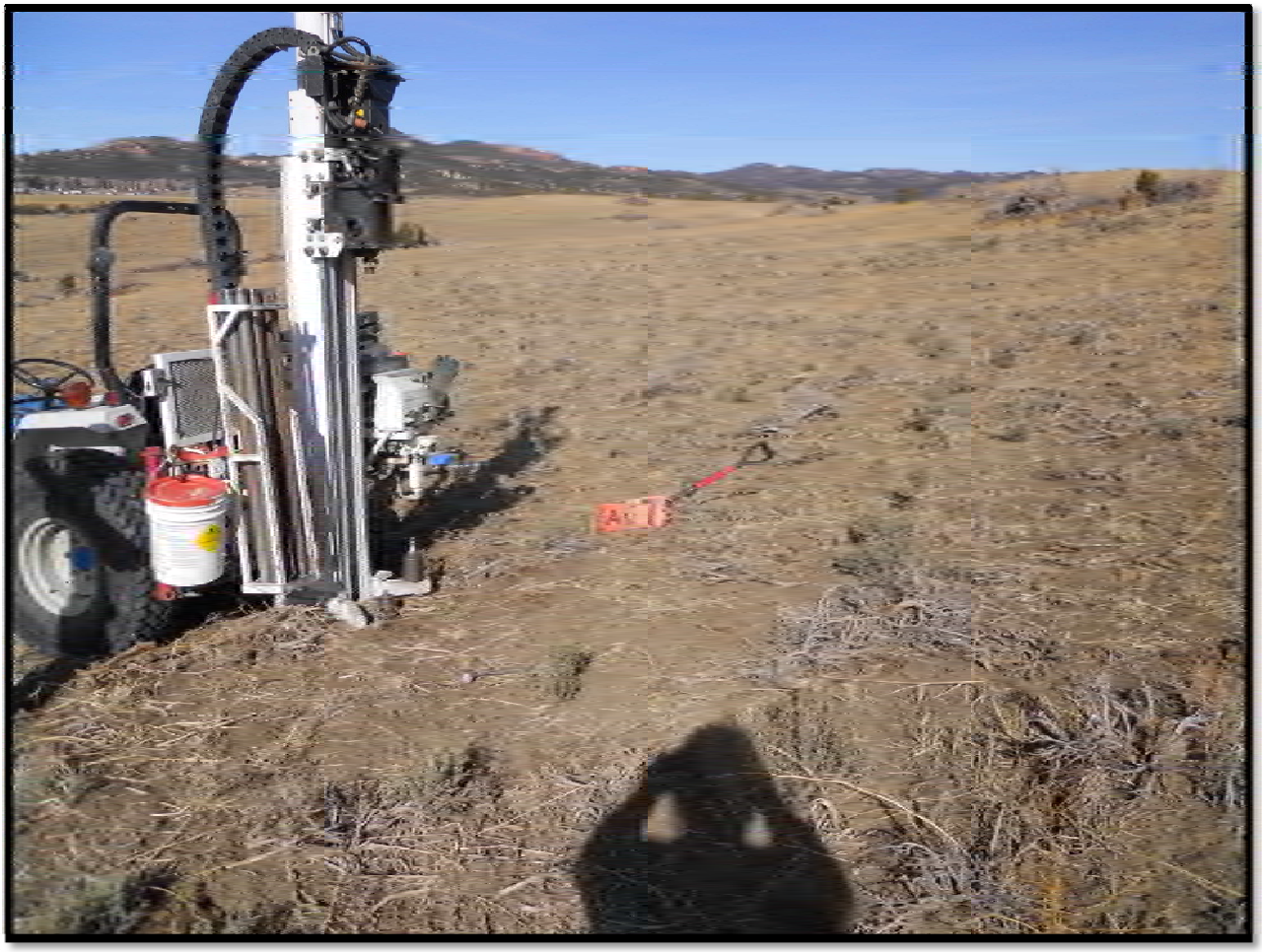

Photo D - 18. Soil profile location 12AS017, Sideshow family, fine, smectitic, mesic Aridic Haplusterts. Looking east across hillslope. Tropic shale was at 47 inches (119 cm) in this push-tube hole. Vegetation is dominated by young Wyoming big sagebrush and grasses. Pinyon pine and Utah juniper recently removed from this area.

12AS018

Photo D - 19. Soil profile location 12AS018, AAA family, fine-loamy, carbonatic, mesic Aridic Haplustepts. Looking east northeast across terrace on south side of 'Elk Fence' west of Kanab Creek. Vegetation is dominated by wheatgrass and rabbitbrush. This push-tube profile was examined to 24 feet (288.2 inches or 732 cm). Piezometer monitoring well NLP-2 was installed at this location.

12AS019

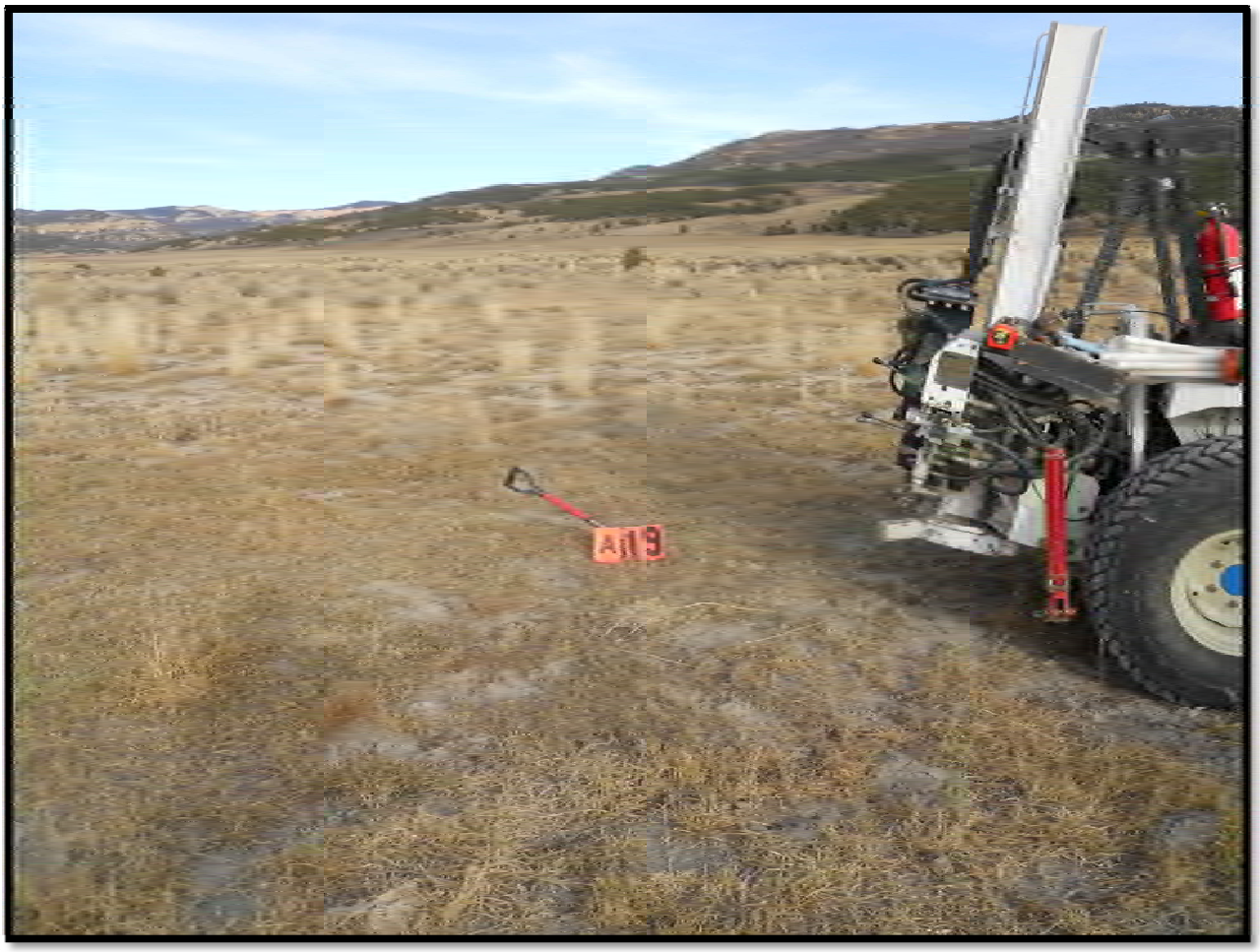

Photo D - 20, . Soil profile location 12AS019, AAA similar, fine-silty, carbonatic, mesic Aridic Haplustepts. Looking east northeast across terrace west of Kanab Creek. Vegetation is dominated by wheatgrass and scattered rabbitbrush. This push-tube profile was examined to 7.9 feet (94.5 inches or 240 cm).

12AS019A

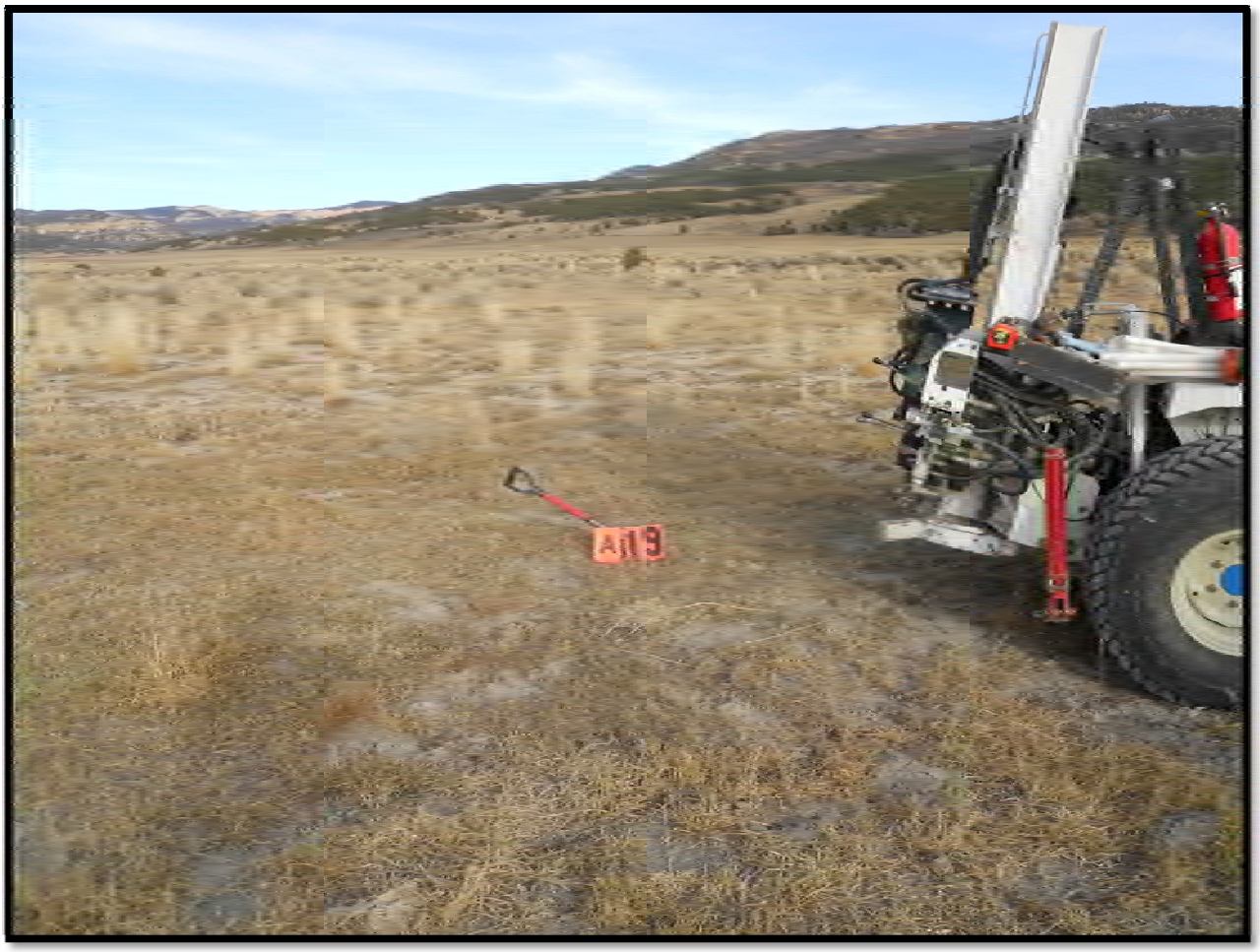

Photo D - 21. Soil profile location 12AS019A, AAA family, fine-loamy, carbonatic, mesic Aridic Haplustepts. Looking northeast across terrace west of Kanab Creek. Profile 12AS019A was drilled in November 2013 within 10 feet (3 meters) of the GPS location for 12AS019, so that a piezometer well (NLP-10) could be installed. This new push-tube hole was examined to 28 feet (335.4 inches or 852 cm). Vegetation is dominated by wheatgrass and scattered rabbitbrush.

12AS020

Photo D - 22. Soil profile location 12AS020, CCC similar, fine-silty, carbonatic, mesic Aridic Calciustepts. Looking east across terrace west of Kanab Creek from location between 'Farm Road' and 'Elk Fence.' Vegetation is dominated by grasses grazed too low for identification. This push-tube profile was examined to 20 feet (240.2 inches or 610 cm). Piezometer monitoring well NLP-1 was installed at this location.

12AS021

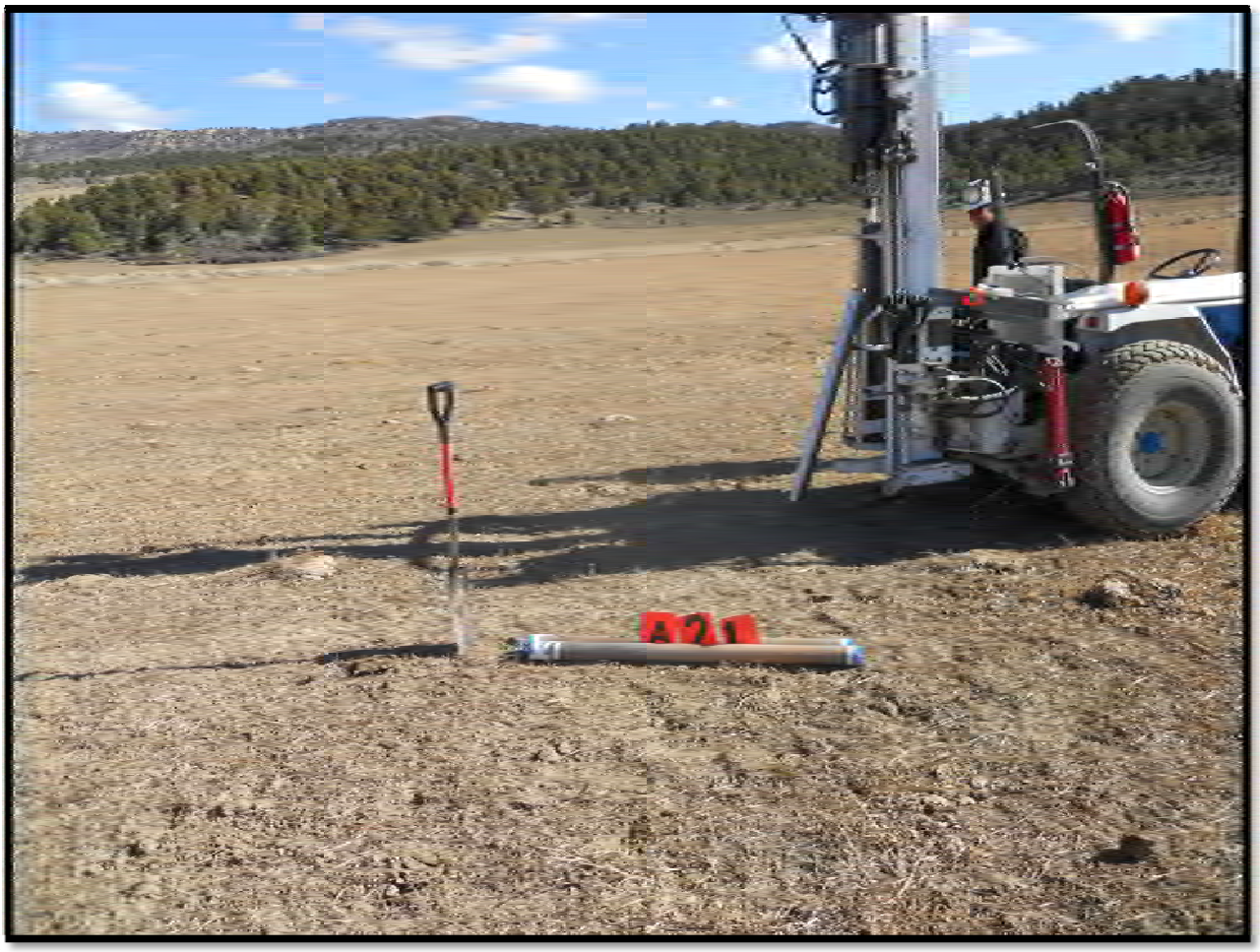

Photo D - 23. Soil profile location 12AS021, Atlatl family, coarse-loamy, carbonatic, mesic Aridic Calciustepts. Looking east across terrace east of Kanab Creek. Vegetation is dominated by grasses grazed too low for identification. This push-tube profile was examined to 24.3 feet (292.1 inches or 853 cm). Piezometer monitoring well NLP-3 was installed at this location.

12AS022

Photo D - 24DDD family, . Soil profile location 12AS022, sandy-skeletal, carbonatic, mesic, Oxyaquic Ustifluvents. Looking north across stream terrace along west side of Kanab Creek on bottom of incised drainage. Vegetation is dominated by sagebrush, wheatgrass, scattered Rocky Mountain junipers and Russian olive trees. This push-tube profile was examined to 7.6 feet (91.3 inches or 232 cm). Piezometer monitoring well NLP-4 was installed at this location. This location was approximately 1.5 feet (45.7 cm) higher than Kanab Creek with groundwater at approximately 3 feet (91.4 cm) below the ground surface. Edge of the riparian zone is visible on the left.

12AS023

Photo D - 25. Soil profile location 12AS023, Bobknoll family, coarse-loamy, mixed, superactive, mesic Aridic Calciustepts. Looking north northeast across terrace east of Kanab Creek. Vegetation is dominated by grasses grazed too low for identification. This push-tube profile was examined to 7.6 feet (90.6 inches or 230 cm).

12AS024

Photo D - 26. Soil profile location 12AS024, DDD family, sandy-skeletal, carbonatic, mesic Oxyaquic Ustifluvents. Looking north across stream terrace and gravel bar on west side of Kanab Creek on bottom of incised drainage. Vegetation is dominated by black sage and Wyoming big sagebrush. This push-tube profile was examined to 10 feet (120.1 inches or 305 cm). Piezometer monitoring well NLP-5 was installed at this location. Riparian zone is visible in lower background.

12AS025

Photo D - 27. Soil profile location 12AS025, Atlatl family, coarse-loamy, carbonatic, mesic Aridic Calciustepts. Looking east across stream terrace west of Kanab Creek. Vegetation is dominated by grasses grazed too low for identification and alfalfa. This push-tube profile was examined to 6.7 feet (80.3 inches or 204 cm).

12AS026

Photo D - 28. Soil profile location 12AS026, Wimmer family, fine-loamy, mixed, superactive, mesic Aridic Calciustepts. Looking north along fence row near interface of fan apron and terrace west of Kanab Creek. Area is irrigated with center pivot sprinkler system on north side of 'Farm Road.' Vegetation along fence row is dominated by brome grass, wheatgrass, and Woods' rose. This push-tube profile was examined to 6.6 feet (79.5 inches or 202 cm).

12AS027

Photo D - 29. Soil profile location 12AS027, Wimmer family, fine-loamy, mixed, superactive, mesic Aridic Calciustepts. Looking north along fence row near interface of fan apron and terrace west of Kanab Creek. Area is irrigated with center pivot sprinkler system on north side of 'Farm Road.' Vegetation along fence row is dominated by brome grass, wheatgrass, and Woods' rose. This push-tube profile was examined to 26 feet (311.8 inches or 792 cm). Piezometer monitoring well NLP-7 was installed at this location.

12AS028

Photo D - 30. Soil profile location 12AS028, AAA family, fine-loamy, carbonatic, mesic Aridic Haplustepts. Looking northeast across terrace west of Kanab Creek. This alfalfa field north of the 'Farm Road' is irrigated with a wheel-line sprinkler system. This push-tube profile was examined to 26 feet (240.2 inches or 610 cm). Piezometer monitoring well NLP-6 was installed at this location.

12AS029

Photo D - 31. Soil profile location 12AS029, Boxcanyon family, fine, smectitic, mesic Calcidic Haplustalfs. Looking northeast across alluvial fan on terrace west of Kanab Creek. This alfalfa is outside of area irrigated by center pivot sprinkler system north of 'Farm Road.' Weathered sandstone was encountered at 16.4 feet (196.9 inches or 500 cm) at this push-tube location. Piezometer monitoring well NLP-8 was installed at this location.

12AS030

Photo D - 32. Soil profile location 12AS030, Sideshow family, fine, smectitic, mesic Aridic Haplusterts. Looking northeast across moderately steep to steep (24 percent) south facing hillslope at north end of soil survey area. This upland area has been seeded with Crested wheatgrass. There are scattered clumps of Wyoming big sagebrush. Tropic shale was at 3.1 feet (37.4 inches or 95 cm).

12AS031

Photo D - 33. Soil profile location 12AS031, Wimmer family, fine-loamy, superactive, mesic Aridic Calciustepts. Looking east across interface of alluvial fan and terrace east of Kanab Creek. Vegetation is dominated by grasses grazed too low for identification with scattered rabbitbrush.

Photo D - 34. Soil profile location 12AS031, Wimmer family, fine-loamy, superactive, mesic Aridic Calciustepts. This backhoe pit was examined to 5.6 feet (67.7 inches or 172 cm).

12AS032

Photo D - 35. Soil profile location 12AS032, Sideshow family, fine, smectitic, mesic Aridic Haplusterts. Looking north northeast up hillslope swale west of Kanab Creek and south of county road. Pinyon pine and Utah juniper were recently removed from area (piles in background) and the area ripped and seeded. Previous vegetation remnant areas consist of Wyoming big sagebrush, brome grass, cheatgrass, and galleta grass. This backhoe pit was examined to 5.4 feet (65 inches or 165 cm).

13AS01

Photo D - 36. Soil profile 13AS01, BBB family, fine-loamy, carbonatic, mesic Aridic Calciustepts. Looking upslope to the north across Tropic sandstone outcrops. Location is near top of hillslope west of Kanab Creek. Weathered Tropic sandstone was at 5.9 feet (70.9 inches or 180 cm). Weathered Tropic sandstone was at (83.9 inches or 213 cm). Vegetation is dominated by western wheatgrass, crested wheatgrass, rabbitbrush, and scattered sagebrush. Shale was observed in the bottom and sidewalls of the adjacent ephemeral channel to the west.

13AS02

Photo D - 37. Soil profile location 13AS02, Wimmer family, fine-loamy, mixed, superactive, mesic Aridic Calciustepts. Looking southwest along south fenceline across hillslope east of Kanab Creek. Tropic shale was at 2.5 feet (29.9 inches or 76 cm). Vegetation is dominated by Wyoming big sagebrush and grasses grazed too low to be identifiable.

13AS03

Photo D - 38. Soil profile location 13AS03, Teromote family, fine-loamy, mixed, superactive, mesic Aridic Haplustepts. Looking east along south fenceline across hillslope east of Kanab Creek. Tropic shale was at 5.4 feet (64.6 inches or 164 cm). Vegetation is dominated by Wyoming big sagebrush and grasses grazed too low to be identifiable.

13AS04

Photo D - 39. Soil profile location 13AS04, Brumley family, fine-loamy, mixed, superactive, mesic Calcidic Haplustalfs. Looking upslope to the north across alluvial fan below Tropic shale and sandstone outcrops (background) east of Kanab Creek. Vegetation is dominated by Wyoming big sagebrush, rabbitbrush, and grasses grazed too low to be identifiable. This push-tube profile was examined to 6.9 feet (82.7 inches or 210 cm).

13AS05

Photo D - 40. Soil profile location 13AS05, Teromote family, fine-loamy, superactive, mesic Aridic Haplustepts. Looking northwest across hillslope and terrace east of Kanab Creek. Vegetation is dominated by Wyoming big sagebrush and grasses grazed too low to be identifiable. This push-tube profile was examined to 16.9 feet (203.1 inches or 516 cm).

13AS06

Photo D - 41. Soil profile location 13AS06, Sideshow family, fine, smectitic, mesic Aridic Haplusterts. Looking west northwest across terrace hillslope. The incised Kanab Creek drainage sideslopes are in the background. Vegetation is dominated by Wyoming big sagebrush and grasses grazed too low to be identifiable. This push-tube profile was examined to 29 feet (348 inches or 884 cm). Piezometer monitoring well NLP-11 was installed at this location. This soil appeared to have developed in alluvium derived from the adjacent Tropic shale outcrops.

13AS07

Photo D - 42. Soil profile location 13AS07, Boxcanyon similar, fine-loamy, mixed, superactive, mesic Calcidic Haplustalfs. Looking southeast across terrace west of Kanab Creek near south edge of survey area. Vegetation is dominated by brome grass, rabbitbrush, and Wyoming big sagebrush. There was a heavy clay increase at 21.5 feet (258.3 inches or 656 cm). Aquic conditions were identified in the soil horizon (17.5 to 21.5 feet or 532 to 656 cm) immediately above and in the heavy clay. Piezometer monitoring well NLP-12 was installed at this location.

13AS08

Photo D - 43. Soil profile location 13AS08, soil similar to Sideslide. The upper 4 foot sample was not recovered. There was not enough soil data available for taxonomic classification. This push-tube profile was examined to 29 feet (192.18 inches or 488 cm). The purpose of this location was to install piezometer monitoring well NLP-13 outside the survey area.

13AS09

Photo D - 44. Soil profile location 13AS09, Quezcan family shallow, clayey, smectitic, calcareous, mesic, shallow Aridic Ustorthents. Looking upslope to the north across hillslope with sandstone outcrops east of Kanab Creek. This soil developed in colluvium from Tropic sandstone and shale over Tropic shale residuum. Weathered Tropic shale was at 1.5 feet (18.1 inches or 46 cm). Vegetation is dominated by pinyon pine, Utah juniper, yucca, Sandberg bluegrass, and broom snakeweed.

14AS01

Photo D - 45. Soil profile location 14AS01, Sideshow family, fine, smectitic, mesic Aridic Haplusterts. Looking west along incised ephemeral drainage east of Kanab Creek across toe of alluvial fan. Vegetation consists of black sage, smooth brome, and intermediate wheatgrass. Profile developed in alluvium derived from Tropic shale. Drainage cutbank was cleaned and examined to 5.4 feet (65 inches or 165 cm).

DP-01

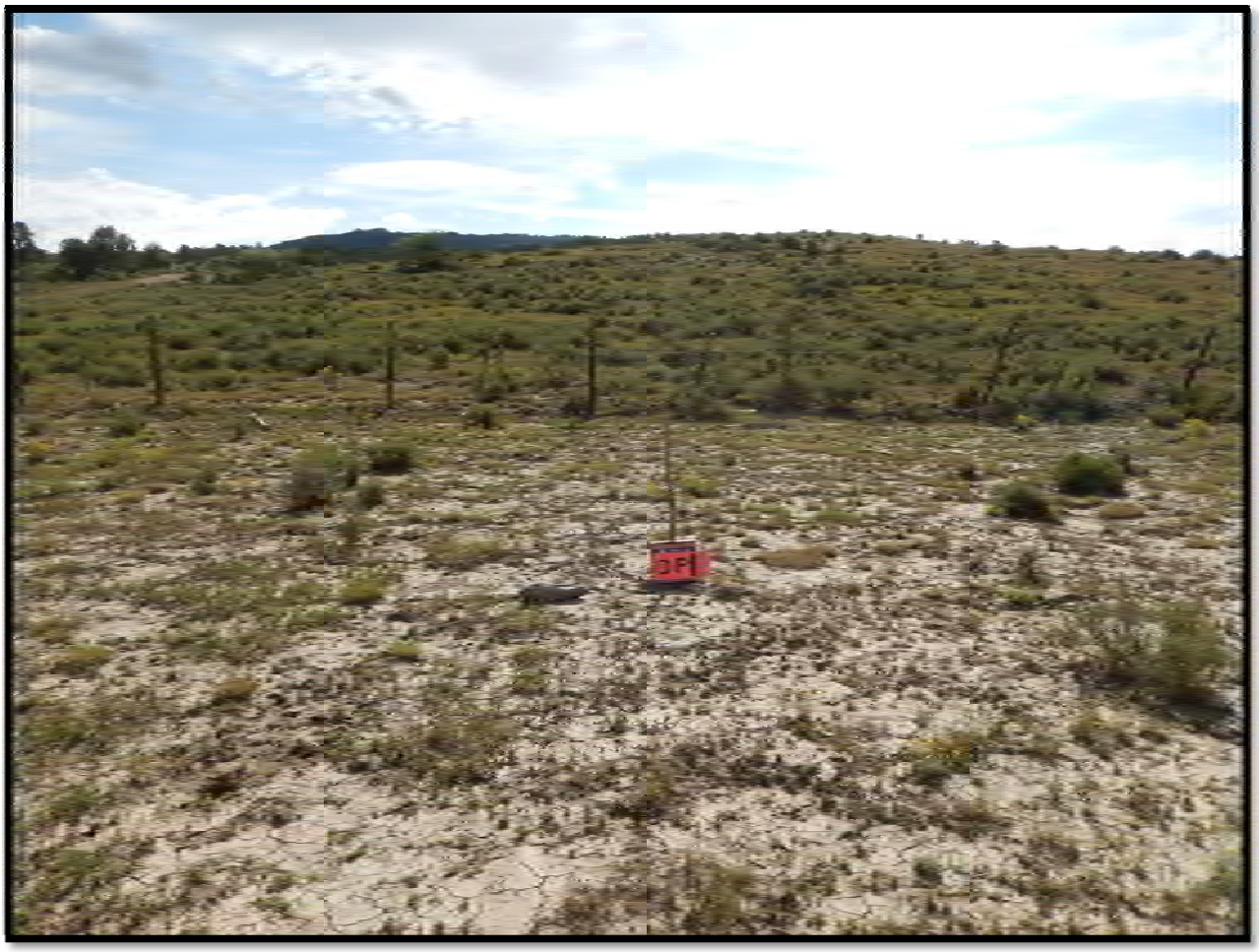

Photo D - 46. Push tube location DP-01 looking upslope to east. Location and setting similar to BBB family. No soil samples were available for evaluation or analysis from this location. Vegetation consists of smooth brome, crested wheatgrass, scattered Wyoming big sagebrush, bindweed, and matchweed.

Photo D - 47. Push tube location DP-01 looking west.

DP-02

Photo D - 48. Push tube location DP-02, Flugle family, fine-loamy, mixed, superactive, mesic Aridic Haplustalfs. Looking east across terrace west of Kanab Creek. DP-01 was located near UTV in background. Vegetation consists of rabbitbrush, crested wheatgrass, Wyoming big sagebrush, and alfalfa. Push-tube profile was examined to 13.5 feet (162.2 inches or 412 cm).

Photo D - 49. Push tube location DP-02, Flugle family, Looking west across terrace west of Kanab Creek. DP-01 was located near UTV in background. Vegetation consists of rabbitbrush, crested wheatgrass, Wyoming big sagebrush, and alfalfa. Push-tube profile was examined to 13.5 feet (162.2 inches or 412 cm).

DP-03

Photo D - 50. Push tube location DP-03, Sideshow family, fine, smectitic, mesic Aridic Haplusterts. Looking west across alluvial fan in foreground and onto terrace east of Kanab Creek. Vegetation consists of western wheatgrass, bindweed, and flax. Weathered Tropic shale was at 4.5 feet (53.9 inches or 137 cm). DP-04 is on terrace beyond UTV (person at location in center of photo).

DP-04

Photo D - 51. Push tube location DP-04, Wimmer family, fine-loamy, mixed, superactive, mesic Aridic Calciustepts. Looking east across terrace and onto toe of alluvial fan. Vegetation consists of smooth brome, crested wheatgrass, rabbitbrush, Wyoming big sagebrush, bindweed, and alfalfa. Push-tube profile was examined to 7.6 feet (91.3 inches or 232 cm). DP-03 is on toe of alluvial fan beyond UTV.

DP-05

Photo D - 52. Push tube location DP-05, Sideshow family, fine, smectitic, mesic Aridic Haplusterts. Looking west across structural bench onto terrace east of Kanab Creek. Vegetation consists of smooth brome, western wheatgrass, crested wheatgrass, and Wyoming big sagebrush. Tropic shale was at 5.3 feet (63.8 inches or 162 cm). DP-06 is on terrace near UTV.

DP-06

Photo D - 53. Push tube location DP-06, Teromote family, fine-loamy, mixed, superactive, mesic Aridic Haplustepts. Looking east across terrace onto structural bench at DP-05 (shovel near center of photo). Vegetation consists of western wheatgrass, rabbitbrush, bindweed, and crested wheatgrass. Push tube profile was examined to 7.6 feet (90.6 inches or 230 cm).

DP-07

Photo D - 54. Push tube location DP-07 looking east across alluvial fan. Correlated to Sideshow family based on setting and subsoil. Upper 4 feet of location was not available for examination. Soil from 4.0 to 8 feet was examined, sampled, and analyzed.

DP-08

Photo D - 55. Push tube location looking west across alluvial fan toward DP-07 (spade in ground near center of photo). Sandstone was encountered at 32 inches (81 cm) in new auger hole at site. Location was correlated to Sideshow based on setting and surface observations. Push tube samples were not available for examination.

DP-09

Photo D - 56. Push tube location DP-09, Sideshow family, fine, smectitic, mesic Aridic Haplusterts. Looking northwest across alluvial fan. Vegetation consists of western wheatgrass, smooth brome, Wyoming big sagebrush, and alfalfa. DP-10 located near UTV. Push tube examined to 8 feet (96.1 inches or 244 cm).

DP-10

Photo D - 57. Push tube location DP-10, Sideshow family, fine, smectitic, mesic Aridic Haplusterts. Correlated to Sideshow based on setting and subsoil. Upper 4 feet unavailable for examination. Looking east up slope across alluvial fan. DP-09 located at shovel near center of photo. Vegetation consists of bindweed, western wheatgrass, and Wyoming big sagebrush.

DP-11

Photo D - 58. Push tube location DP-11, Bobknoll family, coarse-loamy, mixed, superactive, mesic Aridic Calciustepts. Looking south across fan apron from terrace west of Kanab Creek. Vegetation dominated by smooth brome and poverty weed. Push tube profile examined to 8 feet (95.7 inches or 243 cm). DP-12 is on structural bench near center of photo (shovel in ground).

DP-12

Photo D - 59. Push tube location DP-12, Flugle family, fine-loamy, mixed, superactive, mesic Aridic Haplustalfs. Looking north from structural bench toward DP-11 on fan apron near UTV. Vegetation consists of smooth brome, rabbitbrush, and Wyoming big sagebrush. Push tube profile examined to 8 feet (96.1 inches or 244 cm).

DP-13

Photo D - 60. Push tube location DP-13, Flugle family, fine-loamy, mixed, superactive, mesic Aridic Haplustalfs. Looking from structural bench toward a lower structural bench where DP-14 is located near UTV. Vegetation consists of smooth brome, alfalfa, Wyoming big sagebrush, and black sage. Push tube profile was examined to 2.9 feet (34.6 inches or 88 cm). Profile 12AS021 is located on terrace beyond UTV.

DP-14

Photo D - 61. Push tube location DP-14, Bobknoll family, coarse-loamy, mixed, superactive, mesic Aridic Calciustepts. Looking east toward structural bench where DP-13 is located near slope break. Vegetation consists of smooth brome, western wheatgrass, bindweed, and alfalfa. Tropic sandstone was at 2.9 feet (34.6 inches or 88 cm).

DP-15

Photo D - 62. Push tube location DP-15, Teromote family, fine-loamy, mixed, superactive, mesic Aridic Haplustepts. Looking east up hillslope. Vegetation consists of western wheatgrass, rabbitbrush, Wyoming big sagebrush, mountain snowberry, and curlleaf mountain mahogany. Pinyon pine and Utah juniper in picture are on different soil type. Push tube profile was examined to 11.9 feet (142.5 inches or 362 cm).

Photo D - 63. Push tube location DP-15, Teromote family, fine-loamy, mixed, superactive, mesic Aridic Haplustepts. Looking west northwest down hillslope and across terraces incised by Kanab Creek. Vegetation consists of western wheatgrass, rabbitbrush, Wyoming big sagebrush, mountain snowberry, and curlleaf mountain mahogany. Pinyon pine and Utah juniper in picture are on different soil type. Push tube profile was examined to 11.9 feet (142.5 inches or 362 cm).

DP-16

Photo D - 64. Push tube location DP-16, Sideshow family, fine, smectitic, mesic Aridic Haplusterts. Looking east up hillslope. Vegetation consists of western wheatgrass, alfalfa, crested wheatgrass, rabbitbrush, smooth brome, and thistle. Tropic shale was at 3.3 feet (40.2 inches or 102 cm).

Photo D - 65. Push tube location DP-16, Sideshow family, fine, smectitic, mesic Aridic Haplusterts. Looking west down hillslope across terraces (background) incised by Kanab Creek. Vegetation consists of western wheatgrass, alfalfa, crested wheatgrass, rabbitbrush, smooth brome, and thistle. Tropic shale was at 3.3 feet (40.2 inches or 102 cm).

DP-17

Photo D - 66. Push tube location DP-17, Sideshow family, fine, smectitic, mesic Aridic Haplusterts. Looking east up hillslope east of Kanab Creek. Vegetation consists of western wheatgrass, crested wheatgrass, alfalfa, and basin big sage. Push tube profile was examined to 5.6 feet (66.9 inches or 170 cm).

Photo D - 67. Push tube location DP-17, Sideshow family, fine, smectitic, mesic Aridic Haplusterts. Looking northwest across hillslope east of Kanab Creek (incised Kanab Creek drainage across center of photo). Vegetation consists of western wheatgrass, crested wheatgrass, alfalfa, and basin big sage. Push tube profile was examined to 5.6 feet (66.9 inches or 170 cm).

DP-18

Photo D - 68. Push tube location DP-18, Brumley family, fine-loamy, mixed, superactive, mesic Calcidic Haplustalfs. Looking east up slope from terrace east of Kanab Creek toward alluvial fan at edge of soil survey area. Vegetation consists of crested wheatgrass, rabbitbrush, Woods' rose, and globemallow. Push tube profile was examined to 7.9 feet (94.5 inches or 240 cm).

DP-19

Photo D - 69. Push tube location DP-19, Boxcanyon family, fine, smectitic, mesic Calcidic Haplustalfs. Looking east across terrace towards toe of alluvial fan at edge of survey area. Vegetation consists of crested wheatgrass, rabbitbrush, bindweed, and western wheatgrass. The upper 4 feet for this location was not available for examination. Correlated to Boxcanyon family based on surface conditions, setting, and subsoil.

DP-20

Photo D - 70. Push tube location DP-20, Boxcanyon family truncated, fine, smectitic, mesic Calcidic Haplustalfs. Looking east from toe of alluvial fan. This profile is similar to Boxcanyon with the surface (A) horizon removed. Vegetation consists of crested wheatgrass, smooth brome, rabbitbrush, and black sage. This push tube profile was examined to 12 feet (144.1 inches or 366 cm).

DP-21

Photo D - 71. Push tube location DP-21, Teromote family, fine-loamy, mixed, superactive, mesic Aridic Haplustepts. Looking east across footslope of alluvial fan along east edge of survey area. Dirt pile was constructed by landowner to catch upslope runoff and direct it along the contour to reduce soil erosion and conserve moisture. Vegetation consists of western wheatgrass, crested wheatgrass, and black sage. Push tube profile was examined to 11.8 feet (141.7 inches or 360 cm).

Photo D - 72. Push tube location DP-21, Teromote family, fine-loamy, mixed, superactive, mesic Aridic Haplustepts. Looking west from footslope of alluvial fan on east side of survey area. Profile DP-20 is near UTV in upper portion of photo. DP-19 and DP-18 on terrace beyond the UTV.

DP-22

Photo D - 73. Push tube location DP-22, Sideshow family, fine, smectitic, mesic Aridic Haplusterts. Looking west from alluvial fan toward DP23 on fan apron (near UTV). Vegetation consists of western wheatgrass, bindweed, Woods' rose, mule-ear, milkvetch, and Wyoming big sagebrush. Push tube profile was examined to 7.9 feet (94.5 inches or 240 cm).

DP-23

Photo D - 74. Push tube location DP-23, Wimmer family, fine-loamy, mixed, superactive, mesic Aridic Calciustepts. Looking east from fan apron toward footslope of alluvial fan where DP-22 was located in front of sagebrush. Vegetation consists of western wheatgrass, bindweed, and Woods' rose. Push tube profile was examined to 4 feet (48 inches or 122 cm).

DP-24

Photo D - 75. Push tube location DP-24, Sideshow family, fine, smectitic, mesic Aridic Haplusterts. Looking west from alluvial fan towards location of DP-25 (near UTV) on toe of alluvial fan. Vegetation consists of western wheatgrass, bindweed, rabbitbrush, and Wyoming big sagebrush. Push tube profile examined to 12 feet (96.1 inches or 244 cm).

DP-25

Photo D - 76. Push tube location DP-25, Boxcanyon family, fine, smectitic, mesic, Calcidic Haplustalfs. Looking east from toe of alluvial fan toward footslope of fan where DP-24 was located in front of piles. Landowner constructed piles to catch upslope runoff and direct it along the contour to reduce soil erosion and conserve moisture. Vegetation consists of western wheatgrass, bindweed, rabbitbrush, mountain snowberry, and Wyoming big sagebrush. Calcareous sandstone was at 6.8 feet (81.9 inches or 208 cm).

DP-26

Photo D - 77. Push tube location DP-26, BBB family, fine-loamy, carbonatic, mesic Aridic Calciustepts. Looking east from terrace on east side of Kanab Creek toward location of DP-27 on terrace near UTV. Vegetation consists of rabbitbrush, western wheatgrass, bindweed, and Woods' rose. Push tube profile was examined to 12 feet (144.1 inches or 366 cm).

DP-27

Photo D - 78. Push tube location DP-27, CCC similar, fine, smectitic, mesic Aridic Calciustepts. Looking west across terrace east of Kanab Creek toward location DP-26 near UTV. Vegetation consists of rabbitbrush, smooth brome, crested wheatgrass, and black sage. Push tube profile was examined to 16 feet (192.1 inches or 488 cm).

DP-28

Photo D - 79. Push tube location DP-28, Sideshow family, fine, smectitic, mesic Aridic Haplusterts. Looking west along 'Farm Road' toward location of county road on Tropic shale ridge. Vegetation consists of smooth brome, Woods' rose, western wheatgrass, and yarrow. Push tube profile was examined to 4.6 feet (55.1 inches or 140 cm).

DP-29

Photo D - 80. Push tube location DP-29, BBB family, fine-loamy, carbonatic, mesic Aridic Calciustepts. Looking east down 'Farm Road' across fan apron and terrace. Vegetation consists of smooth brome, bindweed, and Woods' rose. Push tube profile was examined to 12 feet (143.7 inches or 365 cm).

DP-30

Photo D - 81. Push tube location DP-30, Sideshow family, fine, smectitic, mesic Aridic Haplusterts. Looking east from shale ridge east of survey area across footslope and across terrace west of Kanab Creek. DP-30 was located near gate in photo. Push tube samples were not available for examination at this location.

Appendix E

Soil Profile Box Photos

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12AS001

Photo E - 1. Soil profile 12AS001, BBB family, Aridic Calciustepts fine-loamy, carbonatic, mesic.

12AS002

Photo E - 2. Soil profile 12AS002, Sideslide family, Typic Endoaquepts fine-loamy, mixed, superactive, mesic.

12AS003

Photo E - 3. Soil profile 12AS003, Atlatl similar family, Aridic Haplustepts coarse-loamy, carbonatic, mesic.

12AS004

Photo E - 4. Soil profile 12AS004, Flugle family, Aridic Haplustalfs fine-loamy, mixed, superactive, mesic.

12AS005

Photo E - 5. Soil profile 12AS005, Quezcan family, Aridic Ustorthent fine, smectitic, superactive, calcareous, mesic.

12AS006

Photo E - 6. Tropic sandstone outcrop (no box sample collected).

12AS007

Photo E - 7. Soil profile 12AS007, Brumley family, Calcidic Haplustalfs fine-loamy, mixed, superactive, mesic.

12AS008

Photo E - 8. Soil profile 12AS008, Vessilla family, Aridic Lithic Ustorthents loamy, mixed, calcareous, active, mesic.

12AS009

Photo E - 9. Soil profile 12AS009, Boxcanyon family, Calcidic Haplustalfs fine, smectitic, mesic. Surface is top of box on the left. Horizons move down box on left and then to top of box on right and down.

12AS010

Photo E - 10. Soil profile 12AS010, BBB family similar, Aridic Calciustepts coarse-loamy, mixed, superactive, mesic.

12AS011

Photo E - 11. Soil profile 12AS011, CCC family, Aridic Calciustepts fine, carbonatic, mesic.

12AS012

Photo E - 12. Soil profile 12AS012, CCC family, Aridic Calciustepts fine, carbonatic, mesic.

12AS013

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Photo E - 13. Soil profile 12AS013, Sideshow family, Aridic Haplusterts fine, smectitic, mesic.

12AS014

Photo E - 14. Soil profile 12AS014, Sideshow family, Aridic Haplusterts fine, smectitic, mesic.

12AS015

Photo E - 15. Soil profile 12AS015, Sideshow family, Aridic Haplusterts fine, smectitic, mesic.

12AS016

Photo E - 16. Soil profile 12AS016, Teromote family, Aridic Haplustepts fine-loamy, mixed, superactive, mesic.

12AS017

Photo E - 17. Soil profile 12AS017, Sideshow family, Aridic Haplusterts fine, smectitic, mesic.

12AS018

Photo E - 18. Soil profile 12AS018, AAA family, Aridic Haplustepts fine-loamy, carbonatic, mesic. Surface is top of box on the left. Horizons move down box on left and then to top of box on right and down.

12AS019

Photo E - 19. Soil profile 12AS019, AAA family similar, Aridic Haplustepts fine-silty, carbonatic, mesic.

12AS019A

Photo E - 20. Soil profile 12AS019A, AAA family, Aridic Haplustepts fine-loamy, carbonatic, mesic. Surface is top of box on the left. Horizons move down box on left and then to top of box on right and down.

12AS020

Photo E - 21. Soil profile 12AS020, CCC family similar, Aridic Calciustepts fine-silty, carbonatic, mesic.

12AS021

Photo E - 22. Soil profile 12AS021, Atlatl family, Aridic Calciustepts coarse-loamy, carbonatic, mesic. Surface is top of box on the left. Horizons move down box on left and then to top of box on right and down.

12AS022

Photo E - 23.Soil profile 12AS022, DDD family, Oxyaquic Ustifluvent sandy-skeletal, carbonatic, mesic.

12AS023

Photo E - 24. Soil profile 12AS023, Bobknoll family, Aridic Calciustepts coarse-loamy, mixed, superactive, mesic.

12AS024

Photo E - 25. Soil profile 12AS024, DDD family, Oxyaquic Ustifluvent sandy-skeletal, carbonatic, mesic.

12AS025

Photo E - 26. Soil profile 12AS025, Atlatl family, Aridic Calciustepts coarse-loamy, carbonatic, mesic.

12AS026

Photo E - 27. Soil profile 12AS026, Wimmer family, Aridic Calciustepts fine-loamy, mixed, superactive, mesic.

12AS027

Photo E - 28. Soil profile 12AS027, Wimmer family, Aridic Calciustepts fine-loamy, mixed, superactive, mesic. Surface is top of box on the left. Horizons move down box on left and then to top of box on right and down.

12AS028

Photo E - 29. Soil profile 12AS028, AAA family, Aridic Haplustepts fine-loamy, carbonatic, mesic. Surface is top of box on the left. Horizons move down box on left and then to top of box on right and down.

12AS029

Photo E - 30. Soil profile 12AS029, Boxcanyon family, Calcidic Haplustalfs fine, smectitic, mesic. Surface is top of box on the left. Horizons move down box on left and then to top of box on right and down.

12AS030

Photo E - 31. Soil profile 12AS030, Sideshow family, Aridic Haplusterts fine, smectitic, mesic.

12AS031

Photo E - 32. Soil profile 12AS031, Wimmer family, Aridic Calciustepts fine-loamy, mixed, superactive, mesic.

12AS032

Photo E - 33. Sideshow family, Aridic Haplusterts fine, smectitic, mesic.

13AS01

Photo E - 34. Soil profile 13AS01, BBB family, Aridic Calciustepts fine-loamy, carbonatic, mesic.

13AS02

Photo E - 35. Soil profile 13AS02, Wimmer family, Aridic Calciustepts fine-loamy, mixed, superactive, mesic.

13AS03

Photo E - 36. Soil profile 13AS03, Treomote family, Aridic Haplustepts fine-loamy, mixed, superactive, mesic.

13AS04

Photo E - 37. Soil profile 13AS04, Brumley family, Calcidic Haplustalfs fine-loamy, mixed, superactive, mesic.

13AS05

Photo E - 38. Soil profile 13AS05, Treomote family, Aridic Haplustepts fine-loamy, mixed, superactive, mesic. Surface is top of box on the left. Horizons move down box on left and then to top of box on right and down.

13AS06

Photo E - 39. Soil profile 13AS06, Sideshow family, Aridic Haplusterts fine, smectitic, mesic. Surface is top of box on the left. Horizons move down box on left and then to top of box on right and down.

13AS07

Photo E - 40. Soil profile 13AS07, Boxcanyon family similar, Calcidic Haplustalfs fine-loamy, mixed, superactive, mesic. Surface is top of box on the left. Horizons move down box on left and then to top of box on right and down.

13AS08

Photo E - 41. Soil profile 13AS08,Sideslide similar, this soil was hydric and the surface 122 cm (48 inches) was not collected.

13AS09

Photo E - 42. Soil profile 13AS09, Quezcan family similar, Aridic Ustorthent fine, smectitic, superactive, calcareous, mesic, shallow.

14AS01

Photo E - 43. Soil profile 14AS01, Sideshow family, Aridic Haplusterts fine, smectitic, mesic.

DP-02

Photo E - 44. Soil profile DP-2, Flugle family, Aridic Haplustalfs fine-loamy, mixed, superactive, mesic.

DP-03

Photo E - 45. Soil profile DP-3, Sideshow family, Aridic Haplusterts fine, smectitic, mesic.

DP-04

Photo E - 46. Soil profile DP-4, Wimmer family, Aridic Calciustepts fine-loamy, mixed, superactive, mesic.

DP-05

Photo E - 47. Soil profile DP-5, Sideshow family, Aridic Haplusterts fine, smectitic, mesic.

DP-06

Photo E - 48. Soil profile DP-6, Teromote family, Aridic Haplustepts fine-loamy, mixed, superactive, mesic

DP-07

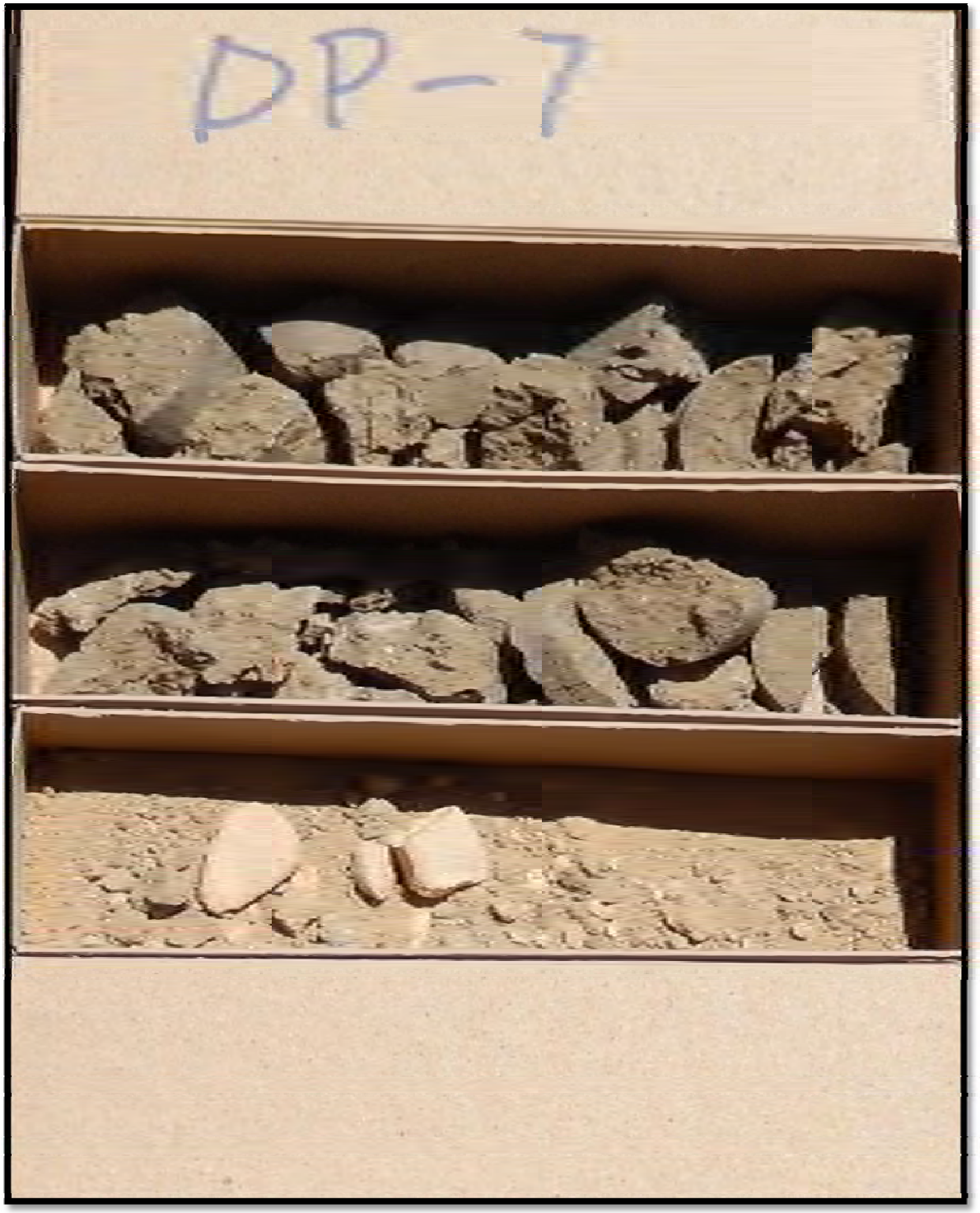


Photo E - 49. Soil profile DP-7, Sideshow family, Aridic Haplusterts fine, smectitic, mesic. Sample was not collected from surface 122 cm. Soil family estimated based on subsoil compared to characteristics of other Sideshow profiles and surface conditions.

DP-09

Photo E - 50. Soil profile DP-9, Sideshow family, Aridic Haplusterts fine, smectitic, mesic.

DP-10

Photo E - 51. Soil profile, Sideshow family, Aridic Haplusterts fine, smectitic, mesic. Sample was not collected from surface 122 cm. Soil family estimated based on subsoil compared to characteristics of other Sideshow profiles.

DP-11

Photo E - 52. Soil profile DP-11, Bobknoll family, Aridic Calciustepts coarse-loamy, mixed, superactive, mesic.

DP-12

Photo E - 53. Soil profile DP-12, Flugle family, Aridic Haplustalfs fine-loamy, mixed, superactive, mesic.

DP-13

Photo E - 54. Soil profile DP-13, Flugle family, Aridic Haplustalfs fine-loamy, mixed, superactive, mesic.

DP-14

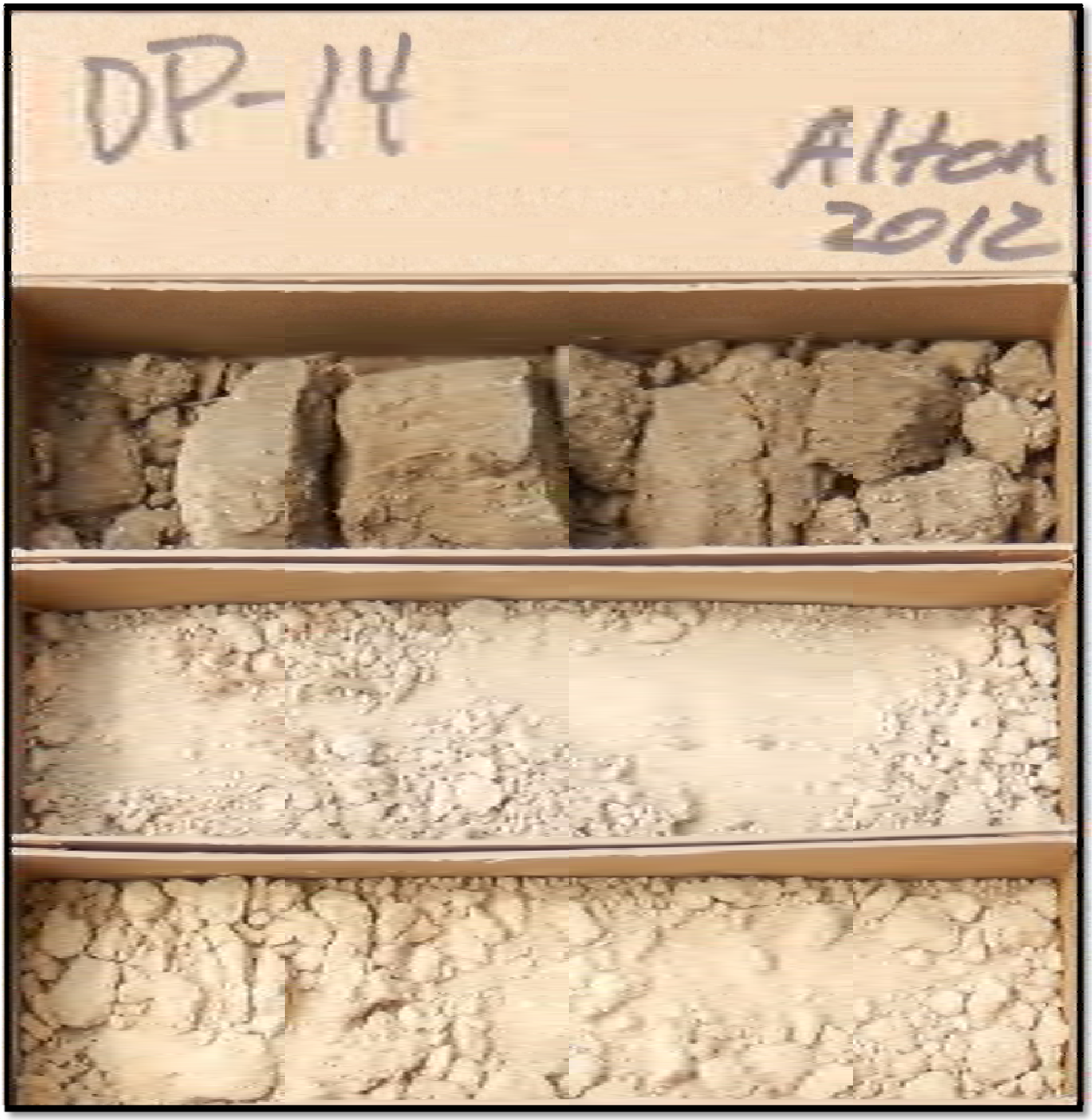


Photo E - 55. Soil profile DP-14, Bobknoll family, Aridic Calciustepts coarse-loamy, mixed, superactive, mesic.

DP-15

Photo E - 56. Soil profile DP-15, Teromote family, Aridic Haplustepts fine-loamy, mixed, superactive, mesic

DP-16

Photo E - 57. Soil profile DP-16, Sideshow family, Aridic Haplusterts fine, smectitic, mesic.

DP-17

Photo E - 58. Soil profile DP-17, Sideshow family, Aridic Haplusterts fine, smectitic, mesic.

DP-18

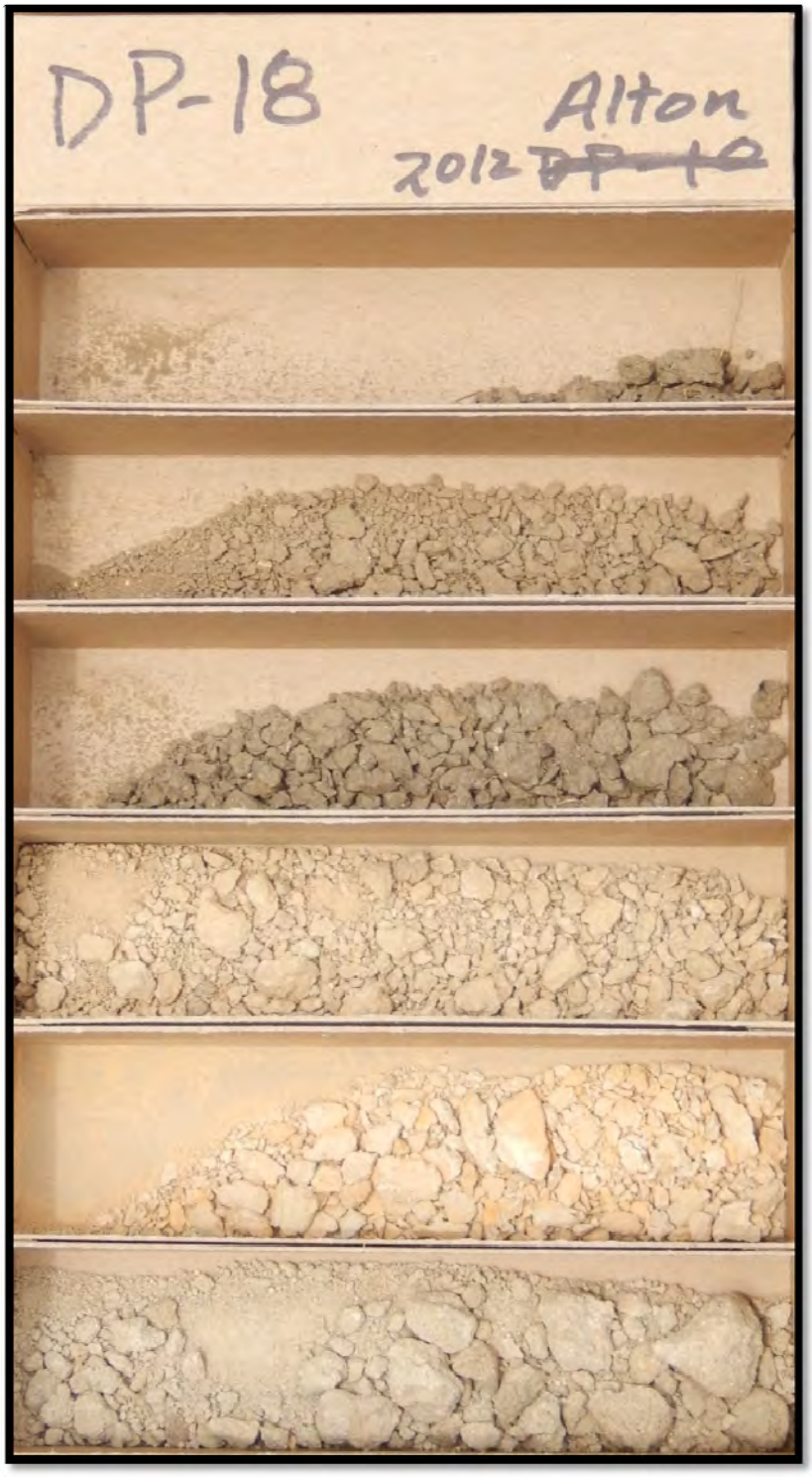


Photo E - 59. Soil profile DP-18, Brumley family, Calcidic Haplustalfs fine-loamy, mixed, superactive, mesic.

DP-19

Photo E - 60. Soil profile DP-19, Boxcanyon family, Calcidic Haplustalfs fine, smectitic, mesic. Sample from 122 cm (48 inches) was not collected. Profile location was estimated to be Boxcanyon based similarity of subsoil to Boxcanyon soil profiles.

DP-20

Photo E - 61. Soil profile DP-20, Boxcanyon family eroded, Calcidic Haplustalfs fine, smectitic, mesic.

DP-21

Photo E - 62. Soil profile DP-21, Teromote family, Aridic Haplustepts fine-loamy, mixed, superactive, mesic.

DP-22

Photo E - 63. Soil profile DP-22, Sideshow family, Aridic Haplusterts fine, smectitic, mesic.

DP-23

Photo E - 64. Soil profile DP-23, Wimmer family, Aridic Calciustepts fine-loamy, mixed, superactive, mesic.

DP-24

Photo E - 65. Soil profile DP-24, Sideshow family, Aridic Haplusterts fine, smectitic, mesic.

DP-25

Photo E - 66. Soil profile DP-25, Boxcanyon family, Calcidic Haplustalfs fine, smectitic, mesic.

DP-26

Photo E - 67. Soil profile DP-26, BBB family, Aridic Calciustepts fine-loamy, carbonatic, mesic.

DP-27

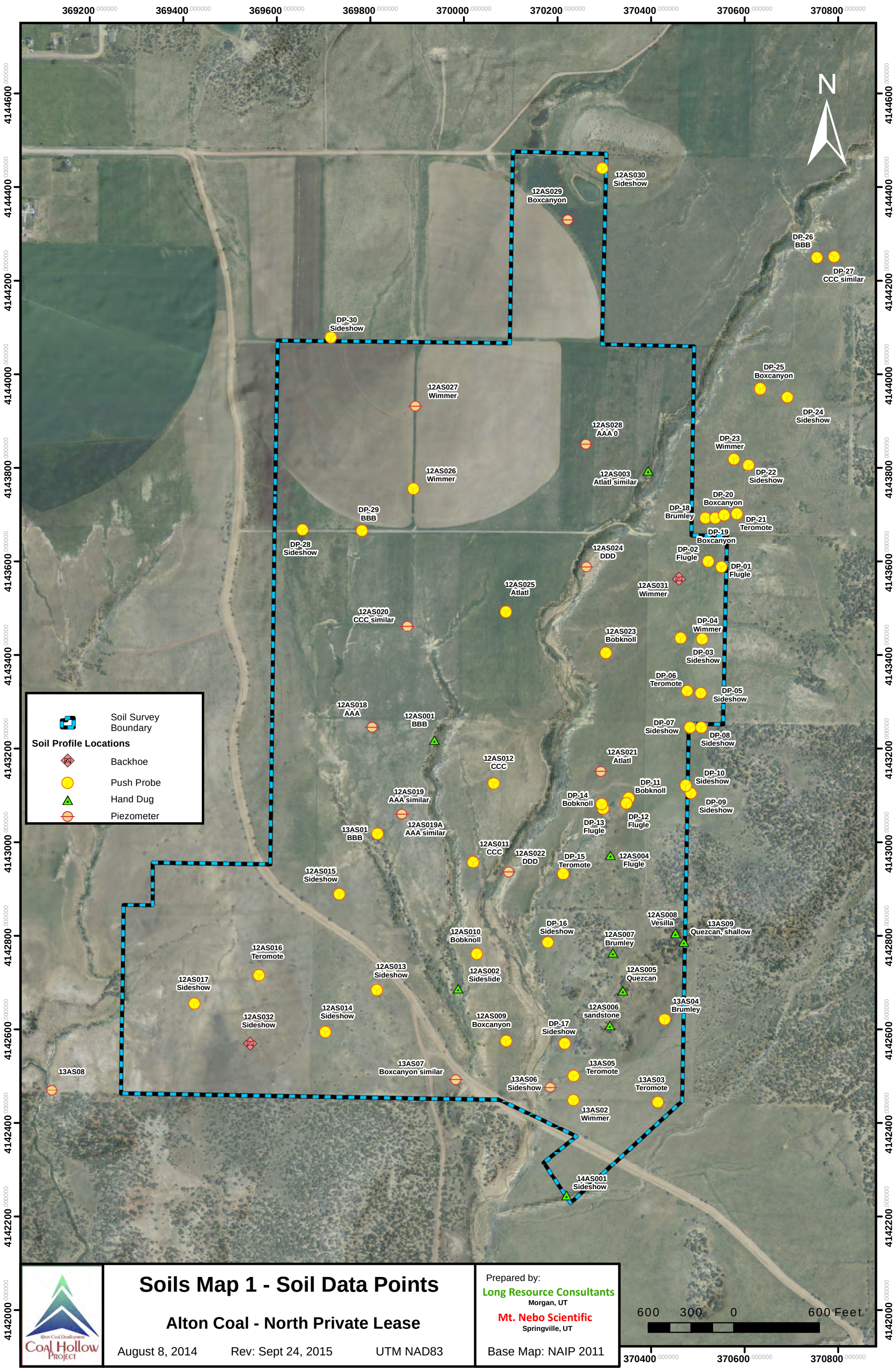
Photo E - 68. Soil profile DP-27, CCC family similar, Aridic Calciustepts fine, smectitic, mesic.

DP-28

Photo E - 69. Soil profile DP-28, Sideshow family, Aridic Haplusterts fine, smectitic, mesic.

DP-29

Photo E - 70. Soil profile DP-29, BBB family, Aridic Calciustepts fine-loamy, carbonatic, mesic.



Soils Map 1 - Soil Data Points

Alton Coal - North Private Lease

August 8, 2014 Rev: Sept 24, 2015 UTM NAD83

Prepared by:
Long Resource Consultants
Morgan, UT
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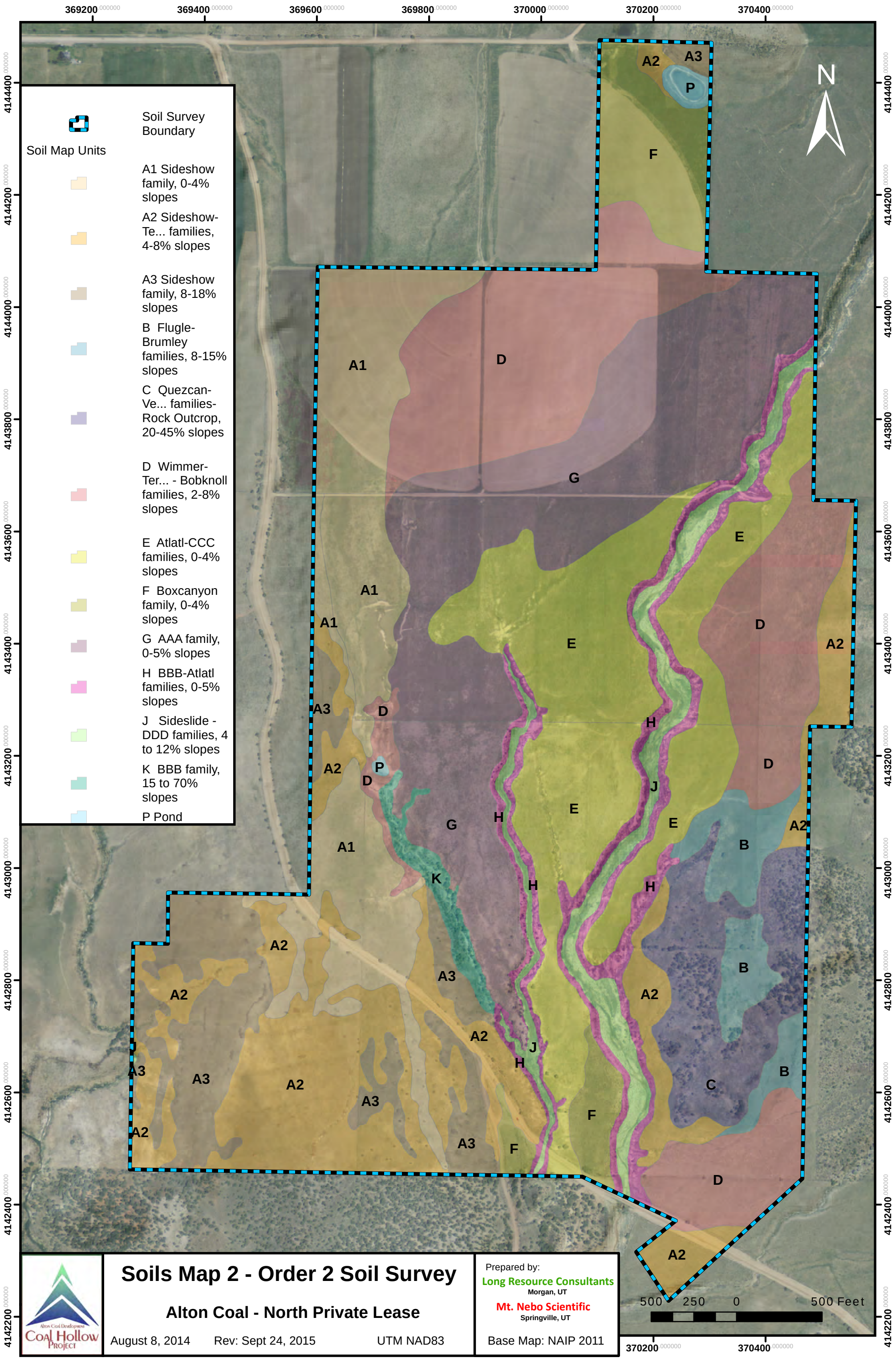
Springville, UT

Base Map: NAIP 2011



Soils Map 2 - Order 2 Soil Survey

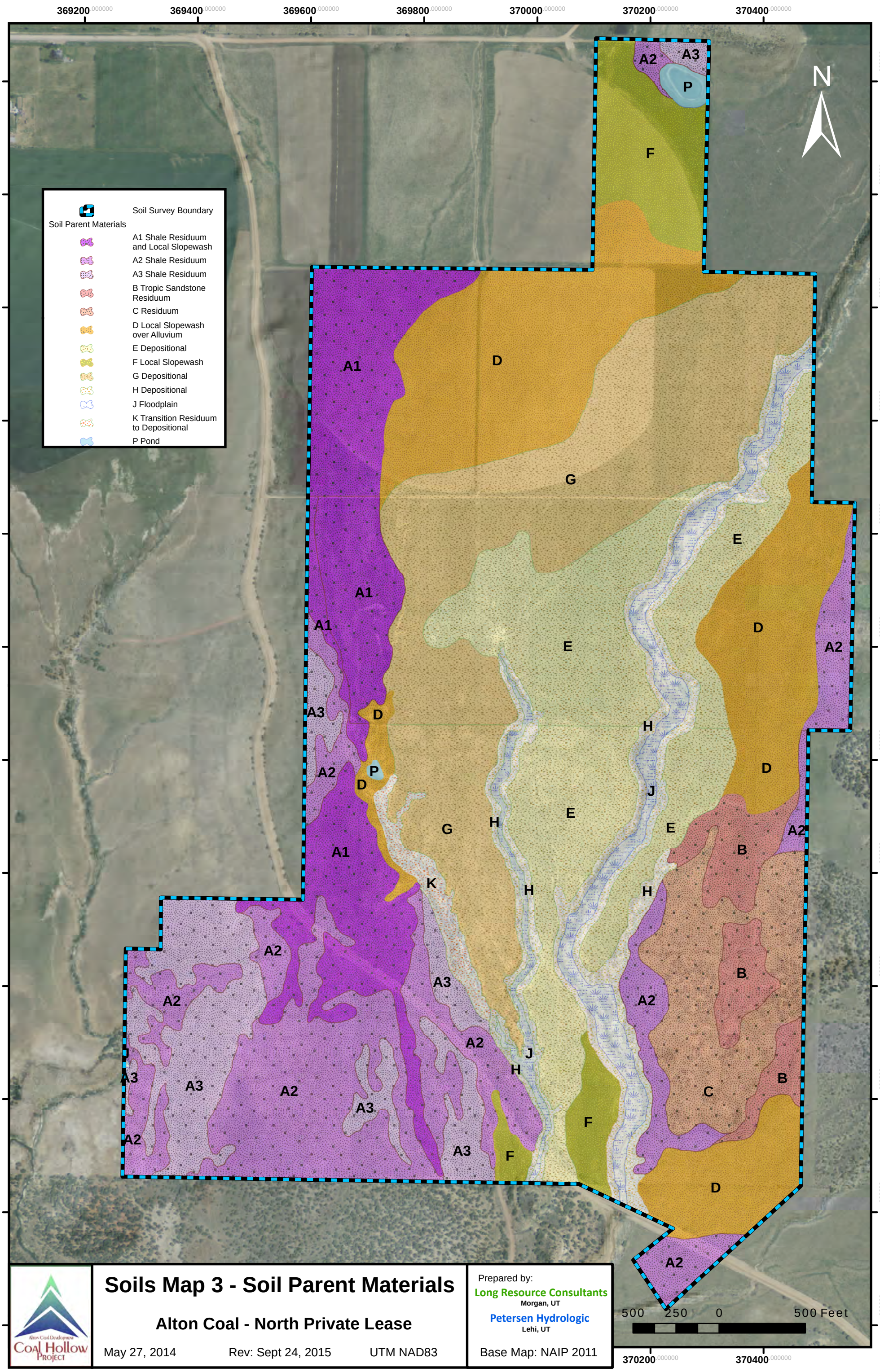
Alton Coal - North Private Lease

August 8, 2014 Rev: Sept 24, 2015 UTM NAD83

Prepared by:
Long Resource Consultants
Morgan, UT
Mt. Nebo Scientific
Springville, UT

Base Map: NAIP 2011

Alton Coal Development
Coal Hollow Project



Soils Map 3 - Soil Parent Materials

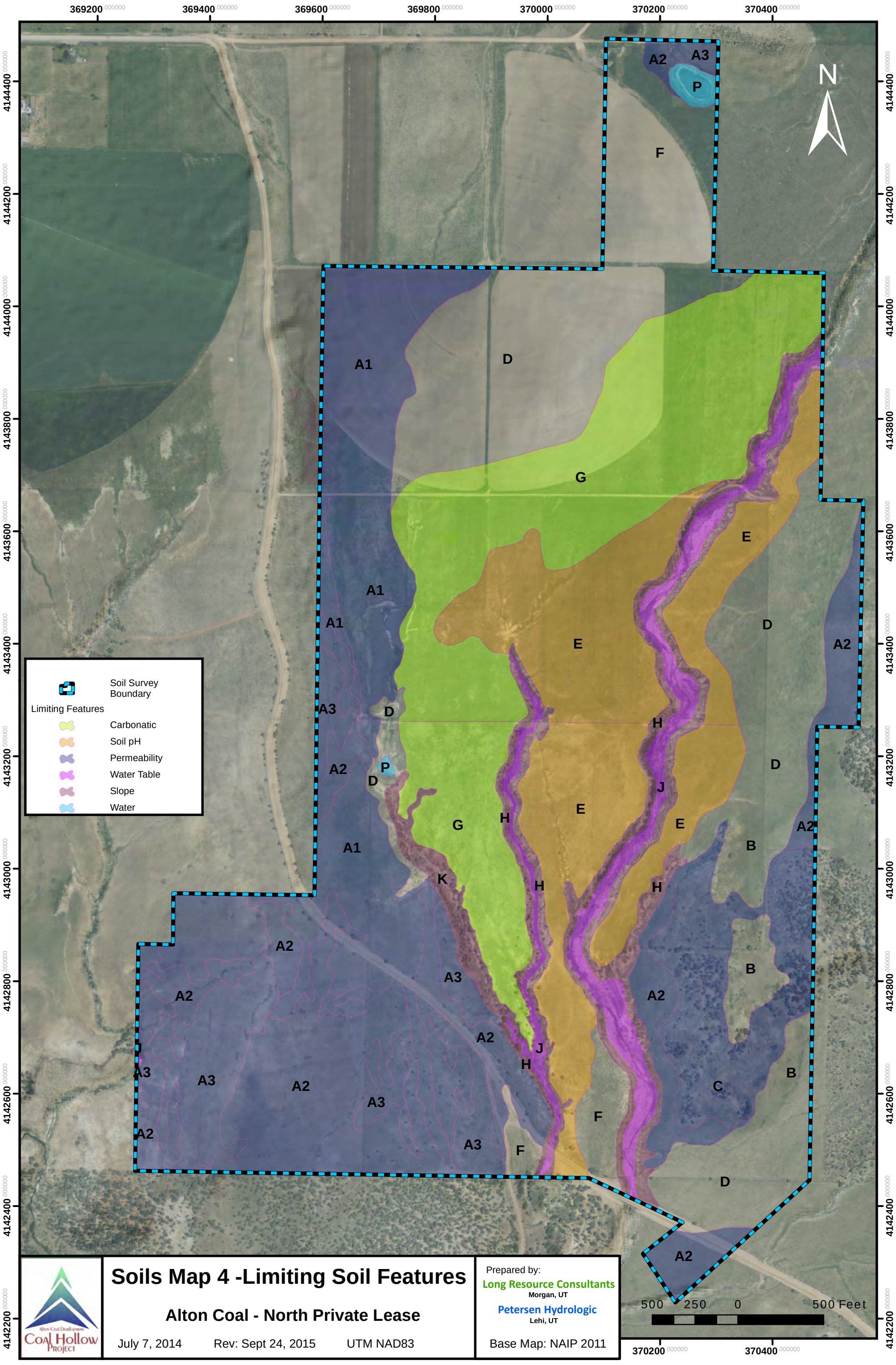
Alton Coal - North Private Lease

May 27, 2014 Rev: Sept 24, 2015 UTM NAD83

Prepared by:
Long Resource Consultants
Morgan, UT
Petersen Hydrologic
Lehi, UT

Base Map: NAIP 2011

Alton Coal Development
Coal Hollow Project



Soils Map 4 -Limiting Soil Features

Alton Coal - North Private Lease

July 7, 2014 Rev: Sept 24, 2015 UTM NAD83

Prepared by:
Long Resource Consultants
Morgan, UT
Petersen Hydrologic
Lehi, UT

Base Map: NAIP 2011

Irrigation areas shown on this map are based on field observations and information collected from landowners.

Legend
- Soil Survey Boundary
- Irrigation Areas

Sprinkler
Center Pivot
Wheel-line
Historic
Historic
Hand Lines
Wheel-line
Hand Lines

N

500 250 0 500 Feet

Soils Map 5 - Irrigation Areas

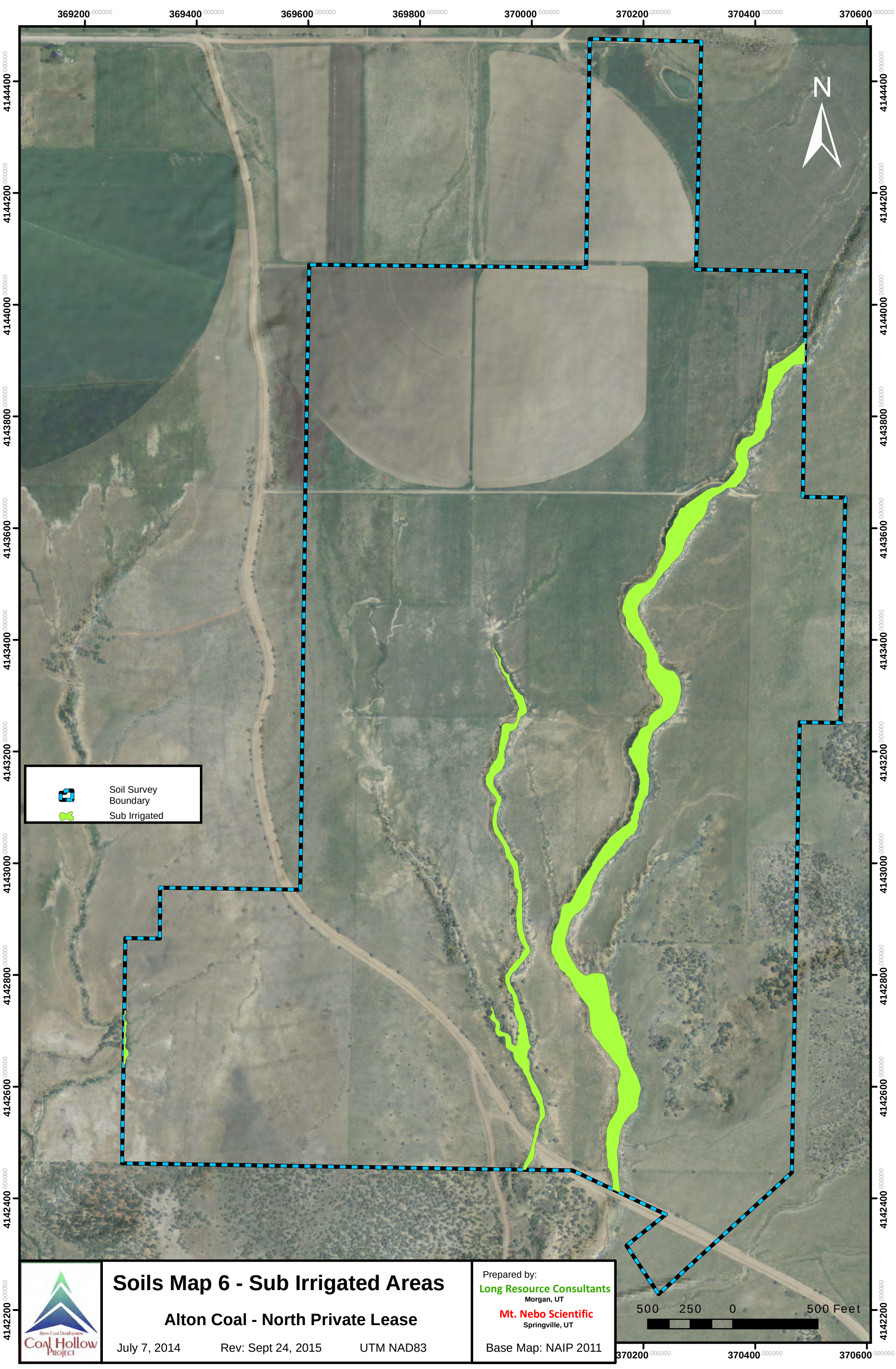
Alton Coal - North Private Lease

July 7, 2014 Rev: Sept 30, 2015 UTM NAD83

Alton Coal Development
Coal Hollow Project

Prepared by:
Long Resource Consultants
Morgan, UT
Petersen Hydrologic
Lehi, UT

Base Map: NAIP 2011



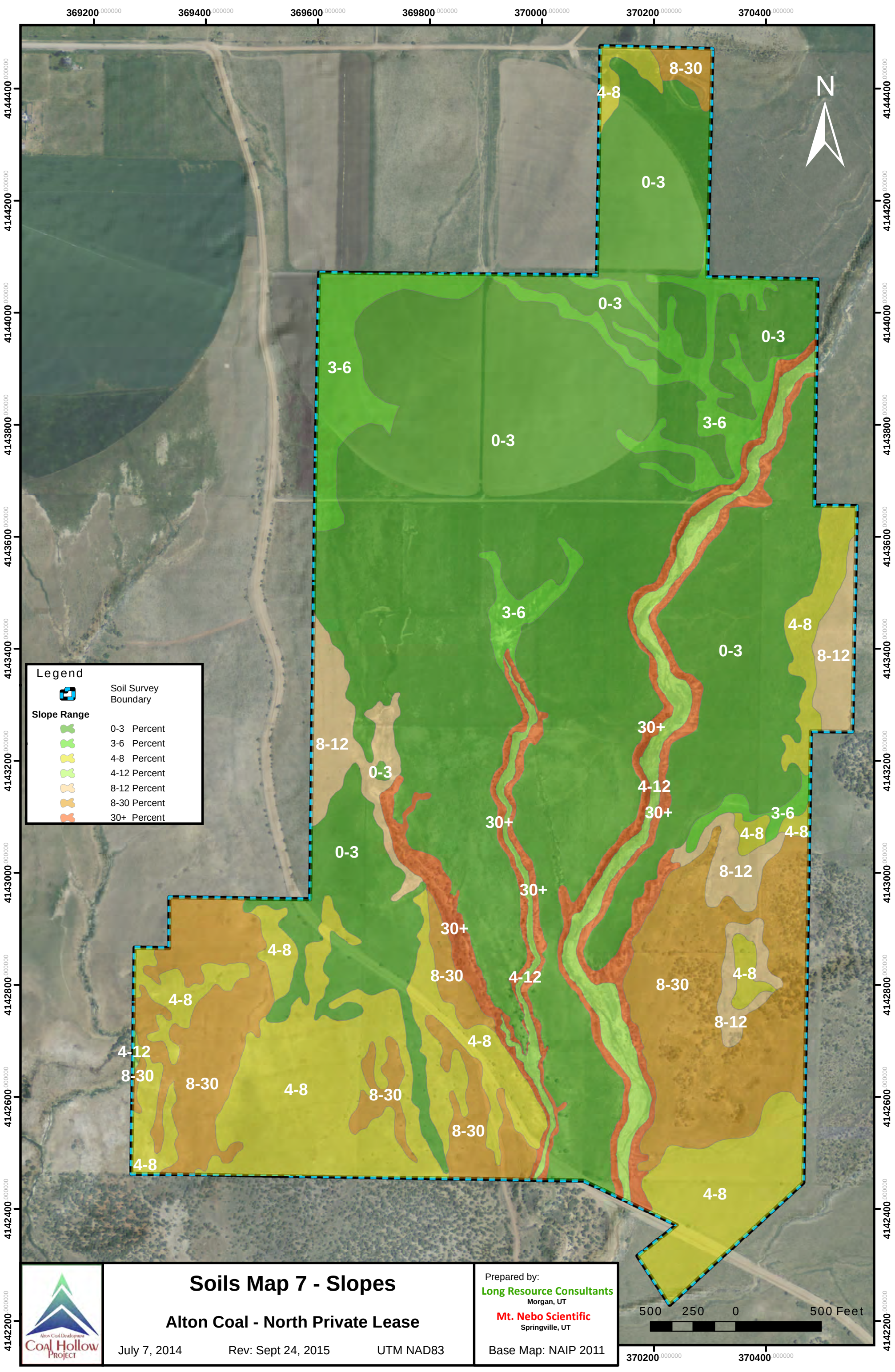
Soils Map 6 - Sub Irrigated Areas

Alton Coal - North Private Lease

July 7, 2014 Rev: Sept 24, 2015 UTM NAD83

Prepared by:
Long Resource Consultants
Morgan, UT
Mt. Nebo Scientific
Springville, UT

Base Map: NAIP 2011



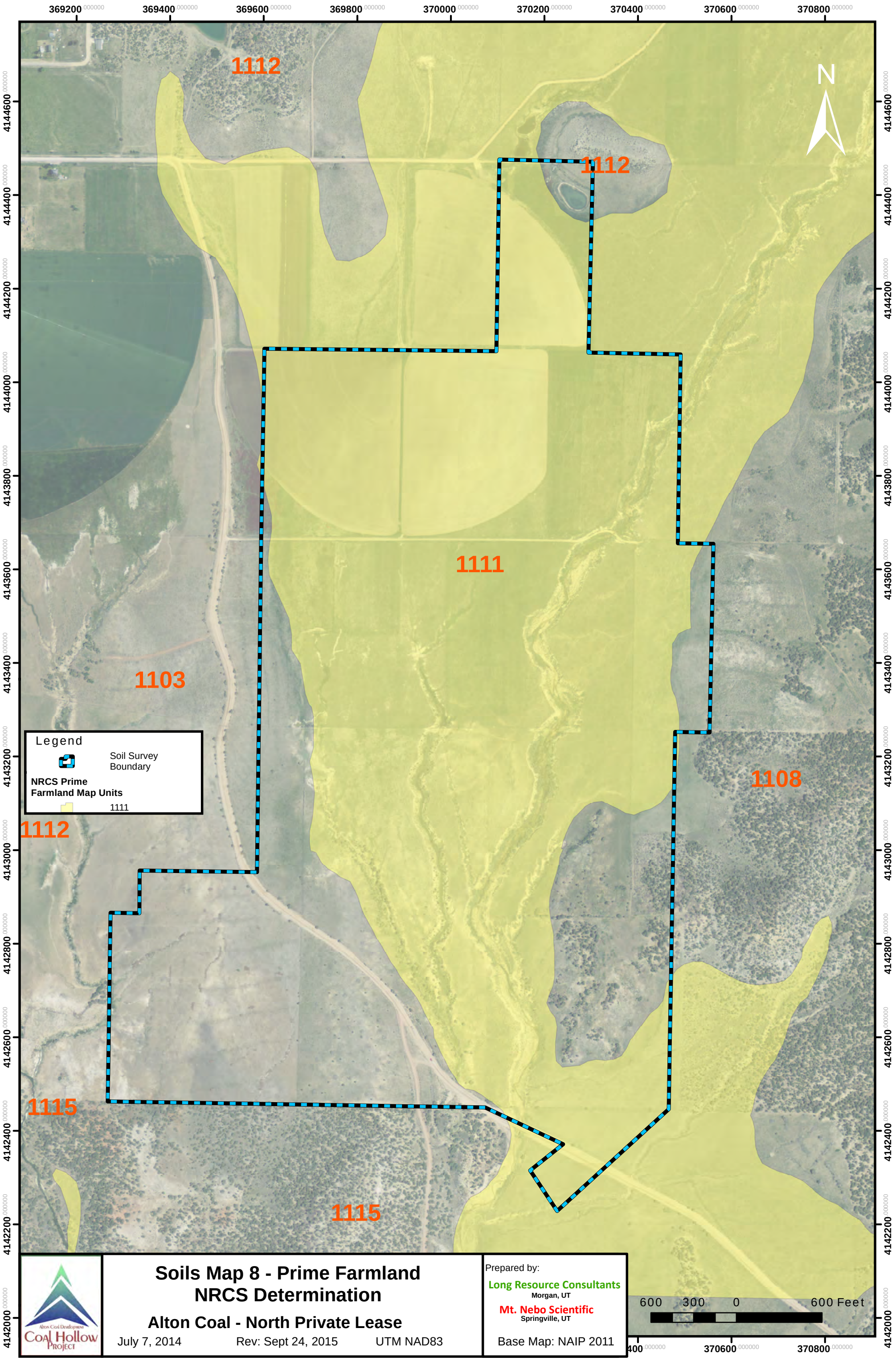
Soils Map 7 - Slopes

Alton Coal - North Private Lease

July 7, 2014 Rev: Sept 24, 2015 UTM NAD83

Prepared by:
Long Resource Consultants
Morgan, UT
Mt. Nebo Scientific
Springville, UT

Base Map: NAIP 2011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4143600 000000
4143400 000000
4143200 000000
4143000 000000
4142800 000000
4142600 000000
4142400 000000
4142200 000000
4142000 000000
N
1112
1112
1111
1103
1108
1112
1115
1115
Legend
Soil Survey Boundary
NRCS Prime Farmland Map Units
1111
600 300 0 600 Feet
Soils Map 8 - Prime Farmland NRCS Determination
Alton Coal - North Private Lease
July 7, 2014
Rev: Sept 24, 2015
UTM NAD83
Prepared by:
Long Resource Consultants
Morgan, UT
Mt. Nebo Scientific
Springville, UT
Base Map: NAIP 2011
Alton Coal Development
Coal Hollow Project

369200 000000 | 369400 000000 | 369600 000000 | 369800 000000 | 370000 000000 | 370200 000000 | 370400 000000 | 370600 000000 | 370800 000000

4144600 | 4144400 | 4144200 | 4144000 | 4143800 | 4143600 | 4143400 | 4143200 | 4143000 | 4142800 | 4142600 | 4142400 | 4142200 | 4142000

N

Soil Survey Boundary

Farmland

- Prime Irrigated
- Prime Unknown Irrigation
- Statewide Irrigated
- State Unknown Irrigation
- Prime Not Irrigated
- Statewide Not Irrigated
- Elk Fence

Irrigation water is allocated, but no evidence of historical irrigation development.

Water is allocated for irrigation, but extent of irrigation development is unknown, area will be assumed to be either Prime Farmland or Farmland of Statewide Importance.

Water is allocated, but no historical irrigation development south of Farm Road line, north of south line of Elk Fence, and east of Kanab Creek.

Soils Map 9 - Prime Farmland Based on Field and Lab Analysis Data

Alton Coal - North Private Lease

Nov 18, 2014 Rev: Sep 30, 2015 UTM NAD83

Alton Coal Development Coal Hollow Project

Prepared by:
Long Resource Consultants
Morgan, UT
Mt. Nebo Scientific
Springville, UT

Base Map: NAIP 2011

600 300 0 600 Feet

Soil Survey Boundary

Estimated Non Prime Farmland Salvage Depths			
Map Unit	Topsoil Salvage	Subsoil Salvage	Total Salvage
	feet	feet	feet
A1	1.2	2.6	3.8
A2	1.1	2.7	3.8
A3	1.2	2.6	3.8
B	1.4	2.1	3.5
C	0.5	1.0	1.5
D	1.2	2.6	3.8
E	1.1	2.9	4.0
F	1.6	2.4	4.0
G	0.9	3.1	4.0
H	1.0	3.0	4.0
J	0.6	3.4	4.0
K	1.0	2.8	3.8

Estimated Horizon Salvage Depths for Prime Farmland Areas, if Irrigated			
Map Unit	A	B	C
	feet	feet	feet
A1	0.7	2.9	0.3
A2	0.7	3.0	0.1
A3	0.7	2.8	0.3
B	0.8	2.7	0.0
D	0.7	3.0	0.0
E	0.5	3.2	0.3
F	0.7	3.3	0.0
G	0.7	3.1	0.2

N

500 250 0 500 Feet

Soils Map 10 - Soil Salvage Depths

Alton Coal - North Private Lease

November 18, 2014 Rev: Sept 24, 2015 UTM NAD83

Prepared by:
Long Resource Consultants
Morgan, UT

Base Map: NAIP 2011

Alton Coal Development
Coal Hollow Project

Appendix G

Approximation of Growing Season Dates

Growing Season Dates

Approximation of the growing season beginning and end dates were determined by three methods. Threshold temperatures used to determine are based on the criteria listed in Table G-1 (NRCS 2015a).

Table G-1. Description and temperature ranges of freeze types.

Freeze Type	Temperature Range	Environmental Conditions
	°F	
Light	32 to 29	Tender plants killed, with little destructive effect on other vegetation.
Moderate	28 to 25	Widely destructive effect on most vegetation with heavy damage to fruit blossoms, tender and semi-hardy plants.
Severe	24 and less	Heavy damage to most plants. At these temperatures, the ground freezes solid, with the depth of the frozen ground dependent on the duration and severity of the freeze, soil moisture, and soil type.
Source: WETS Table Documentation at http://www.wcc.nrcs.usda.gov/climate/wets_doc.html#Section1		

The following information is a summary of methods for approximating the growing season for Alton, Utah based on three methods:

1) recorded spring and fall freeze dates from the Utah Climate Center;
2) growing season probabilities from Western Regional Climate Center data;
3) WETS growing season probabilities.

Utah Climate Center

Table G-2 lists the spring and fall freeze dates based on data from the *Utah Climate Center*. The growing season would begin on June 6 and end on September 25 based on the median data for a threshold temperature of 32° Fahrenheit (0 degrees Celsius).

Table G-2. Summary of spring and fall freeze dates based on 32° F (0° C) for Alton, Utah. Source of data is Utah Climate Center at Utah State University.

Last Spring Freeze					
Early	Early Year	Average	Median	Late	Late Year
May 7	1940	June 6	June 6	July 3	1928
First Fall Freeze					
Early	Early Year	Average	Median	Late	Late Year
August 23	1968	September 24	September 25	October 21	1991
Freeze Free Season					
Short	Short Year	Average	Median	Long	Long Year
64	1942	111.5	114.0	151	1947
Source: https://climate.usurf.usu.edu/reports/freezeDetails.php?station_id=1079777&ntwk=GHCN					

Western Regional Climate Center

Probabilities for spring and fall freeze dates have been calculated for Alton, Utah by the *Western Regional Climate Center* (WRCC 2015). Table G-3 lists the probable freeze dates spring and fall based temperature threshold and 50 percent probability.

Table G-3. Spring fall freezing dates depending on threshold temperature and probability.

Percent Probability	24.5° F	28.5° F	32.5° F
		Spring Freeze[1]	
50	May 6	May 23	June 7
		Fall Freeze[2]	
50	October 21	October 8	September 24
1. Probability that a minimum temperature below the threshold temperature will occur *on or after* the give date.			
2. Probability that a minimum temperature below the threshold will occur *on or before* the given date.			
Source: http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ut0086			

WETS Table

The U.S. Army Corps of Engineers recommends approximation of growing season dates based on the median dates (ie. 5 years in or 50 percent probability) at a threshold temperature of 28°F when conducting wetland delineation surveys (USACE 2008 and USACE 2010.) "These dates are reported in WETS tables available from National Resources Conservation Service (NRCS) National Water and Climate Center (USACE 2008 and USACE 2010)", Table G- 4. The growing season for Alton, Utah based on 28° F and 50 percent probability begins on May 21 and ends on October 4 using the WETS table (NRCS 2015b).

Table G- 4. WETS Table growing season beginning and end dates for Alton, Utah (NRCS 2015).

Percent Probability	24° F or Higher	28° F or Higher	32° F or Higher
50	May 5 to October 18	May 21 to October 4	June 7 to September 23
Source: WETS Table for Alton, Utah at http://agacis.rcc-acis.org/49025/wets/results			

Growing Season Dates for Alton, Utah

The growing season has been determined based on three data sources as listed in Table G-5. Based on these data sources, the maximum length growing season would begin on May 21 (WETS Table) and end on October 8 (Western Regional Climate Center for 28° F).

Table G-5. Summary of growing season beginning and end dates for Alton, Utah.

Data Source	Temperature Threshold	Growing Season Dates
Utah Climate Center	32° F	June 6 to September 25
Western Regional Climate Center	32° F	June 7 to September 24
	28° F	May 23 to October 8
WETS Table	28.5° F	May 21 to October 4

Average Growing Season Precipitation for Alton, Utah

The average amount of growing season precipitation (5.79 inches) that normally occurs at Alton, Utah is determined in Table G-6 based on the approximated growing season of May 21 to October 8.

Table G-6. Determination of average precipitation amount that normally occurs during the approximated growing season of May 21 to October 8 at Alton, Utah.

Month	Percent of Month[1]	Average Monthly Precipitation[2]	Growing Season Precipitation[3]
		inches	inches
April	0	1.06	0.00
May[4]	35	0.82	0.29
June	100	0.53	0.53
July	100	1.43	1.43
August	100	1.73	1.73
September	100	1.47	1.47
October[5]	23	1.49	0.34
Total			5.79

1. Percent of month based on May 21 to October 8 growing season.
2. Average monthly precipitation amounts for Alton, Utah from table 2 (WRCC 2014).
3. Average monthly precipitation multiplied by percent of month in growing season.
4. Percent of May includes first day of growing season (May21) or 11 days.
5. Growing season ending date not included in percent of month. "Since minimum temperatures usually occur in the morning, so effective last day of growing season is the previous day (NRCS 2015a)." The number of days used to calculate percent of October was 7.

Vegetation & Wildlife Habitat of the North Private Lease Area

Coal Hollow Project
Kane County, Utah

Prepared by

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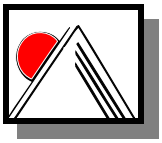
November 2014
(Revised: June 2015)
(Revised: October 2015)



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INTRODUCTION

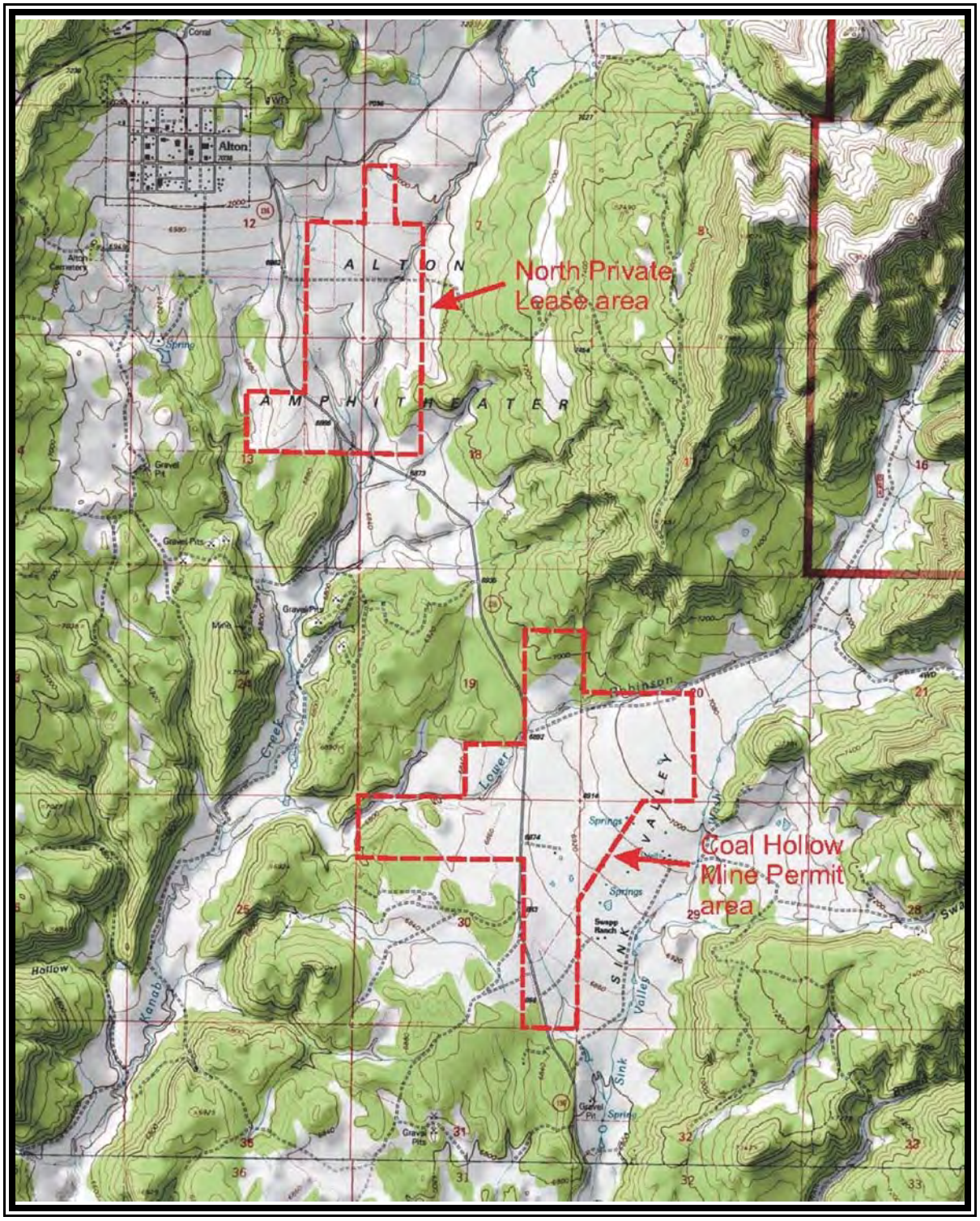
The Coal Hollow Mine is located approximately 3 miles south of the small town of Alton, Kane County, Utah. Alton Coal Development, LLC first submitted a mine permit application to the State of Utah, Division of Oil, Gas & Mining (DOGM) in June 2006. The application was determined complete in October 2009 and DOGM issued a permit to mine coal in the area in November 2010. The first coal was mined at the site in February 2011.

Alton Coal Development has proposed to expand their mining operation north of their current permit area (see the location map below). Consequently, the new area has been studied to address state and federal regulations required to provide a revision to the Coal Hollow Mining & Reclamation Plan (MRP) to DOGM. The study area for the proposed new mining activities is called the North Private Lease.

The Coal Hollow Mine and North Private Lease areas are located within the Alton Amphitheater and bordered on the east and west by the Tropic Shale formation that is present near the surface on the margins of the study area. The economic coal seams lie within the Dakota formation. Kanab Creek dissects the North Private Lease area. Black Mountain separates the Alton Amphitheater from Long Valley with the Paunsaugunt Plateau to the north and northeast, the Markagunt Plateau to the northwest, with Sink Valley and the Skutumpah Terrace on the south end of the area.

To revise the Coal Hollow MRP to accommodate the proposed new mining area, several environmental disciplines are required for baseline studies such as hydrology, soils, geology and engineering, but this report focuses on the baseline biological requirements of the regulations. Previous studies including wetland and ordinary high water mark identifications (see Supplemental Report, VOLUME 10) and alluvial valley floor field investigations of North Private Lease area have been conducted.

Elevation of the North Private Lease lies between 6,800 ft and 7,000 ft above sea level. Historically, native plant communities of the study area were most-likely comprised of sagebrush/grass, pinyon-juniper and small mountain brush areas. Today, however, the native communities have been replaced by developed rangelands, mostly pasture lands.



General location of the existing Coal Hollow Mine and the North Private Lease area.

METHODS

Transect Placement

Transect lines and sample locations for quantitative sampling the vegetation were randomly placed at each study site. From these transect lines, sample locations were chosen using random numbers.

Cover, Frequency & Composition

Cover estimates were made using ocular methods with meter square quadrats. Species composition and relative frequencies were also assessed from the quadrats. Plant nomenclature follows "*A Utah Flora*" (Welsh et al. 2008).

Density

When density of woody plant species was measured, it was accomplished by employing a distance method called the point-quarter technique. In this method, random points were placed on the sample sites and divided into four quarters. The distances to the nearest woody plant species were then recorded in each quarter. The average point-to-individual distance was equal to the square root of the mean area per individual. Final calculations resulted in the number of individual woody plants per acre.

Annual ~~Biomass~~ Production

Total annual ~~biomass~~ productivity was estimated for the plant communities in the North Private Lease. Because the native plant communities of the proposed disturbed areas had been previously altered to create crop and pasture lands and are managed accordingly, clipping, drying and weighing samples would not have been meaningful. In other words, most of the production of the crop and pasture lands is constantly being removed by harvesting and/or livestock grazing during the growing season.
Consequently, annual ~~biomass~~ production estimates were made using other methods. To begin, the production was estimated in the field at the sample sites by experienced biologists from *Mt. Nebo Scientific, Inc.* first by estimating the production harvested that year in sample quadrats, then extrapolating that loss to create the estimated amounts which

were based on several years experience (over 30 years) of clipping and weighing vegetation production. Next, the sample sites were correlated with onsite soil surveys including estimates from documented NRCS Ecological Sites. ~~Finally~~ Later, personal communications with an NRCS plant ecologist (Benson, 2014; see Table 43) were made regarding the site-specific locations. Field measurements taken by Cedar Creek Associates (1987) in analogous plant communities in the area were also compared to the findings reported herein (see MRP, Table 3-34). Finally, personal communications with each landowner were conducted to ascertain current land management practices as well as animal use and harvest rates (see Landowner Production Information, 2015; see Table 43). More detail regarding dates and methods are provided in the summary tables.

Threatened, Endangered & Candidate Species

The most recent document showing the federally listed Threatened, Endangered and Candidate Species for Kane County, Utah was consulted prior to field work in the North Private Lease. Additionally, the State of Utah, Department of Natural Resources' biodiversity database was also consulted with regard to threatened, endangered or otherwise sensitive Species (TES) in the area. These information sources were used to drive sensitive species field surveys if any such species or habitats were known to be at or near the proposed new project.

Photographs & Maps

Color photographs were taken of the sample areas and have been included in this report. Additionally, maps showing the sample site have also been included.

High-Value Wildlife

The State of Utah, Department of Natural Resources geographic information system (GIS) database was consulted with regard to high-value habitats within and adjacent to the North Private Lease study area. The findings have been included in this report.

RESULTS

Vegetation

Plant communities within the North Private Lease study area were first mapped in the field to create final vegetation maps for this report. The general plant community types within the study area are shown on **Vegetation Map 1**. As mentioned, the majority of the area was comprised of rangelands that have been converted to pasture lands. As a result of several environmental studies conducted in the area, current plans in the North Private Lease have been restricted to mining activities south of the road called "Farm Road" (this east-west road can be easily identified on Vegetation Map 1, south of the center-pivot field). Total acreage of the survey area including those areas north and south of Farm Road was approximately 428 acres. The size of the pasture lands was approximately 307 acres (this includes the uplands along the drainage channels). Although there were differences in plant species and composition between pastures due to: land ownership and management practices, seed mixtures planted, and soil types, the pasture lands were most often dominated by grass species such as: intermediate wheatgrass (*Elymus hispidus*), western wheatgrass (*E. smithii*), thickspike wheatgrass (*E. lanceolatus*), smooth brome (*Bromus inerme*) and crested wheatgrass (*Agropyron cristatum*).

There was also a fair amount of land that had been converted to croplands in the study area proper, most of which was north of Farm Road (about 87 acres). Although crops can vary from year-to-year due to rotation practices, the most common crops raised in the study area have been: alfalfa (*Medicago sativa*), wheat (*Triticum aestivum*) and silage crops *(Triticale).* The croplands, however, are currently not proposed for disturbance by mining activities.

Additionally, there was one relatively small area that supported native, mostly undisturbed vegetation (undeveloped rangelands). This area consisted of pinyon-juniper, sagebrush with minor influence of a mountain brush community (including transitional zones between these types). These types comprised nearly 25 acres of the survey area. Examples of plant species common in these communities included: pinyon-pine (*Pinus edulis*), Utah juniper (*Juniperus osteosperma*), Gambel's oak (*Quercus gambelii*), Moki-apple (*Peraphyllum ramosissimum*), Wyoming big sagebrush (*Artemisia tridentata* var. *wyomingensis*), black sagebrush (*A. nova*), alder-leaf mountain-mahogany (*Cercocarpus montanus*), corymb buckwheat (*Eriogonum corymbosum*) and snowberry (*Symphoricarpos oreophilus*).

Next, there were also channels or drainages that dissected the study area. These channels supported some riparian and wetland communities and consisted of about 9 acres of the study area. Field studies indicated some differences in total living cover, species present and composition, but the plants common here were: beaded sedge (*Carex utriculata*), bluegrass (*Poa pratensis*), wooly-sedge (*Carex pellita*), Douglas' sedge (*C. douglasii*), small-wing sedge (*C. microptera*), maritime arrowgrass (*Triglochin maritima*), common threesquare (*Scirpus pungens*), longstyle rush (*Juncus longistylis*), Missouri iris (*Iris missouriensis*), willows (*Salix boothii* and *S. exigua*), wiregrass (*Juncus arcticus*), Wood's rose (*Rosa woodsii*) and Russian olive (*Elaeagnus angustifolia*).

In addition, there were also upland plant communities supported within the above-mentioned drainage channels. Other than grazing pressure and the erosional component common in the area, these upland communities were relatively undisturbed and located on the flood plains and stream terraces bordering the riparian and wetland zones. These communities were primarily dominated by Wyoming big sagebrush and black sagebrush. The acreage measurements of the channel uplands were not separated from the upland pasture lands, but the acreage is closer to that of the wetlands mentioned above.

Total living cover, cover by species, and composition for all sample sites are shown **Tables 1** *through* **42**. Total annual biomass production estimates for all sample sites are shown on **Table 43**. Woody species density values for the pasture lands that have been proposed for disturbance by mining activities are shown on **Table 44**. Finally, all vegetation sample site locations are shown on **Vegetation Map 2**; color photographs of the sample sites are provided in **Figures 1** *through* **21**.

A list of all data tables including community types, data classifications, sample site numbers and parameters sampled is summarized below.

A Summary of the Vegetation Data Tables of North Private Lease of the Coal Hollow Project. Living Cover and Frequency by Plant Species.

Plant Community	Dataset Classification	Sample Site	Cover by Species	Total Cover	Composition	Woody Species Density	Production
Sagebrush	Baseline	V-01	Table 01	Table 02-A	Table 02-B	n/a	Table 43
Wetland	Baseline	V-02	Table 03	Table 04-A	Table 04-B	n/a	Table 43
Sagebrush	Reference	V-03	Table 05	Table 06-A	Table 06-B	n/a	Table 43
Westland	Baseline	V-04	Table 07	Table 08-A	Table 08-B	n/a	Table 43
Sagebrush	Baseline (Alternate Reference Area)	V-05	Table 09	Table 10-A	Table 10-B	n/a	Table 43
Wetland	Reference	V-06	Table 11	Table 12-A	Table 12-B	n/a	Table 43
Sagebrush	Proposed Disturbed	V-07	Table 13	Table 14-A	Table 14-B	n/a	Table 43
Wetland	Proposed Disturbed	V-08	Table 15	Table 16-A	Table 16-B	n/a	Table 43
Wetland	Baseline	V-09	Table 17	Table 18-A	Table 18-B	n/a	Table 43
Wetland	Baseline	V-10	Table 19	Table 20-A	Table 20-B	n/a	Table 43
Cropland	Baseline	V-11	Table 21	Table 22-A	Table 22-B	n/a	Table 43
Pasture Land	Baseline	V-12	Table 23	Table 24-A	Table 24-B	Table 44	Table 43
Pasture Land	Proposed Disturbed	V-13	Table 25	Table 26-A	Table 26-B	Table 44	Table 43
Pinyon-Juniper/ Sagebrush	Baseline	V-14	Table 27	Table 28-A	Table 28-B	Table 44	Table 43
Pasture Land	Proposed Disturbed	V-15	Table 29	Table 30-A	Table 30-B	Table 44	Table 43
Pasture Land	Proposed Disturbed	V-16	Table 31	Table 32-A	Table 32-B	Table 44	Table 43
Pasture Land	Proposed Disturbed	V-17	Table 33	Table 34-A	Table 34-B	Table 44	Table 43
Pasture Land	Proposed Disturbed	V-18	Table 35	Table 36-A	Table 36-B	Table 44	Table 43
Pasture Land	Proposed Disturbed	V-19	Table 37	Table 38-A	Table 38-B	Table 44	Table 43
Pasture Land	Proposed Disturbed	V-20	Table 39	Table 40-A	Table 40-B	Table 44	Table 43
Cropland	Baseline	V-21	Table 41	Table 42-A	Table 42-B	Table 44	Table 43

COVER & COMPOSITION SUMMARY
FOR ALL VEGETATION SAMPLE SITES
IN THE NORTH PRIVATE LEASE AREA

The following tables provide baseline data for the general plant communities of the study area including those communities proposed for disturbance by mining activities.

Table 01: North Private Lease of the Coal Hollow Project. Living Cover and Frequency by Plant Species (2012-14).

Sagebrush Sample Site No. V-01	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Artemisia nova	10.00	0.00	100.00
Salix exigua	5.00	3.00	100.00
FORBS			
Melilotus officinalis	17.50	2.50	100.00
Penstemon sp.	1.50	1.50	50.00
GRASSES			

Table 02: North Private Lease of the Coal Hollow Project. Total Cover and Composition (2012-14).

Sagebrush Sample Site No. V-01		
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	34.00	1.00
Litter	11.00	1.00
Bareground	37.50	2.50
Rock	17.50	2.50
B. % COMPOSITION		
Shrubs	44.42	10.13
Forbs	55.58	10.13
Grasses	0.00	0.00

Table 03: North Private Lease of the Coal Hollow Project. Living Cover and Frequency by Plant Species (2012-14).

Wetland Sample Site No. V-02	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Salix boothii	6.67	9.43	33.33
Salix exigua	16.67	8.50	66.67
FORBS			
Convolvulus arvense	3.33	4.71	33.33
Iva axillaris	5.00	4.08	66.67
Melilotus officinalis	1.67	2.36	33.33
GRASSES			
Juncus arcticus	6.67	9.43	33.33
Poa pratensis	6.67	4.71	66.67

Table 04: North Private Lease of the Coal Hollow Project. Total Cover and Composition (2012-14).

Wetland Sample Site No. V-02		
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	46.67	4.71
Litter	10.00	0.00
Bareground	37.33	9.46
Rock	6.00	6.38
B. % COMPOSITION		
Shrubs	50.00	0.00
Forbs	21.67	8.50
Grasses	28.33	8.50

Table 05: North Private Lease of the Coal Hollow Project. Living Cover and Frequency by Plant Species (2012-14).

Sagebrush Sample Site No. V-03			
	Mean Percent	Standard Deviation	Percent Frequency
SHRUBS			
Artemisia nova	21.25	23.01	50.00
Chrysothamnus nauseosus	8.75	10.23	25.00
FORBS			
GRASSES			
Agropyron cristatum	12.50	12.50	50.00
Bromus inermis	0.75	1.30	25.00
Carex douglasii	0.50	0.87	25.00
Poa pratensis	1.25	2.17	25.00

Table 06: North Private Lease of the Coal Hollow Project. Total Cover and Composition (2012-14).

Sagebrush Sample Site No. V-03		
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	45.00	7.91
Litter	12.00	4.69
Bareground	26.75	17.08
Rock	16.25	19.49
B. % COMPOSITION		
Shrubs	63.39	26.77
Forbs	0.00	0.00
Grasses	36.61	26.77

Table 07: North Private Lease of the Coal Hollow Project. Living Cover and Frequency by Plant Species (2012-14).

Wetland Sample Site No. V-04			
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Salix boothii	2.50	3.82	33.33
FORBS			
GRASSES			
Juncus arcticus	11.67	9.43	66.67
Juncus longistylis	5.00	9.13	66.67
Scirpus pungens	25.83	16.94	33.33

Table 08: North Private Lease of the Coal Hollow Project.
Total Cover and Composition (2012-14).

Wetland Sample Site No. V-04		
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	45.00	5.77
Litter	50.00	5.77
Bareground	3.83	0.37
Rock	1.17	0.37
B. % COMPOSITION		
Shrubs	6.02	9.41
Forbs	0.00	0.00
Grasses	93.98	9.41

Table 09: North Private Lease of the Coal Hollow Project. Living Cover and Frequency by Plant Species (2012-14).

Sagebrush Sample Site No. V-05			
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Artemisia tridentata	34.00	17.72	80.00
Chrysothamnus nauseosus	16.00	8.60	80.00
Rosa woodsii	3.00	4.00	40.00
FORBS			
GRASSES			
Elymus smithii	5.00	6.32	40.00

Table 10: North Private Lease of the Coal Hollow Project. Total Cover and Composition (2012-14).

Sagebrush Sample Site No. V-05		
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	58.00	17.49
Litter	29.40	18.62
Bareground	11.20	5.64
Rock	1.40	0.49
B. % COMPOSITION		
Shrubs	92.14	10.20
Forbs	0.00	0.00
Grasses	7.86	10.20

Table 11: North Private Lease of the Coal Hollow Project. Living Cover and Frequency by Plant Species (2012-14).

Wetland Sample Site No. V-06			
OVERSTORY	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Elaeagnus angustifolia	20.00	28.28	33.33
UNDERSTORY			
SHRUBS			
FORBS			
Melilotus officinalis	1.67	2.36	33.33
GRASSES			
Juncus arcticus	33.33	24.94	66.67
Scirpus pungens	18.33	25.93	33.33

Table 12: North Private Lease of the Coal Hollow Project.
Total Cover and Composition (2012-14).

Wetland Sample Site No. V-06		
A. TOTAL COVER	Mean Percent	Standard Deviation
OVERSTORY (o)	20.00	28.28
UNDERSTORY (u)	53.33	10.27
Litter	23.33	6.24
Bareground	8.67	7.32
Rock	14.67	12.92
o + u	73.33	37.04
B. % COMPOSITION		
Shrubs	0.00	0.00
Forbs	2.56	3.63
Grasses	97.44	3.63

Table 13: North Private Lease of the Coal Hollow Project. Living Cover and Frequency by Plant Species (2012-14).

Sagebrush Sample Site No. V-07			
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Rosa woodsii	0.67	0.94	33.33
Artemisia tridentata wyomingensis	37.67	8.81	100.00
Symphoricarpos oreophilus	6.67	9.43	33.33
FORBS			
GRASSES			

Table 14: North Private Lease of the Coal Hollow Project.
Total Cover and Composition (2012-14).

Sagebrush Sample Site No. V-07		
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	45.00	7.07
Litter	10.67	2.36
Bareground	43.00	8.04
Rock	1.33	0.47
B. % COMPOSITION		
Shrubs	100.00	0.00
Forbs	0.00	0.00
Grasses	0.00	0.00

Table 15: North Private Lease of the Coal Hollow Project. Living Cover and Frequency by Plant Species (2012-14).

Wetland Sample Site No. V–08	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
FORBS			
GRASSES			
Carex utriculata	46.00	15.30	100.00
Juncus arcticus	28.00	15.03	100.00
Poa pratensis	3.00	6.00	20.00

Table 16: North Private Lease of the Coal Hollow Project.
Total Cover and Composition (2012-14).

Wetland Sample Site No. V-08		
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	77.00	15.03
Litter	11.40	5.08
Bareground	10.40	12.08
Rock	1.20	0.40
B. % COMPOSITION		
Shrubs	0.00	0.00
Forbs	0.00	0.00
Grasses	100.00	0.00

Table 17: North Private Lease of the Coal Hollow Project. Living Cover and Frequency by Plant Species (2012-14).

Wetland Sample Site No. V-09			
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Rosa woodsii	7.00	8.72	40.00
FORBS			
GRASSES			
Carex douglasii	8.00	16.00	20.00
Juncus arcticus	67.00	24.62	100.00
Poa pratensis	2.00	4.00	20.00

Table 18: North Private Lease of the Coal Hollow Project.
Total Cover and Composition (2012-14).

Wetland Sample Site No. V-09		
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	84.00	3.74
Litter	13.00	3.74
Bareground	1.40	0.49
Rock	1.60	0.49
B. % COMPOSITION		
Shrubs	8.19	10.10
Forbs	0.00	0.00
Grasses	91.81	10.10

Table 19: North Private Lease of the Coal Hollow Project. Living Cover and Frequency by Plant Species (2012-14).

Wetland Sample Site No. V-10			
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Rosa woodsii	6.67	9.43	33.33
FORBS			
Convolvulus arvense	6.67	9.43	33.33
Iva axillaris	11.67	9.43	100.00
GRASSES			
Bromus inermis	36.67	19.29	100.00
Hordeum jubatum	5.00	7.07	33.33
Phleum pratensis	1.00	1.41	33.33
Poa pratensis	4.00	5.66	33.33

Table 20: North Private Lease of the Coal Hollow Project. Total Cover and Composition (2012-14).

Wetland Sample Site No. V-10		
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	71.67	2.36
Litter	7.00	2.16
Bareground	20.00	0.00
Rock	1.33	0.47
B. % COMPOSITION		
Shrubs	9.52	13.47
Forbs	26.03	13.69
Grasses	64.44	23.52

Table 21: North Private Lease of the Coal Hollow Project. Living Cover and Frequency by Plant Species (2012-14).

Cropland Sample Site No. V-11	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Rosa woodsii	3.33	4.71	33.33
FORBS			
Convolvulus arvense	3.33	4.71	33.33
GRASSES			
Bromus inermis	51.67	26.56	100.00
Elymus smithii	33.33	24.94	66.67

Table 22: North Private Lease of the Coal Hollow Project. Total Cover and Composition (2012-14).

Cropland Sample Site No. V-11		
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	91.67	2.36
Litter	3.67	1.89
Bareground	3.33	0.94
Rock	1.33	0.47
B. % COMPOSITION		
Shrubs	3.51	4.96
Forbs	3.70	5.24
Grasses	92.79	5.11

Table 23: North Private Lease of the Coal Hollow Project. Living Cover and Frequency by Plant Species (2012-14).

Pasture Land Sample Site No.V-12			
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Chrysothamnus nauseosus	22.00	22.83	60.00
FORBS			
Convolvulus arvense	5.50	9.07	30.00
Iva axillaris	7.00	9.80	40.00
Medicago sativa	1.50	4.50	10.00
GRASSES			
Bromus inermis	4.00	6.24	30.00
Elymus hispidus	32.00	20.27	90.00

Table 24: North Private Lease of the Coal Hollow Project. Total Cover and Composition (2012-14).

Pasture Land Sample Site No. V-12		
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	72.00	6.78
Litter	6.50	2.11
Bareground	20.00	7.07
Rock	1.50	0.67
B. % COMPOSITION		
Shrubs	29.66	29.30
Forbs	19.77	17.34
Grasses	50.57	26.49

Table 25: North Private Lease of the Coal Hollow Project. Living Cover and Frequency by Plant Species (2012-14).

Pasture Land Proposed Disturbed Sample Site No. V–13			
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Chrysothamnus nauseosus	4.50	9.07	20.00
FORBS			
Convolvulus arvense	5.00	6.71	40.00
Glycyrrhiza lepidota glabrum	3.00	6.40	20.00
Medicago sativa	1.00	3.00	10.00
GRASSES			
Bromus inermis	18.00	19.00	50.00
Elymus lanceolatus	4.50	4.50	8.95
Elymus smithii	35.00	21.79	90.00

Table 26: North Private Lease of the Coal Hollow Project.
Total Cover and Composition (2012-14).

Pasture Land Proposed Disturbed Sample Site No. V-13		
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	71.00	4.36
Litter	8.20	1.99
Bareground	16.50	4.50
Rock	4.30	2.49
B. % COMPOSITION		
Shrubs	6.70	13.59
Forbs	12.71	11.93
Grasses	80.59	12.52

Table 27: North Private Lease of the Coal Hollow Project. Living Cover and Frequency by Plant Species (2012-14).

Pinyon-Juniper/Sagebrush Sample Site No. V-14			
OVERSTORY	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Cercocarpus montanus	0.75	3.27	5.00
Juniperus osteosperma	7.25	18.27	20.00
Peraphyllum ramossissimum	0.25	1.09	5.00
Pinus edulis	7.00	14.78	20.00
Quercus gambelii	2.00	8.72	10.00
UNDERSTORY			
TREES & SHRUBS			
Artemisia tridentata var. wyomingensis	0.75	3.27	5.00
Cercocarpus montanus	12.25	21.00	40.00
Eriogonum corymbosum	3.25	8.70	15.00
Juniperus osteosperma	1.50	6.54	5.00
Peraphyllum ramosissimum	7.75	11.34	45.00
Pinus edulis	4.00	8.00	25.00
Quercus gambelii	3.75	9.07	15.00
Symphoricarpos oreophilus	1.25	3.83	10.00
FORBS			
GRASSES			
Festuca sp.	0.50	2.18	5.00

Table 28: North Private Lease of the Coal Hollow Project. Total Cover and Composition (2012-14).

Pinyon-Juniper/Sagebrush Sample Site No. V-14		
A. TOTAL COVER	Mean Percent	Standard Deviation
Overstory (o)	17.25	21.18
Understory (u)	35.00	14.92
Litter	18.25	13.90
Bareground	34.20	17.14
Rock	12.55	8.22
o+ u	52.25	18.87
B. % COMPOSITION		
Shrubs	98.75	5.45
Forbs	0.00	0.00
Grasses	1.25	5.45

Table 29: North Private Lease of the Coal Hollow Project. Living Cover and Frequency by Plant Species (2012-14).

Pasture Land Proposed Disturbed Sample Site No. V-15			
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
FORBS			
Medicago sativa	27.00	9.00	100.00
GRASSES			
Bromus inermis	25.00	14.66	90.00
Elymus smithii	30.00	10.49	100.00

Table 30: North Private Lease of the Coal Hollow Project.
Total Cover and Composition (2012-14).

Pasture Land Proposed Disturbed Sample Site No. V-15		
A. TOTAL COVER	Mean Percent	Standard Deviation
COVER Sample Site 04 V-15		
Total Living Cover	82.00	7.81
Litter	5.30	3.16
Bareground	11.50	6.34
Rock	1.20	0.40
B. % COMPOSITION		
Shrubs	0.00	0.00
Forbs	32.62	9.73
Grasses	67.38	9.73

Table 31: North Private Lease of the Coal Hollow Project. Living Cover and Frequency by Plant Species (2012-14).

Pasture Land Proposed Disturbed Sample Site No. V-16			
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Chrysothamnus nauseosus	18.00	15.03	70.00
Rosa woodsii	0.50	1.50	10.00
FORBS			
GRASSES			
Agropyron cristatum	36.50	22.48	80.00
Elymus smithii	11.00	22.11	20.00

Table 32: North Private Lease of the Coal Hollow Project.
Total Cover and Composition (2012-14).

Pasture Land Prooposed Disturbed Sample Site No. V-16		
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	66.00	9.95
Litter	8.70	1.42
Bareground	22.50	8.73
Rock	2.80	1.83
B. % COMPOSITION		
Shrubs	27.11	20.79
Forbs	0.00	0.00
Grasses	72.89	20.79

Table 33: North Private Lease of the Coal Hollow Project. Living Cover and Frequency by Plant Species (2012-14).

Pasture Land Proposed Disturbed Sample Site No. V-17			
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Chrysothamnus nauseosus	10.00	12.25	50.00
FORBS			
Convolvulus arvense	3.50	5.02	40.00
Iva axillaris	0.50	1.50	10.00
Medicago sativa	2.50	5.12	20.00
GRASSES			
Agropyron cristatum	22.50	19.14	70.00
Bromus inermis	2.00	4.00	20.00
Elymus smithii	19.00	24.17	40.00

Table 34: North Private Lease of the Coal Hollow Project.
Total Cover and Composition (2012-14).

Pasture Land Proposed Disturbed Sample Site No. V-17		
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	60.00	10.95
Litter	8.70	1.68
Bareground	29.00	10.44
Rock	2.30	1.79
B. % COMPOSITION		
Shrubs	15.21	17.54
Forbs	13.07	18.31
Grasses	71.72	17.82

Table 35: North Private Lease of the Coal Hollow Project. Living Cover and Frequency by Plant Species (2012-14).

Pasture Land Proposed Disturbed Sample Site No.V-18			
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
FORBS			
Convolvulus arvense	10.50	9.60	60.00
Iva axillaris	9.00	10.20	50.00
Medicago sativa	3.50	7.09	20.00
GRASSES			
Bromus inermis	3.00	4.58	30.00
Elymus smithii	49.00	18.41	100.00

Table 36: North Private Lease of the Coal Hollow Project.
Total Cover and Composition (2012-14).

Pasture Land Proposed Disturbed Sample Site No. V-18		
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	75.00	8.37
Litter	9.30	4.20
Bareground	14.50	6.87
Rock	1.20	0.40
		-
B. % COMPOSITION		
Shrubs	0.00	0.00
Forbs	31.75	19.24
Grasses	68.25	19.24

Table 37: North Private Lease of the Coal Hollow Project. Living Cover and Frequency by Plant Species (2012-14).

Pasture Land Proposed Disturbed Sample Site No.V-19	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Artemisia tridentata	1.00	3.00	10.00
Atriplex canescens	1.00	3.00	10.00
FORBS			
Achillea millefolium	1.00	3.00	10.00
Convolvulus arvense	4.00	12.00	40.00
Medicago sativa	9.00	10.44	50.00
Melilotus officinalis	1.00	3.00	10.00
Sanguisorba minor	7.00	7.14	60.00
GRASSES			
Agropyron cristatum	14.50	16.50	50.00
Bromus inermis	2.00	6.00	10.00
Elymus smithii	8.00	10.05	40.00

Table 38: North Private Lease of the Coal Hollow Project. Total Cover and Composition (2012-14).

Pasture Land Proposed Disturbed Sample Site No. V-19		
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	48.50	11.84
Litter	8.70	2.79
Bareground	37.00	10.77
Rock	5.80	3.06
		-
B. % COMPOSITION		
Shrubs	4.50	9.07
Forbs	43.81	18.22
Grasses	51.69	17.46

Table 39: North Private Lease of the Coal Hollow Project. Living Cover and Frequency by Plant Species (2012-14).

Pasture Land Proposed Disturbed Sample Site No. V-20			
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Artemisia tridentata	2.00	6.00	10.00
Chrysothamnus nauseosus	9.00	9.43	50.00
FORBS			
Medicago sativa	2.50	7.50	10.00
Navarretia sp	2.00	4.00	20.00
GRASSES			
Agropyron cristatum	14.00	15.46	50.00
Elymus smithii	32.00	20.02	90.00

Table 40: North Private Lease of the Coal Hollow Project.
Total Cover and Composition (2012-14).

Pasture Land Proposed Disturbed Sample Site No. V-20		
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	61.50	4.50
Litter	11.40	3.32
Bareground	25.50	6.87
Rock	1.60	1.20
		-
B. % COMPOSITION		
Shrubs	17.70	15.24
Forbs	7.65	13.26
Grasses	74.65	18.79

Table 41: North Private Lease of the Coal Hollow Project. Living Cover and Frequency by Plant Species (2012-14).

Pasture Land Sample Site No. V-21			
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
FORBS			
Medicago sativa	81.50	5.02	100.00
Taraxacum officinale	7.00	4.58	80.00
GRASSES			
Bromus inermis	2.00	6.00	10.00
Elymus smithii	2.00	4.00	20.00

Table 42: North Private Lease of the Coal Hollow Project.
Total Cover and Composition (2012-14).

Pasture Land Sample Site No. V-21		
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	92.50	2.50
Litter	1.90	0.94
Bareground	4.20	2.23
Rock	1.40	0.49
B. % COMPOSITION		
Shrubs	0.00	0.00
Forbs	95.56	7.37
Grasses	4.44	7.37

ANNUAL ~~BIOMASS~~ PRODUCTION SUMMARY FOR ALL VEGETATION SAMPLE SITES AND PASTURES IN THE NORTH PRIVATE LEASE STUDY AREA

The following tables provide baseline data for the general plant communities of the study area including those communities proposed for disturbance by mining activities.

Table 43. Total living cover, annual biomass production, photograph references, and ecological site names of vegetation sample sites in the North Private Lease (2012-2014).

SAMPLE SITE	PLANT COMMUNITY	NRCS ECOLOGICAL SITE NAME*	PRODUCTION (Pounds/Acre)	
V-01	Sagebrush	Upland Stony Loam (black sagebrush)	500[a]	700[e]
V-02	Wetland	Semiwet Fresh Meadow	300[a]	2,400[e]
V-03	Sagebrush	Upland Stony Loam (black sagebrush)	600[a]	700[e]
V-04	Wetland	Semiwet Fresh Meadow	1,000[a]	2,400[e]
V-05	Sagebrush	Upland Loam Wyoming big sagebrush	1,000[a]	1,100[f]
V-06	Wetland	Semiwet Fresh Meadow	1,900[a]	2,400[e]
V-07	Sagebrush	Upland Loam (Wyoming big sagebrush)	900[a]	1,100[f]
V-08	Wetland	Semiwet Fresh Meadow	2,100[a]	2,400[e]
V-09	Wetland	Semiwet Fresh Meadow	2,500[a]	2,400[e]
V-10	Wetland	Semiwet Fresh Meadow	1,100[a]	2,400[e]
V-11	Cropland	Upland Loam (Wyoming big sagebrush)	8,000[c]	1,100[f]
V-12	Pastureland	Upland Loam (Wyoming big sagebrush)	1,150[b]	1,100[f]
V-13	Pastureland	Upland Loam (Wyoming big sagebrush)	1,200[b]	1,100[f]
V-14	Pinyon-Juniper/ Sagebrush	Upland Clay (Pinyon-Juniper)/ Upland Loam (Wyoming big sagebrush)	1,200[b]	550[e]/ 1,100[f]
V-15	Pastureland	Upland Loam (Wyoming big sagebrush)	1,200[b]	1,100[f]
V-16	Pastureland	Upland Loam (Wyoming big sagebrush)	750[b]	1,100[f]
V-17	Pastureland	Upland Loam (Wyoming big sagebrush)	700[b]	1,100[f]
V-18	Pastureland	Upland Loam (Wyoming big sagebrush)	1,200[b]	1,100[f]
V-19	Pastureland	Upland Loam (Wyoming big sagebrush)	500[b]	1,100[f]
V-20	Pastureland	Upland Loam (Wyoming big sagebrush)	700[b]	1,100[f]
V-21	Cropland	Upland Loam (Wyoming big sagebrush)	2,500[b]	1,100[f]

Landowner Production Information[g]:(see MRP Surface Ownership Drawing 1-3)

Property: Heaton Bros. (Parcel 9-6-13-1,9-6-12-5, 120 acres); Unirrigated; Livestock use - 30 days/year (Jun); 1.67 animals/acre; no hay production.

Property: Dean Heaton. (Parcels 9-6-12-2, 9-5-7-4A, 9-5-18-3, 45 acres); Unirrigated; Livestock use - 60 days/year (Aug & Sep); 1.33 animals/ac; hay production = 1 crop/yr, 2,000 lbs/ac, 9 of 10 years.

Property: Ferril Heaton. (Parcels 9-5-7-3A, 9-5-18-5, 9-5-18-3A, 9-6-12-1, 108.34 acres); Unirrigated; Livestock use - 60 days/year (Sep & Oct); 0.69 animals/ac (with supplemental feed); hay production = 1 crop/yr, 2,000 lbs/ac, 9 of 10 years.

Property: Orvil Palmer. (Parcels 9-6-12-3, 7 acres); Unirrigated; Livestock use - 60 days/year (Jul & Aug); 1.43 animals/ac; no hay production.

Sources:

[a] Data collected in 2012 by Mt. Nebo Scientific, Inc., Springville, UT.

[b] Data collected in 2013-14 by Mt. Nebo Scientific, Inc., Springville, UT.

[c] Personal communications in 2014 with landowners/farmers.

[d] Benson, Brock. May 2014. Personal communications. USDA, Natural Resources Conservation Service. Utah ecological sites applicable to the Alton, Utah area. Unpublished ecological site description for Upland Clay* (black sagebrush). Ogden, Utah. (The document date on this ESD was March 27, 2012).

[e] USDA, Natural Resources Conservation Service. 2014 Soil Survey Staff. Utah ecological site descriptions*. Downloaded in May 2014 at: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/ut/technical/landuse/pasture/?cid=nrcs141p2_034193.

[f] Benson, Brock. May 2014. Personal communications. USDA, Natural Resources Conservation Service. Utah ecological sites applicable to the Alton, Utah area. Unpublished ecological site description for Upland Loam * (Wyoming big sagebrush). Ogden, Utah. (The document date on this ESD was April 19, 1992).

[g] Personal communications in September 2015 with Larry Johnson and landowners.

* Estimates based on vegetation of undeveloped rangelands for this soil type.

WOODY SPECIES DENSITY SUMMARY
FOR PLANT COMMUNITIES PROPOSED FOR DISTURBANCE
IN THE NORTH PRIVATE LEASE AREA

The following table shows the woody species densities for the pasture land communities proposed for disturbance by mining activities.

Table 44: North Private Lease of the Coal Hollow Project. Total Woody Species Density (2012-14).

Sample Site V-12
Pasture Land

Species	Number/Acre
Chrysothamnus nauseosus	807.04
TOTAL	**807.04**

Sample Site V-13
Pasture Land

Species	Number/Acre
Chrysothamnus nauseosus	56.25
TOTAL	**56.25**

Sample Site V-14
Pinyon-Juniper/Sagebrush

Species	Number/Acre
Artemisia nova	26.65
Artemisia tridentata var. wyomingensis	53.30
Cercocarpus montanus	426.39
Eriogonum corymbosum	106.60
Juniperus osteosperma	186.54
Peraphyllum ramosissimum	666.23
Pinus edulis	319.79
Quercus gambelii	266.49
Symphoricarpos oreophilus	79.95
TOTAL	**2131.94**

Sample Site V-15
Pasture Land

Species	Number/Acre
Chrysothamnus nauseosus	1.11
TOTAL	**1.11**

Sample Site V-16
Pasture Land

Species	Number/Acre
Chrysothamnus nauseosus	1158.46
Rosa woodsii	60.97
TOTAL	**1219.44**

Sample Site V-17
Pasture Land

Species	Number/Acre
Chrysothamnus nauseosus	358.50
TOTAL	**358.50**

Sample Site V-18
Pasture Land

Species	Number/Acre
Chrysothamnus nauseosus	1.76
TOTAL	**1.76**

Sample Site V-19
Pasture Land

Species	Number/Acre
Artemisia tridentata	24.18
Artemisia nova	0.78
Chrysothamnus nauseosus	4.68
Quercus gambelii	1.56
TOTAL	**31.20**

Sample Site V-20

Pasture Land

Species	Number/Acre
Artemisia tridentata	242.82
Chrysothamnus nauseosus	126.27
Quercus gambelii	19.43
TOTAL	**388.52**

Wildlife Habitat

The State of Utah, Department of Natural Resources, Division of Wildlife Resources (DWR) geographic information system (GIS) database was consulted for the presence of high-value wildlife habitats. Of the species maintained on the database, important habitat of four species have been mapped by DWR within and adjacent to the North Private Lease. These habitats are described below.

First, black bear (*Ursus americanus*) habitat has been mapped in the general area (**Wildlife Map 1**). This habitat within and adjacent to the study area has been listed as *year-long* and classified as having *substantial* value by DWR. Additionally, *year-long* and *crucial* ratings have been mapped about 2 miles to the east and northeast of the study area.

Mule deer (*Odocoileus hemionus*) habitat has also been mapped in the area by DWR. The habitat has been classified as *crucial summer range* and was located within and adjacent areas (**Wildlife Map 2**).

Next, Rocky Mountain elk (*Cervus canadensis*) habitat was located in the area. *Summer* habitat has been mapped throughout the entire area as well as assigned a value as *substantial* and important *calving* habitat (**Wildlife Map 3**).

Finally, sage-grouse (*Centrocercus urophasianus*) habitat has been mapped in the study area. DWR has mapped much of the area to be *occupied* and *brood-rearing* habitat (**Wildlife Map 4**).

Depending on the area and level of study conducted by biologists there, DWR habitat maps can be general and should be ground-truthed on site-specific basis to confirm and refine their findings and map boundaries.

Threatened, Endangered & Sensitive Species

A table of federally listed threatened, endangered and candidate species for Kane County, Utah has been provided below (Table 45). The table also includes the status of the species, along with site-specific notes about the area proposed for disturbance and the probabilities of their occurrences in the study area.

Additionally, GIS data and shape files from the state Utah Conservation Data Center (UCDC) database were consulted for potential habitats of sensitive species. At the time this report was written, the only sensitive species mapped on that database was the greater sage-grouse.

Table 45: Federally listed threatened, endangered and candidate species for Kane County, Utah

This list was compiled using known species occurrences and species observations from the Utah Natural Heritage Program's Biodiversity Tracking and Conservation System (BIOTICS); other federally listed species likely occur in Utah Counties. This list includes both current and historic records. The list was accessed on-line June 15, 2015. Its last update was dated January 12, 2012.

Additional species were added to the list as requested by Utah State Division of Oil, Gas & Mining in June 2015 and are designated by an asterisk (*).

ENDANGERED		**SITE-SPECIFIC NOTES**
Empidonax traillii extimus	Southwestern willow flycatcher	This bird has been observed in Kane, County Utah (see the attached DWR distribution map following this table) . Although it is possible that it could have occurred at some time in the project area as noted from its distribution map, it is most often observed in thick willow riparian habitats. The study area has some willow patches on Kanab Creek, but they are not common on this reach of the stream. The Kanab Creek riparian zone will not be disturbed. It is highly unlikely this species would be impacted by mining in this area. However, after consultations with DOGM & USFWS, it seemed prudent to survey specific areas on Kanab Creek. The surveys ~~will be~~ have been conducted according to protocols by qualified biologists. Habitat assessments and follow up surveys were conducted as recommended by the USFWS (see Yellow-Billed Cuckoo and Southwestern Willow Flycatcher Habitat Assessment & Southwestern Willow Flycatcher Surveys Along Kanab Creek, Kane County, Utah August 2015 (Appendix A). Between the marginal habitat quality at Kanab Creek and the fact that no southwestern willow flycatchers were detected during the surveys conducted, it was concluded that it is highly unlikely that this species would nest in the study area.

Table 45: Federally listed threatened, endangered and candidate species for Kane County, Utah

This list was compiled using known species occurrences and species observations from the Utah Natural Heritage Program's Biodiversity Tracking and Conservation System (BIOTICS); other federally listed species likely occur in Utah Counties. This list includes both current and historic records. The list was accessed on-line June 15, 2015. Its last update was dated January 12, 2012.

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Gila cypha	Humpback chub	Humpback chub in Utah are now confined to a few white-water areas in the Colorado, Green, and White Rivers. These rivers do not occur in the study area and the confluence of Kanab Creek and the Colorado River is well below the known population of this species. There will be no impact to this species from mining in the study area.
Gila elegans	Bonytail	The bonytail is a very rare minnow originally native to the Colorado River system. The known populations of the bonytail are in the Colorado River System well above the confluence of Kanab Creek and the Colorado River. There will be no impact to this species from mining in the study area.
Lesquerella tumulosa *(Physaria rubicudula var tumulosa)*	Kodachrome bladderpod	In Utah, this federally listed endangered species is known only in an isolated area in Kane County on semi-barren shale knolls of the Carmel Formation. This geologic formation nor the habitat of this species is found on the study area. Consequently, there will be no impact to this species from mining in the study area.
Oxyloma kanabense	Kanab ambersnail	Known populations of the gastropod are primarily found in 2 locations along Kanab Creek. The primary and more well known location is in extreme south Kane County, about 6 miles north of the city of Kanab in an area called Three Lakes. The second, much smaller population, is located about 1.3 miles north of the Three Lakes population in Kanab Creek Canyon. According to DWR, however, this population, is thought to be extirpated. Upper Kanab Creek dissects the project area and will not be disturbed from the proposed mining activities. That was associated Kanab Creek will not be impacted, so the downstream habitats, like that of the Kanab ambersnail, will not be negatively impacted by the proposed mine site.
THREATENED		
Asclepias welshii	Welsh's milkweed	In Utah this plant in known to occur only on the Coral Pink sand dunes in Kane County. There are no dune habitats in the project area so this species will not be impacted by it.

Table 45: Federally listed threatened, endangered and candidate species for Kane County, Utah

This list was compiled using known species occurrences and species observations from the Utah Natural Heritage Program's Biodiversity Tracking and Conservation System (BIOTICS); other federally listed species likely occur in Utah Counties. This list includes both current and historic records. The list was accessed on-line June 15, 2015. Its last update was dated January 12, 2012.

Additional species were added to the list as requested by Utah State Division of Oil, Gas & Mining in June 2015 and are designated by an asterisk (*).

*Coccyzus americanus**	Yellow-billed cuckoo	The western yellow-billed cuckoo is listed as a threatened species under the Endangered Species Act. It is an obligate riparian nester, meaning that the species is restricted to more mesic habitat along rivers, streams, and other wetlands. The US historical range of this species is thought to have included all states west of the Rocky Mountains. According to DWR database information, the current range of yellow-billed cuckoo is limited to disjunct fragments of riparian habitat in northern Utah, western Colorado, southwestern Wyoming, southeastern Idaho, southern Nevada and California. That said, the distribution of this bird in Utah is poorly understood (see the attached DWR distribution map following this table), so consultations with DOGM and USFWS ~~are in progress~~ have been conducted. ~~If it is decided that a survey for the cuckoo in the North Lease Area along Kanab Creek is advisable, the surveys will be conducted~~. A habitat assessment was conducted as recommended by the USFWS (see Yellow-Billed Cuckoo and Southwestern Willow Flycatcher Habitat Assessment & Southwestern Willow Flycatcher Surveys Along Kanab Creek, Kane County, Utah, August 2015 (Appendix A). No designated critical habitat occurs in the study area.
Cycladenia humilis var jonesii	Jones cycladenia	Jones cycladenia grows in gypsiferous, saline soils derived from strata much lower (older) in the geologic column than what is found in the project area such as Summerville (Jurassic), Chinle (Triassic), and Cutler (Permian) formations. The project area soils are derived mostly from Tropic Shale and Dakota formations of Cretaceous age. The geology, soils and habitat do not occur in the project area. There will be no impact to this species from mining in the study area.
Cynomys parvidens	Utah prairie-dog	Habitat for this prairie-dog does not exist in the study area. Consequently, there will be no impact to this species as a result of mining in the North Private Lease
Pediocactus sileri	Siler pincushion cactus	In Utah, this small footcactus is known to occur in salt desert shrub communities in Kane and Washington Counties. It tends to be found in gypsiferous, seleniferous and calciferous soils and shales of the Moenkopi formation. The geology, soils and habitat do not occur in the project area. There will be no impact to this species from mining in the study area.

Table 45: Federally listed threatened, endangered and candidate species for Kane County, Utah

This list was compiled using known species occurrences and species observations from the Utah Natural Heritage Program's Biodiversity Tracking and Conservation System (BIOTICS); other federally listed species likely occur in Utah Counties. This list includes both current and historic records. The list was accessed on-line June 15, 2015. Its last update was dated January 12, 2012.

Additional species were added to the list as requested by Utah State Division of Oil, Gas & Mining in June 2015 and are designated by an asterisk (*).

Strix occidentalis lucida	Mexican spotted owl	The primary habitats in Utah for this owl are various forest types and steep rocky canyons. DWR distribution maps suggest the project area is out of its range in Kane County. The required habitat and apparent distributional information indicate that the likelihood for impacts to this bird by the proposed mining is remote.
CANDIDATE		
Cicindela limbata albissima	Coral Pink Sand Dunes tiger beetle	Like Welsh's milkweed described above, this beetle is known to occur only on the Coral Pink sand dunes of Kane County, Utah. There are no sand dune habitats in the project area so this species will not be impacted by it.
OTHER		
*Camissonia exilis**	Meager Camissonia	This is not a federally protected species, however, its conservation status is ranked as "G1" (critically imperiled). This annual plant is a Colorado Plateau endemic found only in gypsiferous strata in Moenkopi and Entrada formations. These formations and habitats are not within the North Private Lease area. Additionally, other gypsiferous substrates have not be found during geologic or soil surveys of the site. There ~~will~~ should be no impact to this species from mining in the study area. However, because this species was noted by DWR to occur in the general area, collaborations between cooperating agencies (DWR & USFWS) regarding potential impact are currently in-progress. Results of findings between agencies will be reported to ACD by DOGM.
*Rana pipiens**	Northern Leopard Frog	This frog is not a federally protected species and it is fairly common in Utah. Although some reports suggest numbers may be declining, the conservation status of this amphibian is ranked as "G5" (demonstrably secure). This species occurs in a variety of aquatic habitats some of which occur in the North Private Lease area, but most are in and adjacent to Kanab Creek. This creek will not be mined and a 100 ft protection buffer will be in-place during mining and reclamation periods. Although impacts to the local populations may be possible due to mining activities relatively close to the habitat, they area thought to be

Table 45: Federally listed threatened, endangered and candidate species for Kane County, Utah

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Additional species were added to the list as requested by Utah State Division of Oil, Gas & Mining in June 2015 and are designated by an asterisk (*).

		relatively minor. However, because this species was noted by DWR to occur in the general area, collaborations by DOGM with cooperating agencies (DWR & USFWS) regarding potential impact are currently in-progress. Results of findings between agencies will be reported to ACD by DOGM.
Centrocercus urophasianus	Greater sage-grouse	Greater sage-grouse (*Centrocercus urophasianus*) habitat has been documented in the study area. DWR has mapped much of the area to be *occupied* and *brood-rearing* habitat (Wildlife Map 4). Additionally Utah's Conservation Plan for Greater Sage-grouse (February 14, 2013) shows the Alton area to be "Other Habitat" habitat for the sage-grouse. Other habitat is defined here as sage-grouse habitat but not part of the lek, nesting or wintering areas. Impacts of mining in the North Private Lease ~~should be~~ have been addressed [see Greater Sage-grouse Management Plan, North Private Lease, Alton, Utah (July 14, 2015), MRP Appendix 3-8].

Table 45 (attachments)

Southwestern Willow Flycatcher

Known Distribution in Utah

Map Source:
Utah Division of Wildlife Resources.
Access Date: 15 June 2015

Yellow-Billed Cuckoo

Utah Gap Analysis

Breeding/Wintering Habitat

Primary Breeding Habitat

Secondary Breeding Habitat

Wintering Habitat

Map Source:
Utah Division of Wildlife Resources
Access Date: 15 June 2015

Migratory Birds

Migratory Bird Communities

There are six types of habitat within the North Private Lease study area, some of which will not be disturbed by mining activities. These types include croplands, pasturelands, wetlands, and small areas of riparian, pinyon-juniper and sagebrush. The small areas of pinyon-juniper and sagebrush offer the best avian nesting habitat. Birds likely to nest in these two habitat types within the project area include black-billed magpie (*Pica hudsonia*), mourning dove (*Zenaida macroura*), American robin (*Turdus migratorius*), sage thrasher (*Oreoscoptes montanus*), Brewer's sparrow (*Spizella breweri*), black-throated sparrow (*Amphispiza bilineata*), vesper sparrow (*Pooecetes gramineus*), western meadowlark (*Sturnella neglecta*), and spotted towhee (*Pipilo maculatus*). Killdeer (*Charadrius vociferus*) and horned larks (*Eremophila alpestris*) are two species that may nest in bare areas within the croplands and pasturelands.

There is a small amount of riparian habitat within the project area, which means that some riparian bird species could nest in the project area as well. Riparian species that were detected within 1.0 mile of the project area in Kanab Creek included black-chinned hummingbird (*Archilochus alexandri*), yellow warbler (*Setophaga petechia*), MacGillivray's warbler (*Geothlypis tolmiei*), and song sparrow (*Melospiza melodia*). The riparian habitat is not substantial enough for the federally listed species southwestern willow flycatcher (*Empidonax traillii extimus*) and western yellow-billed cuckoo (*Coccyzus americanus*) to nest in the project area.

Raptors are unlikely to nest in the project area due to the minimal amount of raptor nesting substrate and the proximity to human activity. However, raptors such as red-tailed hawks (*Buteo jamaicensis*), American kestrels (*Falco sparverius*), and northern harriers (*Circus cyaneus*) could nest within 0.5 mile of the project area.

Potential Impacts

Potential impacts to migratory birds include both indirect and direct impacts. Indirect impacts include the displacement of the birds due to human activity. Direct impacts include the loss of habitat, both nesting and foraging, as well as the potential "take" of active nests. However, as described below, steps will be taken to avoid the take of any migratory birds.

Loss of Habitat. In all, about 310 acres of potential foraging and nesting habitat could be lost to the local bird communities. However, the habitat type being lost in the lease area is prevalent in the surrounding area, and therefore, this loss would be expected to have no negative impact on the local bird populations.

Potential Take. The Migratory Bird Treaty Act (MBTA) prohibits the take of migratory birds, their parts, nests, eggs, and nestlings. To ensure that ground-disturbing activities do not result in the "take" of an active nest or a migratory bird protected under the MBTA, mitigation steps will be taken.

Mitigation Efforts

Passerines - The U.S. Fish and Wildlife Service (USFWS) recommends that ground-disturbing activities or vegetation treatments should begin before the migratory bird-nesting season begins or after any nests have fledged (USFWS 2015[(1)]). However, if activities that would remove potential nesting vegetation are scheduled to begin during the breeding season, which starts after March 1 (see Bird Nesting Seasons below), steps will be taken to keep birds from nesting in the area (It should be noted that once nests are established, they cannot be harassed). Nest surveys will be completed no more than 2 weeks before the start of activities. All active passerine nests that are detected during the nest survey will be protected by a 100-foot buffer between the nest and any activities. The buffer must remain in place until the nest fledges or fails.

Raptors - Nesting raptors can be negatively impacted by human activity even if their nest is not within the lease area itself. If activities are scheduled to begin during the raptor nesting season (see Bird Nesting Seasons below), a raptor nest survey will be conducted within 0.5 mile of the lease area to avoid any potential take. Any raptor nests that are detected within 0.5 mile of the lease area must be afforded the appropriate buffer, as listed in Romin and Muck 2002[(2)]. Depending on the topography of the area and other variables, the USFWS may be inclined to reduce the size of the buffer if the given activities are not deemed a threat to the active nest.

NESTING SEASONS												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Raptors												
General Passerines												

[(1)] U.S. Fish and Wildlife Service (USFWS). 2015. Letter re: Agency Notification of North Private Lease Addition, Alton Coal Development, LLC, Coal Hollow Mine, C/025/0005, Task ID #4942. Sent August 27, 2015, by Larry Crist on behalf of the U.S. Fish and Wildlife Service to Daron R. Haddock of the Utah Division of Oil, Gas & Mining.

[(2)] Romin, L.A., and J.A. Muck. 2002. U.S. Fish and Wildlife Service. Utah field office guidelines for raptor protection from human and land use disturbances.

DISCUSSION

Vegetation Data Recorded

Vegetation data have been recorded for the Coal Hollow Project since 2006 when the site was first proposed as a potential coal mine. Surface mining has been conducted at that site since 2011. Because the coal at the current permit area will soon be depleted, the Coal Hollow Mine has proposed to expand their mining operations to an area called the North Private Lease. Both areas, the current Coal Hollow Permit and the North Private Lease are shown on the location map in the INTRODUCTION of this report. Reasons for conducting vegetation sampling in the North Private Lease study area have been many, including wetland delineations, ordinary high water mark identifications, alluvial valley floor investigations and the baseline environmental requirements prescribed to obtain mine permits. Consequently, to accommodate the scope of these studies and refine the delineation of the proposed new area for mining, it has been necessary to also survey, map and sample those areas within and adjacent to the current proposed mining area. That said, because so much data were available from previous studies, some but not all, of these datasets have been included in this report to provide reviewers with a broader biological understanding of the entire area, rather than the more narrow prospective of only those areas proposed for disturbance by mining activities. For example, some of the vegetation data from wetland studies have been provided herein. However, all of the vegetation data from the wetland delineation study is readily available because the report is provided as a supplemental report (VOLUME 10). Dataset classifications shown in the Summary of Vegetation Data provided above differentiate between *Baseline, Proposed Disturbance* and *Reference* area designations. However, additional vegetation, soils and hydrological data can be found in the MRP as well as the aformentioned Supplement Reports. Another document called *Alluvial Valley Floor Field Investigation in the North Private Lease* (July 2014) was submitted to the State of Utah, Division of Oil, Gas & Mining in Salt Lake City, Utah and is available there.

Standards for Revegetation Success

Final revegetation for the North Private Lease may be somewhat different than other mine sites. First, as the title indicates, the surface of the proposed mine site is privately owned and revegetation plans are subject to the landowners' preferences. Next, the majority of the land surface that is proposed to be disturbed by mining activities has already been altered (disturbed) as a management technique to increase forage for domestic livestock. Lastly, disturbance and replacement to any jurisdictional wetlands are subject to collaboration through the Army Corps of Engineers (COE). Below are some possible scenarios for final revegetation of the North Private Lease area.

Pasture Lands – As explained throughout this report, most of the vegetation in the North Private Lease is comprised of native plant communities that have been previously disturbed to create developed rangelands or pasture lands. Current state and federal regulations have different revegetation success standards for previously disturbed areas – they must be returned to their current (or better) condition. Or, those plant communities that have been disturbed previously by activities other than mining and not reclaimed to the current revegetation standards of applicable regulations are subject to the following: "*at a minimum, the vegetative ground cover will be not less than the ground cover existing before redisturbance and will be adequate to control erosion*". Consequently, no reference areas were chosen to be compared to at the time of final revegetation for the pasture lands. However, the data recorded for this study document the current condition of the vegetation and can be used as revegetation success standards for the future. Although woody species densities were recorded in these areas, these plants, mostly rubber rabbitbrush, are the result of grazing pressure in the pastures and are not considered a desirable component to the ranchers in their fields. In other words, woody species will probably not be seeded at the time of reclamation, and revegetation success standards should not have a woody species density component to them.

Subject to cooperation and approval by the local landowners, the vegetation of these pasture lands could be restored to enhance habitat of greater sage-grouse.

Undeveloped Rangeland – The relatively small area that supported native, mostly undisturbed, plant communities (or undeveloped rangelands) and consisted mostly of pinyon-juniper and sagebrush, will have little mine-related disturbance to it, however, if the fringes of this area are disturbed, the landowner may likely prefer re-seeding it to increase and blend in with the adjacent pastures and not be restored to shrub-lands. Therefore, the revegetation success standards will be similar to the other pasture lands mentioned above.

Drainage Channels – There was a series of shallow to deeply incised channels in the North Private Lease study area, one of which is Kanab Creek – the remaining were ephemeral drainages to the west of it. These areas were studied extensively and reported in the aforementioned wetland and ordinary high watermark document (see Supplemental Report, VOLUME 10).

The channels supported some riparian and wetland communities including riparian wet meadows, mixed riparian scrub/shrub wet meadows, as well as narrow bands of sagebrush communities on the adjacent upland areas. The field studies found that the Private North Lease study area supported 9.44 acres of jurisdictional wetlands, most of which were identified in the Kanab Creek drainage. Kanab Creek and the plant communities supported within it will *not* be disturbed by mining activities. The other channels, however, may be disturbed by mining, some of which supported wetland and upland communities.

The vegetation in these channels that have been proposed for disturbance has been quantitatively sampled as well as other areas that will not be disturbed. The communities that will not be disturbed could be used as "reference areas", or potential sites that can be utilized as revegetation success standards at the time of final reclamation. Figure 22 shows statistical comparisons of the proposed disturbed and reference area plant communities. Figure 22-A shows that the total living covers of upland sagebrush communities within the drainage are exactly the same as the potential reference area. Figure 22-B provides the cover values for one of the proposed disturbed wetland community along with a reference area; statistically analysis indicted that the difference between them is not significant.

The reference areas may be used for future revegetation success values in the channels, but a more appropriate direction to drive revegetation standards, at least for the upland communities in the channels, may be to incorporate more ideal habitat to augment the continuing coal mine's mitigation of the greater sage-grouse. The planning process of this has begun by preliminary collaborations with state biologists. Continued collaboration for this course of action should involve sage-grouse specialists from DWR and DOGM, and possibly the local sage-grouse working group called the *Color County Adaptive Resources Management* (CCARM). A recent document has been prepared for the sage-grouse in the North Private Lease [see MRP Appendix 3-8; Greater Sage-grouse Management Plan, North Private Lease, Alton, Utah (July 14, 2015)]. This plan, however, is also subject to approval and cooperation of the private landowners of the study area.

Figure 22. Student's t-tests - Total living cover comparisons between selected proposed disturbed and reference areas in the North Private Lease of the Coal Hollow Mine.

A. Sagebrush

Proposed Disturbed (V-07):	$\bar{x}$=45.00; s=7.07; n=5
Reference Area (V-03):	$\bar{x}$=45.00; s=7.91; n=4
	t =0.00 ; df =7; SL=NS

B. Wetland

Proposed Disturbed (V-08):	$\bar{x}$=77.00; s=15.03; n=5
Reference Area (V-06):	$\bar{x}$=73.33; s=37.04; n=3
	t =0.2038 ; df=6; SL=NS

$\bar{x}$= sample mean
s = sample standard deviation
n = sample size
NS = non-significant
t = Student's t-value
df = degrees of freedom
SL = significance level

The Sagebrush Reference Area (Sample Site V-03) and Wetland Reference Area (Sample Site V-03) will be monitored annually during the active mining process beginning one year after mining begins to determine whether or not there have been incidental impacts to them as a result of these activities. Because it is adjacent to the proposed mining operation in the North Private Lease, the Sagebrush Reference Area has more potential to be

impacted. Because of this, if negative impacts to this reference area are determined, an alterative reference area outside the permit area has been chosen (Sample Site V-05).

~~Finally,~~ Revegetation and mitigation, along with revegetation success standards for the jurisdictional wetland communities that are proposed for disturbance, will be in collaboration with biologists from DOGM as well as the Army Corps of Engineers. However, a concern was made by a biologist and hydrologist from DOGM that the up-stream mining in the North Private Lease could impact riparian zones downstream and south of the permit area. Consequently, a riparian monitoring site has been chosen and is located approximately 850 ft downstream from the permit boundary (UTM 370090 E 4142016 N; NAD 27). Prior to mining, this site will be field checked by representatives from DOGM and Alton Coal Development to confirm its suitability as an appropriate monitoring site. This site will be monitored annually during the active mining process and two years afterward to determine whether or not there have been major impacts to it a result of these activities.

SUMMARY

The Coal Hollow Mine has proposed an expansion to their surface mining operations in an area located north of the current permit area. This area is called the North Private Lease. Several environmental studies have been conducted in and adjacent to the new mine site resulting in the currently proposed new mine area. Within the larger study area, this plan involves surface mining and associated activities to be conducted south of Farm Road.

Most of the disturbance to the existing vegetation will done in plant communities that have already been altered as a method to convert the natural rangelands into pasture lands. Other disturbances, however, may impact small portions of a native pinyon-juniper/sagebrush community. The remaining disturbance to vegetation will impact ephemeral drainage channels west of Kanab Creek including some wetlands and the upland communities adjacent to them.

Sensitive species studies were conducted in and adjacent to the North Private Lease study area. A table of Federally Listed Threatened, Endangered and Candidate species for Kane County, Utah has been provided that includes the status of the species, along with site-specific notes about the area proposed for disturbance and the probabilities of their occurrences in the study area. One such species that could be impacted by the project as part of its brood-rearing habitat is the greater sage-grouse. Further study is planned regarding this species. Potential impacts to migratory birds were also addressed and have been included in the MRP [see Appendix 3-8; Greater Sage-grouse Management Plan, North Private Lease, Alton, Utah (July 14, 2015)].

An investigation for high-value wildlife habitats was conducted for the project area. Wildlife habitat maps for black bear, mule deer, Rocky Mountain elk and greater sage-grouse have been included in this report.

Standards for final revegetation success following reclamation of the proposed mining activities will be based on the condition of the present vegetation, potential reference areas, restoration/mitigation of wetlands and landowners' preferences.

COLOR PHOTOGRAPHS
OF THE
VEGETATION SAMPLE SITES

Figure 1: Sample Site V-01

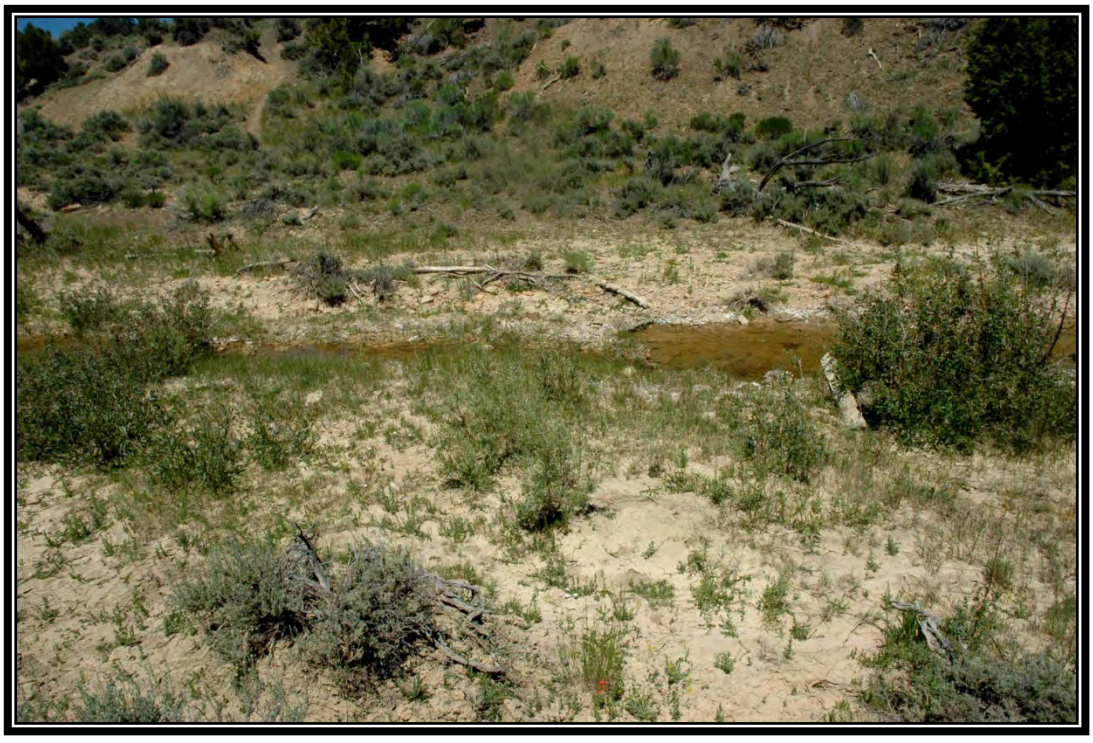

Figure 2: Sample Site V-02

Figure 3: Sample Site V-03

Figure 4: Sample Site V-04

Figure 5: Sample Site V-05

Figure 6: Sample Site V-06

Figure 7: Sample Site V-07

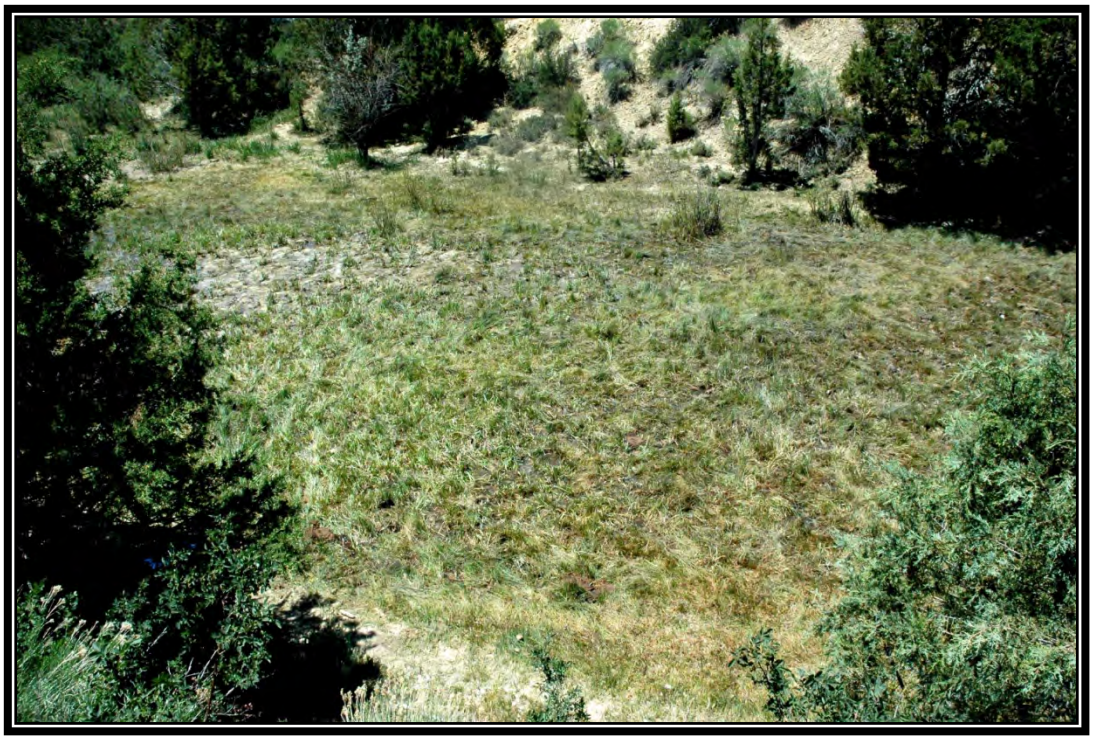

Figure 8: Sample Site V-08

Figure 9: Sample Site V-09

Figure 10: Sample Site V-10

Figure 11: Sample Site V-11

Figure 12: Sample Site V-12

Figure 13: Sample Site V-13

Figure 14: Sample Site V-14

Figure 15: Sample Site V-15

Figure 16: Sample Site V-16

Figure 17: Sample Site V-17

Figure 18: Sample Site V-18

Figure 19: Sample Site V-19

Figure 20: Sample Site V-20

Figure 21: Sample Site V-21

APPENDIX A

YELLOW-BILLED CUCKOO AND SOUTHWESTERN WILLOW FLYCATCHER HABITAT ASSESSMENT & SOUTHWESTERN WILLOW FLYCATCHER SURVEYS ALONG KANAB CREEK, KANE COUNTY, UTAH

Prepared by

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Submitted by

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for

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463 North 100 West
Cedar City, Utah 84721

August 2015

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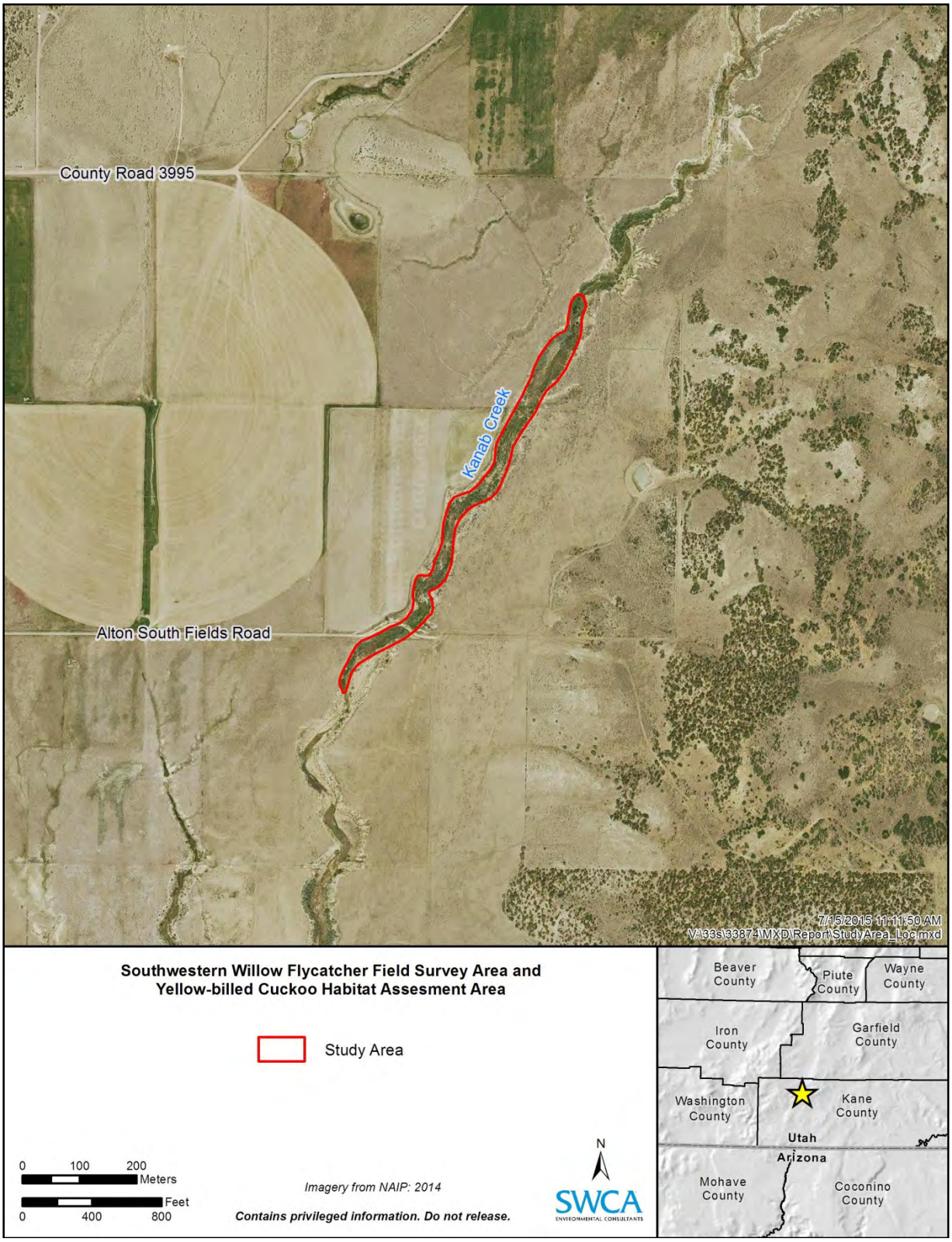
1. INTRODUCTION

This study was undertaken to examine the breeding and migratory status of the federally endangered western yellow-billed cuckoo (*Coccyzus americanus occidentalis)* (YBCU) and the federally endangered southwestern willow flycatcher (*Empidonax traillii extimus*) (SWFL) along Kanab Creek in Kane County, Utah. As part of the environmental permitting process associated with the proposed mining development of the Alton area, potentially suitable western YBCU and SWFL habitat was noted along Kanab Creek that could be affected by mining operations. U.S. Fish and Wildlife Service (USFWS) biologist Melissa Burns recommended that a habitat assessment be conducted for the YBCU and the SWFL and, if habitat was found to be present, that systematic surveys be undertaken to determine whether or not these species breed within the study area. After preliminary habitat assessments, the USFWS reviewed photographs taken from the general area and recommended that SWFL surveys be conducted on a small stretch of Kanab Creek (Figures 1 and 2; see also Appendix A).

The purpose of this report is twofold, as follows:

1. Conduct habitat assessments for the western YBCU and SWFL
2. Document the results of the 2015 SWFL surveys in Kanab Creek


County Road 3995
Kanab Creek
Alton South Fields Road
7/15/2015 11:11:50 AM
V:\33S\33874\MXD\Report\StudyArea_Loc.mxd
Southwestern Willow Flycatcher Field Survey Area and
Yellow-billed Cuckoo Habitat Assesment Area
Study Area
0 100 200
Meters
Feet
0 400 800
Imagery from NAIP: 2014
Contains privileged information. Do not release.
N
SWCA
ENVIRONMENTAL CONSULTANTS
Beaver County
Piute County
Wayne County
Iron County
Garfield County
Washington County
Kane County
Utah
Arizona
Mohave County
Coconino County

2. STUDY AREA

The general study area for this survey consisted of an approximately 2-hectare (ha) (5 acre) portion of the Kanab Creek, dominated by Russian olive (*Elaeagnus angustifolia*) and willows (*Salix spp*.). This area is spread along a 200-meter reach of the creek and occurs all on private lands. The study area was defined in consultation with the U.S. Fish and Wildlife Service and includes areas that could be affected by future mining projects.

Figure 2. Stretch of Kanab Creek in the study area.

3. YELLOW-BILLED CUCKOO

The western YBCU is listed as a threatened species under the Endangered Species Act. It is an obligate riparian nester, meaning that the species is restricted to more mesic habitat along rivers, streams, and other wetlands (Johnson et al. 1987). No designated critical habitat occurs in the study area.

This document provides the results of a habitat assessment for the federally threatened YBCU breeding habitat within the study area. Because breeding habitat for this species is limited to riparian vegetation, Kanab Creek and the adjacent drainages within the project area were reviewed for potential habitat. Following the initial review, the study area was redefined and restricted to a specific stretch along the Kanab Creek corridor. This habitat assessment was conducted to document the potential for cuckoos to breed in the study area as well as to assess the area as a potential stopover during migration. This report serves to document the quality of cuckoo breeding habitat in the study area, recommend whether the four-visit call-broadcast protocol is necessary, and obtain USFWS concurrence on the recommendation. The quality of cuckoo habitat present in the study area was discussed in telephone correspondence and in person between the USFWS and SWCA Environmental Consultants (SWCA) on June 24, 2015, and June 29, 2015.

3.1. Methods and Background

The study area includes a stretch of Kanab Creek. On June 23, 2015, SWCA wildlife ecologist Thomas Sharp and Mt. Nebo Scientific biologist Patrick Collins conducted a habitat assessment for the YBCU within the cuckoo habitat study area (Figure 1; see also Appendix A).

Nesting habitat for this species is restricted to riparian vegetation. In California, nesting generally occurs in cottonwood-willow habitats below 1,400 m (4,350 feet) in elevation (Laymon 1998), although breeding pairs have apparently been observed as high as 1,782 m (5,850 feet) (Corman and Magill 2000). Other habitats used include mixed native associations (cottonwood [*Populus* spp.], willow, ash [*Fraxinus* spp.], mesquite [*Prosopis* spp.], sycamore [*Platanus* spp.], walnut [*Juglans* spp.]), mixed native and introduced associations (any of the previous species with less than 75% tamarisk [*Tamarix* spp.]), mesquite bosque, associations with more than 75% tamarisk, and even fruit orchards adjacent to rivers (e.g., artificial riparian habitat) (Corman and Magill 2000; Laymon and Halterman 1989). Cottonwood-willow habitats appear to be greatly preferred in California (Laymon and Halterman 1989), and other habitats such as mesquite may be occupied only after cottonwood-willow habitats are fully occupied. In the desert Southwest, mesquite and tamarisk may also be used (Hunter et al. 1987). No empirical data exist to demonstrate preference for greater productivity in any particular habitat.

Patch size is an important landscape feature associated with cuckoo nesting habitat. A significant trend correlates increased habitat occupancy with increased patch size; specifically, sites exhibiting both suitable habitat and a patch size of greater than 80 ha (200 acres) were occupied 100% of the time in California, away from the Colorado River. Nevertheless, sites as small as 4 ha (10 acres) have been occupied on the lower Colorado River (Laymon and Halterman 1989).

Canopy cover near a given nest also appears to be an important feature of habitat quality; canopy cover declined and standard deviation increased with increasing distance from the nest (Laymon 1998). The distance to water from cuckoo nests averaged 310 m (1,015 feet) along the South Fork Kern River in California, with an overall range of 0–1,500 m (0–4,920 feet). Distance to water averaged 41 m (135 feet) along the Bill Williams River in Arizona, with a range of 0–175 m (0–575 feet) (Laymon 1998). Relatively high humidity near the nest has been suggested as an important habitat characteristic (Laymon 1998), although no empirical data demonstrate that it is a requirement. In California, cuckoos appear to prefer dense cottonwood-willow stands (Halterman 1991; Rosenberg et al. 1991). Rosenberg et al. (1991) suggest that perhaps the extreme Southwestern midsummer temperatures, which could kill unprotected eggs, may influence the selection of nest sites, with more heavily shaded understory habitats and woody riparian habitats containing standing water being preferred in this region.

3.1.1. Habitat Assessment Criteria

The following criteria were used to determine the potential suitability of the habitat for nesting YBCUs:

- Tree species that occur in the riparian zone
- The density of trees that occur in the riparian zone (checked with aerial photographs, and then ground-truthed in the field)
- The average estimated canopy height of the riparian tree patches
- A description of the understory height and cover
- The patch size of riparian tree habitat (checked with aerial photographs, and then ground-truthed in the field)
- A description of the amount of canopy cover within the riparian zone

Table 1 summarizes the minimal criteria for YBCU breeding habitat.

Table 1. Summary of Minimal Criteria for YBCU Breeding Habitat Patches in the Study Area

Dominant Tree Species	Tree Density	Canopy Height (meters)	Understory Height (meters)	Patch Size (hectares)	Canopy Cover
Cottonwood, willow, or tamarisk	Dense	5	2	4	High

3.2. Results

The riparian corridor in the study area consisted of only one relatively dense patch of riparian forest. The forest was made up of predominantly Russian olive and willows (Figure 3). The patches of tree and shrub vegetation were interspersed by open areas consisting of *Carex* spp. and other wetland plants. The willow ranges from 0.5 to 2.0 m in height. The Russian olive range from 3.0 to 6.0 m in height.

Figure 3. Study area showing open canopy.

Table 2. Assessment Criteria for Habitat Patches in the Study Area

Dominant Tree Species	Tree Density	Canopy Height (meters)	Understory Height (meters)	Patch Size (hectares)	Canopy Cover
Russian olive, willow	Moderate	3–4	1	2.5	Low

3.3. Conclusions and Recommendations

No USFWS designated habitat is found in the study area, nor does the riparian habitat in the study area resemble YBCU breeding habitat as described in Table 1 and based on reported habitat requirements (Corman and Magill 2000; Laymon 1998; Laymon and Halterman 1989). Trees, except for small willows and Russian olive, are sparse. The canopy height is generally insufficient for the species, and although individual Russian olive trees meet the criteria, the canopy cover is low and the understory height is low. Perhaps most significantly, the patch size is too small to support breeding cuckoos. Therefore, due to the habitat qualities described above, it is highly unlikely that cuckoos breed in the study area.

It is also unlikely that this stretch of the Kanab Creek is important to migrating cuckoos. This is because there is very little riparian forest of any size anywhere in this stretch of the Kanab Creek. According to Wallace et al. (2013), YBCUs likely follow greening riparian corridors after monsoon precipitation. Given the general lack of riparian forest along Kanab Creek, it is likely that YBCUs are migrating through other larger riparian corridors.

SWCA recommends that the four-visit survey protocol to locate breeding pairs of YBCUs is not necessary in the study area.

4. SOUTHWESTERN WILLOW FLYCATCHER

The SWFL is listed as an endangered species under the Endangered Species Act (USFWS 1995). The species is an obligate riparian nester, meaning that it is restricted to more mesic habitat along rivers, streams, and other wetlands (Johnson et al. 1987). No designated critical habitat occurs within the study area.

This section provides the results of a habitat assessment and surveys for the SWFL potential breeding habitat that occurs within the study area. Because breeding habitat for this species is limited to riparian vegetation, Kanab Creek and the adjacent drainages within the project area were reviewed for potential habitat. Following the initial review, the study area was refined and restricted to a specific reach along the Kanab Creek corridor. The initial habitat assessment was conducted to determine if the study area contained potential SWFL breeding habitat or had value as a potential stopover habitat during migration.

This report serves to document the quality of the SWFL breeding habitat in the study area, and present the results of the field surveys. The quality of the SWFL habitat in the study area was discussed in telephone correspondence and in person between Melissa Burns (USFWS), Patrick Collins (Mt Nebo Scientific), and Thomas Sharp (SWCA) on June 24, 2015, and June 29, 2015. One stretch of Kanab Creek was determined to potentially contain structural habitat to support the SWFL in the form of dense willows and Russian olive trees. Although the USFWS suggested that SWFL surveys be carried out, upon closer inspection SWCA felt that the willow habitat was not dense enough to support the SWFL.

4.1. Methods and Background

The SWFL survey methods were taken directly from Sogge et al. (2010). However, the first surveys were not conducted until June 24, the last day of Survey Period 2 under the project survey protocol. Therefore, Survey Period 1 (scheduled to be between May 15 and June 1), which had a one-survey minimum, was missed completely. Additionally, Survey Period 2 had a two-survey minimum (to be carried out between June 1 and June 24), but only one survey was conducted. Survey Period 3 (from June 25 to July 17) also had a two-survey minimum, and two surveys were conducted.

In the study area, SWFL survey efforts focused on dense willow stands that have the best structure for nesting willow flycatchers. Areas outside riparian habitat were not surveyed as part of this effort. Surveys for SWFL were conducted using a tape-recorded playback of flycatcher song and call notes (*fitz-bew* and *britt*) according to the standard protocol described by Sogge et al. (2010) and currently mandated by the USFWS. A trained observer conducted three surveys of the study area in two of the three established survey periods: one survey in Survey Period 2 (June 1–24), and two surveys in Survey Period 3 (June 25–July 17). Surveys were conducted on the following 2015 dates: June 24, July 10, and July 16.

Surveys were initiated approximately 30 minutes before sunrise and were terminated by 9:00 a.m. (Mountain Time Zone). Observers played recordings of flycatcher songs at approximately 10-to-15-m intervals in potential flycatcher nesting habitat. The survey route followed the water's edge.

4.2. Results and Discussion

No flycatcher detections were made during the three 2015 surveys. Because no resident flycatchers were detected, nest-searching protocol was not initiated, and nest-monitoring activities were deemed unnecessary.

4.2.1. Observations on Suitability of Existing and Potential Future Habitat

SWCA's qualitative observations of habitat conditions in summer 2015 indicate that the habitat found in the study area stretch of Kanab Creek is of marginal quality at best. Generally, the habitat is not dense nor does it contain good canopy cover. Additionally, it is somewhat of an isolated habitat patch along a creek with relatively little riparian habitat.

4.2.2. Migratory Habitat Value

The 2015 SWFL surveys began after the migratory season had already passed for this species. As a result, these surveys offer no insight into whether SWFL may have migrated through the area. However, SWFL tend to migrate through riparian woodlands, and the habitat they use in migration is generally similar to their breeding habitat. Given this, the study area likely does not contain a great deal of value to the SWFL, although they could still migrate through.

5. CONCLUSION

Based on the results of the habitat assessment for the YBCU, it is SWCA's opinion that there is no reason to conduct surveys for it within the study area. Additionally, between the marginal habitat quality for SWFL and the fact that no SWFL were detected during the three field visits conducted, SWCA believes it to be highly unlikely that SWFL would nest in the study area.

6. LITERATURE CITED

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Appendix A

Annotated Checklist of Bird Species Detected in the Study Area of Kanab Creek June–July, 2015

ANNOTATED CHECKLIST OF BIRD SPECIES DETECTED ALONG KANAB CREEK, JUNE–JULY, 2015

This annotated checklist identifies bird species that were detected along the Kanab Creek study area, Utah, during surveys for southwestern willow flycatchers from late June through late July 2015. Presumed status is based on field observations. Relative abundance categories are modified after Phillips et al. (1964); abundance of a given species is based on SWCA's field observations. Common names and phylogenetic order conform to ornithological standards established by the American Ornithologists' Union (1998, and subsequent revisions).

Presumed Status

Resident (R)	Species apparently occurs in the area throughout the spring and summer nesting season, probably nesting.
Migrant (M)	Species apparently passes through the area during migration, probably not nesting.
Unknown (U)	The presumed status is in question because insufficient information existed for evaluation of status.

Relative Abundance

Abundant (A)	Species is easily detected in large numbers.
Common (C)	Species is easily detected, but not in large numbers.
Fairly Common (FC)	Species regularly detected in small numbers.
Uncommon (U)	Species regularly detected in very small numbers, although not necessarily every day.
Rare (R)	Species detected irregularly in very small numbers.

Table A.1. Bird Species Detected along the Kanab Creek Study area

Common Name	Scientific Name	Presumed Status	Relative Abundance
Mourning dove	*Zenaida macroura*	R	U
Black-chinned hummingbird	*Archilochus alexandri*	R	R
Common raven	*Corvus corax*	R	U
Black-billed magpie	*Pica hudsonia*	R	A
Western scrub jay	*Aphelocoma californica*	R	FC
Blue-gray gnatcatcher	*Polioptila caerulea*	R	U
Mountain bluebird	*Sialia currucoides*	R	U
American robin	*Turdus migratorius*	R	C
Yellow warbler	*Dendroica petechia*	R	R
MacGillivray's warbler	*Oporornis tolmiei*	R	R
Lark sparrow	*Chondestes grammacus*	R	A
Savannah sparrow	*Passerculus sandwichensis*	R	A
Song sparrow	*Melospiza melodia*	R	FC
Western meadowlark	*Sturnella neglecta*	R	C

Appendix B

Personal Correspondence between Mt Nebo Scientific, U.S. Fish and Wildlife Service, and SWCA Environmental Consultants

From: Burns, Melissa [mailto:melissa_burns@fws.gov]
Sent: Monday, July 20, 2015 3:52 PM
To: Thomas Sharp
Cc: mt.nebo@xmission.com
Subject: Re: Alton Southwestern Willow Flycatcher Assessment and Surveys

Hi Thomas,

Sorry for my slow response confirming receipt of this email and thanks for providing the details of our previous discussions. You have accurately summarized our recommendations.

Please let us know if you have additional questions or concerns or if the scope of the project changes.

Best,

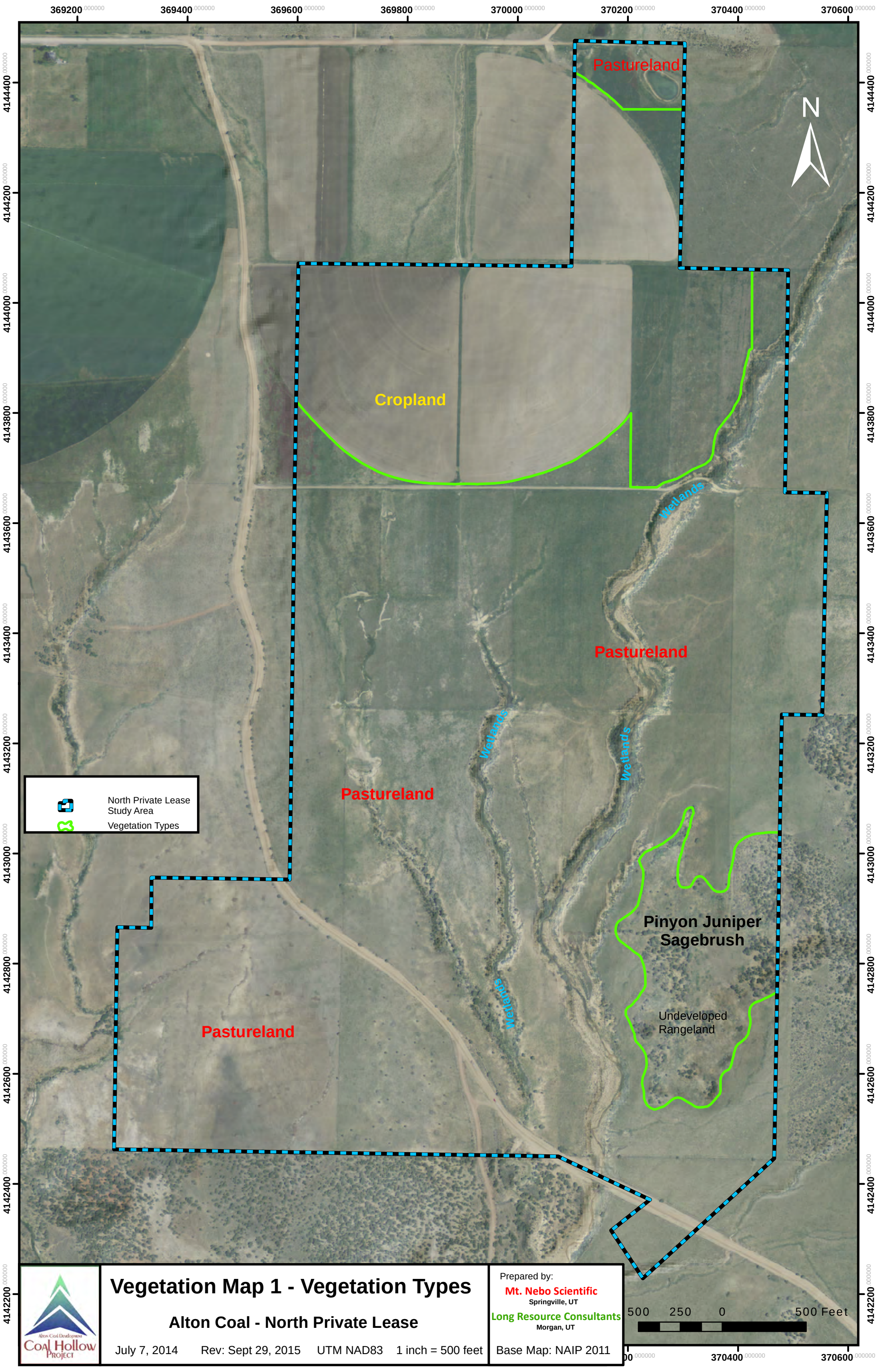
Melissa

On Mon, Jun 29, 2015 at 3:11 PM, Thomas Sharp <tsharp@swca.com> wrote:

> Hi Melissa,
>
> This email stand as a record of and pertains to the potential need for southwestern willow flycatcher (SWFL) surveys for a small patch of habitat just outside of Alton, Utah. As per previous discussions between USFWS and Patrick Collins (Mt Nebo Scientific) there is one small patch of habitat which is potentially suitable for nesting SWFL. Patrick and I revisited the area on June 23, 2015. The habitat patch is small however there area does have the appropriate hydrology, and the willows are dense enough to potentially have the vegetative complexity for nesting SWFL. Though, truthfully the habitat is of marginal quality at best. However, given previous discussions with USFWS we did conduct a SWFL survey the morning of June 24, 2015, thus getting one survey done within the second SWFL protocol window. We intend to conduct 2 SWFL surveys during the third SWFL window as prescribed in the 2010 protocol and as you recommended we do.
>
> Therefore, as per previous discussions, although, we did miss the first SWFL survey window the USFWS thinks it would be useful and recommends that we we will complete the final three surveys.
>
> The habitat is not appropriate for nesting yellow-billed cuckoos and is probably not of much use to migrating cuckoos either. This will be written up as such and we hope that that is all that the USFWS will require for this species.
>
> Please let us know if you have any questions or concerns.
>
> Thomas Sharp
> SWCA
> Wildlife Ecologist

--
Melissa Burns
Regional Conservation Planning Assistance Coordinator
U.S. Fish and Wildlife Service
1011 E. Tudor Road
Anchorage, AK 99503
907-786-3451

VEGETATION & WILDLIFE MAPS
OF THE
NORTH PRIVATE LEASE & ADJACENT AREAS



Vegetation Map 1 - Vegetation Types

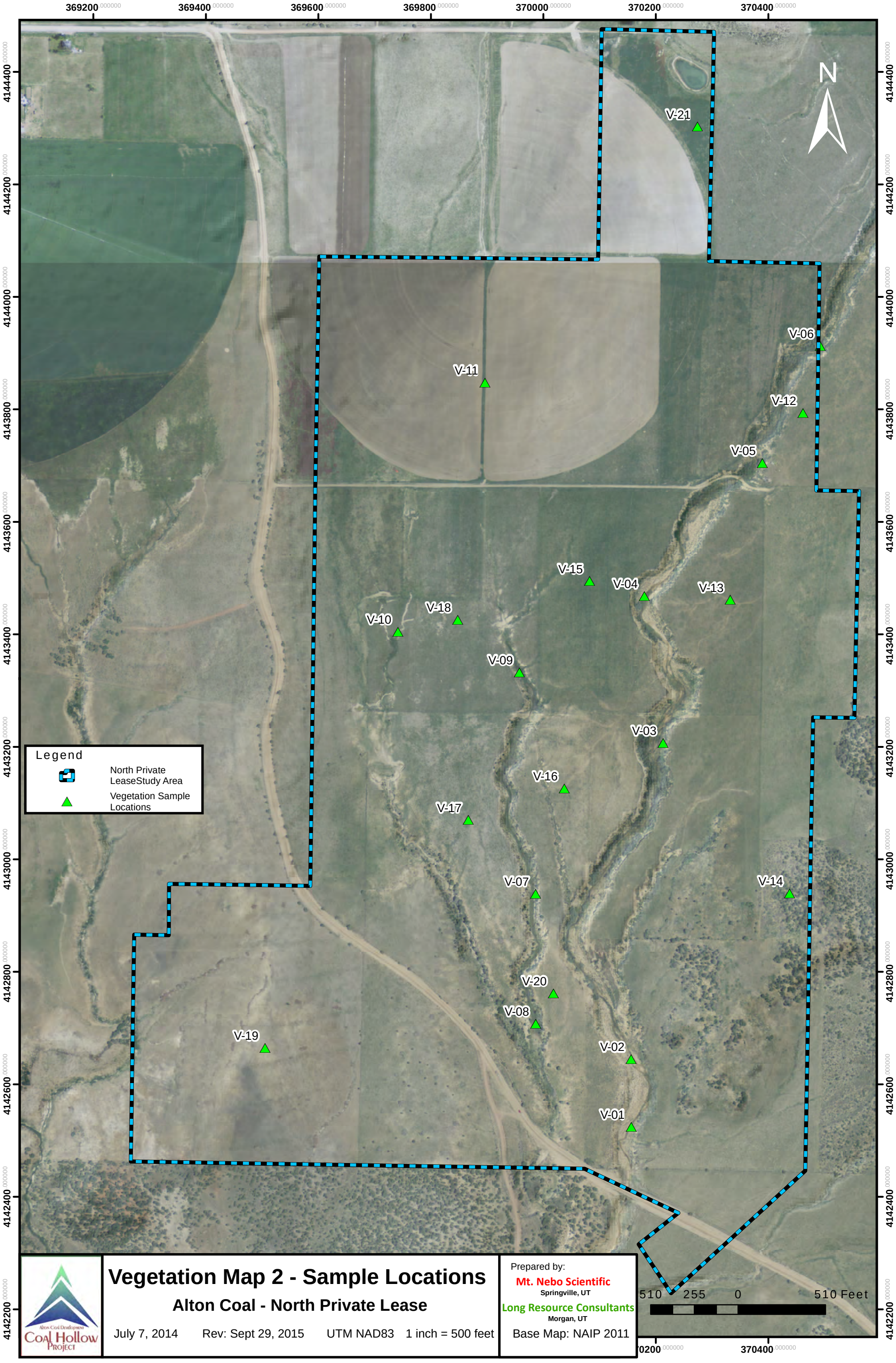
Alton Coal - North Private Lease

July 7, 2014 Rev: Sept 29, 2015 UTM NAD83 1 inch = 500 feet

Alton Coal Development
Coal Hollow Project

Prepared by:
Mt. Nebo Scientific
Springville, UT
Long Resource Consultants
Morgan, UT

Base Map: NAIP 2011



Vegetation Map 2 - Sample Locations

Alton Coal - North Private Lease

July 7, 2014 Rev: Sept 29, 2015 UTM NAD83 1 inch = 500 feet

Prepared by:
Mt. Nebo Scientific
Springville, UT
Long Resource Consultants
Morgan, UT
Base Map: NAIP 2011

Year-Long - Crucial

Year-Long - Substantial

Year-Long - Crucial

ALTON AMPHITHEATER

N

2,000 1,000 0 2,000 Feet

North Private Lease Study Area

Habitat Value

Crucial

Substantial

GIS Data Source:
Black Bear Habitat
Biodiversity Database
Accessed November 10, 2014
Utah Department of Natural Resources
Salt Lake City, Utah

Wildlife Map 1 - Black Bear Habitat

Alton Coal - North Private Lease

Base Map: Alton, Utah USGS 7.5' Topographic Map

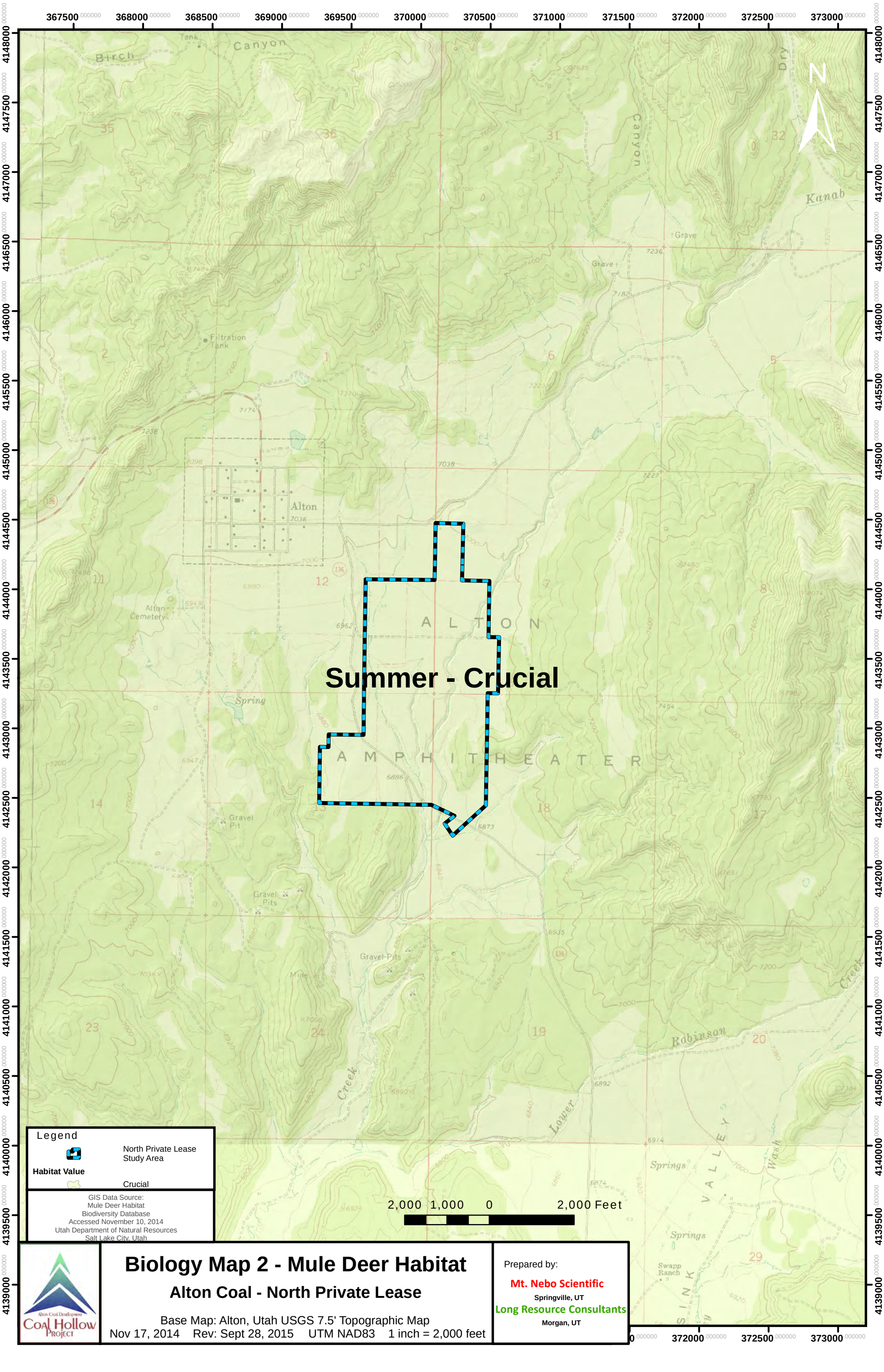
Nov 17, 2014 Rev: Sept 28, 2015 UTM NAD83 1 inch = 2,000 feet

Alton Coal Development
Coal Hollow Project

Prepared by:

Mt. Nebo Scientific
Springville, UT

Long Resource Consultants
Morgan, UT



Biology Map 2 - Mule Deer Habitat

Alton Coal - North Private Lease

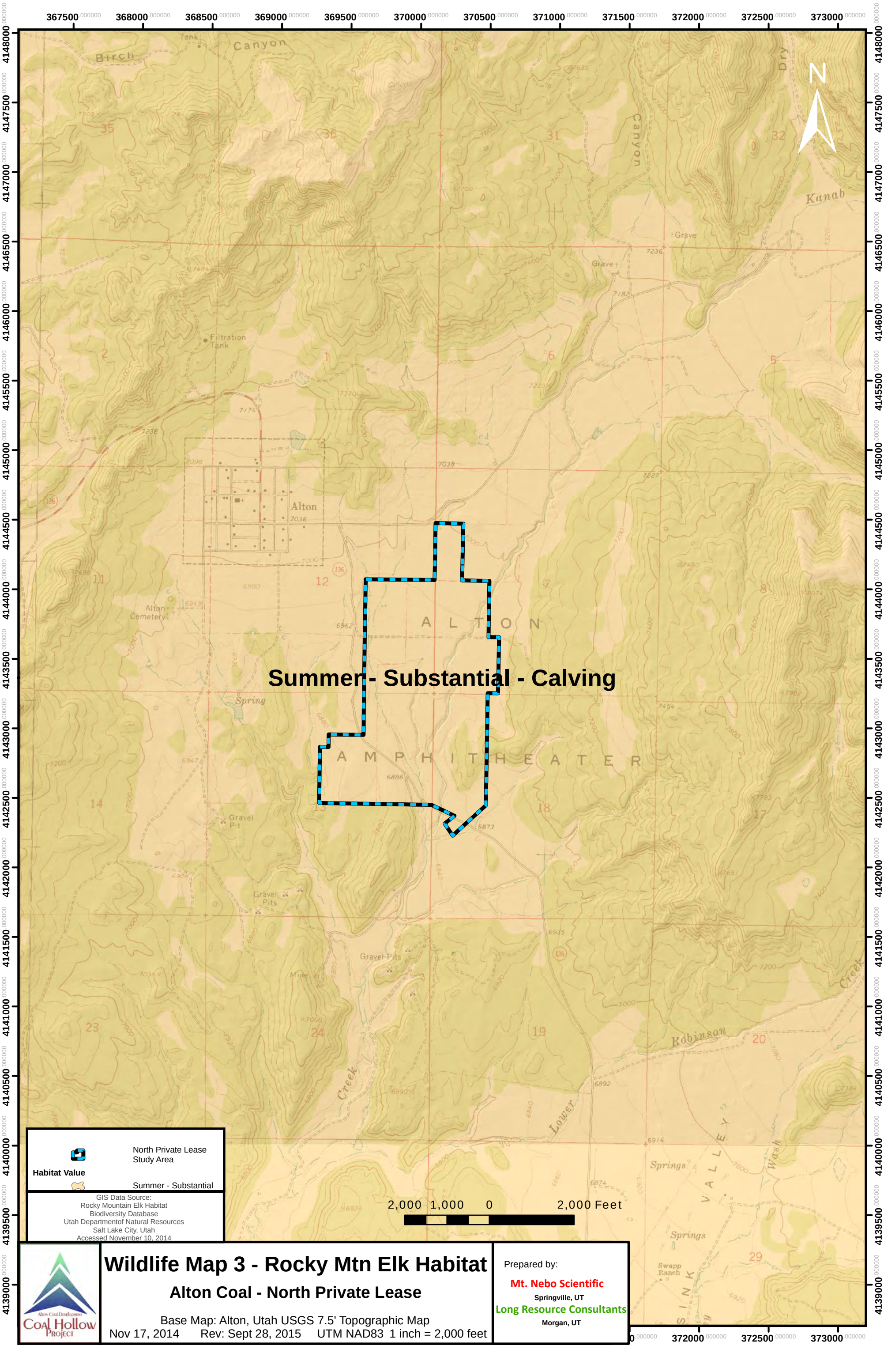
Base Map: Alton, Utah USGS 7.5' Topographic Map
Nov 17, 2014 Rev: Sept 28, 2015 UTM NAD83 1 inch = 2,000 feet

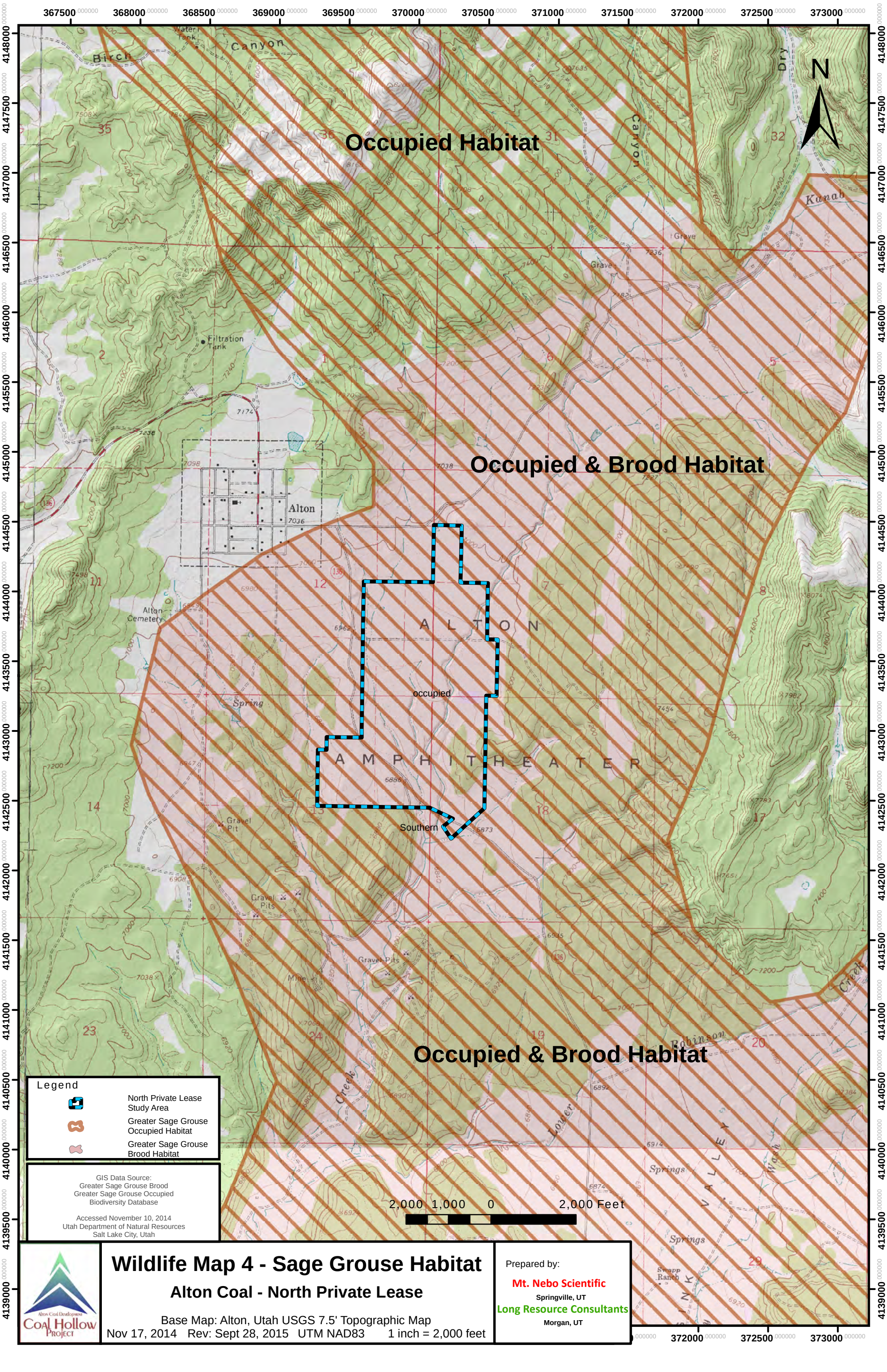
Alton Coal Development
Coal Hollow Project

Prepared by:

Mt. Nebo Scientific
Springville, UT

Long Resource Consultants
Morgan, UT


Summer - Substantial - Calving
Habitat Value
North Private Lease Study Area
Summer - Substantial
GIS Data Source:
Rocky Mountain Elk Habitat
Biodiversity Database
Utah Departmentof Natural Resources
Salt Lake City, Utah
Accessed November 10, 2014
2,000 1,000 0 2,000 Feet
N
Alton
ALTON
AMPHITHEATER
Birch Canyon
Dry Canyon
Kanab
Filtration Tank
Alton Cemetery
Spring
Gravel Pit
Gravel Pits
Mine
Robinson Creek
Lower Wash
SINK VALLEY
Springs
Swapp Ranch
Grave
Tank
Coal Hollow Project
Wildlife Map 3 - Rocky Mtn Elk Habitat
Alton Coal - North Private Lease
Base Map: Alton, Utah USGS 7.5' Topographic Map
Nov 17, 2014 Rev: Sept 28, 2015 UTM NAD83 1 inch = 2,000 feet
Prepared by:
Mt. Nebo Scientific
Springville, UT
Long Resource Consultants
Morgan, UT


Occupied Habitat
Occupied & Brood Habitat
Occupied & Brood Habitat
N
Canyon
Dry
Canyon
Kanab
Grave
Grave
Water Tank
Birch
Filtration Tank
Alton
7036
Alton Cemetery
Spring
Gravel Pit
Gravel Pits
Mine
Gravel Pits
A L T O N
occupied
A M P H I T H E A T E R
Southern
Creek
Lower
Robinson
Creek
Springs
Springs
Swapp Ranch
Wash
2,000 1,000 0 2,000 Feet
Legend
North Private Lease Study Area
Greater Sage Grouse Occupied Habitat
Greater Sage Grouse Brood Habitat
GIS Data Source:
Greater Sage Grouse Brood
Greater Sage Grouse Occupied
Biodiversity Database
Accessed November 10, 2014
Utah Department of Natural Resources
Salt Lake City, Utah
Alton Coal Development
Coal Hollow Project
Wildlife Map 4 - Sage Grouse Habitat
Alton Coal - North Private Lease
Base Map: Alton, Utah USGS 7.5' Topographic Map
Nov 17, 2014 Rev: Sept 28, 2015 UTM NAD83 1 inch = 2,000 feet
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