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

Permittee: Alton Coal Development, LLC
Mine: Coal Hollow Mine
Permit Number: C/025/0005
Title: Pit 10 drainage reconfiguration

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

Add	Replace	Remove	DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☐	☒	☐	Chapter 5, Drawing 5-3C
☐	☒	☐	Chapter 5, Drawing 5-3D
☐	☒	☐	Chapter 5, Appendix 5-2
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Any other specific or special instruction required for insertion of this proposal into the Mining and Reclamation Plan.	Received by Oil, Gas & Mining
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APPENDIX 5-2

Sediment Impoundment and
Diversion Structure Analysis

By: Alton Coal Development, LLC
Chris McCourt, P.E.

Revised August, 2016
Dan W. Guy

UTAH REGISTERED PROFESSIONAL ENGINEER
#154168
DAN W. GUY
8/10/16

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	6.3	12.6	200	6.3
4	3.8	5.5	224	1.7
1B	0.5	0.8	160	0.3

*Design capacities include a minimum of 2 feet free board (spillway to top of embankment)

Two 4" HDPE drainage pipes have been installed from the underground mining sump to the inlet end of Pond 3. Only one pipe is used, with the second in place as a backup. The pipe is expected to carry up to 100 gpm or 0.22 cfs. A 6" decant pipe has been installed in Pond 3, which will allow controlled decanting of the water in the event of a continuous mine water discharge. The pond can be decanted to an elevation of 6808, which is 3 feet below the spillway. At this elevation, the pond can still contain approximately 4.98 ac. ft. of runoff, which is slightly greater than the 4.95 ac. ft. of runoff from a 10-year / 24-hour event of 2.39"; therefore, the pond will still meet the requirement of treating a 10-year / 24-hour runoff event.

The enclosed maps and cross sections detail the design and location for each structure (Drawings 5-25 through 5-34). These drawings also show proposed spillways, diversion ditches and watersheds associated with each structure.

Details

Determining storage capacity requirements using the TR-55 method requires several steps. This section of the report will provide the details and assumptions associated with each step. These steps are: watershed boundaries/flow paths, runoff curve number classification, time of concentration, peak discharge and structure sizing.

- **Watershed Boundaries/Flow Paths**
  The watershed boundaries were determined by first identifying the runoff flow paths for the entire project area. This was completed by creating a three dimensional model of the surface topography. This model was then used to draw flow paths for all the watersheds. Based on these flow paths, boundaries for each watershed are easily determined based on flow direction in combination with proposed control structures (ponds, diversion ditches, etc..).

  Using this process, the project area (in conjunction with diversion ditch locations and berms) was found to be separated into seven distinct watersheds. The natural separations of watersheds in this area are Lower Robinson Creek to the north and Sink Valley Wash at the south end. In addition to these natural separations, the proposed diversion ditches and berms also provide definite boundaries as shown on Drawings 5-26 and 5-27. The following summarizes the watersheds:

Sediment Impoundment Watersheds		
Watershed	**Area (acres)**	**Description**
1	27	North end of project area where facilities are proposed.
2	74	Borders south edge of Lower Robinson Creek.
3	285	Main watershed through the center of permit area.
4	96	Southern most watershed bordered by Sink Valley Wash
*5	28	Isolated area between watersheds 3 and 4
*6	19	Area northwest of Lower Robinson Creek Reconstruction
7	5	Southwest end of facilities area, entrance/exit road

* These watersheds will have silt fence or other appropriate control measures installed.

- **Rainfall Amount and Runoff Curve Number Classification**
  First data required to begin estimating runoff for the watersheds is the rainfall amount and the runoff curve number classification. The rainfall amount is the precipitation associated with a 100 year frequency, 24 hour duration storm event. The runoff curve number classification is a classification of the soil and vegetation cover conditions for the watersheds.

  In order to estimate runoff from rainfall, the rainfall amount for a 100 year frequency, 24 hour duration storm event was determined using the Carlson 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 and 7 have been classified differently since they 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 the five watersheds evaluated, as outlined in Appendix A in TR-55. This classification is for soils having low infiltration rates thus producing high amounts of runoff. The soils

in this classification typically have infiltration rates of 0.05 to 0.15 inches per hour.

The resulting curve number for watersheds 2, 3 and 4 is 63. Watershed 1 and 7 were assigned a curve number of 89. These classifications are intended to be conservative estimates (producing higher than expected runoff) to ensure that the sedimentation structures have more than sufficient storage capacity.

These classifications are used in the next step for determining the time of concentration.

- **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	3,805	2.9	1.8
7	89	750	3.9	0.08

The T_c for each watershed is used to calculate the peak discharge which is the final step leading to the structure sizing.

- **Peak Discharge**
  The peak discharge for each watershed was calculated using the Graphical method. The inputs required for this method include: T_c, drainage area, 100 year 24 hour rainfall and the runoff curve number (CN). The following table outlines these inputs and the peak discharge:

Peak Discharge (*Inflow)					
Watershed	CN	Tc (hr)	Rainfall (in)	Drainage Area (ac)	Peak Discharge (cfs)
1	89	0.16	3.1	27	74.7
2	63	1.7	3.1	74	9.9
3	63	2.2	3.1	285	31.8
4	63	1.8	3.1	96	14.8
7	89	0.8	3.1	5	15.6

*The peak discharge from each watershed will also be the peak inflow to the sedimentation structures.

- **Sedimentation Impoundment Sizing**
  The method used for this step is again from the TR-55 program. A sedimentation structure is required for each one of the five watersheds analyzed. Therefore, a size has been evaluated for the five proposed structures. The inputs for this calculation are the following: drainage area, peak inflow, desired outflow, and runoff depth (Q). The desired outflow in this situation is zero since we do not intend any discharge from the structures. The spillways for these structures are proposed for emergency use only and are not intended for regular discharges. The following table summarizes these inputs and the required storage capacity for each watershed:

Sedimentation Impoundment Sizing

Watershed	Drainage Area (ac)	Inflow (cfs)	Q (in)	Storage Required (ac/ft)
1	27	74.7	2.00	2.6
2	74	9.9	0.48	1.7
3	285	31.8	0.48	6.3
4	96	14.8	0.48	3.8
1B	5	15.6	2.00	0.5

The enclosed maps show the proposed design and locations for each one these structures.

- **Portal Drainage and Sump Design**
  The existing sump in the portal area pit has been redesigned and expanded to reduce the possible sediment load being pumped to Pond 3 as described above. The area draining to the sump has been measured at 25.2 acres. Using the 100 year – 24 hour storm event of 3.1", the calculated total runoff from this area is 1.42 acre feet. In an effort to reduce sediment loading to the sump and Pond 3, the sump will be expanded and divided into 2 sections by installation of a gravel filter dike. The contaminated runoff from the ditches and portal area will flow to the eastern section. Sediment will be allowed to settle in this section as the water filters through the gravel to the western or "clean water" section. The western section will have a capacity of at least 1.00 acre foot. Mine water will continue to flow to the western section, and pumping to Pond 3 will continue as designed and approved. The expanded sump will be constructed with approximately 1H:1V internal slopes and incised as originally constructed.

  It should be noted that the runoff calculated for Pit 10 and the portal area has previously been included in the Sediment Pond 3 and Diversion Ditch 4 calculations in the respective, previously approved sections of this Appendix. As a result, all ditches and culverts described in this section are numbered specifically for Pit 10, to avoid any confusion with other on-site structures previously approved for the mining operation.

All ditches and culverts conveying runoff to the sump area are sized to carry the runoff from the 100 year – 24 hour storm. The runoff from the ditches has been calculated using the OSM "Storm Program 6.20", based on the SCS TR-55 method of peak flow determination. Culvert sizing is based on the Haestad Methods, Flowmaster I, Version 3.43 Computer Program. The typical ditch will be unlined with a "V" shape with 2H:1V side slopes. Although the flow calculations were made on the typical "V" ditch to provide the most conservative sizing, the actual ditch configurations may vary as long as the minimum sizing is maintained. Ditches or culvert outlets with flow velocities in excess of 5 fps will be provided with erosion protection. The erosion protection will consist of placement of minimum 6" D50 rip-rap underlain by erosion control fabric. The rip-rap will be placed to a depth of at least 6" above the maximum calculated flow depth. This protection will be placed in ditch R04 and at the culvert outlets of P10-08, P10-09 and P10-10. Erosion control on bare slopes will be provided by seeding/vegetation with the approved "Interim Seed Mix". If erosion becomes evident in any other area, protection will be provided with rip-rap, check dams or other approved erosion control methods.

The flow for each ditch has been calculated based on the contributing watershed to each ditch, plus runoff from any adjoining ditches or culverts. Using the total runoff to each ditch, along with the slope, the calculated flow depth and velocity was determined.

The maximum flow to each of the culverts was also determined based on the flow from the contributing ditches and watersheds. This flow, along with the slope, was then used to determine the minimum required size of each culvert, along with expected exit velocities. As indicated above, if cutting or erosion becomes evident, rip-rap or other approved erosion protection will be provided.

The following tables will summarize the expected flows and runoff characteristics for each of the individual ditches and culverts in Pit 10:

Watershed	**CN**	**Area** ac.	**Length** ft.	**El. Chg.** ft.	**Flow** cfs	**Volume** ac. ft.
W-R01	63	2.4	200	40	0.74	0.10
W-R02	63	2.1	400	44	0.87	0.08
W-R03	63	0.4	150	30	0.11	0.02
W-R04	63	1.6	200	80	0.46	0.06
W-R05	63	0.5	250	20	0.19	0.02
W-R06	63	0.1	170	24	0.03	0.01
W-S01	63	2.4	300	30	0.94	0.10
W-S02	63	1.7	200	50	0.51	0.07
W-S03	63	1.6	360	40	0.64	0.06
W-S04	63	1.0	400	76	0.39	0.04
W-N01	63	3.3	490	42	1.47	0.13

W-N02	63	4.3	300	90	1.42	0.17
W-F01	89	0.9	90	65	0.75	0.15
W-F02	89	1.3	170	44	1.44	0.22
W-F03	89	0.6	350	54	0.91	0.10
W-F04	89	0.5	100	75	0.42	0.08

Ditch	**Flow** cfs	**Depth** ft.	**Slope** %	**Velocity** fps	**Flow From:**	**Flow To:**
P10-R01	0.74	0.31	8.69	3.90	W-R01	R03
P10-R02	0.87	0.33	8.04	3.95	W-R02	R04
P10-R03	2.30	0.61	2.25	3.12	W-R03, S02	P10-08
P10-R04	5.75	0.68	7.90	6.29	W-R04, R02, P10-08	Basin
P10-R05	0.19	0.18	10.77	3.01	W-R05	R06
P10-R06	0.61	0.25	17.91	4.88	W-R06, R05, S04	P10-07
P10-S01	0.94	0.34	8.45	4.10	W-S01	S02
P10-S02	1.45	0.40	8.33	4.55	W-S02, S01	R03
P10-S03	2.11	0.47	7.69	4.85	W-S03, N01	P10-08
P10-S04	0.39	0.26	5.58	2.82	W-S04	R06
P10-N01	1.47	0.49	2.99	3.11	W-N01	P10-10
P10-N02	1.42	0.57	1.16	2.16	W-N02	P10-09
P10-F01	2.17	0.60	2.08	2.99	W-F01, P10-09	P10-05
P10-F02	1.44	0.54	1.60	2.45	W-F02	P10-07
P10-F03	3.08	0.63	3.33	3.89	W-F03, P10-03	Basin
P10-F04	0.42	0.31	2.50	2.12	W-F04	Basin

*Manning's n = 0.030 for Ditches.

Culvert	**Flow** cfs	**Slope** %	**Velocity** fps	**Min. Size** ft.	**Actual** ft.	**Flow From:**	**Flow To:**
P10-03	2.17	2.08	3.82	0.85	2.00	F01	F03
P10-04	2.17	2.08	3.82	0.85	2.00	F01	P10-03
P10-05	2.17	2.08	3.82	0.85	2.00	F01	P10-04
P10-07	2.05	3.00	4.32	0.78	3.00	R06, F02	Basin
P10-08	4.43	4.00	5.83	0.98	2.00	R03, S03	R04
P10-09	1.42	64.44	12.44	0.38	2.00	N02	F01
P10-10	1.47	46.67	11.12	0.41	2.00	N01	S03

*Manning's n = 0.020 for Culverts.

Note: Drainage control details for the portal area are shown on Drawing 5-3C.
Watersheds are shown on Drawing 5-3D.

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.

The one exception to the above is Pond 3. Although the pond size is 200% greater than required for the 100-year / 24-hour event, the pond may also receive water pumped from the underground mine. If a continuous discharge from the mine should occur, the pond is equipped with a decant which would allow for a static level 3' below the spillway. At this elevation, the pond would still have a retention capacity of 4.98 ac. ft., which is slightly greater than the 4.95 ac. ft. calculated runoff from a 10-year / 24 hour event.

Due to the isolated characteristics and the inability to effectively divert water from Watershed 5 and 6, the method of using silt fence or other appropriate control measures for sediment have 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	17.4	0.6	7.2	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	19.8	0.6	5.4	0.3

*All side slopes are 2h:1v

Details

- **Watersheds**

  The first step used for evaluating the diversions was to determine the peak flow during a 100 year, 24 hour storm event for each diversion. In order to determine this variable, the TR-55 method of watershed analysis was again utilized. This requires determining the watershed boundaries associated with each diversion. The following table summarizes these watersheds:

Diversion Watersheds		
Ditch	**Area (acres)**	**Description**
1	158	Diverts water around project area
2	48	Diverts water along Robinson Creek to Pond 2
3	72	Diverts water around facilities area
4	169	Diverts water from project area into Pond 3

- **Rainfall Amount and Runoff Curve Number Classification**

  The rainfall amount for a 100 year, 24 hour storm event was developed utilizing the same method as previously discussed in the impoundments section of this report. This number is 3.1 inches of precipitation.

  The runoff curve number classification for all four watersheds was estimated to be 63. This classification is consistent with the classification and logic used for the impoundment analysis.

- **Time of Concentration (T_c)**

  T_c is the time for runoff to travel from the furthest point in the watershed to the point that it meets the sedimentation structure. This figure is essential for calculating the peak flow which is used to determine the required size for the diversion ditch. The SCS method for calculating T_c is used in this analysis. The following table summarizes the inputs for calculating the T_c along with the resulting outputs:

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	17.4
2	63	1.4	3.1	48	6.9
3	63	0.7	3.1	72	16.7
4	63	1.8	3.1	169	19.8

- **Diversion Dimensions**
  The Manning's Equation (ME) equation was used to appropriately size the each diversion. Inputs into this equation are manning's coefficient, average diversion slope, peak flow and side slope angles. Outputs are the depth of flow, and base dimension for a trapezoidal channel design. The following table summarizes the inputs and results:

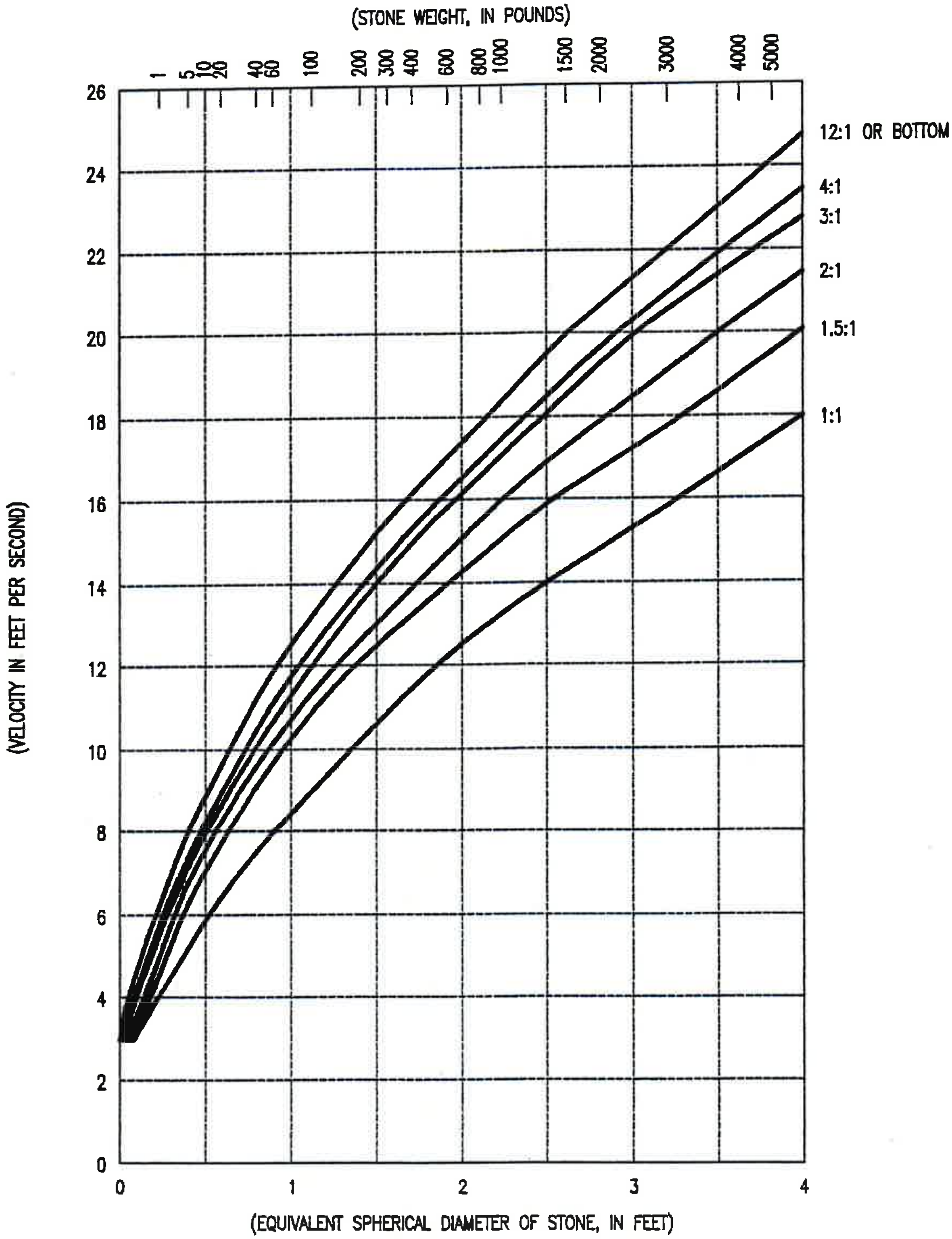
Diversion Ditch Summary							
Ditch	**Base (ft)	*Manning n	Average Slope (%)	Peak Flow (cfs)	Flow Depth (ft)	Velocity (fps)	Freeboard (ft)
1	3.0	0.020	2.8	17.4	0.6	7.2	0.3
2	2.5	0.020	3.5	6.9	0.4	6.0	0.3
3	4.5	0.020	2.4	16.7	0.5	6.3	0.3
4	5.0	0.020	1.1	20.6	0.6	5.0	0.3

*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.

RIP-RAP CHART



SIZE OF STONE THAT WILL RESIST DISPLACEMENT FOR VARIOUS VELOCITIES AND SIDE SLOPES

NOTE:

ADAPTED FROM REPORT OF SUBCOMMITTE ON SLOPE PROTECTION, AM. SOC. CIVIL ENGINEERS PROC. JUNE 1948.
FOR STONE WEIGHING 165 LBS. PER CUBIC FEET.

INCORPORATED
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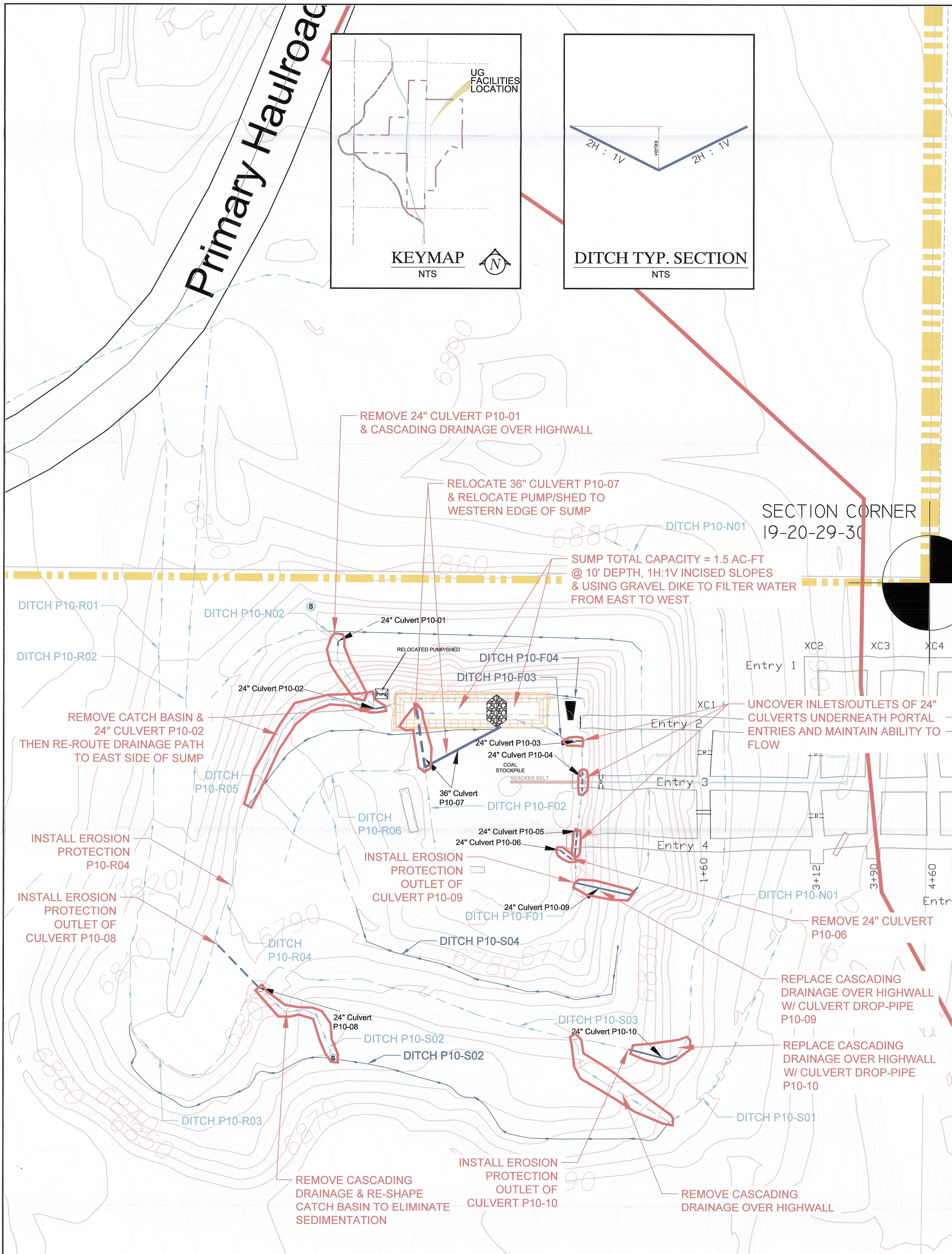
Div. of Oil, Gas & Mining

Figure 1



Note:
Ditch and Culvert sizing calculations shown in Appendix 5-2.

LEGEND:
- PERMIT BOUNDARY
- PRIVATE COAL OWNERSHIP
- SECTION LINE
- EXISTING DRAINAGE PATH
- PROPOSED DRAINAGE PATH
- WATER SUPPLY/ DISCHARGE LINE
- OBSERVED INTERMITTENT SEEP LOCATION

DRAWN BY:	CHECKED BY:
K. NICHOLES	LWJ
DRAWING: 5-3C	DATE: 04/20/2016
	SCALE: 1" = 60'
JOB NUMBER: 1400	SHEET

REVISIONS

DATE:	BY:
5/6/16	AC
6/29/16	AC
8/05/16	AC

UNDERGROUND FACILITIES & STRUCTURES

DESIGN LAYOUT

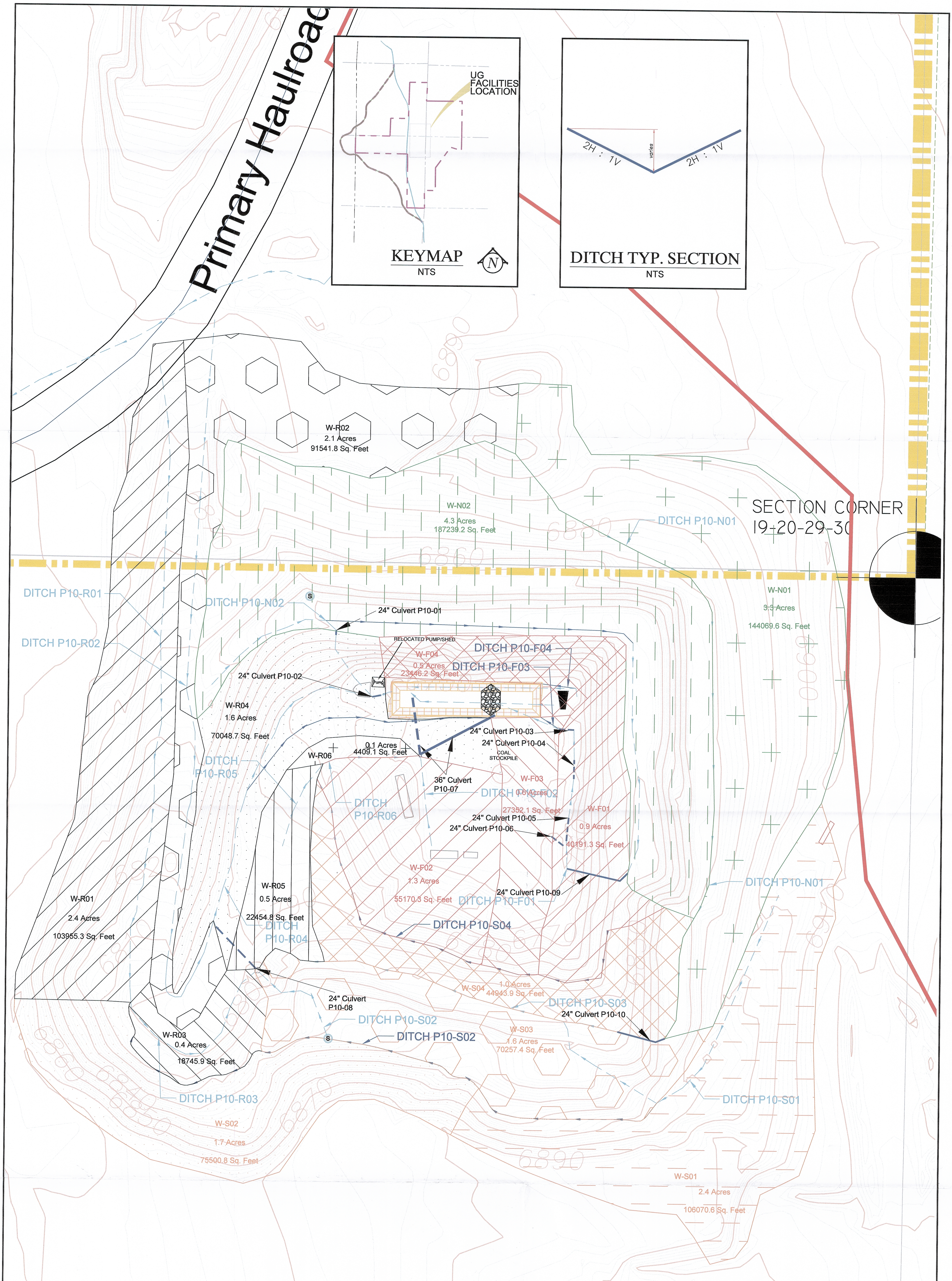
COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 5-3C

INCORPORATED
AUG 12 2016
Div. of Oil, Gas & Mining

UTAH REGISTERED PROFESSIONAL ENGINEER #154168 DAN W. GUY

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



LEGEND:	DRAWN BY:	CHECKED BY:
PERMIT BOUNDARY	A. CHRISTENSEN	DWG
PRIVATE COAL OWNERSHIP	DRAWING:	DATE:
SECTION LINE	5-3D	5/06/2016
EXISTING DRAINAGE PATH		SCALE:
PROPOSED DRAINAGE PATH		1" = 60'
S OBSERVED INTERMITTENT SEEP LOCATION	JOB NUMBER: 1400	SHEET

REVISIONS	
DATE:	BY:
6/29/16	AC
8/05/16	AC

UNDERGROUND FACILITIES & STRUCTURES

WATERSHEDS

COAL HOLLOW PROJECT
ALTON, UTAH

DRAWING: 5-3D

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UTAH REGISTERED PROFESSIONAL ENGINEER
#154168
DAN W. GUY

Alton Coal Development
Coal Hollow Project

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