Alton Coal Development, LLC

Coal Hollow Project

Mining and Reclamation Plan
Completeness Review - Revisions

ALTON COAL DEVELOPMENT
COAL HOLLOW
PROJECT

C/025/0005

File in:
☐ Confidential
☒ Shelf
☐ Expandable
Refer to Record No 0003 Date 1-23-08
In C/0250005, 2008, Incoming
For additional information

UDOGM Correspondence, Administrative Completeness Review

Dated August 27, 2007

JON M. HUNTSMAN, JR.
Governor

GARY R. HERBERT
Lieutenant Governor

State of Utah
DEPARTMENT OF NATURAL RESOURCES

MICHAEL R. STYLER
Executive Director

Division of Oil Gas and Mining

JOHN R. BAZA
Division Director

August 27, 2007

Chris R. McCourt
Alton Coal Development, LLC
463 North 100 West, Suite 1
Cedar City, Utah 84720

Subject: Administrative Completeness Review – Determined Not Complete, Alton Coal Development, LLC, Coal Hollow, C/025/005, Task ID #2814, Outgoing File

Dear Mr. McCourt:

We have reviewed your June 14, 2007 application for a surface coal mining operation near Alton, Utah. The application has been determined to be incomplete, based upon alluvial valley floor information, hydrologic operational plans and designs, geologic core analyses, soils and vegetation information and reporting of technical data. In addition, please provide completed soil and vegetation surveys for the entire permit area when you address the completeness issues.

A copy of the Administrative Completeness Review (ACR) and an Alluvial Valley Floor attachment are enclosed.

Priscilla Burton at the Price Field Office is the review team lead. Please contact Ms. Burton at (435) 613-1146, Ext. 207 or myself at (801) 538-5268 with your questions.

Sincerely,

Pamela Grubaugh-Littig
Permit Supervisor

PWB/SB
Enclosure
cc: Price Field Office
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UTAH DNR OIL, GAS & MINING

ADMINISTRATIVE COMPLETENESS REVIEW WORKSHEET
(R645-100)

DATE: August 10, 2007

REVIEWER(S): Joe Helrich, Wayne Western, Priscilla Burton, David Darby, Dana Dean,

APPLICANT: Alton Coal Development, LLC

MINE NAME: Coal Hollow **FILE NO.:** C00250005

"Administratively Complete Application" means an application for permit approval or approval for coal exploration, where required, which the Division determines to contain information addressing each application requirement of the State Program and to contain all information necessary to initiate processing and public review.

Directions: **The categories listed below correspond to the minimum requirements for information necessary to initiate processing and public review. If a category is checked the Applicant has met the Completeness requirement for that category. If a category is not checked, the Completeness requirements have not been met. The comments column will identify the deficiency and what is necessary to correct it.**

			Comments
301-112	Identification of Interests	X	
100	Applicant's Business Structure	X	
210	Applicant's Name/Address/Phone	X	Alton Coal Development, LLC; Cedar City, UT; 435 867-5331
220	Resident Agent's Name/Address/Phone	X	Chris McCourt 435-867-5331
230	Name/Address/Phone of AML Fees Payer	X	
300	Corporate Structure & Ownership	X	
400	Identify Other Mining Operations in US	X	
500	Surface & Mineral Ownership	X	
600	Ownership Contiguous to Permit	X	
700	MSHA Numbers	X	pending, see Section 112.700
800	Interest in Contiguous Lands	X	

301-113	Violation Information	X	
100	Suspension or Revocation Information	X	
300	List of Violations - **3 Previous Years**	X	
301-114	Right of Entry	X	Confidential Appendix 1-2 is referenced for location of conveyance documents described in Section 114.
301-115	Status of Unsuitability Claims	X	
301-116	Permit Term	X	
301-117	Insurance	X	
	Proof of Publication	—	A copy of the proposed advertisement was included in the application. Corrections to the advertisement should be made to provide the Cedar City address; to provide a map of location with north arrow, permit area boundary, showing Alton, County Rd #163, the Dixie National Forest boundary, Lower Robinson Creek, and Sink Valley Wash to enable identification of area. The public notice must also state that written comments, objections, or requests for informal conferences on the application may be submitted to the DOGM. The advertisement should also provide specifics for county road closure (description of road, dates of closure, timing and duration of closure, illustration of relocated section). If these specifics can not be provided, then a second advertisement will be required prior to the road closure.
	Facilities and Structures Used in Common	X	
301-118	Filing Fee	X	
301-123	Notarized Signature of Responsible Official	X	Authorized signature will be required with revised application as well.

301-130	Information Collection: **Technical Data Accompanied by Names of Persons or Organizations that Collected and Analyzed the Data - Dates of Collections - and Analysis of the Data and Description of the Methodology Used to Collect and Analyze Data**	—	A list of contributors is provided in Chapter 1, but this list erroneously refers to the Soil Conservation Service which no longer exists under this name. Dates and collection methods and analysis are provided with reports, however portions of the vegetation mapping relies on 1987 data taken from a previous coal application. Credentials of the consultant who authored the 1987 report must be provided, along with the original report that describes methods of collection and analysis of data.
301-200	Soils	X	
211	Description of Pre-mining Soil Resources	X	
221	Prime Farmland Investigation	X	
222	Soil Survey	—	Applicant must provide more detail for the E1/2 of the E1/2 Section 30 and the NW1/4 of Sec 29. Technical analysis to focus on map unit distinctions.
224	Substitute Topsoil Info (When Proposed)	X	Not applicable
230	Operation Plan **Topsoil Handling/Removal/Storage**	X	9 inches topsoil and average of 23 inches subsoil stockpiled in three locations. Technical review to focus on doubling topsoil and subsoil recovery to adequately reclaim high SAR spoil..
240	Reclamation Plan **Soil Redistribution/Stabilization**	X	Technical review to focus on inadequate coverage of high SAR spoil (SAR greater than 15). High SAR spoil must be covered with four feet of non-toxi, non-acidic soil.
301-300	Biology	X	The Biology section is included in Volume II, Chapter 3 of the application. It is formatted under the R645 rules and addresses Section R645-301-300 et. sec. of the coal regulations.

320	Vegetation Information	—	The vegetation information is included in Section 321 and describes the plant communities and productivity for the proposed mine permit area. There are two sets of data, one from 1987 and one from 2006. The more recent data is intended to address the first year surface facility and mining projections. According to the information in Chapter three Page 3-2, " Most of the sampling in areas for year one of the proposed new mine has already been conducted," however the 2006 quantitative sampling does not appear to cover the proposed disturbed facility and spoil pile areas as depicted during the first year of mining on Drawing 5-3. Prior to permit issuance, sampling years two and three mining areas will be required for the Division to make a valid Alluvial Valley Floor determination. A preliminary review of the baseline hydrologic and soils information indicates that there is shallow ground water beneath the eastern most meadow vegetative community as depicted on Drawing 3-1B.
322	Fish and Wildlife Information	X	The Fish and Wildlife Information is provided in Section 322 et. sec. and includes Agency consultation and studies, site specific resource information, T&E lists, habitats FWS review, and maps for the proposed mine permit area.
323	Maps/Photos **Vegetation-Fish-Wildlife Areas**	X	Vegetation and wildlife maps are included in Section 323 et. sec. of the application, they include plant communities, deer, elk, black bear, and sage grouse brood habitat.
330	Operation Plan **Vegetation-Fish-Wildlife Protection**	X	Section 333 et. sec. includes procedures to minimize impacts to fish and wildlife during operations.
341	Reclamation Plan for Revegetation	X	Sections 340-342 et. sec. include a reclamation plan for revegetation. The plan contains enough information to initiate a technical analysis.
342	Fish & Wildlife Plan for Reclamation Phase	X	Sections 340-342 include protection and enhancement measures for fish and wildlife during the reclamation phase. Performance standards are included in Section 350 et. sec.
301-400	Land Use and Air Quality	X	Land use is described in Chapter 4 of the application. An air pollution control plan is included in the Chapter 4 , Appendix 4-2 of the application . Some additional air pollution control information is provided in Chapter 5, Section 526.400 of the application. Correspondence with the Bureau of Air Quality will need to be included in the application prior to final approval.

411	Pre-Mining Land Use Information **(Includes Cultural Resources)**	X	Cultural resource information is described in Chapter 4, Section 411 et. sec of the application and includes a cultural resource survey and a map delineating the extent of the survey of the proposed area to be affected by strip mining activities.
412	Post-Mining Land Use Information	X	Post mining land use information is included in Chapter 4 Section 412 of the application. It includes management plans for the two land owners, Richard Dame and Burton Pugh.
301-500	Engineering	X	Proposed Permit Area, or Permit area is identified as Project area on many maps.
510 520	General Description of Operation Plan **(Maps, Locations, Cross-Sections, Narrative, Descriptions & Calculations)**	X	
522	Coal Recovery Description	X	
523	Mining Methods	X	Surface mining truck/shovel operation
524	Blasting and Explosives Plan	X	The Permittee does not plan on any blasting of overburden or coal seam.
525	Subsidence Control Plan	X	NA
526	Mine Facilities Description **(Narrative, Plans, Maps) Including Existing Structures & Support Facilities**	X	
527	Transportation Facilities **(Including Plans & Maps)**	X	
528	Coal Mine Waste Plans **(Description & Designs)**	X	
529	Management of Mine Openings **(Design)**	X	
531	General Plans for Structures	X	
532	Sediment Control	X	
533	Impoundments	X	

301-534	Roads **(Plans, Drawings, Designs, & Specifications)**	X	The Permittee still needs approval from the County to relocate the County road.
535	Spoil	X	
536	Coal Mine Waste	X	
537	Regraded Slopes	X	
540 541-542	Reclamation Narrative, Maps and Plans	X	
551	Casing and Sealing **Underground Openings**	X	
553	Backfilling and Grading Description	X	
301-600	Geology	X	Geology is presented in Chapter 6.
621	Description of Geology **(Permit & Adjacent Area)**	—	Drill hole CH-04-05 appears to be missing from the application. Four boreholes have some lithologic quality analyses. Overburden was analyzed for acid and toxic forming (Appendix 6-1) materials, but not according to the DOGM overburden sampling recommendations oulined in the February 2006 e-mail to Patrick Collins, consultant (attached). No preliminary radiation assessments were made of the overburden. Selenium must be analyzed to a detection limit below 0.1 ppm.
622	Geologic Cross-Sections, Maps, and Plans	X	Drawing 6-6, as referenced to in Drawings 6-7 and 6-8, is not in the Application. Drawing 6-5 does not show top of coal elevations for whole project area.
630	Plans for Casing and Sealing Holes	X	Construction and sealing of wells, boreholes and exploration holes is described in the Operation Plan in Chapter 6.
301-700	Hydrology	X	
721	Description of Hydrologic Resources **(Permit and Adjacent Area)**	X	
722	Cross-Sections and Maps **Subsurface Water - Surface Water - Monitoring Stations - Wells**	X	

723	Sampling and Analysis	X	
724	Baseline Information **Ground Water - Surface Water - Geology - Climatological & Supplemental; If Needed**	X	Baseline water-quality and -quantity data have been submitted electronically to the Division's database, but they are still in the pipeline: water quality parameters need to be set before the data can be uploaded. The proposed plan includes a baseline water quality parameter list, but no operational plan list. Additional baseline data may be needed for AVF determination.
728	PHC Determination	X	Additional data obtained for the AVF determination may affect the Permittee's PHC determination.
730	General Operation Plan **Minimize Disturbance to Hydrologic Balance & Compliance with Clean Water Act**	X	
731	Ground and Surface Water Protection	X	
732	Ground and Surface Water Monitoring	X	

301-740	Plans and Designs **Operation and Reclamation Plan** **Sediment Control Measures** Siltation Structures Sediment Ponds Other Treatment Facilities Diversions Road Drainage Impoundments Discharge Structures Disposal of Excess Spoil Coal Mine Waste Disposal of Non-Coal Mine Waste Casing and Sealing of Wells	— X — X — — — — X X — X	All details and design information (dimensions, shape, erosion control, capacity, clean-out level, length, freeboard, required and actual capacity, etc.) for each diversion and sedimentation pond must be located in the appropriate section of the main text (not just on maps - calculations in appendices are OK - but must be certified) Remove text referring to possible future sediment controls, it is confusing and an amendment with detailed information will be required at such time any change is made to sediment control plans anyway. Detailed information on the "nonclogging dewatering device" and spillways needs to be in the text. Appendix 5-2 is not certified, drawings in Appendix D of Appendix 5-1 are not properly certified (not signed or dated-they are certified elsewhere - remove or certify) Details for road drainage must be in the main text. Appendix 5-3 is not certified, Details of discharge structures must be included in the text. Detailed information for impoundments must be in the text. More information is required for the disposal of noncoal waste. Where will it be disposed of - what DESIGNS will prevent degradation of surface and groundwater, etc. Need current plans, not just a blanket statement that the regulations will be met.
301-800	Bonding and Insurance	X	
820	Applicant **Have Adequate Bond at Permit Issuance**	X	

830	Bond Estimate and Calculations Provided	X	The Permittee will give more detailed information once the reclamation plan is approved.
890	Certificate of Insurance Provided	X	Will provide before permit is issued.
302-200	Special Categories of Mining	—	Not applicable
210	Experimental Practices Mining	—	
220	Mountaintop Removal Mining	—	
230	Steep Slope Mining	—	
240	Auger Mining	—	
250	In Situ Processing Activities	—	
302-260	Coal Processing Plants **(Not Located Within Permit Area of Mine)**	—	
270	Variances From Approximate Original Contour Restoration Requirements	X	The Permittee did not include a specific Section (302-260) that deals with the request for a variance from the approximate original contours. There is information in the plan about the request for the variance.
280	Variances for Delay in Contemporaneous Reclamation Requirement in Combined Surface and Underground Coal Mining Activities	—	
290	Small Operator Assistance Program **(SOAP)**	—	
302-300	Special Areas of Mining	—	
301	Prime Farmland	X	None in the permit area.

302	Alluvial Valley Floors	—	The Applicant presents information from AVF investigations in Appendices 7-1 and 7-4. Both appendices present two basic arguments that there is no AVF: the absence of stream-laid deposits and absence of a continuous stream in Sink Valley. The Division requires more information to make an Alluvial Valley Floor finding, as described on the attached page.

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From: Jim Smith
To: mt.nebo@xmission.com
Date: 2/7/2006 2:15:04 PM
Subject: Re: Overburden

Hello Patrick,

After discussing this with Priscilla and Dave Darby, our RECOMMENDATION is that, because this is a new area, samples be composited over 10-ft intervals*, one suite of samples from the shallowest hole and another suite from the deepest hole, and analyzed for the parameters in the Division's Soils Guideline** plus boron and selenium, and for the ground water baseline metals listed in the Divisions water monitoring guideline Tech-004.

We discussed the utility of analyzing for uranium and vanadium, considering the well known presence of these elements in the Colorado Plateau. Just to be safe, you might use a radiation counter to determine if there are sections with radiation above background level, and if there are, have them analyzed for radioactive elements.

*If there are lithologic units thinner than 10 ft, do a composite of each lithologic stratum.

**I think Priscilla already sent you copies of the Montana and New Mexico guideline, but copies are attached, along with the latest version of the Division's guideline. The Division's old "Guidelines for the Management of Topsoil; and Overburden for Underground and Surface Coal Mines" (Leatherwood 1988) contains recommendations on overburden sampling and hole spacing, drilling methods, sampling depth intervals, sample preparation, and analytical procedures: sorry, I don't have an electronic version of the old guideline.

JIM

James D. SMITH
jimdsmith@utah.gov
801 538 5262

>>> Priscilla Burton 02/02/2006 3:19 PM >>>
Hello Patrick,
I had a long conversation with Julian Calabrese, Soil Scientist, Montana DEQ (406) 444-4276. Montana requires that overburden samples include all of the parameters for the baseline soil information as well as Se, B, acid/base acct'g, Nitrate nitrogen, and Mo (due to the particular geology in MT). The analysis is done on composited samples of intervals no greater than 10 ft within each strata. The minimum composited depth is two ft.

In other words, each strata is represented by at least one composited sample. If the strata extends over thirty feet, then a minimum of trhee composite samples are required. If the strata is less than 2', then a 2' sample would be composited.

I spoke with Jim Smith (DOGM) and we agreed that we would follow Montana's lead of requiring composite samples by depth. For these first six holes, we would like to see the samples composited by 5 ft intervals within each strata. We would like to have the samples analyzed for pH, EC, SAR, texture, B, Se, acid/base acct'g, nitrate nitrogen, and total metals. The latter is added because we are unfamiliar with metals of concern, such as molybdenum, that could exist in the Utah geology.

Since there is no information on the first 40 ft of overburden from these holes, we will likely require additional sampling of the surface 40' during operations, since the surface 40 ft will be inverted and may contact groundwater.

Attached is a copy of the Montana guidelines.
I have a call in to my contact at the New Mexico Mining and Minerals.
Priscilla

Priscilla Burton
Environmental Scientist III/Soils
Utah Division of Oil Gas & Mining
Price Field Office
455 West Rail Road Ave.
Price UT 84501

priscillaburton@utah.gov
(435) 613-1146 x 207

>>> Patrick Collins <mt.nebo@xmission.com> Thursday, February 02, 2006 1:48 PM >>>
Hi Priscilla:

Any more thoughts about depth increments for the overburden samples?

Patrick

CC: David Darby; Priscilla Burton

Phone call to Patrick Collins on 2/8/06 to confirm:
use table #3 except %om
use table #8
+ metals of concern in Tech 004 g H_2O
+ measure and record radiation in all cores. If elevated levels, then analyze for radiation α, β, γ.

[Energy Labs - Billings]

AUGUST 16, 2007
ATTACHMENT TO ACR_2814 FORM
Alluvial Valley Floor Investigation

The Applicant presents information from alluvial valley floor (AVF) investigations in Appendices 7-1 and 7-4. Both appendices present two basic arguments that there is no AVF: the absence of stream-laid deposits and absence of a continuous stream in Sink Valley.

The Division requires more information to make an alluvial valley floor finding. The following required information should be discussed in relationship to the potential for an AVF. The R645 Rule cited is the basis for the request.

R645-302-321.210
Since geologic reports, maps and cross-sections in Chapter 6 identify extensive alluvial deposits in Sink Valley and show both Robinson Creek and Sink Valley Wash as continuous streams indicating stream laid deposits, statements in Appendices 7-1 and 7-4 that there is no continuous channel must be supported by other documentation. The basis for not including alluvial fan deposits as part of an alluvial valley floor must also be explained: Appendices 7-1 and 7-4 refer to definitions in the R645 Rules or OSM guidelines that exclude alluvial fans in Upland Areas, isolated from the floodplain and terrace complex. This exclusion of alluvial fans as AVF is not categorical and the Permittee needs to justify application of this exclusion in Sink Valley.

A map of the flood plain and terraces is requested for Robinson Creek and Sink Valley Wash, showing surface drainage patterns (including flow from the springs). Watershed maps and details for ALL watersheds contributing runoff to the area of the possible alluvial valley floor are requested.

Dwg. 7-13 shows a potentiometric surface for ground water in the alluvium of Sink Valley, however, this map, or an additional map, would be more useful if it were portrayed as an isopach of the depth to ground water, along with the direction of shallow groundwater flow. The potentiometric surface map should correlate with elevations at springs, Alluvial Groundwater Discharge Areas A and B, and along the channels of Robinson Creek and Sink Valley Wash. Information on the ground water found in the geotechnical boreholes (Appendix 5-1) should be included in the discussion of ground water in the alluvium, and, if suitable, incorporated into the maps. Seasonal variation of the water table should be portrayed with cross sections and maps. If seasonal variation can be correlated with vegetation changes, that should be noted.

Maps and additional cross sections showing the thickness of alluvium and, if feasible, variations in the lithology and hydrologic characteristics of the alluvium would probably be beneficial to understanding the alluvial ground-water system, as well as a map showing stream, pond, spring, and well locations in relation to surface geology. The Permit Area Boundary is shown on most maps, but the projected location of the pits and other disturbances in relation to the alluvium and ground-water system would be useful in understanding potential impacts.

R645-302-321.220
App 7-1, p. 48, gives some information about the agricultural use of lands within and adjacent to the permit area by cattle and for crop production. This agricultural use description must include a map showing location of existing undeveloped rangeland, subirrigated lands, crop lands and pastures, accompanied by productivity measurements of the each land use type, and animal units supported. Since none of these pastures are described as irrigated, a map showing subirrigated pastures should be provided, along with the depth to groundwater during the season of use (April - November).

R645-302-321.230

Drawing 7-7 provides locations of historical diversions. The map must also show the historical location of flood irrigated or subirrigated lands. Drawing 7-7 provides locations of water holding ponds. Describe the general construction and use of these ponds and any conveyance systems between ponds.

R645-302-321-240

Document the subirrigation potential based upon groundwater monitoring, water quality, soil moisture, rooting depth, soil mottling and water requirements of pasture and meadow vegetation described in Chapters 3 & 4.

R645-301-321-250

Document of flood irrigation potential based upon streamflow, water quality, water yield, soils measurements, and topographic characteristics.

R645-302-321-260

AVF investigations, (Appendices 7-1 and 7-4) do not provide a series of aerial photographs nor do they analyze the late summer/fall infrared imagery that would highlight the valley floor. Plate 3-1b provides infrared imagery that was flown in July 15, 2006. The applicant has labeled small areas of wet meadow and wet pasture, but this vegetation type was not separately described in the application and the rationale for distinguishing portions of the red imagery as wet from other equally red portions is not clear.

UDOGM and Alton Coal Development Meeting Notes

Meeting Date: September 14, 2007

UTAH OGM COAL PROGRAM MEETING NOTES

Date: September 14, 2007
Time: 10:00 a.m. – 12:30 p.m.
Location: Room 1030

To: Internal File, Coal Hollow, P/025/005, ACR_2814.

From: Priscilla Burton

Attendees: DOGM: Dana Dean, Jim Smith, Dave Darby, Priscilla Burton
Alton Coal Development, LLC: Chris McCourt, Patrick Collins, biologist; Eric Peterson, hydrologist; Bob Long, soil scientist.

Purpose: Discuss the Apparent Completeness Review dated August 27, 2007.

MEETING SUMMARY:
Incomplete vegetation information, sampling of vegetation required for mine facilities and spoil stockpile area. This oversight will be corrected. The Division urged the applicant to provide vegetation sampling for years 2 and 3 mining at this time as well.

Application relies on 1987 vegetation survey information. Patrick will provide name of consultant conducting the survey and methodology and survey locations from the original survey.

Geologic requirements: sampling methods for overburden and drill cores must include selenium to the detection limit of 0.1 ppm which is the allowable concentration limit identified in the Division's overburden handling guidelines. [Bob has a copy.] All cores must be analyzed for radiation using a Geiger counter. If indicated by the initial readings, laboratory analysis of the cores will be conducted for Alpha, Beta and Gamma radiation levels.

The number of overburden core samples taken was discussed. The Division wanted to know if there was a core collected between CH-6-05 and shown on Plate 6-5. Erik stated there were no cores collected, just surface samples represented by sites C7, C8, and C9. Core sampling for acid and toxic analyses was previously described in an e-mail, which was to include composite sampling over 10 ft. intervals or within each lithographic stratum if less than 10 ft. If the unit is extensive in depth a sample shall be taken every ten feet of the unit, which includes the coal seam. A question was raised about the depth of sampling at CH-5-05. Erik pointed out that composite samples were taken and shown in Appendix 6-2. Upon review of the information by the Division it was hard to discern where the sample started, or where the "base" of the sample column starts, from what is shown on the core log of CH-5-05. It appears there were no separate acid and toxic testing conducted on the coal unit.

The lack of information on federal coal is intentional for confidentiality. This explains the lack of drill hole information in the facilities area and the abrupt end to contours on geologic maps.

Robinson Creek diversion was approved by water rights. Was this approval meant to convey a permanent relocation in the configuration described by the application?

Eric Peterson described the new mine plan (this application) as avoiding the alluvial valley floor, which was previously described and planned to be mined in the 1980 application. In the application, Eric sought to show that the area did not meet the definition of AVF. He did not see stream channels formed of streamlaid deposits, nor water sufficient for flood irrigation. He stated that the area is excluded from an AVF based on the following three criteria:

1. lack of stream channel
2. no terraces
3. no stream laid deposit.

The Division countered that Google Earth shows a stream and flood plains and the USGS maps included in the application show unconsolidated deposits as Qa for alluvium and a perennial stream and an intermittent stream in the permit area, with agricultural activity east and south of the permit area.

Division suggested that the application reference maps to support the concept that the area is formed of colluvial outwash from shale sloughing off adjacent hillsides.

Division requested further sampling to define the characteristics of the soil and plants in the area east of the permit boundary. This is private land and sampling should not be destructive. For soils information, auger samples down to 4 ft. can provide depth to water table, mottling, gleying, and rooting depth.

Patrick indicated that the area was previously sampled by a 1987 survey. Since 20 years have passed the Division requests that the wetland meadow delineation survey is current for the purpose of evaluating AVF. Patrick will evaluate the wetlands east of the permit boundary.

Vegetation sampling in pasturelands would include crop & productivity. Patrick wondered about a reference area for pastureland.

Bob discussed the apparent inconsistency with weather data indicating a frigid soil climate and the NRCS Prime Farmland determination, which indicates that the soils are in a mesic climate. This impacts Bob's ability to place the soils series which have been mapped in the Panguitch area, but which are all frigid. Since Corey Meier has since left the NRCS, Bob will talk with Vic Parlow out of the Richfield NRCS office about changing the amending the Prime Farmland determination.

ACTION ITEMS: (Include item, timeline, and responsible person.)

Bob
Provide soil sampling for mining locations in years 2 and 3.

East of permit area, gather soils information, auger samples down to 4 ft. can provide depth to water table, mottling, gleying, and rooting depth.

Talk with Vic Parlow out of the Richfield NRCS office about changing the amending the Prime Farmland determination.

Chris
Obtain landowner permission to sample soils and vegetation east of the permit boundary.

Contact laboratory and have all overburden soil samples and cores re-analyzed for hot water soluble selenium.

All cores must be analyzed for radiation using a Geiger counter. If indicated by the intial readings, laboratory analysis of the cores will be conducted for Alpha, Beta and Gamma radiation levels.

Dave
With this new understanding of how the cores and overburden samples were obtained, Dave will evaluate the information discuss further sampling or coring requirements with Eric.

Eric
Will re-write the alluvial valley floor section to include all requirements of R645-302-321.200 *et seq.*

Will remove blanket statements from the hydrology sections, and make sure all maps and hydrologic calculations are properly certified.

Patrick
Evaluate the wetlands east of the permit boundary.

Complete sampling of vegetation required for mine facilities and spoil stockpile area.

Provide sampling for locations of mining in years 2 and 3.

ADDITIONAL COMMENTS: (This section is intended to provide attendees the opportunity to contribute additional and significant information concerning the meeting content that may not have been mentioned during the meeting.)

Introduction

This update replaces the Introduction provided in Volume 1

The introduction has been updated to reflect the latest steps in the review process. In addition, this update provides the expected operating hours at the Coal Hollow Project.

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 a portion of the Alton coal field. The proposed 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 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.

Proof of Publication

Replaces Contents of Appendix 1-5

Addresses 301-117 Proof of Publication:
Map added showing permit boundary, direction/distance to Alton, County Road #136, Dixie National Forest Boundary, Lower Robinson Creek and Sink Valley Wash; text added stating written comments, objections or requests for informal conferences on the application may be submitted to the DOGM.

The advertisement does not include the county road closure. The specifics for this closure are not currently known and a second advertisement will be provided prior to road closure.

Legal Notice

Public Notice for Permit Application

Notice is hereby given that Alton Coal Development, LLC is applying for a permit to conduct mining operations at the Coal Hollow Mine in Kane County, South Central Utah. The business address for Alton Coal Development is:

Alton Coal Development, LLC
463 North 100 West, Suite 1
Cedar City, UT 84720

Alton Coal Development has filed with the Utah Division of Oil, Gas & Mining a Mining and Reclamation Plan (MRP) application. Permit Number C/025/0005. This Application has been filed for the Coal Hollow Mine. The Coal Hollow Mine is located approximately 35 miles north of Kanab, Utah (the Kane County seat) and approximately 4 miles south of the town of Alton, Utah.

Project Area Legal Description

All certain real property situated in Township 39 South, Range 5 West, SLB&M, Kane County, Utah, more particularly described as follows:

DESCRIPTION: TOWNSHIP 39 SOUTH-RANGE 05 WEST, SLB&M
Section 30: All of Section Lot #1 (NW¼ NW ¼); 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.

DESCRIPTION: 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.

DESCRIPTION: 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.

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

....containing 160.0 acres, more or less

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

....containing 160.0 acres, more or less

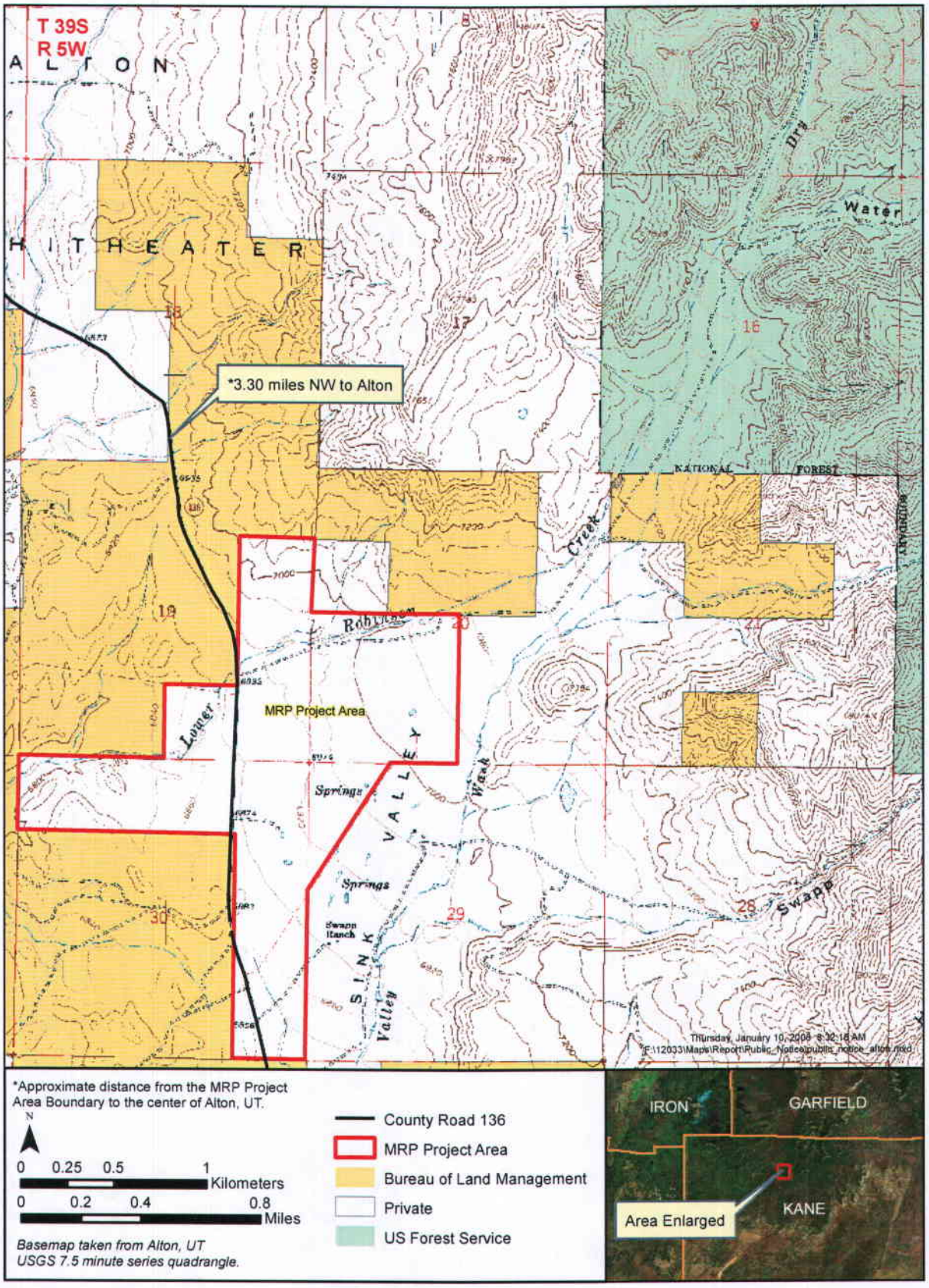
The permit application area is located on the Alton, Utah, U.S. Geological Survey 7.5 minute quadrangle map. The application was filed and this notice is prepared and published to comply with the Surface Mining Control and Reclamation Act of 1977 and State and Federal regulations promulgated pursuant to said act.

A copy of Alton Coal Development's permit application will be filed for public inspection at:

Kane County
70 North Main
Kanab, Utah 84741

The State of Utah
Department of Natural Resources
Division of Oil, Gas & Mining
1549 West Temple, Suite 1210
Salt Lake City, Utah 84114-5801

Written comments, objections or requests for informal conferences on the application may be submitted to the Division of Oil, Gas and Mining at the address provided above.


T 39S
R 5W
ALTON
HITHEATER
*3.30 miles NW to Alton
MRP Project Area
Lower
Springs
Springs
Swapp Ranch
SINK VALLEY
Valley
Wash
Creek
Robinson
Dry
Water
NATIONAL FOREST
Swapp
Thursday, January 10, 2008 8:32:18 AM
F:\12033\Maps\Report\Public_Notice\public_notice_alton.mxd
*Approximate distance from the MRP Project Area Boundary to the center of Alton, UT.
N
0 0.25 0.5 1 Kilometers
0 0.2 0.4 0.8 Miles
Basemap taken from Alton, UT
USGS 7.5 minute series quadrangle.
County Road 136
MRP Project Area
Bureau of Land Management
Private
US Forest Service
IRON
GARFIELD
KANE
Area Enlarged

Notarized Signature of Responsible Official

Replaces Contents of Appendix 1-6

The responsible company official has changed since the original application was submitted in June 2007. This replacement is to up date the responsible official signature.

VERIFICATION STATEMENT

STATE OF UTAH)
:ss
COUNTY OF IRON)

I, Chris R. McCourt, herby certify that I am the manager for the applicant, Alton Coal Development, L.L.C., and that the information contained in this application for the Coal Hollow Mining and Reclamation Plan is true and correct to the best of my knowledge and belief, in all respects, with the laws of Utah, specifically in reference to the applicant's commitments, undertaking and obligations herein.

Signed: Chris R. McCourt
Position: Manager

SUBSCRIBED and SWORN TO by CHRIS R. MCCOURT, the Manager of Alton Coal Development, L.L.C., before me this 22 day of January, 2008.

Notary Public: Catherine Stucki

My Commission Expires: 5/26/10

NOTARY PUBLIC
CATHERINE STUCKI
7181 S. CAMPUS VIEW DR
WEST JORDAN, UTAH 84084
COMMISSION EXPIRES
MAY 26, 2010
STATE OF UTAH

Updated list of Contributors

Replaces Pages 1-8 and 1-9

The outdated name for the Soil Conservation Service was updated to the Natural Resources Conservation Service. The contributor list is updated to reflect the current Mine and Reclamation Plan revisions.

The vegetation mapping data from 1987 has been replaced by updated information from 2007 and is no longer part of the Mine and Reclamation Plan. Therefore, the credentials of the author(s) for the 1987 report are not provided.

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)
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Taylor Geo-Engineering
Alan O. Taylor
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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

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.

R645-301-200 Soils, Chapter 2 Text Replacement

Replaces Text in Chapter 2

Chapter 2 text has been updated to reflect new information from the 2007 order 2 soils survey. The latest information from this survey is provided in the main text for Chapter 2.

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R645-301-200

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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)."

A copy of the NRCS Prime Farmland Determination is included in Section 1 of Appendix 2-1.

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. The survey area 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. This soil survey covers approximately 630 acres.

222.100. Soils Map

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

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

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 – Drifity 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	Drifity 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 Drifity 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 other wise 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.

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.

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). Respresentative 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.

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 by seeding it with an interim seed mix. 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. Drawing 2-2 shows planned topsoil stockpiles and topsoil removal plans.

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 become 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 soil sampling regime will be implemented prior to seeding that should identify fertility problems and will provide a basis for determining necessary soil fertilizers and amendments. The parameters analyzed will be:

Electrical conductivity (EC)
Sodium adsorption ratio SAR)
pH
Texture
Organic matter
Available phosphorus (P)
Potassium (K)
Nitrate (NO_3-N)

One composite sample will be collected from approximately every 1 to 4 acres based on soil types and variability.

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.

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.

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.

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.

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

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. All substitute subsoil materials will be sampled and tested for pH, conductivity, SAR, percent lime, and texture, prior to salvage and stockpiling.

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.

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 is 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.

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.

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.

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.

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.

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.

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. 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.

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 smoothed 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 soil compaction at the surface of the reclaimed areas, they will then be ripped, disked, and harrowed to loosen the seedbed prior to seeding. 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. Further details about seeding can be reviewed in Chapter 3.

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. Grass matting, mulching and/or cross ditches will be implemented as necessary to control erosion.

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 soil 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:

Electrical conductivity (EC)
Sodium adsorption ratio (SAR)
pH
Texture
Organic matter
Available phosphorus (P)
Soluble Potassium (K)
Nitrate-Nitrogen

One composite sample will be collected from approximately every 1 to 4 acres based on soil types and variability. Each composite will be comprised of at least 4 su-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.

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.

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 and seeding has been accomplished in areas that will be reclaimed to native plant communities (areas used for pasture lands will not be mulched). 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.

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.

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.

R645-301-200 Soils, Appendix 2-1 Replacement

Replaces Appendix 2-1

This update replaces Appendix 2-1. The order 2 soils survey has been updated to include the entire permit area and some adjacent property.

Order 2 Soil Survey

of

Coal Hollow Mine Disturbance Area

Located near Alton, Utah

Prepared for Alton Coal Development, LLC

By

Long Resource Consultants, Inc.

Morgan, Utah

January 15, 2008

Coal Hollow Mine
Soil Survey

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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 an area proposed for development of a surface coal mine, Coal Hollow Project, in Kane County, approximately 2.5 miles south southeast of Alton, Utah. The survey area is on private lands owned or leased by ACD. 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. This soil survey covers 630 acres.

Project Area

The Coal Hollow Project soil survey area is located in the Sink Valley portion of the Alton Amphitheater, figures 1-1 and 1-2. It is bounded on the northeast and east by the Paunsaugunt Plateau and by the Markagunt Plateau on the northwest. Black Mountain separates Sink Valley from Long Valley on the west. It is bounded on the south by the Skutumpah Terrace The project area includes portions of the southwest quarter of section 19, southeast quarter of section 20, west quarter of section 29, and east quarter of section 30 in Township 39 south, Range 5 west, Salt Lake Base meridian. Elevation ranges from approximately 6,840 to 7,100 feet.

The ACD soil survey area is drained by Lower Robinson Creek and Sink Valley Wash which flow into Kanab Creek (iGage, 1999).

Native vegetation in the ACD 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 grass pasture.

Climate

An official U.S. Weather Bureau station is located in Alton, Utah. The period of available records for this station is January 1, 1928 through October 31, 2006 (Western Regional Climate Center, April 2007). Average annual precipitation is 16.43 inches and is evenly distributed throughout the year. The average annual air temperature is 45.7 °F. The precipitation pattern is ustic and soil temperature regime is mesic (C. Meir, 2006 AND V. Parslow, 2007) bordering on frigid. Table 1-1 contains a summary of weather data for Alton, Utah. Summers are warm with cool nights.

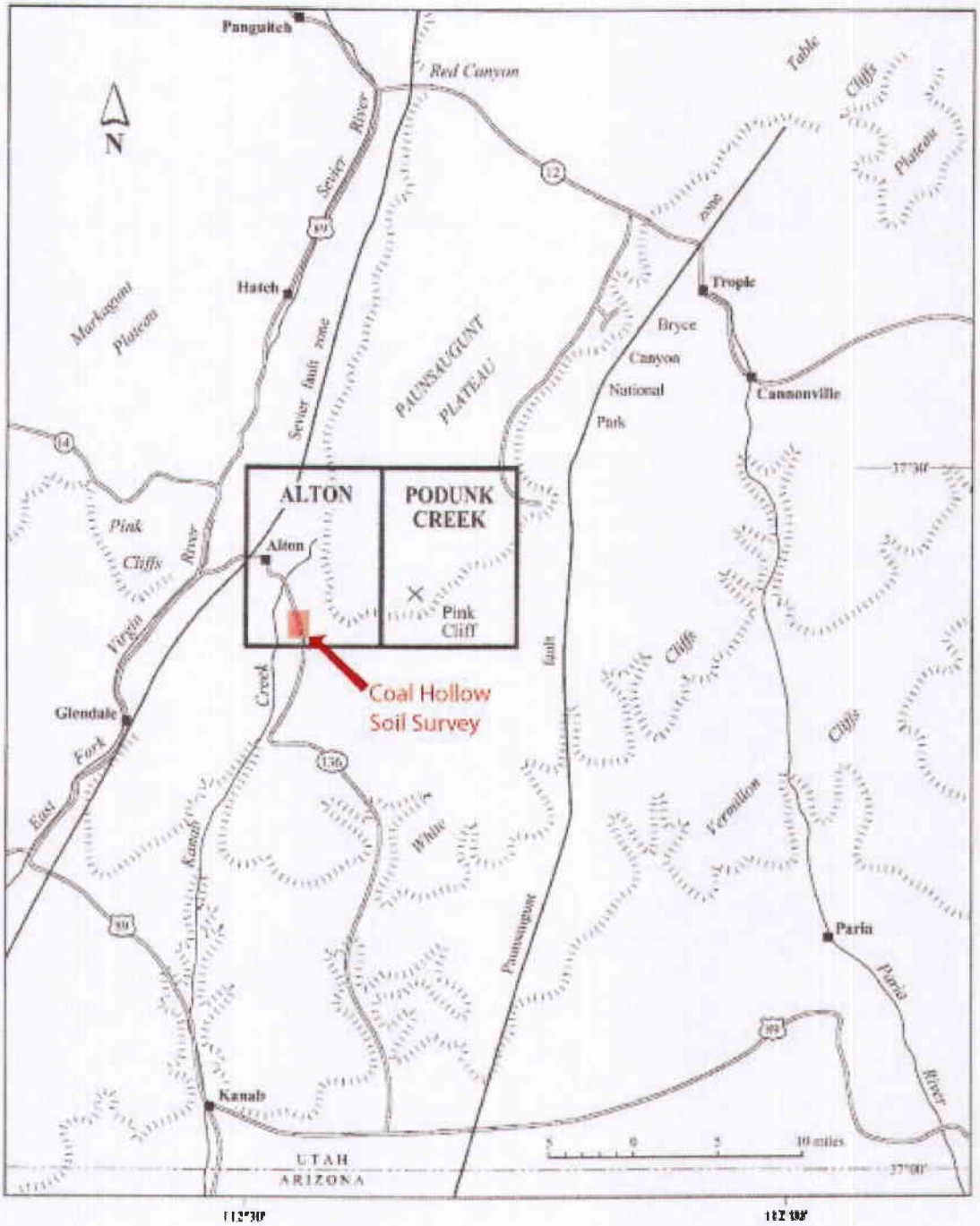

Figure 1. Index map of the Paunsaugunt Plateau region, showing the Alton and Podunk Creek quadrangles. The highest point (Pink Cliff) and only settlement in the study area (Alton) are indicated. The quadrangles were mapped together. The map is adapted from Gregory (1951, p. 3).

Figure 1-1. General location of Coal Hollow Soil Survey area. Location and shape are approximate. Base map is index map of Paunsaugunt Plateau region (Utah Geological Survey, 2001).

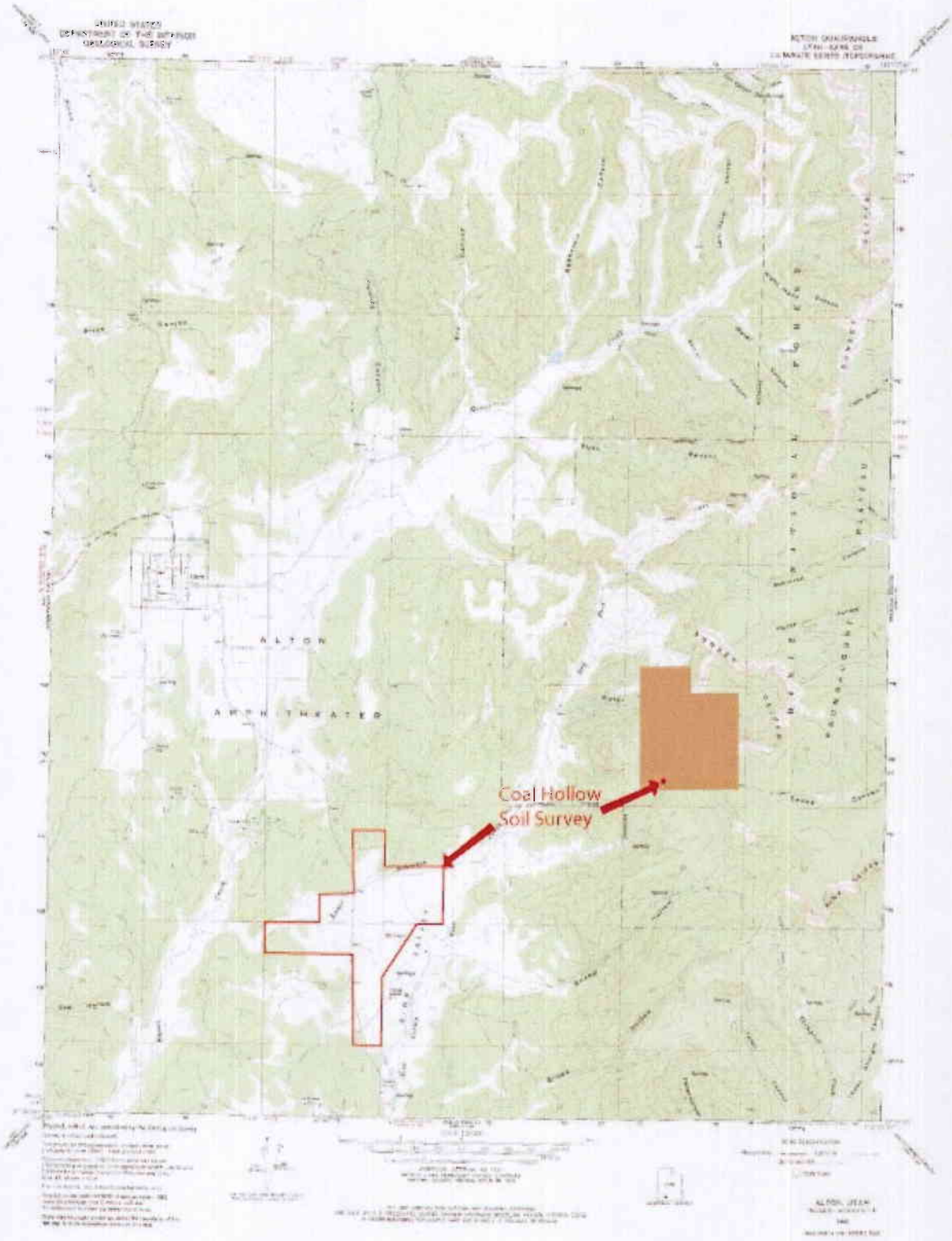

Figure 1-2. Location of Coal Hollow Soil Survey area south of Alton, Utah. Location is approximate. Base map is Alton, Utah quadrangle (iGage, 1999).

Table 1-1. 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	39.6	15.1	1.79	21.1	6
February	42.2	17.5	1.79	19.2	8
March	47.8	21.8	1.57	14.5	5
April	57.7	28.0	1.05	4.4	1
May	67.3	34.8	0.84	0.6	0
June	76.8	42.0	0.56	0.1	0
July	82.7	49.8	1.42	0.0	0
August	80.4	48.9	1.74	0.0	0
September	73.9	41.8	1.49	0.0	0
October	63.0	33.0	1.43	1.3	0
November	49.9	23.0	1.23	6.6	1
December	41.8	16.8	1.52	15.4	2
Annual	60.3	31.0	16.43	83.3	2

Source: Western Regional Climate Center, April 2007.

How the 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 1993). Soils were classified to the taxonomic family using the Keys to Soil Taxonomy, Ninth Edition (USDA 2003). The dominant soil sub-groups identified in the Coal Hollow soil survey area are Aridic Calciustepts, Aridic Calciustolls, Calcidic Haplustalfs, Aeric Epiaquepts, and Aridic Ustorthents. Tables of the taxonomic classification of the soil profiles are contained in appendix B.

Twenty three soil types were identified in the soil survey area. Seven soil types could be correlated to existing soil series (Soil Survey Staff, 2007). Ten soil types were correlated to existing soil series names at the family level. There were no established soil series names at the soil family level for the remaining six soil types, so they were assigned letters (e.g. A Soils Family) for simplified identification is the soils legend.

Field Evaluation of Soils

Soil pedon descriptions were completed for representative backhoe pits dug in September and November 2006 and in March, April, and September 2007. Pits in very deep soils were dug to a minimum 60 inches unless bedrock or wet soil conditions were limiting. But most soil pits were dug and described to 84 inches or deeper. Two soil pits in soils less than 20 inches deep were hand dug. Soil

pedon log sheets were completed for each soil pit using the methods detailed in the *Field Book for Describing and Sampling Soils*, version 2 (Schoeneberger et. al., 2002). Soil pits 1 through 42 were described by Bruce Chesler, soil scientist (B. Chesler, 2007). Soil pits 43 through 50 were described by Robert Long, Certified Professional Soil Scientist.

Aerial photographs (1:15,000 and 1:7,200) were used to delineate soil map unit boundaries based on slope gradient, geomorphic features, and vegetation. The aerial photography was taken in July 2006 by Olympus Aerial Surveys, Inc., Salt Lake City, Utah. A mirror stereoscope was used to view paired photo images.

Samples of soil horizons were collected in gallon size plastic bags and in micro-monolith boxes. The box samples were used for further determination of soil profile characteristics.

Analysis of Soil Samples

Soil samples (145) from 27 representative soil profiles that were collected during September 12-19, 2006 were shipped on September 25 and October 2, 2006 to Inter-mountain Laboratories in Sheridan, Wyoming for chemical and physical analysis. Each of the 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), Table 1-2.

Soil samples (32) collected during November 2006 and March 2007 from 8 representative soil profiles were shipped to Energy Labs in Casper, Wyoming for analysis of the topsoil suitability parameters listed in table 1-2 on March 29, 2007.

Five soil samples collected from two shallow soil pits were shipped to Energy Labs in Casper, Wyoming for analysis of the topsoil suitability parameters listed in table 1-2 on April 11, 2007.

Table 1-2. Soil analysis parameters for topsoil and overburden (Utah DOGM, 2005).

Topsoil Suitability Parameters	
Paste pH	Available Phosphorus
Saturation percent	Particle Size Analysis (% very fine sand, sand, silt, and clay)
Electrical Conductivity (ECe)	Organic Matter Percent
Soluble Na, K, Mg, and Ca	CaCo3 Percent
Sodium Adsorption Ratio	Extractable Potassium
Additional Analyses for Topsoil and Overburden	
Soluble Selenium	Soluble Boron
Alkalinity	

Laboratory data reports of the soil sample analyses are in Appendix B.

Geology and Setting

The Coal Hollow soil survey area is located in Sink Valley in the western part of the Alton Amphitheater southwest of the Paunsaugunt Plateau. Quaternary alluvium (Qa), Tropic shale (Kt), Dakota sandstone (Kd), and the Tibbet Canyon sandstone (Kst) member of the Straight Cliffs Formation are the primary sources of parent material in the soil survey area. Figure 1-3 illustrates geologic formations and features in the soil survey area (Utah Geological Survey, 2001). The Sink Valley fault runs north south through the Coal Hollow Soil Survey area (Utah Geological Survey, 2001).

Quaternary alluvium (Qa) consists of unconsolidated clay, silt, sand, and gravel deposits located in fan alluvium and terrace deposits of Holocene age (Utah Geological Survey, 2001). The primary sources of the Quaternary alluvium is the Tropic shale (Kt), Smoky Hollow sandstone member of the Straight Cliffs formation, John Henry sandstone member of the Straight Cliffs formation, and the Drip Tank sandstone member of the Straight Cliffs formation (Utah Geological Survey, 2001). Soils developed from Quaternary alluvium are situated on a large alluvial fan that flowed out of the Robinson Creek drainage and unnamed smaller drainages and across the Sink Valley fault.

Tropic shale (Kt) is a member of the Upper Cretataceous formation and is also referred to as Moncos shale (Hintze, 1977). It is a medium-brownish-gray to medium dark-gray, very thin-bedded, silty shale. Soils developed from Tropic shale are primarily east of the Sink Valley fault (Utah Geological Survey, 2001). Seeps on top of the Tropic shale have resulted in the development of aquic soils. Shallow soils have developed in Tropic shale along the Sink Valley fault escarpment.

Dakota sandstone (Kd) consists of interbeded yellowish-gray and brown sandstone, gray mudstone, black carbonaceous mudstone and coal, and some bentonite (Utah Geological Survey, 2001). Shallow and moderately deep soils have developed in Dakota sandstone at the east ends of the soil survey area where it is intermingled with Tropic shale.

Tibbet Canyon sandstone (Kst) consists of orangish-gray-weathering sandstone that intermingles with the underlying Tropic shale (Utah Geological Survey, 2001). Shallow and moderately deep soils have developed in Tibbet Canyon sandstone at the north end of the soil survey area.

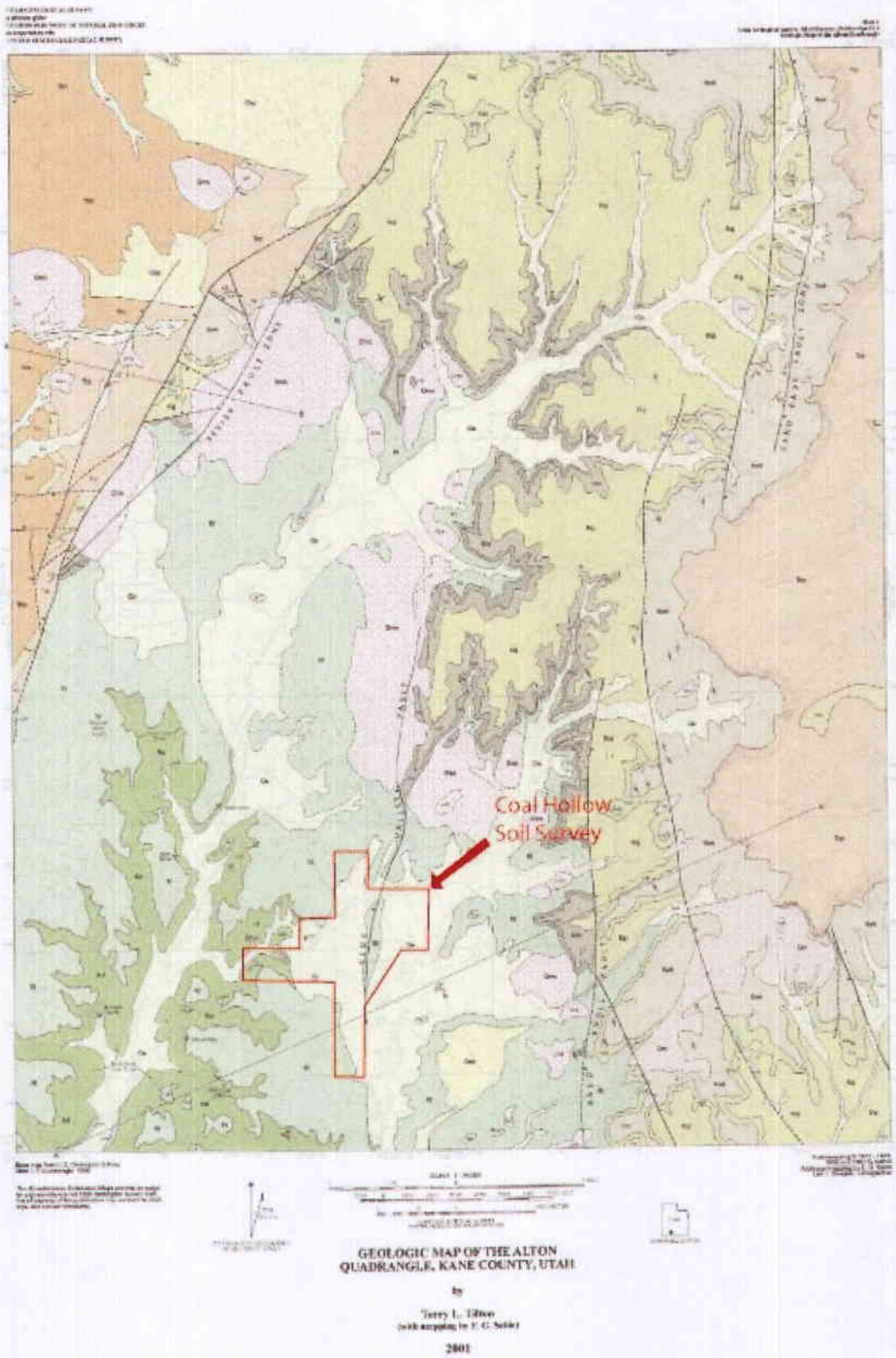

Figure 1-3. Alton quadrangle geological map showing location of Coal Hollow Soil Survey (Utah Geological Survey, 2001).

Prime Farmland

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)."

Soil Survey Legend

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 this section. The Coal Hollow soil survey map is Drawing 2-1.

Typifying soil profile descriptions for each soil type are in section 3 of this soil survey.

Soil profile description sheets are in appendix B.

Results of laboratory analysis of representative soil samples for each soil type are in appendix C.

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.

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

Map Unit	Percent	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	

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

Map Unit	Percent	Soil Type[1]	Taxonomic Classification[2]	Modal Pedon[3]
5		**Calendar Family - M Family – Drifity 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	Drifity 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	

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

Map Unit	Percent	Soil Type[1]	Taxonomic Classification[2]	Modal Pedon[3]
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	Drifity Family	loamy, mixed, superactive, calcareous, mesic Aridic Lithic Ustorthent	
	5	Calendar Family	fine, mixed, superactive, mesic Aridic Haplustepts	
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

1 Soil families were given letter designations, because it was not possible to correlate the soils to established soil series since no NRCS published or SSURGO certified soil survey data exists in or adjacent to the Coal Hollow project area. Assignment of soil type letters enables comparison of map units and simplifies map unit names.

2 Soil families classified using Keys to Soil Taxonomy, Tenth Edition (NRCS 2006).

3 Soil pedon described within map unit boundaries that represents the characteristics of the soil family within the soil map unit.

Map Unit 1, continued from page 2-1

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 – Drifity 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	Drifity 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.

Drififty 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 other wise 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.

Typifying Soil Profile Descriptions

The following soil profile descriptions are representative of the major named soils identified in the eleven soil map units for the Coal Hollow project area. Soil texture and pH are the results of laboratory analysis of samples collected from each horizon. Photographs of the soil profiles are in appendix E and photographs of the soil profile micromonolith boxes are in appendix F.

Soils were correlated to established soils series when possible (NRCS 2007). Soils that are within the range of characteristics of and established series are listed as soils (e.g. Graystone soils). The soils that are not completely within the range of characteristics for a similar established series within the same taxonomic family are listed as family soils (e.g. Calendar family soils). The state of origin for each soil series is listed in parenthesis. When no established series were listed for a soil family, then a single capital letter was used in place of a series name (e.g. A Family Soils).

Typifying pedon descriptions are provided for major soil types.

A Family Soils

The A family soil occurs as major named component in map units 1 and 11. It also occurs as a minor component in map units 3, 4, and 9. This soil is very deep (greater than 60 inches). There are no established soil series in this soil family (NRCS 2007).

Taxonomic classification: fine, mixed, superactive, mesic Aridic Calciustepts

Soil pit 1 is representative of the A family soils that occur within the Coal Hollow project area. It is located in map unit 1. It formed in alluvium deposited by a large alluvial fan over Tropic shale residuum. Slope is 3 percent on a west slope (280°) on a concave fanslope. Vegetation is big sagebrush, grasses and forbs. Soil colors are for dry soil unless specified otherwise. Soil pH values are laboratory pH.

A – 0 to 6 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; weak medium platy parting to fine granular structure; soft, very friable, slightly sticky, and slightly plastic; many very fine, common fine and medium, and few coarse roots; common very fine interstitial and few fine tubular pores; strong effervescence, neutral (pH 7.3); clear smooth boundary.

Bk1 – 6 to 12 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/3) moist; moderate medium and coarse angular blocky structure; hard, very firm, very sticky, and very plastic; common very fine, few fine, medium, and coarse roots; few very fine tubular pores; strong effervescence, moderately alkaline (pH 8.3); gradual wavy boundary.

Bk2 – 12 to 24 inches; light brownish gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/3) moist; strong medium and coarse prismatic structure; very hard, very firm, very sticky, and very plastic; few very fine and fine roots; few very fine tubular pores; strong effervescence, strongly alkaline (pH 8.5); gradual smooth boundary.

Bk3 – 24 to 42 inches; light brownish gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/3) moist; strong medium and coarse prismatic parting to strong angular blocky structure; extremely hard, extremely firm, very sticky, and very plastic; few very fine roots; few very fine tubular pores; strong effervescence, strongly alkaline (pH 8.7); clear wavy boundary.

C – 42 to 60 inches; light gray (2.5Y 7/2) clay, grayish brown (2.5Y 5/2) moist; massive; extremely hard, extremely firm, very sticky, and very plastic; strong effervescence, moderately alkaline (pH 8.4); clear wavy boundary.

Alamosa Soils

The Alamosa soil occurs as a major named component in map units 7 and 11. This soil is very deep (greater than 60 inches). Alamosa soils mapped in the Coal Hollow Project Area are within the range of characteristics listed in the official description (Colorado) of the Alamosa series (NRCS 2007).

Taxonomic classification: fine-loamy, mixed, superactive, frigid Typic Argiaquolls

Soil pit 18A is representative of the Almosa soils that occur within the Coal Hollow project area. It is located in map unit 7 in a wet meadow east of the Sink Valley fault escarpment. It formed in formed in alluvium from Tropic shale deposited by a large alluvial fan. Slope is 4 percent on a west southwest slope (250°). Water table was at 51 inches on September 14, 2006. Vegetation is sedges, grasses, and iris. Soil colors are for dry soil unless specified otherwise. Soil pH values are laboratory pH.

A – 0 to 7 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky parting to medium granular structure; soft, friable, slightly sticky, and slightly plastic; many very fine, fine and medium roots; many very fine interstitial pores; slight effervescence, slightly alkaline (pH 7.7); abrupt smooth boundary

Bw – 7 to 15 inches; pale brown (10YR 6/3) clay loam, brown (10YR 4/3) moist; common faint mottles; moderate fine and medium subangular blocky structure; soft, friable, slightly sticky, and slightly plastic; few very fine and common fine and medium roots; few fine and common medium interstitial pores; moderate effervescence, moderately alkaline (pH 8.0); abrupt smooth boundary.

Bk – 15 to 30 inches; pale yellow (2.5Y 7/3) sandy loam, grayish brown (2.5Y 5/3) moist; common faint mottles; moderate fine and medium subangular structure; slightly hard, friable, slightly sticky, and non-plastic; common medium and few very fine and fine roots; few very fine tubular pores; 30 percent angular sandstone gravels; strong effervescence, moderately alkaline (pH 8.1); abrupt smooth boundary.

2Btk – 30 to 45 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; many prominent mottles; moderate fine subangular structure; slightly hard, firm, slightly sticky, and slightly plastic; common medium and few very fine and fine roots; few very fine tubular pores; 35 percent clay films on ped faces; strong effervescence, moderately alkaline (pH 8.0); abrupt smooth boundary.

2Cg – 45 to 60 inches; light olive brown (5Y 6/2) sandy clay loam, olive gray (5Y 5/2) moist; massive; few fine and medium roots; few fine tubular pores; violent effervescence, moderately alkaline (pH 8.0).

Brumley Soils

The Brumley soils occur as a major named component in map unit 8. It also occurs as a minor component in map unit 7. This soil is very deep (greater than 60 inches). Brumley soils mapped in the Coal Hollow Project Area are within the range of characteristics contained in the official description of the Brumley series (Colorado). The official Brumley description does not contain an Oe or Oi horizon of oak leaves and decomposing litter (NRCS 2007).

Taxonomic classification: fine-loamy, mixed, superactive, mesic Calcidic Haplustalfs

Soil pit 22 is representative of the Brumley soils that occur within the Coal Hollow project area. It is located in map unit 8 on a convex hillslope. It formed in alluvium from Tropic shale deposited by a large alluvial fan. Slope is 8 percent on a southwest slope (220°). Vegetation is Gamble oak, snowberry, and grasses. Soil colors are for dry soil unless specified otherwise. Soil pH values are laboratory pH. The field description for pit 22 describes some soil mottles, but the box sample does not show any signs of redox mottles; and two supporting soil pits (47 and 51) do not contain any mottles.

Oe – 7 to 4 inches; oak leaves, duff and twigs.

Oi – 4 to 0 inches; partially decomposing oak leaf litter.

A – 0 to 6 inches; pale brown (10YR 6/3) sandy loam, yellowish brown (10YR 5/4) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, non sticky, and non plastic; common very fine, fine and

medium roots; few very fine and few fine interstitial pores; slight effervescence, slightly alkaline (pH 7.7); abrupt smooth boundary.

Btk1 – 6 to 15 inches; light yellowish brown (10YR 6/4) silty clay loam, brown (10YR 4/3) moist; moderate medium and coarse subangular blocky structure; hard, firm, sticky, and plastic; few very thin clay films on ped faces; common fine and medium and few very fine and coarse roots; few very fine and fine tubular pores; slight effervescence, slightly alkaline (pH 7.7); clear smooth boundary.

Btk2 – 15 to 28 inches; light yellowish brown (10YR 6/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; moderate fine and medium subangular blocky structure; hard, firm, slightly sticky, and slightly plastic; common thin clay films on ped faces; few fine, medium and coarse roots; few very fine tubular pores; slight effervescence, moderately alkaline (pH 8.0); clear smooth boundary.

Bk1 – 28 to 48 inches; very pale brown (10YR 7/4) sandy loam, yellowish brown (10YR 5/4) moist; few prominent mottles; strong medium and coarse subangular blocky structure; hard, firm, non sticky, and non plastic; few fine, medium and coarse roots; few very fine and fine tubular pores; slight effervescence, moderately alkaline (pH 8.0); clear wavy boundary.

Bk2 – 48 to 60 inches; pale brown (10YR 6/3) sandy loam, yellowish brown (10YR 5/4) moist; common prominent mottles; massive; slightly hard, friable, non sticky, and non plastic; few fine, medium and coarse roots; common very fine tubular pores; slight effervescence, moderately alkaline (pH 8.0); clear wavy boundary.

C – 60 to 84 inches; very pale brown (10YR 7/3) sandy loam, yellowish brown (10YR 5/4) moist; many prominent mottles; massive; slightly hard, friable, non sticky, and non plastic; few very fine, fine, medium and coarse roots; many very fine interstitial pores; slight effervescence, moderately alkaline (pH 8.2).

Calendar Family Soils

The Calendar soil family occurs as a major named component in map units 2 and 5. It also occurs as a minor component in map units 3, 10, and 11. This soil is moderately deep (20 to 40 inches) to Tropic shale. The official description for the Calendar series (New Mexico) has 10YR colors in the A horizon and has a Bk horizon above the shale (NRCS 2007).

Taxonomic classification: fine, mixed, superactive, mesic Aridic Haplustepts

Soil pit 24 is representative of the Calendar soil family that occurs within the Coal Hollow project area. It is located in map unit 5. It formed in Tropic shale residuum on a convex hillslope. Slope is 13 percent on a north northeast slope (20°). Vegetation is pinyon pine and Utah juniper with scattered big sagebrush and grasses. Soil colors are for dry soil unless specified otherwise. Soil pH values are laboratory pH.

A – 0 to 5 inches; dark grayish brown (2.5Y 4/3) clay, dark grayish brown (2.5Y 4/2) moist; weak fine subangular blocky parting to medium granular structure; soft, very friable, sticky, and very plastic; common very fine, few fine, medium, and coarse roots; common very fine and few fine interstitial pores; no effervescence, slightly alkaline (pH 7.6); clear wavy boundary.

Bw1 – 5 to 17 inches; dark grayish brown (2.5Y 4/2) clay, dark grayish brown (2.5Y 4/3) moist; moderate fine and medium subangular blocky structure; extremely hard, extremely firm, very sticky, and very plastic; few very fine and fine roots; few very fine tubular pores; no effervescence, slightly alkaline (pH 7.7); clear wavy boundary.

Bw2 – 17 to 32 inches; light olive gray (5Y 6/2) clay, olive (5Y 5/3) moist; strong medium and coarse angular blocky structure; extremely hard, extremely firm, very sticky, and very plastic; few very fine roots; few very fine tubular pores; no effervescence, slightly alkaline (pH 8.1); abrupt wavy boundary.

Cr – 32 inches; decomposing Tropic shale and sandstone.

Cibeque Family Soils

The Cibeque soil family occurs as a major named component in map unit 3. This soil is very deep (greater than 60 inches). The official description for Cibeque series (Arizona) has a warmer annual temperature (about 53° F) and longer frost free period (120 to 170 days) than the Alton, Utah area (NRCS 2007).

Taxonomic classification: fine-loamy, mixed, superactive, mesic Aridic Calciustepts

Soil pit 6 is representative of the Cibeque soil family that occurs within the Coal Hollow project area. It is located in map unit 3 It formed in alluvium over Tropic shale. Slope is 3 percent on a west northwest slope (290°). Vegetation is big sagebrush, rabbitbrush and grasses. Soil colors are for dry soil unless specified otherwise. Soil pH values are laboratory pH.

A1 – 0 to 6 inches; brown (10YR 5/3) loamy sand, dark yellowish brown (10YR 3/4) moist; weak medium granular structure; loose, loose, non sticky, and non plastic; common very fine, few fine, common medium and few coarse roots; many very fine interstitial pores; strong effervescence, moderately alkaline (pH 8.1); clear wavy boundary.

A2 – 6 to 12 inches; yellowish brown (10YR 5/4) loamy sand, dark grayish brown (10YR 4/2) moist; weak medium subangular structure; soft, very friable, non sticky, and non plastic; common very fine and fine and few medium roots; many very fine interstitial pores; strong effervescence, moderately alkaline (pH 8.3); clear smooth boundary.

Bk1 – 12 to 24 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; moderate fine and medium subangular structure; slightly hard, firm, slightly sticky, and non plastic; common very fine and few fine roots; common very fine interstitial and few fine tubular pores; strong effervescence, moderately alkaline (pH 8.0); abrupt smooth boundary.

Bk2 – 24 to 34 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 4/3) moist; strong medium and coarse subangular structure; hard, very firm, non sticky, and non plastic; few very fine roots; common very fine interstitial and few fine tubular pores; strong effervescence, moderately alkaline (pH 8.3); gradual smooth boundary.

2C – 34 to 60 inches; light brownish gray (10YR 6/2) silty clay, brown (10YR 4/3) moist; massive; extremely hard, extremely firm, very sticky, and very plastic; few very fine roots; few very fine tubular pores; slight effervescence, moderately alkaline (pH 8.3).

Cookcan Soils

The Cookcan soil occurs as a major named component in map unit 6. This soil is greater than 40 inches deep. The official description for Cookcan series does not contain a cambic (Bwg) horizon (Idaho), but is otherwise similar to the soil mapped in the Coal Hollow Project Area (NRCS 2007).

Taxonomic classification: coarse-loamy, mixed, superactive, frigid Typic Calciaquolls

Soil pit 9B is representative of the Cookcan soils that occur within the Coal Hollow project area. It is located in map unit 6 in a small alluvial basin. It formed in alluvium from Tropic shale and mixed sediments. Slope is 1 percent on a south slope (190°). Vegetation is grasses, big sagebrush, and rabbitbrush. Water table was at 57 inches when pit was described on September 12, 2006. Soil colors are for dry soil unless specified otherwise. Soil pH values are laboratory pH. No laboratory analysis was completed on the 2C horizon.

A1 – 0 to 6 inches; dark grayish brown (2.5Y 4/2) loam, very dark gray (2.5Y 3/0) moist; weak medium granular structure; soft, friable, slightly sticky, and slightly plastic; many coarse, common very fine, fine, and few medium roots; many very fine tubular pores; slight effervescence, moderately alkaline (pH 8.0); clear smooth boundary.

Bwg – 6 to 14 inches; grayish brown (2.5Y 5/2) sandy clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium and coarse granular structure; slightly hard, firm, slightly sticky, and slightly plastic; many medium, common very fine and fine roots; common very fine tubular pores; slight effervescence, moderately alkaline (pH 8.2); abrupt smooth boundary.

Bkg – 14 to 28 inches; light grayish brown (2.5Y 6/2) sandy loam, dark gray (2.5Y 4/0) moist; moderate fine and medium subangular blocky structure; hard, firm, slightly sticky, and slightly plastic; common very fine, fine, and medium roots; common very fine tubular pores; strong effervescence, strongly alkaline (pH 8.5); abrupt smooth boundary.

Bk – 28 to 48 inches; light gray (2.5Y 7/2) sandy loam, light olive brown (2.5Y 5/4) moist; soil to wet to identify structure structure; hard, firm, slightly sticky, and slightly plastic; few fine, and medium roots; few very fine tubular pores; strong effervescence, moderately alkaline (pH 8.3); abrupt smooth boundary.

C – 48 to 57 inches; water table at 57 inches, few very fine roots, no effervescence.

D Family Soils

The D family soil occurs as a major named component in map units 2 and 9. It also occurs as a minor component in map units 1 and 4. This soil is very deep (greater than 60 inches). There are no established soil series in this soil family (NRCS 2007).

Taxonomic classification: fine, mixed, superactive, mesic Aridic Calciustolls

Soil pit 2 is representative of the D family soils that occur within the year one portion of the Coal Hollow project area. It is located in map unit 2. It formed in colluvial landslide deposit over Tropic shale. Slope is 6 percent on a south southwest slope (200°). Vegetation is big sagebrush, rabbitbrush and grasses. Soil colors are for dry soil unless specified otherwise. Soil pH values are laboratory pH.

A1 – 0 to 7 inches; brown (10YR 5/3) clay loam, dark yellowish brown (10YR 3/2) moist; moderate medium and coarse platy parting to fine granular structure; soft, very friable, sticky, and plastic; many very fine, common fine and medium, and few coarse roots; common very fine interstitial and common fine tubular pores; strong effervescence, slightly alkaline (pH 7.6); clear smooth boundary.

A2 – 7 to 12 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate fine and medium angular blocky structure; very hard, very firm, very sticky, and very plastic; common very fine, fine and medium, and few coarse roots; common very fine interstitial and few fine tubular pores; strong effervescence, slightly alkaline (pH 7.7); clear wavy boundary.

Bwk1 – 12 to 24 inches; light brownish gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/3) moist; strong medium and coarse prismatic parting fine and medium angular blocky structure; extremely hard, extremely firm, very sticky, and very plastic; few very fine and fine roots; few very fine tubular pores; strong effervescence, slightly alkaline (pH 7.8); gradual wavy boundary.

Bwk2 – 24 to 48 inches; light brownish gray (2.5Y 6/3) clay, dark grayish brown (2.5Y 4/3) moist; strong medium and coarse angular blocky structure; extremely hard, extremely firm, very sticky, and very plastic; few very fine roots; few very fine tubular pores; strong effervescence, slightly alkaline (pH 8.0); gradual irregular boundary.

Bk – 48 to 72 inches; light gray (2.5Y 7/2) silty clay, grayish brown (2.5Y 5/3) moist; massive; extremely hard, extremely firm, very sticky, and very plastic; few very fine tubular pores; moderate effervescence, slightly alkaline (pH 7.8); gradual wavy boundary.

C – 72 to 96 inches; light gray (2.5Y 7/3) clay, grayish brown (2.5Y 5/3) moist; massive; extremely hard, extremely firm, very sticky, and very plastic; moderate effervescence, slightly alkaline (pH 7.8).

Deacon Soils

The Deacon soils occur as a major named component in map unit 9. This soil is deep (greater than 40 inches) to very deep. Soils mapped in the Coal Hollow Project Area have have characteristics that are within the range of characteristics described in the official description (New Mexico) for the Deacon series (NRCS 2007).

Taxonomic classification: fine-loamy, mixed, superactive, mesic Aridic Haplustolls

Soil pit 42 is representative of the Deacon soils that occur within the year one portion of the Coal Hollow project area. It is located in map unit 9 adjacent to Robinson Creek. It formed in alluvium derived from Tropic shale and deposited by a large alluvial fan. Slope is 7 percent. Vegetation is Utah juniper, sagebrush, rabbitbrush, and grasses. Soil colors are for dry soil unless specified otherwise. Soil pH values are laboratory pH. Soils were not described below 48 inches in this pit.

A — 0 to 9 inches; brown (10YR 5/3) cobbly loam, very dark grayish brown (10YR 3.2) moist; moderate fine granular structure; soft, very friable, non-sticky, and non-plastic; common very fine and fine and few medium roots; 10 percent gravels and 5 percent cobbles; moderate effervescence, moderately alkaline (pH 7.9); clear smooth boundary.

Bw — 9 to 24 inches; pale brown (10YR6/3) cobbly silty clay, dark brown (10YR 4/3) moist; strong medium and coarse subangular blocky structure; slightly hard, firm, sticky, and plastic; few very fine, fine, and medium roots; 10 percent gravels and 5 percent cobbles; strong effervescence, moderately alkaline (pH 8.1); gradual wavy boundary.

Bwk – 24 to 36 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; strong medium and coarse subangular blocky structure; slightly hard, firm, slightly sticky, and slightly plastic; few fine and medium roots; 5 percent gravels and 3 percent cobbles; strong effervescence, moderately alkaline (pH 8.3); clear wavy boundary.

Bk – 36 to 48 inches; light yellowish brown (10YR 6/4) sandy loam, yellowish brown (10YR 5/4) moist; massive; hard, firm, slightly sticky, and non-plastic; few very fine and fine roots; trace of gravels and cobbles; strong effervescence, strongly alkaline (pH 8.6).

Drififtу Family Soils

The Drififtу family soil occurs as a major named component in map unit 5. It also occurs as a minor component in map unit 10. This soil is shallow (less than 20 inches) to sandstone and shale. The official series description for Drififtу series (Utah) has a clay content in the particle-size control section that is coarser (10 to 18 percent clay) than in the soils found in the Coal Hollow Project Area (18 to 30 percent clay). The average annual precipitation is also slightly lower 12 to 14 inches) than in the Alton, Area (NRCS 2007).

Taxonomic classification: loamy, mixed, superactive, calcareous, mesic Aridic Lithic Ustorthents

Soil pit 49 is representative of the Drififtу family soils that occur within the Coal Hollow project area. It is located in map unit 5 in the northern portion of the Coal Hollow project area. It formed in interbeded sandstone and shale. Slope is 16 percent on a south slope (180°). Vegetation is pinyon pine, Utah juniper, black sagebrush, and Indian ricegrass. Soil colors are for dry soil unless specified otherwise. Soil pH values are laboratory pH.

A – 0 to 3 inches; light yellowish brown (2.5Y 6/4) gravelly silty clay loam, light olive brown (2.5Y 5/4) moist; weak fine and medium subangular parting to moderate fine granular structure; slightly hard, very friable, slightly sticky,

and slightly plastic; common very fine and few fine, medium and coarse roots; common very fine interstitial and tubular pores; 30 percent angular sandstone gravels; strong effervescence, moderately alkaline (pH 8.1); clear smooth boundary.

C – 3 to 10 inches; light olive brown (2.5Y 5/4) gravelly loam, olive brown (2.5Y 45/4) moist; massive; slightly hard, very friable, slightly sticky, and slightly plastic; common very fine and few fine, medium and coarse roots; few very fine tubular pores; 25 percent angular sandstone gravels; strong effervescence, moderately alkaline (pH 8.4); clear smooth boundary.

R – 10 inches; sandstone interbeded with shale.

Graystone Soils

The Graystone soils occur as a major named component in map unit 6. This soil is very deep (greater than 60 inches). The official description for Graystone series (Wyoming) does not contain a cambic (Bwk) horizon or an organic (Oe) horizon, but is otherwise similar to the soil mapped in the Coal Hollow Project Area (NRCS 2007).

Taxonomic classification: coarse-loamy, mixed, superactive, mesic Aridic Calciustolls

Soil pit 15 is representative of the Graystone soils that occur within the Coal Hollow project area. It is located in map unit 6 in a small alluvial basin. It formed in alluvium from Tropic shale and mixed sediments. Slope is 2 percent on a west slope (260°). Vegetation is grasses, sedges, and black sagebrush. Soil colors are for dry soil unless specified otherwise. Soil pH values are laboratory pH.

Oe – 1-0 inches; dense root mat; abrupt smooth boundary.

A – 0 to 8 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; moderate medium and coarse granular structure; soft, friable, slightly sticky, and non plastic; many very fine, fine, and medium and common coarse roots; common very fine interstitial pores; slight effervescence, moderately alkaline (pH 8.0); abrupt smooth boundary.

Bwk – 8 to 20 inches; pale brown (10YR 6/3) loam, dark yellowish brown (10YR 4/4) moist; moderate fine and medium subangular blocky structure; hard, firm, sticky, and plastic; common very fine and fine, and few medium roots; many very fine and few medium and coarse tubular pores; strong effervescence, strongly alkaline (pH 8.5); abrupt wavy boundary.

Bk1 – 20 to 37 inches; very pale brown (10YR 7/3) loam, brown (10YR 5/3) moist; strong medium and coarse subangular blocky structure; very hard, very firm, sticky, and plastic; common very fine and few fine and medium

roots; few very fine and fine tubular pores; strong effervescence, 4 percent very fine soft calcium carbonate masses, strongly alkaline (pH 8.7); abrupt smooth boundary.

Bk2 – 37 to 58 inches; very pale brown (10YR 7/3) loam, yellowish brown (10YR 5/4) moist; moderate medium and coarse subangular blocky structure; slightly hard, firm, sticky, and plastic; few very fine and fine roots; few very fine tubular pores; strong effervescence, 8 percent very fine and fine soft calcium carbonate masses, strongly alkaline (pH 8.6); abrupt wavy boundary.

C1 – 58 to 73 inches; pale brown (10YR 6/4) sandy loam, yellowish brown (10YR 5/4) moist; common prominent yellowish brown mottles (10YR 5/8, moist); massive; soft, very friable, non sticky, and non plastic; few very fine and fine roots; violent effervescence, moderately alkaline (pH 8.4); abrupt smooth boundary.

C2 – 73 to 96 inches; very pale brown (10YR 7/3) sandy loam, yellowish brown (10YR 5/4) moist; common prominent yellowish brown mottles (10YR 5/8, moist); massive; soft, very friable, non sticky, and non plastic; few very fine and fine roots; violent effervescence, moderately alkaline (pH 8.3).

Graystone Cobbly Substratum Family Soils

The Graystone cobbly substratum soil family occurs as a major named component in map units 4 and 8. This soil is very deep (greater than 60 inches) and is cobbly to very cobbly below 24 inches. The official description for Graystone series (Wyoming) does not contain coarse fragments in the substratum (NRCS 2007).

Taxonomic classification: coarse-loamy, mixed, superactive, mesic Aridic Calciustolls

Soil pit 39 is representative of the Graystone cobbly substratum family soils that occur within the Coal Hollow project area. It is located in map unit 4 on a fan terrace slope. It formed in alluvium from Tropic shale deposited by a large alluvial fan. Slope is 3 to 8 percent on a west slope. The area has been cultivated and planted to upland grasses. Soil colors are for dry soil unless specified otherwise. Soil pH values are laboratory pH. No laboratory analysis was completed on 2C horizon.

Ap – 0 to 6 inches; brown (10YR 5/3) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium granular structure; soft, friable, slightly sticky, and slightly plastic; common very fine and fine and few medium roots; no effervescence, slightly alkaline (pH 7.8); clear wavy boundary.

A2 – 6 to 12 inches; yellowish brown (10YR 5/4) clay loam, dark brown (10YR 3/3) moist; moderate fine subangular blocky parting to medium granular structure; soft, friable, slightly sticky, and slightly plastic; few very fine, common fine and few medium roots; very slight effervescence, slightly alkaline (pH 7.8); clear smooth boundary.

Bk1 – 12 to 24 inches; light yellowish brown (10YR 6/4) sandy loam, yellowish brown (10YR 5/4) moist; strong medium and coarse angular blocky structure; very hard, very firm, non sticky, and non plastic; few very fine roots; strong effervescence, 8 percent soft fine calcium carbonate masses, moderately alkaline (pH 8.0); gradual wavy boundary.

Bk2 – 24 to 36 inches; very pale brown (10YR 7/3) cobbly sandy loam, yellowish brown (10YR 5/4) moist; strong medium and coarse angular blocky structure; very hard, very firm, non sticky, and non plastic; 10 percent gravel and 5 percent cobble; few very fine roots; strong effervescence, 10 percent soft fine calcium carbonate masses, moderately alkaline (pH 7.9); gradual wavy boundary.

2C – 36 to 75 inches; very pale brown (10YR 7/3) very cobbly loamy sandy, brown (10YR 5/3) moist; strong medium and coarse angular blocky structure; very hard, very firm, non sticky, and non plastic; 15 percent gravel and 30 percent cobble; few very fine roots; strong effervescence, 15 percent soft fine calcium carbonate masses, 1 mm thick calcium carbonate concretions on bottom of rock fragments, moderately alkaline (pH 7.9); gradual wavy boundary.

Happyhollow Family Soils

The Happyhollow soil occurs as a major named component in map units 7. This soil is deep to very deep (40 inches to greater than 60 inches). Precipitation range in the official description of the Happyhollow series (Wisconsin) is much higher (28 to 33 inches) than in the Alton, Utah area. No other soil series are listed within this soil family (NRCS 2007).

Taxonomic classification: fine, mixed, superactive frigid Aeric Epiaquepts

Soil pit 38 is representative of the Happyhollow family soils that occur within the Coal Hollow project area. It is located in map unit 7 in a wet meadow east of the Sink Valley fault escarpment. It formed in formed in alluvium from Tropic shale deposited by a large alluvial fan. Slope is 2 percent on a south slope (190°). Water table was at 29 inches on March 7, 2007. Vegetation is sedges, grasses, sagebrush and wild rose. Soil colors are for dry soil unless specified otherwise. Soil pH values are laboratory pH. Soil profile was too wet to sample or describe below 40 inches.

A – 0 to 6 inches; light brownish gray (10YR 6/2) silty clay, very dark grayish brown (10YR 4/2) moist; strong fine and medium subangular blocky structure; slighty hard, friable, sticky, and plastic; many very fine, fine and common medium roots; slight effervescence, moderately alkaline (pH 8.0); clear smooth boundary.

AB – 6 to 12 inches; very pale brown (10YR 7/3) silty clay, yellowish brown (10YR 5/4) moist; strong fine and medium prismatic structure; hard, firm, sticky, and plastic; many very fine, fine and common medium roots; strong effervescence, 3 percent fine soft calcium carbonate masses, moderately alkaline (pH 8.3); abrupt smooth boundary.

Bk – 12 to 20 inches; light gray (10YR 7/2) silty clay, light yellowish brown (10YR 6/4) moist; 35 percent gleyed; massive; hard, firm, sticky, and plastic; violent effervescence, 25 percent fine and medium soft calcium carbonate masses, strongly alkaline (pH 8.5); abrupt smooth boundary.

Bk2 – 20 to 40 inches; white (10YR 8/1) silty clay, light gray (10YR 7/2) moist; gleyed colors; massive; hard, firm, sticky, and plastic; violent effervescence, 40 percent medium soft calcium carbonate masses, strongly alkaline (field pH 8.7).

I Family Soils

The I family soil is a minor component in map unit 6. This soil is very deep (greater than 60 inches). There are no established soil series in this soil family (NRCS 2007).

Taxonomic classification: fine-loamy, mixed superactive, frigid Aquic Calciustepts

Jicarilla Family Soils

The Jicarilla family soil (New Mexico) is a minor component in map unit 7. This soil is very deep (greater than 60 inches).

Taxonomic classification: fine, mixed, superactive, frigid Typic Argiaquolls

Jonale Family Soils

The Jonale soil family occurs as a major named component in map units 4 and 6. It also occurs as a minor component in map units 7 and 8. This soil is very deep (greater than 60 inches). The official description for Jonale series (New Mexico) has a warmer annual temperature (about 54° F) and longer frost free period (150 to 180 days) than the Alton, Utah area (NRCS 2007).

Taxonomic classification: fine-loamy, mixed, superactive, mesic Aridic Calciustolls

Soil pit 17 is representative of the Jonale family soils that occur within the Coal Hollow project area. It is located in map unit 4. It formed in alluvium and colluvium on an alluvial fan slope. Slope is 3 percent on a southwest slope (210°). Vegetation is big sagebrush, rabbitbrush and grasses with scattered pinyon pine and juniper. Soil colors are for dry soil unless specified otherwise. Soil pH values are laboratory pH.

A – 0 to 9 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; moderate medium and coarse platy parting to fine granular structure; soft, friable, sticky, and plastic; many very fine, common fine and medium, and few coarse roots; common very fine interstitial and few fine tubular pores; 1 percent gravels; slight effervescence, slightly alkaline (pH 7.8); clear smooth boundary.

Bw -- 9 to 18 inches; pale brown (10YR 6/3) clay loam, brown (10YR 4/3) moist; moderate fine and medium angular blocky structure; very hard, very firm, sticky, and plastic; common very fine, few fine and medium, and coarse roots; few very fine and fine tubular pores; 2 percent gravels; slight effervescence, moderately alkaline (pH 8.0); clear smooth boundary.

Bwk1 – 18 to 30 inches; light yellowish brown (10YR 6/4) loam, brown (10YR 4/3) moist; strong fine and medium angular blocky structure; very hard, very firm, sticky, and plastic; few very fine, fine, and medium roots; few very fine and fine tubular pores; 2 percent gravels; strong effervescence, moderately alkaline (pH 8.0); clear wavy boundary.

Bwk2 – 30 to 45 inches; pale brown (10YR 6/3) clay loam, dark yellowish brown (10YR 4/4) moist; strong fine and medium angular blocky structure; very hard, very firm, sticky, and plastic; few very fine and fine roots; few fine and medium tubular pores; 2 percent gravels; strong effervescence, 4 percent very fine and fine soft calcium carbonate masses, moderately alkaline (pH 8.1); gradual wavy boundary.

Bk1 – 45 to 60 inches; very pale brown (10YR 7/3) clay loam, yellowish brown (10YR 5/4) moist; strong medium and coarse subangular blocky structure; slightly hard, firm, sticky, and plastic; few very fine roots; few fine and medium tubular pores; 2 percent gravels; strong effervescence, 8 percent very fine and fine soft calcium carbonate masses, moderately alkaline (pH 8.2); gradual wavy boundary.

Bk2 – 60 to 80 inches; very pale brown (10YR 7/4) silty clay, yellowish brown (10YR 5/4) moist; massive; extremely hard, extremely firm, very sticky, and very plastic; common very fine and few fine tubular pores; strong effervescence, 6 percent very fine and fine soft calcium carbonate masses, moderately alkaline (pH 8.0).

M Family Soils

The M family soil occurs as major named component in map units 2 and 5. It also occurs as a minor component in map units 1, 4, and 9. This soil is moderately deep (20 to 40 inches) to Tropic shale. It is the moderately deep phase of the A Family Soil. There are no established soil series in this soil family (NRCS 2007).

Taxonomic classification: fine, mixed, superactive, mesic Aridic Haplustepts

Soil pit 3 is representative of the M family soils that occur within the year one portion of the Coal Hollow project area. It is located in map unit 2 on a convex hillslope. It formed in formed in Tropic shale residuum. Slope is 9 percent on a south southeast slope (160°). Vegetation is big sagebrush, rabbitbrush and grasses. Soil colors are for dry soil unless specified otherwise. Soil pH values are laboratory pH.

A – 0 to 4 inches; brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; weak medium and coarse platy parting to moderate fine granular structure; soft, very friable, slightly sticky, and slightly plastic; common very fine and few fine and medium roots; common very fine and few fine tubular pores; slight effervescence, moderately alkaline (pH 8.1); clear smooth boundary.

Bw – 4 to 13 inches; grayish brown (10YR 5/2) clay loam, brown (10YR 4/3) moist; strong medium and coarse prismatic parting to strong medium angular blocky structure; slightly hard, firm, sticky, and plastic; common very fine and few fine and medium roots; common very fine interstitial and few fine tubular pores; strong effervescence, moderately alkaline (pH 8.3); clear wavy boundary.

Bwk – 13 to 20 inches; light brownish gray (2.5Y 6/2) silty clay loam, olive brown (2.5Y 4/3) moist; strong medium and coarse prismatic parting to strong medium angular blocky structure; very hard, very firm, very sticky, and very plastic; few very fine and fine roots; few very fine tubular pores; strong effervescence, moderately alkaline (pH 8.1); gradual wavy boundary.

Bk – 19 to 33 inches; light brownish gray (2.5Y 6/2) silty clay loam, light olive brown (2.5Y 5/3) moist; strong medium and coarse angular blocky structure; very hard, very firm, very sticky, and very plastic; few very fine roots; few very fine tubular pores; strong effervescence, moderately alkaline (pH 8.4); gradual wavy boundary.

Cr – 33 inches; decomposing Tropic shale.

Manzanst Taxadjunct Family Soils

The Manzanst family soil (Colorado) is the dominant soil component in map unit 12 and a minor component in map unit 1. This soil is very deep (greater than 60 inches). The official description for Manzanst series (Colorado) has a warmer annual temperature (about 50° F) and longer frost free period (135 to 155 days) than the Alton, Utah area (NRCS 2007). Soils in the Coal Hollow project area area a taxadjunct to the official series classification since they have clay percentages in the control section of 60 percent and higher.

Taxonomic classification: fine, smectitic, superactive, mesic Aridic Haplustalfs

Soil pit 48 is representative of the Manzanst soil family that occurs within the Coal Hollow project area. It is located in map unit 12 at the south end of the project area on a linear east northeast facing slope of 4 to 5 percent. It developed Tropic shale residuum. Mottles that occur below 30 inches may be the result of water perching on the underlying dense clay horizons. This profile was difficult to dig with a large excavator.

A – 0 to 3 inches; grayish brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky parting to moderate medium granular structure; hard, friable, moderately sticky, and moderately plastic; common very fine, fine and medium roots; common very fine and fine tubular pores; slight effervescence, slightly alkaline (pH 7.7); clear smooth boundary.

Bt1 – 3 to 12 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/24) moist; moderate medium prismatic parting to moderate medium subangular blocky structure; very hard, firm, sticky, and plastic; common very fine, fine and few medium roots; few very fine tubular pores; slight effervescence, moderately alkaline (pH 8.0); clear smooth boundary.

Bt2 – 12 to 30 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/24) moist; strong medium and coarse prismatic parting to moderate medium subangular blocky structure; very hard, firm, sticky, and plastic; few very fine and fine roots; slight effervescence, moderately alkaline (pH 8.2); clear smooth boundary.

Bt3 – 30 to 48 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/24) moist; strong medium prismatic parting to moderate medium subangular blocky structure; extremely hard, very firm, very sticky, and very plastic; 16 percent strong brown (7.5YR 5/6) fine and medium mottles; moderate effervescence, 3 percent very fine and fine soft lime masses, moderately alkaline (pH 8.1); gradual smooth boundary.

Bt3 – 48 to 84 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/24) moist; strong medium prismatic parting to strong medium subangular blocky structure; extremely hard, extremly firm, very sticky, and very plastic; 7 percent reddish yellow (7.5YR 6/6) fine mottles; moderate to strong effervescence, 10 percent fine soft lime masses, 2 percent fine gypsum masses, moderately alkaline (pH 8.1); gradual smooth boundary.

N Family Soils

The N soil family occurs to a very limited extent in map unit 1. The soil is similar to the D family soil, but aquic soil conditions were identified. This soil is very deep (greater than 60 inches).

Taxonomic classification: fine, mixed, superactive, frigid Aquic Calciustolls

Snilloc Soils

The Snilloc soils occur as a major named component in map unit 8. This soil is very deep (greater than 60 inches). Snilloc soils mapped in the Coal Hollow Project Area are within the range of characteristics contained in the official description (Wyoming) of the Snilloc series (NRCS 2007).

Taxonomic classification: coarse-loamy, mixed, superactive, mesic Aridic Calciustepts

Soil pit 21 is representative of the Snilloc soils that occur within the Coal Hollow project area. It is located in map unit 8 on a convex hillslope. It formed in alluvium from Tropic shale deposited by a large alluvial fan. Slope is 2 percent on a south southwest slope (190°). Vegetation is big sagebrush and grasses surrounded by Gamble oak. Soil colors are for dry soil unless specified otherwise. Soil pH values are laboratory pH.

A – 0 to 8 inches; light brown (7.5YR 6/4) sandy clay loam, brown (7.5YR 4/4) moist; moderate medium and coarse subangular blocky structure; soft, very friable, non sticky, and non plastic; many very fine, common fine and medium, few coarse roots; common very fine and fine interstitial pores; very slight effervescence, moderately alkaline (pH 8.4); clear smooth boundary.

Bwk1 – 8 to 18 inches; light brown (7.5YR 6/3) sandy clay loam, brown (7.5YR 4/3) moist; moderate fine and medium subangular blocky structure; very hard, very firm, sticky, and slightly plastic; few very fine, common very fine and few fine and medium roots; few very fine, fine, and medium tubular pores; strong effervescence, moderately alkaline (pH 8.1); clear wavy boundary.

Bwk2 – 18 to 36 inches; light brown (7.5YR 6/3) sandy loam, brown (7.5YR 4/4) moist; moderate fine and medium subangular blocky structure; slightly hard,

firm, slightly sticky, and slightly plastic; common very fine and few fine and medium roots; few very fine tubular pores; slight effervescence, moderately alkaline (pH 8.4); clear wavy boundary.

Bk – 36 to 50 inches; light brown (7.5YR 6/3) sandy loam, brown (7.5YR 5/4) moist; strong medium and coarse subangular blocky structure; slightly hard, very friable, non sticky, and non plastic; few very fine roots; few very fine tubular pores; slight effervescence, strongly alkaline (pH 8.7); clear smooth boundary.

2C1 – 50 to 62 inches; pale brown (10YR 6/3) sandy loam, dark yellowish brown (10YR 4/4) moist; massive; hard, firm, non sticky, and non plastic; few very fine and fine tubular pores; slight effervescence, strongly alkaline (pH 8.7); clear smooth boundary.

2C2 – 62 to 96 inches; very pale brown (10YR 7/3) sandy loam, yellowish brown (10YR 5/4) moist; single grain; loose, loose, non sticky, and non plastic; many very fine and few fine tubular pores; slight effervescence, strongly alkaline (pH 8.7); clear smooth boundary.

Tetonview Family Soils

The Tetonview family soil (Montana) is a minor component in map unit 7. This soil is deep (greater than 40 inches).

Taxonomic classification: fine-loamy, mixed, superactive frigid Aeric Calciaquolls

V Family Soils

The V family soil was correlated to the O family during preparation of the soil survey report.

Wapiti Family Soils

The Wapiti soil family occurs as a major named component in map units 1, 3 and 4. This soil is very deep (greater than 60 inches). The official description of Wapiti series (Colorado) is similar to the soil mapped in the Coal Hollow project area, but has a warmer annual temperature (51°F) and a longer growing season (125 to 155 days) than the Alton, Utah area (NRCS 2007).

Taxonomic classification: fine-loamy, mixed, superactive, mesic Calcidic Argiustolls

Soil pit 19 is representative of the Wapiti soil family that occurs within the Coal Hollow project area. It is located in map unit 4 on a convex fan terrace slope. It formed in alluvium from Tropic shale deposited by a large alluvial fan. Slope is 5 percent on a south west slope (260°). Vegetation is big sagebrush, rabbitbrush,

grasses and scattered Utah juniper. Soil colors are for dry soil unless specified otherwise. Soil pH values are laboratory pH.

A – 0 to 6 inches; grayish brown (10YR 5/2) loam, brown (10YR 3/2) moist; moderate medium granular structure; soft, very friable, slightly sticky, and slightly plastic; many very fine, few fine, medium, and coarse roots; many very fine interstitial pores; slight effervescence, moderately alkaline (pH 8.0); clear smooth boundary.

Bt – 6 to 12 inches; brown (10YR 5/3) clay loam, dark grayish brown (10YR 4/2) moist; moderate fine and medium subangular blocky structure; hard, very firm, slightly sticky, and slightly plastic; few thin clay films in pores; few very fine and fine roots; few very fine and fine tubular pores; slight effervescence, moderately alkaline (pH 8.2); clear wavy boundary.

Btk1 – 12 to 24 inches; pale brown (10YR 6/3) clay loam, dark yellowish brown (10YR 4/4) moist; moderate fine and medium subangular blocky structure; very hard, very firm, sticky, and plastic; common medium clay films on ped faces and few thin clay films in pores; few very fine and fine roots; few very fine and fine tubular pores; strong effervescence, 4 percent very fine soft calcium carbonate masses, moderately alkaline (pH 8.2); clear wavy boundary.

Btk2 – 24 to 37 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; strong fine and medium subangular blocky structure; hard, very firm, sticky, and plastic; few thin clay films on ped faces and in pores; few fine roots; few very fine and fine tubular pores; strong effervescence, 8 percent fine soft calcium carbonate masses, strongly alkaline (pH 8.5); clear wavy boundary.

Bk1 – 37 to 51 inches; light yellowish brown (10YR 6/4) sandy loam, dark yellowish brown (10YR 4/4) moist; strong fine and medium subangular blocky structure; hard, very firm, slightly sticky, and non plastic; few very fine and fine roots; few very fine tubular pores; strong effervescence, 4 percent fine soft calcium carbonate masses, moderately alkaline (pH 8.4); clear smooth boundary.

Bk2 – 51 to 68 inches; pale brown (10YR 6/3) sandy loam, yellowish brown (10YR 5/4) moist; massive; hard, firm, non sticky, and non plastic; few very fine and fine roots; common very fine and few fine tubular pores; violent effervescence, 6 percent fine soft calcium carbonate masses, strongly alkaline (pH 8.5); clear wavy boundary.

Bk3 – 68 to 90 inches; light yellowish brown (10YR 6/4) sandy loam, yellowish brown (10YR 5/4) moist; massive; loose, loose, non sticky, and non plastic; many very fine interstitial pores; strong effervescence, 6 percent fine soft calcium carbonate masses, strongly alkaline (pH 8.7).

Zigzag Soils

The Zigzag soils occur as a major named component in map unit 10. It also occurs as a minor component in map units 5 and 11. This soil is shallow (less than 20 inches) to Tropic shale. Soils mapped as Zigzag in the Coal Hollow Project Area have characteristics within the range described in the official series description (Colorado) for Zigzag soils (NRCS 2007).

Taxonomic classification: Clayey, mixed, superactive, calcareous, mesic, shallow Aridic Ustorthents

Soil pit 50 is representative of the Zigzag soils that occur within the Coal Hollow project area. It is located in map unit 10 on the Sink Valley fault escarpment. It formed in Tropic shale residuum. Slope is 16 percent on a west northwest slope (292°). Vegetation is Utah juniper, black sagebrush, and Indian ricegrass. Soil colors are for dry soil unless specified otherwise. Soil pH values are laboratory pH.

A – 0 to 4 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; weak medium subangular structure; slightly hard, very friable, sticky, and plastic; common very fine and few fine and medium roots; common very fine interstitial and tubular pores; strong effervescence, moderately alkaline (pH 8.4); clear smooth boundary.

C1 – 4 to 11 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm, sticky, and plastic; common very fine and few fine and medium roots; few very fine tubular pores; strong effervescence, moderately alkaline (pH 8.1); clear smooth boundary.

C2 – 11 to 19 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm, sticky, and plastic; few very fine and fine roots; few very fine tubular pores; strong effervescence, moderately alkaline (pH 8.4); clear smooth boundary.

Cr – 19 inches; decomposing Tropic shale.

Soil Limiting Features

Topsoil and subsoil salvage depths were determined by the depth to carbonates, poor soil pH (greater than 8.5), salinity (EC less than 4.0), sodicity (SAR less than 4), texture and depth to parent material. Clayey soils, carbonate accumulations and corresponding poor pH are the primary limiting soil features in the Coal Hollow project area. The depth to each of these limiting soil features varies by soil type and map unit.

The determination of good, fair, poor, or unsuitable qualities of the topsoil and subsoil is based on the soil suitability criteria established by the Utah Division of Oil Gas and Mining's *Guidelines for Management of Topsoil and Overburden* (Utah DOGM, 2005). The Utah DOGM suitability guidelines are summarized in table 4-1.

Table 4-1. Soil suitability and unsuitability criteria (Utah DOGM, 2005).

Criteria	Good	Fair	Poor	
Saturation %	25 to 55	≥56 to 80	<25 or >80	
pH	6.5 to 8.2	6.0 to 6.4 8.2 to 8.5	5.5 to 6.0 8.6 to 9.0	<5.5 >9.0
EC (mS/cm 25°C)	0 to 4	4 to 8	8 to 15	>15
SAR	0 to 4	5 to 10	10 to 14	>14
$CaCO_3$ %	<15	15 to 30	>30	
Texture	sl, l, sil, scl, vfsl, fsl	cl, sicl, sc, ls, lfs	sic, s, sc, c, cos, fs, vfs	g, vcos
Total Organic Carbon	<10%			≤10%
Available Water Capacity	>0.10 moderate	0.05 to 0.10 low	<0.05 very low	
K factor	<0.37	0.37	>0.37	

Topsoil and Subsoil Salvage Depths

Table 4-2 identifies the depth of topsoil, subsoil, and clayey subsoil that may be available for salvage based on field evaluations of soil pits and laboratory analysis of soil samples. Salvage depths may include some poor quality materials when the weighted average of mixed soil is still within the fair range. Field data sheets are in appendix B. Results of the laboratory analysis of soil samples are contained in appendix C.

Soils with less than good EC and SAR qualities were not included in the salvage depths.

Clayey subsoil (clay and silty clay) is common in the Coal Hollow project area. soil includes soil textures. It is of lesser quality relative to the other subsoil, but will be needed to achieve an adequate reclamation soil profile depth.

Actual topsoil and subsoil salvage depths will be closely monitored by Alton Coal Development staff in consultation with a certified professional soil scientist to ensure that unsuitable materials are not incorporated into the topsoil and subsoil stockpiles or placed directly into the reclamation soil profile.

Table 4-2. Topsoil and subsoil salvage depths by map unit in disturbance area.

Map Unit	Percent of Map Unit	Soil Types	Topsoil Depth	Good/ Fair Subsoil Depth	Poor Subsoil Depth	Average Total Salvage Depth
	%		inches	Inches	Inches	Inches
1		**A Family – Wapiti Family complex, 3 to 8 percent slopes**				
	65	A Family	9	17	64	
	15	Wapiti Family	7	57	21	
	10	D Family	11	16	59	
	5	Manzanst Family	6	24	0	
	5	N Family	8	12	85	
		Average salvage depths[1]	9	23	55	87
2		**M family – Calendar Family - D Family complex, 3 to 8 percent slopes**				
	60	M Family	7	14	9	
	25	Calendar Family	5	23	14	
	15	D Family	11	16	59	
		Average salvage depths[1]	7	17	18	42
3		**Cibeque Family – Wapiti Family complex, 3 to 8 percent slopes**				
	60	Cibeque Family	6	0	66	
	30	Wapiti Family	7	57	21	
	5	A Family	9	17	64	
	5	Calendar Family	5	23	14	
		Average salvage depths[1]	6	19	50	75
4		**Jonale Family – Graystone cobbly substratum Family – Wapiti Family complex, 3 to 8 percent slopes**				
	50	Jonale Family	9	23	47	
	25	Graystone cobbly substratum Family	12	20	0	
	15	Wapiti Family	7	57	21	
	5	D Family	11	16	59	
	5	A Family	9	17	64	
		Average salvage depths[1]	10	27	33	70
5		**Calendar Family – M Family - Drififtу Family complex, 8 to 25 percent slopes**				
	40	Calendar Family	5	23	14	
	30	M Family	7	14	9	
	20	Drififtу Family	10	0	0	
	10	Zigzag	4	15	0	
		Average salvage depths[1]	7	15	8	30

Map Unit	Percent of Map Unit	Soil Types	Topsoil Depth	Good/ Fair Subsoil Depth	Poor Subsoil Depth	Average Total Salvage Depth
	%		inches	Inches	Inches	Inches
6		**Graystone – Cookcan – Jonale Family complex, 1 to 5 percent slopes**				
	45	Graystone	12	50	20	
	20	Cookcan	6	42	0	
	20	Jonale Family	9	23	47	
	15	I Family	12	42	0	
		Average salvage depths[1]	10	42	18	70
7		**Happyhollow Family - Alamosa complex, 1 to 5 percent slopes**				
	55	Happyhollow Family	11	21	42	
	20	Alamosa	10	81	0	
	10	Jicarilla Family	7	47	42	
	10	Tetonview Family	8	16	0	
	3	Brumley	9	76	0	
	2	Jonale Family	9	23	47	
		Average salvage depths[1]	10	37	28	75
8		**Brumley – Graystone - Snilloc complex, 3 to 8 percent slopes**				
	40	Brumley	9	76	0	
	30	Graystone	13	55	11	
	20	Snilloc	8	28	60	
	10	Jonale Family	9	23	47	
		Average salvage depths[1]	10	55	20	85
9		**D Family - Deacon complex, 5 to 30 percent slopes**				
	55	D Family	11	16	59	
	30	Deacon	9	27	12	
	10	A Family	9	17	64	
	5	Creek bottom	0	0	0	
		Average salvage depths[1]	10	19	42	71
10		**Zigzag clay loam, 8 to 25 percent slopes**				
	85	Zigzag	4	14	0	
	10	Drifffty Family	10	0	0	
	5	Calendar Family	5	23	14	
		Average salvage depths[1]	5	13	1	19
11		**A family, 8 to 25 percent slopes**				
	85	A Family	9	17	64	
	10	Calendar Family	5	23	14	
	5	Zigzag	4	14	0	
		Average salvage depths[1]	8	17	56	81
12		**Manzanst Family clay loam, 3 to 12 percent slopes**				
	85	Manzanst Family very deep to shale	6	0	24	
	10	Manzanst Family deep to shale	6	0	20	
	5	A Family	9	17	64	
		Average salvage depths[1]	6	1	26	33
13		**A Family – Happyhollow Family complex, 1 to 5 percent slopes**				
	80	A Family	9	17	64	
	15	Happyhollow Family	11	21	42	
	5	I Family	12	42	0	
		Average salvage depths[1]	9	19	58	86

1. Weighted average salvage depths for map unit are the sum of soil type salvage depths multiplied by percent of map unit.

Topsoil and Subsoil Quantities

The estimated quantities of topsoil and subsoil that will be salvaged from mining disturbance areas are contained in table 4-3. The estimated quantities of salvaged topsoil where facilities, roads, and stockpiles will be constructed are contained in table 4-4. Drawing 2-2 shows the areas where only topsoil will be salvaged and where both topsoil and subsoil will be salvaged.

Table 4-3.1. Estimated topsoil and subsoil quantities that can be salvaged from year 1 mining disturbance areas.

Map Unit	Area	Topsoil	Good/ Fair Subsoil	Poor Subsoil
	acres	Cubic Yards	Cubic Yards	Cubic Yards
1	23.6	28,556	72,976	174,509
2	5.7	5,364	13,028	13,794
3	26.7	21,538	68,024	179,483
4	74.5	100,161	270,435	330,532
5	13.3	12,517	26,822	14,305
6	14.7	19,763	83,006	35,574
7	2.1	2,823	10,446	7,905
8	0.4	538	2,958	1,076
9	7.4	9,949	18,903	41,785
10	0.0	0	0	0
11	5.2	5,593	11,885	39,150
12	4.7	3,791	632	16,429
13	0.1	121	255	780
Total	178.4	210,715	579,550	855,322

Table 4-3.2. Estimated topsoil and subsoil quantities that can be salvaged from year 2 mining disturbance areas.

Map Unit	Area	Topsoil	Good/ Fair Subsoil	Poor Subsoil
	acres	Cubic Yards	Cubic Yards	Cubic Yards
1	0.0	0	0	0
2	0.0	0	0	0
3	20.3	16,375	51,855	136,461
4	1.8	2,420	6,534	7,986
5	0.0	0	0	0
6	1.2	1,613	6,776	2,904
7	35.0	47,056	174,106	131,756
8	0.8	1,076	5,916	2,151
9	0.0	0	0	0
10	7.8	5,243	13,633	1,049
11	1.6	1,721	3,657	12,046
12	12.9	10,406	1,734	45,093
13	0.0	33,396	70,503	215,219
Total	109.0	119,306	334,713	554,664

Table 4-3.3. Estimated topsoil and subsoil quantities that can be salvaged from year 3 mining disturbance areas.

Map Unit	Area	Topsoil	Good/ Fair Subsoil	Poor Subsoil
	acres	Cubic Yards	Cubic Yards	Cubic Yards
1	0.0	0	0	0
2	0.0	0	0	0
3	0.0	0	0	0
4	0.0	0	0	0
5	0.0	0	0	0
6	0.0	0	0	0
7	11.4	15,327	56,709	42,915
8	6.6	8,873	48,803	17,747
9	0.0	0	0	0
10	0.0	0	0	0
11	0.0	0	0	0
12	18.1	14,601	2,433	63,270
13	2.4	2,904	6,131	18,715
Total	38.5	41,705	114,076	142,646

Table 4-4. Estimated topsoil quantities that will be salvaged where facilities, roads, and stockpiles will be constructed in Coal Hollow project area during year 1.

Map Unit	Facilities, Roads, and Stockpile Disturbance Area	Topsoil
	acres	cubic yards
1	33.0	39,930
2	12.3	11,576
3	0.3	242
4	8.3	11,159
5	14.5	13,646
6	0.0	0
7	2.9	3,899
8	11.1	14,923
9	16.3	21,914
10	1.1	739
11	6.7	7,206
12	0.0	0
13	1.0	1,210
Totals	107.5	126,445

Estimated quantities of salvaged topsoil and subsoil should be sufficient to construct a reclamation profile with a minimum thickness of 48 inches as required by Utah DOGM regulations (p. 4, Utah DOGM, 2005). Table 4-5 lists the total estimated quantities of topsoil and subsoil by mining year and the resulting soil profile that could be constructed, if all of the estimated material was salvaged. These estimated quantities are presented for the purpose of illustrating that there

should be sufficient quantities of topsoil and subsoil to construct a 48 inch soil profile.

Topsoil replacement on the roads, facilities, and stockpile areas is estimated to be 8 to 9 inches.

Table 4-5. Estimated total quantities of topsoil and subsoil by mining year.

Mining Year	Topsoil Salvage	Good/Fair Subsoil Salvage	Poor Subsoil Salvage	Acres
	Cubic Yards	Cubic Yards	Cubic Yards	Cubic Yards
1	210,715	579,550	855,322	178.4
2	119,306	334,713	554,664	109.0
3	41,705	114,076	142,646	38.5
Total	371,725	1,028,339	1,552,632	325.9

Table 4-6. Potential reclamation soil profile thickness based on estimated topsoil and subsoil quantities listed in table 4-5 for the mining disturbance areas.

Mining Year	Topsoil Salvage	Good/Fair Subsoil Salvage	Poor Subsoil Salvage	Total Reclamation Profile Depth
	Inches	Inches	Inches	Inches
1	9	24	36	70
2	8	23	38	69
3	8	22	28	58
Weighted Project Average	8	23	35	66

Native Soil Profile Features

The combined depth of topsoil and subsoil varies in native soil profiles within the Coal Hollow project area depending on physiographic setting and soil texture. The depth to which soil carbonates have leached over time is an indicator of how deep soil moisture normally penetrates. Variations in available water holding capacity (determined by soil texture, EC, and SAR) result in varying soil depths, but are similar within soil types. Table 5-1 contains the average depths to carbonates, poor soil pH, or unsuitable SAR levels by soil map unit.

Table 5-1. Average depths to limiting soil features by map unit.

Map Unit	Depth to Limiting Soil Feature	Limiting Soil Feature
	inches	
1	33	Soil carbonate accumulation.
2	37	Soil carbonate accumulation. Moderately deep to shale. Fair EC and SAR.
3	22	Soil carbonate accumulation and pH.
4	30	Soil carbonate accumulation and pH.
5	32	Moderately deep or shallow to shale.
6	18	Poor to unacceptable pH and carbonate accumulation.
7	30	Soil carbonate accumulation and pH.
8	36	Soil carbonate accumulation and pH.
9	36	Poor pH and soil carbonate accumulation.
10	19	Shallow to shale.
11	24	Soil carbonate accumulation.
12	24	Heavy clay texture and pH.
13	26	Soil carbonate accumulation and pH.
Ave	30	Average does not include map units 6 (very limited area) ad 10 (shallow soils) and is not weighted by amount of map unit occurence.

Overburden Quality

SAR and pH are limiting features of the Tropic shale overburden that can have an impact on the establishment of acceptable post mining vegetation. SAR levels in shale overburden from core hole 5 ranged from 33.4 to 52.4. The pH ranged from 8.3 to 9.5 in the core hole 5 samples. Unacceptable SAR levels of 15.9 to 52.2 were also identified in core hole 7. These SAR levels are well above the Utah DOGM's poor range for soil and soil substitutes. It will be important to have adequate depth of suitable cover above this unsuitable material. Utah DOGM Guidelines for Management of Topsoil and Overburden stipulates a minimum of "four feet of cover is required over any toxic or acid-forming materials (p. 4, Utah DOGM, 2005)."

SAR and pH levels in mixed alluvium samples from core hole 3 were within the Utah DOGM good to fair range.

Reclamation Soil Profile Depth

The soil depths listed in table 5-1 represent the average depths to which natural soil development has taken place over time based on normal climatic patterns for the Alton, Utah area. Alton Coal Development will construct a post mining reclamation soil profile that is a minimum 48 inches thick (p. 4, Utah DOGM, 2005). This depth is 1.55 times the native depth to limiting soils features (see table 5-1). It will hold approximately 8.64 inches of moisture (one half of normal October March precipitation) based on an available water capacity (AWC) of 0.18 inches of water per inch of soil. The AWC of 0.18 inches of water per inch of soil is the low end for heavy clay loams, clays, and silty clays, which are dominant in the Coal Hollow project area.

Stockpile and Placement of Topsoil and Subsoil

Topsoil and subsoil will be salvaged and stockpiled or directly placed in its final location separately. Alton Coal Development will minimize the stockpiling of topsoil and subsoil by implementing direct placement of these soil materials as much as possible. Direct placement of topsoil and subsoil will minimize impacts on the soil resource. Topsoil and subsoil stockpiles will be identified with signs and protected from other mining activities. Topsoil and subsoil stockpile locations are shown on Drawing 2-2.

Topsoil and subsoil stockpiles will be protected from wind and water erosion until vegetation has become established.

Topsoil placement depths will range from 6 to 12 inches depending on the soil type and map unit that is being salvaged. It is anticipated that the average topsoil placement depth will be 9 inches in both mined and non-mined areas.

The balance of the 48 inch reclamation soil profile will consist of subsoil. Approximately 90 percent of the subsoil will be comprised of soil with good or fair pH and lime characteristics. The remaining subsoil may have soil pH or lime characteristics in the poor range, if adequate quantities of good to fair subsoil are not identified during salvage operations. No subsoil or overburden with any unacceptable characteristics will be placed within 48 inches of the final reclamation surface (Utah DOGM, 2005).

Substitute Subsoil

The depth of overburden overlaying the Tropic shale ranges from a few feet to fifty feet or more. Laboratory analysis of this material indicates that some of it is similar in quality to the native subsoil, based on the Utah DOGM soil suitability

guidelines (Utah DOGM, 2005). Depending on location, the upper twenty to fifty feet of mixed alluvial (non-shale) overburden is suitable for use as substitute subsoil, based on lab analysis of samples from deep backhoe pits at core hole locations 1, 3, 5, and 6 in April 2007, and core hole 8 in November 2007. Table 5-2, shows the maximum, minimum, and average lab analysis values for the April 2006 core hole samples. The average values in table 5-2 represent an estimate of the resulting values when material from below the topsoil layer and above thirty feet is mixed during excavation. Laboratory analysis results of this overburden testing are in appendix C.

Table 5-2. Ranges and averages of soil suitability for overburden sampled from pits adjacent to core holes 1, 3, 5, and 6 (April 2007) and core hole 8 (November 2007). Data is for alluvial material above 40 feet. Tropic shale overburden is unsuitable for use as subsoil substitute and has not been included in this table.

	Maximum	Minimum	Average
Sand % Silt % Clay % texture	82.0 61.0 61.0	0 13.0 5.0	35.3 35.9 28.8 Clay Loam
pH	8.4	7.8	8.2
ECe (ms/cm)	4.20	0.25	0.67
Saturation %	97.6	20.2	52.6
SAR	3.94	0.05	0.63
AcidBase Potential t/kT	650	160	315
Lime %	64.7	15.6	31.56
Organic Carbon	1.21	0.11	0.46
Boron	0.40	<0.10	0.29

The only parameter listed in table 5-2 with an average value that could be limiting to the establishment of vegetation would be the percent lime. Percent lime values for 9 of the 16 samples are between 15 and 30 percent, which puts them in the fair category (Utah DOGM, 2005).

Tropic shale is closer to the surface at the core hole 7 location which has resulted in the overburden being unacceptable for use as subsoil. SAR values ranges from 15.9 to 52.2 below 6 feet. Conductivity in this material ranges from 0.90 to 10.0 mmhos/cm. Percent clay ranges 49 to 61 percent. Materials similar to that characterized by core hole 7 should not be used as substitute subsoil within the 48 inch reclamation soil profile; and should be covered with as much suitable alluvium as possible.

ACD will monitor pH, conductivity, texture and percent lime in the field during mining operations to ensure that only materials with good or fair suitability are placed in the upper 4 feet of the reclamation soil profile (p. 4, Utah DOGM's *Guidelines for Management of Topsoil and Overburden*, 2005). Representative overburden samples will be analyzed for SAR at a qualified laboratory.

Incoming C0250005

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United States Department of Agriculture

NRCS

Natural Resources Conservation Service
2390 West HWY 56
Cedar City, Utah 84720
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10/30/2006

Priscilla Burton
Environmental Scientist III
Division of Oil, Gas and Mining
State of Utah- Department of Natural Resources
PO Box 145801
1594 West North Temple, Suite 1210
Salt Lake City, UT 84114-5801

RE: Prime Farmland Determination, Alton Coal Development Company, LLC, Proposed Coal Hollow Mine, C/025/0005, Task ID#2567

Dear Priscilla:

As requested, a Farmland Conversion Impact Rating (Form AD 1006) is enclosed, for the proposed Coal Hollow Mine area, located near Alton City in Kane County, Utah.

No Prime Farmland or Soils of Statewide Importance were found within the study area, per criteria outlined in the National Soil Survey Handbook Part 622 and Exhibit UT603-1, respectively. No NRCS published, or SSURGO certified soil survey data exists for the project area, so an on-site investigation, soil sampling and descriptions were used for this assessment. Although soils within the proposed activity area do not presently meet the criteria for Prime Farmland or Soils of Statewide Importance (SSI), they could classify as Soils of Statewide Importance, if irrigated.

Soils are alluvium and residuum, primarily formed from Tropic Shale parent material that exhibit mollic epipedons and contain little to no rock fragments on the soil surface or in the soil profiles, to a depth of 60 inches. Subsurface textures are typically silty clay, with the upper horizons from 0 to 27 inches ranging from silty clay loam to clay loam textures. Visible calcium carbonate and salt concentrations were observed in the soil profile, ranging from 10 inches to 27 inches deep and extending to depths of 60 inches or greater. Slopes range from 1 to 10 percent, with some minor areas exceeding 20 percent. Observed soils are predominantly Fine, mixed, superactive, mesic Pachic Calciustolls and Fine, mixed, superactive, mesic Aridic Natrustolls.

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. In the case

of SSI, a reliable source of water is the only factor that excludes soils from classifying as such where slopes are less than 14 percent.

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 rates.

Within the scope of the proposed project area, no conversion of Prime Farmland or Soils of Statewide Importance would occur because soils in the project area do not classify as such.

If you need any additional information of have questions, please do not hesitate to contact me.

Sincerely,

Corey Meier
Soil Scientist

Enclosures

Cc: Michael Domeier, State Soil Scientist, SLC, UT

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request 10/30/06
Name Of Project Proposed Coal Hollow Mine	Federal Agency Involved USDA - NRCS
Proposed Land Use Coal mine	County And State Kane, Utah
PART II *(To be completed by NRCS)*	Date Request Received By NRCS

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 / Average Farm Size
Major Crop(s)	Farmable Land In Govt. Jurisdiction Acres: %		Amount Of Farmland As Defined In FPPA Acres: %
Name Of Land Evaluation System Used	Name Of Local Site Assessment System		Date Land Evaluation Returned By NRCS

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				
B. Total Acres To Be Converted Indirectly				
C. Total Acres In Site	0.0	0.0	0.0	0.0
PART IV *(To be completed by NRCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland				
B. Total Acres Statewide And Local Important Farmland				
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted				
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value				
PART V *(To be completed by NRCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	0	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	0	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	0	0	0	0

Site Selected:	Date Of Selection 10/30/06	Was A Local Site Assessment Used? Yes ☐ No ☐

Reason For Selection: The project impacts Fine, mixed, superactive, mesic Pachic Calciustolls and Fine, mixed, superactive, mesic Aridic Natrustolls. No NRCS SSURGO certified soil survey presently exists for the project area. Impacted soils and determinations were evaluated by conducting a local site assessment. Observed soils do not classify as Prime Farmland, but do classify as Soils of Statewide Importance, if irrigated. Because no irrigation is present, soils do not classify as Soils of Statewide Importance.

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 160.

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:

$$\frac{\text{Total points assigned Site A}}{\text{Maximum points possible}} = \frac{180}{200} \times 160 = 144 \text{ points for Site "A."}$$

Taxonomic classification of the soil profiles was finalized using the field description notes, results of laboratory analysis of soil samples, and examination of the micromonolith box samples. The following diagnostic soil horizons were identified in some of the Coal Hollow soil profiles.

- Mollic epipedons (dark soil surface);
- Calcic horizon (accumulation of secondary calcium carbonates);
- Cambic horizon (indication of soil development);
- Argillic horizon (accumulation of illuvial clays);
- Aquic conditions (presence of ground water in the soil profile), and
- Lithic or paralithic contact with sandstone or shale parent material.

Mollic epipedon determination is based on the soil color using the Munsell Soil Color Charts. Surface dry colors must have a value of 5 or less with a chroma of 3 or less, while the moist color must have a value of 3 or less with a chroma of 3 or less.

Calcic horizons must be at least 6 inches thick and have secondary calcium carbonates in the subsurface or subsoil. The amount of calcium carbonate required is dependent on the percent clay in the fine-earth fraction.

Cambic horizons are an indication of early soil development. Soils with moderate or strong soil structure in the subsurface are an indication of a cambic horizon.

Argillic horizons are identified by an accumulation of illuvial clay in a subsurface horizon. The amount of clay increase is based on the overlying soil horizon. The presence of clay films in the argillic horizon is also required.

Aquic conditions are identified in the soil profile by the presence of redox concentrations, mottled soil colors, or gleyed colors. The depth at which these features occur determines the suborder (less than 20 inches) or sub-group (20 to 30 inches) classification of the soil. The presence of aquic features below 30 inches does not have an effect on the taxonomic classification of the soil, but was included in the soil type description.

Lithic or paralithic contacts are diagnostic when shale or sandstone occurs within 20 inches or the soil surface. Moderately deep contacts (20 to 40 inches deep) are identified in the soil type descriptions.

It was not possible to correlate the Coal Hollow soil profiles to established soil series. Because most of the established series within the taxonomic soil families were from areas with warmer soil temperatures, longer growing seasons, or other dissimilar features. Most of the established soil series were from eastern New Mexico, southeastern Colorado, northeastern Wyoming, or the Dakotas. Soils in the Alton, Utah area have not been mapped by the Natural Resource Conservation Service (C. Meier, 2006).

Table B-1. Taxonomic classification of soil pedons sorted by pedon, Coal Hollow Soil Survey.

Pedon	Soil Type	Map Unit	Taxonomic Family Classification
LOF-1	A Family	1	fine, mixed, superactive, mesic Aridic Calciustept
LOF-2	D Family	2	fine, mixed, superactive, mesic Aridic Calciustoll
LOF-3	M Family	2	fine, mixed, superactive, mesic Aridic Calciustept
LOF-4	Calendar Family	2	fine, mixed, superactive, mesic Aridic Haplustepts
RDV-5	Jonale Family	4	fine-loamy, mixed, superactive, mesic Aridic Calciustoll
RDV-6	Cibeque Family	3	fine-loamy, mixed, superactive, mesic Aridic Calciustept
RDV-7	D Family	4	fine, mixed, superactive, mesic Aridic Calciustoll
1YR-8	Jonale Family	4	fine-loamy, mixed, superactive, mesic Aridic Calciustoll
1YR-9A	Graystone	6	coarse-loamy, mixed, superactive, mesic Aridic Calciustoll
1YR-9B	Cookcan	6	coarse-loamy, mixed, superactive, frigid Typic Calciaquoll
1YR-10	Jonale Family	4	fine-loamy, mixed, superactive, mesic Aridic Calciustoll
1YR-11	Graystone	4	coarse-loamy, mixed, superactive, mesic Aridic Calciustoll
1YR-12	M Family	2	fine, mixed, superactive, mesic Aridic Calciustept
SP-13	Cibeque Family	3	fine-loamy, mixed, superactive, mesic Aridic Calciustept
SP-14	I Family	6	fine-loamy, mixed, superactive, frigid Aquic Calciustept
SP-15	Graystone	6	coarse-loamy, mixed, superactive, mesic Aridic Calciustoll
SP-16	Jonale Family	6	fine-loamy, mixed, superactive, mesic Aridic Calciustoll
WRD-17	Jonale Family	4	fine-loamy, mixed, superactive, mesic Aridic Calciustoll
WRD-18A	Alamosa	7	fine-loamy, mixed, superactive, frigid Typic Argiaquoll
WRD-18B	Jonale Family	4	fine-loamy, mixed, superactive, mesic Aridic Calciustoll
WRD-19	Wapiti Family	4	fine-loamy, mixed, superactive, mesic Calcidic Argiustoll
WRD-20	Graystone	8	coarse-loamy, mixed, superactive, mesic Aridic Calciustoll
WRD-21	Snilloc	8	coarse-loamy, mixed, superactive, mesic Aridic Calciustept
WRD-22	Brumley	8	fine-loamy, mixed, superactive, mesic Calcidic Haplustalf
WRD-23	Jonale Family	4	fine-loamy, mixed, superactive, mesic Aridic Calciustoll
DAH-24	Calendar Family	5	fine, mixed, superactive, mesic Aridic Haplustepts
DAH-25	M Family	5	fine, mixed, superactive, mesic Aridic Calciustept
SP-26	N Family	1	fine, mixed, superactive, frigid Aquic Calciustoll
SP-27	A Family	1	fine, mixed, superactive, mesic Aridic Calciustept
SP-28	A Family	11	fine, mixed, superactive, mesic Aridic Calciustept
SP-29	D Family	9	fine, mixed, superactive, mesic Aridic Calciustoll
SP-30	A Family	1	fine, mixed, superactive, mesic Aridic Calciustept
SP-31	Wapiti Family	3	fine-loamy, mixed, superactive, mesic Calcidic Argiustoll
SP-32	Wapiti Family	1	fine-loamy, mixed, superactive, mesic Calcidic Argiustoll
SP-33	D Family	1	fine, mixed, superactive, mesic Aridic Calciustoll
SP-34	Jonale Family	4	fine-loamy, mixed, superactive, mesic Aridic Calciustoll
SP-35	Jonale Family	4	fine-loamy, mixed, superactive, mesic Aridic Calciustoll
SP-36	Graystone	4	coarse-loamy, mixed, superactive, mesic Aridic Calciustoll
SP-37	Graystone	4	coarse-loamy, mixed, superactive, mesic Aridic Calciustoll
SP-38	Happyhollow Family	7	fine, mixed, superactive, frigid Aeric Epiaquept
SP-39	Graystone cobbly	4	coarse-loamy, mixed, superactive, mesic Aridic Calciustoll
SP-40	Tetonview Family	7	fine-loamy, mixed, superactive, frigid Aeric Calciaquoll
SP-41	D Family	9	fine, mixed, superactive, mesic Aridic Calciustoll
SP-42	Deacon	9	fine-loamy, mixed, superactive, mesic Aridic Haplustoll
SP-43	Jicarilla Family	7	fine, mixed, superactive, frigid Typic Argiaquoll
SP-44	Happyhollow Family	7	fine, mixed, superactive, frigid Aeric Epiaquept
SP-45	Happyhollow Family	13	fine, mixed, superactive, frigid Aeric Epiaquept
SP-46	Alamosa	7	fine-loamy, mixed, superactive, frigid Typic Argiaquoll
SP-47	Brumley	8	fine-loamy, mixed, superactive, mesic Calcidic Haplustalf

Table B-1. Taxonomic classification of soil pedons sorted by pedon, Coal Hollow Soil Survey.

Pedon	Soil Type	Map Unit	Taxonomic Family Classification
SP-48	Manzanst Taxa Family	12	very fine, mixed, superactive, mesic Aridic Haplustalf
SP-49	Drififfity Family	5	loamy, mixed, superactive, calcareous, mesic Aridic Lithic Ustorthent
SP-50	Zigzag	10	clayey, mixed, superactive, calcareous, mesic, shallow Aridic Ustorthent
SP 51	Brumley	8	fine-loamy, mixed, superactive, mesic Calcidic Haplustalf
SP-52	I Family	13	fine-loamy, mixed, superactive, frigid Aquic Calciustept
SP-53	Disturbed		Disturbed
SP-54	Happyhollow Family	7	fine, mixed, superactive, frigid Aeric Epiaquept
SP-55	Cibeque Family	3	fine-loamy, mixed, superactive, mesic Aridic Calciustept
SP-56	Wapiti Family	3	fine-loamy, mixed, superactive, mesic Calcidic Argiustoll
SP-57	Cibeque Family	13	fine-loamy, mixed, superactive, mesic Aridic Calciustept
SP-58	Manzanst Taxa Family	12	very fine, mixed, superactive, mesic Aridic Haplustalf
SP-59	A Family	13	fine, mixed, superactive, mesic Aridic Calciustept
SP-60	Manzanst Taxa Family	12	very fine, mixed, superactive, mesic Aridic Haplustalf

Table B-2. Taxonomic classification of soil pedons sorted by soil type, Coal Hollow Soil Survey.

Pedon	Soil Type	Map Unit	Taxonomic Family Classification
LOF-1	A Family	1	fine, mixed, superactive, mesic Aridic Calciustept
SP-27	A Family	1	fine, mixed, superactive, mesic Aridic Calciustept
SP-28	A Family	11	fine, mixed, superactive, mesic Aridic Calciustept
SP-30	A Family	1	fine, mixed, superactive, mesic Aridic Calciustept
SP-59	A Family	13	fine, mixed, superactive, mesic Aridic Calciustept
SP-46	Alamosa	7	fine-loamy, mixed, superactive, frigid Typic Argiaquoll
WRD-18A	Alamosa	7	fine-loamy, mixed, superactive, frigid Typic Argiaquoll
SP 51	Brumley	8	fine-loamy, mixed, superactive, mesic Calcidic Haplustalf
SP-47	Brumley	8	fine-loamy, mixed, superactive, mesic Calcidic Haplustalf
WRD-22	Brumley	8	fine-loamy, mixed, superactive, mesic Calcidic Haplustalf
DAH-24	Calendar Family	5	fine, mixed, superactive, mesic Aridic Haplustepts
LOF-4	Calendar Family	2	fine, mixed, superactive, mesic Aridic Haplustepts
RDV-6	Cibeque Family	3	fine-loamy, mixed, superactive, mesic Aridic Calciustept
SP-13	Cibeque Family	3	fine-loamy, mixed, superactive, mesic Aridic Calciustept
SP-55	Cibeque Family	3	fine-loamy, mixed, superactive, mesic Aridic Calciustept
SP-57	Cibeque Family	13	fine-loamy, mixed, superactive, mesic Aridic Calciustept
1YR-9B	Cookcan	6	coarse-loamy, mixed, superactive, frigid Typic Calciaquoll
LOF-2	D Family	2	fine, mixed, superactive, mesic Aridic Calciustoll
RDV-7	D Family	4	fine, mixed, superactive, mesic Aridic Calciustoll
SP-29	D Family	9	fine, mixed, superactive, mesic Aridic Calciustoll
SP-33	D Family	1	fine, mixed, superactive, mesic Aridic Calciustoll
SP-41	D Family	9	fine, mixed, superactive, mesic Aridic Calciustoll
SP-42	Deacon	9	fine-loamy, mixed, superactive, mesic Aridic Haplustoll
SP-53	Disturbed		Disturbed
SP-49	Drififtу Family	5	loamy, mixed, superactive, calcareous, mesic Aridic Lithic Ustorthent
1YR-11	Graystone	4	coarse-loamy, mixed, superactive, mesic Aridic Calciustoll
1YR-9A	Graystone	6	coarse-loamy, mixed, superactive, mesic Aridic Calciustoll
SP-15	Graystone	6	coarse-loamy, mixed, superactive, mesic Aridic Calciustoll
SP-36	Graystone	4	coarse-loamy, mixed, superactive, mesic Aridic Calciustoll
SP-37	Graystone	4	coarse-loamy, mixed, superactive, mesic Aridic Calciustoll
WRD-20	Graystone	8	coarse-loamy, mixed, superactive, mesic Aridic Calciustoll
SP-39	Graystone cobbly	4	coarse-loamy, mixed, superactive, mesic Aridic Calciustoll
SP-38	Happyhollow Family	7	fine, mixed, superactive, frigid Aeric Epiaquept
SP-44	Happyhollow Family	7	fine, mixed, superactive, frigid Aeric Epiaquept
SP-45	Happyhollow Family	13	fine, mixed, superactive, frigid Aeric Epiaquept
SP-54	Happyhollow Family	7	fine, mixed, superactive, frigid Aeric Epiaquept
SP-14	I Family	6	fine-loamy, mixed, superactive, frigid Aquic Calciustept
SP-52	I Family	13	fine-loamy, mixed, superactive, frigid Aquic Calciustept
SP-43	Jicarilla Family	7	fine, mixed, superactive, frigid Typic Argiaquoll
1YR-10	Jonale Family	4	fine-loamy, mixed, superactive, mesic Aridic Calciustoll
1YR-8	Jonale Family	4	fine-loamy, mixed, superactive, mesic Aridic Calciustoll
RDV-5	Jonale Family	4	fine-loamy, mixed, superactive, mesic Aridic Calciustoll
SP-16	Jonale Family	6	fine-loamy, mixed, superactive, mesic Aridic Calciustoll
SP-34	Jonale Family	4	fine-loamy, mixed, superactive, mesic Aridic Calciustoll
SP-35	Jonale Family	4	fine-loamy, mixed, superactive, mesic Aridic Calciustoll
WRD-17	Jonale Family	4	fine-loamy, mixed, superactive, mesic Aridic Calciustoll
WRD-18B	Jonale Family	4	fine-loamy, mixed, superactive, mesic Aridic Calciustoll
WRD-23	Jonale Family	4	fine-loamy, mixed, superactive, mesic Aridic Calciustoll

Table B-2. Taxonomic classification of soil pedons sorted by soil type, Coal Hollow Soil Survey.

1YR-12	M Family	2	fine, mixed, superactive, mesic Aridic Calciustept
DAH-25	M Family	5	fine, mixed, superactive, mesic Aridic Calciustept
LOF-3	M Family	2	fine, mixed, superactive, mesic Aridic Calciustept
SP-48	Manzanst Taxa Family	12	very fine, mixed, superactive, mesic Aridic Haplustalf
SP-58	Manzanst Taxa Family	12	very fine, mixed, superactive, mesic Aridic Haplustalf
SP-60	Manzanst Taxa Family	12	very fine, mixed, superactive, mesic Aridic Haplustalf
SP-26	N Family	1	fine, mixed, superactive, frigid Aquic Calciustoll
WRD-21	Snilloc	8	coarse-loamy, mixed, superactive, mesic Aridic Calciustept
SP-40	Tetonview Family	7	fine-loamy, mixed, superactive, frigid Aeric Calciaquoll
SP-31	Wapiti Family	3	fine-loamy, mixed, superactive, mesic Calcidic Argiustoll
SP-32	Wapiti Family	1	fine-loamy, mixed, superactive, mesic Calcidic Argiustoll
SP-56	Wapiti Family	3	fine-loamy, mixed, superactive, mesic Calcidic Argiustoll
WRD-19	Wapiti Family	4	fine-loamy, mixed, superactive, mesic Calcidic Argiustoll
SP-50	Zigzag	10	clayey, mixed, superactive, calcareous, mesic, shallow Aridic Ustorthent

Aridic Calcinstept UTM 0871325 4140717

USDA - Fo[illegible]rvice Fine, mixed, superactive, mesic

SO[illegible]SCRIPTION

(Re[illegible]ce FSH 2509.18) #13 (P) LOF-1

1. Map Unit Symbol	2. Family or Series	3. Date	4. By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location:
1	FINE, SMECTITIC TYPIC ~~[illegible]~~	9-12-06	BC	2-3 (K)	LOF 1	ALTON	Sec. ___ T. ___ R. ___

9. Area	10. Forest	11. Ranger District	12. State	13. County
LOAD OUT AREA COAL HOLLOW PROJECT, PRIVATE LAND 2 MI. SOUTH OF ALTON, UTAH			UTAH	KANE

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion:
LANDSLIDE DEPOSIT ALLUVIUM + COLLUVIUM	STRAIGHT CLIFFS FM + TROPIC SHALE	70	a. Kind NONE → SLIGHT b. Class RILL

18. Landform	19. Slope:	20. Drainage Class	21. Surface Stone and Rock
ALLUVIAL FANSLOPE	a. % 3 b. Shape PLANAR c. Length 150" d. Aspect 280	SPD	a. GR 2 b. CB 1 c. ST 0 d. BY ___

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
WYOMING BIGSAGEBRUSH - GRASSES, FORBS	15-17"		> 5 FT

HORIZON DESIGNATION (a)	INCHES DEPTH (b)	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	LAB TEXTURE (d)	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	LAB! FIELD pH (i)	BOUNDARY (j)
A	0-6	10YR 4/2	10YR 5/2	/	CLAY LOAM SiCL 36	1MPL → FGR	SD	VFR	SS/PS	/	GR - 0 CB - 0 ST - 0	3VF 2F, M 1C	2VF IN 1F TU	ST	7.3	C, S
BK1 CK1	6-12	2.5Y 4/3	2.5Y 5/2	/	CLAY LOAM SiC 36	2M-C ABU	HA	VFI	VS/VP	/	GR - 0 CB - 0 ST - 0	2VF 1F, M, C	1VF TU	ST	8.3	G, W
BK2 CK2	12-24	2.5Y 5/3	2.5Y 6/2	/	SiC 42	3M-C PR	VH	VFI	VS/VP	/	GR - 0 CB - 0 ST - 0	1VF 1F	1VF TU	ST	8.5	G, S
BK3 C3	24-42	2.5Y 5/3	2.5Y 6/2	/	SiC 46	3MPR → 3ABU	EHA	EFI	VS/VP	/	GR - 0 CB - 0 ST - 0	1VF	V, VF TU	ST	8.7	G, W
Cr	42-60	2.5Y 5/2	2.5Y 7/2	/	CLAY SiC 42	MASSIVE	EH	EFI	VS/VP	/	GR - 0 CB - 0 ST - 0	/	/	ST	8.4	G, W
											GR - CB - ST -					
											GR - CB - ST -					
											GR - CB - ST -					
											GR - CB - ST -					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
	10-40"	42"		> 5 FEET

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
	OCHRIC	CALCIC	10-30"

USDA - Forest Service — Aridic Calciustept — **SOIL DESCRIPTION** (Non-Forest Service) SII 2509.18) #14 (P) LOF-2 — UTM 4[illegible] 0371357 792

1. Map Unit Symbol: 2 ~~[illegible]~~ MUS	2. Family or Series: mixed, super, mesic FINE, ~~SMECTITIC~~ ~~Typic~~ ~~USTEPTMENT~~	3. Date: 9-12-06	4. By: BC	5. Photo. No.: 4-5. (16)	6. Stop No.: LOF-2	7. USGS Quad: ALTON	8. Location: Sec. ____ T. ____ R. ____		
9. Area: CACHE NF SOIL SURVEY	10. Forest: PRIVATE LANDS 2 MI. SOUTH OF ALTON	11. Ranger District: UTAH	12. State: UTAH	13. County: KANE					
14. Parent Material: LANDSLIDE DEPOSIT LANDSLIDE - COLLUVIUM	15. Bedrock Name: TRIASSIC SH + STR. CLIFFS	16. Elevation: FM 70	17. Erosion: a. Kind: NONE → SLIGHT b. Class: RILL						
18. Landform: FOOTSLOPE - TOESLOPE	19. Slope: a. % 6 b. Shape PLANAR c. Length 150' d. Aspect 200	20. Drainage Class: SPD	21. Surface Stone and Rock: a. GR 2 b. CB 2 c. ST 0 d. BY 0						
22. Potential Natural Vegetation: ARTNA - RABBITBRUSH - GRASSES	23. Annual Precipitation: 15-17"	24. Measured Soil Temperature	25. Water Table (Depth): >8 FT.						

HORIZON DESIGNATION (a)	DEPTH (b)	COLOR (c) Moist (1)	COLOR (c) Dry (2)	Mottling (3)	TEXTURE (d) LAB	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	LAB FIELD pH (i)	BOUNDARY (j)
A1	0-7	10YR 3/2	10YR 5/3		CLAY LOAM SiL 31	2M-C PL → FGR	SO	VFR	S/P		CR - CB - ST -	3VF 2F,M 1C	2VF IN 2F TU	ST	7.6	C, S
A2 ~~CH1~~	7-12	10YR 4/2	10YR 5/2		CLAY LOAM SiC 32	2M-F ABK	VH	VFI	S/VP		CR - CB - ST -	2VF 2F,M 1C	2VF IN 1F TU	ST	7.7	C, W
Bwk1 ~~CH2~~	12-24	2.5Y 4/3	2.5Y 6/2		SiC 46	3C-M PR → 3ABK	EHA	EFI	VS/VP		CR - CB - ST -	1VF-F	1VF TU	ST	7.8	G, W
Bwk2 ~~CH3~~	24-48	2.5Y 4/3	2.5Y 6/3		CLAY SiC 41	3M-C ABK	EHA	EFI	VS/VP		CR - CB - ST -	V,VF	1VF TU	ST	8.0	G, I
BK ~~CH4~~	~~48-72~~ 72	2.5Y 5/3	2.5Y 7/2		SiC 45	MASSIVE	EHA	EFI	VS/VP		CR - CB - ST -		1VF TU	me ~~SE~~	7.8	G, W
~~CH5~~	~~72-96~~	2.5Y 5/3	2.5Y 7/3		CLAY 47	MASSIVE	EHA	EFI	VS/VP		CR - CB - ST -			me ~~SE~~	7.8	G, W
											CR - CB - ST -					
											CR - CB - ST -					
											CR - CB - ST -					

26. Partical Size Control Section	a. Depth: 10-40	b. Average Clay %: 38	c. Average Rock Fragment Content: 0
27. Depth to Lithic or Paralithic Contact: > 5 FEET			
28. Diagnostic Horizons	a. Surface: OCHRIC	b. Subsurface: —	
29. Moist Control Section Depth: 10-30"			

FS 2500 1 (12/86)

4 SAMPLES TAKEN — Aridic Calciustept (Reference FSH 2509.18) 50-51 (K) UTM 4140866

1. Map Unit	2. Family or Series	3. Date	By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location:
2	Fine, ~~Smectitic~~ Typic mixed ~~Typic~~ super, mesic ~~Ustorthent~~	9-18-09	BC	16-11 (P)	LOF-3	ALTON	Sec. ___ T. ___ R. ___

9. Area	10. Forest	11. Ranger District	12. State	13. County
LOAD OUT AREA	MODERATELY DEEP		UTAH	KANE

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion:
ALLUVIUM / COLLUVIUM / LSD	TROPIC / STR. CLIFFS	70	a. Kind NONE-SLIGHT b. Class RILL

18. Landform	19. Slope:	20. Drainage Class	21. Surface Stone and Rock
FANSLOPE - TOESLOPE	a. % 9 b. Shape CONVEX c. Length 200 d. Aspect 160°	SPD	a. GR 0 b. CB 0 c. ST 0 d. BY 0

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
BIG SAGEBRUSH - RABBITBRUSH	15-17		NONE TO 5 FT

HORIZON DESIGNATION (a)	INCHES DEPTH (b)	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	LAB TEXTURE (d)	%C	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	LAB FIELD pH (i)	BOUNDARY (j)
A	0-4	10YR 3/3	10YR 4/3	/	LOAM SIL	28	1M-CPL → FGR	SO	VFR	SS PS	/	GR - CB - ST -	2VF 1F,M	2VF IN 1F TU	SE	8.1	GS
BW1 ~~C1~~	4-11	10YR 4/3	10YR 5/2	/	CLAY LOAM SICL	28 32	3M-CPR → 3 ABK	SH	FI	S P	/	GR - CB - ST -	2VF 1F,M	2VF IN 1F TU	ST	8.3	GW
BWK ~~C2~~	11-19	2.5Y 4/3	2.5Y 6/2	/	SICL SILTY CLAY	34	3MPR → 3 ABK	VH	VFI	VS/VP	/	GR - 0 CB - 0 ST - 0	1VF 1F	1VF TU	ST	8.1	G,W
BK ~~C3~~	19-33	2.5Y 5/3	2.5Y 6/2	/	SILTY CLAY SICL	40 37	3 M-C ABK	VH	VFI	VS VP	/	GR - 0 CB - 0 ST - 0	1VF	1VF TU	ST	8.4	G,W
Cr	33+	SOFT TROPIC			SICL	45	SAME BEDROCK					GR - CB - ST -					
												GR - CB - ST -					
												GR - CB - ST -					
												GR - CB - ST -					
												GR - CB - ST -					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
	10-33"	37	0	33"

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
	OCHRIC	CALCIC	10-30"

Previous edition [illegible] lete.

FS-2500-1 (2/86)

USDA - Forest Service

Aridic Haplustept

SOIL DESCRIPTION (Reference FSH 2509.18) 52-53 K

UTM 4140 6

1. Map Unit	2. Family or Series	3. Date	By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location: Sec. ___ T. ___ R. ___
2	FINE, ~~SMECTITIC~~ mixed ~~TYPIC~~ mesic ~~USTORTHENT~~	9-18-06	BC	12-13 (P)	LOF-4	ALTON	

9. Area	10. Forest	11. Ranger District	12. State	13. County
LOAD OUT FACILITY COAL HOLLOW SOIL SURVEY	PRIVATE LANDS 2 1/2 MI. SE OF ALTON		UTAH	KANE

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion: a. Kind	b. Class
COLLUVIUM / LANDSLIDE DEPOSITS FROM	STRAIGHT CLIFFS + TROPIC	70	NONE	

18. Landform	19. Slope: a. %	b. Shape	c. Length	d. Aspect	20. Drainage Class	21. Surface Stone and Rock	a. GR	b. CB	c. ST	d. BY
TOESLOPE - FANSLOPE	6	CONVEX	220	190	SPD	CHEMICAL CRUST	0	0	0	0

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
BIG SAGEBRUSH RABBITBRUSH	15-17"		NONE TO 5 FT.

HORIZON DESIGNATION (a)	DEPTH (b)	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	LAB TEXTURE (d)	%C	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	LAB FIELD pH (i)	BOUNDARY (j)
A	0-5	10YR 4/2	10YR 6/3	/	SILT CLAY SIL	42 23	2M-F PL → 1FGR	SO	VFR	SS PS	/	GR - 0 CB - 0 ST - 0	3VF 2F-M 2C	3VF IN	SE	7.8	C,S
BW1 C1	5-10	10YR 4/2	10YR 6/2	/	SIC	40	2M-F SBR	SO	FR	S P	/	GR - 0 CB - 0 ST -	2VC-F 1M,C	2VF IN 2F TU	ST	7.7	C,W
BW2 C2	10-19	2.5Y 4/2	2.5Y 6/2	/	SIC	45	3C-M PR	VH	VFI	VS VP	/	GR - 0 CB - 0 ST - 0	1VF-F 1M	2VF IN	ST	7.8	G,W
BW3 C3	19-31	2.5Y 4/3	2.5Y 6/3	/	SIC	44	3MPR → 3ABR	VH	VFI	VS VP	/	GR - 0 CB - 0 ST - 0	VIVF	1VF IN	ST	7.9	G,W
C4	31+ *			/	CLAY SIC or		CLAY MASSIVE	EH	EFI	ES EP		GR - 0 CB - 0 ST - 0	/	1VF TU	ST	7.8	
												GR - CB - ST -					
	* NO LAB ANALYSES											GR - CB - ST -					
												GR - CB - ST -					
												GR - CB - ST -					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
	10-40"	42	0	> 50 INCHES

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
	OCHRIC	CALCIC ?	10-30

Previous edition ... lete.

FS-2500-1 (2/86)

Marginal increase for calcic - correlate to Aridic Calciustept

USDA - Forest [redacted] Aridic Calciustoll FLUVENTIC HAPLUSTOLL

SOIL DESCRIPTION

(Reference [redacted] 2509.18)

RDV-5 UTM 4140[redacted]8

1. Map Unit Symbol: 4	2. Family or Series: Fi-loamy, mixed, super, mesic ~~HAPLUSTOLL~~	3. Date: 9/13/06	4. By: BC	5. Photo. No.: 13-14-15-16	6. Stop No.:	7. USGS Quad: ALTON
8. Location: Sec. ___ T. ___ R. ___						
9. Area: COAL HOLLOW	10. Forest:	11. Ranger District:	12. State: UT	13. County: KANE		
14. Parent Material: ALLUVIUM / RESIDUUM	15. Bedrock Name: MIXED SEDIMENTARY	16. Elevation:	17. Erosion: a. Kind: NONE b. Class:			
18. Landform: ALLUVIAL FAN SLOPE	19. Slope: a. % 4 b. Shape CONVEX c. Length 170' d. Aspect 250°	20. Drainage Class: WD	21. Surface Stone and Rock: a. GR 0 b. CB 0 c. ST 0 d. BY 0			
22. Potential Natural Vegetation: PINYON-JUNIPER W/ BIG SAGEBRUSH	23. Annual Precipitation: 15-17"	24. Measured Soil Temperature:	25. Water Table (Depth): NONE			

HORIZON DESIGNATION (a)	INCHES DEPTH (b)	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	LAB TEXTURE (d)	%C	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	LAB FIELD pH (i)	BOUNDARY (j)
A1	0-5	10YR 3/3	10YR 5/3	/	LOAM	18	2M-F GR	SO	VFR	SO/PO	/	GR-0 CB-0 ST-0	2VF 2F 1C	3VF IN 2F TU	SE	8.1	C,W
A2	5-10	10YR 3/4	10YR 5/4	/	LOAM	20	2M-F SBK	SH	FR	SO/PO	/	GR- CB- ST-	2F 1VF 1M-C	2VF-F IN	ST	8.1	G,W
BK ~~CKT~~	10-25	10YR 5/4 10YR 5/6	10YR 6/4 (80) 10YR 6/6 (20)	/	SANDY LOAM	14	2C-M SBK	HA	FI	SS/PO	/	GR- CB- ST-	1VF 1F	2VF-F TU	ST	8.4	A,S
2C1 ~~2C1~~	25-48	2.5Y 5/3	2.5Y 6/2	/	SILT LOAM	12	3M-C ABK	EH	EF	SS/SP	/	GR- CB- ST-	V,VF	1VF TU	ST	8.8	G,W
2C2	48-60	2.5Y 5/2	2.5Y 7/2	/	LOAM	22	MASSIVE	EH	EF	SS/PS	/	GR- CB- ST-	/	1VF TU	ST	9.0	
												GR- CB- ST-					
												GR- CB- ST-					
												GR- CB- ST-					
												GR- CB- ST-					

26. Partical Size Control Section	a. Depth: 10-40"	b. Average Clay %: 15	c. Average Rock Fragment Content: 0	27. Depth to Lithic or Paralithic Contact: >60 INCHES
28. Diagnostic Horizons	a. Surface: MOLLIC	b. Subsurface: CAMBIC / CALCIC		29. Moist Control Section Depth: 10-30"

FS 2509.1 (2/86)

USDA - Forest Service ~~Mollic~~ Aridic Calciustept ~~USTI FLUVENT OR~~

SOIL DESCRIPTION

(Reference Soil 2509.18)

ROV-6 UTM 4140247 = 0370927

1. Map Unit Symbol	2. Family or Series	3. Date	4. By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location:
3	~~co-loamy~~ fine-loamy ~~Haploboroll~~ 2	9-13-06	BC	17,18-19	ROV-6	ALTON	Sec. ___ T. ___ R. ___

9. Area	10. Forest	11. Ranger District	12. State	13. County
COOL HOLLOW	, mixed, super, mesic		UT	KANE

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion: a. Kind	b. Class
ALLUVIUM OVER RESIDUUM	TROK SHALE	68	NONE	

18. Landform	19. Slope: a. %	b. Shape	c. Length	d. Aspect	20. Drainage Class	21. Surface Stone and Rock: a. GR	b. CB	c. ST	d. BY
	3	PLANK	250'	290°	WD	0	0	0	0

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
BIG SAGEBRUSH - RABBITBRUSH	15-17"		>8 FT

HORIZON DESIGNATION (a)	INCHES DEPTH (b)	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	LAB TEXTURE (d)	%C	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	LAB FIELD pH (i)	BOUNDARY (j)
A1	0-6	10YR 3/4	10YR 5/3	/	LSAND	6	1MGR	LO	LO	SO/PO	/	GR - CB - ST -	3VF, F 2M, K	3VF IN	ST	8.1	C.W
A2	6-12	10YR 4/2	10YR 5/4	/	LSAND	6	1MSBK → SG	SO	VFR	SO/PO	/	GR - CB - ST -	2VF, 2F 1M	3VF IN	ST	8.3	C.S
BK1 ~~AC~~	12-24	10YR 4/3	10YR 6/3	/	LOAM	18	2M-F SBK	SH	FI	SS/PO	/	GR - CB - ST -	2VF 1F	2VF IN 1F TU	ST	8.0	A.S
BK2 ~~CK~~	24-34	10YR 4/3 10YR 4/6	10YR 6/3 10YR 6/6	(75) (25)	SANDY LOAM	8	3M-C SBK	HA	VH	SO/PO	/	GR - CB - ST -	1VF	2VF IN 1F TU	ST	8.3	G.S
2C	34-60	10YR 4/3	10YR 6/2	/	SILTY CLAY	40	MASSIVE	EH	EFI	VS/VP	/	GR - 0 CB - 0 ST - 0	1VF	1VF TU	SE	8.5	
												GR - CB - ST -					
												GR - CB - ST -					
												GR - CB - ST -					
												GR - CB - ST -					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
	10-40"	<10	0	>60"

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
	MOLLIC W/MIXNG	CALCIC	10-30"

PSC clay is 18.3% based on lab data

USDA - Forest Service

mixed, super, mesic

SOIL DESCRIPTION

(Reference FSH 2509.18)

RDV-7 UTM 03709.07 41408

1. Map Unit Symbol	2. Family or Series	3. Date	4. By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location:
4	Aridic Calciustoll Fine ~~Typic~~ ~~Ustorthent~~	9-13-06	BC	20.21	RDV-7	ALTON	Sec. ___ T. ___ R. ___

9. Area	10. Forest	11. Ranger District	12. State	13. County
Coal Hollow	Approx. 2 mi SE of Alton Private Land		UT	KANE

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion: a. Kind	b. Class
Alluvium over Residuum	Mixed Alluvium / Tropic Shale		None	

18. Landform	19. Slope: a. %	b. Shape	c. Length	d. Aspect	20. Drainage Class	21. Surface Stone and Rock: a. GR	b. CB	c. ST	d. BY
Fanslope	3	SL convex	150'	255°	SPD	0	0	0	0

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
Big Sagebrush - Rabbitbrush	15-17"		>6 ft

HORIZON DESIGNATION (a)	INCHES DEPTH (b)	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	LAB TEXTURE (d)	%C	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	LAB FIELD pH (i)	BOUNDARY (j)
A1	0-6	10YR 3/2	10YR 5/2	/	Clay Loam	23	1M-F GR	SO	VFR	SS/PS	/	GR - CB - ST -	3VF 3F 2M, 1C	3VF IN	SE	7.5	C, W
A2	6-12	10YR 4/3	10YR 5/2	/	Clay	44	2M-F SBK	HA	FI	VS/VP	/	GR - CB - ST -	2VF 2F, M 1C	2VF IN 1F TV	SE	7.6	G, W
2BK1	12-24	2.5Y 4/2	2.5Y 6/2	/	Clay	47	2C-M ABK	HA	EFI	VS/VP	/	GR - CB - ST -	1F, 1M	1VF TV	ST	8.0	G, S
2BK2	24-60	2.5Y 4/3	2.5Y 6/2	/	Clay	44	3C-M ABK	VH	EFI	VS/VP	/	GR - 0 CB - 0 ST - 0	/	1VF TV	ST	8.0	
												GR - CB - ST -					
												GR - CB - ST -					
												GR - CB - ST -					
												GR - CB - ST -					
												GR - CB - ST -					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
	10-40"	45	0	>60"

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
	Mollic w/ Mixing	Calcic	10-30"

FS 2509.1 (2/86)

SOIL DESCRIPTION

(Refer to SH 2509.18) KUDAM

UTM 0371[illegible] 4139829

USDA - Forest Service: Super, mesic Aridic Calciustoll

1. Map Unit Symbol: ~~3~~ 4	2. Family or Series: Fi-loamy mixed, ~~Entic~~ ~~Argi~~ ustoll	3. Date: 9-12-06	4. By: BC	5. Photo. No.: 2 PITS	6. Stop No.: 1YR-8	7. USGS Quad: ALTON	8. Location: Sec. ___ T. ___ R. ___
9. Area: COAL HOLLOW 1YR MINE	10. Forest: 3 MI. SE OF ALTON PRIVATE LAND			11. Ranger District:		12. State: UTAH	13. County: KANE
14. Parent Material: ALLUVIUM	15. Bedrock Name: MIXED SEDIMENTARY			16. Elevation:		17. Erosion: a. Kind: NONE b. Class:	
18. Landform: ALLUVIAL FAN	19. Slope: a. % 2 b. Shape: CONCAVE c. Length: 100' d. Aspect: 230'			20. Drainage Class: WELL WD		21. Surface Stone and Rock: a. GR 0 b. CB 0 c. ST 0 d. BY 0	
22. Potential Natural Vegetation: BIG SAGEBRUSH, PINYON, CHNA				23. Annual Precipitation: 15-17"		24. Measured Soil Temperature:	25. Water Table (Depth): >7 1/2 FT

HORIZON DESIGNATION (a)	DEPTH (b)	COLOR (c) Moist (1)	COLOR (c) Dry (2)	COLOR (c) Mottling (3)	TEXTURE (d) (LAB)	%C	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	CONSISTENCE (f) Moist (2)	CONSISTENCE (f) Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	FIELD pH (i) (LAB)	BOUNDARY (j)
A8	0-8	10YR 3/3	10YR 5/3		SILT LOAM	30 22	1MPL → 2MGR	SE	FR	SS PO		GR - 0 CB - 0 ST - 0	3VF 2F, M	3VF IN	NE	8.0	C, S
Bwk AB ~~BK~~	8-14	10YR 4/3	10YR 6/3		SICL CLAY LOAM	30	2M-F SBK	HA	FI	S/P		GR - 0 CB - 0 ST - 0	2VF 1F, M	2VF IN 1F TU	SE	8.1	C, W
Bwk BW ~~BK~~	14-22	10YR 4/4	10YR 7/3		LOAM SICL	22	2C-A SBK	HA	VFI	S/P		GR - 0 CB - 0 ST - 0	1F, 1VF	1VF, F TU	ST	8.5	C, W
Bwk BW2 ~~BK~~	22-45	10YR 5/4	10YR 7/3		LOAM SIL	16	2M-F SBM	HA	VFI	SO PO		GR - 0 CB - 0 ST - 0	1VF	1VF, F TU	ST	8.9	G S
2C1	45-65	10YR 5/4	10YR 7/4		LOAMY SAND SL	8 14	MASSIVE	SO	FR	SO PO		GR - 0 CB - 0 ST - 0	1VF	1VF TU	ST	9.0	G, S
2C2	65-85	10YR 5/3	10YR 7/4		LOAMY SAND SL	8 12	MASSIVE					GR - 0 CB - 0 ST - 0		3VF IN	SE	8.9	
												GR - CB - ST -					
			A	0-5"	CLAY		LOAM TEXTURES					GR - CB - ST -					
												GR - CB - ST -					

26. Partical Size Control Section	a. Depth: 10-40"	b. Average Clay %: 19	c. Average Rock Fragment Content: 0	27. Depth to Lithic or Paralithic Contact: >60"
28. Diagnostic Horizons	a. Surface: MOLLIC W/ MIXING	b. Subsurface: CAMBIC		29. Moist Control Section Depth: 10-30"

FS 2509.1 (2/86)

USDA - Forest Service

SOIL DESCRIPTION

Aridic Calciustoll ~~FLUVENTIC HAPLUSTOLL~~ (Refer to Soil 2509.18)

UTM 4138-21

1. Map Unit Symbol: 6	2. Family or Series: ~~FI-SILTY~~ (UR FI-10) mixed, super, mesic HAPLUSTOLL	3. Date: 9-12-06	4. By: BC	5. Photo. No.	6. Stop No.: 1YR9A	7. USGS Quad: ALTON	8. Location: Sec. ___ T. ___ R. ___
9. Area: 1 YEAR MINE	10. Forest: 3 MILES SOUTH OF ALTON PRIVATE LAND			11. Ranger District		12. State: UTAH	13. County: KANE
14. Parent Material: MIXED ALLUVIUM	15. Bedrock Name: ALLUVIUM FRM STRAIGHT CLIFFS			16. Elevation		17. Erosion: a. Kind: None b. Class	
18. Landform: FANSLOPE BASIN	19. Slope: a. % 4 b. Shape CONCAVE c. Length 75' d. Aspect 315°			20. Drainage Class: WD → SPD		21. Surface Stone and Rock: a. GR 0 b. CB 0 c. ST 0 d. BY 0	
22. Potential Natural Vegetation: GRASS + SEDGES w/ FEW SAGEBRUSH				23. Annual Precipitation: 15-17		24. Measured Soil Temperature	25. Water Table (Depth): > 7 FEET

HORIZON DESIGNATION (a)	DEPTH (b)	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	LAB TEXTURE (d)	%C	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	LAB FIELD pH (i)	BOUNDARY (j)
Oe	1½-0	ROOT	MAT				2					GR - 0 CB - 0 ST - 0			SL		
A	0-12	10YR 3/3	10YR 5/3		SANDY LOAM → SL	8 20	2M-F GR	SO	FR	SO/PO		GR - 0 CB - 0 ST - 0	3VF 2F	3VF IN	SE	9.1	C,S
Bw	12-24	10YR 4/3	10YR 6/3		SANDY LOAM	10 22	2M-F SBK	HA	FI	SS/PS		GR - 0 CB - 0 ST - 0	2VF 2F	2VF IN 1F-M TU	SE	9.6	C,S
Bwk	24-42	10YR 5/4	10YR 7/3		SANDY LOAM	10	2M-C SBK	HA	VFI	SS/PS		GR - 0 CB - 0 ST - 0	2VF 1F	2VF, 1M 2F TU	SE	9.6	C,S
BK ~~Bg~~	42-70	10YR 5/4 10YR 5/6	10YR 7/4 (80) 10YR 7/6 (20)	FEW FAINT T.STR 4/6	SANDY LOAM	10	MASSIVE	HA	FI	SO/PO		GR - 0 CB - 0 ST - 0	1VF, 1F	1VF-F TU	SE	9.4	A,S
2Cg 2	70-100	2.5Y 5/2	2.5Y 6/1	COMMON DISTINCT 10YR 6/6	CLAY SLOAM	39	MASSIVE	SH	FR	SO/PO		GR - 0 CB - 0 ST - 0	1VF	1VF TU	NE	8.5	A,S
												GR - CB - ST -					
												GR - CB - ST -					
												GR - CB - ST -					

26. Partical Size Control Section	a. Depth: 10-40"	b. Average Clay %: 10	c. Average Rock Fragment Content: 0	27. Depth to Lithic or Paralithic Contact: > 8 FEET
28. Diagnostic Horizons	a. Surface: MOLLIC	b. Subsurface: CAMBIC		29. Moist Control Section Depth: 10-30"

Calcic based on lab data

SOIL DESCRIPTION

(Refer [illegible] 2509.18)

USDA - Forest Service: [illegible] FINE-LOAMY [illegible] CALCIAQUOLL

03/11/14
DTM 4[illegible] 714

1. Map Unit Symbol	2. Family or Series	3. Date	4. By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location:
6	FINE-LOAMY CO-LOAMY ~~CALCI AQUOLL~~ mixed, super, frigid	9-12-06	BC	2 PITS	1 R 9 B	ALTON	Sec. ___ T. ___ R. ___

9. Area	10. Forest	11. Ranger District	12. State	13. County
COAL HOLLOW MINE YEAR 1	3 MI SE ALTON PRIVATE LAND		UTAH	KANE

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion: a. Kind	b. Class
ALLUVIUM	TROPIC + MIXED SEDS	68	NONE	

18. Landform	19. Slope: a. %	b. Shape	c. Length	d. Aspect	20. Drainage Class	21. Surface Stone and Rock: a. GR	b. CB	c. ST	d. BY
BASIN - FANSLOPE	1	CONCAVE	75	190	SPD	0	0	0	0

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
GRASSY MEADOW W/ SAGE + RABBIT BRUSH	15-17"		57" 56 (1 WK LATER)

HORIZON DESIGNATION (a)	DEPTH (b)	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	TEXTURE (d) (LAB)	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	FIELD pH (i) (LAB)	BOUNDARY (j)
Ag	0-6	2.5Y 4/1	2.5Y 4/2	/	SiL LOAM 24 22	1M GR	SO	FR	SS PS	/	GR - 0 CB - 0 ST - 0	3C 2VF 2M 2F	3VF TU	SE	8.0	CS
Bk Ag ABG	6-11	2.5Y 4/2	2.5Y 5/2	FEW FAINT PROCESS	SANDY CLAY SiCL 23 27	2M-C GR	SH	FI	SS PS	/	GR - 0 CB - 0 ST - 0	3M 2F 2VF	2VF TU	SE	8.2	AS
Bk Ag	14-28	2.5Y 4/1	[illegible]	COMMON PROMINENT	SANDY LOAM SiCL 14	2M-F SBK	HA	FI	SS/PS	/	GR - 0 CB - 0 ST - 0	1VF 1F,M	2VF TU	ST ~~SE~~	8.5	AS
BC	28-48	2.5Y 5/4	[illegible]	MANY PROMINENT	SANDY LOAM SiC 16	WET	HA	FI	SS/PS	/	GR - 0 CB - 0 ST - 0	1F,M	1VF TU	ST ~~NE~~	8.3	AS
BC				MANY PROMINENT		WET					GR - 0 CB - 0 ST - 0	1VF		NE		AS
											GR - CB - ST -					
											GR - CB - ST -					
											GR - CB - ST -					
											GR - CB - ST -					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
		lab 16%		

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
		calcic	

FS 2509.1 (2/86)

USDA - Forest Service

SOIL DESCRIPTION

(Refer to FSH 2509.18) 5 (k)

0370865 UTM 4139873

1. Map Unit	2. Family or Series	3. Date	4. By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location:
4	Aridic ~~Typic~~ Calciustoll; fine-loamy, mixed (or Haplustalf) ~~Ustifluvent~~	9/18/06	BC	18-P	14R-10	Alton	Sec. ___ T. ___ R. ___

9. Area	10. Forest	11. Ranger District	12. State	13. County
YR 1 Coal Mine	super, mesic		Utah	Kane

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion: a. Kind	b. Class
Alluvium + Colluvium	Mixed Sedimentary		None	

18. Landform	19. Slope: a. %	b. Shape	c. Length	d. Aspect	20. Drainage Class	21. Surface Stone and Rock: a. GR	b. CB	c. ST	d. BY
Footslope	4	convex	120'		WD	0	0	0	0

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
Juniper-Pinyon W / Big Sagebrush	15-17"		>

HORIZON DESIGNATION (a)	DEPTH (b)	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	TEXTURE (d) (LAB %C)	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	LAB FIELD pH (i)	BOUNDARY (j)
A	0-2" / 0-7	Cubical 10YR 3/3 10YR 3/3	Crust 1 10YR 6/3 10YR 5/3	/	SL Loam 26	2M-FPL 2M-F GR	SO	VFR	S/P	/	CR-0 CB-0 ST-0	3VF 2F 1M-C	3VF IN	SE	7.8	C, S
Bk	7-13	10YR 4/3	10YR 5/2	/	Loam SIL Loam 26	2M-C SBK	SO	VFR	S/P	1MHOF	CR-0 CB-0 ST-0	3VF 2F 1M.C	2VF IN 1F TU	SE	7.7	C, S
Bw2 (Bt2)	13-26	10YR 4/3	10YR 6/3	/	SIC 34 23	1M-C SBK	SH	FR	SS/PS	1MPF 2M HOO	CR-0 CB-0 ST-0	2VF 1F	2VF IN 1F TU	ST	7.9	C, W
Bk	26-44	10YR 5/3 10YR 5/6	10YR 7/3 (TS) 10YR 7/6 (ES)	/	Clay Loam SIL 34 28	2M-C SBK	HA	FI	SS/PS	/	CR-0 CB-0 ST-0	1VF	1VF-F TU	ST	8.3	G, S
Bk2 (2C)	44-68	10YR 5/3 10YR 5/6	10YR 7/3 10YR 7/4	?	Silty Clay SIL 32 26	Massive Laminar	VH	FI	SS/PS	/	CR-0 CB-0 ST-0	1VF	1VF-F TU	ST	8.5	G. S
2Ck (2C2)	68-84+	10YR 5/4 10YR 6/8	10YR 7/3 10YR 7/6	Moist Silt Layers	Sandy Loam 10 7	Massive Laminar	SO	VFR	SO/PO	/	CR-0 CB-0 ST-0	/	1VF TU	ST	8.4	
											CR- CB- ST-					
											CR- CB- ST-					
											CR- CB- ST-					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
	10-40"	27	0	>8 Feet

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
	~~Ochric~~ Mollic	~~Argillic~~ Cambic, Calcic	10-30"

Previous edition obsolete.

FS-2500-1 (2/86)

USDA - Forest Service

Aridic Calciustoll

SOIL DESCRIPTION

(Refer to SH 2509.18)

UTM 4138[illegible]

1. Map Unit Symbol: 4	2. Family or Series: Co-Loamy ~~Typic~~ ~~Haplobroll~~	3. Date: 9/13/06	4. By: BC	5. Photo. No.: PIT 22-23 LANDSCAPE	6. Stop No.: 1YR-11	7. USGS Quad: ALTON	8. Location: Sec. ___ T. ___ R. ___
9. Area: COAL HOLLOW SURVEY	10. Forest: mixed, super, mesic			11. Ranger District: 24		12. State: UTAH	13. County: KANE
14. Parent Material: ALLUVIUM / RESIDUUM?	15. Bedrock Name: ALLUVIUM / DAKOTA FM			16. Elevation:		17. Erosion: a. Kind: NONE b. Class:	
18. Landform: ALLUVIAL FAN	19. Slope: a. % 4 b. Shape SL CONVEX c. Length 100' d. Aspect 280°			20. Drainage Class: MWD - MOD		21. Surface Stone and Rock: a. GR 2 b. CB TT c. ST 0 d. BY 0	
22. Potential Natural Vegetation: BIG SAGEBRUSH - JUNIPER -				23. Annual Precipitation: 15-17"		24. Measured Soil Temperature:	25. Water Table (Depth): > 8 1/2 FEET

HORIZON DESIGNATION (a)	INCHES DEPTH (b)	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	LAB TEXTURE (d)	%C	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	LAB FIELD pH (i)	BOUNDARY (j)
A11	0-5	10YR 3/2	10YR 5/2	/	SC	9 12	1MPL → 1FGR	LO	FR	SO/PO	/	GR - 2 CB - 2 ST - 0	2F-M 1VF	3VF IN	NE	8.0	C,W
A12	5-16	10YR 3/3	10YR 5/3	/	SANDY LOAM FSL	14 15	1F SBK → 1M GR	SO	FR	SO/PO	/	GR - 1 CB - 0 ST - 2	2F 1M,VF	2VF IN 2F TU	NE	8.2	G,W
Bwk1	16-32	10YR 4/3	10YR 6/3	/	SANDY LOAM	10	2M-F SBK	SH	FI	SO/PO	/	GR - 2 CB - 0 ST - 0	1VF-F	2VF, 1F TU	SE	8.3	G,W
Bwk2	32-48	10YR 5/3	10YR 6/3	/	LOAMY SAND	8	MASSIVE	HA	FI	SS/PO	/	GR - 0 CB - 0 ST - 0	1VF	2VF, 1F TU	SE	8.3	G,W
BK	48-72	10YR 4/4	10YR 6/4	/	LOAMY SAND	8	MASSIVE	HA	FI	SS/PO	/	GR - 3 CB - 1 ST - 0	1VF	2VF TU	ST	8.6	C,S
C	72-90	10YR 5/4	10YR 7/4	/	SAND	4	MASSIVE	SH	FI	SS/PO	/	GR - 4 CB - 1 ST - 0	1VF	3VF IN	ST	8.7	
												GR - CB - ST -					
												GR - CB - ST -					
												GR - CB - ST -					

26. Partical Size Control Section	a. Depth: 10-40"	b. Average Clay %: 13	c. Average Rock Fragment Content: 2	27. Depth to Lithic or Paralithic Contact: >90"
28. Diagnostic Horizons	a. Surface: MOLLIC	b. Subsurface: CAMBIC, CALCIC		29. Moist Control Section Depth: 10-30"

FS 2509.1 (2/06)

USDA - Forest Service

Aridic Calciustept

SOIL DESCRIPTION (Refer FSH 2509.18) 63-64(K) UTM

1. Map Unit	2. Family or Series	3. Date	4. By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location: Sec. ___ T. ___ R. ___
23	FINE, ~~SMECTITIC~~, TYPIC ~~USTORTHENT~~	9-19-06	BC	21 (P)	1YR-12	ADAM	

9. Area	10. Forest	11. Ranger District	12. State	13. County
MINE YEAR 1 COAL HOLLOW SOIL SURVEY	mixed, super, moderately deep, mesic		UTAH	KANE

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion: a. Kind	b. Class
RESIDUM / COLLUVIUM	DAKOTA SS w/ TRIPIC SHALE		NONE	

18. Landform	19. Slope: a. %	b. Shape	c. Length	d. Aspect	20. Drainage Class	21. Surface Stone and Rock a. GR	b. CB	c. ST	d. BY
KNOLL, ~~ERODED~~	8	SLIGHTLY CONVEX	75'	90°	WD	2	2	0	0

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
LOW SAGEBRUSH w/ ~~DWARF~~ UTAH JUNIPER + GRASSES			NONE TO 4½ FEET

HORIZON DESIGNATION (a)	DEPTH (inches) (b)	COLOR (c) Moist (1)	COLOR (c) Dry (2)	COLOR (c) Mottling (3)	TEXTURE (LAB) (d)	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	CONSISTENCE (f) Moist (2)	CONSISTENCE (f) Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	SPECIAL FEATURES (g) Roots (3)	SPECIAL FEATURES (g) Pores (4)	EFFER. CLASS (h)	LAB FIELD pH (i)	BOUNDARY (j)
A	0-5	10YR 3/3	10YR 5/3	/	CLAY LOAM 22	1 MPL → FGR	SO	FR	S/P	/	GR-0 CB-0 ST-0	2VF-F 2M 1C	3VF-M INF TU	NE → SE	7.8	CS
Bw	5-10	10YR 4/3	10YR 6/3	/	CLAY LOAM SICL 32	3 M-F ABK	HA	FI	VS/VP	/	GR-5 CB-3 ST-0	2VF-F 1M 1C	2VF-1F TU	SE	7.8	CW
Bwk	10-26	2.5Y 5/3	2.5Y 7/2	/	SILTY CLAY SICL 44	3 M-C ABK	EH	EF	VS/VP	/	GR-0 CB-5 ST-10	1VF-F	2VF TU	SE	8.4	CW
Cr	26-44	TRIPIC SHALE BEDROCK		/	SICL	3 CPR MASSIVE	EH	EF	VS/VP	/	GR-0 CB-0 ST-10	1VF	1VF TU	SE	8.3	CS
											GR- CB- ST-					
											GR- CB- ST-					
											GR- CB- ST-					
											GR- CB- ST-					
											GR- CB- ST-					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
	10-26"	37	11	26"

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
	OCHRIC	/ calcic	10-26"

based on lab data

Previous edition obsolete.

FS-2500-1 (2/86)

USDA - Forest Service

Aridic Calciustept (Reference - FSH 2509.18) 56-57(K) UTM 4139915

1. Map Unit Symbol	2. Family or Series	3. Date	4. By	5. Photo No.	6. Stop No.	7. USGS Quad	8. Location: Sec. ___ T. ___ R. ___
3	Fi-Loamy mixed, super, mesic ~~Aridic~~ ~~USFF Fluvent~~	9-18-86	BC	49 (P)	DR-13	ALTON	

9. Area	10. Forest	11. Ranger District	12. State	13. County
SETTLING POND YELLOW MINE			UT	KANE

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion: a. Kind	b. Class
Alluvium	MIXED SEDIMENTARY	68	NONE	

18. Landform	19. Slope: a. %	b. Shape	c. Length	d. Aspect	20. Drainage Class	21. Surface Stone and Rock: a. GR	b. CB	c. ST	d. BY
FANSLOPE	2	CONCAVE	125'	270	WD	0	0	0	0

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
BIG SAGEBRUSH - RABBITBRUSH	15-17		NONE TO 8 FT

HORIZON DESIGNATION (a)	DEPTH (b)	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	TEXTURE (d)	%C	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	LAB FIELD pH (i)	BOUNDARY (j)
A	0-6	10YR 4/3	10YR 5/3	/	SANDY LOAM	21	2M-F GR	SO	VFR	SO/PO	/	GR-0 CB-0 ST-0	3VF 2F 1M	3VF-IN 1F TU	SE	8.5	A.S
BK Ac.	6-12	10YR 5/3 10YR 6/6	10YR 6/3 (80) 10YR 6/4 (20)	/	SILT LOAM	26	2M-F SBK	SH	FI	SS/PO	/	GR-0 CB-0 ST-0	3VF 2F 1M	2VF-IN 2F-M TU	SE	8.2	A.S
2BK 2C2	12-24	10YR 5/3 10YR 5/6	10YR 6/3 (85) 10YR 6/6 (15)	/	SILTY CLAY	48	3F SBK	HA		S/P	/	GR-0 CB-0 ST-0	2VF 1F 1M	1VF-F-M TU	ST	8.4	A.S
2BK3 2C3	24-34	7.5YR 5/4 7.5YR 5/8	10YR 7/3 (75) 7.5YR 6/8 (25)	/	CLAY LOAM SiCL	32	2M-CPR → 2ABK	VH		S/P	/	GR-0 CB-0 ST-0	1F 1VF	1F-M TU	ST	8.5	A.S
2BK4 2C4	34-48	7.5YR 5/3 7.5YR 5/4	10YR 6/4 (75) 7.5YR 6/4 (25)	/	CLAY LOAM SiCL	28	2M-C ABK	VH		S/P	/	GR-0 CB-0 ST-0	1VF	1VF-F TU	ST	8.8	A.S
C1	48-60	10YR 4/3 10YR 4/6	10YR 5/4 (80) 10YR 5/6 (20)	/	SANDY CLAY	24	MASSIVE	VH		S/P	/	GR-0 CB-0 ST-0	/	1VF-F TU	ST	8.9	A.S
C2 C6	60-84	10YR 5/3 10YR 5/6	10YR 7/3 (60) 10YR 6/6 (40)	/	LOAM	20	MASSIVE	SO	FR	SO/PO	/	GR-0 CB-0 ST-0	/	2VF 1N	ST	8.7	
												GR- CB- ST-					
												GR- CB- ST-					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
	10-40"	33	0	> 8 FEET

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
	OCHRIC	/	10-30'

Previous edition obsolete. FS-2500-1 (2/86)

USDA - Forest Service

Aquic Calciustept

SOIL DESCRIPTION

(Refer [illegible] 2509.18)

UTM 4139772

1. Map Unit Symbol: 6	2. Family or Series: FI-LOAMY ~~AQUIC USTIFLUVENT~~ ~~AQUOLL~~	3. Date: 9-13-00	4. By: BC	5. Photo. No.: PI4 25-27	6. Stop No.: SP14	7. USGS Quad: ALTON
8. Location: Sec. ___ T. ___ R. ___						
9. Area: COAL HOLLOW	10. Forest: mixed, super, frigid	11. Ranger District:	12. State: UT	13. County: KANE		
14. Parent Material: ALLUVIUM	15. Bedrock Name: ALLUVIUM / RESIDUUM	16. Elevation:	17. Erosion: a. Kind: NONE b. Class:			
18. Landform: BASIN	19. Slope: a. % 1 b. Shape CONCAVE c. Length 100' d. Aspect 350'	20. Drainage Class: SPD	21. Surface Stone and Rock: a. GR 0 b. CB 0 c. ST 0 d. BY 0			
22. Potential Natural Vegetation: GRASS + SEDGES	23. Annual Precipitation: 15-17"	24. Measured Soil Temperature:	25. Water Table (Depth): 90-100"			

HORIZON DESIGNATION (a)	INCHES DEPTH (b)	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	LAB TEXTURE (d)	%C	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	LAB FIELD pH (i)	BOUNDARY (j)
A1	0-6	10YR 3/2	10YR 5/3	NO	SILT CLAY	44	2M-F GR	SO	FR	SS/P	/	GR-0 CB-0 ST-0	3VF 3F 1M	3VF IN	NE	8.7	C,S
Bwk A2	6-13	7.5YR 4/4	7.5YR 5/4	NO	SILTY CLAY	44	1F SBK	VH	VFI	SS/P	/	GR-0 CB-0 ST-0	2VF 2F 1M	2VF TU	SE	7.8	C,W
2BWK ~~2C1~~	13-28	10YR 6/4	10YR 7/3	beginned 24"	CLAY LOAM SICL	27	2M-F SBK	HA	FI	SS/PS	/	GR-0 CB-0 ST-0	1VF	1VF TU	SE	8.1	G,W
2BWK 2C2	28-48	10YR 7/2	10YR 6/3	YES	LOAM	17	2F SBK	HA	VFI	SO/PO	/	GR-0 CB-0 ST-2	1VF	1VF TU	ES	8.7	G,S
3Cg 1	48-70	10YR 5/3 10YR 6/6	10YR 7/2 (60) 10YR 7/6 (40)	FAINT INDISTINCT YES	SILT LOAM	39	MASSIVE	HA	VFI	SO/PO	/	GR-0 CB-0 ST-0	/	1VF-1F TU	ES	8.8	A,S
3Cg 2	70-90	10YR 5/4	10YR 6/3	MANY DISTINCT YES 10YR 6/8	SILT LOAM	32	MASSIVE	VH	VFI	S/P	/	GR-4 CB-0 ST-0	/	1VF TU	SE	8.5	
												GR- CB- ST-					
												GR- CB- ST-					
												GR- CB- ST-					

26. Partical Size Control Section	a. Depth: 10-40"	b. Average Clay %: 24"	c. Average Rock Fragment Content: 3	27. Depth to Lithic or Paralithic Contact: >90"
28. Diagnostic Horizons	a. Surface: MOLLIC	b. Subsurface: —		29. Moist Control Section Depth: 10-30"

lab data shows calcic

6 SAMPLES COARSE-LOAMY ~~[illegible]~~ ~~[illegible]~~ (Reference FSH 2509.18) 6162 (V) 1 UTM

1. Map Unit	2. Family or Series	3. Date	By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location:
6	~~[illegible]~~ mix, super, mesic ~~[illegible]~~	9-19-86	BC	21 P	SP-15	ALTON	Sec. ___ T. ___ R. ___

9. Area	10. Forest	11. Ranger District	12. State	13. County
SETTLING PONDS COAL HOLLOW SOILS SURVEY			UTAH	KANE

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion: a. Kind	b. Class
ALLUVIUM / RESIDUUM	MIXED SEDIMENTARY		NONE	

18. Landform	19. Slope: a. %	b. Shape	c. Length	d. Aspect	20. Drainage Class	21. Surface Stone and Rock: a. GR	b. CB	c. ST	d. BY
BASIN	2	CONCAVE	75'	260°	WD	0	0	0	0

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
GRASS - SEDGES w/ LOW SAGEBRUSH	15-17 INCHES		NONE TO 8½ FEET

HORIZON DESIGNATION (a)	DEPTH (b) INCHES	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	LAB TEXTURE (d)	%C	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	LAB FIELD pH (i)	BOUNDARY (j)
OE	1-0	DENSE ROOT	MAT									GR - CB - ST -			NE		A,S
A	0-8	10YR 3/3	10YR 5/3	/	SILT ~~LOAM~~ SANDY LOAM	16 21	2M-C GR	SO	FR	SS/PO	/	GR - 0 CB - 0 ST - 0	3VF 3F,M	2VF IN	SE/NE	8.0	A,S
BW	8-20	10YR 4/4	10YR 6/3	/	SIL LOAM	18 26	2M-F SBK	HA	FI	S/P	/	GR - 0 CB - 0 ST - 0	2VF-F 1M	3VF IN 2F TN	~~NE~~ → ~~SE~~ ST	8.5	A,W
BK1	20-37	10YR 5/3 10YR 5/6	10YR 7/3 10YR 7/4	/	FSL → SIL LOAM	15 26	3M-C SBK	VH	VFI	S/P	/	GR - 0 CB - 0 ST - 0	2VF 1F,M	1VF-1F TN	ST ~~SE~~	8.7	A,S
BK2	37-58	10YR 5/4	10YR 7/3	~~ORGANIC MATTER~~	LOAM SIL	18 23	2M-C SBK	SH	FI	S/P	/	GR - 0 CB - 0 ST - 0	1VF-1F	1VF-TN	ST ~~SE~~	8.6	A,W
C1	58-73	10YR 5/4 10YR 5/8	10YR 6/4 10YR 6/6	COMMON PROMINENT	SL	8 15	MASSIVE	SO	VFR	SO/PO		GR - 0 CB - 0 ST - 0	1VF 1F	/	VE ~~NE~~	8.4	A S
C2	73-96	10YR 5/4 10YR 5/8	10YR 7/3 10YR 7/6	COMMON PROMINENT	SL	14	MASSIVE	SO	FR	SO/PO	/	GR - 0 CB - 0 ST - 0	/	/	VE ~~NE~~	8.3	
												GR - CB - ST -					
												GR - CB - ST -					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
	10-40"	16	0	> 9 FEET

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
	MOLLIC	CAMBIC CALCIC	10-30"

Previous edition obsolete. FS-2500-1 (2/86)

USDA - Forest Service

FINE-LOAMY ~~Typic Calciustoll~~ Aquic Calciustoll SOIL DESCRIPTION (Reference FSH 2509.18) 59-60K

1. Map Unit Symbol	2. Family or Series	3. Date	4. By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location:
6	~~Fi-Sil~~ (or FI-LD) mixed, super, mesic ~~[illegible]~~	9-19-06	BC	20-P	SP-16	ALTON	Sec. ___ T. ___ R. ___

9. Area	10. Forest	11. Ranger District	12. State	13. County
SETTLING PONDS COAL HOLLOW			UTAH	KANE

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion:
ALLUVIUM / RESIDUUM	ALLUVIUM MIXED SEDIMENTARY		a. Kind NONE b. Class

18. Landform	19. Slope:	20. Drainage Class	21. Surface Stone and Rock
BASIN	a. % 1-2 b. Shape CONCAVE c. Length 160' d. Aspect 310	WD	a. GR 2 b. CB 0 c. ST 0 d. BY 0

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
GRASS + SEDGES	15-17"		> 8 FEET

HORIZON DESIGNATION (a)	DEPTH (b)	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	LAB TEXTURE (d) %C	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	LAB FIELD pH (i)	BOUNDARY (j)
Oe	1½-0	DENSE ROOT MAT.								/	GR - 0 CB - 0 ST - 0			NE		A.W
A1	0-8	10YR 3/2	10YR 4/2		SILTY CLAY LOAM 36	3M-F GR	SO	FR	S/P	/	GR - 0 CB - 0 ST - 0	3VF 3F 3M	3VF 3F 3M	NE	8.3	C.S
BW A2	8-18	7.5YR 5/6	10YR 6/3	/	SILT 44 CLAY 28	2F SBK → cgr	SH	FR	S/P	/	GR - 0 CB - 0 ST - 0	2VF-F 2M 1C	2VF-F 2M 1C	NE	8.2	C.S
BK1	18-36	7.5YR 5/4	7.5YR 7/3	/	CLAY LOAM 28 SIL 27	3M-F ABK	VH	VFI	S/P		GR - 0 CB - 0 ST - 0	2VF 2F	2VF 2F	SE	8.7	A.S
BK2	36-56	7.5YR 5/4	7.5YR 7/4	FEW FAINT 7.5YR 5/6	SILTY CLAY SIL 28 29	2M-C SBK	HA	FI	S/P	/	GR - 0 CB - 0 ST - 0	2F 1VF	2VF 1VF	SE	9.0	A.S
2Cg 1	56-68	7.5YR 5/4 7.5YR 5/6	7.5YR 7/3 7.5YR 7/4	FEW FAINT 7.5YR 4/6	LOAM SIL 14 27	MASSIVE	HA	FI	S/P	/	GR - 0 CB - 0 ST - 0	1VF-F	1VF-F	SE → NE	8.9	A.S
2Cg 2	68-96	2.5Y 5/2	2.5Y 6/2	COMMON PROMIN 5YR 5/6	SCL → SIL 28 30	MASSIVE	HA	VFI	SS/PS	/	GR - 0 CB - 0 ST - 0	1F 1VF	1F 1VF	NE	8.9	
					CLAY LOAM						GR - CB - ST -					
											GR - CB - ST -					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
	10-40"	31	0	> 8 FEET

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
	MOLLIC	CAMBIC calcic	10-30"

FS-2500-1 (2/86)

Previous edition [illegible] lete.

does not make Aquic Calciustoll because mottles are deeper than 30"

USDA - Forest Service

Aridic ~~Fine~~ Calciustoll

SOIL DESCRIPTION

(Refer [illegible] FSH 2509.18) 16-17(P)

UTM 0371420 41404

1. Map Unit Symbol	2. Family or Series	3. Date	4. By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location: Sec. ___ T. ___ R. ___
4	Fine-Loamy ~~Ar~~ Calciustoll	9-18-06	BC	53-54 (V)	WRD-17	Alton	

9. Area	10. Forest	11. Ranger District	12. State	13. County
Waste Rock Dump Coal Hollow Survey	2½ mi. SE of Alton		Utah	Kane

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion: a. Kind	b. Class
Alluvium + Colluvium	Mixed Sedimentary		None	

18. Landform	19. Slope: a. %	b. Shape	c. Length	d. Aspect	20. Drainage Class	21. Surface Stone and Rock: a. GR	b. CB	c. ST	d. BY
Fanslope	3	Planar	200'	210°	WD	0	0	0	0

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
Wyo Big Sagebrush - Rabbitbrush w/ P-J.	15-17"		None to

Horizon Designation (a)	Depth (b)	Color (c) Moist (1)	Dry (2)	Mottling (3)	Texture (d) (LAB)	Structure (e)	Consistence (f) Dry (1)	Moist (2)	Wet (3)	Special Features (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	Effer. Class (h)	Field pH (i) (LAB)	Boundary (j)
A	0-9	10YR 3/3	10YR 5/3	/	Clay Loam Sicl 36 28	3 m-cpl → Fgr	SO	FR	S/P	/	GR - 1 CB - 0 ST - 0	3VF 2F, M 1C	3VF IN 1F TU	SE	7.8	C, S
BW	9-18	10YR 4/3	10YR 6/3	/	Clay Loam Sicl 32 30	2 M-F ABK	VH	VF	S/P	2 mk PF, 1 nPO	GR - 2 CB - 0 ST - 0	2VF 1F 1M 1C	1VF-F TU	SE	8.0	C, S
BK1	18-30	10YR 4/3 10YR 5/8	10YR 6/4 (70) 10YR 6/6 (30)	/	Loam or Sicl 22	3 M-F ABK	VH	VFI	S/P	2 mk PF 1 nPO	GR - 2 CB - 0 ST - 0	1VF 1F, M	1VF-F TU	SE	8.0	G, W
BK2	30-45	10YR 4/4	10YR 6/3	/	Clay Loam Sicl 27	3 M-F ABK	VHA	VFI	S/P	2 nPO 1 nPF	GR - 2 CB - 0 ST - 0	1F, VF	1F-M TU	4VFF CAM ST	8.1	G, W
CK1	45-60	10YR 5/4 7.5YR 5/6	10YR 7/3 7.5YR 6/6	Blue colors from	Clay Loam Sicl 32	3 M-C SBK	SH	FI	S/P	/	GR - 2 CB - 0 ST - 0	1VF	1VF-F TU	8VFF ST cam	8.2	G, W
CK2	60-80+	7.5YR 5/4 7.5YR 5/6	10YR 7/4	LMS	Silty Clay 40						GR - 0 CB - 0 ST - 0	/	2VF-1F TU	ST 6VFF cam	8.0	
											GR - CB - ST -					
											GR - CB - ST -					
											GR - CB - ST -					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
	10-40"	26	8	>7 feet

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
	Mollic	Argillic + Calcic	10-30"

Previous edition [illegible] lete.

FS-2500-1 (2/86)

USDA - Forest Service

SOIL DESCRIPTION

(Refer to SII 2509.18)

FINE-LOAMY Typic Argiaquoll

UTM 0371878 4140230

1. Map Unit Symbol	2. Family or Series	3. Date	4. By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location:
~~E~~ 7	~~FISHERY~~ ~~TYPIC~~ mixed, super, frigid ~~CALCI AQUOLL~~	9/14/06	BC	32-33 (K)	WRD 18A	ALTON	Sec. ___ T. ___ R. ___

9. Area	10. Forest	11. Ranger District	12. State	13. County
COAL HOLLOW STUDY AREA	PRIVATE LANDS 2 MILE SE OF ALTON		UTAH	KANE

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion:
ALLUVIUM / RESIDUUM	ALLUVIUM + TROPIC SHALE		a. Kind NONE b. Class ___

18. Landform	19. Slope:	20. Drainage Class	21. Surface Stone and Rock
FANSLOPE	a. % 4 b. Shape CONCAVE c. Length 250' d. Aspect 250°	SPD	a. GR 0 b. CB 0 c. ST 0 d. BY 0

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
GRASS + SEDGE, FEW ARTA, ROCKY MTN IRIS	15-17"		51" (53 INK)

HORIZON DESIGNATION (a)	DEPTH (b) INCHES	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	TEXTURE (d) LAB %C	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	FIELD pH (i) LAB	BOUNDARY (j)
A	0-7	10YR 3/2	10YR 5/2	/	SIL LOAM 26	1FSBK → MG	SO	FR	SS/PS	/	GR - 0 CB - 0 ST - 0	3VF 3F 3M	3VF IN	SE	7.7	A, S
Bw	7-15	10YR 4/3	10YR 6/3	COMMON FAINT	SIL LOAM 24	2F+M SBK	SO	FR	SS/PS	/	GR - 0 CB - 0 ST - 0	2M-F 3VF	2VF-1F IN	me ~~SE~~	8.0	A, S
BK1 ~~ACg~~	15-30	2.5Y 5/3	2.5Y 7/3	COMMON FAINT	FSL 17 SIL 34	2M-F SBK	HA	FR	SS/PO	/	GR - 0 CB - 0 ST - 0	2M 1F 1VF	1VF TU	ST ~~SE~~	8.1	A, S
2BtKg ACg2	30-45	2.5Y 5/2	2.5Y 6/2	MANY PROMINENT	CLAY LOAM SIL 35	2FSBK → MGR	SH	FI	SS/PS	35 CLF PF /	GR - 0 CB - 0 ST - 0	2M 1F 1VF	1VF TU	ST ~~SE~~	8.0	A, W
2Cg A	45-60	5Y 5/2	5Y 6/2	GLEYED	SANDY CLAY SIL 20	MASSIVE				/	GR - 0 CB - 0 ST - 0	1M 1F	1F TU	VE UNDER WATER	7.9	A
											GR - CB - ST -					
											GR - CB - ST -					
											GR - CB - ST -					
											GR - CB - ST -					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
	10-40"	27	0	>60"

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
	MOLLIC	CALCIC	10-30

FS 2500.1 (2/86)

USDA - Forest Service

Typic Argiaquoll ~~Fluventic Haplustoll~~

SOIL DESCRIPTION

(Reference: FSH 2509.18)

UTM 4140300

1. Map Unit Symbol	2. Family or Series	3. Date	4. By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location: Sec. ___ T. ___ R. ___
4 #	Mix, Super, frigid ~~Argic~~ Calciustoll ? Fi-loamy	9-14-06	BC	34-35	WRO-18B	ALTON	

9. Area	10. Forest	11. Ranger District	12. State	13. County
Coal Hollow Soil Survey	Approx 2 mile SE of Alton		UT	KANE

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion: a. Kind	b. Class
Colluvium / Alluvium	Mixed Sedimentary		None	

18. Landform	19. Slope: a. %	b. Shape	c. Length	d. Aspect	20. Drainage Class	21. Surface Stone and Rock: a. GR	b. CB	c. ST	d. BY
Alluvial Fans Lope	3	Convex	150'	220°	WD	0	0	0	0

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
Wyo Big Sagebrush - Rabbitbrush	15-17"		>8 Feet

HORIZON DESIGNATION (a)	DEPTH (b)	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	LAB TEXTURE (d)	% C	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	LAB FIELD pH (i)	BOUNDARY (j)
A	0-9	10YR 3/4	10YR 5/4	/	Sil Loam	26	2M-F SBK	SO	FR			GR-0 CB-0 ST-0	2M 2C 1VF, F	3VF IN	SE	8.2	C, S
Bt1 ~~Bt~~	9-19	10YR 4/3	10YR 6/3	/	Sil Loam	20	2M-C SBK	SH	FI		/	GR-1 CB- ST	1F, M 1VF, C	2VF-1F IN	SE	8.3	C, W
Bk1	19-34	10YR 5/4	10YR 7/3	/	Loam Sil	18	2M-F SBK	VH	VFI	S/P	~~1 ampf~~ 2 ap	GR-2 CB- ST-	1VF, F	1VF-1F TU	SE	8.5	C, W
Bk2	34-54	10YR 5/4	10YR 6/3	/	Clay Loam Sil	32	2M-C ABK	VH	VFI	S/P	~~1 ampf~~ ~~1 ap~~	GR-2 CB- ST-	1VF	1VF TU	SE	8.7	G, W
Ck	54-72	10YR 4/4	10YR 6/4	/	Clay Loam Sil	34	Massive	VH	VFI	S/P	/	GR-1 CB- ST-	V, VF	1VF TU	SE	8.6	G, W
C	72-96	10YR 5/4	10YR 6/3	/	Loam	20	Massive	EH	EFI	S/P	/	GR-1 CB- ST-	/	2VF TU	VS	8.6	
												GR- CB- ST-	/		~~VS~~		
												GR- CB- ST-					
												GR- CB- ST-					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
	10-40"	25	0	>8 Feet

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
	Mollic	~~Argillic~~ / Calcic	10-30

FS 2509.1 (2/06)

USDA - Forest Service

SOIL DESCRIPTION (Reference FSH 2509.18) Photos 39-40-41 UTM 4130048

1. Map Unit Symbol: 4	2. Family or Series: Fi-Loamy ~~Typic~~ Calcic Argiustoll mixed, super, mesic ~~Typic~~ ~~Argiustoll~~	3. Date: 9/14/06	4. By: BC	5. Photo. No.: 39, 40	6. Stop No.: WRD-19	7. USGS Quad: ALTON	8. Location: Sec. ___ T. ___ R. ___
9. Area: COAL HOLOW SOIL SURVEY	10. Forest: WEATHER STATION TO EAST & 9/17/06	11. Ranger District:	12. State: UT	13. County: KANE			
14. Parent Material: COLLUVIUM / RESIDUUM	15. Bedrock Name: DAKOTA FORMATION	16. Elevation: 700	17. Erosion: a. Kind: NONE b. Class:				
18. Landform: FAN SLOPE	19. Slope: a. % 5 b. Shape CONVEX c. Length 250' d. Aspect 260'	20. Drainage Class: WD → SPD	21. Surface Stone and Rock: a. GR 0 b. CB 0 c. ST 0 d. BY 0				
22. Potential Natural Vegetation: BIG SAGEBRUSH - RABBITBRUSH SCATTERED JUNIPER	23. Annual Precipitation: 15-17"	24. Measured Soil Temperature:	25. Water Table (Depth): NONE				

HORIZON DESIGNATION (a)	INCHES DEPTH (b)	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	LAB TEXTURE (d)	%	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	LAB FIELD pH (i)	BOUNDARY (j)
A	0-6	10YR 3/2	10YR 5/2	/	LOAM SCL	24 27	2M GR	SO	FR	SS/PS	/	GR - 0 CB - 0 ST - 0	3VF 1F, M 1C	3VF IN	SE	8.0	C, S
Bt1	6-12	10YR 4/2	10YR 5/3	/	CLAY LOAM SCL	32 29	2M-F SBK	HA	FI	SS/PS	1 APO	GR - 0 CB - 0 ST - 0	1VF-F	1VF-1F TU	SE	8.2	C, W
Bt1	12-24	10YR 4/4	10YR 6/3	/	CLAY LOAM SCL	30 32	2F-M SBK	VH	VFI	S/P	2 MKPF 1 APO	GR - 0 CB - 0 ST - 0	1VF-F	1VF-1F TU	4VFCAM ~~SE~~ ST	8.3	C, W
Bt2	24-37	10YR 4/3	10YR 6/3	/	LOAM CL	22 34	3F-M SBK	HA	VFI	S/P	1 n pf/po	GR - 0 CB - 0 ST - 0	1F	1VF-1F TU	8FCAM ~~SE~~ ST	8.5	C, W
Bk1	37-51	10YR 4/4	10YR 6/4	/	FINE SL	14 19	2M-C SBK	HA	VFI	SS/PO	/	GR - 0 CB - 0 ST - 0	1F, 1M	1VF TU	ST ~~SE~~ 4FCAM	8.4	C, S
Bk2	51-68	10YR 5/4	10YR 6/3	/	SANDY LOAM	12 17	MA	HA	FI	SO/PO	/	GR - 0 CB - 0 ST - 0	1F, 1M	2VF 1F TU	VE ~~SE~~ 6FCAM	8.5	C, W
Bk3	68-90	10YR 5/4	7.5YR 6/4		SANDY LOAM	10	MA	LO	LO	SO/PO	/	GR - CB - ST -	/	3VF IN	ST 6FCAM	8.7	
												GR - CB - ST -					
												GR - CB - ST -					

26. Partical Size Control Section	a. Depth: 12-32"	b. Average Clay %: 31	c. Average Rock Fragment Content: 0	27. Depth to Lithic or Paralithic Contact: > 6 FEET
28. Diagnostic Horizons	a. Surface: MOLLIC	b. Subsurface: ARGILLIC, calcic		29. Moist Control Section Depth: 1030"

FS 2509.1 (2/06)

USDA - Forest Service CO-loamy, Aridic Calciustoll SOIL DESCRIPTION (Reference FSH 2509.18) 44-46 K UTM 0371990 4140486

1. Map Unit Symbol	2. Family or Series	3. Date	By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location: Sec. T. R.
8	CO-loamy, mix, super, mesic	9-17-06	BC	6-7 (P)	WRD 20		

9. Area	10. Forest	11. Ranger District	12. State	13. County
WHITE RIVER SITE OAK HOLLOW SOIL	Sanpete	Fishlake Lands 2 mi SE of Aldon	Utah	Kane

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion: a. Kind	b. Class
Colluvium	Mixed sedimentary	70	None	

18. Landform	19. Slope: a. %	b. Shape	c. Length	d. Aspect	20. Drainage Class	21. Surface Stone and Rock: a. GR	b. CB	c. ST	d. BY
Alluvial fansope	3	convex	75'	190°	WD	0	0	0	0

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
Oak - snowberry w/ aspen, pinyon, juniper	17-19		>60"

HORIZON DESIGNATION (a)	DEPTH (b) (inches)	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	TEXTURE (d)	%	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	FIELD pH (i)	BOUNDARY (j)
A	0-6	10YR 3/3	10YR 5/3		Loam	24	2M-F GR	SO	FR	SS PS		GR - CB - ST -	3-F 2F 2M, C	3VF-IN	SE	7.9	C, S
BW	6-13	10YR 4/4	10YR 6/4		SiCL Cat Loam	30 22	2M-F SBK	HA	FI	SS PS		GR - TR CB - C ST - O	2M-C 2F 1VF	2VF-1F TU	SE	7.8	C, S
BK	13-28	10YR 5/4	10YR 6/3		Sandy Loam SCL	10 17	3M-C SBK	VH	FI	SO PO		GR - CB - ST -	2M-C 1F, VF	1VF-1F TU	ST	8.1	A, S
CK 2C	28-54	10YR 5/4	10YR 7/4		Loamy Sand LS	7 12	1CSBK → SG	SO	VFR	SO PO		GR - 10 CB - 37 ST -	2VF 1F, M 1C	1VF TU	ST	8.0	A, S
3C1	54-72	7.5YR 5/6	7.5YR 6/4		Loam CL	26 31	MASSIVE	SH	FI	SS PS		GR - CB - ST -	1F-M	1VF-1F TH	ST	8.1	C, bw
OE	3-1½	OAK LEAVES TWIGS, BRANCHES										GR - CB - ST -					
O1	1½-0	SLIGHTLY DECOMPOSED LITTER FOREST										GR - CB - ST -					
3C2	72-96	10YR 4/3	10YR 6/3		Loamy Sand	5	MASSIVE	LO	LO	SO/PO		GR - CB - ST -	1VF	1VF IN	SE	8.2	
												GR - CB - ST -					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
	10-40"	13	0-2%	>96 inches

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
	Ochric	~~Argillic~~ Calcic	10-39"

Previous edition obsolete. FS 2500-1 (2/86)

+ Lense of gravelly alluvium 35-40"

USDA - Forest Service

Aridic Calciustoll ~~Mollic~~ ~~Ustifluvent~~ SOIL DESCRIPTION (Reference 2509.18) 49-48 (K) DTM 4140354

1. Map Unit Symbol: 8	2. Family or Series: ~~Ft-Lomy~~ mix, super, mesic ~~Haplustalf~~	3. Date: 9-18-06	By: BC	5. Photo. No.: 8-9 (P)	6. Stop No.: WRD-21	7. USGS Quad: ALTON
8. Location: Sec. ___ T. ___ R. ___						
9. Area: Waste Rock Dump	10. Forest:	11. Ranger District:	12. State: UT	13. County: KANE		
14. Parent Material: Alluvium	15. Bedrock Name: Mixed Sedimentary	16. Elevation: 70	17. Erosion: a. Kind: None b. Class:			
18. Landform: Fanscope	19. Slope: a. % 2 b. Shape Planar c. Length 100' d. Aspect 191°	20. Drainage Class: WD	21. Surface Stone and Rock: a. GR 0 b. CB 0 c. ST 0 d. BY 0			
22. Potential Natural Vegetation: Big Sagebrush Opening in Oak Grove	23. Annual Precipitation: 17-18"	24. Measured Soil Temperature:	25. Water Table (Depth): None			

HORIZON DESIGNATION (a)	DEPTH (b)	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	TEXTURE (d) LAB %C	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	LAB FIELD pH (i)	BOUNDARY (j)
A	0-8	7.5YR 4/4	7.5YR 6/4	/	Sandy Clay 28 19	2 m-c SBK → PL	SO	VFR	SO PO	/	GR - 0 CB - 0 ST - 0	3VF 2F,M 1C	2VF-2F IN	VS → EO	8.4	C, S
BwK1	8-18	7.5YR 4/3	7.5YR 6/3	/	Sandy Clay SiCL 30 28	2 M-F SBK	VHA	VFI	S PS	/	GR - 0 CB - 0 ST - 0	2VF-F 1M,C	1VF-F, 1M TU	ST	8.1	C, W
BwK2	18-36	7.5YR 4/4	7.5YR 6/3	/	Sandy Loam SCL 21	2 M-F SBK	SH	FI	SS PS	/	GR - 5 CB - 1 ST - 0	1M,F 2VF	1VF TU	ST	8.4	C, W
BwK3	36-50	7.5YR 5/4	7.5YR 6/3	/	SL 8 16	3 m-c SBK	SH	VFR	SO PO	/	GR - 0 CB - 1 ST - 0	1VF	1VF TU	SE	8.7	C, S
2C1	50-62	10YR 4/4	10YR 6/3	1F /	SL 8 14	Massive	HA	FI	SO PO	/	GR - 0 CB - 0 ST - 0	/	1VF-F TU	SE	8.7	C, S
2C2	62-96+	10YR 5/4	10YR 7/3	2 common distinct 7.5YR 4/6	L Sandy Loam 12 6	SG	LO	LO	SO PO	/	GR - CB - ST -	/	3VF 1F TU	SE	8.7	C, W
											GR - CB - ST -					
											GR - CB - ST -					
											GR - CB - ST -					

26. Partical Size Control Section	a. Depth: 8-18	b. Average Clay %: 15	c. Average Rock Fragment Content: 2	27. Depth to Lithic or Paralithic Contact: >8 FEET
28. Diagnostic Horizons	a. Surface: Ochic	b. Subsurface: ~~Argillic~~ Calcic Cambic		29. Moist Control Section Depth: 10-30"

FS 2509.1 (2/86)

USDA - F[illegible]

SOIL [illegible]SCRIPTION

(Refe[illegible] II 2509.18)

WRD-22 UTM

7: 0372353 4142382

1. Map Unit Symbol	2. Family or Series	3. Date	4. By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location:
8	mixed, super, mesic FILLOAMY TYPIC HARLUSTALF	9-14-06	BC	36-37	WRD-22	ALTON	Sec. ___ T. ___ R. ___

9. Area	10. Forest	11. Ranger District	12. State	13. County
GOAL HOLLOW SOIL SURVEY	~ 2½ mi SE of ALTON		UT	KANT

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion:
COLLUVIUM OVER RESIDUUM	TROPIC / DAKOTA RESIDUUM		a. Kind NONE b. Class

18. Landform	19. Slope:	20. Drainage Class	21. Surface Stone and Rock
TOESLOPE	a. % 8 b. Shape CONVEX c. Length 75 d. Aspect 220°	WD	a. GR 0 b. CB 0 c. ST 0 d. BY 0

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
OAK, SNOWBERRY, GRASSES, FORBS			7 feet

HORIZON DESIGNATION (a)	DEPTH (b)	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	LAB TEXTURE (d)	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	LAB FIELD pH (i)	BOUNDARY (j)
OE	7-4	OAK LEAVES, DUFF, TWIGS									GR - CB - ST -					
O1	4-0	PARTIALLY DECOMPOSED OAK LEAF LITTER									GR - CB - ST -					A, S
A	0-6	10YR 5/4	10YR 6/3	/	SANDY CLAY SIL 14	2M-F SBK	SH	VFR	SO/PO	/	GR - 0 CB - 0 ST - 0	2M 2F 1VF	1VF-F IN	SE	7.7	A, S
Bt1	6-15	10YR 4/3	10YR 6/4	/	SILTY CLAY SICL 34	2M-C SBK	HA	FI	S/P	1MKPF	GR - 0 CB - 0 ST - 0	2M 2F 1C, 1VF	1VF-F TN	SE	7.7	C, S
Bt2	15-28	10YR 4/4	10YR 6/4	FEW FAINT ROOT CLAYERS	SANDY CLAY SICL 26	2M-F SBK	HA	FI	SS/PS	2MPO	GR - 0 CB - 0 ST - 0	1F 1M 1C	1VF TN	SE	8.0	C, S
BK1	28-48	10YR 5/4	10YR 7/4	FEW PROMIN	SANDY LOAM 14	3M-C SBK	HA	FI	SO/PO	/	GR - 0 CB - 0 ST - 0	1F 1M 1C	1VF-F TN	SE	8.0	C, W
BK2	48-60	10YR 5/4	10YR 6/3	COMMON PROMINENT	SANDY LOAM 14	MASSIVE	SH	FR	SO/PO	/	GR - 0 CB - 0 ST -	1M 1F 1C	2VF TN	SE	8.0	C, W
C3	60-84	10YR 5/4	10YR 7/3	MANY PROMINENT	SANDY LOAM 8	MASSIVE	SH	FR	SO/PO	/	GR - CB - ST -	1VF-F 1M, C	3VF IN	SE	8.2	
											GR - CB - ST -					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
	6-28	25	0	84" +

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
	OCHRIC	ARGILLIC	10-30"

** Redox mottles not present in box sample. **

SOIL DESCRIPTION

USDA - Forest Service (Reference: Soil Survey Manual 2509.18) 42, 43 Kaiser UTM 41405

Aridic ~~Ustic~~ Calciustoll

1. Map Unit Symbol: 74	2. Family or Series: Fine-loamy mix, super, mesic Argiustoll	3. Date: 9-17-79	4. By: BC	5. Photo No.: 5(P)	6. Stop No.: WRD-23	7. USGS Quad: ALTON	8. Location: Sec. ___ T. ___ R. ___	
9. Area: Coal Hollow Soil Survey	10. Forest: NE EDGE OF SURVEY AREA			11. Ranger District		12. State: UT	13. County: KANE	
14. Parent Material: SEDIMENTARY	15. Bedrock Name: MIXED COLLUVIUM			16. Elevation	17. Erosion: a. Kind: NONE	b. Class		
18. Landform: FANSLOPE	19. Slope: a. % 3 b. Shape: CONCAVE c. Length 130' d. Aspect 200°			20. Drainage Class: WD	21. Surface Stone and Rock: a. GR 0 b. CB 0 c. ST 0 d. BY 0			
22. Potential Natural Vegetation: BIG SAGEBRUSH, SCATTERED JUNIPER, GRASSES				23. Annual Precipitation: 15-17"	24. Measured Soil Temperature		25. Water Table (Depth): NONE	

HORIZON DESIGNATION (a)	DEPTH (b) (inches)	COLOR (c) Moist (1)	COLOR (c) Dry (2)	Mottling (3)	TEXTURE (d) (LAB)	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	FIELD pH (i) (LAB)	BOUNDARY (j)
A	0-6	10YR 3/2	10YR 5/2	/	Clay Loam SiL 31	2MGR	SO	FR	SO PO	/	CR - CB - ST -	3VF 2F, M 1C	3VF IN	SE	7.7	C, S
AB	6-12	10YR 4/3	10YR 6/4	/	SiCL 31 27	3M-F SBK	HA	FI	S PS	/	CR - CB - ST -	2VF 1F 1M, C	2VF IN 1F TU	SE	7.9	C, W
Bk1	12-22	10YR 5/4	10YR 6/3	/	Clay Loam CL 28 30	2F SBK	HA	FI	S PS	/	CR - CB - ST -	2VF 1F, M	3VF-1F TU	ST	7.9	C, S
Bk2	22-40	10YR 5/4	10YR 6/3	1 FAINT 10YR 4/6	LOAM SCL 19 20	2M-C SBK	HA	VFI	SS PO	/	CR - CB - ST -	1VF-1F	1VF-F TU	ST	8.0	C, W
CK	40-62	7.5YR 5/4 7.5	10YR 7/4	1 FAINT 10YR 7/6	(LOAM) SCL 25 22	2M-C SBK	HA	VFI	SS PS	/	CR - CB - ST -	/	2VF TU	ST	8.2	G W
2C2	62+80	7.5YR 5/4 7.5YR 6/8	7.5YR 7/3 7.5YR 6/4	3 FAINT 7.5YR 7/4	SILTY CLAY 41	MASSIVE AUGERED	VH	VFI	S/P	/	CR - CB - ST -	/	2VF TU	ST	8.1	
											CR - CB - ST -					
											CR - CB - ST -					
											CR - CB - ST -					

26. Partical Size Control Section: a. Depth: 6-22 b. Average Clay %: 28 c. Average Rock Fragment Content: 0

27. Depth to Lithic or Paralithic Contact: > 8 FEET

28. Diagnostic Horizons: a. Surface: MOLLIC b. Subsurface: ARGILLIC, CALCIC

29. Moist Control Section Depth: 10-30"

USDA-SCS-NSSL (12/86)

USDA - Forest Service

Aridic Haplustept

SOIL DESCRIPTION

(Refer to FSH 2509.18)

DAH-24 UTM 4139690

1. Map Unit Symbol: ~~SA~~ 5	2. Family or Series: Fine ~~(calcareous)~~, ~~[illegible]~~ mixed, super, mesic ~~[illegible]~~	3. Date: 9-13-06	4. By: BC	5. Photo. No.: 28-29	6. Stop No.: DAH-24	7. USGS Quad: ALTON	8. Location: Sec. ___ T. ___ R. ___

9. Area: COAL HOLLOW SURVEY	10. Forest: MODERATELY DEEP	11. Ranger District:	12. State: UT
			13. County: KANE
14. Parent Material: COLLUVIUM / RESIDUUM	15. Bedrock Name: DAKOTA FM / OR TROPIC	16. Elevation: 68	17. Erosion: a. Kind: NONE b. Class:
18. Landform: HILLSLOPE	19. Slope: a. % 13 b. Shape CONVEX c. Length 50' d. Aspect 20°	20. Drainage Class: PD	21. Surface Stone and Rock: a. GR 0 b. CB 0 c. ST 0 d. BY 0
22. Potential Natural Vegetation: PINYON-JUNIPER W/ BLACK SAGEBRUSH	23. Annual Precipitation: 15-17"	24. Measured Soil Temperature:	25. Water Table (Depth): NONE

HORIZON DESIGNATION (a)	INCHES DEPTH (b)	COLOR (c) Moist (1)	COLOR (c) Dry (2)	COLOR (c) Mottling (3)	LAB TEXTURE (d)	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	CONSISTENCE (f) Moist (2)	CONSISTENCE (f) Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	LAB FIELD pH (i)	BOUNDARY (j)
A	0-5	2.5Y 4/2	2.5Y 4/3	/	CLAY 47	1F SBK → MGR	SO	VFR	S/VP	/	GR - 0 CB - 0 ST - 0	2VF 1F, M, C	2VF-1F IN	NE	7.6	C, W
BW1 ~~C1~~	5-17	2.5Y 4/3	2.5Y 4/2	/	CLAY 44	2M-F SBK	EH	EF	VS/VP	/	GR - CB - ST -	1VF 1F	1VF TU	NE	7.7	C, W
BW2 C2	17-32	5Y 5/3	5Y 5/4 5Y 6/2	/	CLAY 45	3C-M ABK	EH	EF	VS/VP	/	GR - CB - ST -	1VF	1VF TU	NE	8.1	A, W
Cr	32-60	GREY SILTSTONE / SANDSTONE BEDROCK									GR - CB - ST -					
											GR - CB - ST -					
											GR - CB - ST -					
											GR - CB - ST -					
											GR - CB - ST -					
											GR - CB - ST -					

26. Partical Size Control Section	a. Depth: 10-32	b. Average Clay %: 50+	c. Average Rock Fragment Content: 0	27. Depth to Lithic or Paralithic Contact: 32" TO SOFT SHALE
28. Diagnostic Horizons	a. Surface: OCHRIC	b. Subsurface: —		29. Moist Control Section Depth: 10-32"

FS 2509.1 (2/06)

SOIL DESCRIPTION (Reference FSH 2509.18) LABORATORY 31 PTY 413952

USDA - Forest Service

fine, mx, super Aridic Calciustepl

1. Map Unit Symbol	2. Family or Series	3. Date	By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location: Sec. T. R
5	mesic ~~CLAY SUBL~~ ~~HYPE~~ ~~USTOCHREPTS~~	9-13-06	BC	30	DAH-25	ALTON	

9. Area	10. Forest	11. Ranger District	12. State	13. County
CORAL HOLLOW SOIL SURVEY	MODERATELY DEEP		UTAH	KANE

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion: a. Kind	b. Class
RESIDUUM	DAKOTA FM - HARD SANDSTONE	69	SLIGHT SHEET	

18. Landform	19. Slope: a. %	b. Shape	c. Length	d. Aspect	20. Drainage Class	21. Surface Stone and Rock: a. GR	b. CB	c. ST	d. BY
HILLSIDE	19	CONVEX	50'	140°	SPD	20	15	2	TR

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
PINYON-JUNIPER WITH FEW SAGEBRUSH	15-17"		NONE

HORIZON DESIGNATION (a)	INCHES DEPTH (b)	COLOR (c) Moist (1)	COLOR (c) Dry (2)	COLOR (c) Mottling (3)	LAB TEXTURE (d)	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	CONSISTENCE (f) Moist (2)	CONSISTENCE (f) Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	SPECIAL FEATURES (g) Roots (3)	SPECIAL FEATURES (g) Pores (4)	EFFER. CLASS (h)	LAB FIELD pH (i)	BOUNDARY (j)
O1	1/2-0	NEEDLES, DISCONTINUOUS		NONE		2F SBK	HA	FI	S/P	/	CR-25 CB-15 ST-0	VSF 4F 2MLTC		NE		
A	0-5	7.5YR 3/3 7.5YR 4/4	7.5YR 5/2 7.5YR 6/4	NONE	CLAY 40	2M-F SBK	HA	FI	S/P	/	CR-15 CB-15 ST-0	1F 1M 1C	2VF IN 1F TU	NE	6.4	C,S
BK1 A1	5-13	7.5YR 4/2	7.5YR 5/2	NONE	CLAY 47	2M SBK	HA	FI	VS/VP	/	CR-20 CB-10 ST-0	1NF, F 1M	1VF-F TU	NE	7.0	C,W
BK2 C2	13-20	10YR 3/4 7.5YR 5/6	10YR 4/3	NONE	SANDY CLAY 46	2M SBK	HA	FI	VS/VP	/	CR-0 CB-10 ST-10	1VF	1VF TU	NE	7.2	G,W
C3	20-32	10YR 4/4	10YR 5/4	/	SANDY CLAY 33	3M-F ABK	VH	FI	VS/VP	/	CR- CB- ST-	1VF	2VF TU	SE	7.7	G,S
R	32+	HARD SANDSTONE BEDROCK														

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
	10-32"	45	>35%	32" HARD SANDSTONE

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
	OCHRIC	/	10-30"

FS 2509.18 (2/86)

BK based on lab data - but no effervescence in box sample

USDA - Forest Service

SOIL DESCRIPTION

Aquic Calciustoll (Reference FSI 2509.18)

UTM 0371545 4140492

1. Map Unit Symbol	2. Family or Series	3. Date	4. By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location: Sec. ___ T. ___ R. ___
~~SA~~ 1	FINE ~~SMECTITIC~~ mixed, super, frigid ~~TYPIC HAPLUSTOLL~~	9-15-05	BC		26		

9. Area	10. Forest	11. Ranger District	12. State	13. County
[illegible] Soil Survey			UT	KANE

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion: a. Kind ___ b. Class ___
[illegible] - Residuum	Tropic Shale		

18. Landform	19. Slope: a. %	b. Shape	c. Length	d. Aspect	20. Drainage Class	21. Surface Stone and Rock: a. GR	b. CB	c. ST	d. BY
Footslope	3	Concave	125'	260	SPD	0	0	0	0

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
JUNIPER W/ SAGEBRUSH	5-16"		Wet @ 7 ft

HORIZON DESIGNATION (a)	DEPTH (b)	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	TEXTURE (d)	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	FIELD pH (i)	BOUNDARY (j)
A	0-8	10YR 3/3	10YR 5/3	/	SiCL	1MPL → FGR	SO	FR	SS/PO	/	GR: 0 CB: 0 ST: 0	3VF 1F,M	3VF IN	SE		C,S
Bw C1	8-20	2.5Y 4/3	2.5Y 6/3	/	SiCL	2c-M ABK	HA	VFI	VS/VP	/	GR: 1 CB: 0 ST: 0	1F,M 1VF	1VF-F TU	SE		C,S
Bwk C2	20-50	2.5Y 4/3	2.5Y 6/2	2fm 7.5YR 6/6	SiC	3m-c ABK	EH	VFI	VS/VP	/	GR: 2 CB: 2 ST: 0	1VF 1F	1VF-F TU	ST		GW
Bwk C3	50-80	2.5Y 5/2 10YR 6/6	2.5Y 6/3 10YR 7/6	(80) 2f 7.5YR 6/6 (20)	SiC	3m-c ABK	EH	VFI	VS/VP	/	GR: 3 CB: 2 ST: 0	/	1VF TU	ST		GW
2BK1 2C4	80-105	2.5Y 5/2	2.5Y 6/2	1f 7.5YR 6/6	CL	[illegible]	[illegible]	EFI	VS/VP	/	GR: 2 CB: 0 ST: 0	/	2VF TU	[illegible]		[illegible]
2BK2 2C5	105-125	10YR 5/3 10YR 5/6	10YR 6/3 10YR 6/6	3fm 7.5YR 6/6	LOAM	[illegible]	[illegible]	FR	SS/PS		GR: 0 CB: 0 ST: 0	/	2VF IN 1F TU	VE		
											GR: CB: ST:					
											GR: CB: ST:					
											GR: CB: ST:					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
	10-40"	>35	3	>125"

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
	MOLLIC	CALCIC	10-30"

Previous edition Date:

FS 2500-1 (2/86)

USDA - Forest Service

Aridic ~~[illegible]~~ ~~[illegible]~~ Calcium ~~[illegible]~~ (or ~~[illegible]~~) ~~[illegible]~~ SOIL DESCRIPTION (Refer to FSH 2509.18) 0371387 4140122

1. Map Unit Sy	2. Family or Series	3. Date	By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location:
1	mixed, super, mesic Fine ~~[illegible]~~ ~~[illegible]~~	1/13/04	BC		27		Sec. ___ T. ___ R. ___

9. Area	10. Forest	11. Ranger District	12. State	13. County
Haul Road Coal Hollow Soil	Survey		Utah	Kane

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion:
Alluvium	Backhoe Pit		a. Kind None b. Class

18. Landform	19. Slope:	20. Drainage Class	21. Surface Stone and Rock
Seeded - Furrowed Concave Mid Fanslope	a. % 3 b. Shape Concave c. Length 250' d. Aspect 270°	WD	a. GR 0 b. CB 0 c. ST 0 d. BY 0

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
Sagebrush - Rabbitbrush, Grasses			None

HORIZON DESIGNATION (a)	INCHES DEPTH (b)	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	TEXTURE (d)	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	FIELD pH (i)	BOUNDARY (j)
A	9-8	10YR 4/2	10YR 5/2	/	SICL	2M-F SBK	HA	FI	SS/PS	/	GR: 0 CB: 0 ST: 0	1VF, 2F, 2M	2VF IN 2F TU	SE		G, S
BW	8-17	2.5Y 5/3	2.5Y 6/2	/	CL	2M-SBK	VH	VFI	S/VP	/	GR: 0 CB: 0 ST: 0	1VF 1M 2F	1VF-F TU	SE		G, W
BWK	17-38	2.5Y 4/3	2.5Y 6/3	/	CLSY	2C-M ABK	VH	EFI	VS/VP	/	GR: 0 CB: 0 ST: 0	1F 1M 1VF	1VF TU	ST		G, S
BWK	38-65	2.5Y 5/3	2.5Y 6/2	/	CLSY	3CPR → 2ABK	VH	EFI	VS/VP	/	GR: 0 CB: 0 ST: 0	1VF, F 1M	1VF TU	ST		C, S
2BK1	65-90	10YR 5/3 10YR 5/6	10YR 6/2 10YR 6/4	(70) (30)	LOAM	MASSIVE	HA	VFI	SS/P	/	GR: 0 CB: 0 ST: 0	1VF	2VF-1F TU	ST		A S
2BK2	90-115	10YR 5/4	10YR 7/3	FEW FAINT	LS	MASSIVE	HA	FR	SO/PO	/	GR: 0 CB: 0 ST: 0	/	3VF IN	SE		Mottled Moist
3BK3	115-140	7.5YR 5/4	7.5YR 6/4	35% DISTINCT	LFS	SG	SA	FR	SO/PO		GR: 0 CB: 0 ST: 0	/	3VF IN	SE		Mottled Moist
		5YR		YES							GR: CB: ST:			VE		
											GR: CB: ST:					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
	10-40"	>35	0	>140"

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
	Ochric	Calcic	10-30"

Previous edition [illegible] Note.

FS 2500-1 (2/86)

USDA - Forest Service

SOIL DESCRIPTION

(Reference [illegible] 2509.18)

Aridic Calciustept

P(1560) (0212)

UTM 0371447 4140522

1. Map Unit Symbol	2. Family or Series	3. Date	4. By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location: Sec. ___ T. ___ R. ___
11	Fine mixed, super, mesic ~~Typic Ustorthent~~	11/15/06	BC		28		

9. Area	10. Forest	11. Ranger District	12. State	13. County
Coal Hollow	Bacuhoe		UT	Kane

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion: a. Kind	b. Class
Alluvium - Bedrock	Tropic Shale		None	

18. Landform	19. Slope: a. %	b. Shape	c. Length	d. Aspect	20. Drainage Class	21. Surface Stone and Rock: a. GR	b. CB	c. ST	d. BY
Fanside	5	Concave	300'	260	SPO	0	0	0	0

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
Grass Rabbitbrush (Seeded)	15-16		None

HORIZON DESIGNATION (a)	DEPTH (b)	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	TEXTURE (d)	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	FIELD pH (i)	BOUNDARY (j)
A	0-8	10YR 4/2	2.5Y 5/3	/	SiC	2m-f GR	HA	FI	S/P	/	GR-0 CB-0 ST-0	2VF 1F	2VF IN 1F TU	ST		C,S
BW C1	8-24	2.5Y 5/2	2.5Y 6/1	/	CLAY	2m-c SBK	VH	VFI	VS/VP	/	GR-0 CB-0 ST-0	1VF 1F	1VF-F TU	ST		C,W
BWK C2	24-48	2.5Y 5/3	2.5Y 6/1	/	CLAY	3c-pr → 3 ABK	VH	VFI	VS/VP	/	GR-2 CB-0 ST-0	/	1VF-F TU	2fCAM ST		G,W
BK1 C3	48-72	2.5Y 5/3	2.5Y 6/2	/	SiC	MASSIVE	VH	VFI	VS/VP	/	GR-3 CB-0 ST-0	/	1VF TU	2fmCAM ST		
BK2 C4	72-100	2.5Y 5/2	2.5Y 6/2		SiC	MASSIVE	EH	EFI	VS/VP	/	GR- CB- ST-		1VF TU	1fm CAM ST		
											GR- CB- ST-					
											GR- CB- ST-					
											GR- CB- ST-					
											GR- CB- ST-					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
	10-40"	>35"	2	>100"

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
	OCHRIC	CALCIC	10-30"

Previous edition [illegible] Note.

FS-2500-1 (2/86)

USDA - Forest Service

Aridic Calciustoll

SOIL DESCRIPTION

(Refer [illegible] CH 2509.18) DIGITAL [illegible]

0371280 4140210

1. Map Unit Symbol	2. Family or Series	3. Date	4. By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location: Sec. ___ T. ___ R. ___
9	FINE, ~~SMECTITIC~~ mixed, super ~~LYPIC~~ HAPLUSTOLL	11/15/86	BC	2 PITS [illegible]	29		

9. Area	10. Forest	11. Ranger District	12. State	13. County
COALHOLLOW HAUL ROAD	BACKHOE PIT		UT	KANE

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion: a. Kind	b. Class
ALLUVIUM	TROPIC SHALE		SLIGHT	SHEET

18. Landform	19. Slope: a. %	b. Shape	c. Length	d. Aspect	20. Drainage Class	21. Surface Stone and Rock: a. GR	b. CB	c. ST	d. BY
FANSLOPE	5	CONCAVE	70'	290°	SPD	0	0	0	0

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
PJ W/ SAGEBRUSH			NONE

HORIZON DESIGNATION (a)	INCHES DEPTH (b)	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	TEXTURE (d) %C	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	FIELD pH (i)	BOUNDARY (j)
A	0-6	10YR 3/4	10YR 5/3	/	LOAM 27	2MF SBK	SH	FR	SS/PO	/	GR - 0 CB - 0 ST - 0	2VF IN 2F TU	2F IN 1VF	SE		C, S
A2	6-12	10YR 4/3	10YR 6/3	/	LOAM 29	[illegible]	SH	FI	SS/PS	/	GR - 0 CB - 0 ST - 0	2VF IN 1F TU	2F 2M 2VF	SE		C, S
BWK1 ~~C1~~	12-36	2.5Y 5/3	2.5Y 6/2	/	SIC 39	3MPR → MASS	SH	VFI	VS/VP	/	GR - CB - TR ST - 0	1VF-F TU	1VF 1F	3-5% f CAM ST		C W
BWK2 ~~C2~~	36-60	2.5Y 5/2	2.5Y 7/2	/	SIC 42	3MPR	SH	VFI	VS/VP	/	GR - 2 CB - 2 ST - 0	1F TU	1VF	5-8% ST fm CAM		G W
C3 BK1	60-115	2.5Y 5/2 10YR 5/3	2.5Y 6/3 10YR 6/4	(60) 10YR 6/4 (40) mottles	CLAY 44	MASSIVE	SH	VFI	VS/VP	/	GR - 4 CB - 2 ST - 0	1VF TU	/	5-8 fm CAM		G W
BK2 ~~C4~~	115-138	2.5Y 5/1 2.5Y 5/3	2.5Y 6/2 2.5Y 6/1	10YR 6/4 30% mottles	CLAY 45	MASSIVE	SH	EFI	VS/VP	/	GR - 2 CB - 2 ST - 0	1VF-F TU	/	ST		
											GR - CB - ST -					
											GR - CB - ST -					
											GR - CB - ST -					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
	10-40"	>35"	3%	>138"

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
	MOLLIC	CALCIC	10-30"

Previous edition [illegible] Ete.

FS-2500-1 (2/86)

USDA - Forest Service

Aridic Calciustept

SOIL DESCRIPTION

(Refer to FSH 2509.18)

Canon Digital 0371566 4190212 (0522)

1. Map Unit Symbol	2. Family or Series	3. Date	4. By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location: Sec. ___ T. ___ R. ___
	mixed ~~THERMIC~~ Super, mesic ~~LITHIC~~	11-15-90	PBC		30		

9. Area	10. Forest	11. Ranger District	12. State	13. County
CORE HOLLOW NATL FORD			UT	Iron

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion: a. Kind	b. Class
Alluvium	TROPIC SHALE		None	

18. Landform	19. Slope: a. %	b. Shape	c. Length	d. Aspect	20. Drainage Class	21. Surface Stone and Rock: a. GR	b. CB	c. ST	d. BY
Footslope	4	Planar	150	280	SPD	0	0	0	0

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
Sagebrush GRASS FS (SEEDED)	16-17"		None

HORIZON DESIGNATION (a)	INCHES DEPTH (b)	COLOR (c) Moist (1)	COLOR (c) Dry (2)	COLOR (c) Mottling (3)	TEXTURE (d)	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	CONSISTENCE (f) Moist (2)	CONSISTENCE (f) Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	SPECIAL FEATURES (g) Roots (3)	SPECIAL FEATURES (g) Pores (4)	EFFER. CLASS (h)	FIELD pH (i)	BOUNDARY (j)
A	0-6	2.5Y 4/3	2.5Y 5/2	/	SiC 32	2m-f SBK	SO	FR	SS/PS	/	GR-0 CB-0 ST-0	VF IF	3vFIN 1FTN	SE		CS
A2	6-12	2.5Y 4/2	2.5Y 6/2	/	CLAY 42	3m-c SBK	HA	FI	VS/VP	/	GR-0 CB-0 ST-0	VF IF	1VF-F TN	SE		G,W
Bw	12-36	10YR 4/3	10YR 6/3	/	CLAY 43	3m-c PR	VH	VFI	VS/VP	/	GR-0 CB-0 ST-0	VL VF	1VF-F TN	SE		G,W
BWK CK1	1 [illegible]	10YR 5/3	2.5Y 6/1	10YR 7/6	CLAY 43	3m-c INSBK	VH	EFI	VS/VP	/	GR-TR CB-0 ST-0	/	1VF TN	4FCAM ST		G W
BWK2 CK2	36-105	10YR 5/3	10YR 6/2	FR-OR NUM 10YR 7/6	SiC 40	3m-c NBK	EH	EFI	VS/VP	/	GR-2 CB-0 ST-0	/	1VF TN	4FCAM ST		G,W
C	105-120	Accretion		20f m NUM 10YR 7/6	Box					/	GR-4 CB-0 ST-0	/		VE		
											GR- CB- ST-					
											GR- CB- ST-					
											GR- CB- ST-					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
	10-40"	>40"	2	>120"

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
	OCHRIC	CALCIC	10-30"

Previous edition Obsolete.

FS-2500-1 (2/06)

FLUVENTIC HAPLOSTOLL (Reference FSH 2509.18)

1. Map Unit Sy: 3	2. Family or Series: Fluvent ~~Calcic~~ Argiustoll	3. Date: 11/16/	By: BC	5. Photo. No.	6. Stop No. 31	7. USGS Quad	8. Location: Sec. ___ T ___ R ___
9. Area: [illegible]	10. Forest: mix, super, mes. c fine-loamy Calcidic Argiustoll			11. Ranger District		12. State: [illegible]	13. County: [illegible]
14. Parent Material: Alluvium	15. Bedrock Name: Mixed Alluvium			16. Elevation	17. Erosion: a. Kind: Moderate	b. Class: [illegible]	
18. Landform: Floodplain Terrace	19. Slope: a. % 1 b. Shape: Concave c. Length: 50' d. Aspect: 270°			20. Drainage Class: WD	21. Surface Stone and Rock: a. GR ___ b. CB ___ c. ST ___ d. BY ___		
22. Potential Natural Vegetation: Aspen-Douglas Fir Survey Corridor	23. Annual Precipitation			24. Measured Soil Temperature	25. Water Table (Depth): Not [illegible]		

HORIZON DESIGNATION (a)	DEPTH (b)	COLOR (c) Moist (1)	COLOR (c) Dry (2)	COLOR (c) Mottling (3)	TEXTURE (d)	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	CONSISTENCE (f) Moist (2)	CONSISTENCE (f) Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	SPECIAL FEATURES (g) Roots (3)	SPECIAL FEATURES (g) Pores (4)	EFFER. CLASS (h)	FIELD pH (i)	BOUNDARY (j)
A	0-7	10YR 3/3	10YR 4/2	/	2M-F LOAM 23	2MF GR	SO	FR	SS/PS	/	CR 0 CB 0 ST 0	3VF 2F 1M	3VF IN	NE		CS
BWT	7-17	10YR 4/4	10YR 6/4	/	27	2M-F SBK	SH	FI	SS/P	70CLF PF/Po	CR 0 CB 0 ST 0	2VF 2F 1M	2VF-F TU	SE		CW
BTK1	17-38	7.5YR 4/3	7.5YR 5/3	/	29	2M-F SBK	VH	FI	SS/P	50CLF PF/Po	CR 0 CB 0 ST 0	1VF 1F 1M	1VF-F TU	ST		CW
BTK2	38-52	2.5Y 5/3	2.5Y 6/2	/	40	2M-F SBK	—	EFI	VS/VP	90CLF PF/Po	CR 0 CB 0 ST 0	1F 1VF	1VF-F TU	ST		AS
2C1	52-75	10YR 5/3	10YR 7/3	/	15	MASSIVE	VH	VFI	SS/Po	/	CR 0 CB 0 ST 0	1VF 1F	2VF 1F TU	VE		AS
2C2	75-110	7.5YR 5/4	7.5YR 7/4	/	8	SG	LO	LO	SO/Po	/	CR 0 CB 0 ST 0	1F 1VF	3VF IN	SE		AW
2C3	110-135	NOT	SAMPLED	[illegible]	5	SG	LO	LO	SO/Po		CR 0 CB 0 ST 0	/		SE		[illegible]
											CR CB ST					
											CR CB ST					
											CR CB ST					

26. Particle Size Control Section	a. Depth: 17-37"	b. Average Clay %: 18-35	c. Average Rock Fragment Content: 0
27. Depth to Lithic or Paralithic Contact: >9 Ft			
28. Diagnostic Horizons	a. Surface: Mollic (w/ mixing)	b. Subsurface: Calcic	
29. Moist Control Section Depth: 10-30			

USDA - Forest

Calcidic Argiustoll ~~Typic Calciustoll~~

SOIL DESCRIPTION

(Reference Manual 2509.18)

UTM 0371059 4140104

1. Map Unit Symbol	2. Family or Series	3. Date	4. By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location: Sec. ___ T. ___ R. ___
1	Fine-loamy mix super mesic ~~Typic Argiustoll~~	11/16/06	BC		32		

9. Area	10. Forest	11. Ranger District	12. State	13. County
Cockhouse Survey			UT	Kane

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion: a. Kind ___ b. Class ___
Alluvium	Alluvium - Mixed		

18. Landform	19. Slope: a. %	b. Shape	c. Length	d. Aspect	20. Drainage Class	21. Surface Stone and Rock: a. GR	b. CB	c. ST	d. BY
Alluvial Fan	2	Concave	150'	280	WD	0	0	0	0

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
Fallow Field Mid-way Across			None Moist Sand @ 10 ft

HORIZON DESIGNATION (a)	INCHES DEPTH (b)	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	TEXTURE (d)	% C	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	FIELD pH (i)	BOUNDARY (j)
A	0-8	10YR 3/2	10YR 5/3	/	Loam	24	2M-F GR	SO	FR	SS/PS	/	GR - 0 CB - 0 ST - 0	2VF 1VF 1M	3VF IN 1F TU	NE		C, S
Bt	8-17	10YR 4/3	10YR 6/3	/	Clay Loam	31	2CM SBK	HA	FI	S/PS	2MK PF	GR - 0 CB - 0 ST - 0	1F 1VF	1VF-F TU	SE		C, W
Bt K1	17-31"	10YR 4/4	10YR 6/4	/	Clay Loam	34	2M ABK	VA	VFI	S/PS	2MK PF	GR - 0 CB - 0 ST - 0	1VF	1VF-F TU	SE		C, W
Bt K2	31-54	7.5YR 4/3	7.5YR 6/4	/	SiC	39	3CM ABK	EH	EFI	VS/VP	1MPF	GR - 0 CB - 0 ST - 0	1F	1VF-F TU	ST		C, S
Bt K3	54-72	7.5YR 5/3 7.5YR 5/2	7.5YR 7/2 7.5YR 6/4	(70) (30)	Loam	23	3C-M SBK	EH	VFI	S/P	/	GR - 0 CB - 0 ST - 0	/	1VF-F TU	ST		A, S
C1	72-90	7.5YR 5/3	7.5YR 7/4	/	SL	18	Mass Ine	HA	FR	SS/PO	/	GR - 0 CB - 0 ST - 0	/	1VF-F TU	VE		A, S
2C1	90-110	2.5Y 4/3	2.5Y 6/3	Faint 10%	SiC	43	Mass Ine	LO	EF	S/P	/	GR - 0 CB - 0 ST - 0	/	1VF TU	VE		A, S
2C2	115-140	Sampled for box only 7.5YR 5/4	7.5YR 7/3	7.5YR 5/6	Coarse Sand	6	SG	LO	LO	SO/PO		GR - 0 CB - 0 ST - 0	/	3VF IN	NE		Moist Sand
												GR - CB - ST -					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
	10-40"	33	0	>140"

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
	Mollic	Calcic	10-30"

FS 2509.1 (2/86)

SOIL DESCRIPTION

Soil Type MAP UNIT = 4

File No.

Area COAL HOLLOW | Date 3-8-07 | Stop No. 37

Classification CO-LOAMY Aridz CALCIUSTOLL, MIX MESIC SUPERACTIVE, V DEEP

Location: Section T R

N. Veg. RABBITBRUSH - SAGEBRUSH, FEW JUNIPER

Parent Material ALLUVIAL | Climate (Precip.) USTC

Physiography VALLEY FLOOR | Surface Rock Fragments Gravel 0

Relief LONGAVE | Drainage WELL DRAINED | Surface Rock Fragments Cobble 0

Elevation 6700 | Gr.water — | Surface Rock Fragments Stones 5

Slope 4 % | Range | Moisture | Surface Rock Fragments Other

Aspect/Degrees 270° | Root Distr. | % Clay *PSCS

Erosion NONE | % Coarse fragments*PSCS | % Coarser than V.F.S.*PSCS

Permeability MODERATE | Range Site

GPS Latitude N | Microbiotic Crust Class

GPS Longitude W | Rock Formation/Type ALLUVIUM MIXED SEDIMENTARY

GPS Elevation | Topo Quad Name ALTON

Soil Temp at 20" F | Photo Number

Additional Notes DISKED & SEEDED AREA

+ Lab [illegible] 1st 5 samples (TO 58")

SOIL MICRO MANOLITH BOX TAKEN

*Control Section Average

Horizon	Depth (inch)	Color Dry	Color Moist	Texture Clay	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction Effer.	Boundary	Rock Frags	Root	Pore	Ped Surface Features
A1	0-6	10YR 5/3	10YR 3/2	SICL 30	2M-F GR	SO	VFR	SS/PO	NE	C, W	/	3VF 1F		pH 7.2
A2	6-12	10YR 5/3	10YR 3/3	SICL 31	2M-F GR	SO	FR	SS/PS	NE	C, S	/	2VF 1F		7.2
BWK1	12-24	10YR 6/3	10YR 4/3	SANDY LOAM → SCL 24	3F-M ABK	HA	FI	S/PS	5f CAM ST	C, S	/	1VF		7.8
BWK2	[illegible]	10YR 7/4	10YR 5/4	LS 8	3M ABK	VH	VFI	SO/PO	15fm CAM ST	C, W	2 2	1VF		8.4
BK1	33-58	10YR 7/4	10YR 5/4	LFS 6	3C-M SBK	HA	FI	SO/PO	15f cam ST	C S	3 4	/		8.4
RBK1	58-80	10YR 7/4	10YR 5/4	SAND 4	MASSIVE	LO	LO	SO/PO	10fvf CAM ST	A, S	10GR 3CB	/		8.4
RBK2	[illegible]	10YR 7/3	10YR 5/3	SANDY LOAM	SG	LO	LO	SO/PO	VE ~~SE~~ 15fvf CAM		0	/		8.4

USDA - Forest

fine-loamy, mx, super mesic Aridic Calciustoll

SOIL DESCRIPTION

(Reference Manual 2509.18)

1. Map Unit Symbol	2. Family or Series	3. Date	4. By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location:
4	~~Fanlock~~ ~~Haplustoll~~ Ei-loamy, mixed	3/7/07	BC		34	Alton	Sec. ____ T. ____ R. ____

9. Area	10. Forest	11. Ranger District	12. State	13. County
Coal Hollow	(Calc) V. Deep		UT	Kane

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion:
Alluvium + Residuum	Tropic Shale w/ Mixed Alluvium		a. Kind None b. Class ____

18. Landform	19. Slope:	20. Drainage Class	21. Surface Stone and Rock
Fanslope	a. % 2 b. Shape Slightly Concave c. Length 150' d. Aspect ____	WD	a. GR 0 b. CB 2 c. ST Tr d. BY ____

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
Disked Field, Rabbitbrush, Sagebrush	16-18"		

HORIZON DESIGNATION (a)	DEPTH (b)	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	TEXTURE (d)	%C	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	FIELD pH (i)	BOUNDARY (j)
A	0-9	10YR 3/3	10YR 5/3	/	SiL	24	2M-F SBK	SU	VFR	SS/PO	/	GR - / CB - / ST -	3VF 2F		NE	7.6	C.W
BW	9-17	10YR 4/3	10YR 6/3	/	SiL	27	2M SBK	SH	FR	SS/PO	/	GR - 0 CB - 0 ST - 0	2VF 1F		ST	7.4	C.S
BK1	17-27	10YR 5/4	10YR 7/3	/	SiL	26	2M-C SBK	HA	VFI	SS/PO	/	GR - 0 CB - 0 ST - 0	1VF, F		ST 5fCAM	8.2	C.S.
BK2	27-45	10YR 5/3	10YR 6/3	/	SL	14	2C SBK	HA	VFI	SU/PO	/	GR - 2 CB - 0 ST - 0	1VF		10fm CAM ST	8.5	G.W
2BK	45-70	10YR 5/3	10YR 7/3	/	LS	3	MASSIVE	SH	V	SP/PO	/	GR - 3 CB - 2 ST - 0	1VF		15fm CAM VE	8.6	
												GR - CB - ST -					
												GR - CB - ST -					
												GR - CB - ST -					
												GR - CB - ST -					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
		19	7-15%	>60'

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
	Mollic	CAMBIC	10-30

Previous edition [illegible]lete.

FS-2500-1 (2/8[illegible])

EXISTING VEGETATION

30. (Species) TREES	(% Crown Cover)	31. (Species) SHRUBS	(% Crown Cover)	32. (Species) FORBS	(% Crown Cover)	33. (Species) GRASSES	(% Crown Cover)

34. Additional Notes *(Use and Management)*:

LAB CHARACTERIZED TOP 5 SAMPLES

SOIL MICRO MONOLITHS BOX TAKEN

IR | MINING DISTURBANCE

USDA - Forest Service

SOIL DESCRIPTION

(Reference FSH 2509.18)

WITHIN OLD CANAL HIGH SAGEBRUSH

Aridic Calciustoll

1. Map Unit Symbol	2. Family or Series	3. Date	4. By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location:
4	Carter Aridisol Fine-loamy, mix, super, mesic	3-7-07	BC		35	DIXON	Sec. ____ T. ____ R. ____

9. Area	10. Forest	11. Ranger District	12. State	13. County
Old Canal	Dixie N F		UTAH	KANE

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion:
Alluvium			a. Kind NONE b. Class

18. Landform	19. Slope:	20. Drainage Class	21. Surface Stone and Rock
Fan Slope	a. % 3 b. Shape Convex c. Length ____ d. Aspect 220	WD	a. GR ____ b. CB ____ c. ST 2 d. BY 2

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
Big Sagebrush Rabbitbrush			

HORIZON DESIGNATION (a)	DEPTH (b)	COLOR (c) Moist (1)	COLOR (c) Dry (2)	COLOR (c) Mottling (3)	TEXTURE (d)	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	CONSISTENCE (f) Moist (2)	CONSISTENCE (f) Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	SPECIAL FEATURES (g) Roots (3)	SPECIAL FEATURES (g) Pores (4)	EFFER. CLASS (h)	FIELD pH (i)	BOUNDARY (j)
A1	0-9	10YR 3/3	10YR 5/2	/	SiL	2FSBK → MGR	SO	FR	SO/PO	/	GR-0 CB-0 ST-0	3F 2F		NE	7.4	CS
A2 ~~BT~~	9-19	10YR 5/4	10YR 6/3	/	SiCL	2F-M SBK	SH	VFI	SS/PS	1MUPF 1APW	GR-2 CB-0 ST-0	VF 1F		VS	7.6	CW
B1 ~~K~~	19-30	10YR 5/3	10YR 7/3	/	LoAM	2M-F SBK	HD	FI	SS/PS	2M PO	GR-3 CB-0 ST-0	VVF		ST ~~SC~~ 5FCAM	8.4	CW
BK1 ~~CK~~	30-45	10YR 5/3	10YR 7/3	/	FSL	3CM SBK	HA	VFI	SS/PO	/	GR-2 CB-0 ST-0	/		VE 15mCAM	8.6	GW
BK2 ~~CK~~	45-70	10YR 6/3	10YR 7/2	/	S.LOAM	3CM SBK	HA	VFI	SS/PO	/	GR-3 CB-1 ST-0	/		VE 20mCAM	8.6	GW
2C	70-95	10YR 6/3	10YR 8/3	/	GR	MASS VE	SH	FR	SO/PO	/	GR-25 CB-5 ST-2	/		15fmCAM ST	8.7	
											GR- CB- ST-					
											GR- CB- ST-					
											GR- CB- ST-					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
	9-29	26	<20%	>60

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
	None	None	10-30"

Previous edition Note.

FS-2500-1 (2/86)

EXISTING V[illegible]ATION

30. (Species) [illegible]S (% Crown Cover)	31. (Species) SHRUBS (% Crown Cover)	[illegible]ecies) FORBS (% Crown Cover)	33. (Species) GRASSES ([illegible]n Cover)

34. Additional Notes *(Use and Management)*:

AUGERED LAST 15" in 2C THEN HIT COARSE ALLUVIUM

LNB CHARACTERIZED TOP 5 SAMPLES 0-9"

9-19"

SOIL MICRO-BOX TAKEN

19-30

30-45

45-65

YR 1 COAL MINING DISTURBANCE

USDA - Fore[illegible]ce

Aridic

SOIL [illegible]RIPTION

(Reference FSH 2509.18)

1. Map Unit Symbol	2. Family or Series	3. Date	4. By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location:
4	~~TYPIC~~ CALCIUSTOLL ~~fi~~ LOAMY, MX super mesic	3/7/06	BC		36	ALTON	Sec. ____ T. ____ R. ____

9. Area	10. Forest	11. Ranger District	12. State	13. County
COAL HOLLOW			UTAH	KANE

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion:
MIXED ALLUVIUM	SEDIMENTARY ALLUVIUM		a. Kind NONE b. Class

18. Landform	19. Slope:	20. Drainage Class	21. Surface Stone and Rock
FAN	a. % 4 b. Shape CONCAVE c. Length 75' d. Aspect 230		a. GR 0 b. CB 2 c. ST 3 d. BY 1

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
OAK W/ ARTEMA	16-18		NONE

HORIZON DESIGNATION (a)	DEPTH (b) INCHES	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	TEXTURE (d) %C	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	FIELD pH (i)	BOUNDARY (j)
A	0-9	10YR 3/3	10YR 5/3	/	LOAM	3M-C GR	SO	VFR	SO/PO	/	GR - 0 CB - 0 ST - 0	2VF 1F		NE	7.9	C,S
BW	9-24	10YR 4/3	10YR 6/3	/	~~LOAM~~ SL 12	3M-F SBK	HA	VFI	SS/PO	/	GR - CB - ST -	2F 1VF		SE ~~NE~~ 2VF CAM	8.2	C,S
BWK	24-41	10YR 5/4	10YR 7/3	/	~~LOAM~~ SL 10	3M-C NBK	VHA	VFI	SS/PO	/	GR - CB - ST -	1VF		ST ~~SE~~ 8F CAM	8.4	A,S
BK ~~2~~	41-68	10YR 5/4	10YR 7/3	/	F ~~SWBL~~ LS	MASS NE	LO	LO	SO/PO	/	GR - CB - ST -	/		ST ~~SE~~ 12F CAM	8.4	A,W
2C	68-85	10YR 5/3	10YR 6/3	/	LS	SG	LO	LO	SO/PO	/	GR - / CB - / ST - /	/		ST ~~VS~~ CAC BRF	8.4	
											GR - CB - ST -					
											GR - CB - ST -					
											GR - CB - ST -					
											GR - CB - ST -					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
		12%	<5%	

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
		cambic / calcic	

Previous edition [illegible]lete.

FS-2500-1 (2/86)

EXISTING V[illegible]ATION

30. (Species) [illegible] (% Crown Cover)	31. (Species) SHRUBS (% Crown Cover)	3[illegible] [illegible]ecies) FORBS (% Crown Cover)	33. (Species) GRASSES ([illegible]n Cover)

34. Additional Notes *(Use and Management)*:

SAMPLED BY AUGER TO 35" FROM TRENCH BOTTOM

LAC CHARA FIRST 4 [illegible] TO 68'
CTERIZED ONLY

MICRO-SOIL BOX MADE

SOIL DESCRIPTION

Soil Type

File No.

Area COAL HOLLOW | Date 3-8-07 | Stop No. 37

Classification Calcixerollic Aridic Calciustoll, mix, Mesic, superficial, v deep

Location: Section T R

N. Veg. RABBITBRUSH, SAGEBRUSH, FEW JUNIPER

Parent Material ALLUVIUM | Climate (Precip.) USFC

Physiography VALLEY FLOOR | Surface Rock Fragments Gravel 0

Relief CONCAVE | Drainage WELL DRAINED | Surface Rock Fragments Cobble 0

Elevation 6700 | Gr.water — | Surface Rock Fragments Stones 0

Slope 4 % | Range | Moisture | Surface Rock Fragments Other

Aspect/Degrees 270° | Root Distr. | % Clay *PSCS

Erosion NONE | % Coarse fragments *PSCS | % Coarser than V.F.S. *PSCS

Permeability MODERATE | Range Site

GPS Latitude N | Microbiotic Crust Class

GPS Longitude W | Rock Formation/Type ALLUVIUM MIXED SEDIMENTARY

GPS Elevation | Topo Quad Name ALTON

Soil Temp at 20" F | Photo Number

Additional Notes DISTURBED & SEEDED AREA

* Lab analysis on 5 samples (TO 58")
SOIL MICRO MORPHOLOGY BLOCK TAKEN

*Control Section Average

Horizon	Depth	Color Dry	Color Moist	Texture Clay	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction Effer.	Boundary	Rock Frags	Root	Pore	Ped Surface Features
	0-6	10YR 5/3	10YR 3/2	SICL 30	2M-F GR	SO	VFR	SS PO	NE	C, W	/	3VF 1F		pH 7.2
A2	6-12	10YR 5/3	10YR 3/3	SICL 31	2M-F GR	SO	FR	SS PS	NE	C, S	/	2VF 1F		7.2
BWK1	12-24	10YR 6/3	10YR 4/3	SANDY LOAM → SCL 30	3F-M ABK	HA	FI	S PS	5f CAM ST	C, S	/	1VF		7.8
BWK2	24-33	10YR 7/4	10YR 5/4	LS 8	3M ABK	VH	VFI	SO PO	15fmCAM ST	C, W	2 2	1VF		8.4
BK1	33-55	10YR 7/4	10YR 5/4	LFS 6	3C-M SBK	HA	FI	SO PO	15f cam ST	C S	3 4	/		8.4
2BK1	55-80	10YR 7/4	10YR 5/4	SAND 4	MASSIVE	LO	LO	SO PO	10fvf CAM ST	A, S	10CM SCA	/		8.4
2BK2		10YR 7/3	10YR 5/3	SANDY LOAM	SG	LO	LO	SO PO	VE ~~ST~~ 15fvf CAM		0	/		8.4

Microbiotic Crust

Two classes are suggested:

Immature - gray crust of cyanobacteria the sheaths and filaments of which connect soil particles; takes about 5 years to develop

Mature - dark black crust with pedestals; in addition to the bacteria it includes mosses, fungi, and lichens; takes 50 or more years to develop

Quantity definitions for percentage surface cover of microbiotic crusts

- Very few - less than 5% per 10 square feet
- Common - 15 to 50% per 10 square feet
- Few - 5 to 15% per 10 square feet
- Many - more than 50% per 10 square feet

Plasticity

Fld.Code	Class	Description	Fld. Code	Class	Description
PO	Non-plastic	4cm long /6mm thick roll cannot be formed	P	Moderately	4cm long/4mm thick roll will support weitht
PS	Slightly plastic	4cm long/ 6mm thick roll will support weight	VP	Very plastic	4cm long/2mm thick roll will support weight

Stickiness

Fld.Code	Class	Description	Fld.Code	Class	Description
SO	Non-sticky	No material adheres to thumb or forefinger	S	Moderately	Adheres to both digits;stretches slightly
SS	Slightly sticky	Adheres to both digits; does not stretch appreciably	VS	Very sticky	Adheres to both digits;stretches appreciably

Effervescence

Fld. Code	Class	Description	Est. CCE	Fld.Code	Class	Description	Est. CCE
co	Non-effervescent	No bubbles seen	0	es	Strongly effervescent	Bubbles form low foam	15-40
e	Very slightly efferv.	Few bubbles seen	1-3	ev	Violently effervescent	Forms thick foam quickly	40+
em	Slightly effervescent	Bubbles readily seen	3-15				

Pores

Pores are described as a *quantity class, diameter size,* and *shape*

Quantity Class Definitions

Per Unit Area Definitions

- 1 centimeter squared for very fine and fine pores (.40 in^2)
- 1 decimeter squared for medium and coarse pores (4 in^2)
- 1 meter squared for very coarse pores (40 in^2)

Quantity Definitions

- Few - less than 1 per unit area
- Common - 1 to 5 per unit area
- Many - more than 5 per unit area

Diameter Definitions

- Very fine - less than 0.5 mm
- Fine - 1 to 2 mm
- Medium - 2 to 5 mm
- Coarse - 5 to 10 mm
- Very coarse - more than 10 mm

2 common pore shapes are present:

- Tubular - cylindrical or elongated
- Vesicular - spherical or elliptical

Roots

Roots are described as a *quantity class and diameter*

Quantity Class Definitions

Per Unit Area Definition s

- 1 centimeter squared for very fine and fine pores (.40 in^2)
- 1 decimeter squared for medium and coarse pores (4 in^2)
- 1 meter squared for very coarse pores (40 in^2)

Quantity Definitions

- Very few - less than .2 per unit area
- Moderately few - .2 to 1 per unit area
- Few - less than 1 per unit area
- Common - 1 to 5 per unit area
- Many - more than 5 per unit area

Diameter Definitions

- Very fine - less than 1 mm
- Fine - 1 to 2 mm
- Medium - 2 to 5 mm
- Coarse - 5 to 10 mm
- Very coarse - more than 10 mm

Terms for Rock Fragments

Shape and Size	Noun	Shape and Size	Noun
Sehcrical, cubelike, or equiaxial:		Flat:	
2-75 mm diameter	Gravel	2-150 mm long	Channers
75-250 mm diameter	Cobbles	150-380 mm long	Flagstone
250-600 mm diameter	Stones	380-600 mm long	Stones
≥600 mm diameter	Boulders	≥600 mm long	Boulders

Rupture Resistance Classes for Blocklike Speciments

Classes Dry	Moist	Test Description
Loose	Loose	Specimen not obtainable
Soft	Very friable	Fails under very slight force applied slowly between thumb and forefinger
Slightly hard	Friable	Fails under slight force applied slowly between thumb and forefinger
Moderately hard	Firm	Fails under moderate force applied slowly between thumb and forefinger
Hard	Very firm	Fails under strong force applied slowly between thumb and forefinger
Very hard	Extremely firm	Cannot be failed between thumb and forefinger but can be between both hands or by placing on a nonresilent surface and applying gentle force underfoot

USDA - Forest Service

SOIL DESCRIPTION

(Reference FSH 2509.18)

fine, mx, super frigid Aeric Epiaquept

1. Map Unit Symbol	2. Family or Series	3. Date	4. By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location: Sec. ___ T. ___ R. ___
7	~~Coal Hollow, Silt~~	8/7/87	BL		38	Alton	

9. Area	10. Forest	11. Ranger District	12. State	13. County
Fenn Hollow	Soil Survey		Utah	Kane

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion: a. Kind	b. Class
[illegible]	Mixed Alluvium		None	

18. Landform	19. Slope: a. %	b. Shape	c. Length	d. Aspect	20. Drainage Class	21. Surface Stone and Rock a. GR	b. CB	c. ST	d. BY
Swales in Valley Fill	2	Concave	180	140	PD	0	0	0	0

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
Rose Squirrelbush Cheat Grass	16-18"		29 inches

HORIZON DESIGNATION (a)	DEPTH (b)	COLOR (c) Moist (1)	Dry (2)	Mottling (3)	TEXTURE (d)	%C	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	Moist (2)	Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	FIELD pH (i)	BOUNDARY (j)
A	0-6	10YR 4/2	10YR 6/2	No	Silt		3m-f sbk	sh	vfr	s p		GR - 0 CB - 0 ST - 0	3vf 3f 2m		SE	7.5	
Ap	6-12	10YR 5/4	10YR 7/3	No	Silt		3m-f pr	sh	fi	s p		GR - 0 CB - 0 ST - 0	3f 3vf 3m		ST 3f CAM	8.0	A.S
B1	12-24	10YR 6/4	10YR 7/2	Yes 35% Gleyed	Silt		Massive	h	fi	s p		GR - 0 CB - 0 ST - 0			25fm CAM VE	8.6	
B2	24-40	10YR 7/2	10YR 8/1	Not sampled here, take subsoil at backhoe pit (40")	Silt		m	h	Gleyed fi	s p		GR - CB - ST -			40m CAM VE	8.7	
												GR - CB - ST -					
												GR - CB - ST -					
												GR - CB - ST -					
												GR - CB - ST -					
												GR - CB - ST -					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:

Previous edition obsolete.

FS-2500 (2/86)

EXISTING V[illegible]ATION

30. (Species) [illegible]S (% Crown Cover)	31. (Species) SHRUBS (% Crown Cover)	3[illegible]ecies) FORBS (% Crown Cover)	33. (Species) GRASSES ([illegible]n Cover)

34. Additional Notes *(Use and Management)*:

SAMPLED HAND / AUGER IN AREA ABOVE PIPELINE 100 YARDS NE OF BACKHOE PIT (SUBMERGED IN WATER

Lab [illegible] ALL 4 samples

SOIL MICRO-MONOLITH BOX (W/ #40) COMBINED

USDA - Forest Service

Aridic

SOIL DESCRIPTION

(Reference: FSH 2509.18)

1. Map Unit Symbol	2. Family or Series	3. Date	4. By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location: Sec. ____ T. ____ R. ____
4	~~Typic~~ Cowlitzton Colony MX	3-7-85	BC		39	Altonah	

9. Area	10. Forest	11. Ranger District	12. State	13. County
[illegible]	Super, mesic ~~[illegible]~~ VDeep		Utah	Kane

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion: a. Kind	b. Class
[illegible]	Allowing [illegible]		None	

18. Landform	19. Slope: a. % ____ b. Shape ____ c. Length ____ d. Aspect ____	20. Drainage Class	21. Surface Stone and Rock: a. GR ____ b. CB ____ c. ST ____ d. BY ____
Fan Slope		WD	

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
Grasses Dense area next to canal			None

HORIZON DESIGNATION (a)	DEPTH (b)	COLOR (c) Moist (1)	COLOR (c) Dry (2)	COLOR (c) Mottling (3)	TEXTURE (d)	%C	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	CONSISTENCE (f) Moist (2)	CONSISTENCE (f) Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	SPECIAL FEATURES (g) Roots (3)	SPECIAL FEATURES (g) Pores (4)	EFFER. CLASS (h)	FIELD pH (i)	BOUNDARY (j)
Ap	0-6	10YR 3/2	10YR 5/3	/	SiL		2M-F GR	So	FR	SS PS	/	GR-0 CB-0 ST-0	2VF 2F 1M		NE	7.6	C.W
A2	6-12	10YR 2/3	10YR 5/4	/	SiL → L cm	24	2FSBK → M CR	So	FR	SS PS	/	GR-0 CB-0 ST-0	1VF 2F 1M		VS	7.8	C.S
BK1	12-24	10YR 5/4	10YR 6/4	/	SL	15	3M-C ABK	VH	VFI	SO PO	/	GR-0 CB-0 ST-0	VVF		ST 8f CAM	8.4	G.W
BK2	24-36	10YR 5/4	10YR 7/3	/	GR ~~LS~~ SL	7	3M-C ABK	VH	VFI	SO PO	/	GR-10 CB-5 ST-0	/		ST 10f CAM	8.4	G.W
2C	36-75	10YR 5/3	10YR 7/3	/	CBV LSAND		MASSIVE	VH	FI	SO PO	/	GR-75 CB-30 ST-0	/		ST 15f CAM	8.2	
												GR- CB- ST-			1mm CAC BRF		
												GR- CB- ST-					
												GR- CB- ST-					
												GR- CB- ST-					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
	10-40"	~~35~~ 11%	<35	>60

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
	Mollic	Cambic	

Previous edition obsolete.

FS-2500-1 (2/86)

EXISTING VEGETATION

30. (Species) TREES (% Crown Cover)	31. (Species) SHRUBS (% Crown Cover)	32. (Species) FORBS (% Crown Cover)	33. (Species) GRASSES (% Crown Cover)

34. Additional Notes *(Use and Management)*:

FIRST 4 samples TO 36"

LAB CHARACTERIZATION ONLY ON

SOIL MICRO-POR NMSE

USDA - Forest Service

SOIL DESCRIPTION

(Reference FSH 2509.18)

Aeric Calciaquoll, mixed, super frigid

1. Map Unit Symbol	2. Family or Series	3. Date	4. By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location:
7	FINE-LOAMY, mixed, super frigid	7-7-07	BC		40	ALTON	Sec. ____ T. ____ R. ____

9. Area	10. Forest	11. Ranger District	12. State	13. County
Dixie National Forest, Paria Canyon Ranger District	DIXIE NF WATER MOUNTAIN		UTAH	KANE

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion: a. Kind	b. Class
Alluvium	MIXED SEDIMENTARY ALLUVIUM		NONE	

18. Landform	19. Slope: a. %	b. Shape	c. Length	d. Aspect	20. Drainage Class	21. Surface Stone and Rock: a. GR	b. CB	c. ST	d. BY
VALLEY FLOOR	3	LINEAR	75'	180	SPD	0	0	0	0

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
GRASS - SEDGES	16-18		2.3' [illegible]

HORIZON DESIGNATION (a)	DEPTH (b) (Inches)	COLOR (c) Moist (1)	COLOR (c) Dry (2)	COLOR (c) Mottling (3)	TEXTURE (d)	%C	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	CONSISTENCE (f) Moist (2)	CONSISTENCE (f) Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	SPECIAL FEATURES (g) Roots (3)	SPECIAL FEATURES (g) Pores (4)	EFFER. CLASS (h)	FIELD pH (i)	BOUNDARY (j)
A	0-6	10YR 3/2	10YR 5/2		SIL		2 med GR	SO	VFR	SS/PU		GR - 0 CB - 0 ST - 0	3 VF 3 F 3 M 3 C		SE	7.8	A S
Ag	6-12	10YR 4/3	10YR 6/3	YES	SILT		2 med GR	SO	VFR	SS/PU		GR - 0 CB - ST -	3 VF 3 F 3 M		ME	8.2	A S
BK	12-22	10YR 5/4	10YR 7/3	YES	SILT		MASSIVE	SH	FR	SS/PU		GR - CB - ST -	2 VF 2 F 1 M		ST 12-15 f CAM	8.4	A W
Cg3	22-[illegible]	SAME AS	BELOW	24 TH	SIL	UNDER	WATER	TUGGY				GR - CB - ST -					
Cg4	22-00			GLEYED	SILT		MASSIVE					GR - CB - ST -					
												GR - CB - ST -					
												GR - CB - ST -					
												GR - CB - ST -					
												GR - CB - ST -					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:

Previous edition obsolete.

FS 2500-1 (2/86)

EXISTING V[illegible]ATION

30. (Species) [illegible]S (% Crown Cover)	31. (Species) SHRUBS (% Crown Cover)	[illegible]pecies) FORBS (% Crown Cover)	33. (Species) GRASSES ([illegible]n Cover)

34. Additional Notes ***(Use and Management):***

Oe 3" [illegible] MAT, DECOMPOSED PLANT ROOTS BLACK

Lab [illegible] first [illegible] samples

SOIL MICRO-MONOLITH BOX (COMBINED W/ #38)

USDA - Forest Service

SOIL DESCRIPTION

(Reference FSH 2509.18)

mesic fine mixed, super Aridic Calciustoll

1. Map Unit Symbol	2. Family or Series	3. Date	4. By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location: Sec. ____ T. ____ R. ____
9					41		

9. Area	10. Forest	11. Ranger District	12. State	13. County

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion: a. Kind ____ b. Class ____

18. Landform	19. Slope: a. % ____ b. Shape ____ c. Length ____ d. Aspect ____	20. Drainage Class	21. Surface Stone and Rock a. GR ____ b. CB ____ c. ST ____ d. BY ____

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)

HORIZON DESIGNATION (a)	DEPTH (b)	COLOR (c) Moist (1)	COLOR (c) Dry (2)	COLOR (c) Mottling (3)	TEXTURE (d)	%	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	CONSISTENCE (f) Moist (2)	CONSISTENCE (f) Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	Roots (3)	Pores (4)	EFFER. CLASS (h)	FIELD pH (i)	BOUNDARY (j)
A1	0-6	10YR 3/3	10YR 5/3	/								CR - CB - ST -			NE	7.9	
A2	6-12	10YR 3/3	10YR 5/3	/	CL	38						CR - CB - ST -			NE	8.0	
BwK	12-36	10YR 4/3	10YR 6/3	/	C	42						CR - CB - ST -			ST 3-5 f CAM	8.2	
Bk1	36-64	10YR 5/4	10YR 7/3	/	CL	32						CR - CB - ST -			VE 12 fm CAM	8.2	
Bk2	64-80	10YR 5/4	10YR 7/4	/	SCL	22						CR - CB - ST -			VE 10 f CAM	8.6	
												CR - CB - ST -					
												CR - CB - ST -					
												CR - CB - ST -					
												CR - CB - ST -					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
	10-40"	40	0	760"

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:
	Mollic	cambic / Calcic	

30. (Species) TREES (% Crown Cover)	31. (Species) SHRUBS (% Crown Cover)	32. (Species) FORBS (% Crown Cover)	33. (Species) GRASS (% Crown Cover)

34. Additional Notes ***(Use and Management)***:

SAMPLED 5 INCREMENTS

2 PLOW PHOTOS, 1 LANDSCAPE

MICRO
SOIL BOX MADE

YR 1 Mining Dist Survey

USDA - Forest Service

W

Aridic Haplustoll f-loamy mixed skeletal, mesic

SOIL DESCRIPTION

(Reference FSH 2509.18)

1. Map Unit Symbol	2. Family or Series	3. Date	4. By	5. Photo. No.	6. Stop No.	7. USGS Quad	8. Location: Sec. ___ T. ___ R. ___
9	~~[illegible]~~	3/6/87	BC		42	ALTON	

9. Area	10. Forest	11. Ranger District	12. State	13. County
ROBINSON CREEK CUTBANK			UTAH	KANE

14. Parent Material	15. Bedrock Name	16. Elevation	17. Erosion: a. Kind	b. Class
ALLUVIUM	MIXED SHALE ALLUVIUM		MWD	

18. Landform	19. Slope: a. %	b. Shape	c. Length	d. Aspect	20. Drainage Class	21. Surface Stone and Rock: a. GR	b. CB	c. ST	d. BY
STREAM TERRACE	7	CONVEX	50	—	WD				

22. Potential Natural Vegetation	23. Annual Precipitation	24. Measured Soil Temperature	25. Water Table (Depth)
JUNIPER / SAGEBRUSH, ROBUSTA ROSE			

HORIZON DESIGNATION (a)	DEPTH (b)	COLOR (c) Moist (1)	COLOR (c) Dry (2)	COLOR (c) Mottling (3)	TEXTURE (d)	% Sk.	STRUCTURE (e)	CONSISTENCE (f) Dry (1)	CONSISTENCE (f) Moist (2)	CONSISTENCE (f) Wet (3)	SPECIAL FEATURES (g) Cutans (1)	% of Rock Fragments (2)	SPECIAL FEATURES (g) Roots (3)	SPECIAL FEATURES (g) Pores (4)	EFFER. CLASS (h)	FIELD pH (i)	BOUNDARY (j)
A	0-4	10YR 3/2	10YR 5/3		CBL	20	2m-F Gr	SH	VFR	SO PO	/	GR-10 CB-5 ST-0	2vf 2c 1m		ME	7.8	
2Bw	9-24	10YR 4/3	10YR 6/3		CBC	43	3m-c SBK	SH	FR	SO PO	/	GR-10 CB-5 ST-0	1vf 1f 1m		ST	8.2	
2Buk	24-36	10YR 5/3	10YR 6/3		SCL	21	3m-c SBK	SH	FR	SO PO	/	GR-5 CB-3 ST-0	1f 1m		ST	8.4	
2BK	36-48	10YR 5/4	10YR 6/4		L	22	MASSIVE	HARD	FR	SO PO	/	GR-TR CB-TR ST-0	1vf 1f		ST	8.6	
												GR- CB- ST-					
												GR- CB- ST-					
												GR- CB- ST-					
												GR- CB- ST-					
												GR- CB- ST-					

26. Partical Size Control Section	a. Depth:	b. Average Clay %:	c. Average Rock Fragment Content:	27. Depth to Lithic or Paralithic Contact:
	10-40"	31%		

28. Diagnostic Horizons	a. Surface:	b. Subsurface:	29. Moist Control Section Depth:

30. (Species) TREES (% Crown Cover)	31. (Species) SHRUBS (% Crown Cover)	32. (Species) FORBS (% Crown Cover)	33. (Species) GRASS (% Crown Cover)

34. Additional Notes (*Use and Management*):

SAMPLED 4 INCREMENTS TO 48" 0-9, 9-24, 24-36, 36-48"

PEDON TAKEN 2 PHOTOS 1 LANDSCAPE OF MU 13

BACKSIDE PIT AT EDGE OF RODENS IN ARROYO

NO MICROMORPHOLOGY BOX FOR THIS PROFILE MADE OR PHOTOGRAPHED

USDA-NRCS

PEDON DESCRIPTION

PEDON ID #: 43

DRAFT 3/2002

Series or Component Name:	Map Unit Symbol: 7	Photo #:	Classification: Typic Argiaquoll fine, mixed, superactive, frigid	Soil Moist. Regime (Tax.): Ustic

Describer(s): Bob Long	Date: Apr 5, 2007	Weather: High Clouds Temp.: Air: Soil: Depth:	Latitude: ° ' " N Longitude: ° ' " W Datum: 1983	Location: Sec. T. R.

UTM: Zone: mE: mN:	Topo Quad:	Site ID: Yr: State: County: Pedon #:	Soil Survey Area:	MLRA / LRU:	Transect: ID: Stop #: Interval:	

Landscape: Bench	Landform:	Microfeature:	Anthro:	Elevation:	Aspect: SSW 210°	Slope (%): 4	Slope Complexity: Simple	Slope Shape: (Up & Dn / Across) Linear / Linear

Hillslope Profile Position:	Geom. Component:	Microrelief:	Physio. Division:	Physio. Province:	Physio. Section:	State Physio. Area:	Local Physio. Area:

Drainage: Very Poorly	Flooding: —	Ponding: Oc	Soil Moisture Status: Saturated	Permeability: K_{sat}: Very slow	Land Cover / Use: Pasture

Parent Material: Alluvium	Bedrock: Kind: Fract.: Hard.: Depth:	Lithostrat. Units: Group: Formation: Member:	

Erosion: Kind: Degree: None	Runoff: mod slow	Surface Frag %: GR: CB: ST: BD: CN: FL: Kind: — — — — — —	Diagnostic Horz. / Prop.: Kind: Depth: Mollic 0-7" Argillic 7-30" Calcic 17-96"

P. S. Control Section : Depth Range: 7-27"	Ave. Clay %: 40	Ave. Rock Frag %: 0

VEGETATION :

SYMBOL	COMMON NAME	% GD COVER
	Wild rose	
	Bluegrass	
	Sedges	

MISCELLANEOUS FIELD NOTES / SKETCH :

water flowing in 30-54" layer & perching on 54-72"

Component Name: | Map Unit Symbol: | Date: Apr 5, 2007

	Obser. Method	Depth (in) (cm)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Rock Frags Knd %	Rock Frags Rnd	Rock Frags Sz	Structure Grade	Structure Sz	Structure Type	Consistence Dry	Consistence Mst	Consistence Stk	Consistence Pls	Mottles %	Mottles Sz	Mottles Cn	Mottles Col	Mottles Mst	Mottles Sp	Mottles Loc
1	BP	0-7"	A	cs	10YR 5/2	10YR 3/3	L	—			2m	sbk		VH	fr	ss	mP	—						
2		7-17	Bt	cs	10YR 6/2	10YR 3/3	C	—			3mc pr 2fsbk			XH	fi	s	P	20	fm		7.5YR 6/6			
3		17-30	Btk	cs	10YR 7/2	10YR 4/3	CL	—			3mpr 2fsbk			VH	fi	s	P	35	fm		7.5YR 6/4			
4		30-54	Bk	as	10YR 7/2 & 7/3	10YR 4/2	SiL	—			2mpr 1fsbk			VH	fr	ss	mP	45	fm		10YR 5/4			
5		54-72	2Btk1	gs	10YR 7/1	10YR 4/1	C	—			3mpr			XH	vfi	vs	VP	50	m		7.5YR 6/6			
6		72-96"	2Btk2		10YR 8/1	10YR 6/1	SiC	—			2lmpr			XH	vfi	vs	VP	35	mc		10YR 6/8			
7																								
8					mollic	after	mixing	0-7"																
9																								
10																								

	Redoximorphic Features % Sz Cn Hd Sp Kd Loc Bd Col	Concentrations % Sz Cn Hd Sp Kd Loc Bd Col	Ped / V. Surface Features % Dst Cont Kd Loc Col	Roots Qty Sz Loc	Pores Qty Sz Shp	pH (meth)	Effer (agent)	Clay %	CCE	Notes
1	—	—	—	3vff 1m	2vft	8.2	SE	24		
2	—	—	85 CLF PF/PO	3vff 1m	1vft	8.4	SE	42		
3	—	15f CAM	75 CLF PF/PO	2vf 1fm	1vft	8.4	ST	38		
4	—	20fm CAM	—	2vf 1fm	1vft	8.6	ST	26		
5	—	10f CAM	100 CFF PF/PO	1vff	1vft	8.6	VE	50		
6	—	10f CAM	90 CLF PF/PO	1vf	—	8.4	VE	46		
7										
8										
9										
10										

USDA-NRCS

PEDON DESCRIPTION

PEDON ID #: 44

DRAFT 3/2002

Series or Component Name:	Map Unit Symbol: 7	Photo #:	Classification: Aeric Epiaquept fine, mixed, superactive, frigid	Soil Moist. Regime (Tax.): Ustic

Describer(s): Bob Long	Date: Apr 5, 2007	Weather: High clouds Temp.: Air: Soil: Depth:	Latitude: ° ' " N Datum: Longitude: ° ' " W	Location: Sec. T. R.

UTM: Zone: mE: mN:	Topo Quad:	Site ID: Yr: State: County: Pedon #:	Soil Survey Area:	MLRA / LRU:	Transect: ID: Stop #: Interval:	

Landscape:	Landform:	Microfeature:	Anthro:	Elevation:	Aspect: SW 228°	Slope (%): 4-5	Slope Complexity: Simple	Slope Shape: (Up & Dn / Across) Linear / Linear

Hillslope Profile Position:	Geom. Component:	Microrelief:	Physio. Division:	Physio. Province:	Physio. Section:	State Physio. Area:	Local Physio. Area:

Drainage: Very Poorly	Flooding: No	Ponding: Oc	Soil Moisture Status: Wn 0-14" Wd 14-34	Permeability: K_{sat}: Very slow	Land Cover / Use:

Parent Material: Alluvium	Bedrock: Kind: Fract.: Hard.: Depth: 34+ moist	Lithostrat. Units: Group: Formation: Member:	

Erosion: Kind: Degree:	Runoff:	Surface Frag %: GR: CB: ST: BD: CN: FL: Kind: — — — — — —	Diagnostic Horz. / Prop.: Kind: Depth: Calcic 14-96" aquic 7"+

P. S. Control Section: Depth Range: 10-40"	Ave. Clay %:	Ave. Rock Frag %:

VEGETATION :

SYMBOL	COMMON NAME	% GD COVER
	Sedges	
	Bluegrass	

MISCELLANEOUS FIELD NOTES / SKETCH :

water filling pit at 14"

54-96" old decaying roots

44

Component Name: | Map Unit Symbol: | Date: Apr 5 2007

	Obser. Method	Depth (in) (cm)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Rock Frags Knd %	Rock Frags Rnd	Rock Frags Sz	Structure Grade	Structure Sz	Structure Type	Consistence Dry	Consistence Mst	Consistence Stk	Consistence Pls	Mottles %	Mottles Sz	Mottles Cn	Mottles Col	Mottles Mst	Mottles Sp	Mottles Loc
1	BP	0-7"	A1	cs	10YR 6/2	10YR 4/2	SiL	—			3 m sbk	2 f sbk		H	Fr	ms	mp	—						
2	↓	7-14"	A2	cs	10YR 6/2	10YR 4/2	SiCL	—			2 m cpr	3 fm sbk		VH	fi	ms	mp	10 f			7.5YR 6/4			
3		14-34"	Bwk1	as	10YR 8/1	10YR 6/2	SiCL	—			1 m pr	2 m sbk		VH	fi	ms	mp	40 fm			7.5YR 6/6			
4		34-54"	Bwk2	gs	10YR 8/1	10YR 6/1	C	—			3 m cpr	2 f sbk		XH	vfi	vs	vp	60 mc			7.5YR 5/8			
5		54-72"	Bwk1	gs	10YR 8/1	10YR 6/1	C	—			3 m cpr			XH	vfi	vs	vp	25 mc			10YR 6/6			
6		72-96"	Bk2		10YR 8/1	10YR 6/1	SiL	—			m			VH	Fr	ms	mp	40 fm			10YR 6/6			
7																								
8																								
9																								
10																								

	Redoximorphic Features % Sz Cn Hd Sp Kd Loc Bd Col	Concentrations % Sz Cn Hd Sp Kd Loc Bd Col	Ped / V. Surface Features % Dst Cont Kd Loc Col	Roots Qty Sz Loc	Pores Qty Sz Shp	pH (meth)	Effer (agent)	Clay %	CCE	Notes
1	—	—	—	3 vff 2 m	2 vft	8.2	SE	26		
2	—	—	—	3 vff 2 m	2 vft	8.2	SE	28		
3	—	10 f CAM	—	2 vff 1 m	2 vft	8.5	ST	26		
4	—	8 f CAM	—	2 vf 1 f	1 vft	8.4	ST	48		
5	—	15 fm CAM	—	1 vf	—	8.6	VE	52		
6	—	18 fm CAM	—	—	1 vft	8.2	VE	26		
7										
8										
9										
10										

USDA-NRCS

PEDON DESCRIPTION

PEDON ID #: 45

DRAFT 3/2002

Series or Component Name:	Map Unit Symbol: 7	Photo #:	Classification: Aeric Epiaquept fine, mix, superactive, frigid	Soil Moist. Regime (Tax.): Ustic

Describer(s): Bob Long	Date: Apr 5, 2007	Weather: Temp.: Air: Soil: Depth:	Latitude: ° ' " N Datum: Longitude: ° ' " W	Location: Sec. T. R.

UTM: Zone: mE: mN:	Topo Quad:	Site ID: Yr: State: County: Pedon #:	Soil Survey Area: Alton	MLRA / LRU:	Transect: ID: Stop #: Interval:

Landscape:	Landform:	Microfeature:	Anthro:	Elevation:	Aspect: 195° SSW	Slope (%): 3-4	Slope Complexity: Simple	Slope Shape: (Up & Dn / Across) Linear / Linear

Hillslope Profile Position:	Geom. Component:	Microrelief:	Physio. Division:	Physio. Province:	Physio. Section:	State Physio. Area:	Local Physio. Area:

Drainage: Poorly	Flooding: No	Ponding: Oc	Soil Moisture Status:	Permeability: K_{sat}:	Land Cover / Use: Pasture

Parent Material: Alluvium	Bedrock: Kind: Fract.: Hard.: Depth:	Lithostrat. Units: Group: Formation: Member:

Erosion: Kind: sheet Degree: slight	Runoff:	Surface Frag %: GR: — CB: — ST: — BD: — CN: — FL: — Kind:	Diagnostic Horz. / Prop.: Argillic	Kind: Depth: 84"+
P. S. Control Section: Depth Range: 35-48"	Ave. Clay %: 36	Ave. Rock Frag %: 0	argillic too deep	Aquic 5"+ calcic 35-48"

VEGETATION :

SYMBOL	COMMON NAME	% GD COVER

MISCELLANEOUS FIELD NOTES / SKETCH :

Rapid in-flow of water at 66"

Fluvent

45

Component Name: | Map Unit Symbol: | Date: Apr 05, '07

	Obser. Method	Depth (in) (cm)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Rock Frags Knd % Rnd Sz	Structure Grade Sz Type	Consistence Dry	Consistence Mst	Consistence Stk	Consistence Pls	Mottles % Sz Cn Col Mst Sp Loc
1	BP	0-5"	A1	cs	10YR 6/2	10YR 4/2	L	—	1m sbk 2f gr	sh	vfr	ss	sp	—
2		5-12"	A2	as	2.5Y 6/2	2.5Y 4/2	L	—	2 mpr 3f sbk	sh	vfr	ss	sp	3-4% vf 10YR 6/6
3		12-35"	C	as	10YR 7/4	10YR 5/4	SCL	—	1m sbk	sh	vfr	ss	sp	50 mc 10YR 6/6
4		35-48"	2Bwk	cs	10YR 7/2	10YR 6/1	SiC	—	1m pr 2m sbk	h	fr	ms	mp	30 mc 7.5YR 5/4
5		48-66"	3C1	gs	10YR 8/2	10YR 6/4	SCL	—	m	h	vfr	ss	sp	50 mc 10YR 7/6
6		66-84"	3C2	as	10YR 8/3	10YR 6/4	SCL	—	m	vh	vfr	ss	sp	60 mc 10YR 7/6
7		84-100"	4Btk		10YR 7/1	10YR 6/1	SiC	—	3m pr 2m sbk	vh	fi	s	p	5f 7.5YR 7/6
8														
9														
10														

	Redoximorphic Features % Sz Cn Hd Sp Kd Loc Bd Col	Concentrations % Sz Cn Hd Sp Kd Loc Bd Col	Ped / V. Surface Features % Dst Cont Kd Loc Col	Roots Qty Sz Loc	Pores Qty Sz Shp	pH (meth)	Effer (agent)	Clay %	CCE	Notes
1	—	disseminated	—	3vff 2m	2vft	8.4	ST	26		sm
2	—	disseminated	—	3vf 2f lm	2vft	8.2	ST	26		sm
3	—	disseminated	—	2vf 1fm	2vft	8.4	ST	35		wn
4	—	12f CAM disseminated	—	1vff	1vft	8.4	VE	42		ws
5	—	8f CAM disseminated	—	1vff	1vft	8.4	ST	30		wn
6	—	4f CAM disseminated	—	1vff	1vft	8.3	ST	30		ws
7	—	8f CAM disseminated	85 CLF PF/PO	1vff	—	8.3	VE	40		moist
8										
9										
10										

USDA-NRCS

PEDON DESCRIPTION

PEDON ID #: 46

DRAFT 3/2002

Series or Component Name:	Map Unit Symbol: 7	Photo #:	Classification: Typic Argiaquoll fine-loamy, mixed, superactive, frigid	Soil Moist. Regime (Tax.): Ustic
Describer(s): Bob Long	Date: Apr 5, 2002	Weather: Temp.: Air: Soil: Depth:	Latitude: 0' ° ' " N Datum: Longitude: ° ' " W	Location: Sec. T. R.
UTM: Zone: mE: mN:	Topo Quad:	Site ID: Yr: State: County: Pedon #:	Soil Survey Area:	MLRA / LRU: Transect: ID: Stop #: Interval:

Landscape:	Landform:	Microfeature:	Anthro:	Elevation:	Aspect: 195° SSW	Slope (%): 3-4	Slope Complexity:	Slope Shape: (Up & Dn / Across)

Hillslope Profile Position:	Geom. Component:	Microrelief:	Physio. Division:	Physio. Province:	Physio. Section:	State Physio. Area:	Local Physio. Area:

Drainage: Somewhat Poorly	Flooding: —	Ponding: Ra	Soil Moisture Status:	Permeability: K_{sat}:	Land Cover / Use: Pasture

Parent Material: Alluvium	Bedrock: Kind: Fract.: Hard.: Depth:	Lithostrat. Units: Group: Formation: Member:	
Erosion: Kind: Degree:	Runoff:	Surface Frag %: GR: — CB: — ST: — BD: — CN: — FL: — Kind:	Diagnostic Horz. / Prop.: Kind: Depth: Aquic 24"+ Mollic 0-7" Argillic 12-44" Calcic 44-92
P. S. Control Section : Depth Range: 12-32"	Ave. Clay %: 27.2	Ave. Rock Frag %: 14%	

VEGETATION :

SYMBOL	COMMON NAME	% GD COVER
	Grasses	

MISCELLANEOUS FIELD NOTES / SKETCH :

water flowing in at 44"

severe caving of sidewalls

Component Name: | Map Unit Symbol: | Date: Apr 5, 2007

	Obser. Method	Depth (in)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Rock Frags Knd % Rnd Sz	Structure Grade Sz Type	Consistence Dry	Consistence Mst	Consistence Stk	Consistence Pls	Mottles % Sz Cn Col Mst Sp Loc
1	BP	0-6"	A1	CS	10YR 5/3	10YR 3/3	SL	—	1m sbk 2f gr	sh	vfr	so	po	—
2		6-12"	A2	gs	10YR 6/3	10YR 4/4	SCL	—	1m pr 2f sbk	sh	vfr	ss	sp	—
3		12-17"	Bt1	CS	10YR 6/3	10YR 5/4	SCL	—	1m pr 2f sbk	sh	vfr	ss	sp	—
4		17-24"	Bt2	CS	10YR 6/3	10YR 4/4	GRV SCL	Gr 30 CB 10	2m pr 3fm sbk	sh	vfr	ss	sp	—
5		24-44"	2Bt	CS	10YR 6/4	2.5Y 4/4	CL	—	3m pr 2fm sbk	vh	fr	s	p	5-8f faint 10YR 6/6
6		44-68"	2BKl	gs	10YR 8/2	10YR 5/4	SL	—	m	vh	vfr	ss	po	25 mc strong 7.5YR 5/6
7		68-92"	2BK2	gs	2.5Y 6/2	10YR 5/1	SL	—	m	xh	vfr	so	po	45 mc strong 10YR 6/6
8		92-120"	2C		10YR 6/2	10YR 5/1	SL	—	m	xh	vfr	so	po	65 vc strong 10YR 6/6
9														
10							mollic by mixing 0-7"							

	Redoximorphic Features % Sz Cn Hd Sp Kd Loc Bd Col	Concentrations % Sz Cn Hd Sp Kd Loc Bd Col	Ped / V. Surface Features % Dst Cont Kd Loc Col	Roots Qty Sz Loc	Pores Qty Sz Shp	pH (meth)	Effer (agent)	Clay %	CCE	Notes
1		disseminated	—	2vff 1m	2vfti	8.4	em	16		
2			—	2vff 1m	2vft	8.5	em	18		
3			30 CLF PF/BR	2vff 1m	2vft	8.4	em	22		
4			25 CLF PF/BR	2vf 1f	2vfti	8.3	em	22		moist
5			65 CLF PF/BR	1vff	1vft	7.8	se	35		WS
6		2f CAM disseminated	—	1vf	2vfi	8.5	ST	15		WS
7		8f CAM disseminated	—	—	2vfi		ST	12		WS
8		4f CAM disseminated	—	—	2vfi		ST	12		WS
9										
10										

USDA-NRCS

PEDON DESCRIPTION

PEDON ID #: 47

DRAFT 3/2002

Series or Component Name:	Map Unit Symbol: 8	Photo #:	Classification: Calcic Haplustalf fine-loamy, mixed, superactive, frigid	Soil Moist. Regime (Tax.): Ustic

Describer(s): Bob Long	Date: Apr 5, 2007	Weather: High clouds	Temp.: Air: 55 Soil: Depth:	Latitude: ° ' " N Longitude: ° ' " W	Datum: 1983	Location: Sec. T. R.

UTM: Zone: mE: mN:	Topo Quad:	Site ID: Yr: State: County: Pedon #:	Soil Survey Area: Alton	MLRA / LRU:	Transect: ID: Stop #: Interval:

Landscape: Valley	Landform:	Microfeature:	Anthro:	Elevation:	Aspect: 550 200	Slope (%): 6	Slope Complexity: Simple	Slope Shape: (Up & Dn / Across) convex / convex

Hillslope Profile Position:	Geom. Component:	Microrelief:	Physio. Division:	Physio. Province:	Physio. Section:	State Physio. Area:	Local Physio. Area:

Drainage: Somewhat poorly	Flooding: No	Ponding: No	Soil Moisture Status: moist	Permeability: K_{sat}: mod / slow	Land Cover / Use: Range

Parent Material: Alluvium	Bedrock: Kind: Fract.: Hard.: Depth:	Lithostrat. Units: Group: Formation: Member:	

Erosion: Kind: Degree: Flow patterns / slight	Runoff: mod slow	Surface Frag %: GR: 5 CB: — ST: — BD: — CN: — FL: — Kind:	Diagnostic Horz. / Prop.: Kind: Depth: Argillic 11-20" Calcic 20-84" Aquic 32"+	

P. S. Control Section: Depth Range: 11-20"	Ave. Clay %: 30	Ave. Rock Frag %: 0

VEGETATION :

SYMBOL	COMMON NAME	% GD COVER
	Big sage	
	Rabbitbrush	
	Ut serviceberry	
	Rabbitbrush	
	Poa	

MISCELLANEOUS FIELD NOTES / SKETCH :

water running into pit at 80"

Component Name: | Map Unit Symbol: | Date: Apr 5, 2007

	Obser. Method	Depth (in)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Rock Frags Knd % Rnd Sz	Structure Grade Sz Type	Consistence Dry	Consistence Mst	Consistence Stk	Consistence Pls	Mottles % Sz Cn Col Mst Sp Loc
1	BP	0-3"	A	cs	10YR 5/3	10YR 3/3	L	GR 5	2 mc sbk	sh	vfr	ss	sp	—
2		3-11"	2A	cs	10YR 6/4	10YR 5/3	SL	—	1 m sbk	h	fr	so	sp	—
3		11-20"	2Bt	cw	10YR 5/3	10YR 3/3	CL	—	2 m pr / 3 f vf sbk	vh	fi	ms	mp	—
4		20-32"	2BK	cs	10YR 6/4	10YR 4/6	SCL	—	2 m pr / 2 f m sbk	xh	fr	ss	sp	—
5		32-52"	3Btk	cs	10YR 6/4	10YR 3/4	Clay	—	3 c pr / 2 m sbk	xh	vfi	vs	vp	10 ff 10YR 6/6
6		52-84"	3BK		10YR 7/4	10YR 5/6	SCL	—	M	vh	vfr	ss	sp	40 mc strong 10YR 7/8
7														
8														
9														
10														

	Redoximorphic Features % Sz Cn Hd Sp Kd Loc Bd Col	Concentrations % Sz Cn Hd Sp Kd Loc Bd Col	Ped / V. Surface Features % Dst Cont Kd Loc Col	Roots Qty Sz Loc	Pores Qty Sz Shp	pH (meth)	Effer (agent)	Clay %	CCE	Notes
1		disseminated	—	3 vf 2 f 1 m	2 vf ti	7.6	em	24		SM
2			—	2 vf f 1 m	2 vf i	7.7	em	15		SM
3			60 CLF PF/PO	2 vf 1 f m	1 vf t	7.8	em	30		moist
4		6 vf f CAM	90 CLF PF/PO	2 vf 1 f	2 vf i t	8.3	st	23		moist
5		10 f CAM	—	2 vf 1 f	—	8.3	em/st	50		moist
6		8 f CAM	—	1 vf	2 vf i t	8.5	es	20		moist
7										
8										
9										
10										

USDA-NRCS

PEDON DESCRIPTION

PEDON ID #: 48

DRAFT 3/2002

Series or Component Name: 1	Map Unit Symbol: 1	Photo #:	Classification: Aridic Haplustalf fine, mixed, superactive, frigid	Soil Moist. Regime (Tax.): Ustic
Describer(s): Bob Long	Date: Apr 5, 2007	Weather: Temp.: Air: Soil: Depth:	Latitude: ° ' " N Longitude: ° ' " W	Datum: Location: Sec. T. R.
UTM: Zone: mE: mN:	Topo Quad:	Site ID: Yr: State: County: Pedon #:	Soil Survey Area:	MLRA / LRU: Transect: ID: Stop #: Interval:

Landscape:	Landform:	Microfeature:	Anthro:	Elevation:	Aspect:	Slope (%):	Slope Complexity:	Slope Shape: (Up & Dn / Across)
Valley Bottom					ENE 80	4-5	Simple	Linear / Linear

Hillslope Profile Position:	Geom. Component:	Microrelief:	Physio. Division:	Physio. Province:	Physio. Section:	State Physio. Area:	Local Physio. Area:

Drainage:	Flooding:	Ponding:	Soil Moisture Status:	Permeability:	Land Cover / Use:
	No	No		K_{sat}: Very slow	Range

Parent Material:	Bedrock: Kind: Fract.: Hard.: Depth:	Lithostrat. Units: Group: Formation: Member:
Alluvium		

Erosion: Kind: Degree:	Runoff:	Surface Frag %: GR: CB: ST: BD: CN: FL:	Diagnostic Horz. / Prop.: Kind: Depth:
None	mod slow	Kind: 1-2 — — — — —	Argillic 3-84"
			Calcic 48-84"
			aquic 30-84"

P. S. Control Section: Depth Range:	Ave. Clay %:	Ave. Rock Frag %:
	62% (lab)	

VEGETATION :

SYMBOL	COMMON NAME	% GD COVER
	ARTRW	
widely scattered	Juniper + Pinyon	
	Brome	

MISCELLANEOUS FIELD NOTES / SKETCH :

clay too hard to dig below 72"

mollic

episaturation

48

Component Name: | Map Unit Symbol: 1 | Date: Apr 5, 2007

	Obser. Method	Depth (in)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Rock Frags Knd % Rnd Sz	Structure Grade Sz Type	Consistence Dry	Consistence Mst	Consistence Stk	Consistence Pls	Mottles % Sz Cn Col Mst Sp Loc
1	BP	0-3"	A	CS	10YR 5/2	10YR 3/2	CL	—	2 m sbk / 2 m gr	H	fr	ms	mp	—
2	↓	3-12"	Bt1	CS	10YR 4/2	10YR 4/2	clay	—	2 m pr / 3 m sbk	VH	fi	s	P	—
3	↓	12-30"	Bt2	gS	10YR 6/2	10YR 4/2	clay	—	3 mc pr / 2 m sbk	VH	fi	s	P	—
4	↓	30-48	Bt3	CS	2.5Y 6/2	2.5Y 4/2	clay	—	3 m pr / 2 m sbk	XH	vfi	vs	vP	16 fm distinct 7.5YR 5/6
5	↓	48-84	Btk		2.5Y 6/2	2.5Y 4/2	clay	—	3 m pr / 3 m sbk	XH	xfi	vs	vP	7 f distinct 7.5YR 6/6
6														
7														
8														
9														
10														

	Redoximorphic Features % Sz Cn Hd Sp Kd Loc Bd Col	Concentrations % Sz Cn Hd Sp Kd Loc Bd Col	Ped / V. Surface Features % Dst Cont Kd Loc Col	Roots Qty Sz Loc	Pores Qty Sz Shp	pH (meth)	Effer (agent)	Clay %	CCE	Notes
1	—	—	—	2vffm	2vfft	7.8	e	30		
2	—	—	35 CLF PF/PO	2vff 1m	1vft	8.2	e	40		
3	—	—	85 CLF PF/PO	1vff	—	8.3	e	50		
4	—	3 vff CAM disseminated	90 CLF PF/PO	—	—	8.6	me	55		
5	—	10 f CAM 2 f Gyp Masses	95 CLF PF/PO	—	—	7.8	mg/st	60		
6										
7										
8										
9										
10										

USDA-NRCS

PEDON DESCRIPTION

PEDON ID #: 49

DRAFT 3/2002

Series or Component Name:	Map Unit Symbol: 5	Photo #:	Classification: Lithic Ustorthent loamy, mix, super, calc, mesic	Soil Moist. Regime (Tax.): Ustic

Describer(s): Bob Long	Date: Apr 5, 2006	Weather: High clouds	Temp.: Air: 60 Soil: Depth:	Latitude: ° ' " N Longitude: ° ' " W	Datum: 1983	Location: Sec. T. R.

UTM: Zone: mE: mN:	Topo Quad:	Site ID: Yr: State: County: Pedon #: 07 UT KA 49	Soil Survey Area:	MLRA / LRU:	Transect: ID: Stop #: Interval:

Landscape: Ridge	Landform:	Microfeature:	Anthro:	Elevation:	Aspect: 5	Slope (%): 8-12	Slope Complexity: complex	Slope Shape: (Up & Dn / Across) convex / convex

Hillslope Profile Position:	Geom. Component:	Microrelief:	Physio. Division:	Physio. Province:	Physio. Section:	State Physio. Area:	Local Physio. Area:

Drainage: Well	Flooding: No	Ponding: No	Soil Moisture Status: S.M.	Permeability: K_{sat}: Mod	Land Cover / Use: PJ / Range

Parent Material: Residuum	Bedrock: Kind: Fract.: Hard.: Depth: sandstone	Lithostrat. Units: Group: Formation: Member:	

Erosion: Kind: sheet Degree: Mod.	Runoff: mod rapid	Surface Frag %: GR: 25 CB: 3 ST: 1 BD: 1 CN: FL: Kind:	Diagnostic Horz. / Prop.: Lithic 10"+ Kind: Depth: Ochric

P. S. Control Section: Ave. Clay %: Ave. Rock Frag %: Depth Range:	

VEGETATION :

SYMBOL	COMMON NAME	% GD COVER
	Pinyon	
	UT Juniper	
	Black sage	
	Indian Ricegrass	

MISCELLANEOUS FIELD NOTES / SKETCH :

10% soils shallow to shallow
10% mod deep to sandstone

sandstone underlain by shale

Component Name: Hideout | Map Unit Symbol: | Date: Apr 5, 2007

	Obser. Method	Depth (in) (cm)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Rock Frags Knd %	Rock Frags Rnd	Rock Frags Sz	Structure Grade	Structure Sz	Structure Type	Consistence Dry	Consistence Mst	Consistence Stk	Consistence Pls	Mottles %	Mottles Sz	Mottles Cn	Mottles Col	Mottles Mst	Mottles Sp	Mottles Loc
1	SS	0-3"	A	cs	2.5Y 6/4	2.5Y 5/4	GR SCL	GR	30		1 fm 2 fgr	sbk		sh	vfr	ss	sp	—						
2	SS	3-10"	C	as	2.5Y 5/4	2.5Y 4/4	GR CL	GR	25		M			sh	vfr	ss	sp	—						
3	SS	10"+	R		sandstone																			
4																								
5																								
6																								
7																								
8																								
9																								
10																								

	Redoximorphic Features % Sz Cn Hd Sp Kd Loc Bd Col	Concentrations % Sz Cn Hd Sp Kd Loc Bd Col	Ped / V. Surface Features % Dst Cont Kd Loc Col	Roots Qty Sz Loc	Pores Qty Sz Shp	pH (meth)	Effer (agent)	Clay %	CCE	Notes
1	—	—	—	2vf 1fmc	2vfit	7.6	ST	28		
2	—	—	—	2vf 1fmc	1vft	8.2	ST	32		
3										
4										
5										
6										
7										
8										
9										
10										

USDA-NRCS

PEDON DESCRIPTION

PEDON ID #: 50

DRAFT 3/2002

Series or Component Name:	Map Unit Symbol: 10	Photo #:	Classification: Aridic Ustorthent clayey, mectitic, super	Soil Moist. Regime (Tax.): Ustic Aridic

Describer(s): Bob Long	Date: Apr 5, '07	Weather: High Clouds	Temp.: Air: 52° Soil: Depth:	Latitude: ° ' " N Longitude: ° ' " W	Datum:
Location: Sec. T. R.					

UTM: Zone: mE: mN:	Topo Quad:	Site ID: Yr: State: County: Pedon #: 07 UT KA 50	Soil Survey Area:	MLRA / LRU:	Transect: ID: Stop #: Interval:	

Landscape: Scarp	Landform:	Microfeature:	Anthro:	Elevation:	Aspect: WNW 292	Slope (%): 16	Slope Complexity: Complex	Slope Shape: (Up & Dn / Across) Convex / Convex	
Hillslope Profile Position:	Geom. Component:	Microrelief:	Physio. Division:	Physio. Province:	Physio. Section:	State Physio. Area:	Local Physio. Area:		

Drainage: Somewhat Well	Flooding: NO	Ponding: NO	Soil Moisture Status: S.M.	Permeability: K_{sat}: Mod slow	Land Cover / Use: Range

Parent Material: Residuum	Bedrock: Kind: Shale Fract.: Hard.: Depth:	Lithostrat. Units: Tropic	Group: Formation: Member:

Erosion: Kind: Flow Pattern Degree: Mod	Runoff: Mod Rapid	Surface Frag %: GR: — CB: — ST: — BD: — CN: — FL: — Kind:	Diagnostic Horz. / Prop.: Paralithic Ochric	Kind: Depth: 19"

P. S. Control Section: Depth Range: 10-19"	Ave. Clay %: 55% (lab)	Ave. Rock Frag %: 0

VEGETATION :

SYMBOL	COMMON NAME	% GD COVER
	Ut Juniper	
	Pinyon Pine	
	Black sage	
	Indian Ricegrass	

MISCELLANEOUS FIELD NOTES / SKETCH :

Component Name: Cannonville | Map Unit Symbol: | Date: Apr 5, 2007

	Obser. Method	Depth (in) (cm)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Rock Frags Knd % Rnd Sz	Structure Grade Sz Type	Consistence Dry	Consistence Mst	Consistence Stk	Consistence Pls	Mottles % Sz Cn Col Mst Sp Loc
1	SS	0-4	A	CS	2.5Y 6/2	2.5Y 4/2	C	—	1 m sbk / 2 f gr	sh	vfr	s	s	—
2	↓	4-11	C1	CS	2.5Y 6/2	2.5Y 4/2	C	—	m	H	fr	s	s	—
3		11-19	C2	CS	2.5Y 6/2	2.5Y 4/2	C	—	m (shale structure)	H	fr	s	p	—
4		19+	Cr											
5														
6														
7														
8														
9														
10														

	Redoximorphic Features % Sz Cn Hd Sp Kd Loc Bd Col	Concentrations % Sz Cn Hd Sp Kd Loc Bd Col	Ped / V. Surface Features % Dst Cont Kd Loc Col	Roots Qty Sz Loc	Pores Qty Sz Shp	pH (meth)	Effer (agent)	Clay %	CCE	Notes
1	—	—	—	2vf 1fm	2vfit	7.8	ST	45		
2	—	—	—	2vf 1fm	1vft	8.0	ST	55		
3	—	—	—	1vff	1vft	8.4	we	50		
4										
5										
6										
7										
8										
9										
10										

USDA-NRCS

PEDON DESCRIPTION

Pedon ID # : 51 | Draft | Mar-02

Series or Component Name: L	Map Unit Symbol:	Photo #:	Classification: Calcidic Haplustalf fine-loamy, mix, sceper, mesic	Soil Moist. Regime (Tax.):
Describer(s): Bob Long	Date: 9-24-07	Weather: Clear Temp.: Air: 45° Soil: Depth:	Latitude: ° ' " N Longitude: ° ' " W Datum: 10	Location: Sec. T. R.
UTM: Zone: mE: mN:	Topo Quad.: Alton	Site ID: YR: State: County: Pedon #:	Soil Survey Area:	MLRA / LRU: Transect: ID: Stop #: Interval:

Landscape: BS	Landform: Valley	Microfeature:	Anthro:	Elevation:	Aspect: S	Slope (%): 2-3	Slope Complexity: Simple	Slope Shape: (Up & Dn / Across) Linear / Linear
Hillslope Profile Position:	Geom. Component: TR	Microrelief:	Physio. Division:	Physio. Province:	Physio. Section:		State Physio. Area:	Local Physio. Area:

Drainage: Well	Flooding: No	Ponding: No	Soil Moisture Status:	Permeability: Ksat: Mod slow	Land Cover / Use: Pasture
Parent Material: Alluvium	Bedrock: Kind: Fract.: Hard.: Depth:			Lithostrat. Units: Group: Formation: Member:	
Erosion: Kind: Degree: No	Runoff: Slow	Surface Frag %: GR: — CB: — ST: — BD: — CN: — FL: — Kind:			Diagnostic Horz. / Prop.: Kind: Depth: Argillic Calcic
P.S. Control Section: Ave. Clay %: Ave. Rock Frag %: Depth Range:					

VEGETATION :

SYMBOL	COMMON NAME	%GD COVER
	Pasture grass	

MISCELLANEOUS FIELD NOTES / SKETCH :

100 feet of fence near #47

Component Name:		Map Unit Symbol:		Date: 9-24-07

	Obser. Method	Depth (in) (cm)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Rock Frag Knd % Rnd Sz	Structure Grade Sz Type	Consistence Dry	Consistence Mst	Consistence Stk	Consistence Pls	Mottles % Sz Cont. Col Mst Shp Loc
1	SS	0-3"	A	cs		10YR 4/2	CL	—	1 m sbz 2 fm gr	sh	fr	ss	mp	—
2	SS	3-11"	Bt	as		10YR 4/2	CL	—	2 m sbk	h	fr	ms	mp	—
3	Aug	11-24	BtK	gs		10YR 5/3	CL	—	2 fm sbk	h	fr	ms	mp	—
4	Aug	24-38	BK	as		10YR 5/4	SCL	—	2 f sbk	h	fr	ss	sp	—
5	Aug	38-54	2BtK1	gs		10YR 5/3	CL	—	3 fm sbk	vh	fi	ms	mp	—
6	Aug	54-64	2BtK2			10YR 5/4	CL	—	2 fm sbk			ms	mp	—
7														
8														
9														
10														

	Redoximorphic Features % Sz Cn Hd Sp Kd Loc Bd Col	Concentrations % Sz Cn Hd Sp Kd Loc Bd Col	Ped / V. Surface Features % Dst Cont Kd Loc Col	Roots Qty Sz Loc	Pores Qty Sz Shp	pH (meth)	Effer. (agent)	Clay %	CCE	Notes
1		—	—	3vf 2f	2vft	8.2	VS	28		
2		—	65 CLF PF/PO	3vf 2f	2vft	8.2	VS	34		
3		DIS TOT	35 CLF PF/PO	2vf 1f	1vft	8.4	ST	32		
4		12 f CAM	—	2vf 1f	2vft	8.4	VE	22		
5		15 fm CAM	45 CLF PF/PO	1vff	1vft	8.2	ST/VE	35		
6		10-12 f CAM TH	35 CLF PF/PO	1vf	1vft	8.4	VE	32		
7										
8										
9										
10										

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PEDON DESCRIPTION

Pedon ID # : 52 | Draft | Mar-02

Series or Component Name: E/O	Map Unit Symbol:	Photo #:	Classification: Aquic Calciustept fine-loamy, mixed, super, frigid	Soil Moist. Regime (Tax.):

Describer(s): Bob Long	Date: 9-24-07	Weather: Temp.: Air: Soil: Depth:	Latitude: ° ' " N Longitude: ° ' " W Datum: 1983	Location: Sec. T. R.

UTM: Zone: 12 mE: mN:	Topo Quad.: Alton	Site ID: YR: State: County: Pedon #:	Soil Survey Area:	MLRA / LRU:	Transect: ID: Stop #: Interval:		

Landscape: BS	Landform: Valley	Microfeature:	Anthro:	Elevation:	Aspect: SSW	Slope (%): 2-3	Slope Complexity: Simple	Slope Shape: (Up & Dn / Across) Linear / Linear

Hillslope Profile Position:	Geom. Component: TR	Microrelief:	Physio. Division:	Physio. Province:	Physio. Section:	State Physio. Area:	Local Physio. Area:

Drainage: well	Flooding: No	Ponding: No	Soil Moisture Status: SM/Dry / moist	Permeability: Ksat: mod slow	Land Cover / Use: Range / Grazing

Parent Material: Alluvium	Bedrock: Kind: Fract.: Hard.: Depth:	Lithostrat. Units: Group: Formation: Member:	

Erosion: Kind: — Degree: —	Runoff: very slow	Surface Frag %: GR: CB: ST: BD: CN: FL: Kind: — — — — — —	Diagnostic Horz. / Prop.: Kind: Depth: calcic 12-24" aquic 24-62"

P.S. Control Section: Ave. Clay %: Ave. Rock Frag %: Depth Range: 10-40" 29% 0%	

VEGETATION :

SYMBOL	COMMON NAME	%GD COVER
	grass	
	world Rose	

MISCELLANEOUS FIELD NOTES / SKETCH :

Alkaline area

Component Name:		Map Unit Symbol:		Date: 9-24-07

	Obser. Method	Depth (in) (cm)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Rock Frag Knd % Rnd Sz	Structure Grade Sz Type	Consistence Dry	Consistence Mst	Consistence Stk	Consistence Pls	Mottles % Sz Cont. Col Mst Shp Loc
1	SS	0-4"	A1	gs	2.5Y 6/1	2.5Y 4/1	L	—	2fmsbk 2fgr	sh	vfr	SS	SP	—
2	SS	4-12"	A2	cs	2.5Y 5/2	2.5Y 4/2	L	—	2msbk	h	fr	SS	SP	—
3	SS	12-24"	Bk	gs	10YR 7/4	10YR 5/4	SCL	—	2msbk	h	vfr	SS	SP	—
4	aug	24-32"	BK2	cs		10YR 5/4	CL	—	1fmsbk	h	fr	SS	SP	18-20% f 5YR 6/8
5	aug	32-38"	C1	gs		10YR 5/4	C	—	2fmsbk	h	fr	s	p	15-18% f 5YR 6/8
6	aug	38-54	C2g	gs		5Y 4/1	SiCL	—	2fsbk	h	fr	ms	mp	8% vf Gley1 6/10Y
7	aug	54-62	C3			2.5Y 4/2	SiCL	—	2fmsbk	h	fr	ms	mp	15 vff 2.5YR 7/6
8														
9														
10														

	Redoximorphic Features % Sz Cn Hd Sp Kd Loc Bd Col	Concentrations % Sz Cn Hd Sp Kd Loc Bd Col	Ped / V. Surface Features % Dst Cont Kd Loc Col	Roots Qty Sz Loc	Pores Qty Sz Shp	pH (meth)	Effer. (agent)	Clay %	CCE	Notes
1	—	2% vf visible salt	—	2vf 1fm	2vfit		ST	24		Slightly moist
2	—	3 salts visible	—	2vff 1m	2vft		ST	24		Slightly moist
3	—	8 vf-f CAM	—	2vf 1fm	1vft		ST	24		dry
4	—	—	—	2vf 1fm	1vft		ST	28		dry
5	—	—	—	1vf	1vft		SL	40		slightly mois
6	—	—	—	1vf	1vft		SL	30		moist
7	—	—	—	1vf	1vft		SL	34		moist
8										
9										
10										

USDA-NRCS

PEDON DESCRIPTION

Pedon ID # : 53 | Draft | Mar-02

Series or Component Name: Disturbed soil	Map Unit Symbol:	Photo #:	Classification: Aeric Epiaquept co-loamy, mixed, super, frigid	Soil Moist. Regime (Tax.): Ustic
Describer(s): Bob Long	Date: 9-24-07	Weather: clear Temp.: Air: 55°F Soil: Depth:	Latitude: ° ' " N Longitude: ° ' " W Datum: 1983	Location: Sec. T. R.
UTM: Zone: mE: mN:	Topo Quad.:	Site ID: YR: State: County: Pedon #:	Soil Survey Area: ACD / MLRA / LRU:	Transect: ID: Stop #: Interval:

Landscape:	Landform: Valley	Microfeature:	Anthro:	Elevation:	Aspect: SSW	Slope (%): 1	Slope Complexity: Simple	Slope Shape: (Up & Dn / Across) Linear / Linear
Hillslope Profile Position:	Geom. Component:	Microrelief:	Physio. Division:	Physio. Province:	Physio. Section:	State Physio. Area:	Local Physio. Area:	

Drainage: ~~w~~ Somewhat poorly	Flooding: Oc	Ponding: Oc	Soil Moisture Status: 0-27" SM 27+ Wm	Permeability: Ksat: mod	Land Cover / Use: Range/Grazing
Parent Material: Alluvium	Bedrock: Kind: Fract.: Hard.: Depth: —		Lithostrat. Units: Group: Formation: Member: —		
Erosion: Kind: Degree: None	Runoff: Very slow	Surface Frag %: GR: CB: ST: BD: CN: FL: Kind: —		Diagnostic Horz. / Prop.: Kind: Depth:	
P.S. Control Section: Ave. Clay %: Ave. Rock Frag %: Depth Range: 10-40" 16% 0%					

VEGETATION :

SYMBOL	COMMON NAME	%GD COVER
	grass	
	wild rose	
	daisys	

MISCELLANEOUS FIELD NOTES / SKETCH :

Soil profile appears to be the result of organic layers developing around a spring.

Upper 27" could be result of local deposition or land leveling by man

Vegetation indicates disturbance

Component Name:		Map Unit Symbol:		Date: 9-24-07

	Obser. Method	Depth (in) (cm)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Rock Frag Knd % Rnd Sz	Structure Grade Sz Type	Consistence Dry	Consistence Mst	Consistence Stk	Consistence Pls	Mottles % Sz Cont. Col Mst Shp Loc
1	SS	1/2-0" 0-4"	Oi A	as as	decomposing 10YR 5/2	10YR 3/2	L	—	1fsbk	sh	vfr	ss	ps	—
2	SS	4-9"	E	as	2.5Y 8/2	2.5Y 7/2	GRV SL	45 GR traverting gravels	SG	10	10	so	po	—
3	SS	9-22	C	as	2.5Y 7/1	2.5Y 6/1	SL	—	SG	10	10	so	po	5 vff 10YR 7/4
4	any	22-27"	2Oi/A	gs	2.5Y 6/2 Peat + soil	2.5Y 4/2	PTSL	—	m	sh	vfr	so	po	—
5	any	27-38"	2Oe/E	cs	2.5Y 8/2 decomposing	2.5Y 6/2	PTSL peat	—	m	sh	vfr	so	po	—
6	any	38-60	2Cg		2.5Y 6/2	2.5Y 4/2	SiL	—	m	vh	fi	ss	sp	5 vff 10YR 6/6
7														
8														
9														
10														

	Redoximorphic Features % Sz Cn Hd Sp Kd Loc Bd Col	Concentrations % Sz Cn Hd Sp Kd Loc Bd Col	Ped / V. Surface Features % Dst Cont Kd Loc Col	Roots Qty Sz Loc	Pores Qty Sz Shp	pH (meth)	Effer. (agent)	Clay %	CCE	Notes
1	—	—	—	3vf 2f 1m	2vfi	8.0	SL	23		slightly mois
2	—	—	—	2vff 1m	2vfi	8.2	ST	16		traverting gravels slightly moist
3	—	10 vff CAM	—	2vff 1m	2vfi	8.2	ST	16		slightly moist
4	—	—	—	2vff	3vfi	—	—	16		moist
5	—	—	—	2vff	3vfi	—	—	16		moist
6	—	—	—	1vf	1vft	7.8	VS	24		WN
7										
8		OiA 40% mineral soil								
9		OeE 40% mineral soil								
10										

USDA-NRCS

PEDON DESCRIPTION

Pedon ID # : 54 | Draft | Mar-02

Series or Component Name: fine-loamy phase of "O"	Map Unit Symbol:	Photo #:	Classification: Fluvaquentic Epiaquept fine-loamy, mix, super, frigid	Soil Moist. Regime (Tax.):
Describer(s): Bob Long	Date: 9-24-07	Weather: Clear	Temp.: Air: 65 Soil: Depth:	Latitude: ° ' " N Longitude: ° ' " W Datum:
Location: Sec. T. R.	UTM: Zone: mE: mN:	Topo Quad.: Alton	Site ID: YR: State: County: Pedon #:	Soil Survey Area:
MLRA / LRU:	Transect: ID: Stop #: Interval:			

Landscape:	Landform:	Microfeature:	Anthro:	Elevation:	Aspect: 5	Slope (%): 3	Slope Complexity: Simple	Slope Shape: (Up & Dn / Across) Linear / Linear
Hillslope Profile Position:	Geom. Component:	Microrelief:	Physio. Division:	Physio. Province:	Physio. Section:	State Physio. Area:	Local Physio. Area:	

Drainage: poorly	Flooding: No	Ponding: 0	Soil Moisture Status: Slightly	Permeability: Ksat: Slow	Land Cover / Use: Range / Grazing
Parent Material: Alluvium	Bedrock: Kind: Fract.: Hard.: Depth:			Lithostrat. Units: Group: Formation: Member:	
Erosion: Kind: No Degree:	Runoff: Slow	Surface Frag %: GR: CB: ST: BD: CN: FL: Kind:		Diagnostic Horz. / Prop.: Kind: Depth:	
P.S. Control Section: Ave. Clay %: Ave. Rock Frag %: Depth Range: 10-40" 29% 0%					

VEGETATION :

SYMBOL	COMMON NAME	%GD COVER
	wild rose	
	Arctic Rush	
	Mtn Brome	
	Daisy	

MISCELLANEOUS FIELD NOTES / SKETCH :

Component Name:	fine-loamy "O"	Map Unit Symbol:		Date:	9-24-07

	Obser. Method	Depth (in)	Depth (cm)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Rock Frag Knd	Rock Frag %	Rock Frag Rnd	Rock Frag Sz	Structure Grade	Structure Sz	Structure Type	Consistence Dry	Consistence Mst	Consistence Stk	Consistence Pls	Mottles %	Mottles Sz	Mottles Cont	Mottles Col	Mottles Mst	Mottles Shp	Mottles Loc
1	SS	0	3"	AO	CS	10YR 5/3	10YR 3/3	Peaty CL	—				2	f	gr	sh	vfr	ms	mp	—						
2	SS	3	11"	A	CS	2.5Y 6/1	2.5Y 4/1	CL	—				2	f	sbk	h	fr	ms	mp	—						
3	SS/Aug	11	19"	Bw	CS	2.5Y 6/2	2.5Y 4/2	CL	—				3	fm	sbk	h	fr	ms	mp	—						
4	Aug	19	38	BK1	gs	2.5Y 7/3	2.5Y 5/3	SiL	—				2	fm	sbk	h	fr	ss	sp	8%	f	vf	7.5YR 7/6			
5	Aug	32	38	Bk2	CS	2.5Y 6/3	2.5Y 5/3	CL	—				2	fm	sbk	h	fr	ms	mp	18%	f		7.5YR 7/6			
6	Aug	38	48	2Bt	gs	2.5Y 6/1	2.5Y 4/1	C	—				2	m	sbk	vh	vfi	vs	vp	28%	f	vf	7.5YR 6/6			
7	Aug	48	64	2BK		2.5Y 8/2	2.5Y 7/1	C	—				m			vh	fi	s	p	35	fm		7.5YR 6/6			
8																										
9																										
10																										

	Redoximorphic Features % Sz Cn Hd Sp Kd Loc Bd Col	Concentrations % Sz Cn Hd Sp Kd Loc Bd Col	Ped / V. Surface Features % Dst Cont Kd Loc Col	Roots Qty Sz Loc	Pores Qty Sz Shp	pH (meth)	Effer. (agent)	Clay %	CCE	Notes
1	—	—	—	3vff 1m	2vfi		ST	30		
2	—	—	—	2vff 1m	1vft		ST	32		
3	—	—	45 CLF PO/PF	2vff 2m	1vft		ST	34		
4	—	15f CAM	—	2vff 2m	1vft		VE	26		
5	—	15f CAM	—	2vff 2m	1vft		VE	34		
6	—	—	70 CLF PF/PO	1vffm	1vft		me	50		
7	—	15fm CAM	—	1vf	1vft		ST	42		
8										
9										
10										

USDA-NRCS

PEDON DESCRIPTION

Pedon ID # : 55 | Draft | Mar-02

Series or Component Name: E	Map Unit Symbol:	Photo #:	Classification: Aridic Calciustept fine-loamy, mix, super, mesic	Soil Moist. Regime (Tax.): Ustic

Describer(s): Bob Long	Date: 9-24-07	Weather: Temp.: Air: Soil: Depth:	Latitude: ° ' " N Longitude: ° ' " W Datum:	Location: Sec. T. R.

UTM: Zone: 12 mE: mN:	Topo Quad.: Alton	Site ID: YR: 07 State: UT County: KA Pedon #: 55	Soil Survey Area:	MLRA / LRU:	Transect: ID: Stop #: Interval:		

Landscape:	Landform: Valley	Microfeature:	Anthro:	Elevation:	Aspect: N	Slope (%): 4	Slope Complexity:	Slope Shape: (Up & Dn / Across)

Hillslope Profile Position:	Geom. Component:	Microrelief:	Physio. Division:	Physio. Province:	Physio. Section:	State Physio. Area:	Local Physio. Area:

Drainage:	Flooding: No	Ponding: Ra	Soil Moisture Status:	Permeability: Ksat:	Land Cover / Use: Range / Grazing

Parent Material: Alluvium	Bedrock: Kind: Fract.: Hard.: Depth:	Lithostrat. Units: Group: Formation: Member:	

Erosion: Kind: Sheet Degree: SL	Runoff:	Surface Frag %: GR: — CB: — ST: — BD: — CN: — FL: — Kind:	Diagnostic Horz. / Prop.: Kind: Depth: cambic 3-12" calcic 30-62"

P.S. Control Section: Ave. Clay %: Ave. Rock Frag %:
Depth Range: 10-40" 34% 0%

VEGETATION :

SYMBOL	COMMON NAME	%GD COVER
	field bindweed	
	Rabbitbrush	

MISCELLANEOUS FIELD NOTES / SKETCH :

Component Name:		Map Unit Symbol:		Date: 9-24-07

	Obser. Method	Depth (in)	Depth (cm)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Rock Frag Knd % Rnd Sz	Structure Grade Sz Type	Consistence Dry	Consistence Mst	Consistence Stk	Consistence Pls	Mottles % Sz Cont. Col Mst Shp Loc
1	SS	0	3"	A	CS	10YR 5/2	10YR 4/3	L	—	1f sbk 2f gr	sh	vfr	ms	mp	—
2	SS	3	12"	BW	CS	10YR 6/3	10YR 4/2	CL	—	2 m sbk 3 f sbk	vh	fi	s	p	—
3	aug	12	30	BK1	gs	10YR 7/4	10YR 6/4	CL	—	2fmsbk	h	fr	ms	p	—
4	aug	30	41	BK2	CS	10YR 7/4	10YR 6/4	CL	—	2fmsbk	h	fr	ms	mp	—
5	aug	41	53	BK3	gs	10YR 6/4	10YR 5/4	CL	—	2fmsbk	h	fr	ms	mp	20 f 7.5YR 7/6
6	aug	53	62	BK4		10YR 7/4	10YR 5/4	SCL	—	2 m sbk	h	fr	ms	mp	35 f 10YR 7/6
7															
8															
9															
10															

	Redoximorphic Features % Sz Cn Hd Sp Kd Loc Bd Col	Concentrations % Sz Cn Hd Sp Kd Loc Bd Col	Ped / V. Surface Features % Dst Cont Kd Loc Col	Roots Qty Sz Loc	Pores Qty Sz Shp	pH (meth)	Effer. (agent)	Clay %	CCE	Notes
1	—	—	—	2vf 1fm	2vfi	7.8	me	27		
2	—	—	—	2vf 1fm	1vf+	7.9	mc	38		
3	—	8-10f CAM	—	2vf 1fm	1vf+	8.2	ST	36		
4	—	15f CAM	—	2vf 1fm	1vf+	8.4	VE	34		
5	—	12-15f CAM	—	1vff	1vf+	8.4	VE	33		
6	—	12-15f CAM	—	1vf	1vf+	8.4	VE	30		
7										
8										
9										
10										

USDA-NRCS

PEDON DESCRIPTION

Pedon ID # : 56

Draft

Mar-02

Series or Component Name: J	Map Unit Symbol:	Photo #:	Classification: Calcidic Argiustoll fine-loamy, mixed, super, mesic	Soil Moist. Regime (Tax.): Ustic
Describer(s): Bob Long	Date: 9-25-07	Weather: clear Temp.: Air: 40° Soil: Depth:	Latitude: ° ' " N Datum: Longitude: ° ' " W	Location: Sec. T. R.
UTM: Zone: mE: mN:	Topo Quad.:	Site ID: YR: State: County: Pedon #:	Soil Survey Area: ACD	MLRA / LRU:
Transect: ID: Stop #: Interval:				

Landscape:	Landform: Valley	Microfeature:	Anthro:	Elevation:	Aspect: SSE 160°	Slope (%): 5	Slope Complexity: Simple	Slope Shape: (Up & Dn / Across) Linear / Convex
Hillslope Profile Position:	Geom. Component:	Microrelief:	Physio. Division:	Physio. Province:	Physio. Section:	State Physio. Area:	Local Physio. Area:	

Drainage: Well	Flooding: No	Ponding: No	Soil Moisture Status: SM 0-10" Dry 10"+	Permeability: Ksat: Mod	Land Cover / Use: Range / Grazing
Parent Material: Alluvium	Bedrock: Kind: Fract.: Hard.: Depth:			Lithostrat. Units: Group: Formation: Member:	
Erosion: Kind: Degree: None	Runoff: mod slow	Surface Frag %: GR: — CB: — ST: — BD: — CN: — FL: — Kind:			Diagnostic Horz. / Prop.: Kind: Depth: Argillic 4-32" Calcic 10-96"
P.S. Control Section: Ave. Clay %: Ave. Rock Frag %: Depth Range: 4-24 3/20					

VEGETATION :

SYMBOL	COMMON NAME	%GD COVER
	ARTRW	
	Galletta grass	
	Cheatgrass	
	Serviceberry	
	Thistle	

MISCELLANEOUS FIELD NOTES / SKETCH :

Component Name:	J	Map Unit Symbol:		Date:	9-25-07

	Obser. Method	Depth (in) (cm)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Frag Knd % Rnd Sz	Structure Grade Sz Type	Consistence Dry	Mst	Stk	Pls	Mottles % Sz Cont. Col Mst Shp Loc
1	Pit	0-4"	A	cs		10YR3/2	SCL	—	1 m sbk / 2 f gr	sh	vfr	ss	sp	—
2	Pit	4-10"	Bt	cs		10YR3/2	SCL	—	2 fm sbk	sh	vfr	ss	sp	—
3	Pit	10-32"	Btk	cs	10YR6/3	10YR4/3	CL	—	2 m sbk	h	fr	ms	mp	—
4	Pit	32-64"	BK1	gs	10YR7/3	10YR5/4	SCL	—	2 m sbk	vh	fi	ms	mp	—
5	Pit	64-96"	BK2		10YR7/4	10YR6/4	SL	—	2 m sbk	h				
6														
7														
8														
9														
10														

	Redoximorphic Features % Sz Cn Hd Sp Kd Loc Bd Col	Concentrations % Sz Cn Hd Sp Kd Loc Bd Col	Ped / V. Surface Features % Dst Cont Kd Loc Col	Roots Qty Sz Loc	Pores Qty Sz Shp	pH (meth)	Effer. (agent)	Clay %	CCE	Notes
1		—	—	3vf 2f 1mc	2vfi	8.2	vs	24		
2		—	25 CLF PF/BR	2vff 1mc	2vft	8.3	vs	28		
3		4-5% vff CAM	20 CLF PF/BR	2vff 1m	1vft	8.4	st	32		
4		18-20% f-m CAM	—	1vff	1vft	8.6	ve	30		
5		18-20% f-m CAM	—	1vf	1vft	8.6	ve	15		
6										
7										
8										
9										
10										

USDA-NRCS

PEDON DESCRIPTION

Pedon ID # : 57 | Draft | Mar-02

Series or Component Name: E	Map Unit Symbol:	Photo #:	Classification: Aridic Calciustept fine-loamy, mixed, super, mesic	Soil Moist. Regime (Tax.): Ustic

Describer(s): Bob Long	Date: 9-25-07	Weather: Clear Temp.: Air: 50°F Soil: Depth:	Latitude: ° ' " N Longitude: ° ' " W Datum: 1983	Location: Sec. T. R.

UTM: Zone: mE: mN:	Topo Quad.: Alton	Site ID: YR: State: County: Pedon #:	Soil Survey Area: ALD	MLRA / LRU:	Transect: ID: Stop #: Interval:	

Landscape:	Landform: Valley	Microfeature:	Anthro:	Elevation:	Aspect: NW 315°	Slope (%): 2-3	Slope Complexity: Simple	Slope Shape: (Up & Dn / Across) Concave / Linear

Hillslope Profile Position:	Geom. Component:	Microrelief:	Physio. Division:	Physio. Province:	Physio. Section:	State Physio. Area:	Local Physio. Area:

Drainage: Well to 88"	Flooding: No	Ponding: Ra	Soil Moisture Status:	Permeability: Ksat: mod	Land Cover / Use: Range / Grazing

Parent Material: Alluvium	Bedrock: Kind: Fract.: Hard.: Depth:	Lithostrat. Units: Group: Formation: Member:	

Erosion: Kind: sheet Degree: SL	Runoff: slow	Surface Frag %: GR: — CB: — ST: — BD: — CN: — FL: — Kind:	Diagnostic Horz. / Prop.: Kind: cambic Depth: 4-10"

P.S. Control Section: Ave. Clay %: Ave. Rock Frag %: Depth Range: 10-40" 26% 0%	calcic

VEGETATION :

SYMBOL	COMMON NAME	%GD COVER
	Arctic Rush	
	Poa	

MISCELLANEOUS FIELD NOTES / SKETCH :

Buried soil at 24"

fine-loamy Calciustept over co-loamy Calciustept

Component Name:		Map Unit Symbol:		Date: 9-25-07

	Obser. Method	Depth (in) (cm)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	k Frag Knd % Rnd Sz	Structure Grade Sz Type	Consistence Dry	Consistence Mst	Consistence Stk	Consistence Pls	Mottles % Sz Cont. Col Mst Shp Loc
1	Pit	0-4"	A	cs		10YR 4/2	CL	—	1 fm sbk / 2 fgr	sh	vfr	ms	mp	—
2	Pit	4-10"	Bw	cs		10YR 4/3	CL	—	2 fm sbk	sh	vfr	ms	mp	—
3	Pit	10-24"	BK	as		7.5YR 6/4	SCL	—	2 m sbk	h	fr	ms	mp	—
4	Pit	24-34	2A	cw		10YR 4/2	L	—	3 m sbk	vh	fr	ss	sp	—
5	Pit	34-52"	2 BK1	gs		10YR 5/4	SL	—	2 m sbk	vh	fr	so	sp	—
6	Pit	52-88"	2BK2	cs		10YR 5/4	SL	—	2 mc sbk	h	fr	so	po	—
7	Pit	88-100"	2Cg			2.5Y 6/4	SCL	—	m	h	fr	ss	sp	35 fm 2.5Y 7/1
8														
9														
10														

	Redoximorphic Features % Sz Cn Hd Sp Kd Loc Bd Col	Concentrations % Sz Cn Hd Sp Kd Loc Bd Col	Ped / V. Surface Features % Dst Cont Kd Loc Col	Roots Qty Sz Loc	Pores Qty Sz Shp	pH (meth)	Effer. (agent)	Clay %	CCE	Notes
1	—	—	—	3vf 2f 1m	2vfi	8.3	ST	32		moist
2	—	—	—	2vff 1m	2vft	8.4	SL	32		moist
3	—	40 f CAM	—	2vff 1m	1vft	8.4	me	30		dry
4	—	—	—	2vff 1m	1vft	8.2	VS	24		dry
5	—	15-18 fm CAM	—	2vff	1vft	8.2	VE	18		dry
6	—	6f CAM	—	1vf	1vft		ST	15		moist
7	—	—	—	1vf	1vft		me	25		moist
8										
9										
10										

USDA-NRCS

PEDON DESCRIPTION

Pedon ID # : 58 | Draft | Mar-02

Series or Component Name: 5	Map Unit Symbol:	Photo #:	Classification: Andic Haplustalf fine, mixed, super, mesic	Soil Moist. Regime (Tax.): Ustic

Describer(s): Bob Long	Date: 9-25-07	Weather: Clear Temp.: Air: 52 Soil: Depth:	Latitude: ° ' " N Longitude: ° ' " W Datum:	Location: Sec. T. R.

UTM: Zone: mE: mN:	Topo Quad.: Alton	Site ID: YR: State: County: Pedon #:	Soil Survey Area: ACD	MLRA / LRU:	Transect: ID: Stop #: Interval:	

Landscape:	Landform: Valley Sideslope	Microfeature:	Anthro:	Elevation:	Aspect: ENE 75°	Slope (%): 7	Slope Complexity: Simple	Slope Shape: (Up & Dn / Across) Linear / Linear
Hillslope Profile Position: Backslope	Geom. Component:	Microrelief:	Physio. Division:	Physio. Province:	Physio. Section:		State Physio. Area:	Local Physio. Area:

Drainage: Well	Flooding: No	Ponding: No	Soil Moisture Status:	Permeability: Ksat: Very slow	Land Cover / Use: Range / Grazing

Parent Material: Alluvium	Bedrock: Kind: Fract.: Hard.: Depth:	Lithostrat. Units: Group: Formation: Member:		

Erosion: Kind: Degree: Sheet mod	Runoff: Mod Rapid	Surface Frag %: GR: — CB: — ST: — BD: — CN: — FL: — Kind:	Diagnostic Horz. / Prop.: angillic	Kind: Depth:

P.S. Control Section: Depth Range: 4-24"	Ave. Clay %: 47%	Ave. Rock Frag %: 0%	

VEGETATION :

SYMBOL	COMMON NAME	%GD COVER
	Black sage	
	Indian Ricegrass	

MISCELLANEOUS FIELD NOTES / SKETCH :

Profile very similar to #48.

No bulk samples collected.

Component Name:		Map Unit Symbol:		Date: 9-25-07

	Obser. Method	Depth (in) (cm)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Rock Frag Knd % Rnd Sz	Structure Grade Sz Type	Consistence Dry	Consistence Mst	Consistence Stk	Consistence Pls	Mottles % Sz Cont. Col Mst Shp Loc
1	Pit	0-4"	A	CS	2.5Y 6/2	2.5Y 5/2	CL	—	1 m pl 2 fgr	h	fi	s	p	—
2	Pit	4-14"	Bt	CW		2.5Y 4/2	C	—	2 m pr 3 m abk	vh	vfi	vs	vp	—
3	Pit	14-32"	Btk	CW		2.5Y 5/2	C	—	2 m pr 3 m abk	xh	xfi	vs	vp	—
4	Pit	32-52"	Bty1	CW		2.5Y 5/3	C	—	3 m abk	xh	xfi	vs	vp	—
5	Pit	52-64"	Bty2			2.5Y 5/3	C	—	2 m abk	xh	xfi	vs	vp	—
6														
7														
8														
9														
10														

	Redoximorphic Features % Sz Cn Hd Sp Kd Loc Bd Col	Concentrations % Sz Cn Hd Sp Kd Loc Bd Col	Ped / V. Surface Features % Dst Cont Kd Loc Col	Roots Qty Sz Loc	Pores Qty Sz Shp	pH (meth)	Effer. (agent)	Clay %	CCE	Notes
1	—	—		2vf 1fm	2vft	7.8	SL	35		
2	—	—	90 CLF PF/PO	2vff 1m	1vft	8.0	VS	44		
3	—	35 fm CAM	95 CLF PF/PO	2vf 1f 1m	—	6.9	ST	50+		
4	—	1f gyp Crystals PF	95 CLF PF/PO	1vf	—	8.4	VS	50+		
5	—	3 fm gyp masses on PF	95 CLF PF/PO	—	—	8.4	SL	50+		
6										
7										
8										
9										
10										

USDA-NRCS

PEDON DESCRIPTION

Pedon ID # : 59 | Draft | Mar-02

Series or Component Name: A	Map Unit Symbol:	Photo #:	Classification: Aridic Calciustept Fine, mixed, super, mesic	Soil Moist. Regime (Tax.): Ustic

Describer(s): Bob Long	Date: 9-25-07	Weather: Clear	Temp.: Air: 55 Soil: Depth:	Latitude: ° ' " N Longitude: ° ' " W	Datum:
Location: Sec. T. R.					

UTM: Zone: mE: mN:	Topo Quad.: Alton	Site ID: YR: State: County: Pedon #:	Soil Survey Area: ACD	MLRA / LRU:	Transect: ID: Stop #: Interval:	

Landscape:	Landform: Valley	Microfeature:	Anthro:	Elevation:	Aspect: SSW	Slope (%): 1-2	Slope Complexity: Simple	Slope Shape: (Up & Dn / Across) Linear Linear

Hillslope Profile Position:	Geom. Component:	Microrelief:	Physio. Division:	Physio. Province:	Physio. Section:	State Physio. Area:	Local Physio. Area:

Drainage: well to 62" poorly >62"	Flooding: No	Ponding: 0c	Soil Moisture Status:	Permeability: Ksat: slow	Land Cover / Use: Range / Grazing

Parent Material: Alluvium	Bedrock: Kind: Fract.: Hard.: Depth:	Lithostrat. Units: Group: Formation: Member:	

Erosion: Kind: Degree: None	Runoff: Very slow	Surface Frag %: GR: — CB: — ST: — BD: — CN: — FL: — Kind:	Diagnostic Horz. / Prop.: Kind: Depth: Cambic 3-10" Calcic 10-45"

P.S. Control Section: Ave. Clay %:	Ave. Rock Frag %:	
Depth Range: 10-40"	37%	0%

VEGETATION :

SYMBOL	COMMON NAME	%GD COVER
	grasses (grazed short)	
	no shrubs	

MISCELLANEOUS FIELD NOTES / SKETCH :

This area appears white on aerial photo.

Component Name:		Map Unit Symbol:		Date: 9-25-07

	Obser. Method	Depth (in) (cm)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Rock Frag Knd % Rnd Sz	Structure Grade Sz Type	Consistence Dry	Consistence Mst	Consistence Stk	Consistence Pls	Mottles % Sz Cont. Col Mst Shp Loc
1	Pit	0-3"	A	cs	10YR 6/2	10YR 3/3	L	—	2fgr	sh	vfr	ss	sp	—
2	Pit	3-10"	2Bw	cs	10YR 5/2	10YR 3/2	CL	—	2msbk	sh	vfr	ms	mp	—
3	Pit	10-21"	2BK1	gs	10YR 6/4	10YR 5/4	CL	—	2mpr 2fsbk	h	fr	ms	mp	—
4	Pit	21-45"	2BK2	as	10YR 7/3	10YR 6/3	C	—	3msbk	vh	fi	s	p	—
5	Pit	45-53"	3A	cw	2.5Y 6/2	2.5Y 4/2	CL	—	2msbk	h	fr	ms	mp	—
6	Pit	53-62"	3Cy	cs	10YR 7/3	10YR 6/3	SCL	—	2msbk	vh	fi	ss	sp	—
7	Pit	62-76"	3Cg		2.5Y 7/4	2.5Y 6/4	SCL	—	m	h	fr	ss	sp	40 mc 7.5YR 6/6
8														
9														
10					free water accumulating					@ 75"				

	Redoximorphic Features % Sz Cn Hd Sp Kd Loc Bd Col	Concentrations % Sz Cn Hd Sp Kd Loc Bd Col	Ped / V. Surface Features % Dst Cont Kd Loc Col	Roots Qty Sz Loc	Pores Qty Sz Shp	pH (meth)	Effer. (agent)	Clay %	CCE	Field ECe Notes
1	—	—	—	3vfzf	2vfi		me	27		mmhos/cm 0.39
2	—	—	—	2vff	2vfi		me	30		0.96
3	—	8-10 fm CAM	—	2vf 1f	1vft		VE	32		1.30
4	—	12 fm CAM	—	2vf 1f	1vft		ST	40		0.73
5	—	—	—	1vff	1vft		SL	34		0.65
6	—	1vf gyp crystals	—	1vf	2vfi		ST	26		0.60
7	35f 2.5Y 7/1	—	—	—	2vfi		me	22		0.85
8										
9										
10										

USDA-NRCS

PEDON DESCRIPTION

PEDON ID #: 60

NRCS-CPA-110 3/2002

Series or Component Name: S	Map Unit Symbol:	Photo #:	Classification: Aridic Haplustalf fine, mixed, superactive,		Soil Moisture Regime (Tax.): Ustic
Describer(s): Bob Long	Date: 9-25-07	Weather: Temp.: Air: Soil: Depth:	Latitude: ° ' " N Longitude: ° ' " W	Datum:	Location: Sec. T. R.
UTM: Zone: mE: mN:	Topo Quad: Alton	Site ID: Yr: State: County: Pedon #:	Soil Survey Area:	MLRA / LRU:	Transect: ID: Stop #: Interval:

Landscape:	Landform: Valley side slope	Microfeature:	Anthro:	Elevation:	Aspect: E 100	Slope (%): 4-6	Slope Complexity: Simple	Slope Shape: (Up & Dn / Across) convex / Linear
Hillslope Profile Position: Backslope	Geom. Component:	Microrelief:	Physio. Division:	Physio. Province:	Physio. Section:	State Physio. Area:	Local Physio. Area:	

Drainage: well	Flooding: No	Ponding: No	Soil Moisture Status: 5m to 26"	Permeability: K_{sat}: Very slow	Land Cover / Use:
Parent Material:	Bedrock: Kind: Fract.: Hard.: Depth:			Lithostrat. Units: Group: Formation: Member:	
Erosion: Kind: sheet Degree: mod	Runoff:	Surface Frag %: GR: CB: ST: BD: CN: FL: Kind: — — — — — —		Diagnostic Horz. / Prop.: angillic	Kind: Depth:
P. S. Control Section: Depth Range:	Ave. Clay %:	Ave. Rock Frag %:			

VEGETATION:

SYMBOL	COMMON NAME	% COVER
	Utah Juniper	60%
	Pinyon Pine	40%
	Black sage	2
	no grasses	

MISCELLANEOUS FIELD NOTES / SKETCH:

correlate with #48 and 58

60

Component Name: | **Map Unit Symbol:** | **Date:** 9-25-07

	Obser. Method	Depth (in) (cm)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Rock Frags Knd % Rnd Sz	Structure Grade Sz Type	Consistence Dry	Consistence Mst	Consistence Stk	Consistence Pls	Mottles % Sz Cn Col Mst Sp Lc
1	Pit	0-3"	A	CS			CL	—	1 m sbk / 2 f gr	h	fr	ms	mp	—
2	Pit	3-12"	Bt1	CS			C	—	2 m pr / 3 fm sbk	vh	fi	s	p	—
3	Pit	12-26"	Bt2	CS			C	—	2 m pr / 3 m sbk	xh	vfi	vs	vp	—
4	Pit	26-48"	BtK	CS			C	—	3 m sbk	xh	vfi	vs	vp	—
5		48" +	Cr		black shale									
6					stopped at 48"									
7					because profile is similar to pits									
8					48 & 58; and very difficult to move any									
9					more soil among trees									
10														

	Redoximorphic Features % Sz Cn Hd Sp Kd Loc Bd Col	Concentrations % Sz Cn Hd Sp Kd Loc Bd Col	Ped / V. Surface Features % Dst Cont Kd Loc Col	Roots Qty Sz Loc	Pores Qty Sz Shp	pH (meth)	Effer (agent)	Clay %	CCE	Notes
1	—	—	—	2vf / fmc	2vfit		vs	35		
2	—	—	85 CLF PF/PO	2vff / 1mc	1vft		vs	42		
3	—	—	95 CLF PF/PO	2vff / 1mc	1vft		SL	50+		
4	—	30 fm CAM	95 CLF PF/PO	2vf if / 1mc	1vft		ST	50+		
5										
6										
7										
8										
9										
10										

Table C-1. Summary of laboratory analysis of soil samples for Coal Hollow soil survey, year 1.

Sample ID	pH (Sat Paste)	E.C. @25°C	SAR	Sand	Silt	Clay	USDA Texture Class[1]	Very Fine Sand	Saturation Percent	Available Water Capacity[2]	Organic Matter	Organic Carbon (calculated)[3]	Erodibility Factor (K-Factor)[4]	$CaCO_3$	Boron (soluble)	Se (Hot H_2O sol)	Calcium, soluble (Sat. Paste)	Magnesium, soluble (Sat. Paste)	Sodium, soluble (Sat. Paste)	Potassium, soluble (Sat. Paste)	Nitrogen-Nitrate	Phosphorus	Alkalinity
	units	dS/m	unitless	%	%	%		%	%	in/in	%	%	unitless	%	mg/Kg	mg/Kg	meq/L	meq/L	meq/L	meq/L	mg/Kg	mg/Kg	meq/L
1YR-9A 0-12"	9.0	0.91	0.30	60	32	8	SL	26.6	47.0	0.12	4.7	2.5	0.11	26.1	†	†	0.98	7.93	0.62	0.65	4.23	10.0	6.90
1YR-9A 12-24"	9.1	0.83	0.23	68	22	10	SL	22.2	32.8	0.12	1.4	0.7	0.17	22.0	†	†	0.44	7.78	0.46	0.71	0.21	2.02	7.94
1YR-9A 24-42"	9.6	1.26	3.71	68	22	10	SL	20.4	26.4	0.12	0.3	0.2	0.18	23.6	†	†	0.76	6.48	7.06	0.34	0.13	2.22	10.6
1YR-9A 42-70"	9.4	0.90	3.19	69	21	10	SL	26.7	27.7	0.12	0.3	0.2	0.17	23.5	†	†	0.63	3.77	4.73	0.16	0.26	1.88	5.22
1YR-9A 70-100"	8.5	1.31	1.48	30	31	39	CL	27.3	68.6	0.19	0.5	0.3	0.22	9.8	†	†	1.72	8.32	3.31	0.19	0.29	0.82	2.82
1YR-9B 0-6"	8.0	0.62	0.07	44	32	24	L	14.5	63.0	0.16	6.1	3.2	0.09	18.6	†	†	2.19	3.21	0.12	0.74	1.73	1.44	4.49
1YR-9B 6-14"	8.2	0.34	0.21	52	25	23	SCL	18.1	42.4	0.17	3.4	1.8	0.22	15.3	†	†	1.17	1.67	0.25	0.30	0.91	<0.01	2.30
1YR-9B 14-28"	8.5	0.88	0.57	64	22	14	SL	9.7	35.7	0.12	0.9	0.5	0.17	21.2	†	†	1.16	5.71	1.06	0.72	0.50	<0.01	3.03
1YR-9B 28-48"	8.3	0.76	0.70	54	30	16	SL	16.0	31.0	0.12	0.4	0.2	0.22	26.4	†	†	1.49	4.64	1.23	0.37	0.48	<0.01	2.40
1YR-10 0-7"	7.8	0.46	0.05	36	38	26	L	17.9	46.4	0.16	3.9	2.1	0.15	19.2	0.29	<0.02	3.39	0.89	0.08	0.30	3.15	7.45	4.18
1YR-10 7-13"	7.7	0.40	0.06	26	48	26	L	12.3	44.4	0.16	2.4	1.3	0.29	13.9	0.31	<0.02	2.58	0.80	0.08	0.24	0.46	0.67	3.13
1YR-10 13-26"	7.9	0.34	0.07	14	52	34	SiCL	9.4	41.7	0.18	1.6	0.8	0.37	27.8	0.20	<0.02	2.00	0.95	0.09	0.21	0.44	0.37	3.03
1YR-10 26-44"	8.3	0.36	0.16	30	36	34	CL	29.1	45.4	0.19	1.0	0.5	0.25	35.5	0.37	<0.02	0.83	2.50	0.20	0.08	0.15	<0.01	3.55
1YR-10 44-68"	8.5	0.34	0.49	14	54	32	SiCL	7.0	46.0	0.18	0.5	0.3	0.42	34.4	0.24	<0.02	0.71	2.07	0.58	0.05	0.19	<0.01	2.51
1YR-10 68-84"	8.4	0.46	0.48	60	30	10	SL	24.5	28.0	0.12	0.2	0.1	0.24	26.4	0.07	<0.02	0.77	2.96	0.66	0.05	0.32	0.67	2.93
1YR-11 0-5"	8.0	0.48	0.19	72	19	9	SL	19.9	36.3	0.12	2.4	1.3	0.07	1.4	†	†	2.44	1.84	0.28	0.39	1.58	8.21	3.76
1YR-11 5-16"	8.2	0.50	0.28	69	17	14	SL	20.0	31.3	0.12	1.7	0.9	0.13	4.2	†	†	2.76	1.42	0.40	0.36	0.13	0.82	3.55
1YR-11 16-32"	8.3	0.38	0.22	72	18	10	SL	16.1	27.9	0.12	0.9	0.5	0.15	14.4	†	†	1.89	0.87	0.26	0.37	0.20	1.53	3.13
1YR-11 32-48"	8.3	0.41	0.26	79	13	8	LS	17.1	27.3	0.08	0.5	0.3	0.12	19.6	†	†	1.90	1.06	0.32	0.29	0.23	0.44	2.93
1YR-11 48-72"	8.6	0.33	0.24	78	14	8	LS	18.4	28.1	0.08	0.3	0.2	0.13	21.7	†	†	1.44	0.96	0.27	0.12	0.12	2.20	2.82
1YR-11 72-90"	8.7	0.29	0.35	89	7	4	S	14.1	23.9	0.05	0.2	0.1	0.08	18.2	†	†	1.37	1.15	0.39	0.13	0.10	4.93	2.19
1YR-12 0-5"	7.8	0.38	0.13	32	40	28	CL	28.9	46.8	0.19	2.3	1.2	0.20	0.1	†	†	2.66	0.91	0.17	0.20	0.87	7.33	3.03
1YR-12 5-10"	7.8	0.29	0.59	29	39	32	CL	22.2	50.6	0.19	1.9	1.0	0.26	9.3	†	†	1.79	0.69	0.66	0.08	0.67	0.22	2.51
1YR-12 10-26"	8.4	0.21	2.20	16	40	44	SiC	13.8	58.6	0.20	0.7	0.4	0.30	18.8	†	†	0.50	0.24	1.34	0.04	0.94	<0.01	1.99
1YR-12 26-44"	8.3	0.86	6.84	46	19	35	SC	45.0	93.0	0.19	0.7	0.4	0.19	11.9	†	†	0.91	0.57	5.89	0.08	0.20	<0.01	1.67
SP-13 0-6"	8.5	0.72	0.17	59	23	18	SL	15.8	34.1	0.12	2.7	1.4	0.08	19.7	†	†	4.77	2.10	0.31	0.90	3.78	39.5	5.64
SP-13 6-12"	8.2	0.52	0.22	23	51	26	SiL	12.7	43.3	0.18	1.7	0.9	0.32	27.9	†	†	2.64	1.72	0.33	0.41	0.18	3.83	3.87
SP-13 12-24"	8.4	0.55	0.23	14	44	42	SiC	9.1	62.3	0.20	2.9	1.5	0.29	26.9	†	†	1.67	3.09	0.35	0.26	0.50	0.70	3.87
SP-13 24-48"	8.5	0.47	0.29	22	46	32	CL	9.5	46.3	0.19	1.2	0.6	0.31	32.2	†	†	0.91	3.26	0.42	0.12	0.46	0.44	3.55
SP-13 48-60"	8.8	0.31	0.51	33	39	28	CL	13.4	46.1	0.19	1.8	0.9	0.27	29.2	†	†	0.53	3.00	0.67	0.10	0.17	<0.01	1.67
SP-13 60-72"	8.9	1.46	2.20	62	14	24	SCL	19.2	35.6	0.17	1.2	0.6	0.18	20.6	†	†	1.64	8.30	4.90	0.14	0.23	0.99	7.00
SP-13 72-84"	8.7	2.20	2.36	44	36	20	L	18.5	33.5	0.16	0.5	0.3	0.25	28.7	†	†	2.07	15.5	7.00	0.20	0.29	0.73	3.03
SP-14 0-6"	8.7	0.54	0.14	8	48	44	SiC	5.3	58.6	0.20	4.0	2.1	0.21	7.5	†	†	2.34	2.42	0.22	0.35	0.38	8.92	4.81
SP-14 6-13"	7.8	0.36	0.22	8	48	44	SiC	5.7	62.4	0.20	2.1	1.1	0.31	19.9	†	†	1.08	2.05	0.27	0.17	0.58	2.94	2.61
SP-14 13-28"	8.1	0.53	0.49	23	50	27	CL	21.4	50.7	0.19	0.7	0.4	0.36	44.0	†	†	0.41	3.76	0.70	0.14	0.17	4.40	4.28
SP-14 28-48"	8.7	0.77	1.35	40	43	17	L	33.6	43.7	0.16	0.4	0.2	0.34	39.3	†	†	0.49	5.04	2.24	0.10	0.21	2.67	3.55
SP-14 48-70"	8.8	0.80	1.60	21	40	39	CL	5.6	41.7	0.19	0.4	0.2	0.24	30.9	†	†	0.54	4.79	2.61	0.11	0.41	3.54	5.12
SP-14 70-90"	8.5	0.89	1.28	21	47	32	CL	17.7	55.0	0.19	0.6	0.3	0.32	31.5	†	†	0.74	3.87	1.94	0.11	0.64	0.31	2.61

Table C-1. Summary of laboratory analysis of soil samples for Coal Hollow soil survey, year 1.

Sample ID	pH (Sat Paste)	E.C. @25°C	SAR	Sand	Silt	Clay	USDA Texture Class[1]	Very Fine Sand	Saturation Percent	Available Water Capacity[2]	Organic Matter	Organic Carbon (calculated)[3]	Erodibility Factor (K-Factor)[4]	$CaCO_3$	Boron (soluble)	Se (Hot H_2O sol)	Calcium, soluble (Sat. Paste)	Magnesium, soluble (Sat. Paste)	Sodium, soluble (Sat. Paste)	Potassium, soluble (Sat. Paste)	Nitrogen-Nitrate	Phosphorus	Alkalinity
	units	dS/m	unitless	%	%	%		%	%	in/in	%	%	unitless	%	mg/Kg	mg/Kg	meq/L	meq/L	meq/L	meq/L	mg/Kg	mg/Kg	meq/L
LOF-1 0-6"	7.3	1.56	0.23	25	39	36	CL	20.1	50.2	0.19	3.6	1.9	0.16	22.6	†	†	9.03	2.09	0.55	2.20	1.99	2.86	3.76
LOF-1 6-12"	8.3	0.52	1.15	26	38	36	CL	24.3	54.4	0.19	1.8	0.9	0.25	27.1	†	†	2.63	1.09	1.57	0.18	<0.02	0.18	3.45
LOF-1 12-24"	8.5	0.42	2.91	18	40	42	SiC	16.5	54.8	0.20	1.6	0.8	0.29	26.6	†	†	1.07	0.59	2.65	0.07	0.23	0.93	2.72
LOF-1 24-42"	8.7	0.90	4.02	13	41	46	SiC	11.3	60.8	0.20	1.5	0.8	0.28	27.1	†	†	1.61	0.87	4.47	0.14	0.34	<0.01	4.08
LOF-1 42-60"	8.4	4.75	12.3	19	39	42	C	17.1	65.4	0.19	1.1	0.6	0.29	28.3	†	†	6.45	7.65	32.7	0.45	0.21	0.07	1.67
LOF-2 0-7"	7.6	0.47	0.16	32	37	31	CL	14.9	43.3	0.19	2.7	1.4	0.17	18.6	0.27	<0.02	4.93	1.26	0.29	0.65	1.58	9.55	3.13
LOF-2 7-12"	7.7	0.31	0.19	34	34	32	CL	22.3	44.8	0.19	2.4	1.3	0.23	20.1	0.24	<0.02	2.07	0.68	0.22	0.19	0.55	0.40	2.19
LOF-2 12-24"	7.8	0.25	0.62	14	40	46	SiC	12.4	60.2	0.20	1.8	0.9	0.28	26.7	0.30	<0.02	1.29	0.57	0.59	0.09	0.31	<0.01	2.19
LOF-2 24-48"	8.0	0.32	2.12	22	37	41	C	20.2	67.7	0.19	1.7	0.9	0.23	26.9	0.45	<0.02	0.77	0.53	1.71	0.07	0.88	0.04	1.88
LOF-2 48-72"	7.8	7.38	7.27	14	43	43	SiC	11.3	66.7	0.20	1.1	0.6	0.30	27.5	1.08	0.09	23.8	24.9	35.8	0.50	1.07	0.40	1.25
LOF-2 72-96"	7.8	7.17	7.75	18	35	47	C	13.0	62.9	0.19	1.1	0.6	0.26	21.0	0.61	0.12	21.6	26.3	37.9	0.47	13.1	0.76	0.94
LOF-3 0-4"	8.1	0.82	0.27	32	42	26	L	17.5	47.7	0.16	3.9	2.1	0.16	20.3	†	†	5.98	1.58	0.53	1.02	10.6	<0.01	5.64
LOF-3 4-11"	8.3	0.43	0.25	24	48	28	CL	15.9	51.8	0.19	2.9	1.5	0.30	20.4	†	†	3.19	0.73	0.36	0.27	1.07	0.90	3.55
LOF-3 11-19"	8.1	0.41	0.32	16	50	34	SiCL	14.0	42.7	0.18	2.3	1.2	0.35	24.2	†	†	2.86	0.88	0.44	0.22	0.43	0.56	2.51
LOF-3 19-33"	8.4	0.71	4.05	17	43	40	SiC	16.1	53.5	0.20	2.2	1.2	0.30	27.2	†	†	1.67	0.89	4.58	0.15	0.32	0.07	3.87
LOF-4 0-5"	7.8	0.62	0.29	12	46	42	SiC	9.1	52.6	0.20	3.5	1.8	0.22	22.5	†	†	4.54	1.04	0.49	0.26	4.16	0.79	3.03
LOF-4 5-10"	7.7	0.31	0.26	14	46	40	SiC	11.0	53.0	0.20	2.8	1.5	0.30	24.4	†	†	2.28	0.63	0.32	0.08	0.66	9.76	2.72
LOF-4 10-19"	7.8	0.33	0.60	12	43	45	SiC	10.5	53.9	0.20	2.1	1.1	0.29	25.3	†	†	2.00	0.78	0.71	0.08	0.53	0.64	2.40
LOF-4 19-31"	7.9	0.29	1.16	13	43	44	SiC	11.3	53.6	0.20	1.8	0.9	0.29	25.3	†	†	1.12	0.52	1.05	0.06	0.40	0.67	1.88
LOF-4 31-50"	7.8	4.06	5.43	19	39	42	C	16.3	59.8	0.19	1.1	0.6	0.29	27.6	†	†	16.3	12.4	20.5	0.51	1.06	0.43	1.46
RDV-5 0-5"	8.1	0.54	0.27	38	44	18	L	22.6	42.7	0.16	3.6	1.9	0.20	25.7	†	†	3.72	0.90	0.41	0.36	6.14	10.4	3.97
RDV-5 5-10"	8.1	0.50	0.19	33	47	20	L	18.9	39.3	0.16	3.0	1.6	0.29	26.4	†	†	3.98	0.95	0.30	0.23	<0.02	1.82	4.08
RDV-5 10-25"	8.4	0.37	0.31	54	32	14	SL	19.0	32.3	0.12	1.1	0.6	0.23	31.1	†	†	2.37	0.89	0.40	0.22	0.22	16.4	2.72
RDV-5 25-48"	8.8	0.72	7.45	16	72	12	SiL	13.4	56.0	0.18	1.7	0.9	#N/A	28.0	†	†	0.84	0.60	6.33	0.11	0.16	1.48	4.91
RDV-5 48-60"	9.0	3.37	24.0	31	47	22	L	26.6	83.6	0.16	1.3	0.7	0.32	26.5	†	†	1.26	1.76	29.5	0.20	0.22	1.62	6.06
RDV-6 0-6"	8.1	0.52	0.34	82	12	6	LS	21.0	27.9	0.08	1.1	0.6	0.04	18.4	†	†	2.99	1.06	0.48	0.77	1.68	9.41	3.97
RDV-6 6-12"	8.3	0.31	0.25	80	14	6	LS	18.5	29.9	0.08	0.7	0.4	0.13	20.6	†	†	2.13	0.47	0.28	0.14	0.24	0.67	2.51
RDV-6 12-24"	8.0	0.64	0.20	45	37	18	L	17.8	35.4	0.16	2.6	1.4	0.25	28.9	†	†	4.52	1.68	0.36	0.33	<0.02	0.56	4.18
RDV-6 24-34"	8.3	0.40	0.30	69	23	8	SL	35.5	29.7	0.12	0.7	0.4	0.19	29.2	†	†	2.43	1.35	0.41	0.18	0.07	0.56	2.93
RDV-6 34-60"	8.5	0.83	3.43	19	41	40	SiC	15.5	52.9	0.20	1.8	0.9	0.30	25.9	†	†	1.83	2.24	4.89	0.19	0.03	<0.01	5.96
RDV-7 0-6"	7.5	0.58	0.13	26	38	36	CL	20.4	62.9	0.19	4.4	2.3	0.14	10.6	†	†	3.93	1.17	0.20	0.28	2.19	12.5	3.76
RDV-7 6-12"	7.6	0.36	0.22	18	38	44	C	11.9	57.1	0.19	3.0	1.6	0.26	13.2	†	†	2.37	0.78	0.27	0.09	0.28	7.78	2.82
RDV-7 12-24"	8.0	0.24	1.30	16	37	47	C	13.6	55.3	0.19	1.8	0.9	0.26	21.2	†	†	0.82	0.44	1.04	0.04	0.40	0.73	2.09
RDV-7 24-60"	8.0	1.40	5.18	22	34	44	C	20.8	63.8	0.19	1.4	0.7	0.26	23.4	†	†	2.65	2.00	7.90	0.11	0.30	0.46	1.78
1YR-8 0-8"	8.0	0.68	0.18	36	34	30	CL	19.7	51.5	0.19	5.8	3.1	0.12	5.1	†	†	3.68	2.81	0.33	0.45	3.82	10.9	5.54
1YR-8 8-14"	8.1	0.53	0.18	38	32	30	CL	17.2	43.1	0.19	2.1	1.1	0.23	16.3	†	†	3.22	1.63	0.29	0.34	0.05	0.07	2.93
1YR-8 14-22"	8.5	0.40	0.43	48	30	22	L	19.5	35.8	0.16	1.1	0.6	0.22	27.3	†	†	1.77	1.31	0.53	0.37	0.17	0.21	2.30
1YR-8 22-45"	8.9	0.44	0.28	42	42	16	L	23.9	37.6	0.16	0.7	0.4	0.33	30.8	†	†	0.71	3.05	0.39	0.45	0.50	2.51	3.55
1YR-8 45-65"	9.0	0.49	0.28	79	13	8	LS	19.8	27.4	0.08	0.4	0.2	0.12	19.3	†	†	0.70	3.46	0.40	0.41	0.27	0.18	3.66
1YR-8 65-85"	8.9	0.56	0.65	80	12	8	LS	17.9	25.9	0.08	0.3	0.2	0.11	20.4	†	†	1.24	3.81	1.03	0.19	0.20	0.10	4.18

Table C-1. Summary of laboratory analysis of soil samples for Coal Hollow soil survey, year 1.

Sample ID	pH (Sat Paste)	E.C. @25°C	SAR	Sand	Silt	Clay	USDA Texture Class[1]	Very Fine Sand	Saturation Percent	Available Water Capacity[2]	Organic Matter	Organic Carbon (calculated)[3]	Erodibility Factor (K-Factor)[4]	$CaCO_3$	Boron (soluble)	Se (Hot H_2O sol)	Calcium, soluble (Sat. Paste)	Magnesium, soluble (Sat. Paste)	Sodium, soluble (Sat. Paste)	Potassium, soluble (Sat. Paste)	Nitrogen-Nitrate	Phosphorus	Alkalinity
	units	dS/m	unitless	%	%	%		%	%	in/in	%	%	unitless	%	mg/Kg	mg/Kg	meq/L	meq/L	meq/L	meq/L	mg/Kg	mg/Kg	meq/L
SP-15 0-8"	8.0	0.54	0.08	52	32	16	SL	24.2	46.5	0.12	3.5	1.8	0.16	10.8	†	†	2.01	2.43	0.12	0.41	0.68	4.82	4.70
SP-15 8-20"	8.5	0.50	0.11	50	32	18	L	24.3	35.2	0.16	0.8	0.4	0.21	27.6	†	†	0.70	3.80	0.17	0.31	0.16	1.80	4.60
SP-15 20-37"	8.7	0.78	0.72	51	34	15	L	23.7	30.7	0.16	0.5	0.3	0.27	31.9	†	†	0.64	5.91	1.30	0.21	0.58	1.56	4.08
SP-15 37-58"	8.6	1.56	1.81	39	43	18	L	22.7	36.9	0.16	0.4	0.2	0.33	33.4	†	†	0.90	12.0	4.60	0.18	0.32	1.20	3.03
SP-15 58-73"	8.4	3.35	1.92	74	18	8	SL	19.2	27.2	0.12	0.1	0.1	0.15	26.3	†	†	2.52	33.5	8.14	0.26	0.36	0.82	1.99
SP-15 73-96"	8.3	1.77	1.24	52	34	14	SL	25.3	30.2	0.12	0.3	0.2	0.26	28.1	†	†	1.70	12.4	3.30	0.19	0.54	<0.01	2.82
SP-16 0-8"	8.3	0.58	0.31	19	45	36	SiCL	15.1	64.5	0.18	4.8	2.5	0.21	9.6	†	†	3.08	1.84	0.49	0.42	1.19	18.3	4.81
SP-16 8-18"	8.2	0.60	0.25	12	44	44	SiC	10.8	61.9	0.20	1.9	1.0	0.30	24.5	†	†	2.00	2.77	0.39	0.28	0.21	4.70	3.55
SP-16 18-36"	8.7	0.45	0.38	20	52	28	CL	16.2	50.6	0.19	0.6	0.3	0.37	38.8	†	†	0.68	3.12	0.53	0.19	0.24	6.45	4.18
SP-16 36-56"	9.0	0.34	0.56	14	58	28	SiCL	12.4	52.2	0.18	0.6	0.3	0.46	40.1	†	†	0.45	3.38	0.77	0.14	0.23	5.10	3.66
SP-16 56-68"	8.9	0.60	0.78	50	36	14	L	21.6	36.3	0.16	0.3	0.2	0.30	28.1	†	†	0.52	4.30	1.21	0.16	0.30	2.83	4.08
SP-16 68-96"	8.9	0.53	0.81	23	49	28	CL	17.0	55.3	0.19	0.6	0.3	0.36	31.0	†	†	1.00	3.49	1.21	0.18	0.24	1.25	4.81
WRD-17 0-9"	7.8	0.43	0.11	22	42	36	CL	11.0	49.8	0.19	4.6	2.4	0.22	25.4	†	†	1.74	1.11	0.14	0.51	1.09	8.05	3.34
WRD-17 9-18"	8.0	0.24	0.17	34	34	32	CL	16.6	39.6	0.19	2.0	1.1	0.20	25.3	†	†	1.14	0.63	0.16	0.23	0.28	1.26	1.78
WRD-17 18-30"	8.0	0.32	0.11	44	34	22	L	17.3	38.5	0.16	1.6	0.8	0.23	25.3	†	†	0.99	0.69	0.10	0.15	0.85	2.49	2.61
WRD-17 30-45"	8.1	0.28	0.13	36	37	27	CL	17.5	39.3	0.19	0.8	0.4	0.27	29.5	†	†	0.59	0.56	0.10	0.05	0.10	2.82	2.40
WRD-17 45-60"	8.2	0.34	0.22	24	44	32	CL	14.8	40.0	0.19	0.8	0.4	0.31	33.5	†	†	1.17	1.64	0.26	0.07	0.11	0.13	2.19
WRD-17 60-80"	8.0	0.82	0.37	18	40	42	SiC	17.0	61.3	0.20	1.1	0.6	0.30	33.0	†	†	2.86	4.00	0.69	0.14	0.59	0.70	1.88
WRD-18A 0-7"	7.7	0.61	0.10	41	33	26	L	18.3	46.0	0.16	3.9	2.1	0.17	20.2	†	†	3.08	1.36	0.15	0.59	0.57	1.95	3.97
WRD-18A 7-15"	8.0	0.33	0.12	43	33	24	L	20.0	43.4	0.16	2.1	1.1	0.19	24.7	†	†	1.45	1.00	0.13	0.28	0.68	0.61	2.30
WRD-18A 15-30	8.1	0.51	0.29	60	23	17	SL	17.6	31.1	0.12	0.7	0.4	0.15	28.2	†	†	1.97	2.13	0.41	0.09	0.08	2.43	2.30
WRD-18A 30-45	8.0	0.67	0.30	24	41	35	CL	13.8	52.4	0.19	1.5	0.8	0.28	29.3	†	†	2.66	3.06	0.51	0.12	0.13	0.34	1.88
WRD-18A 45-60	7.9	0.44	0.36	57	23	20	SCL	18.4	36.1	0.17	0.7	0.4	0.23	25.8	†	†	1.67	1.63	0.47	0.06	0.16	<0.01	2.09
WRD-18B 0-9"	8.2	0.35	0.18	34	40	26	L	11.4	43.4	0.16	3.6	1.9	0.16	23.8	0.39	<0.02	4.56	1.75	0.31	0.65	3.96	18.6	5.54
WRD-18B 9-19"	8.3	0.61	0.17	50	30	20	L	16.2	41.3	0.16	1.8	0.9	0.22	20.3	0.25	<0.02	3.45	1.56	0.27	0.80	0.31	2.89	4.60
WRD-18B 19-34	8.5	0.52	0.21	44	38	18	L	21.0	35.8	0.16	1.2	0.6	0.28	27.5	0.18	<0.02	2.41	2.17	0.31	0.18	0.09	5.50	3.13
WRD-18B 34-54	8.7	0.38	0.27	21	47	32	CL	13.4	45.5	0.19	1.4	0.7	0.31	29.0	0.33	<0.02	1.63	1.70	0.35	0.12	0.50	0.93	2.61
WRD-18B 54-72	8.6	0.57	0.31	22	44	34	CL	11.8	49.6	0.19	1.1	0.6	0.29	28.3	0.29	<0.02	1.92	2.53	0.46	0.18	0.10	1.19	3.76
WRD-18B 72-96	8.6	1.46	0.56	48	32	20	L	21.2	34.7	0.16	0.5	0.3	0.25	23.1	0.19	<0.02	2.97	11.0	1.48	0.19	0.45	0.21	8.99
WRD-19 0-6"	8.0	0.91	0.15	34	42	24	L	16.5	48.5	0.16	4.9	2.6	0.15	20.1	†	†	4.87	2.07	0.28	1.72	2.77	12.9	6.69
WRD-19 6-12"	8.2	0.65	0.20	32	36	32	CL	13.1	44.1	0.19	3.0	1.6	0.23	17.4	†	†	3.43	1.45	0.30	1.14	1.85	8.32	4.39
WRD-19 12-24"	8.3	0.53	0.23	34	36	30	CL	15.8	40.8	0.19	2.0	1.1	0.25	23.5	†	†	2.85	1.21	0.32	0.87	0.67	1.99	2.51
WRD-19 24-37"	8.5	0.55	0.19	49	29	22	L	24.5	40.8	0.16	1.9	1.0	0.21	24.6	†	†	2.71	1.11	0.26	0.76	0.35	0.99	3.13
WRD-19 37-51"	8.4	0.57	0.18	60	26	14	SL	24.2	34.1	0.12	1.2	0.6	0.19	22.7	†	†	2.94	1.39	0.27	0.59		1.53	2.40
WRD-19 51-68"	8.5	0.48	0.26	66	22	12	SL	17.5	29.1	0.12	0.8	0.4	0.17	19.7	†	†	2.07	1.87	0.36	0.22	0.41	1.71	3.45
WRD-19 68-90"	8.7	0.37	0.30	71	19	10	SL	17.6	26.0	0.12	0.6	0.3	0.16	19.8	†	†	1.11	2.06	0.37	0.10	0.18	1.88	2.93
WRD-20 0-6"	7.9	0.57	0.08	39	37	24	L	15.4	53.3	0.16	6.6	3.5	0.20	18.4	†	†	2.75	1.83	0.12	0.58	0.19	0.94	4.49
WRD-20 6-13"	7.8	0.56	0.10	41	29	30	CL	17.7	47.6	0.19	2.4	1.3	0.16	20.8	†	†	2.47	1.47	0.14	0.67	0.12	1.62	3.13
WRD-20 13-28"	8.1	0.27	0.14	69	21	10	SL	18.6	24.1	0.12	0.6	0.3	0.15	25.4	†	†	1.22	0.63	0.13	0.32	0.07	0.37	2.30
WRD-20 28-54"	8.0	0.32	0.07	79	14	7	LS	15.8	25.4	0.08	0.2	0.1	0.03	21.7	†	†	1.40	0.76	0.07	0.42	0.03	0.94	2.72
WRD-20 54-72"	8.1	0.27	0.23	45	29	26	L	13.9	38.5	0.16	1.1	0.6	0.22	24.3	†	†	1.18	0.87	0.24	0.21	0.53	1.23	2.51
WRD-20 72-96"	8.2	0.32	0.16	82	13	5	LS	17.6	28.3	0.08	0.3	0.2	0.02	16.5	†	†	0.97	1.23	0.16	0.28	0.29	0.28	2.51

Table C-1. Summary of laboratory analysis of soil samples for Coal Hollow soil survey, year 1.

Sample ID	pH (Sat Paste)	E.C. @25°C	SAR	Sand	Silt	Clay	USDA Texture Class[1]	Very Fine Sand	Saturation Percent	Available Water Capacity[2]	Organic Matter	Organic Carbon (calculated)[3]	Erodibility Factor (K-Factor)[4]	$CaCO_3$	Boron (soluble)	Se (Hot H_2O sol)	Calcium, soluble (Sat. Paste)	Magnesium, soluble (Sat. Paste)	Sodium, soluble (Sat. Paste)	Potassium, soluble (Sat. Paste)	Nitrogen-Nitrate	Phosphorus	Alkalinity
	units	dS/m	unitless	%	%	%		%	%	in/in	%	%	unitless	%	mg/Kg	mg/Kg	meq/L	meq/L	meq/L	meq/L	mg/Kg	mg/Kg	meq/L
WRD-21 0-8"	8.4	0.46	0.19	61	11	28	SCL	18.6	30.6	0.17	2.0	1.1	0.16	21.2	†	†	2.94	0.74	0.26	0.48	2.30	7.11	3.76
WRD-21 8-18"	8.1	0.66	0.17	59	11	30	SCL	47.0	46.0	0.17	3.2	1.7	0.15	29.8	†	†	4.12	1.78	0.29	0.20	0.75	0.87	4.08
WRD-21 18-36"	8.4	0.49	0.22	68	18	14	SL	18.2	30.5	0.12	1.2	0.6	0.14	20.3	†	†	2.64	1.61	0.33	0.10	0.26	2.48	2.72
WRD-21 36-50"	8.7	0.48	0.24	67	25	8	SL	14.2	28.6	0.12	0.9	0.5	0.20	21.6	†	†	2.71	1.62	0.36	0.15	0.35	0.79	3.34
WRD-21 50-62"	8.7	0.37	0.25	69	23	8	SL	14.8	27.9	0.12	1.0	0.5	0.18	16.8	†	†	1.91	1.24	0.32	0.12	0.46	2.66	2.51
WRD-21 62-96"	8.7	0.32	0.25	68	20	12	SL	23.7	26.7	0.12	0.7	0.4	0.06	20.7	†	†	1.34	1.60	0.30	0.09	0.17	1.07	2.51
WRD-22 0-6"	7.7	0.40	0.07	63	23	14	SL	25.0	36.6	0.12	1.8	0.9	0.26	20.2	†	†	2.16	0.88	0.08	0.35	1.94	4.52	3.13
WRD-22 6-15"	7.7	0.34	0.13	19	42	39	SiCL	7.0	48.0	0.18	3.7	1.9	0.30	23.8	†	†	1.85	0.83	0.16	0.19	0.76	9.01	2.72
WRD-22 15-28"	8.0	0.29	0.11	47	27	26	SCL	5.6	34.9	0.17	1.2	0.6	0.22	18.9	†	†	1.64	0.80	0.13	0.18	0.80	0.31	2.72
WRD-22 28-48"	8.0	0.25	0.14	65	21	14	SL	13.7	28.0	0.12	0.8	0.4	0.16	17.9	†	†	1.18	0.64	0.13	0.16	0.29	0.13	2.30
WRD-22 48-60"	8.0	0.27	0.10	65	21	14	SL	14.5	30.1	0.12	1.0	0.5	0.16	17.5	†	†	1.34	0.67	0.10	0.16	0.35	0.07	2.30
WRD-22 60-84"	8.2	0.30	0.09	74	18	8	SL	21.8	27.3	0.12	0.5	0.3	0.15	21.0	†	†	1.08	0.96	0.09	0.25	0.57	0.28	2.51
WRD-23 0-6"	7.7	0.60	0.05	31	38	31	CL	12.5	48.4	0.19	4.9	2.6	0.22	21.4	†	†	3.20	1.35	0.07	0.53	1.43	8.26	4.60
WRD-23 6-12"	7.9	0.38	0.13	36	33	31	CL	14.7	44.6	0.19	2.9	1.5	0.19	23.6	†	†	1.97	0.91	0.15	0.30	0.31	1.74	3.34
WRD-23 12-22"	7.9	0.35	0.12	38	34	28	CL	12.5	41.0	0.19	1.8	0.9	0.23	25.6	†	†	1.76	0.92	0.14	0.16	0.29	1.09	3.24
WRD-23 22-40"	8.0	0.24	0.16	51	30	19	L	17.2	33.2	0.16	0.7	0.4	0.22	29.8	†	†	1.12	0.77	0.15	0.06	0.21	1.03	2.30
WRD-23 40-62"	8.2	0.23	0.24	31	44	25	L	20.0	38.6	0.16	0.6	0.3	0.31	35.3	†	†	1.01	0.94	0.24	0.06	0.89	0.28	1.99
WRD-23 62-80"	8.1	0.44	0.48	18	41	41	SiC	14.0	43.9	0.20	0.8	0.4	0.31	30.4	†	†	1.61	1.95	0.64	0.14	0.35	1.65	2.09
DAH-24 0-5"	7.6	0.26	0.53	34	19	47	C	33.0	73.6	0.19	1.3	0.7	0.17	2.9	0.23	<0.02	1.25	0.58	0.50	0.09	4.14	2.25	1.57
DAH-24 5-17"	7.7	0.43	1.32	42	14	44	C	41.4	84.1	0.19	1.2	0.6	0.19	8.7	0.42	<0.02	1.62	0.65	1.40	0.09	0.19	0.16	1.88
DAH-24 17-32"	8.1	7.79	10.0	38	17	45	C	36.5	91.2	0.19	0.9	0.5	0.20	5.0	0.73	<0.02	18.7	30.7	49.9	0.54	0.09	<0.01	1.88
DAH-25 0-5"	6.4	0.21	0.55	32	28	40	C	21.1	58.5	0.19	3.3	1.7	0.25	1.7	†	†	0.98	0.62	0.49	0.08	3.85	6.80	0.52
DAH-25 5-13"	7.0	0.33	0.21	30	23	47	C	21.6	80.6	0.19	2.4	1.3	0.20	30.3	†	†	1.90	0.68	0.23	0.13	0.20	0.19	1.36
DAH-25 13-20"	7.2	0.28	0.23	30	24	46	C	20.7	73.5	0.19	2.1	1.1	0.19	39.4	†	†	1.44	0.44	0.22	0.12	0.29	1.32	1.88
DAH-25 20-32"	7.7	0.26	0.25	48	19	33	SCL	37.6	54.1	0.17	1.2	0.6	0.19	3.8	†	†	1.34	0.52	0.25	0.09	0.15	0.43	1.88
SP-28 0-8"	7.7	0.47	0.65	7	38	55	C		60.2	0.12	2.5	1.3		18.9	†	†	2.8	2.3	1.0	1.00	3.9	<5	†
SP-28 8-24"	8.0	0.48	1.50	9	34	57	C		65.4	0.12	1.4	0.7		17.6	†	†	1.8	2.4	2.2	0.77	1.6	<5	†
SP-28 24-48	8.1	5.94	5.50	4	36	60	C		72.6	0.11	1.0	0.5		18.5	†	†	13	42	29	0.77	2.8	<5	†
SP-35 0-9"	7.7	0.56	0.11	12	44	44	SiC		55.4	0.14	4.3	2.3		16.7	†	†	4.0	2.7	0.20	1.80	5.1	45	†
SP-35 9-19"	7.9	0.44	0.12	16	40	44	SiC		54.6	0.14	1.8	0.9		17.4	†	†	2.4	2.3	0.19	1.60	1.1	25	†
SP-35 19-30"	8.2	0.40	0.22	51	27	22	SCL		31.5	0.12	1.2	0.6		15.0	†	†	1.5	1.8	0.28	1.10	1.1	5	†
SP-35 30-45"	8.4	0.37	0.22	59	27	14	SL		30.5	0.10	0.8	0.4		17.7	†	†	0.98	1.4	0.23	0.70	1.1	<5	†
SP-35 45-70"	8.8	0.46	0.37	42	39	19	L		37.3	0.14	0.9	0.5		18.0	†	†	0.73	1.4	0.37	1.30	1.0	<5	†
SP-37 0-6"	7.8	0.51	0.08	38	30	32	CL		46.7	0.13	4.0	2.1		4.5	†	†	5.1	2.1	0.16	0.83	3.9	10	†
SP-37 6-12"	7.7	0.44	0.09	48	23	29	SCL		45.4	0.12	2.9	1.5		7.5	†	†	4.2	1.8	0.16	0.71	6.5	<5	†
SP-37 12-24"	8.0	0.29	0.13	56	24	20	SL-SCL		38.7	0.11	3.0	1.6		11.1	†	†	2.3	1.4	0.18	0.35	1.9	<5	†
SP-37 24-38"	8.2	0.25	0.14	71	18	11	SL		35.2	0.08	0.7	0.4		15.3	†	†	1.6	1.7	0.18	0.10	2.0	<5	†
SP-37 38-58"	8.2	0.27	0.34	73	18	9	SL		30.3	0.07	0.5	0.2		17.3	†	†	1.5	2.0	0.44	0.07	1.5	<5	†
SP-38 0-6"	8.0	0.47	0.09	12	44	44	SiC		69.9	0.14	6.2	3.3		24.7	†	†	3.2	3.4	0.17	0.74	2.7	8	†
SP-38 6-12"	8.3	0.33	0.15	2	47	51	SiC		81.8	0.13	3.4	1.8		17.8	†	†	1.5	3.4	0.23	0.42	1.6	<5	†
SP-38 12-20"	8.5	0.49	0.39	11	46	43	SiC		71.1	0.15	1.9	1.0		28.3	†	†	1.3	5.2	0.70	0.23	1.4	<5	†
SP-38 20-24"	8.3	0.57	0.44	10	42	48	SiC		71.5	0.14	1.1	0.6		44.5	†	†	1.8	5.6	0.84	0.21	3.0	<5	†

Table C-1. Summary of laboratory analysis of soil samples for Coal Hollow soil survey, year 1.

Sample ID	pH (Sat Paste)	E.C. @25°C	SAR	Sand	Silt	Clay	USDA Texture Class[1]	Very Fine Sand	Saturation Percent	Available Water Capacity[2]	Organic Matter	Organic Carbon (calculated)[3]	Erodibility Factor (K-Factor)[4]	$CaCO_3$	Boron (soluble)	Se (Hot H_2O sol)	Calcium, soluble (Sat. Paste)	Magnesium, soluble (Sat. Paste)	Sodium, soluble (Sat. Paste)	Potassium, soluble (Sat. Paste)	Nitrogen-Nitrate	Phospohorus	Alkalinity
	units	dS/m	unitless	%	%	%		%	%	in/in	%	%	unitless	%	mg/Kg	mg/Kg	meq/L	meq/L	meq/L	meq/L	mg/Kg	mg/Kg	meq/L
SP-39 0-6"	7.8	0.32	0.19	36	33	31	CL		43.7	0.14	2.3	1.2		8.5	†	†	3.1	1.2	0.27	0.45	2.1	6	†
SP-39 6-12"	7.8	0.38	0.21	38	30	32	CL		41.9	0.13	2.4	1.3		7.9	†	†	3.9	1.5	0.34	0.45	1.7	<5	†
SP-39 12-24"	8.0	0.23	0.24	62	20	18	SL		35.3	0.09	1.2	0.6		13.9	†	†	2.2	0.98	0.30	0.17	1.2	<5	†
SP-39 24-36"	7.9	0.20	0.17	75	15	10	SL		32.3	0.06	0.5	0.3		14.4	†	†	1.7	1.0	0.20	0.09	1.2	<5	†
SP-40 0-6"	8.0	0.53	0.47	10	42	48	SiC		85.8	0.13	5.7	3.0		14.4	†	†	2.3	4.6	0.86	1.10	1.5	11	†
SP-40 6-12"	8.4	1.81	1.01	5	44	51	SiC		88.4	0.13	2.9	1.5		18.0	†	†	3.1	20	3.6	0.50	1.1	6	†
SP-40 12-22"	9.0	1.29	1.46	21	44	35	CL		76.1	0.15	1.4	0.7		19.9	†	†	0.51	14	4.1	0.26	1.1	6	†
SP-41 0-6"	8.0	0.46	0.12	46	26	28	SCL		51.3	0.12	3.3	1.7		14.5	†	†	3.9	1.7	0.20	1.10	1.4	8	†
SP-41 6-12"	8.0	0.53	0.15	25	34	41	C		54.9	0.14	3.4	1.8		12.1	†	†	4.4	2.7	0.27	1.50	4.7	6	†
SP-41 12-36"	8.1	0.22	0.15	6	44	50	SiC		69.0	0.13	1.7	0.9		16.6	†	†	1.4	1.6	0.19	0.69	1.1	<5	†
SP-41 36-64"	8.2	0.43	0.40	12	52	36	SiCL		63.9	0.16	1.0	0.5		18.5	†	†	1.4	3.9	0.65	0.41	1.1	<5	†
SP-41 64-80"	8.8	0.66	1.63	54	31	15	SL		31.5	0.12	0.6	0.3		17.3	†	†	0.67	5.7	2.9	0.15	1.2	<5	†
SP-42 0-9"	7.9	0.33	0.10	50	30	20	L		42.8	0.12	2.4	1.3		18.0	†	†	3.7	0.97	0.16	0.42	3.9	5	†
SP-42 9-24"	8.1	0.28	0.19	8	49	43	SiC		60.9	0.15	2.6	1.4		18.5	†	†	2.5	1.3	0.26	0.81	3.5	<5	†
SP-42 24-36"	8.3	0.32	0.20	52	27	21	SCL		44.7	0.12	1.7	0.9		16.0	†	†	2.3	2.9	0.31	0.36	1.5	<5	†
SP-42 36-48"	8.6	0.28	1.14	44	34	22	L		31.4	0.13	0.9	0.5		18.2	†	†	0.94	1.8	1.3	0.43	1.4	<5	†
SP-48 0-3"	7.7	0.52	0.92	7	33	60	C	4.8	85.6	0.10	3.5	1.8	0.22	4.5	†	<0.001	3.60	1.30	1.40	0.19	2.60	10	†
SP-48 3-12"	8.0	0.57	4.68	6	30	64	C	5.3	95.4	0.16	1.9	1.0	0.21	7.2	†	<0.001	1.20	0.55	4.40	0.06	1.10	8	†
SP-48 12-30"	8.2	2.63	11.20	12	28	60	C	11.0	106.0	0.10	1.7	0.9	0.23	7.5	†	<0.001	3.00	1.80	17.00	0.13	1.30	7	†
SP-48 30-48"	8.1	4.65	12.70	10	28	62	C	9.5	81.0	0.11	1.6	0.8	0.23	5.2	†	<0.001	6.50	4.10	29.00	0.23	<1.0	7	†
SP-48 48-84"	7.9	6.20	10.80	7	30	63	C	6.5	87.5	0.11	1.5	0.8	0.22	4.0	†	<0.001	15.00	8.10	37.00	0.35	1.40	9	†
SP-49 0-3"	8.1	0.42	0.05	20	49	31	SiCL	4.8	58.0	0.11	2.0	1.1	0.05	17.8	†	†	2.90	1.50	0.07	0.31	<1.0	7	†
SP-49 3-10"	8.4	0.34	0.06	26	47	27	CL-L	5.3	55.5	0.12	2.3	1.2	0.09	17.7	†	†	2.00	1.50	0.08	0.34	<1.0	8	†
SP-50 0-4"	8.4	0.20	0.13	5	37	58	C	11.0	75.4	0.12	1.4	0.7	0.08	18.5	†	†	1.60	0.36	0.13	0.22	1.40	6	†
SP-50 4-11"	8.1	0.27	0.29	<1.0	39	61	C	9.5	66.2	0.12	1.3	0.7	0.14	18.7	†	†	1.90	0.53	0.32	0.24	1.40	8	†
SP-50 11-19"	8.4	0.30	0.52	6	39	55	C	6.5	72.0	0.12	1.4	0.7	0.14	18.5	†	†	1.90	0.59	0.57	0.18	1.30	9	†

1. Usda soil textures: sand (S); loamy sand (LS); sandy loam (SL); loam (L); clay loam (CL); sandy clay loam (SCL); silty clay loam (SiCL); silty clay (SiC); clay (C).
2. Available water capacity calculated using using *Soil Water Characteristics Model* (Saxton et al., 1986).
3. Organic carbon calculated from percent organic matter.
4.Erodibility factor (K) calculated from lab and field data

Suitability Rating (Table 4. Utah DOGM, 2005): Good Fair Poor Unacceptable

Undable to calculate because referenced calcualtion in Table 7, Footnote # 3 above is invalid for soils with percent silt + fine sand greater than 70 percent.

Profile 1. A Family: fine, mixed, superactive, mesic Aridic Calciustept, photo not available.

Profile 2. D Family: fine, mixed, superactive, mesic Aridic Calciustept.

Profile 3. M Family: fine, mixed, superactive, mesic Aridic Calciustept.

Profile 4. Calendar Family: fine, mixed, superactive, mesic Aridic Haplustepts.

Profile 5. Jonale Family: fine-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 5 Area. Surrounding area.

Profile 6. Cibeque Family: fine-loamy, mixed, superactive, mesic Aridic Calciustept.

Profile 6 Area. Surrounding area.

Profile 7. D Family: fine, mixed, superactive, mesic Aridic Calciustoll.

Profile 9A. Graystone; coarse-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 8. Jonale Family: fine-loamy, mixed, superactive, mesic Aridic Calciustoll.

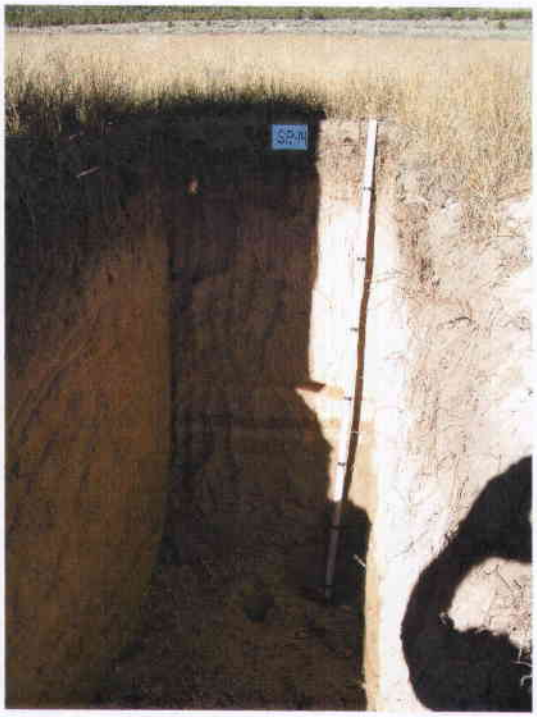
Profile 9B. Cookcan: coarse-loamy, mixed, superactive, frigid Typic Calciaquoll.

Profile 10. Jonale Family: fine-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 12. M Family: fine, mixed, superactive, mesic Aridic Calciustept.

Profile 11. Graystone: coarse-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 13. Cibeque Family: fine-loamy, mixed, superactive, mesic Aridic Calciustept.



Profile 14. I Family: fine-loamy, mixed, superactive, frigid Aquic Calciustept.

Profile 16. Jonale Family: fine-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 15. Graystone: coarse-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 17. Jonale Family: fine-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 18A. Alamosa: fine-loamy, mixed, superactive, frigid Typic Argiaquoll.

Profile 19. Wapiti Family: fine-loamy, mixed, superactive, mesic Calcidic Argiustoll.

Profile 18B. Jonale Family: fine-loamy, mixed, superactive, frigid Aridic Calciustoll.

Profile 20. Graystone: coarse-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 21. Snilloc: coarse-loamy, mixed, superactive, mesic Aridic Calciustept.

Profile 23. Jonale Family: fine-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 22 Brumley: fine-loamy, mixed, superactive, mesic Calcidic Haplustalf.

Profile 24. Calendar Family: fine, mixed, superactive, mesic Aridic Haplustepts.

Profile 25. M family: fine, mixed, superactive, mesic Aridic Calciustept.

Profile 26. N Family: fine, mixed, superactive, frigid Aquic Calciustoll.

Profile 27 A Family: fine, mixed, superactive, mesic Aridic Calciustept, photo not available.

Profile 28. A Family: fine, mixed, superactive, mesic Aridic Calciustept.

Profile 29. D Family: fine, mixed, superactive, mesic Aridic Calciustoll, photo not available.

Inter-Mountain Laboratories, Inc.

Soil Analysis Report
Talon Resources, Inc.
PO Box 1230
Huntington, UT 84528

Report ID: S0610051

Date: 11/14/2006
Work Order: S0610051

Project: Talon Resources Soil
Date Received: 10/3/2006

Lab ID	Sample ID	Depths In.	pH s.u.	Saturation %	Electrical Conductivity dS/m	Organic Matter %	Calcium meq/L	Magnesium meq/L	Sodium meq/L	Potassium meq/L	SAR
S0610051-001	LOF-2	0-7	7.6	43.3	0.47	2.7	4.93	1.26	0.29	0.65	0.16
S0610051-002	LOF-2	7-12	7.7	44.8	0.31	2.4	2.07	0.68	0.22	0.19	0.19
S0610051-003	LOF-2	12-24	7.8	60.2	0.25	1.8	1.29	0.57	0.59	0.09	0.62
S0610051-004	LOF-2	24-48	8.0	67.7	0.32	1.7	0.77	0.53	1.71	0.07	2.12
S0610051-005	LOF-2	48-72	7.8	66.7	7.38	1.1	23.8	24.9	35.8	0.50	7.27
S0610051-006	LOF-2	72-96	7.8	62.9	7.17	1.1	21.6	26.3	37.9	0.47	7.75
S0610051-007	LOF-4	0-5	7.8	52.6	0.62	3.5	4.54	1.04	0.49	0.26	0.29
S0610051-008	LOF-4	5-10	7.7	53.0	0.31	2.8	2.28	0.63	0.32	0.08	0.26
S0610051-009	LOF-4	10-19	7.8	53.9	0.33	2.1	2.00	0.78	0.71	0.08	0.60
S0610051-010	LOF-4	19-31	7.9	53.6	0.29	1.8	1.12	0.52	1.05	0.06	1.16
S0610051-011	LOF-4	31-50	7.8	59.8	4.06	1.1	16.3	12.4	20.5	0.51	5.43
S0610051-012	RDV-7	0-6	7.5	62.9	0.58	4.4	3.93	1.17	0.20	0.28	0.13
S0610051-013	RDV-7	6-12	7.6	57.1	0.36	3.0	2.37	0.78	0.27	0.09	0.22
S0610051-014	RDV-7	12-24	8.0	55.3	0.24	1.8	0.82	0.44	1.04	0.04	1.30
S0610051-015	RDV-7	24-60	8.0	63.8	1.40	1.4	2.65	2.00	7.90	0.11	5.18
S0610051-016	1YR-9	0-6	8.0	63.0	0.62	6.1	2.19	3.21	0.12	0.74	0.07
S0610051-017	1YR-9	6-14	8.2	42.4	0.34	3.4	1.17	1.67	0.25	0.30	0.21
S0610051-018	1YR-9	14-28	8.5	35.7	0.88	0.9	1.16	5.71	1.06	0.72	0.57
S0610051-019	1YR-9	28-48	8.3	31.0	0.76	0.4	1.49	4.64	1.23	0.37	0.70
S0610051-020	1YR-10	0-7	7.8	46.4	0.46	3.9	3.39	0.89	0.08	0.30	0.05

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
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 Barten
Karen Barten, Soil Lab Supervisor

Inter-Mountain Laboratories, Inc.

Soil Analysis Report
Talon Resources, Inc.
PO Box 1230
Huntington, UT 84528

Report ID: S[illegible]51001

Date: 11/14/2006
Work Order: S0610051

Project: Talon Resources Soil
Date Received: 10/3/2006

Lab ID	Sample ID	Depths In.	Sand %	Silt %	Clay %	Texture	Very Fine Sand %	Boron ppm	Nitrogen Nitrate ppm	Phosphorus ppm	Selenium ppm
S0610051-001	LOF-2	0-7	32.0	37.0	31.0	Clay Loam	14.9	0.27	1.58	9.55	<0.02
S0610051-002	LOF-2	7-12	34.0	34.0	32.0	Clay Loam	22.3	0.24	0.55	0.40	<0.02
S0610051-003	LOF-2	12-24	14.0	40.0	46.0	Silty Clay	12.4	0.30	0.31	<0.01	<0.02
S0610051-004	LOF-2	24-48	22.0	37.0	41.0	Clay	20.2	0.45	0.88	0.04	<0.02
S0610051-005	LOF-2	48-72	14.0	43.0	43.0	Silty Clay	11.3	1.08	1.07	0.40	0.09
S0610051-006	LOF-2	72-96	18.0	35.0	47.0	Clay	13.0	0.61	13.1	0.76	0.12
S0610051-007	LOF-4	0-5	12.0	46.0	42.0	Silty Clay	9.1		4.16	0.79	
S0610051-008	LOF-4	5-10	14.0	46.0	40.0	Silty Clay	11.0		0.66	9.76	
S0610051-009	LOF-4	10-19	12.0	43.0	45.0	Silty Clay	10.5		0.53	0.64	
S0610051-010	LOF-4	19-31	13.0	43.0	44.0	Silty Clay	11.3		0.40	0.67	
S0610051-011	LOF-4	31-50	19.0	39.0	42.0	Clay	16.3		1.06	0.43	
S0610051-012	RDV-7	0-6	26.0	38.0	36.0	Clay Loam	20.4		2.19	12.5	
S0610051-013	RDV-7	6-12	18.0	38.0	44.0	Clay	11.9		0.28	7.78	
S0610051-014	RDV-7	12-24	16.0	37.0	47.0	Clay	13.6		0.40	0.73	
S0610051-015	RDV-7	24-60	22.0	34.0	44.0	Clay	20.8		0.30	0.46	
S0610051-016	1YR-9	0-6	44.0	32.0	24.0	Loam	14.5		1.73	1.44	
S0610051-017	1YR-9	6-14	52.0	25.0	23.0	Sandy Clay Loam	18.1		0.91	<0.01	
S0610051-018	1YR-9	14-28	64.0	22.0	14.0	Sandy Loam	9.7		0.50	<0.01	
S0610051-019	1YR-9	28-48	54.0	30.0	16.0	Sandy Loam	16.0		0.48	<0.01	
S0610051-020	1YR-10	0-7	36.0	38.0	26.0	Loam	17.9	0.29	3.15	7.45	<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 Barten
Karen Barten, Soil Lab Supervisor

Inter·Mountain Laboratories, Inc.

Soil Analysis Report
Talon Resources, Inc.
PO Box 1230
Huntington, UT 84528

Report ID: S06[illegible].001

Date: 11/14/2006
Work Order: S0610051

Project: Talon Resources Soil
Date Received: 10/3/2006

Lab ID	Sample ID	Depths In.	Sand %	Silt %	Clay %	Texture	Very Fine Sand %	Boron ppm	Nitrogen Nitrate ppm	Phosphorus ppm	Selenium ppm
S0610051-021	1YR-10	7-13	26.0	48.0	26.0	Loam	12.3	0.31	0.46	0.67	<0.02
S0610051-022	1YR-10	13-26	14.0	52.0	34.0	Silty Clay Loam	9.4	0.20	0.44	0.37	<0.02
S0610051-023	1YR-10	26-44	30.0	36.0	34.0	Clay Loam	29.1	0.37	0.15	<0.01	<0.02
S0610051-024	1YR-10	44-68	14.0	54.0	32.0	Silty Clay Loam	7.0	0.24	0.19	<0.01	<0.02
S0610051-025	1YR-10	68-84	60.0	30.0	10.0	Sandy Loam	24.5	0.07	0.32	0.67	<0.02
S0610051-026	1YR-12	0-5	32.0	40.0	28.0	Clay Loam	28.9		0.87	7.33	
S0610051-027	1YR-12	5-10	29.0	39.0	32.0	Clay Loam	22.2		0.67	0.22	
S0610051-028	1YR-12	10-26	16.0	40.0	44.0	Silty Clay	13.8		0.94	<0.01	
S0610051-029	1YR-12	26-44	46.0	19.0	35.0	Sandy Clay	45.0		0.20	<0.01	
S0610051-030	SP-14	0-6	8.0	48.0	44.0	Silty Clay	5.3		0.38	8.92	
S0610051-031	SP-14	6-13	8.0	48.0	44.0	Silty Clay	5.7		0.58	2.94	
S0610051-032	SP-14	13-28	23.0	50.0	27.0	Clay Loam	21.4		0.17	4.40	
S0610051-033	SP-14	28-48	40.0	43.0	17.0	Loam	33.6		0.21	2.67	
S0610051-034	SP-14	48-70	21.0	40.0	39.0	Clay Loam	5.6		0.41	3.54	
S0610051-045	SP-14	70-90	21.0	47.0	32.0	Clay Loam	17.7		0.64	0.31	
S0610051-036	DAH-24	0-5	34.0	19.0	47.0	Clay	33.0	0.23	4.14	2.25	<0.02
S0610051-037	DAH-24	5-17	42.0	14.0	44.0	Clay	41.4	0.42	0.19	0.16	<0.02
S0610051-038	DAH-24	17-32	38.0	17.0	45.0	Clay	36.5	0.73	0.09	<0.01	<0.02
S0610051-040	DAH-25	0-5	32.0	28.0	40.0	Clay	21.1		3.85	6.80	
S0610051-041	DAH-25	5-13	30.0	23.0	47.0	Clay	21.6		0.20	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 Barten
Karen Barten, Soil Lab Supervisor

Inter-Mountain Laboratories, Inc.

Soil Analysis Report
Talon Resources, Inc.
PO Box 1230
Huntington, UT 84528

Report ID: S06[illegible].001

Date: 11/13/2006
Work Order: S0609512

Project: Talon Resources Soil
Date Received: 9/28/2006

Lab ID	Sample ID	Depths In.	CO3 %	Alkalinity PE meq/L
S0609512-001	LOF-1	0-6	22.6	3.76
S0609512-002	LOF-1	6-12	27.1	3.45
S0609512-003	LOF-1	12-24	26.6	2.72
S0609512-004	LOF-1	24-42	27.1	4.08
S0609512-005	LOF-1	42-60	28.3	1.67
S0609512-006	LOF-3	0-4	20.3	5.64
S0609512-007	LOF-3	4-11	20.4	3.55
S0609512-008	LOF-3	11-19	24.2	2.51
S0609512-009	LOF-3	19-33	27.2	3.87
S0609512-011	RDV-5	0-5	25.7	3.97
S0609512-012	RDV-5	5-10	26.4	4.08
S0609512-013	RDV-5	10-25	31.1	2.72
S0609512-014	RDV-5	25-48	28.0	4.91
S0609512-015	RDV-5	48-60	26.5	6.06
S0609512-016	RDV-6	0-6	18.4	3.97
S0609512-017	RDV-6	6-12	20.6	2.51
S0609512-018	RDV-6	12-24	28.9	4.18
S0609512-019	RDV-6	24-34	29.2	2.93
S0609512-020	RDV-6	34-60	25.9	5.96
S0609512-021	1YR-8	0-8	5.1	5.54

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 Barten
Karen Barten, Soil Lab Supervisor

Inter·Mountain Laboratories, Inc.

Soil Analysis Report
Talon Resources, Inc.
PO Box 1230
Huntington, UT 84528

Report ID: S[illegible]12001

Date: 11/13/2006
Work Order: S0609512

Project: Talon Resources Soil
Date Received: 9/28/2006

Lab ID	Sample ID	Depths In.	Sand %	Silt %	Clay %	Texture	Very Fine Sand %	Boron ppm	Nitrogen Nitrate ppm	Phosphorus ppm	Selenium ppm
S0609512-022	1YR-8	8-14	38.0	32.0	30.0	Clay Loam	17.2		0.05	0.07	
S0609512-023	1YR-8	14-22	48.0	30.0	22.0	Loam	19.5		0.17	0.21	
S0609512-024	1YR-8	22-45	42.0	42.0	16.0	Loam	23.9		0.50	2.51	
S0609512-025	1YR-8	45-65	79.0	13.0	8.0	Loamy Sand	19.8		0.27	0.18	
S0609512-026	1YR-8	65-85	80.0	12.0	8.0	Loamy Sand	17.9		0.20	0.10	
S0609512-027	1YR-9A	0-12	60.0	32.0	8.0	Sandy Loam	26.6		4.23	10.0	
S0609512-028	1YR-9A	12-24	68.0	22.0	10.0	Sandy Loam	22.2		0.21	2.02	
S0609512-029	1YR-9A	24-42	68.0	22.0	10.0	Sandy Loam	20.4		0.13	2.22	
S0609512-030	1YR-9A	42-70	69.0	21.0	10.0	Sandy Loam	26.7		0.26	1.88	
S0609512-031	1YR-9A	70-100	30.0	31.0	39.0	Clay Loam	27.3		0.29	0.82	
S0609512-032	1YR-11	0-5	72.0	19.0	9.0	Sandy Loam	19.9		1.58	8.21	
S0609512-033	1YR-11	5-16	69.0	17.0	14.0	Sandy Loam	20.0		0.13	0.82	
S0609512-034	1YR-11	16-32	72.0	18.0	10.0	Sandy Loam	16.1		0.20	1.53	
S0609512-035	1YR-11	32-48	79.0	13.0	8.0	Loamy Sand	17.1		0.23	0.44	
S0609512-036	1YR-11	48-72	78.0	14.0	8.0	Loamy Sand	18.4		0.12	2.20	
S0609512-037	1YR-11	72-90	89.0	7.0	4.0	Sand	14.1		0.10	4.93	
S0609512-038	SP-13	0-6	59.0	23.0	18.0	Sandy Loam	15.8		3.78	39.5	
S0609512-039	SP-13	6-12	23.0	51.0	26.0	Silt Loam	12.7		0.18	3.83	
S0609512-040	SP-13	12-24	14.0	44.0	42.0	Silty Clay	9.1		0.50	0.70	
S0609512-041	SP-13	24-48	22.0	46.0	32.0	Clay Loam	9.5		0.46	0.44	

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 Potentia
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Barten
Karen Barten, Soil Lab Supervisor

Inter-Mountain Laboratories, Inc.

Soil Analysis Report
Talon Resources, Inc.
PO Box 1230
Huntington, UT 84528

Report ID: S[illegible]12001

Date: 11/13/2006
Work Order: S0609512

Project: Talon Resources Soil
Date Received: 9/28/2006

Lab ID	Sample ID	Depths In.	CO3 %	Alkalinity PE meq/L
S0609512-022	1YR-8	8-14	16.3	2.93
S0609512-023	1YR-8	14-22	27.3	2.30
S0609512-024	1YR-8	22-45	30.8	3.55
S0609512-025	1YR-8	45-65	19.3	3.66
S0609512-026	1YR-8	65-85	20.4	4.18
S0609512-027	1YR-9A	0-12	26.1	6.90
S0609512-028	1YR-9A	12-24	22.0	7.94
S0609512-029	1YR-9A	24-42	23.6	10.6
S0609512-030	1YR-9A	42-70	23.5	5.22
S0609512-031	1YR-9A	70-100	9.8	2.82
S0609512-032	1YR-11	0-5	1.4	3.76
S0609512-033	1YR-11	5-16	4.2	3.55
S0609512-034	1YR-11	16-32	14.4	3.13
S0609512-035	1YR-11	32-48	19.6	2.93
S0609512-036	1YR-11	48-72	21.7	2.82
S0609512-037	1YR-11	72-90	18.2	2.19
S0609512-038	SP-13	0-6	19.7	5.64
S0609512-039	SP-13	6-12	27.9	3.87
S0609512-040	SP-13	12-24	26.9	3.87
S0609512-041	SP-13	24-48	32.2	3.55

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 Potentia
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Barten
Karen Barten, Soil Lab Supervisor

Inter-Mountain Laboratories, Inc.

Soil Analysis Report

Talon Resources, Inc.

PO Box 1230

Huntington, UT 84528

Report ID: S[illegible] 2001

Date: 11/13/2006

Work Order: S0609512

Project: Talon Resources Soil

Date Received: 9/28/2006

Lab ID	Sample ID	Depths In.	pH s.u.	Saturation %	Electrical Conductivity dS/m	Organic Matter %	Calcium meq/L	Magnesium meq/L	Sodium meq/L	Potassium meq/L	SAR
S0609512-042	SP-13	48-60	8.8	46.1	0.31	1.8	0.53	3.00	0.67	0.10	0.51
S0609512-043	SP-13	60-72	8.9	35.6	1.46	1.2	1.64	8.30	4.90	0.14	2.20
S0609512-044	SP-13	72-84	8.7	33.5	2.20	0.5	2.07	15.5	7.00	0.20	2.36
S0609512-045	SP-16	0-8	8.3	64.5	0.58	4.8	3.08	1.84	0.49	0.42	0.31
S0609512-046	SP-16	8-18	8.2	61.9	0.60	1.9	2.00	2.77	0.39	0.28	0.25
S0609512-047	SP-16	18-36	8.7	50.6	0.45	0.6	0.68	3.12	0.53	0.19	0.38
S0609512-048	SP-16	36-56	9.0	52.2	0.34	0.6	0.45	3.38	0.77	0.14	0.56
S0609512-049	SP-16	56-68	8.9	36.3	0.60	0.3	0.52	4.30	1.21	0.16	0.78
S0609512-050	SP-16	68-96	8.9	55.3	0.53	0.6	1.00	3.49	1.21	0.18	0.81
S0609512-051	WRD-18	0-9	8.2	43.4	0.35	3.6	4.56	1.75	0.31	0.65	0.18
S0609512-052	WRD-18	9-19	8.3	41.3	0.61	1.8	3.45	1.56	0.27	0.80	0.17
S0609512-053	WRD-18	19-34	8.5	35.8	0.52	1.2	2.41	2.17	0.31	0.18	0.21
S0609512-054	WRD-18	34-54	8.7	45.5	0.38	1.4	1.63	1.70	0.35	0.12	0.27
S0609512-055	WRD-18	54-72	8.6	49.6	0.57	1.1	1.92	2.53	0.46	0.18	0.31
S0609512-056	WRD-18	72-96	8.6	34.7	1.46	0.5	2.97	11.0	1.48	0.19	0.56
S0609512-057	WRD-19	0-6	8.0	48.5	0.91	4.9	4.87	2.07	0.28	1.72	0.15
S0609512-058	WRD-19	6-12	8.2	44.1	0.65	3.0	3.43	1.45	0.30	1.14	0.20
S0609512-059	WRD-19	12-24	8.3	40.8	0.53	2.0	2.85	1.21	0.32	0.87	0.23
S0609512-060	WRD-19	24-37	8.5	40.8	0.55	1.9	2.71	1.11	0.26	0.76	0.19
S0609512-061	WRD-19	37-51	8.4	34.1	0.57	1.2	2.94	1.39	0.27	0.59	0.18

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 Barten

Karen Barten, Soil Lab Supervisor

Soil Analysis Report
Talon Resources, Inc.
PO Box 1230
Huntington, UT 84528

Report ID: S[illegible] 2001

Date: 11/13/2006
Work Order: S0609512

Project: Talon Resources Soil
Date Received: 9/28/2006

Lab ID	Sample ID	Depths In.	Sand %	Silt %	Clay %	Texture	Very Fine Sand %	Boron ppm	Nitrogen Nitrate ppm	Phosphorus ppm	Selenium ppm
S0609512-042	SP-13	48-60	33.0	39.0	28.0	Clay Loam	13.4		0.17	<0.01	
S0609512-043	SP-13	60-72	62.0	14.0	24.0	Sandy Clay Loam	19.2		0.23	0.99	
S0609512-044	SP-13	72-84	44.0	36.0	20.0	Loam	18.5		0.29	0.73	
S0609512-045	SP-16	0-8	19.0	45.0	36.0	Silty Clay Loam	15.1		1.19	18.3	
S0609512-046	SP-16	8-18	12.0	44.0	44.0	Silty Clay	10.8		0.21	4.70	
S0609512-047	SP-16	18-36	20.0	52.0	28.0	Clay Loam	16.2		0.24	6.45	
S0609512-048	SP-16	36-56	14.0	58.0	28.0	Silty Clay Loam	12.4		0.23	5.10	
S0609512-049	SP-16	56-68	50.0	36.0	14.0	Loam	21.6		0.30	2.83	
S0609512-050	SP-16	68-96	23.0	49.0	28.0	Clay Loam	17.0		0.24	1.25	
S0609512-051	WRD-18	0-9	34.0	40.0	26.0	Loam	11.4	0.39	3.96	18.6	<0.02
S0609512-052	WRD-18	9-19	50.0	30.0	20.0	Loam	16.2	0.25	0.31	2.89	<0.02
S0609512-053	WRD-18	19-34	44.0	38.0	18.0	Loam	21.0	0.18	0.09	5.50	<0.02
S0609512-054	WRD-18	34-54	21.0	47.0	32.0	Clay Loam	13.4	0.33	0.50	0.93	<0.02
S0609512-055	WRD-18	54-72	22.0	44.0	34.0	Clay Loam	11.8	0.29	0.10	1.19	<0.02
S0609512-056	WRD-18	72-96	48.0	32.0	20.0	Loam	21.2	0.19	0.45	0.21	<0.02
S0609512-057	WRD-19	0-6	34.0	42.0	24.0	Loam	16.5		2.77	12.9	
S0609512-058	WRD-19	6-12	32.0	36.0	32.0	Clay Loam	13.1		1.85	8.32	
S0609512-059	WRD-19	12-24	34.0	36.0	30.0	Clay Loam	15.8		0.67	1.99	
S0609512-060	WRD-19	24-37	49.0	29.0	22.0	Loam	24.5		0.35	0.99	
S0609512-061	WRD-19	37-51	60.0	26.0	14.0	Sandy Loam	24.2			1.53	

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 Barten
Karen Barten, Soil Lab Supervisor

Inter-Mountain Laboratories, Inc.

Soil Analysis Report
Talon Resources, Inc.
PO Box 1230
Huntington, UT 84528

Report ID: S[illegible].2001

Date: 11/13/2006
Work Order: S0609512

Project: Talon Resources Soil
Date Received: 9/28/2006

Lab ID	Sample ID	Depths In.	CO3 %	Alkalinity PE meq/L
S0609512-042	SP-13	48-60	29.2	1.67
S0609512-043	SP-13	60-72	20.6	7.00
S0609512-044	SP-13	72-84	28.7	3.03
S0609512-045	SP-16	0-8	9.6	4.81
S0609512-046	SP-16	8-18	24.5	3.55
S0609512-047	SP-16	18-36	38.8	4.18
S0609512-048	SP-16	36-56	40.1	3.66
S0609512-049	SP-16	56-68	28.1	4.08
S0609512-050	SP-16	68-96	31.0	4.81
S0609512-051	WRD-18	0-9	23.8	5.54
S0609512-052	WRD-18	9-19	20.3	4.60
S0609512-053	WRD-18	19-34	27.5	3.13
S0609512-054	WRD-18	34-54	29.0	2.61
S0609512-055	WRD-18	54-72	28.3	3.76
S0609512-056	WRD-18	72-96	23.1	8.99
S0609512-057	WRD-19	0-6	20.1	6.69
S0609512-058	WRD-19	6-12	17.4	4.39
S0609512-059	WRD-19	12-24	23.5	2.51
S0609512-060	WRD-19	24-37	24.6	3.13
S0609512-061	WRD-19	37-51	22.7	2.40

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 Barten
Karen Barten, Soil Lab Supervisor

Inter-Mountain Laboratories, Inc.

Soil Analysis Report

Talon Resources, Inc.

PO Box 1230

Huntington, UT 84528

Report ID: S[illegible]12001

Date: 11/13/2006

Work Order: S0609512

Project: Talon Resources Soil

Date Received: 9/28/2006

Lab ID	Sample ID	Depths In.	pH s.u.	Saturation %	Electrical Conductivity dS/m	Organic Matter %	Calcium meq/L	Magnesium meq/L	Sodium meq/L	Potassium meq/L	SAR
S0609512-062	WRD-19	51-68	8.5	29.1	0.48	0.8	2.07	1.87	0.36	0.22	0.26
S0609512-063	WRD-19	68-90	8.7	26.0	0.37	0.6	1.11	2.06	0.37	0.10	0.30
S0609512-064	WRD-21	0-8	8.4	30.6	0.46	2.0	2.94	0.74	0.26	0.48	0.19
S0609512-065	WRD-21	8-18	8.1	46.0	0.66	3.2	4.12	1.78	0.29	0.20	0.17
S0609512-066	WRD-21	18-36	8.4	30.5	0.49	1.2	2.64	1.61	0.33	0.10	0.22
S0609512-067	WRD-21	36-50	8.7	28.6	0.48	0.9	2.71	1.62	0.36	0.15	0.24
S0609512-068	WRD-21	50-62	8.7	27.9	0.37	1.0	1.91	1.24	0.32	0.12	0.25
S0609512-069	WRD-21	62-96	8.7	26.7	0.32	0.7	1.34	1.60	0.30	0.09	0.25

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 Potentia

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Barten

Karen Barten, Soil Lab Supervisor

Inter-Mountain Laboratories, Inc.

Soil Analysis Report

Talon Resources, Inc.

PO Box 1230

Huntington, UT 84528

Report ID: S[illegible]12001

Date: 11/13/2006

Work Order: S0609512

Project: Talon Resources Soil

Date Received: 9/28/2006

Lab ID	Sample ID	Depths In.	Sand %	Silt %	Clay %	Texture	Very Fine Sand %	Boron ppm	Nitrogen Nitrate ppm	Phosphorus ppm	Selenium ppm
S0609512-062	WRD-19	51-68	66.0	22.0	12.0	Sandy Loam	17.5		0.41	1.71	
S0609512-063	WRD-19	68-90	71.0	19.0	10.0	Sandy Loam	17.6		0.18	1.88	
S0609512-064	WRD-21	0-8	61.0	11.0	28.0	Sandy Clay Loam	18.6		2.30	7.11	
S0609512-065	WRD-21	8-18	59.0	11.0	30.0	Sandy Clay Loam	47.0		0.75	0.87	
S0609512-066	WRD-21	18-36	68.0	18.0	14.0	Sandy Loam	18.2		0.26	2.48	
S0609512-067	WRD-21	36-50	67.0	25.0	8.0	Sandy Loam	14.2		0.35	0.79	
S0609512-068	WRD-21	50-62	69.0	23.0	8.0	Sandy Loam	14.8		0.46	2.66	
S0609512-069	WRD-21	62-96	68.0	20.0	12.0	Sandy Loam	23.7		0.17	1.07	

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 Potentia

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Barten

Karen Barten, Soil Lab Supervisor

Inter-Mountain Laboratories, Inc.

Soil Analysis Report

Talon Resources, Inc.

PO Box 1230

Huntington, UT 84528

Report ID: [illegible]12001

Date: 11/13/2006

Work Order: S0609512

Project: Talon Resources Soil

Date Received: 9/28/2006

Lab ID	Sample ID	Depths In.	CO3 %	Alkalinity PE meq/L
S0609512-062	WRD-19	51-68	19.7	3.45
S0609512-063	WRD-19	68-90	19.8	2.93
S0609512-064	WRD-21	0-8	21.2	3.76
S0609512-065	WRD-21	8-18	29.8	4.08
S0609512-066	WRD-21	18-36	20.3	2.72
S0609512-067	WRD-21	36-50	21.6	3.34
S0609512-068	WRD-21	50-62	16.8	2.51
S0609512-069	WRD-21	62-96	20.7	2.51

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

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 Potentia

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Barten

Karen Barten, Soil Lab Supervisor

Inter·Mountain Laboratories, Inc.

Soil Analysis Report
Talon Resources, Inc.
PO Box 1230
Huntington, UT 84528

Report ID: S[illegible]51001

Date: 11/14/2006
Work Order: S0610051

Project: Talon Resources Soil
Date Received: 10/3/2006

Lab ID	Sample ID	Depths In.	pH s.u.	Saturation %	Electrical Conductivity dS/m	Organic Matter %	Calcium meq/L	Magnesium meq/L	Sodium meq/L	Potassium meq/L	SAR
S0610051-064	WRD-20	6-13	7.8	47.6	0.56	2.4	2.47	1.47	0.14	0.67	0.10
S0610051-065	WRD-20	13-28	8.1	24.1	0.27	0.6	1.22	0.63	0.13	0.32	0.14
S0610051-066	WRD-20	28-54	8.0	25.4	0.32	0.2	1.40	0.76	0.07	0.42	0.07
S0610051-067	WRD-20	54-72	8.1	38.5	0.27	1.1	1.18	0.87	0.24	0.21	0.23
S0610051-079	WRD-20	72-96	8.2	28.3	0.32	0.3	0.97	1.23	0.16	0.28	0.16
S0610051-068	WRD-22	0-6	7.7	36.6	0.40	1.8	2.16	0.88	0.08	0.35	0.07
S0610051-069	WRD-22	6-15	7.7	48.0	0.34	3.7	1.85	0.83	0.16	0.19	0.13
S0610051-070	WRD-22	15-28	8.0	34.9	0.29	1.2	1.64	0.80	0.13	0.18	0.11
S0610051-071	WRD-22	28-48	8.0	28.0	0.25	0.8	1.18	0.64	0.13	0.16	0.14
S0610051-072	WRD-22	48-60	8.0	30.1	0.27	1.0	1.34	0.67	0.10	0.16	0.10
S0610051-073	WRD-22	60-84	8.2	27.3	0.30	0.5	1.08	0.96	0.09	0.25	0.09
S0610051-074	WRD-23	0-6	7.7	48.4	0.60	4.9	3.20	1.35	0.07	0.53	0.05
S0610051-075	WRD-23	6-12	7.9	44.6	0.38	2.9	1.97	0.91	0.15	0.30	0.13
S0610051-076	WRD-23	12-22	7.9	41.0	0.35	1.8	1.76	0.92	0.14	0.16	0.12
S0610051-077	WRD-23	22-40	8.0	33.2	0.24	0.7	1.12	0.77	0.15	0.06	0.16
S0610051-078	WRD-23	40-62	8.2	38.6	0.23	0.6	1.01	0.94	0.24	0.06	0.24
S0610051-035	WRD-23	62-80	8.1	43.9	0.44	0.8	1.61	1.95	0.64	0.14	0.48

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 Barten
Karen Barten, Soil Lab Supervisor

Inter·Mountain Laboratories, Inc.

Soil Analysis Report

Talon Resources, Inc.

PO Box 1230

Huntington, UT 84528

Report ID: S[illegible]1001

Date: 11/14/2006

Work Order: S0610051

Project: Talon Resources Soil

Date Received: 10/3/2006

Lab ID	Sample ID	Depths In.	Sand %	Silt %	Clay %	Texture	Very Fine Sand %	Boron ppm	Nitrogen Nitrate ppm	Phosphorus ppm	Selenium ppm
S0610051-064	WRD-20	6-13	41.0	29.0	30.0	Clay Loam	17.7		0.12	1.62	
S0610051-065	WRD-20	13-28	69.0	21.0	10.0	Sandy Loam	18.6		0.07	0.37	
S0610051-066	WRD-20	28-54	79.0	14.0	7.0	Loamy Sand	15.8		0.03	0.94	
S0610051-067	WRD-20	54-72	45.0	29.0	26.0	Loam	13.9		0.53	1.23	
S0610051-079	WRD-20	72-96	82.0	13.0	5.0	Loamy Sand	17.6		0.29	0.28	
S0610051-068	WRD-22	0-6	63.0	23.0	14.0	Sandy Loam	25.0		1.94	4.52	
S0610051-069	WRD-22	6-15	19.0	42.0	39.0	Silty Clay Loam	7.0		0.76	9.01	
S0610051-070	WRD-22	15-28	47.0	27.0	26.0	Sandy Clay Loam	5.6		0.80	0.31	
S0610051-071	WRD-22	28-48	65.0	21.0	14.0	Sandy Loam	13.7		0.29	0.13	
S0610051-072	WRD-22	48-60	65.0	21.0	14.0	Sandy Loam	14.5		0.35	0.07	
S0610051-073	WRD-22	60-84	74.0	18.0	8.0	Sandy Loam	21.8		0.57	0.28	
S0610051-074	WRD-23	0-6	31.0	38.0	31.0	Clay Loam	12.5		1.43	8.26	
S0610051-075	WRD-23	6-12	36.0	33.0	31.0	Clay Loam	14.7		0.31	1.74	
S0610051-076	WRD-23	12-22	38.0	34.0	28.0	Clay Loam	12.5		0.29	1.09	
S0610051-077	WRD-23	22-40	51.0	30.0	19.0	Loam	17.2		0.21	1.03	
S0610051-078	WRD-23	40-62	31.0	44.0	25.0	Loam	20.0		0.89	0.28	
S0610051-035	WRD-23	62-80	18.0	41.0	41.0	Silty Clay	14.0		0.35	1.65	

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

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Barten

Karen Barten, Soil Lab Supervisor

Inter·Mountain Laboratories, Inc.

Soil Analysis Report
Talon Resources, Inc.
PO Box 1230
Huntington, UT 84528

Report ID: S[illegible]1001

Date: 11/14/2006
Work Order: S0610051

Project: Talon Resources Soil
Date Received: 10/3/2006

Lab ID	Sample ID	Depths In.	CO3 %	Alkalinity PE meq/L
S0610051-064	WRD-20	6-13	20.8	3.13
S0610051-065	WRD-20	13-28	25.4	2.30
S0610051-066	WRD-20	28-54	21.7	2.72
S0610051-067	WRD-20	54-72	24.3	2.51
S0610051-079	WRD-20	72-96	16.5	2.51
S0610051-068	WRD-22	0-6	20.2	3.13
S0610051-069	WRD-22	6-15	23.8	2.72
S0610051-070	WRD-22	15-28	18.9	2.72
S0610051-071	WRD-22	28-48	17.9	2.30
S0610051-072	WRD-22	48-60	17.5	2.30
S0610051-073	WRD-22	60-84	21.0	2.51
S0610051-074	WRD-23	0-6	21.4	4.60
S0610051-075	WRD-23	6-12	23.6	3.34
S0610051-076	WRD-23	12-22	25.6	3.24
S0610051-077	WRD-23	22-40	29.8	2.30
S0610051-078	WRD-23	40-62	35.3	1.99
S0610051-035	WRD-23	62-80	30.4	2.09

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 Potentia
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Barten
Karen Barten, Soil Lab Supervisor

LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development / Talon Resources
Project: Coal Hollow
Workorder: C07040226

Report Date: 04/24/07
Date Received: 04/05/07

		Analysis	EC SatPst	Saturation SatPst	Lime as CaCO3	pH SatPst	NO3 Soluble	K Soluble	K SatPst	K NH4OAc	P, Olsen-NAHCO3	Ca SatPst	Mg SatPst	Na SatPst	SAR
		Units	mmhos/cm	%	%	s_u_	mg/kg-dry	mg/kg-dry	meq/L	meq/100g	mg/kg-dry	meq/L	meq/L	meq/L	unitless
Sample ID	**Client Sample ID**	**Depth**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
C07040226-001	SP-28	0-8	0.47	60.2	18.9	7.7	3.9	7.56	0.32	1.0	< 5	2.8	2.3	1.0	0.65
C07040226-002	SP-28	8-24	0.48	65.4	17.6	8.0	1.6	4.44	0.17	0.77	< 5	1.8	2.4	2.2	1.50
C07040226-003	SP-28	24-48	5.94	72.6	18.5	8.1	2.8	13.6	0.48	0.77	< 5	13	42	29	5.50
C07040226-004	SP-35	0-9	0.56	55.4	16.7	7.7	5.1	27.7	1.3	1.8	45	4.0	2.7	0.20	0.11
C07040226-005	SP-35	9-19	0.44	54.6	17.4	7.9	1.1	27.0	1.3	1.6	25	2.4	2.3	0.19	0.12
C07040226-006	SP-35	19-30	0.40	31.5	15.0	8.2	1.1	20.1	1.6	1.1	5	1.5	1.8	0.28	0.22
C07040226-007	SP-35	30-45	0.37	30.5	17.7	8.4	1.1	24.1	2.0	0.70	< 5	0.98	1.4	0.23	0.22
C07040226-008	SP-35	45-70	0.46	37.3	18.0	8.8	1.0	45.9	3.1	1.3	< 5	0.73	1.4	0.37	0.37
C07040226-009	SP-37	0-6	0.51	46.7	4.5	7.8	3.9	8.71	0.48	0.83	10	5.1	2.1	0.16	0.08
C07040226-010	SP-37	6-12	0.44	45.4	7.5	7.7	6.5	7.15	0.40	0.71	< 5	4.2	1.8	0.16	0.09
C07040226-011	SP-37	12-24	0.29	38.7	11.1	8.0	1.9	3.94	0.26	0.35	< 5	2.3	1.4	0.18	0.13
C07040226-012	SP-37	24-38	0.25	35.2	15.3	8.2	2.0	1.24	0.09	0.096	< 5	1.6	1.7	0.18	0.14
C07040226-013	SP-37	38-58	0.27	30.3	17.3	8.2	1.5	1.22	0.10	0.069	< 5	1.5	2.0	0.44	0.34
C07040226-014	SP-38	0-6	0.47	69.9	24.7	8.0	2.7	14.2	0.52	0.74	8	3.2	3.4	0.17	0.09
C07040226-015	SP-38	6-12	0.33	81.8	17.8	8.3	1.6	5.55	0.17	0.42	< 5	1.5	3.4	0.23	0.15
C07040226-016	SP-38	12-20	0.49	71.1	28.3	8.5	1.4	2.58	0.09	0.23	< 5	1.3	5.2	0.70	0.39
C07040226-017	SP-38	20-24	0.57	71.5	44.5	8.3	3.0	3.04	0.11	0.21	< 5	1.8	5.6	0.84	0.44
C07040226-018	SP-39	0-6	0.32	43.7	8.5	7.8	2.1	2.87	0.17	0.45	6	3.1	1.2	0.27	0.19
C07040226-019	SP-39	6-12	0.38	41.9	7.9	7.8	1.7	3.07	0.19	0.45	< 5	3.9	1.5	0.34	0.21
C07040226-020	SP-39	12-24	0.23	35.3	13.9	8.0	1.2	1.46	0.11	0.17	< 5	2.2	0.98	0.30	0.24
C07040226-021	SP-39	24-36	0.20	32.3	14.4	7.9	1.2	1.10	0.09	0.089	< 5	1.7	1.0	0.20	0.17
C07040226-022	SP-40	0-6	0.53	85.8	14.4	8.0	1.5	19.0	0.57	1.1	11	2.3	4.6	0.86	0.47
C07040226-023	SP-40	6-12	1.81	88.4	18.0	8.4	1.1	13.2	0.38	0.50	6	3.1	20	3.6	1.01
C07040226-024	SP-40	12-22	1.29	76.1	19.9	9.0	1.1	5.83	0.20	0.26	6	0.51	14	4.1	1.46
C07040226-025	SP-41	0-6	0.46	51.3	14.5	8.0	1.4	29.1	1.5	1.1	8	3.9	1.7	0.20	0.12
C07040226-026	SP-41	6-12	0.53	54.9	12.1	8.0	4.7	22.4	1.0	1.5	6	4.4	2.7	0.27	0.15
C07040226-027	SP-41	12-36	0.22	69.0	16.6	8.1	1.1	5.32	0.20	0.69	< 5	1.4	1.6	0.19	0.15
C07040226-028	SP-41	36-64	0.43	63.9	18.5	8.2	1.1	6.72	0.27	0.41	< 5	1.4	3.9	0.65	0.40
C07040226-029	SP-41	64-80	0.66	31.5	17.3	8.8	1.2	3.50	0.28	0.15	< 5	0.67	5.7	2.9	1.63
C07040226-030	SP-42	0-9	0.33	42.8	18.0	7.9	3.9	6.62	0.39	0.42	5	3.7	0.97	0.16	0.10
C07040226-031	SP-42	9-24	0.28	60.9	18.5	8.1	3.5	8.00	0.34	0.81	< 5	2.5	1.3	0.26	0.19
C07040226-032	SP-42	24-36	0.32	44.7	16.0	8.3	1.5	6.81	0.39	0.36	< 5	2.3	2.9	0.31	0.20
C07040226-033	SP-42	36-48	0.28	31.4	18.2	8.6	1.4	5.31	0.43	0.43	< 5	0.94	1.8	1.3	1.14

LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development / Talon Resources
Project: Coal Hollow
Workorder: C07040226

Report Date: 04/24/07
Date Received: 04/05/07

		Analysis	Organic Matter	Sand	Silt	Clay	Texture
		Units	%	%	%	%	
Sample ID	**Client Sample ID**	**Depth**	**Results**	**Results**	**Results**	**Results**	**Results**
C07040226-001	SP-28	0-8	2.5	7.0	38	55	C
C07040226-002	SP-28	8-24	1.4	9.0	34	57	C
C07040226-003	SP-28	24-48	1.0	4.0	36	60	C
C07040226-004	SP-35	0-9	4.3	12	44	44	SiC
C07040226-005	SP-35	9-19	1.8	16	40	44	SiC
C07040226-006	SP-35	19-30	1.2	51	27	22	SCL
C07040226-007	SP-35	30-45	0.75	59	27	14	SL
C07040226-008	SP-35	45-70	0.86	42	39	19	L
C07040226-009	SP-37	0-6	4.0	38	30	32	CL
C07040226-010	SP-37	6-12	2.9	48	23	29	SCL
C07040226-011	SP-37	12-24	3.0	56	24	20	SL - SCL
C07040226-012	SP-37	24-38	0.67	71	18	11	SL
C07040226-013	SP-37	38-58	0.45	73	18	9.0	SL
C07040226-014	SP-38	0-6	6.2	12	44	44	SiC
C07040226-015	SP-38	6-12	3.4	2.0	47	51	SiC
C07040226-016	SP-38	12-20	1.9	11	46	43	SiC
C07040226-017	SP-38	20-24	1.1	10	42	48	SiC
C07040226-018	SP-39	0-6	2.3	36	33	31	CL
C07040226-019	SP-39	6-12	2.4	38	30	32	CL
C07040226-020	SP-39	12-24	1.2	62	20	18	SL
C07040226-021	SP-39	24-36	0.50	75	15	10	SL
C07040226-022	SP-40	0-6	5.7	10	42	48	SiC
C07040226-023	SP-40	6-12	2.9	5.0	44	51	SiC
C07040226-024	SP-40	12-22	1.4	21	44	35	CL
C07040226-025	SP-41	0-6	3.3	46	26	28	SCL
C07040226-026	SP-41	6-12	3.4	25	34	41	C
C07040226-027	SP-41	12-36	1.7	6.0	44	50	SiC
C07040226-028	SP-41	36-64	0.96	12	52	36	SiCL
C07040226-029	SP-41	64-80	0.56	54	31	15	SL
C07040226-030	SP-42	0-9	2.4	50	30	20	L
C07040226-031	SP-42	9-24	2.6	8.0	49	43	SiC
C07040226-032	SP-42	24-36	1.7	52	27	21	SCL
C07040226-033	SP-42	36-48	0.92	44	34	22	L

LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development / Talon Resources
Project: Coal Hollow
Workorder: C07041141

Report Date: 05/13/07
Date Received: 04/24/07

		Analysis	EC SatPst	Saturation SatPst	Lime as CaCO3	pH SatPst	NO3 Soluble	K Soluble	K SatPst	K NH4OAc	P, Olsen-NAHCO3	Se SatPst	Ca SatPst	Mg SatPst	Na SatPst
		Units	mmhos/cm	%	%	s_u_	mg/kg-dry	mg/kg-dry	meq/L	meq/100g	mg/kg-dry	mg/L	meq/L	meq/L	meq/L
Sample ID	**Client Sample ID**	**Depth**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
C07041141-001	Alton 48	0-3	0.52	85.6	4.5	7.7	2.6	6.41	0.19	1.1	10	< 0.001	3.6	1.3	1.4
C07041141-002	Alton 48	3-12	0.57	95.4	7.2	8.0	1.1	2.39	0.06	0.79	8	< 0.001	1.2	0.55	4.4
C07041141-003	Alton 48	12-30	2.63	106	7.5	8.2	1.3	5.38	0.13	0.86	7	< 0.001	3.0	1.8	17
C07041141-004	Alton 48	30-48	4.65	81.0	5.2	8.1	< 1.0	7.36	0.23	0.94	7	< 0.001	6.5	4.1	29
C07041141-005	Alton 48	48-84	6.20	87.5	4.0	7.9	1.4	11.8	0.35	1.1	9	< 0.001	15	8.1	37

LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development / Talon Resources
Project: Coal Hollow
Workorder: C07041141

Report Date: 05/13/07
Date Received: 04/24/07

		Analysis	SAR	Very Fine Sand	Sand	Silt	Clay	Texture	Organic Matter
		Units	unitless	%	%	%	%		%
Sample ID	**Client Sample ID**	**Depth**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
C07041141-001	Alton 48	0-3	0.92	4.8	7.0	33	60	C	3.5
C07041141-002	Alton 48	3-12	4.68	5.3	6.0	30	64	C	1.9
C07041141-003	Alton 48	12-30	11.2	11	12	28	60	C	1.7
C07041141-004	Alton 48	30-48	12.7	9.5	10	28	62	C	1.6
C07041141-005	Alton 48	48-84	10.8	6.5	7.0	30	63	C	1.5

LABORATORY ANALYTICAL REPORT

Revised Date: 05/18/07
Report Date: 05/06/07
Date Received: 04/16/07

Client: Alton Coal Development / Talon Resources
Project: Coal Hollow Project
Workorder: C07040695

		Analysis	EC SatPst	Saturation SatPst	Lime as CaCO3	pH SatPst	NO3 Soluble	K Soluble	K SatPst	K NH4OAc	P, Olsen-NAHCO3	Ca SatPst	Mg SatPst	Na SatPst	SAR
		Units	mmhos/cm	%	%	s_u_	mg/kg-dry	mg/kg-dry	meq/L	meq/100g	mg/kg-dry	meq/L	meq/L	meq/L	unitless
Sample ID	**Client Sample ID**	**Depth**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
C07040695-001	Alton 49	0-3	0.42	58.0	17.8	8.1	< 1.0	7.04	0.31	0.46	7	2.9	1.5	0.07	0.05
C07040695-002	Alton 49	3-10	0.34	55.5	17.7	8.4	< 1.0	7.32	0.34	0.39	8	2.0	1.5	0.08	0.06
C07040695-003	Alton 50	0-4	0.20	75.4	18.5	8.4	1.4	6.38	0.22	0.78	6	1.6	0.36	0.13	0.13
C07040695-004	Alton 50	4-11	0.27	66.2	18.7	8.1	1.4	6.08	0.24	0.81	8	1.9	0.53	0.32	0.29
C07040695-005	Alton 50	11-19	0.30	72.0	18.5	8.4	1.3	4.97	0.18	0.65	9	1.9	0.59	0.57	0.52

LABORATORY ANALYTICAL REPORT

Revised Date: 05/18/07
Report Date: 05/06/07
Date Received: 04/16/07

Client: Alton Coal Development / Talon Resources
Project: Coal Hollow Project
Workorder: C07040695

		Analysis	Very Fine Sand	Sand	Silt	Clay	Texture	Organic Matter
		Units	%	%	%	%		%
Sample ID	**Client Sample ID**	**Depth**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
C07040695-001	Alton 49	0-3	23	26	42	32	CL	2.0
C07040695-002	Alton 49	3-10	27	33	44	23	L	2.3
C07040695-003	Alton 50	0-4	3.7	4.0	38	58	C	1.4
C07040695-004	Alton 50	4-11	4.4	5.0	35	60	C	1.3
C07040695-005	Alton 50	11-19	6.3	7.0	37	56	C	1.4

Table C-2. Summary of laboratory analysis of overburden samples for Coal Hollow cor holes, year 1.

Sample ID	pH (Sat Paste)	E.C. @25°C	SAR	Sand	Silt	Clay	USDA Texture Class[1]	Very Fine Sand	Saturation Percent	Available Water Capacity[2]	Organic Matter (calculated)3	Organic Carbon	Erodibility Factor (K-Factor)[4]	$CaCO_3$	Boron (soluble)	Se (Hot H_2O sol)	Calcium, soluble (Sat. Paste)	Magnesium, soluble (Sat. Paste)	Sodium, soluble (Sat. Paste)	Potassium, soluble (Sat. Paste)	Nitrogen-Nitrate	Phosphorus	Alkalinity
	units	dS/m	unitless	%	%	%		%	%	in/in	%	%	unitless	%	mg/Kg	mg/Kg	meq/L	meq/L	meq/L	meq/L	mg/Kg	mg/Kg	meq/L
CH-01-05, 3 ft	8.00	0.33	0.12	0	49	51	SiC	0	78.4	0.12	2.0	1.05	0.29	28.3	0.4	†	1.42	1.33	0.14	0.37	<1	†	†
CH-01-05, 6 ft	8.20	0.34	0.33	0	49	51	SiC	0	82.9	0.12	1.5	0.77	0.30	30	0.4	†	0.69	2.19	0.4	0.35	<1	†	†
CH-01-05, 9-10 ft	8.40	0.52	0.96	10	61	29	SiCL	3	52.2	0.18	0.8	0.4	0.46	35.3	0.3	†	0.57	3.4	1.36	0.28	<1	†	†
CH-01-05, 12 ft	8.20	0.78	0.8	0	53	47	SiC	0	84.6	0.14	0.9	0.48	0.34	30.3	0.2	†	1.48	5.36	1.49	0.31	<1	†	†
CH-01-05, 12-13 ft	8.30	0.73	0.7	44	39	17	L	11	35.9	0.13	0.6	0.3	0.38	25.5	<0.1	†	1.71	4.89	1.25	0.26	<1	†	†
CH-01-05, 16 ft	8.30	0.65	0.66	20	55	25	SiL	6	50.5	0.17	0.7	0.35	0.42	30.3	0.1	†	1.58	4.05	1.11	0.27	<1	†	†
CH-01-05, 30 ft	8.00	3.13	0.79	8	47	45	SiC	0	81.9	0.14	0.9	0.45	0.32	26.1	0.4	†	16.9	25.8	3.65	1.11	1	†	†
CH-03-05, 0-3 ft	7.80	0.42	0.05	70	21	9	SL	11	25.7	0.08	1.2	0.62	0.24	15.6	<0.1	†	2.98	1.26	0.07	0.3	2	†	†
CH-03-05, 3-6 ft	8.30	0.27	0.09	77	17	6	LS	9	21.8	0.07	0.4	0.23	0.22	27.7	<0.1	†	1.73	0.87	0.1	0.12	<1	†	†
CH-03-05, 9 ft	8.40	0.25	0.11	82	13	5	LS	7	20.4	0.06	0.3	0.15	0.17	46.2	<0.1	†	1.1	1.32	0.13	0.09	<1	†	†
CH-03-05, 16 ft	8.40	0.4	0.31	80	14	6	LS	5	20.2	0.06	0.2	0.11	0.17	64.7	<0.1	†	1.22	2.24	0.4	0.16	<1	†	†
CH-05-05, 0-1 ft	7.90	0.43	0.1	30	41	29	CL	3	44.5	0.15	1.7	0.91	0.30	22.7	0.2	†	2.22	2.21	0.15	0.19	3	†	†
CH-05-05, 3 ft	8.20	0.43	0.19	64	23	13	SL	12	27	0.09	0.7	0.39	0.26	24.9	<0.1	†	1.28	3.02	0.28	0.15	1	†	†
CH-05-05, 9-10 ft	8.40	0.43	0.26	78	17	5	LS	4	20.8	0.06	0.2	0.13	0.18	60	<0.1	†	1.05	3.01	0.36	0.15	<1	†	†
CH-05-05, 14 ft	8.30	0.54	1.04	0	39	61	C	0	97.3	0.26	1.0	0.5	0.24	19.1	0.2	†	1.5	2.69	1.51	0.21	<1	†	†
CH-05-05, 19 ft	8.10	1.04	3.57	2	37	61	C	0	97.6	0.25	0.8	0.44	0.23	18.2	0.4	†	2.67	2.71	5.85	0.27	<1	†	†
Maximum	8.40	3.13	3.57	82.00	61.00	61.00		12	97.60	0.26	2.0	1.05	0.46	64.70	0.40		16.90	25.80	5.85	1.11			
Minimum	7.80	0.25	0.05	0.00	13.00	5.00		0	20.20	0.06	0.2	0.11	0.17	15.60	0.10		0.57	0.87	0.07	0.09			
Average	8.20	0.67	0.63	35.31	35.94	28.75	CL	4	52.61	0.13	0.9	0.46	0.28	31.56	0.29		2.51	4.15	1.14	0.29			

1. USDA soil textures: sand (S); loamy sand (LS); sandy loam (SL); loam (L); clay loam (CL); sandy clay loam (SCL); silty clay loam (SiCL); silty clay (SiC); clay (C).
2. Available water capacity calculated using using *Soil Water Characteristics Model* (Saxton et al., 1986).
3. Organic matter calculated from percent organic carbon.
4.Erodibility factor (K) calculated from lab and field data

Suitability Rating (Table 4. Utah DOGM, 2005): Good | Fair | Poor | Unacceptable

Undable to calculate because referenced calcualtion in Table 7, Footnote # 3 above is invalid for soils with percent silt + fine sand greater than 70 percent.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Workorder: B07041015

Report Date: 04/27/07
Date Received: 04/12/07

	Analysis	Sand	Silt	Clay	Very Fine Sand	Texture	pH, Sat Paste	Cond_ Paste	Saturation	Ca, Sat Paste	Mg, Sat Paste	K, Sat Paste	Na, Sat Paste	SAR
	Units	%	%	%	wt%		s_u_	mmhos/cm	%	meq/L	meq/L	meq/L	meq/L	unitless
Sample ID	**Client Sample ID**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
B07041015-001	CH-01-05, 3 Feet	< 1	49	51	0	SiC	8.00	0.33	78.4	1.42	1.63	0.37	0.14	0.12
B07041015-002	CH-01-05, 6 Feet	< 1	49	51	0	SiC	8.20	0.34	82.9	0.69	2.19	0.35	0.40	0.33
B07041015-003	CH-01-05, 9-10 Feet	10	61	29	3	SiCL	8.40	0.52	52.2	0.57	3.40	0.28	1.36	0.96
B07041015-004	CH-01-5, 12 Feet	< 1	53	47	0	SiC	8.20	0.78	84.6	1.48	5.36	0.31	1.49	0.80
B07041015-005	CH-01-05, 12-13 Feet	44	39	17	11	L	8.30	0.73	35.9	1.71	4.69	0.26	1.25	0.70
B07041015-006	CH-01-05, 16 Feet	20	55	25	6	SiL	8.30	0.65	50.5	1.58	4.05	0.27	1.11	0.66
B07041015-007	CH-01-05, 30 Feet	8	47	45	0	SiC	8.00	3.13	81.9	16.9	25.8	1.11	3.65	0.79
B07041015-008	CH-03-05, 0-3 Feet	70	21	9	11	SL	7.80	0.42	25.7	2.98	1.26	0.30	0.07	0.05
B07041015-009	CH-03-05, 3-6 Feet	77	17	6	9	LS	8.30	0.27	21.8	1.73	0.87	0.12	0.10	0.09
B07041015-010	CH-03-05, 9 Feet	82	13	5	7	LS	8.40	0.25	20.4	1.10	1.32	0.09	0.13	0.11
B07041015-011	CH-03-05, 16 Feet	80	14	6	5	LS	8.40	0.40	20.2	1.22	2.24	0.16	0.40	0.31
B07041015-012	CH-05-05, 0-1 Feet	30	41	29	3	CL	7.90	0.43	44.5	2.22	2.21	0.19	0.15	0.10
B07041015-013	CH-05-05, 3 Feet	64	23	13	12	SL	8.20	0.43	27.0	1.28	3.02	0.15	0.28	0.19
B07041015-014	CH-05-05, 9-10 Feet	78	17	5	4	LS	8.40	0.43	20.8	1.05	3.01	0.15	0.36	0.26
B07041015-015	CH-05-05, 14 Feet	< 1	39	61	0	C	8.30	0.54	97.3	1.50	2.69	0.21	1.51	1.04
B07041015-016	CH-05-05, 19 Feet	2	37	61	0	C	8.10	1.04	97.6	2.67	2.71	0.27	5.85	3.57
B07041015-017	CH-06-05, Soil	2	45	53	0	SiC	8.00	0.54	79.5	1.33	1.51	0.08	3.17	2.66
B07041015-018	CH-06-05, 5-10 Feet	20	39	41	6	C	8.50	ISS	ISS	ISS	ISS	ISS	ISS	ISS
B07041015-019	CH-06-05, 10 Feet	12	41	47	9	SiC	8.20	7.95	90.9	22.7	52.2	0.93	60.8	9.93
B07041015-020	CH-06-05, 20 Feet	10	31	59	6	C	8.00	7.18	143	26.7	23.3	1.07	61.7	12.3
B07041015-021	CH-06-05, 35-40 Feet	7	26	67	4	C	8.20	6.33	275	19.5	9.3	0.88	60.0	15.8
B07041015-022	CH-06-05, 42-49 Feet	6	44	50	5	SiC	8.30	6.47	192	12.3	7.0	1.07	66.4	21.4
B07041015-023	CH-01-05, 50 Feet, Dark Grey Clay	1	34	65	0	C	8.60	2.78	234	1.73	1.03	0.43	26.0	22.2

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Workorder: B07041015

Report Date: 04/27/07
Date Received: 04/12/07

	Analysis	Neut Potential	Acid Potential	Acid/Base Potential	Lime	Organic Carbon	Nitrate as N	B-H2O Extr	As-Total	Ba-Total	Cd-Total	Cr-Total	Cu-Total	Fe-Total
	Units	t/kt	t/kt	t/kt	%	wt%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Sample ID	**Client Sample ID**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
B07041015-001	CH-01-05, 3 Feet	280	1.1	280	28.3	1.05	< 1	0.4	9	99	< 1	24	17	17300
B07041015-002	CH-01-05, 6 Feet	300	0	300	30.0	0.77	< 1	0.4	6	91	< 1	20	16	16100
B07041015-003	CH-01-05, 9-10 Feet	350	0	350	35.3	0.40	< 1	0.3	6	104	< 1	16	11	12800
B07041015-004	CH-01-5, 12 Feet	300	0	300	30.3	0.48	< 1	0.2	< 5	87	< 1	18	14	14400
B07041015-005	CH-01-05, 12-13 Feet	260	0	250	25.5	0.30	< 1	< 0.1	< 5	124	< 1	11	8	9780
B07041015-006	CH-01-05, 16 Feet	300	0	300	30.3	0.35	< 1	0.1	5	89	< 1	13	10	11300
B07041015-007	CH-01-05, 30 Feet	260	0	260	26.1	0.45	1	0.4	6	99	< 1	19	14	14100
B07041015-008	CH-03-05, 0-3 Feet	160	0	160	15.6	0.62	2	< 0.1	< 5	56	< 1	7	6	8620
B07041015-009	CH-03-05, 3-6 Feet	280	0	280	27.7	0.23	< 1	< 0.1	< 5	96	< 1	7	< 5	7000
B07041015-010	CH-03-05, 9 Feet	460	0	460	46.2	0.15	< 1	< 0.1	8	202	< 1	8	< 5	8100
B07041015-011	CH-03-05, 16 Feet	650	0	650	64.7	0.11	< 1	< 0.1	< 5	234	< 1	7	< 5	11400
B07041015-012	CH-05-05, 0-1 Feet	230	0	230	22.7	0.91	3	0.2	7	67	< 1	17	13	13500
B07041015-013	CH-05-05, 3 Feet	250	0	250	24.9	0.39	1	< 0.1	< 5	61	< 1	8	6	8120
B07041015-014	CH-05-05, 9-10 Feet	600	0	600	60.0	0.13	< 1	< 0.1	< 5	107	< 1	7	< 5	8140
B07041015-015	CH-05-05, 14 Feet	190	0	190	19.1	0.50	< 1	0.2	< 5	106	< 1	14	13	14500
B07041015-016	CH-05-05, 19 Feet	180	0	180	18.2	0.44	< 1	0.4	< 5	85	< 1	15	14	14600
B07041015-017	CH-06-05, Soil	21	0	20	2.1	0.73	6	0.2	< 5	65	< 1	18	14	13800
B07041015-018	CH-06-05, 5-10 Feet	130	0	130	12.6	0.37	1	0.6	< 5	63	< 1	12	11	10000
B07041015-019	CH-06-05, 10 Feet	69	0	68	6.9	0.35	3	0.4	< 5	57	< 1	15	13	14200
B07041015-020	CH-06-05, 20 Feet	60	1.6	58	6.0	0.38	8	0.4	< 5	94	< 1	25	19	16600
B07041015-021	CH-06-05, 35-40 Feet	90	3.6	87	9.0	0.33	5	2.3	< 5	124	< 1	11	11	11500
B07041015-022	CH-06-05, 42-49 Feet	51	17	34	5.1	0.90	17	2.7	< 5	84	< 1	15	10	13500
B07041015-023	CH-01-05, 50 Feet, Dark Grey Clay	41	12	29	4.1	0.77	1	4.1	< 5	134	< 1	15	10	10600

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Workorder: B07120398

Report Date: 12/18/07
Date Received: 12/06/07

	Analysis	Sand	Silt	Clay	Very Fine Sand	Texture	pH, Sat Paste	Cond_ Paste	Saturation	Ca, Sat Paste	Mg, Sat Paste	K, Sat Paste	Na, Sat Paste	SAR
	Units	%	%	%	wt%		s_u_	mmhos/cm	%	meq/L	meq/L	meq/L	meq/L	unitless
Sample ID	**Client Sample ID**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
B07120398-001	CH-08 70-79 ft	8	59	33	2	SiCL	8.60	2.68	94.8	0.50	0.27	0.23	26.1	42.1
B07120398-002	CH-08 79.2 - 82.3 ft	35	41	24	18	L	8.30	1.90	55.1	0.20	0.15	0.16	20.8	49.8
B07120398-003	CH-08 82.3 - 83.8 ft	50	31	19	19	L	7.50	6.48	37.9	9.4	4.2	0.90	63.6	24.5
B07120398-004	CH-08 101 - 103 ft underburden	16	42	42	7	SiC	8.40	6.72	110	2.5	2.1	0.54	72.8	48.1
B07120398-005	CH-07 0 - 6 ft	2	45	53	0	SiC	8.30	4.27	88.3	4.91	10.9	0.34	36.5	13.0
B07120398-006	CH-07 6 - 15 ft	10	41	49	3	SiC	8.50	9.33	101	23.2	33.0	0.71	84.2	15.9
B07120398-007	CH-07 15 - 19 ft	5	45	50	4	SiC	8.20	10.0	89.4	22.8	18.4	1.34	106	23.3
B07120398-008	CH-07 19 - 27 ft	< 1	43	57	0	SiC	8.20	8.71	134	20.5	11.1	1.01	90.5	22.8
B07120398-009	CH-07 27 - 36 ft	< 1	39	61	0	C	8.70	3.68	259	1.69	0.83	0.33	35.6	31.7
B07120398-010	CH-07 36 - 46 ft	< 1	45	55	0	SiC	9.40	0.90	240	< 0.05	< 0.08	0.06	9.16	52.2
B07120398-011	CH-08 0 - 6 ft	18	41	41	0	SiC	8.20	3.95	55.8	11.5	48.5	0.60	3.22	0.59
B07120398-012	CH-08 6 - 11 ft	60	25	15	10	SL	8.30	2.96	27.4	8.65	30.1	0.40	3.75	0.85
B07120398-013	CH-08 11 - 20 ft	42	37	21	6	L	8.00	3.84	33.2	24.3	24.0	0.65	7.21	1.47
B07120398-014	CH-08 20 - 30 ft	4	51	45	0	SiC	8.10	2.55	81.6	12.0	7.92	0.56	11.5	3.64
B07120398-015	CH-08 30 - 40 ft	26	45	29	9	CL	8.00	4.20	52.2	25.3	15.1	0.82	17.7	3.94
B07120398-016	CH-08 40 - 50 ft	18	48	34	8	SiCL	8.10	5.44	65.1	21.4	11.3	0.95	43.4	10.7
B07120398-017	CH-08 50 - 60 ft	19	46	35	8	SiCL	8.20	5.63	71.2	16.9	10.6	1.00	49.4	13.3
B07120398-018	CH-08 60 - 70 ft	10	45	45	4	SiC	8.80	4.22	123	3.09	1.58	0.43	43.8	28.7

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Workorder: B07120398

Report Date: 12/18/07
Date Received: 12/06/07

	Analysis	Neut Potential	Acid Potential	Acid/Base Potential	Lime	Organic Carbon	Nitrate as N	B-H2O Extr	Se-H2O Extr	As-Total	Ba-Total	Cd-Total	Cr-Total	Cu-Total
	Units	t/kt	t/kt	t/kt	%	wt%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Sample ID	**Client Sample ID**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
B07120398-001	CH-08 70-79 ft	170	9.8	160	16.7	1.70	1	1.0	0.02	8	74	< 1	12	11
B07120398-002	CH-08 79.2 - 82.3 ft	45	20	25	4.5	7.72	< 1	1.7	< 0.01	6	105	< 1	7	8
B07120398-003	CH-08 82.3 - 83.8 ft	37	13	24	3.7	1.82	< 1	1.4	< 0.01	< 5	54	< 1	5	< 5
B07120398-004	CH-08 101 - 103 ft underburden	110	14	93	10.7	4.60	1	6.5	0.02	< 5	79	< 1	13	13
B07120398-005	CH-07 0 - 6 ft	190	1.4	190	19.4	0.84	2	0.6	0.02	7	130	< 1	21	15
B07120398-006	CH-07 6 - 15 ft	220	1.1	220	21.8	0.33	1	0.8	0.03	< 5	91	< 1	15	12
B07120398-007	CH-07 15 - 19 ft	170	0	170	17.0	0.39	1	0.5	0.02	6	53	< 1	10	9
B07120398-008	CH-07 19 - 27 ft	110	3.2	100	10.7	0.66	1	0.8	0.01	7	56	< 1	11	9
B07120398-009	CH-07 27 - 36 ft	110	8.0	100	11.0	1.26	1	3.7	0.02	8	52	< 1	8	8
B07120398-010	CH-07 36 - 46 ft	95	8.3	87	9.5	1.09	1	3.2	0.01	< 5	49	< 1	< 5	10
B07120398-011	CH-08 0 - 6 ft	330	0	330	32.8	1.21	2	0.4	< 0.01	8	128	< 1	21	13
B07120398-012	CH-08 6 - 11 ft	290	0	290	29.2	0.28	2	0.1	< 0.01	5	124	< 1	9	6
B07120398-013	CH-08 11 - 20 ft	350	0	350	34.6	0.29	1	0.1	< 0.01	< 5	114	< 1	10	8
B07120398-014	CH-08 20 - 30 ft	120	0	120	11.6	0.44	1	0.3	0.01	< 5	59	< 1	12	12
B07120398-015	CH-08 30 - 40 ft	220	0	220	22.3	0.32	1	0.3	< 0.01	< 5	82	< 1	10	9
B07120398-016	CH-08 40 - 50 ft	210	3.8	210	21.2	0.65	1	0.6	< 0.01	5	94	< 1	13	11
B07120398-017	CH-08 50 - 60 ft	210	5.2	200	20.9	0.54	1	0.7	< 0.01	< 5	94	< 1	13	11
B07120398-018	CH-08 60 - 70 ft	150	11	140	15.2	0.70	1	0.8	0.02	< 5	91	< 1	16	14

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Workorder: B07120398

Report Date: 12/18/07
Date Received: 12/06/07

	Analysis	Fe-Total	Pb-Total	Mn-Total	Hg-Total	Mo-Total	Se-Total	Ag-Total	Zn-Total
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Sample ID	**Client Sample ID**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
B07120398-001	CH-08 70-79 ft	13700	11	162	< 1	< 5	< 5	< 5	39
B07120398-002	CH-08 79.2 - 82.3 ft	6860	7	48	< 1	< 5	< 5	< 5	25
B07120398-003	CH-08 82.3 - 83.8 ft	6810	< 5	35	< 1	< 5	< 5	< 5	13
B07120398-004	CH-08 101 - 103 ft underburden	10900	13	127	< 1	< 5	< 5	< 5	46
B07120398-005	CH-07 0 - 6 ft	16400	14	255	< 1	< 5	< 5	< 5	54
B07120398-006	CH-07 6 - 15 ft	11800	11	179	< 1	< 5	< 5	< 5	36
B07120398-007	CH-07 15 - 19 ft	9500	9	109	< 1	< 5	< 5	< 5	26
B07120398-008	CH-07 19 - 27 ft	11300	13	93	< 1	< 5	< 5	< 5	35
B07120398-009	CH-07 27 - 36 ft	9440	13	81	< 1	< 5	< 5	< 5	33
B07120398-010	CH-07 36 - 46 ft	6820	21	86	< 1	10	< 5	< 5	41
B07120398-011	CH-08 0 - 6 ft	13600	11	293	< 1	< 5	< 5	< 5	47
B07120398-012	CH-08 6 - 11 ft	8270	6	184	< 1	< 5	< 5	< 5	24
B07120398-013	CH-08 11 - 20 ft	9330	5	194	< 1	< 5	< 5	< 5	26
B07120398-014	CH-08 20 - 30 ft	9650	11	88	< 1	< 5	< 5	< 5	38
B07120398-015	CH-08 30 - 40 ft	10000	8	166	< 1	< 5	< 5	< 5	31
B07120398-016	CH-08 40 - 50 ft	12200	10	172	< 1	< 5	< 5	< 5	36
B07120398-017	CH-08 50 - 60 ft	11000	9	165	< 1	< 5	< 5	< 5	32
B07120398-018	CH-08 60 - 70 ft	12900	12	148	< 1	< 5	< 5	< 5	45

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project: Coal Hollow Project
Workorder: B07120524

Report Date: 12/18/07
Date Received: 12/07/07

	Analysis	Sand	Silt	Clay	Very Fine Sand	Texture	pH, Sat Paste	Cond_ Paste	Saturation	Ca, Sat Paste	Mg, Sat Paste	K, Sat Paste	Na, Sat Paste	SAR
	Units	%	%	%	wt%		s_u_	mmhos/cm	%	meq/L	meq/L	meq/L	meq/L	unitless
Sample ID	**Client Sample ID**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
B07120524-001	CH-01-05, Coal Grab Sample	92	5	3	5	S	5.70	3.04	75.0	24.8	15.5	0.22	4.42	0.99

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project: Coal Hollow Project
Workorder: B07120524

Report Date: 12/18/07
Date Received: 12/07/07

	Analysis	Neut Potential	Acid Potential	Acid/Base Potential	S, Total	S, H2O Extr	S, HCL Extr	S, HNO3 Extr	S, Residual	Lime	Organic Carbon	Nitrate as N	B-H2O Extr	Se-H2O Extr
	Units	t/kt	t/kt	t/kt	%	%	%	%	%	%	wt%	mg/kg	mg/kg	mg/kg
Sample ID	**Client Sample ID**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
B07120524-001	CH-01-05, Coal Grab Sample	25	81	-56	2.78	0.18	0.01	1.34	1.25	2.5	38.5	1	5.6	< 0.01

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project: Coal Hollow Project
Workorder: B07120524

Report Date: 12/18/07
Date Received: 12/07/07

	Analysis	As-Total	Ba-Total	Cd-Total	Cr-Total	Cu-Total	Fe-Total	Pb-Total	Mn-Total	Hg-Total	Mo-Total	Se-Total	Ag-Total	Zn-Total
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Sample ID	**Client Sample ID**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
B07120524-001	CH-01-05, Coal Grab Sample	< 8	53	< 1	< 5	9	8830	< 5	47	< 1	< 5	< 8	< 5	17

Profile 1. A Family: fine, mixed, superactive, mesic Aridic Calciustept, photo not available.

Profile 2. D Family: fine, mixed, superactive, mesic Aridic Calciustept.

Profile 3. M Family: fine, mixed, superactive, mesic Aridic Calciustept.

Profile 4. Calendar Family: fine, mixed, superactive, mesic Aridic Haplustepts.

Profile 5. Jonale Family: fine-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 5 Area. Surrounding area.

Profile 6. Cibeque Family: fine-loamy, mixed, superactive, mesic Aridic Calciustept.

Profile 6 Area. Surrounding area.

Profile 7. D Family: fine, mixed, superactive, mesic Aridic Calciustoll.

Profile 9A. Graystone; coarse-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 8. Jonale Family: fine-loamy, mixed, superactive, mesic Aridic Calciustoll.

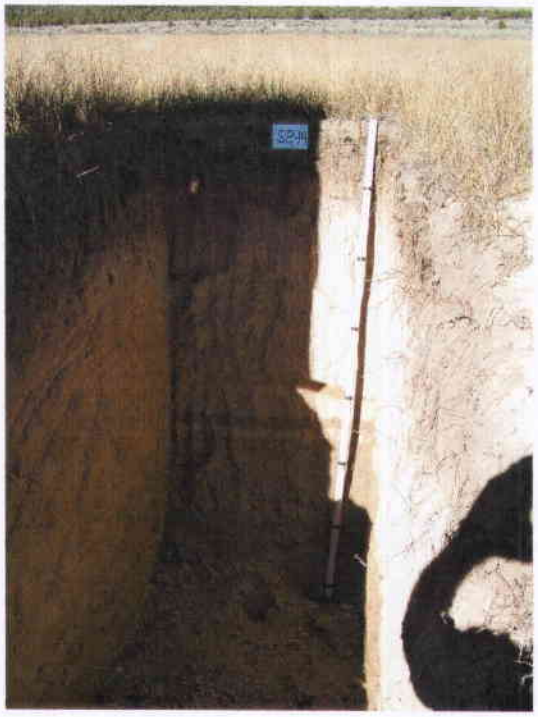
Profile 9B. Cookcan: coarse-loamy, mixed, superactive, frigid Typic Calciaquoll.

Profile 10. Jonale Family: fine-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 12. M Family: fine, mixed, superactive, mesic Aridic Calciustept.

Profile 11. Graystone: coarse-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 13. Cibeque Family: fine-loamy, mixed, superactive, mesic Aridic Calciustept.



Profile 14. I Family: fine-loamy, mixed, superactive, frigid Aquic Calciustept.

Profile 16. Jonale Family: fine-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 15. Graystone: coarse-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 17. Jonale Family: fine-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 18A. Alamosa: fine-loamy, mixed, superactive, frigid Typic Argiaquoll.

Profile 19. Wapiti Family: fine-loamy, mixed, superactive, mesic Calcidic Argiustoll.

Profile 18B. Jonale Family: fine-loamy, mixed, superactive, frigid Aridic Calciustoll.

Profile 20. Graystone: coarse-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 21. Snilloc: coarse-loamy, mixed, superactive, mesic Aridic Calciustept.

Profile 23. Jonale Family: fine-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 22 Brumley: fine-loamy, mixed, superactive, mesic Calcidic Haplustalf.

Profile 24. Calendar Family: fine, mixed, superactive, mesic Aridic Haplustepts.

Profile 25. M family: fine, mixed, superactive, mesic Aridic Calciustept.

Profile 26. N Family: fine, mixed, superactive, frigid Aquic Calciustoll.

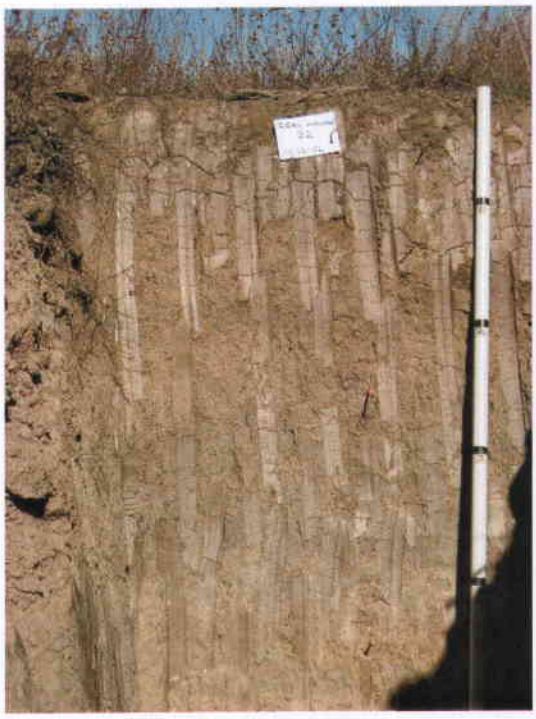
Profile 27 A Family: fine, mixed, superactive, mesic Aridic Calciustept, photo not available.

Profile 28. A Family: fine, mixed, superactive, mesic Aridic Calciustept.

Profile 29. D Family: fine, mixed, superactive, mesic Aridic Calciustoll, photo not available.

Profile 30. A Family; fine, mixed, superactive, mesic Aridic Calciustept.

Profile 31. Wapiti Family: fine-loamy, mixed, superactive, mesic Calcidic Argiustoll, photo not available.



Profile 32 Wapiti Family: fine-loamy, mixed, superactive, mesic Calcidic Argiustoll.

Profile 33. D Family: fine, mixed, superactive, mesic Aridic Calciustoll, photo not available.

Profile 34. Jonale Family; fine-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 35. Jonale Family: fine-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 34 Area. Surrounding area.

Profile 35 Area. Surrounding area.

Profile 36. Graystone: coarse-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 37. Graystone: coarse-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 36 Area. Surrounding area.

Profile 37 Area. Surrounding area.

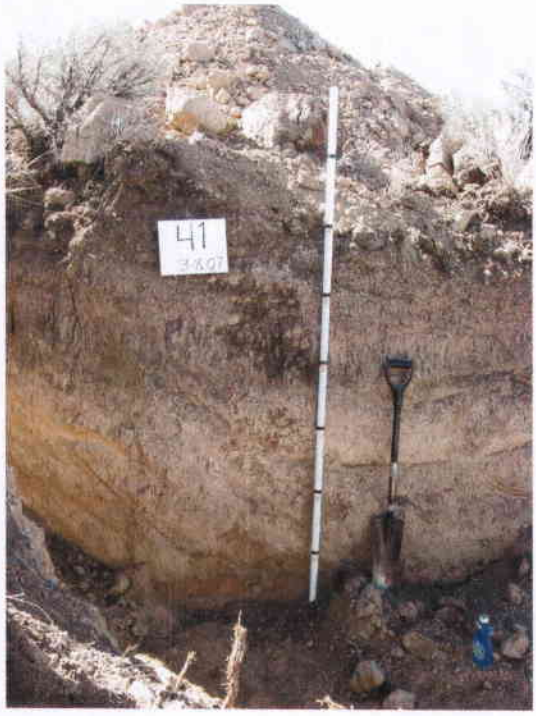
Profiles 38. Happyhollow Family: fine, mixed, superactive, frigid Aeric Epiaquept.

Profile 39. Graystone cobbly substratum family: coarse-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 38 Area. Surrounding area.

Profile 39 Area. Surrounding area.

Profile 40. Tetonview Family: fine-loamy, mixed, superactive, frigid Aeric Calciaquoll.



Profile 41. D Family: fine, mixed, superactive, mesic Aridic Calciustoll.

Profile 42. Deacon: fine-loamy, mixed, superactive, mesic Aridic Haplustoll.

Profile 41 Area. Surrounding area.

Profile 42 area. Surrounding area.

Profile 43. Jicarilla Family: fine, mixed, superactive, frigid Typic Argiaquoll, photo not available.

Profile 44. Happyhollow Family: fine, mixed, superactive, frigid Aeric Epiaquept.

Profile 45. Happyhollow Family: fine, mixed, superactive, frigid Aeric Epiaquept.

Profile 46. Alamosa: fine-loamy, mixed, superactive, frigid Typic Argiaquoll.

Profile 47. Brumley: fine-loamy, mixed, superactive, mesic Calcidic Hapustalf.

Profile 48. Manzanst Taxadjunct Family: fine, mixed, superactive, mesic Aridic Haplustalf.

Profile 49 Area. Drififtу Family: loamy, mixed, superactive, calcareous, mesic Aridic Lithic Ustorthent.

Profile 50. Zigzag: clayey, mixed, superactive, calcareous, mesic, shallow Aridic Ustorthent.

Profile 51. Brumley: fine-loamy, mixed superactive, mesic Calcidic Haplustalf. No photo available.

Photo 52. I Family: fine-loamy, mixed, superactive, frigid Aquic Calciustept.

Photo 53. Disturbed soil with single head sunflower.

Photo 54. Happyhollow Family: fine, mixed, superactive, frigid Aeric Epiaquept.

Photo 55. Cibeque Family: fine-laomy, mixed, superactive, mesic Aridic Calciustept.

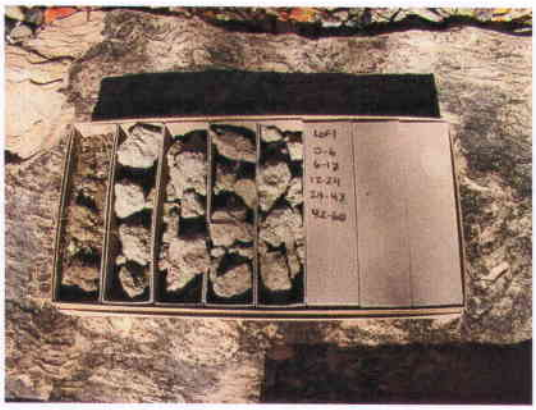
Photo 56. Wapiti Family: fine-loamy, mixed, superactive, mesic Calcidic Argiustoll.

Photo 57. Cibeque Family. fine-loamy, mixed, superactive, mesic Aridic Calciustept.

Photo 58. Manzanst Taxadjunct Family: very fine, mixed, superactive, mesic Aridic Haplustalf.

Photo 59. A Family: fine, mixed, superactive, mesic Aridic Calciustept.

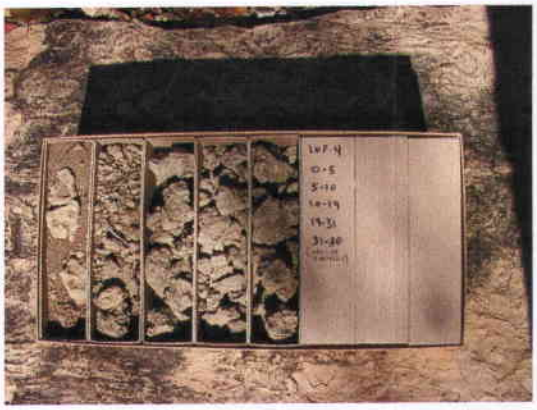
Photo 60. Manzanst Taxadjunct Family: very fine, mixed, superactive, mesic Aridic Haplustalf.



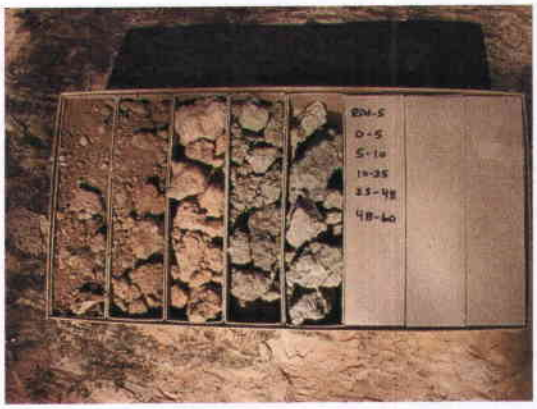
Profile 1. A Family: fine, mixed, superactive, mesic Aridic Calciustept.

Profile 2. D Family: fine, mixed, superactive, mesic Aridic Calciustept.

Profile 3. M Family; fine, mixed, superactive, mesic Aridic Calciustept.

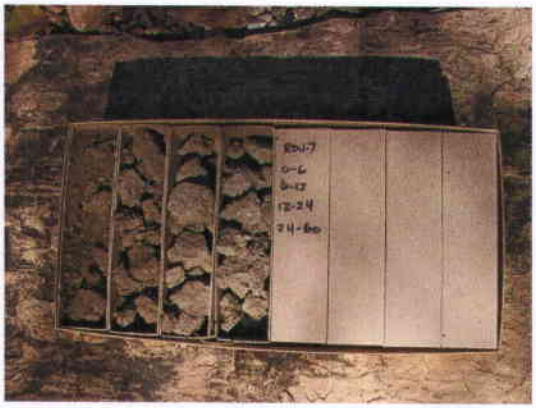


Profile 4. Calendar Family: fine, mixed, superactive, mesic Aridic Haplustepts.



Profile 5. Jonale Family: fine-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 6. Cibeque Family: fine-loamy, mixed, superactive, mesic Aridic Calciustept.



Profile 7. D Family: fine, mixed, superactive, mesic Aridic Calciustoll.

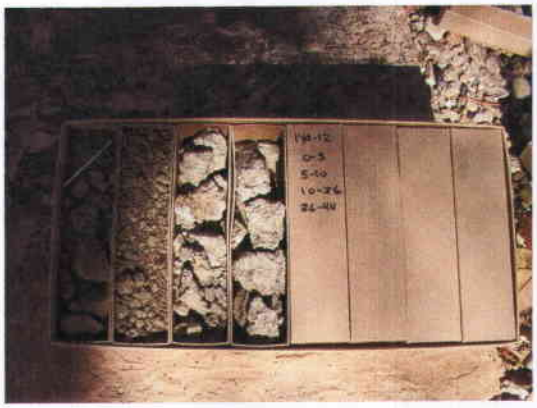
Profile 8. Jonale Family: fine-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 9A. Graystone: coarse-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 9B. Photo not available: Cookcan: coarse-loamy, mixed, superactive, frigid Typic Calciaquoll.

Profile 10. Jonale Family: fine-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 11. Graystone: coarse-loamy, mixed, superactive, mesic Aridic Calciustoll.



Profile 12. M Family: fine, mixed, superactive, mesic Aridic Calciustept.

Profile 13. Cibeque Family: fine-loamy, mixed, superactive, mesic Aridic Calciustept.

Profile 14. I Family: fine-loamy, mixed, superactive, frigid Aquic Calciustept.

Profile 15. Graystone: coarse-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 16. Jonale Family: fine-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 17. Jonale Family: fine-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 18A. Alamosa: fine-loamy, mixed, superactive, frigid Typic Argiaquoll.

Profile 18B. Jonale Family: fine-loamy, mixed, superactive, frigid Typic Argiaquoll.

Profile 21. Snilloc: coarse-loamy, mixed, superactive, mesic Aridic Calciustept.

Profile 19. Wapiti Family: fine-loamy, mixed, superactive, mesic Calcidic Argiustoll.

Profile 22. Brumley: fine-loamy, mixed, superactive, mesic Calcidic Haplustalf.

Profile 20. Graystone: coarse-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 23. Jonale Family: fine-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 24. Calendar Family: fine, mixed, superactive, mesic Aridic Haplustepts.

Profile 27. A Family: fine, mixed, superactive, mesic Aridic Calciustept.

Profile 25. M Family: fine, mixed, superactive, mesic Aridic Calciustept.

Profile 28. A Family: fine, mixed, superactive, mesic Aridic Calciustept.

Profile 26. N Family: fine, mixed, superactive, frigid Aquic Calciustoll.

Profile 29. D Family: fine, mixed, superactive, mesic Aridic Calciustoll.

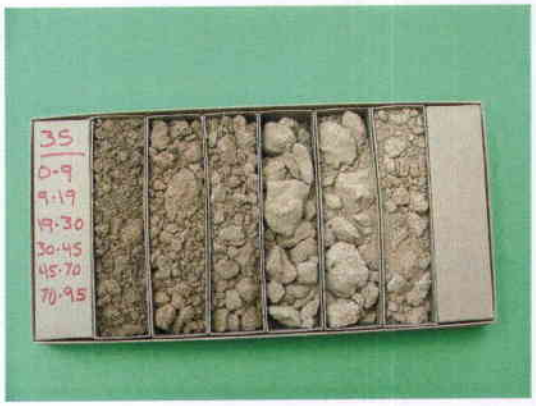
Profile 30. A Family: fine, mixed, superactive, mesic Aridic Calciustept.

Profile 33. D Family: fine, mixed, superactive, mesic Aridic Calciustoll.

Profile 31. Wapiti Family: fine-loamy, mixed, superactive, mesic Calcidic Argiustoll.

Profile 34. Jonale Family: fine-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 32. Wapiti Family: fine-loamy, mixed, superactive, mesic Calcidic Argiustoll.



Profile 35. Jonale Family: fine-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 36. Graystone: coarse-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 37. Graystone: coarse-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profiles 38 (Left) and 40 (Right). Happyhollow Family: fine, mixed, superactive, frigid Aeric Epiaquept; Tetonview Family: (40) fine-loamy, mixed, superactive, frigid Aeric Calciaquoll.

Profile 39. Graystone cobbly substratum Family: coarse-loamy, mixed, superactive, mesic Aridic Calciustoll.

Profile 41. D Family: fine, mixed, superactive, mesic Aridic Calciustoll.

Profile 42. Deacon: fine-loamy, mixed, superactive, mesic Aridic Haplustoll.

Profile 43. Jicarilla Family: fine, mixed, superactive, frigid Typic Argiaquoll.

Profile 46. Alamosa: fine-loamy, mixed, superactive, frigid Typic Argiaquoll.

Profile 44. Happyhollow Family: fine, mixed, superactive, frigid Aeric Epiaquept.

Profile 47. Brumley: fine-loamy, mixed, superactive, mesic Calcidic Hapustalf.

Profile 45. Happyhollow Family: fine, mixed, superactive, frigid Aeric Epiaquept.

Profile 48. Manzanst Taxadjunct Family: very fine, mixed, superactive, mesic Aridic Haplustalf.

Profile 49 (Left) and 50 (Right). Drifity Family (49): loamy, mixed, superactive, calcareous, mesic Aridic Lithic Ustorthent; and Zigzag (50): clayey, mixed, superactive, calcareous, mesic, shallow Aridic Ustorthent.

Profile 51. Brumley: fine-loamy, mixed, superactive, mesic Calcidic Haplustalf.

Profile 52. I Family: fine-loamy, mixed, superactive, frigid Aquic Calciustept.

Profile 53. Disturbed soil with one-head sunflowers.

Profile 54. Happyhollow Family: fine mixed, superactive, frigid Aeric Epiaquept.

Profile 55. Cibeque Family: fne-loamy, mixed, superactive, mesic Aridic Calciustept.

Profile 56. Wapiti Family: fine-loamy, mixed, superactive, mesic Calcidic Argiustoll.

Profile 57. Cibeque Family: fine-loamy, mixed, superactive, mesic Aridic Calciustept.

Profile 58. Manzanst Taxadjunct Family: very fine, mixed, superactive, mesic Aridic Haplustalf.

Profile 59. A Family: fine, mixed, superactive, mesic Aridic Calciustept.

Profile 60. Manzanst Taxadjunct Family: very fine, mixed, superactive, mesic Aridic Haplustalf.

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R645-301-200 Soils, Soil Survey Map Replacement

Replaces Drawing 2-1

This update replaces Drawing 2-1. The order 2 soils survey has been updated to include the entire permit area and some adjacent property.

R645-301-300 Biology, Chapter 3 Text Replacement

Replaces Text in Chapter 3

Chapter 3 text has been updated to reflect new information from vegetation sampling in the fall of 2007. The latest information from this sampling is provided in the main text for Chapter 3.

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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.

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.

[**NOTE**: The rabbitbrush/sagebrush community was not sampled for baseline data information. This small area represented less that 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].

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 operations during the first year of mining activities. The proposed disturbed pasture land (*south*) was an area proposed for disturbance by operations in the second year of mining activities.

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**)].

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	2.38	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

322. FISH AND WILDLIFE INFORMATION

322.100. Agency Consultation and Studies Conducted

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.

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		
SCIENTIFIC NAME	COMMON NAME	STATUS*
PLANTS		
Asclepias welshii	Welsh's Milkweed	T
Carex specuicola	Navajo Sedge	T
Cycladenia humilis var jonesii	Jones Cycladenia	T
Lesquerella tumulosa	Kodachrome Bladderpod	E
Pediocactus sileri	Siler Pincushion Cactus	T
ANIMALS		
Cicindela limbata albissima	Coral Pink Sand Dunes Tiger Beetle	C
Coccyzus americanus	Yellow-billed Cuckoo (possible)	C
Cynomys parvidens	Utah Prairie-dog	T
Empidonax traillii extimus	Southwestern Willow Flycatcher	E
Gila cypha	Humpback Chub (historical)	E
Gilia elegans	Bonytail (historical)	E
Gymnogypes californianus	California Condor	Exp
Haliaeetus leucocephalus	Bald Eagle	T
Oxyloma kanabense	Kanab Ambersnail	E
Ptychocheilus lucius	Colorado Pikeminnow (historical)	E
Strix occidentalis lucida	Mexican Spotted Owl	T
Xyrauchen texanus	Razorback Sucker (historical)	E
* T=Threatened, E=Endangered C=Candidate, Exp=Experimental		

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.

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. 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, black bear (*Ursus americanus*) habitat was located on the east side of the permit area and continues east for some distance (Drawing 3-2). This habitat has been listed as "year-long" and classified as having "substantial" habitat by DWR.

Next, Rocky Mountain elk (*Cervus canadensis*) habitat was located in the area. "High-value" summer range was mapped throughout the entire area from the town of Alton south into Sink Valley. Additionally, year-long "substantial" 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. The habitat has been classified as "high-value" summer range and was located throughout the permit and adjacent areas (Drawing 3-4).

Finally, sage-grouse (*Centrocercus urophasianus*) habitat has been documented in the project area. DWR has mapped much of the area to be 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 "*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**).

In 2006 to the present, 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, took 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 is currently being conducted. An effort by the U.S. Department of Interior, Bureau of Land Management (BLM) and the State of Utah, Division of Wildlife Resources (DWR) removed many of the juniper trees that have encroached the valley by grinding them up by chipping 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 2,000 juniper trees have been removed by this technique. In doing so, the technique causes relatively minor impacts to the sagebrush component of the community.

In addition to the habitat improvements mentioned above for sage-grouse, seed mixtures to restore pasture lands disturbed by mining will include plant species that are used by the birds for food, cover and breeding. Moreover, one area that is presently 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 (see Postmining Land Use, Chapter 4, for more detailed information).

322.230. Other Species or Habitats

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.

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.

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 ground-truthing), 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.

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

Because mining in the Coal Hollow Project area will be a surface operation, and subsidence is usually associated more with underground mining, it is not considered a factor for the Coal Hollow Project. However, current elevation of the existing topography may be slightly altered in the mining and reclamation operations. 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 area. 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

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. 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: 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 following measures to minimize impacts and enhance habitat for this species have been propose and are subject to further consideration by the operator and regulatory agencies.

Short-Term Mitigation Plan

The following information was taken directly from the "*Alton Sage-Grouse Habitat Assessment and Mitigation Plan*" (**Appendix 3-1**).

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. 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. Sites could be selected for storing these materials that are distant from prime sage-grouse habitat, in particular potential nesting habitat. Coal processing equipment will be located in areas that create the least possible disturbance to sage-grouse and sage-grouse habitat. Intact sagebrush sites will be cleared of all young juniper trees with the use of chainsaws or hand tools. 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.

Long-Term Mitigation Plan

The following information was taken directly from the "*Alton Sage-Grouse Habitat Assessment and Mitigation Plan*" (**Appendix 3-1**) and "*Sage-grouse Distribution and Habitat Improvement in Alton, Utah*" (**Appendix 3-3**).

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.

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 2,000 juniper trees that had encroached the sagebrush open areas. Long-term mining plans will remove hundreds of acres of juniper woodlands, significantly increasing conditions that are more suitable to sage-grouse nesting and post- nesting requirements. This landscape-level operation could greatly enhance sagebrush restoration objectives by the BLM that is currently limited by constrained budgets and manpower.

Over time, juniper encroachment has likely been the primary factor in isolating the Alton sage-grouse population from nearby populations. According to local sources, a sage-grouse population is 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.

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, irrigated alfalfa fields will be created in Swapp Valley (south of the Swapp Ranch house). In addition to alfalfa, many sage-grouse forage species (forbs) will be included in the seed mix. This will increase brood-rearing habitat closer to breeding and

nesting habitat. This in turn will reduce potential predation that occurs near towns by ravens, crows, cats, dogs and people. It will also reduce bird mortality associated with large-scale farming practices.

The Alton sage-grouse population could be enhanced by importing birds from nearby populations that are relatively large and stable. Captured and relocated birds (initially 10-15) in the Alton area will increase genetic diversity as well as stabilize population numbers to offset losses associated with disease and emigration (unrelated to mining activities). Additionally, birds from the Alton population (5-10) can be trapped and released in a nearby population through the mining period. Once complete, these birds can be trapped again and returned to the original Alton population. This will ensure the survival of members of the original Alton population.

Habitat Reclamation Plan

Taken directly from the "*Alton Sage-Grouse Habitat Assessment and Mitigation Plan*" (**Appendix 3-1**), the following habitat reclamation plan has been proposed.

Seed mixes that are used for reclamation will consist of native grasses and forb species that provide cover and food in order to accelerate shrub re-establishment, bareroot or potted sagebrush and bitterbrush transplants will be planted. To ensure the integrity of the planting materials, indigenous seed and cuttings could be collected for reclamation. At Bryce Canyon National Park, seed and transplants obtained from indigenous materials had greater long-term survival and higher cover and production than commercial varieties of the same species (Petersen et al. 2004).

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 followed by chemical treatments will be applied.

Seeding and planting will occur in the fall season following the growing season and into dormancy. 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.

Monitoring Plan

Taken directly from the "*Alton Sage-Grouse Habitat Assessment and Mitigation Plan*" (**Appendix 3-1**), the following monitoring plan has been proposed.

Birds trapped and relocated to the Alton population will be collared with radio- collars. Birds will be monitored throughout the year to assess bird survival, nest site and nest success, brood-rearing sites, and key winter habitat areas. Lek counts will be conducted each year to determine the number of birds at the lek. Reclamation sites will be monitored to assess restoration success. With the establishment of desirable plant communities, sagebrush obligate species habitat will be

improved. Birds that depend on these communities include sage sparrows (*Oreoscoptes montanus*), sage thrasher (*Amphispiza belli*), and Brewer's sparrow (*Spizelis breweri*). Also, mule deer habitat will increase, especially with the establishment of antelope bitterbrush and other palatable browse species. Grassland development will also increase forage for elk (*Cervus canadensis*). Reclaimed sites will be monitored to assess utilization by these and other wildlife species.

To provide consistent monitoring and assessment, plans are being discussed to employ a graduate student from an established university to use this project as the basis for a graduate thesis. This would provide peer-reviewed research and monitoring of this project. It would also provide a mechanism for publishing the results of this project as a source of information and knowledge that can be applied to similar work in other areas.

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. Briefly, the mine will conduct operations in one area (segment) at a time. No more than 40 acres will be disturbed at one time for mining. Once mined, the plan includes redistributing subsoil and topsoil followed by seeding this segment with the final seed mix contemporaneously, or at the same time the mining of the next segment begins. However, seeding will be accomplished only in appropriate periods (usually late-fall, but early-spring could also be an option). 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 has been included in Chapter 5 of this document.

341.200. Reclamation Description

The Coal Hollow Project 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	
MAP SYMBOL (see *Vegetation Map, Drawing 3-1*)	PLANT COMMUNITY
S/G	Sagebrush/Grass
P	Pasture Land
P-J	Pinyon-Juniper
M	Meadow
OB	Oak brush
RB/SB	Rabbitbrush/Sagebrush

Seed mixtures for each disturbance type are shown on Tables 3-37 *through* 3-42. 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/ft^2
SHRUBS		
*Artemisia nova**	0.20	4.16
*Artemisia tridentata**	0.10	5.74
Ceratoides lanata	3.00	3.79
Purshia tridentata	15.00	5.17
Symphoricarpos oreophilus	3.00	5.17
FORBS* **		
Achillea millefolium	0.03	1.91
Hedysarum boreale	5.00	3.86
Linum lewisii	0.70	4.47
Lupinus argenteus	15.00	4.30
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
TOTALS	**47.23**	**75.60**

* 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/ft^2
SHRUBS		
FORBS**		
Achillea millefolium	0.04	2.54
Astragalus cicer	1.50	4.99
Hedysarum boreale	6.00	4.63
Linum lewisii	1.00	6.38
Medicago sativa	1.00	4.82
GRASSES		
Bromus inermis	1.00	2.87
Dactylis glomeratus	0.20	3.00
Elymus smithii	1.50	4.34
Elymus lanceolatus	1.50	5.30
Elymus junceus	1.00	4.02
Elymus hispidus	2.00	4.27
Phleum pratensis	0.20	5.97
Poa pratensis	0.10	5.00
TOTALS	**17.04**	**58.14**

* 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 3-39: Revegetation Seed Mixture for the Pinyon-Juniper Community at the Coal Hollow Project

	Rate* (# PLS/Ac)	Seeds/ft^2
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
TOTALS	**49.81**	**77.67**

* 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/ft^2
SHRUBS		
FORBS**		
Iris missouriensis	15.00	7.23
Achillea millefolium	0.10	6.36
GRASSES (or Grass-likes)		
Carex microptera	0.40	7.78
Carex nebrascensis	0.50	6.13
Elymus trachycaulus	2.00	7.35
Phleum pratensis	0.20	5.97
Poa pratensis	0.10	5.00
Poa secunda	0.30	6.37
Scirpus americanus.	2.00	8.26
Sporobolus airoides	0.20	8.03
TOTALS	**20.80**	**68.47**

* 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/ft^2
SHRUBS		
Amelanchier utahensis	10.00	5.92
Artemisia nova	0.20	4.16
Artemisia tridentata var. vaseyana	0.07	4.02
Cercocarpus montanus	3.00	4.06
Purshia tridentata	12.00	4.13
Symphoricarpos oreophilus	3.00	5.17
Ephedra viridis	8.00	4.59
FORBS		
Artemisia ludoviciana	0.04	4.13
Sphaeralcea coccinea	0.40	4.59
Vicia americana	12.00	5.51
Viguiera multiflora	0.20	4.84
GRASSES		
Bromus carinatus	2.00	4.59
Elymus spicatus	1.50	4.82
Elymus trachycaulus	1.50	5.51
Poa pratensis	0.10	5.00
Poa secunda	0.20	4.25
Stipa hymenoides	1.00	4.32
TOTALS	**55.21**	**79.62**

* 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/ft^2
SHRUBS		
*Artemisia nova**	0.20	4.16
*Artemisia tridentata**	0.10	5.74
Ceratoides lanata	3.00	3.79
Purshia tridentata	15.00	5.17
Symphoricarpos oreophilus	3.00	5.17
FORBS* **		
Achillea millefolium	0.03	1.91
Hedysarum boreale	5.00	3.86
Linum lewisii	0.70	4.47
Lupinus argenteus	15.00	4.30
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
TOTALS	**47.23**	**75.60**

* 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.*

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 soil 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 may include:

- Electrical conductivity (EC)
- Sodium adsorption ratio (SAR)
- pH
- Texture
- Organic matter
- Available phosphorus (P)
- Potassium (K)
- Nitrate

If heavy equipment results in soil compaction at the surface of the reclaimed areas, they will then be ripped, disked, and harrowed to loosen the seedbed prior to seeding. 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.

In some of the more sloped areas that will be reclaimed to the native plant community, "roughening" or "gouging" may also be employed. The gouges would be depressions created at the surface with dimensions of approximately 1.5 ft (d) x 3 ft (l) x 3 ft (w).

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.

Containerized plants will 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 "watered-in" 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 in areas that will be reclaimed to native plant communities (areas used for pasture lands will not be mulched). 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.

Certified weed-free *straw* will be used in those areas where drill seeding has been employed at a rate of 1 ton/acre. The straw will be crimped or otherwise held to the surface by tackifier or plastic mesh stapled to the ground.

In those areas where broadcast seeding is employed, straw or *hydro-mulch* may be used. In other areas where hydro-seeding is employed, hydro-mulching will also be done. In such cases, seed and mulch will be applied as separate applications, with seeding accomplished first. The mulch will be held to the surface by an effective tackifier that is added to the slurry mix prior to application.

Finally, in areas that need extra protection due to steepness of slope or where soils are especially erodible, erosion control mat will be utilized. Several excellent materials are available and will be applied at the manufactures recommended rates.

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.

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.

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).

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).

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). 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).

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:

$$Total\ Diversity = \frac{1}{\sum P_i^2}$$

where,

P_i = the proportion of the sum frequency for a community contributed by the ith 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 3-1*). 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*).

356.230. 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.

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-by-case 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 (see Chapter 7). At this time, the Coal Hollow Project plans to avoid disturbances to them, enhance them where practicable, and restore, or replace, wetlands and riparian vegetation along rivers and streams if disturbance to them it done.

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.

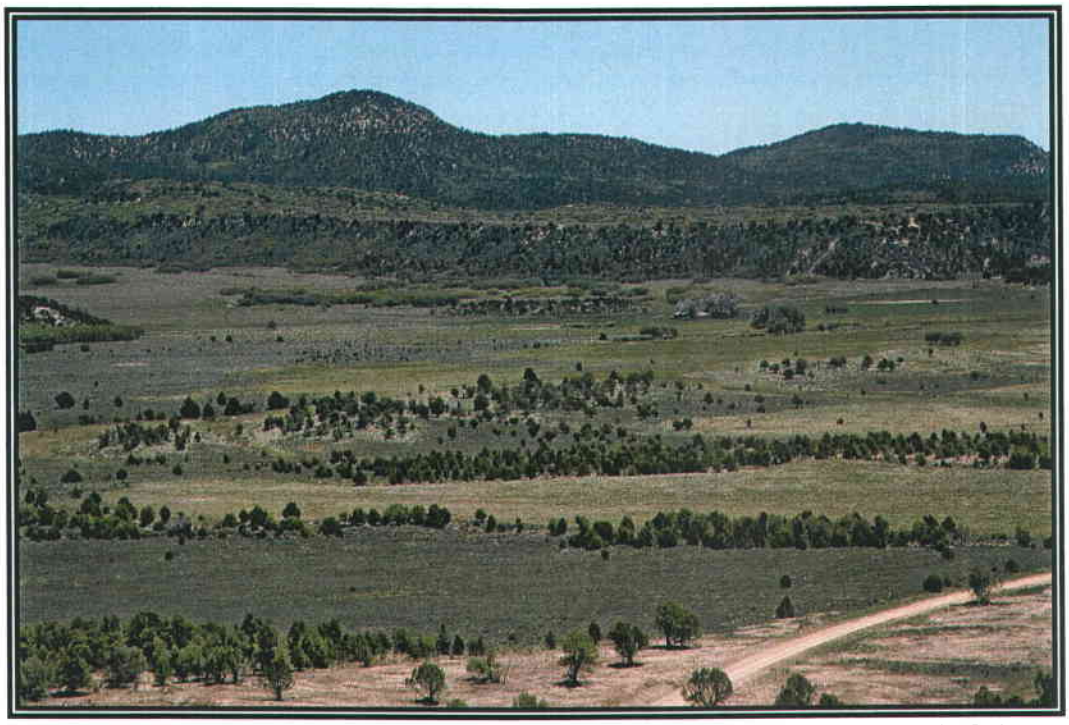
358.520. Fences & Conveyers

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 will fence, cover, or use other appropriate methods to exclude wildlife from ponds which contain hazardous concentrations of toxic-forming materials.

PHOTOGRAPHS



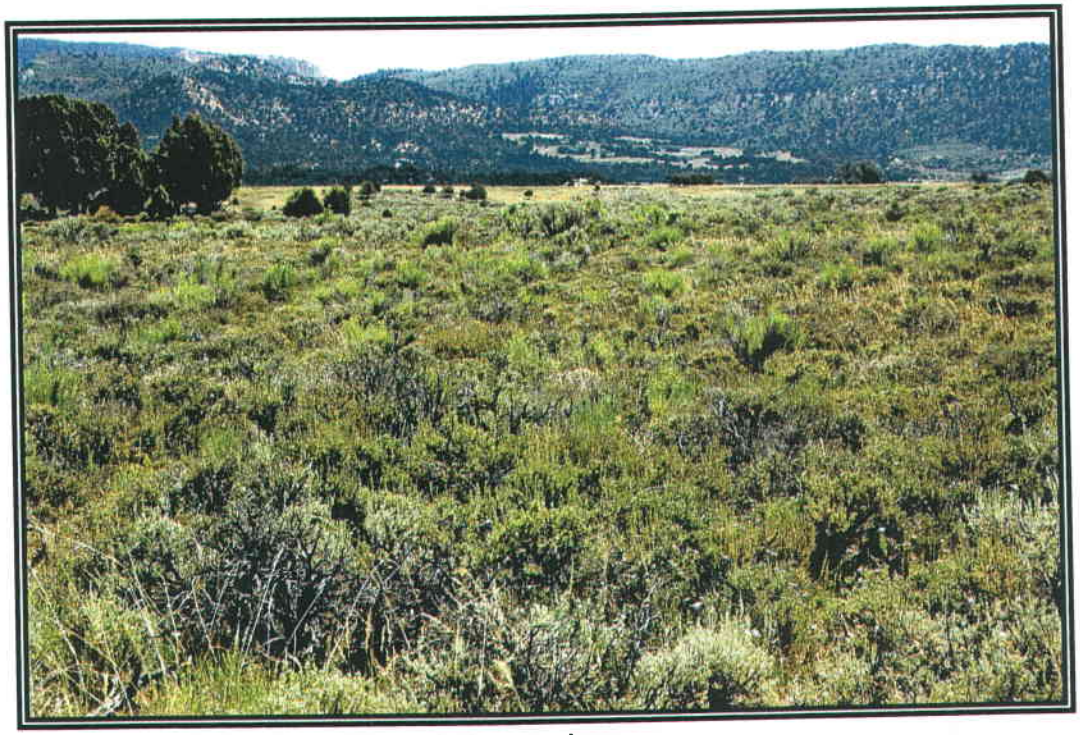
Photograph 3-1: Plant Communities of the Coal Hollow Project (General View: 1 of 4)

Photograph 3-2: Plant Communities of the Coal Hollow Project (General View; 2 of 4)

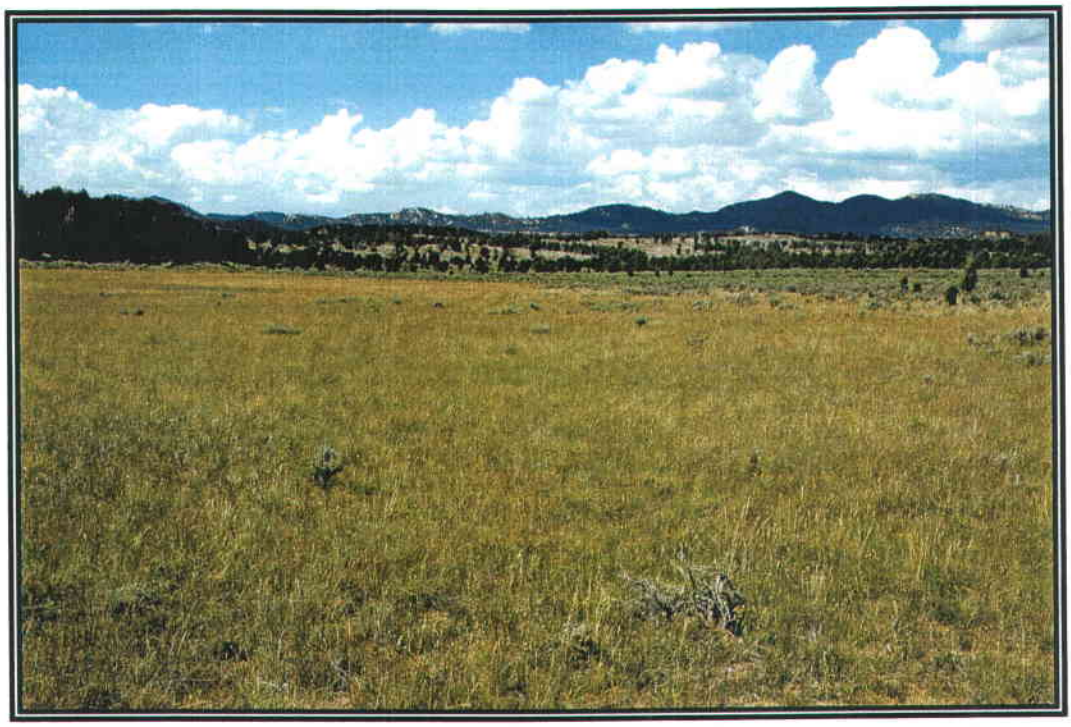
Photograph 3-3: Plant Communities of the Coal Hollow Project (General View: 3 of 4)

Photograph 3-4: Plant Communities of the Coal Hollow Project (General View: 1 of 4)

Photograph 3-5: Proposed Disturbed Sagebrush/Grass Community



Photograph 3-6: Sagebrush/Grass Reference Area

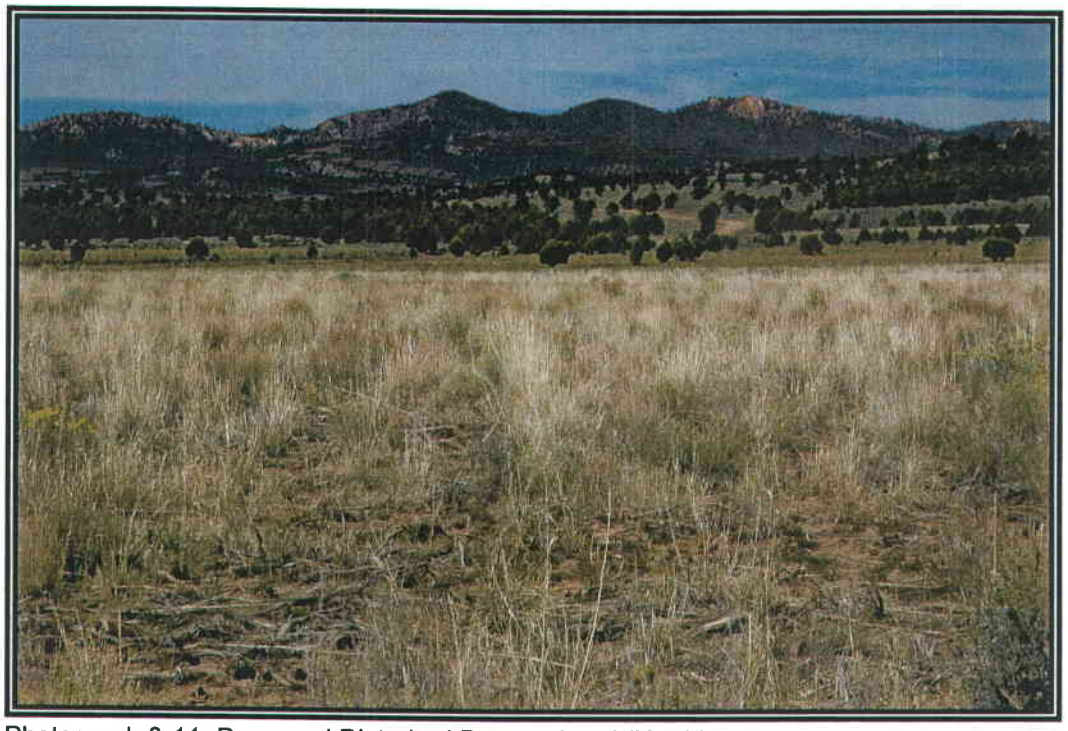


Photograph 3-7: Proposed Disturbed Meadow Community (Dry)

Photograph 3-8: Meadow (Dry) Reference Area

Photograph 3-9: Proposed Disturbed Pinyon-Juniper Community

Photograph 3-10: Pinyon-Juniper Reference Area

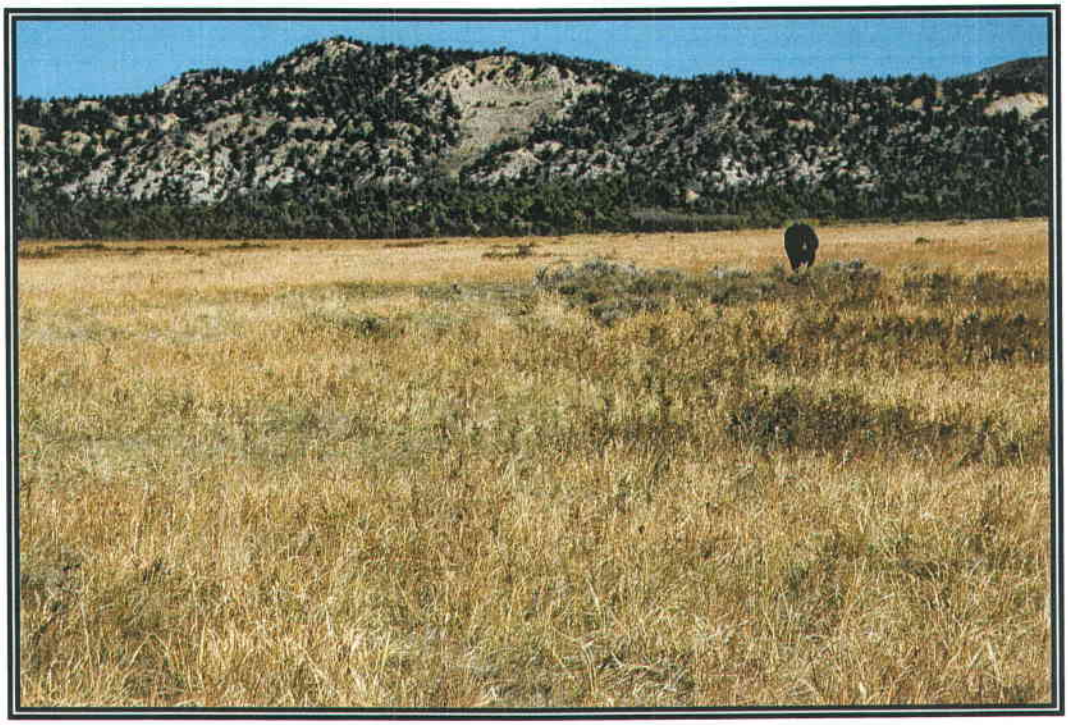


Photograph 3-11: Proposed Disturbed Pasture Land (North)

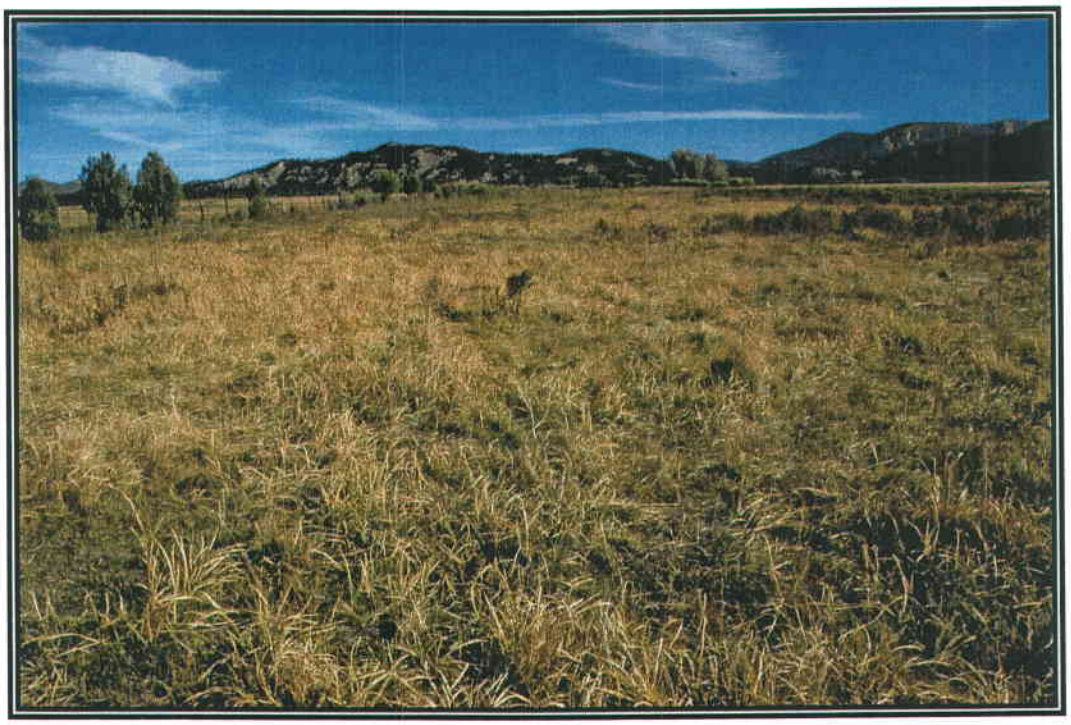
Photograph 3-12: Proposed Disturbed Pasture Land (South)

Photograph 3-13: Proposed Disturbed Oak Brush

Photograph 3-14: Oak Brush Reference Area



Photograph 3-15: Proposed Disturbed Meadow Community



Photograph 3-16: Meadow Reference Area

R645-301-300 Biology, Vegetation Sampling Appendix

Additional Appendix 3-4

This appendix is an addition to Chapter 3. This appendix is meant to be placed at the end of the appendices section in Chapter 3.

APPENDIX 3-4

VEGETATION SAMPLING IN THE COAL HOLLOW PROJECT AREA

2007

FOR
ALTON COAL DEVELOPMENT

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INTRODUCTION

A surface coal mine has been proposed near the town of Alton, Utah. The company developing the mine is called **Alton Coal Development** – the mine project is called the *Coal Hollow Project*. The proposed new mine is located entirely on private property.

Upon development of the mine, the existing plant communities within the permit area will be disturbed as a consequence of mining activities. The *proposed disturbed* plant communities have been quantitatively sampled to provide baseline data prior to any mine disturbance. Additionally, similar communities that will *not* be disturbed by mining have also been sampled and compared statistically to those proposed for disturbance. These areas, called "Reference Areas", will be used for comparisons at the time of final reclamation for revegetation success standards once the property has been restored to its approximate original condition. Additionally, sampling was conducted in other plant communities outside the permit area that will not be disturbed. This information could provide further information for related studies such as alluvial valley floor (AVF) determinations.

This document is the next report in a sequence of reports showing sampling results for the plant communities of the Coal Hollow Project. A previous report, called *Vegetation of the Sagebrush/Grass & Meadow Areas: 2006,* presented results from quantitative sampling accomplished in 2006 in an area where some of the first of the mining activities have been planned. Since that time, the mining plan has progressed in the planning stages to a point where

more is known about the sequential order in which mining will be conducted. With this refinement to the mine plan, more is known about the specific plant communities that will be disturbed over-time. Consequently, this report identifies the next plant communities to be disturbed by the Coal Hollow Project and shows the results from sampling them.

METHODS

Methodologies used for this study were performed in accordance with the guidelines supplied by the State of Utah, Division of Oil, Gas and Mining (DOGM). Quantitative and qualitative data for this report were taken within the plant communities proposed for disturbance and their respective reference areas in September 2007.

Vegetation Maps

The sample areas were mapped in the field and recorded on a GPS unit. Earlier versions of the Coal Hollow Project vegetation map have been submitted, but a new version that combines previous information with new information has been submitted in the Mining and Reclamation Plan (MRP) for this project. The most current map shows the new sample locations as well as previous sample areas [see MRP, *Vegetation Map, Drawing 3-1 (12/26/07)*].

Sampling Design and Transect/Quadrat Placement

Transect lines for vegetation sampling were placed randomly within the boundaries of the proposed disturbed, reference and other study areas. The transect placement technique was employed with the goal to adequately sample a representative subset of the entire site. Once the transects were randomly established, quadrat locations for sampling were chosen using random numbers from the transect lines with the objective to record data without preconceived bias.

Cover and Composition

Cover estimates were made using ocular methods with meter square quadrats. Species composition, cover by species, and relative frequencies were also assessed from the quadrats. Additional information recorded on the raw data sheets were: estimated precipitation, slope, exposure, grazing use, animal disturbance and/or other appropriate notes. Plant nomenclature follows "A Utah Flora" (Welsh et al., 2003).

Density

Density of woody plant species for the proposed disturbed and reference areas were estimated using the point-quarter method. In this method, random points were placed on the sample sites and measured 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. The number of individuals per acre was the end results of the calculations.

Sample Size & Adequacy

Sampling adequacy for cover and density was attempted by using the formula given below.

$$nMIN = \frac{t^2 s^2}{(dx)^2}$$

where,

nMIN	= minimum adequate sample
t	= appropriate confidence t-value
s	= standard deviation
x	= sample mean
d	= desired change from mean

Statistical Analyses

Student's t-tests were employed to compare the total living cover and total woody species density of each proposed disturbed area with its respective reference area.

Photographs

Color photographs of the sample areas were taken at the time of sampling and have been submitted with this report.

Threatened & Endangered Plant Species

Prior to recording quantitative data on the plant communities, a sensitive plant species survey was conducted. To initiate the study, appropriate agencies were consulted and other sources were reviewed (sensitive species files at *Mt. Nebo Scientific, Inc.*) for potential plant species that are known to be rare, endemic, threatened, endangered or otherwise sensitive in the project area.

RESULTS

Summarized below are the results from quantitatively sampling each plant community for the Coal Hollow Project during the 2007 sample period. Color photographs of each sample site have also been provided new at the end of this report. Locations of the sample areas have been added to a vegetation map [see MRP, *Vegetation Map, Drawing 3-1 (12/26/07)*].

The most recent mine plan indicates that mining will occur for three (3) years. Consequently, disturbances to the plant communities will be done in sequential order and based on the mine plan. Therefore, identifying plant communities for study was based on the mining activities and

the year a given community would be disturbed. Information about the proposed disturbed areas and the year of disturbance is given below. This report, along with the aforementioned report regarding the sampling that was done in 2006, provides data for all plant communities presently known to be proposed for disturbance in the mining operations for the Coal Hollow Project. As a side note, if a specific plant community that has been proposed for disturbance had been sampled previously in one location of the mine permit area, that dataset will also be used to represent other proposed disturbed areas of that same community. For example, sagebrush/grass communities occur in several areas proposed for disturbance, but baseline sampling only occurred in one (or sometimes two with the data combined) of the proposed disturbed sagebrush/grass communities. However, in some areas where a specific plant community has been proposed for disturbance in different mining years (year 1, 2 or 3) and they are located in very close proximity to each other, data have been recorded in the different mine years and combined together to make one dataset. These data can be easily separated in the future if desired. Finally, this report shows the results from sampling other areas that will *not* be disturbed by mining such as reference areas and additional study areas in meadow communities (this will explained later in the report).

Pinyon-Juniper Community (Proposed Disturbed)

Several areas proposed for disturbance by mining activities currently support pinyon-juniper plant communities. For a representative picture of these sample areas see Photograph 1. Pinyon-juniper communities were sampled in two areas. One such area, shown as the "Prop. Dist.

Pinyon-Juniper Sample Area (North)" on the map [see MRP, *Vegetation Map, Drawing 3-1 (12/26/07)*], 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. Another pinyon-juniper sample area or the "Prop. Dist. Pinyon-Juniper Sample Area (South)" on the map, is located near the southern 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.

Overstory cover of the pinyon-juniper community was represented by only two species in the sample quadrats and was dominated by Utah juniper (*Juniperus osteosperma*), followed distantly by pinyon pine (*Pinus edulis*). Understory cover was dominated by black sagebrush (*Artemisia nova*), followed by Utah juniper and pinyon pine (Table 1). 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 2-A). The understory composition by lifeform in this community was comprised of 95.88 % woody species (Table 2-B). Woody species density was measured at 2,657 individuals per acre (Table 3).

Pinyon-Juniper Community (Reference Area)

A reference area, or an area chosen to represent future revegetation success standards, was sampled in another pinyon-juniper plant community (see Photograph 2). This reference area will *not* be disturbed by the mining activities, so it may 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 MRP, *Vegetation Map, Drawing 3-1 (12/26/07)*].

Like the above proposed disturbed community, the overstory cover of the reference area was dominated by Utah juniper followed by pinyon pine. Likewise, understory was also dominated by black sagebrush, Utah juniper and pinyon pine (Table 4). Again, forbs were not present in the quadrats (Table 4); grasses that were present were slender wheatgrass (*Elymus trachycaulus*) 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 5-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 5-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 6).

Pasture Lands (Proposed Disturbed)

The areas called "pasture lands" were plant communities that have been altered to 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 vegetation report mentioned in the *Introduction* of this report. Although differences occur between pastures due to grazing practices and species planted in them, representative pastures were sampled for this study (see Photographs 3 and 4). The sample areas were located near the center of the permit area [see MRP, *Vegetation Map, Drawing 3-1 (12/26/07)*]. Like the community described above, 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 operations during the first year of mining activities. The proposed disturbed pasture land (*south*) was an area proposed for disturbance by operations in the second year of mining activities.

The sampling results for the north and south pasture lands indicated 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 7). 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 8-A). The composition of the pasture land consisted of 52.16% grasses, 30.19% shrubs and 17.64% forbs

(Table 8-B). Woody species density measurements show the 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 9).

Pasture Lands (Reference Area)

Because the pasture lands were unnatural, or comprised of non-native conditions, a native reference area was not chosen. Appropriate standards of revegetation success will be developed using the site-specific knowledge contributed by the landowners and as well as qualified botanists representing the coal company and regulatory agencies.

Oak Brush Community (Proposed Disturbed)

An oak brush community has been proposed for disturbance by future mining operations (see Photograph 5). This community is located in the northeast region of the permit area [see MRP, *Vegetation Map, Drawing 3-1 (12/26/07)*].

Overstory of this community was greater than the understory cover. The dominant overstory species present by a wide margin was Gambel's oak (*Quercus gambelii*) with a 41.25% cover; it was present in 85.00% of the samples. The dominant understory species were big sagebrush, snowberry (*Symphoricarpos oreophilus*) and Gambel's oak (Table 10).

The total living cover in the oak brush community was estimated at 66.75%, 43.00% from overstory and 23.75% came from understory plants (Table 11-A). Woody species comprised 97.75% of the understory composition with the remaining 2.25% coming from grass species. No forbs were present in the sample quadrats (Table 11-B). 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 12).

Oak Brush Community (Reference Area)

A oak brush reference area was chosen to represent future standards for revegetation success (see Photograph 6). This reference area was located on the east side of the permit area [see MRP, *Vegetation Map, Drawing 3-1 (12/26/07)*]. Like the proposed disturbed area it was chosen to represent, the reference area cover was greater for overstory than that of 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 13).

Overstory cover was estimated at 53.25%, whereas understory cover was 20.00%. The total living cover of those covers combined was 73.25% (Table 14-A). Understory lifeform composition was comprised of 66.92% trees and shrubs and 33.08% grasses – no forbs were present in the samples (Table 14-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 15).

Meadow Community (Proposed Disturbed)

Meadow areas in and adjacent to the project area have been studied [see MRP, *Vegetation Map, Drawing 3-1 (12/26/07)*]. A dry meadow was studied earlier and reported in the aforementioned 2006 vegetation report. Another wetter meadow community has been studied that may also be disturbed due to the proposed mining activities (see Photograph 7).

The dominant plant species by cover and frequency in this community were wiregrass *(Juncus arcticus)*, Missouri iris (*Iris missouriensis*) and Wood's rose (*Rosa woodsii*). For a list of all species present in the sample quadrats refer to Table 16. This meadow community had a total living cover of 86.00% (Table 17-A). Of this living cover 51.58% of it was comprised of grasses or grass-like species, 32.54% were forbs and 15.88% were shrubs (Table 17-B). Woody species density of the community was 384 individuals per acre, all of which were Wood's rose plants (Table 18).

Meadow Community (Reference Area)

The reference area, or area chosen to represent future revegetation success standards, was located just outside the permit area [see MRP, *Vegetation Map, Drawing 3-1 (12/26/07)*; Photograph 8]. Similar species dominated this community as were represented in the proposed disturbed area,

namely wiregrass, Missouri iris, Kentucky bluegrass and Wood's rose (Table 19). The total living cover in the reference area was estimated at 88.50% (Table 20-A). Composition here was calculated to be comprised of 51.57% grass and grasslike species, 37.38% forbs and 11.04% shrubs (Table 20-B). Woody species density in this area was estimated at 2,226 plants per acre (Table 21).

Dames' Meadow

One meadow area that *visually* appeared somewhat different than other meadow areas was located outside the permit area and within a private fenced pasture [see MRP, *Vegetation Map, Drawing 3-1 (12/26/07)*]. Unlike the above meadow areas, a tall composite plant was the most common species by cover (see Photograph 9). This plant was onehead sunflower (*Helianthella uniflora*), had a cover of 31.00% and was present in 95% of the sample quadrats (Table 22). However, other plants common in this pasture meadow were also common in other meadow e.g. wiregrass, Missouri iris, Kentucky bluegrass and Wood's rose.

Total living cover, all of it from understory cover, was estimated at 82.50% (Table 23-A). Lifeform composition was comprised fo 54.00% forbs, 41.04% grasses (or grasslike species) and only 4.97% shrubs (Table 23-B). Woody species density was not measured in the meadow because: 1) there were very few woody plants present (as suggested by the cover values for woody plants), 2) the area is outside the permit area and is therefore *not* proposed for disturbance by mining activities, and 3) total living cover, cover and frequency by species and

composition were the desired parameters to be used for comparisons and discussions regarding other studies in the meadow.

Dames' Meadow Reference Area

As mentioned above, Dames' Meadow is *not* proposed for future mining activities. Therefore, revegetation in this area will not be conducted, so a reference for future standards will not be needed.

Sorensen's Meadow

This meadow was another area that will *not* be disturbed by mining operations and was located outside the permit area. It was sampled to provide additional information about the meadow community as a whole. This meadow community was located on Sorensen's property [see MRP, *Vegetation Map, Drawing 3-1 (12/26/07)*] and is currently used for pasture and/or mowed to sustain livestock (see Photograph 10).

As shown on Table 24, the most common species in this area were wiregrass, Missouri iris, Kentucky bluegrass and aster (*Aster* sp.). The total living cover for this area was 86.50% (Table 25-A) and was comprised of 53.84% grasses or grasslike species and 46.16% forbs (Table 25-B). No woody species were present in the sample quadrats.

Woody species density in Sorensen's meadow was not measured for the same reasons as those described in the Dames' meadow. It should be noted, however, that even fewer woody plants were observed in this pasture, possibly due simply to different management techniques such as the mowing mentioned above.

Sorensen's Meadow Reference Area

As mentioned, Sorensen's Meadow has *not* been proposed for future mining activities. Therefore, revegetation in this area will not be conducted, so a reference for future standards will not be needed.

Threatened & Endangered Plant Species Survey

No rare, endemic, threatened, endangered or otherwise sensitive species were found in the study areas.

DISCUSSION & SUMMARY

Total Living Cover

The total living cover of the areas proposed for disturbance by mining and related activities were compared statistically with their respective reference areas. The statistical tests employed to make these comparisons were Student's t-tests. When the total living cover of the proposed disturbed **pinyon-juniper community** was statistically compared with the total living cover of its reference area, the differences were not significant (Figure 1-A). Likewise, when the total living cover of the **oak brush community** was compared to its reference area, the differences here were also non-significant (Figure 1-B). Finally, when the total living cover of the proposed disturbed **meadow community** was compared to the cover of the reference area, the differences again were non-significant (Figure 3-C).

Woody Species Density

Woody species densities of the proposed disturbed areas were also compared statistically to representative reference areas. When the woody species density of the **pinyon-juniper community** was statistically compared with the density of the reference area, Student's t-test suggest that the reference area supported more woody species than the pinyon-juniper community proposed for disturbance by the mining activities (Figure 2-A). Moreover, when the total density of the proposed disturbed **oak brush community** was compared to its reference area, the

differences were also significant – more woody plants occurred in the proposed disturbed area (Figure 2-B). Lastly the woody species density of the proposed disturbed **meadow community** was compared to the meadow reference area. Like the other density comparisons, the differences were statistically significant, with many more individuals per acre occurring in the meadow reference area (Figure 2-C).

Species Present and Composition

Reviewing the data summary tables show that the species present in the sample quadrats and lifeform composition proportions for the areas proposed for disturbance were relatively similar when compared to the respective reference areas.

Reference Area Considerations

Quantitative sampling was conducted in areas proposed for disturbance by coal mining-related activities at the Coal Hollow Project near Alton, Utah. Reference areas chosen to represent future standards for them were also sampled. Total cover (including total living cover, litter cover, rock cover and bareground) were recorded in the sample quadrats. Cover of each plant species were also recorded including the frequency of occurrences of these species. Additionally, lifeform composition of the understory cover was calculated. Finally, the woody species density of each sample area was measured.

Statistical tests comparing specific parameters of the proposed disturbed and reference areas were employed. When total living cover of the areas proposed for disturbance was compared to the appropriate reference areas, the differences were non-significant suggesting that the cover estimates were nearly identical. However, when woody species densities were compared, there appeared to be differences between the proposed disturbed and reference areas.

Nevertheless, the findings do suggest that the reference areas may be appropriate, especially when total living cover is concerned. Even though the woody species densities were dissimilar, these reference areas would likely still be appropriate. It is often difficult to predict the most appropriate number of woody species for wildlife habitat of animals supported on a given community. Trees and shrubs provide forage and cover for many species, but too many woody plants sometimes reduces available forage of understory herbaceous plants for other species. For example, deer and elk can benefit by having oak brush for certain habitat requirements such as cover for concealment, but too high density, or too many of these species per area, can exclude other herbaceous and smaller woody species for forage and browse. In other examples, certain landowners may prefer a minimal amount of woody species to enhance rangeland for domestic livestock. Therefore, at the time of final reclamation, although the reference areas chosen to represent standards for most parameters (i.e. cover, composition and diversity), other considerations can also be used to provide insight for woody species density standards. Collaboration by biologists representing DOGM, DWR and ACD as well as input from the landowners should be considered as a means to provide the woody species density standards. In other words, a specific number of plants per acre can be formulated for this standard – one where

botanists, wildlife biologists and landowners agree upon. For similar reasons the pasture lands were not assigned a reference area for final revegetation standards. As describe in the *Results* above, these areas were not represented in their natural or native condition within the permit area. Final standards for revegetation success can be established for species cover, production and woody species density values of these artificial plant communities with consultations by the same group mentioned above. Finally, with the above considerations, the reference areas chosen for revegetation success standards at the time of final reclamation should be appropriate.

Table 1: Coal Hollow Project. Living Cover and Frequency by Plant Species (2007).

Pinyon-Juniper (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 2: Coal Hollow Project. Total Cover and Composition (2007).

Pinyon-Juniper (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: Coal Hollow Project. Woody Species Density (2007).

Pinyon-Juniper (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 4: Coal Hollow Project. Living Cover and Frequency by Plant Species (2007).

Pinyon-Juniper (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 5: Coal Hollow Project. Total Cover and Composition (2007).

Pinyon-Juniper (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 6: Coal Hollow Project. Woody Species Density (2007).

Pinyon-Juniper (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 7: Coal Hollow Project. Living Cover and Frequency by Plant Species (2007).

Pasture Lands (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 8: Coal Hollow Project. Total Cover and Composition (2007).

Pasture Lands (Proposed Disturbed)		
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	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 9: Coal Hollow Project. Woody Species Density (2007).

Pasture Lands (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 10: Coal Hollow Project. Living Cover and Frequency by Plant Species (2007).

Oak Brush (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 11: Coal Hollow Project. Total Cover and Composition (2007).

Oak Brush (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 12: Coal Hollow Project. Woody Species Density (2007).

Oak Brush (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 13: Coal Hollow Project. Living Cover and Frequency by Plant Species (2007).

Oak Brush (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 14: Coal Hollow Project. Total Cover and Composition (2007).

Oak Brush (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 15: Coal Hollow Project. Woody Species Density (2007).

Oak Brush (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 16: Coal Hollow Project. Living Cover and Frequency by Plant Species (2007).

Meadow Community (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 17: Coal Hollow Project. Total Cover and Composition (2007).

Meadow Community (Proposed Disturbed)		
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	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 18: Coal Hollow Project. Woody Species Density (2007).

Meadow Community (Proposed Disturbed)	
SPECIES	**Individuals Per Acre**
Rosa woodsii	384.06
TOTAL	**384.06**

Table 19: Coal Hollow Project. Living Cover and Frequency by Plant Species (2007).

Meadow (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 20: Coal Hollow Project. Total Cover and Composition (2007).

Meadow (Reference Area)		
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	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 21: Coal Hollow Project. Woody Species Density (2007).

Meadow (Reference Area)	
SPECIES	**Individuals Per Acre**
Rosa woodsii	2225.69
TOTAL	2225.69

Table 22: Coal Hollow Project. Living Cover and Frequency by Plant Species (2007).

Dames' Meadow	Mean Percent	Standard Deviation	Percent Frequency
SHRUBS			
Rosa woodsii	4.25	13.06	25.00
Salix exigua	0.25	1.09	5.00
FORBS			
Castilleja exilis	0.50	1.50	10.00
Iris missouriensis	13.50	17.83	45.00
Potentilla anserina	0.50	1.50	10.00
Helianthella uniflora	31.00	26.77	95.00
GRASSES (and grass-likes)			
Carex microptera	0.50	2.18	5.00
Juncus arcticus	23.50	11.41	100.00
Poa pratensis	8.50	12.85	45.00

Table 23: Coal Hollow Project. Total Cover and Composition (2007).

Dames' Meadow		
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	82.50	7.83
Litter	13.35	7.23
Bareground	3.00	1.64
Rock	1.15	0.36
B. % COMPOSITION (u)		
Shrubs	4.97	13.76
Forbs	54.00	20.34
Grasses	41.04	22.28

Table 24: Coal Hollow Project. Living Cover and Frequency by Plant Species (2007).

Sorensen's Meadow	Mean Percent	Standard Deviation	Percent Frequency
SHRUBS			
FORBS			
Aster sp.	6.00	7.18	55.00
Equisetum arvensis	1.00	2.00	20.00
Erigeron sp.	0.25	1.09	5.00
Gentiana affinis	1.25	2.68	20.00
Iris missouriensis	30.50	7.57	100.00
Potentilla anserina	0.75	1.79	15.00
Verbascum thapsus	0.25	1.09	5.00
GRASSES (and grass-likes)			
Carex microptera	3.50	9.23	15.00
Elymus smithii	0.50	1.50	10.00
Juncus arcticus	33.00	11.34	100.00
Koeleria nitida	0.50	2.18	5.00
Poa pratensis	7.00	7.31	55.00
Poa secunda	0.50	2.18	5.00
Scirpus americanus	1.50	4.77	10.00

Table 25: Coal Hollow Project. Total Cover and Composition (2007).

Sorensen's Meadow		
A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	86.50	3.91
Litter	6.85	3.29
Bareground	5.60	2.60
Rock	1.05	0.22
B. % COMPOSITION (u)		
Shrubs	0.00	0.00
Forbs	46.16	8.48
Grasses	53.84	8.48

FIGURE 1. STUDENT'S T-TEST - **Total Living Cover** Comparisons Between Proposed Disturbed and Reference Areas (2007).

A.
Pinyon-Juniper

Proposed Disturbed:	$\bar{x}$=43.00; s=15.20	
Reference Area:	$\bar{x}$=39.00; s=11.36	t = 0.943; df =38 , SL=N.S.

B.
Oak Brush

Proposed Disturbed:	$\bar{x}$=66.75; s=14.86	
Reference Area:	$\bar{x}$=73.25; s=12.68	t = 1.488 ; df = 38, SL=N.S.

C.
Meadow

Proposed Disturbed:	$\bar{x}$=86.00; s=7.18	
Reference Area:	$\bar{x}$=88.50; s=5.94	t = 1.200; df = 38, SL=N.S.

$\bar{x}$ = mean
s = standard deviation
t = Student's t-value
df = degrees of freedom
SL= Significance Level
N.S.=Non-Significant

FIGURE 2. STUDENT'S T-TEST - **Woody Species Density** Comparisons Between Proposed Disturbed and Reference Areas (2007).

A.
Pinyon-Juniper

Proposed Disturbed:	$\bar{x}$=2656.53; s=1495.02	
Reference Area:	$\bar{x}$=4214.70; s=2153.56	t = -2.658; df =38, SL=p<.05

B.
Oak Brush

Proposed Disturbed:	$\bar{x}$=3742.70; s=1891.96	
Reference Area:	$\bar{x}$=2091.57; s=1134.18	t = 3.347; df =38, SL=p<.05

C.
Meadow

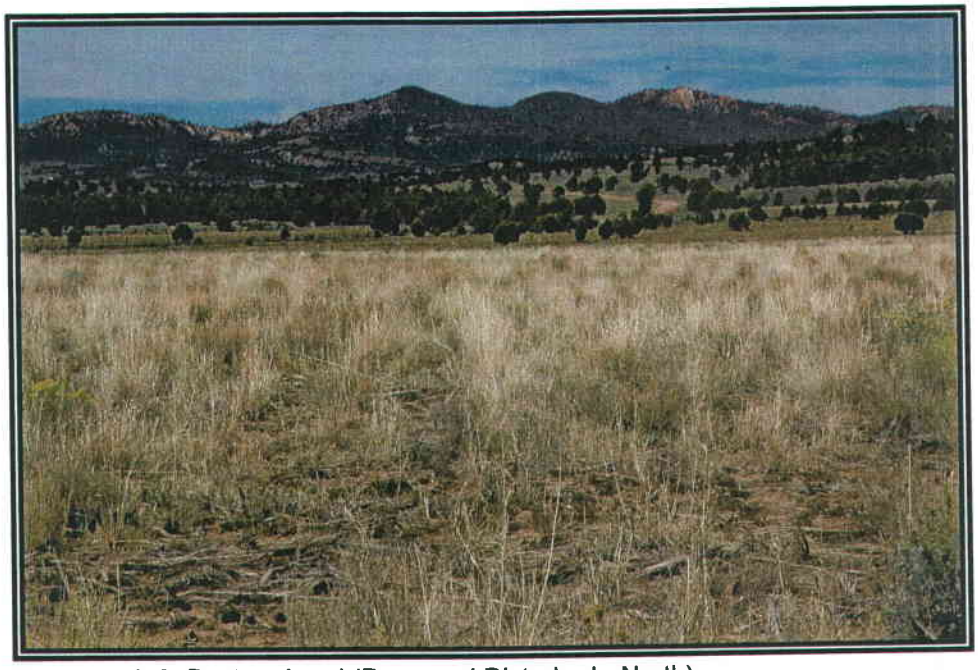
Proposed Disturbed:	$\bar{x}$= 384.06; s= 494.12	
Reference Area:	$\bar{x}$=2225.69; s=2323.34	t = -3.467; df =38, SL=p<.05

$\bar{x}$ = mean
s = standard deviation
t = Student's t-value
df = degrees of freedom
SL= Significance Level
p = probability
N.S.=Non-Significant

COLOR PHOTOGRAPHS
OF
SAMPLE AREAS

Photograph 1: Pinyon-Juniper (Proposed Disturbed)

Photograph 2: Pinyon-Juniper (Reference Area)

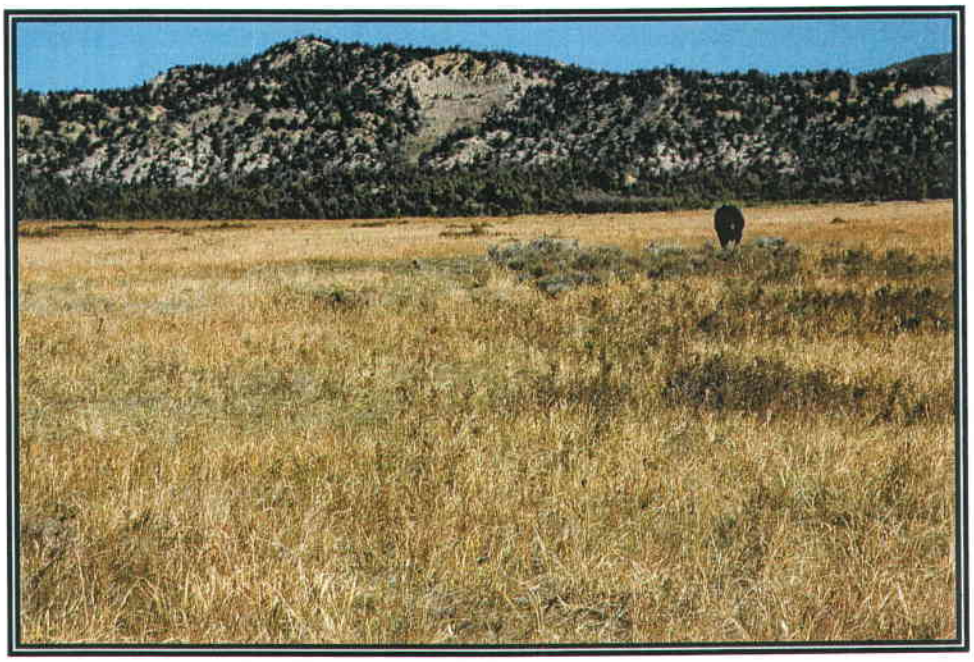


Photograph 3: Pasture Land (Proposed Disturbed - North)

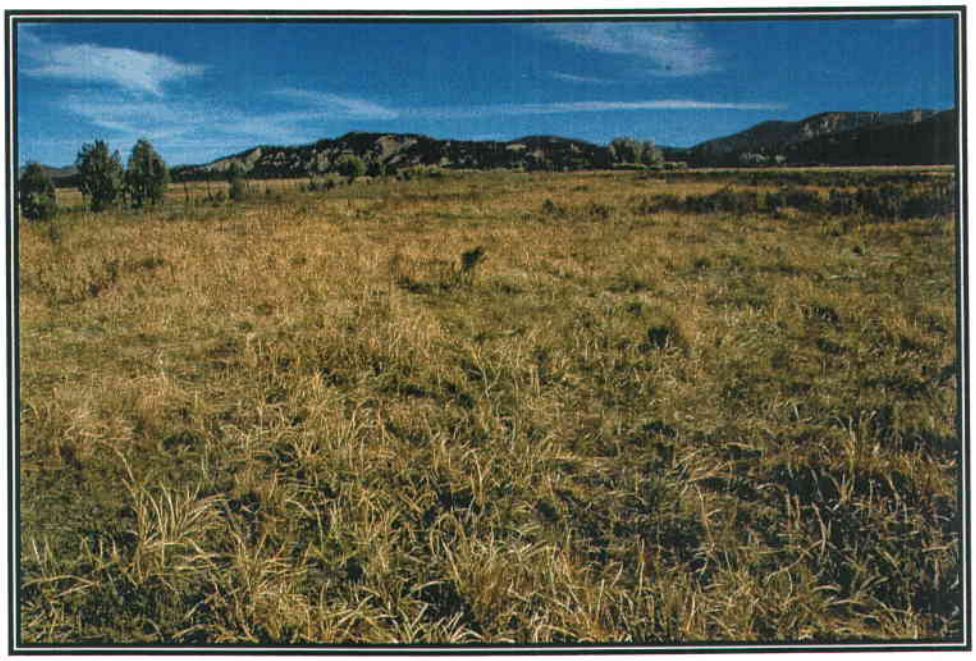
Photograph 4: Pasture Land (Proposed Disturbed - South)

Photograph 5: Oak Brush (Proposed Disturbed)

Photograph 6: Oak Brush (Reference Area)

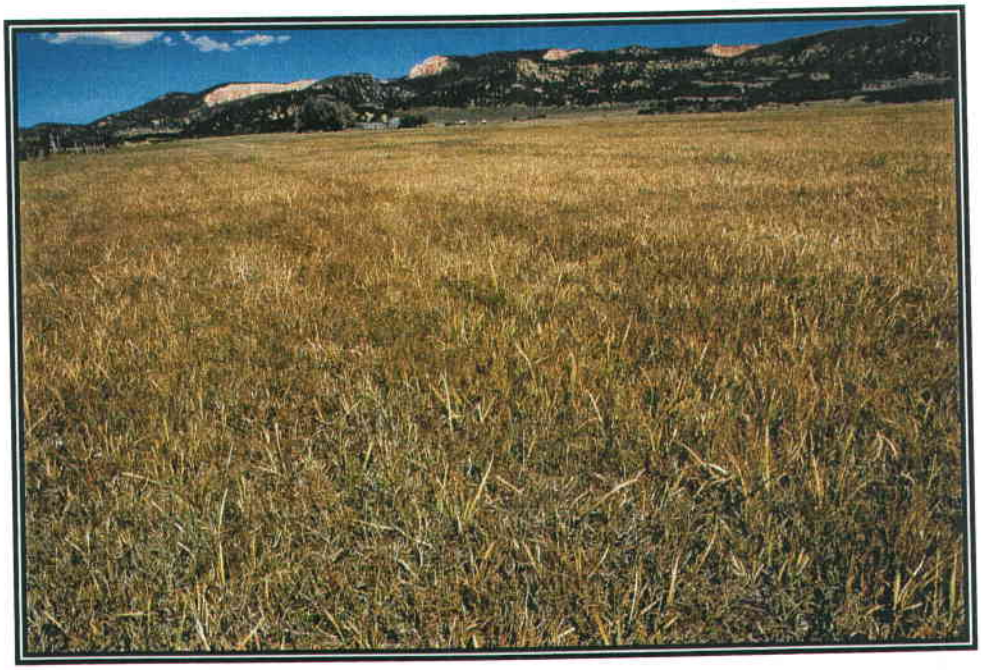


Photograph 7: Meadow (Proposed Disturbed)



Photograph 8: Meadow (Reference Area)

Photograph 9: Dames' Meadow



Photograph 10: Sorensen's Meadow

R645-301-300 Biology, Vegetation Map Replacement

Replaces Drawing 3-1 and 3-1b

This update replaces Drawing 3-1 and 3-1b. Vegetation communities and sampling have been updated to include all areas planned for disturbance and some adjacent property.

Chapter 4, Text Updated to Reflect Map Name Change

Replaces pages 4-6, 4-7 and 4-8 in Chapter 4

The latest Vegetation map has been changed from 3-1b to 3-1. These pages directly reference this map and therefore the text has been changed to reflect this name change.

411.143.1 Collection of Additional Information

Alton Coal Development will continue to conduct field investigations when determined needed.

A map showing the survey area already investigated for archeological importance is included in Appendix 4-1.

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). An exception to this plan is that one area that is currently pasture land will be reseeded appropriately to provide additional habitat for 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, Drawing 1-3). Descriptions of current management practices as well as future grazing plans for the postmining land use have been provided below.

Management Plan for 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 some plant species for wildlife habitat. 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).

The livestock currently sustained on Mr. Dame 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 management plan 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

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 pasture land property are mostly cattle, but sometimes horses are 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 including: the sagebrush/grass (Table 3-17), meadows (Table 3-18), pasture lands (Table 3-19), oakbrush (Table 3-21), and pinyon-juniper communities (Table 3-23).

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' 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 3-1 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).

A copy of this management plan 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.

412.130. Post-Mining 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 use 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

Clarification of Noncoal Waste Disposal

Replaces Chapter 5, Page 5-41

Text is modified to clarify noncoal waste disposal. Final disposal will not take place within the permit area.

745.122 : Underdrains

No underdrains are planned in the excess spoil area.

745.300: Durable Rock Fills

Not Applicable

745.400: Preexisting Benches

Not Applicable

528.320. Coal Mine Waste.

Not Applicable

528.322. Refuse Piles.

Not Applicable

528.323. Burning and Burned Waste Utilization.

Not Applicable

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.

Topsoil and Subsoil Update

Replaces Chapter 5, Page 5-54

Updates topsoil and subsoil replacement thicknesses based on fall of 2007 soil survey data.

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.

542 NARRATIVE, DRAWINGS AND PLANS:

542-100 through 600 Plan and Timetable.

Reclamation at the Coal Hollow Mine 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 (areas used for pasture lands will not be

Topsoil and Subsoil Update

Replaces Chapter 5, Page 5-56

Updates topsoil and subsoil replacement thicknesses based on fall of 2007 soil survey data.

excess spoil structure will remain. 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 permanent. 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.
- 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 no longer needed will be closed to traffic; and all bridges and culverts removed, unless approved as part of the postmining land use. 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 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.
- 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.

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. The bulk of this period will be required to backfill the final pits.

542.700. Final Abandonment of Mine Openings and Disposal Areas.

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.

Clarification of Noncoal Waste Disposal

Replaces Chapter 5, Page 5-58

Text is modified to clarify noncoal waste disposal. Final disposal will not take place within the permit area.

542.720. Disposal of Excess Spoil.

A geotechnical analysis has been completed for the proposed excess spoil structure. This analysis estimates the long-term safety factor to be 1.7 to 1.8 based on the proposed design. Following proper construction practices of building the structure in maximum four foot lifts and meeting 90% 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 A5-1.

Excess spoil that is combustible will be adequately covered with noncombustible material to prevent sustained combustion.

542.730. Disposal of Coal Mine Waste.

Not applicable

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.

542.800. Reclamation Cost.

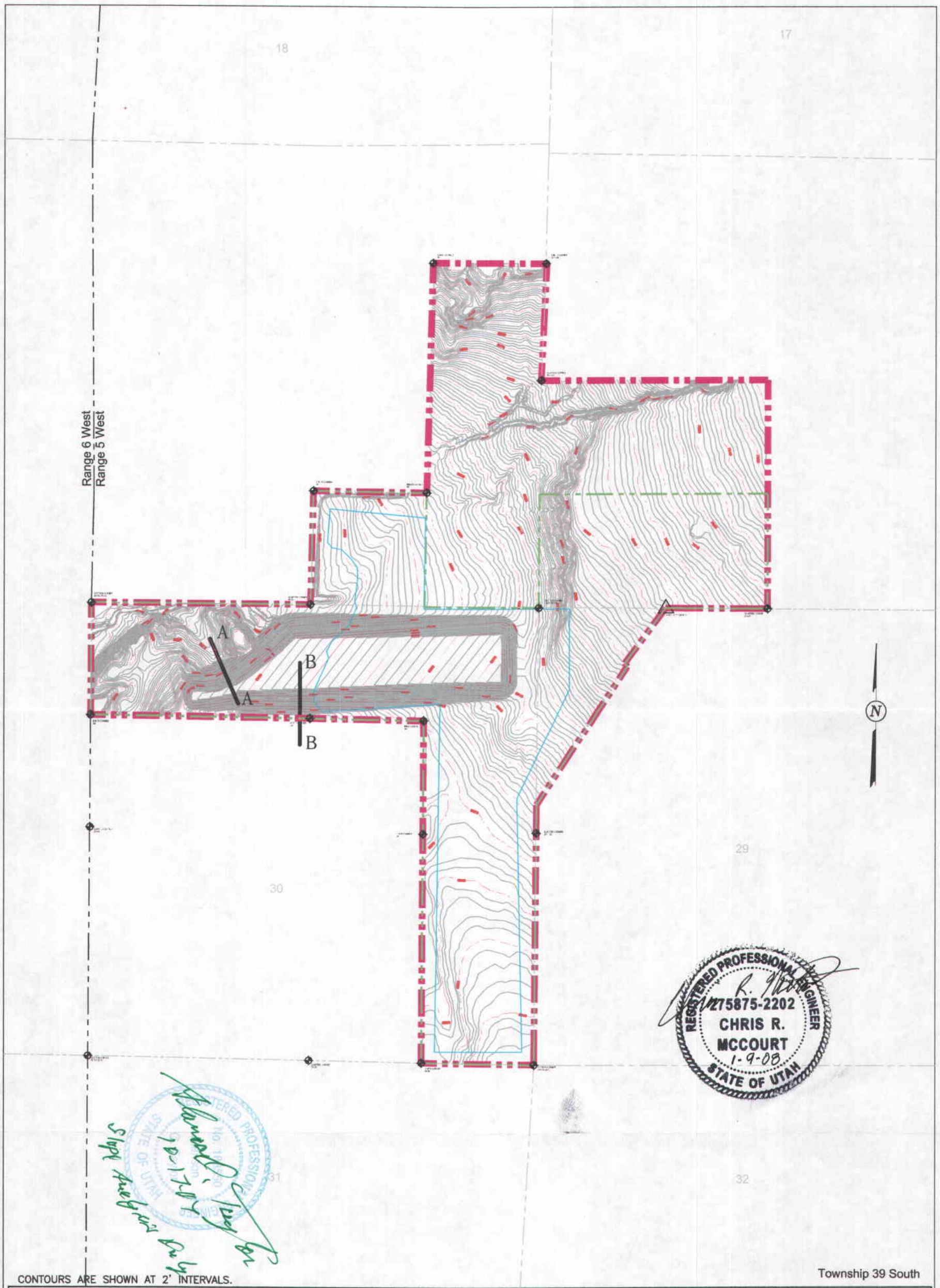
The amount of the bond will depend upon the requirements of the ***approved*** permit and reclamation plan (R645-830.120).

A preliminary estimate of reclamation costs is included in Appendix 8-1. This estimate is based upon the proposed plan. A final bond estimate will be provided by the applicant to the Division upon completion of the approved permit and reclamation plan.

Appendix 5-1, Professional Engineer Certified Drawings

Replaces Figures 11, 12, 13, 14 and 15 in Appendix 5-1

These drawings are resubmitted with seals from two professional engineers. These drawings were prepared mainly by or under direct supervision of Chris McCourt but had some minor modifications by Alan Taylor. Therefore, Mr. Taylor has stamped the drawings in reference to his edits and Mr. McCourt has stamped the drawings for the base drawing which Mr. Taylor edited.



CONTOURS ARE SHOWN AT 2' INTERVALS.

LEGEND:
- PROJECT AREA
- PRIVATE COAL OWNERSHIP
- COAL LINE
- COAL BOUNDARY
- COAL RECOVERY LINE
- SECTION LINE
- FOUND SECTION CORNER
- FOUND PROPERTY CORNER

DRAWN BY:	CHECKED BY:
J. STANSFIELD	CRM/APC
DRAWING:	DATE: 4/20/07
	SCALE: 1" = 1000'
JOB NUMBER: 1400	SHEET

REVISIONS

DATE:	BY:

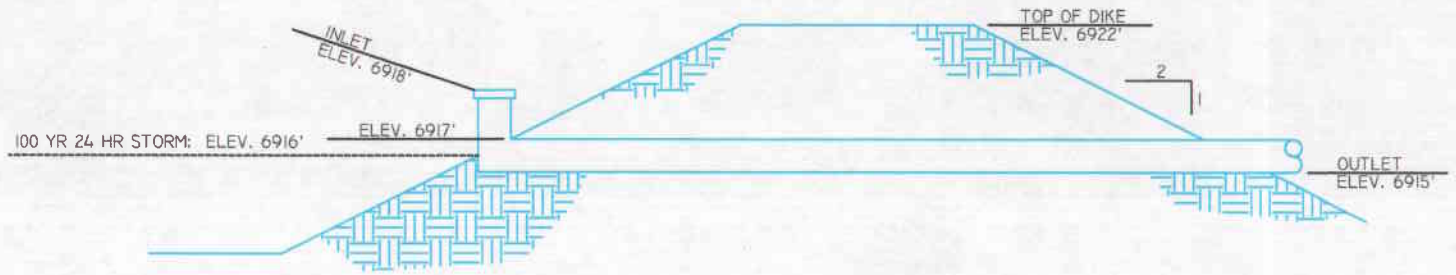
PREMINING TOPOGRAPHY

COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 5-11

Registered Professional Engineer
275875-2202
CHRIS R. McCOURT
State of Utah

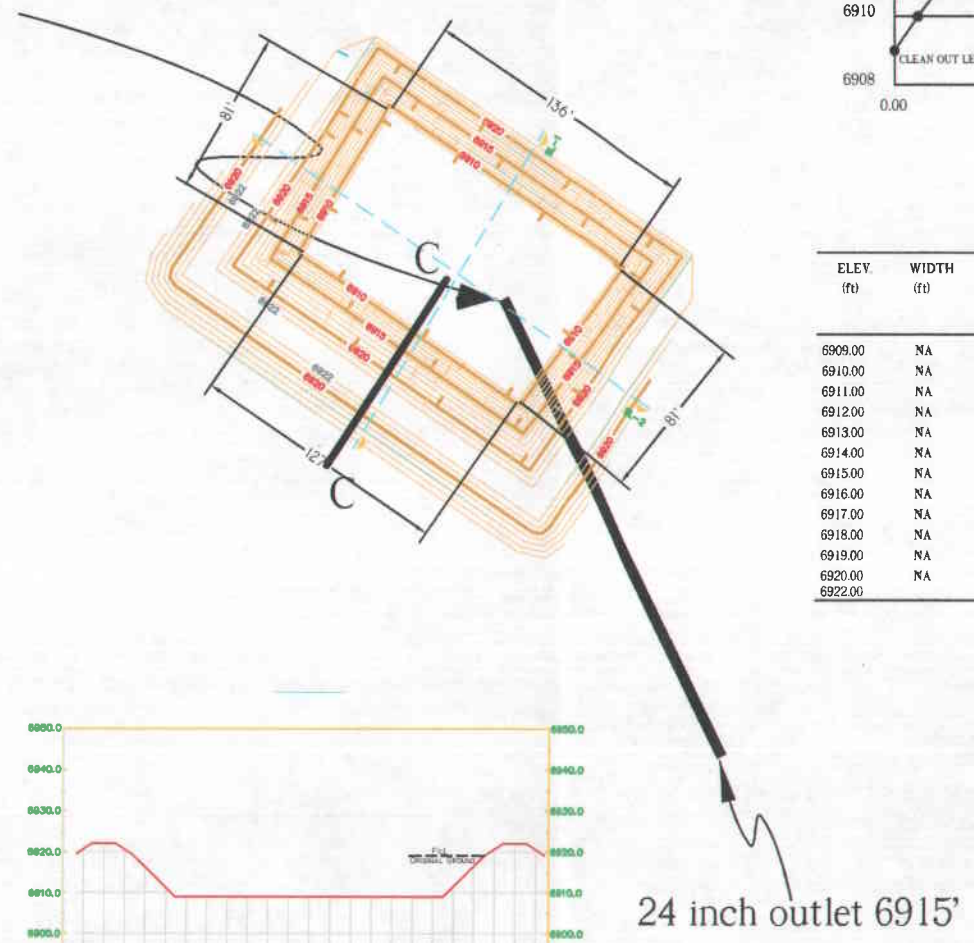
Figure No. 11



TYPICAL CROSS SECTION

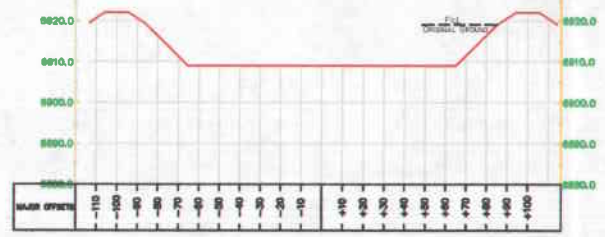
Not to Scale

24 inch Drop Pipe Spillway
Top of riser 6918'
Bottom of riser 6915'



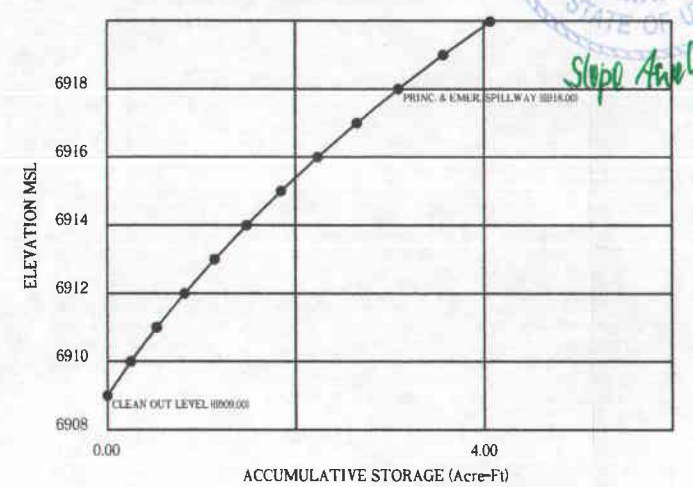
24 inch outlet 6915'

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					
				0.2485	1.00	0.2485	0.2485	1.00
6910.00	NA	NA	0.2650					
				0.2760	1.00	0.2760	0.5245	2.00
6911.00	NA	NA	0.2870					
				0.2980	1.00	0.2980	0.8225	3.00
6912.00	NA	NA	0.3090					
				0.3200	1.00	0.3200	1.1425	4.00
6913.00	NA	NA	0.3310					
				0.3425	1.00	0.3425	1.4850	5.00
6914.00	NA	NA	0.3540					
				0.3655	1.00	0.3655	1.8505	6.00
6915.00	NA	NA	0.3770					
				0.3895	1.00	0.3895	2.2400	7.00
6916.00	NA	NA	0.4020					
				0.4155	1.00	0.4155	2.6555	8.00
6917.00	NA	NA	0.4290					
				0.4440	1.00	0.4440	3.0995	9.00
6918.00	NA	NA	0.4590					
				0.4755	1.00	0.4755	3.5750	10.00
6919.00	NA	NA	0.4920					
				0.5055	0.98	0.4954	4.0704	10.98
6920.00	NA	NA	0.5190					
6922.00								

Pond #1

Required Storage for 100 year, 24 event = 2.57 acre/ft

Slope Analysis only

Alanson C. Taylor 10-17-07

REGISTERED PROFESSIONAL ENGINEER 275875-2202 CHRIS R. MCCOURT 1-9-08 STATE OF UTAH

REGISTERED PROFESSIONAL ENGINEER 275875-2202 CHRIS R. McCOURT State of Utah

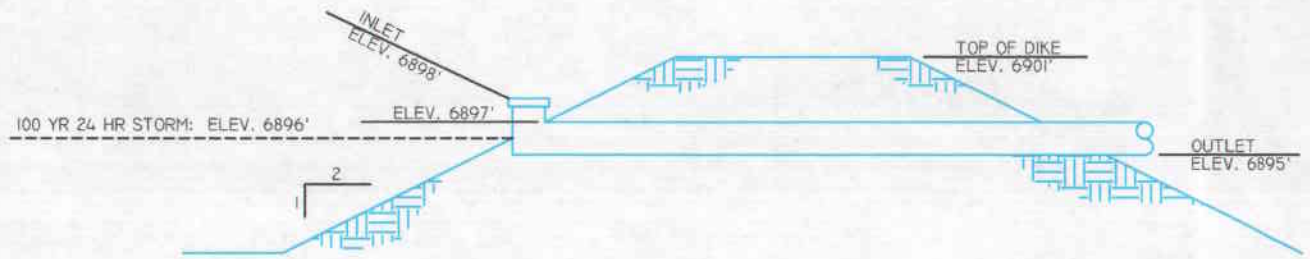
Coal Hollow Project
615 North, 400 East
P.O. Box 1230
Huntington, Utah 84528
Phone (435)687-5310
Fax (435)687-5311

SEDIMENT IMPOUNDMENT 1
DESIGN & DETAILS
COAL HOLLOW PROJECT
ALTON, UTAH
DRAWING: 5-28

REVISIONS
DATE: BY:

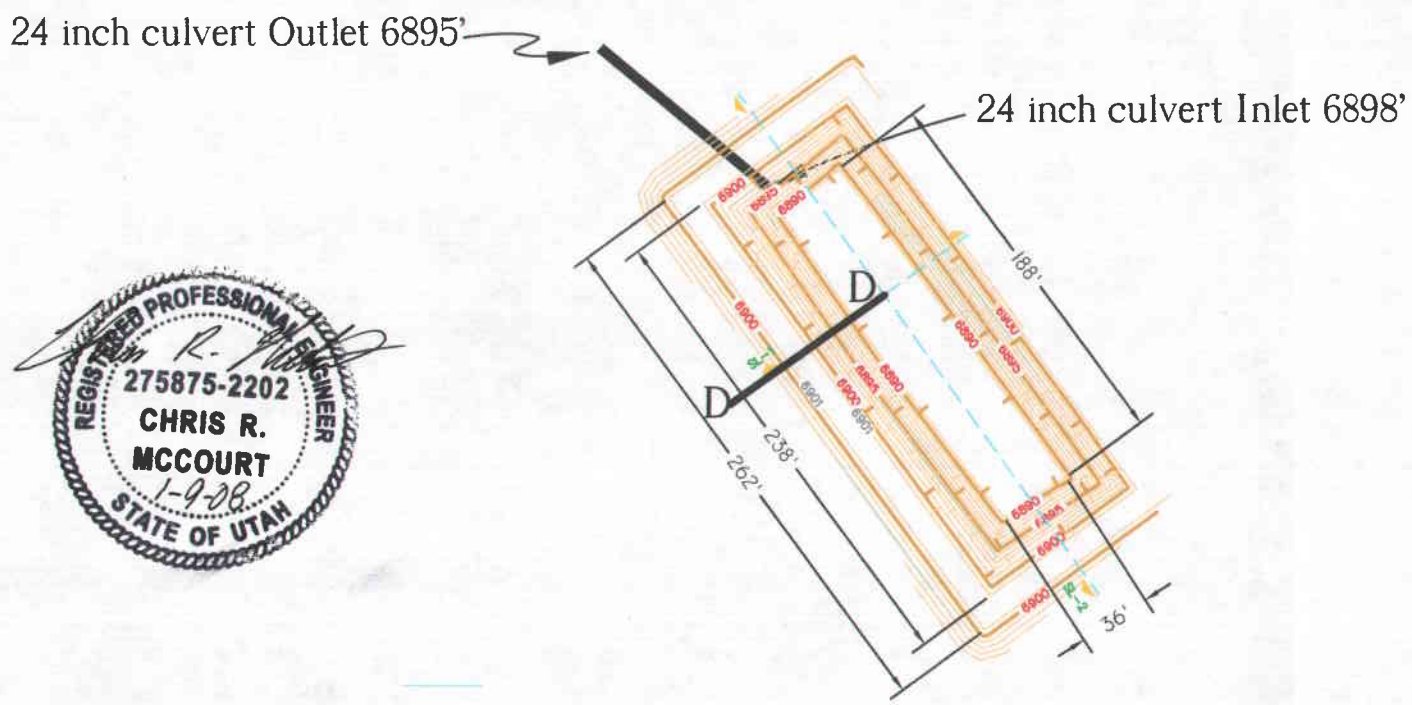
DRAWN BY: C. MCCOURT
CHECKED BY: CM
DRAWING: 5-28
DATE: 04/20/07
SCALE: 1" = 80'
JOB NUMBER: 1400
SHEET

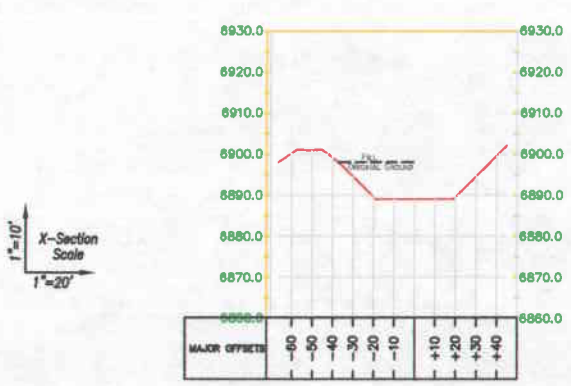
Figure No. 12



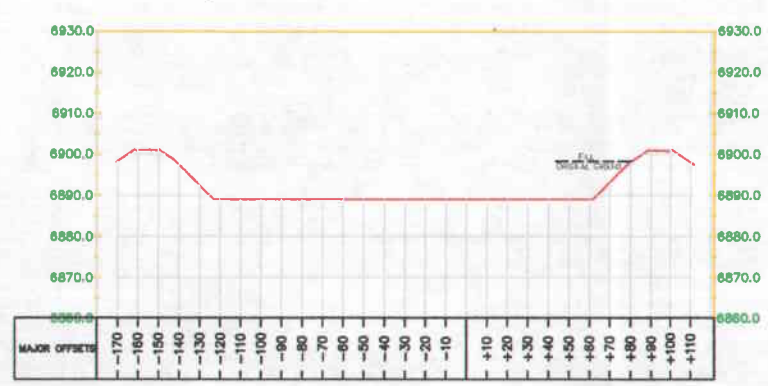
TYPICAL CROSS SECTION

Not to Scale





SL-1



SL-2

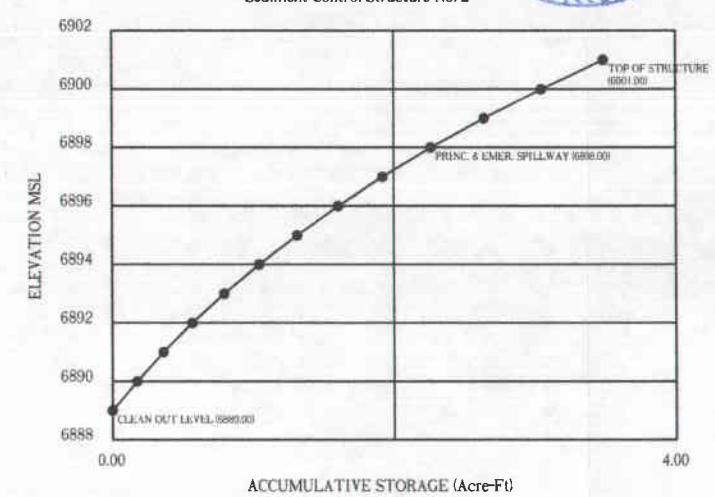
REGISTERED PROFESSIONAL ENGINEER
275875-2202
CHRIS R.
MCCOURT
1-9-08
STATE OF UTAH

REGISTERED PROFESSIONAL ENGINEER
Alan W. Taylor
STATE OF UTAH
1-9-07

Slope Analysis On Fy

STAGE STORAGE CURVE

Sediment Control Structure No. 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	0.5693	3.00
6893.00	NA	NA	0.2370	0.2265	1.00	0.2265	0.7960	4.00
6894.00	NA	NA	0.2580	0.2475	1.00	0.2475	1.0435	5.00
6895.00	NA	NA	0.2810	0.2695	1.00	0.2695	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

Coal Hollow Project
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Registered Professional Engineer
275875-2202
CHRIS R. McCOURT
State of Utah

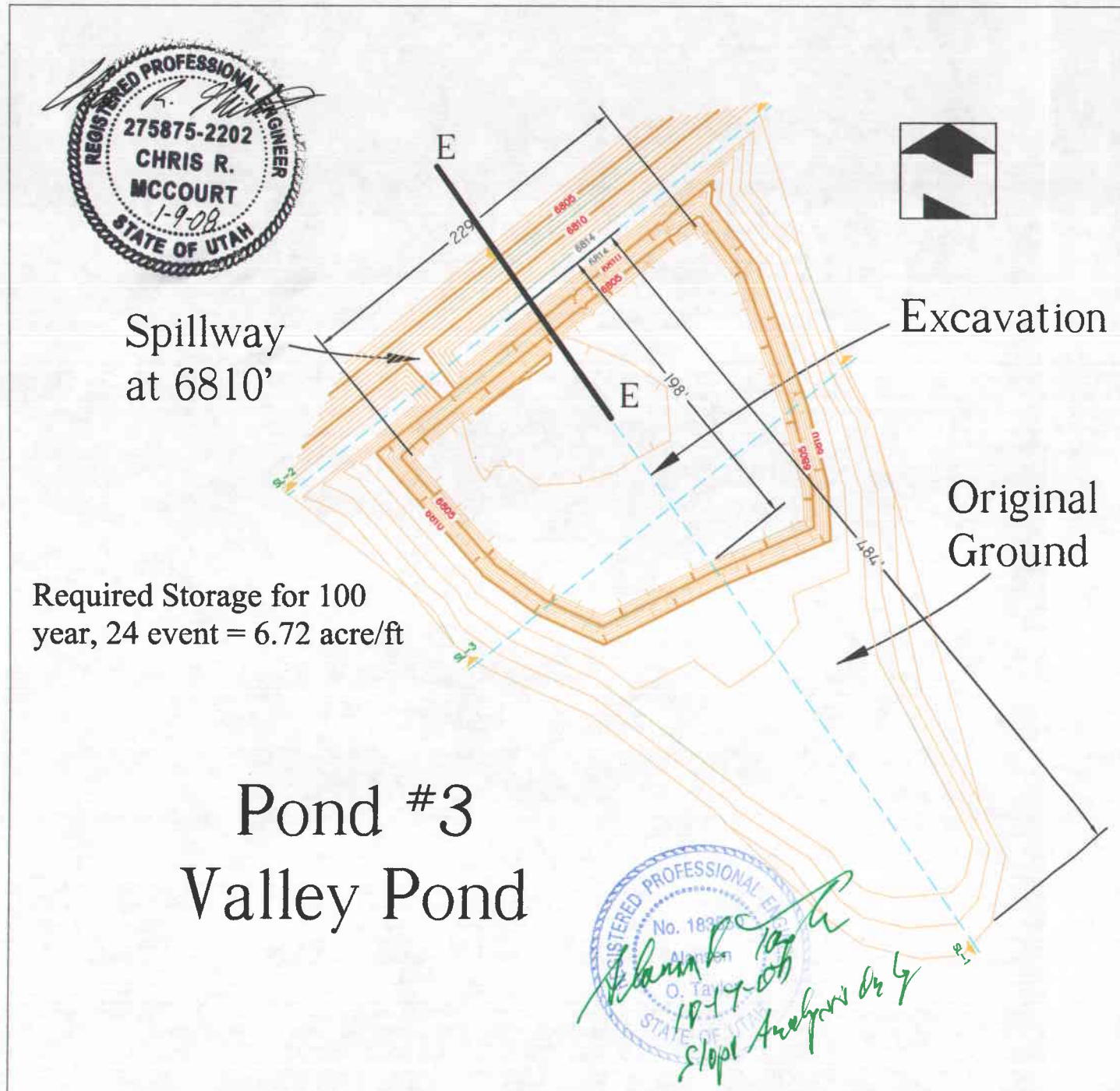
SEDIMENT IMPOUNDMENT 2
DESIGN & DETAILS
COAL HOLLOW PROJECT
ALTON, UTAH
DRAWING: 5-29

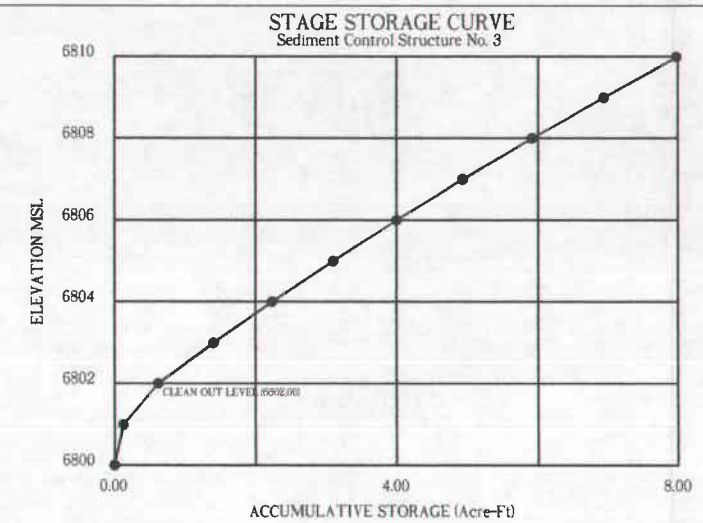
REVISIONS

DATE:	BY:

DRAWN BY:	CHECKED BY:
C. MCCOURT	CM
DRAWING: 5-29	DATE: 04/20/07
	SCALE: 1" = 80'
JOB NUMBER: 1400	SHEET

Figure No. 13



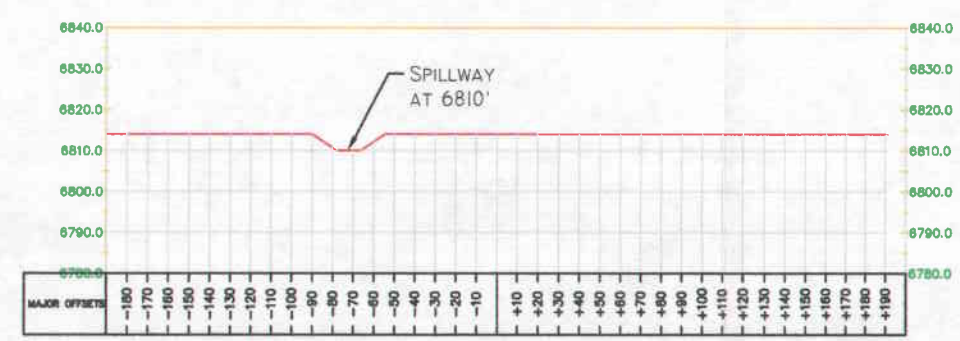


STORAGE VOLUME COMPUTATIONS
Sediment Control Structure No. 3

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					
				0.1250	1.00	0.1250	0.1250	1.00
6801.00	NA	NA	0.2320					
				0.4950	1.00	0.4950	0.6200	2.00
6802.00	NA	NA	0.7580					
				0.7845	1.00	0.7845	1.4045	3.00
6803.00	NA	NA	0.8110					
				0.8295	1.00	0.8295	2.2340	4.00
6804.00	NA	NA	0.8480					
				0.8660	1.00	0.8660	3.1000	5.00
6805.00	NA	NA	0.8840					
				0.9030	1.00	0.9030	4.0030	6.00
6806.00	NA	NA	0.9220					
				0.9400	1.00	0.9400	4.9430	7.00
6807.00	NA	NA	0.9580					
				0.9765	1.00	0.9765	5.9195	8.00
6808.00	NA	NA	0.9950					
				1.0175	1.00	1.0175	6.9370	9.00
6809.00	NA	NA	1.0400					
				1.0535	1.00	1.0430	7.9800	10.00
6810.00	NA	NA	1.0670					

SL-3

SL-1



SL-2

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CHRIS R. McCOURT
State of Utah

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

REGISTERED PROFESSIONAL ENGINEER
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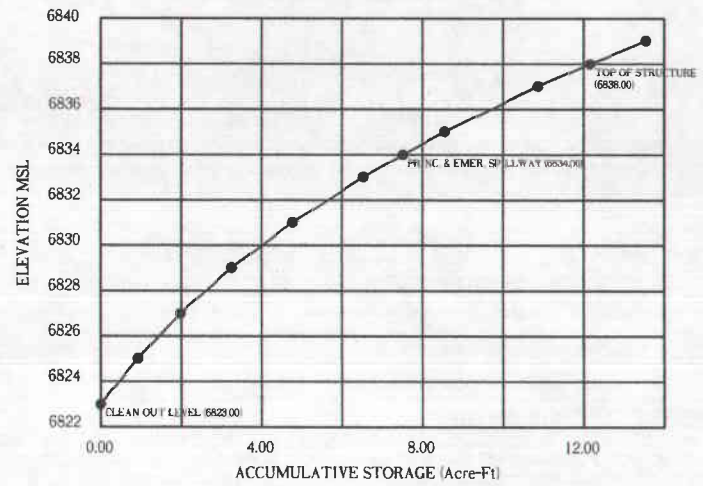
STATE OF UTAH

STAGE STORAGE CURVE

Sediment Control Structure No. 4

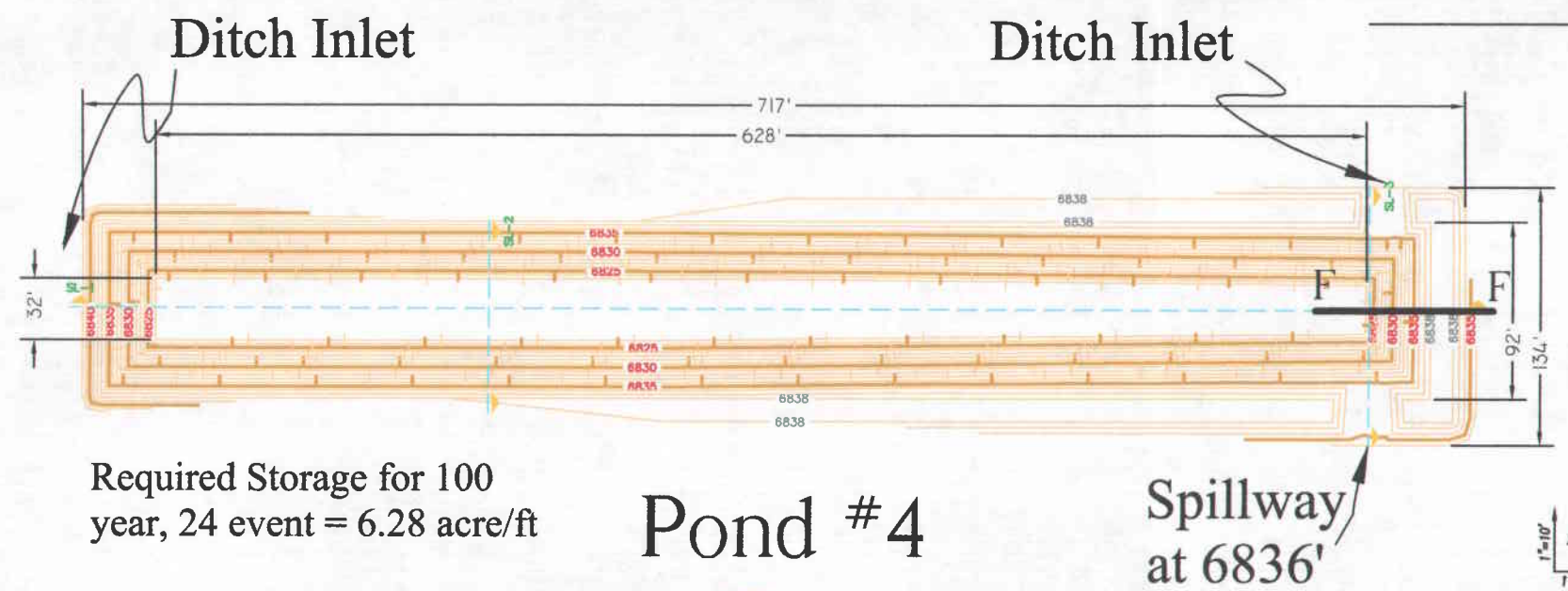


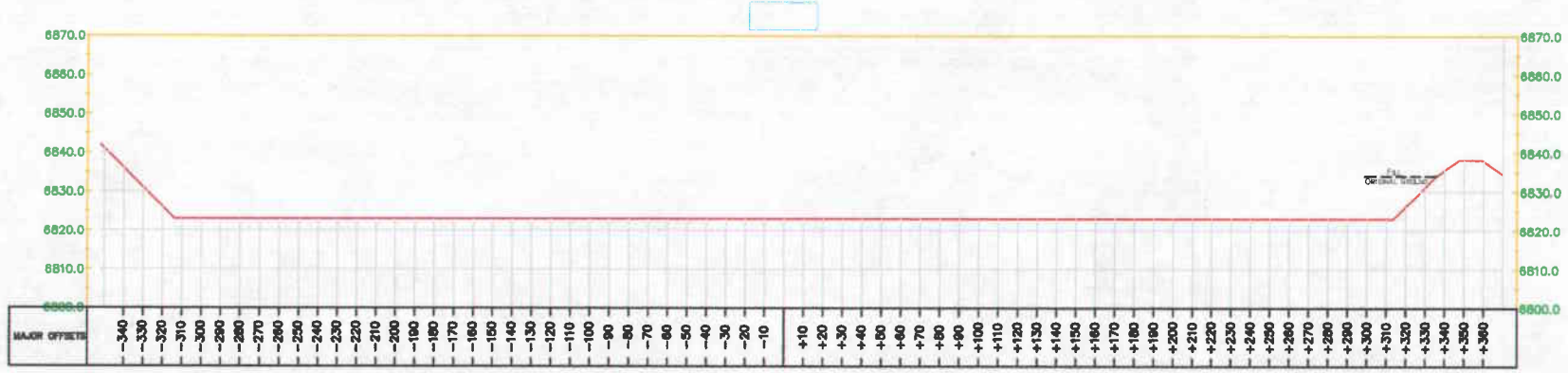
REGISTERED PROFESSIONAL ENGINEER
No. 183550
Alanson B. Taylor
STATE OF UTAH
1-7-08
Stage Analysis Only

STORAGE VOLUME COMPUTATIONS

Sediment Control Structure No. 4

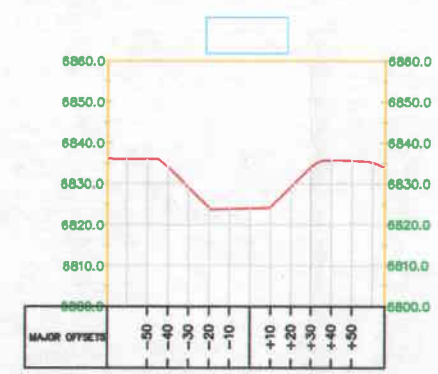
ELEV. (ft)	WIDTH (ft)	LENGTH (ft)	AREA (ac)	AVG. AREA (ac)	INTERVAL (ft)	STORAGE (ac-ft)	ACC. STORAGE (ac-ft)	STAGE INTERVAL (ft)
6823.00	NA	NA	0.0000					
6825.00	NA	NA	0.4660	0.4660	2.00	0.9320	0.9320	2.00
6827.00	NA	NA	0.5810	0.5235	2.00	1.0470	1.9790	4.00
6829.00	NA	NA	0.6990	0.6400	2.00	1.2800	3.2590	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	1.0090	0.9760	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





SL-1

SL-2



SL-3

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State of Utah

SEDIMENT IMPOUNDMENT 4
DESIGN & DETAILS
COAL HOLLOW PROJECT
ALTON, UTAH
DRAWING: 5-31

REVISIONS	
DATE:	BY:

DRAWN BY: C. MCCOURT	CHECKED BY: CM		
DRAWING: 5-31	DATE: 04/20/07	SCALE: 1" = 80'	
			JOB NUMBER: 1400
			SHEET

Figure No. 15

Sediment Impoundment and Diversion Analysis, Professional Engineer Certified

Replaces Appendix 5-2

These pages replace Appendix 5-2 which was not certified in the original MRP. This submittal replaces the original appendix and the cover page bears the seal of the professional engineer that prepared the document.

APPENDIX 5-2

Sediment Impoundment and
Diversion Structure Analysis

By: Alton Coal Development, LLC
Chris McCourt, P.E.

REGISTERED PROFESSIONAL ENGINEER
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1-10-08
STATE OF UTAH

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 four 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 above requirement	Additional Storage (ac/ft)
1	2.6	3.1	119	0.5
2	1.7	2.3	135	0.6
3	6.7	7.7	115	1.0
4	5.7	7.5	132	1.8

*Design capacities include a minimum of 2 feet free board (spillway to top of embankment)

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) was found to be separated into five 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 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	300	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

* This watershed will have silt fence installed rather than a pond

- **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 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.

   Watershed 1 has been classified differently since it includes the mine facilities area. This watershed is 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 all four watersheds 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. Watershed 1 was 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.

- **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

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	300	33.9
4	63	2.3	3.1	256	27.8

*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 four watershed. Therefore, a size has been evaluated for the four 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:

Sedimentation Impoundment Sizing				
Watershed	Drainage Area (ac)	Inflow (cfs)	Q (in)	Storage Required (ac/ft)
1	28	74.7	2.00	2.6
2	77	9.9	0.48	1.7
3	302	33.9	0.48	6.7
4	282	30.4	0.48	5.7

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 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 Watershed 5, the method of using silt fence to control sediment for this watershed has been chosen and is included on the 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:

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	1.1	20.6	0.6	5.0	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	183	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:

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	183	20.6

- **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	1.1	20.6	0.6	5.0	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.

Lower Robinson Creek Culvert and Diversion Analysis, Professional Engineer Certified

Replaces Appendix 5-3

These pages replace Appendix 5-3 which was not certified in the original MRP. This submittal replaces the original appendix and the cover page bears the seal of the professional engineer that supervised preparation of the document.

APPENDIX 5-3

Lower Robinson Creek
Culvert and Diversion Analysis

By: Dr. James E. Nelson - Assistant Professor, Civil and Environmental Engineering - Brigham Young University

REGISTERED PROFESSIONAL ENGINEER
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CHRIS R.
MCCOURT
1-10-08
STATE OF UTAH

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.

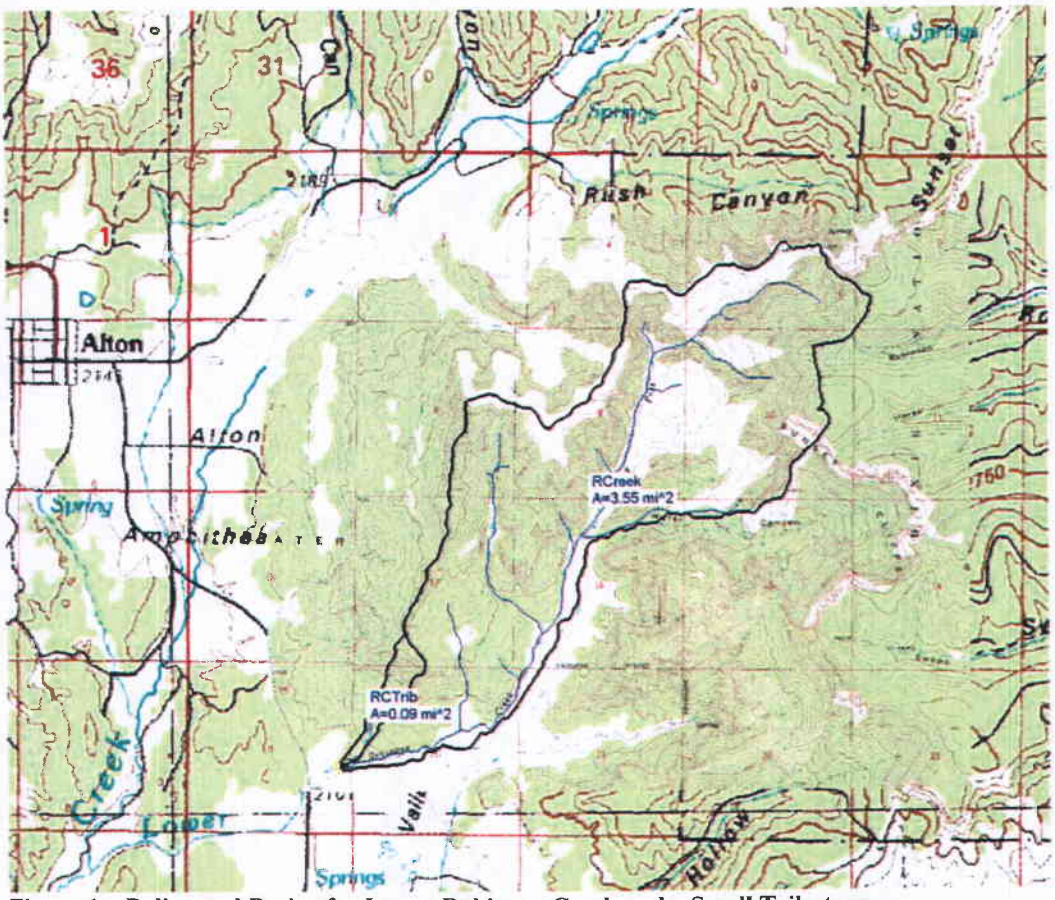


Figure 1 – Delineated Basins for Lower Robinson Creek and a Small Tributary.

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

downloaded from the USGS seamless data website and overlaid with the delineated basins as shown in Figure 2.

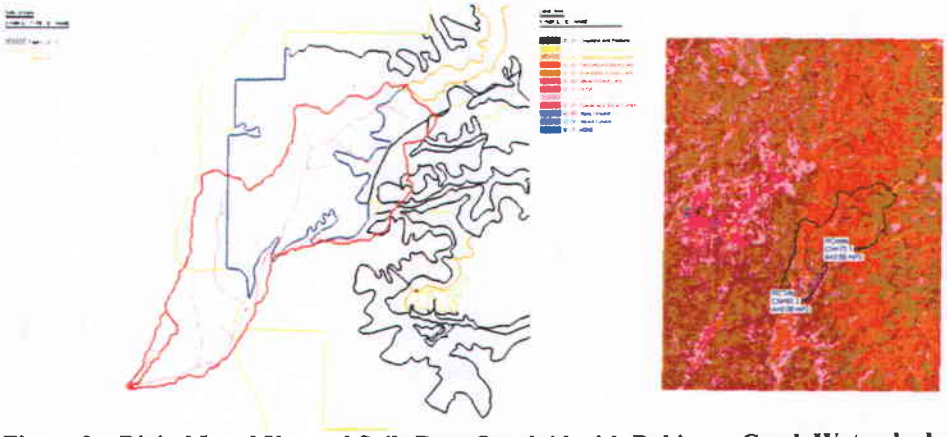


Figure 2 – Digital Land Use and Soils Data Overlaid with Robinson Creek Watersheds.

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

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).

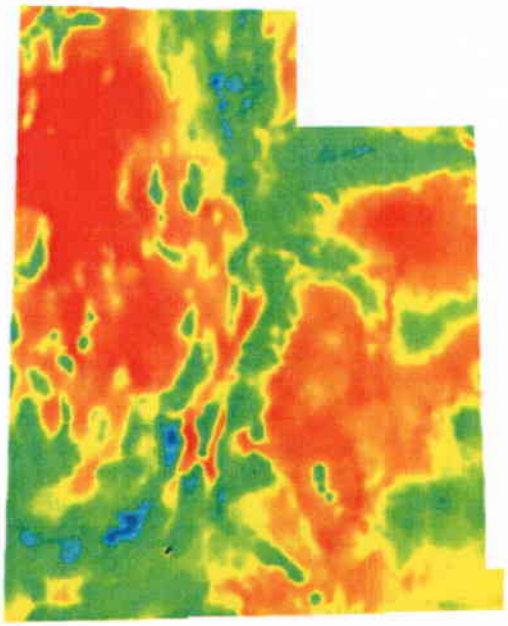


Figure 3 – NOAA Rainfall Data for the 100-Year Six Hour Storm.

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

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.

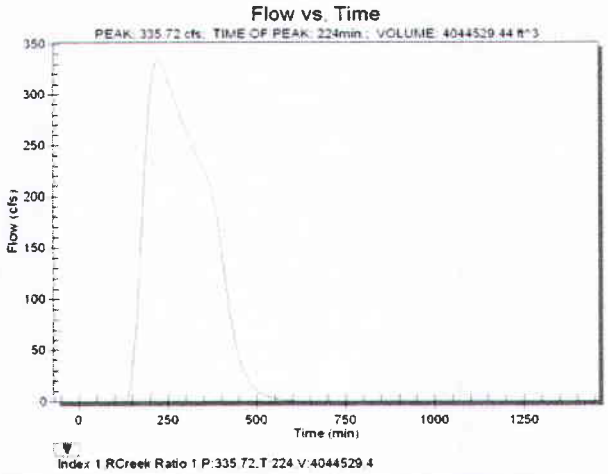


Figure 4 – Computed Runoff Hydrograph for RCreek

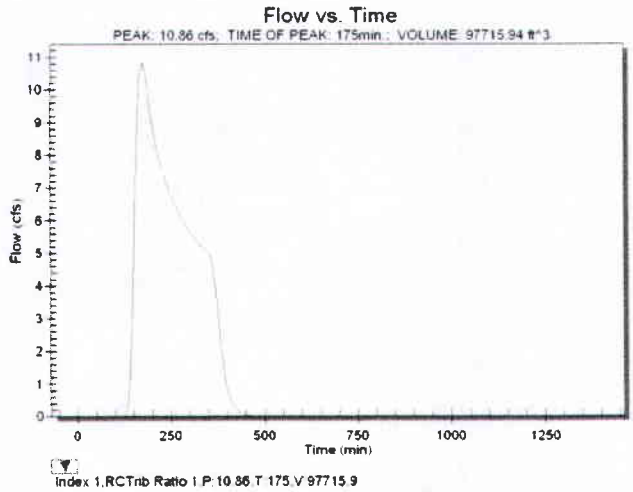


Figure 5 – Computed Runoff Hydrograph for RCTrib

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

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

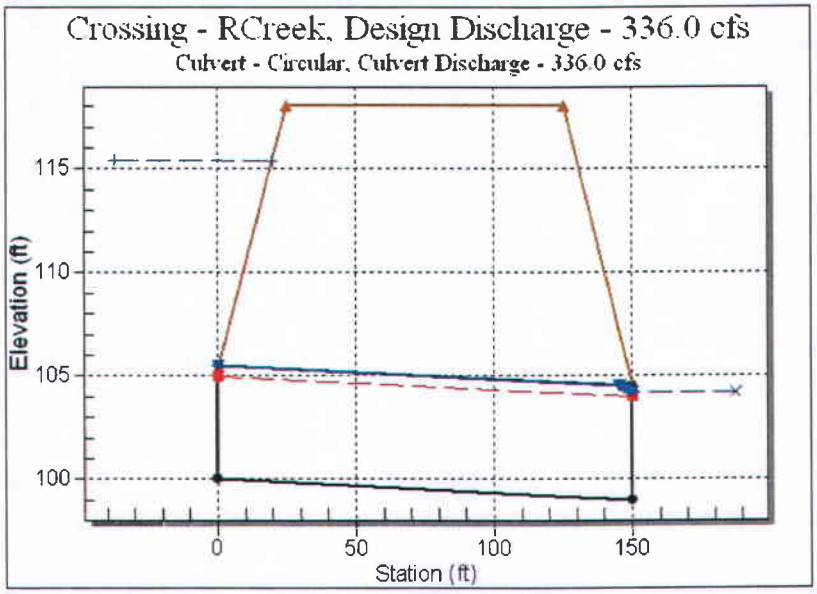


Figure 6 – Profile through RCreek culvert for 5.5 foot barrel size.

Culvert Data Summary – 8.0 foot Circular for RCreek Crossing

Barrel Shape: Circular

Barrel Diameter: 8.00 ft

Barrel Material: Corrugated Steel

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

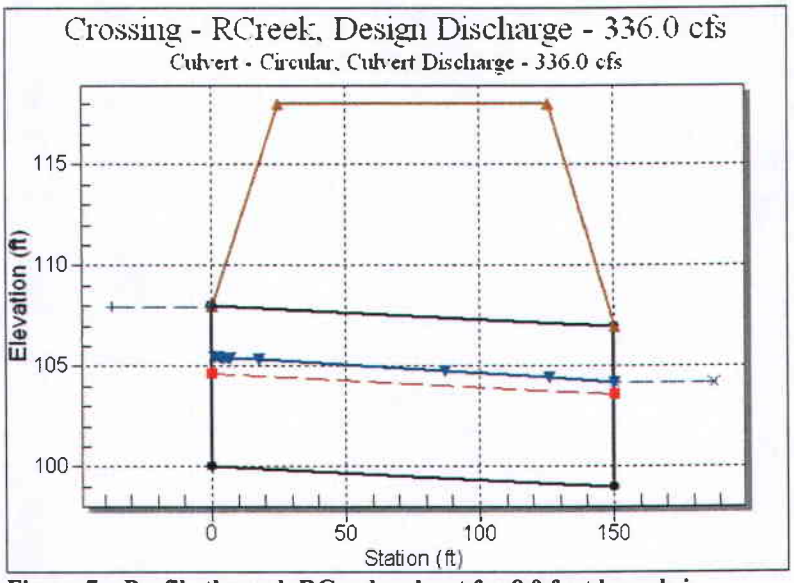


Figure 7 – Profile through RCreek culvert for 8.0 foot barrel size

Culvert Data Summary – 2.5 foot Circular for RCTrib

Barrel Shape: Circular

Barrel Diameter: 2.50 ft

Barrel Material: Corrugated Steel

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

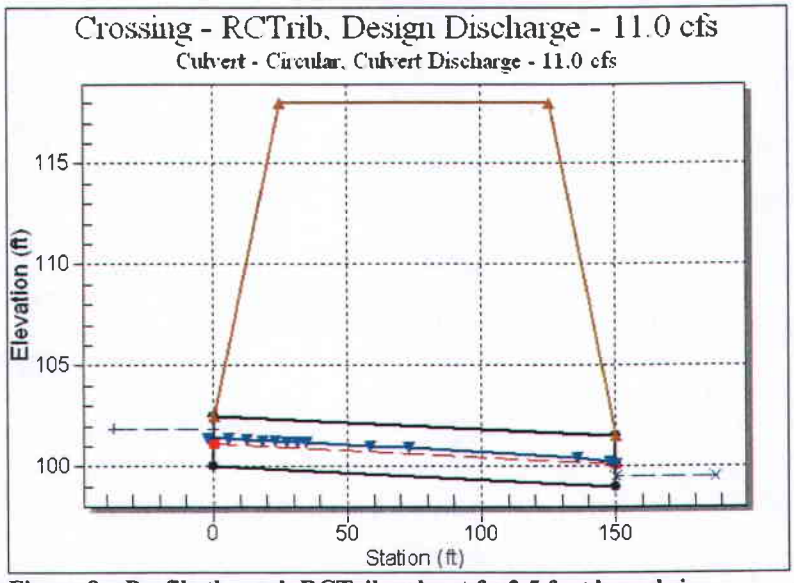


Figure 8 – Profile through RCTrib culvert for2.5 foot barrel size

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.

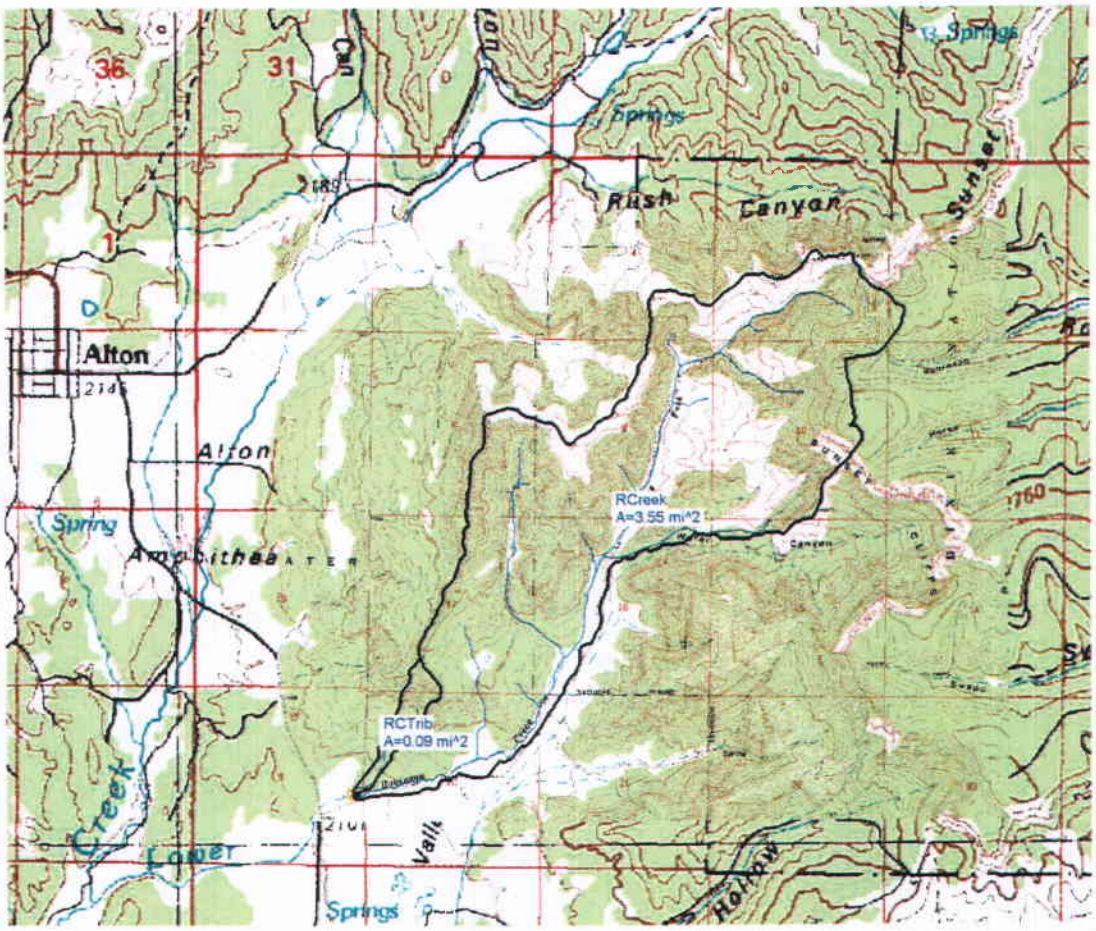


Figure 1 – Delineated Basins for Lower Robinson Creek and a Small Tributary.

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.

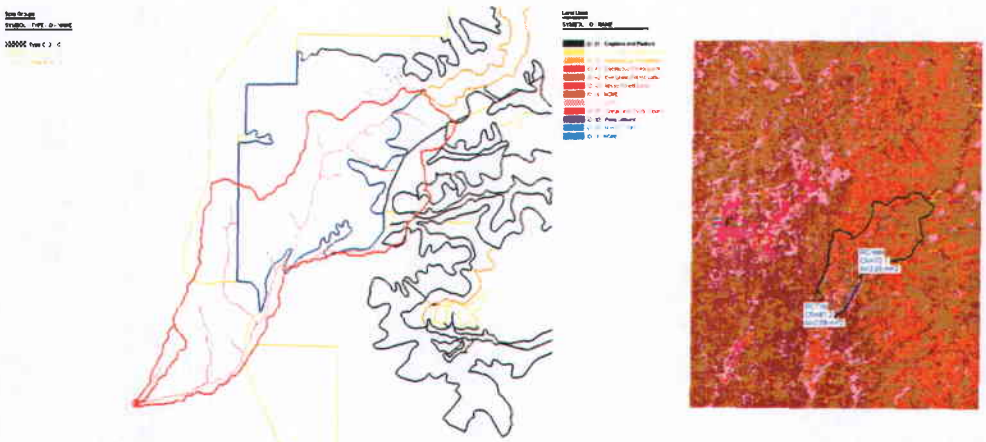


Figure 2 – Digital Land Use and Soils Data Overlaid with Robinson Creek Watersheds.

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

```
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

	(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      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 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.

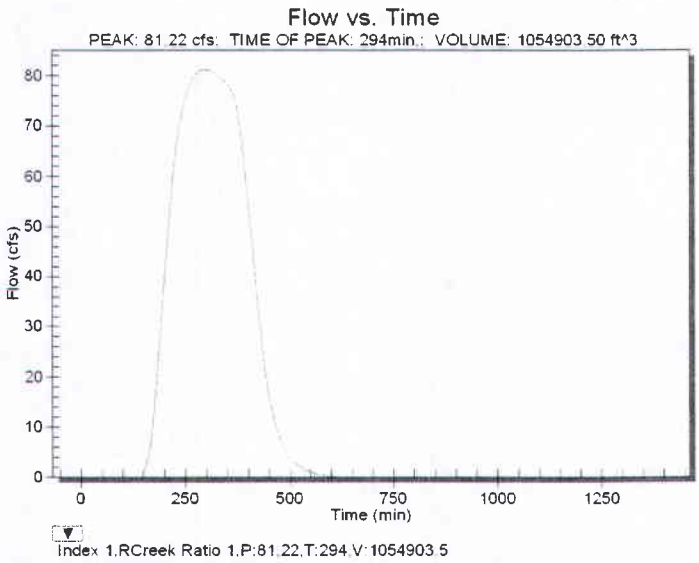


Figure 4 – Computed Runoff Hydrograph for RCreek

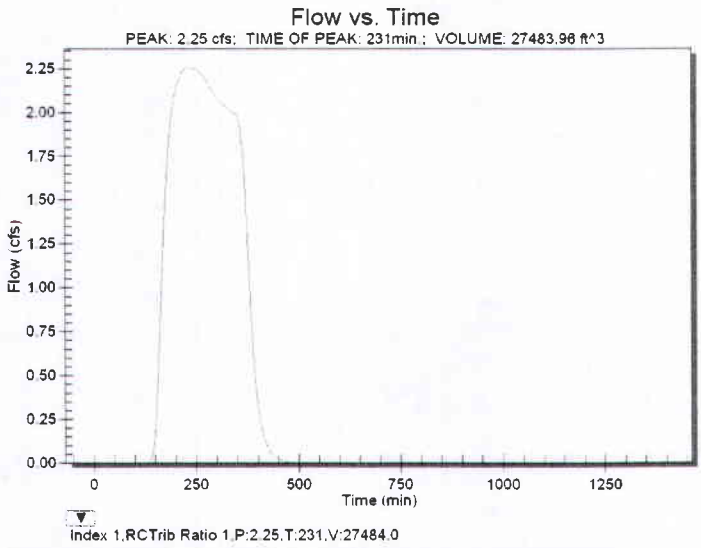


Figure 5 – Computed Runoff Hydrograph for RCTrib

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.

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: http://www.fhwa.dot.gov/engineering/hydraulics/library_arc.cfm?pub_number=15&id=32.

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]	0.025	0.020	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	0.036	0.030	0.024

[1]Based on data from Kouwen, et al. (1980), Cox, et al. (1970), McWhorter, et al. (1968) and Thibodeaux (1968).
[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

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	1.8-4.5	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}=7.5 mm (0.3 in)	5.8	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)	113	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, 1967).
[2]Based on Equation 4.5 derived from USDA (1987)
[3]Based on Equation 6.7 with Shield's parameter equal to 0.047.

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.

$$K_b = 2.00 \qquad R_C/T \leq 2$$

$$K_b = 2.38 - 0.206\left(\frac{R_c}{T}\right) + 0.0073\left(\frac{R_c}{T}\right)^2 \qquad 2 < R_C/T < 10 \qquad (3.7)$$

$$K_b = 1.05 \qquad 10 \leq R_C/T$$

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.

R645-301-600 Geology, 2005 and 2007 Drilling Update

Replaces Page 6-8, Chapter 6

This page is updated to include 2007 drilling and to clarify that CH-04-05 was included in the 2005 drilling plan but was never drilled.

approximate coal seam thicknesses are shown in Drawing 6-3. A geologic cross-section depicting regional stratigraphic relationships is shown in Drawing 6-9. An overburden isopach map is provided in Drawing 5-15.

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. Drill holes CH-01-05, CH-03-05, CH-05-05, and CH-06-05 were drilled during the 2005 drilling program. Drill hole CH-02-05 was a planned coal exploration hole located outside the proposed mining areas that was drilled at a later time. Due to drilling complications, drill hole CH-02-05 could not be advanced to the coal seam and, subsequently, was abandoned. Drill hole CH-04-05 was permitted in 2005, but was not drilled. Two additional boreholes, CH-7 and CH-8, were drilled during the 2007 drilling program. No rider seams are present in the overburden strata in the proposed coal mining area.

622.300
The outcrop line of the seam to be mined (Smirl coal zone) is shown on the geologic map in Drawing 6-1. The strike and dip of the Smirl coal zone in the permit area is also shown on Drawings 6-1 and 6-6.

622.400
No oil and gas wells exist within the proposed Coal Hollow Mine 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 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 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

Table 6-1, Drillhole Information Table

Replaces Table 6-1, Chapter 6

Table 6-1 is updated to include 2007 drillhole information

Table 6-1 Drill hole information.

Drill hole number	Land coordinates UTM Z12 NAD 27 (easting, northing)	Collar elevation (feet)	Total depth of hole (feet)	Overburden thickness (feet)	Elevation of top of coal seam (feet)	Coal seam thickness, Smirl zone (feet)	Cored interval (feet)	Plugged interval (feet)
CH-01-05	4139959, 371167	6863	80	59.2	6803.8	13.8	40-80	0-80
CH-03-05	4139608, 370977	6855	63.5	46	6809	15	41-63.5	0-63.5
CH-05-05	4139608, 371651	6927	175	154.7	6772.3	16.8	40-175	0-175
CH-06-05	4138401, 371434	6853	83.5	62.3	6790.7	17.2	40-83.5	0-83.5
CH-7	4139552, 371358	6881.4	46	---	---	---	---	0-46
CH-8	4139015, 371348	6860.2	103	83.8	6776.4	17.2	---	0-103

301-621 Acid- and Toxic-Forming Information

Replaces Appendix 6-2

Addresses Geology section 301-621

Additional drilling (CH-07 and CH-08) for acid- and toxic-forming information was completed and data is provided in this appendix. Four coal samples from different locations were analyzed for the same parameters as overburden and the results are also provided. Additional lab analysis is provided for drillhole CH-06-05. Samples were analyzed for hot water soluble selenium.

A preliminary radiation assessment has been completed. No radiation was detected in any of the samples available and the results are documented in a letter from Applied Geotechnical Engineering Consultants who conducted the tests.

APPENDIX 6-2

Acid- and Toxic-Forming Information

and

Preliminary Radiation Assessment

Appendix 6-2
Data Gathering Summary

This appendix contains the results of physical and chemical laboratory acid- and toxic-forming analysis of samples collected in the Coal Hollow Project area. The laboratory analyses were performed by Energy Laboratories, Inc. of Billings, Montana. The comprehensive list of laboratory analytical parameters was developed in consultation with the Utah Division of Oil, Gas and Mining. Sample identifications, laboratory sample numbers, sample intervals and types, and lithologic descriptions of samples are presented in the summary table in this appendix. Sample locations are shown in the location map in this appendix.

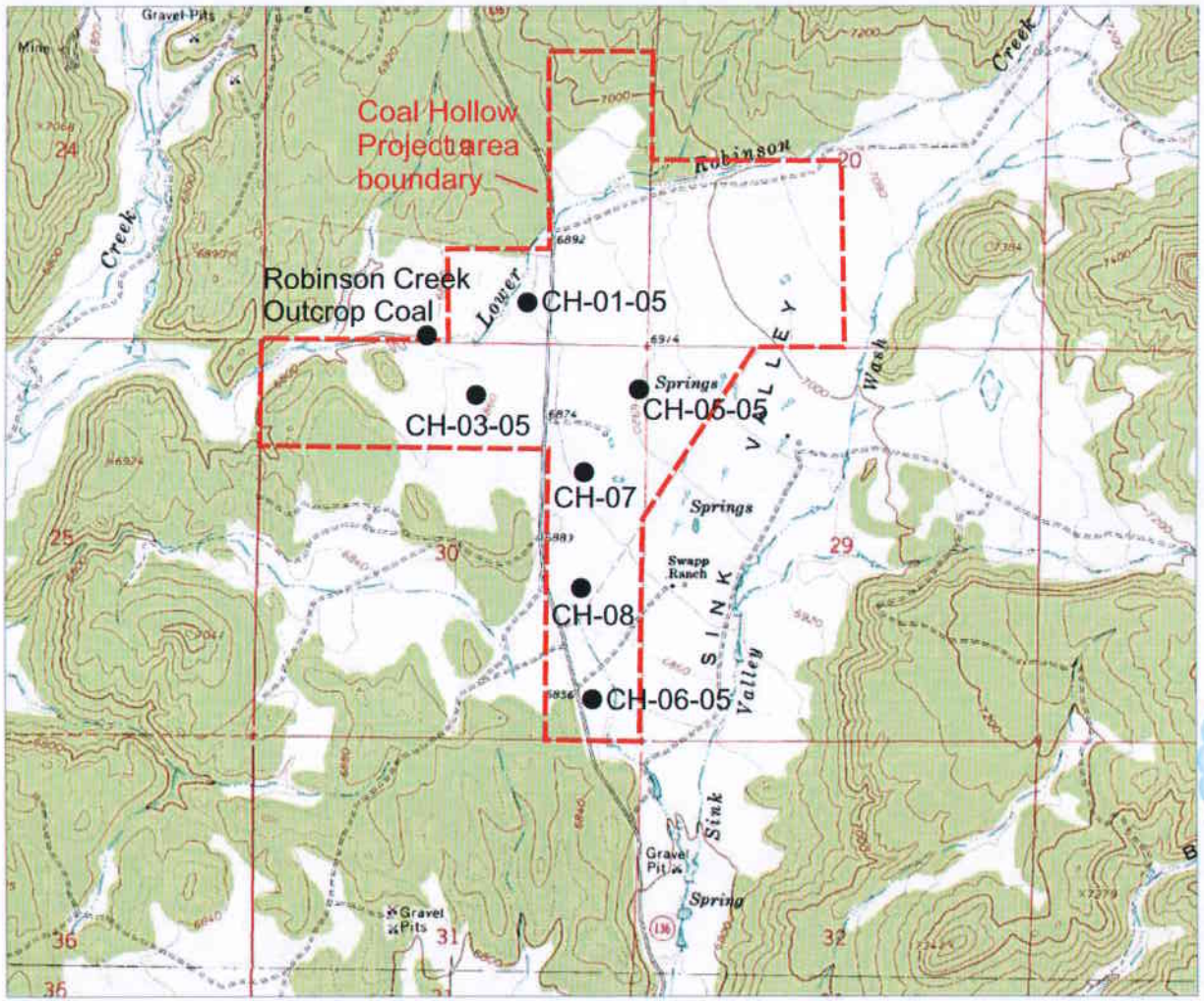
Sediment, bedrock, and coal samples were collected from several locations within the project area for analysis of acid- and toxic-forming potential. A sample of coal from the Smirl Coal Zone was collected from an outcrop in the Lower Robinson Creek drainage. The other samples were collected from the drill hole locations shown on the location map in this appendix. Samples at the drill hole locations were collected using various techniques (as detailed in the summary table in this appendix) including core composite samples, drill cutting grab samples, and grab samples from track-hoe pit excavations.

Drill holes CH-01-05, CH-03-05, CH-05-05, and CH-06-05 were drilled during the 2005 drilling program. Drill hole CH-02-05 was a planned coal exploration hole located outside the proposed mining areas that was drilled at a later time. Due to drilling complications, drill hole CH-02-05 could not be advanced to the coal seam and, subsequently, was abandoned. Drill hole CH-04-05 was permitted in 2005, but was not drilled. This exploration drilling program was designed primarily for the purposes of determining coal thicknesses and for obtaining samples for coal quality and geotechnical analysis. As a secondary purpose, samples were collected for acid- and toxic-forming chemical analysis. In these holes, the upper approximately 40 feet of the hole was drilled using auger drilling techniques. Representative grab samples of the shallow sediments were collected from the strata encountered in the holes and selected samples were sent for physical and chemical acid- and toxic-forming analysis. Composite samples of the cored intervals were prepared from 10-foot depth intervals and selected composite samples were sent to the laboratory for physical and chemical acid- and toxic-forming analysis.

In December 2007, a drilling program was implemented for the purpose of obtaining additional samples for acid- and toxic-forming laboratory analysis and for obtaining additional geologic information from the overburden strata. The December 2007 holes included CH-07 and CH-08. Drill hole CH-07, which was drilled using auger and air-rotary drilling techniques, was drilled to a depth of 46 feet within the Tropic Shale. Limitations in the drilling technique combined with geologic conditions prohibited drilling to deeper depths in CH-07. Drill Hole CH-08 was drilled using auger, air-rotary, and core drilling techniques. CH-08 was drilled through the overburden and Smirl Zone coal seam and into the Dakota Formation underburden to a depth of 103 feet. Composite samples from both of these drill holes were prepared and sent to the laboratory for physical and chemical acid-and toxic-forming analysis.

112° 28' 45.517" W
37° 24' 36.220" N

112° 25' 29.180" W
37° 24' 38.632" N



37° 22' 25.703" N
112° 28' 42.952" W

37° 22' 28.112" N
112° 25' 26.710" W

1/23/08

0 ¼ ½ 1 Mile

0 1000 2000 3000 5000 Feet

0 0.5 1 Kilometer

1927 North American Datum; UTM grid zone 12
Generated by BigTopo7 (www.igage.com)
Map compiled from USGS Quads: Alton; UT
Bald Knoll; UT

UTM Grid and 2008 Magnetic North Declination at Center of Sheet
Grid to TN 0.682° (16 mils)
TN to MN 12.973° (231 mils)

Location map for
Appendix 6-2
Coal Hollow Project
acid-and toxic-forming
sample locations.

Appendix 6-2

Sample identification table for acid and toxic forming laboratory analyses (Energy Laboratories laboratory reports)

Sample ID	Lab ID	Sample location and type	Stratigraphic interval of sample	Lithologic description of sample
CH-05-05 Core Composite Samples				
Box 1 CH-5 Overburden	B06030458-001	CH-05-05 core composite sample	Tropic shale; 94.3 to 104.3 feet above base	Carbonaceous shale/clayst., minor shaley siltst.
Box 2 CH-5 Overburden	B06030458-002	CH-05-05 core composite sample	Tropic Shale; 84.3 to 94.3 feet above base	Carbonaceous shale/claystone
Box 3 CH-5 Overburden	B06030458-003	CH-05-05 core composite sample	Tropic Shale; 74.3 to 84.3 feet above base	Carbonaceous shale/claystone
Box 4 CH-5 Overburden	B06030458-004	CH-05-05 core composite sample	Tropic Shale; 68.3 to 74.3 feet above base	Carbonaceous shale/claystone
Box 5 CH-5 Overburden	B06030458-005	CH-05-05 core composite sample	Tropic Shale; 54.3 to 63.8 feet above base	Siltstone, bentonite, carbonaceous shale/clayst.
Box 6 CH-5 Overburden	B06030458-006	CH-05-05 core composite sample	Tropic Shale; 44.3 to 54.3 feet above base	Carbonaceous shale/claystone, siltstone
Box 7 CH-5 Overburden	B06030458-007	CH-05-05 core composite sample	Tropic Shale; 34.3 to 44.3 feet above base	Carbonaceous shale/claystone, siltstone
Box 8 CH-5 Overburden	B06030458-008	CH-05-05 core composite sample	Tropic 21.8 to 34.3 feet above base	Carbonaceous shale/clayst., bentonite, minor lst.
Box 9 CH-5 Overburden	B06030458-009	CH-05-05 core composite sample	Tropic Shale; 10.9 to 21.8 feet above base	Carbonaceous shale/claystone, bentonite
Box 10 CH-5 Overburden	B06030458-010	CH-05-05 core composite sample	Tropic Shale; base to 10.9 feet above base	Carbonaceous shale/claystone, minor siltstone
Box 13 CH-5 Below	B06030458-011	CH-05-05 core composite sample	Dakota Formation, beneath smirl coal seam	Siltstone, carbonaceous shale
CH-03-05 Core Composite Samples				
CH 3 Below Underburden	B06030458-012	CH-03-05 core composite sample	Dakota Formation, beneath smirl coal seam	Silty shale (immediately below coal)
CH-3 Above Underburden	B06030458-013	CH-03-05 core composite sample	Tropic Shale; Base to 4.5 feet above base	Carbonaceous shale
CH-01-05 Cuttings Grab Samples				
CH-01-05, 3 ft	B07041015-001	CH-01-05 cuttings grab sample	Lower Robinson Creek Alluvium, 3 ft. bgs	Brown clayey soil
CH-01-05 6 ft	B07041015-002	CH-01-05 cuttings grab sample	Lower Robinson Creek Alluvium, 6 ft. bgs	Brown clayey soil
CH-01-05, 9-10 ft	B07041015-003	CH-01-05 cuttings grab sample	Lower Robinson Creek Alluvium, 9-10 ft. bgs	grayish brown silty clay alluvium
CH-01-05, 12 ft	B07041015-004	CH-01-05 cuttings grab sample	Lower Robinson Creek Alluvium, 12 ft. bgs	grayish brown silty clay alluvium
CH-01-05, 12-13 ft	B07041015-005	CH-01-05 cuttings grab sample	Lower Robinson Creek Alluvium, 12-13 ft. bgs	grayish brown silty clay alluvium
CH-01-05, 16 ft	B07041015-006	CH-01-05 cuttings grab sample	Lower Robinson Creek Alluvium, 3 ft. bgs	grayish brown silty clay alluvium
CH-01-05, 30 ft	B07041015-007	CH-01-05 cuttings grab sample	Lower Robinson Creek Alluvium, 30 ft. bgs	grayish brown silty clay alluvium
CH-01-05, 50 ft	B07041015-023	CH-01-05 cuttings grab sample	Lower Robinson Creek Alluvium, 50 ft. bgs	Dark gray clay alluvium
CH-03-05 Cuttings Grab Samples				
CH-03-05, 0-3 ft	B07041015-008	CH-03-05 cuttings grab sample	Lower Robinson Creek Alluvium, 0-3 ft. bgs	Brownish gray clay
CH-03-05, 3-6 ft	B07041015-009	CH-03-05 cuttings grab sample	Lower Robinson Creek Alluvium, 3-6 ft. bgs	grayish brown silty clay alluvium
CH-03-05, 9 ft	B07041015-010	CH-03-05 cuttings grab sample	Lower Robinson Creek Alluvium, 9 ft. bgs	grayish brown silty clay alluvium
CH-03-05, 16 ft	B07041015-011	CH-03-05 cuttings grab sample	Lower Robinson Creek Alluvium, 16 ft. bgs	grayish brown silty clay alluvium
CH-05-05 Excavation Grab Samples				
CH-05-05, 0-1 ft	B07041015-012	CH-05-05 excavation grab sample	Sink Valley Alluvium, W of fault, 0-1 ft. bgs	silty, clayey soil, brown
CH-05-05, 3 ft	B07041015-013	CH-05-05 excavation grab sample	Sink Valley Alluvium, 3 ft. bgs	silty, clayey soil, brown
CH-05-05, 9-10 ft	B07041015-014	CH-05-05 excavation grab sample	Sink Valley Alluvium, 9-10 ft. bgs	Silty sand and cobbles, alluvium, reddish
CH-05-05, 14 ft	B07041015-015	CH-05-05 excavation grab sample	Sink Valley Alluvium, 14 ft. bgs	Clay, silt, alluvium
CH-05-05 19 ft	B07041015-016	CH-05-05 excavation grab sample	Sink Valley Alluvium, 19 ft. bgs	Tight clay, alluvium
CH-06-05 Cuttings Grab Samples/Core Samples				
CH-06-05, soil	B07041015-017	CH-06-05 cuttings grab sample	Sink Valley Alluvium, 0-3 ft. bgs	Hard, clayey soil
CH-06-05, 5-10 ft	B07041015-018	CH-06-05 cuttings grab sample	Sink Valley Alluvium, 5-10 ft. bgs	Silty, sandy clay alluvium
CH-06-05, 10 ft	B07041015-019	CH-06-05 cuttings grab sample	Sink Valley Alluvium, 10 ft. bgs	Silty, sandy clay alluvium
CH-06-05, 20 ft	B07041015-020	CH-06-05 cuttings grab sample	Sink Valley Alluvium, 20 ft. bgs	Clay, grayish green to grayish brown, alluvium
CH-06-05, 35-40 ft	B07041015-021	CH-06-05 cuttings grab sample	Sink Valley Alluvium, 35-40 ft. bgs	Clay, grayish green to grayish brown, alluvium
CH-06-05, 42-49 ft	B07041015-022	CH-06-05 cuttings grab sample	Sink Valley Alluvium, 42-49 ft. bgs	Silty clay, bluish gray, alluvium
CH-06-05, 49.5-59.5 ft	B07110830-001	CH-06-05 core composite sample	Tropic Shale, 2.8 ft. above base	Carbanaceous shale
CH-06-05, 59.5-62.3 ft	B07110830-002	CH-06-05 core composite sample	Tropic Shale, base to 2.8 ft above base	Clayey siltstone, dark gray, mottled
CH-06-05, 79.5-83.5 ft	B07110830-003	CH-06-05 core composite sample	Dakota Formation, beneath smirl coal seam	Clayey siltstone, Organic siltstone/shale

CH-07 Cuttings Grab Samples				
CH-07 0 - 6 ft	B07120398-005	CH-07 cuttings composite sample	Soil/Weathered Tropic Shale, 0-6 ft. bgs	Clayey silt and clayey, silty soil, brown/reddish brown
CH-07 6 - 15 ft	B07120398-006	CH-07 cuttings composite sample	Weathered Tropic Shale, 6-15 ft. bgs	Clayey silt, brown and brownish gray
CH-07 15 - 19 ft	B07120398-007	CH-07 cuttings composite sample	Weathered Tropic Shale, 15-19 ft. bgs	Clayey silt, brownish gray
CH-07 19 - 27 ft	B07120398-008	CH-07 cuttings composite sample	Weathered Tropic Shale, 19-27 ft bgs	Silty clay, dark gray and greenish gray
CH-07 27 - 36 ft	B07120398-009	CH-07 cuttings composite sample	Tropic Shale, 65-74 feet above base	Silty claystone, dark gray
CH-07 36 - 46 ft	B07120398-010	CH-07 cuttings composite sample	Tropic Shale, 55-65 feet above base	Silty Claystone, dark gray
CH-08 Cuttings Grab Samples/Core Samples				
CH-08 0 - 6 ft	B07120398-011	CH-08 cuttings composite sample	Sink Valley Alluvium, 0' to 6'	Clayey silt and very-fine-grained sand, brown
CH-08 6 - 11 ft	B07120398-012	CH-08 cuttings composite sample	Sink Valley Alluvium, 6' to 11'	Silty fine-grained sand, sandstone cobble, yellowish brown
CH-08 11 - 20 ft	B07120398-013	CH-08 cuttings composite sample	Sink Valley Alluvium, 11' to 20'	Clayey silt and silty fine-grained sand, grayish brown
CH-08 20 - 30 ft	B07120398-014	CH-08 cuttings composite sample	Sink Valley Alluvium, 20' to 30'	Silty clay, minor fine-grained sand,bluish gray
CH-08 30 - 40 ft	B07120398-015	CH-08 cuttings composite sample	Sink Valley Alluvium, 30' to 40'	Silty clay, minor fine-grained sand, yellowish brown
CH-08 40 - 50 ft	B07120398-016	CH-08 cuttings composite sample	Tropic Shale, 33.8-43.8 feet above base	Claystone and silty claystone, brownish gray
CH-08 50 - 60 ft	B07120398-017	CH-08 cuttings composite sample	Tropic Shale, 23.8-33.8 feet above base	Claystone and silty claystone, gray and greenish gray
CH-08 60 - 70 ft	B07120398-018	CH-08 cuttings composite sample	Tropic Shale, 13.8-23.8 feet above base	Claystone and silty claystone, gray and greenish gray
CH-08 70 - 79 ft	B07120398-001	CH-08 cuttings composite sample	Tropic Shale, 4.6-13.8 feet above base	Claystone and silty claystone, gray and greenish gray
CH-08 79.2 - 82.3 ft	B07120398-002	CH-08 composite core sample	Tropic Shale 0.6-4.6 feet above base	Clayey siltstone, dark gray to black
CH-08 82.3 - 83.8 ft	B07120398-003	CH-08 composite core sample	Tropic Shale, 0-0.6 feet above base	Organic-rich siltstone/very-fine-grained sandstone, gray
CH-08 101 -103 ft	B07120398-004	CH-08 cuttings composite sample	Dakota Formation, 0-2 feet below upper contact	Silty claystone/siltstone, gray
Coal Samples				
CH-08 Coal Composite	B07120636-001	CH-08 core/cuttings composite sample	Smirl Coal Zone sample	Black bituminous coal
CH-01-05 Coal Grab Sample	B07120524-001	CH-01-05 coal grab sample	Smirl Coal Zone sample	Black bituminous coal
CH-03-05 Coal Composite	B07120636-003	CH-03-05 core grab sample	Smirl Coal Zone sample	Black bituminous coal
Robinson Creek Outcrop Coal	B07120636-004	Outcrop sample in Robinson Creek drainage	Smirl Coal Zone sample	Black bituminous coal

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LABORATORY ANALYTICAL REPORT

Client: Patrick Collins
Project: Coal Hollow
Lab ID: B06030458-001
Client Sample ID: Box 1 CH-5 Overburden

Report Date: 03/30/06
Collection Date: Not Provided
Date Received: 03/07/06
Matrix: Soil

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	12	%		1		ASA15-5	03/16/06 08:32 / srm
Silt	53	%		1		ASA15-5	03/16/06 08:32 / srm
Clay	35	%		1		ASA15-5	03/16/06 08:32 / srm
Very Fine Sand	3	wt%				ASA15-5	03/30/06 09:23 / srm
Texture	SiCL					ASA15-5	03/16/06 08:32 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.60	s.u.		0.10		ASAM10-3.2	03/15/06 11:13 / srm
Conductivity, sat. paste	3.50	mmhos/cm		0.01		ASA10-3	03/15/06 11:13 / srm
Saturation	99.1	%		0.1		USDA27a	03/15/06 11:13 / srm
Calcium, sat. paste	1.01	meq/L		0.05		SW6010B	03/15/06 18:15 / rlh
Magnesium, sat. paste	0.58	meq/L		0.08		SW6010B	03/15/06 18:15 / rlh
Potassium, sat. paste	0.32	meq/L		0.03		SW6010B	03/15/06 18:15 / rlh
Sodium, sat. paste	32.9	meq/L	D	0.07		SW6010B	03/15/06 18:15 / rlh
Sodium Adsorption Ratio (SAR)	36.9	unitless		0.01		Calculation	03/16/06 10:44 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	220	t/kt		1.0		Sobek Modified	03/16/06 16:04 / srm
Acid Potential	12	t/kt		1.0		Sobek Modified	03/16/06 16:04 / srm
Acid/Base Potential	210	t/kt				Sobek Modified	03/16/06 16:04 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	22.0	%		0.1		USDA23c	03/16/06 10:05 / srm
Organic Carbon	1.32	wt%		0.02		ASA29-3	03/14/06 14:52 / srm
Nitrate as N, KCL Extract	ND	mg/kg		1		ASA33-8.1	03/15/06 13:59 / srm
METALS, WATER EXTRACTABLE							
Boron	0.8	mg/kg		0.1		SW6010B	03/17/06 03:20 / rlh
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	03/13/06 22:23 / rlh
Barium	53	mg/kg		5		SW6010B	03/13/06 22:23 / rlh
Cadmium	ND	mg/kg		1		SW6010B	03/13/06 22:23 / rlh
Chromium	8	mg/kg		5		SW6010B	03/13/06 22:23 / rlh
Copper	16	mg/kg		5		SW6010B	03/13/06 22:23 / rlh
Iron	9820	mg/kg		5		SW6010B	03/13/06 22:23 / rlh
Lead	8	mg/kg		5		SW6010B	03/13/06 22:23 / rlh
Manganese	195	mg/kg		5		SW6010B	03/13/06 22:23 / rlh
Mercury	ND	mg/kg		1		SW7471A	03/15/06 17:22 / jkc
Molybdenum	ND	mg/kg		5		SW6010B	03/13/06 22:23 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Patrick Collins
Project: Coal Hollow
Lab ID: B06030458-001
Client Sample ID: Box 1 CH-5 Overburden

Report Date: 03/30/06
Collection Date: Not Provided
Date Received: 03/07/06
Matrix: Soil

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Selenium	ND	mg/kg		5		SW6010B	03/13/06 22:23 / rlh
Silver	ND	mg/kg		5		SW6010B	03/13/06 22:23 / rlh
Zinc	41	mg/kg		5		SW6010B	03/13/06 22:23 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development LLC
Project:
Lab ID: B07110148-001
Client Sample ID: Box 1, CH-5 94.3 to 104.3

Report Date: 11/14/07
Collection Date: Not Provided
DateReceived: 11/02/07
Matrix: Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, WATER EXTRACTABLE							
Selenium	0.01	mg/kg		0.01		SW6020	11/12/07 14:12 / sas

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Patrick Collins
Project: Coal Hollow
Lab ID: B06030458-002
Client Sample ID: Box 2 CH-5 Overburden

Report Date: 03/30/06
Collection Date: Not Provided
Date Received: 03/07/06
Matrix: Soil

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	14	%		1		ASA15-5	03/16/06 08:32 / srm
Silt	56	%		1		ASA15-5	03/16/06 08:32 / srm
Clay	30	%		1		ASA15-5	03/16/06 08:32 / srm
Very Fine Sand	11	wt%				ASA15-5	03/30/06 09:23 / srm
Texture	SiCL					ASA15-5	03/16/06 08:32 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.80	s.u.		0.10		ASAM10-3.2	03/15/06 11:13 / srm
Conductivity, sat. paste	2.58	mmhos/cm		0.01		ASA10-3	03/15/06 11:13 / srm
Saturation	101	%		0.1		USDA27a	03/15/06 11:13 / srm
Calcium, sat. paste	0.37	meq/L		0.05		SW6010B	03/15/06 18:20 / rlh
Magnesium, sat. paste	0.11	meq/L		0.08		SW6010B	03/15/06 18:20 / rlh
Potassium, sat. paste	0.18	meq/L		0.03		SW6010B	03/15/06 18:20 / rlh
Sodium, sat. paste	23.6	meq/L	D	0.07		SW6010B	03/15/06 18:20 / rlh
Sodium Adsorption Ratio (SAR)	48.1	unitless		0.01		Calculation	03/16/06 10:44 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	210	t/kt		1.0		Sobek Modified	03/16/06 16:04 / srm
Acid Potential	13	t/kt		1.0		Sobek Modified	03/16/06 16:04 / srm
Acid/Base Potential	200	t/kt				Sobek Modified	03/16/06 16:04 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	21.2	%		0.1		USDA23c	03/16/06 10:05 / srm
Organic Carbon	1.10	wt%		0.02		ASA29-3	03/14/06 14:52 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	03/15/06 14:00 / srm
METALS, WATER EXTRACTABLE							
Boron	1.0	mg/kg		0.1		SW6010B	03/17/06 03:29 / rlh
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	03/13/06 22:34 / rlh
Barium	52	mg/kg		5		SW6010B	03/13/06 22:34 / rlh
Cadmium	ND	mg/kg		1		SW6010B	03/13/06 22:34 / rlh
Chromium	6	mg/kg		5		SW6010B	03/13/06 22:34 / rlh
Copper	12	mg/kg		5		SW6010B	03/13/06 22:34 / rlh
Iron	9000	mg/kg		5		SW6010B	03/13/06 22:34 / rlh
Lead	9	mg/kg		5		SW6010B	03/13/06 22:34 / rlh
Manganese	143	mg/kg		5		SW6010B	03/13/06 22:34 / rlh
Mercury	ND	mg/kg		1		SW7471A	03/15/06 17:28 / jkc
Molybdenum	ND	mg/kg		5		SW6010B	03/13/06 22:34 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Patrick Collins
Project: Coal Hollow
Lab ID: B06030458-002
Client Sample ID: Box 2 CH-5 Overburden

Report Date: 03/30/06
Collection Date: Not Provided
Date Received: 03/07/06
Matrix: Soil

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Selenium	ND	mg/kg		5		SW6010B	03/13/06 22:34 / rlh
Silver	ND	mg/kg		5		SW6010B	03/13/06 22:34 / rlh
Zinc	38	mg/kg		5		SW6010B	03/13/06 22:34 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development LLC
Project:
Lab ID: B07110148-002
Client Sample ID: Box 2, CH-5 84.3 to 94.3

Report Date: 11/14/07
Collection Date: Not Provided
DateReceived: 11/02/07
Matrix: Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, WATER EXTRACTABLE							
Selenium	0.03	mg/kg		0.01		SW6020	11/12/07 14:54 / sas

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Patrick Collins
Project: Coal Hollow
Lab ID: B06030458-003
Client Sample ID: Box 3 CH-5 Overburden

Report Date: 03/30/06
Collection Date: Not Provided
Date Received: 03/07/06
Matrix: Soil

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	6	%		1		ASA15-5	03/16/06 08:32 / srm
Silt	61	%		1		ASA15-5	03/16/06 08:32 / srm
Clay	33	%		1		ASA15-5	03/16/06 08:32 / srm
Very Fine Sand	6	wt%				ASA15-5	03/30/06 09:23 / srm
Texture	SiCL					ASA15-5	03/16/06 08:32 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	9.30	s.u.		0.10		ASAM10-3.2	03/15/06 11:13 / srm
Conductivity, sat. paste	1.74	mmhos/cm		0.01		ASA10-3	03/15/06 11:13 / srm
Saturation	144	%		0.1		USDA27a	03/15/06 11:13 / srm
Calcium, sat. paste	0.21	meq/L		0.05		SW6010B	03/15/06 18:24 / rlh
Magnesium, sat. paste	ND	meq/L		0.08		SW6010B	03/15/06 18:24 / rlh
Potassium, sat. paste	0.10	meq/L		0.03		SW6010B	03/15/06 18:24 / rlh
Sodium, sat. paste	15.9	meq/L		0.04		SW6010B	03/15/06 18:24 / rlh
Sodium Adsorption Ratio (SAR)	43.1	unitless		0.01		Calculation	03/16/06 10:44 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	89	t/kt		1.0		Sobek Modified	03/16/06 16:04 / srm
Acid Potential	13	t/kt		1.0		Sobek Modified	03/16/06 16:04 / srm
Acid/Base Potential	76	t/kt				Sobek Modified	03/16/06 16:04 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	8.9	%		0.1		USDA23c	03/16/06 10:05 / srm
Organic Carbon	1.18	wt%		0.02		ASA29-3	03/14/06 14:52 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	03/15/06 14:01 / srm
METALS, WATER EXTRACTABLE							
Boron	1.4	mg/kg		0.1		SW6010B	03/17/06 03:38 / rlh
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	03/13/06 22:42 / rlh
Barium	53	mg/kg		5		SW6010B	03/13/06 22:42 / rlh
Cadmium	ND	mg/kg		1		SW6010B	03/13/06 22:42 / rlh
Chromium	ND	mg/kg		5		SW6010B	03/13/06 22:42 / rlh
Copper	9	mg/kg		5		SW6010B	03/13/06 22:42 / rlh
Iron	8040	mg/kg		5		SW6010B	03/13/06 22:42 / rlh
Lead	9	mg/kg		5		SW6010B	03/13/06 22:42 / rlh
Manganese	83	mg/kg		5		SW6010B	03/13/06 22:42 / rlh
Mercury	ND	mg/kg		1		SW7471A	03/15/06 17:30 / jkc
Molybdenum	ND	mg/kg		5		SW6010B	03/13/06 22:42 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Patrick Collins
Project: Coal Hollow
Lab ID: B06030458-003
Client Sample ID: Box 3 CH-5 Overburden

Report Date: 03/30/06
Collection Date: Not Provided
Date Received: 03/07/06
Matrix: Soil

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Selenium	ND	mg/kg		5		SW6010B	03/13/06 22:42 / rlh
Silver	ND	mg/kg		5		SW6010B	03/13/06 22:42 / rlh
Zinc	42	mg/kg		5		SW6010B	03/13/06 22:42 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Patrick Collins
Project: Coal Hollow
Lab ID: B06030458-004
Client Sample ID: Box 4 CH-5 Overburden

Report Date: 03/30/06
Collection Date: Not Provided
Date Received: 03/07/06
Matrix: Soil

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	8	%		1		ASA15-5	03/16/06 08:32 / srm
Silt	53	%		1		ASA15-5	03/16/06 08:32 / srm
Clay	39	%		1		ASA15-5	03/16/06 08:32 / srm
Very Fine Sand	6	wt%				ASA15-5	03/30/06 09:23 / srm
Texture	SiCL					ASA15-5	03/16/06 08:32 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	9.50	s.u.		0.10		ASAM10-3.2	03/15/06 11:13 / srm
Conductivity, sat. paste	0.91	mmhos/cm		0.01		ASA10-3	03/15/06 11:13 / srm
Saturation	162	%		0.1		USDA27a	03/15/06 11:13 / srm
Calcium, sat. paste	0.10	meq/L		0.05		SW6010B	03/15/06 19:05 / rlh
Magnesium, sat. paste	ND	meq/L		0.08		SW6010B	03/15/06 19:05 / rlh
Potassium, sat. paste	0.05	meq/L		0.03		SW6010B	03/15/06 19:05 / rlh
Sodium, sat. paste	8.20	meq/L		0.04		SW6010B	03/15/06 19:05 / rlh
Sodium Adsorption Ratio (SAR)	33.4	unitless		0.01		Calculation	03/16/06 10:44 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	100	t/kt		1.0		Sobek Modified	03/16/06 16:04 / srm
Acid Potential	10	t/kt		1.0		Sobek Modified	03/16/06 16:04 / srm
Acid/Base Potential	95	t/kt				Sobek Modified	03/16/06 16:04 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	10.5	%		0.1		USDA23c	03/16/06 10:05 / srm
Organic Carbon	0.96	wt%		0.02		ASA29-3	03/14/06 14:52 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	03/15/06 14:01 / srm
METALS, WATER EXTRACTABLE							
Boron	1.4	mg/kg		0.1		SW6010B	03/17/06 04:15 / rlh
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	03/13/06 22:45 / rlh
Barium	46	mg/kg		5		SW6010B	03/13/06 22:45 / rlh
Cadmium	ND	mg/kg		1		SW6010B	03/13/06 22:45 / rlh
Chromium	ND	mg/kg		5		SW6010B	03/13/06 22:45 / rlh
Copper	7	mg/kg		5		SW6010B	03/13/06 22:45 / rlh
Iron	6480	mg/kg		5		SW6010B	03/13/06 22:45 / rlh
Lead	10	mg/kg		5		SW6010B	03/13/06 22:45 / rlh
Manganese	74	mg/kg		5		SW6010B	03/13/06 22:45 / rlh
Mercury	ND	mg/kg		1		SW7471A	03/15/06 17:33 / jkc
Molybdenum	ND	mg/kg		5		SW6010B	03/13/06 22:45 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Patrick Collins
Project: Coal Hollow
Lab ID: B06030458-004
Client Sample ID: Box 4 CH-5 Overburden

Report Date: 03/30/06
Collection Date: Not Provided
Date Received: 03/07/06
Matrix: Soil

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Selenium	ND	mg/kg		5		SW6010B	03/13/06 22:45 / rlh
Silver	ND	mg/kg		5		SW6010B	03/13/06 22:45 / rlh
Zinc	32	mg/kg		5		SW6010B	03/13/06 22:45 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development LLC
Project:
Lab ID: B07110148-003
Client Sample ID: Box 4, CH-5 68.3 to 74.3

Report Date: 11/14/07
Collection Date: Not Provided
DateReceived: 11/02/07
Matrix: Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, WATER EXTRACTABLE							
Selenium	0.01	mg/kg		0.01		SW6020	11/12/07 15:02 / sas

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Patrick Collins
Project: Coal Hollow
Lab ID: B06030458-005
Client Sample ID: Box 5 CH-5 Overburden

Report Date: 03/30/06
Collection Date: Not Provided
Date Received: 03/07/06
Matrix: Soil

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	18	%		1		ASA15-5	03/16/06 08:32 / srm
Silt	47	%		1		ASA15-5	03/16/06 08:32 / srm
Clay	35	%		1		ASA15-5	03/16/06 08:32 / srm
Very Fine Sand	8	wt%				ASA15-5	03/30/06 09:23 / srm
Texture	SiCL					ASA15-5	03/16/06 08:32 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	9.30	s.u.		0.10		ASAM10-3.2	03/15/06 11:13 / srm
Conductivity, sat. paste	1.28	mmhos/cm		0.01		ASA10-3	03/15/06 11:13 / srm
Saturation	144	%		0.1		USDA27a	03/15/06 11:13 / srm
Calcium, sat. paste	0.18	meq/L		0.05		SW6010B	03/15/06 19:09 / rlh
Magnesium, sat. paste	ND	meq/L		0.08		SW6010B	03/15/06 19:09 / rlh
Potassium, sat. paste	0.08	meq/L		0.03		SW6010B	03/15/06 19:09 / rlh
Sodium, sat. paste	11.6	meq/L		0.04		SW6010B	03/15/06 19:09 / rlh
Sodium Adsorption Ratio (SAR)	35.8	unitless		0.01		Calculation	03/16/06 10:44 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	160	t/kt		1.0		Sobek Modified	03/16/06 16:04 / srm
Acid Potential	9.0	t/kt		1.0		Sobek Modified	03/16/06 16:04 / srm
Acid/Base Potential	140	t/kt				Sobek Modified	03/16/06 16:04 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	15.5	%		0.1		USDA23c	03/16/06 10:05 / srm
Organic Carbon	0.86	wt%		0.02		ASA29-3	03/14/06 14:52 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	03/15/06 14:02 / srm
METALS, WATER EXTRACTABLE							
Boron	1.4	mg/kg		0.1		SW6010B	03/17/06 04:20 / rlh
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	03/13/06 22:49 / rlh
Barium	55	mg/kg		5		SW6010B	03/13/06 22:49 / rlh
Cadmium	ND	mg/kg		1		SW6010B	03/13/06 22:49 / rlh
Chromium	ND	mg/kg		5		SW6010B	03/13/06 22:49 / rlh
Copper	7	mg/kg		5		SW6010B	03/13/06 22:49 / rlh
Iron	5730	mg/kg		5		SW6010B	03/13/06 22:49 / rlh
Lead	12	mg/kg		5		SW6010B	03/13/06 22:49 / rlh
Manganese	825	mg/kg		5		SW6010B	03/13/06 22:49 / rlh
Mercury	ND	mg/kg		1		SW7471A	03/15/06 17:35 / jkc
Molybdenum	ND	mg/kg		5		SW6010B	03/13/06 22:49 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Patrick Collins
Project: Coal Hollow
Lab ID: B06030458-005
Client Sample ID: Box 5 CH-5 Overburden

Report Date: 03/30/06
Collection Date: Not Provided
Date Received: 03/07/06
Matrix: Soil

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Selenium	ND	mg/kg		5		SW6010B	03/13/06 22:49 / rlh
Silver	ND	mg/kg		5		SW6010B	03/13/06 22:49 / rlh
Zinc	41	mg/kg		5		SW6010B	03/13/06 22:49 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development LLC
Project:
Lab ID: B07110148-004
Client Sample ID: Box 5, CH-5 54.3 to 63.8

Report Date: 11/14/07
Collection Date: Not Provided
DateReceived: 11/02/07
Matrix: Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, WATER EXTRACTABLE							
Selenium	0.03	mg/kg		0.01		SW6020	11/12/07 15:09 / sas

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Patrick Collins
Project: Coal Hollow
Lab ID: B06030458-006
Client Sample ID: Box 6 CH-5 Overburden

Report Date: 03/30/06
Collection Date: Not Provided
Date Received: 03/07/06
Matrix: Soil

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	8	%		1		ASA15-5	03/16/06 08:32 / srm
Silt	63	%		1		ASA15-5	03/16/06 08:32 / srm
Clay	29	%		1		ASA15-5	03/16/06 08:32 / srm
Very Fine Sand	8	wt%				ASA15-5	03/30/06 09:23 / srm
Texture	SiCL					ASA15-5	03/16/06 08:32 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.80	s.u.		0.10		ASAM10-3.2	03/15/06 11:13 / srm
Conductivity, sat. paste	2.87	mmhos/cm		0.01		ASA10-3	03/15/06 11:13 / srm
Saturation	85.0	%		0.1		USDA27a	03/15/06 11:13 / srm
Calcium, sat. paste	0.42	meq/L		0.05		SW6010B	03/15/06 19:13 / rlh
Magnesium, sat. paste	0.19	meq/L		0.08		SW6010B	03/15/06 19:13 / rlh
Potassium, sat. paste	0.24	meq/L		0.03		SW6010B	03/15/06 19:13 / rlh
Sodium, sat. paste	26.8	meq/L	D	0.07		SW6010B	03/15/06 19:13 / rlh
Sodium Adsorption Ratio (SAR)	48.6	unitless		0.01		Calculation	03/16/06 10:44 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	100	t/kt		1.0		Sobek Modified	03/16/06 16:04 / srm
Acid Potential	11	t/kt		1.0		Sobek Modified	03/16/06 16:04 / srm
Acid/Base Potential	91	t/kt				Sobek Modified	03/16/06 16:04 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	10.2	%		0.1		USDA23c	03/16/06 10:05 / srm
Organic Carbon	1.28	wt%		0.02		ASA29-3	03/14/06 14:52 / srm
Nitrate as N, KCL Extract	ND	mg/kg		1		ASA33-8.1	03/15/06 14:06 / srm
METALS, WATER EXTRACTABLE							
Boron	1.3	mg/kg		0.1		SW6010B	03/17/06 04:24 / rlh
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	03/13/06 22:52 / rlh
Barium	76	mg/kg		5		SW6010B	03/13/06 22:52 / rlh
Cadmium	ND	mg/kg		1		SW6010B	03/13/06 22:52 / rlh
Chromium	11	mg/kg		5		SW6010B	03/13/06 22:52 / rlh
Copper	14	mg/kg		5		SW6010B	03/13/06 22:52 / rlh
Iron	7990	mg/kg		5		SW6010B	03/13/06 22:52 / rlh
Lead	7	mg/kg		5		SW6010B	03/13/06 22:52 / rlh
Manganese	64	mg/kg		5		SW6010B	03/13/06 22:52 / rlh
Mercury	ND	mg/kg		1		SW7471A	03/15/06 17:41 / jkc
Molybdenum	ND	mg/kg		5		SW6010B	03/13/06 22:52 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Patrick Collins
Project: Coal Hollow
Lab ID: B06030458-006
Client Sample ID: Box 6 CH-5 Overburden

Report Date: 03/30/06
Collection Date: Not Provided
Date Received: 03/07/06
Matrix: Soil

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Selenium	ND	mg/kg		5		SW6010B	03/13/06 22:52 / rlh
Silver	ND	mg/kg		5		SW6010B	03/13/06 22:52 / rlh
Zinc	43	mg/kg		5		SW6010B	03/13/06 22:52 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development LLC
Project:
Lab ID: B07110148-011
Client Sample ID: Box 6, CH-5 Overburden

Report Date: 11/14/07
Collection Date: Not Provided
DateReceived: 11/06/07
Matrix: Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, WATER EXTRACTABLE							
Selenium	0.03	mg/kg		0.01		SW6020	11/12/07 16:34 / sas

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Patrick Collins
Project: Coal Hollow
Lab ID: B06030458-007
Client Sample ID: Box 7 CH-5 Overburden

Report Date: 03/30/06
Collection Date: Not Provided
Date Received: 03/07/06
Matrix: Soil

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	18	%		1		ASA15-5	03/16/06 08:32 / srm
Silt	57	%		1		ASA15-5	03/16/06 08:32 / srm
Clay	25	%		1		ASA15-5	03/16/06 08:32 / srm
Very Fine Sand	16	wt%				ASA15-5	03/30/06 09:23 / srm
Texture	SiL					ASA15-5	03/16/06 08:32 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.60	s.u.		0.10		ASAM10-3.2	03/15/06 11:13 / srm
Conductivity, sat. paste	3.39	mmhos/cm		0.01		ASA10-3	03/15/06 11:13 / srm
Saturation	72.9	%		0.1		USDA27a	03/15/06 11:13 / srm
Calcium, sat. paste	0.65	meq/L	D	0.07		SW6010B	03/15/06 19:22 / rlh
Magnesium, sat. paste	0.34	meq/L		0.08		SW6010B	03/15/06 19:22 / rlh
Potassium, sat. paste	0.29	meq/L		0.03		SW6010B	03/15/06 19:22 / rlh
Sodium, sat. paste	31.8	meq/L	D	0.07		SW6010B	03/15/06 19:22 / rlh
Sodium Adsorption Ratio (SAR)	45.3	unitless		0.01		Calculation	03/16/06 10:44 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	130	t/kt		1.0		Sobek Modified	03/16/06 16:04 / srm
Acid Potential	11	t/kt		1.0		Sobek Modified	03/16/06 16:04 / srm
Acid/Base Potential	120	t/kt				Sobek Modified	03/16/06 16:04 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	13.4	%		0.1		USDA23c	03/16/06 10:05 / srm
Organic Carbon	0.89	wt%		0.02		ASA29-3	03/14/06 14:52 / srm
Nitrate as N, KCL Extract	ND	mg/kg		1		ASA33-8.1	03/15/06 14:06 / srm
METALS, WATER EXTRACTABLE							
Boron	1.1	mg/kg		0.1		SW6010B	03/17/06 04:29 / rlh
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	03/13/06 23:04 / rlh
Barium	61	mg/kg		5		SW6010B	03/13/06 23:04 / rlh
Cadmium	ND	mg/kg		1		SW6010B	03/13/06 23:04 / rlh
Chromium	8	mg/kg		5		SW6010B	03/13/06 23:04 / rlh
Copper	10	mg/kg		5		SW6010B	03/13/06 23:04 / rlh
Iron	9060	mg/kg		5		SW6010B	03/13/06 23:04 / rlh
Lead	6	mg/kg		5		SW6010B	03/13/06 23:04 / rlh
Manganese	319	mg/kg		5		SW6010B	03/13/06 23:04 / rlh
Mercury	ND	mg/kg		1		SW7471A	03/15/06 17:44 / jkc
Molybdenum	ND	mg/kg		5		SW6010B	03/13/06 23:04 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Patrick Collins
Project: Coal Hollow
Lab ID: B06030458-007
Client Sample ID: Box 7 CH-5 Overburden

Report Date: 03/30/06
Collection Date: Not Provided
Date Received: 03/07/06
Matrix: Soil

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Selenium	ND	mg/kg		5		SW6010B	03/13/06 23:04 / rlh
Silver	ND	mg/kg		5		SW6010B	03/13/06 23:04 / rlh
Zinc	33	mg/kg		5		SW6010B	03/13/06 23:04 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development LLC
Project:
Lab ID: B07110148-005
Client Sample ID: Box 7, CH-5 34.3 to 44.3

Report Date: 11/14/07
Collection Date: Not Provided
DateReceived: 11/02/07
Matrix: Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, WATER EXTRACTABLE							
Selenium	0.02	mg/kg		0.01		SW6020	11/12/07 15:16 / sas

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Patrick Collins
Project: Coal Hollow
Lab ID: B06030458-008
Client Sample ID: Box 8 CH-5 Overburden

Report Date: 03/30/06
Collection Date: Not Provided
Date Received: 03/07/06
Matrix: Soil

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	12	%		1		ASA15-5	03/16/06 08:32 / srm
Silt	59	%		1		ASA15-5	03/16/06 08:32 / srm
Clay	29	%		1		ASA15-5	03/16/06 08:32 / srm
Very Fine Sand	12	wt%				ASA15-5	03/30/06 09:23 / srm
Texture	SiCL					ASA15-5	03/16/06 08:32 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	9.30	s.u.		0.10		ASAM10-3.2	03/15/06 11:13 / srm
Conductivity, sat. paste	1.81	mmhos/cm		0.01		ASA10-3	03/15/06 11:13 / srm
Saturation	142	%		0.1		USDA27a	03/15/06 11:13 / srm
Calcium, sat. paste	0.15	meq/L		0.05		SW6010B	03/15/06 19:26 / rlh
Magnesium, sat. paste	ND	meq/L		0.08		SW6010B	03/15/06 19:26 / rlh
Potassium, sat. paste	0.11	meq/L		0.03		SW6010B	03/15/06 19:26 / rlh
Sodium, sat. paste	16.5	meq/L		0.04		SW6010B	03/15/06 19:26 / rlh
Sodium Adsorption Ratio (SAR)	52.4	unitless		0.01		Calculation	03/16/06 10:44 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	60	t/kt		1.0		Sobek Modified	03/16/06 16:04 / srm
Acid Potential	23	t/kt		1.0		Sobek Modified	03/16/06 16:04 / srm
Acid/Base Potential	37	t/kt				Sobek Modified	03/16/06 16:04 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	6.0	%		0.1		USDA23c	03/16/06 10:05 / srm
Organic Carbon	0.96	wt%		0.02		ASA29-3	03/14/06 14:52 / srm
Nitrate as N, KCL Extract	ND	mg/kg		1		ASA33-8.1	03/15/06 14:20 / srm
METALS, WATER EXTRACTABLE							
Boron	2.2	mg/kg		0.1		SW6010B	03/17/06 04:33 / rlh
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	03/13/06 23:08 / rlh
Barium	106	mg/kg		5		SW6010B	03/13/06 23:08 / rlh
Cadmium	ND	mg/kg		1		SW6010B	03/13/06 23:08 / rlh
Chromium	15	mg/kg		5		SW6010B	03/13/06 23:08 / rlh
Copper	17	mg/kg		5		SW6010B	03/13/06 23:08 / rlh
Iron	11800	mg/kg		5		SW6010B	03/13/06 23:08 / rlh
Lead	8	mg/kg		5		SW6010B	03/13/06 23:08 / rlh
Manganese	94	mg/kg		5		SW6010B	03/13/06 23:08 / rlh
Mercury	ND	mg/kg		1		SW7471A	03/15/06 17:46 / jkc
Molybdenum	ND	mg/kg		5		SW6010B	03/13/06 23:08 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Patrick Collins
Project: Coal Hollow
Lab ID: B06030458-008
Client Sample ID: Box 8 CH-5 Overburden

Report Date: 03/30/06
Collection Date: Not Provided
Date Received: 03/07/06
Matrix: Soil

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Selenium	ND	mg/kg		5		SW6010B	03/13/06 23:08 / rlh
Silver	ND	mg/kg		5		SW6010B	03/13/06 23:08 / rlh
Zinc	38	mg/kg		5		SW6010B	03/13/06 23:08 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development LLC
Project:
Lab ID: B07110148-006
Client Sample ID: Box 8, CH-5 21.8 to 34.3

Report Date: 11/14/07
Collection Date: Not Provided
DateReceived: 11/02/07
Matrix: Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, WATER EXTRACTABLE							
Selenium	0.03	mg/kg		0.01		SW6020	11/12/07 15:30 / sas

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Patrick Collins
Project: Coal Hollow
Lab ID: B06030458-009
Client Sample ID: Box 9 CH-5 Overburden

Report Date: 03/30/06
Collection Date: Not Provided
Date Received: 03/07/06
Matrix: Soil

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	12	%		1		ASA15-5	03/16/06 08:32 / srm
Silt	53	%		1		ASA15-5	03/16/06 08:32 / srm
Clay	35	%		1		ASA15-5	03/16/06 08:32 / srm
Very Fine Sand	10	wt%				ASA15-5	03/30/06 09:23 / srm
Texture	SiCL					ASA15-5	03/16/06 08:32 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	9.30	s.u.		0.10		ASAM10-3.2	03/15/06 11:13 / srm
Conductivity, sat. paste	1.30	mmhos/cm		0.01		ASA10-3	03/15/06 11:13 / srm
Saturation	163	%		0.1		USDA27a	03/15/06 11:13 / srm
Calcium, sat. paste	0.11	meq/L		0.05		SW6010B	03/15/06 19:31 / rlh
Magnesium, sat. paste	ND	meq/L		0.08		SW6010B	03/15/06 19:31 / rlh
Potassium, sat. paste	0.09	meq/L		0.03		SW6010B	03/15/06 19:31 / rlh
Sodium, sat. paste	12.3	meq/L		0.04		SW6010B	03/15/06 19:31 / rlh
Sodium Adsorption Ratio (SAR)	46.9	unitless		0.01		Calculation	03/16/06 10:44 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	34	t/kt		1.0		Sobek Modified	03/16/06 16:04 / srm
Acid Potential	21	t/kt		1.0		Sobek Modified	03/16/06 16:04 / srm
Acid/Base Potential	13	t/kt				Sobek Modified	03/16/06 16:04 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	3.4	%		0.1		USDA23c	03/16/06 10:05 / srm
Organic Carbon	0.86	wt%		0.02		ASA29-3	03/14/06 14:52 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	03/15/06 14:08 / srm
METALS, WATER EXTRACTABLE							
Boron	1.9	mg/kg		0.1		SW6010B	03/17/06 04:38 / rlh
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	03/13/06 23:11 / rlh
Barium	118	mg/kg		5		SW6010B	03/13/06 23:11 / rlh
Cadmium	ND	mg/kg		1		SW6010B	03/13/06 23:11 / rlh
Chromium	11	mg/kg		5		SW6010B	03/13/06 23:11 / rlh
Copper	12	mg/kg		5		SW6010B	03/13/06 23:11 / rlh
Iron	10700	mg/kg		5		SW6010B	03/13/06 23:11 / rlh
Lead	10	mg/kg		5		SW6010B	03/13/06 23:11 / rlh
Manganese	73	mg/kg		5		SW6010B	03/13/06 23:11 / rlh
Mercury	ND	mg/kg		1		SW7471A	03/15/06 17:48 / jkc
Molybdenum	ND	mg/kg		5		SW6010B	03/13/06 23:11 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Patrick Collins
Project: Coal Hollow
Lab ID: B06030458-009
Client Sample ID: Box 9 CH-5 Overburden

Report Date: 03/30/06
Collection Date: Not Provided
Date Received: 03/07/06
Matrix: Soil

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Selenium	ND	mg/kg		5		SW6010B	03/13/06 23:11 / rlh
Silver	ND	mg/kg		5		SW6010B	03/13/06 23:11 / rlh
Zinc	41	mg/kg		5		SW6010B	03/13/06 23:11 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development LLC
Project:
Lab ID: B07110148-007
Client Sample ID: Box 9, CH-5 10.9 to 21.8

Report Date: 11/14/07
Collection Date: Not Provided
DateReceived: 11/02/07
Matrix: Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, WATER EXTRACTABLE							
Selenium	0.03	mg/kg		0.01		SW6020	11/12/07 15:37 / sas

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Patrick Collins
Project: Coal Hollow
Lab ID: B06030458-010
Client Sample ID: Box 10 CH-5 Overburden

Report Date: 03/30/06
Collection Date: Not Provided
Date Received: 03/07/06
Matrix: Soil

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	32	%		1		ASA15-5	03/16/06 08:32 / srm
Silt	43	%		1		ASA15-5	03/16/06 08:32 / srm
Clay	25	%		1		ASA15-5	03/16/06 08:32 / srm
Very Fine Sand	27	wt%				ASA15-5	03/30/06 09:23 / srm
Texture	L					ASA15-5	03/16/06 08:32 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.30	s.u.		0.10		ASAM10-3.2	03/15/06 11:13 / srm
Conductivity, sat. paste	5.42	mmhos/cm		0.01		ASA10-3	03/15/06 11:13 / srm
Saturation	76.7	%		0.1		USDA27a	03/15/06 11:13 / srm
Calcium, sat. paste	2.24	meq/L		0.05		SW6010B	03/15/06 19:35 / rlh
Magnesium, sat. paste	1.14	meq/L		0.08		SW6010B	03/15/06 19:35 / rlh
Potassium, sat. paste	0.46	meq/L		0.03		SW6010B	03/15/06 19:35 / rlh
Sodium, sat. paste	54.2	meq/L	D	0.1		SW6010B	03/15/06 19:35 / rlh
Sodium Adsorption Ratio (SAR)	41.7	unitless		0.01		Calculation	03/16/06 10:44 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	23	t/kt		1.0		Sobek Modified	03/16/06 16:04 / srm
Acid Potential	15	t/kt		1.0		Sobek Modified	03/16/06 16:04 / srm
Acid/Base Potential	8	t/kt				Sobek Modified	03/16/06 16:04 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	2.3	%		0.1		USDA23c	03/16/06 10:05 / srm
Organic Carbon	2.92	wt%		0.02		ASA29-3	03/14/06 14:52 / srm
Nitrate as N, KCL Extract	ND	mg/kg		1		ASA33-8.1	03/15/06 14:08 / srm
METALS, WATER EXTRACTABLE							
Boron	1.5	mg/kg		0.1		SW6010B	03/17/06 04:42 / rlh
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	03/13/06 23:15 / rlh
Barium	70	mg/kg		5		SW6010B	03/13/06 23:15 / rlh
Cadmium	ND	mg/kg		1		SW6010B	03/13/06 23:15 / rlh
Chromium	6	mg/kg		5		SW6010B	03/13/06 23:15 / rlh
Copper	7	mg/kg		5		SW6010B	03/13/06 23:15 / rlh
Iron	6720	mg/kg		5		SW6010B	03/13/06 23:15 / rlh
Lead	8	mg/kg		5		SW6010B	03/13/06 23:15 / rlh
Manganese	68	mg/kg		5		SW6010B	03/13/06 23:15 / rlh
Mercury	ND	mg/kg		1		SW7471A	03/15/06 17:50 / jkc
Molybdenum	ND	mg/kg		5		SW6010B	03/13/06 23:15 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Patrick Collins
Project: Coal Hollow
Lab ID: B06030458-010
Client Sample ID: Box 10 CH-5 Overburden

Report Date: 03/30/06
Collection Date: Not Provided
Date Received: 03/07/06
Matrix: Soil

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Selenium	ND	mg/kg		5		SW6010B	03/13/06 23:15 / rlh
Silver	ND	mg/kg		5		SW6010B	03/13/06 23:15 / rlh
Zinc	29	mg/kg		5		SW6010B	03/13/06 23:15 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development LLC
Project:
Lab ID: B07110148-008
Client Sample ID: Box 10, CH-5 Base to 10.9

Report Date: 11/14/07
Collection Date: Not Provided
DateReceived: 11/02/07
Matrix: Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, WATER EXTRACTABLE							
Selenium	0.04	mg/kg		0.01		SW6020	11/12/07 15:44 / sas

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Patrick Collins
Project: Coal Hollow
Lab ID: B06030458-011
Client Sample ID: Box 13 CH-5 Below

Report Date: 03/30/06
Collection Date: Not Provided
Date Received: 03/07/06
Matrix: Soil

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	6	%		1		ASA15-5	03/16/06 08:32 / srm
Silt	56	%		1		ASA15-5	03/16/06 08:32 / srm
Clay	38	%		1		ASA15-5	03/16/06 08:32 / srm
Very Fine Sand	6	wt%				ASA15-5	03/30/06 09:23 / srm
Texture	SiCL					ASA15-5	03/16/06 08:32 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	9.00	s.u.		0.10		ASAM10-3.2	03/15/06 11:13 / srm
Conductivity, sat. paste	1.66	mmhos/cm		0.01		ASA10-3	03/15/06 11:13 / srm
Saturation	49.0	%		0.1		USDA27a	03/15/06 11:13 / srm
Calcium, sat. paste	0.23	meq/L		0.05		SW6010B	03/15/06 19:39 / rlh
Magnesium, sat. paste	ND	meq/L		0.08		SW6010B	03/15/06 19:39 / rlh
Potassium, sat. paste	0.18	meq/L		0.03		SW6010B	03/15/06 19:39 / rlh
Sodium, sat. paste	18.1	meq/L		0.04		SW6010B	03/15/06 19:39 / rlh
Sodium Adsorption Ratio (SAR)	46.3	unitless		0.01		Calculation	03/16/06 10:44 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	51	t/kt		1.0		Sobek Modified	03/16/06 16:04 / srm
Acid Potential	2.0	t/kt		1.0		Sobek Modified	03/16/06 16:04 / srm
Acid/Base Potential	49	t/kt				Sobek Modified	03/16/06 16:04 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	5.1	%		0.1		USDA23c	03/16/06 10:05 / srm
Organic Carbon	0.75	wt%		0.02		ASA29-3	03/14/06 14:52 / srm
Nitrate as N, KCL Extract	ND	mg/kg		1		ASA33-8.1	03/15/06 14:09 / srm
METALS, WATER EXTRACTABLE							
Boron	1.8	mg/kg		0.1		SW6010B	03/17/06 04:47 / rlh
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	03/13/06 23:19 / rlh
Barium	21	mg/kg		5		SW6010B	03/13/06 23:19 / rlh
Cadmium	ND	mg/kg		1		SW6010B	03/13/06 23:19 / rlh
Chromium	18	mg/kg		5		SW6010B	03/13/06 23:19 / rlh
Copper	24	mg/kg		5		SW6010B	03/13/06 23:19 / rlh
Iron	5700	mg/kg		5		SW6010B	03/13/06 23:19 / rlh
Lead	19	mg/kg		5		SW6010B	03/13/06 23:19 / rlh
Manganese	59	mg/kg		5		SW6010B	03/13/06 23:19 / rlh
Mercury	ND	mg/kg		1		SW7471A	03/15/06 17:52 / jkc
Molybdenum	ND	mg/kg		5		SW6010B	03/13/06 23:19 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Patrick Collins
Project: Coal Hollow
Lab ID: B06030458-011
Client Sample ID: Box 13 CH-5 Below

Report Date: 03/30/06
Collection Date: Not Provided
Date Received: 03/07/06
Matrix: Soil

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Selenium	ND	mg/kg		5		SW6010B	03/13/06 23:19 / rlh
Silver	ND	mg/kg		5		SW6010B	03/13/06 23:19 / rlh
Zinc	75	mg/kg		5		SW6010B	03/13/06 23:19 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development LLC
Project:
Lab ID: B07110148-009
Client Sample ID: Box 13, CH-5 Below Coal

Report Date: 11/14/07
Collection Date: Not Provided
DateReceived: 11/02/07
Matrix: Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, WATER EXTRACTABLE							
Selenium	0.15	mg/kg		0.01		SW6020	11/12/07 15:52 / sas

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Patrick Collins
Project: Coal Hollow
Lab ID: B06030458-012
Client Sample ID: CH 3 Below Underburden

Report Date: 03/30/06
Collection Date: Not Provided
Date Received: 03/07/06
Matrix: Soil

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	8	%		1		ASA15-5	03/16/06 08:32 / srm
Silt	45	%		1		ASA15-5	03/16/06 08:32 / srm
Clay	47	%		1		ASA15-5	03/16/06 08:32 / srm
Very Fine Sand	5	wt%				ASA15-5	03/30/06 09:23 / srm
Texture	SiC					ASA15-5	03/16/06 08:32 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.20	s.u.		0.10		ASAM10-3.2	03/15/06 11:13 / srm
Conductivity, sat. paste	1.88	mmhos/cm		0.01		ASA10-3	03/15/06 11:13 / srm
Saturation	60.0	%		0.1		USDA27a	03/15/06 11:13 / srm
Calcium, sat. paste	1.80	meq/L		0.05		SW6010B	03/15/06 19:44 / rlh
Magnesium, sat. paste	1.20	meq/L		0.08		SW6010B	03/15/06 19:44 / rlh
Potassium, sat. paste	0.46	meq/L		0.03		SW6010B	03/15/06 19:44 / rlh
Sodium, sat. paste	15.3	meq/L		0.04		SW6010B	03/15/06 19:44 / rlh
Sodium Adsorption Ratio (SAR)	12.5	unitless		0.01		Calculation	03/16/06 10:44 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	78	t/kt		1.0		Sobek Modified	03/16/06 16:04 / srm
Acid Potential	2.0	t/kt		1.0		Sobek Modified	03/16/06 16:04 / srm
Acid/Base Potential	75	t/kt				Sobek Modified	03/16/06 16:04 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	7.8	%		0.1		USDA23c	03/16/06 10:05 / srm
Organic Carbon	0.78	wt%		0.02		ASA29-3	03/14/06 14:52 / srm
Nitrate as N, KCL Extract	ND	mg/kg		1		ASA33-8.1	03/15/06 14:10 / srm
METALS, WATER EXTRACTABLE							
Boron	3.0	mg/kg		0.1		SW6010B	03/17/06 04:56 / rlh
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	03/13/06 23:22 / rlh
Barium	21	mg/kg		5		SW6010B	03/13/06 23:22 / rlh
Cadmium	ND	mg/kg		1		SW6010B	03/13/06 23:22 / rlh
Chromium	19	mg/kg		5		SW6010B	03/13/06 23:22 / rlh
Copper	27	mg/kg		5		SW6010B	03/13/06 23:22 / rlh
Iron	6820	mg/kg		5		SW6010B	03/13/06 23:22 / rlh
Lead	20	mg/kg		5		SW6010B	03/13/06 23:22 / rlh
Manganese	89	mg/kg		5		SW6010B	03/13/06 23:22 / rlh
Mercury	ND	mg/kg		1		SW7471A	03/15/06 17:54 / jkc
Molybdenum	ND	mg/kg		5		SW6010B	03/13/06 23:22 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Patrick Collins
Project: Coal Hollow
Lab ID: B06030458-012
Client Sample ID: CH 3 Below Underburden

Report Date: 03/30/06
Collection Date: Not Provided
Date Received: 03/07/06
Matrix: Soil

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Selenium	ND	mg/kg		5		SW6010B	03/13/06 23:22 / rlh
Silver	ND	mg/kg		5		SW6010B	03/13/06 23:22 / rlh
Zinc	122	mg/kg		5		SW6010B	03/13/06 23:22 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Patrick Collins
Project: Coal Hollow
Lab ID: B06030458-013
Client Sample ID: CH 3 Above Overburden

Report Date: 03/30/06
Collection Date: Not Provided
Date Received: 03/07/06
Matrix: Soil

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	8	%		1		ASA15-5	03/16/06 08:32 / srm
Silt	59	%		1		ASA15-5	03/16/06 08:32 / srm
Clay	33	%		1		ASA15-5	03/16/06 08:32 / srm
Very Fine Sand	8	wt%				ASA15-5	03/30/06 09:23 / srm
Texture	SiCL					ASA15-5	03/16/06 08:32 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	7.80	s.u.		0.10		ASAM10-3.2	03/15/06 11:13 / srm
Conductivity, sat. paste	3.25	mmhos/cm		0.01		ASA10-3	03/15/06 11:13 / srm
Saturation	88.5	%		0.1		USDA27a	03/15/06 11:13 / srm
Calcium, sat. paste	9.16	meq/L	D	0.07		SW6010B	03/15/06 20:00 / rlh
Magnesium, sat. paste	10.3	meq/L		0.08		SW6010B	03/15/06 20:00 / rlh
Potassium, sat. paste	0.86	meq/L		0.03		SW6010B	03/15/06 20:00 / rlh
Sodium, sat. paste	16.0	meq/L	D	0.07		SW6010B	03/15/06 20:00 / rlh
Sodium Adsorption Ratio (SAR)	5.14	unitless		0.01		Calculation	03/16/06 10:44 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	100	t/kt		1.0		Sobek Modified	03/16/06 16:04 / srm
Acid Potential	10	t/kt		1.0		Sobek Modified	03/16/06 16:04 / srm
Acid/Base Potential	90	t/kt				Sobek Modified	03/16/06 16:04 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	10	%		0.1		USDA23c	03/16/06 10:05 / srm
Organic Carbon	0.95	wt%		0.02		ASA29-3	03/14/06 14:52 / srm
Nitrate as N, KCL Extract	ND	mg/kg		1		ASA33-8.1	03/15/06 14:11 / srm
METALS, WATER EXTRACTABLE							
Boron	1.6	mg/kg		0.1		SW6010B	03/17/06 05:13 / rlh
METALS, TOTAL - EPA SW846							
Arsenic	12	mg/kg		5		SW6010B	03/13/06 23:26 / rlh
Barium	41	mg/kg		5		SW6010B	03/13/06 23:26 / rlh
Cadmium	ND	mg/kg		1		SW6010B	03/13/06 23:26 / rlh
Chromium	6	mg/kg		5		SW6010B	03/13/06 23:26 / rlh
Copper	10	mg/kg		5		SW6010B	03/13/06 23:26 / rlh
Iron	11600	mg/kg		5		SW6010B	03/13/06 23:26 / rlh
Lead	8	mg/kg		5		SW6010B	03/13/06 23:26 / rlh
Manganese	124	mg/kg		5		SW6010B	03/13/06 23:26 / rlh
Mercury	ND	mg/kg		1		SW7471A	03/15/06 17:56 / jkc
Molybdenum	ND	mg/kg		5		SW6010B	03/13/06 23:26 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Patrick Collins
Project: Coal Hollow
Lab ID: B06030458-013
Client Sample ID: CH 3 Above Øverburden

Report Date: 03/30/06
Collection Date: Not Provided
Date Received: 03/07/06
Matrix: Soil

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Selenium	ND	mg/kg		5		SW6010B	03/13/06 23:26 / rlh
Silver	ND	mg/kg		5		SW6010B	03/13/06 23:26 / rlh
Zinc	41	mg/kg		5		SW6010B	03/13/06 23:26 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development LLC
Project:
Lab ID: B07110148-010
Client Sample ID: CH-03, Above Underburden

Report Date: 11/14/07
Collection Date: Not Provided
DateReceived: 11/06/07
Matrix: Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, WATER EXTRACTABLE							
Selenium	0.08	mg/kg		0.01		SW6020	11/12/07 16:27 / sas

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-001
Client Sample ID: CH-01-05, 3 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	ND	%		1		ASA15-5	04/19/07 08:29 / srm
Silt	49	%		1		ASA15-5	04/19/07 08:29 / srm
Clay	51	%		1		ASA15-5	04/19/07 08:29 / srm
Very Fine Sand	0	wt%		1		ASA15-5	04/19/07 08:29 / srm
Texture	SiC					ASA15-5	04/19/07 08:29 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.00	s.u.		0.10		ASAM10-3.2	04/18/07 14:45 / srm
Conductivity, sat. paste	0.33	mmhos/cm		0.01		ASA10-3	04/19/07 08:29 / srm
Saturation	78.4	%		0.1		USDA27a	04/19/07 08:29 / srm
Calcium, sat. paste	1.42	meq/L		0.05		SW6010B	04/20/07 11:13 / rlh
Magnesium, sat. paste	1.63	meq/L		0.08		SW6010B	04/20/07 11:13 / rlh
Potassium, sat. paste	0.37	meq/L		0.03		SW6010B	04/20/07 11:13 / rlh
Sodium, sat. paste	0.14	meq/L		0.04		SW6010B	04/20/07 11:13 / rlh
Sodium Adsorption Ratio (SAR)	0.12	unitless		0.01		Calculation	04/23/07 13:22 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	280	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid Potential	1.1	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid/Base Potential	280	t/kt				Sobek Modifie	04/23/07 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	28.3	%		0.1		USDA23c	04/23/07 00:00 / srm
Organic Carbon	1.05	wt%		0.02		ASA29-3	04/18/07 14:45 / srm
Nitrate as N, KCL Extract	ND	mg/kg		1		ASA33-8.1	04/18/07 12:14 / srm
METALS, WATER EXTRACTABLE							
Boron	0.4	mg/kg		0.1		SW6010B	04/20/07 13:37 / rlh
Selenium	ND	mg/kg		0.01		SW6020	10/17/07 00:21 / sas
METALS, TOTAL - EPA SW846							
Arsenic	9	mg/kg		5		SW6010B	04/18/07 22:03 / rlh
Barium	99	mg/kg		5		SW6010B	04/18/07 22:03 / rlh
Cadmium	ND	mg/kg		1		SW6010B	04/18/07 22:03 / rlh
Chromium	24	mg/kg		5		SW6010B	04/18/07 22:03 / rlh
Copper	17	mg/kg		5		SW6010B	04/18/07 22:03 / rlh
Iron	17300	mg/kg	D	8		SW6010B	04/18/07 22:03 / rlh
Lead	13	mg/kg		5		SW6010B	04/18/07 22:03 / rlh
Manganese	272	mg/kg		5		SW6010B	04/18/07 22:03 / rlh
Mercury	ND	mg/kg		1		SW7471A	04/19/07 13:10 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-001
Client Sample ID: CH-01-05, 3 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	04/18/07 22:03 / rlh
Selenium	ND	mg/kg		5		SW6010B	04/18/07 22:03 / rlh
Silver	ND	mg/kg		5		SW6010B	04/18/07 22:03 / rlh
Zinc	63	mg/kg		5		SW6010B	04/18/07 22:03 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-002
Client Sample ID: CH-01-05, 6 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	ND	%		1		ASA15-5	04/19/07 08:29 / srm
Silt	49	%		1		ASA15-5	04/19/07 08:29 / srm
Clay	51	%		1		ASA15-5	04/19/07 08:29 / srm
Very Fine Sand	0	wt%		1		ASA15-5	04/19/07 08:29 / srm
Texture	SiC					ASA15-5	04/19/07 08:29 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.20	s.u.		0.10		ASAM10-3.2	04/18/07 14:45 / srm
Conductivity, sat. paste	0.34	mmhos/cm		0.01		ASA10-3	04/19/07 08:29 / srm
Saturation	82.9	%		0.1		USDA27a	04/19/07 08:29 / srm
Calcium, sat. paste	0.69	meq/L		0.05		SW6010B	04/20/07 11:17 / rlh
Magnesium, sat. paste	2.19	meq/L		0.08		SW6010B	04/20/07 11:17 / rlh
Potassium, sat. paste	0.35	meq/L		0.03		SW6010B	04/20/07 11:17 / rlh
Sodium, sat. paste	0.40	meq/L		0.04		SW6010B	04/20/07 11:17 / rlh
Sodium Adsorption Ratio (SAR)	0.33	unitless		0.01		Calculation	04/23/07 13:22 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	300	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid/Base Potential	300	t/kt				Sobek Modifie	04/23/07 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	30.0	%		0.1		USDA23c	04/23/07 00:00 / srm
Organic Carbon	0.77	wt%		0.02		ASA29-3	04/18/07 14:45 / srm
Nitrate as N, KCL Extract	ND	mg/kg		1		ASA33-8.1	04/18/07 12:14 / srm
METALS, WATER EXTRACTABLE							
Boron	0.4	mg/kg		0.1		SW6010B	04/20/07 13:41 / rlh
Selenium	ND	mg/kg		0.01		SW6020	10/17/07 00:35 / sas
METALS, TOTAL - EPA SW846							
Arsenic	6	mg/kg		5		SW6010B	04/18/07 22:14 / rlh
Barium	91	mg/kg		5		SW6010B	04/18/07 22:14 / rlh
Cadmium	ND	mg/kg		1		SW6010B	04/18/07 22:14 / rlh
Chromium	20	mg/kg		5		SW6010B	04/18/07 22:14 / rlh
Copper	16	mg/kg		5		SW6010B	04/18/07 22:14 / rlh
Iron	16100	mg/kg	D	8		SW6010B	04/18/07 22:14 / rlh
Lead	12	mg/kg		5		SW6010B	04/18/07 22:14 / rlh
Manganese	222	mg/kg		5		SW6010B	04/18/07 22:14 / rlh
Mercury	ND	mg/kg		1		SW7471A	04/19/07 13:14 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-002
Client Sample ID: CH-01-05, 6 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	04/18/07 22:14 / rlh
Selenium	ND	mg/kg		5		SW6010B	04/18/07 22:14 / rlh
Silver	ND	mg/kg		5		SW6010B	04/18/07 22:14 / rlh
Zinc	61	mg/kg		5		SW6010B	04/18/07 22:14 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-003
Client Sample ID: CH-01-05, 9-10 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	10	%		1		ASA15-5	04/19/07 08:29 / srm
Silt	61	%		1		ASA15-5	04/19/07 08:29 / srm
Clay	29	%		1		ASA15-5	04/19/07 08:29 / srm
Very Fine Sand	3	wt%		1		ASA15-5	04/19/07 08:29 / srm
Texture	SiCL					ASA15-5	04/19/07 08:29 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.40	s.u.		0.10		ASAM10-3.2	04/18/07 14:45 / srm
Conductivity, sat. paste	0.52	mmhos/cm		0.01		ASA10-3	04/19/07 08:29 / srm
Saturation	52.2	%		0.1		USDA27a	04/19/07 08:29 / srm
Calcium, sat. paste	0.57	meq/L		0.05		SW6010B	04/20/07 11:22 / rlh
Magnesium, sat. paste	3.40	meq/L		0.08		SW6010B	04/20/07 11:22 / rlh
Potassium, sat. paste	0.28	meq/L		0.03		SW6010B	04/20/07 11:22 / rlh
Sodium, sat. paste	1.36	meq/L		0.04		SW6010B	04/20/07 11:22 / rlh
Sodium Adsorption Ratio (SAR)	0.96	unitless		0.01		Calculation	04/23/07 13:22 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	350	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid/Base Potential	350	t/kt				Sobek Modifie	04/23/07 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	35.3	%		0.1		USDA23c	04/23/07 00:00 / srm
Organic Carbon	0.40	wt%		0.02		ASA29-3	04/18/07 14:45 / srm
Nitrate as N, KCL Extract	ND	mg/kg		1		ASA33-8.1	04/18/07 12:15 / srm
METALS, WATER EXTRACTABLE							
Boron	0.3	mg/kg		0.1		SW6010B	04/20/07 13:45 / rlh
Selenium	ND	mg/kg		0.01		SW6020	10/17/07 01:02 / sas
METALS, TOTAL - EPA SW846							
Arsenic	6	mg/kg		5		SW6010B	04/18/07 22:29 / rlh
Barium	104	mg/kg		5		SW6010B	04/18/07 22:29 / rlh
Cadmium	ND	mg/kg		1		SW6010B	04/18/07 22:29 / rlh
Chromium	16	mg/kg		5		SW6010B	04/18/07 22:29 / rlh
Copper	11	mg/kg		5		SW6010B	04/18/07 22:29 / rlh
Iron	12800	mg/kg	D	8		SW6010B	04/18/07 22:29 / rlh
Lead	11	mg/kg		5		SW6010B	04/18/07 22:29 / rlh
Manganese	225	mg/kg		5		SW6010B	04/18/07 22:29 / rlh
Mercury	ND	mg/kg		1		SW7471A	04/19/07 13:17 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-003
Client Sample ID: CH-01-05, 9-10 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	04/18/07 22:29 / rlh
Selenium	ND	mg/kg		5		SW6010B	04/18/07 22:29 / rlh
Silver	ND	mg/kg		5		SW6010B	04/18/07 22:29 / rlh
Zinc	43	mg/kg		5		SW6010B	04/18/07 22:29 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-004
Client Sample ID: CH-01-5, 12 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	ND	%		1		ASA15-5	04/19/07 08:29 / srm
Silt	53	%		1		ASA15-5	04/19/07 08:29 / srm
Clay	47	%		1		ASA15-5	04/19/07 08:29 / srm
Very Fine Sand	0	wt%		1		ASA15-5	04/19/07 08:29 / srm
Texture	SiC					ASA15-5	04/19/07 08:29 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.20	s.u.		0.10		ASAM10-3.2	04/18/07 14:45 / srm
Conductivity, sat. paste	0.78	mmhos/cm		0.01		ASA10-3	04/19/07 08:29 / srm
Saturation	84.6	%		0.1		USDA27a	04/19/07 08:29 / srm
Calcium, sat. paste	1.48	meq/L		0.05		SW6010B	04/20/07 11:26 / rlh
Magnesium, sat. paste	5.36	meq/L		0.08		SW6010B	04/20/07 11:26 / rlh
Potassium, sat. paste	0.31	meq/L		0.03		SW6010B	04/20/07 11:26 / rlh
Sodium, sat. paste	1.49	meq/L		0.04		SW6010B	04/20/07 11:26 / rlh
Sodium Adsorption Ratio (SAR)	0.80	unitless		0.01		Calculation	04/23/07 13:22 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	300	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid/Base Potential	300	t/kt				Sobek Modifie	04/23/07 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	30.3	%		0.1		USDA23c	04/23/07 00:00 / srm
Organic Carbon	0.48	wt%		0.02		ASA29-3	04/18/07 14:45 / srm
Nitrate as N, KCL Extract	ND	mg/kg		1		ASA33-8.1	04/18/07 12:16 / srm
METALS, WATER EXTRACTABLE							
Boron	0.2	mg/kg		0.1		SW6010B	04/20/07 13:54 / rlh
Selenium	0.02	mg/kg		0.01		SW6020	10/17/07 01:09 / sas
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	04/18/07 22:33 / rlh
Barium	87	mg/kg		5		SW6010B	04/18/07 22:33 / rlh
Cadmium	ND	mg/kg		1		SW6010B	04/18/07 22:33 / rlh
Chromium	18	mg/kg		5		SW6010B	04/18/07 22:33 / rlh
Copper	14	mg/kg		5		SW6010B	04/18/07 22:33 / rlh
Iron	14400	mg/kg	D	8		SW6010B	04/18/07 22:33 / rlh
Lead	11	mg/kg		5		SW6010B	04/18/07 22:33 / rlh
Manganese	283	mg/kg		5		SW6010B	04/18/07 22:33 / rlh
Mercury	ND	mg/kg		1		SW7471A	04/19/07 13:19 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-004
Client Sample ID: CH-01-5, 12 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	04/18/07 22:33 / rlh
Selenium	ND	mg/kg		5		SW6010B	04/18/07 22:33 / rlh
Silver	ND	mg/kg		5		SW6010B	04/18/07 22:33 / rlh
Zinc	54	mg/kg		5		SW6010B	04/18/07 22:33 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-005
Client Sample ID: CH-01-05, 12-13 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	44	%		1		ASA15-5	04/19/07 08:29 / srm
Silt	39	%		1		ASA15-5	04/19/07 08:29 / srm
Clay	17	%		1		ASA15-5	04/19/07 08:29 / srm
Very Fine Sand	11	wt%		1		ASA15-5	04/19/07 08:29 / srm
Texture	L					ASA15-5	04/19/07 08:29 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.30	s.u.		0.10		ASAM10-3.2	04/18/07 14:45 / srm
Conductivity, sat. paste	0.73	mmhos/cm		0.01		ASA10-3	04/19/07 08:29 / srm
Saturation	35.9	%		0.1		USDA27a	04/19/07 08:29 / srm
Calcium, sat. paste	1.71	meq/L		0.05		SW6010B	04/20/07 11:35 / rlh
Magnesium, sat. paste	4.69	meq/L		0.08		SW6010B	04/20/07 11:35 / rlh
Potassium, sat. paste	0.26	meq/L		0.03		SW6010B	04/20/07 11:35 / rlh
Sodium, sat. paste	1.25	meq/L		0.04		SW6010B	04/20/07 11:35 / rlh
Sodium Adsorption Ratio (SAR)	0.70	unitless		0.01		Calculation	04/23/07 13:22 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	260	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid/Base Potential	250	t/kt				Sobek Modifie	04/23/07 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	25.5	%		0.1		USDA23c	04/23/07 00:00 / srm
Organic Carbon	0.30	wt%		0.02		ASA29-3	04/18/07 14:45 / srm
Nitrate as N, KCL Extract	ND	mg/kg		1		ASA33-8.1	04/18/07 12:18 / srm
METALS, WATER EXTRACTABLE							
Boron	ND	mg/kg		0.1		SW6010B	04/20/07 14:02 / rlh
Selenium	ND	mg/kg		0.01		SW6020	10/17/07 01:16 / sas
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	04/18/07 22:36 / rlh
Barium	124	mg/kg		5		SW6010B	04/18/07 22:36 / rlh
Cadmium	ND	mg/kg		1		SW6010B	04/18/07 22:36 / rlh
Chromium	11	mg/kg		5		SW6010B	04/18/07 22:36 / rlh
Copper	8	mg/kg		5		SW6010B	04/18/07 22:36 / rlh
Iron	9780	mg/kg	D	8		SW6010B	04/18/07 22:36 / rlh
Lead	9	mg/kg		5		SW6010B	04/18/07 22:36 / rlh
Manganese	191	mg/kg		5		SW6010B	04/18/07 22:36 / rlh
Mercury	ND	mg/kg		1		SW7471A	04/19/07 13:21 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-005
Client Sample ID: CH-01-05, 12-13 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	04/18/07 22:36 / rlh
Selenium	ND	mg/kg		5		SW6010B	04/18/07 22:36 / rlh
Silver	ND	mg/kg		5		SW6010B	04/18/07 22:36 / rlh
Zinc	33	mg/kg		5		SW6010B	04/18/07 22:36 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-006
Client Sample ID: CH-01-05, 16 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	20	%		1		ASA15-5	04/19/07 08:29 / srm
Silt	55	%		1		ASA15-5	04/19/07 08:29 / srm
Clay	25	%		1		ASA15-5	04/19/07 08:29 / srm
Very Fine Sand	6	wt%		1		ASA15-5	04/19/07 08:29 / srm
Texture	SiL					ASA15-5	04/19/07 08:29 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.30	s.u.		0.10		ASAM10-3.2	04/18/07 14:45 / srm
Conductivity, sat. paste	0.65	mmhos/cm		0.01		ASA10-3	04/19/07 08:29 / srm
Saturation	50.5	%		0.1		USDA27a	04/19/07 08:29 / srm
Calcium, sat. paste	1.58	meq/L		0.05		SW6010B	04/20/07 11:47 / rlh
Magnesium, sat. paste	4.05	meq/L		0.08		SW6010B	04/20/07 11:47 / rlh
Potassium, sat. paste	0.27	meq/L		0.03		SW6010B	04/20/07 11:47 / rlh
Sodium, sat. paste	1.11	meq/L		0.04		SW6010B	04/20/07 11:47 / rlh
Sodium Adsorption Ratio (SAR)	0.66	unitless		0.01		Calculation	04/23/07 13:22 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	300	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid/Base Potential	300	t/kt				Sobek Modifie	04/23/07 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	30.3	%		0.1		USDA23c	04/23/07 00:00 / srm
Organic Carbon	0.35	wt%		0.02		ASA29-3	04/18/07 14:45 / srm
Nitrate as N, KCL Extract	ND	mg/kg		1		ASA33-8.1	04/18/07 12:19 / srm
METALS, WATER EXTRACTABLE							
Boron	0.1	mg/kg		0.1		SW6010B	04/20/07 14:06 / rlh
Selenium	ND	mg/kg		0.01		SW6020	10/17/07 01:51 / sas
METALS, TOTAL - EPA SW846							
Arsenic	5	mg/kg		5		SW6010B	04/18/07 22:40 / rlh
Barium	89	mg/kg		5		SW6010B	04/18/07 22:40 / rlh
Cadmium	ND	mg/kg		1		SW6010B	04/18/07 22:40 / rlh
Chromium	13	mg/kg		5		SW6010B	04/18/07 22:40 / rlh
Copper	10	mg/kg		5		SW6010B	04/18/07 22:40 / rlh
Iron	11300	mg/kg	D	8		SW6010B	04/18/07 22:40 / rlh
Lead	10	mg/kg		5		SW6010B	04/18/07 22:40 / rlh
Manganese	159	mg/kg		5		SW6010B	04/18/07 22:40 / rlh
Mercury	ND	mg/kg		1		SW7471A	04/19/07 13:23 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-006
Client Sample ID: CH-01-05, 16 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	04/18/07 22:40 / rlh
Selenium	ND	mg/kg		5		SW6010B	04/18/07 22:40 / rlh
Silver	ND	mg/kg		5		SW6010B	04/18/07 22:40 / rlh
Zinc	40	mg/kg		5		SW6010B	04/18/07 22:40 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-007
Client Sample ID: CH-01-05, 30 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	8	%		1		ASA15-5	04/19/07 08:29 / srm
Silt	47	%		1		ASA15-5	04/19/07 08:29 / srm
Clay	45	%		1		ASA15-5	04/19/07 08:29 / srm
Very Fine Sand	0	wt%		1		ASA15-5	04/19/07 08:29 / srm
Texture	SiC					ASA15-5	04/19/07 08:29 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.00	s.u.		0.10		ASAM10-3.2	04/18/07 14:45 / srm
Conductivity, sat. paste	3.13	mmhos/cm		0.01		ASA10-3	04/19/07 08:29 / srm
Saturation	81.9	%		0.1		USDA27a	04/19/07 08:29 / srm
Calcium, sat. paste	16.9	meq/L		0.05		SW6010B	04/20/07 11:51 / rlh
Magnesium, sat. paste	25.8	meq/L		0.08		SW6010B	04/20/07 11:51 / rlh
Potassium, sat. paste	1.11	meq/L		0.03		SW6010B	04/20/07 11:51 / rlh
Sodium, sat. paste	3.65	meq/L		0.04		SW6010B	04/20/07 11:51 / rlh
Sodium Adsorption Ratio (SAR)	0.79	unitless		0.01		Calculation	04/23/07 13:22 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	260	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid/Base Potential	260	t/kt				Sobek Modifie	04/23/07 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	26.1	%		0.1		USDA23c	04/23/07 00:00 / srm
Organic Carbon	0.45	wt%		0.02		ASA29-3	04/18/07 14:45 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	04/18/07 12:20 / srm
METALS, WATER EXTRACTABLE							
Boron	0.4	mg/kg		0.1		SW6010B	04/20/07 14:18 / rlh
Selenium	ND	mg/kg		0.01		SW6020	10/17/07 01:58 / sas
METALS, TOTAL - EPA SW846							
Arsenic	6	mg/kg		5		SW6010B	04/18/07 22:43 / rlh
Barium	99	mg/kg		5		SW6010B	04/18/07 22:43 / rlh
Cadmium	ND	mg/kg		1		SW6010B	04/18/07 22:43 / rlh
Chromium	19	mg/kg		5		SW6010B	04/18/07 22:43 / rlh
Copper	14	mg/kg		5		SW6010B	04/18/07 22:43 / rlh
Iron	14100	mg/kg	D	8		SW6010B	04/18/07 22:43 / rlh
Lead	11	mg/kg		5		SW6010B	04/18/07 22:43 / rlh
Manganese	202	mg/kg		5		SW6010B	04/18/07 22:43 / rlh
Mercury	ND	mg/kg		1		SW7471A	04/19/07 13:25 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-007
Client Sample ID: CH-01-05, 30 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	04/18/07 22:43 / rlh
Selenium	ND	mg/kg		5		SW6010B	04/18/07 22:43 / rlh
Silver	ND	mg/kg		5		SW6010B	04/18/07 22:43 / rlh
Zinc	49	mg/kg		5		SW6010B	04/18/07 22:43 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-023
Client Sample ID: CH-01-05, 50 Feet, Dark Grey Clay

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	1	%		1		ASA15-5	04/20/07 08:30 / srm
Silt	34	%		1		ASA15-5	04/20/07 08:30 / srm
Clay	65	%		1		ASA15-5	04/20/07 08:30 / srm
Very Fine Sand	0	wt%		1		ASA15-5	04/20/07 08:30 / srm
Texture	C					ASA15-5	04/20/07 08:30 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.60	s.u.		0.10		ASAM10-3.2	04/18/07 14:45 / srm
Conductivity, sat. paste	2.78	mmhos/cm		0.01		ASA10-3	04/19/07 08:29 / srm
Saturation	234	%		0.1		USDA27a	04/19/07 08:29 / srm
Calcium, sat. paste	1.73	meq/L		0.05		SW6010B	04/20/07 13:16 / rlh
Magnesium, sat. paste	1.03	meq/L		0.08		SW6010B	04/20/07 13:16 / rlh
Potassium, sat. paste	0.43	meq/L		0.03		SW6010B	04/20/07 13:16 / rlh
Sodium, sat. paste	26.0	meq/L		0.04		SW6010B	04/20/07 13:16 / rlh
Sodium Adsorption Ratio (SAR)	22.2	unitless		0.01		Calculation	04/23/07 13:22 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	41	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid Potential	12	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid/Base Potential	29	t/kt				Sobek Modifie	04/23/07 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	4.1	%		0.1		USDA23c	04/23/07 00:00 / srm
Organic Carbon	0.77	wt%		0.02		ASA29-3	04/18/07 14:45 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	04/18/07 12:34 / srm
METALS, WATER EXTRACTABLE							
Boron	4.1	mg/kg		0.1		SW6010B	04/20/07 16:11 / rlh
Selenium	0.03	mg/kg		0.01		SW6020	10/17/07 04:57 / sas
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	04/19/07 00:10 / rlh
Barium	134	mg/kg		5		SW6010B	04/19/07 00:10 / rlh
Cadmium	ND	mg/kg		1		SW6010B	04/19/07 00:10 / rlh
Chromium	15	mg/kg		5		SW6010B	04/19/07 00:10 / rlh
Copper	10	mg/kg		5		SW6010B	04/19/07 00:10 / rlh
Iron	10600	mg/kg	D	8		SW6010B	04/24/07 23:58 / rlh
Lead	13	mg/kg		5		SW6010B	04/19/07 00:10 / rlh
Manganese	80	mg/kg		5		SW6010B	04/19/07 00:10 / rlh
Mercury	ND	mg/kg		1		SW7471A	04/19/07 14:28 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-023
Client Sample ID: CH-01-05, 50 Feet, Dark Grey Clay

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	04/19/07 00:10 / rlh
Selenium	ND	mg/kg		5		SW6010B	04/19/07 00:10 / rlh
Silver	ND	mg/kg		5		SW6010B	04/19/07 00:10 / rlh
Zinc	43	mg/kg		5		SW6010B	04/19/07 00:10 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-008
Client Sample ID: CH-03-05, 0-3 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	70	%		1		ASA15-5	04/19/07 08:29 / srm
Silt	21	%		1		ASA15-5	04/19/07 08:29 / srm
Clay	9	%		1		ASA15-5	04/19/07 08:29 / srm
Very Fine Sand	11	wt%		1		ASA15-5	04/19/07 08:29 / srm
Texture	SL					ASA15-5	04/19/07 08:29 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	7.80	s.u.		0.10		ASAM10-3.2	04/18/07 14:45 / srm
Conductivity, sat. paste	0.42	mmhos/cm		0.01		ASA10-3	04/19/07 08:29 / srm
Saturation	25.7	%		0.1		USDA27a	04/19/07 08:29 / srm
Calcium, sat. paste	2.98	meq/L		0.05		SW6010B	04/20/07 11:59 / rlh
Magnesium, sat. paste	1.26	meq/L		0.08		SW6010B	04/20/07 11:59 / rlh
Potassium, sat. paste	0.30	meq/L		0.03		SW6010B	04/20/07 11:59 / rlh
Sodium, sat. paste	0.07	meq/L		0.04		SW6010B	04/20/07 11:59 / rlh
Sodium Adsorption Ratio (SAR)	0.05	unitless		0.01		Calculation	04/23/07 13:22 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	160	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid/Base Potential	160	t/kt				Sobek Modifie	04/23/07 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	15.6	%		0.1		USDA23c	04/23/07 00:00 / srm
Organic Carbon	0.62	wt%		0.02		ASA29-3	04/18/07 14:45 / srm
Nitrate as N, KCL Extract	2	mg/kg		1		ASA33-8.1	04/18/07 12:21 / srm
METALS, WATER EXTRACTABLE							
Boron	ND	mg/kg		0.1		SW6010B	04/20/07 14:22 / rlh
Selenium	ND	mg/kg		0.01		SW6020	10/17/07 02:04 / sas
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	04/18/07 22:47 / rlh
Barium	56	mg/kg		5		SW6010B	04/18/07 22:47 / rlh
Cadmium	ND	mg/kg		1		SW6010B	04/18/07 22:47 / rlh
Chromium	7	mg/kg		5		SW6010B	04/18/07 22:47 / rlh
Copper	6	mg/kg		5		SW6010B	04/18/07 22:47 / rlh
Iron	8620	mg/kg	D	8		SW6010B	04/18/07 22:47 / rlh
Lead	7	mg/kg		5		SW6010B	04/18/07 22:47 / rlh
Manganese	152	mg/kg		5		SW6010B	04/18/07 22:47 / rlh
Mercury	ND	mg/kg		1		SW7471A	04/19/07 13:32 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-008
Client Sample ID: CH-03-05, 0-3 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	04/18/07 22:47 / rlh
Selenium	ND	mg/kg		5		SW6010B	04/18/07 22:47 / rlh
Silver	ND	mg/kg		5		SW6010B	04/18/07 22:47 / rlh
Zinc	28	mg/kg		5		SW6010B	04/18/07 22:47 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-009
Client Sample ID: CH-03-05, 3-6 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	77	%		1		ASA15-5	04/19/07 08:29 / srm
Silt	17	%		1		ASA15-5	04/19/07 08:29 / srm
Clay	6	%		1		ASA15-5	04/19/07 08:29 / srm
Very Fine Sand	9	wt%		1		ASA15-5	04/19/07 08:29 / srm
Texture	LS					ASA15-5	04/19/07 08:29 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.30	s.u.		0.10		ASAM10-3.2	04/18/07 14:45 / srm
Conductivity, sat. paste	0.27	mmhos/cm		0.01		ASA10-3	04/19/07 08:29 / srm
Saturation	21.8	%		0.1		USDA27a	04/19/07 08:29 / srm
Calcium, sat. paste	1.73	meq/L		0.05		SW6010B	04/20/07 12:04 / rlh
Magnesium, sat. paste	0.87	meq/L		0.08		SW6010B	04/20/07 12:04 / rlh
Potassium, sat. paste	0.12	meq/L		0.03		SW6010B	04/20/07 12:04 / rlh
Sodium, sat. paste	0.10	meq/L		0.04		SW6010B	04/20/07 12:04 / rlh
Sodium Adsorption Ratio (SAR)	0.09	unitless		0.01		Calculation	04/23/07 13:22 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	280	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid/Base Potential	280	t/kt				Sobek Modifie	04/23/07 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	27.7	%		0.1		USDA23c	04/23/07 00:00 / srm
Organic Carbon	0.23	wt%		0.02		ASA29-3	04/18/07 14:45 / srm
Nitrate as N, KCL Extract	ND	mg/kg		1		ASA33-8.1	04/18/07 12:21 / srm
METALS, WATER EXTRACTABLE							
Boron	ND	mg/kg		0.1		SW6010B	04/20/07 14:27 / rlh
Selenium	ND	mg/kg		0.01		SW6020	10/17/07 02:11 / sas
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	04/18/07 22:51 / rlh
Barium	96	mg/kg		5		SW6010B	04/18/07 22:51 / rlh
Cadmium	ND	mg/kg		1		SW6010B	04/18/07 22:51 / rlh
Chromium	7	mg/kg		5		SW6010B	04/18/07 22:51 / rlh
Copper	ND	mg/kg		5		SW6010B	04/18/07 22:51 / rlh
Iron	7000	mg/kg	D	8		SW6010B	04/18/07 22:51 / rlh
Lead	5	mg/kg		5		SW6010B	04/18/07 22:51 / rlh
Manganese	141	mg/kg		5		SW6010B	04/18/07 22:51 / rlh
Mercury	ND	mg/kg		1		SW7471A	04/19/07 13:34 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-009
Client Sample ID: CH-03-05, 3-6 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	04/18/07 22:51 / rlh
Selenium	ND	mg/kg		5		SW6010B	04/18/07 22:51 / rlh
Silver	ND	mg/kg		5		SW6010B	04/18/07 22:51 / rlh
Zinc	19	mg/kg		5		SW6010B	04/18/07 22:51 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-010
Client Sample ID: CH-03-05, 9 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	82	%		1		ASA15-5	04/19/07 08:29 / srm
Silt	13	%		1		ASA15-5	04/19/07 08:29 / srm
Clay	5	%		1		ASA15-5	04/19/07 08:29 / srm
Very Fine Sand	7	wt%		1		ASA15-5	04/19/07 08:29 / srm
Texture	LS					ASA15-5	04/19/07 08:29 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.40	s.u.		0.10		ASAM10-3.2	04/18/07 14:45 / srm
Conductivity, sat. paste	0.25	mmhos/cm		0.01		ASA10-3	04/19/07 08:29 / srm
Saturation	20.4	%		0.1		USDA27a	04/19/07 08:29 / srm
Calcium, sat. paste	1.10	meq/L		0.05		SW6010B	04/20/07 12:08 / rlh
Magnesium, sat. paste	1.32	meq/L		0.08		SW6010B	04/20/07 12:08 / rlh
Potassium, sat. paste	0.09	meq/L		0.03		SW6010B	04/20/07 12:08 / rlh
Sodium, sat. paste	0.13	meq/L		0.04		SW6010B	04/20/07 12:08 / rlh
Sodium Adsorption Ratio (SAR)	0.11	unitless		0.01		Calculation	04/23/07 13:22 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	460	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid/Base Potential	460	t/kt				Sobek Modifie	04/23/07 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	46.2	%		0.1		USDA23c	04/23/07 00:00 / srm
Organic Carbon	0.15	wt%		0.02		ASA29-3	04/18/07 14:45 / srm
Nitrate as N, KCL Extract	ND	mg/kg		1		ASA33-8.1	04/18/07 12:22 / srm
METALS, WATER EXTRACTABLE							
Boron	ND	mg/kg		0.1		SW6010B	04/20/07 14:31 / rlh
Selenium	ND	mg/kg		0.01		SW6020	10/17/07 02:18 / sas
METALS, TOTAL - EPA SW846							
Arsenic	8	mg/kg		5		SW6010B	04/18/07 22:54 / rlh
Barium	202	mg/kg		5		SW6010B	04/18/07 22:54 / rlh
Cadmium	ND	mg/kg		1		SW6010B	04/18/07 22:54 / rlh
Chromium	8	mg/kg		5		SW6010B	04/18/07 22:54 / rlh
Copper	ND	mg/kg		5		SW6010B	04/18/07 22:54 / rlh
Iron	8100	mg/kg	D	8		SW6010B	04/18/07 22:54 / rlh
Lead	ND	mg/kg		5		SW6010B	04/18/07 22:54 / rlh
Manganese	217	mg/kg		5		SW6010B	04/18/07 22:54 / rlh
Mercury	ND	mg/kg		1		SW7471A	04/19/07 13:36 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-010
Client Sample ID: CH-03-05, 9 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	04/18/07 22:54 / rlh
Selenium	ND	mg/kg		5		SW6010B	04/18/07 22:54 / rlh
Silver	ND	mg/kg		5		SW6010B	04/18/07 22:54 / rlh
Zinc	14	mg/kg		5		SW6010B	04/18/07 22:54 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-011
Client Sample ID: CH-03-05, 16 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	80	%		1		ASA15-5	04/19/07 08:29 / srm
Silt	14	%		1		ASA15-5	04/19/07 08:29 / srm
Clay	6	%		1		ASA15-5	04/19/07 08:29 / srm
Very Fine Sand	5	wt%		1		ASA15-5	04/19/07 08:29 / srm
Texture	LS					ASA15-5	04/19/07 08:29 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.40	s.u.		0.10		ASAM10-3.2	04/18/07 14:45 / srm
Conductivity, sat. paste	0.40	mmhos/cm		0.01		ASA10-3	04/19/07 08:29 / srm
Saturation	20.2	%		0.1		USDA27a	04/19/07 08:29 / srm
Calcium, sat. paste	1.22	meq/L		0.05		SW6010B	04/20/07 12:12 / rlh
Magnesium, sat. paste	2.24	meq/L		0.08		SW6010B	04/20/07 12:12 / rlh
Potassium, sat. paste	0.16	meq/L		0.03		SW6010B	04/20/07 12:12 / rlh
Sodium, sat. paste	0.40	meq/L		0.04		SW6010B	04/20/07 12:12 / rlh
Sodium Adsorption Ratio (SAR)	0.31	unitless		0.01		Calculation	04/23/07 13:22 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	650	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid/Base Potential	650	t/kt				Sobek Modifie	04/23/07 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	64.7	%		0.1		USDA23c	04/23/07 00:00 / srm
Organic Carbon	0.11	wt%		0.02		ASA29-3	04/18/07 14:45 / srm
Nitrate as N, KCL Extract	ND	mg/kg		1		ASA33-8.1	04/18/07 12:23 / srm
METALS, WATER EXTRACTABLE							
Boron	ND	mg/kg		0.1		SW6010B	04/20/07 14:35 / rlh
Selenium	ND	mg/kg		0.01		SW6020	10/17/07 02:25 / sas
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	04/18/07 22:58 / rlh
Barium	234	mg/kg		5		SW6010B	04/18/07 22:58 / rlh
Cadmium	ND	mg/kg		1		SW6010B	04/18/07 22:58 / rlh
Chromium	7	mg/kg		5		SW6010B	04/18/07 22:58 / rlh
Copper	ND	mg/kg		5		SW6010B	04/18/07 22:58 / rlh
Iron	11400	mg/kg	D	8		SW6010B	04/18/07 22:58 / rlh
Lead	ND	mg/kg		5		SW6010B	04/18/07 22:58 / rlh
Manganese	276	mg/kg		5		SW6010B	04/18/07 22:58 / rlh
Mercury	ND	mg/kg		1		SW7471A	04/19/07 13:38 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-011
Client Sample ID: CH-03-05, 16 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	04/18/07 22:58 / rlh
Selenium	ND	mg/kg		5		SW6010B	04/18/07 22:58 / rlh
Silver	ND	mg/kg		5		SW6010B	04/18/07 22:58 / rlh
Zinc	23	mg/kg		5		SW6010B	04/18/07 22:58 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-012
Client Sample ID: CH-05-05, 0-1 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	30	%		1		ASA15-5	04/19/07 08:29 / srm
Silt	41	%		1		ASA15-5	04/19/07 08:29 / srm
Clay	29	%		1		ASA15-5	04/19/07 08:29 / srm
Very Fine Sand	3	wt%		1		ASA15-5	04/19/07 08:29 / srm
Texture	CL					ASA15-5	04/19/07 08:29 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	7.90	s.u.		0.10		ASAM10-3.2	04/18/07 14:45 / srm
Conductivity, sat. paste	0.43	mmhos/cm		0.01		ASA10-3	04/19/07 08:29 / srm
Saturation	44.5	%		0.1		USDA27a	04/19/07 08:29 / srm
Calcium, sat. paste	2.22	meq/L		0.05		SW6010B	04/20/07 12:17 / rlh
Magnesium, sat. paste	2.21	meq/L		0.08		SW6010B	04/20/07 12:17 / rlh
Potassium, sat. paste	0.19	meq/L		0.03		SW6010B	04/20/07 12:17 / rlh
Sodium, sat. paste	0.15	meq/L		0.04		SW6010B	04/20/07 12:17 / rlh
Sodium Adsorption Ratio (SAR)	0.10	unitless		0.01		Calculation	04/23/07 13:22 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	230	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid/Base Potential	230	t/kt				Sobek Modifie	04/23/07 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	22.7	%		0.1		USDA23c	04/23/07 00:00 / srm
Organic Carbon	0.91	wt%		0.02		ASA29-3	04/18/07 14:45 / srm
Nitrate as N, KCL Extract	3	mg/kg		1		ASA33-8.1	04/18/07 12:24 / srm
METALS, WATER EXTRACTABLE							
Boron	0.2	mg/kg		0.1		SW6010B	04/20/07 14:39 / rlh
Selenium	ND	mg/kg		0.01		SW6020	10/17/07 02:39 / sas
METALS, TOTAL - EPA SW846							
Arsenic	7	mg/kg		5		SW6010B	04/18/07 23:01 / rlh
Barium	67	mg/kg		5		SW6010B	04/18/07 23:01 / rlh
Cadmium	ND	mg/kg		1		SW6010B	04/18/07 23:01 / rlh
Chromium	17	mg/kg		5		SW6010B	04/18/07 23:01 / rlh
Copper	13	mg/kg		5		SW6010B	04/18/07 23:01 / rlh
Iron	13500	mg/kg	D	8		SW6010B	04/18/07 23:01 / rlh
Lead	11	mg/kg		5		SW6010B	04/18/07 23:01 / rlh
Manganese	264	mg/kg		5		SW6010B	04/18/07 23:01 / rlh
Mercury	ND	mg/kg		1		SW7471A	04/19/07 13:40 / jjw

Report Definitions:
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ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-012
Client Sample ID: CH-05-05, 0-1 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	04/18/07 23:01 / rlh
Selenium	ND	mg/kg		5		SW6010B	04/18/07 23:01 / rlh
Silver	ND	mg/kg		5		SW6010B	04/18/07 23:01 / rlh
Zinc	47	mg/kg		5		SW6010B	04/18/07 23:01 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-013
Client Sample ID: CH-05-05, 3 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	64	%		1		ASA15-5	04/19/07 08:29 / srm
Silt	23	%		1		ASA15-5	04/19/07 08:29 / srm
Clay	13	%		1		ASA15-5	04/19/07 08:29 / srm
Very Fine Sand	12	wt%		1		ASA15-5	04/19/07 08:29 / srm
Texture	SL					ASA15-5	04/19/07 08:29 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.20	s.u.		0.10		ASAM10-3.2	04/18/07 14:45 / srm
Conductivity, sat. paste	0.43	mmhos/cm		0.01		ASA10-3	04/19/07 08:29 / srm
Saturation	27.0	%		0.1		USDA27a	04/19/07 08:29 / srm
Calcium, sat. paste	1.28	meq/L		0.05		SW6010B	04/20/07 12:21 / rlh
Magnesium, sat. paste	3.02	meq/L		0.08		SW6010B	04/20/07 12:21 / rlh
Potassium, sat. paste	0.15	meq/L		0.03		SW6010B	04/20/07 12:21 / rlh
Sodium, sat. paste	0.28	meq/L		0.04		SW6010B	04/20/07 12:21 / rlh
Sodium Adsorption Ratio (SAR)	0.19	unitless		0.01		Calculation	04/23/07 13:22 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	250	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid/Base Potential	250	t/kt				Sobek Modifie	04/23/07 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	24.9	%		0.1		USDA23c	04/23/07 00:00 / srm
Organic Carbon	0.39	wt%		0.02		ASA29-3	04/18/07 14:45 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	04/18/07 12:24 / srm
METALS, WATER EXTRACTABLE							
Boron	ND	mg/kg		0.1		SW6010B	04/20/07 14:44 / rlh
Selenium	ND	mg/kg		0.01		SW6020	10/17/07 02:46 / sas
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	04/18/07 23:13 / rlh
Barium	61	mg/kg		5		SW6010B	04/18/07 23:13 / rlh
Cadmium	ND	mg/kg		1		SW6010B	04/18/07 23:13 / rlh
Chromium	8	mg/kg		5		SW6010B	04/18/07 23:13 / rlh
Copper	6	mg/kg		5		SW6010B	04/18/07 23:13 / rlh
Iron	8120	mg/kg	D	8		SW6010B	04/18/07 23:13 / rlh
Lead	7	mg/kg		5		SW6010B	04/18/07 23:13 / rlh
Manganese	152	mg/kg		5		SW6010B	04/18/07 23:13 / rlh
Mercury	ND	mg/kg		1		SW7471A	04/19/07 13:42 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-013
Client Sample ID: CH-05-05, 3 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	04/18/07 23:13 / rlh
Selenium	ND	mg/kg		5		SW6010B	04/18/07 23:13 / rlh
Silver	ND	mg/kg		5		SW6010B	04/18/07 23:13 / rlh
Zinc	25	mg/kg		5		SW6010B	04/18/07 23:13 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-014
Client Sample ID: CH-05-05, 9-10 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	78	%		1		ASA15-5	04/19/07 08:29 / srm
Silt	17	%		1		ASA15-5	04/19/07 08:29 / srm
Clay	5	%		1		ASA15-5	04/19/07 08:29 / srm
Very Fine Sand	4	wt%		1		ASA15-5	04/19/07 08:29 / srm
Texture	LS					ASA15-5	04/19/07 08:29 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.40	s.u.		0.10		ASAM10-3.2	04/18/07 14:45 / srm
Conductivity, sat. paste	0.43	mmhos/cm		0.01		ASA10-3	04/19/07 08:29 / srm
Saturation	20.8	%		0.1		USDA27a	04/19/07 08:29 / srm
Calcium, sat. paste	1.05	meq/L		0.05		SW6010B	04/20/07 12:25 / rlh
Magnesium, sat. paste	3.01	meq/L		0.08		SW6010B	04/20/07 12:25 / rlh
Potassium, sat. paste	0.15	meq/L		0.03		SW6010B	04/20/07 12:25 / rlh
Sodium, sat. paste	0.36	meq/L		0.04		SW6010B	04/20/07 12:25 / rlh
Sodium Adsorption Ratio (SAR)	0.26	unitless		0.01		Calculation	04/23/07 13:22 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	600	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid/Base Potential	600	t/kt				Sobek Modifie	04/23/07 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	60.0	%		0.1		USDA23c	04/23/07 00:00 / srm
Organic Carbon	0.13	wt%		0.02		ASA29-3	04/18/07 14:45 / srm
Nitrate as N, KCL Extract	ND	mg/kg		1		ASA33-8.1	04/18/07 12:25 / srm
METALS, WATER EXTRACTABLE							
Boron	ND	mg/kg		0.1		SW6010B	04/20/07 14:52 / rlh
Selenium	ND	mg/kg		0.01		SW6020	10/17/07 03:41 / sas
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	04/18/07 23:17 / rlh
Barium	107	mg/kg		5		SW6010B	04/18/07 23:17 / rlh
Cadmium	ND	mg/kg		1		SW6010B	04/18/07 23:17 / rlh
Chromium	7	mg/kg		5		SW6010B	04/18/07 23:17 / rlh
Copper	ND	mg/kg		5		SW6010B	04/18/07 23:17 / rlh
Iron	8140	mg/kg	D	8		SW6010B	04/18/07 23:17 / rlh
Lead	ND	mg/kg		5		SW6010B	04/18/07 23:17 / rlh
Manganese	233	mg/kg		5		SW6010B	04/18/07 23:17 / rlh
Mercury	ND	mg/kg		1		SW7471A	04/19/07 13:45 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-014
Client Sample ID: CH-05-05, 9-10 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	04/18/07 23:17 / rlh
Selenium	ND	mg/kg		5		SW6010B	04/18/07 23:17 / rlh
Silver	ND	mg/kg		5		SW6010B	04/18/07 23:17 / rlh
Zinc	16	mg/kg		5		SW6010B	04/18/07 23:17 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-015
Client Sample ID: CH-05-05, 14 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	ND	%		1		ASA15-5	04/19/07 08:29 / srm
Silt	39	%		1		ASA15-5	04/19/07 08:29 / srm
Clay	61	%		1		ASA15-5	04/19/07 08:29 / srm
Very Fine Sand	0	wt%		1		ASA15-5	04/19/07 08:29 / srm
Texture	C					ASA15-5	04/19/07 08:29 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.30	s.u.		0.10		ASAM10-3.2	04/18/07 14:45 / srm
Conductivity, sat. paste	0.54	mmhos/cm		0.01		ASA10-3	04/19/07 08:29 / srm
Saturation	97.3	%		0.1		USDA27a	04/19/07 08:29 / srm
Calcium, sat. paste	1.50	meq/L		0.05		SW6010B	04/20/07 12:42 / rlh
Magnesium, sat. paste	2.69	meq/L		0.08		SW6010B	04/20/07 12:42 / rlh
Potassium, sat. paste	0.21	meq/L		0.03		SW6010B	04/20/07 12:42 / rlh
Sodium, sat. paste	1.51	meq/L		0.04		SW6010B	04/20/07 12:42 / rlh
Sodium Adsorption Ratio (SAR)	1.04	unitless		0.01		Calculation	04/23/07 13:22 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	190	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid/Base Potential	190	t/kt				Sobek Modifie	04/23/07 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	19.1	%		0.1		USDA23c	04/23/07 00:00 / srm
Organic Carbon	0.50	wt%		0.02		ASA29-3	04/18/07 14:45 / srm
Nitrate as N, KCL Extract	ND	mg/kg		1		ASA33-8.1	04/18/07 12:27 / srm
METALS, WATER EXTRACTABLE							
Boron	0.2	mg/kg		0.1		SW6010B	04/20/07 15:32 / rlh
Selenium	0.04	mg/kg		0.01		SW6020	10/17/07 03:48 / sas
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	04/18/07 23:20 / rlh
Barium	106	mg/kg		5		SW6010B	04/18/07 23:20 / rlh
Cadmium	ND	mg/kg		1		SW6010B	04/18/07 23:20 / rlh
Chromium	14	mg/kg		5		SW6010B	04/18/07 23:20 / rlh
Copper	13	mg/kg		5		SW6010B	04/18/07 23:20 / rlh
Iron	14500	mg/kg	D	8		SW6010B	04/18/07 23:20 / rlh
Lead	11	mg/kg		5		SW6010B	04/18/07 23:20 / rlh
Manganese	87	mg/kg		5		SW6010B	04/18/07 23:20 / rlh
Mercury	ND	mg/kg		1		SW7471A	04/19/07 13:47 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-015
Client Sample ID: CH-05-05, 14 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	04/18/07 23:20 / rlh
Selenium	ND	mg/kg		5		SW6010B	04/18/07 23:20 / rlh
Silver	ND	mg/kg		5		SW6010B	04/18/07 23:20 / rlh
Zinc	50	mg/kg		5		SW6010B	04/18/07 23:20 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-016
Client Sample ID: CH-05-05, 19 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	2	%		1		ASA15-5	04/19/07 08:29 / srm
Silt	37	%		1		ASA15-5	04/19/07 08:29 / srm
Clay	61	%		1		ASA15-5	04/19/07 08:29 / srm
Very Fine Sand	0	wt%		1		ASA15-5	04/19/07 08:29 / srm
Texture	C					ASA15-5	04/19/07 08:29 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.10	s.u.		0.10		ASAM10-3.2	04/18/07 14:45 / srm
Conductivity, sat. paste	1.04	mmhos/cm		0.01		ASA10-3	04/19/07 08:29 / srm
Saturation	97.6	%		0.1		USDA27a	04/19/07 08:29 / srm
Calcium, sat. paste	2.67	meq/L		0.05		SW6010B	04/20/07 12:46 / rlh
Magnesium, sat. paste	2.71	meq/L		0.08		SW6010B	04/20/07 12:46 / rlh
Potassium, sat. paste	0.27	meq/L		0.03		SW6010B	04/20/07 12:46 / rlh
Sodium, sat. paste	5.85	meq/L		0.04		SW6010B	04/20/07 12:46 / rlh
Sodium Adsorption Ratio (SAR)	3.57	unitless		0.01		Calculation	04/23/07 13:22 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	180	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid/Base Potential	180	t/kt				Sobek Modifie	04/23/07 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	18.2	%		0.1		USDA23c	04/23/07 00:00 / srm
Organic Carbon	0.44	wt%		0.02		ASA29-3	04/18/07 14:45 / srm
Nitrate as N, KCL Extract	ND	mg/kg		1		ASA33-8.1	04/18/07 12:29 / srm
METALS, WATER EXTRACTABLE							
Boron	0.4	mg/kg		0.1		SW6010B	04/20/07 15:36 / rlh
Selenium	0.03	mg/kg		0.01		SW6020	10/17/07 03:55 / sas
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	04/18/07 23:24 / rlh
Barium	85	mg/kg		5		SW6010B	04/18/07 23:24 / rlh
Cadmium	ND	mg/kg		1		SW6010B	04/18/07 23:24 / rlh
Chromium	15	mg/kg		5		SW6010B	04/18/07 23:24 / rlh
Copper	14	mg/kg		5		SW6010B	04/18/07 23:24 / rlh
Iron	14600	mg/kg	D	8		SW6010B	04/18/07 23:24 / rlh
Lead	11	mg/kg		5		SW6010B	04/18/07 23:24 / rlh
Manganese	144	mg/kg		5		SW6010B	04/18/07 23:24 / rlh
Mercury	ND	mg/kg		1		SW7471A	04/19/07 13:49 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
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ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-016
Client Sample ID: CH-05-05, 19 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	04/18/07 23:24 / rlh
Selenium	ND	mg/kg		5		SW6010B	04/18/07 23:24 / rlh
Silver	ND	mg/kg		5		SW6010B	04/18/07 23:24 / rlh
Zinc	54	mg/kg		5		SW6010B	04/18/07 23:24 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-017
Client Sample ID: CH-06-05, Soil

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	2	%		1		ASA15-5	04/19/07 08:29 / srm
Silt	45	%		1		ASA15-5	04/19/07 08:29 / srm
Clay	53	%		1		ASA15-5	04/19/07 08:29 / srm
Very Fine Sand	0	wt%		1		ASA15-5	04/19/07 08:29 / srm
Texture	SiC					ASA15-5	04/19/07 08:29 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.00	s.u.		0.10		ASAM10-3.2	04/18/07 14:45 / srm
Conductivity, sat. paste	0.54	mmhos/cm		0.01		ASA10-3	04/19/07 08:29 / srm
Saturation	79.5	%		0.1		USDA27a	04/19/07 08:29 / srm
Calcium, sat. paste	1.33	meq/L		0.05		SW6010B	04/20/07 12:50 / rlh
Magnesium, sat. paste	1.51	meq/L		0.08		SW6010B	04/20/07 12:50 / rlh
Potassium, sat. paste	0.08	meq/L		0.03		SW6010B	04/20/07 12:50 / rlh
Sodium, sat. paste	3.17	meq/L		0.04		SW6010B	04/20/07 12:50 / rlh
Sodium Adsorption Ratio (SAR)	2.66	unitless		0.01		Calculation	04/23/07 13:22 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	21	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid/Base Potential	20	t/kt				Sobek Modifie	04/23/07 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	2.1	%		0.1		USDA23c	04/23/07 00:00 / srm
Organic Carbon	0.73	wt%		0.02		ASA29-3	04/18/07 14:45 / srm
Nitrate as N, KCL Extract	6	mg/kg		1		ASA33-8.1	04/18/07 12:30 / srm
METALS, WATER EXTRACTABLE							
Boron	0.2	mg/kg		0.1		SW6010B	04/20/07 15:40 / rlh
Selenium	ND	mg/kg		0.01		SW6020	10/17/07 04:02 / sas
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	04/18/07 23:27 / rlh
Barium	65	mg/kg		5		SW6010B	04/18/07 23:27 / rlh
Cadmium	ND	mg/kg		1		SW6010B	04/18/07 23:27 / rlh
Chromium	18	mg/kg		5		SW6010B	04/18/07 23:27 / rlh
Copper	14	mg/kg		5		SW6010B	04/18/07 23:27 / rlh
Iron	13800	mg/kg	D	8		SW6010B	04/18/07 23:27 / rlh
Lead	11	mg/kg		5		SW6010B	04/18/07 23:27 / rlh
Manganese	118	mg/kg		5		SW6010B	04/18/07 23:27 / rlh
Mercury	ND	mg/kg		1		SW7471A	04/19/07 13:51 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-017
Client Sample ID: CH-06-05, Soil

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	04/18/07 23:27 / rlh
Selenium	ND	mg/kg		5		SW6010B	04/18/07 23:27 / rlh
Silver	ND	mg/kg		5		SW6010B	04/18/07 23:27 / rlh
Zinc	46	mg/kg		5		SW6010B	04/18/07 23:27 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-018
Client Sample ID: CH-06-05, 5-10 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	20	%		1		ASA15-5	04/19/07 08:29 / srm
Silt	39	%		1		ASA15-5	04/19/07 08:29 / srm
Clay	41	%		1		ASA15-5	04/19/07 08:29 / srm
Very Fine Sand	6	wt%		1		ASA15-5	04/19/07 08:29 / srm
Texture	C					ASA15-5	04/19/07 08:29 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.50	s.u.		0.10		ASAM10-3.2	04/18/07 14:45 / srm
Conductivity, sat. paste	ISS	mmhos/cm		0.01		ASA10-3	04/18/07 16:34 / srm
Saturation	ISS	%		0.1		USDA27a	04/18/07 16:34 / srm
Calcium, sat. paste	ISS	meq/L		0.09		SW6010B	04/18/07 16:34 / srm
Magnesium, sat. paste	ISS	meq/L		0.09		SW6010B	04/18/07 16:34 / srm
Potassium, sat. paste	ISS	meq/L		0.09		SW6010B	04/18/07 16:34 / srm
Sodium, sat. paste	ISS	meq/L		0.09		SW6010B	04/18/07 16:34 / srm
Sodium Adsorption Ratio (SAR)	ISS	unitless		0.01		Calculation	04/18/07 16:34 / srm
ISS = Insufficient sample for analysis							
ACID-BASE ACCOUNTING							
Neutralization Potential	130	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid/Base Potential	130	t/kt				Sobek Modifie	04/23/07 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	12.6	%		0.1		USDA23c	04/23/07 00:00 / srm
Organic Carbon	0.37	wt%		0.02		ASA29-3	04/18/07 14:45 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	04/18/07 12:31 / srm
METALS, WATER EXTRACTABLE							
Boron	0.6	mg/kg		0.1		SW6010B	04/20/07 15:44 / rlh
Selenium	0.02	mg/kg		0.01		SW6020	10/17/07 04:08 / sas
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	04/18/07 23:31 / rlh
Barium	63	mg/kg		5		SW6010B	04/18/07 23:31 / rlh
Cadmium	ND	mg/kg		1		SW6010B	04/18/07 23:31 / rlh
Chromium	12	mg/kg		5		SW6010B	04/18/07 23:31 / rlh
Copper	11	mg/kg		5		SW6010B	04/18/07 23:31 / rlh
Iron	10000	mg/kg	D	8		SW6010B	04/18/07 23:31 / rlh
Lead	10	mg/kg		5		SW6010B	04/18/07 23:31 / rlh
Manganese	114	mg/kg		5		SW6010B	04/18/07 23:31 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-018
Client Sample ID: CH-06-05, 5-10 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Mercury	ND	mg/kg		1		SW7471A	04/19/07 13:58 / jjw
Molybdenum	ND	mg/kg		5		SW6010B	04/18/07 23:31 / rlh
Selenium	ND	mg/kg		5		SW6010B	04/18/07 23:31 / rlh
Silver	ND	mg/kg		5		SW6010B	04/18/07 23:31 / rlh
Zinc	35	mg/kg		5		SW6010B	04/18/07 23:31 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-019
Client Sample ID: CH-06-05, 10 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	12	%		1		ASA15-5	04/19/07 08:29 / srm
Silt	41	%		1		ASA15-5	04/19/07 08:29 / srm
Clay	47	%		1		ASA15-5	04/19/07 08:29 / srm
Very Fine Sand	9	wt%		1		ASA15-5	04/19/07 08:29 / srm
Texture	SiC					ASA15-5	04/19/07 08:29 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.20	s.u.		0.10		ASAM10-3.2	04/18/07 14:45 / srm
Conductivity, sat. paste	7.95	mmhos/cm		0.01		ASA10-3	04/19/07 08:29 / srm
Saturation	90.9	%		0.1		USDA27a	04/19/07 08:29 / srm
Calcium, sat. paste	22.7	meq/L	D	0.1		SW6010B	04/20/07 12:55 / rlh
Magnesium, sat. paste	52.2	meq/L	D	0.1		SW6010B	04/20/07 12:55 / rlh
Potassium, sat. paste	0.93	meq/L		0.03		SW6010B	04/20/07 12:55 / rlh
Sodium, sat. paste	60.8	meq/L	D	0.08		SW6010B	04/20/07 12:55 / rlh
Sodium Adsorption Ratio (SAR)	9.93	unitless		0.01		Calculation	04/23/07 13:22 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	69	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid/Base Potential	68	t/kt				Sobek Modifie	04/23/07 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	6.9	%		0.1		USDA23c	04/23/07 00:00 / srm
Organic Carbon	0.35	wt%		0.02		ASA29-3	04/18/07 14:45 / srm
Nitrate as N, KCL Extract	3	mg/kg		1		ASA33-8.1	04/18/07 12:31 / srm
METALS, WATER EXTRACTABLE							
Boron	0.4	mg/kg		0.1		SW6010B	04/20/07 15:49 / rlh
Selenium	ND	mg/kg		0.01		SW6020	10/17/07 04:15 / sas
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	04/18/07 23:35 / rlh
Barium	57	mg/kg		5		SW6010B	04/18/07 23:35 / rlh
Cadmium	ND	mg/kg		1		SW6010B	04/18/07 23:35 / rlh
Chromium	15	mg/kg		5		SW6010B	04/18/07 23:35 / rlh
Copper	13	mg/kg		5		SW6010B	04/18/07 23:35 / rlh
Iron	14200	mg/kg	D	8		SW6010B	04/18/07 23:35 / rlh
Lead	9	mg/kg		5		SW6010B	04/18/07 23:35 / rlh
Manganese	108	mg/kg		5		SW6010B	04/18/07 23:35 / rlh
Mercury	ND	mg/kg		1		SW7471A	04/19/07 14:00 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-019
Client Sample ID: CH-06-05, 10 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	04/18/07 23:35 / rlh
Selenium	ND	mg/kg		5		SW6010B	04/18/07 23:35 / rlh
Silver	ND	mg/kg		5		SW6010B	04/18/07 23:35 / rlh
Zinc	35	mg/kg		5		SW6010B	04/18/07 23:35 / rlh

Report Definitions:
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MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-020
Client Sample ID: CH-06-05, 20 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	10	%		1		ASA15-5	04/19/07 08:29 / srm
Silt	31	%		1		ASA15-5	04/19/07 08:29 / srm
Clay	59	%		1		ASA15-5	04/19/07 08:29 / srm
Very Fine Sand	6	wt%		1		ASA15-5	04/19/07 08:29 / srm
Texture	C					ASA15-5	04/19/07 08:29 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.00	s.u.		0.10		ASAM10-3.2	04/18/07 14:45 / srm
Conductivity, sat. paste	7.18	mmhos/cm		0.01		ASA10-3	04/19/07 08:29 / srm
Saturation	143	%		0.1		USDA27a	04/19/07 08:29 / srm
Calcium, sat. paste	26.7	meq/L	D	0.1		SW6010B	04/20/07 13:03 / rlh
Magnesium, sat. paste	23.3	meq/L	D	0.1		SW6010B	04/20/07 13:03 / rlh
Potassium, sat. paste	1.07	meq/L		0.03		SW6010B	04/20/07 13:03 / rlh
Sodium, sat. paste	61.7	meq/L	D	0.08		SW6010B	04/20/07 13:03 / rlh
Sodium Adsorption Ratio (SAR)	12.3	unitless		0.01		Calculation	04/23/07 13:22 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	60	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid Potential	1.6	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid/Base Potential	58	t/kt				Sobek Modifie	04/23/07 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	6.0	%		0.1		USDA23c	04/23/07 00:00 / srm
Organic Carbon	0.38	wt%		0.02		ASA29-3	04/18/07 14:45 / srm
Nitrate as N, KCL Extract	8	mg/kg		1		ASA33-8.1	04/18/07 12:32 / srm
METALS, WATER EXTRACTABLE							
Boron	0.4	mg/kg		0.1		SW6010B	04/20/07 15:53 / rlh
Selenium	0.05	mg/kg		0.01		SW6020	10/17/07 04:50 / sas
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	04/18/07 23:38 / rlh
Barium	94	mg/kg		5		SW6010B	04/18/07 23:38 / rlh
Cadmium	ND	mg/kg		1		SW6010B	04/18/07 23:38 / rlh
Chromium	25	mg/kg		5		SW6010B	04/18/07 23:38 / rlh
Copper	19	mg/kg		5		SW6010B	04/18/07 23:38 / rlh
Iron	16600	mg/kg	D	8		SW6010B	04/18/07 23:38 / rlh
Lead	11	mg/kg		5		SW6010B	04/18/07 23:38 / rlh
Manganese	121	mg/kg		5		SW6010B	04/18/07 23:38 / rlh
Mercury	ND	mg/kg		1		SW7471A	04/19/07 14:02 / jjw

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-020
Client Sample ID: CH-06-05, 20 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	04/18/07 23:38 / rlh
Selenium	ND	mg/kg		5		SW6010B	04/18/07 23:38 / rlh
Silver	ND	mg/kg		5		SW6010B	04/18/07 23:38 / rlh
Zinc	45	mg/kg		5		SW6010B	04/18/07 23:38 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-021
Client Sample ID: CH-06-05, 35-40 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	7	%		1		ASA15-5	04/20/07 08:30 / srm
Silt	26	%		1		ASA15-5	04/20/07 08:30 / srm
Clay	67	%		1		ASA15-5	04/20/07 08:30 / srm
Very Fine Sand	4	wt%		1		ASA15-5	04/20/07 08:30 / srm
Texture	C					ASA15-5	04/20/07 08:30 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.20	s.u.		0.10		ASAM10-3.2	04/18/07 14:45 / srm
Conductivity, sat. paste	6.33	mmhos/cm		0.01		ASA10-3	04/19/07 08:29 / srm
Saturation	275	%		0.1		USDA27a	04/19/07 08:29 / srm
Calcium, sat. paste	19.5	meq/L	D	0.1		SW6010B	04/20/07 13:07 / rlh
Magnesium, sat. paste	9.3	meq/L	D	0.1		SW6010B	04/20/07 13:07 / rlh
Potassium, sat. paste	0.88	meq/L		0.03		SW6010B	04/20/07 13:07 / rlh
Sodium, sat. paste	60.0	meq/L	D	0.08		SW6010B	04/20/07 13:07 / rlh
Sodium Adsorption Ratio (SAR)	15.8	unitless		0.01		Calculation	04/23/07 13:22 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	90	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid Potential	3.6	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid/Base Potential	87	t/kt				Sobek Modifie	04/23/07 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	9.0	%		0.1		USDA23c	04/23/07 00:00 / srm
Organic Carbon	0.33	wt%		0.02		ASA29-3	04/18/07 14:45 / srm
Nitrate as N, KCL Extract	5	mg/kg		1		ASA33-8.1	04/18/07 12:33 / srm
METALS, WATER EXTRACTABLE							
Boron	2.3	mg/kg		0.1		SW6010B	04/20/07 15:58 / rlh
Selenium	ISS	mg/kg	D	0.2		SW6010B	04/20/07 15:58 / rlh
-Insufficient Sample for Analysis							
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	04/19/07 00:03 / rlh
Barium	124	mg/kg		5		SW6010B	04/19/07 00:03 / rlh
Cadmium	ND	mg/kg		1		SW6010B	04/19/07 00:03 / rlh
Chromium	11	mg/kg		5		SW6010B	04/19/07 00:03 / rlh
Copper	11	mg/kg		5		SW6010B	04/19/07 00:03 / rlh
Iron	11500	mg/kg	D	8		SW6010B	04/24/07 23:51 / rlh
Lead	19	mg/kg		5		SW6010B	04/19/07 00:03 / rlh
Manganese	322	mg/kg		5		SW6010B	04/19/07 00:03 / rlh

Report Definitions:
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QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-021
Client Sample ID: CH-06-05, 35-40 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Mercury	ND	mg/kg		1		SW7471A	04/19/07 14:24 / jjw
Molybdenum	ND	mg/kg		5		SW6010B	04/19/07 00:03 / rlh
Selenium	ND	mg/kg		5		SW6010B	04/19/07 00:03 / rlh
Silver	ND	mg/kg		5		SW6010B	04/19/07 00:03 / rlh
Zinc	44	mg/kg		5		SW6010B	04/19/07 00:03 / rlh

Report Definitions:
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MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-022
Client Sample ID: CH-06-05, 42-49 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	6	%		1		ASA15-5	04/19/07 08:29 / srm
Silt	44	%		1		ASA15-5	04/19/07 08:29 / srm
Clay	50	%		1		ASA15-5	04/19/07 08:29 / srm
Very Fine Sand	5	wt%		1		ASA15-5	04/19/07 08:29 / srm
Texture	SiC					ASA15-5	04/19/07 08:29 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.30	s.u.		0.10		ASAM10-3.2	04/18/07 14:45 / srm
Conductivity, sat. paste	6.47	mmhos/cm		0.01		ASA10-3	04/19/07 08:29 / srm
Saturation	192	%		0.1		USDA27a	04/19/07 08:29 / srm
Calcium, sat. paste	12.3	meq/L	D	0.1		SW6010B	04/20/07 13:12 / rlh
Magnesium, sat. paste	7.0	meq/L	D	0.1		SW6010B	04/20/07 13:12 / rlh
Potassium, sat. paste	1.07	meq/L		0.03		SW6010B	04/20/07 13:12 / rlh
Sodium, sat. paste	66.4	meq/L	D	0.08		SW6010B	04/20/07 13:12 / rlh
Sodium Adsorption Ratio (SAR)	21.4	unitless		0.01		Calculation	04/23/07 13:22 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	51	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid Potential	17	t/kt		1.0		Sobek Modifie	04/23/07 00:00 / srm
Acid/Base Potential	34	t/kt				Sobek Modifie	04/23/07 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	5.1	%		0.1		USDA23c	04/23/07 00:00 / srm
Organic Carbon	0.90	wt%		0.02		ASA29-3	04/18/07 14:45 / srm
Nitrate as N, KCL Extract	17	mg/kg		1		ASA33-8.1	04/18/07 12:33 / srm
METALS, WATER EXTRACTABLE							
Boron	2.7	mg/kg		0.1		SW6010B	04/20/07 16:02 / rlh
Selenium	ISS	mg/kg	D	0.2		SW6010B	04/20/07 16:02 / rlh
-Insufficient Sample for Analysis							
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	04/19/07 00:06 / rlh
Barium	84	mg/kg		5		SW6010B	04/19/07 00:06 / rlh
Cadmium	ND	mg/kg		1		SW6010B	04/19/07 00:06 / rlh
Chromium	15	mg/kg		5		SW6010B	04/19/07 00:06 / rlh
Copper	10	mg/kg		5		SW6010B	04/19/07 00:06 / rlh
Iron	13500	mg/kg	D	8		SW6010B	04/24/07 23:55 / rlh
Lead	12	mg/kg		5		SW6010B	04/19/07 00:06 / rlh
Manganese	148	mg/kg		5		SW6010B	04/19/07 00:06 / rlh

Report Definitions:
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QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project:
Lab ID: B07041015-022
Client Sample ID: CH-06-05, 42-49 Feet

Report Date: 10/23/07
Collection Date: Not Provided
DateReceived: 04/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Mercury	ND	mg/kg		1		SW7471A	04/19/07 14:26 / jjw
Molybdenum	ND	mg/kg		5		SW6010B	04/19/07 00:06 / rlh
Selenium	ND	mg/kg		5		SW6010B	04/19/07 00:06 / rlh
Silver	ND	mg/kg		5		SW6010B	04/19/07 00:06 / rlh
Zinc	39	mg/kg		5		SW6010B	04/19/07 00:06 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development LLC/Talon Resources
Project:
Lab ID: B07110830-001
Client Sample ID: CH-06-05 49.5 to 59.5

Report Date: 11/27/07
Collection Date: Not Provided
DateReceived: 11/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	24	%		1		ASA15-5	11/18/07 15:17 / srm
Silt	49	%		1		ASA15-5	11/18/07 15:17 / srm
Clay	27	%		1		ASA15-5	11/18/07 15:17 / srm
Very Fine Sand	16	wt%		1		ASA15-5	11/18/07 15:20 / srm
Texture	CL					ASA15-5	11/18/07 15:17 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.00	s.u.		0.10		ASAM10-3.2	11/18/07 15:17 / srm
Conductivity, sat. paste	5.63	mmhos/cm		0.01		ASA10-3	11/18/07 15:17 / srm
Saturation	66.5	%		0.1		USDA27a	11/18/07 15:17 / srm
Calcium, sat. paste	3.37	meq/L		0.05		SW6010B	11/16/07 05:06 / rlh
Magnesium, sat. paste	2.05	meq/L		0.08		SW6010B	11/16/07 05:06 / rlh
Potassium, sat. paste	0.63	meq/L		0.03		SW6010B	11/16/07 05:06 / rlh
Sodium, sat. paste	55.8	meq/L		0.04		SW6010B	11/16/07 05:06 / rlh
Sodium Adsorption Ratio (SAR)	33.9	unitless		0.01		Calculation	11/18/07 15:17 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	39	t/kt		1.0		Sobek Modifie	11/18/07 15:12 / srm
Acid Potential	13	t/kt		1.0		Sobek Modifie	11/18/07 15:12 / srm
Acid/Base Potential	26	t/kt				Sobek Modifie	11/18/07 15:12 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	3.9	%		0.1		USDA23c	11/18/07 15:12 / srm
Organic Carbon	0.96	wt%		0.02		ASA29-3	11/18/07 15:22 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	11/16/07 20:32 / srm
METALS, WATER EXTRACTABLE							
Boron	1.7	mg/kg		0.1		SW6010B	11/20/07 08:39 / rlh
Selenium	ND	mg/kg		0.1		SW6020	11/19/07 23:36 / sas
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	11/16/07 01:29 / rlh
Barium	91	mg/kg		5		SW6010B	11/16/07 01:29 / rlh
Cadmium	ND	mg/kg		1		SW6010B	11/16/07 01:29 / rlh
Chromium	8	mg/kg		5		SW6010B	11/16/07 01:29 / rlh
Copper	8	mg/kg		5		SW6010B	11/16/07 01:29 / rlh
Iron	9210	mg/kg	D	20		SW6010B	11/16/07 01:29 / rlh
Lead	10	mg/kg		5		SW6010B	11/16/07 01:29 / rlh
Manganese	59	mg/kg		5		SW6010B	11/16/07 01:29 / rlh
Mercury	ND	mg/kg		1		SW7471A	11/15/07 14:07 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development LLC/Talon Resources
Project:
Lab ID: B07110830-001
Client Sample ID: CH-06-05 49.5 to 59.5

Report Date: 11/27/07
Collection Date: Not Provided
DateReceived: 11/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	11/16/07 01:29 / rlh
Selenium	ND	mg/kg		5		SW6010B	11/16/07 01:29 / rlh
Silver	ND	mg/kg		5		SW6010B	11/16/07 01:29 / rlh
Zinc	39	mg/kg		5		SW6010B	11/16/07 01:29 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development LLC/Talon Resources
Project:
Lab ID: B07110830-002
Client Sample ID: CH-06-05 59.5 to 62.3

Report Date: 11/27/07
Collection Date: Not Provided
DateReceived: 11/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	40	%		1		ASA15-5	11/18/07 15:17 / srm
Silt	41	%		1		ASA15-5	11/18/07 15:17 / srm
Clay	19	%		1		ASA15-5	11/18/07 15:17 / srm
Very Fine Sand	29	wt%		1		ASA15-5	11/18/07 15:20 / srm
Texture	L					ASA15-5	11/18/07 15:17 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.90	s.u.		0.10		ASAM10-3.2	11/18/07 15:17 / srm
Conductivity, sat. paste	7.29	mmhos/cm		0.01		ASA10-3	11/18/07 15:17 / srm
Saturation	39.0	%		0.1		USDA27a	11/18/07 15:17 / srm
Calcium, sat. paste	18.2	meq/L	D	0.1		SW6010B	11/16/07 05:14 / rlh
Magnesium, sat. paste	13.2	meq/L	D	0.1		SW6010B	11/16/07 05:14 / rlh
Potassium, sat. paste	1.34	meq/L		0.03		SW6010B	11/16/07 05:14 / rlh
Sodium, sat. paste	65.8	meq/L	D	0.08		SW6010B	11/16/07 05:14 / rlh
Sodium Adsorption Ratio (SAR)	16.6	unitless		0.01		Calculation	11/18/07 15:17 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	43	t/kt		1.0		Sobek Modifie	11/18/07 15:12 / srm
Acid Potential	10	t/kt		1.0		Sobek Modifie	11/18/07 15:12 / srm
Acid/Base Potential	34	t/kt				Sobek Modifie	11/18/07 15:12 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	4.3	%		0.1		USDA23c	11/18/07 15:12 / srm
Organic Carbon	1.30	wt%		0.02		ASA29-3	11/18/07 15:22 / srm
Nitrate as N, KCL Extract	ND	mg/kg		1		ASA33-8.1	11/16/07 20:32 / srm
METALS, WATER EXTRACTABLE							
Boron	1.6	mg/kg		0.1		SW6010B	11/20/07 08:47 / rlh
Selenium	ND	mg/kg		0.1		SW6020	11/19/07 23:50 / sas
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	11/16/07 01:32 / rlh
Barium	17	mg/kg		5		SW6010B	11/16/07 01:32 / rlh
Cadmium	ND	mg/kg		1		SW6010B	11/16/07 01:32 / rlh
Chromium	7	mg/kg		5		SW6010B	11/16/07 01:32 / rlh
Copper	6	mg/kg		5		SW6010B	11/16/07 01:32 / rlh
Iron	6000	mg/kg		5		SW6010B	11/16/07 01:32 / rlh
Lead	6	mg/kg		5		SW6010B	11/16/07 01:32 / rlh
Manganese	36	mg/kg		5		SW6010B	11/16/07 01:32 / rlh
Mercury	ND	mg/kg		1		SW7471A	11/15/07 14:09 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development LLC/Talon Resources
Project:
Lab ID: B07110830-002
Client Sample ID: CH-06-05 59.5 to 62.3

Report Date: 11/27/07
Collection Date: Not Provided
DateReceived: 11/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	11/16/07 01:32 / rlh
Selenium	ND	mg/kg		5		SW6010B	11/16/07 01:32 / rlh
Silver	ND	mg/kg		5		SW6010B	11/16/07 01:32 / rlh
Zinc	24	mg/kg		5		SW6010B	11/16/07 01:32 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development LLC/Talon Resources
Project:
Lab ID: B07110830-003
Client Sample ID: CH-06-05 79.5 to 83.5

Report Date: 11/27/07
Collection Date: Not Provided
DateReceived: 11/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	6	%		1		ASA15-5	11/18/07 15:17 / srm
Silt	52	%		1		ASA15-5	11/18/07 15:17 / srm
Clay	42	%		1		ASA15-5	11/18/07 15:17 / srm
Very Fine Sand	4	wt%		1		ASA15-5	11/18/07 15:20 / srm
Texture	SiC					ASA15-5	11/18/07 15:17 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.00	s.u.		0.10		ASAM10-3.2	11/18/07 15:17 / srm
Conductivity, sat. paste	2.80	mmhos/cm		0.01		ASA10-3	11/18/07 15:17 / srm
Saturation	46.0	%		0.1		USDA27a	11/18/07 15:17 / srm
Calcium, sat. paste	0.35	meq/L		0.05		SW6010B	11/16/07 05:21 / rlh
Magnesium, sat. paste	0.23	meq/L		0.08		SW6010B	11/16/07 05:21 / rlh
Potassium, sat. paste	0.31	meq/L		0.03		SW6010B	11/16/07 05:21 / rlh
Sodium, sat. paste	26.1	meq/L		0.04		SW6010B	11/16/07 05:21 / rlh
Sodium Adsorption Ratio (SAR)	48.5	unitless		0.01		Calculation	11/18/07 15:17 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	16	t/kt		1.0		Sobek Modifie	11/18/07 15:12 / srm
Acid Potential	3.0	t/kt		1.0		Sobek Modifie	11/18/07 15:12 / srm
Acid/Base Potential	13	t/kt				Sobek Modifie	11/18/07 15:12 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	1.6	%		0.1		USDA23c	11/18/07 15:12 / srm
Organic Carbon	1.67	wt%		0.02		ASA29-3	11/18/07 15:22 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	11/16/07 20:33 / srm
METALS, WATER EXTRACTABLE							
Boron	2.0	mg/kg		0.1		SW6010B	11/20/07 08:54 / rlh
Selenium	0.2	mg/kg		0.1		SW6020	11/19/07 23:57 / sas
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	11/16/07 01:36 / rlh
Barium	25	mg/kg		5		SW6010B	11/16/07 01:36 / rlh
Cadmium	ND	mg/kg		1		SW6010B	11/16/07 01:36 / rlh
Chromium	23	mg/kg		5		SW6010B	11/16/07 01:36 / rlh
Copper	30	mg/kg		5		SW6010B	11/16/07 01:36 / rlh
Iron	8430	mg/kg		5		SW6010B	11/16/07 01:36 / rlh
Lead	25	mg/kg		5		SW6010B	11/16/07 01:36 / rlh
Manganese	57	mg/kg		5		SW6010B	11/16/07 01:36 / rlh
Mercury	ND	mg/kg		1		SW7471A	11/15/07 14:11 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development LLC/Talon Resources
Project:
Lab ID: B07110830-003
Client Sample ID: CH-06-05 79.5 to 83.5

Report Date: 11/27/07
Collection Date: Not Provided
DateReceived: 11/12/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	11/16/07 01:36 / rlh
Selenium	ND	mg/kg		5		SW6010B	11/16/07 01:36 / rlh
Silver	ND	mg/kg		5		SW6010B	11/16/07 01:36 / rlh
Zinc	90	mg/kg		5		SW6010B	11/16/07 01:36 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-005
Client Sample ID: CH-07 0 - 6 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	2	%		1		ASA15-5	12/14/07 12:59 / srm
Silt	45	%		1		ASA15-5	12/14/07 12:59 / srm
Clay	53	%		1		ASA15-5	12/14/07 12:59 / srm
Very Fine Sand	0	wt%		1		ASA15-5	12/17/07 13:35 / srm
Texture	SiC					ASA15-5	12/14/07 12:59 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.30	s.u.		0.10		ASAM10-3.2	12/14/07 12:51 / srm
Conductivity, sat. paste	4.27	mmhos/cm		0.01		ASA10-3	12/14/07 12:51 / srm
Saturation	88.3	%		0.1		USDA27a	12/14/07 12:51 / srm
Calcium, sat. paste	4.91	meq/L		0.05		SW6010B	12/14/07 07:24 / rlh
Magnesium, sat. paste	10.9	meq/L		0.08		SW6010B	12/14/07 07:24 / rlh
Potassium, sat. paste	0.34	meq/L		0.03		SW6010B	12/14/07 07:24 / rlh
Sodium, sat. paste	36.5	meq/L		0.04		SW6010B	12/14/07 07:24 / rlh
Sodium Adsorption Ratio (SAR)	13.0	unitless		0.01		Calculation	12/14/07 12:51 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	190	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid Potential	1.4	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid/Base Potential	190	t/kt				Sobek Modifie	12/14/07 12:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	19.4	%		0.1		USDA23c	12/14/07 12:00 / srm
Organic Carbon	0.84	wt%		0.02		ASA29-3	12/14/07 12:51 / srm
Nitrate as N, KCL Extract	2	mg/kg		1		ASA33-8.1	12/14/07 16:34 / srm
METALS, WATER EXTRACTABLE							
Boron	0.6	mg/kg		0.1		SW6010B	12/14/07 02:44 / rlh
Selenium	0.02	mg/kg		0.01		SW6020	12/13/07 15:36 / jjw
METALS, TOTAL - EPA SW846							
Arsenic	7	mg/kg		5		SW6010B	12/11/07 21:41 / rlh
Barium	130	mg/kg		5		SW6010B	12/11/07 21:41 / rlh
Cadmium	ND	mg/kg		1		SW6010B	12/11/07 21:41 / rlh
Chromium	21	mg/kg		5		SW6010B	12/11/07 21:41 / rlh
Copper	15	mg/kg		5		SW6010B	12/11/07 21:41 / rlh
Iron	16400	mg/kg	D	20		SW6010B	12/11/07 21:41 / rlh
Lead	14	mg/kg		5		SW6010B	12/11/07 21:41 / rlh
Manganese	255	mg/kg		5		SW6010B	12/11/07 21:41 / rlh
Mercury	ND	mg/kg		1		SW7471A	12/13/07 08:14 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-005
Client Sample ID: CH-07 0 - 6 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	12/11/07 21:41 / rlh
Selenium	ND	mg/kg		5		SW6010B	12/11/07 21:41 / rlh
Silver	ND	mg/kg		5		SW6010B	12/11/07 21:41 / rlh
Zinc	54	mg/kg		5		SW6010B	12/11/07 21:41 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-006
Client Sample ID: CH-07 6 - 15 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	10	%		1		ASA15-5	12/14/07 12:59 / srm
Silt	41	%		1		ASA15-5	12/14/07 12:59 / srm
Clay	49	%		1		ASA15-5	12/14/07 12:59 / srm
Very Fine Sand	3	wt%		1		ASA15-5	12/17/07 13:35 / srm
Texture	SiC					ASA15-5	12/14/07 12:59 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.50	s.u.		0.10		ASAM10-3.2	12/14/07 12:51 / srm
Conductivity, sat. paste	9.33	mmhos/cm		0.01		ASA10-3	12/14/07 12:51 / srm
Saturation	101	%		0.1		USDA27a	12/14/07 12:51 / srm
Calcium, sat. paste	23.2	meq/L	D	0.1		SW6010B	12/14/07 07:28 / rlh
Magnesium, sat. paste	33.0	meq/L	D	0.1		SW6010B	12/14/07 07:28 / rlh
Potassium, sat. paste	0.71	meq/L		0.03		SW6010B	12/14/07 07:28 / rlh
Sodium, sat. paste	84.2	meq/L	D	0.08		SW6010B	12/14/07 07:28 / rlh
Sodium Adsorption Ratio (SAR)	15.9	unitless		0.01		Calculation	12/14/07 12:51 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	220	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid Potential	1.1	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid/Base Potential	220	t/kt				Sobek Modifie	12/14/07 12:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	21.8	%		0.1		USDA23c	12/14/07 12:00 / srm
Organic Carbon	0.33	wt%		0.02		ASA29-3	12/14/07 12:51 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	12/14/07 16:35 / srm
METALS, WATER EXTRACTABLE							
Boron	0.8	mg/kg		0.1		SW6010B	12/14/07 02:48 / rlh
Selenium	0.03	mg/kg		0.01		SW6020	12/13/07 15:40 / jjw
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	12/11/07 21:45 / rlh
Barium	91	mg/kg		5		SW6010B	12/11/07 21:45 / rlh
Cadmium	ND	mg/kg		1		SW6010B	12/11/07 21:45 / rlh
Chromium	15	mg/kg		5		SW6010B	12/11/07 21:45 / rlh
Copper	12	mg/kg		5		SW6010B	12/11/07 21:45 / rlh
Iron	11800	mg/kg		5		SW6010B	12/11/07 21:45 / rlh
Lead	11	mg/kg		5		SW6010B	12/11/07 21:45 / rlh
Manganese	179	mg/kg		5		SW6010B	12/11/07 21:45 / rlh
Mercury	ND	mg/kg		1		SW7471A	12/13/07 08:16 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-006
Client Sample ID: CH-07 6 - 15 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	12/11/07 21:45 / rlh
Selenium	ND	mg/kg		5		SW6010B	12/11/07 21:45 / rlh
Silver	ND	mg/kg		5		SW6010B	12/11/07 21:45 / rlh
Zinc	36	mg/kg		5		SW6010B	12/11/07 21:45 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-007
Client Sample ID: CH-07 15 - 19 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	5	%		1		ASA15-5	12/14/07 12:59 / srm
Silt	45	%		1		ASA15-5	12/14/07 12:59 / srm
Clay	50	%		1		ASA15-5	12/14/07 12:59 / srm
Very Fine Sand	4	wt%		1		ASA15-5	12/17/07 13:35 / srm
Texture	SiC					ASA15-5	12/14/07 12:59 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.20	s.u.		0.10		ASAM10-3.2	12/14/07 12:51 / srm
Conductivity, sat. paste	10.0	mmhos/cm		0.01		ASA10-3	12/14/07 12:51 / srm
Saturation	89.4	%		0.1		USDA27a	12/14/07 12:51 / srm
Calcium, sat. paste	22.8	meq/L	D	0.1		SW6010B	12/14/07 07:32 / rlh
Magnesium, sat. paste	18.4	meq/L	D	0.1		SW6010B	12/14/07 07:32 / rlh
Potassium, sat. paste	1.34	meq/L		0.03		SW6010B	12/14/07 07:32 / rlh
Sodium, sat. paste	106	meq/L	D	0.08		SW6010B	12/14/07 07:32 / rlh
Sodium Adsorption Ratio (SAR)	23.3	unitless		0.01		Calculation	12/14/07 12:51 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	170	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid/Base Potential	170	t/kt				Sobek Modifie	12/14/07 12:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	17.0	%		0.1		USDA23c	12/14/07 12:00 / srm
Organic Carbon	0.39	wt%		0.02		ASA29-3	12/14/07 12:51 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	12/14/07 16:36 / srm
METALS, WATER EXTRACTABLE							
Boron	0.5	mg/kg		0.1		SW6010B	12/14/07 02:59 / rlh
Selenium	0.02	mg/kg		0.01		SW6020	12/13/07 15:45 / jjw
METALS, TOTAL - EPA SW846							
Arsenic	6	mg/kg		5		SW6010B	12/11/07 21:48 / rlh
Barium	53	mg/kg		5		SW6010B	12/11/07 21:48 / rlh
Cadmium	ND	mg/kg		1		SW6010B	12/11/07 21:48 / rlh
Chromium	10	mg/kg		5		SW6010B	12/11/07 21:48 / rlh
Copper	9	mg/kg		5		SW6010B	12/11/07 21:48 / rlh
Iron	9500	mg/kg		5		SW6010B	12/11/07 21:48 / rlh
Lead	9	mg/kg		5		SW6010B	12/11/07 21:48 / rlh
Manganese	109	mg/kg		5		SW6010B	12/11/07 21:48 / rlh
Mercury	ND	mg/kg		1		SW7471A	12/13/07 08:22 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-007
Client Sample ID: CH-07 15 - 19 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	12/11/07 21:48 / rlh
Selenium	ND	mg/kg		5		SW6010B	12/11/07 21:48 / rlh
Silver	ND	mg/kg		5		SW6010B	12/11/07 21:48 / rlh
Zinc	26	mg/kg		5		SW6010B	12/11/07 21:48 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-008
Client Sample ID: CH-07 19 - 27 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	ND	%		1		ASA15-5	12/14/07 12:59 / srm
Silt	43	%		1		ASA15-5	12/14/07 12:59 / srm
Clay	57	%		1		ASA15-5	12/14/07 12:59 / srm
Very Fine Sand	0	wt%		1		ASA15-5	12/17/07 13:35 / srm
Texture	SiC					ASA15-5	12/14/07 12:59 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.20	s.u.		0.10		ASAM10-3.2	12/14/07 12:51 / srm
Conductivity, sat. paste	8.71	mmhos/cm		0.01		ASA10-3	12/14/07 12:51 / srm
Saturation	134	%		0.1		USDA27a	12/14/07 12:51 / srm
Calcium, sat. paste	20.5	meq/L	D	0.1		SW6010B	12/14/07 07:36 / rlh
Magnesium, sat. paste	11.1	meq/L	D	0.1		SW6010B	12/14/07 07:36 / rlh
Potassium, sat. paste	1.01	meq/L		0.03		SW6010B	12/14/07 07:36 / rlh
Sodium, sat. paste	90.5	meq/L	D	0.08		SW6010B	12/14/07 07:36 / rlh
Sodium Adsorption Ratio (SAR)	22.8	unitless		0.01		Calculation	12/14/07 12:51 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	110	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid Potential	3.2	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid/Base Potential	100	t/kt				Sobek Modifie	12/14/07 12:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	10.7	%		0.1		USDA23c	12/14/07 12:00 / srm
Organic Carbon	0.66	wt%		0.02		ASA29-3	12/14/07 12:51 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	12/14/07 16:36 / srm
METALS, WATER EXTRACTABLE							
Boron	0.8	mg/kg		0.1		SW6010B	12/14/07 03:03 / rlh
Selenium	0.01	mg/kg		0.01		SW6020	12/13/07 15:49 / jjw
METALS, TOTAL - EPA SW846							
Arsenic	7	mg/kg		5		SW6010B	12/11/07 21:52 / rlh
Barium	56	mg/kg		5		SW6010B	12/11/07 21:52 / rlh
Cadmium	ND	mg/kg		1		SW6010B	12/11/07 21:52 / rlh
Chromium	11	mg/kg		5		SW6010B	12/11/07 21:52 / rlh
Copper	9	mg/kg		5		SW6010B	12/11/07 21:52 / rlh
Iron	11300	mg/kg	D	20		SW6010B	12/11/07 21:52 / rlh
Lead	13	mg/kg		5		SW6010B	12/11/07 21:52 / rlh
Manganese	93	mg/kg		5		SW6010B	12/11/07 21:52 / rlh
Mercury	ND	mg/kg		1		SW7471A	12/13/07 08:25 / jjw

Report Definitions:
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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-008
Client Sample ID: CH-07 19 - 27 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	12/11/07 21:52 / rlh
Selenium	ND	mg/kg		5		SW6010B	12/11/07 21:52 / rlh
Silver	ND	mg/kg		5		SW6010B	12/11/07 21:52 / rlh
Zinc	35	mg/kg		5		SW6010B	12/11/07 21:52 / rlh

Report Definitions:
RL - Analyte reporting limit.
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MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-009
Client Sample ID: CH-07 27 - 36 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	ND	%		1		ASA15-5	12/14/07 12:59 / srm
Silt	39	%		1		ASA15-5	12/14/07 12:59 / srm
Clay	61	%		1		ASA15-5	12/14/07 12:59 / srm
Very Fine Sand	0	wt%		1		ASA15-5	12/17/07 13:35 / srm
Texture	C					ASA15-5	12/14/07 12:59 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.70	s.u.		0.10		ASAM10-3.2	12/14/07 12:51 / srm
Conductivity, sat. paste	3.68	mmhos/cm		0.01		ASA10-3	12/14/07 12:51 / srm
Saturation	259	%		0.1		USDA27a	12/14/07 12:51 / srm
Calcium, sat. paste	1.69	meq/L		0.05		SW6010B	12/14/07 07:40 / rlh
Magnesium, sat. paste	0.83	meq/L		0.08		SW6010B	12/14/07 07:40 / rlh
Potassium, sat. paste	0.33	meq/L		0.03		SW6010B	12/14/07 07:40 / rlh
Sodium, sat. paste	35.6	meq/L		0.04		SW6010B	12/14/07 07:40 / rlh
Sodium Adsorption Ratio (SAR)	31.7	unitless		0.01		Calculation	12/14/07 12:51 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	110	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid Potential	8.0	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid/Base Potential	100	t/kt				Sobek Modifie	12/14/07 12:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	11.0	%		0.1		USDA23c	12/14/07 12:00 / srm
Organic Carbon	1.26	wt%		0.02		ASA29-3	12/14/07 12:51 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	12/14/07 16:37 / srm
METALS, WATER EXTRACTABLE							
Boron	3.7	mg/kg		0.1		SW6010B	12/14/07 03:07 / rlh
Selenium	0.02	mg/kg		0.01		SW6020	12/13/07 15:54 / jjw
METALS, TOTAL - EPA SW846							
Arsenic	8	mg/kg		5		SW6010B	12/11/07 21:56 / rlh
Barium	52	mg/kg		5		SW6010B	12/11/07 21:56 / rlh
Cadmium	ND	mg/kg		1		SW6010B	12/11/07 21:56 / rlh
Chromium	8	mg/kg		5		SW6010B	12/11/07 21:56 / rlh
Copper	8	mg/kg		5		SW6010B	12/11/07 21:56 / rlh
Iron	9440	mg/kg		5		SW6010B	12/11/07 21:56 / rlh
Lead	13	mg/kg		5		SW6010B	12/11/07 21:56 / rlh
Manganese	81	mg/kg		5		SW6010B	12/11/07 21:56 / rlh
Mercury	ND	mg/kg		1		SW7471A	12/13/07 08:27 / jjw

Report Definitions:
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ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-009
Client Sample ID: CH-07 27 - 36 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	12/11/07 21:56 / rlh
Selenium	ND	mg/kg		5		SW6010B	12/11/07 21:56 / rlh
Silver	ND	mg/kg		5		SW6010B	12/11/07 21:56 / rlh
Zinc	33	mg/kg		5		SW6010B	12/11/07 21:56 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-010
Client Sample ID: CH-07 36 - 46 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	ND	%		1		ASA15-5	12/14/07 12:59 / srm
Silt	45	%		1		ASA15-5	12/14/07 12:59 / srm
Clay	55	%		1		ASA15-5	12/14/07 12:59 / srm
Very Fine Sand	0	wt%		1		ASA15-5	12/17/07 13:35 / srm
Texture	SiC					ASA15-5	12/14/07 12:59 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	9.40	s.u.		0.10		ASAM10-3.2	12/14/07 12:51 / srm
Conductivity, sat. paste	0.90	mmhos/cm		0.01		ASA10-3	12/14/07 12:51 / srm
Saturation	240	%		0.1		USDA27a	12/14/07 12:51 / srm
Calcium, sat. paste	ND	meq/L		0.05		SW6010B	12/14/07 07:44 / rlh
Magnesium, sat. paste	ND	meq/L		0.08		SW6010B	12/14/07 07:44 / rlh
Potassium, sat. paste	0.06	meq/L		0.03		SW6010B	12/14/07 07:44 / rlh
Sodium, sat. paste	9.16	meq/L		0.04		SW6010B	12/14/07 07:44 / rlh
Sodium Adsorption Ratio (SAR)	52.2	unitless		0.01		Calculation	12/14/07 12:51 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	95	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid Potential	8.3	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid/Base Potential	87	t/kt				Sobek Modifie	12/14/07 12:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	9.5	%		0.1		USDA23c	12/14/07 12:00 / srm
Organic Carbon	1.09	wt%		0.02		ASA29-3	12/14/07 12:51 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	12/14/07 16:39 / srm
METALS, WATER EXTRACTABLE							
Boron	3.2	mg/kg		0.1		SW6010B	12/14/07 03:11 / rlh
Selenium	0.01	mg/kg		0.01		SW6020	12/13/07 16:17 / jjw
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	12/11/07 21:59 / rlh
Barium	49	mg/kg		5		SW6010B	12/11/07 21:59 / rlh
Cadmium	ND	mg/kg		1		SW6010B	12/11/07 21:59 / rlh
Chromium	ND	mg/kg		5		SW6010B	12/11/07 21:59 / rlh
Copper	10	mg/kg		5		SW6010B	12/11/07 21:59 / rlh
Iron	6820	mg/kg		5		SW6010B	12/11/07 21:59 / rlh
Lead	21	mg/kg		5		SW6010B	12/11/07 21:59 / rlh
Manganese	86	mg/kg		5		SW6010B	12/11/07 21:59 / rlh
Mercury	ND	mg/kg		1		SW7471A	12/13/07 08:29 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-010
Client Sample ID: CH-07 36 - 46 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	10	mg/kg		5		SW6010B	12/11/07 21:59 / rlh
Selenium	ND	mg/kg		5		SW6010B	12/11/07 21:59 / rlh
Silver	ND	mg/kg		5		SW6010B	12/11/07 21:59 / rlh
Zinc	41	mg/kg		5		SW6010B	12/11/07 21:59 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-011
Client Sample ID: CH-08 0 - 6 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	18	%		1		ASA15-5	12/14/07 12:59 / srm
Silt	41	%		1		ASA15-5	12/14/07 12:59 / srm
Clay	41	%		1		ASA15-5	12/14/07 12:59 / srm
Very Fine Sand	0	wt%		1		ASA15-5	12/17/07 13:35 / srm
Texture	SiC					ASA15-5	12/14/07 12:59 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.20	s.u.		0.10		ASAM10-3.2	12/14/07 12:51 / srm
Conductivity, sat. paste	3.95	mmhos/cm		0.01		ASA10-3	12/14/07 12:51 / srm
Saturation	55.8	%		0.1		USDA27a	12/14/07 12:51 / srm
Calcium, sat. paste	11.5	meq/L		0.05		SW6010B	12/14/07 07:48 / rlh
Magnesium, sat. paste	48.5	meq/L		0.08		SW6010B	12/14/07 07:48 / rlh
Potassium, sat. paste	0.60	meq/L		0.03		SW6010B	12/14/07 07:48 / rlh
Sodium, sat. paste	3.22	meq/L		0.04		SW6010B	12/14/07 07:48 / rlh
Sodium Adsorption Ratio (SAR)	0.59	unitless		0.01		Calculation	12/14/07 12:51 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	330	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid/Base Potential	330	t/kt				Sobek Modifie	12/14/07 12:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	32.8	%		0.1		USDA23c	12/14/07 12:00 / srm
Organic Carbon	1.21	wt%		0.02		ASA29-3	12/14/07 12:51 / srm
Nitrate as N, KCL Extract	2	mg/kg		1		ASA33-8.1	12/14/07 16:40 / srm
METALS, WATER EXTRACTABLE							
Boron	0.4	mg/kg		0.1		SW6010B	12/14/07 03:15 / rlh
Selenium	ND	mg/kg		0.01		SW6020	12/13/07 16:22 / jjw
METALS, TOTAL - EPA SW846							
Arsenic	8	mg/kg		5		SW6010B	12/11/07 22:03 / rlh
Barium	128	mg/kg		5		SW6010B	12/11/07 22:03 / rlh
Cadmium	ND	mg/kg		1		SW6010B	12/11/07 22:03 / rlh
Chromium	21	mg/kg		5		SW6010B	12/11/07 22:03 / rlh
Copper	13	mg/kg		5		SW6010B	12/11/07 22:03 / rlh
Iron	13600	mg/kg		5		SW6010B	12/11/07 22:03 / rlh
Lead	11	mg/kg		5		SW6010B	12/11/07 22:03 / rlh
Manganese	293	mg/kg		5		SW6010B	12/11/07 22:03 / rlh
Mercury	ND	mg/kg		1		SW7471A	12/13/07 08:31 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-011
Client Sample ID: CH-08 0 - 6 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	12/11/07 22:03 / rlh
Selenium	ND	mg/kg		5		SW6010B	12/11/07 22:03 / rlh
Silver	ND	mg/kg		5		SW6010B	12/11/07 22:03 / rlh
Zinc	47	mg/kg		5		SW6010B	12/11/07 22:03 / rlh

Report Definitions:
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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-012
Client Sample ID: CH-08 6 - 11 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	60	%		1		ASA15-5	12/14/07 12:59 / srm
Silt	25	%		1		ASA15-5	12/14/07 12:59 / srm
Clay	15	%		1		ASA15-5	12/14/07 12:59 / srm
Very Fine Sand	10	wt%		1		ASA15-5	12/17/07 13:35 / srm
Texture	SL					ASA15-5	12/14/07 12:59 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.30	s.u.		0.10		ASAM10-3.2	12/14/07 12:51 / srm
Conductivity, sat. paste	2.96	mmhos/cm		0.01		ASA10-3	12/14/07 12:51 / srm
Saturation	27.4	%		0.1		USDA27a	12/14/07 12:51 / srm
Calcium, sat. paste	8.65	meq/L		0.05		SW6010B	12/14/07 07:59 / rlh
Magnesium, sat. paste	30.1	meq/L		0.08		SW6010B	12/14/07 07:59 / rlh
Potassium, sat. paste	0.40	meq/L		0.03		SW6010B	12/14/07 07:59 / rlh
Sodium, sat. paste	3.75	meq/L		0.04		SW6010B	12/14/07 07:59 / rlh
Sodium Adsorption Ratio (SAR)	0.85	unitless		0.01		Calculation	12/14/07 12:51 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	290	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid/Base Potential	290	t/kt				Sobek Modifie	12/14/07 12:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	29.2	%		0.1		USDA23c	12/14/07 12:00 / srm
Organic Carbon	0.28	wt%		0.02		ASA29-3	12/14/07 12:51 / srm
Nitrate as N, KCL Extract	2	mg/kg		1		ASA33-8.1	12/14/07 16:41 / srm
METALS, WATER EXTRACTABLE							
Boron	0.1	mg/kg		0.1		SW6010B	12/14/07 03:22 / rlh
Selenium	ND	mg/kg		0.01		SW6020	12/13/07 16:31 / jjw
METALS, TOTAL - EPA SW846							
Arsenic	5	mg/kg		5		SW6010B	12/12/07 23:49 / rlh
Barium	124	mg/kg		5		SW6010B	12/11/07 22:14 / rlh
Cadmium	ND	mg/kg		1		SW6010B	12/11/07 22:14 / rlh
Chromium	9	mg/kg		5		SW6010B	12/11/07 22:14 / rlh
Copper	6	mg/kg		5		SW6010B	12/11/07 22:14 / rlh
Iron	8270	mg/kg		5		SW6010B	12/11/07 22:14 / rlh
Lead	6	mg/kg		5		SW6010B	12/11/07 22:14 / rlh
Manganese	184	mg/kg		5		SW6010B	12/11/07 22:14 / rlh
Mercury	ND	mg/kg		1		SW7471A	12/13/07 08:33 / jjw

Report Definitions:
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MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-012
Client Sample ID: CH-08 6 - 11 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	12/11/07 22:14 / rlh
Selenium	ND	mg/kg		5		SW6010B	12/11/07 22:14 / rlh
Silver	ND	mg/kg		5		SW6010B	12/11/07 22:14 / rlh
Zinc	24	mg/kg		5		SW6010B	12/11/07 22:14 / rlh

Report Definitions:
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ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-013
Client Sample ID: CH-08 11 - 20 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	42	%		1		ASA15-5	12/14/07 12:59 / srm
Silt	37	%		1		ASA15-5	12/14/07 12:59 / srm
Clay	21	%		1		ASA15-5	12/14/07 12:59 / srm
Very Fine Sand	6	wt%		1		ASA15-5	12/17/07 13:35 / srm
Texture	L					ASA15-5	12/14/07 12:59 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.00	s.u.		0.10		ASAM10-3.2	12/14/07 12:51 / srm
Conductivity, sat. paste	3.84	mmhos/cm		0.01		ASA10-3	12/14/07 12:51 / srm
Saturation	33.2	%		0.1		USDA27a	12/14/07 12:51 / srm
Calcium, sat. paste	24.3	meq/L		0.05		SW6010B	12/14/07 08:03 / rlh
Magnesium, sat. paste	24.0	meq/L		0.08		SW6010B	12/14/07 08:03 / rlh
Potassium, sat. paste	0.65	meq/L		0.03		SW6010B	12/14/07 08:03 / rlh
Sodium, sat. paste	7.21	meq/L		0.04		SW6010B	12/14/07 08:03 / rlh
Sodium Adsorption Ratio (SAR)	1.47	unitless		0.01		Calculation	12/14/07 12:51 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	350	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid/Base Potential	350	t/kt				Sobek Modifie	12/14/07 12:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	34.6	%		0.1		USDA23c	12/14/07 12:00 / srm
Organic Carbon	0.29	wt%		0.02		ASA29-3	12/14/07 12:51 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	12/14/07 16:41 / srm
METALS, WATER EXTRACTABLE							
Boron	0.1	mg/kg		0.1		SW6010B	12/14/07 03:30 / rlh
Selenium	ND	mg/kg		0.01		SW6020	12/13/07 16:36 / jjw
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	12/12/07 23:53 / rlh
Barium	114	mg/kg		5		SW6010B	12/11/07 22:18 / rlh
Cadmium	ND	mg/kg		1		SW6010B	12/11/07 22:18 / rlh
Chromium	10	mg/kg		5		SW6010B	12/11/07 22:18 / rlh
Copper	8	mg/kg		5		SW6010B	12/11/07 22:18 / rlh
Iron	9330	mg/kg		5		SW6010B	12/11/07 22:18 / rlh
Lead	5	mg/kg		5		SW6010B	12/11/07 22:18 / rlh
Manganese	194	mg/kg		5		SW6010B	12/11/07 22:18 / rlh
Mercury	ND	mg/kg		1		SW7471A	12/13/07 08:35 / jjw

Report Definitions:
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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-013
Client Sample ID: CH-08 11 - 20 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	12/11/07 22:18 / rlh
Selenium	ND	mg/kg		5		SW6010B	12/11/07 22:18 / rlh
Silver	ND	mg/kg		5		SW6010B	12/11/07 22:18 / rlh
Zinc	26	mg/kg		5		SW6010B	12/11/07 22:18 / rlh

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-014
Client Sample ID: CH-08 20 - 30 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	4	%		1		ASA15-5	12/14/07 12:59 / srm
Silt	51	%		1		ASA15-5	12/14/07 12:59 / srm
Clay	45	%		1		ASA15-5	12/14/07 12:59 / srm
Very Fine Sand	0	wt%		1		ASA15-5	12/17/07 13:35 / srm
Texture	SiC					ASA15-5	12/14/07 12:59 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.10	s.u.		0.10		ASAM10-3.2	12/14/07 12:51 / srm
Conductivity, sat. paste	2.55	mmhos/cm		0.01		ASA10-3	12/14/07 12:51 / srm
Saturation	81.6	%		0.1		USDA27a	12/14/07 12:51 / srm
Calcium, sat. paste	12.0	meq/L		0.05		SW6010B	12/14/07 08:10 / rlh
Magnesium, sat. paste	7.92	meq/L		0.08		SW6010B	12/14/07 08:10 / rlh
Potassium, sat. paste	0.56	meq/L		0.03		SW6010B	12/14/07 08:10 / rlh
Sodium, sat. paste	11.5	meq/L		0.04		SW6010B	12/14/07 08:10 / rlh
Sodium Adsorption Ratio (SAR)	3.64	unitless		0.01		Calculation	12/14/07 12:51 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	120	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid/Base Potential	120	t/kt				Sobek Modifie	12/14/07 12:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	11.6	%		0.1		USDA23c	12/14/07 12:00 / srm
Organic Carbon	0.44	wt%		0.02		ASA29-3	12/14/07 12:51 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	12/14/07 16:42 / srm
METALS, WATER EXTRACTABLE							
Boron	0.3	mg/kg		0.1		SW6010B	12/14/07 03:33 / rlh
Selenium	0.01	mg/kg		0.01		SW6020	12/13/07 18:01 / jjw
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	12/12/07 23:56 / rlh
Barium	59	mg/kg		5		SW6010B	12/11/07 22:22 / rlh
Cadmium	ND	mg/kg		1		SW6010B	12/11/07 22:22 / rlh
Chromium	12	mg/kg		5		SW6010B	12/11/07 22:22 / rlh
Copper	12	mg/kg		5		SW6010B	12/11/07 22:22 / rlh
Iron	9650	mg/kg		5		SW6010B	12/11/07 22:22 / rlh
Lead	11	mg/kg		5		SW6010B	12/11/07 22:22 / rlh
Manganese	88	mg/kg		5		SW6010B	12/11/07 22:22 / rlh
Mercury	ND	mg/kg		1		SW7471A	12/13/07 08:37 / jjw

Report Definitions:
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MCL - Maximum contaminant level.
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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-014
Client Sample ID: CH-08 20 - 30 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	12/11/07 22:22 / rlh
Selenium	ND	mg/kg		5		SW6010B	12/11/07 22:22 / rlh
Silver	ND	mg/kg		5		SW6010B	12/11/07 22:22 / rlh
Zinc	38	mg/kg		5		SW6010B	12/11/07 22:22 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-015
Client Sample ID: CH-08 30 - 40 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	26	%		1		ASA15-5	12/14/07 12:59 / srm
Silt	45	%		1		ASA15-5	12/14/07 12:59 / srm
Clay	29	%		1		ASA15-5	12/14/07 12:59 / srm
Very Fine Sand	9	wt%		1		ASA15-5	12/17/07 13:35 / srm
Texture	CL					ASA15-5	12/14/07 12:59 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.00	s.u.		0.10		ASAM10-3.2	12/14/07 12:51 / srm
Conductivity, sat. paste	4.20	mmhos/cm		0.01		ASA10-3	12/14/07 12:51 / srm
Saturation	52.2	%		0.1		USDA27a	12/14/07 12:51 / srm
Calcium, sat. paste	25.3	meq/L		0.05		SW6010B	12/14/07 08:18 / rlh
Magnesium, sat. paste	15.1	meq/L		0.08		SW6010B	12/14/07 08:18 / rlh
Potassium, sat. paste	0.82	meq/L		0.03		SW6010B	12/14/07 08:18 / rlh
Sodium, sat. paste	17.7	meq/L		0.04		SW6010B	12/14/07 08:18 / rlh
Sodium Adsorption Ratio (SAR)	3.94	unitless		0.01		Calculation	12/14/07 12:51 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	220	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid Potential	0	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid/Base Potential	220	t/kt				Sobek Modifie	12/14/07 12:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	22.3	%		0.1		USDA23c	12/14/07 12:00 / srm
Organic Carbon	0.32	wt%		0.02		ASA29-3	12/14/07 12:51 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	12/14/07 16:44 / srm
METALS, WATER EXTRACTABLE							
Boron	0.3	mg/kg		0.1		SW6010B	12/14/07 03:45 / rlh
Selenium	ND	mg/kg		0.01		SW6020	12/13/07 18:06 / jjw
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	12/13/07 00:00 / rlh
Barium	82	mg/kg		5		SW6010B	12/11/07 22:25 / rlh
Cadmium	ND	mg/kg		1		SW6010B	12/11/07 22:25 / rlh
Chromium	10	mg/kg		5		SW6010B	12/11/07 22:25 / rlh
Copper	9	mg/kg		5		SW6010B	12/11/07 22:25 / rlh
Iron	10000	mg/kg		5		SW6010B	12/11/07 22:25 / rlh
Lead	8	mg/kg		5		SW6010B	12/11/07 22:25 / rlh
Manganese	166	mg/kg		5		SW6010B	12/11/07 22:25 / rlh
Mercury	ND	mg/kg		1		SW7471A	12/13/07 08:40 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-015
Client Sample ID: CH-08 30 - 40 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	12/11/07 22:25 / rlh
Selenium	ND	mg/kg		5		SW6010B	12/11/07 22:25 / rlh
Silver	ND	mg/kg		5		SW6010B	12/11/07 22:25 / rlh
Zinc	31	mg/kg		5		SW6010B	12/11/07 22:25 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-016
Client Sample ID: CH-08 40 - 50 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	18	%		1		ASA15-5	12/14/07 12:59 / srm
Silt	48	%		1		ASA15-5	12/14/07 12:59 / srm
Clay	34	%		1		ASA15-5	12/14/07 12:59 / srm
Very Fine Sand	8	wt%		1		ASA15-5	12/17/07 13:35 / srm
Texture	SiCL					ASA15-5	12/14/07 12:59 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.10	s.u.		0.10		ASAM10-3.2	12/14/07 12:51 / srm
Conductivity, sat. paste	5.44	mmhos/cm		0.01		ASA10-3	12/14/07 12:51 / srm
Saturation	65.1	%		0.1		USDA27a	12/14/07 12:51 / srm
Calcium, sat. paste	21.4	meq/L		0.05		SW6010B	12/14/07 08:22 / rlh
Magnesium, sat. paste	11.3	meq/L		0.08		SW6010B	12/14/07 08:22 / rlh
Potassium, sat. paste	0.95	meq/L		0.03		SW6010B	12/14/07 08:22 / rlh
Sodium, sat. paste	43.4	meq/L		0.04		SW6010B	12/14/07 08:22 / rlh
Sodium Adsorption Ratio (SAR)	10.7	unitless		0.01		Calculation	12/14/07 12:51 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	210	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid Potential	3.8	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid/Base Potential	210	t/kt				Sobek Modifie	12/14/07 12:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	21.2	%		0.1		USDA23c	12/14/07 12:00 / srm
Organic Carbon	0.65	wt%		0.02		ASA29-3	12/14/07 12:51 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	12/14/07 16:45 / srm
METALS, WATER EXTRACTABLE							
Boron	0.6	mg/kg		0.1		SW6010B	12/14/07 03:49 / rlh
Selenium	ND	mg/kg		0.01		SW6020	12/13/07 18:11 / jjw
METALS, TOTAL - EPA SW846							
Arsenic	5	mg/kg		5		SW6010B	12/13/07 00:12 / rlh
Barium	94	mg/kg		5		SW6010B	12/11/07 22:29 / rlh
Cadmium	ND	mg/kg		1		SW6010B	12/11/07 22:29 / rlh
Chromium	13	mg/kg		5		SW6010B	12/11/07 22:29 / rlh
Copper	11	mg/kg		5		SW6010B	12/11/07 22:29 / rlh
Iron	12200	mg/kg	D	20		SW6010B	12/11/07 22:29 / rlh
Lead	10	mg/kg		5		SW6010B	12/11/07 22:29 / rlh
Manganese	172	mg/kg		5		SW6010B	12/11/07 22:29 / rlh
Mercury	ND	mg/kg		1		SW7471A	12/13/07 08:42 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-016
Client Sample ID: CH-08 40 - 50 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	12/11/07 22:29 / rlh
Selenium	ND	mg/kg		5		SW6010B	12/11/07 22:29 / rlh
Silver	ND	mg/kg		5		SW6010B	12/11/07 22:29 / rlh
Zinc	36	mg/kg		5		SW6010B	12/11/07 22:29 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-017
Client Sample ID: CH-08 50 - 60 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	19	%		1		ASA15-5	12/14/07 12:59 / srm
Silt	46	%		1		ASA15-5	12/14/07 12:59 / srm
Clay	35	%		1		ASA15-5	12/14/07 12:59 / srm
Very Fine Sand	8	wt%		1		ASA15-5	12/17/07 13:35 / srm
Texture	SiCL					ASA15-5	12/14/07 12:59 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.20	s.u.		0.10		ASAM10-3.2	12/14/07 12:51 / srm
Conductivity, sat. paste	5.63	mmhos/cm		0.01		ASA10-3	12/14/07 12:51 / srm
Saturation	71.2	%		0.1		USDA27a	12/14/07 12:51 / srm
Calcium, sat. paste	16.9	meq/L	D	0.1		SW6010B	12/14/07 08:26 / rlh
Magnesium, sat. paste	10.6	meq/L	D	0.1		SW6010B	12/14/07 08:26 / rlh
Potassium, sat. paste	1.00	meq/L		0.03		SW6010B	12/14/07 08:26 / rlh
Sodium, sat. paste	49.4	meq/L	D	0.08		SW6010B	12/14/07 08:26 / rlh
Sodium Adsorption Ratio (SAR)	13.3	unitless		0.01		Calculation	12/14/07 12:51 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	210	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid Potential	5.2	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid/Base Potential	200	t/kt				Sobek Modifie	12/14/07 12:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	20.9	%		0.1		USDA23c	12/14/07 12:00 / srm
Organic Carbon	0.54	wt%		0.02		ASA29-3	12/14/07 12:51 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	12/14/07 16:46 / srm
METALS, WATER EXTRACTABLE							
Boron	0.7	mg/kg		0.1		SW6010B	12/14/07 03:53 / rlh
Selenium	ND	mg/kg		0.01		SW6020	12/13/07 18:15 / jjw
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	12/13/07 00:15 / rlh
Barium	94	mg/kg		5		SW6010B	12/11/07 22:32 / rlh
Cadmium	ND	mg/kg		1		SW6010B	12/11/07 22:32 / rlh
Chromium	13	mg/kg		5		SW6010B	12/11/07 22:32 / rlh
Copper	11	mg/kg		5		SW6010B	12/11/07 22:32 / rlh
Iron	11000	mg/kg		5		SW6010B	12/11/07 22:32 / rlh
Lead	9	mg/kg		5		SW6010B	12/11/07 22:32 / rlh
Manganese	165	mg/kg		5		SW6010B	12/11/07 22:32 / rlh
Mercury	ND	mg/kg		1		SW7471A	12/13/07 08:48 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-017
Client Sample ID: CH-08 50 - 60 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	12/11/07 22:32 / rlh
Selenium	ND	mg/kg		5		SW6010B	12/11/07 22:32 / rlh
Silver	ND	mg/kg		5		SW6010B	12/11/07 22:32 / rlh
Zinc	32	mg/kg		5		SW6010B	12/11/07 22:32 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-018
Client Sample ID: CH-08 60 - 70 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	10	%		1		ASA15-5	12/14/07 12:59 / srm
Silt	45	%		1		ASA15-5	12/14/07 12:59 / srm
Clay	45	%		1		ASA15-5	12/14/07 12:59 / srm
Very Fine Sand	4	wt%		1		ASA15-5	12/17/07 13:35 / srm
Texture	SiC					ASA15-5	12/14/07 12:59 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.80	s.u.		0.10		ASAM10-3.2	12/14/07 12:51 / srm
Conductivity, sat. paste	4.22	mmhos/cm		0.01		ASA10-3	12/14/07 12:51 / srm
Saturation	123	%		0.1		USDA27a	12/14/07 12:51 / srm
Calcium, sat. paste	3.09	meq/L		0.05		SW6010B	12/14/07 08:29 / rlh
Magnesium, sat. paste	1.58	meq/L		0.08		SW6010B	12/14/07 08:29 / rlh
Potassium, sat. paste	0.43	meq/L		0.03		SW6010B	12/14/07 08:29 / rlh
Sodium, sat. paste	43.8	meq/L		0.04		SW6010B	12/14/07 08:29 / rlh
Sodium Adsorption Ratio (SAR)	28.7	unitless		0.01		Calculation	12/14/07 12:51 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	150	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid Potential	11	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid/Base Potential	140	t/kt				Sobek Modifie	12/14/07 12:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	15.2	%		0.1		USDA23c	12/14/07 12:00 / srm
Organic Carbon	0.70	wt%		0.02		ASA29-3	12/14/07 12:51 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	12/14/07 16:46 / srm
METALS, WATER EXTRACTABLE							
Boron	0.8	mg/kg		0.1		SW6010B	12/14/07 03:57 / rlh
Selenium	0.02	mg/kg		0.01		SW6020	12/13/07 18:20 / jjw
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	12/13/07 00:19 / rlh
Barium	91	mg/kg		5		SW6010B	12/11/07 22:36 / rlh
Cadmium	ND	mg/kg		1		SW6010B	12/11/07 22:36 / rlh
Chromium	16	mg/kg		5		SW6010B	12/11/07 22:36 / rlh
Copper	14	mg/kg		5		SW6010B	12/11/07 22:36 / rlh
Iron	12900	mg/kg		5		SW6010B	12/11/07 22:36 / rlh
Lead	12	mg/kg		5		SW6010B	12/11/07 22:36 / rlh
Manganese	148	mg/kg		5		SW6010B	12/11/07 22:36 / rlh
Mercury	ND	mg/kg		1		SW7471A	12/13/07 08:50 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-018
Client Sample ID: CH-08 60 - 70 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	12/11/07 22:36 / rlh
Selenium	ND	mg/kg		5		SW6010B	12/11/07 22:36 / rlh
Silver	ND	mg/kg		5		SW6010B	12/11/07 22:36 / rlh
Zinc	45	mg/kg		5		SW6010B	12/11/07 22:36 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-001
Client Sample ID: CH-08 70-79 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	8	%		1		ASA15-5	12/14/07 12:59 / srm
Silt	59	%		1		ASA15-5	12/14/07 12:59 / srm
Clay	33	%		1		ASA15-5	12/14/07 12:59 / srm
Very Fine Sand	2	wt%		1		ASA15-5	12/17/07 13:35 / srm
Texture	SiCL					ASA15-5	12/14/07 12:59 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.60	s.u.		0.10		ASAM10-3.2	12/14/07 12:51 / srm
Conductivity, sat. paste	2.68	mmhos/cm		0.01		ASA10-3	12/14/07 12:51 / srm
Saturation	94.8	%		0.1		USDA27a	12/14/07 12:51 / srm
Calcium, sat. paste	0.50	meq/L		0.05		SW6010B	12/14/07 06:54 / rlh
Magnesium, sat. paste	0.27	meq/L		0.08		SW6010B	12/14/07 06:54 / rlh
Potassium, sat. paste	0.23	meq/L		0.03		SW6010B	12/14/07 06:54 / rlh
Sodium, sat. paste	26.1	meq/L		0.04		SW6010B	12/14/07 06:54 / rlh
Sodium Adsorption Ratio (SAR)	42.1	unitless		0.01		Calculation	12/14/07 12:51 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	170	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid Potential	9.8	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid/Base Potential	160	t/kt				Sobek Modifie	12/14/07 12:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	16.7	%		0.1		USDA23c	12/14/07 12:00 / srm
Organic Carbon	1.70	wt%		0.02		ASA29-3	12/14/07 12:51 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	12/14/07 16:31 / srm
METALS, WATER EXTRACTABLE							
Boron	1.0	mg/kg		0.1		SW6010B	12/14/07 02:20 / rlh
Selenium	0.02	mg/kg		0.01		SW6020	12/13/07 14:40 / jjw
METALS, TOTAL - EPA SW846							
Arsenic	8	mg/kg		5		SW6010B	12/11/07 21:08 / rlh
Barium	74	mg/kg		5		SW6010B	12/11/07 21:08 / rlh
Cadmium	ND	mg/kg		1		SW6010B	12/11/07 21:08 / rlh
Chromium	12	mg/kg		5		SW6010B	12/11/07 21:08 / rlh
Copper	11	mg/kg		5		SW6010B	12/11/07 21:08 / rlh
Iron	13700	mg/kg	D	20		SW6010B	12/11/07 21:08 / rlh
Lead	11	mg/kg		5		SW6010B	12/11/07 21:08 / rlh
Manganese	162	mg/kg		5		SW6010B	12/11/07 21:08 / rlh
Mercury	ND	mg/kg		1		SW7471A	12/13/07 07:59 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-001
Client Sample ID: CH-08 70-79 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	12/11/07 21:08 / rlh
Selenium	ND	mg/kg		5		SW6010B	12/11/07 21:08 / rlh
Silver	ND	mg/kg		5		SW6010B	12/11/07 21:08 / rlh
Zinc	39	mg/kg		5		SW6010B	12/11/07 21:08 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-002
Client Sample ID: CH-08 79.2 - 82.3 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	35	%		1		ASA15-5	12/14/07 12:59 / srm
Silt	41	%		1		ASA15-5	12/14/07 12:59 / srm
Clay	24	%		1		ASA15-5	12/14/07 12:59 / srm
Very Fine Sand	18	wt%		1		ASA15-5	12/17/07 13:35 / srm
Texture	L					ASA15-5	12/14/07 12:59 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.30	s.u.		0.10		ASAM10-3.2	12/14/07 12:51 / srm
Conductivity, sat. paste	1.90	mmhos/cm		0.01		ASA10-3	12/14/07 12:51 / srm
Saturation	55.1	%		0.1		USDA27a	12/14/07 12:51 / srm
Calcium, sat. paste	0.20	meq/L		0.05		SW6010B	12/14/07 06:58 / rlh
Magnesium, sat. paste	0.15	meq/L		0.08		SW6010B	12/14/07 06:58 / rlh
Potassium, sat. paste	0.16	meq/L		0.03		SW6010B	12/14/07 06:58 / rlh
Sodium, sat. paste	20.8	meq/L		0.04		SW6010B	12/14/07 06:58 / rlh
Sodium Adsorption Ratio (SAR)	49.8	unitless		0.01		Calculation	12/14/07 12:51 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	45	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid Potential	20	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid/Base Potential	25	t/kt				Sobek Modifie	12/14/07 12:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	4.5	%		0.1		USDA23c	12/14/07 12:00 / srm
Organic Carbon	7.72	wt%		0.02		ASA29-3	12/14/07 12:51 / srm
Nitrate as N, KCL Extract	ND	mg/kg		1		ASA33-8.1	12/14/07 16:31 / srm
METALS, WATER EXTRACTABLE							
Boron	1.7	mg/kg		0.1		SW6010B	12/14/07 02:28 / rlh
Selenium	ND	mg/kg		0.01		SW6020	12/13/07 14:49 / jjw
METALS, TOTAL - EPA SW846							
Arsenic	6	mg/kg		5		SW6010B	12/11/07 21:19 / rlh
Barium	105	mg/kg		5		SW6010B	12/11/07 21:19 / rlh
Cadmium	ND	mg/kg		1		SW6010B	12/11/07 21:19 / rlh
Chromium	7	mg/kg		5		SW6010B	12/11/07 21:19 / rlh
Copper	8	mg/kg		5		SW6010B	12/11/07 21:19 / rlh
Iron	6860	mg/kg	D	20		SW6010B	12/11/07 21:19 / rlh
Lead	7	mg/kg		5		SW6010B	12/11/07 21:19 / rlh
Manganese	48	mg/kg		5		SW6010B	12/11/07 21:19 / rlh
Mercury	ND	mg/kg		1		SW7471A	12/13/07 08:07 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-002
Client Sample ID: CH-08 79.2 - 82.3 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	12/11/07 21:19 / rlh
Selenium	ND	mg/kg		5		SW6010B	12/11/07 21:19 / rlh
Silver	ND	mg/kg		5		SW6010B	12/11/07 21:19 / rlh
Zinc	25	mg/kg		5		SW6010B	12/11/07 21:19 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-003
Client Sample ID: CH-08 82.3 - 83.8 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	50	%		1		ASA15-5	12/14/07 12:59 / srm
Silt	31	%		1		ASA15-5	12/14/07 12:59 / srm
Clay	19	%		1		ASA15-5	12/14/07 12:59 / srm
Very Fine Sand	19	wt%		1		ASA15-5	12/17/07 13:35 / srm
Texture	L					ASA15-5	12/14/07 12:59 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	7.50	s.u.		0.10		ASAM10-3.2	12/14/07 12:51 / srm
Conductivity, sat. paste	6.48	mmhos/cm		0.01		ASA10-3	12/14/07 12:51 / srm
Saturation	37.9	%		0.1		USDA27a	12/14/07 12:51 / srm
Calcium, sat. paste	9.4	meq/L	D	0.1		SW6010B	12/14/07 07:01 / rlh
Magnesium, sat. paste	4.2	meq/L	D	0.1		SW6010B	12/14/07 07:01 / rlh
Potassium, sat. paste	0.90	meq/L		0.03		SW6010B	12/14/07 07:01 / rlh
Sodium, sat. paste	63.6	meq/L	D	0.08		SW6010B	12/14/07 07:01 / rlh
Sodium Adsorption Ratio (SAR)	24.5	unitless		0.01		Calculation	12/14/07 12:51 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	37	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid Potential	13	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid/Base Potential	24	t/kt				Sobek Modifie	12/14/07 12:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	3.7	%		0.1		USDA23c	12/14/07 12:00 / srm
Organic Carbon	1.82	wt%		0.02		ASA29-3	12/14/07 12:51 / srm
Nitrate as N, KCL Extract	ND	mg/kg		1		ASA33-8.1	12/14/07 16:32 / srm
METALS, WATER EXTRACTABLE							
Boron	1.4	mg/kg		0.1		SW6010B	12/14/07 02:36 / rlh
Selenium	ND	mg/kg		0.01		SW6020	12/13/07 15:27 / jjw
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	12/11/07 21:34 / rlh
Barium	54	mg/kg		5		SW6010B	12/11/07 21:34 / rlh
Cadmium	ND	mg/kg		1		SW6010B	12/11/07 21:34 / rlh
Chromium	5	mg/kg		5		SW6010B	12/11/07 21:34 / rlh
Copper	ND	mg/kg		5		SW6010B	12/11/07 21:34 / rlh
Iron	6810	mg/kg		5		SW6010B	12/11/07 21:34 / rlh
Lead	ND	mg/kg		5		SW6010B	12/11/07 21:34 / rlh
Manganese	35	mg/kg		5		SW6010B	12/11/07 21:34 / rlh
Mercury	ND	mg/kg		1		SW7471A	12/13/07 08:09 / jjw

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-003
Client Sample ID: CH-08 82.3 - 83.8 ft

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	12/11/07 21:34 / rlh
Selenium	ND	mg/kg		5		SW6010B	12/11/07 21:34 / rlh
Silver	ND	mg/kg		5		SW6010B	12/11/07 21:34 / rlh
Zinc	13	mg/kg		5		SW6010B	12/11/07 21:34 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-004
Client Sample ID: CH-08 101 - 103 ft underburden

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	16	%		1		ASA15-5	12/14/07 12:59 / srm
Silt	42	%		1		ASA15-5	12/14/07 12:59 / srm
Clay	42	%		1		ASA15-5	12/14/07 12:59 / srm
Very Fine Sand	7	wt%		1		ASA15-5	12/17/07 13:35 / srm
Texture	SiC					ASA15-5	12/14/07 12:59 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	8.40	s.u.		0.10		ASAM10-3.2	12/14/07 12:51 / srm
Conductivity, sat. paste	6.72	mmhos/cm		0.01		ASA10-3	12/14/07 12:51 / srm
Saturation	110	%		0.1		USDA27a	12/14/07 12:51 / srm
Calcium, sat. paste	2.5	meq/L	D	0.1		SW6010B	12/14/07 07:17 / rlh
Magnesium, sat. paste	2.1	meq/L	D	0.1		SW6010B	12/14/07 07:17 / rlh
Potassium, sat. paste	0.54	meq/L		0.03		SW6010B	12/14/07 07:17 / rlh
Sodium, sat. paste	72.8	meq/L	D	0.08		SW6010B	12/14/07 07:17 / rlh
Sodium Adsorption Ratio (SAR)	48.1	unitless		0.01		Calculation	12/14/07 12:51 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	110	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid Potential	14	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid/Base Potential	93	t/kt				Sobek Modifie	12/14/07 12:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	10.7	%		0.1		USDA23c	12/14/07 12:00 / srm
Organic Carbon	4.60	wt%		0.02		ASA29-3	12/14/07 12:51 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	12/14/07 16:33 / srm
METALS, WATER EXTRACTABLE							
Boron	6.5	mg/kg		0.1		SW6010B	12/14/07 02:40 / rlh
Selenium	0.02	mg/kg		0.01		SW6020	12/13/07 15:31 / jjw
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	12/11/07 21:38 / rlh
Barium	79	mg/kg		5		SW6010B	12/11/07 21:38 / rlh
Cadmium	ND	mg/kg		1		SW6010B	12/11/07 21:38 / rlh
Chromium	13	mg/kg		5		SW6010B	12/11/07 21:38 / rlh
Copper	13	mg/kg		5		SW6010B	12/11/07 21:38 / rlh
Iron	10900	mg/kg	D	20		SW6010B	12/11/07 21:38 / rlh
Lead	13	mg/kg		5		SW6010B	12/11/07 21:38 / rlh
Manganese	127	mg/kg		5		SW6010B	12/11/07 21:38 / rlh
Mercury	ND	mg/kg		1		SW7471A	12/13/07 08:12 / jjw

Report Definitions:
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QCL - Quality control limit.
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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120398-004
Client Sample ID: CH-08 101 - 103 ft underburden

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/06/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Molybdenum	ND	mg/kg		5		SW6010B	12/11/07 21:38 / rlh
Selenium	ND	mg/kg		5		SW6010B	12/11/07 21:38 / rlh
Silver	ND	mg/kg		5		SW6010B	12/11/07 21:38 / rlh
Zinc	46	mg/kg		5		SW6010B	12/11/07 21:38 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120636-001
Client Sample ID: Composite of CH-08 Coal Core and Rotary

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/10/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	80	%		1		ASA15-5	12/17/07 11:49 / srm
Silt	11	%		1		ASA15-5	12/17/07 11:49 / srm
Clay	9	%		1		ASA15-5	12/17/07 11:49 / srm
Very Fine Sand	6	wt%		1		ASA15-5	12/17/07 13:38 / srm
Texture	LS					ASA15-5	12/17/07 11:49 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	7.50	s.u.		0.10		ASAM10-3.2	12/17/07 11:49 / srm
Conductivity, sat. paste	4.04	mmhos/cm		0.01		ASA10-3	12/17/07 11:49 / srm
Saturation	64.7	%		0.1		USDA27a	12/17/07 11:49 / srm
Calcium, sat. paste	1.44	meq/L		0.05		SW6010B	12/15/07 02:35 / rlh
Magnesium, sat. paste	1.06	meq/L		0.08		SW6010B	12/15/07 02:35 / rlh
Potassium, sat. paste	0.30	meq/L		0.03		SW6010B	12/15/07 02:35 / rlh
Sodium, sat. paste	37.7	meq/L		0.04		SW6010B	12/15/07 02:35 / rlh
Sodium Adsorption Ratio (SAR)	33.8	unitless		0.01		Calculation	12/17/07 11:49 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	32	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid Potential	41	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid/Base Potential	-10	t/kt				Sobek Modifie	12/14/07 12:00 / srm
Sulfur, Total	1.48	%		0.01		Sobek Modifie	12/14/07 12:00 / srm
Sulfur, Hot Water Extractable	0.16	%		0.01		Sobek Modifie	12/14/07 12:00 / srm
Sulfur, HCl Extractable	0.12	%		0.01		Sobek Modifie	12/14/07 12:00 / srm
Sulfur, HNO3 Extractable	0.58	%		0.01		Sobek Modifie	12/14/07 12:00 / srm
Sulfur, Residual	0.62	%		0.01		Sobek Modifie	12/14/07 12:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	3.2	%		0.1		USDA23c	12/14/07 12:00 / srm
Organic Carbon	42.8	wt%		0.02		ASA29-3	12/17/07 11:49 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	12/14/07 16:48 / srm
METALS, WATER EXTRACTABLE							
Boron	7.4	mg/kg		0.1		SW6010B	12/14/07 04:05 / rlh
Selenium	ND	mg/kg		0.1		SW6020	12/13/07 18:29 / jjw
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg	D	8		SW6010B	12/13/07 22:14 / rlh
Barium	99	mg/kg		5		SW6010B	12/13/07 22:14 / rlh
Cadmium	ND	mg/kg		1		SW6010B	12/13/07 22:14 / rlh
Chromium	ND	mg/kg		5		SW6010B	12/13/07 22:14 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120636-001
Client Sample ID: Composite of CH-08 Coal Core and Rotary

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/10/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Copper	19	mg/kg		5		SW6010B	12/13/07 22:14 / rlh
Iron	5350	mg/kg		5		SW6010B	12/13/07 22:14 / rlh
Lead	ND	mg/kg		5		SW6010B	12/13/07 22:14 / rlh
Manganese	28	mg/kg		5		SW6010B	12/13/07 22:14 / rlh
Mercury	ND	mg/kg		1		SW7471A	12/13/07 15:45 / jjw
Molybdenum	ND	mg/kg		5		SW6010B	12/13/07 22:14 / rlh
Selenium	0.7	mg/kg		0.1		SW6020	12/17/07 14:18 / sas
Silver	ND	mg/kg		5		SW6010B	12/13/07 22:14 / rlh
Zinc	16	mg/kg		5		SW6010B	12/13/07 22:14 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project: Coal Hollow Project
Lab ID: B07120524-001
Client Sample ID: CH-01-05, Coal Grab Sample

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/07/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	92	%		1		ASA15-5	12/14/07 12:59 / srm
Silt	5	%		1		ASA15-5	12/14/07 12:59 / srm
Clay	3	%		1		ASA15-5	12/14/07 12:59 / srm
Very Fine Sand	5	wt%		1		ASA15-5	12/17/07 13:35 / srm
Texture	S					ASA15-5	12/14/07 12:59 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	5.70	s.u.		0.10		ASAM10-3.2	12/14/07 12:51 / srm
Conductivity, sat. paste	3.04	mmhos/cm		0.01		ASA10-3	12/14/07 12:51 / srm
Saturation	75.0	%		0.1		USDA27a	12/14/07 12:51 / srm
Calcium, sat. paste	24.8	meq/L		0.05		SW6010B	12/14/07 08:33 / rlh
Magnesium, sat. paste	15.5	meq/L		0.08		SW6010B	12/14/07 08:33 / rlh
Potassium, sat. paste	0.22	meq/L		0.03		SW6010B	12/14/07 08:33 / rlh
Sodium, sat. paste	4.42	meq/L		0.04		SW6010B	12/14/07 08:33 / rlh
Sodium Adsorption Ratio (SAR)	0.99	unitless		0.01		Calculation	12/14/07 12:51 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	25	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid Potential	81	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid/Base Potential	-56	t/kt				Sobek Modifie	12/14/07 12:00 / srm
Sulfur, Total	2.78	%		0.01		Sobek Modifie	12/14/07 12:00 / srm
Sulfur, Hot Water Extractable	0.18	%		0.01		Sobek Modifie	12/14/07 12:00 / srm
Sulfur, HCl Extractable	0.01	%		0.01		Sobek Modifie	12/14/07 12:00 / srm
Sulfur, HNO3 Extractable	1.34	%		0.01		Sobek Modifie	12/14/07 12:00 / srm
Sulfur, Residual	1.25	%		0.01		Sobek Modifie	12/14/07 12:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	2.5	%		0.1		USDA23c	12/14/07 12:00 / srm
Organic Carbon	38.5	wt%		0.02		ASA29-3	12/14/07 12:51 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	12/14/07 16:47 / srm
METALS, WATER EXTRACTABLE							
Boron	5.6	mg/kg		0.1		SW6010B	12/14/07 04:01 / rlh
Selenium	ND	mg/kg		0.01		SW6020	12/13/07 18:25 / jjw
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg	D	8		SW6010B	12/13/07 00:43 / rlh
Barium	53	mg/kg		5		SW6010B	12/13/07 00:43 / rlh
Cadmium	ND	mg/kg		1		SW6010B	12/13/07 00:43 / rlh
Chromium	ND	mg/kg		5		SW6010B	12/13/07 00:43 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal
Project: Coal Hollow Project
Lab ID: B07120524-001
Client Sample ID: CH-01-05, Coal Grab Sample

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/07/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Copper	9	mg/kg		5		SW6010B	12/13/07 00:43 / rlh
Iron	8830	mg/kg		5		SW6010B	12/13/07 00:43 / rlh
Lead	ND	mg/kg		5		SW6010B	12/13/07 00:43 / rlh
Manganese	47	mg/kg		5		SW6010B	12/13/07 00:43 / rlh
Mercury	ND	mg/kg		1		SW7471A	12/13/07 09:10 / jjw
Molybdenum	ND	mg/kg		5		SW6010B	12/13/07 00:43 / rlh
Selenium	ND	mg/kg	D	8		SW6010B	12/13/07 00:43 / rlh
Silver	ND	mg/kg		5		SW6010B	12/13/07 00:43 / rlh
Zinc	17	mg/kg		5		SW6010B	12/13/07 00:43 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development LLC/Talon Resources
Project: Coal Hollow Project
Lab ID: B07121124-001
Client Sample ID CH-03-05 Composite Coal

Report Date: 01/04/08
Collection Date: Not Provided
DateReceived: 12/14/07
Matrix: Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	89	%		1		ASA15-5	12/21/07 11:43 / srm
Silt	10	%		1		ASA15-5	12/21/07 11:43 / srm
Clay	1	%		1		ASA15-5	12/21/07 11:43 / srm
Very Fine Sand	3	wt%		1		ASA15-5	12/21/07 11:43 / srm
Texture	S					ASA15-5	12/21/07 11:43 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	5.60	s.u.		0.10		ASAM10-3.2	12/21/07 11:43 / srm
Conductivity, sat. paste	2.50	mmhos/cm		0.01		ASA10-3	12/21/07 11:43 / srm
Saturation	79.3	%		0.1		USDA27a	12/21/07 11:43 / srm
Calcium, sat. paste	12.5	meq/L		0.05		SW6010B	12/20/07 18:57 / rlh
Magnesium, sat. paste	10.6	meq/L		0.08		SW6010B	12/20/07 18:57 / rlh
Potassium, sat. paste	0.23	meq/L		0.03		SW6010B	12/20/07 18:57 / rlh
Sodium, sat. paste	9.73	meq/L		0.04		SW6010B	12/20/07 18:57 / rlh
Sodium Adsorption Ratio (SAR)	2.87	unitless		0.01		Calculation	12/21/07 11:43 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	17	t/kt		1.0		Sobek Modifie	12/20/07 00:00 / srm
Acid Potential	38	t/kt		1.0		Sobek Modifie	12/20/07 00:00 / srm
Acid/Base Potential	-22	t/kt				Sobek Modifie	12/20/07 00:00 / srm
Sulfur, Total	1.25	%		0.01		Sobek Modifie	12/20/07 00:00 / srm
Sulfur, Hot Water Extractable	0.02	%		0.01		Sobek Modifie	12/20/07 00:00 / srm
Sulfur, HCl Extractable	ND	%		0.01		Sobek Modifie	12/20/07 00:00 / srm
Sulfur, HNO3 Extractable	0.48	%		0.01		Sobek Modifie	12/20/07 00:00 / srm
Sulfur, Residual	0.74	%		0.01		Sobek Modifie	12/20/07 00:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	1.7	%		0.1		USDA23c	12/20/07 00:00 / srm
Organic Carbon	43.0	wt%		0.02		ASA29-3	12/21/07 09:16 / srm
Nitrate as N, KCL Extract	1	mg/kg		1		ASA33-8.1	12/21/07 15:59 / srm
METALS, WATER EXTRACTABLE							
Boron	14.1	mg/kg		0.1		SW6010B	12/21/07 00:38 / rlh
Selenium	ND	mg/kg		0.01		SW6020	12/21/07 03:38 / sam
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6020	12/24/07 13:05 / sam
Barium	58	mg/kg		5		SW6010B	12/20/07 21:58 / rlh
Cadmium	ND	mg/kg		1		SW6020	12/24/07 13:05 / sam
Chromium	ND	mg/kg		5		SW6010B	12/20/07 21:58 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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800-735-4489 • 406-252-6325 • 406-252-6069 fax • eli@energylab.com

LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development LLC/Talon Resources
Project: Coal Hollow Project
Lab ID: B07121124-001
Client Sample ID CH-03-05 Composite Coal

Report Date: 01/04/08
Collection Date: Not Provided
DateReceived: 12/14/07
Matrix: Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Copper	5	mg/kg		5		SW6020	12/24/07 13:05 / sam
Iron	2340	mg/kg		5		SW6010B	12/20/07 21:58 / rlh
Lead	ND	mg/kg		5		SW6020	12/24/07 13:05 / sam
Manganese	10	mg/kg		5		SW6010B	12/20/07 21:58 / rlh
Mercury	ND	mg/kg		1		SW7471A	12/20/07 14:30 / aje
Molybdenum	ND	mg/kg		5		SW6020	12/24/07 13:05 / sam
Selenium	0.7	mg/kg		0.1		SW6020	01/02/08 22:10 / aje
Silver	ND	mg/kg		5		SW6020	12/24/07 13:05 / sam
Zinc	6	mg/kg		5		SW6020	12/24/07 13:05 / sam

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120636-004
Client Sample ID: Robinson Creek Outcrop Coal

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/10/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	67	%		1		ASA15-5	12/17/07 11:49 / srm
Silt	26	%		1		ASA15-5	12/17/07 11:49 / srm
Clay	7	%		1		ASA15-5	12/17/07 11:49 / srm
Very Fine Sand	12	wt%		1		ASA15-5	12/17/07 13:38 / srm
Texture	SL					ASA15-5	12/17/07 11:49 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	7.10	s.u.		0.10		ASAM10-3.2	12/17/07 11:49 / srm
Conductivity, sat. paste	5.41	mmhos/cm		0.01		ASA10-3	12/17/07 11:49 / srm
Saturation	132	%		0.1		USDA27a	12/17/07 11:49 / srm
Calcium, sat. paste	11.8	meq/L		0.05		SW6010B	12/15/07 02:47 / rlh
Magnesium, sat. paste	34.9	meq/L		0.08		SW6010B	12/15/07 02:47 / rlh
Potassium, sat. paste	0.60	meq/L		0.03		SW6010B	12/15/07 02:47 / rlh
Sodium, sat. paste	27.3	meq/L		0.04		SW6010B	12/15/07 02:47 / rlh
Sodium Adsorption Ratio (SAR)	5.65	unitless		0.01		Calculation	12/17/07 11:49 / srm
ACID-BASE ACCOUNTING							
Neutralization Potential	44	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid Potential	9.4	t/kt		1.0		Sobek Modifie	12/14/07 12:00 / srm
Acid/Base Potential	34	t/kt				Sobek Modifie	12/14/07 12:00 / srm
Sulfur, Total	0.41	%		0.01		Sobek Modifie	12/14/07 12:00 / srm
Sulfur, Hot Water Extractable	0.11	%		0.01		Sobek Modifie	12/14/07 12:00 / srm
Sulfur, HCl Extractable	0.01	%		0.01		Sobek Modifie	12/14/07 12:00 / srm
Sulfur, HNO3 Extractable	0.02	%		0.01		Sobek Modifie	12/14/07 12:00 / srm
Sulfur, Residual	0.26	%		0.01		Sobek Modifie	12/14/07 12:00 / srm
- The acid base potential was calculated from non-sulfate sulfur.							
CHEMICAL CHARACTERISTICS							
Lime as CaCO3	4.4	%		0.1		USDA23c	12/14/07 12:00 / srm
Organic Carbon	45.2	wt%		0.02		ASA29-3	12/17/07 11:49 / srm
Nitrate as N, KCL Extract	5	mg/kg		1		ASA33-8.1	12/14/07 16:49 / srm
METALS, WATER EXTRACTABLE							
Boron	4.8	mg/kg		0.1		SW6010B	12/14/07 04:16 / rlh
Selenium	ND	mg/kg		0.1		SW6020	12/13/07 19:02 / jjw
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg	D	8		SW6010B	12/13/07 22:21 / rlh
Barium	37	mg/kg		5		SW6010B	12/13/07 22:21 / rlh
Cadmium	ND	mg/kg		1		SW6010B	12/13/07 22:21 / rlh
Chromium	ND	mg/kg		5		SW6010B	12/13/07 22:21 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Alton Coal Development, LLC
Project: Coal Hollow Project
Lab ID: B07120636-004
Client Sample ID: Robinson Creek Outcrop Coal

Report Date: 12/18/07
Collection Date: Not Provided
DateReceived: 12/10/07
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL - EPA SW846							
Copper	14	mg/kg		5		SW6010B	12/13/07 22:21 / rlh
Iron	6660	mg/kg		5		SW6010B	12/13/07 22:21 / rlh
Lead	ND	mg/kg		5		SW6010B	12/13/07 22:21 / rlh
Manganese	41	mg/kg		5		SW6010B	12/13/07 22:21 / rlh
Mercury	ND	mg/kg		1		SW7471A	12/13/07 15:54 / jjw
Molybdenum	ND	mg/kg		5		SW6010B	12/13/07 22:21 / rlh
Selenium	2.2	mg/kg		0.1		SW6020	12/17/07 14:32 / sas
Silver	ND	mg/kg		5		SW6010B	12/13/07 22:21 / rlh
Zinc	12	mg/kg		5		SW6010B	12/13/07 22:21 / rlh

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

Preliminary Radiation Assessment

By

Applied Geotechnical Engineering Consultants, Inc.

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

December 7, 2007

Alton Coal Development, LLC
463 N 100 W, Suite 1
Cedar City, Utah 84720

Attention: Chris R. McCourt, P.E.

Subject: Consultation
Coal Hollow Coal Project
Alton, Utah

Gentlemen:

Applied Geotechnical Engineering Consultants, Inc. was requested to perform an examination of the drilled cores and core cuttings from the Coal Hollow project located in Alton, Utah. Our examination was performed to provide an indication as to wether or not radioactivity was present in the samples.

Core and core cutting samples were delivered to our laboratory in Cedar City. The samples were contained in standard core sampling boxes or sample bags and were identified by drill hole number, box/bag number and depth. Drill hole and box numbers and/or depths were as follows;

Drill hole CH-02-05 boxes 1-5 and 7-8
Drill hole CH-01-05 boxes 2-3
Drill hole CH-05-05 boxes 2-5, 7-11 and 13
Drill hole CH-06-05 boxes 1-2 and 4
Drill hole CH-03-05 box 2 (coal)
Drill hole CH-8 (0' to 103')
Drill hole CH-7 (0' to 46")

An examination was conducted by scanning each group of samples using a Radiation Alert MC1K radiation monitor. Each box/bag of samples was scanned for several seconds with the box lids off or the bag open.

During our examination no radiation was indicated by the monitor used.

The Radiation monitor was calibrated on 31 May, 2007 and was used in accordance with the manufacturers recommendations.

If you have any questions or if we can be of further service, please call.

Sincerely,

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

Mike Shurtz
MS/msC:\Documents and Settings\Mikes\My Documents\coal hollow letter letterhead.wpd

429 North 2150 West • Cedar City, Utah 84721 • (435) 586-8387 • FAX (435) 586-8582

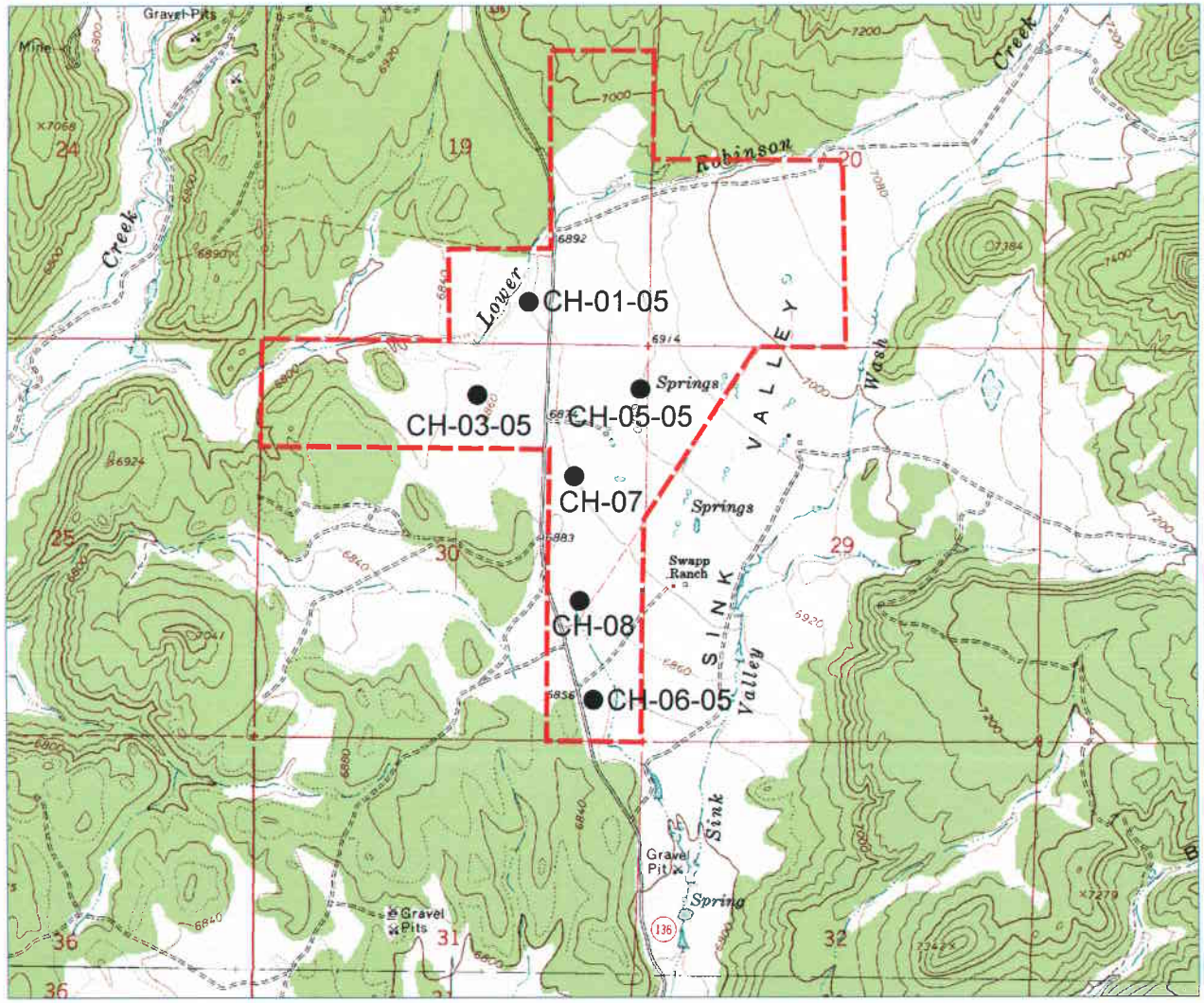
Appendix 6-4, Geologic Logs

Add to Chapter 6 Appendices

Updated with 2007 drilling information. New geologic logs for CH-07 and CH-08.

112° 28' 45.517" W
37° 24' 36.220" N

112° 25' 29.180" W
37° 24' 38.632" N



37° 22' 25.703" N
112° 28' 42.952" W

37° 22' 28.112" N
112° 25' 26.710" W

1/23/08

0 ¼ ½ 1 Mile

0 1000 2000 3000 5000 Feet

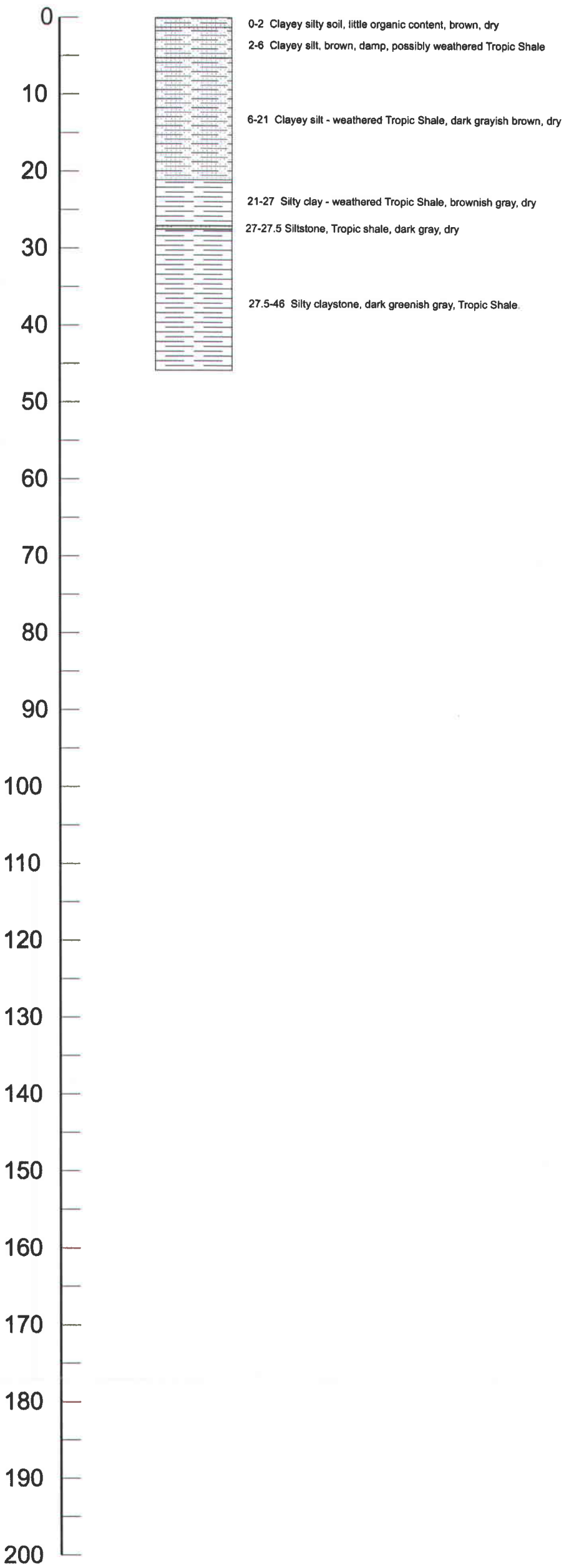
0 0.5 1 Kilometer

1927 North American Datum; UTM grid zone 12
Generated by BigTopo7 (www.igage.com)
Map compiled from USGS Quads: Alton; UT
Bald Knoll; UT

UTM Grid and 2006 Magnetic North
Declination at Center of Sheet
GN to TN 0.882° (16 mills)
TN to MN 12.973° (231 mills)

Locations of boreholes

CH-07



Project: Alton Coal Development, LLC
Borehole: CH-07
Location (UTM, NAD 27) Northing: 4139552
Easting: 371358
Ground elevation: 6881.4
Date Drilled: 30 November 2007
Geologist: Erik Petersen, P. G.
Drilling Company: Geotechnical Drilling Services
St. George, Utah

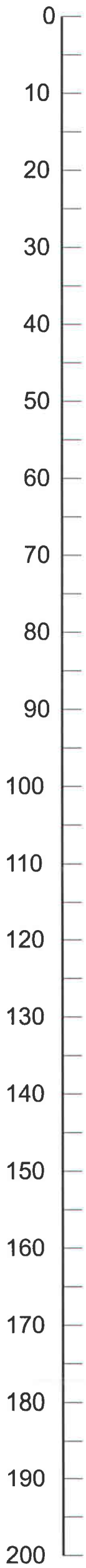
Drilling Method: Auger (0-33 feet)
Air-rotary (33-46 feet)

1/23/08

Erik C. Petersen, P.G.
Utah PG #5373615-2250

PETERSEN HYDROLOGIC, LLC
CONSULTANTS IN HYDROGEOLOGY

CH-08



0-6 Clayey silt with fine-grained sand, brown, dry

6-11 Silty fine-grained sand, yellowish brown, wet

11-12 Clayey silt, dark grayish brown, wet
12-14 Silty, clayey, very-fine-grained sand, yellowish brown, wet

14-17 Clayey silt, little very-fine-grained sand, grayish brown, wet

17-18 Fine- and medium-grained sand with silt, gray, wet
18-20 Clayey silt, two 3-inch thick sandy zones, gray and brown, wet

20-28 Silty clay, minor fine-grained sand, hard, bluish gray and greenish gray, wet

28-40 Silty clay, minor fine-grained sand, yellowish brown, wet

40-55 Tropic Shale, silty claystone, brownish gray, wet

55-60 Tropic Shale, claystone, gray/greenish gray, wet

60-65 Tropic Shale, silty claystone, gray, wet

65-73 Tropic Shale, claystone, greenish gray, dry

73-79.2 Tropic Shale, silty claystone, dark gray, dry

79.2-82.3 Tropic Shale, clayey siltstone, medium to dark gray, dry
82.3-83.8 Tropic Shale, organic-rich siltstone/very-fine-grained sandstone, gray, dry

83.8-101 Coal, bituminous, black

101-103 Dakota Formation, silty claystone/siltstone, gray

Project: Alton Coal Development, LLC
Borehole: CH-08
Location (UTM, NAD 27) Northing:4139015
Easting: 371348
Ground elevation: 6860.20
Date Drilled: 27-29 November 2007
Geologist: Erik Petersen, P. G.
Drilling Company: Geotechnical Drilling Services
St. George, Utah

Drilling Method: Auger (0-73 feet)
Continuous NQ core (73-84 feet)
Air-rotary (84-103 feet)

1/23/08

Erik C. Petersen, P.G.
Utah PG #5373615-2250

PETERSEN HYDROLOGIC, LLC
CONSULTANTS IN HYDROGEOLOGY

Drilling Log

Drillhole ID: CH-7 Project: Coal Hollow (ACD) Page 1 of 2

Date drilled: Nov 30, 2007 Drilling method: Auger / Air-rotary

Logged by: Erik Petersen Location: Northing 4139552, Easting 371358, UTM NAD 27
Elevation 6881.4

From	To	Lithologic description	Color	Wetness
		Auger drilling:		
0	2	clayey silty soil, little organic content	brown + reddish brown	dry
2	6	clayey silt	brown + reddish brown	damp
6	9	clayey silt / weathered Tropic Shale	medium brown	dry
9	15	clayey silt, hard drilling / weathered Tropic shale	brownish gray	dry
15	19	clayey silt / weathered Tropic shale	brownish gray	dry
19	21	clayey silt / silty clay / weathered Tropic shale	dark brownish gray	dry
21	23	silty clay / weathered Tropic Shale	dark gray / greenish gray	dry / moist
23	25	silty clay / weathered Tropic Shale	dark gray / greenish gray	dry
25	27	Silty clay / weathered Tropic Shale	dark gray	dry
27	27.5	Tropic Shale, siltstone	gray, dark	dry
27.5	29	Tropic Shale, silty claystone	dark greenish gray	dry
29	33	Tropic Shale, silty claystone	dark greenish gray	moist
		Auger binding up in the hole, switched to air-rotary		

Drilling Log

Drillhole ID: CH-7 Project: Coal Hollow (ACD) Page 2 of 2

Date drilled: Nov 30, 2007 Drilling method: Auger / Air-rotary

Logged by: Erik Petersen Location:

From	To	Lithologic description	Color	Wetness
33	36	Tropic Shale, silty claystone	dark greenish gray	dry
36	46	Tropic Shale, silty claystone, increased silt content	dark greenish gray	dry

Drilling Log

Drillhole ID: CH-8 Project: Coal Hollow (ACD) Page 1 of 3

Date drilled: Nov 27-29, 2007 Drilling method: Auger / Air-rotary / core

Logged by: Erik Petersen Location: Northing 4139015, Easting 371348, UTM NAD 27
Elevation 6860.20

From	To	Lithologic description	Color	Wetness
		Auger drilling, split spoon sampling		
0	2	Clayey silt with very-fine-grained sand	medium-brown	dry
2	4	Clayey silt, minor fine-grained sand	medium reddish brown	dry
4	6	Clayey silt, minor fine-grained sand	medium reddish brown	slightly moist
6	8	silty very-fine-grained sand, soft	yellowish and reddish brown	wet
		saturated at about 5 feet		
8	10	Silty fine-grained sand – Encountered a rock/boulder at appx 9 feet.	brownish, yellowish gray	wet
10	11	Silty fine-grained sand	medium yellowish brown	wet
11	12	Clayey silt, plastic	dark grayish brown	wet
12	14	Silty clayey v fine-grained sand	medium yellowish grayish brown	wet
14	16	clayey silt, little very-fine-grained sand	medium grayish brown	drier than above
16	17	clayey silt, little very-fine-grained sand	medium grayish brown	wet
17	18	fine- and medium-grained sand with silt	gray	wet

Drilling Log

Drillhole ID: CH-8 Project: Coal Hollow Page 2 of 3

Date drilled: Nov 27-29, 2007 Drilling method: Auger/Air-rotary/Core

Logged by: Erik Petersen Location:

From	To	Lithologic description	Color	Wetness
18	20	clayey silt, two 3-inch sandy zones	gray + brown	wet
20	22	silty clay, minor fine-grained sand	bluish gray and greenish gray	moist
22	24	silty clay, hard and dense	bluish gray and greenish gray	moist
24	26	silty clay, hard and dense	bluish gray and greenish gray	moist
26	28	silty clay, very hard and dense	bluish gray and greenish gray	moist
		Switched to air-rotary drilling, couldn't establish cutting circulation with the moist clay		
		Resumed auger drilling, logged and sampled from auger cutting returns		
28	30	silty clay, minor fine-grained sand	yellowish brown	wet
30	40	silty clay, minor fine-grained sand	yellowish brown	drier than above
40	55	Tropic Shale, silty claystone	brownish gray	wet
55	60	Tropic Shale, claystone	gray, greenish gray	

Drilling Log

Drillhole ID: CH-8 Project: Coal Hollow

Date drilled: Nov 27-29, 2007 Drilling method: Auger / Air-rotary / Core

Logged by: Erik Petersen Location:

From	To	Lithologic description	Color	Wetness
60	65	Tropic Shale, silty claystone	gray	wet
65	67	Tropic Shale, claystone	gray	wet
67	73	Tropic Shale, claystone	greenish gray	wet
		Started core drilling - poor recovery 18" of 5 feet core barrel.		
73	79.2	Tropic Shale, silty claystone / shale	dark gray	dry
79.2	81.6	Tropic shale, clayey siltstone, harder than below	medium gray	dry
81.6	82.3	Tropic Shale, hard, clayey siltstone	dark gray to black	dry
82.3	83.8	Tropic Shale, organic-rich siltstone / very-fine-grained Sandstone	medium to dark gray	dry
83.8	101	Coal, Smirl coal zone (increased water)	black	dry
101	103	Dakota Formation, silty claystone / siltstone	gray	
		Note: Switched from core drilling to air-rotary within the coal seam because the cored coal would not stay in the core barrel. Samples in this interval were collected from air-rotary cutting returns.		

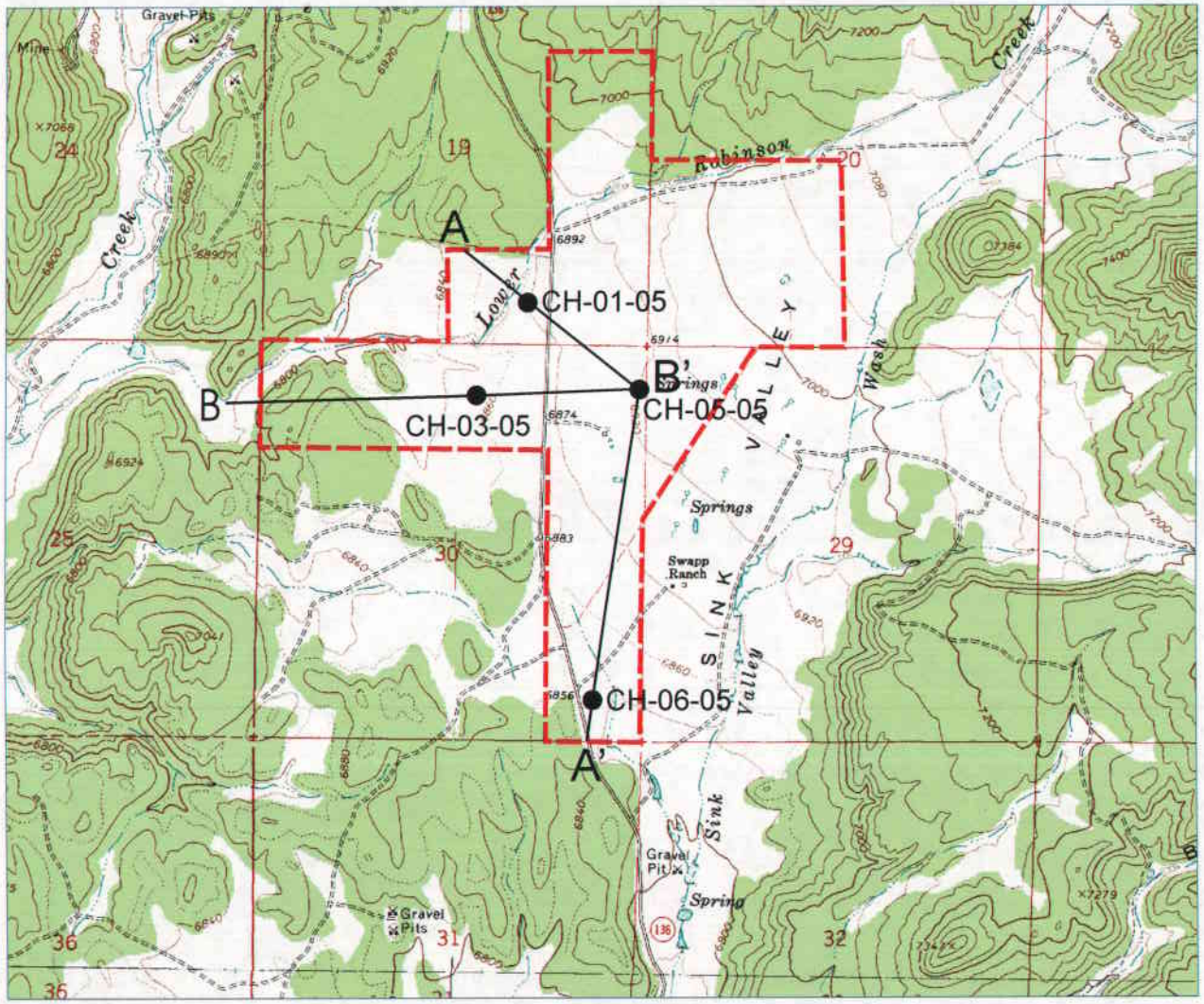
Drawings 6-6, Geologic Cross Sections Location Map

Add to Chapter 6 Drawings

Drawing was not included in MRP submittal.

112° 28' 45.517" W
37° 24' 36.220" N

112° 25' 29.180" W
37° 24' 38.632" N



37° 22' 25.703" N
112° 28' 42.952" W

37° 22' 28.112" N
112° 25' 26.710" W

1/23/08

1927 North American Datum; UTM grid zone 12
Generated by BigTopo7 (www.igage.com)
Map compiled from USGS Quads: Alton; UT
Bald Knoll; UT

UTM Grid and 2008 Magnetic North Declination at Center of Sheet
GN to TN 0.882° (16 mils)
TN to MN 12.973° (231 mils)

0 ¼ ½ 1 Mile

0 1000 2000 3000 5000 Feet

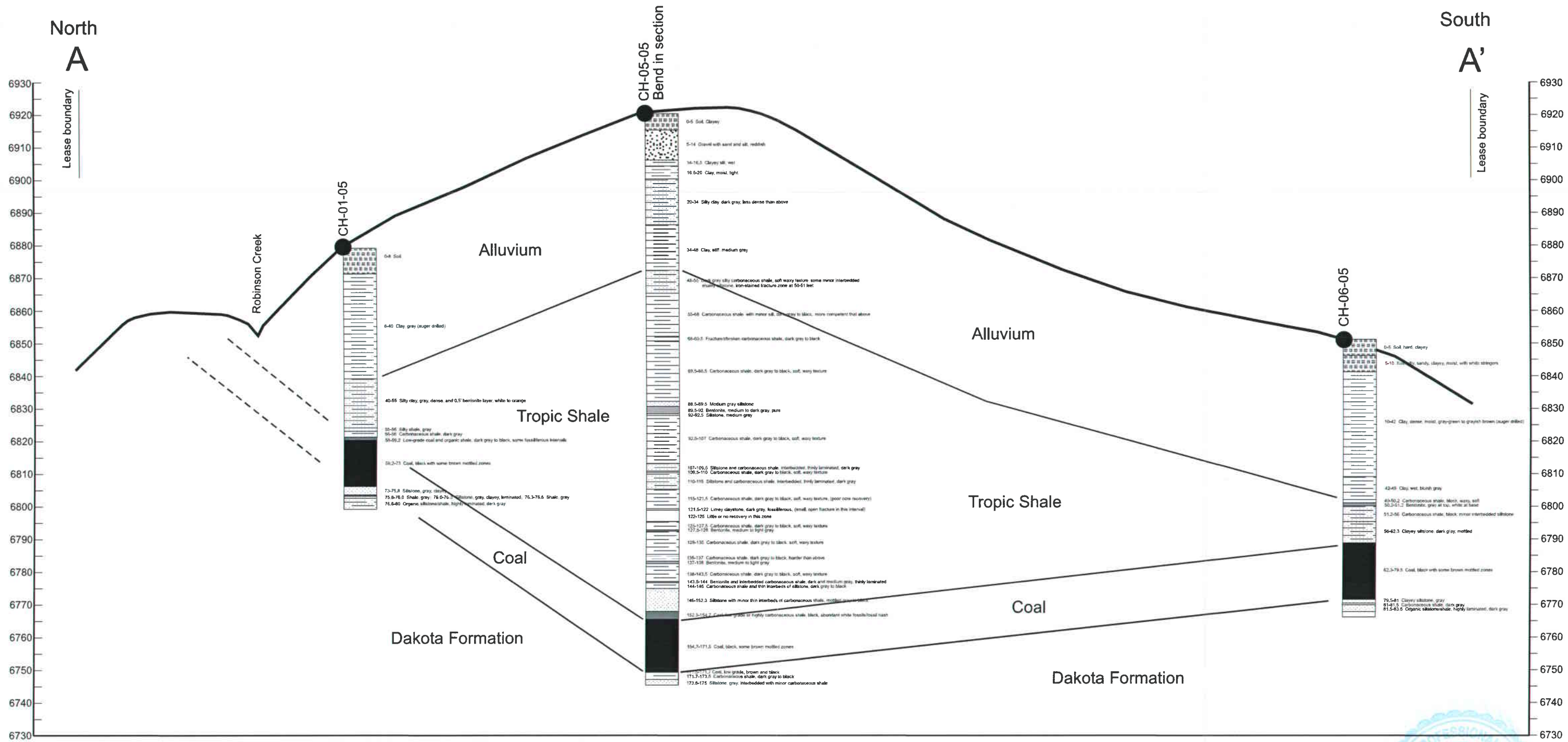
0 0.5 1 Kilometer

Drawing 6-6
Location map for
Coal Hollow Project
cross-sections

Drawings 6-7 and 6-8, Geologic Cross Sections

Replaces Drawings 6-7 and 6-8

Corrections made to vertical scales on cross sections.

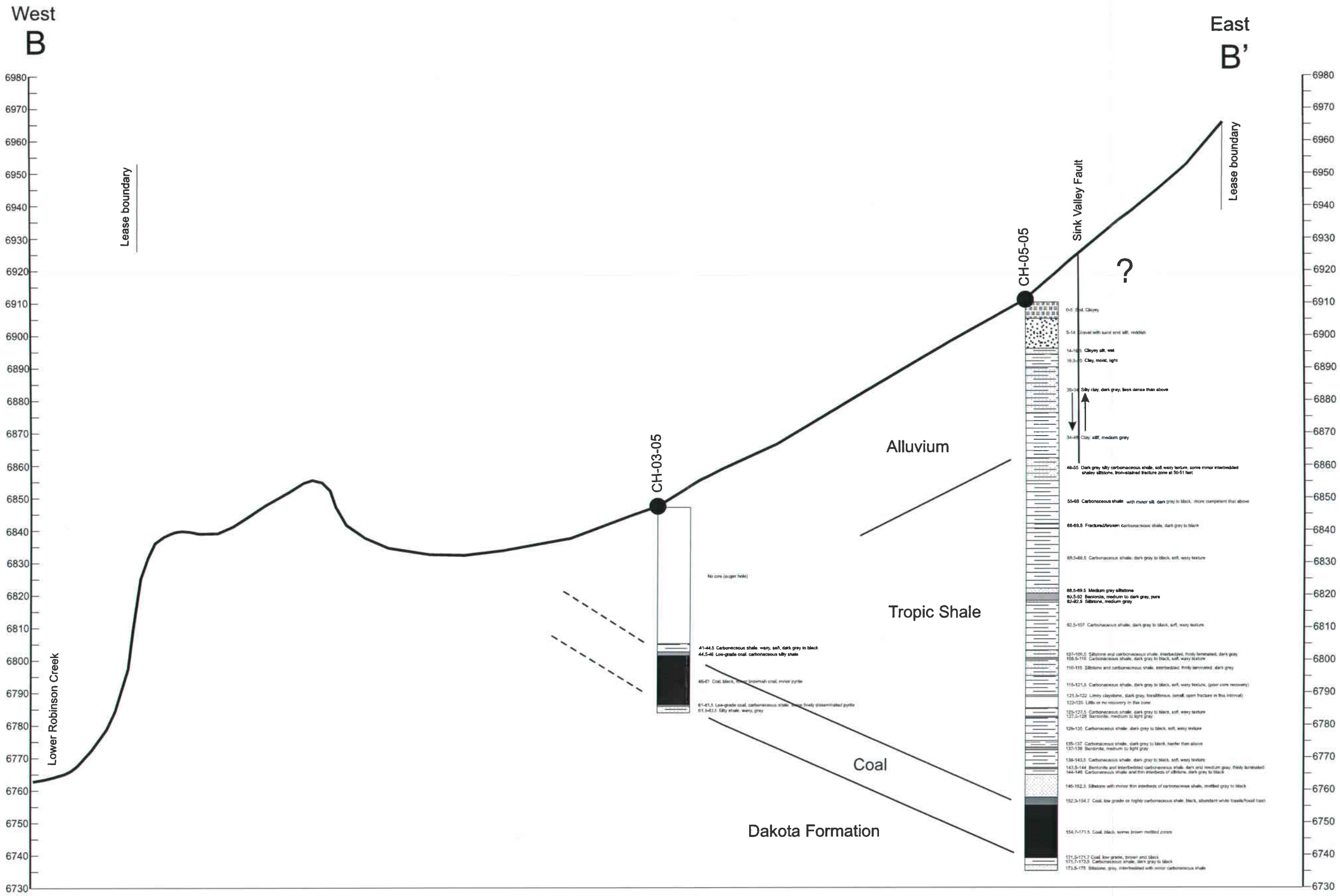


1,000 feet

19X vertical exaggeration

1/23/08

Drawing 6-7
Coal Hollow Project
Cross-section A-A'
(See Drawing 6-6 for location)



1,000 feet

19X vertical exaggeration

Drawing 6-8
Coal Hollow Project
Cross-section B-B'
(See Drawing 6-6 for location)

Chapter 7, Sections 733 through 765

Replaces Pages 7-49 through 7-81

Text has been updated in these sections to include details for impoundments, diversions, discharge structures and road drainage. Disposal of noncoal waste text is modified to clarify that final disposal of such waste will not take place within the permit boundary.

Chapter 5 appendices referred to in this section have been certified and are located in Chapter 5 of this modification.

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 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.

Four 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:

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	6.7	7.7	115	1.0
4	5.7	7.5	132	1.8

Structure 1 is a rectangular impoundment approximately 136 feet long by 81 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 6909' and 6918', respectively. The top of the embankment is at elevation 6922'. Details for the design can be viewed on Drawing 5-28.

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 6889' and 6898', respectively. Top of the embankment is at elevation 6901'. 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. The spillway will be an open channel that will have vegetated slopes. This pond will control storm water runoff from a watershed of approximately 300 acres. The cleanout and spillway elevation are 6802' 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 92 feet wide by 628 feet long and 11 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 vegetated slopes. This pond will control storm water runoff from a watershed of approximately 256 acres. The cleanout and spillway elevation are 6823' 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.

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. Detailed designs and calculations are provided in this section, Drawings 5-26 through 5-32 and Appendix 5-2. No other impoundments are anticipated.

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 four 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 1.7 for each structure. The details for this analysis can be viewed in Appendix 5-1.

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 be vegetated to minimize erosion and spillway slopes will not exceed 3h:1v. Drawing 5-32 provides the details for the open channel spillways.

Impoundments 1 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.

735 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 1.7 to 1.8 based on the proposed design. Following proper construction practices of building the structure in maximum

four foot lifts and meeting 90% 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 1.7 to 1.8 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 90% 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.

736 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.

737 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 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. 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.

Four 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:

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	6.7	7.7	115	1.0
4	5.7	7.5	132	1.8

Structure 1 is a rectangular impoundment approximately 136 feet long by 81 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 6909' and 6918', respectively. The top of the embankment is at elevation 6922'. Details for the design can be viewed on Drawing 5-28.

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 6889' and 6898', respectively. Top of the embankment is at elevation 6901'. 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. The spillway will be an open channel that will have vegetated slopes. This pond will control storm water runoff from a watershed of approximately 300 acres. The cleanout and spillway elevation are 6802' 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 92 feet wide by 628 feet long and 11 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 vegetated slopes. This pond will control storm water runoff from a watershed of approximately 256 acres. The cleanout and spillway elevation are 6823' 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.

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 which 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 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:

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	1.1	20.6	0.6	5.0	0.3

*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.

742.200 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 5-3. Details associated with these structures can be viewed on Drawings 5-25 through 5-34 and Appendix 5-2.

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.

742.220 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 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:

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	6.7	7.7	115	1.0
4	5.7	7.5	132	1.8

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. Stage-Storage curves for each pond can be viewed on Drawings 5-28 through 5-31.

742.221.32 The sedimentation ponds 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. 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.

742.221.33 The sedimentation ponds 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 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 be vegetated to minimize erosion and spillway slopes will not exceed 3h:1v. Drawing 5-32 provides the details for the open channel spillways.

Impoundments 1 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.

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 do not meet the size or other qualifying standard for MSHA, 30 CFR 77.216(a).

742.223 Each sedimentation pond 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

The drop pipe spillways for impoundments 1 and 2 will be of nonerodible construction. The open channel spillways for impoundments 3 and 4 will be grass lined and are designed to carry short-term, infrequent flows at non erosive velocities where sustained flows are not expected.

742.224 Either the requirements of 742.223.1 or 742.223.2 will be met for each sediment impoundment.

742.225 Not Applicable

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 prevent 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 diversions are planned and one permanent diversion. Two diversions will be primarily used to route water from upland, undisturbed areas away from the planned disturbed areas. Two diversions are planned to direct water from disturbed areas into sediment impoundments. The permanent diversion is to reroute Lower Robinson Creek 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. 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 Each diversion 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:

Temporary 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	1.1	20.6	0.6	5.0	0.3

*All side slopes are 2h:1v

As shown in the above table, 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.

Based on the size of the watershed for Lower Robinson Creek, a different method of analysis was used than the method used for the temporary 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 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 permanent diversion will be constructed in a responsible manner. The original conditions of this intermittent stream channel are not desirable since excessive erosion has occurred and the channel is not currently in a stable condition. The permanent diversion will provide improved conditions such as a flatter flow grade, rip rap to minimize erosion, stable slope angles and vegetated slopes. 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.

742.320 Diversion of Perennial and Intermittent Streams.

742.321 Permanent diversion of one intermittent stream is planned for the Coal Hollow Project. The planned diversion is in a length of the stream that only experiences flows 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 into a layer of alluvium 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 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 and approved by the Utah Division of Water Rights (DWR), Permit Number 07-85-02SA. This approval by the DWR constitutes compliance with Section 404(e) of the Clean Water Act (33 USC 1344) pursuant to General Permit 040 issued to the State of Utah by the U.S. Army Corps of Engineers. This Stream Channel Alteration Permit was issued June 26, 2007 to Alton Coal Development, LLC.

742.330 Diversion of Miscellaneous Flows.

742.331 Diversion of miscellaneous flows 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. Two diversions are planned to direct runoff from disturbed areas into sediment impoundments. 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.

742.333 Each diversion 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:

Temporary 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	1.1	20.6	0.6	5.0	0.3

*All side slopes are 2h:1v

As shown in the above table, 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.

742.333 All four miscellaneous flow diversions planned for the project 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.

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. 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 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, 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 Primary 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 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.

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 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. 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.

742.412 No roads will be located in the channel of an intermittent or perennial stream.

742.413 Primary roads 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 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 5-21. 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 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, 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 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 appropriately sized for a 100 year, 6 hour event.

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 the Primary 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) 6 foot berms placed as necessary along fills
8) Runoff from roads will be directed to sediment impoundments

The location and details for roads can be viewed on Drawings 5-3 and 5-22 through 5-24. Drainage flow paths for the primary roads can be viewed on Drawing 5-22.

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. 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 and approved by the Utah Division of Water Rights (DWR), Permit Number 07-85-02SA. This approval by the DWR constitutes compliance with Section 404(e) of the Clean Water Act (33 USC 1344) pursuant to General Permit 040 issued to the State of Utah by the U.S. Army Corps of Engineers. This Stream Channel Alteration Permit was issued June 26, 2007 to Alton Coal Development, LLC.

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.

743 IMPOUNDMENTS

743.100 General Requirements

Four temporary impoundments are planned at the Coal Hollow Project. Design for these structures are shown in Drawings 5-28 through 5-32. 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. The certifications, drawings and cross sections can be viewed in Drawings 5-25 through 5-31 and Appendices 5-1 and 5-2.

Each impoundment is designed with a minimum freeboard of 3 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

The drop pipe spillways for impoundments 1 and 2 will be of nonerodible construction. The open channel spillways for impoundments 3 and 4 will be grass 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 be vegetated to minimize erosion and spillway slopes will not exceed 3h:1v. Drawing 5-32 provides the details for the open channel spillways.

Impoundments 1 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.

The drop pipe spillways for impoundments 1 and 2 will be of nonerodible construction. The open channel spillways for impoundments 3 and 4 will be grass lined 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.

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 1.7 to 1.8 based on the proposed design. Following proper construction practices of building the structure in maximum four foot lifts and meeting 90% 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 1.7 to 1.8 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 90% 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.

Not applicable

746.300. Impounding structures.

Not applicable

746.330. Drainage control.

Not applicable.

746.400. Return of Coal Processing Waste to Abandoned Underground Workings.

Not applicable

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.

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.

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.

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. All primary roads will be reclaimed to approximate original contour. Cuts and fills for the 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. 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.

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. 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. The final contour for this area can be viewed on Drawing 5-35.

The reclamation sequence and final landform can be viewed on Drawings 5-35 and 5-38.

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.

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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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Chapter 7 Table of Contents, Update

Replaces Table of Contents in Chapter 7

Table of Contents are updated to reflect changes in text, drawings and appendices.

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Chapter 7, Baseline Water Monitoring Table Reference

Replaces Page 7-44, Chapter 7

Text updated to reference baseline water monitoring tables.

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.

731.200 Water Monitoring

This section describes the hydrologic monitoring plan. 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 and baseline field and laboratory hydrologic monitoring parameters for surface water are listed in Table 7-6A and 7-6B, and for groundwater in Table 7-7A and 7-7B, respectively. The hydrologic monitoring parameters have been selected in consultation with the Division's directive Tech-004, *Water Monitoring Programs for Coal Mines.*

The groundwater and surface-water monitoring plan is extensive and includes 54 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.

Chapter 7 – Ponds, Ditches and Subirrigated/Flood Irrigated Land

Replaces Drawing 7-7

Drawing updated to include subirrigated and historical flood irrigated lands.

Chapter 7, Water Monitoring Parameter Lists

New Tables 6a, 6b replace Table 6
New Tables 7a, 7b replace Table 7

Added baseline parameter lists to tables.

Table 7-6A Surface water operational water quality monitoring

FIELD MEASUREMENTS	REPORTED AS
pH	pH units
Specific Conductivity	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 Conductivity	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
Phosphate (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 water quality monitoring.

FIELD MEASUREMENTS	REPORTED AS
pH	pH units
Specific Conductivity	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 Conductivity	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
Phosphate (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	%

Chapter 7, Alluvial Valley Floor Supplemental Information

Add to Chapter 7 Appendices

Appendix is added to address alluvial valley floor 645-302 regulations.

Supplemental Information for Utah Division of Oil, Gas and Mining Alluvial Valley Floor Finding for the Proposed Coal Hollow Mine

15 January 2008

Alton Coal Development, LLC
Cedar City, Utah

PETERSEN HYDROLOGIC, LLC
CONSULTANTS IN HYDROGEOLOGY

Supplemental Information for Utah Division of Oil, Gas and Mining Alluvial Valley Floor Finding for the Proposed Coal Hollow Mine

15 January 2008

Alton Coal Development, LLC
Cedar City, Utah

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Supplemental Information for
Utah Division of Oil, Gas and Mining
Alluvial Valley Floor Finding for the
Proposed Coal Hollow Mine

1.0 Introduction

Alton Coal Development, LLC has made an application for a Utah State coal mining permit from the Utah Division of Oil, Gas and Mining (Division) to mine coal at the proposed Coal Hollow Mine permit area. The proposed Coal Hollow Mine permit area is located on private lands in the Alton Coal Field of south-central Utah, approximately three miles south of the town of Alton, Utah (Figure 1).

In its 27 August 2007 Administrative Completeness Review, the Division requested more information from Alton Coal Development, LLC to make an alluvial valley floor finding. The purpose of this document is to provide the additional information requested by the Division.

This document is organized according to the R645 Rules cited by the Division as the basis for the information request. The information requested by the Division is presented in the following sections of this document.

2.0 R645-302-321.210

2.1 Alluvial sediment deposition

Sink Valley is an upland area located at approximately 7,000 feet elevation, situated at the base of the precipitous Paunsaugunt Plateau escarpment. In such geomorphologic settings, alluvial fan deposition in the arid western United States is common. The alluvial fan system in Sink Valley consists of a series of coalesced fans derived from sediments shed from the adjacent highland regions on the Paunsaugunt Plateau. Sediment deposition processes in the alluvial fan system are likely dominated by sheet floods, mudflows, and debris flows. The sediments near the distal portions of the fan complex in Sink Valley (as observed in drill holes, surface outcrops, and soils pits within the Coal Hollow Project area) are dominated by fine-grained materials including silts, clays, and fine-grained sands (see Chapters 6 and 7, Coal Hollow Project MRP). Coarser sediments are observed in surface exposures nearer the apex of the alluvial fans along the base of the precipitous Paunsaugunt Plateau escarpment. Coarse-grained sediments, including boulders, gravels, and coarse-grained sands, which would be more typical of stream-laid deposits, were almost entirely absent in at least the upper 50 feet of alluvium drilled in Sink Valley in and around the proposed Coal Hollow Project area.

As stated in the OSM alluvial valley floor identification and study guidelines (1983), the SMCRA definition of an alluvial valley floor "does not include upland areas which are generally overlain by a thin veneer of colluvial deposits composed chiefly of debris from sheet erosion, deposits formed by unconcentrated runoff or slope wash, together with talus, or other mass-movement accumulations and windblown deposits" (OSM, page II-5). Further, an alluvial valley floor is defined by the existence of flood plains and terraces underlain by unconsolidated stream-laid deposits (page II-11). Included in the AVF definition are only those areas characterized as being "within that valley, those surface landforms that are either

flood plains or terraces if these landforms are underlain by unconsolidated deposits...Alluvial valley floors are not merely those valleys filled with alluvium".

2.2 Lack of continuous stream channel

The locations of existing stream channels in the Coal Hollow Project and adjacent area are plotted on an infrared aerial photograph in Plate 1. Spring discharges are also plotted on Plate 1. It is apparent in this plate, and based on field investigations, that although there are many discontinuous drainage segments in the area, there is no continuous stream channel through Sink Valley. The lack of a continuous stream channel in Sink Valley is likely largely attributable to the manner of sediment deposition in the valley (i.e. mudflows, debris flows, and sheet floods). It should be noted that the various historical activities of landowners in the valley may have influenced surface drainage patterns to some extent. However, it seems likely that prior to the settlement and agricultural development of the valley by humans, conditions in the valley similar to those currently present likely prevailed as a result of the fan depositional regime.

It should also be noted that the greater Sink Valley Wash and Kanab Creek drainages appear to currently be in unstable condition. Significant down-cutting of stream channels is currently occurring throughout large portions of these drainages. The Lower Robinson Creek drainage is deeply incised throughout the extent of the proposed Coal Hollow Project permit area. In several locations in the project area, the Lower Robinson Creek stream bed has been incised several tens of feet below the surrounding topography. Based on recent observations, it is apparent that stream channel down-cutting and erosion/collapse of the steep arroyo walls adjacent to Lower Robinson Creek is actively ongoing at present. As shown on Plate 1, the unstable, incised stream channel in the Lower Robinson Creek drainage (located north of Sink Valley) is continuous through the northern portion of the project.

It is also evident that active head-cutting in the Sink Valley Wash drainage is currently occurring near the southern extent of Sink Valley in the northwest corner of Section 32, T39S, R5W, near Alluvial Groundwater Discharge Area B (see Appendix 7-1 in Chapter 7 of Coal Hollow Project MRP). As the drainage channels become increasingly incised and migrate northward further into Sink Valley, water levels in alluvial groundwaters adjacent to these drainages channels will likely decline (i.e. the incised drainages will act as drains).

2.3 USGS 7.5 minute topographic maps

On the 7.5 minute Alton, Utah USGS topographic map, a continuous stream channel is shown for Sink Valley Wash from its headwaters area to the southern extents of Sink Valley. However, field surveys of stream drainages in Sink Valley indicate that the stream channels are ***not*** continuous through the valley, but rather exist as a series of discontinuous drainage segments. It is not uncommon for inaccuracies of this sort to exist on USGS topographic maps, as these maps are commonly constructed using large-scale aerial photographs and photogrammetric mapping techniques. Ground truthing of all mapped features is not routinely performed. In the absence of ground truthing of the stream drainages in Sink Valley and adjacent areas, it is not unexpected that the delineation of continuous stream channels in Sink Valley has been incorrectly delineated on the topographic map. Field investigations in the Lower Robinson Creek drainage indicate that this drainage is continuous through the Coal Hollow Project and adjacent area.

2.4 Flood plains and terraces

No flood plains or stream terrace deposits have been identified by studies in the Coal Hollow Project area. Consequently, a map showing the locations of flood plains and terraces in the project area has not been prepared. A drawing showing surface drainage patterns, including the flow from springs is provided as Plate 1.

As shown on the USGS 7.5 minute Alton, Utah quadrangle topographic map, the surface morphology of Sink Valley is moderately convex in cross-fan section and consists of several lobes formed by sediment deposition derived from several different drainages. A drawing showing examples of valley cross-sections showing some possible relations in valley alluvium (with terracing) is shown in Figure 2. The surface morphology in Sink Valley is typical of an alluvial fan system. In contrast, a flood plain is, by definition, a planar feature. "Stream terraces are flat surfaces along the valley sides of stream courses marking the level of former valleys. They are vestiges of former flood plains formed by streams which were higher in elevation than the present stream" (OSM, 1983). No such stream terraces are observed in Sink Valley. The lack of a characteristic flood plain, the convex cross-fan surface topography, and the lack of a continuous stream channel through Sink Valley, are all inconsistent with both the scientific and the regulatory definitions of an alluvial valley floor.

2.5 Surface water drainages

A map showing the extent and details for all watersheds that can contribute runoff to the Coal Hollow Project and adjacent area is presented in Plate 2.

2.6 Alluvial groundwater systems potentiometric information

A map showing potentiometric levels in alluvial groundwater systems in the Coal Hollow Project and adjacent area has been previously provided as Drawing 7-13 in Chapter 7 of the Coal Hollow Project MRP. This map was created using the elevations of springs and Alluvial Groundwater Discharge Areas A and B and the elevations of waters encountered in the Sink Valley Wash stream channel. Additional information on alluvial groundwater systems, including the approximate directions of shallow groundwater flow has been provided as Figure 21 in Appendix 7-1 to Chapter 7 of the Coal Hollow Project MRP. Long-

term seasonal variability in water levels in alluvial groundwater systems in the project area is documented with historic monitoring data at alluvial monitoring wells and springs in Appendix 7-1 of Chapter 7 of the Coal Hollow Project MRP and in baseline water monitoring data submitted to the Utah Division of Oil, Gas and Mining on-line hydrology database (UDOGM, 2008). Information on depth below the ground surface of potentiometric levels measured in existing and newly constructed alluvial monitoring wells in and around the Coal Hollow Project area during 2007 is presented in Table 1. These data are plotted in a series of hydrographs in Figure 3. It should be noted that the water levels measured in the piezometers are representative of the potentiometric pressure in the piezometer screened intervals. Where confined groundwater conditions exist in the alluvial groundwater system, the water levels measured in the piezometers are generally not the same as the depth at which groundwater would first be encountered in an excavated hole (or the depth at which a plant's roots may encounter water). For example, the shut-in potentiometric head measured at well Y-61 is several feet above the ground surface at the well site. However, an excavated hole near the well may not encounter groundwater in the shallow subsurface, due to groundwater confinement by low-permeability strata overlying the strata with artesian pressure.

To facilitate the evaluation of climatic effects on potentiometric levels in the alluvial groundwater systems, an updated plot of the Palmer Hydrologic Drought Index (PHDI) for the region (Utah Region 4) is provided as Figure 4. A description of the use and interpretation of PHDI data is provided in Appendix 7-1 of Chapter 7 of the Coal Hollow Project MRP.

A perhaps more meaningful measurement of the depth to first water in the shallow alluvial sediments is provided in Table 2 and Figure 5. Table 2 includes hydrologic and soils information obtained from 60 soils pits dug in the Coal Hollow Project and adjacent area. Included in Table 2 and Figure 5 for each soils pit are the depth below the ground surface at which groundwater was first encountered in the soils pit, the uppermost extent of any soil mottling (red or gray coloration in cracks or pores in the soil matrix resulting from iron precipitation related to changing redox conditions with changes in soil water saturation)

observed, and the uppermost extent of the presence of any aquic soils observed in the pit. The construction of an isopach map of the depth to groundwater was not created using these data. This is because of the significant heterogeneity of the alluvial groundwater system in the Coal Hollow Project area. Groundwater was encountered in some of the soil pits while other nearby pits were dry. Additionally, groundwater in the alluvial system in many locations in and around the Coal Hollow Project area occurs under perched conditions. Consequently, extrapolation of observed saturation conditions in a soils pit or monitoring well to surrounding areas where saturation data are not available would be arbitrary and not meaningful. Under such groundwater conditions, the direction of groundwater flow is largely constrained by the geometry of permeable and lower-permeability sediments and local microtopography and is not readily predictable. Given these conditions, it is not possible to create a meaningful potentiometric surface map in these areas, or to infer shallow groundwater flow directions and, consequently, no such attempt has been made to do so herein.

The drilling of the shallow exploration boreholes referenced in Appendix 5-1 of Chapter 5 of the Coal Hollow Project MRP occurred during seasonal high-flow runoff conditions in late February and early March 2007. At the time of the drilling of these boreholes, copious amounts of snowmelt water was running over the ground surface and ponding on the low-permeability clayey sediments. While appreciable shallow groundwater was noted during drilling, the groundwater encountered was likely shallow in origin and most likely occurred under perched conditions. Within several weeks of the drilling of the exploration boreholes, the conditions in the soils and shallow alluvial sediments were found to have dried out appreciably and little groundwater was found to be present. This information suggests that, while seasonal snowmelt and shallow perched groundwater was present in the area of the exploration boreholes at the time of the drilling, a continuously saturated alluvial groundwater system through which appreciable groundwater flow was occurring was not present.

2.7 Alluvial groundwater systems maps and cross-sections

A series of six east-west cross-sections through the alluvial sediments in and around the proposed Coal Hollow Mine permit area are presented in Figure 6. A map showing the locations of streams, ponds, springs, and wells in relation to the surface geology is presented in Figure 8. The locations of proposed disturbances and mine pit locations are also shown on the map in Figure 8. It should be noted that in Figure 6, extrapolation of potentiometric levels between some monitoring wells was not performed. This is because, as discussed previously, alluvial groundwaters in many parts of the Coal Hollow Project area occur under perched conditions with discontinuous zones of saturation. Consequently, the extrapolation of potentiometric levels between distant monitoring wells under such conditions would be incorrect. In other areas, particularly near the eastern margins of Sink Valley, where a more continuous artesian alluvial groundwater system exists, some extrapolation of hydraulic head between piezometers is more meaningful.

In the various field investigations conducted in the Coal Hollow Project, specific correlation between seasonal variation in alluvial water levels and vegetation changes have not been noted.

Additional geologic information on the stratigraphy and hydrostratigraphy of the alluvial sediments, Tropic Shale overburden, the Smirl Coal Zone, and the Dakota Formation underburden is provided in Appendix 6-1 in Chapter 6 of the Coal Hollow Project MRP.

3.0 R645-302-321.220

3.1 Land type map

The locations of undeveloped rangeland, "improved" rangeland and pasture lands are shown on the Vegetation Map, Drawing 3-1 in Chapter 3 of the Coal Hollow Mine MRP. A table correlating the vegetative type map units shown on Drawing 3-1 and the land type as requested by the Division under R645-302-321.220 is provided below.

Drawing 3-1 map unit	R645-302-321.220 description
P-J (Pinyon/Juniper)	Undeveloped rangeland
S/G (Sagebrush / Grass)	Undeveloped rangeland
SB (Sagebrush)	Undeveloped rangeland
SB (chipped P-J)	Improved rangeland for sage-grouse habitat
RB/SB (Rabbitbrush / Sagebrush)	Undeveloped rangeland
P (Pasture Land)	Crop lands and pastures
M (Meadow)	Undeveloped Rangeland
OB (Oak Brush)	Undeveloped rangeland

3.2 Productivity measurements

Annual biomass productivity measurements of the plant communities of the area are provided in Section 321.200 and summarized in Table 3-34 of Chapter 3 of the Coal Hollow Project MRP.

3.3 Subirrigated pasture map

The locations of subirrigated lands are shown in Drawing 7-7 of Chapter 7 of the Coal Hollow Project MRP.

It should be noted that some small areas that may potentially be subirrigated lands, which are identified as dry meadows in the western portion of the project area in Drawing 3-1 in Chapter 3 of the Coal Hollow Project MRP, are not marked as subirrigated lands on Drawing 7-7. The land areas of these dry meadows are small, and conditions in which these dry meadows occur may be at least in part due to microtopgraphy.

3.4 Depth to groundwater information

Potentiometric data from piezometers including the season of use (April – November) in the alluvial groundwater systems in the project area in and near the pastures are provided in Table 1. This information together with additional water level information in the alluvial groundwater systems has been submitted to the Division's on-line hydrology database (UDOGM 2008). Depth to groundwater information in excavated soils pits is provided in Table 2 and Figure 5. Additional characterization of conditions in the soils pits is provided in Chapter 2 of the Coal Hollow Project MRP. Generally, the depths to alluvial groundwater in the subirrigated areas are within several inches to a few feet below the ground surface and are seasonally variable, with water levels typically declining gradually during the summer and fall months. Depths to groundwater in the pasture land areas in the southern portions of the proposed permit area range from about one to two feet under high-flow conditions, and up to several feet below the ground surface during low-flow conditions (see Table 1). During 2007, the depths to shallow groundwater in the subirrigated areas were least during the early winter season and declined gradually during the remainder of the year (Table 1). In most

other areas, where subirrigation is not occurring, the depths to alluvial groundwater below the ground surface were generally greater.

Discharge monitoring of seeps SP-28, SP-29, SP-30, SP-31, and SP-32 in lower Sink Valley demonstrate the seasonal variability of the alluvium in this location. Visible discharges were observed in all of these seeps in June 2005, which was a particularly wet year (Figure 4). By August of 2005 all of these seeps were dry as alluvial water levels dropped below the elevations of the spring discharge locations (see Appendix B of Appendix 7-1 of Chapter 7 of the Coal Hollow Project MRP).

4.0 R645-302-321.230

4.1 Locations of flood irrigated or subirrigated lands

The locations of historically flood irrigated and subirrigated lands are shown on Drawing 7-7 in Chapter 7 of the Coal Hollow Project MRP.

The subirrigated lands are located in the meadow areas east of the Tropic Shale ridge that bisects the Coal Hollow Project area (see Drawing 7-7 in the Chapter 7 of the Coal Hollow Project MRP). These areas have been identified as subirrigated based on considerations of alluvial groundwater conditions, water quality, soil moisture, rooting depth, soil mottling, the water requirements of vegetation, and from analysis of the infrared imagery of the region. Additionally, some areas of dry meadow located west of the Tropic Shale ridge in the project area also have also been identified as having localized subirrigation potential. These areas are of limited extent (see "Meadows (dry)" in Drawing 3-1 in Chapter 3 of the Coal Hollow Project MRP. However, based on recent observations, it is apparent that these dry meadows are wet only early in the year and the soils dry out rapidly during the spring. The early-season wet conditions in the dry meadows may be at least in part due to microtopography. Consequently, although there is some potential for these lands to be subirrigated, they are not delineated as subirrigated in Drawing 7-7 of Chapter 7 of the Coal Hollow Project MRP).

The delineation of historically flood irrigated lands in the Coal Hollow Project area is problematic. Historically, attempts at irrigated crop production in the area have occurred in a few homestead locations in and around the Coal Hollow Project area (personal communication, Darlynn Sorensen, 2008). Most of the flood irrigation at these locations was probably of relatively small scale, consisting primarily of irrigation of domestic gardens (personal communication, Darlynn Sorensen, 2008). Some limited flood irrigation occurred at the Swapp Ranch and Pugh Homesteads historically, although there is no indication that any flood irrigation at these properties has occurred in the past several years. Irrigation and

crop production on a larger scale has occurred on the Darlynn Sorensen property (discussed below). With the exception of the crop production at the Sorensen property, none of the other attempts at irrigation and crop production were ultimately successful and all have since been abandoned.

Historically, the most significant use of flood irrigation in the Coal Hollow Project area has occurred at the Sorensen property (Drawing 7-7 in Chapter 7 of Coal Hollow Project MRP). Crops (hay and grain) in these fields were periodically flood irrigated using surface water from Swapp Hollow creek stored temporarily in pond 29-7 (see Drawing 7-7 in the Coal Hollow Project MRP). Flood irrigation at the Sorensen property has typically consisted of the application of a single watering event to the fields in the springtime during wet years when adequate water was available for use. The application of the single springtime irrigation watering resulted in improved hay or grain crop yield relative to the yield in years when no irrigation water could be applied (personal communication, Darlynn Sorensen, 2008). During years with dryer climatic conditions, there was not sufficient surface water available to flood irrigate the lands. Recently (for the past many years) the quantity of water in Swapp Hollow creek has not been sufficient to allow flood irrigation. During this many year period, flood irrigation of the Sorensen property has occurred on only one occasion (during the very wet year 2005). During other recent years, adequate water for useful irrigation of the fields has not been available and flood irrigation of Mr. Sorensen's fields has not been performed (personal communication, Darlynn Sorensen, 2008).

It should be noted that the lack of appreciable flood irrigation currently in Sink Valley and the failures of historic flood irrigation attempts is a direct result of the lack of a reliable supply of water in sufficient quantities to irrigate useful acreage of agricultural lands in the valley.

4.2 General construction and use of water holding ponds

The water holding ponds identified in Drawing 7-7 in the Coal Hollow Project MRP have the appearance of having been constructed as simple earthen embankments. Discussions with the local property owners support this conclusion (personal communication, Darlynn Sorensen, 2008). The earthen embankments for the water holding ponds are typically situated across the bottoms of surface water drainages and are intended to store surface-water runoff. Most of the water holding ponds are used to impound water for stock watering use. A few water holding ponds have also been equipped with water outlet control devices to facilitate the release of the stored water for irrigation or other use. The outlet control structure typically consists of a pipe buried near the base of the pond which is equipped with a control valve to regulate the flow from the pond. The water holding ponds that are equipped with water outlet controls to facilitate irrigation releases include the following:

Water holding ponds equipped with outlet structure for irrigation use

Pond	Water source	Use
29-7	Swapp Hollow creek	Stock watering and flood irrigation of the Sorensen property irrigated lands
20-1	Groundwater diversion from Water Canyon high elevation spring (via some sections of irrigation pipe and some sections of unlined earthen ditches)	Stock watering and historic flood irrigation of Pugh Homestead
29-3	Groundwater from alluvial spring SP-20	Stock watering and historic flood irrigation of Swapp Ranch
24-1 25-1	Kanab Creek	Stock watering and flood irrigation of lands in Kanab Creek drainage (not in project area)

See Drawing 7-7 in the Coal Hollow Project MRP for pond locations

4.3 Conveyance systems between ponds

For most of the ponds in the Coal Hollow Project area, there are no constructed conveyance systems between ponds. Rather, pond overflow or bypass typically runs down the surface drainage to a pond lower in the same drainage (if any). The conveyance systems for the water holding ponds used either currently or historically for irrigation consist of unlined earthen ditches as shown in Drawing 7-7 in Chapter 7 of the Coal Hollow Project MRP.

5.0 R645-302-321-240

5.1 Subirrigation potential (groundwater monitoring)

Monitoring information from shallow groundwater systems in the proposed Coal Hollow Project and adjacent area has been submitted electronically to the Division's on-line hydrology database (UDOGM, 2008). These data have been analyzed and a characterization of the shallow groundwater systems in the area is provided in Appendix 7-1 of Chapter 7 of the Coal Hollow Project MRP. Potentiometric data from alluvial monitoring wells as monitored during 2007 is presented in Table 1. Depth to water hydrographs for these wells are presented in Figure 3. Additional information pertinent to alluvial saturation levels in near-surface sediments in the Coal Hollow Project area is provided in Table 2 and Figure 5.

5.2 Subirrigation potential (water quality)

As described previously, subirrigated lands in the Coal Hollow Project area include lands in two regions. Both of these regions are located east of the north-south trending Tropic Shale bedrock ridge that bisects the Coal Hollow Project area into eastern and western regions (see Appendix 7-1 of the Coal Hollow Project MRP for information on the hydrogeologic influence of the Tropic Shale ridge). To characterize the suitability of shallow groundwater for subirrigation use in these two areas, the average water quality characteristics of two nearby alluvial springs is evaluated here. Spring SP-8 discharges to the surface from the artesian alluvial groundwater system in the vicinity of the northern potentially subirrigated area. Spring SP-6 discharges to the surface from the alluvial groundwater system in the vicinity of the southern potentially subirrigated area. Water quality characteristics of shallow groundwaters in the northern and southern subirrigation areas, as represented by groundwaters from springs SP-8 and SP-6, respectively, are presented in Table 3. These data

have also been submitted electronically to the Division's on-line hydrology database (UDOGM, 2008). Water quality suitability criteria for irrigation use as presented in the OSM Alluvial Valley Floor Identification and Study Guidelines (1983) are used in this analysis. The water quality suitability for the northern and southern subirrigation areas are depicted on Figure 9.

5.2.1 Northern subirrigation area water quality

It is apparent from Figure 9 that the shallow groundwater available for subirrigation in the northern subirrigation area plots near the boundary between C2-S1 and C3-S1 class waters on the SAR – conductivity classification of irrigation water (OSM, 1983). This indicates a medium to high salinity hazard with low sodium danger. As a result of the medium to high salinity hazard, the groundwater could be used if a moderate amount of leaching occurs. Waters falling in the C3-S1 area indicate that waters in this class cannot be used on soils with restricted drainage. Special management for salinity control may be required and plants with good salt tolerance should be selected. Shallow alluvial groundwater from the northern subirrigation area as represented by SP-8, averages 424 mg/L (Table 3). Based on the dissolved-solids hazard for irrigation water (Table B-5, OSM, 1983) as a result of irrigation using this water, no detrimental effects will usually be noticed, and the salinity hazard is low. Using the criteria shown on Table B-6 (OSM, 1983), which considers boron, SAR, chloride, sulfate, specific conductance, and TDS levels, the water in the northern subirrigation area is a Class I, which is excellent to good for overall soil/climate management, and suitable for irrigation of all or most plants, including boron-sensitive species.

5.2.2 Southern subirrigation area water quality

It is apparent from Figure 9 that the shallow groundwater available for subirrigation in the southern subirrigation area plots near the boundary between C3-S1 and C4-S1 class waters on the SAR – conductivity classification of irrigation water (Figure B-5, OSM, 1983). This indicates a high to very high salinity hazard with a low sodium danger. Waters classified as C3-S1 indicate that the water cannot be used on soils with restricted drainage. Special

management for salinity control may be required and plants with good salt tolerance should be selected. Waters falling in the C4-S1 area contain very high salinity water, which is not suitable for irrigation under normal conditions. Shallow alluvial groundwater from the northern subirrigation area averages 1,330 mg/L (Table 3). Based on the dissolved-solids hazard for irrigation water (Table B-5, OSM, 1983) irrigation with this water can have detrimental effects on sensitive crops. Using the criteria shown on Table B-6 (OSM, 1983), which considers boron, SAR, chloride, sulfate, specific conductance, and TDS levels, the water in the northern subirrigation area is a Class II water, which is good to injurious; harmful under certain conditions of soil, climate, and practices. Irrigation with Class II water is not suitable for most salinity- and boron-sensitive plants, but is suitable for all tolerant and many semitolerant species.

It should be noted that shallow alluvial groundwaters in areas west of the subirrigated lands in the Coal Hollow Project and adjacent area commonly contain water that is appreciably elevated in dissolved solids concentrations (UDOGM, 2008). Shallow alluvial groundwaters were sampled from trenches in the alluvial system in the eastern ¼ of Section T39S, R5W in April 2006. Locations and chemical information for these trenches is provided in Appendix 7-1 of Chapter 7 of the Coal Hollow Project MRP and has been submitted electronically to the Division's on-line hydrology database. Alluvial groundwater sampled from these trenches had specific conductance values ranging from 1,142 to 3,700 uS/cm with TDS concentrations ranging from 903 to 3,608 mg/L. This information suggests that shallow groundwater in some of these areas may not be suitable for subirrigation.

Monitoring of alluvial seeps SP-28, SP-29, SP-30, SP-31, and SP-32 in the southern end of Sink Valley near the southern subirrigation area indicate that the quality of shallow groundwater potentially available for subirrigation in this area is of poor quality, with measured specific conductance values ranging from 2,110 to 4,150 uS/cm, and averaging about 2,900 uS/cm. Waters of this quality are classified as high-salinity waters and are not usually useful for crop irrigation.

5.3 Subirrigation potential (soil moisture)

Qualitative soil moisture evaluations were performed in excavated soils pits by qualified soil scientists. Information on soil moisture is provided in Chapter 2 of the Coal Hollow Project MRP. This information has been utilized in performing the analysis of alluvial systems presented in this document.

5.4 Subirrigation potential (soil mottling, rooting depth, soil moisture)

Root size and density (abundance) data was collected at each soil pit as part of the description of the soils. Data for each individual soil pit was provided on the profile description sheets of the soil survey report (MRP Appendix 2-1). Summarized depths of roots including sizes, densities and mottles of the major soil types (named) for each soil map unit (by plant community) was evaluated and has been presented in Table 4.

The parameters for root density and size are described in the Field Book for Describing Soils, version 2 (Schoeneberger et. al., 2002). Table 5 defines the terms used to describe roots in the Coal Hollow Project soil survey.

5.4.1 Soil Mottles

The presence of soil mottles suggests that the soil depths where they appear were saturated with water at some time. Groundwater studies in the Coal Hollow Project area indicated that the periods of highest groundwater elevations are during late winter and early spring before the plants' consumptive use of water is at their peak. In addition, lab analysis of the groundwater indicated that it has TDS values that may diminish the benefit of the water to plants.

Figure 10 and Figure 11 illustrate the relationship of average root density and size versus depth for each plant community identified in the MRP for the Coal Hollow Project area. The figures also compare root density and size with the depth to soil mottles for specific plant communities when mottling was the dominant condition. The *dominant condition* is justified in the "Notes" on Table 4. This data evaluation was limited by the variety of soil pit depths.

5.4.2 Results of the Root Data Evaluation by Plant Community

The **meadow** (M) plant community was characterized by sedges, rushes, and wild iris. There were "many" roots in the upper 11 inches of the soil profile. The root density was "common" from 11 inches down to 37 inches and a "few" roots extended down to 52 inches. The depth of the "many" roots zone corresponds closely with the average depth to soil mottles of 10 inches. The meadow plant community is analogous to soil map unit 7. *Coarse* roots were not "common" in these soils, but *medium* roots extended down to 39 inches. *Fine* roots extended to 44 inches and *very fine* roots to 49 inches. This soil type and plant community could be classified as sub-irrigated.

The **dry meadow** [M(dry)] plant community had characteristics of both meadow and upland (pasture and sagebrush/grass) plant communities. Delineations of this plant community and soil type were in micro-depressions where off-site surface runoff collects and perches on deep clay horizons. The dominant vegetation consisted of upland grasses with scattered shrubs and some meadow vegetation. There were "many" roots in the upper 8 inches of the soil profile. "Common" roots extended from 8 to 18 inches. A "few" roots extended from 18 inches to 79 inches. *Coarse* roots from shrubs were limited to the upper 8 inches. *Medium* roots extended to 18 inches. *Fine* roots extended to 72 inches and *very fine* roots to 80 inches. The depth to soil mottles ranged from 6 to 58 inches with an average of 36 inches. The average soil mottle depth corresponds with depth of "common" root density. This soil type

and plant community demonstrates characteristics of potential sub-irrigation in localized area, but it is of limited extent in the Coal Hollow Project area.

The **oak brush** (OB) plant community had roots that extended to 90 inches. "Many" roots were limited to the upper 3 inches. "Common" roots extended from 3 to 35 inches. A "few" roots extended to 91 inches. *Coarse* roots from the oak brush extended to 69 inches. *Medium* and *fine* roots extended to 78 inches. *Very fine* roots reached to 90 inches. One of two data points representing this plant community had a few soil mottles at 15 inches, but none in the other soil pit. The dominant soils and vegetation for this plant community indicate that it is not sub-irrigated.

The **pasture land** (P) plant community was dominated by introduced upland grass species. "Many" roots were limited to the upper 3 inches. "Common" roots extended from 3 to 23 inches. A "few" roots extended to 65 inches. Only one of the 16 soil data points had *coarse* roots (limited to upper the 10 inches at that soil pit). *Medium* roots extended to 18 inches. *Fine* roots extended to 46 inches. *Very fine* roots reached to 64 inches. Only seven of the 16 soil data points had any soil mottles (average 50 inches for the seven soil pits). Soil and vegetation characteristics suggest that this plant community is not sub-irrigated. Small localized areas within the pasture land community may have potential for sub-irrigation.

The **pinyon-juniper** (PJ) plant community was dominated by pinyon pine and Utah juniper. The average soil depth was 41 inches to Tropic Shale. "Common" roots were in the upper 15 inches. A "few" roots extended to 30 inches. *Coarse* roots occurred in the upper 14 inches. *Medium* roots extended to 18 inches. *Fine* roots extended to 24 inches. *Very fine* roots reached 30 inches. Soil mottles occurred in one of five pits, but were most likely the result of moisture perching in the very fine clay textures (greater than 60 percent clay). Soil and native vegetation suggest that this plant community is not sub-irrigated.

The **rabbitbrush/sagebrush** (RB/SB) plant community was limited to disturbed areas. It was of very limited extent in the Coal Hollow Project area and there was only one soil data point.

This soil type and plant and soil community does not exhibit any characteristics of being sub-irrigated.

The **sagebrush/grass** (S/G) plant community was dominated by big sagebrush and upland grasses. "Many" roots were in the upper 4 inches. "Common" roots were from 4 to 18 inches. A "few" roots reached to 57 inches. *Coarse* roots were in the upper 7 inches. *Medium* roots extended to 17 inches. *Fine* roots extended to 34 inches. *Very fine* roots extended to 57 inches. Soil mottles occurred in only 5 of 20 soil data points (average 52 inches for the 5 soil pits). Soils and native vegetation indicate this plant community is not sub-irrigated.

5.4.3 Soil Map Units

Soil map unit 7 had characteristics of sub-irrigation (Table 6). Soil mottling was identified within one foot of the soil surface. The presence of water is usually at or near the soil surface during the spring and early summer depending on the annual precipitation. Occasional seasonal localized ponding may also occur in this map unit.

Map units 6 and 13 have localized potential for sub-irrigation depending on the soil type. Upland soils comprise 80 percent of the soil map unit. Aquic soils occurred in micro-depressions and may be the result of localized runoff water perching on top of deep clay layers.

5.4.4 Summary

Table 7 identifies the plant communities that exhibit soil and plant characteristics of sub-irrigation. Only the meadow and dry meadow plant communities exhibit characteristics of sub-irrigation in the major soil types of the associated soil map units.

5.5 Subirrigation potential (water requirements of pasture and meadow vegetation)

The areas called "pasture lands" in the Coal Hollow Project area are plant communities that have been altered to increase herbaceous cover and productivity for domestic livestock. Prior to pasture lands, these communities were probably native sagebrush/grass plant communities. Like the native and unaltered plant communities in the area, and because they are not irrigated, the water requirements for the pasture lands in the study area are solely dependent on the annual precipitation regime (which averages about 16 inches per year; see MRP Chapter 7, Section 724.400) and other environmental variables described below.

Native plant communities called "meadows" are also present in and adjacent to the project area. Dry meadows are located on the west side of the permit area and wetter meadows can be found on the east side. Factors that influence establishment and survival of these meadows are local climatic conditions as well as other environmental variables such as: exposure to light, soil texture, salinity and permeability, hydrologic regimes, saturation periods in the growing season, stratigraphy, topography, morphological, physiological and reproductive adaptations of the plant species present, and evapotranspiration rates. For specific onsite quantitative data and other applicable information regarding the above environmental conditions at the Coal Hollow Project area, refer to MRP Chapter 2 (soils), Chapter 3 (vegetation) and Chapter 7 (hydrology and climate).

Published information regarding water requirements of selected plant types for Alton, Utah area is presented in Table 8.

6.0 R645-301-321-250

6.1 Flood irrigation potential (streamflow and water yield)

The potential for successful flood irrigation of lands in the Coal Hollow Project area is directly limited by the amount of water available for that use. Discharge and water quality data for waters that could potentially be utilized for flood irrigation in the Coal Hollow Project and adjacent area are presented in Table 9. Baseline monitoring data including discharge and water quality measurements for these potential sources of flood irrigation water have been submitted electronically to the Division's on-line hydrology database (UDOGM, 2008). Each of the potential surface water sources for flood irrigation in the Coal Hollow Project and adjacent area is discussed below.

6.1.1 Swapp Hollow creek

The largest source of surface water for potential flood irrigation use in the Coal Hollow Project area is from Swapp Hollow creek. Monitoring on Swapp Hollow creek has been performed at monitoring site SW-8 (see Drawing7-10 in Chapter 7 of the Coal Hollow Project MRP). Historical discharge and water quality data for Swapp Hollow creek are provided in Table 9. Discharge measurements performed at SW-8 indicate considerable seasonal and climatic variability. The long-term average instantaneous discharge in the creek as monitored at SW-8 is 55 gpm (0.12 cfs). Flow has been present during all monitoring events at SW-8. Assuming an average discharge of 55 gpm, an annual yield of 88.7 acre-feet is calculated.

Assuming an alfalfa plant evapotranspiration requirement of 27.2 inches over the irrigation season (May – early September; Table 8) and an average precipitation during the same irrigation period of about 5 inches, it was calculated that about 1.85 acre-feet per acre of alfalfa is required for the growing season. Thus, during an average year a total of about 48

acres of alfalfa could be irrigated, assuming that ***all*** of the water that flowed in the creek could successfully be applied to the irrigated crop. Similarly, the requirement for pasture irrigation is 23.31 inches in the Alton area over the irrigation season (April through September; Table 8). Thus, assuming a seasonal irrigation requirement of 1.35 acre-feet per acre of irrigated pasture, and assuming average precipitation occurred during the growing period, it is calculated that about 66 acres of pasture could be irrigated assuming that ***all*** of the water flowing through Swapp Hollow creek during an average year could be efficiently applied to the pasture vegetation. However, for several reasons, both of these approximations likely considerably overestimate the actual acreage that could be flood irrigated. Using a commonly used "rule-of-thumb" approximation, about 50 percent of the flood irrigation water transmitted through an earthen ditch from the point of diversion to the point of application to the crops is lost in transmission. Consequently, a more realistic estimate of the amount of flood irrigation that could be accomplished using the entire annual yield from Swapp Hollow creek is about half of that estimated above, or about 24 acres of alfalfa, or about 33 acres of pasture land using all of the average annual yield for flood irrigation. Additionally, it should be noted that groundwater and surface-water resources in the region are fully appropriated by the State of Utah. Consequently, no new water rights are available that could be used for this potential flood irrigation. Much of the water in Swapp Hollow creek is currently being used for stock watering use and would not be available for flood irrigation. Thus, the acreage that could be irrigated is likely appreciably less than that estimated above. Additionally, it should be noted that these calculations are based on the *average* annual yield from Swapp Hollow creek. The annual yield in the drainage will fluctuate year to year because of climatic variability. Because there is no excess capacity in the creek, the actual amount of land that could be flood irrigated will vary correspondingly. Such conditions are not conducive to agricultural planning and successful flood irrigation in the area.

The results of these calculations are not intended to provide specific flood irrigation requirements for crop irrigation in the Coal Hollow Project area. Rather these calculations

are presented to demonstrate the very limited potential for flood irrigation in the Coal Hollow Project and adjacent area.

The other potential sources of flood irrigation waters in the Coal Hollow Project area include the Lower Robinson Creek/Dry Canyon drainage, Section 21 canyon drainage, the spring diversion in upper Water Canyon, and Sink Valley Wash. Discharge measurements from these waters are listed in Table 9. Additionally, while not surface-water related, spring discharge from some alluvial groundwater systems has historically provided limited quantities of water for irrigation use. None of these sources of flood irrigation water are as significant as that in Swapp Hollow creek and none of these are deemed as acceptable sources for successful flood irrigation of lands in the Coal Hollow Project area. The streamflow and water yield characteristics of these potential sources are described below.

6.1.2 Lower Robinson Creek/Dry Canyon

Discharge in the Lower Robinson Creek/Dry Canyon drainage occurs only in direct response to torrential precipitation events or substantial snowmelt. Discharge measurements from Lower Robinson Creek (below the confluence with Dry Canyon) have been performed historically at monitoring site SW-4 (see Drawing 7-10 in Chapter 7 of the Coal Hollow Project MRP). Monitoring site SW-101 is also located on this drainage. During baseline monitoring at the project area, discharge has been monitored at SW-4 only during a snowmelt event in May of 2005, which was a very wet year (Figure 4). Additionally, in direct response to a torrential thunderstorm event, surface water in the drainage at SW-101 was monitored. It should be noted that the duration of the surface flow at that time was only a few minutes. On all other monitoring events, this stream has been dry. Consequently, the Lower Robinson Creek/Dry Canyon drainage is not considered a reasonably potential source for flood irrigation activities in the Coal Hollow Project and adjacent area.

6.1.3 Section 21 canyon drainage

Discharge has not been observed in Section 21 canyon during the period of baseline monitoring (as monitored at baseline monitoring site SW-7). This drainage is not considered

a reasonably potential source for flood irrigation activities in the Coal Hollow Project and adjacent area.

6.1.4 Upper Water Canyon spring diversion

Historically, water from a spring in the upper reaches of the Water Canyon drainage about two miles east of the Coal Hollow Project area has been conveyed to pond 20-1 (see Drawing 7-7 of Chapter 7 of the Coal Hollow Project MRP). Discharge is monitored in this diversion at site RID-1, located near the USDA Forest Service boundary above pond 29-1 (see Drawing 7-10 of Chapter 7 of the Coal Hollow Project MRP). Discharge and water quality data for this site are presented in Table 9. Discharge at RID-1 averages 21.7 gpm or 35.0 acre feet per year. As discussed above (see Swapp Hollow creek discussion), quantities of water on this scale are not sufficient to sustain appreciable flood irrigation activities in the Coal Hollow Project area.

6.1.5 Sink Valley Wash

Sink Valley Wash is monitored at site SW-6 (see Drawing 7-10 in Chapter 7 of the Coal Hollow Project MRP). Discharge data for SW-6 are presented in Table 9. It is apparent that discharge in Sink Valley Wash is not useful for subirrigation purposes in the Coal Hollow Project area. During baseline monitoring activities, flowing water has only been observed on one occasion at SW-6 during March of 2006. On this occasion, sheet floods were occurring in Sink Valley in direct response to the copious melting of snow in the valley. It is noteworthy that on this occasion the waters in the fields above SW-6 were not flowing through any discernable stream drainage. Rather the surface flow was running down the valley over a large upstream area in an unconcentrated sheet flood.

6.1.6 Alluvial groundwater spring discharges

Historically, some small-scale domestic flood irrigation (likely domestic flood irrigation of gardens for family use) of lands near the historic homestead locations has occurred using water from alluvial springs in the Coal Hollow Project and adjacent area. Currently, groundwater from spring SP-20 gravity flows from the spring discharge area to pond 29-3.

At the current time, when available, water from this pond overtops the water holding pond and runs into the field below the pond and is lost to evapotranspiration. The water is used currently for stock watering, and is not used for irrigation. The discharge from alluvial spring SP-20 averages about 6 gpm. Groundwater from spring SP-8 is currently collected in a spring box and conveyed via a buried pipe to the Swapp Ranch house for domestic use. Surplus water from SP-8 is piped to a newly constructed water holding pond (pond 29-5; see drawing 7-7 of the Coal Hollow Project MRP) adjacent to the ranch house. The water in the pond is not currently used for irrigation. Discharge from spring SP-8 averages about 13.8 gpm, or about 22.3 acre-feet per year.

6.2 Flood irrigation potential (water quality)

Groundwater discharge data for all streams that may potentially provide surface water for flood irrigation in Sink Valley have been submitted electronically to the Division's on-line hydrology database. Discharge and water quality data for streams that could potentially be used for flood irrigation are presented in Table 9. As described above, the two streams with the greatest annual discharge, and consequently the best potential for flood irrigation use in the project area are Swapp Hollow creek and the Water Canyon spring diversion. The water quality characteristics of these two sources are described below.

6.2.1 Swapp Hollow creek

Surface water at Swapp Hollow creek is monitored at site SW-8 (see Drawing 7-10 in Chapter 7 of the Coal Hollow Project MRP). It is apparent from Figure 12 that the surface water in Swapp Hollow creek is a C2-S1 class water on the SAR – conductivity classification of irrigation water (Figure B-5, OSM, 1983). This indicates medium-salinity water. The water may be used for flood irrigation if a moderate amount of leaching occurs. The sodium hazard is low. The surface water in Swapp Hollow creek averages 311 mg/L (Table 9). Based on the dissolved-solids hazard for irrigation water (Table B-5, OSM, 1983) irrigation with this water will not usually result in detrimental effects. Using the criteria shown on

Table B-6 (OSM, 1983), which considers boron, SAR, chloride, sulfate, specific conductance, and TDS levels, the Swapp Hollow water is a Class I water. This indicates excellent to good water with a low salinity hazard that is suitable for most conditions. It is suitable for irrigation of all or most plants, including salinity- and boron-sensitive species.

6.2.2 Water Canyon spring diversion

Waters in the Water Canyon spring diversion are monitored at site RID-1 (see Drawing 7-10 in Chapter 7 of the Coal Hollow Project MRP). It is apparent from Figure 12 that waters in the Water Canyon spring diversion are C2-S1 class waters on the SAR – conductivity classification of irrigation water (Figure B-5, OSM, 1983). This indicates medium-salinity water. The water may be used for flood irrigation if a moderate amount of leaching occurs. The sodium hazard is low. The waters in the Water Canyon spring diversion average 248 mg/L (Table 9). Based on the dissolved-solids hazard for irrigation water (Table B-5, OSM, 1983) irrigation with this water will not usually result in detrimental effects. Using the criteria shown on Table B-6 (OSM, 1983), which considers boron, SAR, chloride, sulfate, specific conductance, and TDS levels, the Water Canyon spring diversion waters are Class I waters. This indicates excellent to good water with a low salinity hazard that is suitable for most conditions. The water in this class is suitable for irrigation of all or most plants, including salinity- and boron-sensitive species.

6.2.3 Alluvial groundwater springs

A characterization of the water quality characteristics of alluvial groundwater systems from which spring discharges could potentially be used for flood irrigation (SP-20 and SP-8) is presented in Section 5.2.1 above. In that analysis, the water quality conditions at spring SP-8 were characterized. The water quality characteristics of springs SP-8 and SP-20 are similar to each other and to other springs originating in Alluvial Groundwater Discharge Area A (see Appendix 7-1 in Chapter 7 of the Coal Hollow Project MRP). Water quality data for springs and wells in the alluvial groundwater system in this area have been submitted electronically to the Division's on-line hydrology database (UDOGM, 2008).

6.3 Flood irrigation potential (soils measurements)

Information on soil characteristics in the Coal Hollow Project area are provided in Chapter 2 of the Coal Hollow Project MRP. This information includes physical and chemical properties of the soils sampled in 60 soils pits excavated and surveyed by qualified soils scientists. Also included in Chapter 2 are qualitative evaluations of prevailing soil moisture conditions in the shallow subsurface in the project area.

6.4 Flood irrigation potential (topographic characteristics)

The topographic characteristics of the land surface in the Coal Hollow Project have been documented using high-accuracy aerial surveys. A contour map depicting this information is provided in Drawing 5-1 in Chapter 5 of the Coal Hollow Project MRP. The surface topography of the Coal Hollow Project and adjacent area is also shown on a digitally shaded USGS topographic map in Figure 1. Based on this information, it is apparent that the topographic characteristics of most lands in the project and adjacent area are compatible with flood irrigation techniques. This conclusion is based on the fact that 1) the streams entering the project area originate in upland areas with considerably hydraulic head appreciably greater than the elevations in the project area, and 2) consequently, based on the surface topography, it is apparent that conveyance ditches could be constructed that could convey surface waters from the highland areas in the east to most locations within the project area. Areas that could not reasonably be irrigated by flood irrigation techniques include the steep, isolated hills located mostly in the western portions of the project area.

7.0 R645-302-321-260

7.1 Aerial photographs and infrared imagery

Aerial photographs of the Coal Hollow Project and adjacent area are provided in Plates 3 and 4. The late summer/fall infrared imagery has been analyzed extensively in the analysis of the valley floor in Sink Valley. The infrared imagery has been utilized by researchers in each of the various scientific disciplines and was an important investigative tool in developing the conclusions presented in this report

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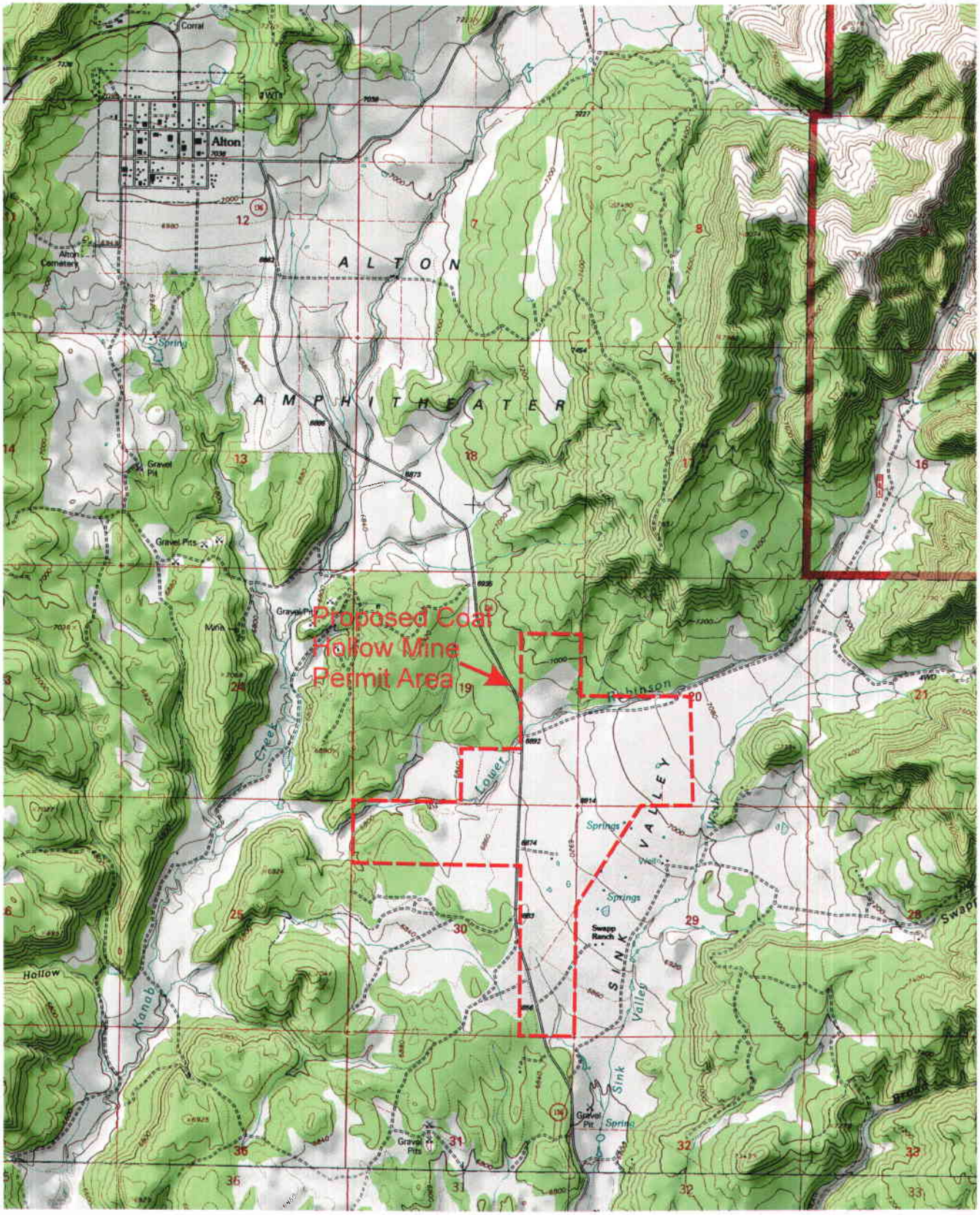

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Figure 1 Location map of proposed Coal Hollow Mine permit and adjacent area and the town of Alton, Utah.

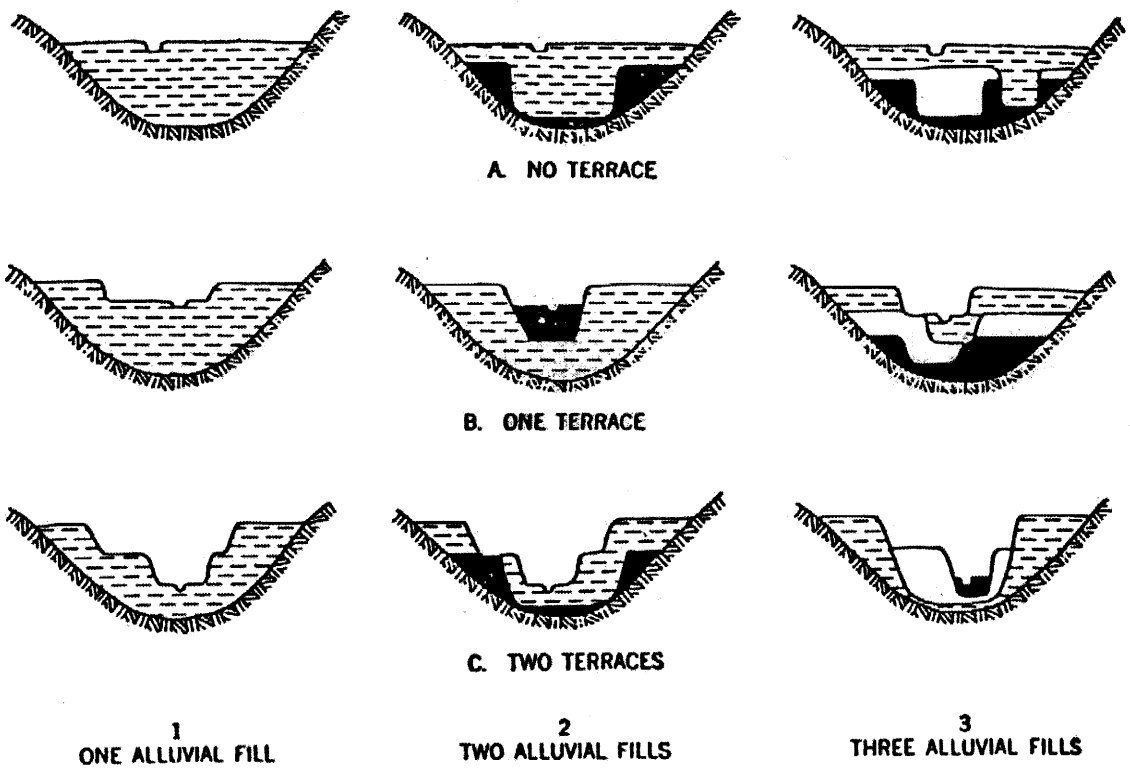
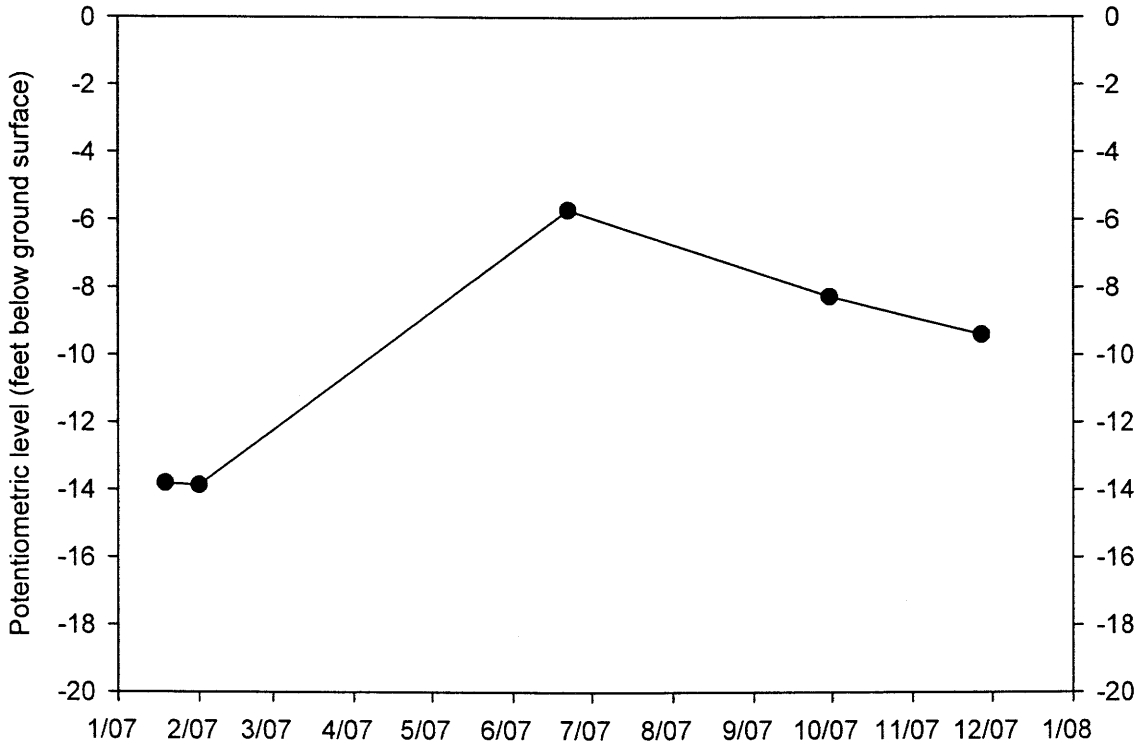


Figure 2 Examples of valley cross-sctions showing some possible relations in valley alluvium (from OSM, 1983).

Figure 3

Depth to groundwater hydrographs for alluvial piezometers for 2007.

C0-18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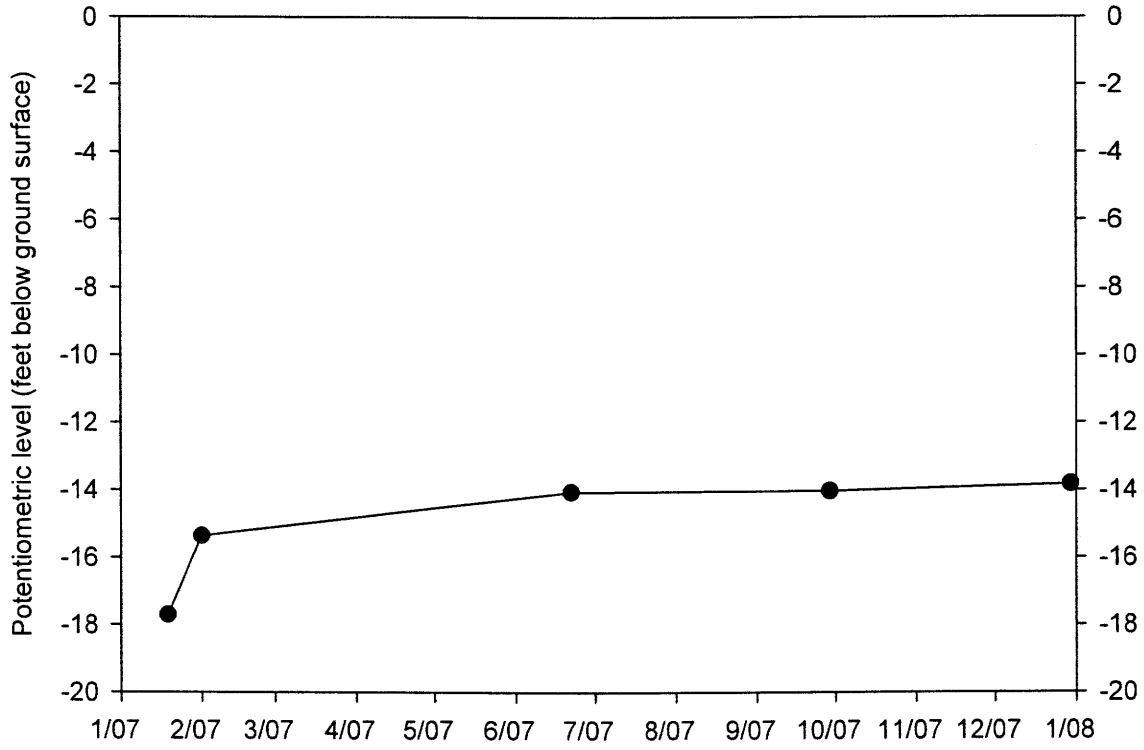
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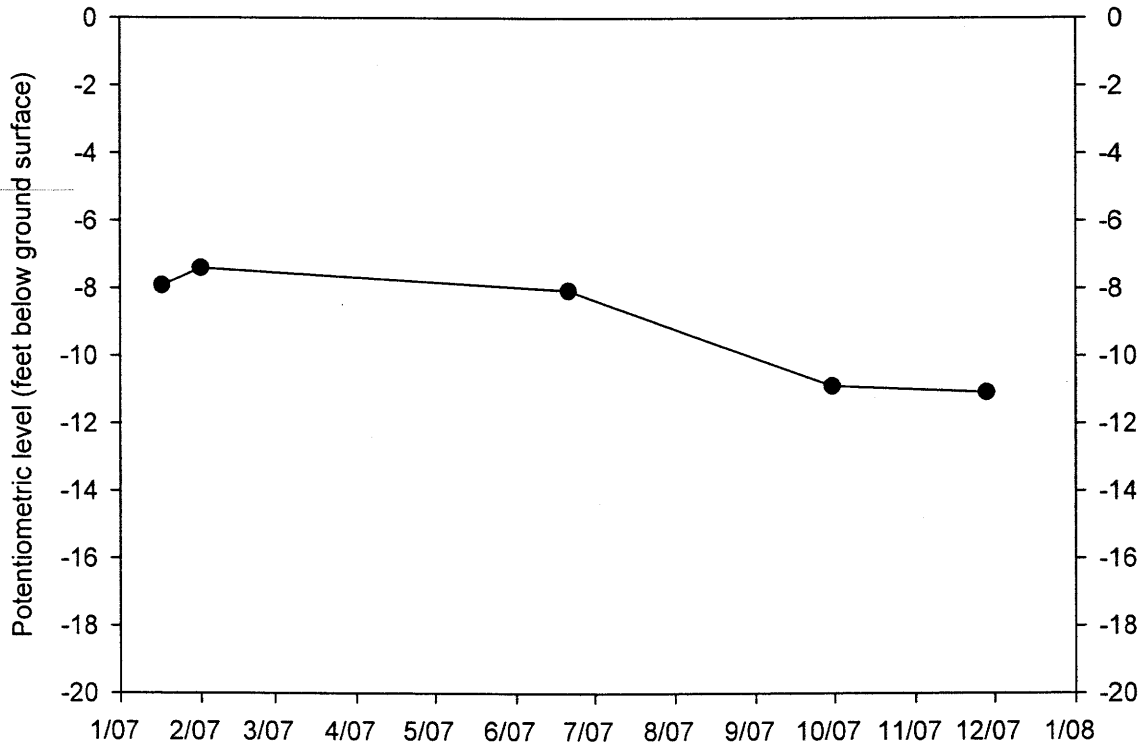
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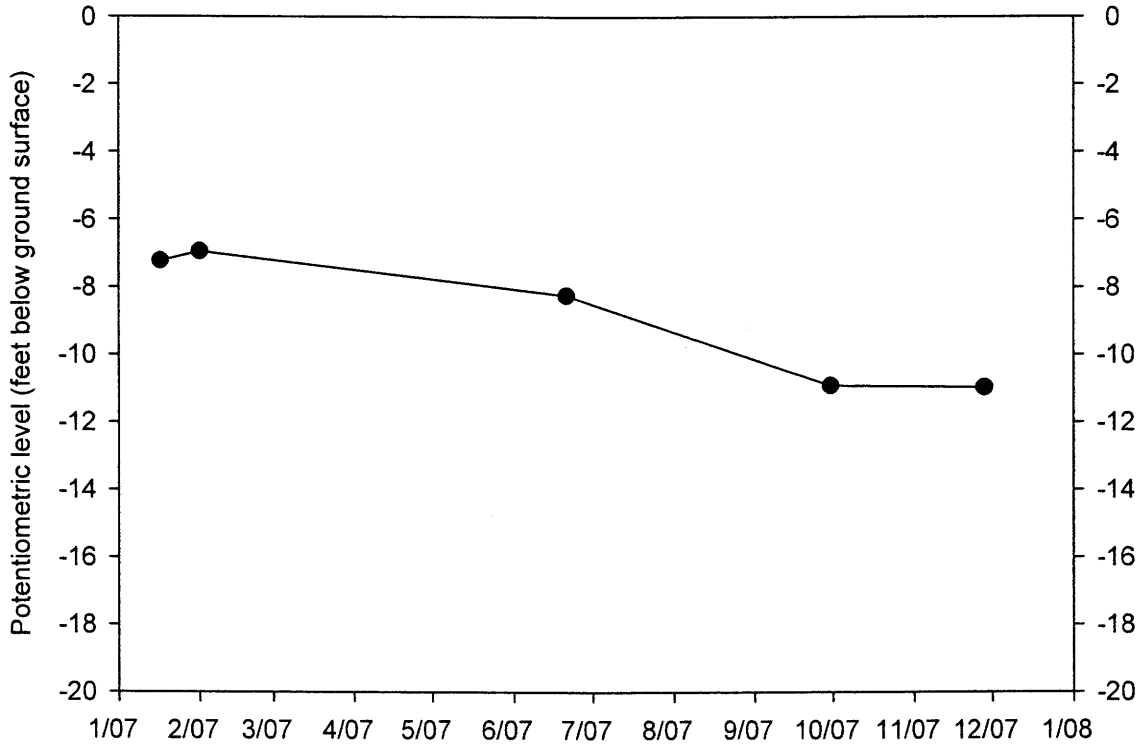
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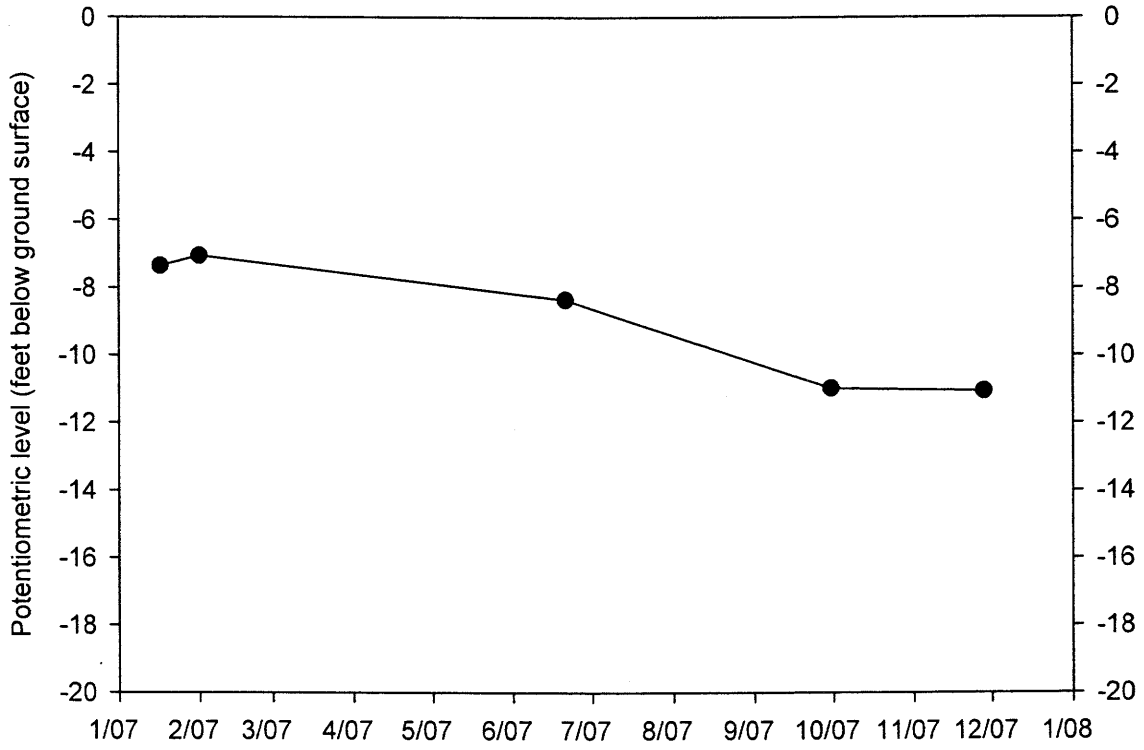
C2-40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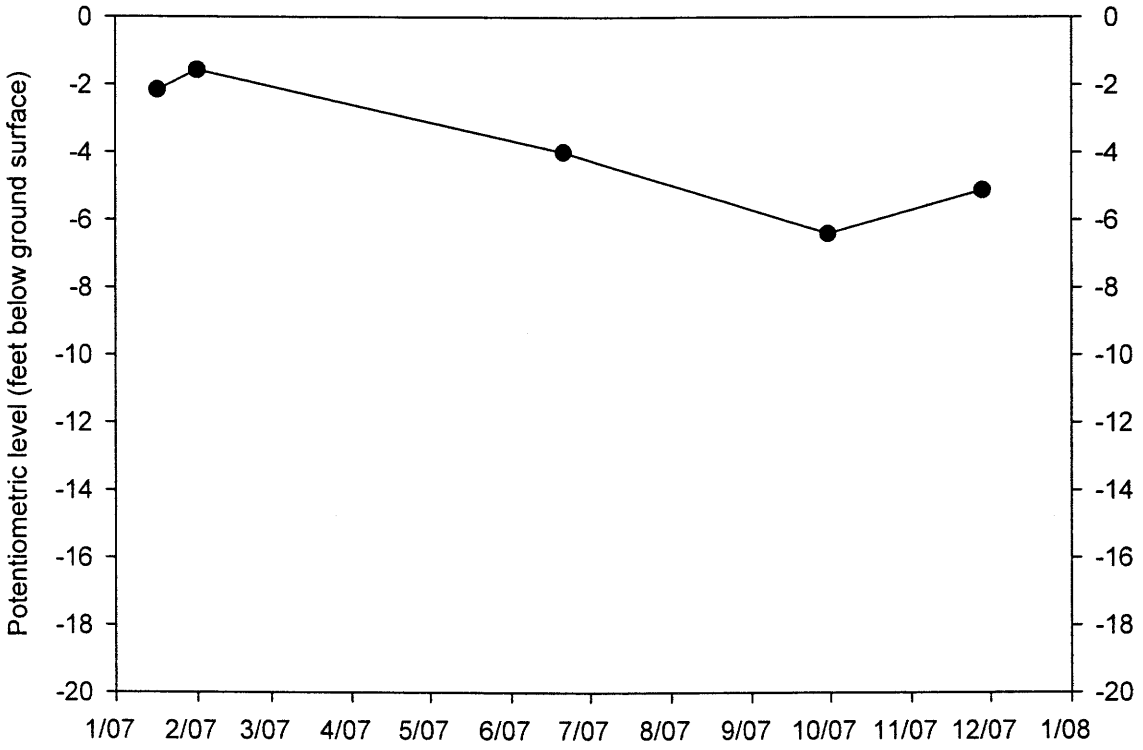
C3-15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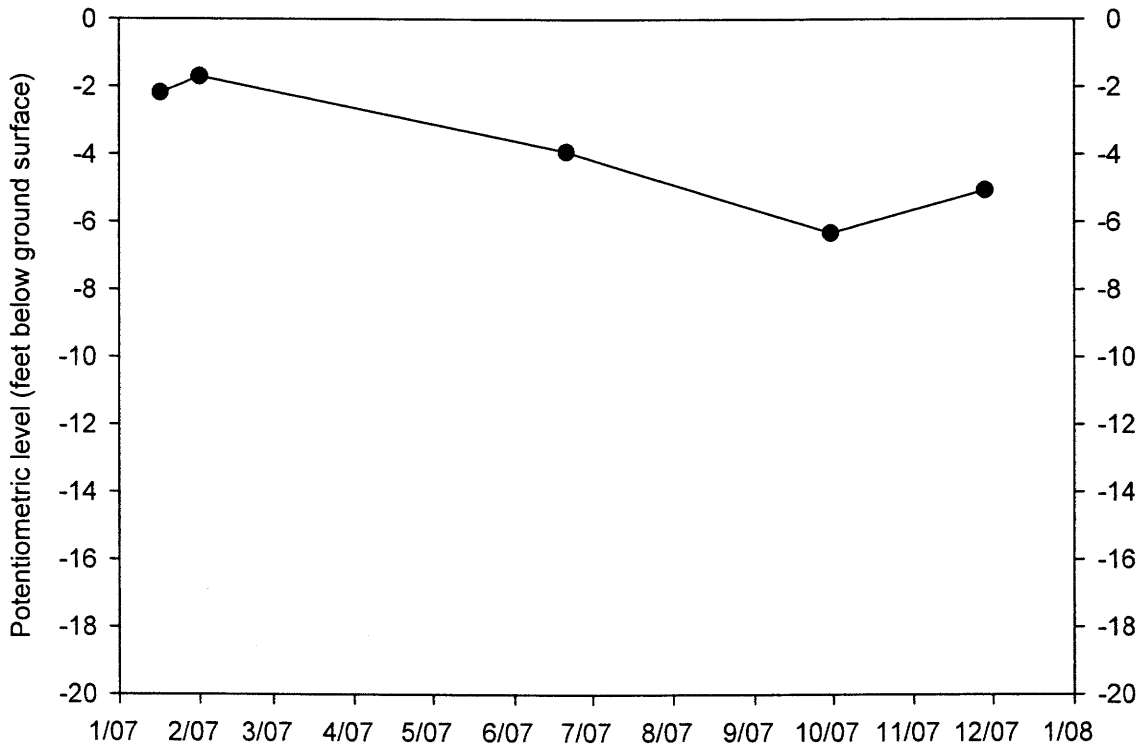
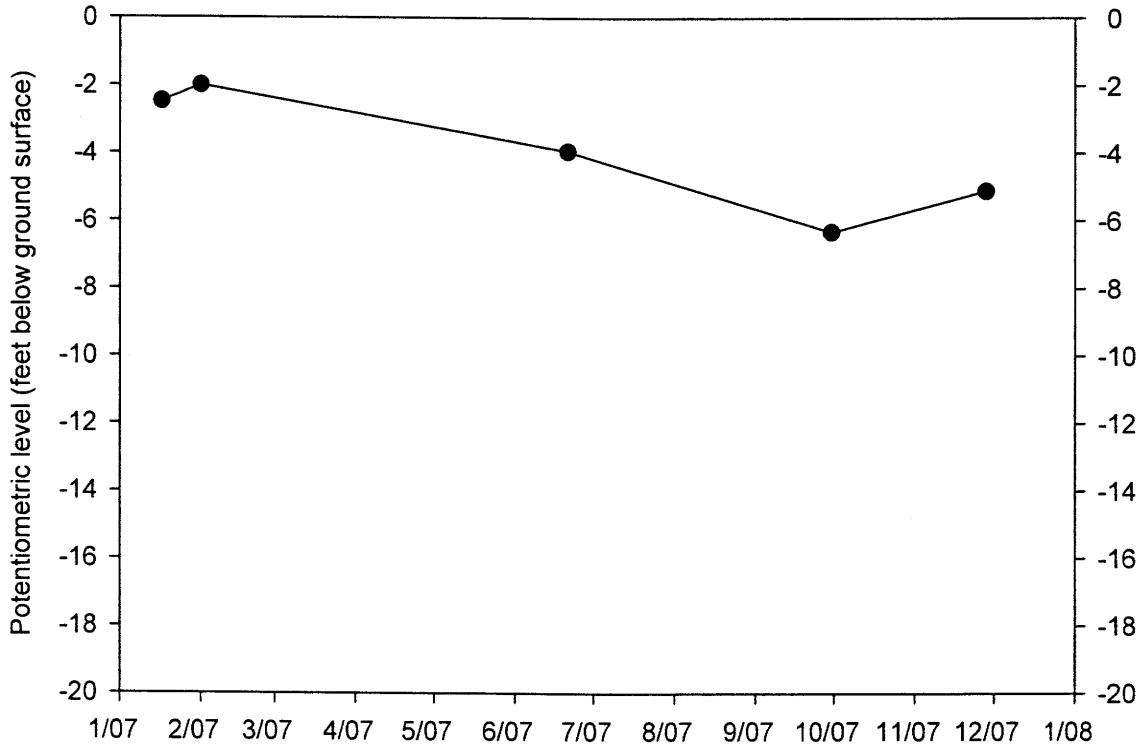
-14
-16
-18
-20
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

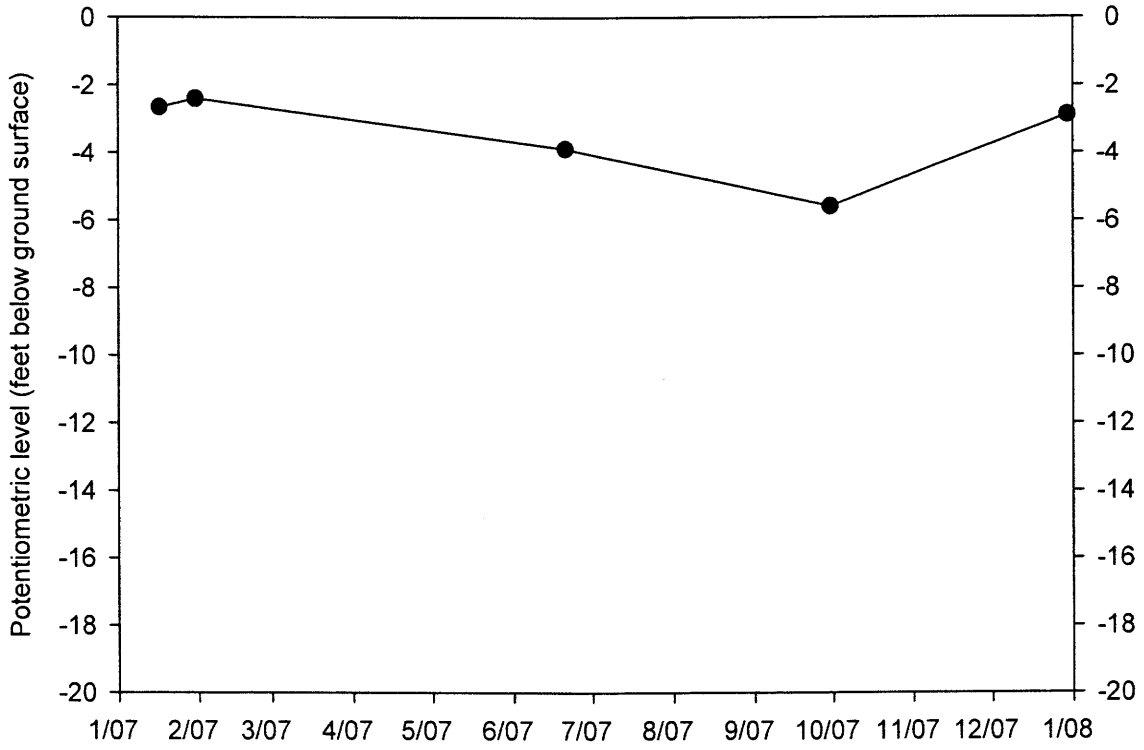
C3-30


Potentiometric level (feet below ground surface)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

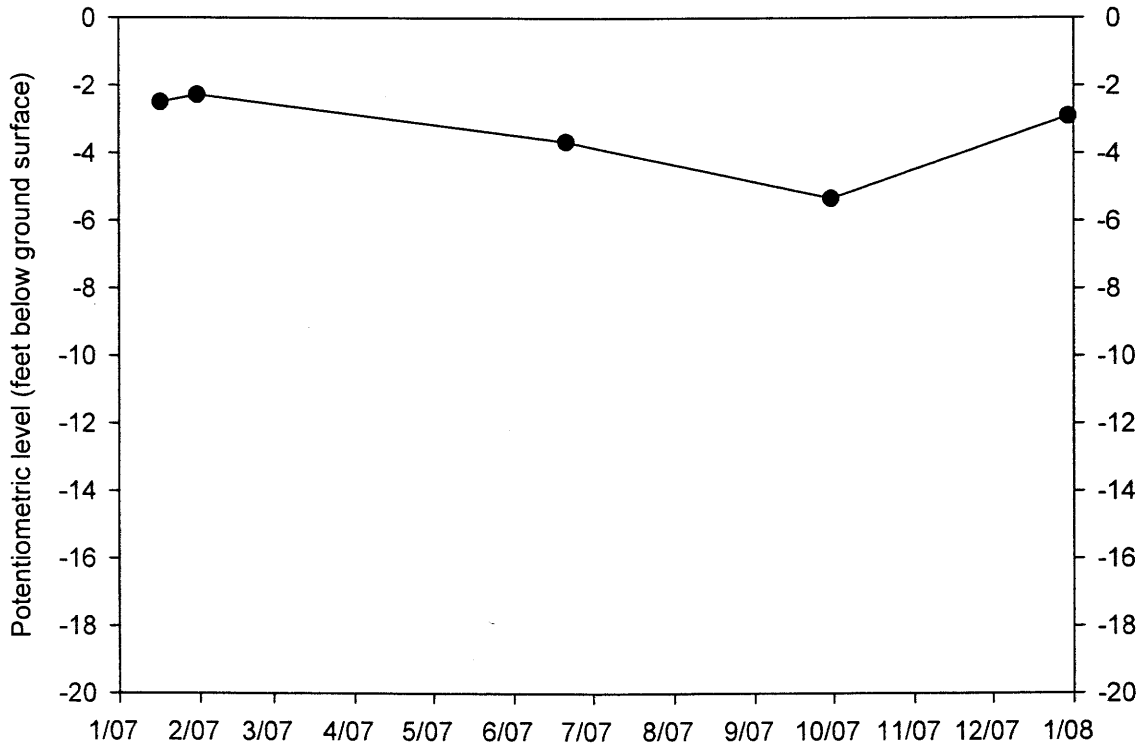
C3-40


Potentiometric level (feet below ground surface)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

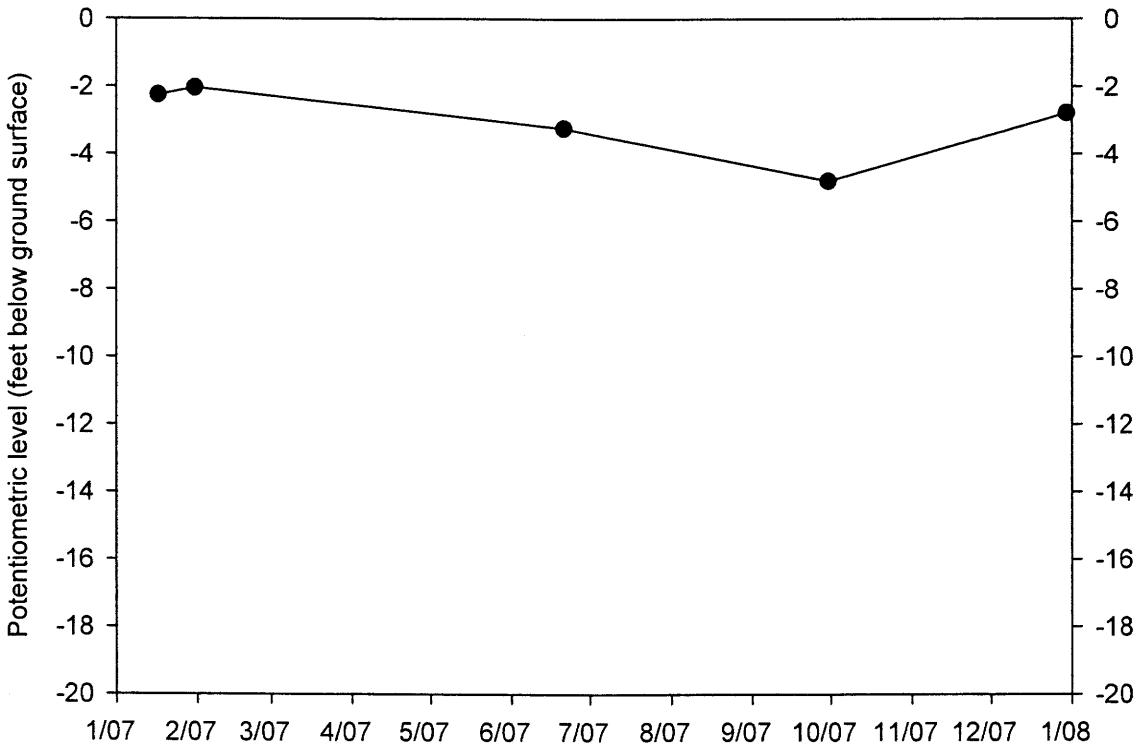
C4-15


Potentiometric level (feet below ground surface)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

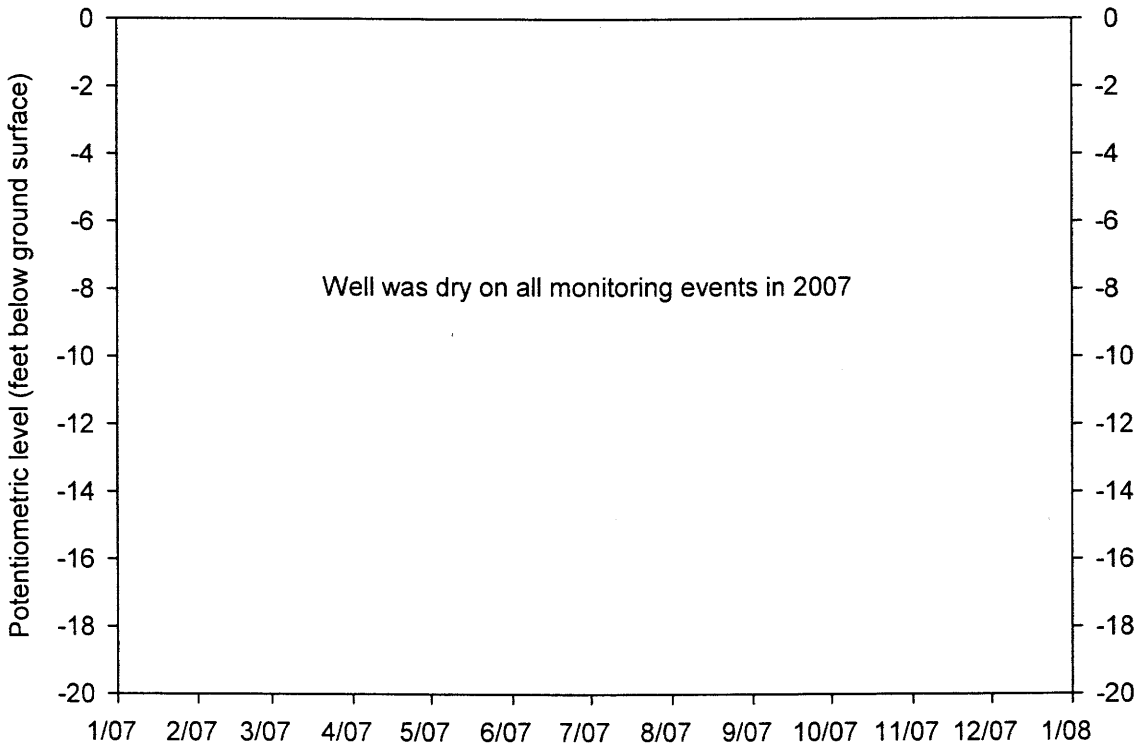
C4-30


Potentiometric level (feet below ground surface)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

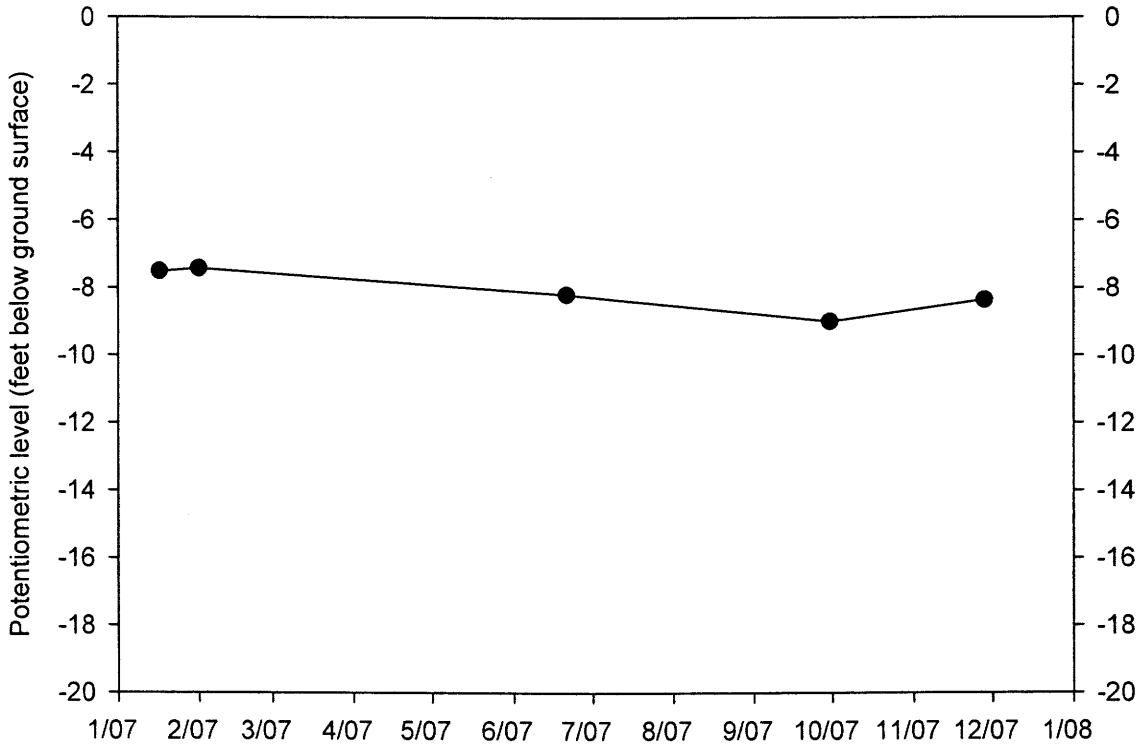
C4-50


Potentiometric level (feet below ground surface)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

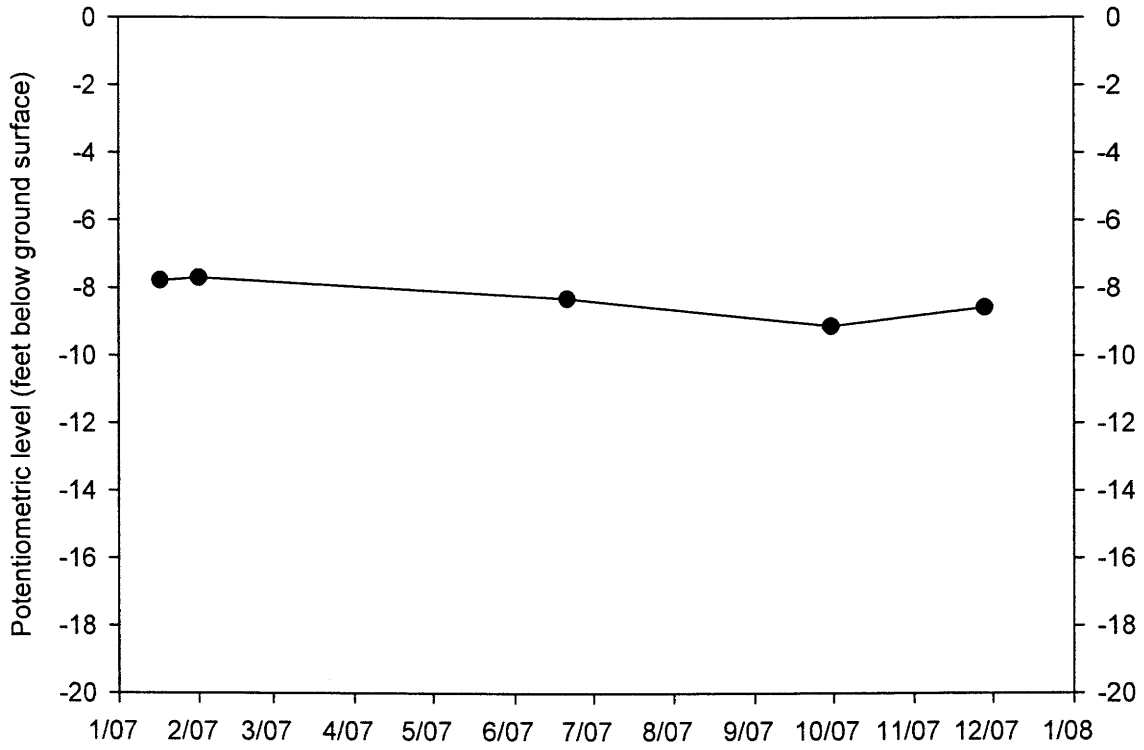
C6-15


Potentiometric level (feet below ground surface)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
Well was dry on all monitoring events in 2007
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

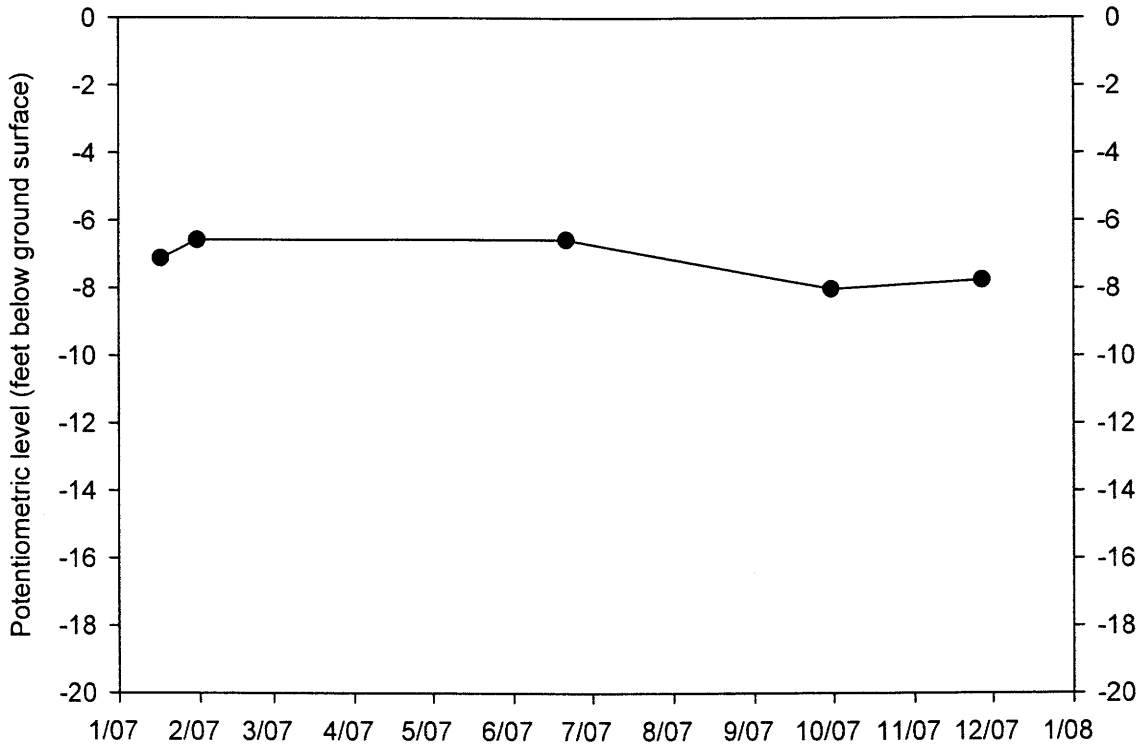
C7-10


Potentiometric level (feet below ground surface)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

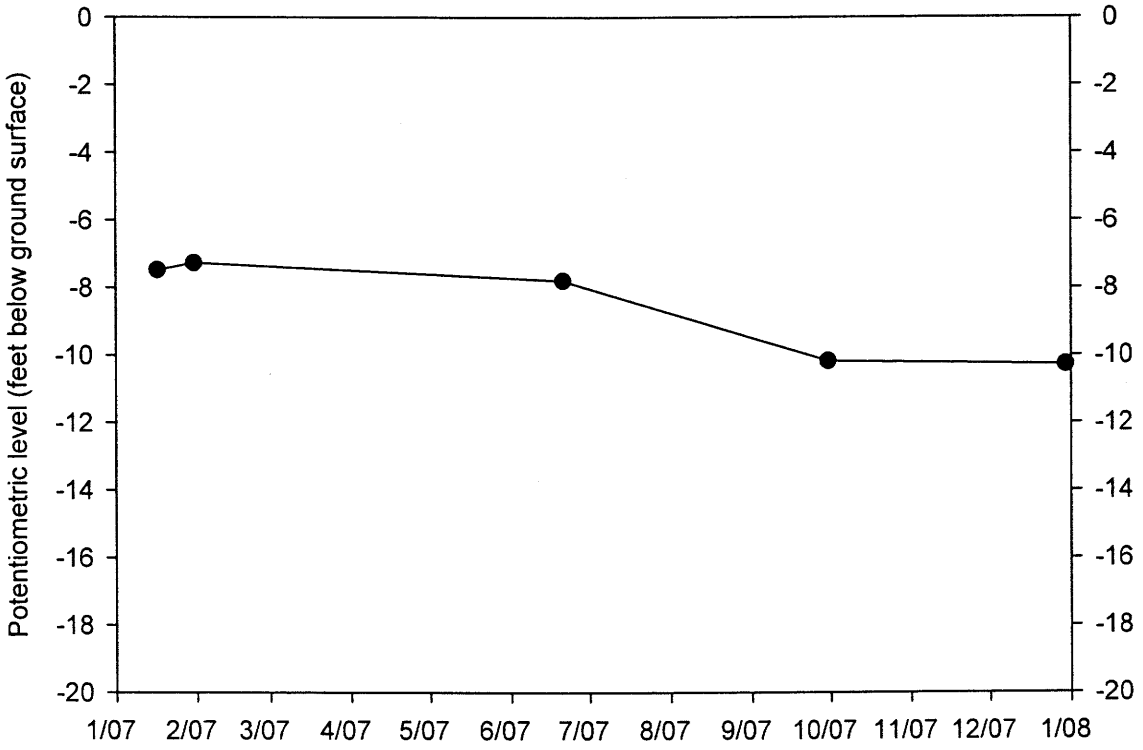
C7-20


Potentiometric level (feet below ground surface)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

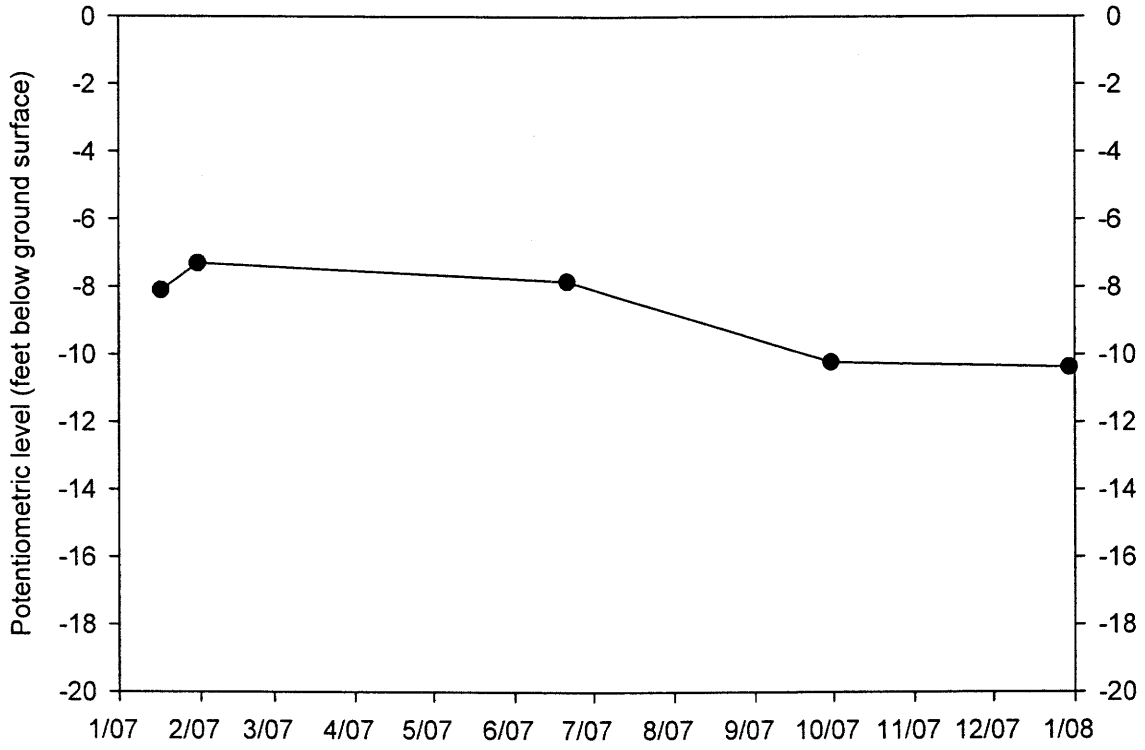
C8-25


Potentiometric level (feet below ground surface)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

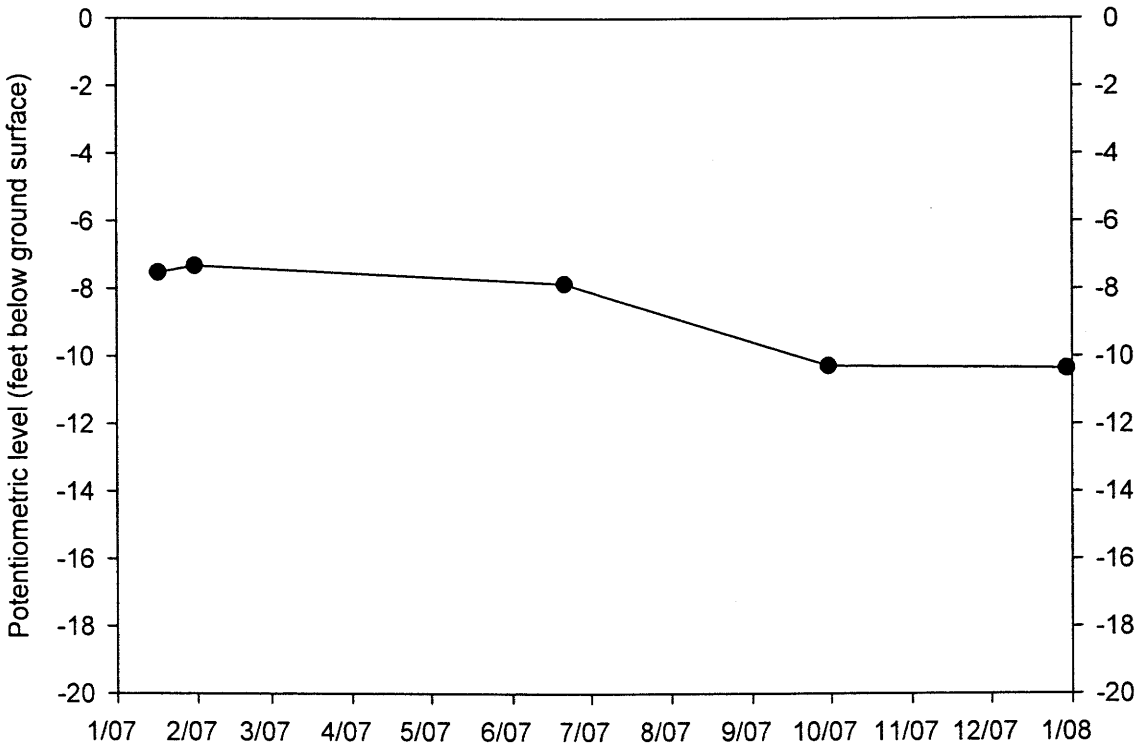
C9-15


Potentiometric level (feet below ground surface)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

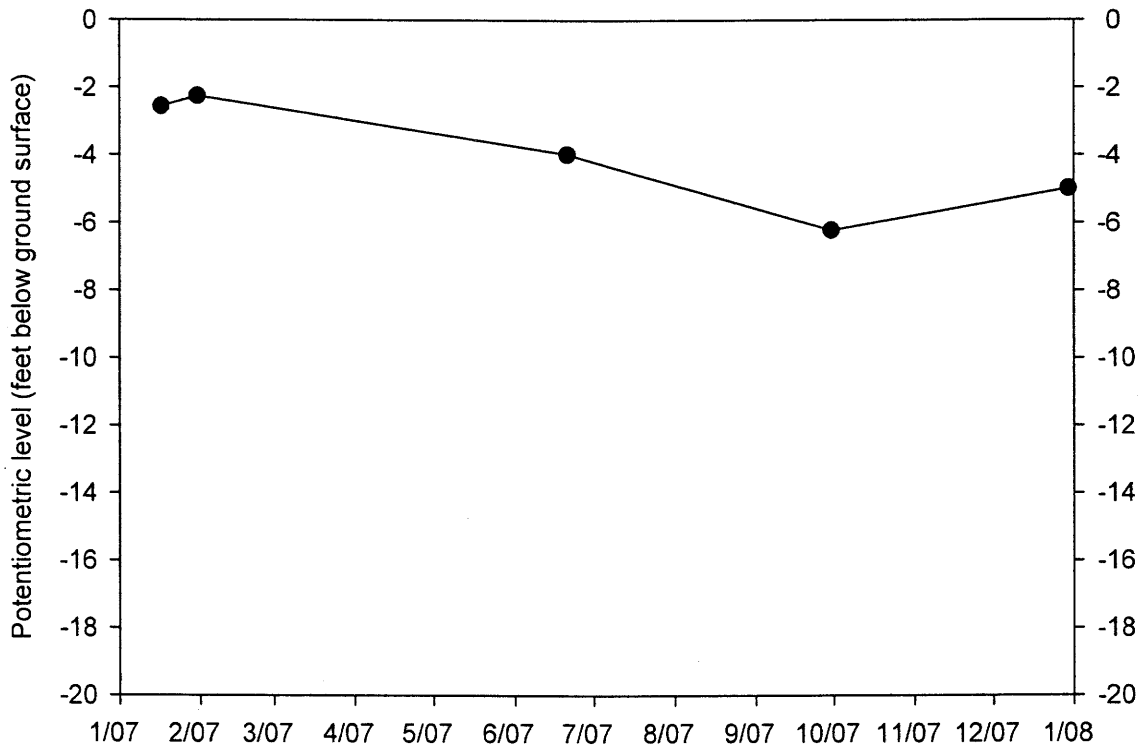
C9-25


Potentiometric level (feet below ground surface)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

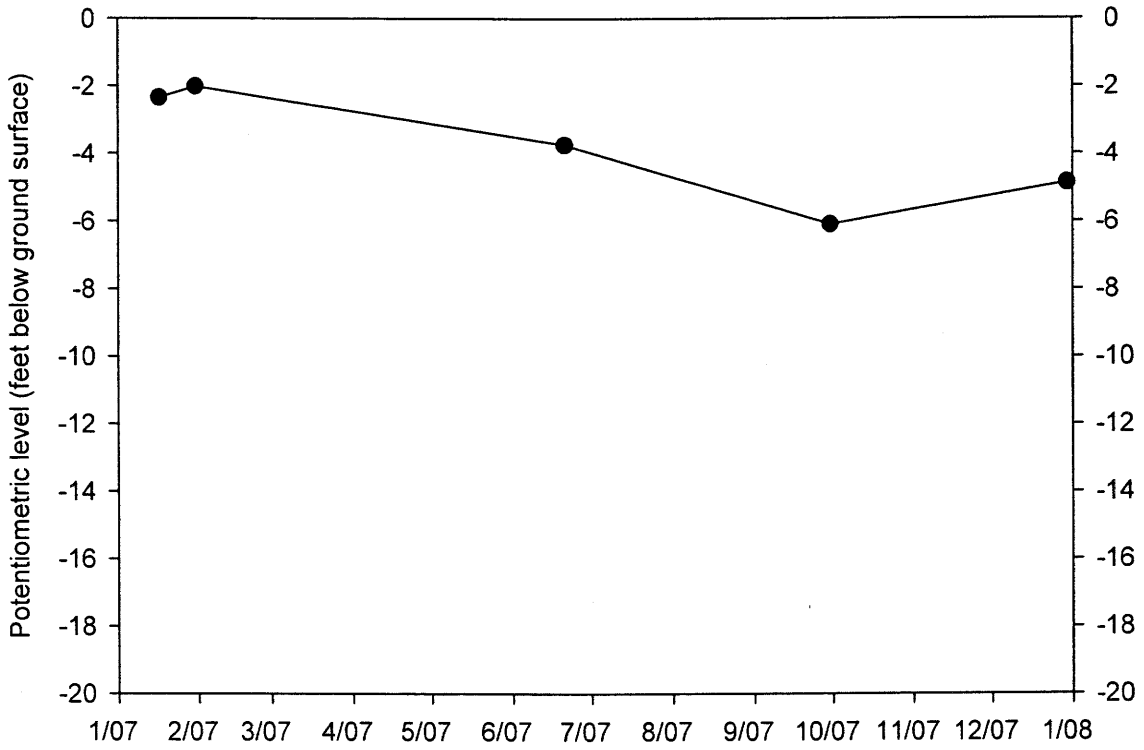
C9-40


Potentiometric level (feet below ground surface)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

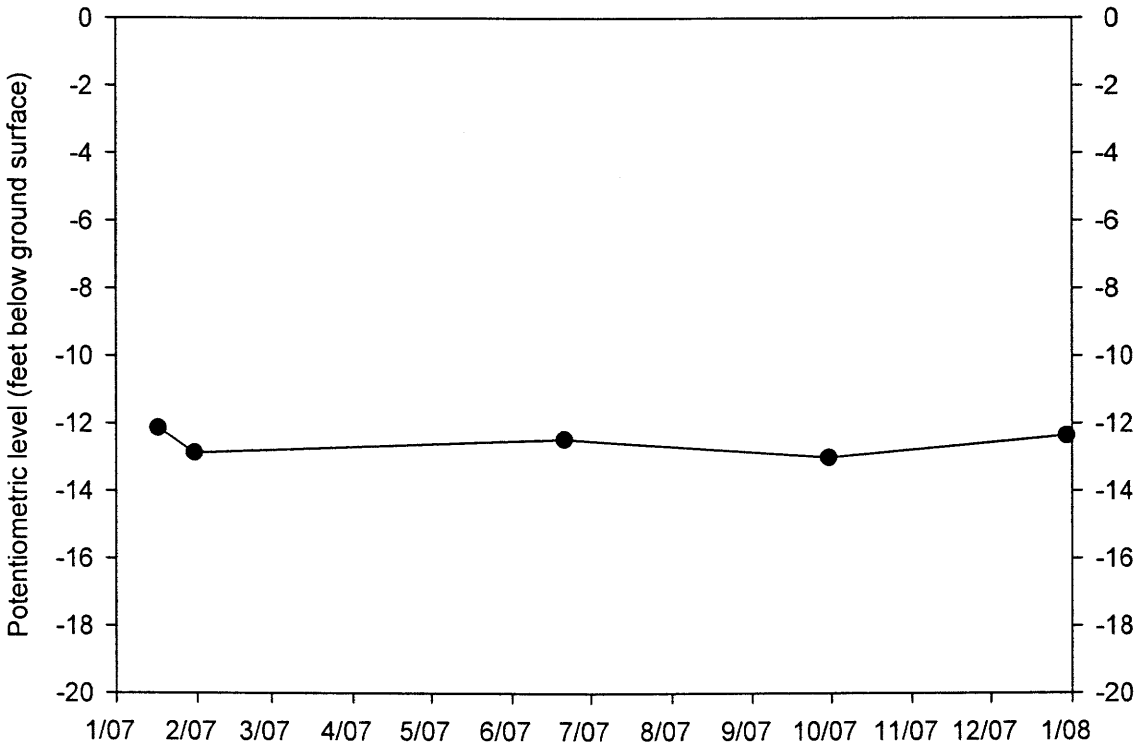
SS-15


Potentiometric level (feet below ground surface)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

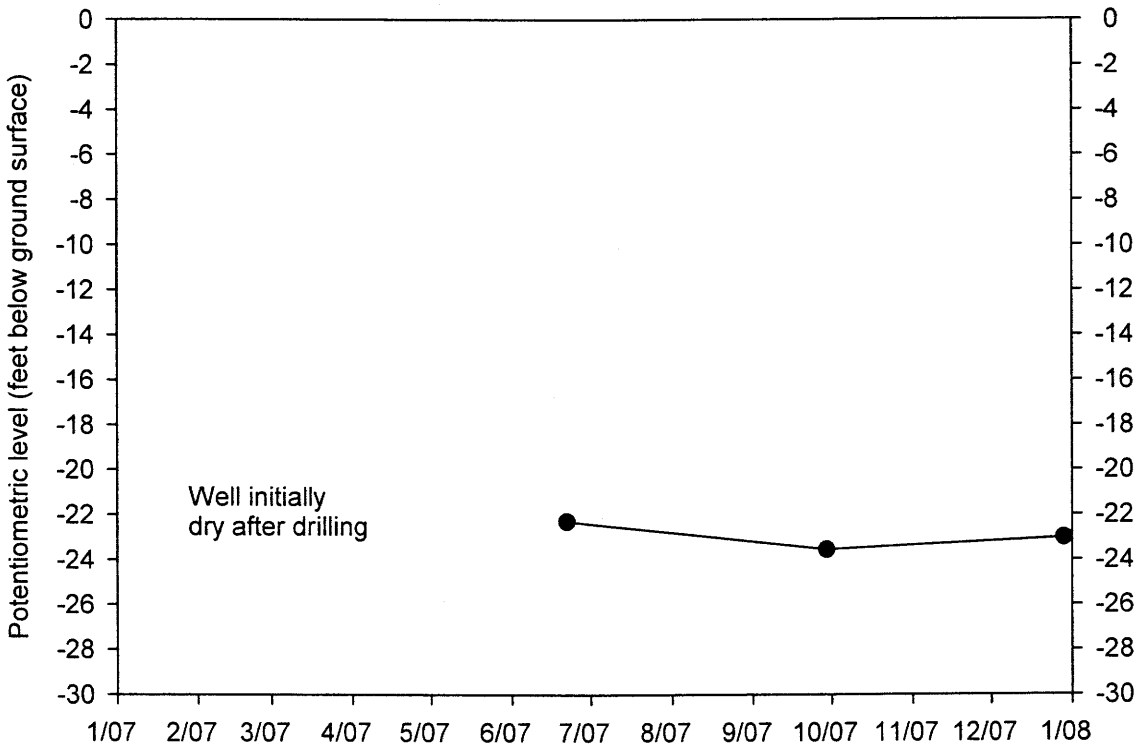
SS-30


Potentiometric level (feet below ground surface)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

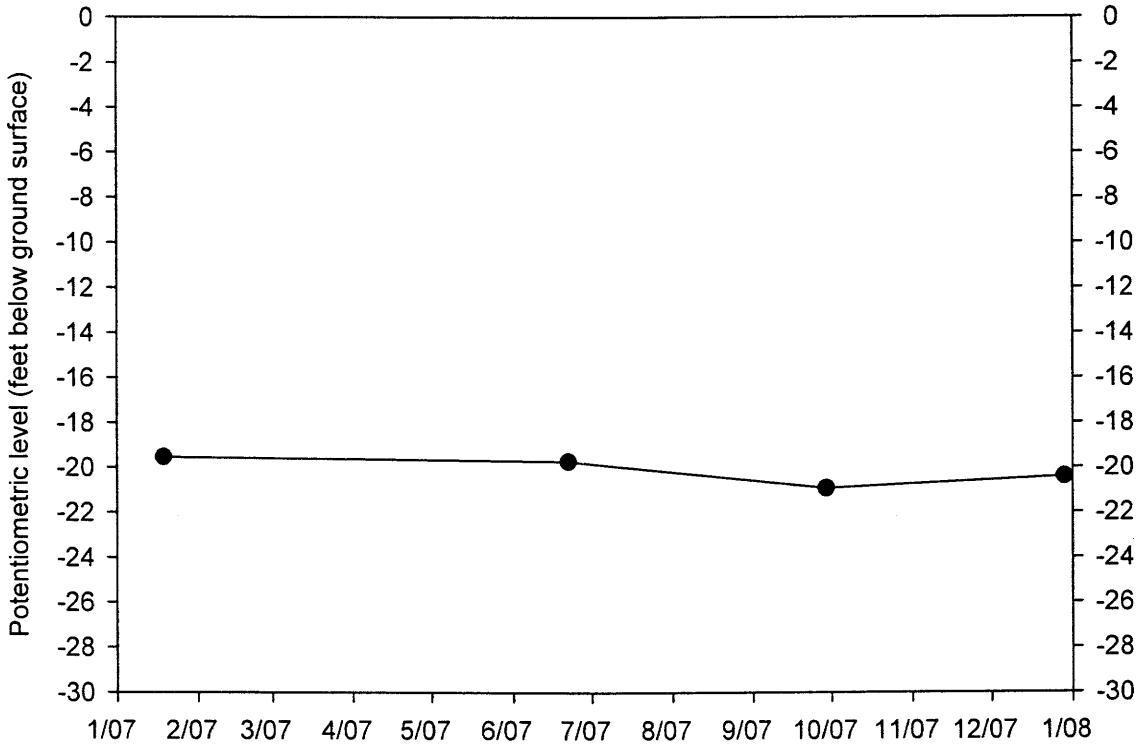
SS-75


Potentiometric level (feet below ground surface)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

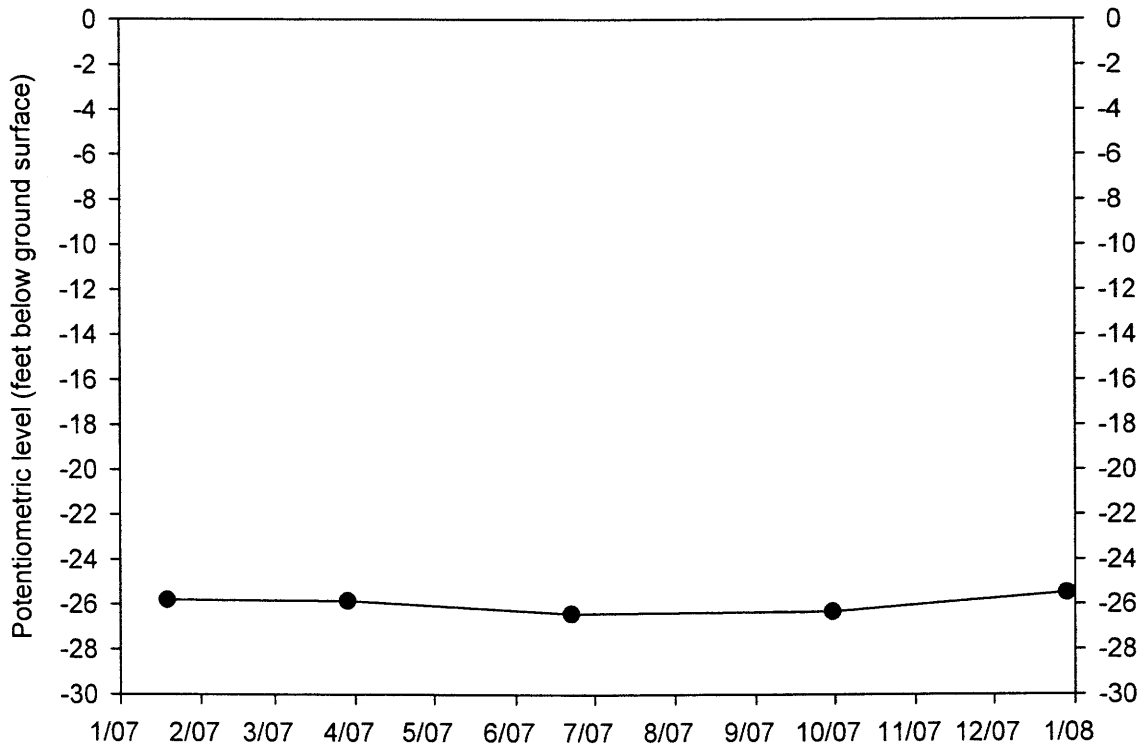
UR-29


Potentiometric level (feet below ground surface)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
Well initially
dry after drilling
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

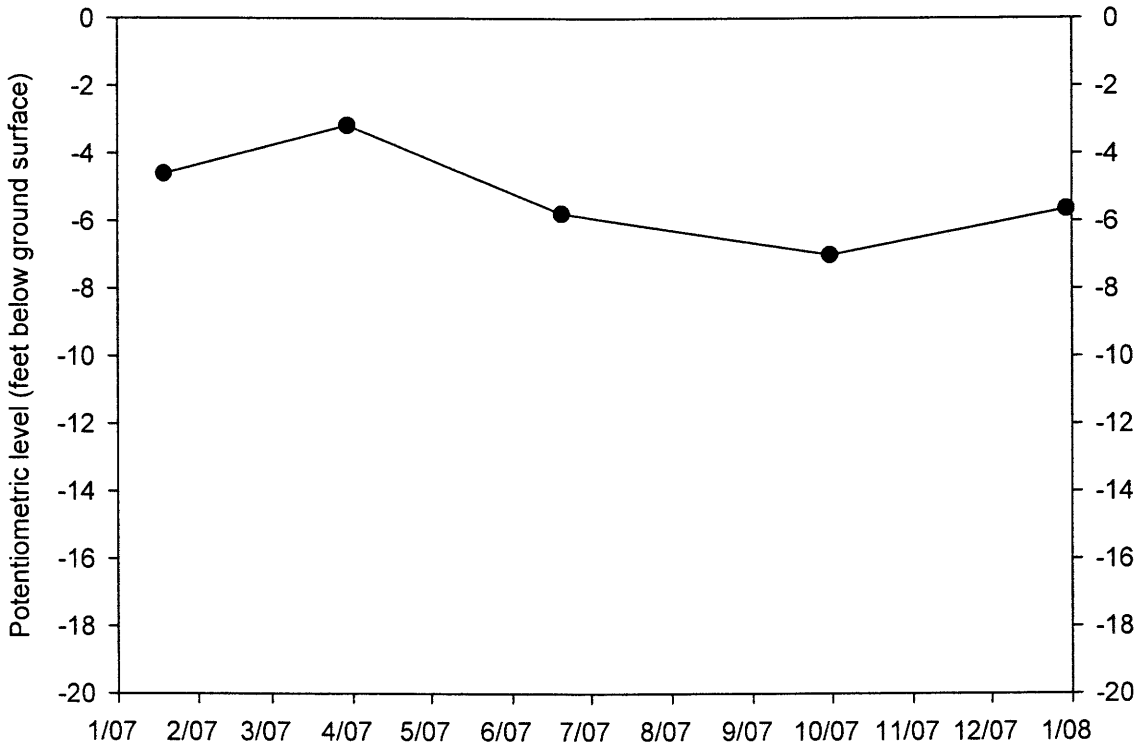
UR-70


Potentiometric level (feet below ground surface)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

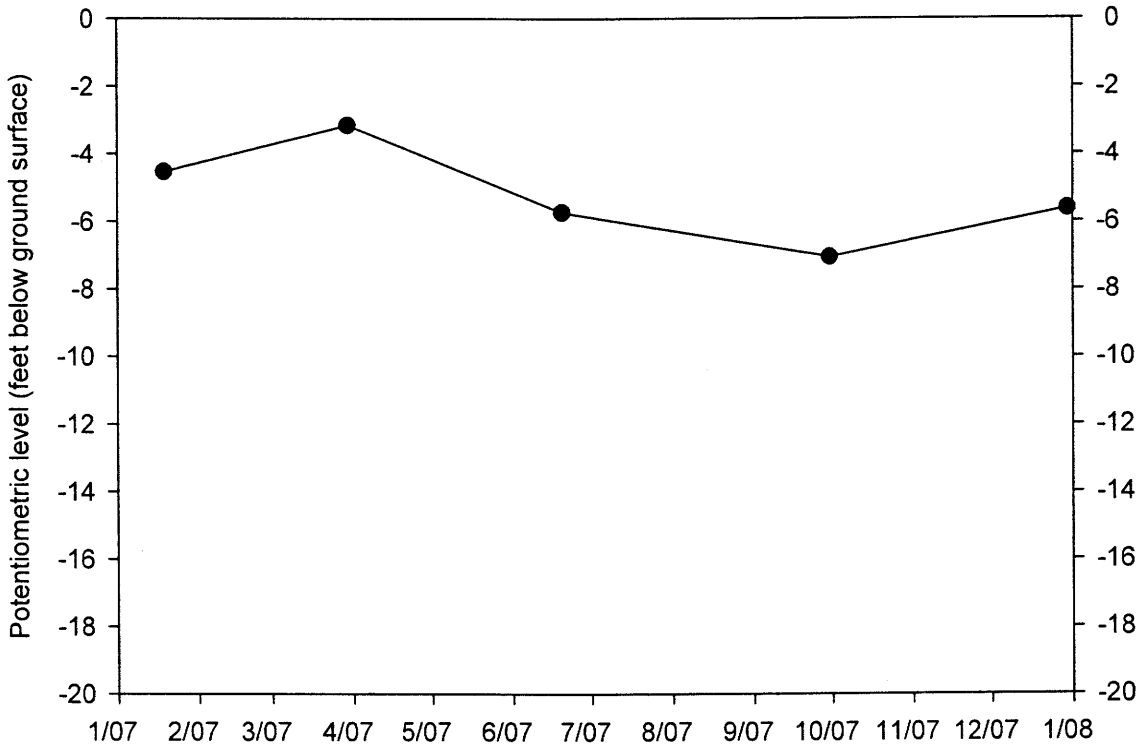
LR-45


Potentiometric level (feet below ground surface)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

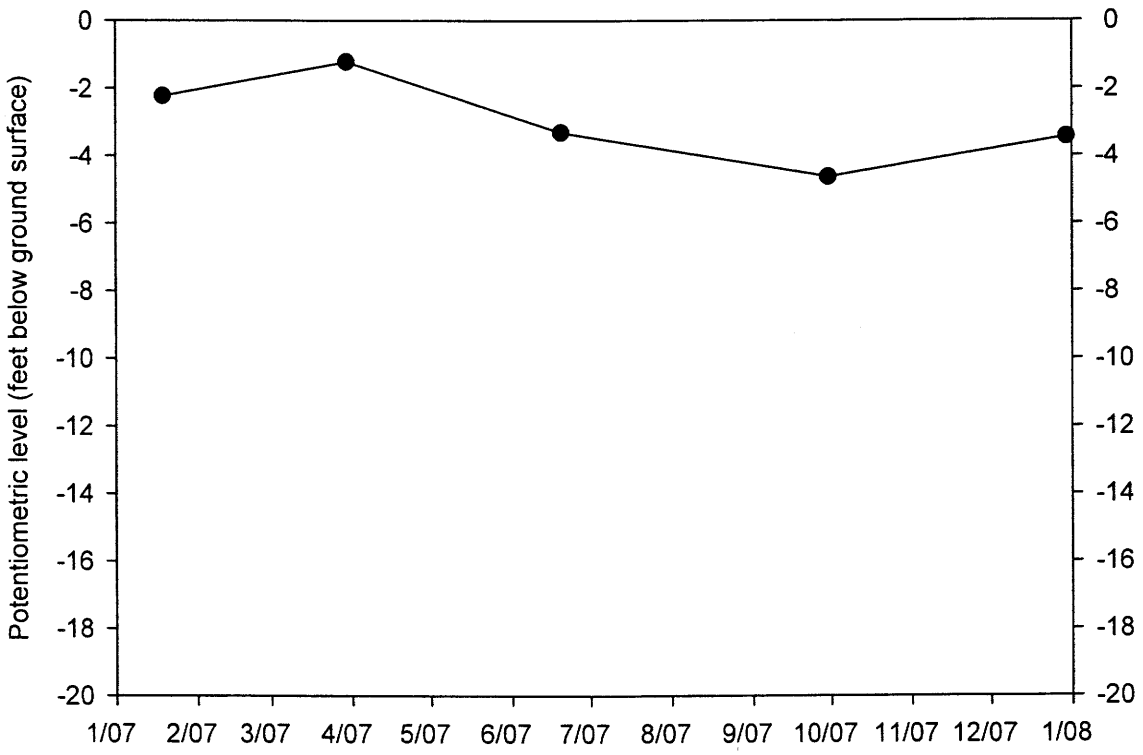
LS-15


Potentiometric level (feet below ground surface)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

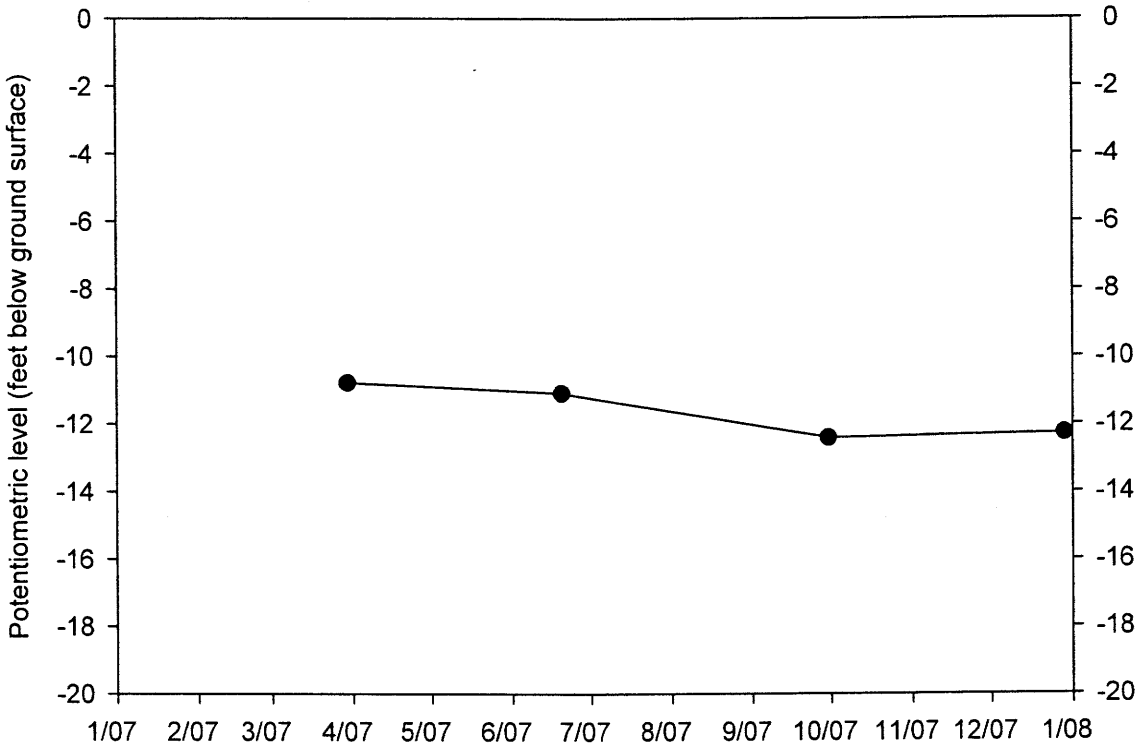
LS-28


Potentiometric level (feet below ground surface)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

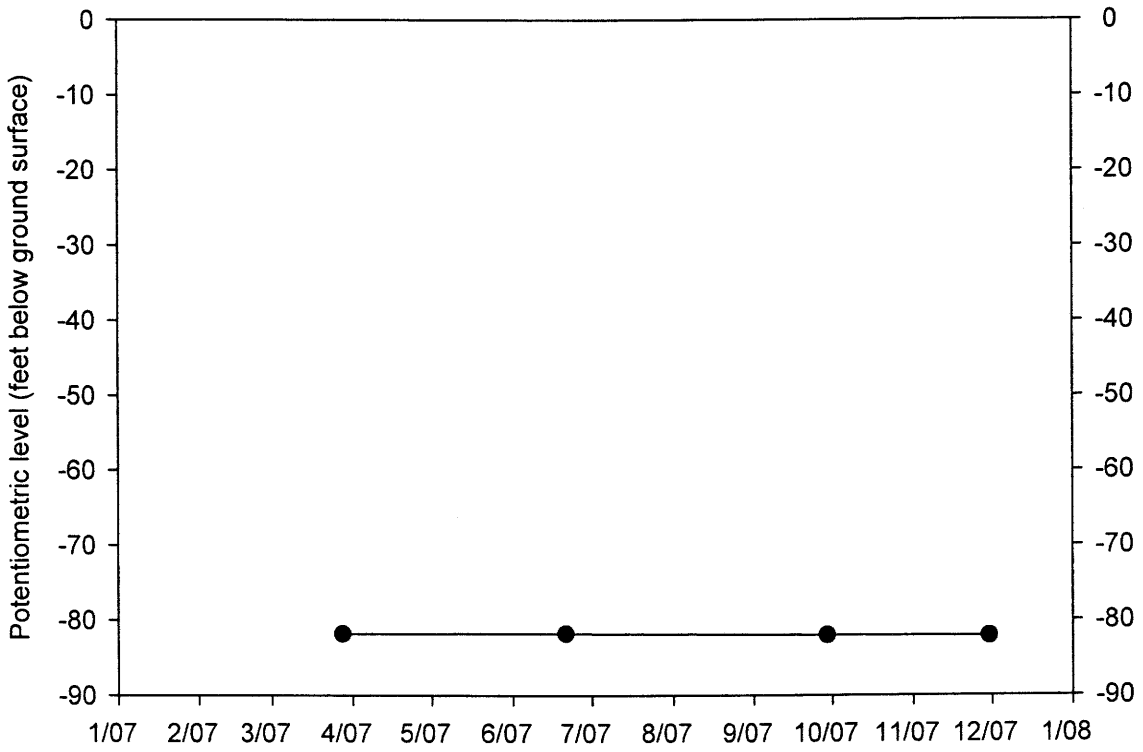
LS-60


Potentiometric level (feet below ground surface)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

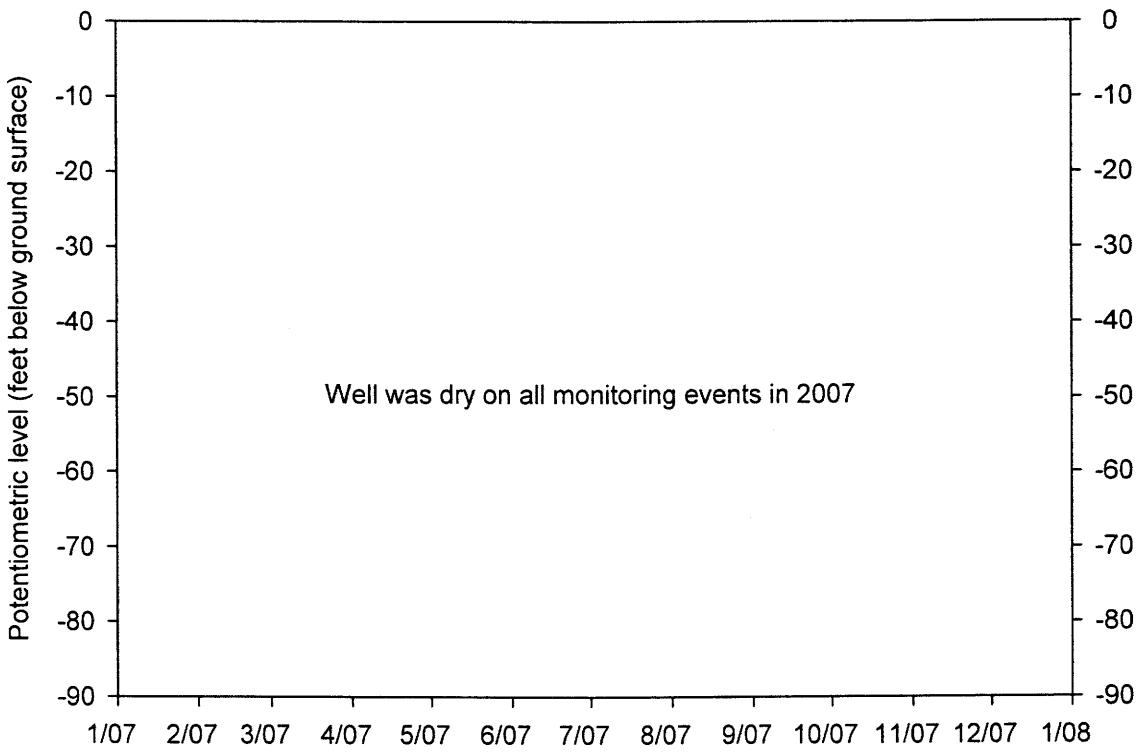
Y-63


Potentiometric level (feet below ground surface)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

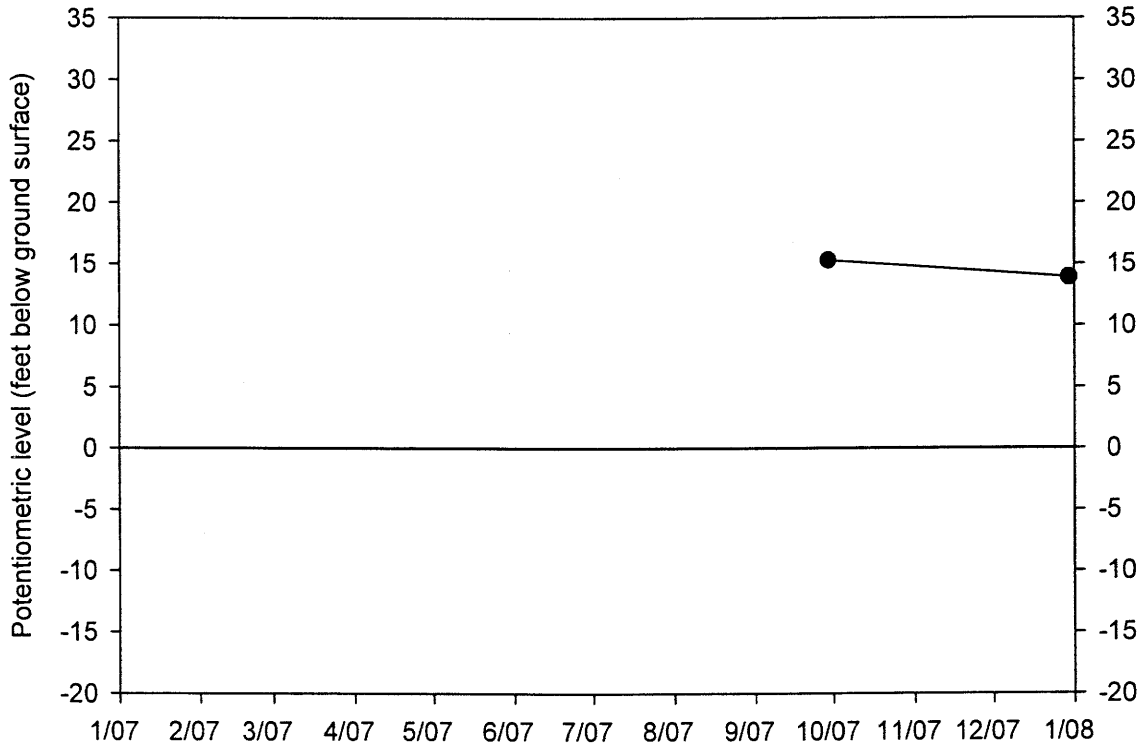
Y-98


Potentiometric level (feet below ground surface)
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

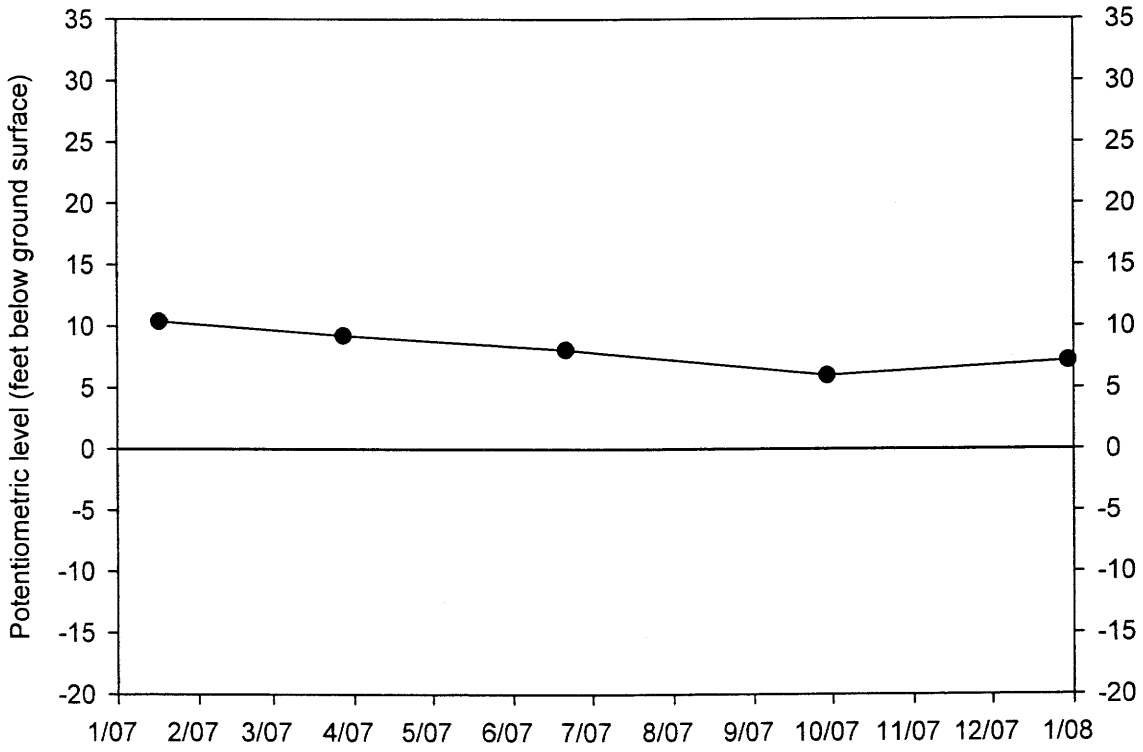
Y-99


Potentiometric level (feet below ground surface)
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Well was dry on all monitoring events in 2007
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

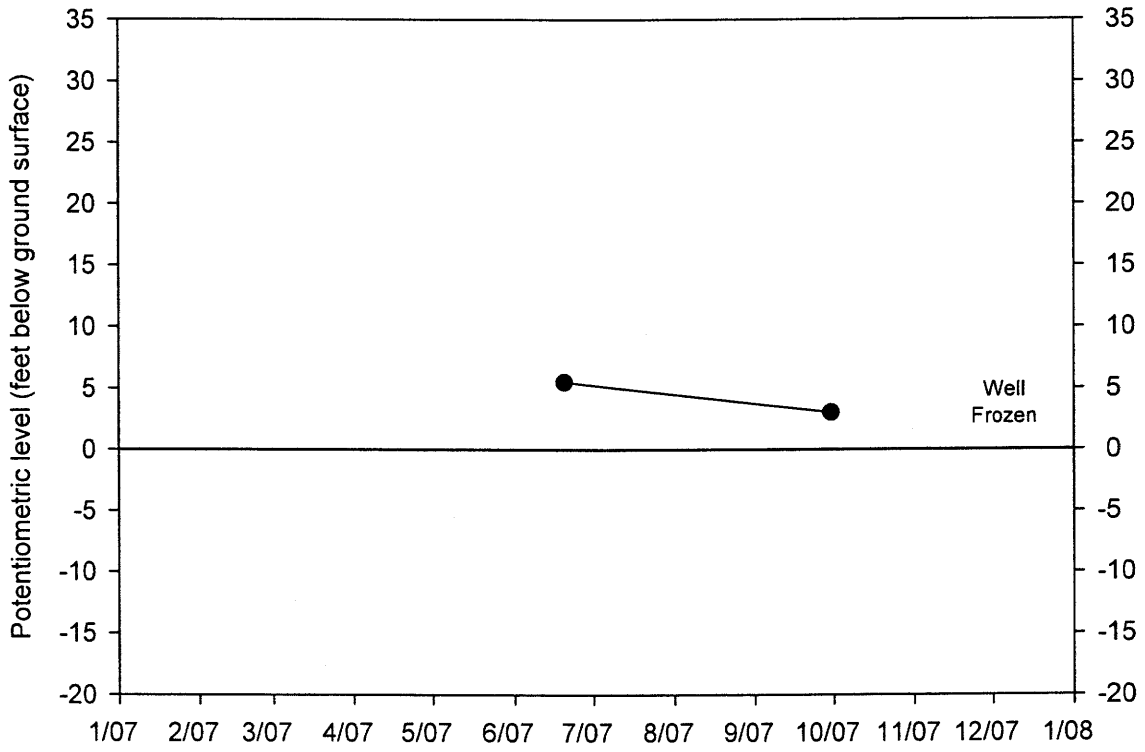
Y-61


Potentiometric level (feet below ground surface)
35
30
25
20
15
10
5
0
-5
-10
-15
-20
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

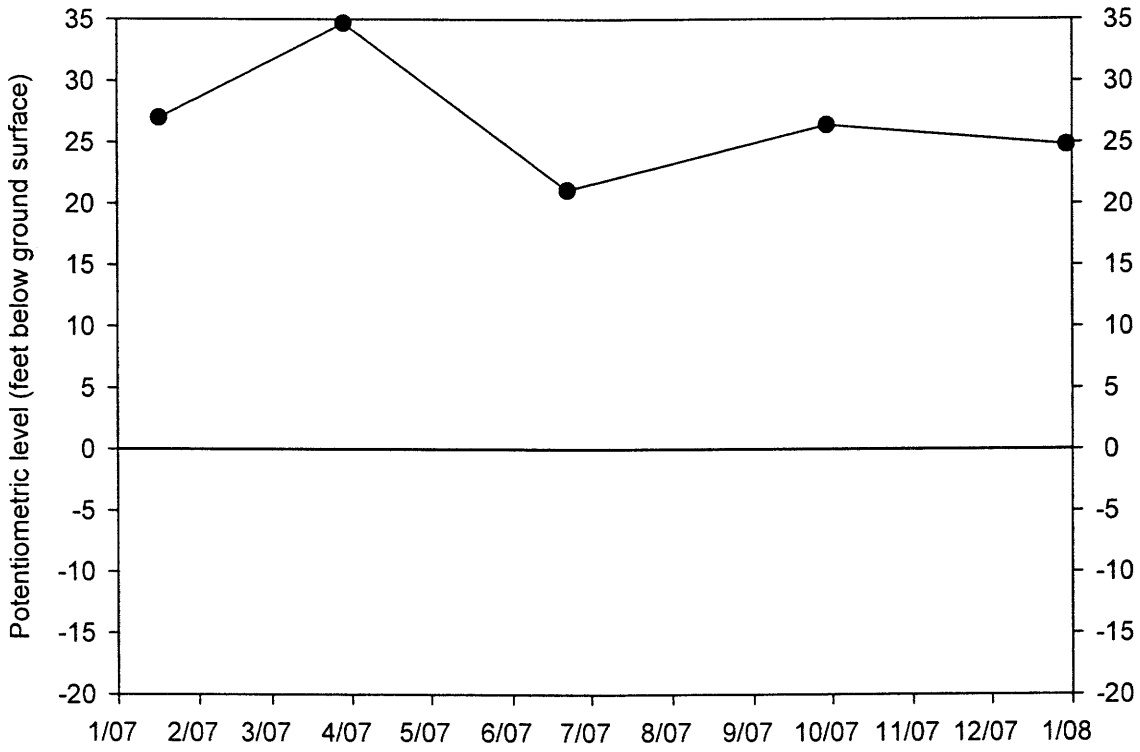
Y-102

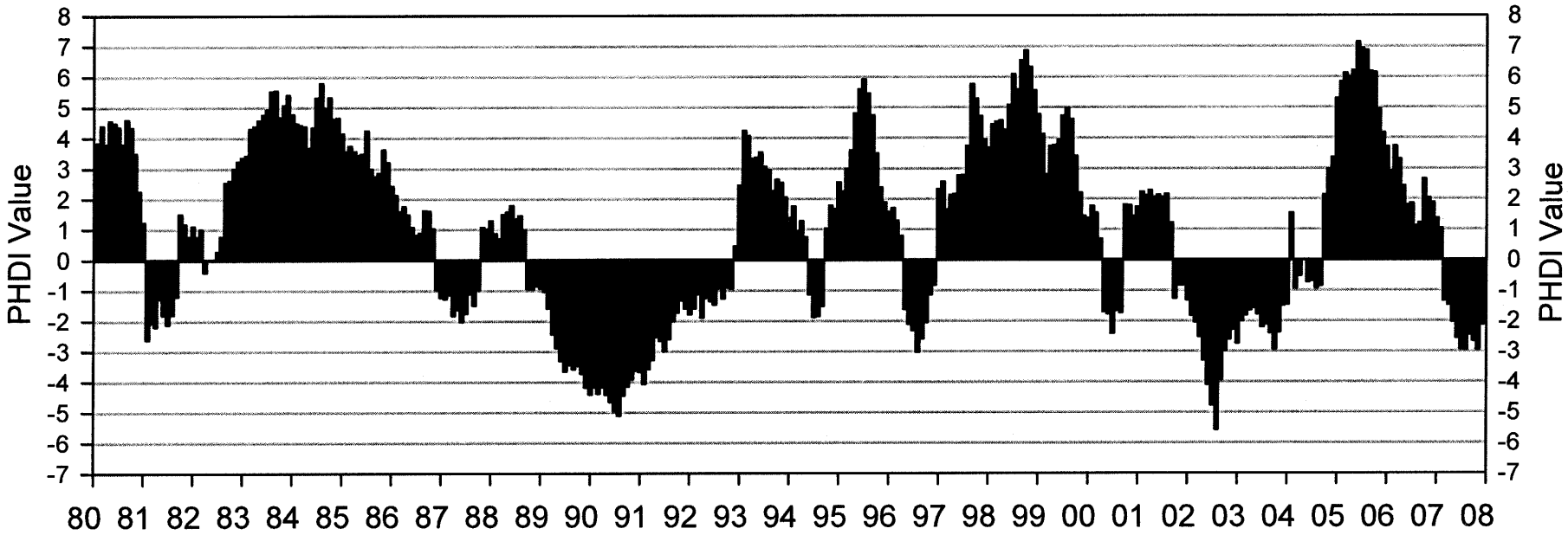

Potentiometric level (feet below ground surface)
35
30
25
20
15
10
5
0
-5
-10
-15
-20
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

LS-85


Potentiometric level (feet below ground surface)
35
30
25
20
15
10
5
0
-5
-10
-15
-20
Well
Frozen
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08

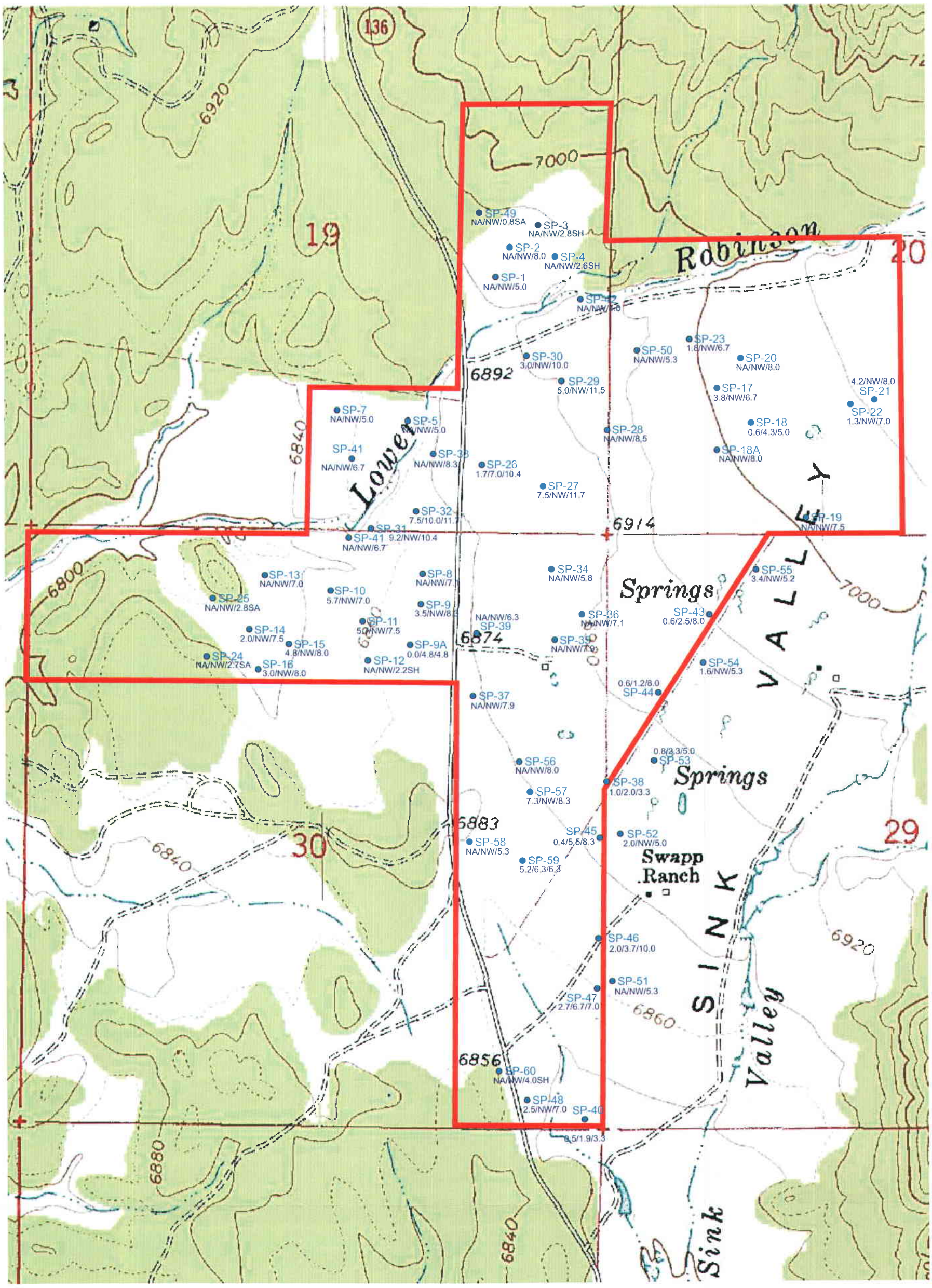
C5-130


Potentiometric level (feet below ground surface)
35
30
25
20
15
10
5
0
-5
-10
-15
-20
1/07
2/07
3/07
4/07
5/07
6/07
7/07
8/07
9/07
10/07
11/07
12/07
1/08



-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 4 Plot of Palmer Hydologic Drought Index for Utah Region 4.



Legend

● SP-60	Soil pit location
NA/NW/4.0SH	Depth to aquic soil (ft) /Depth to soil mottling (ft) /depth of pit (ft) (SS=sandstone bedrock in pit bottom; SH = shale bedrock in pit bottom)

0 — 1,000 feet — 2,000 feet

North

Figure 5 Depth to aquic soils and soil mottling in soils pits in the Coal Hollow Project area.

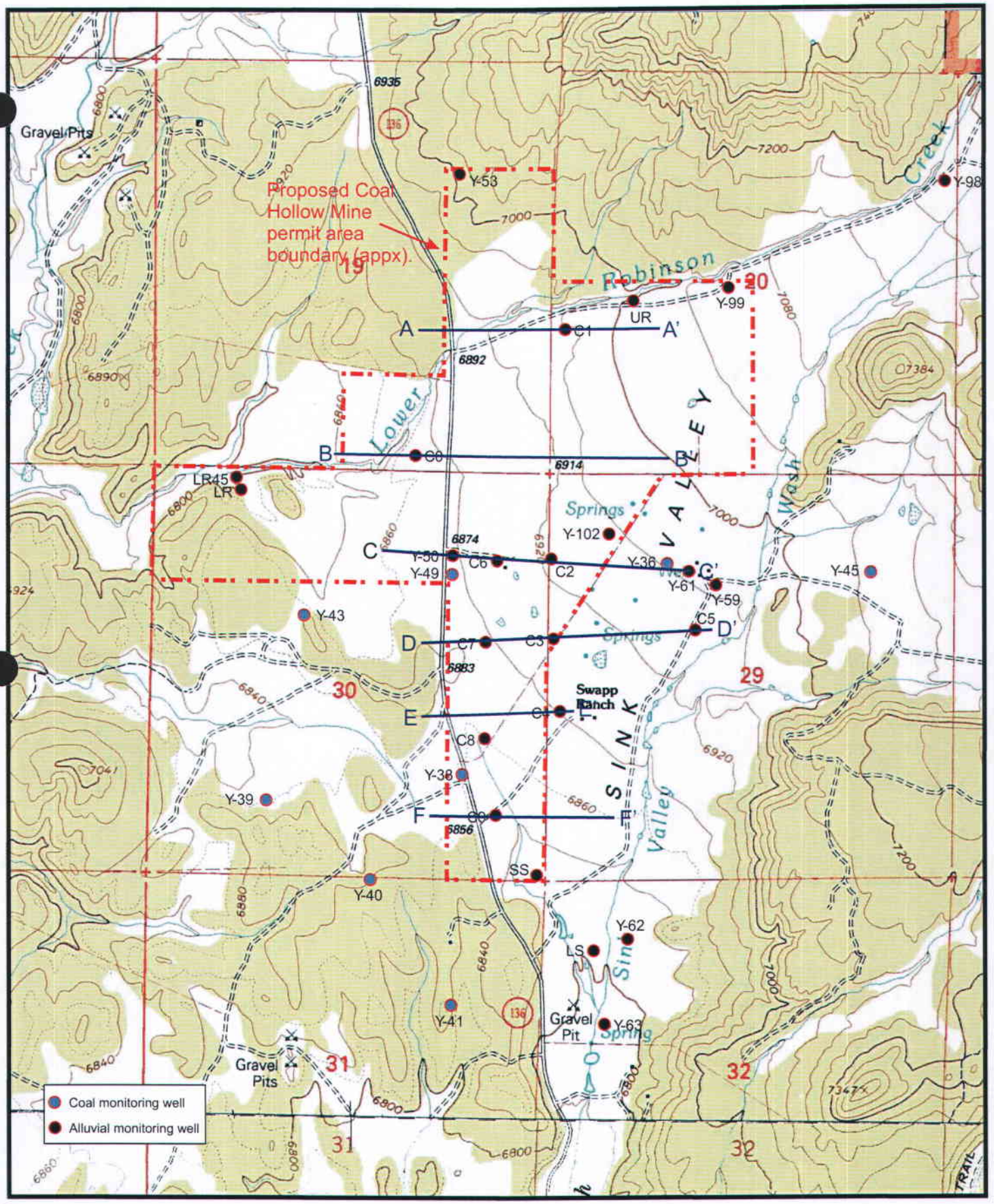
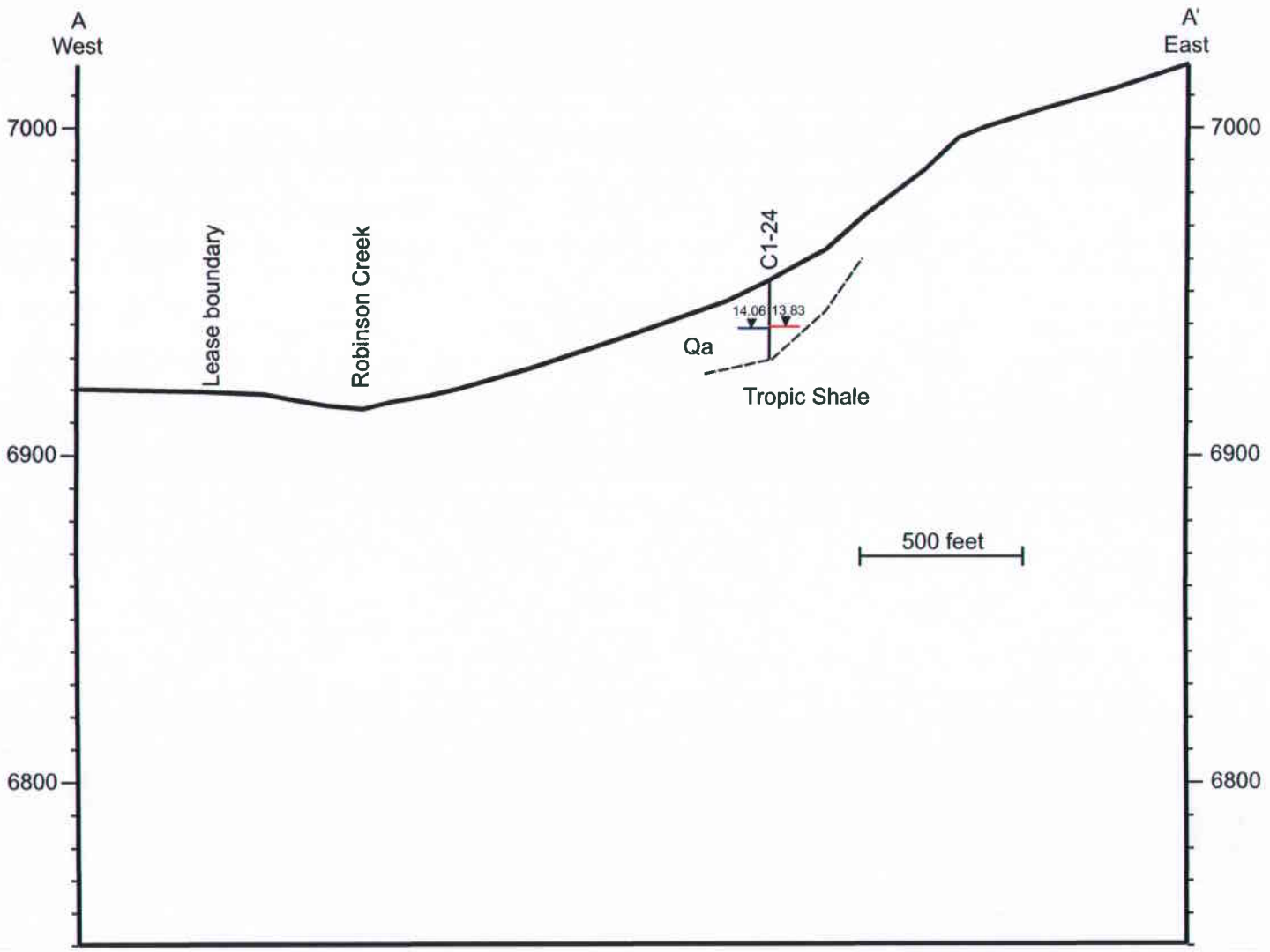


Figure 6a Cross-sections location map.



7.79 Depth to water below ground surface June 2007

10.28 Depth to water below ground surface Nov/Dec 2007

500 feet

Figure 6b Cross-section A - A'

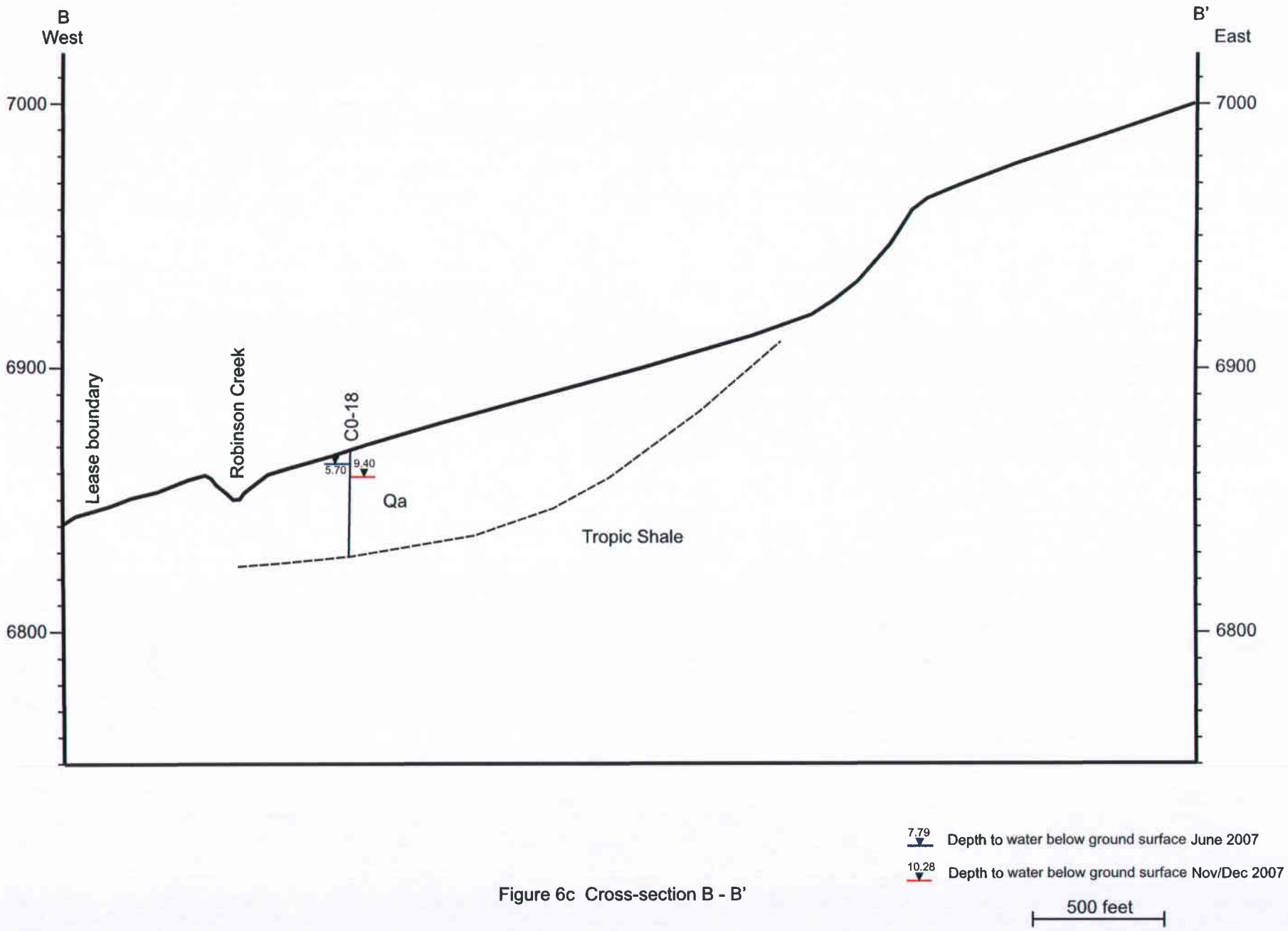


Figure 6c Cross-section B - B'

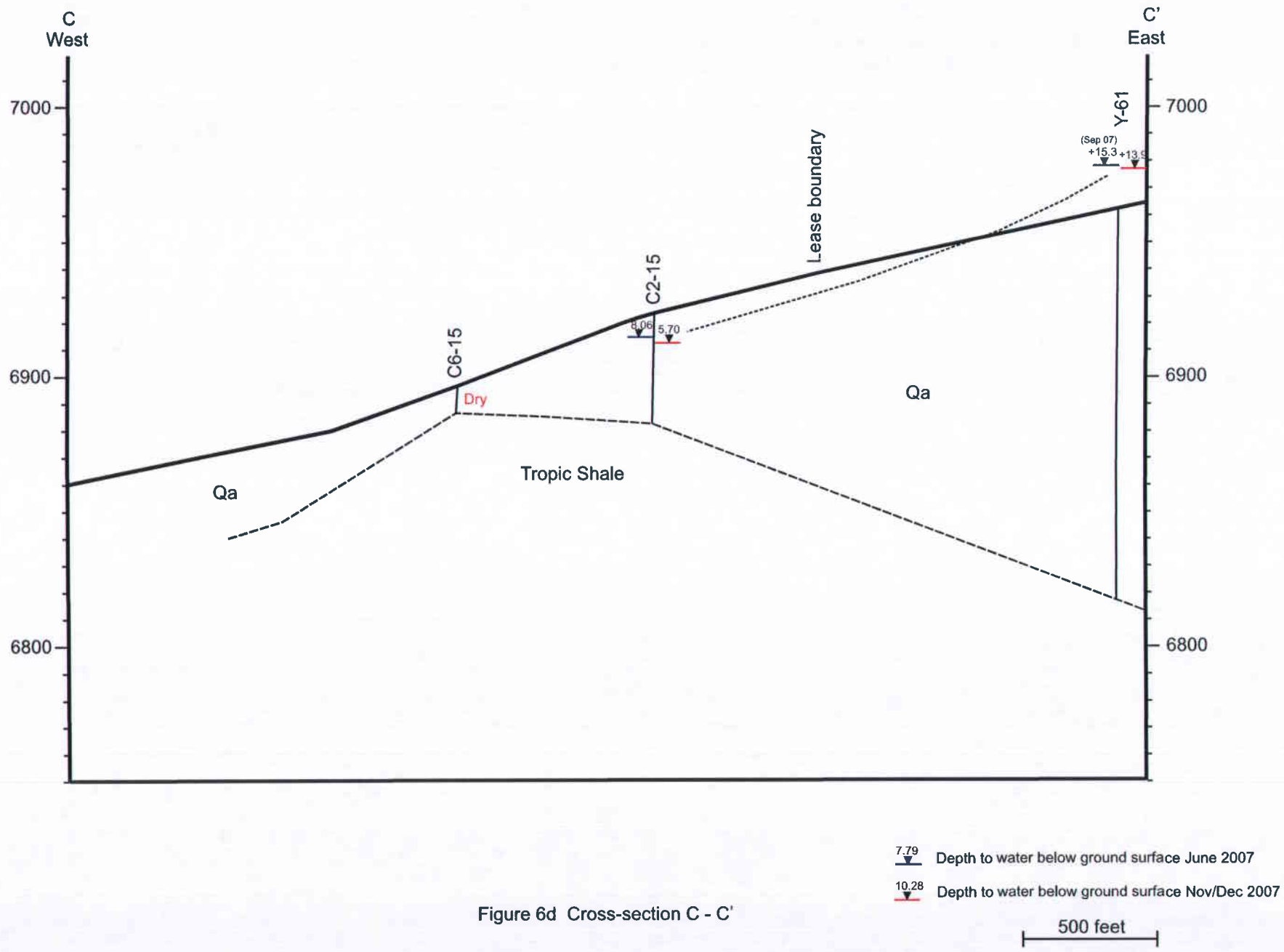
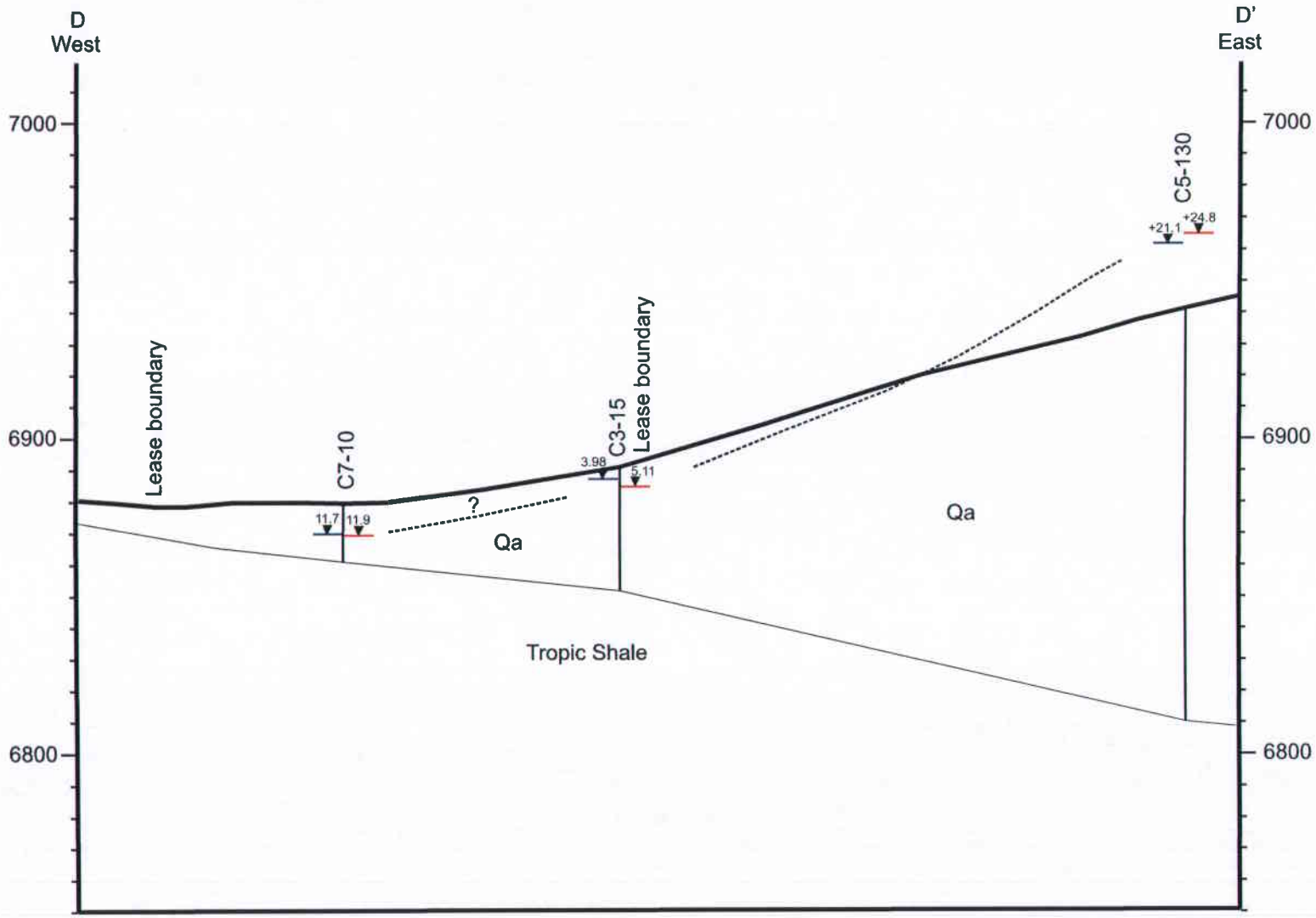


Figure 6d Cross-section C - C'

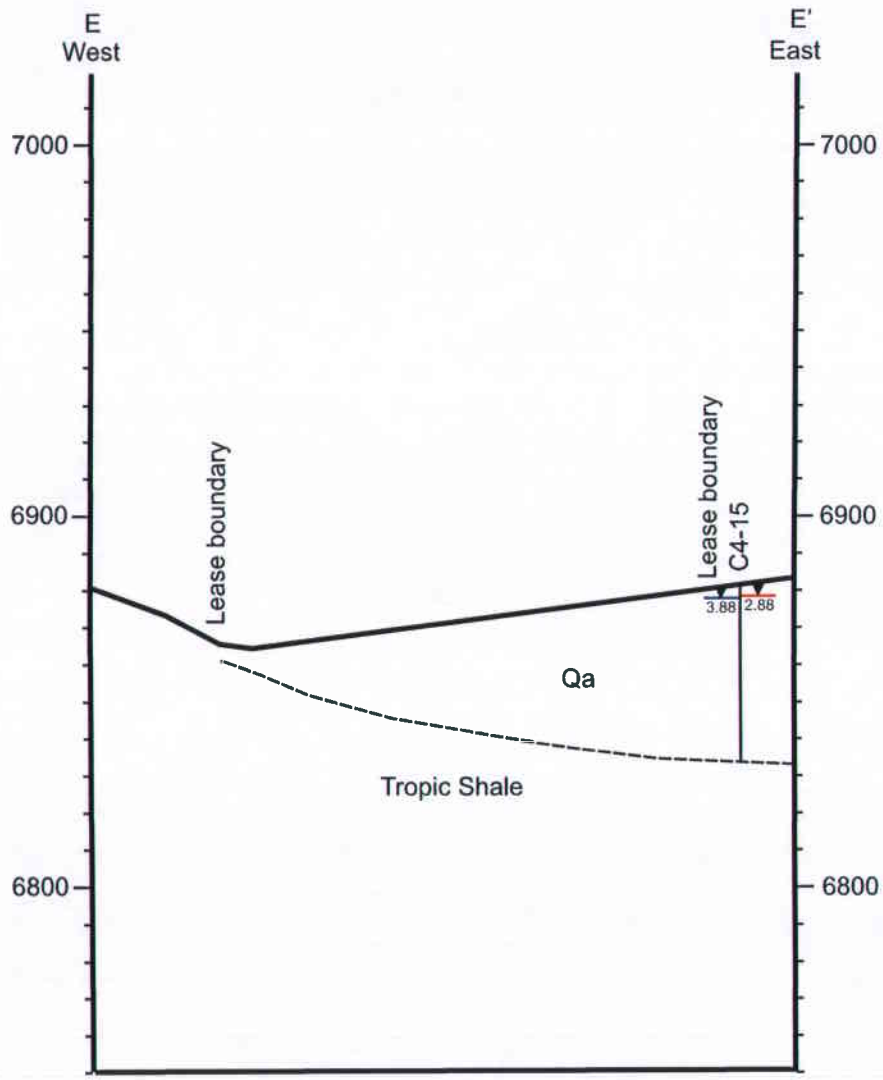


7.79 Depth to water below ground surface June 2007

10.28 Depth to water below ground surface Nov/Dec 2007

500 feet

Figure 6e Cross-section D - D'

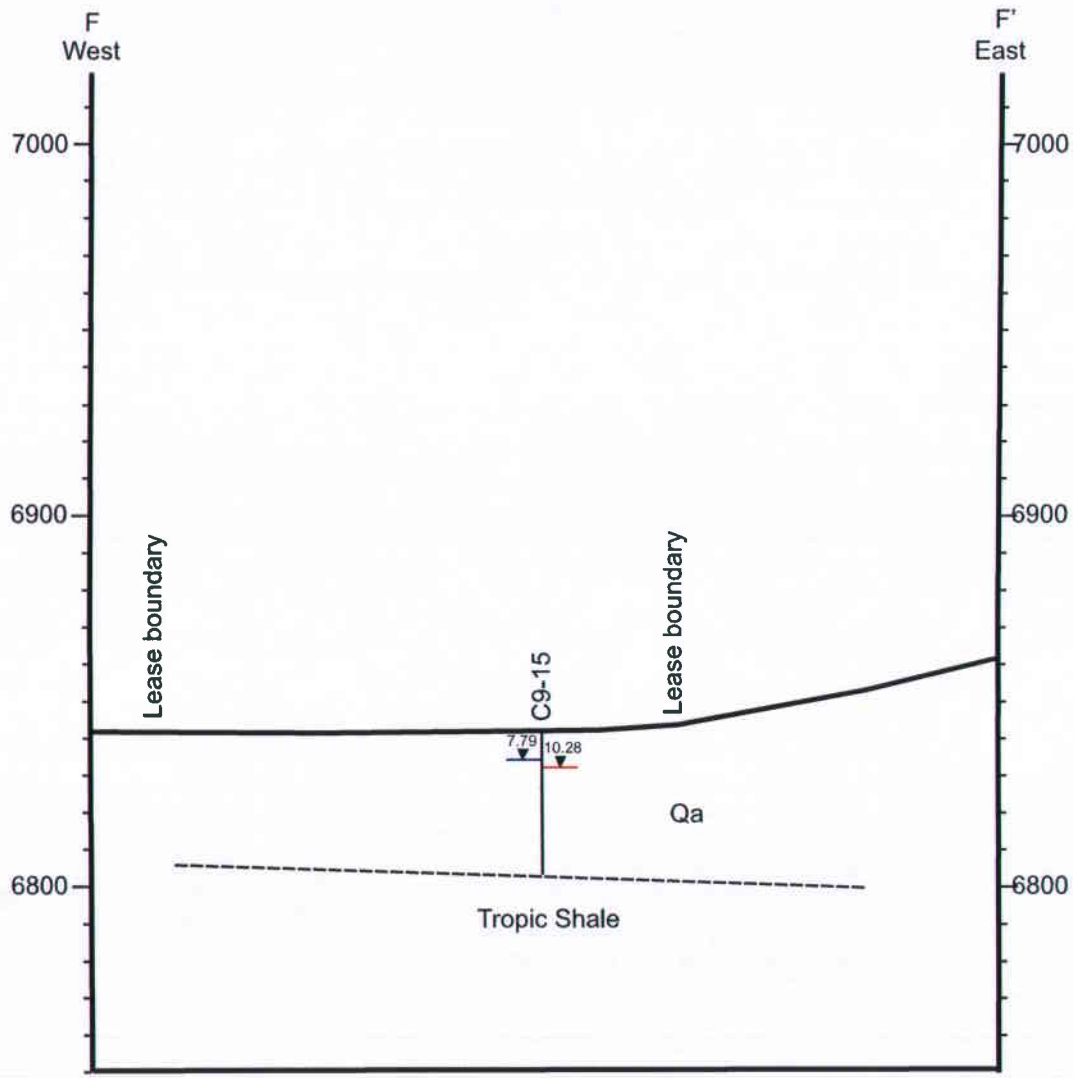


7.79 Depth to water below ground surface June 2007

10.28 Depth to water below ground surface Nov/Dec 2007

500 feet

Figure 6f Cross-section E - E'

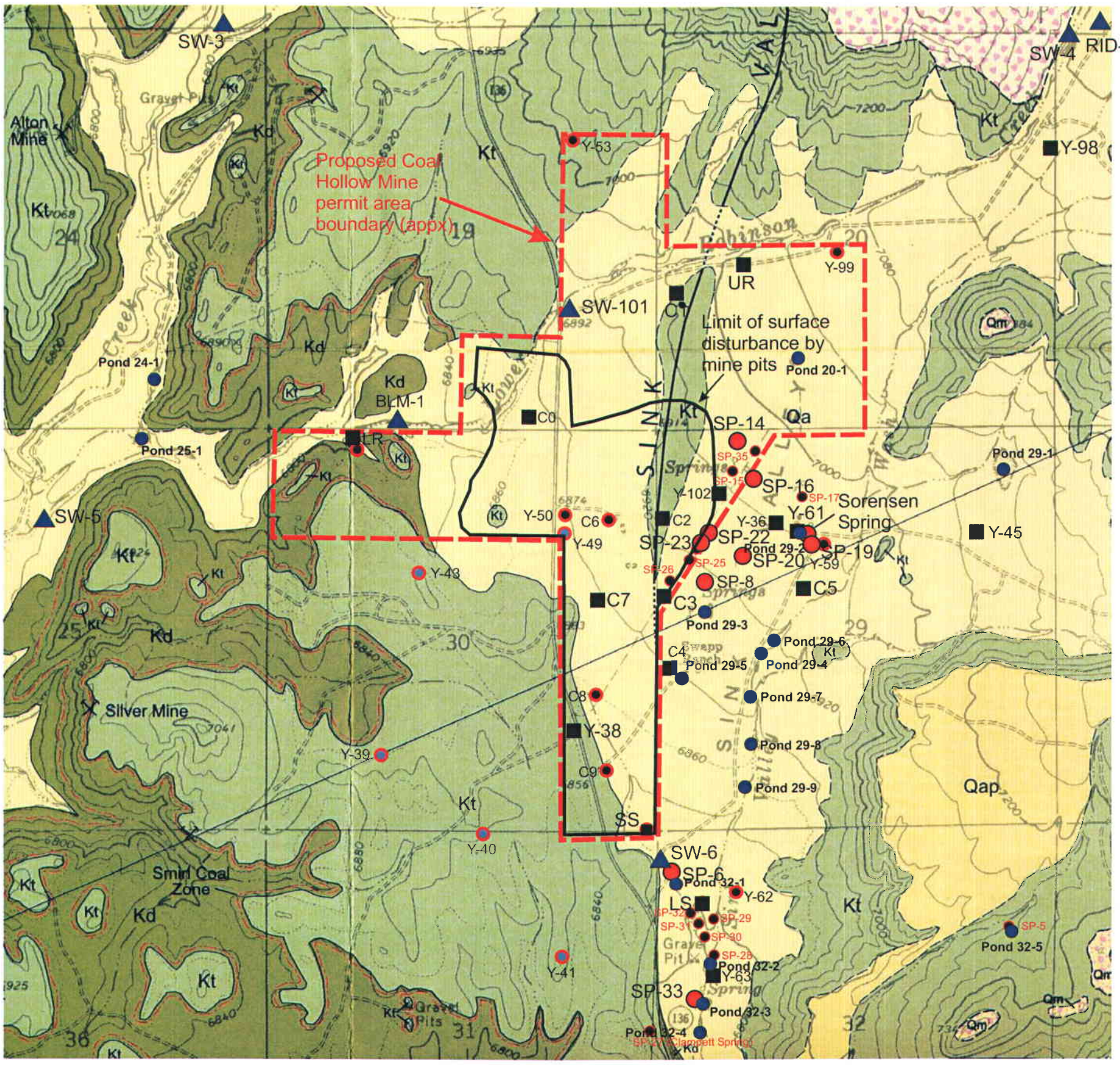


7.79 Depth to water below ground surface June 2007

10.28 Depth to water below ground surface Nov/Dec 2007

500 feet

Figure 6g Cross-section F - F'



Springs

Monitored springs

spring and seep survey

Ponds

Stream monitoring station

Monitoring wells

Alluvial well

Coal well

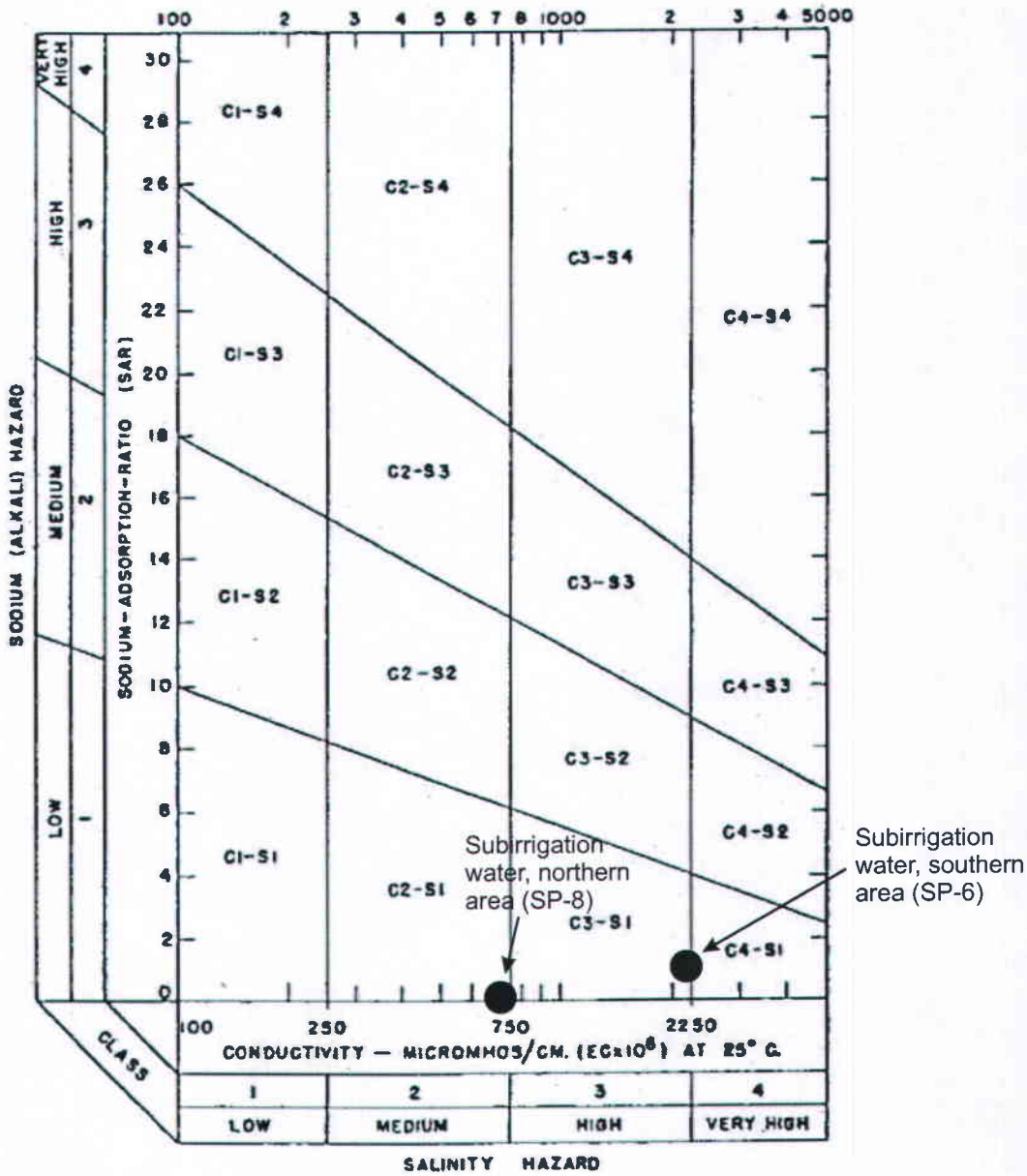
Baseline monitoring well

North

1 Mile

See Appendix 6-3 for geologic legend

Figure 8 Locations of streams, ponds, springs and wells in relation to surface geology.



After OSM (1983)

Conductivity

C1 Low-salinity water: Can be used for irrigation with most crops on most soils with little likelihood that soil salinity will develop.
C2 Medium-salinity water: Can be used in a moderate amount of leaching occurs.
C3 High-salinity water: Cannot be used on soils with restricted drainage. With adequate drainage, special management for salinity control may be required and plants with good salt tolerance should be selected.
C4 Very high salinity water: Is not suitable for irrigation under ordinary conditions.

Sodium

S1 Low-sodium water: Can be used for irrigation on almost all soils with little danger of the development of harmful levels of exchangeable sodium.
S2 Medium-sodium water: Will present an appreciable sodium hazard in fine-textured soils having a high cation-exchange capacity, especially under low-leaching conditions.
S3 High-sodium water: May produce harmful levels of exchangeable sodium in most soils and will require special management – good drainage, high leaching, and organic matter additions.
S4 Very high sodium water: Is generally unsatisfactory for irrigation purposes except at low and perhaps medium salinity.

Figure 9 Water quality suitability criteria for potential subirrigation waters.

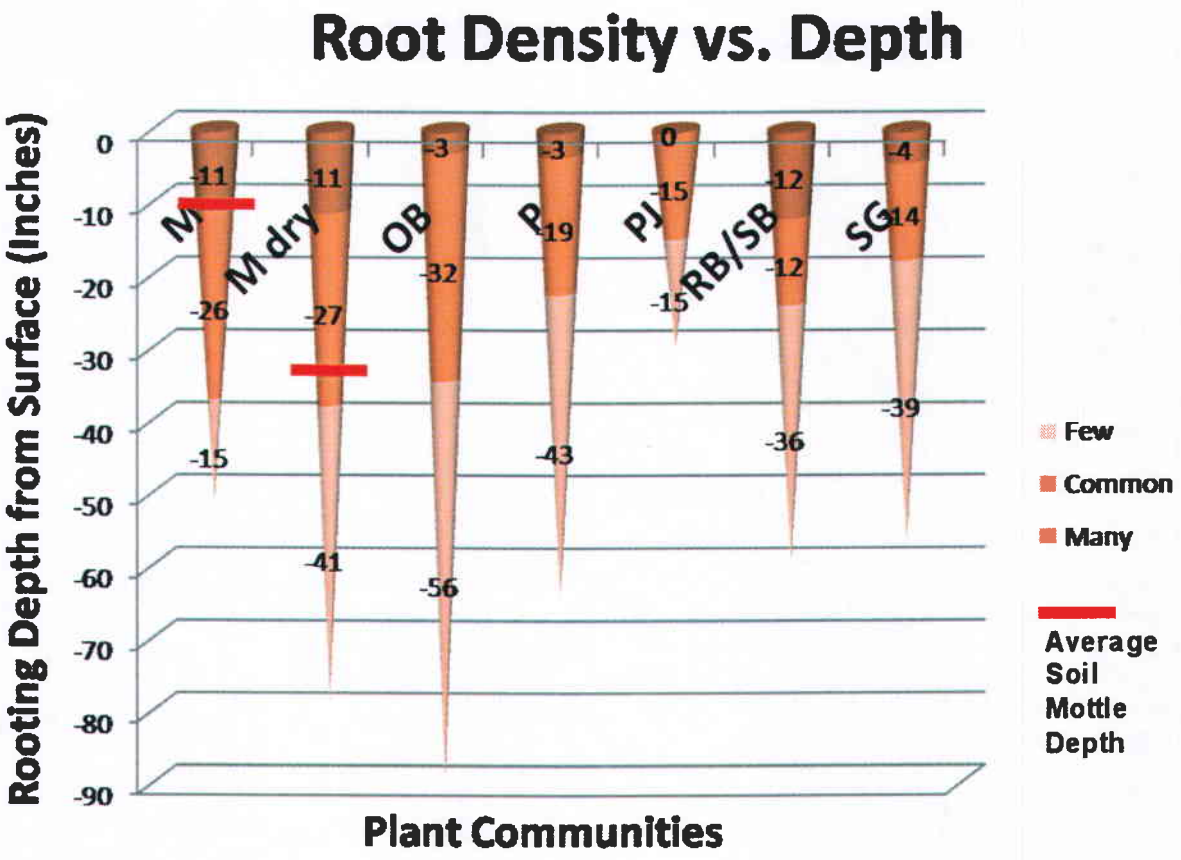


Figure 10 Root density versus depth and depth of soil mottles. (depth of mottles are shown only in those plant communities where they were the dominant condition).

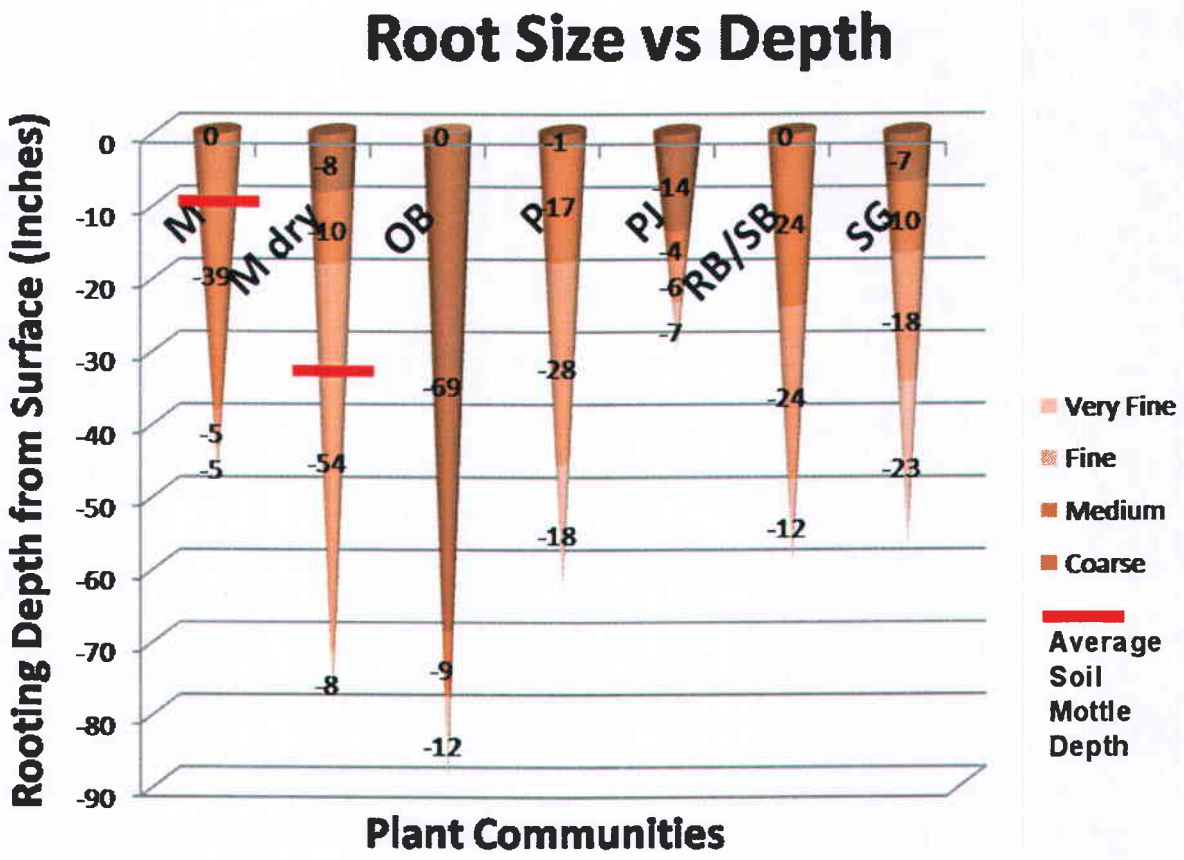
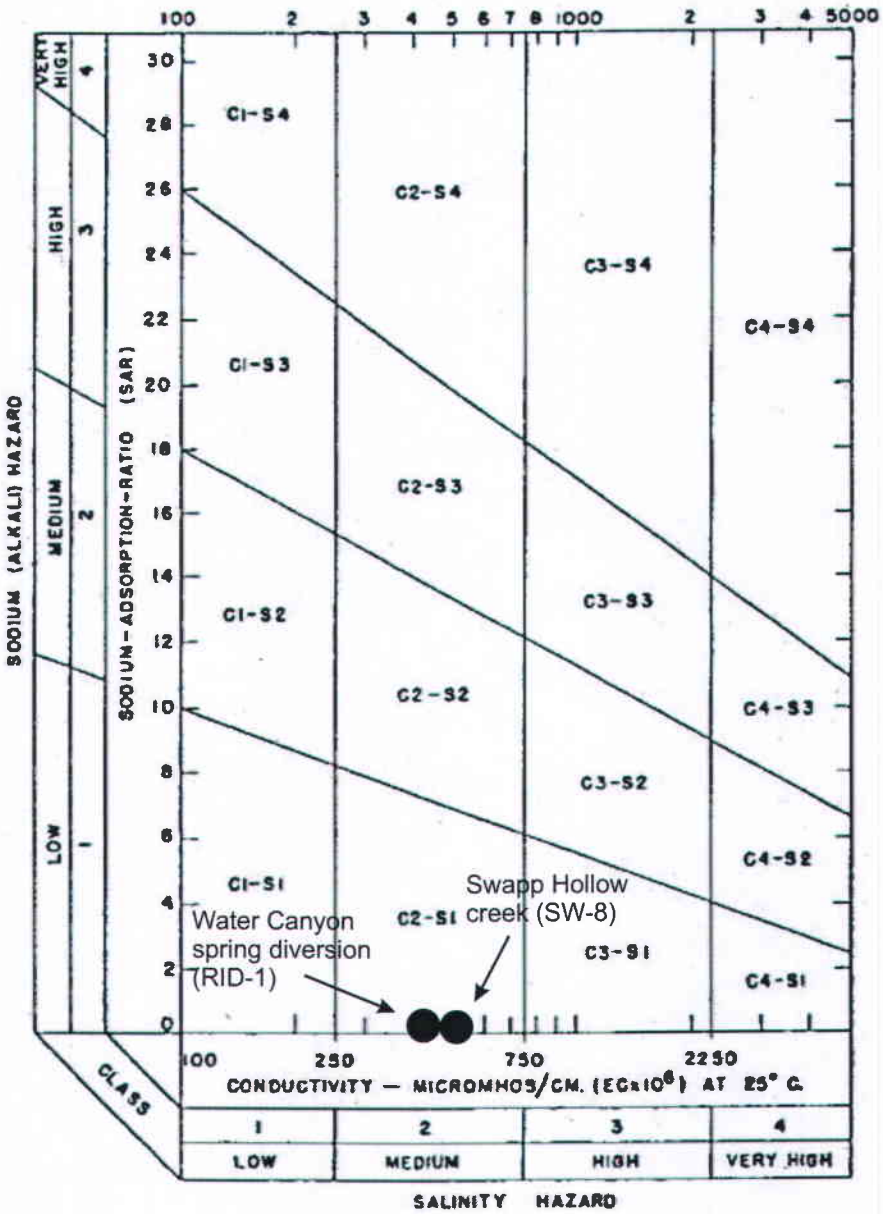


Figure 11 Root size versus depth and depth of soil mottles (depth of mottles are shown only in those plant communities where they were the dominant condition).



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C1 Low-salinity water: Can be used for irrigation with most crops on most soils with little likelihood that soil salinity will develop.
C2 Medium-salinity water: Can be used in a moderate amount of leaching occurs.
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C4 Very high salinity water: Is not suitable for irrigation under ordinary conditions.

Sodium

S1 Low-sodium water: Can be used for irrigation on almost all soils with little danger of the development of harmful levels of exchangeable sodium.
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S3 High-sodium water: May produce harmful levels of exchangeable sodium in most soils and will require special management – good drainage, high leaching, and organic matter additions.
S4 Very high sodium water: Is generally unsatisfactory for irrigation purposes except at low and perhaps medium salinity.

Figure 12 Water quality suitability criteria for potential flood irrigation waters.

Table 1 Coal Hollow Project alluvial monitoring well depth to water information for 2007.

Well	Collar elevation (feet)	Stick-up (feet)	Date	Depth to water (feet below top of casing)	Depth to water (feet below ground surface)
C0-18	6864.14	4.32	19-Jan-07	18.13	13.81
C0-18	6864.14	4.32	1-Feb-07	18.19	13.87
C0-18	6864.14	4.32	22-Jun-07	10.02	5.70
C0-18	6864.14	4.32	30-Sep-07	12.59	8.27
C0-18	6864.14	4.32	27-Nov-07	13.72	9.40
C1-24	6949.19	2.92	19-Jan-07	20.63	17.71
C1-24	6949.19	2.92	1-Feb-07	18.29	15.37
C1-24	6949.19	2.92	22-Jun-07	16.98	14.06
C1-24	6949.19	2.92	29-Sep-07	16.96	14.04
C1-24	6949.19	2.92	30-Dec-07	16.75	13.83
C2-15	6920.28	1.69	17-Jan-07	9.60	7.91
C2-15	6920.28	1.69	1-Feb-07	9.09	7.40
C2-15	6920.28	1.69	21-Jun-07	9.75	8.06
C2-15	6920.28	1.69	30-Sep-07	12.58	10.89
C2-15	6920.28	1.69	28-Nov-07	12.77	11.08
C2-28	6919.81	1.21	17-Jan-07	8.43	7.22
C2-28	6919.81	1.21	1-Feb-07	8.15	6.94
C2-28	6919.81	1.21	21-Jun-07	9.45	8.24
C2-28	6919.81	1.21	30-Sep-07	12.12	10.91
C2-28	6919.81	1.21	28-Nov-07	12.18	10.97
C2-40	6919.58	0.98	17-Jan-07	8.34	7.36
C2-40	6919.58	0.98	1-Feb-07	8.04	7.06
C2-40	6919.58	0.98	21-Jun-07	9.33	8.35
C2-40	6919.58	0.98	30-Sep-07	11.96	10.98
C2-40	6919.58	0.98	28-Nov-07	12.04	11.06
C3-15	6890.41	1.12	17-Jan-07	3.27	2.15
C3-15	6890.41	1.12	1-Feb-07	2.69	1.57
C3-15	6890.41	1.12	21-Jun-07	5.10	3.98
C3-15	6890.41	1.12	30-Sep-07	7.52	6.40
C3-15	6890.41	1.12	28-Nov-07	6.23	5.11
C3-30	6890.77	1.49	17-Jan-07	3.67	2.18
C3-30	6890.77	1.49	1-Feb-07	3.19	1.70
C3-30	6890.77	1.49	21-Jun-07	5.40	3.91
C3-30	6890.77	1.49	30-Sep-07	7.81	6.32
C3-30	6890.77	1.49	28-Nov-07	6.54	5.05
C3-40	6890.73	1.45	17-Jan-07	3.92	2.47
C3-40	6890.73	1.45	1-Feb-07	3.45	2.00
C3-40	6890.73	1.45	21-Jun-07	5.39	3.94
C3-40	6890.73	1.45	30-Sep-07	7.78	6.33
C3-40	6890.73	1.45	28-Nov-07	6.56	5.11

Well	Collar elevation (feet)	Stick-up (feet)	Date	Depth to water (feet below top of casing)	Depth to water (feet below ground surface)
C4-15	6873.92	1.64	17-Jan-07	4.29	2.65
C4-15	6873.92	1.64	31-Jan-07	4.04	2.40
C4-15	6873.92	1.64	21-Jun-07	5.52	3.88
C4-15	6873.92	1.64	30-Sep-07	7.22	5.58
C4-15	6873.92	1.64	30-Dec-07	4.52	2.88
C4-30	6873.91	1.62	17-Jan-07	4.11	2.49
C4-30	6873.91	1.62	31-Jan-07	3.89	2.27
C4-30	6873.91	1.62	21-Jun-07	5.27	3.65
C4-30	6873.91	1.62	30-Sep-07	6.95	5.33
C4-30	6873.91	1.62	30-Dec-07	4.52	2.90
C4-50	6873.52	1.24	17-Jan-07	3.48	2.24
C4-50	6873.52	1.24	31-Jan-07	3.27	2.03
C4-50	6873.52	1.24	21-Jun-07	4.47	3.23
C4-50	6873.52	1.24	30-Sep-07	6.03	4.79
C4-50	6873.52	1.24	30-Dec-07	4.02	2.78
C5-130	6938.92	2.13	17-Jan-07	10.75 psi	+27.0
C5-130	6938.92	2.13	29-Mar-07	14.1 psi	+34.7
C5-130	6938.92	2.13	22-Jun-07	8.2 psi	+21.1
C5-130	6938.92	2.13	29-Sep-07	10.5 psi	+26.4
C5-130	6938.92	2.13	30-Dec-07	9.8 psi	+24.8
C6-15	6897.63	1.84	19-Jan-07	dry	---
C6-15	6897.63	1.84	21-Jun-07	dry	---
C6-15	6897.63	1.84	30-Sep-07	dry	---
C6-15	6897.63	1.84	28-Nov-07	dry	---
C7-10	6873.77	3.54	17-Jan-07	11.05	7.51
C7-10	6873.77	3.54	1-Feb-07	10.97	7.43
C7-10	6873.77	3.54	21-Jun-07	11.73	8.19
C7-10	6873.77	3.54	30-Sep-07	12.53	8.99
C7-10	6873.77	3.54	28-Nov-07	11.9	8.36
C7-20	6872.89	2.66	17-Jan-07	10.44	7.78
C7-20	6872.89	2.66	1-Feb-07	10.36	7.70
C7-20	6872.89	2.66	21-Jun-07	10.96	8.30
C7-20	6872.89	2.66	30-Sep-07	11.78	9.12
C7-20	6872.89	2.66	28-Nov-07	11.23	8.57
C8-25	6859.70	2.69	17-Jan-07	9.80	7.11
C8-25	6859.70	2.69	31-Jan-07	9.26	6.57
C8-25	6859.70	2.69	21-Jun-07	9.25	6.56
C8-25	6859.70	2.69	30-Sep-07	10.71	8.02
C8-25	6859.70	2.69	27-Nov-07	10.44	7.75
C9-15	6846.77	2.02	17-Jan-07	9.50	7.48
C9-15	6846.77	2.02	31-Jan-07	9.29	7.27
C9-15	6846.77	2.02	21-Jun-07	9.81	7.79
C9-15	6846.77	2.02	30-Sep-07	12.19	10.17

Well	Collar elevation (feet)	Stick-up (feet)	Date	Depth to water (feet below top of casing)	Depth to water (feet below ground surface)
C9-15	6846.77	2.02	30-Dec-07	12.3	10.28
C9-25	6846.36	1.61	17-Jan-07	9.71	8.10
C9-25	6846.36	1.61	31-Jan-07	8.91	7.30
C9-25	6846.36	1.61	21-Jun-07	9.44	7.83
C9-25	6846.36	1.61	30-Sep-07	11.83	10.22
C9-25	6846.36	1.61	30-Dec-07	11.98	10.37
C9-40	6846.94	2.19	17-Jan-07	9.71	7.52
C9-40	6846.94	2.19	31-Jan-07	9.51	7.32
C9-40	6846.94	2.19	21-Jun-07	10.04	7.85
C9-40	6846.94	2.19	30-Sep-07	12.47	10.28
C9-40	6846.94	2.19	30-Dec-07	12.55	10.36
SS-15	6831.57	1.57	17-Jan-07	4.13	2.56
SS-15	6831.57	1.57	31-Jan-07	3.82	2.25
SS-15	6831.57	1.57	21-Jun-07	5.54	3.97
SS-15	6831.57	1.57	30-Sep-07	7.78	6.21
SS-15	6831.57	1.57	30-Dec-07	6.55	4.98
SS-30	6830.47	0.47	17-Jan-07	2.81	2.34
SS-30	6830.47	0.47	31-Jan-07	2.48	2.01
SS-30	6830.47	0.47	21-Jun-07	4.21	3.74
SS-30	6830.47	0.47	30-Sep-07	6.56	6.09
SS-30	6830.47	0.47	30-Dec-07	5.33	4.86
SS-75	6832.06	2.06	17-Jan-07	14.20	12.14
SS-75	6832.06	2.06	31-Jan-07	14.93	12.87
SS-75	6832.06	2.06	21-Jun-07	14.52	12.46
SS-75	6832.06	2.06	30-Sep-07	15.07	13.01
SS-75	6832.06	2.06	30-Dec-07	14.42	12.36
UR-29	7004.14	0.97	17-Jan-07	dry	---
UR-29	7004.14	0.97	22-Jun-07	23.27	22.30
UR-29	7004.14	0.97	29-Sep-07	24.53	23.56
UR-29	7004.14	0.97	29-Dec-07	24.00	23.03
UR-70	7005.14	1.97	19-Jan-07	21.51	19.54
UR-70	7005.14	1.97	22-Jun-07	21.69	19.72
UR-70	7005.14	1.97	29-Sep-07	22.9	20.93
UR-70	7005.14	1.97	29-Dec-07	22.38	20.41
LR-45	6798.41	1.71	19-Jan-07	27.51	25.80
LR-45	6798.41	1.71	29-Mar-07	27.56	25.85
LR-45	6798.41	1.71	22-Jun-07	28.12	26.41
LR-45	6798.41	1.71	30-Sep-07	28.03	26.32
LR-45	6798.41	1.71	29-Dec-07	27.2	25.49
LS-15	6810.28	1.79	19-Jan-07	6.38	4.59
LS-15	6810.28	1.79	30-Mar-07	4.96	3.17
LS-15	6810.28	1.79	20-Jun-07	7.56	5.77

Well	Collar elevation (feet)	Stick-up (feet)	Date	Depth to water (feet below top of casing)	Depth to water (feet below ground surface)
LS-15	6810.28	1.79	30-Sep-07	8.79	7.00
LS-15	6810.28	1.79	30-Dec-07	7.43	5.64
LS-28	6810.23	1.74	19-Jan-07	6.27	4.53
LS-28	6810.23	1.74	30-Mar-07	4.89	3.15
LS-28	6810.23	1.74	20-Jun-07	7.47	5.73
LS-28	6810.23	1.74	30-Sep-07	8.79	7.05
LS-28	6810.23	1.74	30-Dec-07	7.36	5.62
LS-60	6810.35	1.85	19-Jan-07	4.07	2.22
LS-60	6810.35	1.85	30-Mar-07	3.06	1.21
LS-60	6810.35	1.85	20-Jun-07	5.15	3.30
LS-60	6810.35	1.85	30-Sep-07	6.47	4.62
LS-60	6810.35	1.85	30-Dec-07	5.29	3.44
LS-85	6810.53	2.03	20-Jun-07	1.5 psi	+5.5
LS-85	6810.53	2.03	30-Sep-07	0.42 psi	+3.00
LS-85	6810.53	2.03	30-Dec-07	frozen	---
Y-59	6959.06	2.50	16-Jan-07	8.00 psi	+21.0
Y-59	6959.06	2.50	22-Jun-07	8.8 psi	+22.8
Y-59	6959.06	2.50	29-Sep-07	8.2 psi	+21.4
Y-59	6959.06	2.50	30-Nov-07	7.7 psi	+20.3
Y-61	6962.10	2.80	29-Sep-07	5.4 psi	+15.3
Y-61	6962.10	2.80	30-Dec-07	4.8 psi	+13.9
Y-63-62	6789.34	2.67	30-Mar-07	13.45	10.78
Y-63-62	6789.34	2.67	20-Jun-07	13.76	11.09
Y-63-62	6789.34	2.67	30-Sep-07	15.09	12.42
Y-63-62	6789.34	2.67	29-Dec-07	14.95	12.28
Y-98 (A1)	7173.50	3.00	28-Mar-07	84.84	81.84
Y-98 (A1)	7173.50	3.00	21-Jun-07	84.79	81.79
Y-98 (A1)	7173.50	3.00	29-Sep-07	85.02	82.02
Y-98 (A1)	7173.50	3.00	30-Nov-07	85.13	82.13
Y-99 (A2)	7055.54	3.00	28-Mar-07	dry	---
Y-99 (A2)	7055.54	3.00	21-Jun-07	dry	---
Y-99 (A2)	7055.54	3.00	29-Sep-07	dry	---
Y-99 (A2)	7055.54	3.00	30-Nov-07	dry	---
Y-102 (A4)	6950.06	1.41	17-Jan-07	3.9 psi	+10.4
Y-102 (A4)	6950.06	1.41	28-Mar-07	3.4 psi	+9.26
Y-102 (A4)	6950.06	1.41	21-Jun-07	2.9 psi	+8.1
Y-102 (A4)	6950.06	1.41	29-Sep-07	2.0 psi	+6.0
Y-102 (A4)	6950.06	1.41	30-Dec-07	2.5 psi	+7.2

Table 2 Depth to aquic soil conditions and water table in Coal Hollow Project soils pits.

Soil Pit	Depth to Aquic Soil Conditions	Depth to Water Table	Pit Depth	Soil Pit	Depth to Aquic Soil Conditions	Depth to Water Table	Pit Depth	Soil Pit	Depth to Aquic Soil Conditions	Depth to Water Table	Pit Depth
	Inches	Inches	Inches		Inches	Inches	Inches		Inches	Inches	Inches
1	NA	NW	60	20	NA	NW	96	41	NA	NW	80
2	NA	NW	96	21	50	NW	96	42	NA	NW	48
3	NA	NW	33 sh	22	15	NW	84	43	7	30	96
4	NA	NW	31 sh	23	22	NW	80	44	7	14	96
5	NA	NW	60	24	NA	NW	32 sa	45	5	66	100
6	NA	NW	60	25	NA	NW	33 sa	46	24	44	120
7	NA	NW	60	26	20	84	125	47	32	80	84
8	NA	NW	85	27	90	NW	140	48	30	NW	84
9A	42	NW	100	28	NA	NW	102	49	NA	NW	10 sa
9B	Surface	57	57	29	60	NW	138	50	NA	NW	19 sh
10	68	NW	84	30	36	NW	120 sh	51	NA	NW	64
11	NA	NW	90	31	110	NW	125	52	24	NW	60
12	NA	NW	26 sh	32	90	120	140	53	9	27	60
13	NA	NW	84	33	NA	NW	100	54	19	NW	64
14	24	NW	90	34	NA	NW	70	55	41	NW	62
15	58	NW	96	35	NA	NW	95	56	NA	NW	96
16	36	NW	96	36	NA	NW	85	57	88	NW	100
17	45	NW	80	37	NA	NW	90	58	NA	NW	64
18A	7	51	60	38	12	24	40	59	62	75	76
18B	NA	NW	96	39	NA	NW	75	60	NA	NW	48 sh
19	NA	NW	90	40	6	23	40				

NA	No Aquic conditions	sh	Shale bedrock
NW	No Water Table	sa	Sandstone bedrock

Table 3 Discharge and water quality information for shallow alluvial groundwater in subirrigated areas.

	Date	discharge (gpm)	T (°C)	pH	Cond. (µS/cm)	TDS (mg/L)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	HCO_3 (mg/L)	CO_3 (mg/L)	SO_4 (mg/L)	Cl (mg/L)	Cl (meq/L)	B (mg/L)	SAR
SP-6	3-Jul-87	Seep	18.8		3485												
SP-6	5-Aug-87	Seep	19.1		2900												
SP-6	17-Sep-87	Seep	12.0		3140	2280	32	426	156		1268	<5	798	56	1.58	0.47	1.59
SP-6	28-Oct-87	Seep	12.3		2520												
SP-6	17-Nov-87	Seep	7.9		2830												
SP-6	9-Dec-87	Seep	6.1		2385	1638	19	371	95		1069	<5	492	44	1.24	0.31	1.04
SP-6	15-Jan-88	Seep	5.6		2350												
SP-6	15-Feb-88	Frozen	---	---	---												
SP-6	11-Mar-88	Seep	3.0		2265	1598	14	334	72		913	<5	572	46	1.30	0.20	0.83
SP-6	24-Sep-05	Seep	16.0	7.41	1310	707	84.1	98.1	33	7.87	602	<5	112	6	0.17	0.10	0.58
SP-6	3-Nov-05	Seep	10.5	7.76	1602	1083	84.5	133	81.3	18.8	612	<5	301	44	1.24	0.14	1.28
SP-6	3-Nov-05		10.5	7.76	1602	1083	84.5	133	81.3	18.8	746.16	<5.	301	44	1.24	0.14	1.28
SP-6	29-May-06	0	25.2	8.12	1475	944	63.4	162	55.6	5.58	948.55	<5.	139	6	0.17	0.21	0.84
SP-6	7-Sep-06	<0.05	15.4	7.53	1038	666	71.06	89.43	38.5	10.14	587.66	<5.	126	23	0.65	0.1	0.72
SP-6	30-Dec-06	<0.05	5.6	7.91	1175	935	81.17	152.19	46.92	4.08	657.16	<5.	300	19	0.54	0.09	0.71
SP-6	30-Mar-07	0	2.2	8.46	2920	2365	13.3	505	113	4.52	1569.1	<5.	807	52	1.47	0.25	1.07
SP-8	3-Jul-87	10.0	10.9		785												
SP-8	5-Aug-87	8.6	10.7		795												
SP-8	18-Sep-87	10.0	11.2	7.25	725	386	81	56	6	2	308	<5	76	5	0.14	<0.02	0.13
SP-8	27-Oct-87	10.7	10.8		750												
SP-8	15-Nov-87	10.0	7.5		715												
SP-8	9-Dec-87	10.0	10.0	6.8	765	420	88	60	6	2	329	<5	76	5	0.14	<0.02	0.12
SP-8	9-Jan-88	15.9	12.0		685												
SP-8	18-Feb-88	15.4	7.8		675												
SP-8	18-Mar-88	12.2	10.1	7.4	725	438	77	50	6	2	324	<5	82	5	0.14	<0.02	0.13
SP-8	27-May-05	17.6	10.3	7.89	642	456	73.6	54.5	7.44	1.37	328	<5	77	4	0.11	0.02	0.16
SP-8	24-Sep-05	9.1	9.6	7.27	704	426	83.7	54.5	6.87	1.60	338	<5	71	3	0.08	0.02	0.14
SP-8	27-May-05	17.6	10.3	7.89	642	456	73.6	54.5	7.44	1.37	399.9	<5.	77	4	0.11	0.02	0.16
SP-8	24-Sep-05	9.1	9.6	7.27	704	426	83.7	54.5	6.87	1.6	412.09	<5.	71	3	0.08	0.02	0.14
SP-8	4-Nov-05	12.8	9.6	7.48	706	413	80.1	47.7	6.47	1.43	406	<5.	65	2	0.06	0.02	0.14
SP-8	31-Mar-06	20.3	9.3	7.1	716	407	79.7	49.4	6.55	1.47	335	<5	74	4	0.11	0.02	0.14
SP-8	31-Mar-06	20.3	9.3	7.1	716	407	79.7	49.4	6.55	1.47	408.44	<5.	74	4	0.11	0.02	0.14
SP-8	29-May-06	14.3	10.5	7.75	701	432	83.8	52.4	6.99	1.67	410.88	<5.	69	4	0.11	0.03	0.15
SP-8	30-Dec-06	19.3	8.1	7.79	668	417	85.06	50.96	6.98	1.34	413.31	<5.	72	3	0.08	0.02	0.15
SP-8	29-Mar-07	19.6	9.4	7.5	696	433	81.8	51.4	7.02	1.38	413.31	<5.	75	4	0.11	0.02	0.15

Table 4. Average root density and size by depth for plant communities in the Coal Hollow project area.

	Plant Community						
	M	M dry	OB	P	PJ	RB/SB	SG
	Soil Depth to Bottom of Root Feature (Inches)						
Root Density							
Many	11	11	3	3	0	12	4
Common	37	38	35	23	15	24	18
Few	52	79	90	65	30	60	57
Root Size							
Coarse	0	8	69	1	14	0	7
Medium	39	18	78	18	18	24	17
Fine	44	72	78	46	24	48	34
Very Fine	48	79	90	64	30	60	57
Soil Features							
Bedrock					31		
Depth to Mottles	11	36	Note 1	Note 2	Note 3		Note 4
Hole Depth	65	85	90	93	41	84	85

Notes

1 One of two soil data points in the oak brush (OB) plant community had soil mottles (15 inches in soil pit 22).

2 Seven of sixteen soil data points in the pasture (P) plant community had soil mottles (50 inch average depth for the seven soil data points).

3 One of five soil data points in the pinyon-juniper (PJ) plant community had soil mottles at 30 inches, but these were most likely the result of infiltrating surface water perching within the very dense clay subsoil.

4 Five of twenty soil data points in the sage-grass (SG) plant community had soil mottles (52 inch average depth for the five soil data points).

Table 5. Definitions of root density and size terms used in soil pit descriptions (Schoeneberger et. al., 2002).

Root Density		Root Size	
Many	>5 roots per unit area	Coarse	5 to 10 mm
Common	1 to 5 roots per unit area	Medium	2 to 5 mm
Few	<1 root per unit area	Fine	1 to 2 mm
		Very fine	<1 mm

Table 6. Soil map units that exhibit soil characteristics of potential sub-irrigation.

Soil Map Unit	Soil map Unit Name[1]	Sub-Irrigated[2]
1	A family – Wapiti Family complex, 3 to 8% slopes	No
2	M Family – Calendar family – D Family complex, 3 to 8% slopes	No
3	Cibeque Family – Wapiti Family complex, 3 to 8% slopes	No
4	Jonale Family – Graystone cobbly substratum Family – Wapiti Family complex, 3 to 8% slopes	No
5	Calendar Family – M Family – Drifity Family complex, 8 to 25% slopes	No
6	Graystone – Cookcan – Jonale family complex, 1 to 5% slopes	Localized Potential[3]
7	Happyhollow Family – Alamosa complex, 1 to 5% slopes	Yes
8	Brumley – Graystone – Snilloc complex, 3 to 8% slopes	No
9	D Family – Deacon complex, 5 to 30% slopes	No
10	Zigzag clay, 8 to 25% slopes	No
11	A Family clay, 8 to 25% slopes	No
12	Manzanst Taxadjunct Family clay, 3 to 12% slopes	No
13	A Family – Happyhollow Family complex, 1 to 5% slopes	Localized Potential[3]

Footnotes:

1 Soil map unit descriptions are available in section 2 of the Coal Hollow soil survey report (Appendix 2-1 of MRP).
2 Potential for sub-irrigation is based on the taxonomic classification of the soil components in each map unit.
3 Localized potential occurs when one major soil component has the potential for sub-irrigation.

Table 7 Plant communities that exhibit soil and vegetation characteristics of sub-irrigation based on the dominant conditions.

Plant Community	Sub-Irrigated
Meadow (M)	Yes
Meadow – dry (M dry)	Localized Potential
Oak brush (OB)	No
Pasture (P)	No
Pinyon Juniper (PJ)	No
Rabbitbrush – sagebrush (RB/SB)	No
Sagebrush – grass (S/B)	No

Table 8 Monthly water requirements (evapotranspiration) for plants in Alton, Utah (after Hill and Heaton, 2001).

	Monthly Crop Evapotranspiration (inches)						
Plant	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Season Total**
Alfalfa	---	4.96	8.31	6.26	7.11	0.51	27.16
Pasture	0.61	4.01	5.4	5.59	4.85	2.85	23.31
Sp. Grain	0.30	3.13	8.05	8.28	1.97	---	21.73
Turf	1.06	3.72	4.65	4.82	4.18	2.89	

Adapted from: Consumptive Use of Irigated Crops in Utah, Utah Agricultural Experiment Station Research Report No. 145. Oct. 1994.

Table 9 Discharge and water-quality information for surface waters that could potentially be used for flood irrigation.

	Date	discharge (gpm)	T (°C)	pH	Cond. (µS/cm)	TDS (mg/L)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	HCO_3 (mg/L)	CO_3 (mg/L)	SO_4 (mg/L)	Cl (mg/L)	Cl (meq/L)	B (mg/L)	SAR
Section 21 Canyon drainage																	
SW-7	2-Jul-87	Dry															
SW-7	4-Aug-87	Dry															
SW-7	6-Sep-87	Dry															
SW-7	27-Oct-87	Dry															
SW-7	15-Nov-87	Dry															
SW-7	4-Dec-87	Dry															
SW-7	5-Jan-88	Dry															
SW-7	16-Feb-88	Dry															
SW-7	18-Mar-88	Dry															
SW-7	4-Nov-05	Dry															
SW-7	7-Sep-06	Dry															
SW-7	21-Dec-06	Dry															
SW-7	28-Mar-07	Dry															
SW-7	21-Jun-07	Dry															
SW-7	29-Sep-07	Dry															
SW-7	30-Nov-07	Dry															
Swapp Hollow																	
SW-8	6-Jul-87	36	10.3	8.5	490	286	37	38	7.00	1	228	<5	31	10	0.28	<0.01	0.19
SW-8	6-Aug-87	22	14.1	8.4	490	262	44	36	5.00	1	241	<5	14	3	0.08	<0.02	0.14
SW-8	17-Sep-87	40	7.1	8.5	480	245	51	40	4.00	1	232	<5	21	3	0.08	<0.02	0.10
SW-8	28-Oct-87	36	18.2	8.2	430	256	48	38	5.00	1	241	<5	27	4	0.11	<0.02	0.13
SW-8	17-Nov-87	40	9	8.2	525	302	49	36	4.00	1	243	<5	29	3	0.08	<0.02	0.11
SW-8	15-Dec-87	13	0.8	7.7	585	338	57	40	6.00	1	300	<5	33	7	0.20	<0.02	0.15
SW-8	13-Jan-88	40	0.3	8.2	550	306	47	38	4.00	1	250	<5	33	7	0.20	<0.02	0.11
SW-8	17-Feb-88	49	-0.3	8.1	565	324	61	40	4.00	1	273	<5	31	3	0.08	<0.02	0.10
SW-8	21-Mar-88	49	1.5	8.2	610	290	56	38	4.00	1	263	<5	29	<1		<0.02	0.10
SW-8	18-Jun-05	290	17.5	8.38	566	366	59.2	44.1	6.75	1.03	368	<5.	34	5	0.14	0.02	0.16
SW-8	12-Aug-05	130	17.8	8.41	493	274	51.4	37.7	6.63	1.03	243	<5	38	4	0.11	0.02	0.17
SW-8	24-Sep-05	69	14.0	8.36	536	298	48.4	38.9	6.09	0.99	250	<5	33	4	0.11	<0.02	0.16
SW-8	24-Sep-05	69	14	8.36	536	298	48.4	38.9	6.09	0.99	305	<5.	33	4	0.11	0.02	0.16
SW-8	4-Nov-05	71	6.2	8.63	555	321	59.8	39	7.95	1.04	265	<5	49	4	0.11	0.01	0.20
SW-8	30-May-06	35	23.2	8.89	586	350	44.7	39.4	11.7	1.22	274	<5.	69	7	0.20	0.03	0.31
SW-8	7-Sep-06	50.7	12.5	8.01	576	331	47.48	39.92	17.75	1.75	288	<5.	89	7	0.20	0.02	0.46
SW-8	20-Dec-06	32.1	10.1	8.84	553	337	64.07	39.43	8.45	0.91	335	<5.	46	5	0.14	0.64	0.20
SW-8	29-Mar-07	33.6	2.2	8.68	524	324	59.6	36.4	9.2	0.96	322	<5.	49	5	0.14	0.01	0.23

	Date	discharge (gpm)	T (°C)	pH	Cond. (µS/cm)	TDS (mg/L)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	HCO_3 (mg/L)	CO_3 (mg/L)	SO_4 (mg/L)	Cl (mg/L)	Cl (meq/L)	B (mg/L)	SAR
SW-8	22-Jun-07	13.8	20.2	8.66	566	356	55.1	41.0	10.5	6.52	328	<5	45	8	0.23		0.26
SW-8	29-Sep-07	10.4	13.6	8.70	561	353	58.7	42.6	9.94	1.94	334	<5	56	6	0.17		0.24
SW-8	30-Nov-07	12.5	0.4	8.16	445												
Sink Valley																	
SW-6	17-Sep-87	Dry	11.0	8.70	860	556	34	98	29.00	11	292	40	140	18	0.51	0.21	0.57
SW-6	15-Dec-87	Dry	0.8	8.3	1840	1212	51	209	73.00	9	602	37	418	41	1.16	0.21	1.01
SW-6	11-Mar-88	Dry	1.5	8.4	1600	992	45	182	63.00	5	590	<5	344	34	0.96	0.16	0.93
SW-6	17-Jun-05	Dry															
SW-6	30-Mar-06	58	13.8	8.91	1352	1028	58.9	161	31.30	12.5	436	47	361	22	0.62	0.17	0.48
SW-6	16-May-06	Dry															
SW-6	29-May-06	Dry															
SW-6	7-Sep-06	Dry															
SW-6	30-Dec-06	Dry															
SW-6	20-Jun-07	Dry															
SW-6	30-Sep-07	Dry															
SW-6	30-Dec-07	Dry															
Robinson Creek																	
SW-4	2-Jul-87	Dry															
SW-4	4-Aug-87	Dry															
SW-4	6-Sep-87	Dry															
SW-4	27-Oct-87	Dry															
SW-4	15-Nov-87	Dry															
SW-4	4-Dec-87	Dry															
SW-4	5-Jan-88	Dry															
SW-4	16-Feb-88	Dry															
SW-4	18-Mar-88	Dry															
SW-4	27-May-05	539	19.1	8.4	453	283	47.7	35.8	2.23	0.6	297.49	<5.	18	2		0.01	0.06
SW-4	4-Nov-05	Dry															
SW-4	16-May-06	Dry															
SW-4	8-Sep-06	Dry															
SW-4	21-Dec-06	Dry															
SW-4	28-Mar-07	Dry															
SW-4	29-Mar-07	Dry															
SW-4	21-Jun-07	Dry															
SW-4	29-Sep-07	Dry															
SW-4	29-Dec-07	Dry															
SW-5	10-Aug-87	13.5	27.5	8.65	1680	984	39	160	69	7	433	49	403	24	0.68	0.17	1.09

	Date	discharge (gpm)	T (°C)	pH	Cond. (µS/cm)	TDS (mg/L)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	HCO_3 (mg/L)	CO_3 (mg/L)	SO_4 (mg/L)	Cl (mg/L)	Cl (meq/L)	B (mg/L)	SAR
SW-5	14-Sep-87	13.5	9.0	8.65	1480	1008	49	162	61	5	444	12	368	3	0.08	0.11	0.94
SW-5	29-Oct-87	58	12.5	8.10	1070	666	42	105	49	4	290	<5	298	19	0.54	0.08	0.92
SW-5	18-Nov-87	Puddle	1.2	8.00	1305	886	54	129	58	4	402	16	350	21	0.59	0.06	0.98
SW-5	11-Feb-88	36	0.0	8.00	665	446	46	59	23	6	204	<5	163	10	0.28	0.02	0.53
SW-5	17-Mar-88	4.5	9.1	8.20	1670	876	54	104	55	5	378	<5	344	21	0.59	0.06	1.01
SW-5	17-Mar-88	4.5	9.1	8.2	1670												
SW-5	27-May-05	410	18	8.46	721	469	63	60.6	20.2	1.84	405	8.3	144	6	0.17	0.04	0.44
SW-5	25-Sep-05	Dry															
SW-5	30-May-06	5.37	11.4	8.88	1543	1205	69.8	148	85.2	5.67	513	<5.	503	26	0.73	0.16	1.32
SW-5	7-Sep-06	4.96	13.7	8.36	1394	1081	59.04	143.68	83.11	6.02	456	<5.	474	27	0.76	0.16	1.33
SW-5	30-Dec-06	Dry															
SW-5	29-Mar-07	Dry															
SW-5	22-Jun-07	Dry															
SW-5	29-Sep-07	14.1	9.6	8.56	960	751	75.3	95.7	38.3	6.57	372	<5	300	15	0.42		0.69
SW-5	29-Dec-07	Dry															
SW-101	27-May-05	734	17.7	8.41	495	309	54.2	36	4.67	1.02	421	13	45	4	0.11	0.02	0.12
SW-101	31-Mar-06	20.8	8.6	8.62	3120	3013	356	148	282	16.4	820	<5	1899	47	1.33	0.19	3.17
SW-101	21-May-06	Dry															
SW-101	25-Sep-05	Dry															
SW-101	3-Nov-05	Dry															
SW-101	21-Dec-06	Dry															
SW-101	30-Dec-06	Dry															
SW-101	20-Jun-07	Dry															
SW-101	30-Sep-07	Dry															
SW-101	26-Dec-07	Dry															
Water Canyon																	
RID-1	4-Nov-05	64.7	1.0	8.73	376	250	47.5	36.8	1.76	0.87	290	<5	16	2	0.06	<0.01	0.05
RID-1	29-May-06	48.6	10.4	8.89	412	265	36.3	36.1	1.9	0.88	267	<5	17	3	0.08	0.01	0.05
RID-1	8-Sep-06	31.0	18.3	8.37	440	222	43.8	34.9	1.64	0.9	271	<5	17	3	0.08	<0.01	0.04
RID-1	21-Dec-06	6.2	0.1	8.87	470	273	54.32	35.8	1.85	0.9	295	18	19	2	0.06	<0.01	0.05
RID-1	28-Mar-07	12.8	1.5	8.83	412	254	43.7	32.6	1.69	0.64	272	20	17	2	0.06		0.05
RID-1	21-Jun-07	3.45	14.2	8.97	359	224	24.9	37.1	2.28	1.21	218	17	18	2	0.06		0.07
RID-1	29-Sep-07	6.64	12.7	8.81	416	245	41.4	37.5	1.83	1.12	257	27	19	2	0.06		0.05
RID-1	29-Dec-07	Dry															

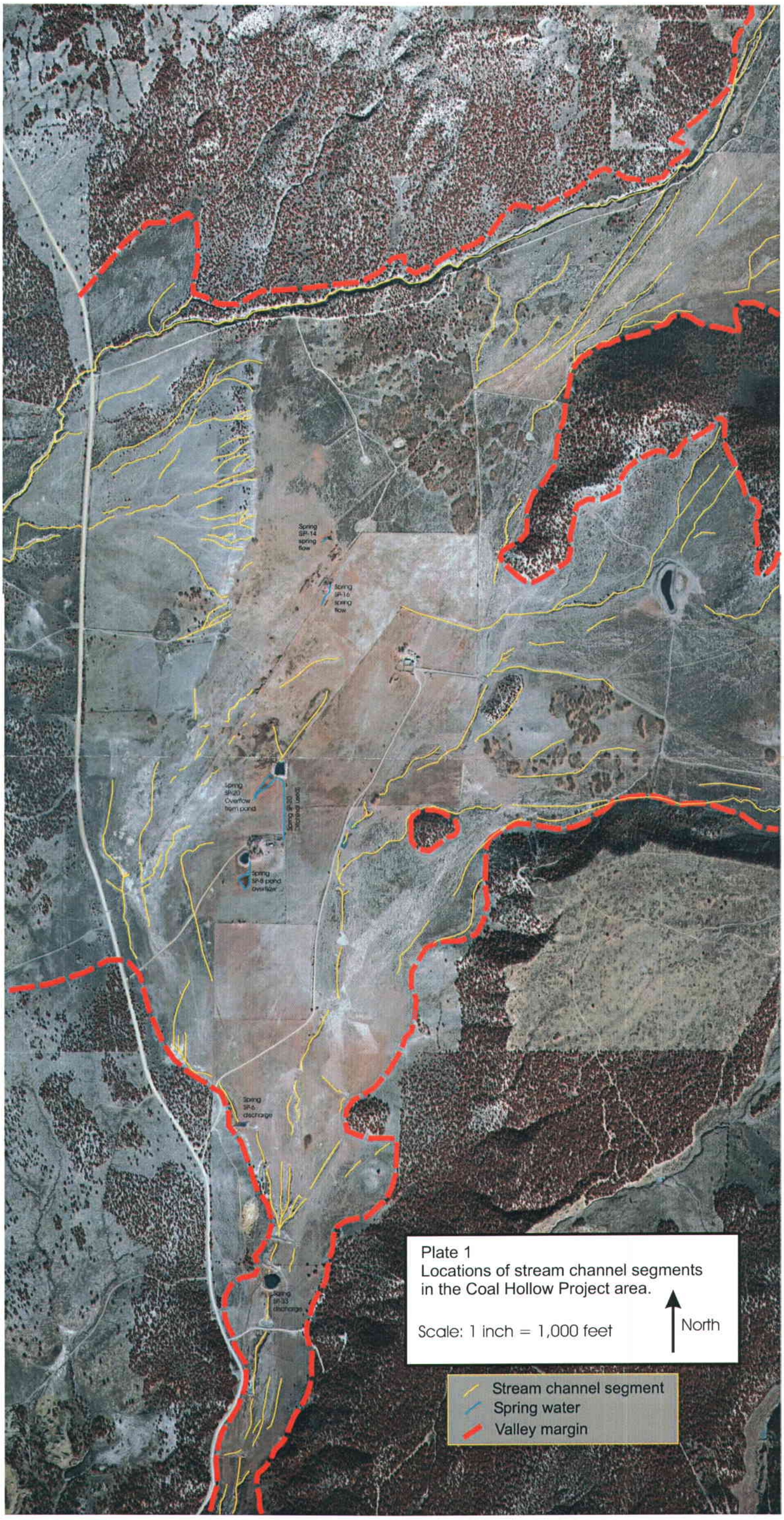

Plate 1
Locations of stream channel segments in the Coal Hollow Project area.

Scale: 1 inch = 1,000 feet

North

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