CHAPTER 1

LEGAL, FINANCIAL, COMPLIANCE AND RELATED INFORMATION

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TABLE 1-2

Disturbed Acres by Well Site

Well Site	Disturbed Acres
G-1	0.6
G-2	1.21
G-3	0.97
G-4	0.85
G-5	0.75
G-6	0.32
G-7	1.25
G-8	0.9
G-9	2.2
G-10	1.7
G-11	1.6
G-12	2
G-13	2.75
G-14	2
G-15	2.5
G-16	2
G-17	1.25
G-19	2.3

CHAPTER 2

SOILS

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210 INTRODUCTION

This chapter and associated attachments address the pertinent data required for the addition of the degassification well sites for the Dugout Canyon Mine. Only those sections of the Division regulations that apply to the well sites have been addressed. The remainder of the regulations have already been addressed in the existing M&RP. The M&RP and this document contain pertinent information relating to the identification, management, and reclamation activities associated with the soil resources.

220 ENVIRONMENTAL DESCRIPTION

The well sites range in elevation from approximately 7400 to 9000 feet. The well sites are located in the Pace Canyon area of the Book Cliffs. General vegetation includes sagebrush, serviceberry, aspen, Douglas-fir, and snowberry.

221 Prime Farmland Investigation

Due to limiting terrain, lack of water for irrigation and no evidence of past cultivation of the sites, it is concluded that no prime farmland exists within the area of the well site disturbance.

222 Soil Survey

222.100 Soils Map

The soils have been mapped as part of the Soil Survey of the Carbon Area, Utah by the Soil Conservation Service (1988), at an Order III intensity level.

A description of the soils is included in Appendix 2-2 of the approved M&RP and in Attachment 2-1, which includes a report by Dan Larsen, Soil Scientist, entitled "Soil Inventory and Assessment Six

Methane Degassification Borehole Sites". An additional report for well site G-6 was prepared in 2004 and is incorporated into Attachment 2-1. Soil information for Well G-7 is incorporated into Attachment 2-1. A photograph of the G-7 site is included in Attachment 3-1. Well site G-3 and the access road can be seen on the photograph.

The soils report prepared by Dan Larsen, Soil Scientist for wells G-8 thru G-13 is provided in Attachment 2-1. Wells are being permitted in groups: G-8 thru G-10, G-11 thru G-12 and G-13 thru G-17.

222.200 Soil Identification

Well No.	Soil Map Unit	Soil Components
G-1	62/88	Midfork-Comodore complex, Rabbitex-Datino Varient
G-2	7	Brycan, Beje-Trag complex, 3-30% slopes
G-3	7	Beje-Trag complex, 3-30% slopes
G-4	62/103	Midfork-Comodore complex, Senchert-Toze complex
G-5	103	Senchert-Croydon
G-6	62	Midfork-Comodore complex
G-7	7	Beje-Trag complex, 3-30% slopes
G-8	21	Croydon Loam, 8 to 30% slopes
G-9	97/62	Midfork-Comodore complex, Rottulee family-Trag complex
G-10	97	Rottulee family-Trag complex
G-11	11, 26	Cabba- family, 40 to 70 percent slopes, Doney family, 50 to 70 percent slopes
G-12	47, 88	Guben-Rock outcrop complex, Rabbitex family-Datino Variant complex

G-13	23	Curecanti family
G-14A	62	Midfork family - Comodore complex
G-15	115, 62	Trag stony loam, 30 to 60 percent slopes, Midfork family - Comodore complex
G-16	26	Doney family
G-17	103	Senchert-Toze family Complex
G-19	62~~, 97~~	Midfork family - Comodore complex, ~~Rottulee family-Trag complex~~

222.300 Soil Description

Refer to Attachment 2-1 of the submittal for soil descriptions.

222.400 Soil Productivity

The depth of topsoil at each site was measured to determine the amount of growth medium available for reclamation. The following table lists each well site and the approximate amount of growth medium available.

TABLE 2-1

Topsoil Volumes*

Well No.	Cubic Yards of Material
G-1	415
G-2	3,104
G-3	1,182
G-4	1,100
G-5	1,909

G-6	792
G-7	1251
G-8	543
G-9	1,574
G-10	2,344
G-11	254
G-12	563
G-13	2,162
G-14	1,544
G-15	1,475
G-16	1,092
G-17	797
G-19	~~2716~~ 2037

* These total do not include soil salvaged from roads which is bladed to the side of the road.

Figure 5-1 through Figure 5-25 show the layout and approximate size of well pads for G-1 thru G-6. Figures 5-27 thru 5-29 show the layout and size for well G-7. The figures for wells G-8 thru G-19 are located in Attachment 5-1. Topsoil volume calculations can be found in Attachment 2-2.

Estimated topsoil salvage from the G-1 well site will average about 7". This site on a ridge top has previously been disturbed for exploration drilling. The site has pockets of fractured sandstone bedrock at the surface and stony subsoils, which are the limiting factors in the quantity of salvageable topsoil. The average topsoil depth at well site G-2 is 30". The average topsoil thickness for well site G-3 is 10". However, enough soil will be stripped to allow 12" of soil to be placed during reclamation. Thus some subsoils will be stripped with the topsoil to generate the required volume. The estimated topsoil salvage from well site G-4 area will be 28" except on the area of the exiting road(s). The average salvageable topsoil at well site G-5 is 22". Well site G-6

will be established on a pre-existing drill pad, with a portion of the new pad extending onto undisturbed area. Topsoil on the pre-existing drill pad ranges from 0 to 30 inches, on the north edge in from 20 to 28 inches and on the cut slope on the south edge from 6 to 30 inches. The slope will be restored to original contour with the application of topsoil, the entire site will receive at least 12 inches of topsoil. Twelve inches was used to calculate the volume of topsoil to be salvaged and to determine the size of the topsoil pile for drill site G-6. Degas well G-7 will be developed on a site with soils consistent with G-3. There is a pre-existing road to well G-3 that continues on to the G-7 proposed site. There are signs of previous vehicle disturbance at the site, however the majority of the site is undisturbed. Topsoil available for salvage has been estimated to be 10 to 12 inches. Available topsoil will be salvaged and if necessary some subsoils will be stripped with the topsoil to generate the required volume to place a minimum of 12 inches during site reclamation. Available topsoil at each site will be salvaged, stockpiled and redistributed.

Twelve inches of soil will be salvaged at well site s G-9. Well site G-9 has no topsoil over approximately half of the site, thus requiring the salvage of subsoil to generate the foot of soil proposed for reclamation. Suitable soil for salvage at site G-10 is approximately 15 inches with some areas having 24 inches of soil. Where available soil will be salvaged to a minimum of 15 inches and approximately 18 inches will be available to cover the G-10 disturbed area at the time of reclamation. G-8 was not constructed, however the available topsoil at site was estimated at about six inches.

The majority of the area at well site G-11 has been disturbed by road construction and the major part of the undisturbed portion has shallow eroded soils, except for a small area on the west side of the site. The shallow eroded soils are approximately 5 inches deep and the soils in the small area are between 10 and 16 inches deep. Approximately fifty percent of the G-12 well site is a road with no topsoil or vegetation. Between 12 and 30 inches of soil is suitable for salvage from the other fifty percent of the pad area for site G-12.Twelve inches will be returned to the reclamation slope at G-11 and between 12 and 15 inches at G-12. Large boulders are suspected to be present at the G-12 site.

At well site G-13, parent materials for soil formation are primarily colluvial deposits derived from sandstone and shale. The surface ranges from relatively smooth and non-stoney to very stoney. Suitable soil for salvage ranges from about 8 to 28 inches, limitation are due to high rock fragment content and low organic matter. Portions along the southeast edge are too stony for soil salvage. Well site G-14 (DUG205), is relatively uniform with soils of and similar to the Midfork family. Topsoil thickness range from 12 to 24 inches, with the typical depth being 15 to18 inches. The G-14 well site has been disturbed by logging. Between 14 and 16 inches of topsoil will be placed at well sites G-13 and G-14 during reclamation.

The road to G-13 and G-14 are existing roads, however, the soil will be bladed to the side of the road at site G-14 and replaced during reclamation.

Well site G-15 is about 50 percent disturbed by a road, slope cut and fill. The undisturbed portion of the site is a slope with a southeast aspect (35 to 45 percent gradient). The topsoil on this slope is typically 13 to 20 inches thick, with a loam texture. Approximately 14 inches of topsoil will be replaced during reclamation.

Well site G-16 was previously the site of an exploration hole, having been disturbed and reclaimed. Approximately, 14 inches of soil will be salvaged as topsoil and replaced during reclamation. The topsoil on the access road will be bladed to one side of the road and replaced during reclamation.

At well site G-17 approximately one-third of the site is an existing road. Sufficient topsoil will be salvaged to replace 12 inches over the area of disturbance during reclamation.

The entire area of well site G-19 was previously disturbed by logging activities with two roads crossing through the area. During the soil survey it was determined that the topsoil was ~~ranged from~~ 8 ~~to 35~~ inches in depth. Approximately ~~16~~ 12 inches of topsoil and subsoil will be salvaged for replacement ~~on the slopes~~ during reclamation. Although, two soil pits were samples only SP-2 is representative of the site. SP-1 is not within the G-19 site's disturbed area.

223 Soil Characterization

The topsoil evaluation described in this chapter was performed by Daniel M. Larsen, Professional Soil Scientist and Dean Stacy, NRCS Range Management Specialist in accordance with the standards of the National Cooperative Soil Survey. The topsoil evaluation for Well G-19 was performed by Craig Clement, P.G. and Dean Stacy, NRCS Management Specialist in accordance with the standards of the National Cooperative Soil Survey and using the USDA/NRCS WEB Soil Survey utility.

224 Substitute Topsoil

Dugout Canyon does not plan to use substitute topsoil as growth media except as described in Section 222.400.

230 OPERATION PLAN

231 General Requirements

231.100 Removing and Storing Topsoil Methods

The topsoil will be removed, stockpiled and protected with a berm and/or silt fence. A qualified person will be on site during soil salvage to monitor and supervise the operation for the purpose of maximizing salvage volumes. Prior to topsoil salvage shrubs/vegetation will be removed and placed/wind rowed along the inside perimeter of the disturbed area.

After the topsoil is removed, the mud pit will be excavated and the soils from the mud pit excavation will be stored immediately adjacent to the mud pit. Mud pit excavation of subsoil will be approximately 110 CY at each well site.

The subsoil excavation for the mud pits at G-7 thru G-17 and G-19 was approximately 430 CY. A portable container for drilling fluids will be used if necessary, should there not be sufficient subsoil depth to excavate a mud pit.

Topsoil beneath the topsoil stockpiles will not be removed. Ribbon or a marking fabric will be placed on top of the topsoil prior to placement of the topsoil from the well pad area.

The approximate volume of subsoil to be salvaged and used to create berms around the perimeter of the well site including the topsoil stockpile perimeter is: G-1 - 161 CY; G-2 - 254 CY, G-3 - 208 CY, G-4-165 CY, G-5 - 191 CY, G-6 - 156 CY, G-7 - 107 CY, G-8 - 143 CY, G-9 - 182 CY, G-10 - 137 CY, G-11 - 185 CY, G-12 - 260 CY, G-13 - 142 CY, G-14A - 123 CY, G-15 - 101 CY, G-16 - 98 CY, G-17 - 83 CY and G-19 - 48 CY.

At the G-19 drill pad there is a variance between the disturbed area acreage and the acreage where topsoil will be salvaged. Portions of the site have no topsoil, due to previous disturbance by logging, these areas include roads, a gully and skid trails. In addition there is a perimeter buffer area that will not be disturbed and thus will not have topsoil removed from the area unless it becomes necessary due to unforseen issues during construction, such as buried outcrops, large boulders, tree root systems, etc. An area within the northeastern portion of the disturbed area has two road forks extending from the end of the existing road, these two forks have no topsoil on them and the area between them will not be disturbed and therefore will not have topsoil salvaged. A sketch of these areas is located in Attachment 2-1.

231.200 Suitability of Topsoil Substitutes/Supplements

See Section 224.

231.300 Testing of Topsoil Handling and Reclamation Procedures Regarding Revegetation

Dugout will exercise care to guard against erosion during and after application of topsoil and will employ the necessary measures to ensure the stability on graded slopes. Erosion control measures will include silt fences, berms, seeding, straw bales, soil roughening, and mulching of the soils.

Topsoil will be redistributed and the original soil surface beneath the topsoil stockpile will be roughened as presented in Section 242.100 and seeded with the seed mix described in Chapter 3, Section 352.

Methods used to evaluate success of revegetation and stabilization are discussed in Chapter 3, Section 356.

231.400 Construction, Modification, Use, and Maintenance of Topsoil Storage Pile

Topsoil removed from the drill pad sites will be stockpiled on the site, except at well site G-14 where it will be stockpiled approximately 1/10 mile away. The estimated volumes of topsoil stockpile for each site are shown in Table 2-1. The stockpiles will be sized as shown in Table 2-2.

The slopes of the stockpile will be 1H:1V or approximately 45^0 during the construction phase. Soils in these areas generally have an angle of repose greater than 50 degrees, making a stockpile with 1:1 slopes feasible. The steeper slope also help minimize the area to be disturbed. When space is available topsoil will be stockpiled with slopes of 2H:1V.

TABLE 2-2

Topsoil Stockpile Dimensions*

Well No.	Length (ft)	Width (ft)	Height (ft)
G-1	55	35	16
G-2	156	50	20
G-3	70	60	17
G-4	110	35	17
G-5	90	65	21
G-6	105	30	13
G-7	80	70	6 to12
G-8**	168	60	6
G-9**	160	90	30
G-10**	170	80	65
G-11**	40	50	12
G-12**	60	80	18
G-13**	120	100	17
G-14A**	120	60	11
G-15**	90	90	19
G-16**	100	80	12
G-17**	85	55	10
G-19**	235 (Lower Road)	8	5
	140 (Pad)	52	35

* These are approximate dimensions of the topsoil stockpile and construction dimensions may vary.

** The height represents the elevation difference between the lowest point and highest point of the topsoil stockpile. The topsoil thickness will vary with the slope of the native ground surface. When stored on steep slopes the topsoil thickness will be much less than the estimated height of the stockpile.

See Section 234.200 for detailed information on the topsoil stockpile(s).

232 Topsoil and Subsoil Removal

232.100 Topsoil Removal and Segregation

All topsoil will be removed as a single layer with no segregation. Topsoil will be removed using a dozer and/or loader. Refer to Section 231.100 for additional details.

232.200 Poor Topsoil

No poor soils exist at the well sites see Attachment 2-1.

232.300 Thin Topsoil

Not applicable see Attachment 2-1.

232.400 Minor Disturbances Not Requiring Topsoil Removal

Topsoil will not be removed along the fence line at the wells sites.

232.500 Subsoil Segregation

The B and C soil horizons will not be removed. Any small quantity of subsoil removed with the topsoil will not be segregated.

232.600 Timing

Topsoil removal will take place after all vegetation that could interfere with salvaging the topsoil has been grubbed.

232.700 Topsoil and Subsoil Removal Under Adverse Conditions

The topsoil will be removed first and stockpiled and the remaining soil horizons will be left in place, except where natural conditions render removal operations hazardous or detrimental to soils outside the disturbed area then topsoil will not be removed.

Conventional Machines - In locations where steep grades, adverse terrains, severe rockiness, limited depth of soils, or other adverse conditions exist that render soil removal activities using conventional machines hazardous, soils will not be salvaged and stockpiled. Such conditions are not likely to occur in these areas.

Substitute Topsoil - Importing of substitute topsoil is not anticipated (Section 224).

233 Topsoil Substitutes and Supplements

233.100 Overburden Materials Supplementing and/or Replacing Topsoil

No overburden material will be used.

233.200 Suitability of Topsoil Substitutes and Supplements

No substitute topsoil is planned.

233.300 Physical and Chemical Analysis

See Section 243.

233.400 Testing of Substitute Topsoil

No substitute topsoil is planned.

234 Topsoil Storage

234.100 Topsoil Stockpiling

Topsoil will be stockpiled for later use in reclamation operations. The topsoil will be stored and treated as outlined in Section 234 of this amendment. Refer to Sections 231 through 234 of the M&RP for additional information pertaining to the topsoil at the Pace Canyon Fan site.

234.200 Topsoil Stockpile

Stable Stockpile Site - Stockpiled material will be placed on a stable site.

Protection from Contaminants and Compaction - To protect the topsoil from contaminants and unnecessary compaction that could interfere with vegetation, the stockpile will be isolated from the main surface area by a berm and/or silt fence. A sign designating "topsoil" will be installed on the stockpile.

The topsoil stockpile will be constructed in such a manner as to allow access for repair of the pile surfaces and diversion structures.

Wind and Water Erosion Protection - The topsoil stockpile will be protected from water erosion by berms, which trap sediment runoff from the stockpile. The berms have been designed to completely contain the 10-year 24-hour storm event (see Attachment 7-1). The stockpile will be surface pitted, gouged and/or roughened and revegetated using the grass seeds listed in Table 3-2 to prevent wind erosion.

Topsoil Redistribution - Stockpile soil will not be moved until redistribution during contemporaneous or final reclamation operations unless approved by the Division.

At well pad G-19 a portion of the salvaged topsoil will be stored on a fork of the existing road. There is no topsoil remaining on the road and the road will remain following reclamation of the G-19 pad site. Wide flagging will be used as a marker to identify the separate between the road surface and the stored topsoil. Landowner correspondence pertaining to topsoil storage on the existing road is contained in Attachment 2-3.

234.300 Topsoil Stockpile Relocation

Stockpiled soil in jeopardy of being detrimentally affected in terms of its quantity and quality by drilling operations may be temporarily redistributed or relocated on approval by the Division and modification of this M&RP.

240 RECLAMATION PLAN

241 General Information

Reclamation of the degassification sites (topsoil redistribution, amendments, and stabilization) is discussed in Sections 242, 243, and 244 respectively.

242 Soil Redistribution

242.100 Soil Redistribution Practices

The topsoil will be placed after recontouring of the site has occurred. Topsoil will be handled when they are loose or in a friable condition. The moisture content will be visually monitored and water will be added as needed to enhance the soil's condition for handling. The approximate amount of topsoil available for each site is shown in Table 2-1. The reclamation time line can be found on Figure 5-15 for sites G-2 and G-3 and on Figure 5-26 for sites G-4 thru G-17 and G-19.

The topsoil will be distributed in two phases at well site G-2, the first phase will be the contemporaneous reclamation of a portion of the pad area used during well construction (see Figures 5-4, 5-8 and 5-12). During contemporaneous reclamation topsoil from the stockpile will be distributed in the depths shown in Table 2-3.

Final reclamation will occur at all well sites after venting of the methane gas is complete, venting equipment has been removed and the well has been plugged. Well plugging will be delayed at well sites G-2, G-5 and G-7, to allow additional time for venting of the gob behind the sealed panels and to provide surface access to the mine. The surface at well sites G-2 and G-5 will be reclaimed in 2006/2007, however the wells will not be plugged. The surface at well site G-7 will be reclaimed in 2008, but the wells will not be plugged. The topsoil stockpile storage area and access road (G-2 and G-5) will be reclaimed during this final phase. The access roads to G-3, G-4, G-6, G-7, G-8, G-9, G-10, G-11 and G-12 are pre-existing and will not be reclaimed.

The topsoil stockpile storage area and access road (G-2 and G-5) will be reclaimed following the plugging of the wells . The access roads to , G-3, G-4, G-6, G-7, G-8, G-9, G-10, G-11, G-12, G-13, G-15, G-17 and G-19 are pre-existing and will not be reclaimed. The access road joining the pre-existing road to G-16 and the portion of the access road between the topsoil stockpile and the well site at G-14 will be pocked/gouged and seeded during final reclamation of the site.

Refer to Section 341 for additional information.

Soil Thickness - The topsoil will be distributed during contemporaneous and final reclamation in the thickness shown in Table 2-3.

Compaction - Prior to the application of topsoil, compacted subsoils will be roughened or loosened for a depth of 18 to 24 inches. To prevent compaction of topsoil, soil moving equipment will refrain from unnecessary operation over spread topsoil. The topsoil will be in a loosened condition prior to seeding.

Following the drying of the mud pit materials, the dirt excavated to create the mud pit will be mixed with the drill cutting and returned to the pit to prevent a boundary of hard material from forming in the mud pit area that would hamper root penetration and then compacted to minimize settling.

Erosion - Care will be exercised to ensure the stability of topsoil on graded slopes to guard against erosion during and after topsoil application. Post reclamation (contemporaneous and final) erosion control measures will be surface roughing, mulching and seeding.

242.200 Regrading

The areas will be graded to their approximate original topographic configuration, except as approved by the Division.

242.300 Topsoil Redistribution on Impoundments and Roads

The mud pits will be dismantled and filled following completion of drilling. See Section 242.100, Compaction for additional information. Mud pits will be covered with the same amount of topsoil as the rest of the site. The roads existing prior to starting the drilling program will not be reclaimed. Access roads built to allow entrance to the drilling pads will be reclaimed and will receive topsoil in the same depth as their corresponding pad areas .

243 Soil Nutrients and Amendments

The soils will be analyzed directly following salvage to determine if amendments are needed. Testing of the topsoil will be done according to Table 6 of the Division's Topsoil and Overburden Guidelines. The topsoil will be tested at a minimum for the following parameters: pH, electrical conductivity, total carbon, SAR, water holding capacity, plant available nitrogen, and phosphorus. Results of these analyses will be incorporated into Attachment 2-2.

TABLE 2-3

Approximate Topsoil Distribution Thickness

Well Site No.	Topsoil Thickness (Inches)
G-1*	7
G-2	30
G-3	12
G-4	28
G-5	22
G-6	12
G-7	12
G-8*	12
G-9	12
G-10	18
G-11	12
G-12	15
G-13	14 - 16
G-14A	14 - 16
G-15	14
G-16	14
G-17	12
G-19	~~16~~ 12

* Wells G-1 and G-8 were never constructed.

244 Soil Stabilization

244.100 Protection and Stabilization of Surface Area

All reclaimed areas will be stabilized to control erosion by application of mulch, tackifier, and roughening of the surface. The areas will be graded to the approximately original topographic configuration. Seeding will be accomplished with the application of seeds and mulch with a long fiber tackifier or broadcast. Methods of protection and stabilization are further discussed in Chapter 3, Section 341.

244.200 Mulch Application

Mulch/tackifier will be applied to stabilize the soil on all areas that have been regraded and covered with growth media. For further discussion of revegetation practices to be utilized, see Chapter 3, Section 341.

244.300 Rills and Gullies

Postmining Land Use and Revegetation - Rills and gullies that are approximately nine (9) inches in depth and disrupt the postmining land use or reestablishment of vegetative cover will be regraded and seeded. In addition, the repair of rills and gullies will assist in the maintenance of water quality standards.

250 PERFORMANCE STANDARDS

251 Topsoil, Subsoil, and Topsoil Supplements Management

All topsoil, subsoil, and topsoil supplements will be managed as outlined in Sections 230 and 240.

252 Stockpiled Topsoil and Subsoil

All stockpiled topsoil and subsoil will be managed according to plans outlined in Sections 230 and 240.

ATTACHMENT 2-1

SOIL INVENTORY AND ASSESSMENT

add to the back of existing information

Site **19-SP-1** Gilson Methane Drainage Wells

Name	Craig Clement		**Drainage**	WD	Well Drained
Date	11/20/2006		**Flooding**	none	
Weather	Clear, 30°F		**Ponding**	none	
Location	N 39.68058°, W 110.48319°		**Depth to Water Table**	Unknown	
Datum	NAD 83		**Earth Cover**	SOS	sagebrush, Douglas fir
Topographic Map	Mount Bartles, UT; 1:24,000; 1972		**Parent Material**	COL	colluvium
Slope Aspect	ENE		**Bedrock, Kind**	SST, SIS, SHA	Interbedded sandstone, siltstone and shale
Slope Gradient	100%		**Bedrock, Fracture**	-	
Slope Complexity	Complex		**Bedrock, Hardness**	MO	Moderate
Slope Shape	VC	Convex, Concave	**Bedrock, Depth**	200 cm	estimated based on outcrops in ravine
Hillslope Profile Postion	BS	backslope	**Erosion, Kind**	G	gully
Geomorphic Component	NS	nose slope	**Erosion, Degree**	1	>0 up to 25%
Microrelief	MH	microhigh	**Runoff**	VH	Very High
Drainage Pattern	dendritic		**Surface Fragments**	Stony	

Diagnostic Horizons	**Observation Method**	**Depth (cm)**		**Boundary**		**Color (moist)**		**Texture**	**Structure**	**Reaction (HCl)**	**% Rock Fragments & Size**	**% Roots, Size & Location**
		From	To	Distinctness	Topography							
A	SP	0	90	Gradual	Wavy	Moderate yellowish brown	10YR 5/4	SI w/ trace FS	1,VF,GR	VE	5%, GR to CB	15% VF to M, T
B	SP	90	150	Gradual	Wavy	Grayish orange	10YR 7/4	SIC	1,VF,GR	VE	5%,GR to CB	2% VF to M, T

Penetration with pick became very difficult

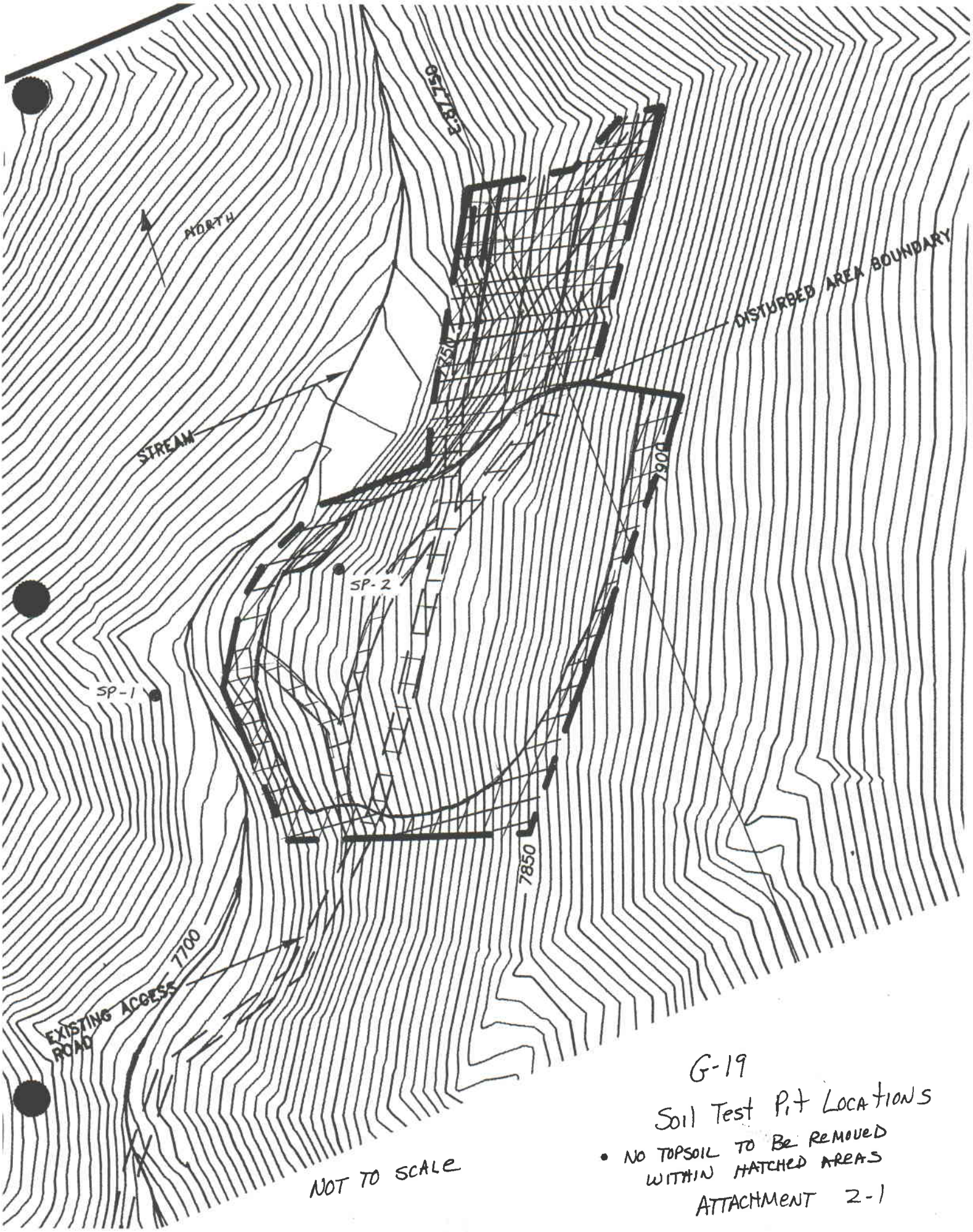
Depth (cm)		**Description**
From	To	
0	90	Silt w/ trace fine sand, minor amount of sandstone clasts (gravel-size to ~1'), moist, moderate amount of roots
90	150	Silty clay with trace sandstone clasts, slightly moist to dry

Site **19-SP-2** Gilson Methane Drainage Wells

Name	Craig Clement		**Drainage**	WD	Well Drained
Date	11/20/2006		**Flooding**	none	
Weather	Clear, 30°F		**Ponding**	none	
Location	N 39.68066°, W 110.48273°		**Depth to Water Table**	Unknown	
Datum	NAD 83		**Earth Cover**	TCO	Douglas fir
Topographic Map	Mount Bartles, UT; 1:24,000; 1972		**Parent Material**	COL	colluvium
Slope Aspect	W		**Bedrock, Kind**	SST, SIS, SHA	Interbedded sandstone, siltstone and shale
Slope Gradient	70%		**Bedrock, Fracture**	-	
Slope Complexity	Complex		**Bedrock, Hardness**	MO	Moderate
Slope Shape	VC	Convex, Concave	**Bedrock, Depth**	80 cm	observed
Hillslope Profile Postion	BS	backslope	**Erosion, Kind**	G	gully
Geomorphic Component	SS	side slope	**Erosion, Degree**	1	>0 up to 25%
Microrelief	MH	microhigh	**Runoff**	VH	Very High
Drainage Pattern	dendritic		**Surface Fragments**	Stony	

Diagnostic Horizons	**Observation Method**	**Depth (cm)**		**Boundary**		**Color (moist)**		**Texture**	**Structure**	**Reaction (HCl)**	**% Rock Fragments & Size**	**% Roots, Size & Location**
		From	To	Distinctness	Topography							
A	SP	0	20	Clear	Wavy	Moderate yellowish brown	10YR 5/4	SIC	1,VF,GR	VE	10%, GR to CB	5% VF to M, T
B	SP	20	80	Clear	Wavy	Grayish orange	10YR 7/4	SIC	1,VF,GR	VE	5%,GR to CB	2% VF to F, T
C	SP	80	+			Grayish orange	10YR 7/4	Weathered siltstone bedrock				

Depth (cm)		**Description**
From	To	
0	20	Silty clay with minor amount of sandstone clasts (more abundant at surface), moist, minor amount of roots
20	80	Silty clay with minor amount of sandstone clasts (gray to buff), slightly moist to dry, minor amount of roots
80	+	Weathered siltstone, fractured with some root in fractures, moist



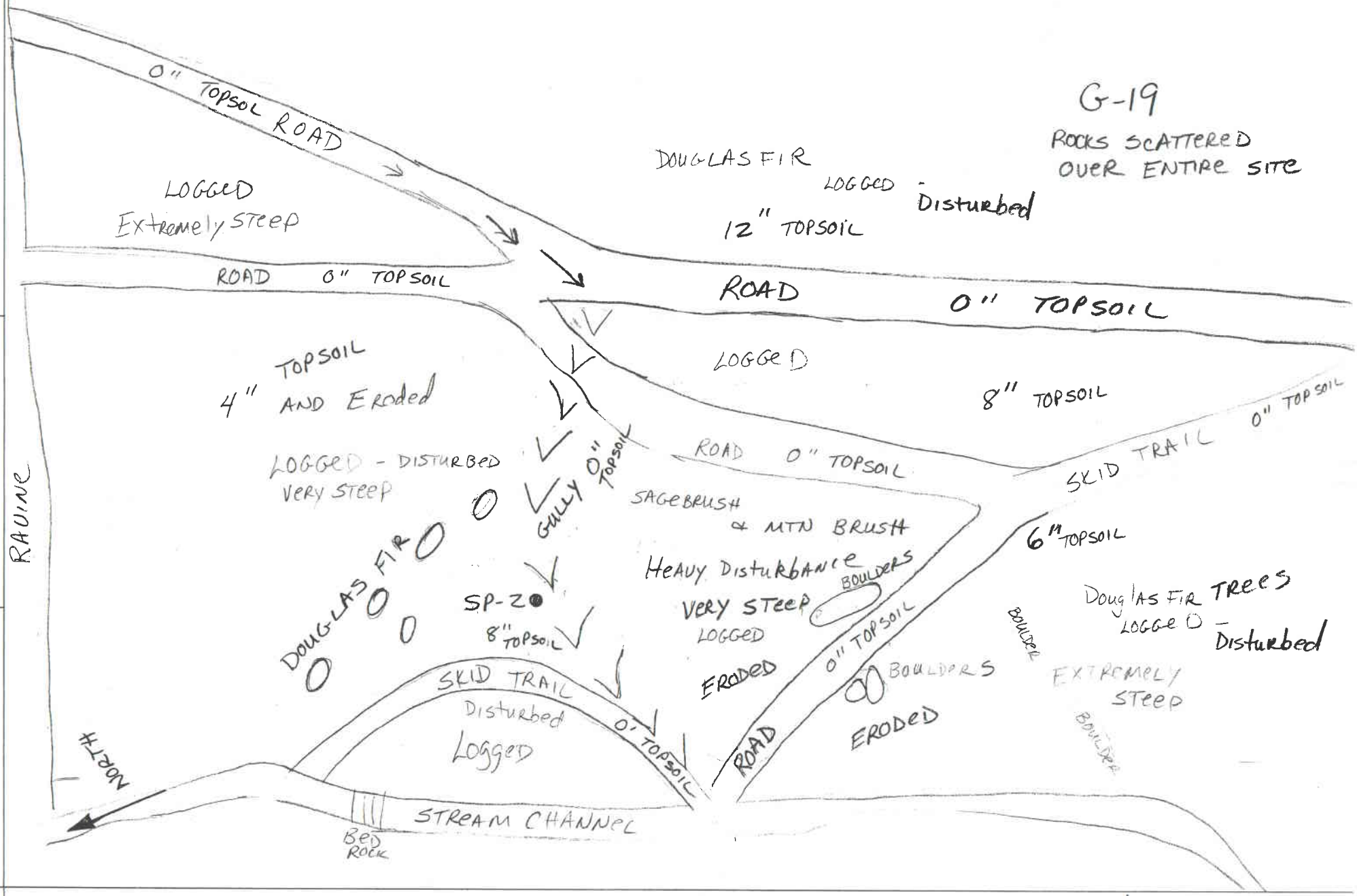
G-19

Soil Test Pit Locations

• NO TOPSOIL TO BE REMOVED WITHIN HATCHED AREAS

NOT TO SCALE

ATTACHMENT 2-1



ATTACHMENT 2-1

8"

CRAIG M. CLEMENT, P.G.

GEOLOGIST

Education

BS, Geology, Brigham Young University, 1994

Professional Registrations

Professional Geologist: Wyoming #PG-3460, 2002; Utah #5263617-2250, 2003

Continuing Education

40-hr OSHA HAZWOPER: 1997

8-hr OSHA HAZWOPER Refresher: 2002

MS Degree Coursework in Hydrogeology/ Geophysics

Mine Safety Training Administration Part 48 (24-hr) New Miner Training: August 2005

I have over thirteen years of experience as a geologist/ environmental scientist and have worked on projects in fifteen states. Responsibilities have included utilizing various geophysical methods to provide information regarding subsurface conditions and properties. I have experience with geophysical methods including well logs, seismic SASW and refraction, ground penetrating radar and electrical resistivity. Projects I have worked on also include Environmental Impact Statements, risk assessments (used to evaluate threats to human health and the environment); preparation of air, surface water and groundwater discharge permit applications; and compliance monitoring associated with the resultant permits. I have assisted with mining related permitting including evaluating impacts to soil, groundwater and surface waste resources. I am proficient with Trimble GPS equipment, including data loggers and software for differential correction, and am familiar with Geographic Information System (GIS) database management and ESRI ArcGIS software.

GEOLOGIC / GEOPHYSICAL RECONNAISSANCE AND MAPPING

- ***Wind Turbine Geotechnical Investigations: Abilene, Texas, Idaho Falls, Idaho and Judith Gap, Montana.*** *Project Geologist.* Conducted down-hole seismic shear wave surveys and spectral analysis of surface waves (SASW) surveys to determine shear and compression wave velocities for wind turbine foundation design using a Geometrics SmartSeis S12 seismograph. Projects included investigating more than 175 turbine locations. Collected and interpreted seismic data and calculated the bulk modulus, shear modulus, Poisson's ratio and Young's modulus of the subsurface materials.

- ***Proposed Housing Development Fault Mapping: Jackson Hole, Wyoming.*** *Project Geologist.* Conducted bedrock mapping to establish fault locations at the proposed Elk Dance Estates using Geometrics SmartSeis S12 seismograph and seismic refraction modeling software. Collected and interpreted seismic data and developed cross-sections for determining fault locations.

- ***Jim Bridger Power Plant Ash Pond Expansion Bedrock Mapping: Sweetwater County, Wyoming.*** *Project Geologist.* Conducted bedrock mapping to establish depth to bedrock and bedrock velocities using Geometrics SmartSeis S12 seismograph and seismic refraction modeling software. Collected and interpreted seismic data and developed cross-sections for determining bedrock characteristics.

- ***Montana and Wyoming Departments of Transportation Projects Bedrock Mapping: Montana and Wyoming.*** *Project Geologist.* Projects included Bigfork North and South, U.S. Highway 93 North, Clearwater Junction, Carbon County Line and I-90 slope failures near Sheridan, WY. Conducted bedrock mapping using Geometrics SmartSeis 512 seismograph and seismic refraction modeling software. Collected and interpreted seismic data and developed cross-sections for determining depth to bedrock and bedrock rippability.

- ***CENEX and ConocoPhillips Refinery Cross-Hole Hear Wave Seismic Surveys: Laurel and Billings, Montana.*** *Project Geologist.* Conducted cross-hole seismic surveys to determine shear and compression wave velocities for process equipment foundation design using a Geometrics SmartSeis S12 seismograph, a triaxial borehole geophone and a Ballard Borehole Seismic Source. Collected and interpreted seismic data and calculated the bulk modulus, shear modulus, Poisson's ratio and Young's modulus of the subsurface materials.

NATURAL RESOURCE DEVELOPMENT

- ***Garfield Wetlands Monitoring, Kennecott Utah Copper: Magna, Utah.*** *Project Geologist.* Assisted Kennecott in developing monitoring protocols for sampling water, soil and macroinvertabrates in the North End Wetland Mitigation Area. Monitoring was performed under an agreement with the U.S. Environmental Protection Agency (EPA) in order to evaluate potential impacts of metals in the wetlands to avian species. Conducted monitoring and assisted Kennecott with report presentation and representation to meetings with the Technical Resource Committee and representatives from EPA, U.S. Fish and Wildlife Service, Utah Department of Environmental Quality, Friends of the Great Salt Lake and the local community.

- ***BLM Black Butte Pit 14 Coal Lease-by-Application Environmental Impact Statement (EIS): Paonia, Colorado.*** *Project Scientist.* Responsible for preparing the Soil, Surface Water and Groundwater Resources sections of the EIS and assessing impacts of mining-related impacts on soil and water resources.

- ***USDA-Forest Service Dry Fork Coal Lease-by-Application Environmental Impact Statement (EIS): Paonia, Colorado.*** *Project Scientist.* Responsible for preparing the Water Resources sections of the EIS and assessing impacts of mining-related subsidence on water resources.

- ***Bureau of Land Management (BLM) Pocatello Resource Management Plan (RMP): Southeastern Idaho.*** *Project Scientist.* Prepared sections of the RMP related to soils and geology. Evaluated soil types in the Pocatello District and potential impacts to soil quality through activities conducted on BLM-administered lands.

- ***BLM Utah Fire Management Plan Environmental Assessments (EAs) and Land Use Plan Amendments EA: Utah.*** *Project Scientist.* Prepared sections of the RMP related to soils and geology. Coordinated with BLM resource specialists across the state of Utah to obtain information necessary for the Affected Environment and Environmental Consequence sections of the documents.

- ***Dubois Fish Rearing Station Groundwater Supply Evaluation: Dubois, Wyoming.*** *Project Geologist.* Evaluated potential groundwater sources not influenced by surface water, recommended drilling locations and designed test and production wells. Conducted on-site oversight of drilling and well completion. Conducted well performance testing. Project resulted in two flowing artesian wells to supply fish hatchery needs.

- ***Underground Mining Impacts on Surface Water Sources: Sevier County, Utah.*** *Project Geologist.* Conducted gain/loss studies to characterize effects on perennial streams of proposed long-wall mining activity at the Box Canyon Tract of SUFCO Mine. The project involved stream gauging and water quality monitoring to evaluate potential impacts of underground mining on the west and east forks of Box Canyon Creek.

WATER RESOURCE INVESTIGATION

- ***Bear Claw Ranch Groundwater Study Evaluation: Sheridan County, Wyoming.*** *Staff Geologist.* Conducted an evaluation of a regional geologic and hydrogeologic setting. Developed alternatives for supplying groundwater to meet ranch water supply requirements.

- ***Coal Lease Area Seep and Spring Survey: Scofield, Utah.*** *Project Geologist.* Conducted a seep and spring survey as part of baseline data collection for a proposed coal lease area. Located all seeps and springs in the 12-square mile lease area, and collected water quality data at each site. Mapped the sites using GPS coordinates. Baseline data was incorporated into an environmental impact study.

GEOGRAPHIC INFORMATION SYSTEMS SERVICES

- ***Seminoe and Pioneer Pipe Lines Geotechnical Survey: Utah and Wyoming.*** *Project Geologist.* Conducted a geotechnical survey of over 600 miles of pipeline to identify areas of potential instability, pipeline exposures due to erosion and other threats to pipeline integrity. Compiled data in a GIS database with geologic and topographic information to identify areas requiring field inspections. Results of the field inspections were recorded and located using GPS equipment and added to the GIS database. Areas of concern were ranked based on potential threat to the pipeline.

- ***Boy Scouts of America Camp GPS Mapping: Summit County, Utah.*** *Project Geologist.* Mapped new and existing camp facilities (using GPS equipment) at Bear West Company Boy Scouts of America Camp Steiner. Compiled existing base map information mapped features, aerial photography and U.S. Geological Survey (USGS) topographic maps into GIS database. Produced maps for environmental assessment scoping document and public meeting presentation.

- ***Pioneer Pipe Line GPS Mapping: Utah and Wyoming.*** *Project Geologist.* Conducted helicopter-borne GPS mapping of potential routes for the Pioneer Pipe Line, and evaluated potential slope instabilities along the proposed route.

ABANDONED MINE RECLAMATION

- ***Abandoned Uranium Mines Location and Evaluation: Utah.*** *Field Technician.* Work performed for Bureau of Land Management. Mines were prioritized for reclamation based on health and safety criteria, including measured radiation levels. Collected data using Trimble GPS systems and compiled it into a GIS database after differential correction.

PROFESSIONAL INSTRUCTION

- ***Geology, Physical Science and Astronomy Courses: Utah Valley State College.*** *Adjunct Faculty.* Responsible for conducting oral, visual and written presentations of technical material to a wide variety of audiences.

- ***Geology Courses: Brigham Young University, Provo, Utah.*** *Teaching and Research Assistant.* Taught geology courses and assisted with summer field camp for seniors in geology, which included geologic and structural mapping, measuring geologic sections and environmental field methods. Led a field trip to Hidalgo, Mexico, to assess groundwater problems associated with wastewater from Mexico City and set up exchange of graduate students between La Universidad Autonoma De Hidalgo and Brigham Young University.

PROFESSIONAL EMPLOYMENT HISTORY

2006 – Present	President and Operator of Clement Drilling & Geophysical, Inc.
1997 – 2006	Project Manager and Geophysical Department Manager, Maxim Technologies (now Tetra Tech)
1996 – 1997	Adjunct Faculty, Utah Valley State College
1993 – 1997	Geologist, Mayo and Associates

Inter-Mountain Labo[illegible]ries, Inc.
1673 Terra Avenue, Sheridan, Wy[illegible]g 82801
(307) 672-8945

Soil Analysis Report

Canyon Fuel Company

Dugout Canyon Mine
P.O. Box 1029
Wellington, UT 84542

Report ID: S0707379001

Project: Dugout Canyon Mine
Date Received: 7/23/2007

Date: 7/30/2007
Work Order: S0707379

Lab ID	Sample ID	Depths cm	pH s.u.	Saturation %	Electrical Conductivity dS/m	Field Capacity %	Wilt Point %
S0707379-001	G-19 SP1	0-90	7.5	33.8	0.46	15	10
S0707379-002	G-19 SP1	90-150	8.0	37.6	0.20	15	11
S0707379-003	G-19 SP2	0-20	7.6	57.3	0.44	24	18
S0707379-004	G-19 SP2	20-80	7.8	37.7	0.31	16	11

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Laboratories, Inc.
1673 Terra Avenue, Sheridan, Wyoming 82801
(307) 672-8945

Soil Analysis Report

Canyon Fuel Company

Dugout Canyon Mine
P.O. Box 1029
Wellington, UT 84542

Report ID: S0707379001

Project: Dugout Canyon Mine
Date Received: 7/23/2007

Date: 7/30/2007
Work Order: S0707379

Lab ID	Sample ID	Depths cm	Calcium meq/L	Magnesium meq/L	Sodium meq/L	Potassium meq/L	SAR	Available Sodium meq/100g	Exchangeable Sodium meq/100g
S0707379-001	G-19 SP1	0-90	4.31	1.46	0.34	0.20	0.20	0.03	0.02
S0707379-002	G-19 SP1	90-150	2.05	1.08	0.16	0.12	0.13	0.03	0.02
S0707379-003	G-19 SP2	0-20	3.87	0.74	0.25	0.23	0.16	0.03	0.01
S0707379-004	G-19 SP2	20-80	2.74	0.61	0.23	0.28	0.18	0.03	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
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Date: 7/30/2007
Work Order: S0707379

Lab ID	Sample ID	Depths cm	Sand %	Silt %	Clay %	Texture	Coarse Fragment %
S0707379-001	G-19 SP1	0-90	36.0	44.0	20.0	Loam	19.8
S0707379-002	G-19 SP1	90-150	8.0	56.0	36.0	Silty Clay Loam	22.1
S0707379-003	G-19 SP2	0-20	36.0	39.0	25.0	Loam	11.2
S0707379-004	G-19 SP2	20-80	37.0	38.0	25.0	Loam	12.8

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Canyon Fuel Company
Dugout Canyon Mine
P.O. Box 1029
Wellington, UT 84542

Report ID: S0707379001

Project: Dugout Canyon Mine
Date Received: 7/23/2007

Date: 7/30/2007
Work Order: S0707379

Lab ID	Sample ID	Depths cm	Boron ppm	TKN %	Nitrogen Nitrate ppm	Phosphorus ppm	Selenium ppm
S0707379-001	G-19 SP1	0-90	0.40	0.13	1.72	3.88	<0.02
S0707379-002	G-19 SP1	90-150	0.18	0.07	0.35	<0.01	<0.02
S0707379-003	G-19 SP2	0-20	0.70	0.20	1.71	26.3	<0.02
S0707379-004	G-19 SP2	20-80	0.42	0.11	1.46	6.80	<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
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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Canyon Fuel Company

Dugout Canyon Mine
P.O. Box 1029
Wellington, UT 84542

Report ID: S0707379001

Project: Dugout Canyon Mine
Date Received: 7/23/2007

Date: 7/30/2007
Work Order: S0707379

Lab ID	Sample ID	Depths cm	Total Sulfur %	T.S. AB t/1000t	Neut. Pot. t/1000t	T.S. ABP t/1000t	Total Carbon %	TOC %
S0707379-001	G-19 SP1	0-90	0.02	0.68	442	441	6.6	1.3
S0707379-002	G-19 SP1	90-150	<0.01	<0.01	463	463	5.9	0.4
S0707379-003	G-19 SP2	0-20	0.01	0.43	162	162	5.8	3.9
S0707379-004	G-19 SP2	20-80	<0.01	<0.01	185	185	3.4	1.2

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

ATTACHMENT 2-2
TOPSOIL CALCULATIONS

add to the back of existing information

TOPSOIL CALCULATIONS
FOR
DEGAS WELL G-19

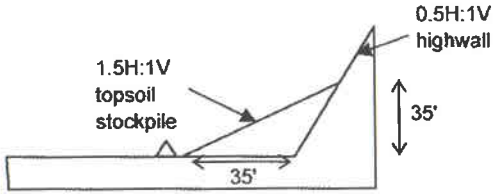
REGISTERED PROFESSIONAL ENGINEER
No. 168246
RICHARD B.
WHITE
27 Jul 2007
STATE OF UTAH

PAD G-19 Summary

Topsoil Excavation Volume Assuming 12 in. Salvage Depth (cyd)	2,037
Topsoil Storage Volume Along Lower Access Road and on Pad (cyd)	2,131
Disturbed Area Acreage (ac)	2.3
Subsoil Volume for Berms (cyd)	31.9
Topsoil Stockpile Dimensions:	
Lower Access Road	5'H X 8'W X 225'L
Pad Stockpile (against highwall)	35'HX52'WX140'L

PAD G-19 Topsoil Stockpile Volume Calculations

Pad Stockpile

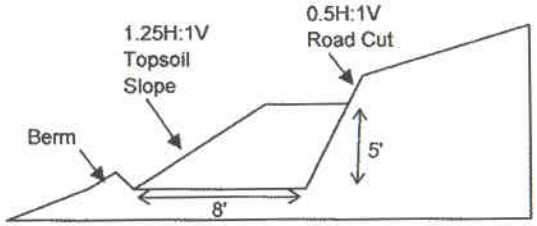


X-Sectional schematic of Pad Topsoil Stockpile (not to scale)

Volume = 22.7 cyd/ft plus end slope

Vol (cyd) = 1,996

Road Stockpile



X-Sectional schematic of Road Topsoil Stockpile (not to scale)

Volume = 0.6 cyd/ft

Storage Volume on Lower Road (225 ft long): 135

TOTAL STORAGE VOLUME (cyd): 2,131

Total Anticipated Topsoil Volume

Assume 12" thickness, and 1.26 acres of disturbance

Vol. (cyd): 2,037

PAD G-19 Subsoil Quantities Required for Berms

Lower Road Topsoil Stockpile (235 ft long)

1H:1V Side Slopes, 225' long @1 ft tall, 20' long @2 ft tall
V = X-sectional area * Length
V= 10.6 cyd

Pad Topsoil Stockpile

1H:1V Side Slopes,144' long @ 2 ft tall
V = X-sectional area * Length
V= 21.3 cyd

TOTAL: 31.9 cyd

ATTACHMENT 2-3

LAND OWNER CORRESPONDENCE

July 25, 2007

Priscilla Burton
Utah Division of Oil, Gas and Mining
455 West Railroad Avenue
Price, Utah 84501

Per your request as the representative of the Milton and Ardith Thayn Trust, I am giving permission for the existing access road(s) running through and associated with the proposed degas drill pad G-19 be blocked. We require that these existing access road(s) remain and not be reclaimed.

Sincerely,

David Thayn

David Thayn
Milton and Ardith Thayn Trust

ATTACHMENT 5-1

Degas Wells G-8 thru G-17 and G-19

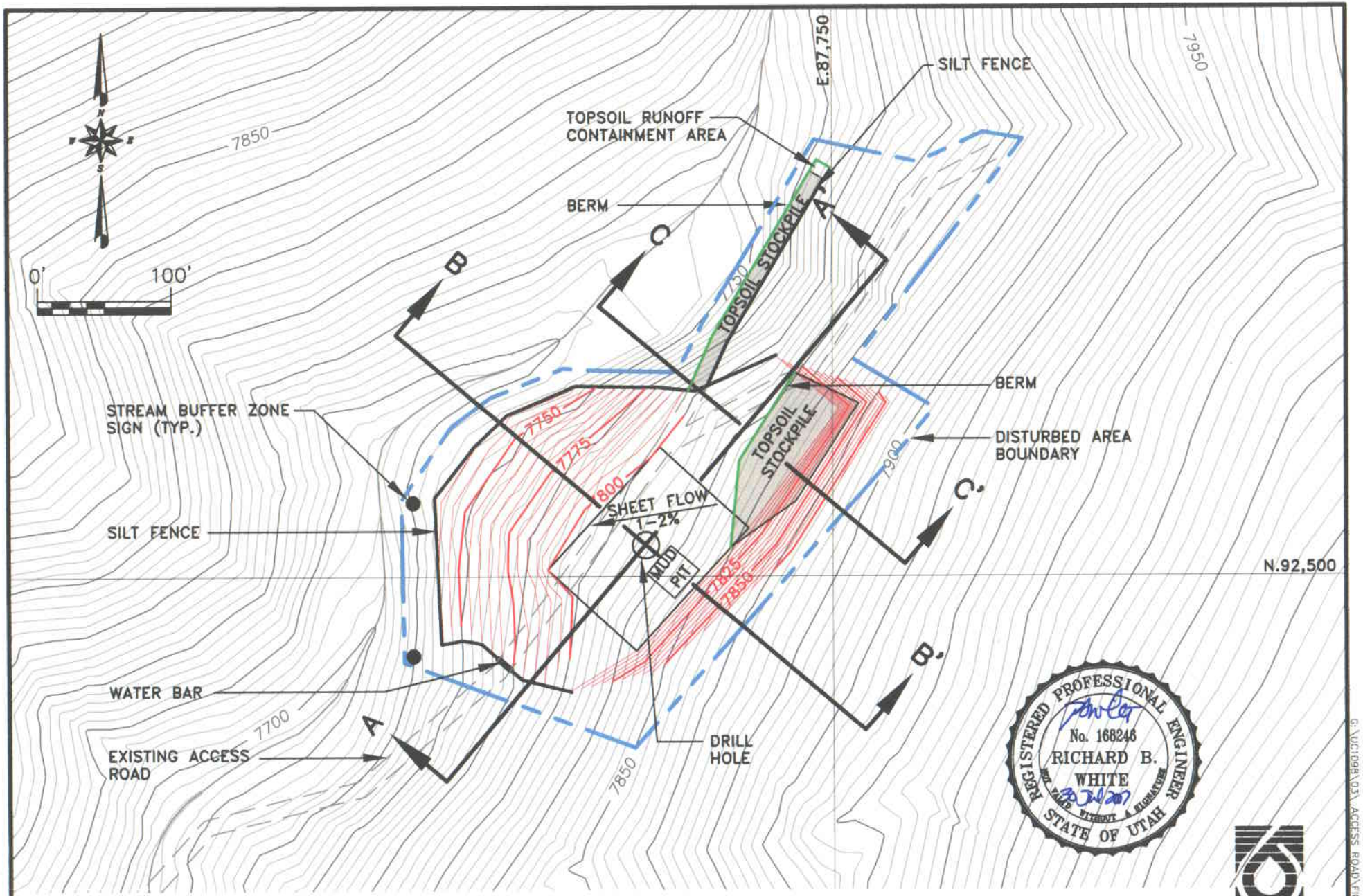
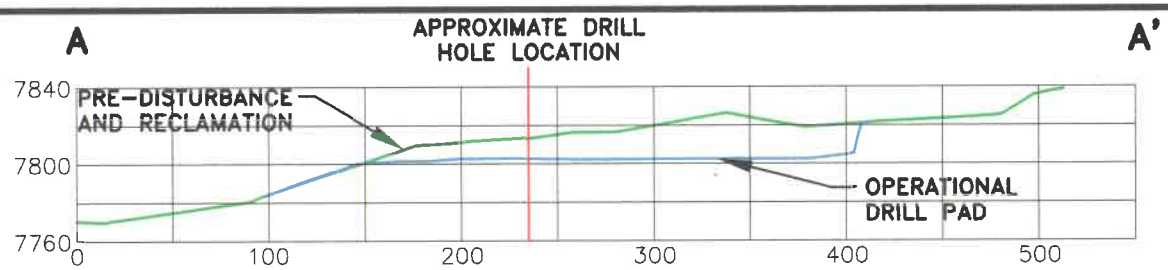
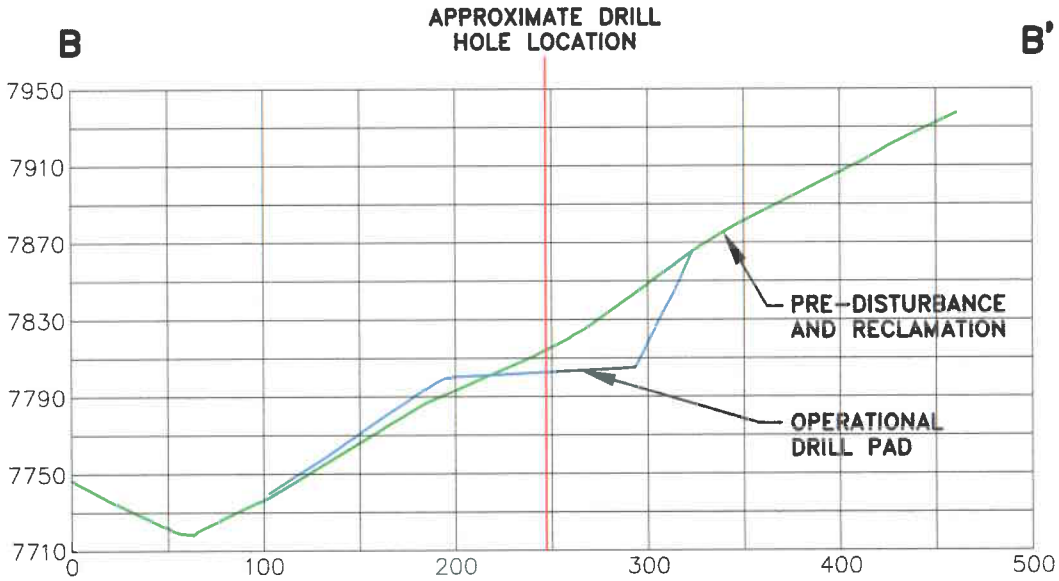


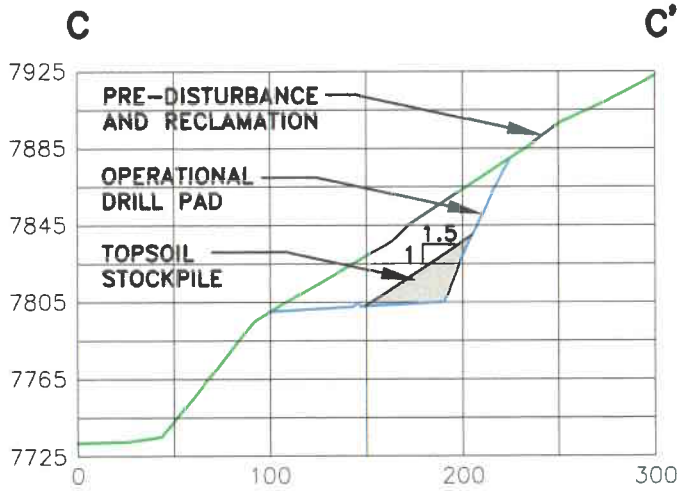
FIGURE 1. CONTOUR MAP FOR G-19

G:\UC1098\03 Access Road\FIG1-G19.DWG, 7/27/2007 1:47:08 PM

G:\UC1098\03\ ACCESS ROAD\FIG1-G19.DWG







0' 100'

HORZ. AND VERT.

REGISTERED PROFESSIONAL ENGINEER
No. 168246
RICHARD B. WHITE
30 Jul 2007
NOT VALID WITHOUT A SIGNATURE
STATE OF UTAH

EarthFax

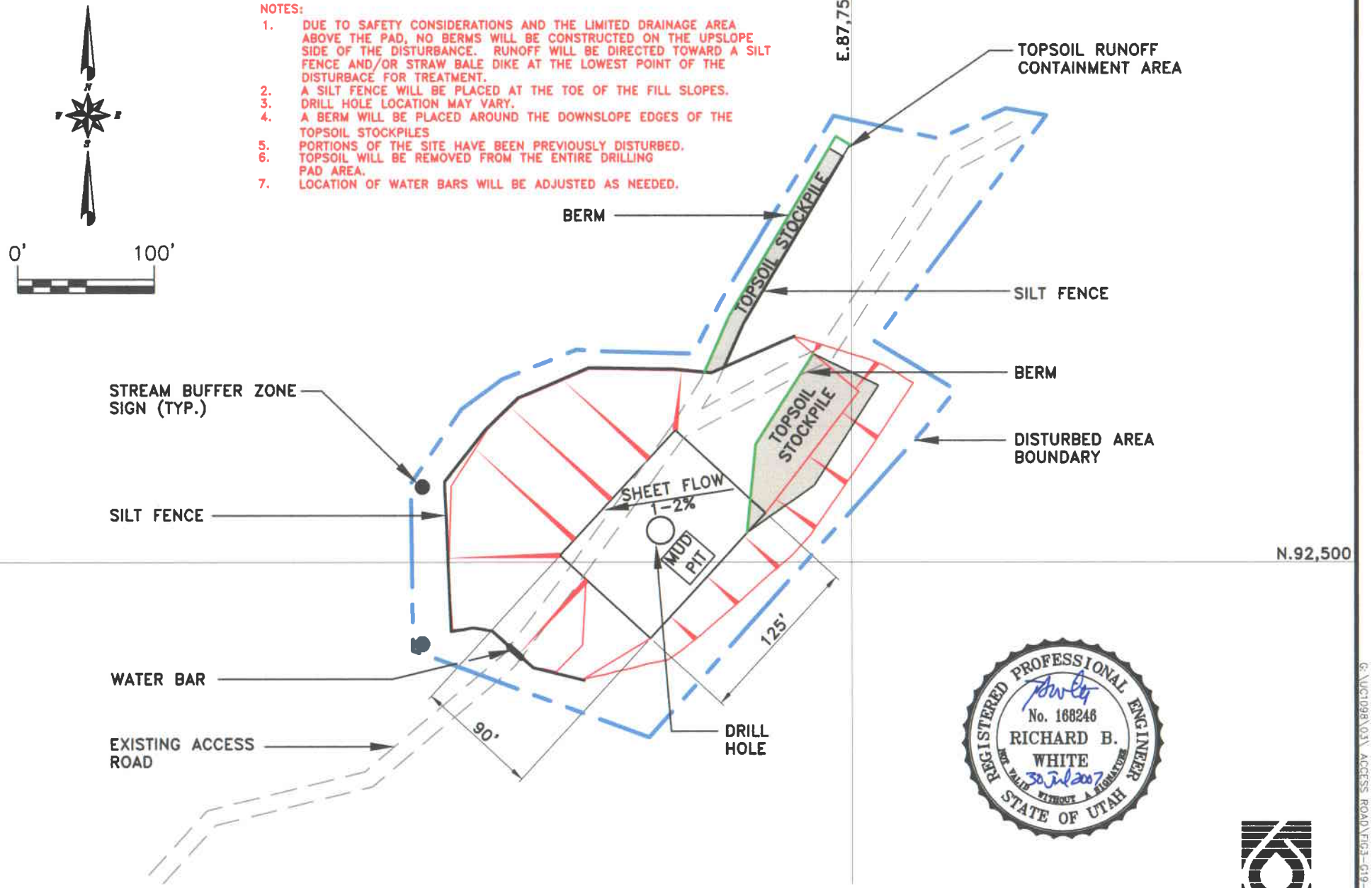
FIGURE 2. TYPICAL CROSS-SECTIONS FOR G-19

G:\UC1098\03 Access Road\FIG2-G19-XSEC.DWG, 7/27/2007 1:47:55 PM

G:\UC1098\03\ ACCESS ROAD\FIG2-G19-XSEC.DWG

NOTES:

1. DUE TO SAFETY CONSIDERATIONS AND THE LIMITED DRAINAGE AREA ABOVE THE PAD, NO BERMS WILL BE CONSTRUCTED ON THE UPSLOPE SIDE OF THE DISTURBANCE. RUNOFF WILL BE DIRECTED TOWARD A SILT FENCE AND/OR STRAW BALE DIKE AT THE LOWEST POINT OF THE DISTURBACE FOR TREATMENT.
2. A SILT FENCE WILL BE PLACED AT THE TOE OF THE FILL SLOPES.
3. DRILL HOLE LOCATION MAY VARY.
4. A BERM WILL BE PLACED AROUND THE DOWNSLOPE EDGES OF THE TOPSOIL STOCKPILES
5. PORTIONS OF THE SITE HAVE BEEN PREVIOUSLY DISTURBED.
6. TOPSOIL WILL BE REMOVED FROM THE ENTIRE DRILLING PAD AREA.
7. LOCATION OF WATER BARS WILL BE ADJUSTED AS NEEDED.



REGISTERED PROFESSIONAL ENGINEER
No. 168246
RICHARD B. WHITE
30 Jul 2007
NOT VALID WITHOUT A SIGNATURE
STATE OF UTAH

FIGURE 3. APPROXIMATE DRILLING LOCATION FOR G-19

EarthFax

G:\UC1098\03 Access Road\FIG3-G19-LAYOUT.DWG, 7/27/2007 1:51:41 PM

G:\UC1098\03\ ACCESS ROAD\FIG3-G19-LAYOUT.DWG

ATTACHMENT 5-2

Methane Degassification

Well No.	Year Constructed		Year Plugged		Contemporaneous Reclamation		Final Reclamation	
	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual
G-2		2004			2007			
G-3		2004		2005		2005		2006
G-4		2004		2005				2005
G-5		2004			2007			
G-6		2004		2005				2007
G-7		2005			2007			
G-9		2005			2008			
G-10	2006				2007			
G-11	2006				2008			
G-12	2006				2007			
G-13	2006				2008			
G-14	2006				2008			
G-15	2007				2008			
G-16	2008							
G-17	2008							
G-18	2007				2009			
G-19	2007				2008			
G-31	2007				2009			

Dates are approximate, all events are subject to availability of contractors, weather, mining needs, etc.
Although permitted, wells G-1 and G-8 were never drilled/constructed.

ATTACHMENT 7-1

HYDROLOGY CALCULATIONS

add to the back of existing information

HYDROLOGY CALCULATIONS
FOR
DEGAS WELL G-19

REGISTERED PROFESSIONAL ENGINEER
No. 168246
RICHARD B. WHITE
27 Jul 2007
STATE OF UTAH

PAD G-19 Topsoil Stockpile Runoff Volume Calculations

Storm (Rec. Int. - Duration)	Watershed	Watershed Area (sq. ft.)	Watershed Area (acres)	Precip. - *P* (in)	Hydraulic Length - *l* (ft)	Curve Number (*CN*)	Potential Max. Retention - *S* (in.)	Runoff - *Q* (in)	Runoff Volume - *V* (ft^3)
10 yr. - 24 hr.	Pad Topsoil	9,700	0.2	2.05	150	87	1.49	0.94	764
10 yr. - 24 hr.	L Rd Topsoil	2,350	0.1	2.05	367	87	1.49	0.94	185

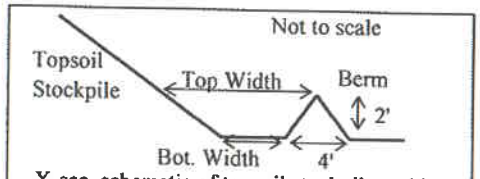
Notes

Topsoil is derived from the Midfork Family - Comodore Complex, as described in the NRCS Soil Survey for Carbon Area, Parts of Carbon and Emery Counties. Calculations based on Soil Conservation Service (SCS) Method, National Engineering Handbook Section 4, Chapters 9 & 10 by Victor Mockus, 1972 CN = 87, based on Table 9.1, NEH s4 ch9. Assume Hyd. Soil Gp. C (Midfork = B and Comodore = D in NRCS survey). Assume road, dirt surface (non-vegetated, conservative case).

$S = (1000/CN) - 10$

$Q = (P - 0.2*S)^2 / (P + 0.8*S)$

$V = \text{Area} * Q$



X-sec. schematic of topsoil stockpile and berm

Topsoil Stockpile Runoff Containment Volume Calculations

Area	Bottom Width (ft)	Top Width (ft)	Max Depth (ft)	Impounding Length of Berm (ft)	Total Length of Berm (ft)	Fill Req'd for Berm (yd^3)	Containment Volume (ft^3)	Contain Vol > Runoff Vol ?
Pad Topsoil	2	7	2	130	144	21.3	1170	Yes
L Rd Topsoil	10	14.5	2	20	245	10.6	245	Yes

Notes

The bottom width is the distance between the toe of the topsoil stockpile and the base of the berm. (see schematic)

The top width is the horizontal distance between the crest of the berm and the topsoil stockpile. (see schematic)

The max depth is the maximum height of the berm.

The Impounding Length of the berm accounts for the slope of the ground, and is the portion of the berm that will impound runoff. This is the downslope edge of the berm.

The Total Length of Berm is its entire length. The Pad Topsoil Stockpile berm should measure at least 2 ft. tall along its entire length. The Lower Road Topsoil Stockpile berm should measure at least 1 ft tall, except for at the lower end, which should measure at least 2 ft tall. The 2 ft tall section should extend at least 10 ft along the road beyond the lower end of the stockpile.

The Fill Required for Berm is the volume of subsoil required to construct each berm, and is based on the length, height, and width of each berm. Berms shall be constructed with 1H:1V slopes.

The Containment Volume = Length * Cross sectional area of the space between the topsoil stockpile and the inby side of the berm.

BERM DESIGN FOR DRILLING AND OPERATIONAL PHASES

G-19

$P = 2.05''$ (10yr - 24hr event)

HYDROLOGIC SOIL GROUP IS ASSUMED TO BE C SINCE IT IS A MIX OF SOILS CLASSIFIED AS HYD. SOIL GROUPS B (MIDFORK) AND D (COMODORE) AS PER NRCS SOIL SURVEY OF CARBON AREA, PARTS OF CARBON AND EMERY COUNTIES.

CN = 87 (DIRT ROAD) THE TOPSOIL STOCKPILES WILL BE SEEDED BUT THIS CALC ASSUMES NO VEG. (CONSERVATIVE). CN TAKEN FROM NAT'L ENGRNG HANDBOOK S4 ch9 Table 9.1 (Mockus, 1969)

$$\text{RUNOFF DEPTH} = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$S = \frac{1000}{CN} - 10 = \frac{1000}{87} - 10 = 1.49$$

$$\text{RUNOFF DEPTH} = \frac{\{2.05 - (0.2)(2.05)\}^2}{2.05 + (0.8)(1.49)} = 0.94''$$

TOPSOIL STOCKPILE AREAS:

PAD STOCKPILE — 9700 ft^2
LOWER ROAD STOCKPILE — 2350 ft^2

RUNOFF VOL = (AREA (ft^2)) × RUNOFF DEPTH (") ÷ 12

PAD STOCKPILE = $9700 \times 0.94 \div 12 = 764\ ft^3$
LOWER ROAD STOCKPILE = $2350 \times 0.94 \div 12 = 185\ ft^3$

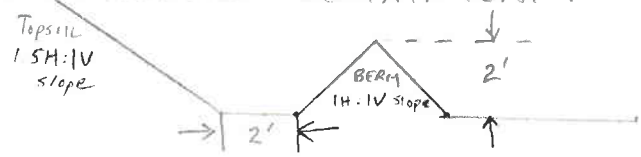
RUNOFF FLOW DIRECTION:

PAD STOCKPILE : W
LOWER RD STOCKPILE : N

THE CONTAINMENT VOLUME IS CALCULATED USING THE BERM HEIGHT AND LENGTH AND DISTANCE FROM THE STOCKPILE. THE SLOPE OF THE GROUND IS CONSIDERED, AND THE DOWN-SLOPE PORTION OF THE BERM WILL BE BUILT TALLER WHERE NECESSARY

CONTAINMENT VOLUMES (CONTINUED)

PAD STOCKPILE CONTAINMENT:



LENGTH OF BERM DETAINING WATER: 130'

CONTAINMENT AREA $= \frac{1}{2}(2+7)(2) = 9ft^2$

CONTAINMENT VOLUME $= 9ft^2 \times 130ft = 1170ft^3$
($406ft^3$ extra capacity)

LOWER ROAD STOCKPILE CONTAINMENT

LENGTH OF DETENTION AREA: 10'

CONTAINMENT AREA $= \frac{1}{2}(10+14.5)(2) = 24.5ft^2$

CONTAINMENT VOLUME $= 24.5ft^2 \times 10ft = 245ft^3$
($60ft^3$ extra capacity)

NOTE: CONTAINMENT CALCULATIONS ARE FOR BOTH DRILLING AND OPERATIONAL PHASES.

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

Utah 39.68175 N 110.48129 W 7946 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

Extracted: Tue Jun 26 2007

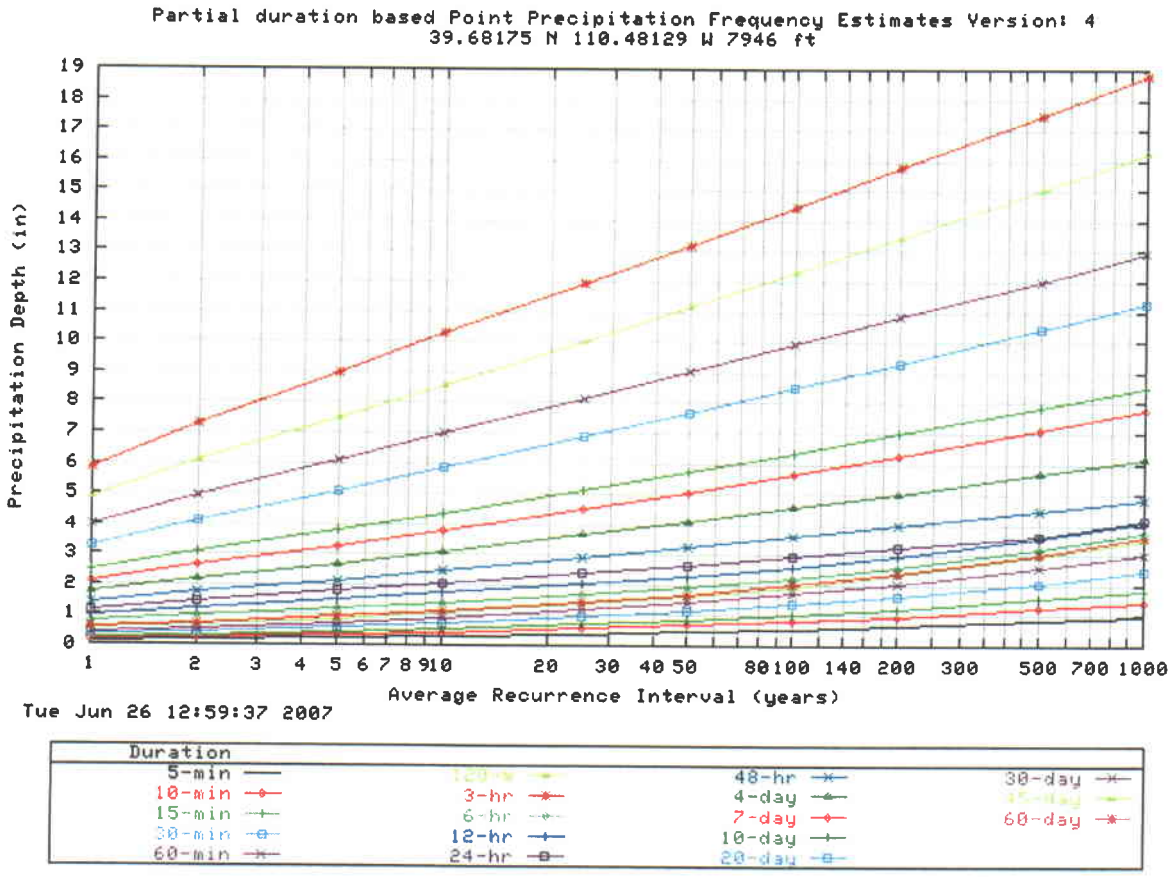
Confidence Limits | Seasonality | Location Maps | Other Info. | GIS data | Maps | Help | D

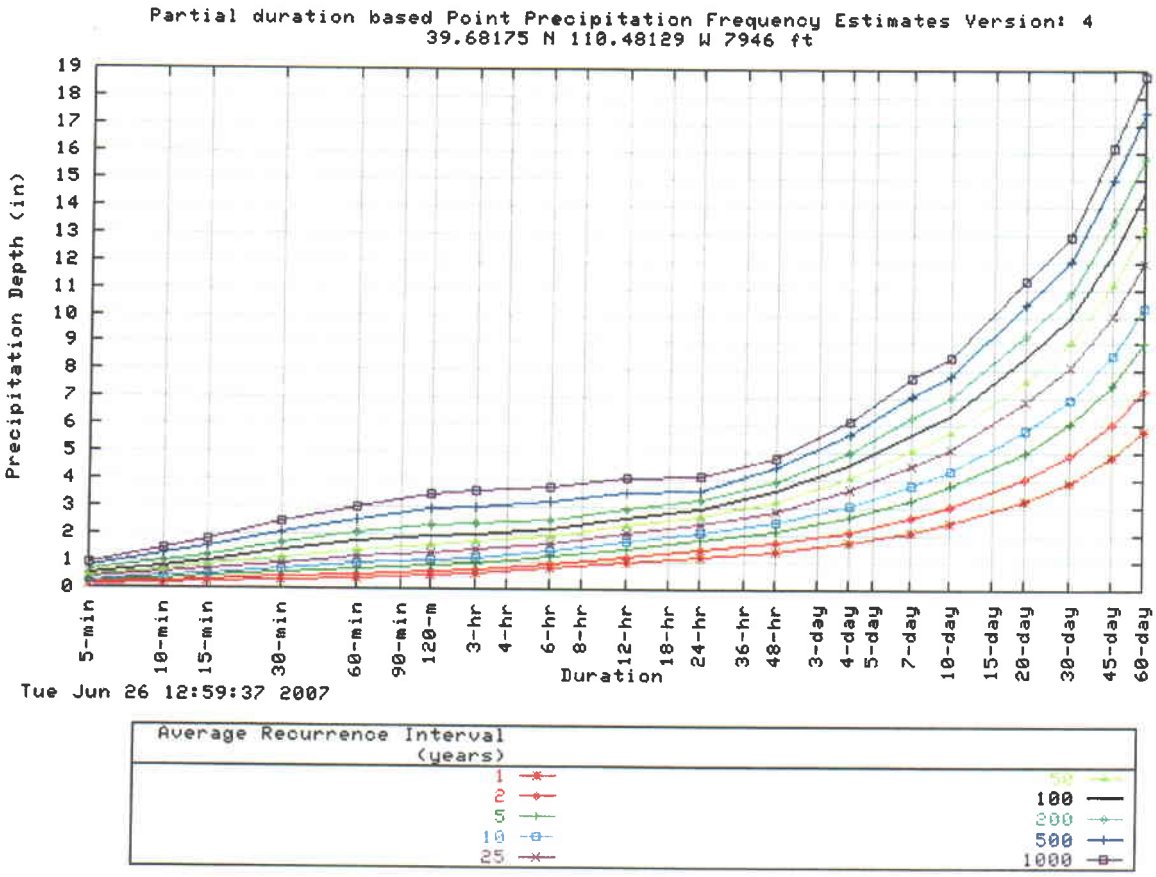
Precipitation Frequency Estimates (inches)

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	0.14	0.20	0.25	0.34	0.42	0.52	0.59	0.77	0.99	1.18	1.40	1.74	2.12	2.44	3.26	3.97	4.88	5.83
2	0.17	0.26	0.33	0.44	0.55	0.65	0.74	0.96	1.23	1.46	1.74	2.16	2.65	3.06	4.08	4.95	6.10	7.31
5	0.24	0.36	0.45	0.60	0.74	0.86	0.95	1.19	1.50	1.78	2.13	2.67	3.29	3.78	5.05	6.09	7.50	9.00
10	0.29	0.45	0.55	0.74	0.92	1.06	1.15	1.38	1.73	2.05	2.46	3.08	3.80	4.36	5.82	6.98	8.59	10.29
25	0.38	0.58	0.72	0.97	1.20	1.36	1.45	1.67	2.05	2.40	2.89	3.65	4.52	5.14	6.86	8.15	10.04	11.96
50	0.46	0.70	0.86	1.16	1.44	1.64	1.72	1.92	2.32	2.68	3.24	4.09	5.08	5.74	7.66	9.04	11.15	13.22
100	0.55	0.83	1.03	1.39	1.72	1.96	2.04	2.22	2.60	2.96	3.60	4.55	5.67	6.36	8.48	9.94	12.29	14.50
200	0.65	0.99	1.23	1.66	2.05	2.33	2.41	2.57	2.94	3.25	3.96	5.03	6.28	7.00	9.31	10.84	13.44	15.78
500	0.82	1.24	1.54	2.08	2.57	2.93	3.03	3.18	3.53	3.64	4.45	5.67	7.11	7.86	10.44	12.03	14.99	17.48
1000	0.97	1.47	1.83	2.46	3.04	3.49	3.59	3.74	4.09	4.13	4.84	6.17	7.77	8.53	11.30	12.94	16.22	18.80

Text version of table

* These precipitation frequency estimates are based on a partial duration series. **ARI** is the Average Recurrence Interval. Please refer to the documentation for more information. NOTE: Formatting forces estimates near zero to appear as zero.


Partial duration based Point Precipitation Frequency Estimates Version: 4
39.68175 N 110.48129 W 7946 ft
Precipitation Depth (in)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
1 2 3 4 5 6 7 8 9 10 20 30 40 50 80 100 140 200 300 500 700 1000
Average Recurrence Interval (years)
Tue Jun 26 12:59:37 2007
Duration
5-min
10-min
15-min
30-min
60-min
3-hr
6-hr
12-hr
24-hr
48-hr
4-day
7-day
10-day
30-day
60-day



Confidence Limits -

*** Upper bound of the 90% confidence interval**
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	0.16	0.24	0.30	0.41	0.51	0.60	0.69	0.88	1.11	1.31	1.56	1.94	2.41	2.74	3.65	4.43	5.44	6.49
2	0.21	0.32	0.39	0.53	0.65	0.76	0.86	1.09	1.38	1.63	1.94	2.42	3.01	3.42	4.56	5.54	6.80	8.12
5	0.28	0.43	0.53	0.72	0.89	1.01	1.11	1.35	1.68	2.00	2.38	2.98	3.73	4.24	5.66	6.80	8.37	10.00
10	0.35	0.53	0.66	0.89	1.10	1.24	1.33	1.58	1.94	2.29	2.74	3.44	4.33	4.89	6.53	7.79	9.60	11.44
25	0.46	0.69	0.86	1.16	1.43	1.60	1.69	1.91	2.32	2.69	3.23	4.08	5.15	5.76	7.70	9.12	11.24	13.33
50	0.55	0.83	1.04	1.40	1.73	1.93	2.01	2.21	2.63	3.00	3.62	4.58	5.80	6.45	8.61	10.14	12.51	14.77
100	0.66	1.00	1.24	1.67	2.07	2.33	2.40	2.58	2.97	3.33	4.03	5.11	6.50	7.17	9.55	11.18	13.80	16.25
200	0.79	1.20	1.49	2.01	2.49	2.79	2.87	3.01	3.38	3.66	4.45	5.65	7.22	7.91	10.53	12.23	15.15	17.77
500	1.01	1.54	1.90	2.56	3.17	3.59	3.67	3.79	4.13	4.17	5.04	6.42	8.24	8.93	11.88	13.66	17.01	19.80
1000	1.22	1.85	2.30	3.09	3.83	4.35	4.43	4.52	4.85	4.90	5.51	7.04	9.06	9.75	12.94	14.77	18.49	21.43

* The **upper** bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are **greater** than.
** These precipitation frequency estimates are based on a partial duration series. **ARI** is the Average Recurrence Interval.
Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

*** Lower bound of the 90% confidence interval**

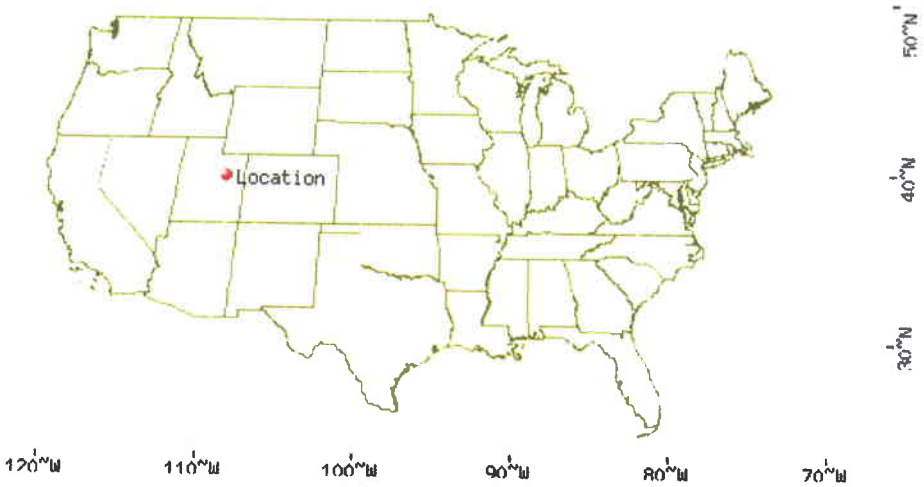
Precipitation Frequency Estimates (inches)

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	0.12	0.18	0.22	0.29	0.36	0.45	0.52	0.69	0.90	1.07	1.26	1.56	1.89	2.19	2.94	3.59	4.41	5.28
2	0.15	0.23	0.28	0.38	0.47	0.57	0.65	0.85	1.11	1.32	1.57	1.95	2.36	2.75	3.68	4.48	5.51	6.61
5	0.20	0.31	0.38	0.52	0.64	0.75	0.84	1.05	1.34	1.61	1.92	2.39	2.92	3.38	4.53	5.49	6.75	8.10
10	0.25	0.38	0.47	0.63	0.79	0.90	1.00	1.22	1.54	1.84	2.20	2.75	3.37	3.88	5.22	6.26	7.69	9.22
25	0.32	0.48	0.59	0.80	0.99	1.14	1.24	1.45	1.81	2.15	2.58	3.23	3.97	4.55	6.10	7.27	8.94	10.66
50	0.37	0.56	0.70	0.94	1.17	1.34	1.44	1.65	2.02	2.39	2.86	3.60	4.43	5.05	6.76	8.02	9.86	11.71
100	0.43	0.66	0.82	1.10	1.36	1.56	1.67	1.88	2.23	2.62	3.15	3.97	4.90	5.55	7.41	8.75	10.78	12.73
200	0.50	0.76	0.94	1.27	1.57	1.81	1.93	2.13	2.48	2.85	3.44	4.34	5.36	6.06	8.07	9.47	11.69	13.73
500	0.60	0.91	1.13	1.52	1.88	2.17	2.32	2.56	2.93	3.15	3.81	4.82	5.99	6.71	8.90	10.36	12.86	15.01
1000	0.68	1.04	1.29	1.73	2.15	2.48	2.65	2.94	3.34	3.38	4.10	5.18	6.46	7.19	9.53	11.03	13.76	15.97

* The **lower** bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are **less** than.
** These precipitation frequency estimates are based on a partial duration maxima series. **ARI** is the Average Recurrence Interval.

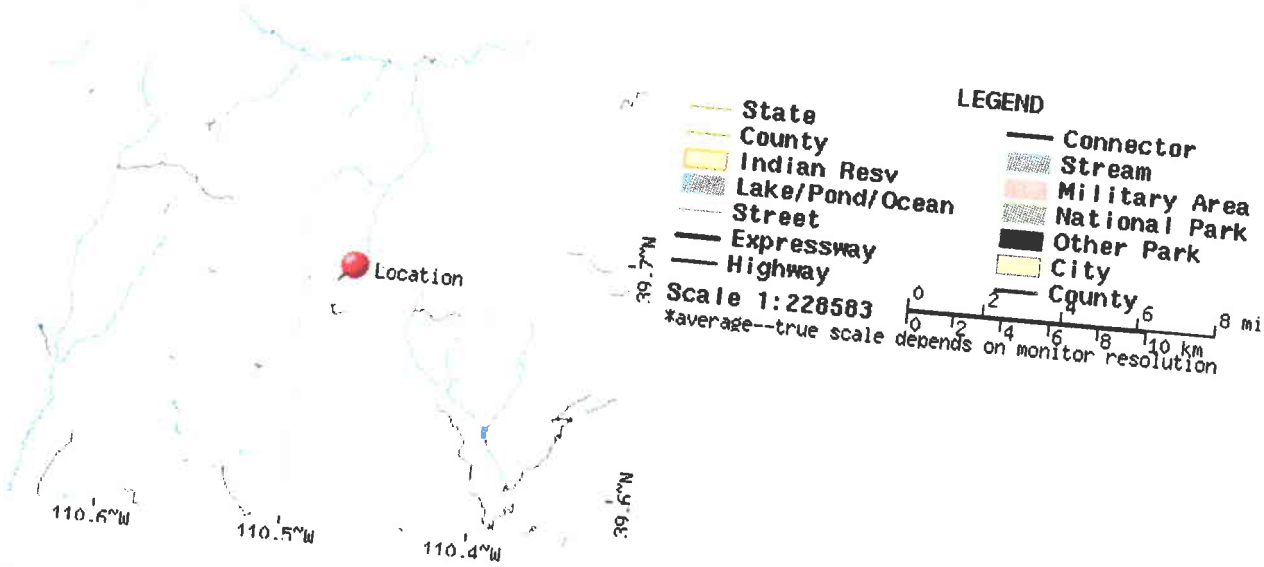
Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero

Maps -



These maps were produced using a direct map request from the U.S. Census Bureau Mapping and Cartographic Resources **Tiger Map Server**.

Please read disclaimer for more information.



Other Maps/Photographs -

View USGS digital orthophoto quadrangle (DOQ) covering this location from TerraServer; USGS Aerial Photograph may also be available
from this site. A DOQ is a computer-generated image of an aerial photograph in which image displacement caused by terrain relief and camera tilts has been removed. It combines the image characteristics of a photograph with the geometric qualities of a map. Visit the USGS for more information.

Watershed/Stream Flow Information -

Find the Watershed for this location using the U.S. Environmental Protection Agency's site.

Climate Data Sources -

Precipitation frequency results are based on data from a variety of sources, but largely NCDC. The following links provide general information
about observing sites in the area, regardless of if their data was used in this study. For detailed information about the stations used in this study,
please refer to our documentation.

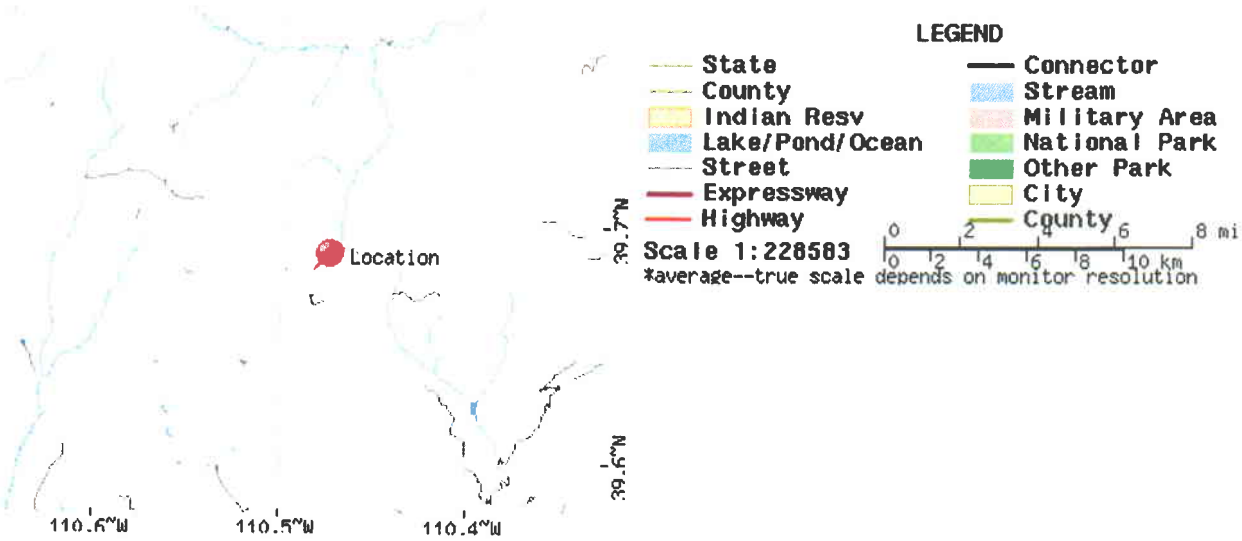
Using the National Climatic Data Center's (NCDC) station search engine, locate other climate stations within:

+/-30 minutes ...OR... +/-1 degree of this location (39.68175/-110.48129). Digital ASCII data can be obtained directly from NCDC.

Find Natural Resources Conservation Service (NRCS) SNOTEL (SNOwpack TELemetry) stations by visiting the Western Regional Climate Center's state-specific SNOTEL station maps.

Hydrometeorological Design Studies Center
DOC/NOAA/National Weather Service
1325 East-West Highway
Silver Spring, MD 20910
(301) 713-1669
Questions?: HDSC.Questions@noaa.gov

Disclaimer



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+/-30 minutes ...OR... +/-1 degree of this location (39.68175/-110.48129). Digital ASCII data can be obtained directly from **NCDC**.

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Hydrometeorological Design Studies Center
DOC/NOAA/National Weather Service
1325 East-West Highway
Silver Spring, MD 20910

(301) 713-1669
Questions? HDSC.Questions@noaa.gov

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