

**Direct Costs**

Subtotal Demolition and Removal	\$638,882
Subtotal Backfilling and Grading	\$695,002
Subtotal Revegetation	<u>\$221,569</u>
Subtotal Direct Costs	\$1,555,453

**Indirect Costs**

Mobilization/Demobilization	\$155,545	10.00%
Contingencies	\$77,773	5.00%
Engineering Redesign	\$38,886	2.50%
Main Office Expense	\$105,771	6.80%
Project Management Fee	<u>\$38,886</u>	2.50%
Subtotal Indirect Costs	<u>\$416,861</u>	

**Total Costs** \$1,972,315

Inflation Factor 0.025226  
 Years 5  
 Inflation \$248,773

Reclamation Cost Inflated \$2,221,087

Bond Amount (rounded to nearest \$1,000) \$2,221,000

Inflation Factor =  $\frac{\text{ENR Construction Cost Index (CCI) for Current Year}}{\text{ENR CCI for mo/yr 5 years prior to Current Year}}$

Current Year Sept. 2002	<u>6589</u>	=	1.126132
Prior Sept. 1997	5851		12.61%

Confidential  
 Shelf  
 Expandable  
 Refer to Record No. 0049 Date 07312003  
 In Case 0070037 doc 3 Following  
 For additional information

**COPY**

*C/007/039 OK*  
*Incoming*



**Canyon Fuel Company, LLC**  
Soldier/Dugout Canyon Mine  
P.O. Box 1029  
Wellington, Utah 84542  
(435)637-6360 Fax: (435)636-2897

July 31, 2003

Ms. Pamela Grubaugh-Littig  
Department of Natural Resources  
Division of Oil, Gas and Mining  
1594 West North Temple  
Suite 1210  
Salt Lake City, UT 84114-5801

**RE:** Methane Degassification Amendment, Wells G-1, G-2, and G-3,  
Canyon Fuel Company, LLC, Dugout Mine, C/007/039

Dear Ms. Grubaugh-Littig:

Enclosed please find four copies of the submittal to address the drilling of three methane degassification wells at the Dugout Canyon Mine. The information provided in the degassification amendment is to be kept in a separate binder and not incorporated into the M&RP binders. However, Plate 1-4 and Appendix 5-6 of the M&RP are part of this amendment and have received revisions and will need to be incorporated into the M&RP binders once this amendment has been approved.

The construction of the wells will increase the disturbed area for Dugout Canyon Mine by a total of 2.78 acres. We have not incorporated the increased disturbed acreage into the M&RP text at this time, but will do so before they are drilled. The drilling of the wells rests on two factors, first how far mining has progressed by the time this amendment is approved and secondly the intensity of the methane in the panels where the wells are proposed. Dugout's plan is to drill at least one of the wells this year.

As you are aware a meeting has been scheduled for August 6<sup>th</sup>, to discuss the permitting of these wells.

An additional copy of the submittal has been delivered to the Price Field Office.

Please contact Vicky Miller at (435) 636-2869, if there are any questions concerning this submittal.

Sincerely yours,

*Vicky S. Miller*

Vicky S. Miller

ENC. IN  
*C/007/0039, 2003, Incoming*  
Refer to:  
 Confidential  
 Shelf  
 Expandable  
Date *07/31/03* for additional information

**RECEIVED**

**AUG 01 2003**

**DIV. OF OIL, GAS & MINING**

Cc: Chris Hansen (no enclosures)  
Dave Spillman (enclosures)  
Pete Hess (enclosures)

# APPLICATION FOR COAL PERMIT PROCESSING

# COPY

Permit Change  New Permit  Renewal  Exploration  Bond Release  Transfer

Permittee: Canyon Fucl Company, LLC

Mine: Dugout Canyon Mine

Permit Number: C/007/039

Title: Degassification Wells G-1, G-2, & G-3 Amendment

Description, include reason for application and timing required to implement:

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

- Yes  No 1. Change in the size of the Permit Area? Acres: \_\_\_\_\_ Disturbed Area: 2.78  increase  decrease.
- Yes  No 2. Is the application submitted as a result of a Division Order? DO# \_\_\_\_\_
- Yes  No 3. Does the application include operations outside a previously identified Cumulative Hydrologic Impact Area?
- Yes  No 4. Does the application include operations in hydrologic basins other than as currently approved?
- Yes  No 5. Does the application result from cancellation, reduction or increase of insurance or reclamation bond?
- Yes  No 6. Does the application require or include public notice publication?
- Yes  No 7. Does the application require or include ownership, control, right-of-entry, or compliance information?
- Yes  No 8. Is proposed activity within 100 feet of a public road or cemetery or 300 feet of an occupied dwelling?
- Yes  No 9. Is the application submitted as a result of a Violation? NOV # \_\_\_\_\_
- Yes  No 10. Is the application submitted as a result of other laws or regulations or policies?

*Explain:* \_\_\_\_\_

- Yes  No 11. Does the application affect the surface landowner or change the post mining land use?
- Yes  No 12. Does the application require or include underground design or mine sequence and timing? (Modification of R2P2)
- Yes  No 13. Does the application require or include collection and reporting of any baseline information?
- Yes  No 14. Could the application have any effect on wildlife or vegetation outside the current disturbed area?
- Yes  No 15. Does the application require or include soil removal, storage or placement?
- Yes  No 16. Does the application require or include vegetation monitoring, removal or revegetation activities?
- Yes  No 17. Does the application require or include construction, modification, or removal of surface facilities?
- Yes  No 18. Does the application require or include water monitoring, sediment or drainage control measures?
- Yes  No 19. Does the application require or include certified designs, maps or calculation?
- Yes  No 20. Does the application require or include subsidence control or monitoring?
- Yes  No 21. Have reclamation costs for bonding been provided?
- Yes  No 22. Does the application involve a perennial stream, a stream buffer zone or discharges to a stream?
- Yes  No 23. Does the application affect permits issued by other agencies or permits issued to other entities?

Please attach four (4) review copies of the application. If the mine is on or adjacent to Forest Service land please submit five (5) copies, thank you. (These numbers include a copy for the Price Field Office)

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

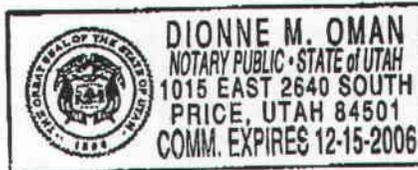
REID W. OLSEN  
Print Name

R.W. Olson Gen Mgr 07-31-03  
Sign Name, Position, Date

Subscribed and sworn to before me this 31 day of July, 2003

Dionne M. Oman  
Notary Public

My commission Expires: 12-15, 2006  
Attest: State of Utah ) ss:  
County of Carbon



For Office Use Only:

Assigned Tracking Number:

Received by Oil, Gas & Mining

## RECEIVED

### AUG 01 2003

DIV. OF OIL, GAS & MINING



Materials	Reference Number	Cost	Unit
Excavate Broken Concrete 3 CY (325BL)	02315 400 0300	2.01	/CY
Front-End Loader 5 CY (966G)	02315 400 1650	1.30	/CY
12 CY Truck, 1/2 mile Round Trip	02320 200 0320	3.09	/CY
On Site Disposal	02220 375 5550	6.80	/CY
Asphalt	02220 375 1750	6.20	/SY
Distance Disposal >5 miles	0220 375 5600	9.38	/CY
Steel Building	02220 100 0012	0.24	/CF
City Service	City Service Price	4.00	/CY
Haul, per mile over 8 CY Truck	02225 730 5100	17.20	/CY
16 Ton Truck	01590 200 5300	517.66	/Day
Truck Driver		38.10	/HR
Masonry Building	02220 100 0080	0.20	/CF
1 CY Skid Loader	02315 440 3020	10.92	/CY
Excavator, Diesel Hydraulic, 3-1/2 CY Operating Rate	Blue Book	53.15	/HR
Excavator, Diesel Hydraulic, 3-1/2 CY Rental Rate	Blue Book	15,130.00	/Month
Concrete Pump	03310 700 5350	19.75	/CY
Excavator, Diesel Hydraulic, 2 CY (325B)	02315 400 260	1.71	/CY
Backfill trench, 2-1/4 CY Bucket	02315 900 3080	1.55	/CY
Machine Placed for Slope Protection	02370 300 0100	27.45	/CY
Polypropylene Mesh, Stapled, 6.5 oz./SY	02370 300 0200	1.45	/SY
Drill and Blast Open Face >1500 Cy	02315 340 0010	8.29	/CY
D9R U-Blade ROPS Operating Rate	Blue Book	70.00	/HR
D9R U-Blade ROPS Rental Rate	Blue Book	17,590.00	/Month
815 F Compactor Operating Rate	Blue Book	31.85	/HR
815 F Compactor Rental Rate	Blue Book	9,064.00	/Month
613C Water Wagon Operating Rate	Blue Book	25.70	/HR
613 C Water Wagon Rental Rate	Blue Book	5,010.00	/Month
Truck Pickup 3/4 ton, 4 Wheel drive Operating Rate	Blue Book	7.40	/HR
Truck Pickup 3/4 ton, 4 Wheel drive Rental Rate	Blue Book	785.00	/Month
Foreman		39.60	/HR
Labor		36.50	/HR
Heavy Equipment Operator		47.15	/HR
Front-End Loader 5 CY (966G) Operating Rate	Blue Book	29.05	/HR
Front-End Loader 5 CY (966G) Rental Rate	Blue Book	7,095.00	/Month
12 CY Truck	01590 200 5250	19.90	/HR
Excavator, Diesel Hydraulic, 2 CY (325B)	01590 200 0300	33.90	/HR
Hydro seeding, seed, fertilizer, wood mulch	02920 500 1100	0.47	/SY
State Nursery		1.00	/Plant
Shrubs	02930 410 0200	6.05	/Plant
Storm Drainage	02630 100 2240	31.50	/FT
Water Line	02220 875 3200	4.96	/FT
Sewer Line	02220 875 3200	9.88	/FT
Backhoe-Loader	01590 200 0460	9.20	/HR
12-18 CY Truck Operating Rate	Blue Book	25.05	/HR
12-18 CY Truck Rental Rate	Blue Book	3,580.00	
Silt Fence	02370 550 1100	0.93	/LF
Chicken Wire	02820 500 0010	6.56	/LF
Crew B 13	Means Crew B 13	374.41	/HR
6000 gal to 8000 gal tank	02115 200 0310	225.00	/EA
Mixed Material Building, Large	02220 100 0100	0.26	/CF
Pipe Removal 12 inch	02220 875 2900	6.50	/LF
Excavating 2-1/2 CY hydraulic backhoe	02315 900 0620	2.58	/CY
ECDC	ECDC	35.00	/TON
Seal Portals	AML1	5,200.00	/EA
Concrete-Geneva Rock	R03310-060	69.00	/CY
Fencing, barbed wire, 3 strand	0200-875-0600	1.36	/LF
Bare root seedlings 6 to 10 inch, heavy soil		1.15	EA

Note:

Resources used were:

R. S. Means Building Construction Cost Data 60th Edition

Concrete Breakage

Concrete Demolition 13.56 per cu. yd.

Powerline

1/3 the cost of a new line \$1,550 plus \$705 for labor and equipment divided by 5,280 feet. Personal communication with Means 0.23 /FT

Powerpoles

1/3 the cost of a new pole \$226 plus \$51 for labor and equipment 126 /Pole  
Personal communication with Means.

Ref.	Description	Cost
1	Mine Belt BC-1	18,333
2	Transfer Building	34,105
3	Feed Belt BC-2	12,941
4	Stack Tube (2)	4,436
5	Head House #1	6,233
6	Transfer Belt BC-3	8,254
7	Head House #2	1,567
8	Reclaim Tunnel	39,378
9	Reclaim Belt BC-4	11,599
10	60" Escape Tunnel	909
11	Crusher Building	30,113
12	Truck Loadout Belt BC-5	9,569
13	Truck Loadout and Scale	25,024
14	Bathhouse	126,051
15	Substation	1,920
16	Power Lines and Poles	2,884
17	Retaining Wall	844
18	Gabion Wall	55,822
19	Pump House	3,074
20	Paved Roads	53,439
21	Stream Culverts	45,702
22	Water Tank (2)	3,430
23	Rock Dust Bin	1,117
24	Fueling Station	1,610
25	Holding Tank (Sewer)	315
26	Ventilation Fan	2,146
27	Magnet	578
28	Water System	65,266
29	Sewage System	21,873
30	Containers	9,160
31	Gilson Well	1,768
32	Shop Building	5,032
33	Switch Houses	1,128
34	Sampling System	1,472
35	Storage Building	1,950
36	Stoker Storage Bin	990
37	Substation No 2	2,849
38	Seal Portals	26,000
	<b>Total</b>	<b>638,882</b>

Ref.	Description	Cost
39	Cut and Fill Mine Site	311,921
40	Topsoil Placement	143,686
41	Stream Channel	108,250
42	Gabion Baskets	447
43	Refuse Site	91,166
44	G-1	5,925
45	G-2	19,818
46	G-3	<u>13,790</u>
	Total	695,002

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost	
1	Mine Bell BC-1																				
	Structure Demolition Cost																				
	Structure Vol. Demolished	Steel Building	02220 100 0012	0.24	/CF						62800					CF		62800	CF	15,072	
	Bulkies Weight (exclude steel)																	0.35	814	CY	
	Truck Capacity																				
	Haulage																				
	Transportation Cost Non-Steel Truck																				
	Transportation Cost Non-Steel Drive																				
	Disposal Cost Non-Steel																				
	Steel Weight																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Steel Truck	16 Ton Truck	01590 200 5300	517.66	/Day						52					Ton			3.3	Days	1,706
	Transportation Cost Steel Drive	Truck Driver		36.10	/HR														26	Hrs.	991
	Disposal Cost Steel																				
	Subtotal																				12,771
	Equipment Disposal Cost																				
	Dismantling Cost																				
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition	Concrete Demolition		13.58	/CY						20					CY			20	CY	276
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost	Front-End Loader 5 CY (999G)	02315 400 1650	1.30	/CY																34
	Transportation Cost	12 CY Truck, 1/2 mile Round Trip	02320 200 0320	3.09	/CY																80
	Disposal Cost	On Site Disposal	02220 375 5650	6.80	/CY																177
	Subtotal																				652
	Excavation																				
	Excavation Brinwall																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																				18,333



Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost	
3	Feed Belt BC-2																				
	Structure Demolition Cost																				
	Structure Vol. Demolished	Steel Building	02220 100 0012	0.24	/CF						47438					CF		47438	CF	11,386	
	Bubbles Weight (exclude steel)																0.35	815	CY		
	Truck Capacity																				
	Headage																				
	Transportation Cost Non-Steel Truck																				
	Transportation Cost Non-Steel Drive																				
	Disposal Cost Non-Steel																				
	Steel Weight																				
	Truck Capacity																				
	Headage																				
	Transportation Cost Steel Truck	18 Ton Truck	01590 200 8300	617.86	/Day						30					Ton		1.9	Days	664	
	Transportation Cost Steel Drive	Truck Driver		38.10	/HR													15	Hrs	572	
	Disposal Cost Steel																				
	Subtotal																				12,941
	Equipment Disposal Cost																				
	Dismantling Cost																				
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Excavation																				
	Excavation Binwall																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																				12,941

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
4	Stack Tube (2)																			
	Structure Demolition Cost																			
	Structure Vol. Demolished																			
	Bubbles Weight (exclude steel)																			
	Truck Capacity																			
	Haulage																			
	Transportation Cost Non-Steel Truck																			
	Transportation Cost Non-Steel Drive																			
	Disposal Cost Non-Steel																			
	Steel Weight																			
	Truck Capacity																			
	Haulage																			
	Transportation Cost Steel Truck																			
	Transportation Cost Steel Drive																			
	Disposal Cost Steel																			
	Subtotal																			
	Equipment Disposal Cost																			
	Dismantling Cost																			
	Equipment Vol. Demolished																			
	Loading Costs																			
	Transport Costs																			
	Disposal Costs																			
	Subtotal																			
	Concrete Demolition	Concrete Demolition		13.58	/CY						158					CY		158	CY	2,142
	Demolition Cost																			
	Concrete Vol. Demolished																1.3		206	CY
	Loading Cost	Front-End Loader 5 CY (986G)	02315 400 1650	1.30	/CY														206	CY
	Transportation Cost	12 CY Truck, 1/2 mile Round Trip	02320 200 0320	3.09	/CY														206	CY
	Disposal Cost	On Site Disposal	02220 375 6550	6.60	/CY														206	CY
	Subtotal																			1,384
	Excavation																			
	Excavation Binwall																			
	Excavate																			
	Vol. To Be Disposed																			
	Loading Cost																			
	Transportation Cost																			
	Disposal Costs																			
	Subtotal																			
	Concrete Demolition																			
	Demolition Cost																			
	Concrete Vol. Demolished																			
	Loading Cost																			
	Transportation Cost																			
	Disposal Cost																			
	Subtotal																			
	Total																			4,436



Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost	
6	Transfer Bell BC-3																				
	Structure Demolition Cost																				
	Structure Vol. Demolished	Steel Building	02220 100 0012	0.24	/CF						30000					CF		30000	CF	7,200	
	Bubble Weight (exclude steel)																0.35	350	CY		
	Truck Capacity																				
	Haulage																				
	Transportation Cost Non-Steel Truck																				
	Transportation Cost Non-Steel Drive																				
	Disposal Cost Non-Steel																				
	Steel Weight																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Steel Truck	15 Ton Truck	01590 200 5300	517.66	/Day						20					Ton		1.3	Days	673	
	Transportation Cost Steel Drive	Truck Driver		38.10	/HR													10	Hrs	381	
	Disposal Cost Steel																				
	Subtotal																				
	Equipment Disposal Cost																				
	Dismantling Cost																				
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Excavation																				
	Excavation Binwall																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																				

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
7	Head House #2																			
	Structure Demolition Cost																			
	Structure Vol. Demolished	Steel Building	02220 100 0012	0.24	/CF						4436					CF		4436	CF	1,065
	Subbase Weight (exclude steel)																0.36	58	CY	
	Truck Capacity																			
	Haulage																			
	Transportation Cost Non-Steel Truck																			
	Transportation Cost Non-Steel Drive																			
	Disposal Cost Non-Steel																			
	Steel Weight																			
	Truck Capacity																			
	Haulage																			
	Transportation Cost Steel Truck	18 Ton Truck	01590 200 5300	517.96	/Day						10					Ton		0.6	Days	311
	Transportation Cost Steel Drive	Truck Driver		36.10	/HR													6	Hrs	181
	Disposal Cost Steel																			
	Subtotal																			1,467
	Equipment Disposal Cost																			
	Dismantling Cost																			
	Equipment Vol. Demolished																			
	Loading Costs																			
	Transport Costs																			
	Disposal Costs																			
	Subtotal																			
	Concrete Demolition																			
	Demolition Cost																			
	Concrete Vol. Demolished																			
	Loading Cost																			
	Transportation Cost																			
	Disposal Cost																			
	Subtotal																			
	Excavation																			
	Excavation Binwall																			
	Excavate																			
	Vol. To Be Disposed																			
	Loading Cost																			
	Transportation Cost																			
	Disposal Costs																			
	Subtotal																			
	Concrete Demolition																			
	Demolition Cost																			
	Concrete Vol. Demolished																			
	Loading Cost																			
	Transportation Cost																			
	Disposal Cost																			
	Subtotal																			
	Total																			

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Steel Factor	Quantity	Unit	Cost	
8	Reclaim Tunnel																				
	Structure Demolition Cost																				
	Structure Vol. Demolished	Steel Building	02220 100 0012	0.24	CF						18774							18774	CF	4,506	
	Bubbles Weight (exclude steel)																				
	Truck Capacity																	0.35	243	CY	
	Haulage																				
	Transportation Cost Non-Steel Truck																				
	Transportation Cost Non-Steel Drive																				
	Disposal Cost Non-Steel																				
	Steel Weight																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Steel Truck	18 Ton Truck	01590 200 5300	517.66	/Day						32								2	Days	1,036
	Transportation Cost Steel Drive	Truck Driver		38.10	/HR														16	Hrs.	610
	Disposal Cost Steel																				
	Subtotal																				4,626
	Equipment Disposal Cost																				
	Dismantling Cost																				
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition	Concrete Demolition		13.55	/CY						1182								1182	CY	16,028
	Demolition Cost																				
	Concrete Vol. Demolished																	1.8	1537	CY	
	Loading Cost	Front-End Loader 5 CY (966G)	02315 400 1650	1.30	/CY																1,998
	Transportation Cost	12 CY Truck, 1/2 mile Round Trip	02320 200 0320	3.09	/CY																4,749
	Disposal Cost	On Site Disposal	02220 375 5550	6.80	/CY																10,452
	Subtotal																				33,277
	Excavation																				
	Excavation Bitwall																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																				33,277

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost	
B	Reclaim Belt BC-4																				
	Structure Demolition Cost																				
	Structure Vol. Demolished	Steel Building	02220 100 0012	0.24	/CF						35180					CF		35180	CF	8,443	
	Bubbles Weight (exclude steel)																0.35	456	CY		
	Truck Capacity																				
	Haulage																				
	Transportation Cost Non-Steel Truck																				
	Transportation Cost Non-Steel Drive																				
	Disposal Cost Non-Steel																				
	Steel Weight																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Steel Truck	18 Ton Truck	01590 200 5300	517.66	/Day						40					Ton		2.5	Days	1,294	
	Transportation Cost Steel Drive	Truck Drive		38.10	/hr													20	Hrs	782	
	Disposal Cost Steel																				
	Subtotal																				
	Equipment Disposal Cost																				
	Dismantling Cost																				
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition	Concrete Demolition		13.58	/CY						36					CY		36	CY	520	
	Demolition Cost																				
	Concrete Vol. Demolished																1.3	51	CY		
	Loading Cost	Front-End Loader 6 CY (668G)	02316 400 1650	1.30	/CY														51	CY	66
	Transportation Cost	12 CY Truck, 1/2 mile Round Trip	02320 200 0320	3.09	/CY														51	CY	158
	Disposal Cost	On Site Disposal	02220 375 5650	6.80	/CY														51	CY	347
	Subtotal																				
	Excavation																				
	Excavation Binwall																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																				

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost		
10	80' Escape Tunnel																					
	Structure Demolition Cost																					
	Structure Vol. Demolished	Steel Building	02220 100 0012	0.24	ICF						2827					CF		2827	CF	878		
	Bubbles Weight (exclude steel)																	0.35	37	CY		
	Truck Capacity																					
	Haulage																					
	Transportation Cost Non-Steel Truck																					
	Transportation Cost Non-Steel Drive																					
	Disposal Cost Non-Steel																					
	Steel Weight																					
	Truck Capacity																					
	Haulage																					
	Transportation Cost Steel Truck	18 Ton Truck	01590 200 5300	517.66	/Day						4					Ton			0.3	Days	155	
	Transportation Cost Steel Drive	Truck Driver		38.10	/HR															2	Hrs.	76
	Disposal Cost Steel																					
	Subtotal																					
	Equipment Disposal Cost																					
	Dismantling Cost																					
	Equipment Vol. Demolished																					
	Loading Costs																					
	Transport Costs																					
	Disposal Costs																					
	Subtotal																					
	Concrete Demolition																					
	Demolition Cost																					
	Concrete Vol. Demolished																					
	Loading Cost																					
	Transportation Cost																					
	Disposal Cost																					
	Subtotal																					
	Excavation																					
	Excavation Bermal																					
	Excavate																					
	Vol. To Be Disposed																					
	Loading Cost																					
	Transportation Cost																					
	Disposal Costs																					
	Subtotal																					
	Concrete Demolition																					
	Demolition Cost																					
	Concrete Vol. Demolished																					
	Loading Cost																					
	Transportation Cost																					
	Disposal Cost																					
	Subtotal																					
	Total																					

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost	
11	Crusher Building																				
	Structure Demolition Cost																				
	Structure Vol. Demolished	Steel Bulking	02220 100 0012	0.24	/CF						93306							93306	CF	22,393	
	Bulking Weight (exclude steel)																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Non-Steel Truck																				
	Transportation Cost Non-Steel Drive																				
	Disposal Cost Non-Steel																				
	Steel Weight																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Steel Truck	18 Ton Truck	01590 200 5300	517.66	/Day						100					Ten		6.3	Days	3,261	
	Transportation Cost Steel Drive	Truck Driver		38.10	/HR													50	Hrs.	1,905	
	Disposal Cost Steel																				
	Subtotal																				7,659
	Equipment Disposal Cost																				
	Dismantling Cost																				
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition	Concrete Demolition		13.56	/CY						91								91	CY	1,234
	Demolition Cost																	1.3		118	CY
	Concrete Vol. Demolished																				
	Loading Cost	Front-End Loader 5 CY (996G)	02315 400 1650	1.30	/CY															118	CY
	Transportation Cost	12 CY Truck, 1/2 mile Round Trip	02320 200 0320	3.09	/CY															118	CY
	Disposal Cost	On Site Disposal	02220 375 5650	6.80	/CY															118	CY
	Subtotal																				502
	Excavation																				
	Excavation Binwall																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																				30,110

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost				
12	Truck Loadout Bell BC-5																							
	Structure Demolition Cost																							
	Structure Vol. Demolished	Steel Building	02220 100 0012	0.24	/CF						30899					CF		30899	CF	7,416				
	Bubbles Weight (exclude steel)																	0.35	401	CY				
	Truck Capacity																							
	Haulage																							
	Transportation Cost Non-Steel Truck																							
	Transportation Cost Non-Steel Drive																							
	Disposal Cost Non-Steel																							
	Steel Weight																							
	Truck Capacity																							
	Haulage																							
	Transportation Cost Steel Truck	16 Ton Truck	01590 200 5300	517.96	/Day						20					Ton			1.3	Days	673			
	Transportation Cost Steel Drive	Truck Driver		38.10	/HR															10	Hrs	381		
	Disposal Cost Steel																							
	Subtotal																				1,470			
	Equipment Disposal Cost																							
	Dismantling Cost																							
	Equipment Vol. Demolished																							
	Loading Costs																							
	Transport Costs																							
	Disposal Costs																							
	Subtotal																							
	Concrete Demolition	Concrete Demolition		13.58	/CY						39					CY			39	CY	529			
	Demolition Cost																							
	Concrete Vol. Demolished																							
	Loading Cost	Front-End Loader 5 CY (986G)	02315 400 1650	1.30	/CY																51	CY	66	
	Transportation Cost	12 CY Truck, 1/2 mile Round Trip	02320 200 0320	3.09	/CY																	51	CY	156
	Disposal Cost	On Site Disposal	02220 375 5650	6.80	/CY																	51	CY	347
	Subtotal																					3,100		
	Excavation																							
	Excavation Bimwall																							
	Excavate																							
	Vol. To Be Disposed																							
	Loading Cost																							
	Transportation Cost																							
	Disposal Costs																							
	Subtotal																							
	Concrete Demolition																							
	Demolition Cost																							
	Concrete Vol. Demolished																							
	Loading Cost																							
	Transportation Cost																							
	Disposal Cost																							
	Subtotal																							
	Total																					7,500		

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost	
13	Truck Loadout and Scale																				
	Structure Demolition Cost										74978					CF	0.35	74978	CF	17,994	
	Structure Vol. Demolished	Steel Building	02220 100 0012	0.24	ACF													972	CY		
	Bubbles Weight (exclude steel)																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Non-Steel Truck																				
	Transportation Cost Non-Steel Drive																				
	Disposal Cost Non-Steel																				
	Steel Weight																				
	Truck Capacity																				
	Haulage										50					Ton			3.1	Days	1,805
	Transportation Cost Steel Truck	16 Ton Truck	01590 200 5300	517.66	/Day																953
	Transportation Cost Steel Drive	Truck Drive		35.10	/HR																
	Disposal Cost Steel																				
	Subtotal																				
	Equipment Disposal Cost																				
	Dismantling Cost																				
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal										156					CY			156	CY	2,155
	Concrete Demolition	Concrete Demolition																			
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost	Front-End Loader 5 CY (996G)	02315 400 1850	1.30	/CY																285
	Transportation Cost	12 CY Truck, 1/2 mile Round Trip	02320 200 0320	3.09	/CY																840
	Disposal Cost	On Site Disposal	02220 375 5550	6.80	/CY																1,406
	Subtotal																				
	Excavation																				
	Excavation Berwall																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																				

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost	
14	Bathrooms																				
	Structure Demolition Cost																				
	Structure Vol. Demolished	Steel Building	02220 100 0012	0.24	/CF						416365							416365	CF	99,628	
	Bubbles Weight (exclude steel)																	0.2	3084	CY	
	Truck Capacity																				
	Haulage																				
	Transportation Cost Non-Steel Truck	City Service	City Service Price	4.00	/CY														3084	CY	
	Transportation Cost Non-Steel Drive																				
	Disposal Cost Non-Steel																				
	Steel Weight																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Steel Truck	18 Ton Truck	01590 200 5300	517.66	/Day						107								6.7	Days	
	Transportation Cost Steel Drive	Truck Driver		38.10	/HR														54	Hrs.	
	Disposal Cost Steel																				
	Subtotal																			117,140	
	Equipment Disposal Cost																				
	Dismantling Cost																				
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition	Concrete Demolition		13.56	/CY						294								294	CY	
	Demolition Cost																		352	CY	
	Concrete Vol. Demolished																		1.3		
	Loading Cost	Front-End Loader 5 CY (666G)	02315 400 1850	1.30	/CY															352	CY
	Transportation Cost	12 CY Truck, 1/2 mile Round Trip	02320 200 0320	3.09	/CY															352	CY
	Disposal Cost	On Site Disposal	02220 375 5550	6.80	/CY															352	CY
	Subtotal																			2,598	
	Excavation																				
	Excavation Binwall																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																				

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost	
15	Subtotal																				
	Structure Demolition Cost	Mixed Material Bldg, Large	02220 100 0100	0.26	/CF						4000					CF		4000	CF	1040	
	Structure Vol. Demolished																0.35	52	CY		
	Bulbs Weight (exclude steel)																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Non-Steel Truck																				
	Transportation Cost Non-Steel Drive																				
	Disposal Cost Non-Steel	City Service	City Service Price	4.00	/CY													52	CY	208	
	Steel Weight																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Steel Truck																				
	Transportation Cost Steel Drive																				
	Disposal Cost Steel																				
	Subtotal																				1248
	Equipment Disposal Cost																				
	Dismantling Cost																				
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition	Concrete Demolition		13.56	/CY						24					CY		24	CY	326	
	Demolition Cost																	31	CY		
	Concrete Vol. Demolished																1.3				
	Loading Cost	Front-End Loader 6 CY (8850)	02316 400 1650	1.30	/CY														31	CY	40
	Transportation Cost	12 CY Truck, 1/2 mile Round Trip	02320 200 0320	3.09	/CY														31	CY	96
	Disposal Cost	On Site Disposal	02220 375 5550	6.80	/CY														31	CY	211
	Subtotal																				572
	Excavation																				
	Excavation Binwall																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																				1720

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
18	Power Lines and Poles																			
	Structure Demolition Cost	Wire Removal		0.23	/FT						3773					FT		3773	FT	888
	Structure Vol. Demolished																			
	Rubbish Weight (exclude steel)																			
	Truck Capacity																			
	Haulage																			
	Transportation Cost Non-Steel Truck																			
	Transportation Cost Non-Steel Drive																			
	Disposal Cost Non-Steel																			
	Steel Weight																			
	Truck Capacity																			
	Haulage																			
	Transportation Cost Steel Truck																			
	Transportation Cost Steel Drive																			
	Disposal Cost Steel																			
	Subtotal																			888
	Equipment Disposal Cost																			
	Dismantling Cost	Pole Removal		126	/Pole						18					Poles		18	Poles	2,016
	Equipment Vol. Demolished																			
	Loading Costs																			
	Transport Costs																			
	Disposal Costs																			
	Subtotal																			2,016
	Concrete Demolition																			
	Demolition Cost																			
	Concrete Vol. Demolished																			
	Loading Cost																			
	Transportation Cost																			
	Disposal Cost																			
	Subtotal																			
	Excavation																			
	Excavation Binwall																			
	Excavate																			
	Vol. To Be Disposed																			
	Loading Cost																			
	Transportation Cost																			
	Disposal Costs																			
	Subtotal																			
	Concrete Demolition																			
	Demolition Cost																			
	Concrete Vol. Demolished																			
	Loading Cost																			
	Transportation Cost																			
	Disposal Cost																			
	Subtotal																			
	Total																			

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost	
17	Retaining Wall																				
	Structure Demolition Cost																				
	Structure Vol. Demolished																				
	Bulkies Weight (exclude steel)																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Non-Steel Truck																				
	Transportation Cost Non-Steel Drive																				
	Disposal Cost Non-Steel																				
	Steel Weight																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Steel Truck																				
	Transportation Cost Steel Drive																				
	Disposal Cost Steel																				
	Subtotal																				
	Equipment Disposal Cost																				
	Demanting Cost																				
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition	Concrete Demolition		13.56	/CY						30					CY		30	CY	407	
	Demolition Cost																	30	CY		
	Concrete Vol. Demolished																	30	CY		
	Loading Cost	Front-End Loader 5 CY (986G)	02315 400 1650	1.30	/CY													30	CY	51	
	Transportation Cost	12 CY Truck, 1/2 mile Round Trip	02320 200 0320	3.09	/CY													30	CY	121	
	Disposal Cost	On Site Disposal	02220 375 5550	6.80	/CY													30	CY	205	
	Subtotal																				444
	Excavation																				
	Excavation Barrow																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																				444

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost	
18	Gabion Wall																				
	Structure Volume										890					CY					
	Demolition Time 60 CY/DAY															117	HR				
	Structure Demolition Cost																				
	Structure Vol. Demolished	Crew B 13	Means Crew B 13	374.41	/HR													117	HR	43,806	
	Bubbles Weight (exclude steel)												2			TONS/CY		1760	TONS		
	Truck Capacity																				
	Haulage																				
	Transportation Cost Non-Steel Truck																				
	Transportation Cost Non-Steel Drive																				
	Disposal Cost Non-Steel																				
	Steel Weight																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Steel Truck	16 Ton Truck	01560 200 5300	517.66	/Day														14.6	Days	7,558
	Transportation Cost Steel Drive	Truck Driver		36.10	/HR														117	Hrs	4,458
	Disposal Cost Steel																				
	Subtotal																			45,622	
	Equipment Disposal Cost																				
	Dismantling Cost																				
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Excavation																				
	Excavation Binwall																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																			65,622	

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost	
16	Pump House																				
	Structure Demolition Cost																				
	Structure Vol. Demolished	Steel Building	02220 100 0012	0.24	/CY						2216							2216	CY	533	
	Bubbles Weight (exclude steel)																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Non-Steel Truck																				
	Transportation Cost Non-Steel Drive																				
	Disposal Cost Non-Steel																				
	Steel Weight																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Steel Truck	16 Ton Truck	01580 200 5300	517.66	/Day						5								0.3	Days	155
	Transportation Cost Steel Drive	Truck Driver		36.10	/HR														2	Hrs	76
	Disposal Cost Steel																				
	Subtotal																				
	Equipment Disposal Cost																				
	Dismantling Cost																				
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition	Concrete Demolition		13.56	/CY						62								62	CY	1,112
	Demolition Cost																				
	Concrete Vol. Demolished																		1.3	107	CY
	Loading Cost	Front-End Loader 5 CY (685G)	02315 400 1650	1.30	/CY																139
	Transportation Cost	12 CY Truck, 12 mile Round Trip	02320 200 0320	3.06	/CY																331
	Disposal Cost	On Site Disposal	02220 375 5550	6.80	/CY																726
	Subtotal																				
	Excavation																				
	Excavation Birwall																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																				

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost	
20	Paved Roads																				
	Structure Demolition Cost																				
	Structure Vol. Demolished																				
	Bubbles Weight (exclude steel)																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Non-Steel Truck																				
	Transportation Cost Non-Steel Drive																				
	Disposal Cost Non-Steel																				
	Steel Weight																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Steel Truck																				
	Transportation Cost Steel Drive																				
	Disposal Cost Steel																				
	Subtotal																				
	Equipment Disposal Cost																				
	Dismantling Cost	Asphalt	02220 375 1750	6.20	/SY						8448					SY		8448	SY	52,376	
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs	On Site Disposal	02220 375 1750	6.80	/CY						156					CY		156	CY	1,061	
	Subtotal																				53,437
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Excavation																				
	Excavation Binwall																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																				53,437

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost	
21	Stream Culverts																				
	Excavate Culvert	Excavator, Diesel Hydraulic, 2 CY (325B)	02315 400 280	1.71	JCY	2350	12	12			12533								12533	CY	21431
	Backfill Culvert	Backfill trench, 2-1/4 CY Bucket	02315 600 3080	1.55	JCY	2350	12	12			12533								12533	CY	19426
	Structure Vol. Demolished																				
	Bubbles Weight (exclude steel)																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Non-Steel Truck																				
	Transportation Cost Non-Steel Drive																				
	Disposal Cost Non-Steel																				
	Steel Weight																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Steel Truck	16 Ton Truck	01590 200 5300	517.66	/Day						94					Ton		5.9	Days	3,064	
	Transportation Cost Steel Drive	Truck Driver		38.10	/HR														47	Hrs	1,781
	Disposal Cost Steel																				
	Subtotal																				48,299
	Equipment Disposal Cost																				
	Dismantling Cost																				
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Excavation																				
	Excavation Barwall																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																				

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
22	Water Tank (2)																			
	Structure Demolition Cost																			
	Structure Vol. Demolished	Steel Building	02220 100 0012	0.24	/CF						241					CF	0.35	241	CF	58
	Bubbles Weight (exclude steel)																			
	Truck Capacity																			
	Haulage																			
	Transportation Cost Non-Steel Truck																			
	Transportation Cost Non-Steel Drive																			
	Disposal Cost Non-Steel																			
	Steel Weight																			
	Truck Capacity																			
	Haulage																			
	Transportation Cost Steel Truck	18 Ton Truck	01590 200 5300	517.66	/Day						39					Ton		2.4	Days	1,242
	Transportation Cost Steel Drive	Truck Driver		38.10	/HR													19	Hrs.	724
	Disposal Cost Steel																			
	Subtotal																			2,024
	Equipment Disposal Cost																			
	Dismantling Cost																			
	Equipment Vol. Demolished																			
	Loading Costs																			
	Transport Costs																			
	Disposal Costs																			
	Subtotal																			
	Concrete Demolition	Concrete Demolition		13.58	/CY						50					CY	1.3	50	CY	678
	Demolition Cost																			
	Concrete Vol. Demolished																			
	Loading Cost	Front-End Loader 6 CY (986G)	02315 400 1660	1.30	/CY															85
	Transportation Cost	12 CY Truck, 1/2 mile Round Trip	02320 200 0320	3.09	/CY															201
	Disposal Cost	On Site Disposal	02220 375 5660	6.80	/CY															442
	Subtotal																			400
	Excavation																			
	Excavation Binwall																			
	Excavate																			
	Vol. To Be Disposed																			
	Loading Cost																			
	Transportation Cost																			
	Disposal Costs																			
	Subtotal																			
	Concrete Demolition																			
	Demolition Cost																			
	Concrete Vol. Demolished																			
	Loading Cost																			
	Transportation Cost																			
	Disposal Cost																			
	Subtotal																			
	Total																			3,490

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
23	Rock Dust Bin																			
	Structure Demolition Cost																			
	Structure Vol. Demolished	Steel Building	02220 100 0012	0.24	JCF						2265					CF		2265	CF	544
	Bubbles Weight (exclude steel)																			
	Truck Capacity																			
	Haulage																			
	Transportation Cost Non-Steel Truck																			
	Transportation Cost Non-Steel Drive																			
	Disposal Cost Non-Steel																			
	Steel Weight																			
	Truck Capacity																			
	Haulage																			
	Transportation Cost Steel Truck	18 Ton Truck	01580 200 5300	517.66	/Day						5					Ton		0.3	Days	156
	Transportation Cost Steel Drive	Truck Driver		38.10	/HR													2.0	Hrs	76
	Disposal Cost Steel																			
	Subtotal																			216
	Equipment Disposal Cost																			
	Dismantling Cost																			
	Equipment Vol. Demolished																			
	Loading Costs																			
	Transport Costs																			
	Disposal Costs																			
	Subtotal																			
	Concrete Demolition	Concrete Demolition		13.56	/CY						12					CY		12	CY	163
	Demolition Cost																	1.3		16
	Concrete Vol. Demolished																			
	Loading Cost	Front-End Loader 5 CY (866G)	02315 400 1650	1.30	/CY															16
	Transportation Cost	12 CY Truck, 1/2 mile Round Trip	02320 200 0320	3.00	/CY															49
	Disposal Cost	On Site Disposal	02220 375 5550	6.80	/CY															106
	Subtotal																			342
	Excavation																			
	Excavation Binwall																			
	Excavate																			
	Vol. To Be Disposed																			
	Loading Cost																			
	Transportation Cost																			
	Disposal Costs																			
	Subtotal																			
	Concrete Demolition																			
	Demolition Cost																			
	Concrete Vol. Demolished																			
	Loading Cost																			
	Transportation Cost																			
	Disposal Cost																			
	Subtotal																			
	Total																			1177

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost			
24	Fueling Station																						
	Structure Demolition Cost																						
	Structure Vol. Demolished	Steel Building	02220 100 0012	0.24	CF						3945						CF	3945	CF	947			
	Bubbles Weight (exclude steel)																	0.35	51	CY			
	Truck Capacity																						
	Haulage																						
	Transportation Cost Non-Steel Truck																						
	Transportation Cost Non-Steel Drive																						
	Disposal Cost Non-Steel																						
	Steel Weight																						
	Truck Capacity																						
	Haulage																						
	Transportation Cost Steel Truck	18 Ton Truck	01690 200 6300	517.68	/Day						7					Ton			0.4	Days	207		
	Transportation Cost Steel Drive	Truck Driver		36.10	/HR															3	Hrs.	114	
	Disposal Cost Steel																						
	Subtotal																				103.46		
	Equipment Disposal Cost																						
	Dismantling Cost																						
	Equipment Vol. Demolished																						
	Loading Costs																						
	Transport Costs																						
	Disposal Costs																						
	Subtotal																						
	Concrete Demolition	Concrete Demolition		13.56	/CY						12									12	CY	163	
	Demolition Cost																						
	Concrete Vol. Demolished																			1.3	16	CY	
	Loading Cost	Front-End Loader 5 CY (986G)	02315 400 1850	1.30	/CY																16	CY	21
	Transportation Cost	12 CY Truck, 1/2 mile Round Trip	02320 200 0320	3.09	/CY																18	CY	49
	Disposal Cost	On Site Disposal	02220 375 6660	6.80	/CY																18	CY	106
	Subtotal																					347	
	Excavation																						
	Excavation Binwall																						
	Excavate																						
	Vol. To Be Disposed																						
	Loading Cost																						
	Transportation Cost																						
	Disposal Costs																						
	Subtotal																						
	Concrete Demolition																						
	Demolition Cost																						
	Concrete Vol. Demolished																						
	Loading Cost																						
	Transportation Cost																						
	Disposal Cost																						
	Subtotal																						
	Total																					1,610	

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost	
25	Holding Tank (Sewer)																				
	Structure Demolition Cost																				
	Structure Vol. Demolished																				
	Bubbles Weight (exclude steel)																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Non-Steel Truck	8000 gal to 8000 gal tank		225.00	Gal						1					EA		1	Gal	225	
	Transportation Cost Non-Steel Drive											2				TON		2	TON		
	Disposal Cost Non-Steel																				
	Steel Weight																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Steel Truck	16 Ton Truck	01590 200 6300	517.66	Day														0.10	Days	62
	Transportation Cost Steel Drive	Truck Driver		38.10	HR														1	Hrs.	38
	Disposal Cost Steel																				
	Subtotal																				
	Equipment Disposal Cost																				
	Dismantling Cost																				
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Excavation																				
	Excavation Binwall																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																				

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost	
26	Ventilation Fan																				
	Structure Demolition Cost																				
	Structure Vol. Demolished	Steel Building	02220 100 0012	0.24	/CF						6850					CF		6850	/CF	1,644	
	Bubble Weight (exclude steel)																0.35	89	CY		
	Truck Capacity																				
	Haulage																				
	Transportation Cost Non-Steel Truck																				
	Transportation Cost Non-Steel Drive																				
	Disposal Cost Non-Steel																				
	Steel Weight																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Steel Truck	16 Ton Truck	01590 200 5300	517.98	/Day						10					Ton		0.6	Days	311	
	Transportation Cost Steel Drive	Truck Driver		38.10	/HR														5	Hrs.	191
	Disposal Cost Steel																				
	Subtotal																				2,144
	Equipment Disposal Cost																				
	Dismantling Cost																				
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Excavation																				
	Excavation Binwall																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																				2,144

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost	
27	Magnet																				
	Structure Demolition Cost																				
	Structure Vol. Demolished	Steel Building																			
	Bubbles Weight (exclude steel)																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Non-Steel Truck																				
	Transportation Cost Non-Steel Drive																				
	Disposal Cost Non-Steel																				
	Steel Weight																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Steel Truck	16 Ton Truck	01990 200 5300	\$17.86	/Day																
	Transportation Cost Steel Drive	Truck Driver		\$8.10	/HR																
	Disposal Cost Steel																				
	Equipment Disposal Cost																				
	Dismantling Cost																				
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition	Concrete Demolition																			
	Demolition Cost																				
	Concrete Vol. Demolished	Front-End Loader 5 CY (668G)	02315 400 1850	1.23	/CY																
	Loading Cost	12 CY Truck, 1/2 mile Round Trip	02320 200 0320	3.28	/CY																
	Transportation Cost	On Site Disposal	02220 375 5550	6.80	/CY																
	Disposal Cost																				
	Subtotal																				
	Excavation																				
	Excavation Binwall																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																				

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost	
28	Water System																				
	Excavate Pipe	Excavating 2-1/2 CY hydraulic backhoe	02315 900 0620	2.68	ACY	8450		2	4		67800								2504	CY	6460
	Pipe Removal	Pipe Removal 12 inch	02220 875 2900	6.50	LF	8450													8450	LF	54825
	Backfill Trench	Backfill trench, 2-1/4 CY Bucket	02315 900 3080	1.56	ACY	8450		2	4		67800								2504	CY	3681
	Structure Demolition Cost																				
	Structure Vol. Demolished																				
	Bubbles Weight (exclude steel)																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Non-Steel Truck																				
	Transportation Cost Non-Steel Drive																				
	Disposal Cost Non-Steel																				
	Steel Weight																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Steel Truck																				
	Transportation Cost Steel Drive																				
	Disposal Cost Steel																				
	Subtotal																				65,200
	Equipment Disposal Cost																				
	Dismantling Cost																				
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Excavation																				
	Excavation Binwall																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																				

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost	
29	Sewage System																				
	Excavate Pipe	Excavating 2-1/2 CY hydraulic backhoe	02315 900 0630	2.58	JCY	2632	2	4			22656					CF		839	CY	2165	
	Pipe Removal	Pipe Removal 12 inch	02220 875 2800	6.50	LF	2632													2632	LF	18408
	Backfill Trench	Backfill trench, 2-1/4 CY Bucket	02315 900 3080	1.55	JCY	2632	2	4			22656					CF		839	CY	1300	
	Structure Demolition Cost																				
	Structure Vol. Demolished																				
	Bubbles Weight (exclude steel)																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Non-Steel Truck																				
	Transportation Cost Non-Steel Drive																				
	Disposal Cost Non-Steel																				
	Steel Weight																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Steel Truck																				
	Transportation Cost Steel Drive																				
	Disposal Cost Steel																				
	Subtotal																				
	Equipment Disposal Cost																				
	Dismantling Cost																				
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Excavation																				
	Excavation Binwall																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																				

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost	
30	Containers																				
	Structure Demolition Cost																				
	Structure Vol. Demolished	Mixed Material Building, Large	02220 100 0100	0.26	/CF	40	10	10			4000				8	CF		32000	CF	8,320	
	Bubbles Weight (exclude steel)																				
	Truck Capacity																	0.35		CF	
	Haulage																				
	Transportation Cost Non-Steel Truck																				
	Transportation Cost Non-Steel Drive																				
	Disposal Cost Non-Steel	ECDC	ECDC	35.00	/TON						24					TON		24	TON	840	
	Steel Weight																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Steel Truck																				
	Transportation Cost Steel Drive																				
	Disposal Cost Steel																				
	Subtotal																				8,160
	Equipment Disposal Cost																				
	Dismantling Cost																				
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Excavation																				
	Excavation Binwall																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																				9,160

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost	
31	Gilson Well																				
	Structure Demolition Cost																				
	Structure Vol. Demolished	Steel Building	02220 100 0012	0.24	JCF						800					CF		800	CF	182	
	Bubbles Weight (exclude steel)																0.35	10	CY		
	Truck Capacity																				
	Haulage																				
	Transportation Cost Non-Steel Truck																				
	Transportation Cost Non-Steel Drive																				
	Disposal Cost Non-Steel																				
	Steel Weight																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Steel Truck	16 Ton Truck	01590 200 5300	517.66	/Day						0.5					Ton		0.03	Days	18	
	Transportation Cost Steel Drive	Truck Driver		36.10	/HR													0.2	Hrs.	8	
	Disposal Cost Steel																				
	Subtotal																			218	
	Equipment Disposal Cost																				
	Dismantling Cost																				
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition	Concrete Demolition		13.56	/CY						55					CY		55	CY	748	
	Demolition Cost																	1.3	72	CY	
	Concrete Vol. Demolished																				
	Loading Cost	Front-End Loader 5 CY (955G)	02315 400 1660	1.30	/CY														72	CY	
	Transportation Cost	12 CY Truck, 1/2 mile Round Trip	02320 200 0320	3.09	/CY														72	CY	
	Disposal Cost	On Site Disposal	02220 375 5550	6.80	/CY														72	CY	
	Subtotal																			490	
	Excavation																				
	Excavation Binwall																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																			1552	

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost	
32	Shop Building																				
	Structure Demolition Cost																				
	Structure Vol. Demolished	Steel Building	02220 100 0012	0.24	ACF						14400					CF		14400	CF	3,458	
	Subbase Weight (exclude steel)																0.35	187	CY		
	Truck Capacity																				
	Haulage																				
	Transportation Cost Non-Steel Truck																				
	Transportation Cost Non-Steel Drive																				
	Disposal Cost Non-Steel																				
	Steel Weight																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Steel Truck	18 Ton Truck	01890 200 5300	517.68	/Day							0.5				Ton		0.03	Days	18	
	Transportation Cost Steel Drive	Truck Driver		38.10	/HR													0.2	Hrs	8	
	Disposal Cost Steel																				
	Subtotal																			3,460	
	Equipment Disposal Cost																				
	Dismantling Cost																				
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition	Concrete Demolition		13.68	ICY						55					CY		55	CY	746	
	Demolition Cost																	1.3	72	CY	
	Concrete Vol. Demolished																				
	Loading Cost	Front-End Loader 5 CY (996G)	02315 400 1650	1.30	ICY														72	CY	94
	Transportation Cost	12 CY Truck, 1/2 mile Round Trip	02320 200 0320	3.08	ICY														72	CY	222
	Disposal Cost	On Site Disposal	02220 375 5550	6.80	ICY														72	CY	490
	Subtotal																			1,552	
	Excavation																				
	Excavation Binwall																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																			5,462	

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost	
33	Switch Houses																				
	Structure Demolition Cost																				
	Structure Vol. Demolished																				
	Bubble Weight (exclude steel)																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Non-Steel Truck																				
	Transportation Cost Non-Steel Drive																				
	Disposal Cost Non-Steel																				
	Steel Weight																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Steel Truck	18 Ton Truck	01590 200 6300	517.66	/Day							18				Ton			1.00	Days	518
	Transportation Cost Steel Drive	Truck Driver		36.10	/HR														8	Hrs	305
	Disposal Cost Steel																				
	Equipment Disposal Cost																				
	Dismantling Cost																				
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition	Concrete Demolition		13.56	/CY							11				CY			11	CY	149
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost	Front-End Loader 5 CY (966G)	02315 400 1650	1.30	/CY																
	Transportation Cost	12 CY Truck, 1/2 mile Round Trip	02320 200 0320	3.09	/CY																
	Disposal Cost	On Site Disposal	02220 375 5660	6.80	/CY																
	Subtotal																				
	Excavation																				
	Excavation Binwall																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																				

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost	
34	Sampling System																				
	Structure Demolition Cost																				
	Structure Vol. Demolished																				
	Bubbles Weight (exclude steel)																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Non-Steel Truck																				
	Transportation Cost Non-Steel Drive																				
	Disposal Cost Non-Steel																				
	Steel Weight																				
	Truck Capacity																				
	Transportation Cost Steel Truck	16 Ton Truck	01590 200 5300	517.66	J/Day						16					Ton		1.1	Days	569	
	Transportation Cost Steel Drive	Truck Driver		38.10	/HR													6	Hrs.	343	
	Disposal Cost Steel																				
	Subtotal																				972
	Equipment Disposal Cost																				
	Dismantling Cost																				
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition	Concrete Demolition		13.56	JCY						19.84					CY		1.3	19.84	CY	269
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost	Front-End Loader 5 CY (998G)	02315 400 1650	1.30	JCY																34
	Transportation Cost	12 CY Truck, 1/2 mile Round Trip	02320 200 0320	3.09	JCY																80
	Disposal Cost	On Site Disposal	02220 375 5550	6.80	JCY																177
	Subtotal																				590
	Excavation																				
	Excavation Binwall																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																				

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost	
35	Storage Building																				
	Structure Demolition Cost	Steel Building	02220 100 0012	0.24	/CF						2284					CF	0.35	2284	CF	548	
	Structure Vol. Demolished																	30	CY		
	Bubble Weight (exclude steel)																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Non-Steel Truck																				
	Transportation Cost Non-Steel Drive																				
	Disposal Cost Non-Steel																				
	Steel Weight																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Steel Truck	16 Ton Truck	01560 200 5300	517.66	/Day						6					Ton		0.4	Days	207	
	Transportation Cost Steel Drive	Truck Driver		38.10	/HR													9	Hrs	114	
	Disposal Cost Steel																				
	Subtotal																				
	Equipment Demolition Cost																				
	Dismantling Cost																				
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition	Concrete Demolition		13.66	/CY						38.4					CY	1.3	38.4	CY	621	
	Demolition Cost																	50	CY		
	Concrete Vol. Demolished																				
	Loading Cost	Front-End Loader 5 CY (066G)	02315 400 1550	1.30	/CY														60	CY	85
	Transportation Cost	12 CY Truck, 1/2 mile Round Trip	02320 200 0320	3.06	/CY														60	CY	185
	Disposal Cost	On Site Disposal	02220 375 6550	6.60	/CY														50	CY	340
	Subtotal																				
	Excavation																				
	Excavation Binwall																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																				

Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swat Factor	Quantity	Unit	Cost	
36	Skoker Storage Bin																				
	Structure Demolition Cost																				
	Structure Vol. Demolished																				
	Bubbles Weight (exclude steel)																				
	Truck Capacity																				
6	Haulage																				
	Transportation Cost Non-Steel Truck																				
	Transportation Cost Non-Steel Drive																				
	Disposal Cost Non-Steel																				
	Steel Weight																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Steel Truck																				
	Transportation Cost Steel Drive																				
	Disposal Cost Steel																				
	Subtotal																				
	Equipment Disposal Cost																				
	Dismantling Cost																				
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition	Concrete Demolition		13.56	/CY						35					CY		35	CY	475	
	Demolition Cost																	1.3	46	CY	
	Concrete Vol. Demolished																				
	Loading Cost	Front-End Loader 5 CY (865G)	02315 400 1850	1.30	/CY															46	CY
	Transportation Cost	12 CY Truck, 1/2 mile Round Trip	02320 200 0320	3.08	/CY															46	CY
	Disposal Cost	On Site Disposal	02220 375 5550	6.60	/CY															46	CY
	Subtotal																			46	CY
	Subtotal																				313
	Subtotal																				420
	Excavation																				
	Excavation Binwall																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																				



Demolition

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost	
38	Seal Portals																				
	Structure Demolition Cost	Seal Portals	AML1	5,200.00	/EA											5	EA		5	EA	26000
	Structure Vol. Demolished																				
	Bubbles Weight (exclude steel)																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Non-Steel Truck																				
	Transportation Cost Non-Steel Drive																				
	Disposal Cost Non-Steel																				
	Steel Weight																				
	Truck Capacity																				
	Haulage																				
	Transportation Cost Steel Truck																				
	Transportation Cost Steel Drive																				
	Disposal Cost Steel																				
	Subtotal																				26,000
	Equipment Disposal Cost																				
	Dismantling Cost																				
	Equipment Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Excavation																				
	Excavation Berwall																				
	Excavate																				
	Vol. To Be Disposed																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Cost																				
	Subtotal																				
	Total																				







Earth Work

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
42	Gabion Baskets																			
	Structure Demolition Cost																			
	Structure Vol. Demolished																			
	Bubbles Weight (exclude steel)																			
	Truck Capacity																			
	Haulage																			
	Transportation Cost Non-Steel Truck																			
	Transportation Cost Non-Steel Drive																			
	Disposal Cost Non-Steel																			
	Steel Weight																			
	Truck Capacity																			
	Haulage																			
	Transportation Cost Steel Truck																			
	Transportation Cost Steel Drive																			
	Disposal Cost Steel																			
	Subtotal																			
	Equipment Disposal Cost																			
	Dismantling Cost																			
	Equipment Vol. Demolished																			
	Loading Costs																			
	Transport Costs																			
	Disposal Costs																			
	Subtotal																			
	Concrete Demolition																			
	Demolition Cost																			
	Concrete Vol. Demolished																			
	Loading Cost																			
	Transportation Cost																			
	Disposal Cost																			
	Subtotal																			
	Excavation																			
	Excavation Binwall																			
	Excavate	Excavator, Diesel Hydraulic, 2 CY	02315 400 0260	1.71	/CY						88					CY		88	CY	150
	Vol. To Be Disposed																			
	Loading Cost	Laborers (2) 4 Hours/Laborer		38.50	/HR						8					Hrs		8	Hrs.	292
	Transportation Cost		City Service Price	4.00	/CY						1.22					CY		1.22	CY	5
	Disposal Costs																			
	Subtotal																			
	Concrete Demolition																			
	Demolition Cost																			
	Concrete Vol. Demolished																			
	Loading Cost																			
	Transportation Cost																			
	Disposal Cost																			
	Subtotal																			
	Total																			

Earth Work

Ref	Description	Materials	Means Reference Number	Unit Cost	Unit	Hourly Operating Costs	Hourly Equipment Costs	Operator's Hourly Wage Rate	Hourly Cost	Number or Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Unit	Equip. + Labor Time/Disc.	Unit	Cost	
43	Refuse Site																			
	Structure Demolition Cost	Fencing, barbed wire, 3 strand	0200-875-0600	1.36	LF								3250	LF				1.36	LF	4,420
	Grading and Backfilling	D9R U-Blade ROPS Operating Rate		17,590		70.00	0.1	47.15	234.09	1	234.09	\$/Hr	9887	CY	102	CT/Hr	96.9	Hrs	22,683	
	<b>Subtotal</b>																			27,103
	Spread Topsoil	Front-End Loader 5 CY (986G)		7,065		29.05	0.1	47.15	123.45	1	123.45	\$/Hr	36700	CY	203	LCY/Hr	180.8	Hrs	22,318	
	<b>Subtotal</b>																			22,318
	Foreman							39.60	39.60	1	39.60	\$/Hr						277.7	Hrs	10,998
	Truck Pickup 3/4 ton, 4 Wheel drive			785		7.40	0.1	13.05	13.05	1	13.05	\$/Hr						277.7	Hrs	3,824
	5,000 Gallon Water Wagon			5,010		25.70	0.1	38.10	97.68	1	97.68	\$/Hr						277.7	Hrs	27,125
	<b>Total</b>																			81,156







Revegetation

	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost		
47	Vegetation																					
	De-gas G-1																					
	Soil Preparation																					
	Packing	Excavator, Diesel Hydraulic, 2 CY (325B)	02315 400 260	1.71	ACY					0.6						AC		968	CY	1,655		
	Subtotal																				1,655	
	Fence																					
	Silt Fence	Silt Fence	02370 550 1100	0.93	LF			0								FT		0	FT	0	0	
	Chicken Wire	Fence Chicken Wire	02820 500 0010	6.56	LF			0								FT		0	FT	0	0	
	Subtotal																				0	
	Seed Mix																					
	Hydroseed Equipment and Labor	Hydro Spreader (equip. & labor) B-81	Reveg005	19.95	/MSF					0.6						AC		26	MSF	518		
	Hydroseed Material	De-Gas Seed Mix No. 1	Maple Leaf	358.00	/AC					0.6						AC		1	AC	215		
	Subtotal																				3,633	
	De-gas G-2																					
	Soil Preparation																					
	Packing	Excavator, Diesel Hydraulic, 2 CY (325B)	02315 400 260	1.71	ACY					1.21						AC		1,952	CY	3,336		
	Subtotal																				3,336	
	Fence																					
	Silt Fence	Silt Fence	02370 550 1100	0.93	LF			0								FT		0	FT	0	0	
	Chicken Wire	Fence Chicken Wire	02820 500 0010	6.56	LF			0								FT		0	FT	0	0	
	Subtotal																				0	
	Seed Mix																					
	Hydroseed Equipment and Labor	Hydro Spreader (equip. & labor) B-81	Reveg005	19.85	/MSF					1.21						AC		83	MSF	1,667		
	Hydroseed Material	De-Gas Seed Mix No. 2	Maple Leaf	358.00	/AC					1.21						AC		1	AC	430		
	Subtotal																				1,490	
	De-gas G-3																					
	Soil Preparation																					
	Packing	Excavator, Diesel Hydraulic, 2 CY (325B)	02315 400 260	1.71	ACY					0.97						AC		1,565	CY	2,676		
	Subtotal																				2,676	
	Fence																					
	Silt Fence	Silt Fence	02370 550 1100	0.93	LF			0								FT		0	FT	0	0	
	Chicken Wire	Fence Chicken Wire	02820 500 0010	6.56	LF			0								FT		0	FT	0	0	
	Subtotal																				0	
	Seed Mix																					
	Hydroseed Equipment and Labor	Hydro Spreader (equip. & labor) B-81	Reveg005	19.95	/MSF					0.97						AC		42	MSF	836		
	Hydroseed Material	De-Gas Seed Mix No. 2	Maple Leaf	358.00	/AC					0.97						AC		1	AC	347		
	Subtotal																				1,183	
	Seed Mix No. 3 Refuse Site																					
	Hydroseed Equipment and Labor	Hydro Spreader (equip. & labor) B-81	Reveg005	19.95	/MSF					15.6						AC		680	MSF	13,586		
	Hydroseed Material	Refuse Seed Mix No. 1	Maple Leaf	164.95	/AC					15.6						AC		16	AC	2,573		
	Transplant Area No. 3																					
	Area									15.6						AC						
	Transplant Materials																					
		Black Sagebrush		0.40	EA											200	/AC		3,120	EA	1,248	
		Schadscale		0.75	EA											200	/AC		3,120	EA	2,340	
	Transplant Labor	Bare root seedlings 6 to 10 inch, heavy soil		1.15	EA															8,240	EA	7,178
	Subtotal																				48,569	
	Revegetation																					
	25% Vegetation Rate																				5,784	
	Subtotal																				5,784	
	Total																				56,007	



**Productivity and Hours Required for Dozer Use**

**Earthmoving Activity:**

Rough grading and backfilling

**Characterization of Dozer Used (type, size, etc.):**

Caterpillar Dozer D0R-9SU

**Description of Dozer Use (origin, destination, grade, haul distance, materials, etc.):**

Level grade, 21 feet blade width, 11.4 cu. yd. Capacity, 500 foot push

**Productivity Calculations:**

Operating =	0.85 x	0.9 x	0.83 x	1.0
Adjustment	operation	material	efficiency	grade
Hours	factor	factor	factor	factor
	0.97 x	1.0 x	1.0 x	1.0
	weight	production	visibility	elevation
	correction	method/blade	factor	factor
	factor	factor		
	=	0.62		

Net Hourly =	300 LCY/Hr	x	0.62 =	186 LCY/Hr
Production	normal hourly		operating adjustment	
	production		factor	

**Data Source:**

Caterpillar Performance Handbook - Edition 30

**Productivity and Hours Required for Compactor Use**

**Earthmoving Activity:**

Rough grading of loose and compacted material

**Characterization of Compactor Used (type, size, etc.):**

Caterpillar Sheepfoot Compactor 815F

**Description of Compactor Used (loading, geometry, materials, etc.):**

3 passes per lift, 8-inch lifts, 4 MPH, 80% efficiency, 77 inches width of wheel

**Productivity Calculations:**

Production Table = 1095 LCY/Hr

Net Hourly = 1095 LCY/Hr x 0.8 = 876 LCY/Hr  
Production production efficiency

**Data Source:**

Caterpillar Performance Handbook - Edition 30

**Productivity and Hours Required for Excavator Use**

**Earthmoving Activity:**

Rough grading of loose and compacted material

**Characterization of Excavator Used (type, size, etc.):**

Caterpillar Excavator 325 BL

**Description of Excavator Used (loading, geometry, materials, etc.):**

Loose and compacted dirt, 3.5 C.Y.

**Productivity Calculations:**

$$\begin{array}{rclclcl} \text{Net Bucket Capacity} & = & 3.5 \text{ LCY} & \times & 0.9 & = & 3.15 \text{ LCY} \\ & & \text{heaped bucket capacity} & & \text{bucket fill factor} & & \end{array}$$

$$\begin{array}{rclclcl} \text{Hourly Production} & = & 3.15 \text{ LCY} & \times & 60 \text{ min/hr} & / & \\ & & \text{net bucket capacity} & & & & \\ & & 0.4 \text{ x} & & 0.83 & = & 392 \text{ LCY/Hr} \\ & & \text{cycle time} & & \text{efficiency factor} & & \end{array}$$

**Data Source:**

Caterpillar Performance Handbook - Edition 30

**Productivity and Hours Required for Loader Use**

**Earthmoving activity:**

Rough grading of loose and compacted materials

**Characterization of Loader Used (type, size, etc.):**

Caterpillar Front End Loader 966G

**Description of Loader Used (loading, geometry, materials, etc.):**

Loose and compacted dirt, 2.5 C.Y.

**Productivity Calculations:**

$$\begin{array}{rclclcl} \text{Cycle Time} & = & 0.18 \text{ min} & + & 0.18 \text{ min} & + \\ & & \text{haul time} & & \text{return time} & \\ & & \text{(loaded)} & & \text{(empty)} & \end{array}$$

$$\begin{array}{rclcl} & & 0.25 \text{ min} & = & 0.61 \text{ min} \\ & & \text{basic} & & \\ & & \text{cycle time} & & \end{array}$$

$$\begin{array}{rclclcl} \text{Net Bucket Capacity} & = & 2.5 \text{ LCY} & \times & 1 & = & 2.5 \text{ LCY} \\ & & \text{heaped bucket} & & \text{bucket} & & \\ & & \text{capacity} & & \text{fill factor} & & \end{array}$$

$$\begin{array}{rclclcl} \text{Hourly Production} & = & 2.5 \text{ LCY} & / & 0.61 \text{ min} & \times \\ & & \text{net bucket} & & \text{cycle time} & \\ & & \text{capacity} & & & \end{array}$$

$$\begin{array}{rclclcl} & & 0.83 \times & & 60 \text{ min/hr} & = & 204 \text{ LCY/Hr} \\ & & \text{efficiency} & & & & \\ & & \text{factor} & & & & \end{array}$$

**Data Source:**

Caterpillar Performance Handbook - Edition 30

Earth Work  
Mine Site

**Productivity and Hours Required for Truck Use**

**Earthmoving Activity:**  
Hauling Topsoil

**Characterization of Trucks Used (type, size, etc.):**  
Trailer and pup, 18 C.Y.

**Description of Trucks Used (origin, destination, grade, haul distance, capacity, etc.):**

**Productivity Calculations**

No. Loader Passes/ Truck	=	18 C. Y. truck capacity	/	2.5 LCY loader bucket capacity	
	=	7.2 passes			
Net Truck Capacity	=	2.5 LCY loader bucket capacity	x	7.2 = no. loader passes/truck	18 LCY
Loading Time/Truck	=	0.61 min loader cycle time	x	7.2 = no. loader passes/truck	4.39 min.
Truck Cycle Time	=	19 min haul time	+	18 min return time	+
		4.392 min loading time	+	2 min dump and maneuver time	=
		43.392 min			
No. Trucks Required	=	43.392 min	/	4.392 min	=
		9.88 trucks	use	10 trucks	
Production Rate	=	20 LCY	x	10 / no. trucks	43.392 min truck cycle time
	=	4.61 LCY/min			
Hourly Production	=	4.61 LCY/min production rate	x	60 min/hr	x
		0.83 = efficiency		230 LCY/Hr	

Earth Work  
Mine Site

**Productivity and Hours Required for Truck Use**

**Earthmoving Activity:**  
Hauling Topsoil

**Characterization of Trucks Used (type, size, etc.):**  
Trailer and pup, 12 C.Y.

**Description of Trucks Used (origin, destination, grade, haul distance, capacity, etc.):**

**Productivity Calculations**

$$\begin{array}{l} \text{No. Loader =} \\ \text{Passes/} \\ \text{Truck} \end{array} = \frac{12 \text{ C. Y.}}{\text{truck capacity}} \div \frac{2.5 \text{ LCY}}{\text{loader bucket capacity}} = 4.8 \text{ passes}$$

$$\begin{array}{l} \text{Net Truck =} \\ \text{Capacity} \end{array} = \frac{2.5 \text{ LCY}}{\text{loader bucket capacity}} \times \frac{4.8 =}{\text{no. loader passes/truck}} = 12$$

$$\begin{array}{l} \text{Loading =} \\ \text{Time/Truck} \end{array} = \frac{0.61 \text{ min}}{\text{loader cycle time}} \times \frac{4.8 =}{\text{no. loader passes/truck}} = 2.93$$

$$\begin{array}{l} \text{Truck =} \\ \text{Cycle Time} \end{array} = \frac{33 \text{ min}}{\text{haul time}} + \frac{33 \text{ min}}{\text{return time}} + \frac{2.93 \text{ min}}{\text{loading time}} + \frac{3 \text{ min}}{\text{dump and maneuver time}} = 71.93 \text{ min}$$

$$\begin{array}{l} \text{No. Trucks =} \\ \text{Required} \end{array} = \frac{71.93 \text{ min}}{2.93 \text{ min}} \div \frac{2.93 \text{ min}}{6 \text{ trucks}} = 24.57 \text{ trucks use 6 trucks}$$

$$\begin{array}{l} \text{Production =} \\ \text{Rate} \end{array} = \frac{12 \text{ LCY}}{24.57 \text{ trucks}} \times \frac{6}{\text{no. trucks}} \div \frac{71.93}{\text{truck cycle time}} = 1.00 \text{ LCY/min}$$

$$\begin{array}{l} \text{Hourly =} \\ \text{Production} \end{array} = \frac{1.00 \text{ LCY/min}}{\text{production rate}} \times \frac{60 \text{ min/hr}}{\text{efficiency}} = 0.83 = 50 \text{ LCY/Hr}$$

**Productivity and Hours Required for Loader Use**

**Earthmoving activity:**

Fill in mud pit

**Characterization of Loader Used (type, size, etc.):**

Caterpillar Front End Loader 966G

**Description of Loader Used (loading, geometry, materials, etc.):**

5 CY bucket, haul distance 50 feet, zero percent grade

**Productivity Calculations:**

$$\begin{array}{rclclcl} \text{Cycle} & = & 0.5 \text{ min} & + & 0.5 \text{ min} & + \\ \text{Time} & & \text{haul time} & & \text{return time} & \\ & & \text{(loaded)} & & \text{(empty)} & \end{array}$$

$$\begin{array}{rclcl} & & 0.55 \text{ min} & = & 1.55 \text{ min} \\ & & \text{basic} & & \\ & & \text{cycle time} & & \end{array}$$

$$\begin{array}{rclclcl} \text{Net} & = & 5 \text{ LCY} & \times & 1.2 & = & 6 \text{ LCY} \\ \text{Bucket} & & \text{heaped bucket} & & \text{bucket} & & \\ \text{Capacity} & & \text{capacity} & & \text{fill factor} & & \end{array}$$

$$\begin{array}{rclclcl} \text{Hourly} & = & 6 \text{ LCY} & / & 1.55 \text{ min} & \times \\ \text{Production} & & \text{net bucket} & & \text{cycle time} & \\ & & \text{capacity} & & & \end{array}$$

$$\begin{array}{rclclcl} & & 0.83 \times & 60 \text{ min/hr} & = & 193 \text{ LCY/Hr} \\ & & \text{efficiency} & & & \\ & & \text{factor} & & & \end{array}$$

**Data Source:**

Caterpillar Performance Handbook - Edition 30



**Productivity and Hours Required for Dozer Use**

**Earthmoving Activity:**

Rough grading and backfilling

**Characterization of Dozer Used (type, size, etc.):**

Caterpillar Dozer D0R-9SU

**Description of Dozer Use (origin, destination, grade, haul distance, materials, etc.):**

Level grade, 21 feet blade width, 11.4 cu. yd. Capacity, 400 foot push

**Productivity Calculations:**

Operating =	0.85 x	0.8 x	0.83 x	1.0
Adjustment	operation	material	efficiency	grade
Hours	factor	factor	factor	factor
	0.9 x	1.0 x	1.0 x	1.0
	weight	production	visibility	elevation
	correction	method/blade	factor	factor
	factor	factor		
	=	0.51		

Net Hourly =	200 LCY/Hr	x	0.51 =	102 LCY/Hr
Production	normal hourly		operating adjustment	
	production		factor	

**Data Source:**

Caterpillar Performance Handbook - Edition 30

**Productivity and Hours Required for Loader Use**

**Earthmoving activity:**

Moving and spreading topsoil

**Characterization of Loader Used (type, size, etc.):**

Caterpillar Front End Loader 966G

**Description of Loader Used (loading, geometry, materials, etc.):**

5 CY bucket, haul distance 500 feet, -2% grade

**Productivity Calculations:**

$$\begin{array}{rcllcl} \text{Cycle} & = & 0.38 \text{ min} & + & 0.4 \text{ min} & + \\ \text{Time} & & \text{haul time} & & \text{return time} & \\ & & \text{(loaded)} & & \text{(empty)} & \\ & & & & & \\ & & 0.5 \text{ min} & = & 1.28 \text{ min} & \\ & & \text{basic} & & & \\ & & \text{cycle time} & & & \end{array}$$

$$\begin{array}{rcllcl} \text{Net} & = & 5 \text{ LCY} & \times & 0.95 & = & 4.75 \text{ LCY} \\ \text{Bucket} & & \text{heaped bucket} & & \text{bucket} & & \\ \text{Capacity} & & \text{capacity} & & \text{fill factor} & & \end{array}$$

$$\begin{array}{rcllcl} \text{Hourly} & = & 4.75 \text{ LCY} & / & 1.28 \text{ min} & \times \\ \text{Production} & & \text{net bucket} & & \text{cycle time} & \\ & & \text{capacity} & & & \end{array}$$

$$\begin{array}{rcllcl} & & 0.91 \times & 60 \text{ min/hr} & = & 203 \text{ LCY/Hr} \\ & & \text{efficiency} & & & \\ & & \text{factor} & & & \end{array}$$

**Data Source:**

Caterpillar Performance Handbook - Edition 30

Canyon Fuel Company, LLC  
Dugout Canyon Mine

Methane Degassification Amendment  
August 2003

## **CHAPTER 1**

### **LEGAL, FINANCIAL, COMPLIANCE AND RELATED INFORMATION**

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**110 MINIMUM REQUIREMENTS FOR LEGAL, FINANCIAL, COMPLIANCE AND RELATED INFORMATION**

**111 Introduction**

The degassification wells will be located on property owned by the Milton and Ardith Thayn Trust. The well locations are found in Table 1-1 and are shown in Figure 1-1.

**TABLE 1-1  
Degas Well Locations  
Pine Canyon, Utah Quadrangle, Salt Lake Meridian**

<b>Hole Number</b>	<b>Section</b>	<b>Township and Range</b>
G-1	Portion of N1/2SE1/4NW1/4 Section 24	Township 13 South, Range 12 East
G-2	Portion of N1/2SW1/4NE1/4 Section 24	Township 13 South, Range 12 East
G-3	Portion of N1/2SW1/4NW1/4 Section 19	Township 13 South, Range 13 East

**112 Identification of Interests**

Refer to the same section of the approved M&RP.

**112.100 Business Entity**

Refer to the same section of the approved M&RP.

**112.200 Applicant and Operator**

APPLICANT: Operations, Administration, Permit Revisions, and Amendments

Canyon Fuel Company, LLC  
6955 South Union Park Center  
Suite 540  
Midvale, Utah 84047  
Telephone: (801) 569-4700  
Employer Identification: 87-0567183

Operator: Canyon Fuel Company, LLC  
6955 South Union Park Center  
Suite 540  
Midvale, Utah 84047  
Telephone: (801) 569-4700

Resident Agent: C. T. Corporation Systems  
50 West Broadway  
Salt Lake City, Utah 84104  
Telephone: (801) 658-9486

Contact Person: Reed Olsen  
Canyon Fuel Company, LLC  
Dugout Canyon Mine  
P. O. Box 1029  
Wellington, Utah 84542  
Telephone: (435) 637-6360

PERSON WHO WILL PAY ABANDON MINE RECLAMATION FEES:

Richard D. Pick  
Canyon Fuel Company, LLC  
6955 South Union Park Center  
Suite 540  
Midvale, Utah 84047

**112.300 Officers of the Applicant**

Refer to the same section of the approved M&RP.

**112.400 Coal Mining and Reclamation Operation Owned or Controlled**

Refer to the same section of the approved M&RP.

**112.500 Legal or Equitable Owner of the Surface and Mineral Properties**

The legal and equitable owner of the surface and mineral properties to be affected by this operation during the duration of the permit period are list below.

Milton & Ardith Thayn Trust  
7730 East US Highway 6  
Sunnyside Star Route  
Price, Utah 84501

United States of America  
State of Utah, Department of Interior  
Bureau of Land Management  
Price Field Office  
125 South 600 West  
Price, Utah 84501

**112.600 Owners of Record of Property Contiguous to Proposed Permit Area**

Owners of record for surface and mineral properties contiguous to the proposed permit area are list below.

United States of America	State of Utah
Department of Interior	School and Industrial
Bureau of Land Management	Trust Lands Administration
Price Field Office	675 East 500 South
125 South 600 West	Salt Lake City, Utah 84102-2818
Price, Utah 84501	

**112.700 MSHA Numbers**

Refer to the same section of the approved M&RP.

**112.800 Interest In Contiguous Lands**

Canyon Fuel Company, LLC has no interest in contiguous lands other than those currently owned as shown on Plate 1-1 of the approved M&RP.

**112.900 Certification of Submittal Information**

No information has changed in the approved M&RP because of this submittal. Refer to the same section of the approved M&RP.

**113 Violation Information**

Refer to the same section in the approved M&RP.

**114 Right-of-Entry Information**

Refer to the same section of the approved M&RP.

See Table 1-2 for disturbed acreage for each well site. The disturbed acres will be added to the total disturbed acreage for the Dugout Mine as each site is constructed.

**TABLE 1-2**  
**Disturbed Acres by Well Site**

<b>Well Site</b>	<b>Disturbed Acres</b>
<b>G-1</b>	0.6
<b>G-2</b>	1.21
<b>G-3</b>	0.97

**115 Status of Unsuitability Claims**

Refer to the same section of the approved M&RP.

**116 Permit Term**

Refer to the same section of the approved M&RP.

**117 Insurance, Proof of Publication, and Facilities and Structures Used in Common**

The certificate of insurance(s) for each well will be obtained if required when the well is drilled. The certificate of insurance(s) will be included in Appendix 1-2 of the approved M&RP.

### **118 Filling Fees**

Refer to the same section of the approved M&RP.

### **120 PERMIT APPLICATION FORMAT AND CONTENTS**

This amendment submittal will comply with R645-301-120.

### **130 REPORTING OF TECHNICAL DATA**

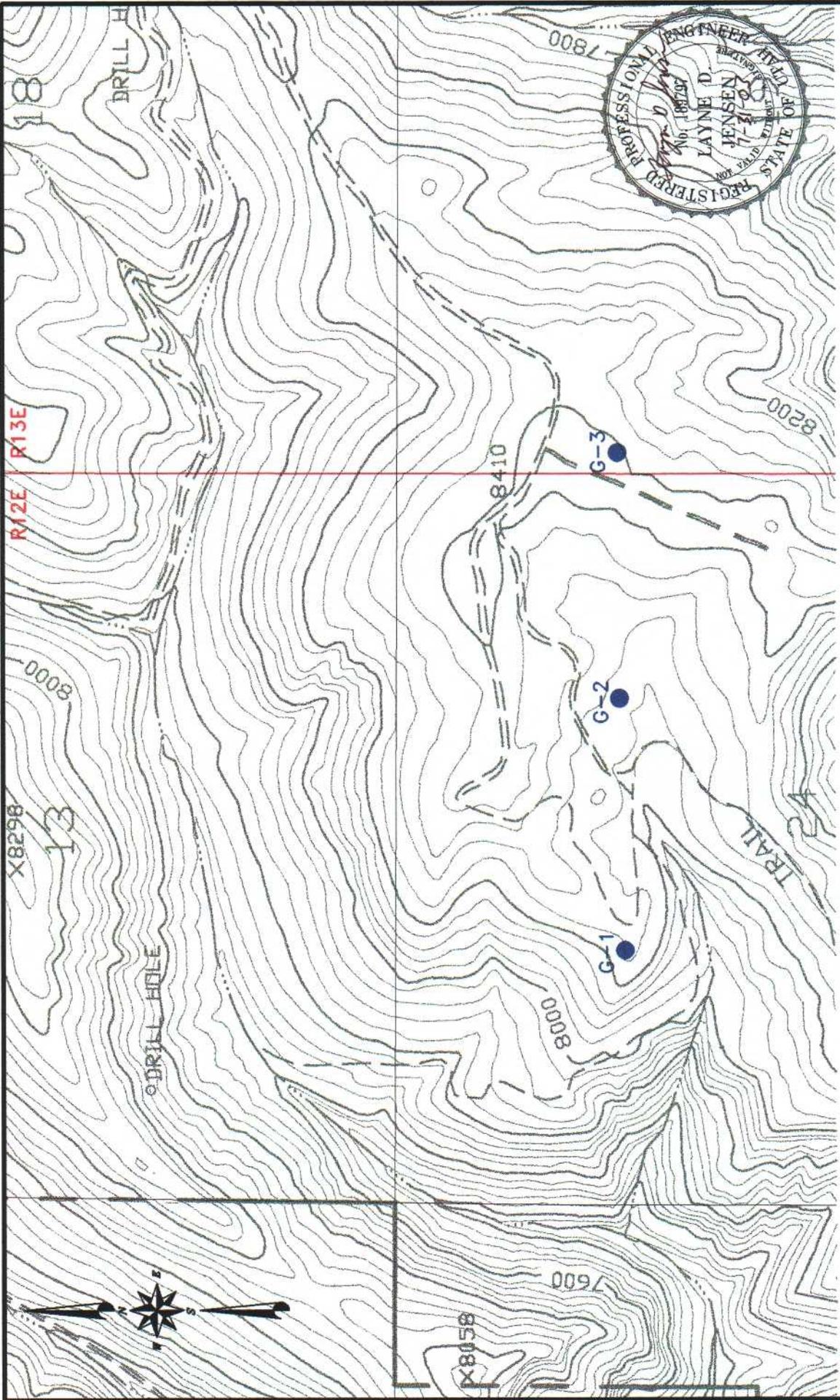
All technical data submitted in the amendment will be accompanied by the name or organization responsible for the collection and analysis of data, dates of collection and descriptions of methodology used. Technical analyses will be planned by or under the direction of a qualified professional in the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

### **140 MAPS AND PLANS**

The maps and plans in the Mining and Reclamation Plan will correspond with the requirements in R645-301-140.

### **150 COMPLETENESS**

CFC believes the information in this permit application to be complete and correct.



NOTE:  
 FOR MORE ACCURATE ROAD LOCATIONS  
 ADJACENT TO WELL SITES REFER TO  
 FIGURES 5-1, 5-5, AND 5-9.



FIGURE 1-1. METHANE DEGAS BORE HOLE LOCATIONS

Canyon Fuel Company, LLC  
Dugout Canyon Mine

Methane Degassification Amendment  
August 2003

## **CHAPTER 2**

### **SOILS**

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<b>Attachment 2-1</b>	Soil Inventory and Assessment
<b>Attachment 2-2</b>	Topsoil Calculations

## **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 8100 to 8400 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".

#### 222.200 Soil Identification

<u>Well No.</u>	<u>Soil Map Unit</u>	<u>Soil Components</u>
G-1	62/88	Midfork-Comodore complex, Rabbitex-Datino Variant
G-2	7	Brycan, Beje-Trag complex, 3-30% slopes
G-3	7	Beje-Trag complex, 3-30% slopes

#### 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**

<b>Well No.</b>	<b>Cubic Yards of Material</b>
G-1	415
G-2	3,104
G-3	1,182

Figure 5-1 through Figure 5-12 show the layout and approximate size of each well pad. 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. Available topsoil at each site will be salvaged and stockpiled.

### **223 Soil Characterization**

The topsoil evaluation described in this chapter was performed by Daniel M. Larsen, Professional Soil Scientist in accordance with the standards of the National Cooperative Soil Survey.

### **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.

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.

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.

#### **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. 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°. 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.

**TABLE 2-2  
Topsoil Stockpile Dimensions\***

<b>Well No.</b>	<b>Length (ft)</b>	<b>Width (ft)</b>	<b>Height (ft)</b>
G-1	55	30	13
G-2	156	50	18
G-3	70	60	15

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

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 and moved to the disturbed area perimeter.

### **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.

#### **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 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.

### **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.

The topsoil will be distributed in two phases, 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 this phase the berms surrounding the disturbed pad area will be used as topsoil. When needed additional topsoil will be used from the topsoil stockpile.

Final reclamation will occur after venting of the methane gas is complete, venting equipment has been removed and the well has been plugged. The topsoil for this phase will come from the topsoil pile and the berms surrounding the operational pad area. The topsoil stockpile storage area and access road will be reclaimed during this final phase. Refer to Section 341 for additional information.

**Soil Thickness** - The topsoil will be distributed in the thickness shown in Table 2-3.

**TABLE 2-3**  
**Approximate Topsoil Distribution Thickness**

<b>Well Site No.</b>	<b>Topsoil Thickness (Inches)</b>
G-1	7
G-2	30
G-3	12

**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.

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.

**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 area will be graded to the approximate original topographic configuration.

### **242.300 Topsoil Redistribution on Impoundments and Roads**

The mud pits will be dismantled during contemporaneous reclamation and reclaimed with the portion of the well pad area not remaining during the well operational phase (see Figures 5-4, 5-8, and 5-12). 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 when methane venting is complete.

### **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.

### **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. 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.

**Water Quality** - There are no streams immediately adjacent to the well sites.

### **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.

Canyon Fuel Company, LLC  
Dugout Canyon Mine

Methane Degassification Amendment  
August 2003

**ATTACHMENT 2-1**  
**SOIL INVENTORY AND ASSESSMENT**

**Soil Inventory and Assessment  
Six Methane Degassification Borehole Sites  
Dugout Canyon Mine  
Carbon County, Utah**

For:  
**Canyon Fuel Co., LLC  
P. O. Box 1029  
Wellington, Utah 84542**

By:  
**EIS Environmental &  
Engineering Consulting  
31 North Main Street  
Helper, UT 84526**

**July 2003**

# **Soil Inventory and Assessment Methane Degassification Borehole Sites Dugout Canyon Mine**

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- 4.0 Soil Resources
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# **Soil Inventory and Assessment Methane Degassification Borehole Sites Dugout Canyon Mine**

## **1.0 INTRODUCTION**

This soil inventory and assessment was conducted to provide soils information on six proposed methane degassification borehole sites near the Dugout Canyon Mine as requested by Canyon Fuel Company, LLC. The work was performed by Daniel M. Larsen, Soil Scientist, EIS Environmental and Engineering consultants, Helper, Utah. Mr. Larsen has three years experience as a teaching and research assistant at the University of Minnesota, 30 years as a soil scientist with the USDA, Forest Service, and five years as a soils specialist with Environmental Industrial Services (EIS). He has a BS degree in natural resources management, MS in soil sciences, and retired from the Forest Service in 1997 at the GS 12 step 10 level. Coal mining and reclamation activities have been major areas of work for over 30 years of his career.

Assistance in report preparation was provided by Melody Marrelli, Office Assistant, and Nicole Butkovich, GIS Specialist both of EIS. The project was coordinated with Vicky Miller, Environmental Specialist, Canyon Fuel Co., LLC.

The project area is located about 11 miles northeast of Wellington, Utah between Dugout Canyon and Pace Canyon in Carbon County. It is near the mountaintop east of the Dugout Canyon mine facilities site. The sites are in the north half of section 24, township 13 south, range 12 east and the west half of the northwest quarter of section 19, township 13 south, range 13 east. Each drill site is about one half acre in size.

## **2.0 SETTING**

The area is within the Book Cliffs-Roan Plateau Physiographic Section (Stokes, 1986). It is along a mountaintop between steeply sloping, dissected canyons. Elevation ranges from about 8120 to 8320 feet. Annual precipitation is estimated at about 18 to 20 inches. The soil temperature regime is at the transition of frigid and cryic. The north-facing slopes supporting aspen and Douglas-fir are considered cryic whereas the more open sites with sagebrush, ponderosa pine, and juniper are considered frigid. The soil moisture regime is mostly ustic; being somewhat dry but receiving significant moisture from summer thundershowers.

Soil parent materials consist of sedimentary rocks including sandstone, shale, siltstone, mudstone, and limestone, which are believed to include portions of the Price River, North Horn, and Flagstaff formations.

### 3.0 METHODS

Information from the Soil Survey of the Carbon Area, Utah (SCS, 1988) was used as base soils information and reference to general soil map units and taxonomic units. A detailed soils inventory was conducted at each of the six borehole sites on June 10, 11, and 13, 2003. Landscape and vegetation features were noted as appropriate to relate to soil characteristics and management implications. Soils were examined by use of a spade and soil auger. The sites were checked for variability and then representative soil descriptions were taken at each site. Descriptions were recorded on a form SCS-232 that displays standard soil pedon information and site features on a one-page format. Photographs were taken and sketches with field notes were prepared for each borehole site.

Twenty-eight soil samples were obtained in one-quart size bags for reference and more detailed assessment of color, pH, reaction, and plasticity, and texture. Emphasis was on determining the quality, distribution, and amount of suitable topsoil to salvage and redistribute as part of the site reclamation procedure. Topsoil was identified as the mollic epipedon; the dark-colored, organic matter rich surface layer, which is the primary rooting zone for native plants.

Evaluation included an extension of about 100 feet in distance from the borehole sites as staked.

The sites are referenced as G1 through G6.

### 4.0 SOIL RESOURCES

#### 4.1 Existing NRCS Information

The project area has been mapped at the Order 3 Soil Survey intensity level as part of the Soil Survey of the Carbon Area Utah by the Soil Conservation Service (now the Natural Resources Conservation Service-NRCS), USDA, 1988. Soil map units identified in the area include:

7	Beje-Trag Complex
21	Croydon loam, 8 to 30 percent slopes
62	Midfork family – Comodore complex
75	Perma family, 15 to 40 percent slopes
88	Rabbitex family – Datino Varient complex
97	Rottulee family – Trag complex
103	Senchert-Toze family complex

A soils map showing the location of the borehole sites in relation to the map unit delineations is presented in Appendix 6.2 along with soil map unit description in Appendix 6.3 and taxonomic unit descriptions in Appendix 6.4.

The soil taxonomic classification given in the Soil Survey of the Carbon Area has changed due to revisions in the classification system. The following is an up to date list of the soils and their classification as of July 2003:

Beje:	Loamy, mixed, superactive, frigid Lithic Argiustolls
Comodore:	Loamy-skeletal, mixed, superactive, frigid Lithic Haplustolls
Croydon:	Fine-loamy, mixed, superactive Typic Argicryolls
Datino:	Loamy-skeletal, mixed, superactive, frigid Entic Haplustolls
Midfork:	Loamy-skeletal, mixed, superactive Typic Haplocryolls
Perma:	Loamy-skeletal, mixed, superactive, frigid Typic Haplustalls
Rottulee:	Fine-loamy, mixed, superactive, frigid Entic Haplustalls
Senchert:	Fine-loamy, mixed, superactive Pachic Argicryolls
Toze:	Fine-loamy, mixed, superactive Calcic Pachic Haplocryolls
Trag:	Fine-loamy, mixed, superactive, frigid Typic Argiustolls

In the Soil Survey of the Carbon Area the Croydon soil series is classified as fine-loamy, mixed Argic Cryoborolls. The revised official series description dated March, 1999 has Croydon classified as a Pachic Argicryoll however the range in the mollic epipedon is 11 to 16 inches thick. Since the mollic epipedon is typically less than 16 inches, the Croydon series is considered a Typic Argicryoll for this report. The problem appears to be the selection of a typical pedon that has a mollic epipedon that is 16 inches thick.

#### 4.2 General Soils Discussion

The soils in the area have formed from sedimentary rocks including sandstone, siltstone, shale, and minor amounts of limestone. Materials are residual (soils formed on bedrock), colluvial, and local alluvial forms. Soil textures are commonly silt loam or loam at the surface and heavy silt loam, clay loam, or silty clay loam in the subsoil. The sand sized particles are mostly very fine sand and fine sand (USDA). The soils range from shallow (less than 20 inches) over bedrock along ridges to very deep on the mountainside slopes and sites that receive deposition of alluvial material.

The soils are well drained and have moderate to moderately slow permeability. They have a moderate to moderately high erosion potential.

Rock fragments are primarily composed of sandstone and are generally less than 20 percent of the volume of the surface soils. Some limestone is present at borehole site G3, and total rock fragment content is highest at borehole site G1.

The dark colored topsoil is well defined and generally overlies on dark yellowish brown to light brown subsoil that has a higher rock fragment content and more clay than the surface. Topsoils are commonly very thick.

The soil pH and carbonates are higher on the more open brushy sites (G1, G2, G3, and part of G5) than on the sites supporting aspen and Douglas-fir (G4, G5, G6, and part of G1). Most parent materials are high in carbonates, especially the more shaly materials as noted at site G3. The soils are typically neutral to mildly alkaline (pH 6.6 to 7.8). Table A displays some of the pertinent soil features at the borehole sites.

**TABLE A**  
**Soil Features – Degassification Boreholes**

Site No.	Carbon Area Soil Map Unit	Soils Present	Common Features
G1	62/88	Comodore Midfork Rabbitex Datino Vraiant	Shallow to moderately deep soils over sandstone and shale. Some rocky spots at the surface. Topsoil 5 to 14 inches thick. Variable in rock fragment content. Silt loam to loam textures. Some silty clay loam along east side.
G2	7	Brycan Beje Trag	Very deep dark colored soils at pad site. Alluvial deposits in swale. Shallow to moderately deep soils north and east of pad site. Very deep soils at south edge.
G3	7	Trag Beje	Shallow to moderately deep soils having silt loam to silty clay loam textures. Topsoil ranges from 5 to 16 inches thick. Limestone, shale, and sandstone present.
G4	62 (More like 103)	Senchert	Very thick dark colored surface soils mostly over stony colluvial subsoils. Textures are silt loam to loam in about the upper 30 inches and clay loam to sandy clay loam below. Some boulders and stones on the surface. Site is in Huance by side of road.
G5	103	Senchert Croydon	Very thick and moderately thick topsoils ranging from about 8 to over 40 inches. Thinnest topsoils. Are near the center of the pad site, textures are silt loam to cobbly clay loam.
G6	103	Senchert	Very thick dark colored surface soils. A fairly uniform site with topsoils of about 30 inches in thickness. Typically silt loam at the surface with a high amount of organic matter and heavy silt loam to silty clay loam below about 24 inches. Relatively stone free to about 36".

#### **4.3 Borehole Site Evaluation**

Photographs taken at each of the sites showing a representative soil and the site conditions are in Appendix 6.5. Field soil description forms are in Appendix 6.7. A discussion of the soils at each site follows:

#### **Borehole Site G1 –**

This site is on a slight ridge top near a steep slope break. A few ponderosa pine trees are present and some have been cut on the drier, more stone spots with shallow soils. The slope pitches gently northward with more vegetation, including Douglas-fir, and deeper soils. The main dirt road lies just east of the site. This was a previous drill site and timber has been removed. Soil disturbance is evident by compaction and displacement.

The soils are shallow along the south and west portions of the site with small spots of fractured sandstone bedrock at the surface. The soils become deeper, and the topsoil is thicker to the north and northeast. Topsoils are thin (5") along the ridge and range up to about 14 inches at the thickest point. Subsoils are mostly very stony, but some are relatively non-stony in spots near the road.

The site is at a transition of NRCS soil map units 62 and 88. Map unit 75 is west of the site on the steep slopes.

#### **Borehole Site G2 –**

This site is along a swale and slight alluvial fan surrounded by steeper more stony slopes. The soils at the borehole site are very deep and dark colored. They have formed primarily in local alluvium from materials deposited from slope wash. The site is within NRCS soil maps unit 7, however it is an inclusion of deeper soils more like the Brycan soil series (fine loamy, mixed, superactive, frigid Cumulic Haplustolls). Dark colored soils of silt loam to silty clay loam texture are about 30 inches thick over most of the site. Top soil becomes thinner as the slope gradient increases just out side of the borehole site to the east and north. This site supports primarily sagebrush and grass with a few small juniper trees. The slope is about 8 to 15 percent.

#### **Borehole Site G3 –**

This site is along an open mountain ridge top supporting sagebrush, snowberry, and associated species. The site slopes to the east with about a 10 to 20 percent gradient. The dirt access road is to the west along the ridge, and to the east the slope becomes steeper.

Soils along the west and northwest portion of the site have fairly thin topsoils having a heavy silt loam texture. The surface soils are about 5 to 8 inches thick over a light colored silty clay loam subsoil that is high in carbonates. Some limestone rock fragments (cobbles) are present near the upper part of the site with sandstone being more evident downslope.

To the south and southeast the density of vegetation increases and the soils become deeper. Topsoil ranges up to 16 inches in thickness. The site was mapped as NRCS soil map unit 7 (Beje-Trag complex) and this is representative of the soils present on the site.

#### **Borehole Site G4 –**

This site is along a dirt road on a north facing slope supporting Douglas-fir and aspen. It was mapped in the Soil Survey of the Carbon Area as map unit 62 but is more like 103, which is nearby. The soil is representative of the Senchert family. It has a very thick dark colored surface layer underlain by dark yellowish brown, stony subsoil. Most of the site is relatively free of

stones although surface stones and boulders are present along the southwest edge and upslope near the ridge above the site.

The site has been logged. The road transects the site, with fill material and logging slash along the north side. A steeper slope pitches off to the north at the edge of the slash. Slope above the road is about 40 percent gradient.

#### **Borehole Site G5 –**

This site is along the north edge of the mountaintop where the open sagebrush merges with an aspen and Douglas-fir timber type. The slope pitches steeply to the north on the north side of the site. A short section of access road going through mostly sagebrush and snowberry is included. Slopes are about 1 to 15 percent at the site.

The site was mapped as NRCS map unit 103 (Senchert-Toze family complex). Soils identified included Senchert and a soil more like Midfork. Two soil descriptions were taken due to the variability in the topsoil thickness. Near the center of the site the topsoil is about 8 inches thick whereas at the northwest corner it is up to 40 inches thick. Topsoil thickness along the borehole pad site and access road is commonly around 20 inches.

#### **Borehole Site G6 –**

This site is on a north-facing slope of about 30 percent supporting mostly aspen and big tooth maple. It was mapped as NRCS soil map unit 103 and is uniformly representative of the Senchert family soil. Dark colored soils (topsoils) are very thick and have a silt loam texture with a slight increase in clay content with depth. Suitable topsoil thickness is about 30 inches over the site.

## **5.0 TOPSOIL SUITABILITY EVALUATION**

Table B gives a summary of the approximate amount of topsoil available at each of the borehole sites. A pad site of about ½ acre (150 x 150ft) was used for calculations although the actual pad measurements may vary. Short sections of access road would also be involved at Sites G5 and G6. Topsoil is considered to be the soil material that consists of the mollic epipedon. This may include a soil horizon designated as a BT horizon, which has a higher percentage of clay than the soil above it yet the soil colors are dark (10 YR 3/3 or darker moist) and the organic matter content is relatively high.

**TABLE B**  
**Topsoil Summary-Degassification Borehole Sites**  
**Dugout Canyon Mine**

<u>Site No.</u>	<u>Topsoil Thickness</u>	<u>Approx. Average</u>	<u>Thickness Factor (yds)</u>	<u>Approx. Volume available (1/2 acre, 2500 sq. yds)</u>
G1	20% 0-5" 50% 5-8" 30% 8-14	7"	0.194	485 cu. yds.
G2	90% 30-45" 10% 18-30"	30"	0.833	2080 cu. yds.
G3	25% 5-8" 50% 8-12" 25% 12-16"	10"	0.278	695 cu. yds.
G4	25% 16-26" 75% 26-38"	28"	0.778	1945 cu. yds. minus roadway Est. 1300 cu. yds. adjusted
G5	20% 8-12" 50% 12-24" 30% 24-40"	22"	0.611	1527 for pad Est. 200 cu. yds. for access road
G6	100% 28-36"	30"	0.833	2080 cu. yds.

**APPENDIX 6.1 -**

**Site Location Map**

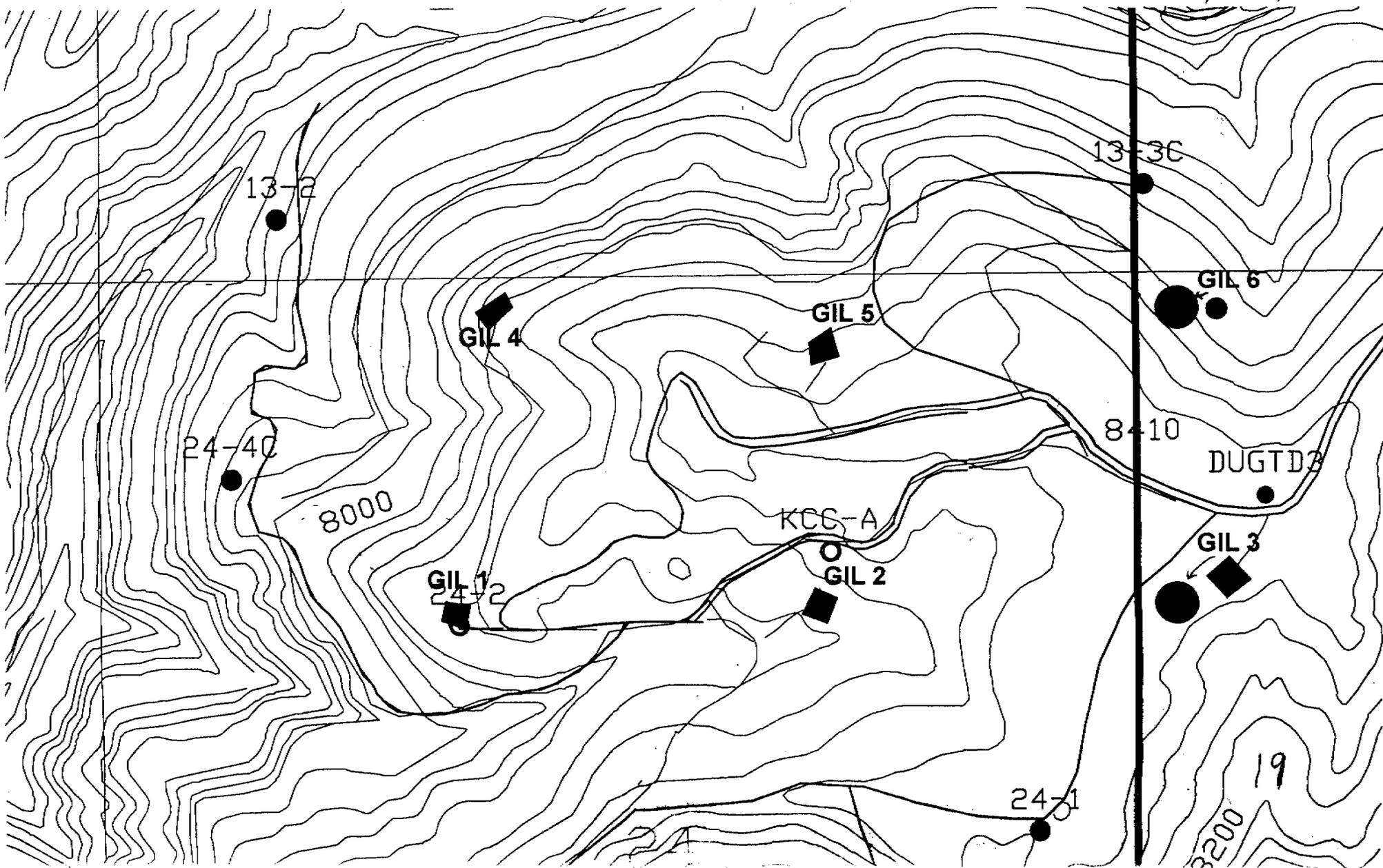
**Degassification Borehole Sites  
Dugout Canyon Mine**

Declassification Borehole Site Locations  
Dugout Canyon Mine

GIL 1 - GIL 6

Sec. 24, T13S, R12E

Sec. 19, T13S, R13E



**APPENDIX 6.2 -**

**Soils Map**

**Degassification Borehole Sites  
Dugout Canyon Mine**



Soils Map - Methane Degussification Borehole Sites,  
 Dugout Canyon Mine. Reference: Soil Survey  
 Carbon Area, Utah. SCS. 1988.

A drafted map is being prepared. Note of 7/15/87  
 SWZ

**APPENDIX 6.3 -**

**NRCS Soil Map Unit Descriptions**

**Degassification Borehole Sites  
Dugout Canyon Mine**

**7—Beje-Trag complex.** This map unit is on gently sloping to sloping plateaus. It is in the Price Canyon and Minniemaud Creek areas. Slopes are 3 to 30 percent. They are 200 to 300 feet long and convex. The present vegetation is mainly mountain big sagebrush, serviceberry, Salina wildrye, and western wheatgrass. Elevation is 7,000 to 9,700 feet. The average annual precipitation is about 16 to 20 inches, the average annual air temperature is 38 to 45 degrees F, and the average freeze-free period is 60 to 100 days.

This unit is 55 percent Beje loam, 3 to 15 percent slopes; 20 percent Trag clay loam, 3 to 30 percent slopes; and 25 percent other soils. The Beje soil is on ridges. The Trag soil is in draws. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are about 8 percent Doney family soils on ridges, 5 percent Trag loam in swales, 8 percent Senchert family soils, 2 percent Rock outcrop, and 2 percent Silas soils. Also included are small areas of a soil that is similar to the Beje soil but has a layer of calcium carbonate accumulation.

The Beje soil is shallow and well drained. It formed in residuum derived dominantly from calcareous sandstone. Typically, the surface layer is brown loam about 6 inches thick. The subsoil, to a depth of 14 inches, is brown clay loam over fractured sandstone. Depth to sandstone ranges from 10 to 20 inches.

Permeability of the Beje soil is moderate. Available water capacity is about 2 to 3 inches. Water supplying capacity is 4 to 6 inches. Effective rooting depth is 10 to 20 inches. The organic matter content of the surface layer is 3 to 5 percent. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

The Trag soil is very deep and well drained. It formed in alluvium derived dominantly from sandstone and shale. Typically, the surface layer is dark brown clay loam about 5 inches thick. The subsoil is brown and light brown clay loam about 34 inches thick. The substratum to a depth of 60 inches or more is light yellowish brown clay loam.

Permeability of the Trag soil is moderate. Available water capacity is about 10 to 11 inches. Water supplying capacity is 10 to 16 inches. Effective rooting depth is 60 inches or more. The organic matter content of the surface layer is 3 to 5 percent. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as rangeland and wildlife habitat.

The potential plant community on the Beje soil is 60 percent grasses, 15 percent forbs, and 25 percent

shrubs. Among the important plants are Salina wildrye, mountain big sagebrush, bluegrass, and slender wheatgrass.

Management practices that maintain or improve the rangeland vegetation include proper grazing use, a planned grazing system, and proper location of water developments. Suitable brush management practices include prescribed burning and chemical spraying.

The suitability of this soil for rangeland seeding is very poor. The main limitations for rangeland seeding are the shallow depth to bedrock and steepness of slope.

The potential plant community on the Trag soil is 60 percent grasses, 10 percent forbs, and 30 percent shrubs. Among the important plants are Salina wildrye, bluegrass, mountain big sagebrush, and snowberry.

If the desirable forage plants are mostly depleted, brush management and seeding can be used to improve the rangeland vegetation. Suitable brush management practices include prescribed burning, chemical spraying, and mechanical treatment.

The suitability of this soil for rangeland seeding is good. Plants suitable for rangeland seeding include all adapted native plants, intermediate wheatgrass, smooth brome, regar brome, slender wheatgrass, and alfalfa. The suitability for grazing is good.

This map unit is in capability subclass VIIe, nonirrigated. The Beje soil is in the Mountain Shallow Loam (Mountain Big Sagebrush) range site. The Trag soil is in the Mountain Loam (Saline Wildrye) range site.

**21—Croydon loam, 8 to 30 percent slopes.** This deep, well drained, moderately slowly permeable soil is on foot slopes. It is between Winter Quarts Canyon and Boardinghouse Canyon, south of Scofield. It formed in alluvium derived dominantly from shale and sandstone. Slopes are about 300 to 400 feet long, are concave to convex, and mostly have east aspect. The present vegetation in most areas is mainly quaking aspen, blue wildrye, slender wheatgrass, peavine, bearded wheatgrass, and silver sagebrush. Elevation is 7,800 to 9,500 feet. The average annual precipitation is 20 to 25 inches, the average annual air temperature is 34 to 38 degrees F, and the average freeze-free period is 40 to 60 days.

Typically, the surface layer is dark yellowish brown and yellowish brown loam about 16 inches thick. The subsurface layer is very pale brown loam about 7 inches thick. The subsoil to a depth of 48 inches is light yellowish brown clay loam over weathered sandstone. Depth to weathered sandstone ranges from 40 to 60 inches or more.

Included in this unit are 5 percent soils that are similar to this Croydon soil but has about 25 percent cobbles in the surface layer and 5 percent Croydon loam that has slopes of 30 to 50 percent.

Permeability of this Croydon soil is moderately slow. Available water capacity is 7 to 9 inches. Water supplying capacity is 16 to 18 inches. Effective rooting depth is 40 to 60 inches or more. The organic matter content of the surface layer is 5 to 10 percent. Runoff is slow, and the hazard of water erosion is slight.

This unit is used as rangeland, woodland, and wildlife habitat and for urban development.

The potential vegetation on the Croydon soil includes an overstory of aspen with a canopy of 40 percent. The understory vegetation is 65 percent grasses, 15 percent forbs, and 20 percent shrubs. Among the important plants are slender wheatgrass, Columbia needlegrass, Thurber fescue, and quaking aspen.

This unit is well suited to the production of aspen. The site index for aspen ranges from 60 to 80. Production of aspen is about 40 cubic feet per year. Minimizing the risk of erosion is essential in harvesting timber. The main limitation for the harvesting of wood products is the steepness of slope.

The suitability of this unit for grazing is good. Management practices that maintain or improve the rangeland vegetation include proper grazing use, a planned grazing system, and proper location of water developments. If the desirable forage plants are mostly depleted, burning can be used to improve the rangeland vegetation.

The suitability for rangeland seeding is poor. The main limitation is competition from aspen.

This map unit is in capability subclass VIe, nonirrigated, and in High Mountain Loam (Aspen) woodland site.

22—Croydon loam, 30 to 50 percent slopes. This deep, well drained, moderately slowly permeable soil is on mountain slopes in the vicinity of Pleasant Valley. It formed in alluvium and colluvium derived dominantly from sandstone and shale. Slopes are 100 to 200 feet long, are concave to convex, and have north and east aspects. The present vegetation in most areas is mainly quaking aspen, snowberry, blue wildrye, slender wheatgrass, and peavine. Elevation is 7,800 to 9,500 feet. The average annual precipitation is 20 to 25 inches, the average annual air temperature is 34 to 38 degrees F, and the average freeze-free season is 40 to 60 days.

Typically, the surface layer is dark yellowish brown and yellowish brown loam about 16 inches thick. The subsurface layer is very pale brown loam about 7 inches thick. The subsoil to a depth of 48 inches is light yellowish brown clay loam over weathered sandstone. Depth to sandstone ranges from 40 to 60 inches or more.

Included in this unit are about 5 percent Uinta family soils under conifers and small areas of a soil that is about 10 inches thick over sandstone. Also included are small areas of Croydon loam that has slopes of 8 to 30 percent and Trag stony loam.

Permeability of this Croydon soil is moderately slow. Available water capacity is about 7 to 9 inches. Water supplying capacity is 16 to 18 inches. Effective rooting depth is 40 to 60 inches or more. The organic matter content of the surface layer is 5 to 10 percent. Runoff is rapid, and the hazard of water erosion is severe.

This unit is used as rangeland, woodland, and wildlife habitat.

The vegetation on the Croydon soil includes an overstory of aspen with a canopy of 60 percent. The understory vegetation is 65 percent grasses, 15 percent forbs, and 20 percent shrubs. Among the important plants are slender wheatgrass, Columbia needlegrass, Thurber fescue, and quaking aspen.

This unit is well suited to the production of aspen. The site index for aspen ranges from 60 to 80. Production of aspen is about 40 cubic feet per acre per year. This unit is severely limited for the harvesting of wood products because of the steepness of slope and the hazard of erosion. If wood products are harvested, care should be taken to minimize the risk of erosion. Proper design of road drainage systems is essential.

The suitability of this unit for grazing is good. Management practices that maintain or improve the rangeland vegetation include proper grazing use, a planned grazing system, and proper location of water developments. If the desirable forage plants are mostly depleted, burning can be used to improve the rangeland vegetation.

The suitability of this unit for rangeland seeding is poor because of the steepness of slope and competition from aspen.

This unit is in capability subclass VIIe, nonirrigated, and in High Mountain Loam (Aspen) woodland site.

**62—Midfork family-Comodore complex.** This map unit is on mountain slopes. It is along the Book Cliffs and Whitmore and Price Canyons. Slopes are 200 to 300 feet long and are convex. The present vegetation is mainly Douglas-fir, snowberry, and quaking aspen. Elevation is 7,900 to 9,500 feet.

This unit is 50 percent Midfork family bouldery loam, 50 to 70 percent slopes; 20 percent Comodore bouldery loam, 50 to 70 percent slopes; and 30 percent other soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are about 15 percent soils that are similar to the Midfork family soil but have a dark-colored surface layer less than 6 inches thick; 10 percent soils that are similar to the Midfork family soil but have a thick surface layer and a layer of calcium carbonate accumulation; and 5 percent Comodore very stony fine sandy loam, moist.

The Midfork family soil is very deep and well drained. It formed in colluvium derived dominantly from sandstone and shale. The average annual precipitation is 20 to 25 inches, the average annual air temperature is 34 to 38 degrees F, and the average freeze-free period is 40 to 60 days.

Typically, the surface is covered with a mat of partially decomposed twigs, leaves, and needles about 2 inches thick. The surface layer is brown bouldery loam about 7 inches thick. The next layer is yellowish brown very channery loam 10 inches thick. Below this to a depth of 60 inches or more is yellowish brown very gravelly loam.

Permeability of the Midfork family soil is moderate. Available water capacity is about 5.5 to 7.0 inches. Water supplying capacity is 10 to 17 inches. Effective rooting depth is 60 inches or more. The organic matter content of the surface layer is 5 to 10 percent. Runoff is rapid, and the hazard of water erosion is high.

The Comodore soil is shallow and well drained. It formed in colluvium derived dominantly from sandstone, siltstone, and shale. The average annual precipitation is 16 to 20 inches, the average annual air temperature is 38 to 45 degrees F, and the average freeze-free period is 60 to 80 days.

Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is brown bouldery loam about 6 inches thick. The underlying material to a depth of 19 inches is brown very stony loam over sandstone. Depth to sandstone ranges from 10 to 20 inches.

Permeability of the Comodore soil is moderate. Available water capacity is about 1.5 to 2.5 inches. Water supplying capacity is 3 to 5 inches. Effective rooting depth is 10 to 20 inches. The organic matter content of the surface layer is 3 to 5 percent. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for wildlife habitat and woodland.

The potential vegetation on this unit includes an overstory of Douglas-fir with a canopy of 90 percent. The understory vegetation is 10 percent grasses, 5 percent forbs, and 85 percent shrubs. Among the important plants are sedge, mountainlover, and snowberry.

The site index for Douglas-fir is 50. Average yield is about 27,200 board feet per acre for 100-year-old trees 12 inches in diameter or more.

This unit is severely limited for the harvesting of wood products because of the steepness of slope and the hazard of erosion.

This map unit is in capability subclass VIIe, nonirrigated, and in the High Mountain Very Steep Loam (Douglas-fir) woodland site.

**75—Perma family, 15 to 40 percent slopes.** This very deep, well drained soil is on steep escarpments of benches. It is near Steer Ridge and Bishop Ridge, in the Book Cliffs. It formed in colluvium derived dominantly from sandstone and shale. Slopes are 300 to 400 feet long and are convex. The present vegetation is mainly serviceberry, birchleaf mountainmahogany, big sagebrush, and curleaf mountainmahogany. Elevation is 7,200 to 8,000 feet. The average annual precipitation is about 16 to 20 inches, the average annual air temperature is 38 to 45 degrees F, and the average freeze-free period is 70 to 90 days.

Typically, the surface layer is dark brown very stony sandy loam about 7 inches thick. The upper 15 inches of the subsoil is brown cobbly sandy loam, and the lower 13 inches is brown very cobbly sandy loam. The substratum to a depth of 60 inches or more is brown very stony sandy loam.

Included in this unit are about 10 percent Datino Variant loam, 5 percent soils that are similar to this Perma family soil but have an extremely bouldery surface layer, and 5 percent soils that are similar to this Perma family soil but have slopes of 40 to 70 percent. The included areas are intermingled throughout the unit.

Permeability of this Perma family soil is moderately rapid. Available water capacity is about 3 to 5 inches. Water supplying capacity is 6 to 9 inches. Effective rooting depth is 60 inches or more. The organic matter content of the surface layer is 3 to 5 percent. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and wildlife habitat.

The potential plant community on the Perma family soil is 20 percent grasses, 10 percent forbs, and 70 percent shrubs. Among the important plants are birchleaf mountainmahogany and serviceberry.

Management practices that maintain or improve the rangeland vegetation include proper grazing use, a planned grazing system, and proper location of water developments.

It is not practical to revegetate large areas of this unit because of the stoniness of the soil. For critical erosion control, small areas can be mechanically treated and seeded. Plants that may be suitable for critical area seedings are those native to the unit, intermediate wheatgrass, orchardgrass, smooth brome, ladak alfalfa, Lewis flax, small burnet, and yellow sweetclover.

This map unit is in capability subclass VIe, nonirrigated, and in the Mountain Stony Loam (Browse) range site.

**88—Rabbitex family-Datino Variant complex.** This map unit is on mountain slopes. It is in the Price Canyon area and south of Whitmore Park. Slopes are 15 to 50 percent, 100 to 200 feet long, and concave to convex. Elevation is 7,000 to 8,500 feet. The average annual precipitation is about 16 to 20 inches, the average annual air temperature is 38 to 45 degrees F, and the average freeze-free period is 60 to 100 days.

This unit is 55 percent Rabbitex family stony loam, 30 to 50 percent slopes; 30 percent Datino Variant very stony loam, 15 to 40 percent slopes; and 15 percent other soils. The Rabbitex family soil is on the steeper side slopes and in convex areas on ridges, and the Datino Variant soil is in concave areas. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are 5 percent Trag soils on ridges, 5 percent Midfork family soils in concave areas, and 5 percent Comodore soils in concave areas.

The Rabbitex family soil is deep and well drained. It formed in colluvium and residuum derived dominantly from sandstone and shale. The present vegetation is mainly ponderosa pine, white fir, Douglas-fir, Gambel oak, and Salina wildrye. Typically, the upper part of the surface layer is dark grayish brown stony loam about 4 inches thick and the lower part is dark grayish brown cobbly loam about 9 inches thick. The underlying material to a depth of 45 inches is light yellowish brown and very pale brown cobbly loam over sandstone. A layer of carbonate accumulation is at a depth of about 13 inches.

Permeability of the Rabbitex family soil is moderate. Available water capacity is about 5.5 to 7.0 inches. Water supplying capacity is 6 to 11 inches. Effective rooting depth is 45 inches or more. The organic matter content of the surface layer is 3 to 5 percent. Runoff is medium, and the hazard of water erosion is moderate.

The Datino Variant soil is very deep and well drained. It formed in colluvium derived dominantly from sandstone and shale. The present vegetation is mainly Gambel oak, serviceberry, birchleaf mountainmahogany, and mountain big sagebrush. Typically, the surface layer is dark grayish brown very stony loam about 4 inches thick. The subsoil is grayish brown very cobbly loam about 10 inches thick. The upper 8 inches of the substratum is pale brown very cobbly loam, and the lower part to a depth of 60 inches or more is pale brown very stony fine sandy loam. A layer of carbonate accumulation is at a depth of about 15 inches.

Permeability of the Datino Variant soil is moderate. Available water capacity is about 4.0 to 6.5 inches. Water supplying capacity is 7 to 9 inches. Effective rooting depth is 60 inches or more. The organic matter

content of the surface layer is 3 to 5 percent. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as rangeland, wildlife habitat, and recreation areas.

The potential vegetation on the Rabbitex family soil includes an overstory of ponderosa pine with a canopy of 30 percent. The understory vegetation is 35 percent grasses, 20 percent forbs, and 45 percent shrubs. Among the important plants are Gambel oak, Salina wildrye, Letterman needlegrass, and snowberry.

The site index for ponderosa pine ranges from 60 to 80. Because this soil is only in small, widely spaced areas, the potential for commercial harvesting of wood products is low.

The potential plant community on the Datino Variant soil is 35 percent grasses, 10 percent forbs, and 55 percent shrubs. Among the important plants are Gambel oak, serviceberry, bluegrass, and snowberry.

Management practices that maintain or improve the rangeland vegetation include proper grazing use, a planned grazing system, and proper location of water developments. If the desirable forage plants are mostly depleted, brush management and rangeland seeding can be used to improve the rangeland vegetation. Suitable brush management practices include prescribed burning, chemical spraying, and mechanical treatment. Eradication of Gambel oak is very difficult. A combination of burning, spraying, and mechanical treatment may have to be used; however, Gambel oak will re-occupy the site in time.

The suitability for rangeland seeding is good. The main limitation is plant competition. Plants suitable for seeding include adapted native plants and smooth brome, orchardgrass, intermediate wheatgrass, and alfalfa.

This map unit is in capability subclass VIIe, nonirrigated. The Rabbitex family soil is in the Mountain Stony Loam (Ponderosa Pine) woodland site. The Datino Variant soil is in the Mountain Loam (Oak) range site.

**97—Rottulee family-Trag complex.** This map unit is on mountain slopes and canyon sides. It is in the vicinity of Whitmore and Emma Parks. Slopes are 30 to 60 percent. Elevation is 7,100 to 8,700 feet. The average annual precipitation is about 16 to 20 inches, the average annual air temperature is 38 to 45 degrees F, and the average freeze-free period is 60 to 100 days.

This unit is 60 percent Rottulee family loam, 30 to 60 percent slopes; 20 percent Trag stony loam, 30 to 60 percent slopes, eroded; and 20 percent other soils. About 30 percent of the acreage of this unit has slopes of 30 to 50 percent. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are about 8 percent Trag clay loam, 5 percent Curecanti family soils, and small areas of Rock outcrop, Badland, and Senchert loam, 30 to 50 percent slopes.

The Rottulee family soil is moderately deep and well drained. It formed in colluvium and residuum derived dominantly from sandstone and shale. Slopes are 50 to 100 feet long and are convex. The present vegetation is serviceberry, Salina wildrye, and mountain big sagebrush. Typically, the surface layer is reddish brown loam about 2 inches thick. The upper 13 inches of the subsoil is reddish brown loam and clay loam, and the lower 8 inches is reddish brown gravelly silty clay loam. The substratum to a depth of 34 inches is reddish brown gravelly silt loam over shale. Depth to shale ranges from 20 to 40 inches.

Permeability of the Rottulee family soil is moderate. Available water capacity is about 5 to 6 inches. Water supplying capacity is 7 to 10 inches. Effective rooting

depth is 20 to 40 inches. The organic matter content of the surface layer is 3 to 5 percent. Runoff is rapid, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

The Trag soil is very deep and well drained. It formed in colluvium derived dominantly from sandstone and shale. Slopes are 75 to 100 feet long and are concave. The present vegetation is mainly mountain big sagebrush, Salina wildrye, snowberry, serviceberry, and scattered Douglas-fir. Typically, the surface layer is dark grayish brown stony loam about 10 inches thick. The subsoil is dark grayish brown clay loam about 26 inches thick. The substratum to a depth of 60 inches or more is dark grayish brown and very pale brown clay loam.

Permeability of the Trag soil is moderate. Available water capacity is about 9.0 to 10.5 inches. Water supplying capacity is 10 to 16 inches. Effective rooting depth is 60 inches or more. The organic matter content of the surface layer is 3 to 5 percent. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for wildlife habitat and rangeland.

The potential plant community on the Rottulee family soil is 20 percent grasses, 10 percent forbs, and 70 percent shrubs. Among the important plants are birchleaf mountainmahogany and serviceberry.

For critical erosion control, small areas can be mechanically treated and seeded. Plants that may be suitable for critical area seedings are those native to the soil and intermediate wheatgrass, orchardgrass, smooth brome, ladak alfalfa, Lewis flax, small burnet, and yellow sweetclover.

This soil is not grazeable by livestock because of the steepness of slope.

The potential plant community on the Trag soil is 60 percent grasses, 10 percent forbs, and 30 percent shrubs. Among the important plants are Salina wildrye, bluegrass, mountain big sagebrush, and snowberry.

If the desirable forage plants are mostly depleted, brush management and seeding can be used to improve the rangeland vegetation. Suitable brush management practices include prescribed burning, chemical spraying, and mechanical treatment.

The suitability of the Trag soil for rangeland seeding is good. Plants suitable for seeding include those native to this soil and intermediate wheatgrass, smooth brome, regar brome, slender wheatgrass, and alfalfa. The suitability for grazing is good.

This unit is in capability subclass VIIe, nonirrigated. The Rottulee family soil is in the Mountain Very Steep Stony Loam (Browse) range site. The Trag soil is in the Mountain Loam (Saline Wildrye) range site.

**103—Senchert-Toze family complex.** This map unit is on north, east, and west aspects of mountain slopes. It is in the vicinity of the Patmos Head, Mount Bartles, and Jump Creek. Slopes are 15 to 35 percent. The present vegetation is mainly aspen, white fir, and Douglas-fir. Elevation is 7,500 to 9,500 feet. The average annual precipitation is about 20 to 25 inches, the average annual air temperature is 36 to 38 degrees F, and the average freeze-free period is 40 to 60 days.

This unit is 50 percent Senchert loam, clayey substratum, 15 to 30 percent slopes; 30 percent Toze family loam, 15 to 35 percent slopes; and 20 percent other soils. The Senchert soil is in plane areas, and the Toze family soil is in concave areas. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are about 5 percent soils that are similar to the Senchert soil but are 40 to 60 inches thick; 5 percent Podo gravelly sandy loam, dry, 8 to 30 percent slopes, on canyon rims; 5 percent Trag clay loam in small sagebrush parks; and 5 percent soils that are similar to the Toze family soil but have slopes of 35 to 50 percent.

The Senchert soil is moderately deep and well drained. It formed in residuum and colluvium derived dominantly from sandstone and shale. Slopes are 300 to 400 feet long and are concave. Typically, the surface is covered with a mat of partially decomposed leaves, twigs, and needles about 1 inch thick. The surface layer is very dark grayish brown loam 4 inches thick. The subsoil is grayish brown clay loam about 14 inches thick. The substratum to a depth of 25 inches is light brownish gray silty clay over calcareous sandstone. Depth to sandstone ranges from 20 to 40 inches.

Permeability of the Senchert soil is moderately slow. Available water capacity is about 3.5 to 5.0 inches. Water supplying capacity is 8.5 to 12.0 inches. Effective rooting depth is 20 to 40 inches. The organic matter content of the surface layer is 5 to 10 percent. Runoff is slow, and the hazard of water erosion is moderate.

The Toze family soil is very deep and well drained. It formed in colluvium derived dominantly from sandstone, siltstone, and shale. Slopes are 200 to 400 feet long and are concave. Typically, the surface is covered with a mat of leaves, twigs, and needles about 1 inch thick. The upper 3 inches of the surface layer is dark grayish brown loam, and the lower 22 inches is dark grayish brown loam and gravelly silt loam. The next layer is grayish brown gravelly silt loam about 8 inches thick. Below this to a depth of 60 inches or more is pale brown very gravelly fine sandy loam. A layer of calcium carbonate accumulation is at a depth of about 24 inches.

Permeability of the Toze family soil is moderate. Available water capacity is about 6 to 9 inches. Water supplying capacity is 11 to 18 inches. The organic matter content of the surface layer is 3 to 5 percent. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as rangeland, woodland, wildlife habitat, and recreation areas.

The potential vegetation on the Senchert and Toze family soils includes an overstory of Douglas-fir with a canopy of 60 percent. The understory vegetation is 10 percent grasses, 5 percent forbs, and 85 percent shrubs. Among the important plants are sedges, mountainlover, snowberry, Oregon-grape, and quaking aspen.

The site index for aspen is 50. Average yield is about 27,200 board feet per acre of trees 12 inches in diameter or more. The unit is moderately limited for producing and harvesting wood products because of the steepness of slope, the hazard of erosion, and plant competition during the regeneration of Douglas-fir.

Management practices that maintain or improve the rangeland vegetation on this unit include proper grazing use, a planned grazing system, and proper location of water developments. The suitability for grazing is poor because of the low forage production. If the Douglas-fir is thinned, the desirable plants present can be expected to increase for a short period before Douglas-fir revegetates the unit.

This map unit is in capability subclass VIIe, nonirrigated, and in the High Mountain Loam (Douglas-fir) range site.

**APPENDIX 6.4 -**

**NRCS Soil Taxonomic  
Unit Descriptions**

**Degassification Borehole Sites  
Dugout Canyon Mine**

LOCATION BEJE

UT+CO

Established Series  
Rev. EJ/DKR/TWH  
06/2002

## BEJE SERIES

The Beje series consists of shallow, well drained soils that formed in reworked eolian material, residuum, slope alluvium, and colluvium derived from sandstone and shale. Beje soils are on plateaus, hills, mesas, mountains, ridges, and structural benches. Slopes range from 1 to 50 percent. Mean annual precipitation is about 16 inches and the mean annual temperature is about 42 degrees F.

**TAXONOMIC CLASS:** Loamy, mixed, superactive, frigid Lithic Argiustolls

**TYPICAL PEDON:** Beje loam in rangeland. (Colors are for dry soil unless otherwise noted.)

**A--**0 to 6 inches; brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine, fine, and medium pores; slightly alkaline (pH 7.6); abrupt smooth boundary. (2 to 6 inches thick)

**Bt--**6 to 14 inches; brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; strong medium subangular blocky structure; hard, firm, moderately sticky and moderately plastic; common very fine, fine, and medium roots; common very fine and fine pores; few faint clay films on faces of peds; slightly alkaline (pH 7.6); abrupt smooth boundary. (6 to 18 inches thick)

**R--**14 inches; sandstone.

**TYPE LOCATION:** Carbon County, Utah; about 12 miles northeast of Price; located about 1,000 feet west and 1,500 feet south of the northeast corner of sec. 19, T. 13 S., R. 12 E.

### RANGE IN CHARACTERISTICS:

**Soil moisture:** The soil moisture control section is affected by precipitation that is fairly evenly distributed throughout except for July through October being slightly wetter and April through June being slightly drier. Typic ustic moisture regime.

**Particle-size control section:** 18 to 35 percent clay

**Depth to lithic contact:** 10 to 20 inches to hard sandstone

**Thickness of the mollic epipedon:** 7 to 16 inches

**A horizon:**

Hue: 7.5YR or 10YR

Value: 3 or 4 dry, 2 or 3 moist

Chroma: 2 or 3 dry or moist

Rock fragments: 0 to 35 percent sandstone fragments

Reaction: neutral to moderately alkaline

**Bt horizon:**

<http://ortho.ftw.nrcs.usda.gov/cgi-bin/osd/osdname.cgi?-P>

1/16/03

Hue: 7.5YR or 10YR

Value: 3 to 5 dry, 2 or 4 moist

Chroma: 2 to 4 dry or moist

Texture: clay loam, loam, or sandy clay loam

Rock fragments: 0 to 35 percent sandstone gravel and cobbles

Reaction: neutral to moderately alkaline

**COMPETING SERIES:** These are the Beenom, Berland, Bonjea, Cedric, Coni, Connieo, Kiln, and Viewpoint series.

Berland soils are less than 10 inches deep to a lithic contact.

Beenom soils have soil moisture control sections that are more moist during the spring and drier during the summer.

Cedric soils formed in granite and have accumulations of secondary calcium carbonate.

Coni soils formed in arkosic beds overlying tuff or conglomerate and have granitic rock fragments.

Bonjea and Connieo soils formed in granite and have granitic rock fragments.

Kiln soils formed in limestone and have limestone rock fragments.

Viewpoint soils formed in basalt and have basalt-breccia rock fragments.

**GEOGRAPHIC SETTING:**

Parent material: reworked eolian material, residuum, slope alluvium, and colluvium derived from sandstone and shale

Landform: plateaus, hills, mesas, mountains, ridges, and structural benches

Slopes: 1 to 50 percent

Elevation: 6,800 to 9,700 feet

Mean annual temperature: 38 to 47 degrees F

Mean annual precipitation: 14 to 22 inches

Precipitation is fairly evenly distributed throughout the year with July through October being slightly wetter and April through June being slightly dryer.

Frost-free period: 60 to 120 days

**GEOGRAPHICALLY ASSOCIATED SOILS:** These are the Comodore, Rottulee, Senchert and Trag series. Comodore soils are skeletal. Rottulee and Senchert soils have bedrock at a depth of 20 to 40 inches. Trag soils lack bedrock at depths less than 40 inches.

**DRAINAGE AND PERMEABILITY:** well drained, low to high runoff, moderate or moderately rapid permeability

**USE AND VEGETATION:** These soils are used for rangeland and pinyon-juniper woodland. Present native vegetation is pinyon, juniper, mountain big sagebrush, Salina wildrye, bluebunch wheatgrass and snowberry. This soil at the type location has been correlated to the 048AY436UT Mountain shallow loam (mountain big sage brush) range site.

**DISTRIBUTION AND EXTENT:** South central Utah and southwest Colorado. LRR D, E, MLRA 34, 36, 47, 48A. This series is of moderate extent.

**MLRA OFFICE RESPONSIBLE:** Lakewood, Colorado

**SERIES ESTABLISHED:** Carbon County, Utah. 1982. The name is coined.

**REMARKS:** Diagnostic horizons and features recognized in this pedon are:

Mollic epipedon: The zone from 0 to 6 inches. (A horizon)

Argillic horizon: The zone from 6 to 14 inches. (Bt horizon)

Lithic contact: The contact with sandstone at 14 inches. (R layer)

Particle-size control section: The zone from 0 to 14 inches. (A, Bt horizons)

Keys to Soil Taxonomy: Series classified according to Eighth Edition, 1998.

The lower end of the range of precipitation, at 14 to about 16 inches, may actually be in an aridic ustic moisture regime subclass. This needs further study.

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National Cooperative Soil Survey  
U.S.A.

LOCATION BRYCAN

UT+NM

Established Series  
REV: LHS/HKS/RLT  
06/2000

## BRYCAN SERIES

The Brycan series consists of very deep, well drained, moderately permeable soils that formed in alluvium from sedimentary rocks. Brycan soils are on alluvial fans and valley floors and have slopes of 0 to 15 percent. The average annual precipitation is about 15 inches and the mean annual temperature is about 42 degrees F.

**TAXONOMIC CLASS:** Fine-loamy, mixed, superactive, frigid Cumulic Haplustolls

**TYPICAL PEDON:** Brycan very fine sandy loam--rangeland. (Colors are for air-dry soil unless otherwise stated.)

**A1**--0 to 5 inches; brown (5YR 5/4) very fine sandy loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and few medium roots; few fine tubular pores; mildly alkaline (pH 7.6); clear smooth boundary. (4 to 8 inches thick)

**A2**--5 to 12 inches; brown (7.5YR 5/4) very fine sandy loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium roots; few fine tubular pores; mildly alkaline (pH 7.6); clear smooth boundary. (3 to 8 inches thick)

**Bt1**--12 to 30 inches; brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 3/2) moist; weak medium subangular blocky structure; hard, firm, sticky and plastic; few fine roots; few fine tubular pores; common thin clay films on faces of peds and in pores; mildly alkaline (pH 7.6); gradual wavy boundary. (12 to 20 inches thick)

**Bt2**--30 to 37 inches; reddish yellow (7.5YR 6/6) sandy clay loam, brown (7.5YR 4/4) moist; weak medium subangular blocky structure; hard, friable, slightly sticky and plastic; few fine roots; common fine and few medium tubular pores; few thin clay films on faces of peds and in pores; mildly alkaline (pH 7.8); clear smooth boundary. (5 to 8 inches thick)

**BC**--37 to 47 inches; brownish yellow (10YR 6/6) sandy loam, yellowish brown (10YR 5/6) moist; massive; hard, very friable; few fine roots; few fine random tubular pores; mildly alkaline (pH 7.8); clear wavy boundary. (8 to 12 inches thick)

**2Bkb**--47 to 62 inches; light yellowish brown (10YR 6/4) clay loam, brown (10YR 5/3) moist; massive; hard, firm, sticky and plastic; few fine roots; few fine and medium random tubular pores; strongly calcareous; carbonates are in veins; moderately alkaline (pH 8.4). TYPE LOCATION: Garfield County, Utah; 1.5 miles east of Triangle Bryce Canyon; NE 1/4 sec. 8, T. 36 S., R. 3 W.

**RANGE IN CHARACTERISTICS:** The mollic epipedon is 20 to 36 inches thick. The combined thickness of the A and Bt horizons ranges from 22 to 40 inches. The mean annual soil temperature is about 40 to 47 degrees F. and the mean summer soil temperature at a depth of 20 inches is 59 to 64

degrees F.

The A horizon has hue of 5YR to 10YR, value 4 or 5 dry, 2 or 3 moist and chromas of 2 to 4 dry, and 2 or 3 moist. It is mildly alkaline or moderately alkaline.

The Bt horizon has hue of 5YR to 10YR, value of 5 or 6 dry, 3 or 4 moist, and chroma of 2 to 6. It is loam, sandy clay loam or clay loam. It is mildly alkaline or moderately alkaline. This horizon lacks the clay increase to qualify for an argillic horizon.

The BC and 2Bkb horizons have hue of 10YR to 5YR, value of 4 to 6 dry, 3 to 5 moist, and chroma of 3 to 6. It is clay loam, silt loam, sandy clay loam, fine sandy loam or sandy loam and is gravelly below 30 inches in some pedons. It is mildly alkaline or moderately alkaline.

**COMPETING SERIES:** These are the Cordeston, Enbar, Frolic, Jodero, McGaffey, Mitch, Nutrioso, and Straw series. Cordeston soils have mollic epipedon 36 to 50 inches thick. Enbar soils lack cambic horizons. Frolic soils have mottles in the series control section and water tables at 3 to 5 feet. Jodero, Mitch, and Nutrioso soils lack cambic horizons. Also, Jodero soils have mollic epipedons more than 40 inches thick and Nutrioso soils have chroma of 1 or 2 throughout. McGaffey soils lack cambic horizons and have hue redder than 7.5YR. Straw soils lack cambic horizons and have chroma of 2 or less in the B horizon.

**GEOGRAPHIC SETTING:** Brycan soils are gently sloping to moderately steep alluvial fans and valleys at elevations of 7,600 to 8,600 feet. Slope gradients range from 0 to 15 percent. The soils formed in deep alluvium from limestone, sandstone, and shale. The climate is dry subhumid. The average annual precipitation is 13 to 20 inches. Mean annual temperature is 38 to 45 degrees F. The mean summer temperature is 59 to 64 degrees F. and the freeze-free period is 70 to 110 days.

**GEOGRAPHICALLY ASSOCIATED SOILS:** These are Osote, Pahreah, and Paunsaugunt soils. Osote soils have mollic epipedons less than 16 inches thick. Pahreah soils lack cambic horizons and have more than 35 percent rock fragments in the particle size control section. Paunsaugunt soils have a lithic contact at depths of less than 20 inches and have more than 35 percent rock fragments in the particle size control section.

**DRAINAGE AND PERMEABILITY:** Well drained; slow runoff; moderate permeability.

**USE AND VEGETATION:** Used as rangeland wildlife habitat, and recreation. Potential vegetation is prairie junegrass, mountain brome, mountain muhly and western wheatgrass.

**DISTRIBUTION AND EXTENT:** South-central Utah. The series is inextensive.

**MLRA OFFICE RESPONSIBLE:** Lakewood, Colorado

**SERIES ESTABLISHED:** Garfield County (Paunsaugunt Area), Utah, 1969.

**REMARKS:** These soils were formerly classified as Alluvial soils.

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National Cooperative Soil Survey  
U.S.A.

LOCATION COMODORE

CO+UT

Established Series

Rev. GB

02/1999

## COMODORE SERIES

The Comodore series consists of shallow, well drained soils that formed in material weathered from igneous or metamorphic rocks. Comodore soils are on upland hills, ridges and mountain sides and have slopes of 4 to 70 percent. The mean annual precipitation is about 18 inches and the mean annual temperature is about 42 degrees F.

**TAXONOMIC CLASS:** Loamy-skeletal, mixed, superactive, frigid Lithic Haplustolls

**TYPICAL PEDON:** Comodore very stony loam, grassland. (Colors are for dry soil unless otherwise noted.)

A--0 to 9 inches; grayish brown (10YR 5/2) very stony loam, very dark brown (10YR 2/2) moist; weak fine subangular blocky structure parting to fine granular; soft, very friable, slightly sticky, slightly plastic; 60 percent stones; slightly acid; clear smooth boundary. (6 to 16 inches thick)

C--9 to 13 inches; brown (10YR 5/3) extremely stony loam, dark brown (10YR 4/3) moist; massive; slightly hard, very friable, slightly sticky, slightly plastic; 70 percent stones; slightly acid; abrupt smooth boundary. (4 to 14 inches thick)

R--13 inches; hard igneous and metamorphic bedrock.

**TYPE LOCATION:** Alamosa County, Colorado; approximately 1/4 mile west of the southeast corner, sec. 9, T. 28 S., R. 73 W.

**RANGE IN CHARACTERISTICS:** The soils usually are noncalcareous throughout but have thin discontinuous calcareous subhorizons just above the bedrock in some pedons. Base saturation is more than 20 percent and ranges from 60 to 100 percent. Depth to the lithic contact ranges from 10 to 20 inches. The particle size control section is usually very stony, extremely stony, or very cobbly loam, sandy clay loam, or clay loam but in the fine earth fraction has 18 to 35 percent clay, 5 to 55 percent silt and 20 to 70 percent sand with more than 15 percent being fine or coarser sand. Rock fragments range from 35 to 85 percent and range dominantly from 10 to 36 inches in diameter. However, some pedons have rock fragments less than 10 inches with 15 to 20 percent pebbles and 10 to 15 percent cobbles. The A and C horizons range from slightly acid to mildly alkaline. The mean annual soil temperature is 45 degrees F, and mean summer soil temperature is 62 degrees F.

The A horizon has hue of 2.5Y through 7.5YR, value of 4 or 5, 2 or 3 moist, and chroma of 1 to 3.

The C horizon has hue of 2.5Y through 7.5YR, value of 5 or 6, 3 or 4 moist, and chroma of 2 or 3.

**COMPETING SERIES:** These are the Boriana, Castner, Cathedral, Celeste, Firo, Onaqui, Paunsaugunt, and Pendant series. Castner, Paunsaugunt, and Pendant soils are calcareous at or near the <http://ortho.ftw.nrcs.usda.gov/osd/dat/C/COMODORE.html>

surface. Borianna and Cathedral soils have fine earth matrix material that is coarse sandy loam, or loam with less than 18 percent clay. In addition, Cathedral soils have a large proportion of medium, coarse, and very coarse angular granite sand. Celeste soils have hue of 5YR or redder. Firo and Onaqui soils lack coarse fragments that predominantly are greater than 10 inches in diameter.

**GEOGRAPHIC SETTING:** Comodore soils are on upland hills, ridges, and mountainsides. Slope gradients range from 4 to 70 percent. The soil formed in material weathered from underlying igneous or metamorphic rock. The average annual precipitation is 16 to 18 inches with peak periods of precipitation occurring in the spring and early summer. Mean annual temperature ranges from 40 to 45 degrees F. In Utah and elsewhere in Colorado, the average annual precipitation ranges from 12 to 20 inches at elevations of 6,800 to 9,500 feet.

**GEOGRAPHICALLY ASSOCIATED SOILS:** These are the competing Firo soils and the Uracca soils. Uracca soils have argillic horizons and lack bedrock above depth of 20 inches.

**DRAINAGE AND PERMEABILITY:** Well drained to excessively drained; runoff is rapid; permeability is moderate above the bedrock.

**USE AND VEGETATION:** These soils are used principally as native pastureland or for recreational purposes. Principal native vegetation is mainly pinon pine, juniper, cedar, blue grama, mountain muhly, fringe sage, and mountainmahogany. Some spruce and fir occur on north facing slopes.

**DISTRIBUTION AND EXTENT:** Mountainous areas of south central Colorado surrounding the Alamosa Basin and northeastern and southern parts of Utah. The series is of moderate extent.

**MLRA OFFICE RESPONSIBLE:** Lakewood, Colorado

**SERIES ESTABLISHED:** Alamosa County, Colorado, 1974.

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National Cooperative Soil Survey  
U.S.A.

LOCATION CROYDON

UT

Established Series  
Rev. EJ/JAC/RLM/SSP  
03/1999

## CROYDON SERIES

The Croydon series consists of deep, well drained, moderately slow permeable soils that formed in residuum and colluvium weathered from sandstone and shale. These soils are on east and north facing mountainsides. The average annual precipitation is about 30 inches and the mean annual temperature is about 38 degrees F.

**TAXONOMIC CLASS:** Fine-loamy, mixed, superactive Pachic Argicryolls

**TYPICAL PEDON:** Croydon loam, woodland. (Colors are for moist soil unless otherwise noted.)

**0--**1 inch to 0; leaves and other plant material. (1 to 4 inches thick)

**A1--**0 to 4 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak thick platy structure parting to moderate fine granular; soft, friable, and slightly plastic; many very fine, fine and coarse roots; slightly acid (pH 6.5); clear smooth boundary. (3 to 16 inches thick)

**A2--**4 to 16 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; moderate medium granular structure; soft, very friable and slightly plastic; many very fine through coarse roots; slightly acid (pH 6.5); abrupt broken boundary. (0 to 13 inches thick)

**E--**16 to 22 inches; brown (10YR 4/3) loam, pale brown (10YR 6/3) dry; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine through coarse roots; common fine pores; 20 percent pebbles; 35 percent of this horizon is animal burrow material from A1 horizon above; slightly acid (pH 6.4); clear wavy boundary. (3 to 11 inches thick)

**Bt1--**22 to 28 inches; light olive brown (2.5Y 5/4) silty clay loam, pale olive (5Y 6/3) dry; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; few very fine, fine and medium roots; common fine pores; common thin and many moderately thick clay films on faces of peds; small pockets of A1 horizon from animal burrows; slightly acid (pH 6.2); clear smooth boundary. (3 to 10 inches thick)

**Bt2--**28 to 40 inches; light olive brown (2.5Y 5/4) silty clay loam, pale olive (5Y 6/3) dry; moderate coarse subangular blocky structure parting to moderate fine subangular blocky; very hard, firm, sticky and plastic; few very fine and fine roots; common fine pores; continuous thin clay films on faces of peds; slightly acid (pH 6.2); clear smooth boundary. (6 to 31 inches thick)

**C--**40 to 48 inches; light olive brown (2.5Y 5/4) heavy silt loam, pale olive (5Y 6/3) dry; weak medium subangular blocky structure; hard, friable, slightly sticky and plastic; few fine roots; slightly acid (pH 6.2); abrupt smooth boundary. (0 to 22 inches thick)

R--48 inches; weathered sandstone.

**TYPE LOCATION:** Morgan County, Utah; about 8.5 miles east, and 4 miles north of Croydon, Utah; 1,475 feet south and 200 feet east of the NW corner of section 34, T.5N., R.5E.

**RANGE IN CHARACTERISTICS:** The mollic epipedon is 11 to 16 inches thick. The combined thickness of the A, E and Bt horizons ranges from 39 to 60 inches. Soft weathered sandstone occurs at depths of 40 to 60 inches. The mean annual soil temperature at depth of 20 inches ranges from 39 to 42 degrees F. The mean summer soil temperature ranges from 56 to 59 degrees F. The soils are usually moist but are dry for 30 to 45 consecutive days during late summer. Rock fragments consists of rounded pebbles and cobbles, and range from 0 to 20 percent in the A horizon, 0 to 30 percent in the E horizon, 0 to 20 percent in the Bt horizon and 0 to 20 percent in the C horizon.

The A horizon has value of 3 through 5 dry, 2 or 3 moist, and chroma of 2 to 4 dry. Reaction is medium acid to slightly acid.

The E horizon has hue of 10YR or 2.5Y, value of 5 through 8 dry, 4 through 6 moist, and chroma of 2 through 4 dry and moist. It ranges from loam or cobbly loam to cobbly sandy loam. Reaction is slightly acid or medium acid.

The Bt horizon has dominant hue of 10YR, 2.5Y or 5Y, value of 5 through 7 dry, 4 or 5 moist, and chroma of 2 through 4 dry and moist. It ranges from silty clay loam to clay loam. This horizon has weak to moderate, fine to coarse subangular blocky structure. Reaction is neutral to medium acid.

The C horizon has dominant hue of 2.5Y or 5Y (10YR in parts of some pedons), value of 5 through 7 dry, 4 or 5 moist, and chroma of 2 through 4 dry and moist. It ranges from silt loam to loam, gravelly loam, clay loam or silty clay loam. This horizon ranges from noncalcareous to moderately calcareous and is medium acid to neutral.

**COMPETING SERIES:** These are the Amsden, Archabal, Dra, Gelke, Hourglass, Kezar, Kimmons, Leavitt, Lucky, Lymanson, Lyonman, Michaelson, Miracle, Monida, Morset, Mult, Newlands, Oro Fino, Passcreek, Philipsburg, Primeaux, Rammel, Sponseller, Tingey, Tripit, Troutdale, Wellsville, Woosley and Youga series. All of these soils lack E horizons. Amsden, Dra, Gelke, Kimmons, Leavitt, Lymanson, Michaelson, Monida, Morset, Oro Fino, Passcreek, Philipsburg, Rammel, Tingey, Wellsville and Woosley soils have horizons of secondary calcium carbonate accumulation. Archabal soils are strongly acid. Hourglass soils have 20 to 35 percent rock fragmens in the Bt horizon. Kezar, Kimmons, Lucky, Lymanson, Miracle, Mult, Newlands, Passcreek, Primeaux, Rammel, Tripit, Troutdale, and Woosley soils are 2 to 40 inches deep over bedrock. Lyonman soils have high chroma iron stains in the lower part of the B and upper C horizons and dominant hues of 10YR or redder. Newland soils have hue of 10YR or redder in all parts of the Bt horizon. Sponseller soils have hue of 5YR or 2.5YR. Youga soils have A horizons 5 to 10 inches thick.

**GEOGRAPHIC SETTING:** Croydon soils are at elevations of 6,400 to 9,500 feet. They occur on east and north facing mountainsides. Slopes range from 30 to 60 percent. These soils formed in residuum and colluvium weathered from sandstone. The climate is humid and the average annual precipitation ranges from 20 to 34 inches. The mean annual temperature is 34 to 40 degrees F. and the mean summer temperature is 53 to 56 degrees F. The frost free season ranges from 40 to 75 days.

**GEOGRAPHICALLY ASSOCIATED SOILS:** These are the Hades, Isabell, Kilfoil, Lucky Star, and Scave soils. Hades soils have mollic epipedons more than 20 inches thick and lack E horizons. Isabell soils have summer soil temperature greater than 59 degrees F. and lack E horizons. Kilfoil soils lack a

mollic epipedon and are 20 to 40 inches deep to bedrock. Lucky Star and Scave soils have more than 35 percent rock fragments in the particle size control section and have hue of 7.5YR, 5YR or 2.5YR.

**DRAINAGE AND PERMEABILITY:** Well drained; slow runoff; moderately slow permeability.

**USE AND VEGETATION:** These soils are used for watershed, range, wildlife habitat and timber production. The potential vegetation is aspen, white fir, Douglas fir, with an understory of snowberry, mountain brome grass, ninebark, blue wildrye, peavine, sedges and willows.

**DISTRIBUTION AND EXTENT:** Northern and central Utah. The series is inextensive.

**MLRA OFFICE RESPONSIBLE:** Lakewood, Colorado

**SERIES ESTABLISHED:** Morgan County (Morgan Area), Utah, 1974.

**REMARKS:**

Depth class narrowed from deep and very deep to deep.

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National Cooperative Soil Survey  
U.S.A.

LOCATION DATINO

UT

Established Series  
Rev. WRM/AJE  
11/2000

## DATINO SERIES

Typically, Datino soils have grayish brown, neutral very gravelly light loam A1 horizons about 3 inches thick; brown, mildly alkaline, very cobbly heavy loam B2 horizons and pinkish white, moderately alkaline, very cobbly loam Cca horizons.

**TAXONOMIC CLASS:** Loamy-skeletal, mixed, superactive, frigid Entic Haplustolls

**TYPICAL PEDON:** Datino very gravelly loam, rangeland. (Colors are for dry soil unless otherwise noted.)

**A--**0 to 2 inches; grayish brown (10YR 5/2) very gravelly light loam, dark brown (10YR 3/3) moist; weak medium platy structure that parts to weak fine granular; soft, friable, slightly sticky and nonplastic; common fine vesicular pores; 40 percent gravel and 3 percent cobbles; noneffervescent; neutral (pH 7.0); clear smooth boundary. (2 to 9 inches thick)

**AB--**2 to 7 inches; brown (7.5YR 4/2) very cobbly clay loam, dark brown (7.5YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine and medium roots; few fine interstitial and tubular pores; 20 percent gravel and 15 percent cobbles; noneffervescent; slightly alkaline (pH 7.5); gradual wavy boundary. (0 to 6 inches thick)

**Bt--**7 to 11 inches; brown (7.5YR 5/2) very cobbly loam, dark brown (7.5YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine, medium and coarse roots; few fine interstitial pores; few thin clay films in pores; few fine distinct pinkish white (7.5YR 8/2) carbonate segregations, pinkish gray (7.5YR 7/2) moist; 30 percent cobbles and 20 percent gravel coated on bottom sides with carbonates; matrix is slightly effervescent and the carbonate segregations are violently effervescent; slightly alkaline (pH 7.8); gradual wavy boundary. (3 to 10 inches thick)

**Bk1--**11 to 17 inches; pinkish white (7.5YR 8/2) very cobbly loam, pinkish gray (7.5YR 7/2) moist; massive; hard, firm, slightly sticky and nonplastic; few fine, medium and coarse roots; few fine and coarse interstitial pores; 40 percent cobbles and 20 percent gravel coated with carbonates; violently effervescent; moderately alkaline (pH 8.0); gradual wavy boundary. (4 to 7 inches thick)

**Bk2--**17 to 32 inches; pinkish white (7.5YR 8/2) extremely cobbly loam, pinkish gray (7.5YR 7/2) moist; massive; hard, firm, slightly sticky and nonplastic; few very fine roots; few fine and coarse interstitial pores; 50 percent cobbles and 30 percent gravel coated with carbonates; violently effervescent; moderately alkaline (pH 8.0); gradual wavy boundary. (10 to 18 inches thick)

**Bk3--**32 to 50 inches; pink (7.5YR 7/4) extremely cobbly loam, light brown (7.5YR 6/4) moist; massive; slightly hard, firm, nonsticky and nonplastic; few fine and coarse interstitial pores; 50 percent cobbles and 30 percent gravel coated with carbonates; violently effervescent; moderately alkaline (pH

8.0).

**TYPE LOCATION:** Garfield County, Utah; Lost Creek, S1/4 corner section 30, T.31S., R.3W.

**RANGE IN CHARACTERISTICS:**

The estimated depth of regolith to bedrock is 20 to 50 feet.

The mollic epipedon is 7 to 9 inches thick and is over 1/3 the thickness of the solum.

The rock fragments range from 20 to 50 percent in the

A horizon, 50 to 80 percent in the B and C horizons and average 35 to 60 percent in the A1 horizon,

50 to 80 percent in the B and C horizons and average 35 to 60 percent in the control section.

These soils are noneffervescent in the upper 7 inches and increase to violently effervescent in the Cca horizon.

Depth to the Bk (calcic) horizon ranges from 10 to 17 inches.

These soils have a mean annual soil temperature of 44 to 47 degrees F.,

and a mean summer soil temperature at a depth of 20 inches of 59 to 64 degrees F.

The soils are dry in all parts of the moisture control section for less than 60 consecutive days in more than 7 out of 10 years. They are moist in some part of the moisture control section more than 1/2 the time the soil temperature is above 41 degrees F.

The A and Bt horizons have hue of 7.5YR or 10YR, value of 4 or 5 dry, 2 or 3 moist, and chroma of 2 or 3.

The ABhorizon has value of 5 to 8 dry, 4 to 7 moist, and chroma of 2 or 3. It ranges from very gravelly or very cobbly loam to stony loam, very gravelly or very cobbly light clay loam.

The Bk horizon has hue of 7.5YR or 10YR, value of 6 to 8 dry, 5 to 7 moist, and chroma of 2 to 4. It ranges from very extremely gravelly or very extremely cobbly sandy loam to very extremely gravelly or very extremely cobbly loam and very stony fine sandy loam.

**COMPETING SERIES:** These are the Brycan, Guben, Losee, Mitch, Panguitch, Paunsaugunt, Perma, Peso, Syrett and Widtsoe series. Brycan, Mitch, and Panguitch soils have less than 35 percent rock fragments in the control section. Guben soils are calcareous to the surface. Losee soils lack a mollic epipedon. Paunsaugunt soils have a lithic contact within a depth of 20 inches. Perma soils are noncalcareous to depths of at least 40 inches. Peso soils have limestone bedrock at depths of at least 40 inches. Peso soils have limestone bedrock at depths of 20 to 40 inches. Syrett soils lack a cambic horizon and have a lithic contact within a depth of 40 inches. Widtsoe soils have an argillic horizon and a weakly to strongly cemented Cca horizons.

**GEOGRAPHIC SETTING:** Datino soils are on gently to strongly sloping alluvial fans dissected by

many intermittent drainageways. Elevations ranges from 6,800 to 8,700 feet. The soils formed in mixed volcanic alluvium. Slope gradients are 5 to 80 percent. The average annual precipitation is 12 to 20 inches. The mean annual temperature is 38 to 45 degrees F., and the average summer temperature is 59 to 64 degrees F. The frost free season ranges from 60 to 120 days.

**GEOGRAPHICALLY ASSOCIATED SOILS:** These are the competing Panguitch and Widtsoe soils.

**DRAINAGE AND PERMEABILITY:** Well drained; rapid runoff; slow permeability.

**USE AND VEGETATION:** Used for rangeland, wildlife and watershed. Native vegetation is pinyon pine, Utah juniper, big sagebrush, Indian ricegrass, needleandthread grass, blue grama grass, and snakeweed.

**DISTRIBUTION AND EXTENT:** These soils are in the south central part of Utah. They are inextensive.

**MLRA OFFICE RESPONSIBLE:** Phoenix, Arizona

**SERIES ESTABLISHED:** Garfield County (Paunsaugunt Area), Utah, 1969.

**REMARKS:** In October 2000, taxonomic classification was converted to the closest match found in Soil Taxonomy, Second Edition 1999. Some update was made to horizon nomenclature, competing series section, etc. Other placements may be more appropriate after a complete update.

These soils were formerly classified as Calcisols.

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National Cooperative Soil Survey  
U.S.A.

LOCATION MIDFORK

WY+UT

Established Series  
Rev. PSD  
02/1999

## MIDFORK SERIES

The Midfork series consists of deep, well drained soils that formed in stream and slope alluvium. Midfork soils are on fan aprons and mountain slopes. Slopes are 3 to 70 percent. The mean annual precipitation is about 45 inches, and the mean annual temperature is about 32 degrees F.

**TAXONOMIC CLASS:** Loamy-skeletal, mixed, superactive Typic Haplocryolls

**TYPICAL PEDON:** Midfork very stony loam-rangeland. (Colors are for dry soil unless otherwise stated.)

**A1--**0 to 4 inches; brown (7.5YR 5/2) very stony loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine, medium, and coarse roots; 20 percent limestone and dolomite pebbles, 10 percent cobbles and 10 percent stones; mildly alkaline (pH 7.7); clear wavy boundary. (4 to 15 inches thick)

**A2--**4 to 10 inches; brown (7.5YR 5/2) very stony loam, dark brown (7.5YR 3/2) moist; weak medium subangular blocky structure parting to weak medium and fine granular; soft, very friable, sticky and slightly plastic; common fine, many medium and coarse roots; 20 percent limestone and dolomite pebbles, 10 percent cobbles and 10 percent stones; mildly alkaline (pH 7.7); gradual wavy boundary. (0 to 10 inches thick)

**C1--**10 to 15 inches; brown (7.5YR 5/3) very cobbly loam, dark brown (7.5YR 4/3) moist; weak medium subangular blocky structure; slightly hard, very friable, sticky and slightly plastic; common fine, many medium and coarse roots; 20 percent limestone and dolomite pebbles, 20 percent cobbles, 10 percent stones; mildly alkaline (pH 7.7); gradual wavy boundary. (0 to 10 inches thick)

**C2--**15 to 60 inches; light brownish gray (10YR 6/2) very cobbly loam, grayish brown (10YR 5/2) moist; weak medium and fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; few medium and fine roots; strongly effervescent, lime disseminated; 20 percent limestone and dolomite pebbles, 20 percent cobbles, and 10 percent stones; moderately alkaline (pH 8.0).

**TYPE LOCATION:** Teton County, Wyoming; 200 feet east of Middlefork cutoff--Moose Creek trail junction; unsectionized area.

**RANGE IN CHARACTERISTICS:** The mollic epipedon is 7 to 15 inches thick. Depth to uniformly calcareous material is 4 to 15 inches. The mean annual soil temperature is 32 to 36 degrees F. The control section is very cobbly loam, very 2 - Midfork Series

gravelly loam, very channery loam, or very cobbly clay loam and averages 18 to 35 percent clay. Coarse fragments range from 35 to 65 percent.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry, 2 or 3 moist, and chroma of 2 or 3. It is

<http://ortho.ftw.nrcs.usda.gov/cgi-bin/osd/osdname.cgi?-P>

1/16/03

neutral through moderately alkaline.

The C horizon has hue of 10YR or 7.5YR. It is mildly alkaline through strongly alkaline. Calcium carbonate equivalent is 1 to 14 percent.

**COMPETING SERIES:** These are the Antrobus, Broad Canyon, Farlow, Fairydell, Foxmount, Grafen, Greyback, Handran, Kamack, McCort, Maurice, Midelight, Parachute, Sebud, Supervisor, Teemat, Tiban, and Tineman series. Antrobus soils formed in material from basalt and have many dark colored mineral grains in the sand and silt fraction. Broad Canyon, Foxmount, Grafen, Handran, Kamack, McCort, Maurice, Sebud, and Supervisor soils are noncalcareous. Fairydell soils have a horizon of silicate accumulation. Farlow soils have more than 15 percent calcium carbonate equivalent. Greyback soils grade to sandy-skeletal material in the lower part. Midelight soils have a very channery loam control section. Parachute soils have a lithic contact at a depth of 20 to 40 inches. Teemat soils have less than 18 percent clay in the control section. Tiban soils have a C2 horizon with hue of 2.5YR. Tineman soils have a horizon of gravelly sand or loamy sand in the lower part of the control section.

**GEOGRAPHIC SETTING:** Midfork soils are on fans and mountainsides. Slopes are 3 to 70 percent. The soils formed in alluvium weathered from calcareous sedimentary rocks. Elevation is 7,000 to 11,000 feet. The average annual precipitation is about 30 to 60 inches. The mean annual temperature is about 30 to 38 degrees F.

**GEOGRAPHICALLY ASSOCIATED SOILS:** These are the Kitchell, Starman, and Spearhead soils. Kitchell and Spearhead soils are pachic. Kitchell soils also have a calcic horizon. Starman soils are shallow over sandstone and are neutral or slightly acid throughout.

**DRAINAGE AND PERMEABILITY:** Well drained; medium to rapid runoff; moderate permeability.

**USE AND VEGETATION:** These soils are used for recreation and wildlife habitat. Native vegetation is parsley, wild geranium, and wild flax.

**DISTRIBUTION AND EXTENT:** Mountains of western Wyoming. The series is of small extent.

**MLRA OFFICE RESPONSIBLE:** Lakewood, Colorado

**SERIES ESTABLISHED:** Teton County, Wyoming, Grand Teton National Park Area; 1976.

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National Cooperative Soil Survey  
U.S.A.

LOCATION PERMA

MT+CO UT WY

Established Series  
Rev. BDD-DES-JAL  
03/1999

## PERMA SERIES

The Perma series consists of very deep, somewhat excessively drained soils that formed in alluvium, colluvium, and glacial outwash. These soils are on stream terraces, alluvial fans, outwash plains, moraines, hills and mountains. Slopes are 0 to 80 percent. Mean annual precipitation is about 17 inches, and mean annual temperature is about 43 degrees F.

**TAXONOMIC CLASS:** Loamy-skeletal, mixed, superactive, frigid Typic Haplustolls

**TYPICAL PEDON:** Perma gravelly loam, in grassland (colors are for dry soil unless otherwise noted).

**A1--**0 to 6 inches; dark grayish brown (10YR 4/2) gravelly loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; common very fine and fine pores; 20 percent pebbles; neutral (pH 7.0); clear wavy boundary.

**A2--**6 to 12 inches; dark grayish brown (10YR 4/2) gravelly loam, very dark brown (10YR 2/2) moist; weak fine and medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; common very fine and fine pores; 30 percent pebbles; neutral (pH 7.2); clear wavy boundary. (Combined thickness of A horizons is 7 to 15 inches.)

**Bw1--**12 to 22 inches; brown (10YR 5/3) very gravelly loam, dark brown (10YR 4/3) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common very fine and fine roots; common very fine pores; 35 percent pebbles, 15 percent cobbles; neutral (pH 7.2); gradual wavy boundary. (5 to 20 inches thick)

**Bw2--**22 to 36 inches; pale brown (10YR 6/3) very gravelly sandy loam, dark brown (10YR 4/3) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine and fine roots; common very fine pores; 40 percent pebbles, 15 percent cobbles; slightly alkaline (pH 7.4); gradual wavy boundary. (8 to 16 inches thick)

**BC--**36 to 60 inches; very pale brown (10YR 7/3) extremely gravelly loamy sand, grayish brown (10YR 5/2) moist; single grain; loose, nonsticky and nonplastic; few very fine roots; 50 percent pebbles, 20 percent cobbles; slightly alkaline (pH 7.4).

**TYPE LOCATION:** Missoula County, Montana; 1,500 feet east and 300 feet north of the SW corner of sec. 19, T. 14 N., R. 15 W.

### RANGE IN CHARACTERISTICS:

Soil temperature - 38 to 47 degrees F.

Moisture control section - between 8 and 24 inches.

Mollic epipedon thickness - 10 to 15 inches.

Depth to extremely gravelly material - 30 to 38 inches.

Below a depth of 40 inches the rock fragments may have few to many distinct lime casts on their undersides.

A horizons - Value: 4 or 5 dry, 2 or 3 moist

Chroma: 2 or 3

Texture: loam or sandy loam

Clay content: 7 to 27 percent

Rock fragments: 15 to 60 percent--0 to 30 percent cobbles, stones, and boulders; 10 to 50 percent pebbles

Reaction: pH 6.1 to 7.3

Bw horizons - Hue: 2.5Y, 10YR or 7.5YR

Value: 4, 5, or 6 dry; 3, 4, or 5 moist

Chroma: 2, 3, or 4

Texture: loam or sandy loam

Clay content: 7 to 27 percent

Rock fragments: 35 to 85 percent--0 to 50 percent cobbles and stones; 25 to 65 percent pebbles

Reaction: pH 6.1 to 7.8

BC horizon - Hue: 2.5Y, 10YR, 7.5YR or 5YR

Value: 4, 5, 6, or 7 dry; 3, 4, or 5 moist

Chroma: 2, 3, or 4

Texture: loam, loamy sand, coarse sandy loam or sandy loam

Clay content: 0 to 20 percent

Rock fragments: 60 to 85 percent--10 to 50 percent cobbles and stones; 25 to 65 percent pebbles

Calcium carbonate equivalent: 0 to 10 percent

<http://ortho.ftw.nrcs.usda.gov/cgi-bin/osd/osdname.cgi?-P>

Reaction: pH 6.6 to 8.4

**COMPETING SERIES:**

Datino (UT) - calcareous at shallow depths.

Kutler (CO) - has a paralithic contact at 20 to 40 inches.

Labre (MT) - calcareous at shallow depths.

Peso (NM) - bedrock at a depth of 20 to 40 inches.

Renegade (UT) - has a paralithic contact at 40 to 60 inches.

Sandia (NM) - more than 50 percent cobbles and stones in the particle-size control section; chroma of 1 in the mollic epipedon.

Slimbutte (SD) - calcareous at shallow depths.

Subwell (MT) - has a discontinuity of secondary calcium carbonate accumulation; is nonskeletal above the discontinuity.

Towave (UT) - does not have a cambic horizon.

Veatch (CO) - bedrock at a depth of 20 to 40 inches.

Vigilante (MT) - bedrock at a depth of 40 to 60 inches.

Wanagan (ND) - calcareous at shallow depths.

Wimper (MT) - has horizons of secondary calcium carbonate accumulation at depths of 10 to 15 inches; has a calcic horizon.

**GEOGRAPHIC SETTING:**

Landform - stream terraces, alluvial fans, outwash plains, moraines, hills and mountains.

Elevation - 3,500 to 7,800 feet.

Slope- 0 to 80 percent.

Parent material - alluvium; colluvium; glacial outwash.

Climate - long, cold winters; moist springs; warm summers.

Mean annual precipitation - 15 to 22 inches, much of which falls as snow and spring rain.

Mean annual air temperature - 36 to 45 degrees F.

Frost-free period - 70 to 135 days.

**DRAINAGE AND PERMEABILITY:** Somewhat excessively drained; moderate permeability.

**USE AND VEGETATION:** Perma soils are used mainly as rangeland. The potential native vegetation is rough fescue, Idaho fescue, bluebunch wheatgrass, prairie junegrass, and perennial native forbs.

**DISTRIBUTION AND EXTENT:** Perma soils are of moderate extent in western and central Montana.

**MLRA OFFICE RESPONSIBLE:** Bozeman, Montana

**SERIES ESTABLISHED:** Mineral County, Montana, 1970.

**REMARKS:** Soil interpretation records: MT0117, MT0211, MT0148. Diagnostic horizons and features recognized in this pedon are: a mollic epipedon from the soil surface to 12 inches (A1, A2 horizons); a cambic horizon from 12 to 36 inches (Bw1, Bw2 horizons); extremely gravelly material below a depth of 36 inches (BC horizon); a particle-size control section from 10 to 40 inches (A2, Bw1, Bw2, BC horizons). Perma soils have a frigid temperature regime and an ustic moisture regime.

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National Cooperative Soil Survey  
U.S.A.

LOCATION RABBITEX

CO+UT WY

Established Series  
Rev. LWW/GB/JPP  
02/1999

## RABBITEX SERIES

The Rabbitex series consists of deep or very deep or very deep, well drained soils formed in colluvium and residuum weathered from calcareous sedimentary rocks. Rabbitex soils are on mountainsides and ridgetops. Slopes range from 10 to 70 percent. The mean annual precipitation is about 17 inches and the mean annual temperature is about 40 degrees F.

**TAXONOMIC CLASS:** Fine-loamy, mixed, superactive, frigid Aridic Calcicustolls

**TYPICAL PEDON:** Rabbitex flaggy loam - native range. (Colors are for dry soil unless otherwise noted.)

**A--**0 to 12 inches; brown (10YR 5/3) flaggy loam, dark grayish brown (10YR 3/2) moist; moderate medium granular structure; soft, very friable, nonsticky and nonplastic; 5 percent flagstones on the surface, 5 percent fine channers within horizon; strongly effervescent; moderately alkaline; clear wavy boundary. (6 to 14 inches thick)

**Bk1--**12 to 21 inches; pale brown (10YR 6/3) channery loam, brown (10YR 4/3) moist; weak medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic; 15 percent channers; strongly effervescent; moderately alkaline; clear wavy boundary. (0 to 14 inches thick)

**Bk2--**21 to 43 inches; white (10YR 8/2) channery loam, pale brown (10YR 6/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; 20 percent channers; violently effervescent with lime disseminated and as soft masses; strongly alkaline; clear wavy boundary. (12 to 32 inches thick)

**R--**43 inches; fractured calcareous sandstone.

**TYPE LOCATION:** Rio Blanco County, Colorado; about 20 miles south of Rangely and 2 miles northwest of Texas Mountain; 1,540 feet south and 20 feet east of the northwest corner of Sec. 8, T. 3 S., S., R 102 W. U.S.G.S. Texas Creek quad.; Lat. 39 degrees, 48 minutes, 18 seconds N., and Long. 108 degrees, 52 minutes, 32 seconds W.

**RANGE IN CHARACTERISTICS:** Mean annual soil temperature ranges from 43 to 47 degrees F., and mean summer soil temperature ranges from 59 to 62 degrees F. The soils are dry in some part of the moisture control section less than 6/10 of the time in most years between May 10 and October 30. The mollic epipedon is 7 to 14 inches thick. Depth to the top of the calcic horizon is 17 to 43 inches. The particle-size control section has 18 to 35 percent clay. Rock fragments, which are mainly channers, range from 15 to 35 percent. Depth to bedrock ranges from 40 to more than 60 inches, but is generally less than 60 inches.

The A horizon has hue of 2.5Y through 7.5YR, value of 3 through 5 dry, 2 or 3 moist, and chroma of 2 or 3. Rock fragments, consisting chiefly of flat pieces of marlstone and sandstone, constitute 5 to 35

percent of the volume. It commonly has granular structure, but in some pedons it has subangular blocky structure in the lower part.

The Bk horizons have hue of 2.5Y through 7.5YR, value of 5 through 8 dry, 4 through 7 moist, and chroma of 2 through 4. It is loam or sandy clay loam or clay loam, modified with channers, cobbles, or pebbles. It has 18 to 35 percent clay. Reaction is moderately alkaline or strongly alkaline. Calcium carbonate equivalent ranges from 15 to 40 percent.

**COMPETING SERIES:** These are the Beanlake (MT), Buse (MT), Ipano (MT), Kiev (MT) Roundor (MT), and Zahl (ND) series. Beanlake soils are very deep, formed in glacial till, and have horizons with gypsum accumulation. Buse soils are very deep, formed in glacial till of Wisconsin age, and have 2 to 12 percent rock fragments in the A and C horizons. Ipano and Roundor soils have bedrock at a depth of 20 to 40 inches. Kiev soils have less than 15 percent rock fragments in the particle-size control section and lack bedrock within a depth of 70 inches. Zahl soils lack rock fragments in the particle-size control section.

**GEOGRAPHIC SETTING:** Rabbitex soils are on mountainsides and ridgetops. Slopes range from 10 to 70 percent. The soil formed in colluvium and residuum weathered from calcareous sedimentary rocks (marlstone, calcareous shale, siltstone and sandstone). Elevation ranges from 5,800 to 9,000 feet. The mean annual precipitation ranges from 14 to 20 inches, which is about evenly distributed in forms of rain and snow. Mean annual temperature ranges from 36 to 45 degrees F. The frost-free period varies widely from 70 to 110 days. In Utah the frost free-period is as low as 50 days.

**GEOGRAPHICALLY ASSOCIATED SOILS:** These are the Moyerson, Rentsac, and Work soils. Moyerson soils have an ochric epipedon, are shallow, fine-textured, and have montmorillonitic mineralogy. Rentsac soils have an ochric epipedon, have a lithic contact within 20 inches, and are loamy-skeletal. Work soils have an argillic horizon which is fine-textured and of montmorillonitic mineralogy.

**DRAINAGE AND PERMEABILITY:** Well drained; medium runoff; moderate permeability.

**USE AND VEGETATION:** These soils are used for grazing as habitat for wildlife and for watershed purposes. Native vegetation consists of pinyon, serviceberry, spiny phlox, and bluebunch wheatgrass. In Utah this soil is under Gambel oak and ponderosa pine.

**DISTRIBUTION AND EXTENT:** Northwestern Colorado and eastern parts of Utah. The series is of moderate extent.

**MLRA OFFICE RESPONSIBLE:** Lakewood, Colorado

**SERIES ESTABLISHED:** Rio Blanco County, Colorado, 1979.

**REMARKS:** Diagnostic horizons and features recognized in this pedon are: Mollic epipedon - the zone from 0 to 12 inches; Calcic horizon - the zone from 12 to 43 inches; lithic contact - at 43 inches. It has an ustic moisture regime; and a frigid temperature regime. Last updated by the state 4/95.

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National Cooperative Soil Survey  
U.S.A.

LOCATION SENCHERT

UT

Established Series  
REV: EJ/JMD/RLM  
02/1999

## SENCHEART SERIES

The Senchert series consists of moderately deep, well drained, moderately permeable soils that formed in alluvium and colluvium derived dominantly from sandstone and shale. These soils are on mountainsides, ridges and plateaus. Slopes range from 1 to 50 percent. Mean annual temperature is 37 degrees F. and average annual precipitation is 22 inches.

**TAXONOMIC CLASS:** Fine-loamy, mixed, superactive Pachic Argicryolls

0--3 inches to 0; somewhat decomposed leaves and twigs.

**A--**0 to 4 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; soft, very friable; few fine and very fine roots; neutral (pH 7.2); abrupt smooth boundary. (2 to 11 inches thick)

**Bt1--**4 to 9 inches; brown (10YR 4/3) loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few fine medium and coarse roots; few very fine and fine pores; few thin clay films on faces of peds and in pores; neutral (pH 7.2); clear smooth boundary. (4 to 16 inches thick)

**Bt2--**9 to 16 inches; brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; few very fine, fine and medium roots; few very fine and fine pores; common, moderately thick clay films on faces of peds and in pores; mildly alkaline (pH 7.6); clear smooth boundary. (0 to 16 inches thick)

**Bt3--**16 to 35 inches; brown (10YR 5/3) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; hard, firm, sticky and plastic; few very fine, fine and medium roots; few very fine and fine pores; few thin clay films on faces of peds and in pores; mildly alkaline (pH 7.6); abrupt smooth boundary. (0 to 19 inches thick)

**R--**35 inches; calcareous sandstone.

**TYPE LOCATION:** Carbon County, Utah, about 10 miles north and 2 miles west of East Carbon City; about 2,700 feet south and 1,000 feet east of the NW corner of sec. 4., T. 16 S., R. 16 E.

**RANGE IN CHARACTERISTICS:** The mollic epipedon and the solum are 16 to 35 inches thick. Depth to bedrock is 20 to 40 inches. Mean annual soil temperature ranges from 38 to 40 degrees F. The mean summer soil temperature is 44 to 47 degrees F.

The A horizon has value of 3 through 5 dry, 2 or 3 moist and chroma of 2 or 3. Clay content is 10 to 24 percent.

The Bt horizon has value of 4 or 5 dry and chroma of 2 or 3. Texture is loam or clay loam. Rock

<http://ortho.ftw.nrcs.usda.gov/cgi-bin/osd/osdname.cgi?-P>

1/16/03

fragment content is 0 to 15 percent, which is mostly pebbles. Clay content is 18 to 35 percent. Reaction is neutral to mildly alkaline.

The C horizon where present is clay loam or silty clay.

**COMPETING SERIES:** These are Bachus, Benteen, Cambern, Clayburn, Decross, Demast, Dranyon, Echemoor, Gordo, Harmehl, Stubbs, Thulepah, and Winu series. Benteen soils have 20 to 40 percent limestone fragments in the lower profile. Cambern soils contain ash and tuff in the profile. Clayburn, Decross, Demast, Dranyon, Gordo, Thulepah soils lack bedrock within depths of 40 inches. Echemoor and Stubbs soils have paralithic contacts at depths of 20 to 40 inches. Harmehl and Winu soils have 15 to 35 percent rock fragments in the argillic horizon. Bachus soils are medium acid or slightly acid.

**GEOGRAPHIC SETTING:** Senchert soils are on mountainsides, ridges, plateaus and benches. Slopes are 1 to 50 percent. The soils formed in alluvium and colluvium from sandstone, shale, and siltstone. The elevation is 7,200 to 10,100 feet. The mean annual temperature is 36 to 38 degrees F. The average annual precipitation is 20 to 30 inches.

**GEOGRAPHICALLY ASSOCIATED SOILS:** These are Beenon, Toze and Trag soils. Beenon and Trag soils are associated with Senchert at the lower elevation and have mean annual temperature of 38 to 42 degrees F. Beenon soils are shallow and Trag soils are deep. Troze soils lack argillic horizon and have calcic horizon.

**DRAINAGE AND PERMEABILITY:** Well drained; runoff is slow or medium; moderate permeability.

**USE AND VEGETATION:** Rangeland and wildlife habitat. Some areas have been used for woodland. Present vegetation is Douglas-fir, Englemann spruce, white fir, quaking aspen, mountain big sagebrush, snowberry, and Thurber fescue.

**DISTRIBUTION AND EXTENT:** The Senchert soils are moderately extensive. They are in the high mountain areas of Carbon County, Utah.

**MLRA OFFICE RESPONSIBLE:** Lakewood, Colorado

**SERIES ESTABLISHED:** Carbon County, Utah, 1982 The name of this series is coined.

**REMARKS:**

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National Cooperative Soil Survey  
U.S.A.

LOCATION TRAG

CO+NM UT

Established Series  
Rev. DCM, GB, AP  
09/2000

## TRAG SERIES

The Trag series consists of very deep, well drained soils that formed in material weathered from granite and schist. Trag soils are on mountains, slopes and fans. Slopes range from 1 to 40 percent. The mean annual precipitation is about 17 inches and the mean annual temperature is about 45 degrees F.

**TAXONOMIC CLASS:** Fine-loamy, mixed, superactive, frigid Typic Argiustolls

**TYPICAL PEDON:** Trag sandy loam, rangeland. (Colors are for dry soil unless otherwise noted.)

A--0 to 9 inches; dark grayish brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; weak medium subangular blocks parting to moderate fine granular structure; soft, very friable; slightly acid; clear wavy boundary. (4 to 15 inches thick)

BA--9 to 15 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; weak medium prisms parting to moderate medium subangular blocky structure; hard, firm; thin patchy clay films; neutral; clear wavy boundary. (0 to 12 inches thick)

Bt--15 to 35 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) moist; moderate medium prisms parting to moderate medium subangular blocky structure; very hard, firm; thin nearly continuous clay films; neutral; clear smooth boundary. (16 to 34 inches thick)

C--35 to 60 inches; brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; very hard, friable; neutral.

**TYPE LOCATION:** Larimer County, Colorado; 2,350 feet east and 600 feet south of the NW corner of Sec. 10, T. 7 N., R. 71 W.

### RANGE IN CHARACTERISTICS:

Soil moisture: Ustic moisture regime.

Peak precipitation coming during the months of March through June.

Mean annual soil temperature: 45 to 47 degrees F

Mean summer soil temperature: 59 to 60 degrees F

Depth to secondary calcium carbonate: 40 or more inches

Particle-size control section (weighted average):

Clay content: 18 to 35 percent

Sand content: 30 to 65 percent

Rock fragments: 0 to 30 percent by volume

A horizon:

Hues: 7.5YR or 10YR

Value: 3 through 5 dry, 2 or 3 moist

Chroma: 2 or 3

<http://ortho.ftw.nrcs.usda.gov/cgi-bin/osd/osdname.cgi?-P>

1/16/03

Base saturation: 75 to 100 percent  
Reaction: slightly acid to mildly alkaline

BA horizon (if present):

Hues: 7.5YR or 10YR

Value: 3 through 6 dry, 2 through 6 moist

Chroma: 2 through 4

Texture: clay loam, sandy clay loam, sandy loam, loam

Reaction: slightly acid to mildly alkaline

Bt horizon(s):

Hues: 7.5YR or 10YR

Value: 4 through 6 dry, 3 through 5 moist

Chroma: 2 through 6

Texture: clay loam, sandy clay loam, loam, silty clay loam

Clay content: 18 to 35 percent

Reaction: neutral to mildly alkaline

Bridging of clay between sand grains and clay films exist on vertical ped faces and in pores.

C horizon (if present):

Hues: 7.5YR or 10YR

Texture: clay loam, sandy clay loam, loam

Base saturation: 90 to 100 percent

Reaction: neutral to moderately alkaline

**COMPETING SERIES:** Absarook - calcium carbonate above 40 inches depth

Archmesa - moderately deep to bedrock

Bielenberg - deep to bedrock

Burtoner - moderately deep to bedrock

Clancy - moderately deep to bedrock

Clasoil - have hues as yellow as 2.5Y

Dooley - calcium carbonate above 40 inches depth

Doughty - calcium carbonate above 40 inches depth

Empedrado - calcium carbonate above 40 inches depth

Fairfield - calcium carbonate above 40 inches depth

Farnuf - calcium carbonate above 40 inches depth

Farside - lower elevations and more northerly latitudes

Felor - calcium carbonate above 40 inches depth

Greenway - calcium carbonate above 40 inches depth

Gurney - moderately deep to bedrock

Hangdo - formed in eolian material over alluvium

Hoppers - moderately deep to bedrock

Hyalite - lithologic discontinuity in Bt

Jeffcity - moderately deep to bedrock

Kokoruda - forested soil with O horizon

Livona - calcium carbonate above 40 inches depth

Martinsdale - calcium carbonate above 40 inches depth

Maudlin - moderately deep to bedrock

Meagher - calcium carbonate above 40 inches depth

Moen - moderately deep to bedrock

Moento - moderately deep to bedrock  
Pianohill - moderately deep to bedrock  
Placerton - moderately deep to bedrock  
Reeder - moderately deep to bedrock  
Reedwest - moderately deep to bedrock  
Snakejohn - deep to bedrock  
Tragmon - formed sandstone and shale parent material  
Trazuni - redox features in the lower part  
Ulrant - deep to bedrock  
Vida - calcium carbonate above 40 inches depth  
Watne - calcium carbonate above 40 inches depth  
Watrous - moderately deep to bedrock  
Williams - calcium carbonate above 40 inches depth  
Yegen - calcium carbonate above 40 inches depth

**GEOGRAPHIC SETTING:** Trag soils are on mountain slopes and fans. Slopes range from 1 to 40 percent. The soil formed in material weathered from granite and schist that has been locally transported in places. Elevation ranges from 6,800 to 8,900 feet. The soils are in a cool semiarid climate with annual precipitation ranging from 15 to 22 inches. The mean annual temperature is 43 to 46 degrees F. The frost-free season is about 65 to 100 days. In New Mexico, precipitation ranges to 22 inches with air temperatures down to 40 degrees F. and frost-free periods up to 110 days.

**GEOGRAPHICALLY ASSOCIATED SOILS:** These are the Boyle, Bruce, Ratake, and Wetmore soils and the competing Farnuf and Moen soils. Boyle, Ratake and Wetmore soils have bedrock at depths of less than 20 inches. Bruce soils are coarse-loamy.

**DRAINAGE AND PERMEABILITY:** Well drained; medium to rapid runoff; moderate to moderately slow permeability.

**USE AND VEGETATION:** The soils are used for rangeland. Native vegetation is mainly blue grama, big and little bluestem, junegrass, some forbs and shrubs, and widely spaced ponderosa pine.

**DISTRIBUTION AND EXTENT:** Mountainous parts of Northern and central Colorado, eastern Utah, and central New Mexico. The series is of small extent.

**MLRA OFFICE RESPONSIBLE:** Lakewood, Colorado

**SERIES ESTABLISHED:** Larimer County, Colorado, 1975. The name is a coined name.

**REMARKS:** This soil has:

Mollic Epipedon: The zone from 0 to 15 inches

Argillic Horizon: The zone from 15 to 35 inches

Prior to 2/1999 OSD update the classification was a Typic Argiboroll, fine-loamy, mixed. The 2/1999 update reclassified this series to a Pachic Argiustoll, fine-loamy, mixed, superactive, frigid. Historically this series concept was not pachic. Therefore, in this update a one inch reduction in the thickness of the mollic epipedon was incorporated and adjustment to the range in characteristics to maintain the series concept as typic.

Taxonomic Version: Eighth Edition, 1998

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National Cooperative Soil Survey  
U.S.A.

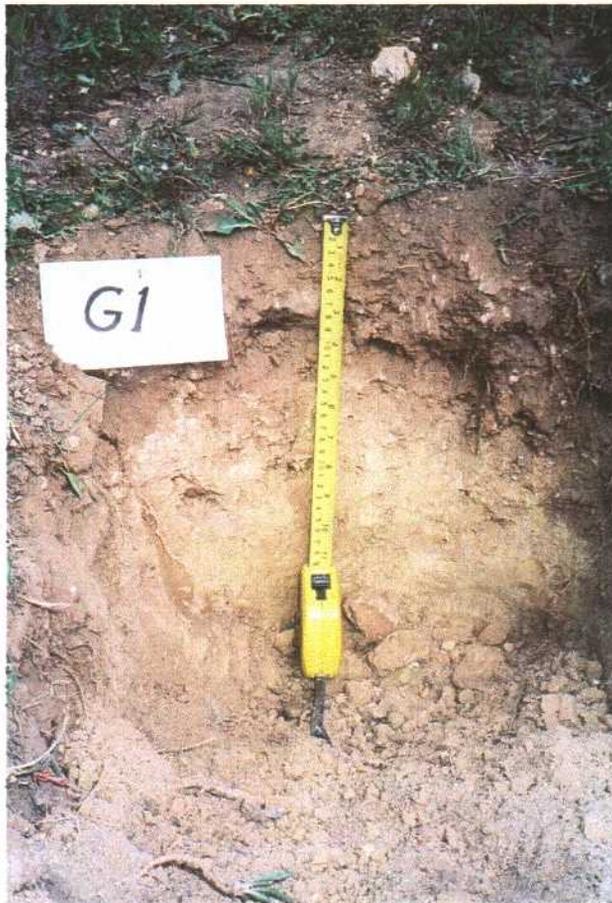
**APPENDIX 6.5 -**

**Site and Soil Profile Photographs**

**Degassification Borehole Sites  
Dugout Canyon Mine**

## Photographs

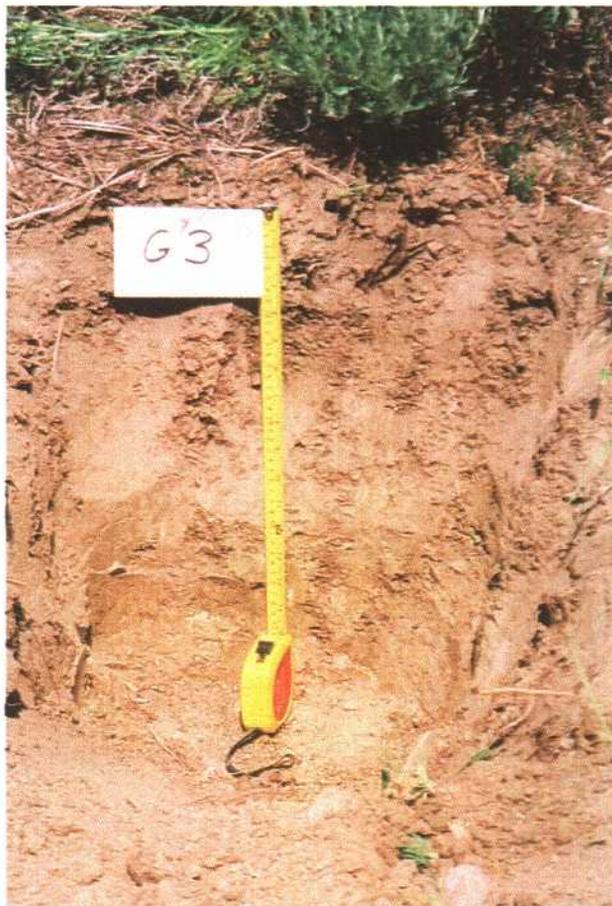
Site and soil at methane degassification borehole site G-1, near center



Site and soil at methane degassification borehole site G-2, near center



Site and soil at methane degassification borehole site G-3, near center



Site and soil at methane degassification borehole site G-4, near center



Site and soil at methane degassification borehole site G-5, near center



Site and soil at methane degassification borehole site G-5, northwest corner



Site and soil at methane degassification borehole site G-6, near center



APPENDIX 6.6 -

Soil Profile Descriptions

Degassification Borehole Sites  
Dugout Canyon Mine







SOIL DESCRIPTION

Soil type *Sanchert*  
*11ka*

Dugout  
File No. *G-4*

Area *Dugout Degas Boreholes above Poca Canyon* *Carbon Co. MT* Date *6/13/03* *D. Larson* Stop No.

Classification *Fine-loamy, mixed, Pachic Argicryoll* or *Palcryoll*

Location *G-4 dips boreholes* *NE 1/4, NW 1/4, S 24, T13S, R13E*

N. veg. (or crop) *Douglas Fir, snowberry, aspen, Oregon grape* Climate *Cryic*

Parent material *Sandstone & shale* *elderberry above*

Physiography *Mountain side slope*

Relief *Mod. steep* Drainage *well drained* Salt or alkali

Elevation *28120* Gr. water Stoniness

Slope *40%* Moisture

Aspect *NW* Root distrib. % Clay \*

Erosion *light* % Coarse fragments \* % Coarser than V.F.S. \*

Permeability *Moderate / moderately slow*

Additional notes *NACS 62 M. Stark Composite complex* *above road*

	GROUND COVER (%)	RANGE	AVERAGE
<i>Sandstone rock fragments</i>			
<i>Boulders to the SE</i>			
Gravel 2MM-3"			1
Cobble 3-10"			
Stone 10-24"			
Boulder >24"			
Vegetation <i>7%</i>			45
Litter			51
Bare			3

*Dress (to 36") Top soil all along*  
*ide's cut*  
*Like map unit 103 - Sanchert*

\* Control section average

Horizon	Depth	Color		Texture	Structure	Consistence			Reac- tion	Bound- ary	% Rock Frag- ments	Root Dist- ribution
		Dry	Moist			Dry	Moist	Wet				
<i>A1</i>	<i>0-12</i>		<i>very dark brown 10YR 2/2</i>	<i>sil-1</i>	<i>mfgr</i>	<i>SH</i>	<i>FA</i>	<i>S/P</i>	<i>6.6</i>	<i>gw</i>	<i>59</i>	<i>mf m</i>
<i>A2</i>	<i>12-30</i>		<i>Very dark grayish brown 10YA 3/2</i>		<i>mfgr</i>		<i>FA</i>	<i>S/P</i>	<i>6.0</i>	<i>ck</i>		<i>CF, m + co</i>
<i>A3</i>	<i>30-38</i>		<i>very dark br. 10YA 2/2</i>				<i>FA</i>	<i>S/P</i>	<i>6.0</i>	<i>ck</i>	<i>10Y 15 co 10Y</i>	<i>CM F.F.</i>
<i>Bt</i>	<i>38-45+</i>		<i>Dark yellowish brown 10YA 4/6 4/4</i>	<i>scl-ck</i>	<i>wpshk</i>		<i>SFi</i>	<i>S/P</i>	<i>7.0</i>			<i>FF</i>

SOIL DESCRIPTION

Dugout

File No. 65c

Soil type *Midfork IIIa*  
*entire looks like arenosollic*

Area <i>Dugout Dezas Beroholes</i>		Date <i>6/10/03</i> <i>D. Larsen</i>	Stop No.
Classification <i>loamy-skeletal Typic Haplocryoll or Argicryoll</i>			
Location <i>G-5 NE 1/4 NW 1/4 NE 1/4 S24 near center of pad site</i>			
N. veg. (or crop) <i>Sagebrush, snowberry, Douglas-Fir</i>			Climate <i>Cryic</i>
Parent material <i>Sandstone and shale</i>			
Physiography <i>Convex ridge top sloping off to the north</i>			
Relief <i>Mod. sloping</i>	Drainage <i>Well drained</i>	Salt or alkali	
Elevation <i>38240 feet</i>	Gr. water	Stoniness <i>None</i>	
Slope <i>6-15%</i>	Moisture	% Clay *	
Aspect <i>North</i>	Root distrib.	% Coarser than V.F.S. *	
Erosion <i>slight</i>	% Coarse fragments *		
Permeability <i>Moderately slow</i>			

Additional notes	GROUND COVER (%)		RANGE	AVERAGE
<i>NACS 103 Sembrt - Taze</i>	Gravel 2MM-3"			<i>10</i>
<i>Soil is like Midfork</i>	Cobble 3-10"			<i>5</i>
<i>more rock fragments than Crydon</i>	Stone 10-24"			<i>1</i>
	Boulder >24"			
	Vegetation			<i>30</i>
	Litter			<i>40</i>
	Bare			<i>24</i>

\* Control section average

Horizon	Depth	Color		Texture	Structure	Consistence			Reaction	Bound-ary	% Rock Frag-ments	Root Dist-ribution
		Dry	Moist			Dry	Moist	Wet				
<i>A</i>	<i>0-9</i>		<i>Very dark grayish brown 10YR 3/2</i>	<i>hsl</i>	<i>MMLR-5BR</i>	<i>SH</i>	<i>FA-F1</i>	<i>S/P</i>	<i>7.2</i>	<i>ea</i>	<i>10ai 15ca 10st</i>	<i>mu-f-m</i>
<i>BC</i>	<i>9-20</i>		<i>Brown-olive green 2.5Y 4/3 - 10YR 4/3</i>	<i>sicL-CL</i>	<i>MMSBK</i>	<i>H</i>	<i>F1</i>	<i>S/P</i>	<i>es</i>	<i>ea</i>	<i>10ai 15ca 15st</i>	<i>cf-m</i>
<i>C</i>	<i>20-32</i>		<i>Light olive brown 2.5Y 5/3</i>	<i>sicL-sic</i>	<i>MMSBK-FA</i>	<i>H</i>	<i>F1</i>	<i>VS/P</i>	<i>7.7</i>	<i>ea</i>	<i>10ai 20ca 25st</i>	<i>ff</i>

SOIL DESCRIPTION

Soil type *Sandert*

File No. *G5NW*

Area *Depout Canyon Mine - Dugas Borohole sites* <sup>Carbunko, UT</sup> Date *6/13/07* <sup>D.L.</sup> Stop No. \_\_\_\_\_

Classification *fine-loamy Pachic Argosol*

Location *G5 Dugas borohole site*

N. veg. (or crop) *Douglas-Pir, snowberry, sagebrush, few aspen* Climate *Cryic*

Parent material *Sandstone and shale, local alluvium, slope wash material*

Physiography *Upper mountain slope, slight curve*

Relief *Mod. Sloping* Drainage *well drained* Salt or alkali \_\_\_\_\_

Elevation *8240 feet* Gr. water \_\_\_\_\_ Stoniness \_\_\_\_\_

Slope *10-15%* Moisture \_\_\_\_\_

Aspect *North* Root distrib. *well distributed* % Clay\* \_\_\_\_\_

Erosion *slight* % Coarse fragments\* \_\_\_\_\_ % Coarser than V.F.S.\* \_\_\_\_\_

Permeability *Moderate*

Additional notes

*Very deep soil on the site*

	GROUND COVER (%)	RANGE	AVERAGE
Gravel 2MM-3"			5
Cobble 3-10"			
Stone 10-24"			
Boulder >24"			
Vegetation			40
Litter			45
Bare			10

\* Control section average

Horizon	Depth	Color		Texture	Structure	Consistence			Reaction	Boundary	% Rock Fragments	Root Distribution
		Dry	Moist			Dry	Moist	Wet				
	0-6		<i>Very dark grayish brown - v. dk br</i> <i>10YR 3/2 - 2/2</i>	<i>SIL</i>	<i>MMGA</i>	<i>SH</i>	<i>FA</i>	<i>SS/SP</i>	<i>26.7</i> <i>eo</i>	<i>gw</i>	<i>25%</i>	<i>mr R-F</i>
	6-20		<i>10YR 3/2</i>	<i>SIL</i>	<i>WMSBK</i>	<i>SH</i>	<i>FA</i>	<i>SS/SP</i>	<i>eo</i>	<i>gw</i>		<i>CF-m</i>
	20-55		<i>10YR 3/2</i>	<i>hSIL</i>	<i>WMSBK</i>	<i>SH</i>	<i>FA</i>	<i>S/P</i>	<i>eo</i>	<i>clw</i>		<i>CF-m</i>
	55-60		<i>Dark brown to dk yellowish br.</i> <i>10YR 3/3 - 4/3</i>	<i>SILL</i>	<i>OM</i>	<i>SH</i>	<i>FI</i>	<i>S/P</i>	<i>eo</i>			<i>PF</i>

SOIL DESCRIPTION

Soil type *Sanchert*

Dugout  
File No. *G6*

Area <i>Dugout Degez Benchley</i>		Date <i>6/13/03 D. Larsen</i>	Stop No.
Classification <i>Fine-foamy mixed, superactive Pachic Argicryoll</i>			
Location <i>G6</i>		<i>NW1/4, NW1/4, S1/4, T13S, R13E</i>	
N. veg. (or crop) <i>Aspen, maple, Oregon grape</i>		Climate <i>Cryc</i>	
Parent material <i>Sandstone + shale</i>			
Physiography <i>Mountain slope</i>			
Relief <i>single MA. Steep</i>	Drainage <i>Well drained</i>		Salt or alkali
Elevation <i>28220 feet</i>	Gr. water		Stoniness
Slope <i>30%</i>	Moisture		
Aspect <i>NE</i>	Root distrib.		% Clay *
Erosion <i>Slight</i>	% Coarse fragments *		% Coarser than V.F.S. *
Permeability <i>Moderate/moderately slow</i>			
Additional notes <i>NASS 113 Sanchert - core from complex</i>			

GROUND COVER (%)		RANGE	AVERAGE
Gravel 2MM-3"			
Cobble 3-10"			
Stone 10-24"			
Boulder >24"			
Vegetation			<i>30</i>
Litter			<i>68</i>
Bare			<i>&lt; 2</i>

\* Control section average

Horizon	Depth	Color		Texture	Structure	Consistence			Reaction	Boundary	% Rock Fragments	Root Distribution
		Dry	Moist			Dry	Moist	Wet				
<i>0</i>	<i>2-0</i>	<i>Leaves, + decomposing organic matter</i>							<i>aw</i>			
<i>A1</i>	<i>0-10</i>		<i>Very dark gray to black</i>	<i>SIL</i>	<i>MMCA</i>	<i>SH</i>	<i>FR</i>	<i>SS/SA</i>	<i>26.6</i>	<i>eo</i>	<i>gw</i>	<i>25% CF, M L up to 2'</i>
<i>A2</i>	<i>10-24</i>		<i>Very dark grayish brown</i>	<i>SIL</i>	<i>MMCA</i>	<i>WFSBK</i>	<i>SH</i>	<i>SP/SP</i>	<i>eo</i>	<i>clw</i>		<i>1'</i>
<i>B1</i>	<i>24-33</i>			<i>hSIL</i>	<i>WFSBK</i>	<i>SH</i>	<i>SR</i>	<i>S/P</i>	<i>eo</i>			<i>5% 10% CF, M</i>
<i>B2</i>	<i>33-36</i>			<i>hSIL-SIL</i>	<i>MMGBK</i>	<i>SH</i>	<i>FR-FI</i>	<i>S/P</i>				<i>5%</i>
		<i>HYT rock at 36"</i>										
		<i>Subsoil is 10YA 4/4. CL on road cut</i>										

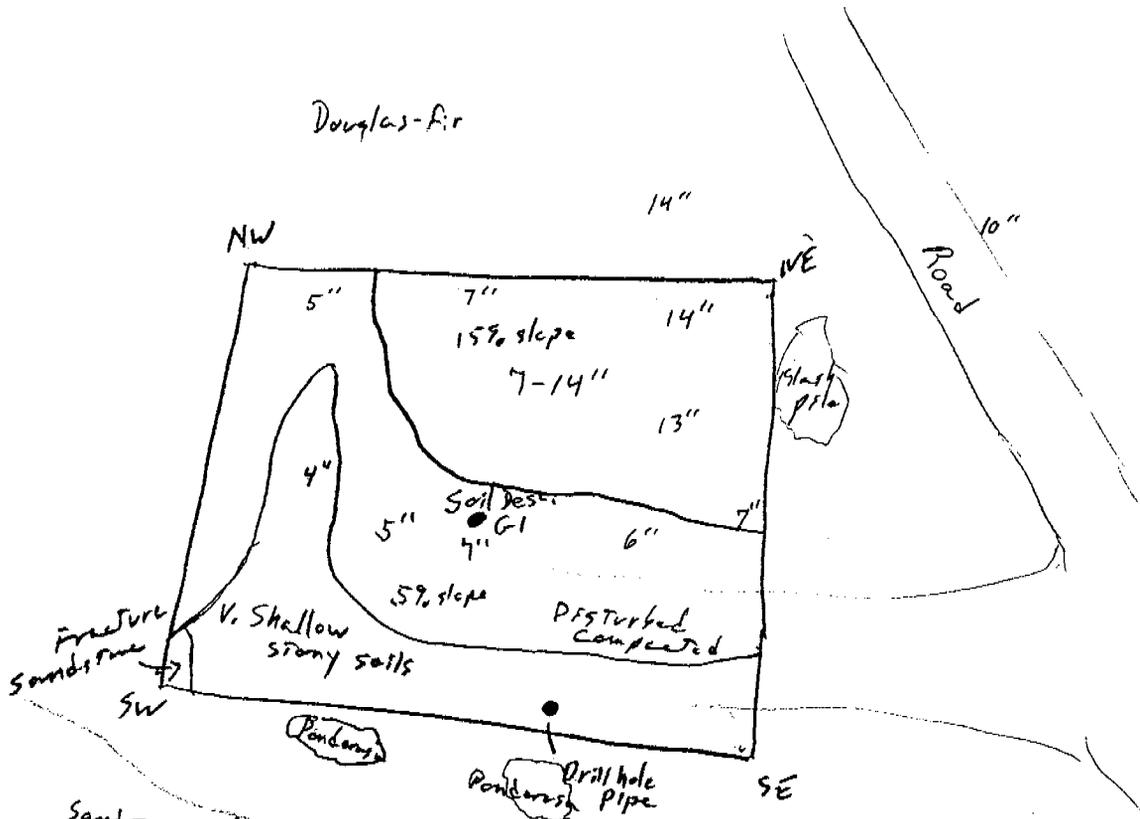
APPENDIX 6.7 -

Site Sketches and Notes

Degassification Borehole Sites  
Dugout Canyon Mine

# Site Sketch G1

" refers to Topsoil thickness



Sandstone rock outcrop

Steep rocky slope

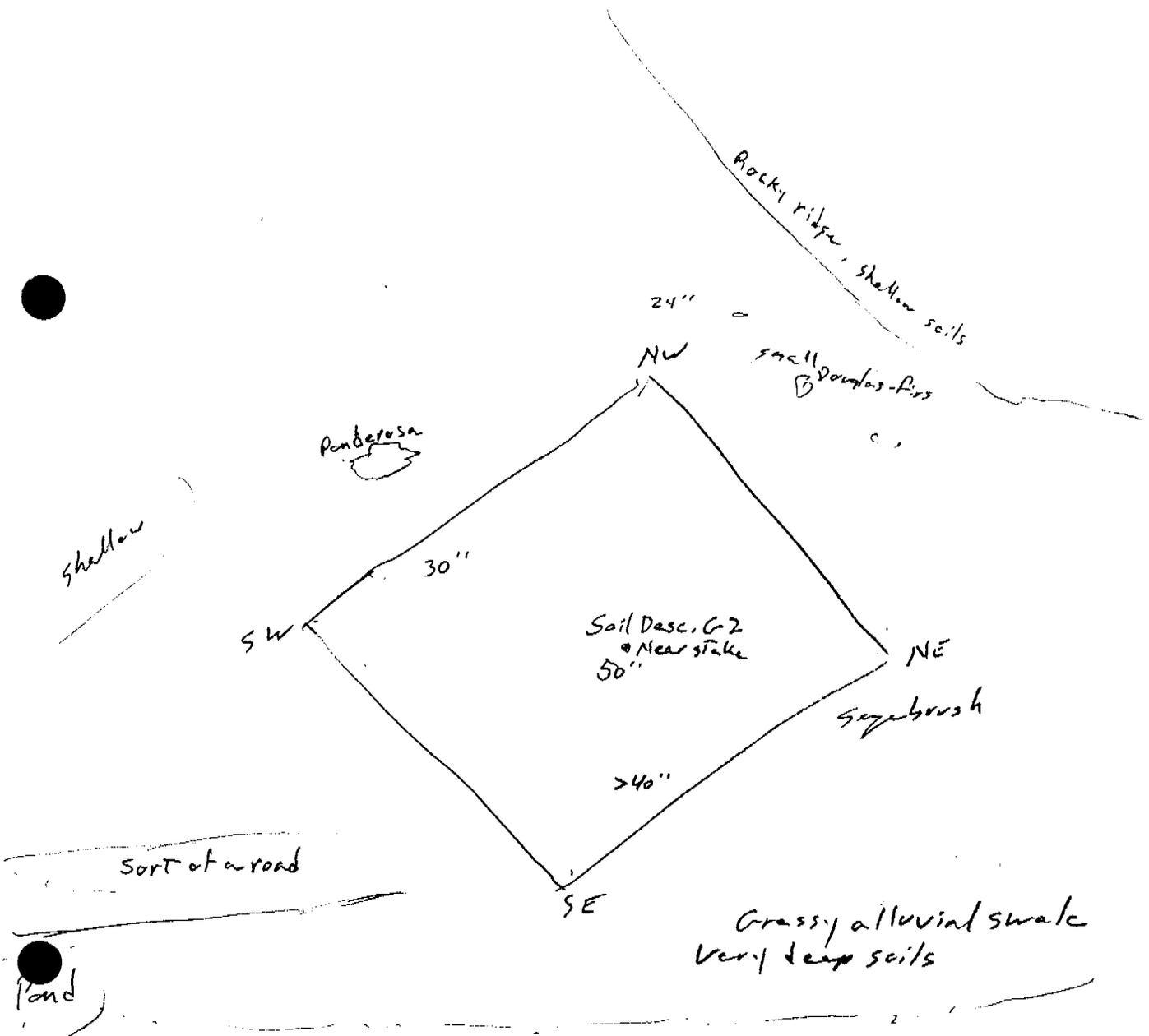
65% slope P-D, serviceberry

@ Desc. G1 hard rock was encountered at 14 inches

# Site Sketch G2

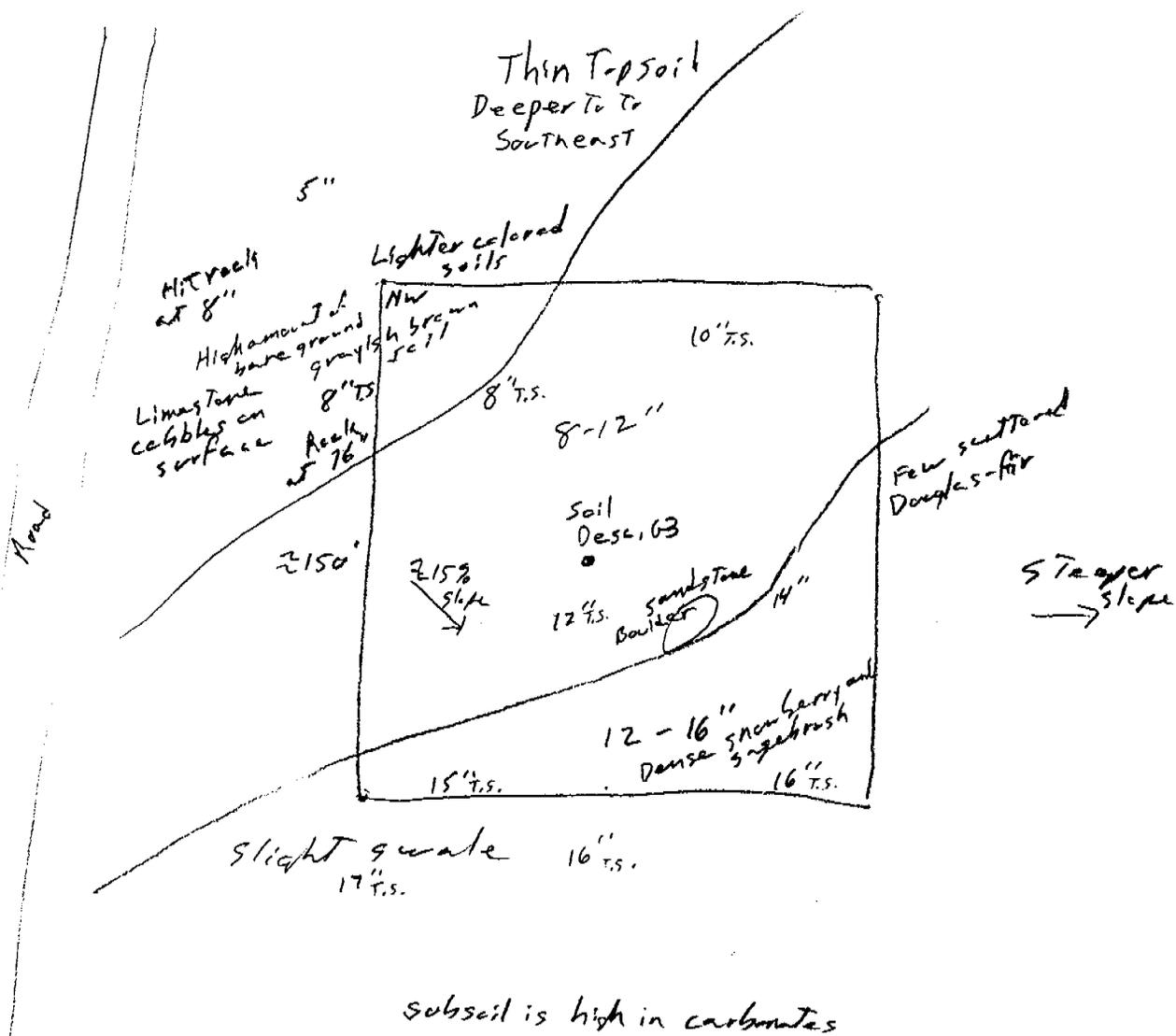
" refers to Topsoil thickness

East of pond at the edge of a swale, slight drainage but not running water.



# Site Sketch G-3

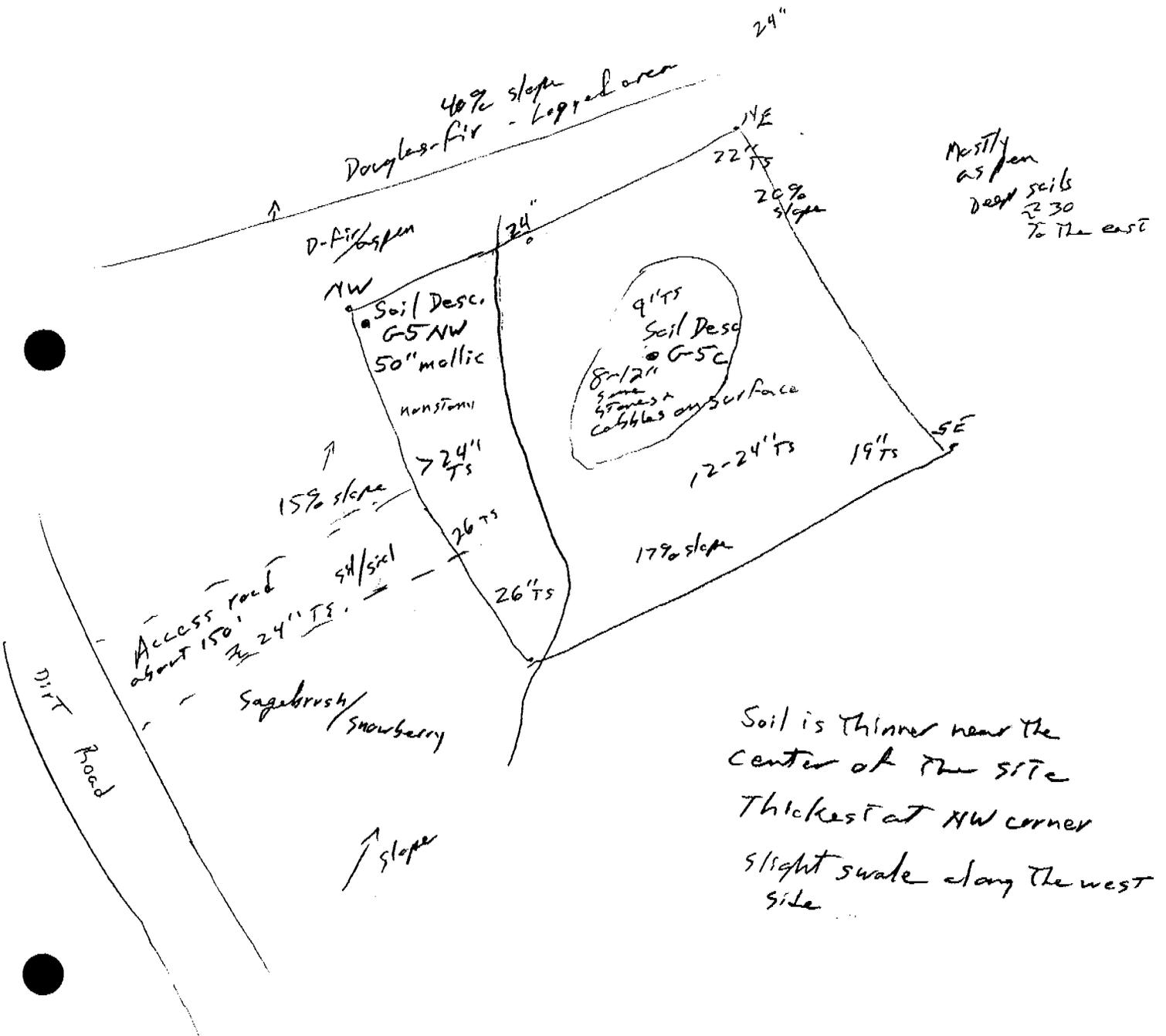
" refers to Topsoil thickness



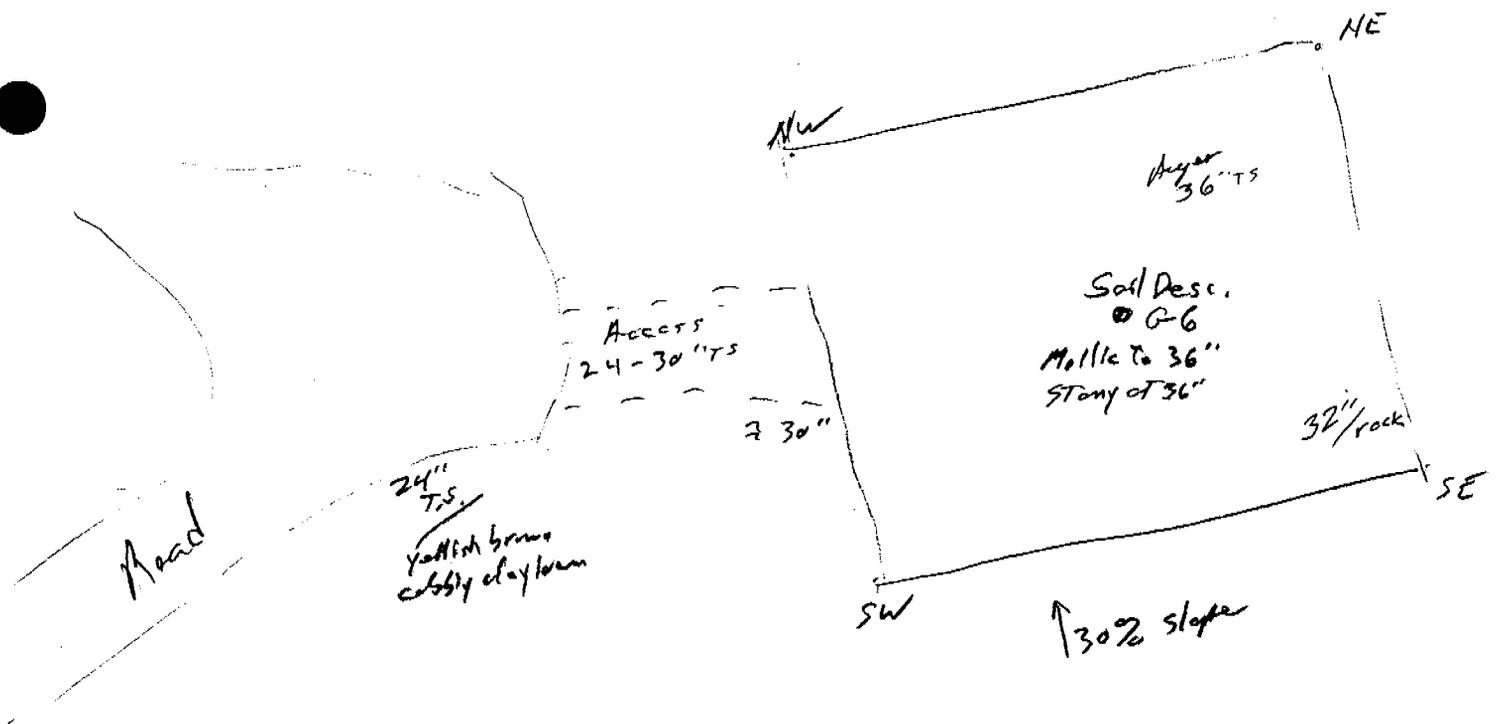
Site Sketch G-4



# Site Sketch G-5



# Site Sketch G-6



Site is fairly uniform  
Aspen/maple/dragon grape, etc  
Soils appear similar over the site

APPENDIX 6.8 -

Scope of Work for Soils Information

Degassification Borehole Sites  
Dugout Canyon Mine



Canyon Fuel Company, LLC

Soldier Canyon Mine

P.O. Box 1029

Wellington, Utah 84542

(435) 637-6360 Fax: (435) ~~637-0108~~

636-2897

May 30, 2003

Dan Larsen  
EIS  
31 North Main Street  
Helper, UT 84526

RE: Studies for six (6) borehole sites and an breakout site for Canyon Fuel Company, LLC,  
Dugout Canyon Mine

Dear Dan,

The plan for the degas borehole sites has been revised and the permitting effort escalated due to mine plan changes. Your original proposal was for fifteen (15) boreholes, we have narrowed the scope of work to six (6) boreholes. We understand that you have other projects on your schedule but would appreciate your assistance in completing the collection and reporting of information as soon as possible. We have included a due date, but would like an opportunity to review your information prior to that date and before you make multiple copies of the information.

Access to the sites will be through a locked gate at the bottom of Pace Canyon and all sites are located on private land (Thayn Trust). When you are ready to go to the sites please let me know and I will either meet you at the gate or at a location more familiar to you and will provide a combination or key for the gate. The access details have not yet been worked out with the landowner.

All sites are in the Pace Canyon area. We will attempt to put all borehole pads on previously disturbed ground (previous disturbance includes logging and drilling). A typical borehole site layout and borehole/breakout location map (approximate) are enclosed. Please contact me if you need assistance in locating either the boreholes or breakout site.

A scope of work is attached to this letter. Please review the scope of work and provide us with a cost to complete the work. We need this information to prepare our internal service authorization to allow payment of your invoice. Please e-mail the cost information to me as soon as possible.

Please make any suggestions or notify us of any potential omissions to the scope of work. Do not hesitate to call or e-mail with any questions.

Sincerely your,

Vicky Miller

**Scope of Work  
SOILS**

**Six (6) Methane Degassification Borehole Sites and Mine Breakout**

Location: Township 13 South, Range 12 East, Section 24  
Township 13 South, Range 13 East, Sections 19 and 30

All areas are accessible by dirt road. The area for the borehole and breakout sites will be staked. All studies should extend 50 feet outside the perimeter of the staked area, to allow for movement of the sites, should it become necessary. Borehole pads will be approximately 200 feet by 300 feet. The breakout site is approximately two acres.

Task	Cost to Perform Study
Soil sampling will not be needed at this time. All reported information will include names and qualifications of the personnel performing the study/work.	
Inventory of existing soils, including soil classifications and descriptions at a minimum per USDA, Soil Survey of Carbon County. Field Work will include: Survey of six (6) borehole sites G-1, 2, 4 & 5 - located in the North ½ of Section 24, T13SR12E G-3 & 6 - located in the West ½ of the Northwest Quarter of Section 19, T13SR13E Breakout site is located in the North ½ Northwest Quarter, Section 30, T13SR13E	
Report to include at minimum, date, personnel and qualifications, brief description of site, level of study, soil map units No., soil components, soil assessment, soil field notes and other information necessary to satisfy UDOGM regulations.. Anticipated topsoil salvage depths and volumes. Drawing showing approximate location of topsoil with estimated salvage depths (hand sketch acceptable).	
Six copies of the report will be provided, including a disk/CD copy of the information by July 15, 2003. One copy to be bound, remaining five (5) unbound.	
Total	

# EIS ENVIRONMENTAL & ENGINEERING CONSULTING STAFF



**Daniel M. Larsen**  
**Soil Scientist/ Soil Management Specialist**

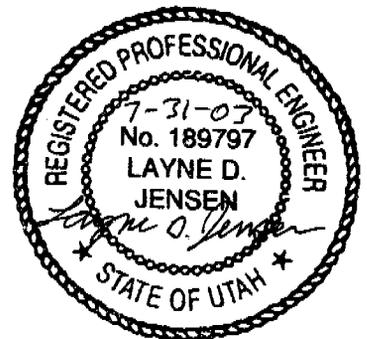
Mr. Larsen (B.S. Conservation of Natural Resources, Wisconsin State University; & M.S. Soil Science, University of Minnesota) has been a professional soil scientist for over 30 years. Dan served as a teaching and research assistant, with emphasis on soil fertility evaluation. After graduation he was a Soil Scientist with the USDA, Forest Service until 1997. Assignments included the Tongass National Forest in Alaska; Superior National Forest in Minnesota; Wayne-Hoosier National Forest in Indiana and Ohio; and the Manti-La Sal National Forest in Utah and Colorado. Dan served as a soils and reclamation specialist on an inter-agency environmental task force on coal in Salt Lake City, Utah which developed the EIS for proposed mining in Central and Southern Utah. Other work includes Forest Service projects and cooperative soil surveys with the Natural Resources Conservation Service. He authored the Soil Resource Inventory of the Deschutes National Forest, Oregon, a soil inventory of 1.8 million acres, and participated in the field work for the preparation of the Soil Survey of Canyonlands Area, Utah, Soil Survey of the Fairfield-Nephi Area, Utah, and the Soil Survey of the San Miguel Area, Colorado manuals.

Dan's experience has covered a wide array of activities related to soil management and soil survey. He has served as an interdisciplinary team member on numerous projects to develop project plans and conduct environmental analyses. Activities included assessment of timber harvest and reforestation, watershed evaluation and improvement, range management, wildlife habitat improvement, minerals exploration and development, mine reclamation, recreation use, land management planning, and ecosystems classification. His interests lie in total resource management, with an emphasis on soil and associated environmental factors in perspective to understand environmental relationships and identify capabilities, limitations, and management options of the land.

Canyon Fuel Company, LLC  
Dugout Canyon Mine

Methane Degassification Amendment  
August 2003

**ATTACHMENT 2-2**  
**TOPSOIL CALCULATIONS**



Topsoil Calculations

General

- Out slopes of topsoil stockpiles assumed to be at 1:1 (45°)
- Cut slopes at a 0.8:1 slope
- The berm above the pad to divert runoff is assumed to be 5' wide at the base with 1:1 sideslopes and a height of 2.5'. Cross-sectional area = 6.25 ft<sup>2</sup>
- Calculations made using average topsoil depth provided by Don Larsen of EIS. Topsoil volume estimates are likely conservative.

G-1

Ave topsoil Depth = 7"

Pad Area = 17,825 ft<sup>2</sup> ⇒ 10,398 ft<sup>3</sup> of topsoil

Road Area = 1374 ft<sup>2</sup> ⇒ 802 ft<sup>3</sup> of topsoil

Total stripped topsoil = 11,200 ft<sup>3</sup>

Topsoil in berms = (495' X 6.25 ft<sup>2</sup>) = 3,094 ft<sup>3</sup>

Using Average end Area to calculate volumes and AutoCAD to obtain the volumes.

0	0 ft <sup>2</sup>	>	57 ft <sup>2</sup>
2	57 ft <sup>2</sup>	>	597 ft <sup>2</sup>
4	540 ft <sup>2</sup>	>	1864 ft <sup>2</sup>
6	1324	>	6069 ft <sup>2</sup>
13	410	>	8587 ft <sup>2</sup>

Total storage capacity = 11,681 ft<sup>3</sup> > 11,200 ft<sup>3</sup> ∴ OK

Operational

Pad Area = 5218 ft<sup>2</sup> ⇒ 3043 ft<sup>3</sup>  
Road Area = 1374 ft<sup>2</sup> ⇒ 802 ft<sup>3</sup> > 3845 ft<sup>3</sup>

Assume topsoil for reclamation removed from the top of the stockpile leaving the foot print the same

With a height of 7.5' the topsoil stockpile has a vol of 4,305 ft<sup>3</sup>

4,305 > 3845 ft<sup>3</sup> ∴ OK

G-2

Ave Depth = 30"

Pad Area = 23,445 ft<sup>2</sup> ⇒ 58,612 ft<sup>3</sup> = 2170 yd<sup>3</sup>

Road Area = 10,074 ft<sup>2</sup> ⇒ 25,185 ft<sup>3</sup> = 933 yd<sup>3</sup>

Total topsoil = 83,797 ft<sup>3</sup> = 3104 yd<sup>3</sup>

Topsoil in berm = 575 × 6.25 = 3594 ft<sup>3</sup>

topsoil pushed Northwest of the pad.

make simplifying assumption that stockpile is built as if the ground was flat. The slope is such that the stockpile can be built as if the site is flat.

Bottom	50 × 156	=	7800	>	34,100 ft <sup>3</sup>
5	40 × 146	=	5840	>	24,800 ft <sup>3</sup>
10	30 × 136	=	4080	>	16,500 ft <sup>3</sup>
15	20 × 126	=	2520	>	6,300 ft <sup>3</sup>
18	14 × 120	=	1680	>	<u>81,700 ft<sup>3</sup></u>

Operational

Pad Area = 4083 ft<sup>2</sup> ⇒ 10,208 ft<sup>3</sup>

Total topsoil = 10,208 + 25,185 ft<sup>3</sup> = 35,393 ft<sup>3</sup>

A portion of the topsoil stockpile from the Drill phase will be left in place for use during final reclamation.

Bottom	50 × 75	=	3750	>	38,664 ft <sup>3</sup> ok
18	14 × 39	=	546		



**CHAPTER 3**  
**BIOLOGY**

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### **310 INTRODUCTION**

This chapter presents a description of the biological resources found on the Dugout Canyon degas well site areas.

#### **311 Vegetative, Fish and Wildlife Resources**

Vegetative, fish, and wildlife resource conditions in and adjacent to the proposed degassification wells are discussed in Section 320 of this submittal and the approved M&RP.

#### **312 Potential Impacts to Vegetative, Fish, and Wildlife Resources**

Potential impacts to vegetative, fish, and wildlife resources and the associated mitigation plan is presented in Sections 330 and 340 of this chapter.

#### **313 Description of Reclamation Plan**

The reclamation plan used to restore the vegetative, fish, and wildlife resources to a condition suitable for the post mining land use is presented in Section 340.

### **320 ENVIRONMENTAL DESCRIPTION**

#### **321 Vegetation Information**

This section and the approved M&RP contain the environmental descriptions of the vegetation for the permit and adjacent areas.

### **321.100 Plant Communities Within the Proposed Permit Area**

During June 2003, the degassification well sites were surveyed by Patrick Collins, Mt. Nebo Scientific). The report and survey for the areas are included in Attachment 3-1.

### **321.200 Land Productivity Prior to Mining**

Productivity of the well site lands prior to mining are shown in Table 3-1. The productivity is based on data for similar sites from the U.S. Department of Agriculture.

**TABLE 3-1**  
**Land Productivity**

<b>Well No.</b>	<b>Productivity (lbs.)</b>
G-1	300
G-2	300
G-3	100

### **322 Fish and Wildlife Information**

A summary of the fish and wildlife resource information for the permit and adjacent areas is contained in Sections 322.100 through 322.200 of the approved M&RP.

#### **322.100 Level of Detail**

The scope and level of detail within the approved M&RP are sufficient to design the protection and enhancement plan for wildlife and fish in the area.

### **322.200 Site-Specific Resource Information**

**Raptors** - An aerial raptor nest survey was done of the area by the Utah Division of Wildlife Resource (DWR, Chris Colt, Leroy Mead) and CFC personnel in May of 2003, refer to Attachment 3-3.

No raptor nests were recorded during the survey in the area (portions of N1/2SE1/4NW1/4 and N1/2SW1/4NE1/4 of Section 24; a portions of N1/2SW1/4NW1/4 Section 19, Township 13 South, Range 13 East) of the degas wells. Refer to Figure 1-1 for mapped well locations.

A raptor survey will be conducted of the well site areas, each year that the wells are in operation.

**Bats** - No known open mine shafts, caves, adits or other man made structures that might provide habitats for bats are known to exist in the degas project area. The sites are open, with limited trees and the lack of a food source would force the bats to seek habitat and nourishment elsewhere.

**Mexican Spotted Owl** - In the Summer of 2003, a calling point survey was conducted in the degas well area by EIS Environmental and Engineering Consulting. The survey report concluded that "within the project area, a thorough search did not reveal the presence of any Mexican spotted owls". The report is included in Attachment 3-2.

**Threatened and Endangered Plant and Wildlife Species** - There are no known federally or state listed threatened and endangered plant and wildlife species within the sites planned for degassification wells.

**Federal and State Listed, Threatened, Endangered and Candidate Species  
Plants and Wildlife  
Carbon County, Utah  
October 2002**

Common Name	Scientific Name	Status	Habitat Present*
<b>Plants</b>			
Uinta Basin Hookless Cactus	<i>Sclerocactus glaucus</i>	T	No habitat available
Graham Beardtongue	<i>Penstemon grahamii</i>	C	No habitat available
<b>Fish</b>			
Humpback Chub	<i>Gila cypha</i>	E	No habitat available
Roundtail Chub**	<i>Gila robusta</i>	T	No habitat available
Bonytail	<i>Gila elegans</i>	E	No habitat available
Colorado Pikeminnow	<i>Ptychocheilus lucius</i>	E	No habitat available
Razorback Sucker	<i>Xyrauchen texanus</i>	E	No habitat available
<b>Birds</b>			
Bald Eagle	<i>Haliaeetus leucocephalus</i>	T	No habitat available, See Attachment 3-3
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>	C	No habitat available
Peregrine Falcon**	<i>Falco Peregrinus</i>	D	See definition of 'D' below
Ferruginous Hawk**	<i>Buteo Regalis</i>	T	No habitat available
Southwestern Willow Flycatcher**	<i>Empidonax traillii extimus</i>	E	No habitat available
Mexican Spotted Owl	<i>Strix occidentalis lucida</i>	T	See Attachment 3-2
<b>Mammals</b>			
Black-footed Ferret	<i>Mustela nigripes</i>	EX	No habitat available

\* Habitat availability in Carbon County/Dugout Mine/Degas Well Sites.

\*\* Utah State Listed Species - Information verified with Bill Bates, DWR (personal communication 7/17/03)

E = A taxon that is listed by the U.S. Fish and Wildlife Service as "endangered" with the possibility of worldwide extinction.

T = A taxon that is listed by the U.S. Fish and Wildlife Service as "threatened" with becoming endangered.

C = A taxon for which the U.S. Fish and Wildlife Service has on file sufficient information on biological vulnerability and threats to justify it being a "candidate" for listing as and endangered or threatened.

D = In the process of being delisted, process began in 2000.

Source: Utah Division of Wildlife Resources data base - created 10/24/02

### **322.300 Fish and Wildlife Service Review**

If requested, Dugout Canyon authorizes the release of information pertaining to Section 322 and 333 to the U. S. Fish and Wildlife Service Regional and Field Office for their review.

### **323 Maps and Aerial Photographs**

Location of the well sites can be seen in Figure 1-1 of this submittal.

### **323.100 Location and Boundary of Proposed Reference Area**

Reference areas for the degassification wells were established during the vegetative study conducted in the Summer of 2003. Well sites G-2 and G-3 will be compared to the Sagebrush/Snowberry/Grass reference area and G-1 to the Aspen/Maple/Douglas Fir reference area. Refer to Attachment 3-1 for the location of the reference areas.

### **323.200 Elevation and Locations of Monitoring Stations**

Refer to Section 323.200 of the approved M&RP.

### **323.300 Facilities for Protection and Enhancement**

Section 333.300 and 358.500 of the approved M&RP contain additional discussion pertaining to protective measures to be taken by Dugout Canyon on behalf of wildlife.

### **323.400 Vegetation Type and Plant Communities**

Vegetative types and plant communities are outlined in the vegetative report in Attachment 3-1. Plate 3-1 in the approved M&RP gives details of the vegetation types located adjacent to the well sites.

## **330 OPERATION PLAN**

### **331 Measures Taken to Disturb the Smallest Particle Area**

The well sites will be sized to disturb the smallest acreage possible and still meet the requirements for the drilling equipment. The drainage control required will be built to satisfy the environmental requirements.

### **332 Description of Anticipated Impacts of Subsidence**

Refer to Section 525.

### **333 Plan to Minimize Disturbances and Adverse Impacts**

General control and mitigation measures addressing potential related biological impacts will include the following:

- Minimizing the total area of disturbance,
- Design, construction, and operation of the well sites to minimize biological impacts including barriers to wildlife movement,
- Exclusion of wildlife from potentially hazardous areas, and
- Reclamation of disturbed areas when they are no longer needed.

All water associated with the drilling of these wells will be appropriated and hauled to the sites by a licensed contractor. Since the drilling of degas wells does not involve the mining of coal, the USWFS consumption requirements for underground operations do not apply (i.e., evaporation from ventilation, coal preparation, sediment pond evaporation, subsidence of springs, alluvial aquifer abstractions into the mine, postmining inflow to workings, coal moisture loss, direct diversions).

#### **333.100 Minimize Disturbance to Endangered or Threatened Species**

Dugout Canyon will apply all methods necessary to minimize disturbances or any adverse effects to threatened or endangered species. See Section 322.200.

#### **333.200 Species and Habitats**

All species and habitats within the permit area will be protected to the best of Dugout Canyon's ability.

### **333.300 Protective Measures**

Refer to Section 333.300 of the approved M&RP.

## **340 RECLAMATION PLAN**

### **341 Revegetation**

Revegetation of the sites will occur in two phases. The first phase is to redistribute topsoil and seed the well area not needed for access and operation of the gas exhaust blower. The second phase will consist of plugging the well and distributing the remaining topsoil and seeding on the remaining pad area. Refer to Section 242.100 for additional detail.

The short-term goal of this revegetation plan is the immediate stabilization of the disturbed sites through erosion control. This objective will be achieved through controlled grading practices, proper seedbed preparation to encourage rapid plant establishment, inclusion of rapidly establishing species in the seed mixture to be planted, and mulch application.

The long-term goals are to establish useful, and productive range. These goals will be attained through the selection and placement of desirable and productive plant species and a commitment to monitor and maintain revegetated areas throughout the bond liability period.

The well sites will be fenced to discourage wildlife and livestock from grazing the reclaimed areas until bond release.

### **341.100 Schedule and Timetable**

The reclamation timetable is shown in Figure 5-15 of this submittal and the reclamation monitoring schedule is found in Chapter 3, Table 3-3 of the approved M&RP.

### **341.200 Descriptions**

**Species and Amounts of Seed** - The well sites will be planted with the seed mix listed on Table 3-2. The seed mix will be used in both contemporaneous and final reclamation phases. The seed will be incorporated with mulch and applied by hydroseeding. Refer to Section 234.200 for topsoil stockpile seeding description.

**Methods Used for Planting and Seeding** - The degassification sites will be graded to final contour, then ripped to relieve compaction. The depth of ripping will be from 18 to 24 inches. Following ripping, topsoil will be applied to the ripped surface and left in a roughened state.

**Mulching Techniques** - Organic mulch will be applied at the rate of 2,000 pounds per acre and anchored with a tackifier

**Irrigation, Pest, and Disease Control** - No irrigation is planned and pesticides will not be used unless previously approved by the Division.

**Measures Proposed for Revegetation Success** - Refer to Section 356.

### **341.300 Greenhouse Studies, Field Trials or Other Equivalent Studies**

Refer to the Section 341.300 of the approved M&RP.

### **342 Fish and Wildlife**

Prior to collecting and stockpiling topsoil, large rocks and large woody vegetation (limited) will be removed and piled on disturbed area perimeter. The rocks and woody vegetation will be used as habitat enhancement following revegetation of the sites.

### **342.100 Enhancement Measures**

No enhancements are planned other than those described in the this section.

### **342.200 Plants Used for Wildlife Habitat**

**Nutritional Value** - The nutritional value will be consistent with that of vegetation in the surrounding areas.

**Cover** - Cover will be comparable to the cover on the associated reference area.

### **342.300 Cropland**

Cropland is not a postming land use.

### **342.400 Residential, Public Service, and Industrial Land Use**

No residential, industrial or public service use is planned.

## **350 PERFORMANCE STANDARDS**

### **351 General Requirements**

Dugout Canyon commits to conduct all operations in accordance with the plans submitted in Sections R645-301-330 through R645-301-340 of the permit application.

### **352 Contemporaneous Reclamation**

Reclamation activities prior to final reclamation will to the extent feasible, be performed contemporaneously. Contemporaneous reclamation will be performed at the well sites following construction of the wells. Refer to Section 341 for additional details.

### **353 Revegetation: General Requirements**

A vegetative cover will be established on all reclaimed areas to allow for the designated postmining land use of grazing. Refer to Section 411 for additional information.

#### **353.100 Vegetative Cover**

The seed mix proposed for revegetation is intended to provide vegetative cover that will be diverse, effective, and permanent. The seed mixture was selected with respect to the climate, potential seedbed quality, erosion control, drought tolerance, and the mixture's ability for quick establishment and spreading.

**Native Species** - The reclamation vegetation mixture will be comprised of species indigenous to the area and capable of achieving the postmining land use. Diversity of species should allow utilization of plants by wildlife and domestic livestock. The recommended seed mix is comprised of native species.

**Extent of Cover** - The vegetative cover will be at least equal in extent to the cover at the designated reference areas.

**Stabilizing** - The vegetative cover mixture is capable of stabilizing the soil surfaces from erosion.

**Table 3-2**  
**Reclamation Seed Mix**

<u>SPECIES</u>	<u># pls/acre</u>	<u># pls/sq. ft.**</u>
<b>Grasses, Forbs, and Shrubs</b>		
Sheep Fescue (530,000 seeds/lb)*	2.0	24
Mountain Brome (64,000 seeds/lb)*	2.0	3
Sandberg Bluegrass (1,100,000 seeds/lb)*	1.0	25
Western Wheatgrass (114,000 seeds/lb)*	3.0	8
Rocky Mountain Penstemon (478,000 seeds/lb)*	1.0	11
Mountain Lupine (12,000 seeds/lb)*	3.0	1
Mtn. Snowberry (54,000 seeds/lb)*	4.0	5
Wyoming Big Sage (2,500,000 seeds/lb)*	<u>0.5</u>	<u>29</u>
<b>TOTAL</b>	<b>16.5</b>	<b>106</b>

\* Native Plants

\*\* Rounded nearest whole seed

### **353.200 Reestablished Plant Species**

**Compatible** - The reestablished plant species have been selected to insure their compatibility with the approved postmining use.

**Seasonal Characteristics** - The revegetation plant species will have the same growing season as the adjacent areas.

**Self-Generation** - The reestablished plants are species capable of self-generation and plant succession.

**Compatibility** - The seed mix suggested for revegetation contains plants native to the area and compatible with the plant and animal species of the permit area.

**Federal and Utah Laws or Regulations** - The seed mix purchased to revegetate the degassification well sites will contain no poisonous or noxious plant (see Section 234.200). No species will be introduced in the area without being approved by the Division.

### **353.300 Vegetative Exception**

Dugout Canyon does not require vegetative exception at this time.

### **353.400 Cropland**

The permit area contains no land designated as cropland.

### **354 Revegetative: Timing**

Dugout Canyon will follow the recommended guidelines for revegetation and planting during the first normal period for favorable planting conditions after replacement of the topsoil. In Utah the planting period is usually Fall due to the precipitation events.

### **355 Revegetation: Mulching and Other Soil Stabilizing Practices**

Mulch and/or other soil stabilizing practices (roughing, etc.) will be used on all areas that have been regraded and covered by topsoil (Section 341.200). Dugout Canyon Mine will exercise care to guard against erosion during and after application of topsoil.

### **356 Revegetation: Standards for Success**

#### **356.100 Success of Revegetation**

The success of revegetation will be judged on the effectiveness of the vegetation for postmining land use, the extent of cover on each degassification well site compared to their respective reference areas.

**Sampling Techniques** - Dugout Canyon will comply with the standards for success, statistically valid sampling techniques for measuring success, and the approved methods outline in the Division's "Vegetation Information Guidelines, Appendix A" for sampling.

The sampling methods to be used during reclamation will be specific to the requirements at the time of reclamation. Nonetheless, according to the currently approved UDOGM guidelines, these sampling methods would be used: sample adequacy, cover (line interception), density (belt transects or plots) and productivity (clipping and/or NRCS estimation). The Jaccard's Community Coefficient will be used to calculate acceptable plant similarity and diversity.

**Standards for Success** - The standards for success will include criteria representative of undisturbed lands in the area of the degas wells as means to evaluate ground cover, production and stocking of the reclaimed site.

#### **356.200 Standards for Success**

Standards of success will be applied in accordance with the approved postmining land use as described in this section.

**Grazing Land and Pasture Land** - The ground cover and production of living plants on the revegetated area will be at least equal to the reference area.

**Cropland** - There is no area designated as cropland within the degassification well sites.

**Fish and Wildlife Habitat** - The postmining land use for the degas well sites will be grazing.

**Industrial, Commercial or Residential** - The postmining land use for the permit area is not designated for industrial, commercial, or residential use.

**Previously Disturbed Areas** - Site G-1 has been previously disturbed. Sites G-2 and G-3 have not been previously disturbed. Standards of success for all sites will be applied in accordance with the postmining land use of grazing as described in this section.

#### **356.300 Siltation Structures**

Siltation structures will be maintained until the disturbed areas have been stabilized and revegetated. For additional details on siltation structures, see Sections 542 and 763 of this amendment.

#### **356.400 Removal of Siltation Structures**

The land on which siltation structures are located will be revegetated in accordance with the reclamation plan discussed in Section 353 and 357. Refer to Section 763 for additional information pertaining to the removal of siltation structures.

#### **357 Revegetation: Extended Responsibility Period**

Dugout Canyon will be responsible for the success of revegetation for a period of 10 years following seeding of the reclaimed area or upon Division bond release.

### **357.100 Extended Period Begins**

The period of extended responsibility will begin after disturbed areas have been reseeded.

### **357.200 Vegetation Parameters**

Vegetation parameters will equal or exceed the approved success standard during the last 2 years of the responsibility period. The success standards are outline in Section 356 of this application.

### **357.300 Husbandry Practices**

The use of husbandry practices are not being requested by Dugout Canyon for the degas well sites.

## **358 Protection of Fish, Wildlife, and Related Environmental Values**

Dugout Canyon will minimize disturbances and adverse impacts on wildlife and their related environments as outline in Section 333 of the approved M&RP and Section 342 of this submittal. See Chapter 7, Section 731.100 of the approved M&RP for methods to protect water sources in the area.

### **358.100 Existence of Endangered or Threatened Species**

The well sites will not be constructed or operated where they might jeopardize the existence of any endangered or threatened species. Refer to Section 322.200 and Attachments 3-1, 3-2 and 3-3 for additional information pertaining to threatened, endangered, and sensitive species.

State or federally listed endangered or threatened species will be reported to the Division upon its discovery.

### **358.200 Bald and Golden Eagles**

Dugout Canyon understands that there is no permission implied by these regulations for taking of bald or golden eagles, their nests, or eggs. If found, nests will be reported to the Division.

### **358.300 Taking of Endangered or Threatened Species**

Dugout Canyon understands that there is no permission implied by these regulations for taking of endangered or threatened species, their nests, or eggs.

### **358.400 Replacement of Wetland or Riparian Vegetation**

The sites contain no wetland or riparian vegetation.

### **358.500 Manmade Wildlife Protection Measure**

**Electric Power Lines** - No utilities will exist at the well sites.

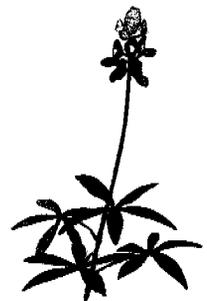
**Potential Barriers** - No potential barriers will exist at any of the well sites, except for the perimeter fence. No ponds exist at the well sites. Refer to Sections 231.100 and 242 for information pertaining to the mud pit.

Canyon Fuel Company, LLC  
Dugout Canyon Mine

Methane Degassification Amendment  
August 2003

**ATTACHMENT 3-1  
VEGETATION INVENTORY**

VEGETATION OF THE  
DUGOUT CANYON MINE  
DE-GAS BOREHOLE SITES



*Prepared by*

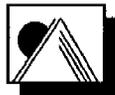
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July 2003



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## INTRODUCTION

Canyon Fuel Company has plans to drill borehole sites as part of a de-gasification process to facilitate coal mining operations at the Dugout Canyon Mine. In order to develop the drill sites, a small amount of land will be disturbed at each location. The plant communities proposed for disturbance at each of these sites have been described and sampled, with the results provided in this report. A sensitive plant species survey was also conducted for the sites.

The proposed borehole study area was located on private land and was accessed through Pace Canyon in Carbon County, Utah. More specifically, the study area was located in Township 13 South, Range 12 East, Section 24 and Township 13 South, Range 13 East, Section 19 (USGS Pine Canyon, 7.5 minute topographic quad).

To minimize land disturbance, attempts have been made by Canyon Fuel to plan construction of the borehole pads in areas where previous disturbance has already been caused by logging or other activities. Each proposed borehole pad is approximately 200 ft. x 300 ft in size. Short access roads from the existing dirt roads may also need to be constructed.

Two *Reference Areas* were chosen to represent future standards for final revegetation success of the six sites. These Reference Areas were chosen for their similarities in geology, soils, slope, aspect, and plant community composition to the areas that are proposed for disturbance. In those cases where the proposed new disturbances exist in areas that were previously disturbed by other

activities, attempts were made to choose the Reference Areas to represent those native plant communities that were present at the site prior to these perturbations.

## METHODS

Methodologies used herein were performed in accordance with the guidelines supplied by the State of Utah, Division of Oil, Gas and Mining (DOGGM). Quantitative and qualitative data were taken on the vegetation of the areas proposed for disturbance and their respective Reference Areas from June 10 - June 14, 2003.

Proposed drill sites were surveyed, mapped and staked in the field by Canyon Fuel prior to sampling. The Reference Areas chosen were approximately one acre in size and were marked in the field with blue flagging and metal t-posts in their centers. UTM Northing and Easting coordinates were also recorded by a small GPS unit and are provided in the RESULTS section of this report.

### Sampling Design and Transect/Quadrat Placement

Transect lines for vegetation sampling were placed randomly within the boundaries of the proposed disturbed and Reference Areas. The sample boundaries included 100 ft outside the proposed drill site and 50 ft from the centerline of the access roads. The transect placement technique was employed with the goal to adequately sample a representative subset of the entire

site as a whole. Once the transects were 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 other appropriate notes. Plant nomenclature follows "A Utah Flora" (Welsh et al., 1993).

### Woody Species 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.

$$n_{MIN} = \frac{t^2 s^2}{(dx)^2}$$

where,

*n*<sub>MIN</sub> = minimum adequate sample  
t = appropriate confidence t-value  
s = standard deviation  
x = sample mean  
d = desired change from mean

With the values used for “t” and “d” above, the goal was to meet sample adequacy with 80% confidence within a 10% deviation from the true mean. In areas where sample viability was unnaturally high (e.g. previous disturbance sites), these parameters may have been too rigorous.

## Statistical Analyses

Student’s t-tests were employed to compare the total living cover and total woody species density of each proposed disturbed borehole site with their 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 (e.g. *Utah Natural Heritage Program*) 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 study area.

### Raw Data

The raw data for cover have been summarized on a spreadsheet and were included in the Appendix of this report.

## RESULTS

### Borehole Site G-1

Borehole Site G-1 was located in an area that was disturbed previously by roads, logging and other activities (see photographs). Presently dominated by a host of invader plant species, this site was once dominated by aspen (*Populus tremuloides*), Douglas fir (*Pseudotsuga menziesii*)

and ponderosa pine (*Pinus ponderosa*).

Total living cover was estimated at 37.50%, only 1.17% of which was overstory cover (Table 1). Forbs comprised 50.95%, woody species 27.78% and grasses 21.27% of the living cover (Table 1). Although there were no species that clearly dominated the site, the most common woody species were Vasey sagebrush (*Artemisia tridentata* var. *vaseyana*), snowberry (*Symphoricarpos oreophilus*) and Douglas fir. Dominant forbs were Arizona woollybase (*Hymenoxys acaulis* var. *arizonica*), yellow-eye cryptanth (*Cryptantha flavoculata*) and common dandelion (*Taraxacum officinale*). The most common grass species were bluebunch wheatgrass (*Elymus spicatus*) and Canada bluegrass (*Poa compressa*). For a list of species present in the sample quadrats reported by cover and frequency, refer to Table 2

Total woody species density was estimated at 1,241 individuals per acre (Table 3). Most common woody species by density were the same as those reported above for cover and frequency.

#### Borehole Site G-2

Borehole Site G-2 was a relatively undisturbed Sagebrush/Snowberry/Grass plant community, but because it was located near a pond where livestock water, animals appear to congregate at the site and have impacted it (see Photographs). The proposed access road was sampled along with the proposed borehole drill site. The access road was closer to the valley bottom and more impacted

by livestock. The drill pad was more on the slope and had less impact. Because the road and pad site were basically in the same communities, these data sets were “lumped” to create one data set.

Total living cover of the site was 65.67% (Table 4), of which 43.64% of this cover were woody species, 38.76% forbs and 17.60% were grasses (Table 4).

Dominant shrubs species by cover and frequency were Vasey sagebrush and snowberry. The most common forbs were: common dandelion, Watson’s penstemon (*Penstemon watsonii*), longleaf phlox (*Phlox longifolia*). For cover by species and frequency refer to Table 5.

Woody species density was estimated at 4,812 individuals per acre, comprised almost exclusively of Vasey sagebrush and snowberry (Table 6).

### Borehole Site G-3

Borehole Site G-3 was a native plant community that has not been disturbed by logging, mining or livestock. This site was another Sagebrush/Snowberry/Grass community and was located on the slopes of a ridge (see Photographs).

Total living cover was estimated at 59.50% (Table 7). Shrub species and forbs were nearly equally represented in the cover at 43.66% and 44.06%, respectively, followed by grasses at 12.28% (Table 7).

Vasey sagebrush dominated the community by cover and frequency, followed by Watson's penstemon and bluebunch wheatgrass (Table 8). Density measurements of woody species suggest Vasey sagebrush and snowberry to be the dominant woody species. Total density of this site was estimated to be 6,306 plants per acre (Table 9).

#### Borehole Site G-4

Borehole Site G-4 was a disturbed Aspen/Douglas Fir community (see Photographs). Varying degrees of disturbances have been caused by road building and logging activities. Much of the borehole pad area was located on a dirt road, however, more disturbance has been proposed upslope from this area where logging has disturbed the native Aspen/Douglas Fir community.

Sample transects were randomly placed in both areas. Data of the two areas were combined to provide averages, but could easily be separated because the raw data have been included in this report (sample numbers 1-15 were within the road disturbance areas; numbers 16-30 were within the logged areas).

Total living cover for the site was 47.83%, and only 1.50% of it was overstory cover (Table 10). Forbs dominated the understory cover comprising 54.74% of it. Woody species and grasses were nearly equally represented at 22.51% and 22.75%, respectively (Table 10).

The dominant species of this area were common dandelion and hounds-tongue (*Cynoglossum officinale*) – invader species and a function of the disturbed condition of the area (Table 11).

Other common species were western wheatgrass (*Elymus smithii*), snowberry and Oregon grape (*Mahonia repens*).

Woody species density was estimated at only 358 individuals per acre, most of which was comprised of snowberry, Oregon grape, aspen and Douglas fir (Table 12).

#### Borehole Site G-5

Like Borehole Sites G-1 and G-2, Site G-3 was a native, undisturbed Sagebrush/Snowberry/Grass plant community. This community, however, was transitional to a Aspen/Douglas Fir community that exists adjacent to it (see Photographs).

Total living cover of this community was 63.33%, of which only 0.67% was overstory cover. Forbs made up 43.12%, shrubs 42.56% and grasses 15.32% of the living cover (Table 13). The dominant plants were shrub species, snowberry and Vasey sagebrush, followed by forbs lupine (*Lupinus argenteus*), common dandelion and, grasses Sandberg's bluegrass (*Poa secunda*). For cover and frequency by species, refer to Table 14.

Woody species density was estimated at 6,718 plants per acre, most of which were Vasey sagebrush and snowberry (Table 15).

### Borehole Site G-6

This area began near an existing logging road and continued to an undisturbed Aspen/Maple/Douglas Fir community (see Photographs). The sampling was conducted in the undisturbed plant community.

Total living cover was estimated at 93.67%; 56.00% of that cover was overstory cover (Table 16). Woody plants dominated the species composition and comprised 72.82%, whereas, forbs and grasses made up 22.49% and 4.60% of the living cover, respectively (Table 16). The dominant overstory species by cover and frequency were aspen, big-toothed maple (*Acer grandidentatum*) and Douglas Fir (Table 17). The dominant understory species were Oregon grape, big-toothed maple and aspen (Table 17).

Total woody species density was 2,355 individuals per acre and was also dominated by aspen, big-toothed maple and Douglas Fir (Table 18).

### Reference Area: Sagebrush/Snowberry/Grass

A Reference Area has been chosen to represent future revegetation success standards for the Sagebrush/Snowberry/Grass communities that have been proposed for disturbance by construction of the de-gasification boreholes sites (see Photographs). UTM coordinates for this area were: 12S <sup>05</sup>41<sup>789</sup> E.; <sup>43</sup>92<sup>550</sup> N. The proposed new disturbance sites that the

Sagebrush/Snowberry/Grass Reference Area will represent are **G-2, G-3 and G-5**.

Total living cover of the Reference Area was 63.33%, of which 45.99% were forbs, 37.00% were shrubs, and 17.01% were grasses (Table 19). Like the communities it was chosen to represent, the dominant species in this community were: Vasey sagebrush, Watson penstemon, lupine, and bluebunch wheatgrass (Table 20).

Woody species density was estimated at 4,811 plants per acre, most of which was Vasey sagebrush followed by snowberry (Table 21).

#### Reference Area: Aspen/Maple/Douglas Fir

A second Reference Area was chosen to represent future revegetation success standards for proposed disturbed sites **G-1, G-4 and G-6**. This Reference Area was within an Aspen/Maple/Douglas Fir community (see Photographs). UTM coordinates for this area were: 12S <sup>05</sup>41<sup>840</sup> E.; <sup>43</sup>92<sup>837</sup> N.

Total living cover in this Reference Area was 89.67%, 45.67% of which was overstory cover (Table 22). Woody species comprised 51.60%, forbs 33.65%, and grasses 14.76% of the living cover (Table 22). Dominant plants of the overstory quadrats were big-toothed maple and aspen (Table 23). Dominant understory cover was from the following species: big-toothed maple, Douglas fir, muttongrass (*Poa fendleriana*) and, bedstraw (*Galium bifolium*).

Total woody species density was estimated at 4,265 individuals per acre, and mostly comprised of snowberry, big-toothed maple, aspen and Douglas Fir (Table 24).

#### Threatened & Endangered Plant Species Survey

Prior to recording quantitative data on the plant communities, a sensitive plant species survey was conducted. No rare, endemic, threatened, endangered or otherwise sensitive species were found in the study areas.

## DISCUSSION

As mentioned previously in this report, Reference Areas with similar environmental attributes were chosen to represent future revegetation success standards of the areas proposed for disturbance by the de-gasification borehole drill sites. In other words, once the borehole sites are reclaimed and revegetated, they will be compared to their respective Reference Areas by again recording quantitative and qualitative data of each site and comparing the results statistically. Present state and federal regulations require the revegetated plant communities to be “diverse, effective and permanent”. Moreover, these reclaimed communities should be “capable of self-regeneration and plant succession” and be “compatible with the plant and animal species of the area”. Parameters including total living cover, woody species density and diversity will be measured and compared statistically with the Reference Areas before the mine operator is released from rehabilitation responsibility of these areas. Success of the reclaimed areas must be

greater than or equal to the Reference Areas using a 90 percent statistical confidence interval (i.e. one-sided test with a 0.10 alpha error).

Prior to creating any disturbance to the plant communities that exist in the area, total living cover and woody species densities of the Reference Areas have been compared statistically with those areas proposed for disturbance. The Reference Areas were chosen in an attempt to provide fair and consistent standards for future revegetation success for those borehole areas where the plant communities are proposed to be disturbed.

For most total living cover measurement (with two exceptions) there were no statistical differences between the proposed disturbed borehole sites with their respective Reference Areas (Fig. 1). The exceptions were Borehole Sites G-1 and G4. As explained in the RESULTS section above, these borehole sites were sites that had been disturbed by previous activities such as road/pad building and logging activities. With the absence of well-developed overstory cover, the total living covers were significantly less than that of the Reference Area.

Woody species densities were significantly different in most areas (Fig. 2). This can be explained in some areas due to previous disturbance as explained in the previous paragraph. In the other areas, the differences came due to the natural variability in native plant communities. These variables and differences should be considered and reasonable guidelines sought, in order to provide future revegetation success standards by representatives from the mine and state regulators. Considerations should be made for those areas that have already been disturbed by

previous activities. For example, should those areas be required to meet the standards derived from Reference Areas that have not been disturbed previously?

In choosing standards, it may be more straightforward for those areas that have never been disturbed, yet they may still differ somewhat from those areas chosen to be success standards.

Without exception, the parameter that was significantly different was woody species density. All woody species densities measured in the native undisturbed communities, whether proposed for disturbance or Reference Areas, are appropriate density standards for future success. In fact, numbers somewhat lower than those numbers may be somewhat justified, and can be decided upon by the representatives for the mine and regulatory authorities.

**Table 1: Site G1 (Dugout Mine) - Total Cover, standard deviation and sample size.**

<b>TOTAL COVER</b>	<b>% Mean Cover</b>	<b>Standard Deviation</b>	<b>Sample Size</b>
Living Cover (o)	1.17	3.80	30
Living Cover (u)	36.33	13.60	30
Living Cover (o+u)	37.50	12.02	30
Litter	10.13	10.86	30
Bareground	41.00	18.50	30
Rock	12.53	9.72	30
<b>COMPOSITION (u)</b>	<b>27.78</b>	<b>24.75</b>	<b>30</b>
Trees/Shrubs	50.95	27.18	30
Forbs	21.27	18.27	30
Grasses			
o = overstory u = understory			

Table 2: Site G1 (Dugout Mine) - Mean percent cover, standard deviation and percent frequency by species.

	Mean Percent	Standard Deviation	Percent Frequency
<b>OVERSTORY</b>			
<i>Pinus edulis</i>	0.50	2.69	3.33
<i>Pinus ponderosa</i>	0.67	2.81	6.67
<b>UNDERSTORY</b>			
<b>Trees &amp; Shrubs</b>			
<i>Artemisia tridentata</i>	4.90	6.04	50.00
<i>Ceanothus martinii</i>	0.17	0.90	3.33
<i>Mahonia repens</i>	0.23	0.96	6.67
<i>Pinus ponderosa</i>	0.17	0.90	3.33
<i>Pseudotsuga menziesii</i>	2.57	10.38	10.00
<i>Symphoricarpos oreophilus</i>	3.73	6.80	33.33
<b>Forbs</b>			
<i>Achillea millefolium</i>	0.33	1.80	3.33
<i>Bassia hyssopifolia</i>	0.17	0.90	3.33
<i>Castilleja miniata</i>	1.20	1.99	30.00
<i>Cirsium sp.</i>	0.40	0.95	16.67
<i>Cryptantha flavoculata</i>	2.20	3.09	43.33
<i>Cymopterus longipes</i>	0.50	1.50	10.00
<i>Cynoglossum officinale</i>	0.40	1.52	6.67
<i>Erigeron engelmannii</i>	0.93	1.65	30.00
<i>Erigeron sp.</i>	0.93	1.79	23.33
<i>Fragaria vesca</i>	0.17	0.90	3.33
<i>Hymenoxys acaulis var. arizonica</i>	5.53	7.09	63.33
<i>Machaeranthera grindelioides</i>	0.47	1.31	13.33
<i>Medicago sativa</i>	0.27	1.03	6.67
<i>Penstemon watsonii</i>	0.27	1.03	6.67
<i>Phlox longifolia</i>	1.00	1.90	23.33
<i>Taraxacum officinale</i>	1.90	3.44	36.67
<i>Zigademus paniculatus</i>	0.67	1.62	20.00
<b>Grasses</b>			
<i>Agropyron cristatum</i>	0.33	1.25	6.67
<i>Bromus carinatus</i>	0.90	2.27	16.67
<i>Bromus tectorum</i>	0.17	0.90	3.33
<i>Elymus spicatus</i>	2.50	2.23	60.00
<i>Poa compressa</i>	1.90	5.27	23.33
<i>Poa pratensis</i>	1.07	2.38	20.00
<i>Stipa comata</i>	0.37	1.14	10.00

Table 3: Site G1 (Dugout Mine) - Woody species densities.

Species	Individuals Per Acre
<i>Amalanchier utahensis</i>	20.69
<i>Artemisia tridentata var. vaseyana</i>	475.82
<i>Ceanothus martinii</i>	31.03
<i>Juniperus communis</i>	10.34
<i>Pinus ponderosa</i>	41.38
<i>Pinus edulis</i>	31.03
<i>Pseudotsuga menziesii</i>	134.47
<i>Symphoricarpos oreophilus</i>	496.51
<b>TOTAL</b>	<b>1241.28</b>

**Table 4: Site G2 (Dugout Mine) - Total Cover, standard deviation and sample size.**

<b>TOTAL COVER</b>	<b>% Mean Cover</b>	<b>Standard Deviation</b>	<b>Sample Size</b>
Living Cover (u)	65.67	8.14	30
Litter	20.00	9.10	30
Bareground	13.13	9.44	30
Rock	1.20	0.75	30
<b>COMPOSITION (u)</b>			
Trees/Shrubs	43.64	13.79	30
Forbs	38.76	14.50	30
Grasses	17.60	6.75	30
u = understory			

Table 5: Site G2 (Dugout Mine) - Mean percent cover, standard deviation and percent frequency by species.

	Mean Percent	Standard Deviation	Percent Frequency
<b>Trees &amp; Shrubs</b>			
<i>Artemisia tridentata</i> var. <i>vaseyana</i>	19.17	10.33	90.00
<i>Symphoricarpos oreophilus</i>	9.53	8.55	70.00
<b>Forbs</b>			
<i>Achillea millefolium</i>	1.93	4.29	23.33
<i>Cymopterus longipes</i>	0.20	0.75	6.67
<i>Cynoglossum officinale</i>	1.37	3.32	23.33
<i>Delphinium nelsonii</i>	0.17	0.90	3.33
<i>Erigeron engelmannii</i>	1.83	2.96	33.33
<i>Gilia leptomeria</i>	0.07	0.36	3.33
<i>Hedysarum boreale</i>	0.17	0.90	3.33
<i>Lupinus argenteus</i>	0.83	2.91	10.00
<i>Penstemon watsonii</i>	7.03	4.96	86.67
<i>Phlox longifolia</i>	2.57	3.17	43.33
<i>Senecio multilobatus</i>	0.33	1.25	6.67
<i>Taraxacum officinale</i>	8.93	10.37	80.00
<b>Grasses</b>			
<i>Elymus spicatus</i>	6.17	4.62	76.67
<i>Poa pratensis</i>	3.03	4.39	36.67
<i>Poa secunda</i>	2.33	3.98	30.00

Table 6: Site G2 (Dugout Mine) - Woody species densities.

Species	Individuals Per Acre
<i>Artemisia tridentata</i> var. <i>vaseyana</i>	3208.23
<i>Pseudotsuga menziesii</i>	40.10
<i>Symphoricarpos oreophilus</i>	1564.01
<b>TOTAL</b>	<b>4812.34</b>

**Table 7: Site G3 (Dugout Mine) - Total Cover, standard deviation and sample size.**

<b>TOTAL COVER</b>	<b>% Mean Cover</b>	<b>Standard Deviation</b>	<b>Sample Size</b>
Living Cover (u)	59.50	11.50	30
Litter	17.17	10.37	30
Bareground	19.90	13.13	30
Rock	3.43	3.96	30
<b>COMPOSITION (u)</b>			
Trees/Shrubs	43.66	18.87	30
Forbs	44.06	18.30	30
Grasses	12.28	9.94	30
u = understory			

Table 8: Site G3 (Dugout Mine) - Mean percent cover, standard deviation and percent frequency by species.

	Mean Percent	Standard Deviation	Percent Frequency
<b>Trees &amp; Shrubs</b>			
<i>Amalanchier utahensis</i>	2.67	7.39	13.33
<i>Artemisia tridentata</i> var. <i>vaseyana</i>	14.03	10.74	83.33
<i>Mahonia repens</i>	0.50	2.69	3.33
<i>Symphoricarpos oreophilus</i>	9.63	12.47	63.33
<b>Forbs</b>			
<i>Castilleja flava</i>	0.50	1.50	13.33
<i>Cymopterus longipes</i>	3.90	3.67	66.67
<i>Delphinium nelsonii</i>	2.57	3.08	50.00
<i>Erigeron engelmannii</i>	2.47	2.62	56.67
<i>Erigeron</i> sp.	2.13	4.72	23.33
<i>Gilia leptomeria</i>	0.43	1.17	13.33
<i>Lupinus argenteus</i>	3.73	6.74	43.33
<i>Penstemon watsonii</i>	4.97	4.51	63.33
<i>Phlox longifolia</i>	2.97	3.36	60.00
<i>Senecio multiflobatus</i>	0.33	1.25	6.67
<i>Taraxacum officinale</i>	1.20	1.90	33.33
<b>Grasses</b>			
<i>Elymus spicatus</i>	4.97	4.02	70.00
<i>Poa secunda</i>	2.50	6.82	23.33

Table 9: Site G3 (Dugout Mine) - Woody species densities.

Species	Individuals Per Acre
<i>Amalanchier utahensis</i>	210.19
<i>Artemisia tridentata</i> var. <i>vaseyana</i>	3835.95
<i>Symphoricarpos oreophilus</i>	2259.53
<b>TOTAL</b>	<b>6305.67</b>

Table 10: Site G4 (Dugout Mine) - Total Cover, standard deviation and sample size.

TOTAL COVER	% Mean Cover	Standard Deviation	Sample Size
Living Cover (o)	1.50	5.65	30
Living Cover (u)	46.33	13.54	30
Living Cover (o+u)	47.83	14.18	30
Litter	28.27	23.46	30
Bareground	23.37	19.11	30
Rock			
<b>COMPOSITION (u)</b>			
Trees/Shrubs	22.51	28.73	30
Forbs	54.74	30.53	30
Grasses	22.75	25.84	30
o = overstory u = understory			

Table 11: Site G4 (Dugout Mine) - Mean percent cover, standard deviation and percent frequency by species.

	Mean Percent	Standard Deviation	Percent Frequency
<b>OVERSTORY</b>			
<i>Populus tremuloides</i>	0.67	3.59	3.33
<i>Pseudotsuga menziesii</i>	0.83	4.49	3.33
<b>UNDERSTORY</b>			
<b>Trees &amp; Shrubs</b>			
<i>Mahonia repens</i>	3.17	6.64	26.67
<i>Populus tremuloides</i>	1.33	5.62	6.67
<i>Pseudotsuga menziesii</i>	0.67	2.81	6.67
<i>Symphoricarpos oreophilus</i>	4.93	11.01	23.33
<b>Forbs</b>			
<i>Achillea millefolium</i>	0.17	0.90	3.33
<i>Bassia hyssopifolia</i>	0.67	3.59	3.33
<i>Chenopodium fremontii</i>	0.33	1.80	3.33
<i>Cirsium sp.</i>	0.23	0.96	6.67
<i>Cynoglossum officinale</i>	8.53	16.19	36.67
<i>Delphinium nelsonii</i>	0.73	1.71	16.67
<i>Descurainia pinnata</i>	1.33	6.32	6.67
<i>Galium bifolium</i>	0.50	1.98	6.67
<i>Gilia leptomeria</i>	0.17	0.90	3.33
<i>Lappula occidentalis</i>	0.17	0.90	3.33
<i>Medicago sativa</i>	0.77	2.01	13.33
<i>Osmorhiza depauperata</i>	0.83	4.49	3.33
<i>Penstemon watsonii</i>	0.50	1.50	10.00
<i>Senecio integerrimus</i>	1.83	9.87	3.33
<i>Taraxacum officinale</i>	8.83	11.16	70.00
<b>Grasses</b>			
<i>Bromus tectorum</i>	0.33	1.25	6.67
<i>Dactylis glomeratus</i>	0.17	0.90	3.33
<i>Elymus smithii</i>	7.83	14.59	33.33
<i>Elymus spicatus</i>	1.23	2.60	20.00
<i>Poa secunda</i>	1.07	4.62	6.67

Table 12: Site G4 (Dugout Mine) - Woody species densities.

Species	Individuals Per Acre
<i>Artemisia tridentata</i> var. <i>vaseyana</i>	32.82
<i>Mahonia repens</i>	71.61
<i>Populus tremuloides</i>	47.74
<i>Pseudotsuga menziesii</i>	44.76
<i>Sambucus caerulea</i>	8.95
<i>Symphoricarpos oreophilus</i>	152.17
<b>TOTAL</b>	<b>358.05</b>

**Table 13: Site G5 (Dugout Mine) - Total Cover, standard deviation and sample size.**

<b>TOTAL COVER</b>	<b>% Mean Cover</b>	<b>Standard Deviation</b>	<b>Sample Size</b>
Living Cover (o)	0.67	2.81	30
Living Cover (u)	62.67	8.83	30
Living Cover (o+u)	63.33	8.69	30
Litter	22.70	9.74	30
Bareground	12.57	10.07	30
Rock	2.07	2.64	30
<b>COMPOSITION (u)</b>			
Trees/Shrubs	42.56	23.18	30
Forbs	43.12	18.39	30
Grasses	15.32	10.94	30
o = overstory u = understory			

Table 14: Site G5 (Dugout Mine) - Mean percent cover, standard deviation and percent frequency by species.

	Mean Percent	Standard Deviation	Percent Frequency
<b>OVERSTORY</b>			
<i>Pseudotsuga menziesii</i>	0.67	2.81	6.67
<b>UNDERSTORY</b>			
<b>Trees &amp; Shrubs</b>			
<i>Artemisia tridentata</i> var. <i>vaseyana</i>	12.93	12.49	80.00
<i>Pseudotsuga menziesii</i>	0.60	1.93	10.00
<i>Symphoricarpos oreophilus</i>	13.93	15.64	83.33
<b>Forbs</b>			
<i>Achillea millefolium</i>	0.73	1.59	20.00
<i>Cymopterus longipes</i>	0.63	1.54	16.67
<i>Cynoglossum officinale</i>	0.77	2.84	10.00
<i>Delphinium nelsonii</i>	4.13	3.16	73.33
<i>Erigeron engelmannii</i>	1.30	2.02	33.33
<i>Erysimum asperum</i>	0.17	0.90	3.33
<i>Lupinus argenteus</i>	5.50	6.22	70.00
<i>Penstemon watsonii</i>	3.47	4.49	50.00
<i>Phlox longifolia</i>	3.93	2.37	90.00
<i>Taraxacum officinale</i>	5.50	6.08	66.67
<b>Grasses</b>			
<i>Elymus cinereus</i>	0.17	0.90	3.33
<i>Elymus spicatus</i>	3.53	5.33	46.67
<i>Poa secunda</i>	5.37	5.35	66.67

Table 15: Site G5 (Dugout Mine) - Woody species densities.

Species	Individuals Per Acre
<i>Amalanchier utahensis</i>	111.96
<i>Artemisia tridentata</i> var. <i>vaseyana</i>	3638.86
<i>Juniperus communis</i>	55.98
<i>Pseudotsuga menziesii</i>	503.84
<i>Symphoricarpos oreophilus</i>	2407.25
TOTAL	6717.90

**Table 16: Site G6 (Dugout Mine) - Total Cover, standard deviation and sample size.**

<b>TOTAL COVER</b>	<b>% Mean Cover</b>	<b>Standard Deviation</b>	<b>Sample Size</b>
Living Cover (o)	56.00	24.61	30
Living Cover (u)	37.67	10.70	30
Living Cover (o+u)	93.67	26.49	30
Litter	57.60	10.88	30
Bareground	3.67	2.81	30
Rock	1.07	0.36	30
<b>COMPOSITION (u)</b>			
Trees/Shrubs	72.82	20.27	30
Forbs	22.49	18.46	30
Grasses	4.69	9.97	30
o = overstory u = understory			

Table 17: Site G6 (Dugout Mine) - Mean percent cover, standard deviation and percent frequency by species.

	Mean Percent	Standard Deviation	Percent Frequency
<b>OVERSTORY</b>			
<i>Acer grandidentatum</i>	19.67	24.70	46.67
<i>Populus tremuloides</i>	26.00	26.72	56.67
<i>Pseudotsuga menziesii</i>	8.83	24.14	13.33
<i>Symphoricarpos oreophilus</i>	1.50	8.08	3.33
<b>UNDERSTORY</b>			
<b>Trees &amp; Shrubs</b>			
<i>Acer grandidentatum</i>	6.77	11.79	40.00
<i>Mahonia repens</i>	11.97	8.48	86.67
<i>Populus tremuloides</i>	5.60	8.25	53.33
<i>Prunus virginiana</i>	0.17	0.90	3.33
<i>Pseudotsuga menziesii</i>	1.17	3.80	13.33
<i>Rosa woodsii</i>	0.33	1.25	6.67
<i>Symphoricarpos oreophilus</i>	1.90	3.22	30.00
<b>Forbs</b>			
<i>Achillea millefolium</i>	0.30	1.00	10.00
<i>Delphinium nelsonii</i>	0.67	1.70	13.33
<i>Galium bifolium</i>	2.20	4.20	33.33
<i>Osmorhiza depauperata</i>	0.67	1.70	13.33
<i>Osmorhiza depauperata</i>	1.90	3.00	33.33
<i>Smilacina stellata</i>	0.40	1.52	6.67
<i>Taraxacum officinale</i>	0.17	0.90	3.33
<i>Thalictrum fendleri</i>	1.03	2.04	23.33
<i>Viola adunca</i>	0.83	1.75	20.00
<b>Grasses</b>			
<i>Elymus trachycaulus</i>	1.17	3.08	16.67
<i>Poa fendleriana</i>	0.43	1.33	10.00

Table 18: Site G6 (Dugout Mine) - Woody species densities.

Species	Individuals Per Acre
<i>Acer grandidentatum</i>	588.68
<i>Abies concolor</i>	58.87
<i>Juniperus scopulorum</i>	19.62
<i>Populus tremuloides</i>	1040.00
<i>Pseudotsuga menziesii</i>	333.59
<i>Rosa woodsii</i>	58.87
<i>Symphoricarpos oreophilus</i>	255.09
<b>TOTAL</b>	<b>2354.72</b>

Table 19: Sagebrush/Snowberry/Grass Reference Area (Dugout Mine) - Total Cover, standard deviation and sample size.

<b>TOTAL COVER</b>	<b>% Mean Cover</b>	<b>Standard Deviation</b>	<b>Sample Size</b>
Living Cover (u)	63.33	8.60	30
Litter	17.90	8.86	30
Bareground	10.53	8.16	30
Rock	8.23	7.87	30
<b>COMPOSITION (u)</b>			
Trees/Shrubs	37.00	18.87	30
Forbs	45.99	18.68	30
Grasses	17.01	11.86	30
u = understory			

Table 20: Sagebrush/Snowberry/Grass Reference Area (Dugout Mine) - Mean percent cover, standard deviation and percent frequency by species.

	Mean Percent	Standard Deviation	Percent Frequency
<b>Trees &amp; Shrubs</b>			
<i>Amalanchier utahensis</i>	2.00	5.13	20.00
<i>Artemisia tridentata</i> var. <i>vaseyana</i>	16.77	13.39	86.67
<i>Mahonia repens</i>	0.50	2.69	3.33
<i>Pseudotsuga menziesii</i>	0.33	1.80	3.33
<i>Symphoricarpos oreophilus</i>	4.67	7.52	33.33
<b>Forbs</b>			
<i>Castilleja flava</i>	1.93	2.83	33.33
<i>Cymopterus longipes</i>	4.63	3.83	70.00
<i>Delphinium nelsonii</i>	2.07	2.67	43.33
<i>Erigeron engelmannii</i>	2.07	2.67	43.33
<i>Erigeron</i> sp.	0.47	1.31	13.33
<i>Eriogonum</i> sp.	0.17	0.90	3.33
<i>Erysimum asperum</i>	0.37	1.05	13.33
<i>Gilia leptomeria</i>	0.73	2.14	13.33
<i>Hedysarum boreale</i>	0.17	0.90	3.33
<i>Hymenoxys acaulis</i> var. <i>arizonica</i>	0.33	1.25	6.67
<i>Lupinus argenteus</i>	5.27	6.93	56.67
<i>Penstemon watsonii</i>	8.17	5.81	83.33
<i>Phlox longifolia</i>	1.13	2.33	23.33
<i>Senecio multilobatus</i>	0.17	0.90	3.33
<i>Taraxacum officinale</i>	0.77	1.63	20.00
<b>Grasses</b>			
<i>Elymus elymoides</i>	0.17	0.90	3.33
<i>Elymus spicatus</i>	5.23	4.19	70.00
<i>Poa secunda</i>	5.23	5.88	56.67

Table 21: Sagebrush/Snowberry/Grass Reference Area  
(Dugout Mine) - Woody species densities.

Species	Individuals Per Acre
<i>Amalanchier utahensis</i>	240.54
<i>Artemisia tridentata</i> var. <i>vaseyana</i>	3928.75
<i>Pseudotsuga menziesii</i>	40.09
<i>Symphoricarpos oreophilus</i>	601.34
<b>TOTAL</b>	<b>4810.71</b>

Table 22: Aspen/Maple/Douglas Fir Reference Area (Dugout Mine) - Total Cover, standard deviation and sample size.

TOTAL COVER	% Mean Cover	Standard Deviation	Sample Size
Living Cover (o)	45.67	34.37	30
Living Cover (u)	44.00	13.87	30
Living Cover (o+u)	89.67	35.19	30
Litter	49.53	14.06	30
Bareground	5.40	5.00	30
Rock	1.07	0.25	30
<b>COMPOSITION (u)</b>			
Trees/Shrubs	51.60	26.09	30
Forbs	33.65	19.35	30
Grasses	14.76	15.61	30
o = overstory u = understory			

Table 23: Aspen/Maple/Douglas Fir Reference Area (Dugout Mine) - Mean percent cover, standard deviation and percent frequency by species.

	Mean Percent	Standard Deviation	Percent Frequency
<b>OVERSTORY</b>			
<i>Acer grandidentatum</i>	22.67	27.47	53.33
<i>Populus tremuloides</i>	23.00	29.88	40.00
<b>UNDERSTORY</b>			
<b>Trees &amp; Shrubs</b>			
<i>Acer grandidentatum</i>	7.43	9.92	53.33
<i>Juniperus communis</i>	1.00	5.39	3.33
<i>Mahonia repens</i>	0.77	2.39	10.00
<i>Populus tremuloides</i>	3.43	7.24	30.00
<i>Pseudotsuga menziesii</i>	6.50	11.77	30.00
<i>Rosa woodsii</i>	0.33	1.80	3.33
<i>Symphoricarpos oreophilus</i>	4.47	6.99	46.67
<b>Forbs</b>			
<i>Achillea millefolium</i>	0.43	1.09	20.00
<i>Aquilegia caerulea</i>	0.43	1.33	10.00
<i>Delphinium nelsonii</i>	1.23	2.17	26.67
<i>Erigeron engelmannii</i>	0.17	0.90	3.33
<i>Galium bifolium</i>	4.77	6.67	20.00
<i>Osmorhiza depauperata</i>	1.80	4.66	26.67
<i>Penstemon watsonii</i>	0.33	1.80	3.33
<i>Phlox longifolia</i>	0.67	1.58	16.67
<i>Smilacina stellata</i>	0.17	0.90	3.33
<i>Taraxacum officinale</i>	1.77	2.56	40.00
<i>Thalictrum fendleri</i>	1.43	2.12	33.33
<i>Viola adunca</i>	0.93	2.21	20.00
<b>Grasses</b>			
<i>Elymus trachycaulus</i>	0.33	1.25	6.67
<i>Poa fendleriana</i>	5.60	6.06	73.33

Table 24: Aspen/Maple/Douglas Fir Reference Area  
(Dugout Mine) - Woody species densities.

Species	Individuals Per Acre
<i>Acer grandidentatum</i>	1208.39
<i>Artemisia tridentata</i> var. <i>vaseyana</i>	35.54
<i>Juniperus communis</i>	35.54
<i>Populus tremuloides</i>	1030.68
<i>Pseudotsuga menziesii</i>	533.11
<i>Rosa woodsii</i>	106.62
<i>Symphoricarpos oreophilus</i>	1315.01
TOTAL	4264.89

FIG. 1. A statistical comparison (Student's t-tests) of the total living cover between the proposed disturbed borehole sites and their reference areas.

	$\bar{x}$	s	n	t	df	SL
<b>Borehole Site G-1</b>						
Proposed Disturbed:	37.50	12.02	30			
A/M/D Reference Area:	89.67	35.19	30			
t-test				-7.684	58	p<.001
<b>Borehole Site G-2</b>						
Proposed Disturbed:	65.67	8.14	30			
S/S/G Reference Area:	63.33	8.60	30			
t-test				1.082	58	N.S.
<b>Borehole Site G-3</b>						
Proposed Disturbed:	59.50	11.50	30			
S/S/G Reference Area:	63.33	8.60	30			
t-test				-1.461	58	N.S.
<b>Borehole Site G-4</b>						
Proposed Disturbed:	47.83	14.18	30			
A/M/D Reference Area:	89.67	35.19	30			
t-test				-6.040	58	p<.001
<b>Borehole Site G-5</b>						
Proposed Disturbed:	63.33	8.69	30			
S/S/G Reference Area:	63.33	8.60	30			
t-test				0.00	58	N.S.
<b>Borehole Site G-6</b>						
Proposed Disturbed:	93.67	26.49	30			
A/M/D Reference Area:	89.67	35.19	30			
t-test				0.497	58	N.S.

$\bar{x}$  = mean  
s = standard deviation  
n = sample size  
t = Student's t-value  
df = degrees of freedom  
SL = Significance Level  
S/S/G = Sagebrush/Snowberry/Grass  
A/M/D = Aspen/Maple/Douglas Fir

**FIG. 2.** A statistical comparison (Student's t-tests) of the **woody species density** between the proposed disturbed borehole sites and their reference areas.

	<u><math>\bar{x}</math></u>	<u>s</u>	<u>n</u>	<u>t</u>	<u>df</u>	<u>SL</u>
<b>Borehole Site G-1</b>						
<u>Proposed Disturbed:</u>	1241.28	1299.39	30			
<u>A/M/D Reference Area:</u>	4264.89	2448.14	30			
t-test				-5.975	58	p<.001
<b>Borehole Site G-2</b>						
<u>Proposed Disturbed:</u>	4812.34	1599.42	30			
<u>S/S/G Reference Area:</u>	4810.71	1813.87	30			
t-test				0.004	58	N.S.
<b>Borehole Site G-3</b>						
<u>Proposed Disturbed:</u>	6305.67	2397.80	30			
<u>S/S/G Reference Area:</u>	4810.71	1813.87	30			
t-test				2.723	58	p<.010
<b>Borehole Site G-4</b>						
<u>Proposed Disturbed:</u>	358.05	454.42	30			
<u>A/M/D Reference Area:</u>	4264.89	2448.14	30			
t-test				-8.594	58	p<.001
<b>Borehole Site G-5</b>						
<u>Proposed Disturbed:</u>	6717.90	3328.96	30			
<u>S/S/G Reference Area:</u>	4810.71	1813.87	30			
t-test				2.755	58	p<.010
<b>Borehole Site G-6</b>						
<u>Proposed Disturbed:</u>	2354.72	1403.98	30			
<u>A/M/D Reference Area:</u>	4264.89	2448.14	30			
t-test				-3.707	58	p<.001

$\bar{x}$  = mean

s = standard deviation

n = sample size

t = Student's t-value

df = degrees of freedom

SL= Significance Level

S/S/G = Sagebrush/Snowberry/Grass

A/M/D = Aspen/Maple/Douglas Fir

**COLOR PHOTOGRAPHS  
OF THE  
STUDY AREAS**



Borehole Site G-1



Borehole Site G-2



Borehole Site G-3



Borehole Site G-4



Borehole Site G-5



Borehole Site G-6



Sagebrush/Snowberry/Grass Reference Area



Aspen/Maple/Douglas Fir Reference Area

**APPENDIX**

(Raw Data)

CANYON FUEL  
 Dugout - DE-GAS Site G1  
 Previously Disturbed Aspen/Fir  
 Exposure: NW  
 Slope: 3 - 6 deg.  
 Sample Date: 13 Jun 03

	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00
<b>OVERSTORY</b>								
<i>Pinus edulis</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Pinus ponderosa</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>UNDERSTORY</b>								
<b>TREES &amp; SHRUBS</b>								
<i>Artemisia tridentata</i>	10.00	0.00	0.00	0.00	20.00	0.00	0.00	5.00
<i>Ceanothus martinii</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Mahonia repens</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Pinus ponderosa</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Pseudotsuga menziesii</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Symphoricarpos oreophilus</i>	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00
<b>FORBS</b>								
<i>Achillea millefolium</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Bassia hyssopifolia</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Castilleja miniata</i>	0.00	2.00	0.00	5.00	0.00	0.00	2.00	0.00
<i>Cirsium sp.</i>	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00
<i>Cryptantha flavoculata</i>	0.00	10.00	10.00	5.00	5.00	5.00	0.00	3.00
<i>Cymopterus longipes</i>	0.00	0.00	0.00	0.00	5.00	0.00	0.00	5.00
<i>Cynoglossum officinale</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Erigeron engelmannii</i>	0.00	0.00	0.00	0.00	5.00	0.00	5.00	0.00
<i>Erigeron sp.</i>	0.00	3.00	0.00	5.00	0.00	0.00	5.00	3.00
<i>Fragaria vesca</i>	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Hymenoxys acaulis var. arizonica</i>	5.00	20.00	10.00	20.00	0.00	20.00	20.00	0.00
<i>Machaeranthera grindelloides</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Medicago sativa</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Penstemon watsonii</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Phlox longifolia</i>	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Taraxacum officinale</i>	5.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
<i>Zigademos paniculatus</i>	0.00	0.00	0.00	0.00	0.00	7.00	1.00	2.00
<b>GRASSES</b>								
<i>Agropyron cristatum</i>	5.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00
<i>Bromus carinatus</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Bromus tectorum</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Elymus spicatus</i>	0.00	0.00	0.00	0.00	5.00	3.00	0.00	5.00
<i>Poa compressa</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Poa pratensis</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Stipa comata</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>COVER</b>								
Overstory	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Understory	35.00	35.00	20.00	35.00	45.00	35.00	40.00	25.00
Litter	18.00	2.00	1.00	5.00	15.00	5.00	10.00	5.00
Bareground	40.00	55.00	70.00	50.00	10.00	55.00	45.00	65.00
Rock	7.00	8.00	9.00	10.00	30.00	5.00	5.00	5.00
<b>% COMPOSITION</b>								
Woody Plants	28.57	0.00	0.00	0.00	55.56	0.00	0.00	20.00
Forbs	57.14	100.00	100.00	100.00	33.33	91.43	87.50	60.00
Grasses	14.29	0.00	0.00	0.00	11.11	8.57	12.50	20.00
Overstory + Understory	35.00	35.00	20.00	35.00	45.00	35.00	40.00	25.00

9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00
0.00	0.00	0.00	0.00	0.00	15.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	15.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00
15.00	10.00	0.00	3.00	0.00	0.00	5.00	0.00	9.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	55.00	0.00	20.00	0.00
0.00	0.00	5.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.00	5.00	0.00	0.00	0.00	0.00	0.00	5.00	5.00	5.00	0.00
3.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
2.00	0.00	0.00	0.00	8.00	0.00	0.00	0.00	0.00	0.00	5.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	4.00	0.00	1.00	0.00	0.00	2.00	0.00
0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.00	5.00	5.00	3.00	2.00	1.00	7.00	5.00	10.00	0.00	20.00
5.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	2.00	5.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	1.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	5.00	2.00	2.00	5.00	4.00	2.00	0.00	3.00	4.00	5.00
5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	5.00
5.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00
0.00	0.00	15.00	0.00	0.00	15.00	0.00	0.00	5.00	0.00	0.00
50.00	40.00	15.00	15.00	20.00	5.00	25.00	65.00	30.00	40.00	40.00
8.00	10.00	15.00	5.00	5.00	55.00	5.00	5.00	5.00	5.00	10.00
40.00	45.00	30.00	70.00	65.00	5.00	65.00	10.00	55.00	30.00	30.00
2.00	5.00	40.00	10.00	10.00	35.00	5.00	20.00	10.00	25.00	20.00
30.00	25.00	33.33	20.00	0.00	0.00	60.00	84.62	30.00	55.00	0.00
50.00	37.50	53.33	66.67	75.00	20.00	32.00	15.38	50.00	27.50	75.00
20.00	37.50	13.33	13.33	25.00	80.00	8.00	0.00	20.00	17.50	25.00
50.00	40.00	30.00	15.00	20.00	20.00	25.00	65.00	35.00	40.00	40.00

20.00	21.00	22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00	30.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	15.00	5.00	5.00	0.00	15.00	10.00	15.00	5.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	27.00	0.00	0.00	5.00	15.00	5.00	0.00	20.00	10.00	15.00
0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00
5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00
2.00	1.00	0.00	0.00	0.00	5.00	0.00	5.00	0.00	0.00	0.00
0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	7.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00
2.00	2.00	0.00	0.00	0.00	0.00	5.00	2.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	5.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	3.00	0.00
0.00	0.00	0.00	3.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	5.00	3.00	5.00	5.00	0.00
0.00	5.00	5.00	0.00	0.00	10.00	15.00	5.00	2.00	2.00	0.00
5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	5.00	0.00	0.00	5.00	10.00	0.00	0.00	5.00	2.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00
5.00	5.00	5.00	0.00	5.00	0.00	5.00	0.00	0.00	0.00	5.00
5.00	0.00	0.00	0.00	28.00	0.00	0.00	0.00	0.00	8.00	3.00
2.00	0.00	5.00	0.00	0.00	5.00	0.00	0.00	5.00	0.00	0.00
0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35.00	55.00	25.00	30.00	55.00	55.00	45.00	40.00	50.00	50.00	35.00
5.00	5.00	5.00	5.00	35.00	10.00	25.00	5.00	10.00	5.00	5.00
35.00	35.00	55.00	60.00	5.00	30.00	20.00	45.00	35.00	35.00	40.00
25.00	5.00	15.00	5.00	5.00	5.00	10.00	10.00	5.00	10.00	20.00
0.00	58.18	0.00	50.00	30.91	36.36	11.11	37.50	60.00	50.00	57.14
65.71	32.73	40.00	40.00	9.09	45.45	55.56	50.00	20.00	24.00	14.29
34.29	9.09	60.00	10.00	60.00	18.18	33.33	12.50	20.00	26.00	28.57
35.00	55.00	25.00	30.00	55.00	55.00	45.00	40.00	50.00	50.00	35.00

CANYON FUEL  
 Dugout - DE-GAS Site G1  
 Previously Disturbed Aspen/Fir  
 Exposure: NW  
 Slope: 3 - 6 deg.  
 Sample Date: 13 Jun 03

Mean	SDev	Freq	
			OVERSTORY
0.50	2.69	3.33	<i>Pinus edulis</i>
0.67	2.81	6.67	<i>Pinus ponderosa</i>
			UNDERSTORY
			TREES & SHRUBS
4.90	6.04	50.00	<i>Artemisia tridentata</i>
0.17	0.90	3.33	<i>Ceanothus martinii</i>
0.23	0.96	6.67	<i>Mahonia repens</i>
0.17	0.90	3.33	<i>Pinus ponderosa</i>
2.57	10.38	10.00	<i>Pseudotsuga menziesii</i>
3.73	6.80	33.33	<i>Symphoricarpos oreophilus</i>
			FORBS
0.33	1.80	3.33	<i>Achillea millefolium</i>
0.17	0.90	3.33	<i>Bassia hyssopifolia</i>
1.20	1.99	30.00	<i>Castilleja miniata</i>
0.40	0.95	16.67	<i>Cirsium sp.</i>
2.20	3.09	43.33	<i>Cryptantha flavoculata</i>
0.50	1.50	10.00	<i>Cymopterus longipes</i>
0.40	1.52	6.67	<i>Cynoglossum officinale</i>
0.93	1.65	30.00	<i>Erigeron engelmannii</i>
0.93	1.79	23.33	<i>Erigeron sp.</i>
0.17	0.90	3.33	<i>Fragaria vesca</i>
5.53	7.09	63.33	<i>Hymenoxys acaulis var. arizonica</i>
0.47	1.31	13.33	<i>Machaeranthera grindelioides</i>
0.27	1.03	6.67	<i>Medicago sativa</i>
0.27	1.03	6.67	<i>Penstemon watsonii</i>
1.00	1.90	23.33	<i>Phlox longifolia</i>
1.90	3.44	36.67	<i>Taraxacum officinale</i>
0.67	1.62	20.00	<i>Zigademus paniculatus</i>
			GRASSES
0.33	1.25	6.67	<i>Agropyron cristatum</i>
0.90	2.27	16.67	<i>Bromus carinatus</i>
0.17	0.90	3.33	<i>Bromus tectorum</i>
2.50	2.23	60.00	<i>Elymus spicatus</i>
1.90	5.27	23.33	<i>Poa compressa</i>
1.07	2.38	20.00	<i>Poa pratensis</i>
0.37	1.14	10.00	<i>Stipa comata</i>
			COVER
1.17	3.80		Overstory
36.33	13.60		Understory
10.13	10.86		Litter
41.00	18.50		Bareground
12.53	9.72		Rock
			% COMPOSITION
27.78	24.45		Woody Plants
50.95	26.44		Forbs
21.27	18.27		Grasses
37.50	12.02		Overstory + Understory

CANYON FUEL

Dugout - DE-GAS Site G2

Sagebrush/Grass

Exposure: SSW

Slope: 2 - 6 deg.

Sample Date: 12 Jun 03

	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00
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TREES & SHRUBS

<i>Artemisia tridentata var. vaseyana</i>	35.00	10.00	30.00	10.00	25.00	0.00	35.00	35.00
<i>Symphoricarpos oreophilus</i>	0.00	0.00	5.00	7.00	0.00	7.00	0.00	0.00

FORBS

<i>Achillea millefolium</i>	0.00	8.00	0.00	0.00	0.00	10.00	0.00	0.00
<i>Cymopterus longipes</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Cynoglossum officinale</i>	5.00	2.00	2.00	15.00	0.00	0.00	10.00	5.00
<i>Delphinium nelsonii</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Erigeron engelmannii</i>	0.00	0.00	5.00	3.00	0.00	5.00	0.00	0.00
<i>Gilia leptomeria</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Hedysarum boreale</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Lupinus argenteus</i>	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00
<i>Penstemon watsonii</i>	0.00	5.00	5.00	10.00	0.00	3.00	5.00	5.00
<i>Phlox longifolia</i>	5.00	0.00	0.00	0.00	5.00	5.00	0.00	5.00
<i>Senecio multilobatus</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Taraxacum officinale</i>	15.00	5.00	3.00	5.00	35.00	45.00	10.00	10.00

GRASSES

<i>Elymus spicatus</i>	5.00	5.00	0.00	7.00	10.00	0.00	15.00	5.00
<i>Poa pratensis</i>	5.00	10.00	0.00	8.00	5.00	0.00	0.00	10.00
<i>Poa secunda</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

COVER

Understory	70.00	45.00	55.00	65.00	80.00	75.00	75.00	75.00
Litter	20.00	35.00	35.00	30.00	15.00	5.00	5.00	15.00
Bareground	9.00	15.00	9.00	4.00	4.00	19.00	18.00	9.00
Rock	1.00	5.00	1.00	1.00	1.00	1.00	2.00	1.00

% COMPOSITION

Woody Plants	50.00	22.22	63.64	26.15	31.25	9.33	46.67	46.67
Forbs	35.71	44.44	36.36	50.77	50.00	90.67	33.33	33.33
Grasses	14.29	33.33	0.00	23.08	18.75	0.00	20.00	20.00

9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00
20.00	25.00	0.00	5.00	0.00	15.00	20.00	15.00	20.00	10.00	30.00
0.00	5.00	20.00	25.00	20.00	0.00	10.00	20.00	5.00	25.00	10.00
0.00	5.00	0.00	5.00	20.00	0.00	0.00	5.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	10.00	0.00	0.00	0.00	5.00	0.00	5.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.00	10.00	5.00	5.00	5.00	10.00	10.00	10.00	5.00	15.00	15.00
10.00	5.00	0.00	0.00	0.00	0.00	5.00	5.00	5.00	10.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00
15.00	5.00	5.00	10.00	5.00	20.00	5.00	5.00	10.00	0.00	0.00
15.00	7.00	5.00	5.00	10.00	5.00	5.00	5.00	10.00	10.00	0.00
0.00	8.00	0.00	5.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00
10.00	0.00	5.00	0.00	0.00	0.00	5.00	5.00	0.00	0.00	15.00
80.00	70.00	50.00	60.00	60.00	55.00	65.00	75.00	60.00	70.00	70.00
15.00	20.00	9.00	14.00	30.00	8.00	9.00	10.00	19.00	20.00	25.00
4.00	9.00	40.00	25.00	9.00	35.00	25.00	14.00	20.00	9.00	4.00
1.00	1.00	1.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00
25.00	42.86	40.00	50.00	33.33	27.27	46.15	46.67	41.67	50.00	57.14
43.75	35.71	40.00	33.33	50.00	54.55	38.46	40.00	41.67	35.71	21.43
31.25	21.43	20.00	16.67	16.67	18.18	15.38	13.33	16.67	14.29	21.43

20.00	21.00	22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00	30.00
10.00	20.00	20.00	25.00	30.00	15.00	25.00	35.00	20.00	20.00	15.00
25.00	5.00	15.00	7.00	15.00	15.00	20.00	10.00	0.00	0.00	15.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00
3.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00
5.00	0.00	5.00	0.00	2.00	0.00	0.00	0.00	10.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00
0.00	0.00	15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
8.00	20.00	5.00	15.00	0.00	10.00	10.00	5.00	0.00	0.00	5.00
7.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
2.00	5.00	0.00	0.00	3.00	0.00	0.00	5.00	15.00	25.00	5.00
5.00	5.00	10.00	13.00	8.00	5.00	15.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	10.00	15.00
0.00	5.00	0.00	0.00	7.00	8.00	0.00	10.00	0.00	0.00	0.00
65.00	60.00	70.00	65.00	65.00	65.00	70.00	65.00	60.00	60.00	70.00
9.00	24.00	14.00	30.00	30.00	14.00	25.00	30.00	30.00	30.00	25.00
25.00	15.00	15.00	4.00	4.00	20.00	4.00	4.00	9.00	9.00	4.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
53.85	41.67	50.00	49.23	69.23	46.15	64.29	69.23	33.33	33.33	42.86
38.46	41.67	35.71	30.77	7.69	33.85	14.29	15.38	50.00	50.00	35.71
7.69	16.67	14.29	20.00	23.08	20.00	21.43	15.38	16.67	16.67	21.43

CANYON FUEL  
 Dugout - DE-GAS Site G2  
 Sagebrush/Grass  
 Exposure: SSW  
 Slope: 2 - 6 deg.  
 Sample Date: 12 Jun 03

Mean	SDev	Freq	
<hr/>			
TREES & SHRUBS			
19.17	10.33	90.00	<i>Artemisia tridentata var. vaseyana</i>
9.53	8.55	70.00	<i>Symphoricarpos oreophilus</i>
FORBS			
1.93	4.29	23.33	<i>Achillea millefolium</i>
0.20	0.75	6.67	<i>Cymopterus longipes</i>
1.37	3.32	23.33	<i>Cynoglossum officinale</i>
0.17	0.90	3.33	<i>Delphinium nelsonii</i>
1.83	2.96	33.33	<i>Erigeron engelmannii</i>
0.07	0.36	3.33	<i>Gilia leptomeria</i>
0.17	0.90	3.33	<i>Hedysarum boreale</i>
0.83	2.91	10.00	<i>Lupinus argenteus</i>
7.03	4.96	86.67	<i>Penstemon watsonii</i>
2.57	3.17	43.33	<i>Phlox longifolia</i>
0.33	1.25	6.67	<i>Senecio multilobatus</i>
8.93	10.37	80.00	<i>Taraxacum officinale</i>
GRASSES			
6.17	4.62	76.67	<i>Elymus spicatus</i>
3.03	4.39	36.67	<i>Poa pratensis</i>
2.33	3.98	30.00	<i>Poa secunda</i>
<hr/>			
COVER			
65.67	8.14		Understory
20.00	9.10		Litter
13.13	9.44		Bareground
1.20	0.75		Rock
<hr/>			
% COMPOSITION			
43.64	13.79		Woody Plants
38.76	14.50		Forbs
17.60	6.75		Grasses
<hr/>			

CANYON FUEL  
 Dugout - DE-GAS Site G3  
 Sagebrush/Grass  
 Exposure: E  
 Slope: 4 - 10 deg.

Sample Date: 11 Jun 03      1.00      2.00      3.00      4.00      5.00      6.00      7.00      8.00

TREES & SHRUBS

<i>Amalanchier utahensis</i>	0.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00
<i>Artemisia tridentata var. vaseyana</i>	15.00	20.00	25.00	15.00	25.00	0.00	0.00	0.00
<i>Mahonia repens</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Symphoricarpos oreophilus</i>	14.00	2.00	5.00	8.00	4.00	22.00	23.00	40.00

FORBS

<i>Castilleja flava</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
<i>Cymopterus longipes</i>	5.00	10.00	5.00	3.00	0.00	5.00	3.00	0.00
<i>Delphinium nelsonii</i>	0.00	3.00	0.00	3.00	0.00	5.00	5.00	7.00
<i>Erigeron engelmannii</i>	3.00	0.00	5.00	7.00	5.00	0.00	5.00	3.00
<i>Erigeron sp.</i>	0.00	0.00	0.00	0.00	0.00	0.00	7.00	0.00
<i>Gilia leptomeria</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Lupinus argenteus</i>	5.00	5.00	5.00	0.00	0.00	7.00	0.00	10.00
<i>Penstemon watsonii</i>	0.00	5.00	10.00	5.00	10.00	8.00	7.00	0.00
<i>Phlox longifolia</i>	3.00	5.00	5.00	2.00	10.00	5.00	0.00	5.00
<i>Senecio multilobatus</i>	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Taraxacum officinale</i>	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00

GRASSES

<i>Elymus spicatus</i>	15.00	5.00	5.00	5.00	6.00	8.00	5.00	5.00
<i>Poa secunda</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

COVER

Understory	65.00	55.00	75.00	50.00	60.00	60.00	55.00	75.00
Litter	10.00	10.00	20.00	35.00	15.00	12.00	9.00	13.00
Bareground	15.00	30.00	4.00	13.00	22.00	27.00	35.00	10.00
Rock	10.00	5.00	1.00	2.00	3.00	1.00	1.00	2.00

% COMPOSITION

Woody Plants	44.62	40.00	53.33	46.00	48.33	36.67	41.82	53.33
Forbs	32.31	50.91	40.00	44.00	41.67	50.00	49.09	40.00
Grasses	23.08	9.09	6.67	10.00	10.00	13.33	9.09	6.67

9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00
0.00	0.00	0.00	0.00	15.00	0.00	30.00	25.00	0.00	0.00	0.00
20.00	10.00	30.00	25.00	10.00	25.00	0.00	8.00	15.00	14.00	7.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00	0.00	0.00	0.00
10.00	10.00	5.00	20.00	0.00	0.00	0.00	0.00	45.00	0.00	8.00
0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	3.00	5.00	5.00	5.00	5.00	10.00	5.00	0.00	5.00	0.00
0.00	2.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	2.00	5.00
0.00	0.00	2.00	0.00	0.00	3.00	10.00	2.00	0.00	5.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	4.00	0.00
0.00	0.00	0.00	2.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00
0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.00
12.00	0.00	5.00	0.00	0.00	2.00	7.00	0.00	10.00	15.00	0.00
2.00	5.00	3.00	0.00	10.00	5.00	0.00	2.00	0.00	0.00	5.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00	0.00	5.00	3.00	0.00	5.00	0.00	0.00	0.00	5.00	5.00
10.00	0.00	10.00	5.00	0.00	0.00	0.00	5.00	10.00	5.00	10.00
0.00	0.00	0.00	0.00	0.00	15.00	3.00	0.00	0.00	0.00	5.00
55.00	40.00	65.00	70.00	40.00	60.00	65.00	65.00	80.00	65.00	45.00
10.00	10.00	12.00	25.00	9.00	25.00	10.00	10.00	4.00	19.00	40.00
33.00	45.00	20.00	4.00	50.00	10.00	20.00	5.00	15.00	15.00	14.00
2.00	5.00	3.00	1.00	1.00	5.00	5.00	20.00	1.00	1.00	1.00
54.55	50.00	53.85	64.29	62.50	41.67	46.15	73.85	75.00	21.54	33.33
27.27	50.00	30.77	28.57	37.50	33.33	49.23	18.46	12.50	70.77	33.33
18.18	0.00	15.38	7.14	0.00	25.00	4.62	7.69	12.50	7.69	33.33

20.00	21.00	22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00	30.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.00	35.00	5.00	7.00	5.00	28.00	2.00	35.00	0.00	20.00	5.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.00	0.00	5.00	38.00	0.00	0.00	0.00	10.00	5.00	0.00	0.00
5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.00	5.00	10.00	0.00	15.00	5.00	3.00	0.00	0.00	0.00	0.00
5.00	7.00	3.00	10.00	0.00	5.00	0.00	0.00	0.00	10.00	0.00
0.00	5.00	0.00	0.00	0.00	0.00	2.00	4.00	5.00	5.00	3.00
0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.00	20.00	5.00	15.00
0.00	0.00	3.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	3.00	5.00	35.00	7.00	5.00	0.00	5.00
0.00	8.00	10.00	5.00	5.00	0.00	0.00	5.00	0.00	10.00	10.00
0.00	0.00	2.00	0.00	7.00	12.00	0.00	1.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00
0.00	0.00	2.00	0.00	0.00	5.00	0.00	3.00	0.00	0.00	0.00
5.00	10.00	0.00	5.00	5.00	0.00	0.00	0.00	5.00	10.00	0.00
0.00	0.00	35.00	0.00	0.00	0.00	0.00	5.00	0.00	5.00	7.00
50.00	70.00	75.00	70.00	40.00	60.00	55.00	70.00	40.00	65.00	45.00
19.00	20.00	20.00	25.00	50.00	30.00	15.00	9.00	10.00	9.00	10.00
30.00	8.00	4.00	4.00	5.00	9.00	25.00	20.00	45.00	25.00	35.00
1.00	2.00	1.00	1.00	5.00	1.00	5.00	1.00	5.00	1.00	10.00
60.00	50.00	13.33	64.29	12.50	46.67	3.64	64.29	12.50	30.77	11.11
30.00	35.71	40.00	28.57	75.00	53.33	96.36	28.57	75.00	46.15	73.33
10.00	14.29	46.67	7.14	12.50	0.00	0.00	7.14	12.50	23.08	15.56

CANYON FUEL  
 Dugout - DE-GAS Site G3  
 Sagebrush/Grass  
 Exposure: E  
 Slope: 4 - 10 deg.  
 Sample Date: 11 Jun 03

Mean	SDev	Freq	
<b>TREES &amp; SHRUBS</b>			
2.67	7.39	13.33	<i>Amalanchier utahensis</i>
14.03	10.74	83.33	<i>Artemisia tridentata var. vaseyana</i>
0.50	2.69	3.33	<i>Mahonia repens</i>
9.63	12.47	63.33	<i>Symphoricarpos oreophilus</i>
<b>FORBS</b>			
0.50	1.50	13.33	<i>Castilleja flava</i>
3.90	3.67	66.67	<i>Cymopterus longipes</i>
2.57	3.08	50.00	<i>Delphinium nelsonii</i>
2.47	2.62	56.67	<i>Erigeron engelmannii</i>
2.13	4.72	23.33	<i>Erigeron sp.</i>
0.43	1.17	13.33	<i>Gilia leptomeria</i>
3.73	6.74	43.33	<i>Lupinus argenteus</i>
4.97	4.51	63.33	<i>Penstemon watsonii</i>
2.97	3.36	60.00	<i>Phlox longifolia</i>
0.33	1.25	6.67	<i>Senecio multilobatus</i>
1.20	1.90	33.33	<i>Taraxacum officinale</i>
<b>GRASSES</b>			
4.97	4.02	70.00	<i>Elymus spicatus</i>
2.50	6.82	23.33	<i>Poa secunda</i>

<b>COVER</b>		
59.50	11.50	Understory
17.17	10.37	Litter
19.90	13.13	Bareground
3.43	3.96	Rock

<b>% COMPOSITION</b>		
43.66	18.87	Woody Plants
44.06	18.30	Forbs
12.28	9.94	Grasses

CANYON FUEL

Dugout - DE-GAS Site G4

Disturbed Aspen/Doug Fir

Exposure: N

Slope: 16 deg.

Sample Date: 13 Jun 03

	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00
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OVERSTORY

<i>Populus tremuloides</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Pseudotsuga menziesii</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

UNDERSTORY

TREES & SHRUBS

<i>Mahonia repens</i>	0.00	0.00	0.00	0.00	0.00	5.00	5.00	0.00
<i>Populus tremuloides</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Pseudotsuga menziesii</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Symphoricarpos oreophilus</i>	8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

FORBS

<i>Achillea millefolium</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Bassia hyssopifolia</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Chenopodium fremontii</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Cirsium sp.</i>	0.00	0.00	2.00	0.00	5.00	0.00	0.00	0.00
<i>Cynoglossum officinale</i>	10.00	0.00	33.00	0.00	30.00	3.00	30.00	0.00
<i>Delphinium nelsonii</i>	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Descurainia pinnata</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Galium bifolium</i>	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00
<i>Gilia leptomeria</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Lappula occidentalis</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Medicago sativa</i>	0.00	0.00	0.00	5.00	0.00	0.00	8.00	0.00
<i>Osmorhiza depauperata</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Penstemon watsonii</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Senecio integerrimus</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Taraxacum officinale</i>	30.00	15.00	0.00	10.00	5.00	0.00	10.00	35.00

GRASSES

<i>Bromus tectorum</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Dactylis glomeratus</i>	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Elymus smithii</i>	0.00	35.00	10.00	15.00	10.00	0.00	0.00	5.00
<i>Elymus spicatus</i>	0.00	0.00	0.00	0.00	0.00	7.00	0.00	0.00
<i>Poa secunda</i>	0.00	0.00	0.00	0.00	0.00	0.00	7.00	0.00

COVER

Overstory	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Understory	55.00	50.00	45.00	30.00	55.00	15.00	60.00	40.00
Litter	10.00	4.00	45.00	65.00	35.00	80.00	25.00	5.00
Bareground	30.00	45.00	9.00	4.00	8.00	4.00	13.00	50.00
Rock	5.00	1.00	1.00	1.00	2.00	1.00	2.00	5.00

% COMPOSITION

Woody Plants	14.55	0.00	0.00	0.00	0.00	33.33	8.33	0.00
Forbs	76.36	30.00	77.78	50.00	81.82	20.00	80.00	87.50
Grasses	9.09	70.00	22.22	50.00	18.18	46.67	11.67	12.50

Overstory + Understory	55.00	50.00	45.00	30.00	55.00	15.00	60.00	40.00
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20.00	21.00	22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00	30.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	0.00	0.00	0.00
10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
0.00	0.00	0.00	30.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00
15.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	35.00	0.00	30.00	5.00	30.00
0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.00	40.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	5.00	0.00	0.00	5.00	5.00	0.00	5.00	0.00	0.00
0.00	0.00	5.00	0.00	0.00	0.00	0.00	35.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	0.00
0.00	0.00	0.00	0.00	0.00	5.00	5.00	0.00	5.00	0.00	0.00
0.00	0.00	0.00	0.00	55.00	0.00	0.00	0.00	0.00	0.00	0.00
5.00	0.00	5.00	5.00	0.00	5.00	5.00	0.00	0.00	0.00	10.00
0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	5.00	5.00	0.00	10.00	0.00	0.00	5.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	20.00	0.00	0.00
35.00	40.00	25.00	50.00	55.00	50.00	55.00	35.00	50.00	30.00	70.00
4.00	50.00	65.00	30.00	4.00	30.00	40.00	9.00	40.00	65.00	20.00
60.00	9.00	9.00	19.00	40.00	18.00	4.00	55.00	9.00	4.00	9.00
1.00	1.00	1.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00
71.43	0.00	0.00	60.00	0.00	30.00	63.64	0.00	60.00	16.67	50.00
28.57	100.00	60.00	30.00	100.00	50.00	36.36	100.00	30.00	83.33	14.29
0.00	0.00	40.00	10.00	0.00	20.00	0.00	0.00	10.00	0.00	35.71
35.00	40.00	25.00	50.00	55.00	50.00	55.00	60.00	70.00	30.00	70.00

CANYON FUEL  
 Dugout - DE-GAS Site G4  
 Disturbed Aspen/Doug Fir  
 Exposure: N  
 Slope: 16 deg.  
 Sample Date: 13 Jun 03

Mean	SDev	Freq	
<hr/>			
OVERSTORY			
0.67	3.59		<i>Populus tremuloides</i>
0.83	4.49		<i>Pseudotsuga menziesii</i>
UNDERSTORY			
TREES & SHRUBS			
3.17	6.64	26.67	<i>Mahonia repens</i>
1.33	5.62	6.67	<i>Populus tremuloides</i>
0.67	2.81	6.67	<i>Pseudotsuga menziesii</i>
4.93	11.01	23.33	<i>Symphoricarpos oreophilus</i>
FORBS			
0.17	0.90	3.33	<i>Achillea millefolium</i>
0.67	3.59	3.33	<i>Bassia hyssopifolia</i>
0.33	1.80	3.33	<i>Chenopodium fremontii</i>
0.23	0.96	6.67	<i>Cirsium sp.</i>
8.53	16.19	36.67	<i>Cynoglossum officinale</i>
0.73	1.71	16.67	<i>Delphinium nelsonii</i>
1.33	6.32	6.67	<i>Descurainia pinnata</i>
0.50	1.98	6.67	<i>Galium bifolium</i>
0.17	0.90	3.33	<i>Gilia leptomeria</i>
0.17	0.90	3.33	<i>Lappula occidentalis</i>
0.77	2.01	13.33	<i>Medicago sativa</i>
0.83	4.49	3.33	<i>Osmorhiza depauperata</i>
0.50	1.50	10.00	<i>Penstemon watsonii</i>
1.83	9.87	3.33	<i>Senecio integerrimus</i>
8.83	11.16	70.00	<i>Taraxacum officinale</i>
GRASSES			
0.33	1.25	6.67	<i>Bromus tectorum</i>
0.17	0.90	3.33	<i>Dactylis glomeratus</i>
7.83	14.59	33.33	<i>Elymus smithii</i>
1.23	2.60	20.00	<i>Elymus spicatus</i>
1.07	4.62	6.67	<i>Poa secunda</i>
<hr/>			
COVER			
1.50	5.65		Overstory
46.33	13.54		Understory
28.27	23.46		Litter
23.37	19.11		Bareground
2.03	1.60		Rock
<hr/>			
% COMPOSITION			
22.51	28.73		Woody Plants
54.74	30.53		Forbs
22.75	25.84		Grasses
<hr/>			
47.83	14.18		Overstory + Understory
<hr/>			

CANYON FUEL

Dugout - DE-GAS Site G5

Snowberry/Sage Brush

Exposure: NNW

Slope: 6 - 8 deg.

Sample Date: 12 Jun 03

1.00 2.00 3.00 4.00 5.00 6.00 7.00 8.00

OVERSTORY

*Pseudotsuga menziesii* 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

UNDERSTORY

TREES & SHRUBS

*Artemisia tridentata* var. *vaseyana* 15.00 15.00 10.00 10.00 5.00 20.00 7.00 5.00

*Pseudotsuga menziesii* 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

*Symphoricarpos oreophilus* 25.00 5.00 0.00 5.00 0.00 20.00 8.00 5.00

FORBS

*Achillea millefolium* 0.00 0.00 5.00 0.00 0.00 0.00 0.00 0.00

*Cymopterus longipes* 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

*Cynoglossum officinale* 0.00 0.00 3.00 0.00 5.00 0.00 0.00 0.00

*Delphinium nelsonii* 10.00 5.00 0.00 5.00 0.00 3.00 7.00 5.00

*Erigeron engelmannii* 0.00 0.00 0.00 0.00 0.00 0.00 5.00 0.00

*Erysimum asperum* 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

*Lupinus argenteus* 0.00 5.00 15.00 15.00 0.00 12.00 0.00 0.00

*Penstemon watsonii* 0.00 10.00 0.00 0.00 0.00 0.00 5.00 5.00

*Phlox longifolia* 5.00 5.00 5.00 5.00 0.00 5.00 5.00 5.00

*Taraxacum officinale* 15.00 5.00 7.00 5.00 10.00 0.00 15.00 15.00

GRASSES

*Elymus cinereus* 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

*Elymus spicatus* 0.00 0.00 0.00 0.00 20.00 5.00 13.00 5.00

*Poa secunda* 0.00 5.00 10.00 25.00 0.00 0.00 0.00 10.00

COVER

Overstory 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

Understory 70.00 55.00 55.00 70.00 40.00 65.00 65.00 55.00

Litter 9.00 35.00 13.00 20.00 11.00 4.00 30.00 13.00

Bareground 20.00 9.00 30.00 9.00 45.00 30.00 4.00 30.00

Rock 1.00 1.00 2.00 1.00 4.00 1.00 1.00 2.00

% COMPOSITION

Woody Plants 57.14 36.36 18.18 21.43 12.50 61.54 23.08 18.18

Forbs 42.86 54.55 63.64 42.86 37.50 30.77 56.92 54.55

Grasses 0.00 9.09 18.18 35.71 50.00 7.69 20.00 27.27

Overstory + Understory 70.00 55.00 55.00 70.00 40.00 65.00 65.00 55.00

9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00
15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	20.00	15.00	0.00	0.00	0.00	15.00	5.00	0.00	10.00	15.00
3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.00	30.00	20.00	70.00	0.00	30.00	15.00	5.00	10.00	10.00	10.00
0.00	0.00	2.00	0.00	3.00	5.00	0.00	0.00	0.00	5.00	0.00
0.00	0.00	0.00	0.00	5.00	2.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	5.00	7.00	0.00	0.00	2.00	10.00	5.00	7.00	5.00	10.00
0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	3.00	0.00	5.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30.00	0.00	3.00	5.00	5.00	0.00	10.00	8.00	5.00	5.00	5.00
7.00	5.00	0.00	0.00	0.00	0.00	10.00	7.00	20.00	5.00	0.00
3.00	5.00	3.00	2.00	2.00	3.00	5.00	5.00	5.00	10.00	10.00
2.00	5.00	5.00	0.00	25.00	5.00	0.00	10.00	10.00	0.00	5.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.00	5.00	0.00	0.00	0.00	3.00	5.00	0.00	5.00	0.00	0.00
0.00	0.00	5.00	3.00	10.00	5.00	5.00	10.00	5.00	10.00	5.00
15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
55.00	75.00	60.00	80.00	50.00	60.00	75.00	55.00	70.00	60.00	65.00
35.00	9.00	30.00	15.00	40.00	30.00	20.00	35.00	25.00	30.00	20.00
9.00	15.00	9.00	4.00	9.00	9.00	4.00	8.00	4.00	5.00	10.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00	5.00	5.00
14.55	66.67	58.33	87.50	0.00	50.00	40.00	18.18	14.29	33.33	38.46
76.36	26.67	33.33	8.75	80.00	36.67	46.67	63.64	71.43	50.00	53.85
9.09	6.67	8.33	3.75	20.00	13.33	13.33	18.18	14.29	16.67	7.69
70.00	75.00	60.00	80.00	50.00	60.00	75.00	55.00	70.00	60.00	65.00

20.00	21.00	22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00	30.00
0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
45.00	5.00	1.00	20.00	18.00	50.00	20.00	7.00	35.00	20.00	0.00
0.00	0.00	0.00	8.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00
10.00	30.00	40.00	5.00	0.00	5.00	5.00	40.00	5.00	5.00	0.00
0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	5.00	2.00	0.00	0.00	5.00
0.00	0.00	0.00	0.00	0.00	0.00	15.00	0.00	0.00	0.00	0.00
3.00	5.00	0.00	5.00	8.00	0.00	5.00	2.00	5.00	5.00	0.00
0.00	0.00	3.00	5.00	1.00	2.00	0.00	0.00	0.00	5.00	5.00
0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.00	3.00	5.00	0.00	4.00	0.00	5.00	5.00	5.00	10.00	0.00
0.00	8.00	0.00	2.00	0.00	5.00	0.00	5.00	5.00	0.00	5.00
2.00	2.00	2.00	5.00	5.00	3.00	0.00	1.00	0.00	5.00	5.00
0.00	2.00	2.00	10.00	2.00	0.00	0.00	0.00	0.00	0.00	10.00
0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	5.00	5.00	0.00	0.00	5.00	5.00	20.00
10.00	0.00	10.00	0.00	5.00	0.00	5.00	8.00	10.00	5.00	0.00
0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
75.00	60.00	65.00	65.00	55.00	70.00	60.00	70.00	70.00	60.00	50.00
20.00	25.00	9.00	30.00	35.00	25.00	30.00	8.00	25.00	30.00	20.00
4.00	13.00	25.00	4.00	9.00	4.00	8.00	20.00	4.00	8.00	15.00
1.00	2.00	1.00	1.00	1.00	1.00	2.00	2.00	1.00	2.00	15.00
73.33	58.33	63.08	50.77	45.45	78.57	41.67	67.14	57.14	41.67	0.00
13.33	33.33	21.54	49.23	36.36	14.29	50.00	21.43	21.43	41.67	60.00
13.33	8.33	15.38	0.00	18.18	7.14	8.33	11.43	21.43	16.67	40.00
75.00	60.00	65.00	65.00	60.00	70.00	60.00	70.00	70.00	60.00	50.00

CANYON FUEL  
 Dugout - DE-GAS Site G5  
 Snowberry/Sage Brush  
 Exposure: NNW  
 Slope: 6 - 8 deg.  
 Sample Date: 12 Jun 03

Mean	SDev	Freq	
<hr/>			
OVERSTORY			
0.67	2.81		<i>Pseudotsuga menziesii</i>
UNDERSTORY			
TREES & SHRUBS			
12.93	12.49	80.00	<i>Artemisia tridentata var. vaseyana</i>
0.60	1.93	10.00	<i>Pseudotsuga menziesii</i>
13.93	15.64	83.33	<i>Symphoricarpos oreophilus</i>
FORBS			
0.73	1.59	20.00	<i>Achillea millefolium</i>
0.63	1.54	16.67	<i>Cymopterus longipes</i>
0.77	2.84	10.00	<i>Cynoglossum officinale</i>
4.13	3.16	73.33	<i>Delphinium nelsonii</i>
1.30	2.02	33.33	<i>Erigeron engelmannii</i>
0.17	0.90	3.33	<i>Erysimum asperum</i>
5.50	6.22	70.00	<i>Lupinus argenteus</i>
3.47	4.49	50.00	<i>Penstemon watsonii</i>
3.93	2.37	90.00	<i>Phlox longifolia</i>
5.50	6.08	66.67	<i>Taraxacum officinale</i>
GRASSES			
0.17	0.90	3.33	<i>Elymus cinereus</i>
3.53	5.33	46.67	<i>Elymus spicatus</i>
5.37	5.35	66.67	<i>Poa secunda</i>
<hr/>			
COVER			
0.67	2.81		Overstory
62.67	8.83		Understory
22.70	9.74		Litter
12.57	10.07		Bareground
2.07	2.64		Rock
<hr/>			
% COMPOSITION			
41.56	23.18		Woody Plants
43.12	18.39		Forbs
15.32	10.94		Grasses
<hr/>			
63.33	8.69		Overstory + Understory
<hr/>			

CANYON FUEL  
 Dugout - DE-GAS Site G6  
 Aspen/ Doug Fir  
 Exposure: NNE  
 Slope: 16 deg.  
 Sample Date: 13 Jun 03

1.00      2.00      3.00      4.00      5.00      6.00      7.00      8.00

OVERSTORY

<i>Acer grandidentatum</i>	75.00	45.00	65.00	0.00	45.00	80.00	50.00	20.00
<i>Populus tremuloides</i>	0.00	0.00	0.00	40.00	0.00	0.00	0.00	0.00
<i>Pseudotsuga menziesii</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Symphoricarpos oreophilus</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

UNDERSTORY

TREES & SHRUBS

<i>Acer grandidentatum</i>	10.00	0.00	30.00	8.00	0.00	0.00	7.00	0.00
<i>Mahonia repens</i>	0.00	18.00	10.00	25.00	5.00	20.00	20.00	20.00
<i>Populus tremuloides</i>	0.00	0.00	0.00	7.00	0.00	0.00	5.00	0.00
<i>Prunus virginiana</i>	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Pseudotsuga menziesii</i>	0.00	0.00	0.00	0.00	5.00	0.00	5.00	5.00
<i>Rosa woodsii</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Symphoricarpos oreophilus</i>	0.00	0.00	0.00	0.00	5.00	5.00	0.00	0.00

FORBS

<i>Achillea millefolium</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
<i>Delphinium nelsonii</i>	0.00	5.00	0.00	0.00	5.00	0.00	0.00	0.00
<i>Galium bifolium</i>	0.00	5.00	0.00	5.00	0.00	0.00	3.00	5.00
<i>Osmorhiza depauperata</i>	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00
<i>Osmorhiza depauperata</i>	10.00	5.00	0.00	0.00	0.00	0.00	0.00	5.00
<i>Smilacina stellata</i>	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Taraxacum officinale</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Thalictrum fendleri</i>	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00
<i>Viola adunca</i>	0.00	2.00	0.00	5.00	0.00	0.00	0.00	3.00

GRASSES

<i>Elymus trachycaulus</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Poa fendleriana</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00

COVER

Overstory	75.00	45.00	65.00	40.00	45.00	80.00	50.00	20.00
Understory	30.00	35.00	40.00	50.00	25.00	30.00	40.00	45.00
Litter	68.00	63.00	58.00	45.00	70.00	67.00	55.00	50.00
Bareground	1.00	1.00	1.00	2.00	4.00	2.00	4.00	4.00
Rock	1.00	1.00	1.00	3.00	1.00	1.00	1.00	1.00

% COMPOSITION

Woody Plants	50.00	51.43	100.00	80.00	60.00	83.33	92.50	55.56
Forbs	50.00	48.57	0.00	20.00	40.00	16.67	7.50	33.33
Grasses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.11

Overstory + Understory	105.00	80.00	105.00	90.00	70.00	110.00	90.00	65.00
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110.00	115.00	70.00	50.00	120.00	80.00	70.00	45.00	85.00	105.00	155.00
10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20.00	11.11	6.67	12.50	0.00	62.50	28.00	66.67	20.00	0.00	0.00
70.00	88.89	83.33	87.50	100.00	37.50	72.00	33.33	80.00	100.00	100.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4.00	1.00	1.00	1.00	1.00	1.00	4.00	4.00	4.00	4.00	4.00
45.00	53.00	68.00	58.00	58.00	58.00	70.00	65.00	50.00	80.00	40.00
50.00	45.00	30.00	40.00	40.00	40.00	25.00	30.00	45.00	15.00	55.00
60.00	70.00	40.00	10.00	80.00	40.00	45.00	15.00	40.00	90.00	100.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00
0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00
5.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	5.00	0.00	0.00	0.00	20.00	5.00	6.00	5.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	5.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	5.00	0.00	0.00	5.00	5.00	5.00	8.00	13.00	5.00
15.00	15.00	0.00	0.00	0.00	10.00	13.00	0.00	16.00	2.00	5.00
0.00	25.00	20.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	50.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60.00	35.00	40.00	10.00	80.00	40.00	45.00	0.00	0.00	0.00	10.00
0.00	35.00	0.00	0.00	0.00	0.00	0.00	15.00	0.00	0.00	0.00
9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00

20.00	21.00	22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00	30.00
0.00	0.00	30.00	35.00	25.00	40.00	0.00	30.00	0.00	0.00	0.00
0.00	0.00	30.00	0.00	50.00	40.00	60.00	50.00	50.00	65.00	75.00
0.00	90.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.00	0.00	0.00	0.00	0.00	15.00	0.00	25.00	5.00	0.00	0.00
10.00	0.00	5.00	20.00	15.00	5.00	10.00	5.00	15.00	15.00	30.00
25.00	0.00	0.00	0.00	5.00	5.00	0.00	20.00	5.00	15.00	5.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	5.00
0.00	10.00	5.00	5.00	5.00	0.00	0.00	0.00	0.00	0.00	5.00
0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	5.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	10.00	5.00	5.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.00	0.00	0.00	5.00	0.00	5.00	5.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	5.00	0.00	0.00
0.00	15.00	5.00	5.00	5.00	0.00	0.00	0.00	0.00	5.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	90.00	60.00	35.00	75.00	80.00	60.00	80.00	50.00	65.00	75.00
45.00	35.00	15.00	45.00	45.00	35.00	15.00	50.00	40.00	45.00	50.00
50.00	50.00	80.00	49.00	50.00	60.00	75.00	40.00	58.00	50.00	45.00
4.00	14.00	4.00	5.00	4.00	4.00	9.00	9.00	1.00	4.00	4.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
84.44	28.57	66.67	55.56	55.56	71.43	66.67	100.00	62.50	77.78	90.00
15.56	28.57	0.00	33.33	33.33	28.57	33.33	0.00	37.50	11.11	10.00
0.00	42.86	33.33	11.11	11.11	0.00	0.00	0.00	0.00	11.11	0.00
45.00	125.00	75.00	80.00	120.00	115.00	75.00	130.00	90.00	110.00	125.00

CANYON FUEL  
 Dugout - DE-GAS Site G6  
 Aspen/ Doug Fir  
 Exposure: NNE  
 Slope: 16 deg.  
 Sample Date: 13 Jun 03

Mean	SDev	Freq	
<hr/>			
OVERSTORY			
19.67	24.70		<i>Acer grandidentatum</i>
26.00	26.72		<i>Populus tremuloides</i>
8.83	24.14		<i>Pseudotsuga menziesii</i>
1.50	8.08		<i>Symphoricarpos oreophilus</i>
UNDERSTORY			
TREES & SHRUBS			
6.77	11.79	40.00	<i>Acer grandidentatum</i>
11.97	8.48	86.67	<i>Mahonia repens</i>
5.60	8.25	53.33	<i>Populus tremuloides</i>
0.17	0.90	3.33	<i>Prunus virginiana</i>
1.17	3.80	13.33	<i>Pseudotsuga menziesii</i>
0.33	1.25	6.67	<i>Rosa woodsii</i>
1.90	3.22	30.00	<i>Symphoricarpos oreophilus</i>
FORBS			
0.30	1.00	10.00	<i>Achillea millefolium</i>
0.67	1.70	13.33	<i>Delphinium nelsonii</i>
2.20	4.20	33.33	<i>Galium bifolium</i>
0.67	1.70	13.33	<i>Osmorhiza depauperata</i>
1.90	3.00	33.33	<i>Osmorhiza depauperata</i>
0.40	1.52	6.67	<i>Smilacina stellata</i>
0.17	0.90	3.33	<i>Taraxacum officinale</i>
1.03	2.04	23.33	<i>Thalictrum fendleri</i>
0.83	1.75	20.00	<i>Viola adunca</i>
GRASSES			
1.17	3.08	16.67	<i>Elymus trachycaulus</i>
0.43	1.33	10.00	<i>Poa fendleriana</i>
<hr/>			
COVER			
56.00	24.61		Overstory
37.67	10.70		Understory
57.60	10.88		Litter
3.67	2.81		Bareground
1.07	0.36		Rock
<hr/>			
% COMPOSITION			
72.82	20.27		Woody Plants
22.49	18.46		Forbs
4.69	9.97		Grasses
<hr/>			
93.67	26.49		Overstory + Understory
<hr/>			

CANYON FUEL  
 Dugout - Reference Area  
 Sagebrush/Grass/Snowberry  
 Exposure: E  
 Slope: 10 deg.

Sample Date: 12 Jun 03

	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00
<b>TREES &amp; SHRUBS</b>								
<i>Amalanchier utahensis</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Artemisia tridentata var. vaseyana</i>	20.00	20.00	15.00	15.00	5.00	5.00	0.00	28.00
<i>Mahonia repens</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Pseudotsuga menziesii</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Symphoricarpos oreophilus</i>	0.00	0.00	0.00	0.00	0.00	5.00	25.00	0.00

<b>FORBS</b>								
<i>Castilleja flava</i>	0.00	5.00	0.00	5.00	5.00	5.00	0.00	0.00
<i>Cymopterus longipes</i>	5.00	5.00	10.00	10.00	0.00	5.00	5.00	10.00
<i>Delphinium nelsonii</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
<i>Erigeron engelmannii</i>	0.00	5.00	0.00	5.00	5.00	3.00	5.00	5.00
<i>Erigeron sp.</i>	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Eriogonum sp.</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Erysimum asperum</i>	0.00	0.00	0.00	2.00	0.00	2.00	0.00	0.00
<i>Gilia leptomeria</i>	0.00	0.00	10.00	0.00	0.00	5.00	0.00	0.00
<i>Hedysarum boreale</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Hymenoxys acaulis var. arizonica</i>	0.00	0.00	0.00	0.00	5.00	5.00	0.00	0.00
<i>Lupinus argenteus</i>	5.00	0.00	0.00	0.00	0.00	0.00	5.00	5.00
<i>Penstemon watsonii</i>	10.00	5.00	10.00	20.00	5.00	0.00	5.00	10.00
<i>Phlox longifolia</i>	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00
<i>Senecio multilobatus</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Taraxacum officinale</i>	0.00	0.00	0.00	0.00	0.00	0.00	5.00	2.00

<b>GRASSES</b>								
<i>Elymus elymoides</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Elymus spicatus</i>	5.00	10.00	10.00	0.00	15.00	0.00	10.00	0.00
<i>Poa secunda</i>	5.00	5.00	0.00	5.00	20.00	20.00	10.00	0.00

<b>COVER</b>								
Understory	50.00	60.00	55.00	65.00	60.00	55.00	70.00	65.00
Litter	20.00	18.00	40.00	10.00	25.00	20.00	15.00	10.00
Bareground	25.00	20.00	4.00	20.00	5.00	5.00	10.00	20.00
Rock	5.00	2.00	1.00	5.00	10.00	20.00	5.00	5.00

<b>% COMPOSITION</b>								
Woody Plants	40.00	33.33	27.27	23.08	8.33	18.18	35.71	43.08
Forbs	40.00	41.67	54.55	69.23	33.33	45.45	35.71	56.92
Grasses	20.00	25.00	18.18	7.69	58.33	36.36	28.57	0.00

9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00
0.00	5.00	0.00	25.00	0.00	0.00	0.00	5.00	12.00	0.00	0.00
20.00	35.00	15.00	15.00	55.00	15.00	10.00	15.00	20.00	0.00	5.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	10.00	10.00	0.00	5.00	15.00	0.00	15.00	0.00
8.00	0.00	0.00	0.00	5.00	3.00	0.00	0.00	0.00	0.00	0.00
2.00	0.00	2.00	0.00	0.00	10.00	10.00	5.00	5.00	5.00	0.00
0.00	5.00	5.00	5.00	5.00	2.00	0.00	5.00	0.00	5.00	10.00
0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	5.00
2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00
2.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	20.00	0.00	0.00	8.00	5.00	0.00	10.00	30.00	15.00
5.00	5.00	0.00	10.00	0.00	0.00	15.00	10.00	8.00	15.00	10.00
0.00	5.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	10.00
0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	7.00	0.00	5.00	5.00	5.00	10.00	10.00	5.00	0.00	10.00
16.00	8.00	8.00	5.00	0.00	0.00	0.00	0.00	10.00	0.00	0.00
60.00	70.00	50.00	80.00	80.00	50.00	60.00	70.00	70.00	70.00	70.00
5.00	20.00	35.00	15.00	10.00	5.00	10.00	25.00	20.00	25.00	25.00
5.00	5.00	10.00	3.00	8.00	30.00	10.00	4.00	5.00	4.00	4.00
30.00	5.00	5.00	2.00	2.00	15.00	20.00	1.00	5.00	1.00	1.00
33.33	57.14	30.00	62.50	81.25	30.00	25.00	50.00	45.71	21.43	7.14
40.00	21.43	54.00	25.00	12.50	60.00	58.33	35.71	32.86	78.57	78.57
26.67	21.43	16.00	12.50	6.25	10.00	16.67	14.29	21.43	0.00	14.29

20.00	21.00	22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00	30.00
0.00	0.00	0.00	0.00	0.00	8.00	0.00	0.00	0.00	5.00	0.00
0.00	20.00	10.00	20.00	5.00	30.00	30.00	5.00	20.00	0.00	50.00
15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00
20.00	0.00	0.00	15.00	0.00	0.00	0.00	0.00	0.00	20.00	0.00
2.00	0.00	5.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	5.00
5.00	10.00	10.00	0.00	10.00	0.00	0.00	5.00	5.00	5.00	0.00
0.00	0.00	5.00	0.00	0.00	0.00	0.00	5.00	2.00	3.00	0.00
0.00	2.00	0.00	0.00	0.00	5.00	0.00	10.00	5.00	5.00	0.00
0.00	5.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.00	5.00	5.00	0.00	5.00	3.00	0.00	10.00	5.00	7.00	0.00
5.00	10.00	10.00	10.00	25.00	7.00	15.00	5.00	0.00	5.00	10.00
0.00	3.00	0.00	5.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00
0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	10.00	5.00	5.00	5.00	5.00	5.00	0.00	5.00	0.00	10.00
5.00	0.00	10.00	10.00	0.00	5.00	0.00	5.00	10.00	0.00	0.00
70.00	65.00	65.00	70.00	60.00	65.00	65.00	50.00	55.00	50.00	75.00
25.00	10.00	10.00	20.00	10.00	15.00	25.00	25.00	30.00	10.00	4.00
4.00	10.00	5.00	5.00	5.00	5.00	5.00	20.00	10.00	30.00	20.00
1.00	15.00	20.00	5.00	25.00	15.00	5.00	5.00	5.00	10.00	1.00
50.00	30.77	15.38	50.00	8.33	58.46	61.54	10.00	36.36	50.00	66.67
42.86	53.85	53.85	28.57	83.33	26.15	30.77	80.00	36.36	50.00	20.00
7.14	15.38	30.77	21.43	8.33	15.38	7.69	10.00	27.27	0.00	13.33

CANYON FUEL  
 Dugout - Reference Area  
 Sagebrush/Grass/Snowberry  
 Exposure: E  
 Slope: 10 deg.  
 Sample Date: 12 Jun 03

Mean	SDev	Freq	
<hr/>			
TREES & SHRUBS			
2.00	5.13	20.00	<i>Amalanchier utahensis</i>
16.77	13.39	86.67	<i>Artemisia tridentata</i> var. <i>vaseyana</i>
0.50	2.69	3.33	<i>Mahonia repens</i>
0.33	1.80	3.33	<i>Pseudotsuga menziesii</i>
4.67	7.52	33.33	<i>Symphoricarpos oreophilus</i>
FORBS			
1.93	2.83	33.33	<i>Castilleja flava</i>
4.63	3.83	70.00	<i>Cymopterus longipes</i>
2.07	2.67	43.33	<i>Delphinium nelsonii</i>
2.07	2.67	43.33	<i>Erigeron engelmannii</i>
0.47	1.31	13.33	<i>Erigeron</i> sp.
0.17	0.90	3.33	<i>Eriogonum</i> sp.
0.37	1.05	13.33	<i>Erysimum asperum</i>
0.73	2.14	13.33	<i>Gilia leptomeria</i>
0.17	0.90	3.33	<i>Hedysarum boreale</i>
0.33	1.25	6.67	<i>Hymenoxys acaulis</i> var. <i>arizonica</i>
5.27	6.93	56.67	<i>Lupinus argenteus</i>
8.17	5.81	83.33	<i>Penstemon watsonii</i>
1.13	2.33	23.33	<i>Phlox longifolia</i>
0.17	0.90	3.33	<i>Senecio multilobatus</i>
0.77	1.63	20.00	<i>Taraxacum officinale</i>
GRASSES			
0.17	0.90	3.33	<i>Elymus elymoides</i>
5.23	4.19	70.00	<i>Elymus spicatus</i>
5.23	5.88	56.67	<i>Poa secunda</i>
<hr/>			
COVER			
63.33	8.60		Understory
17.90	8.86		Litter
10.53	8.16		Bareground
8.23	7.87		Rock
<hr/>			
% COMPOSITION			
37.00	18.87		Woody Plants
45.99	18.68		Forbs
17.01	11.86		Grasses
<hr/>			

CANYON FUEL  
 Dugout - Reference Area  
 Aspen/Maple/ Doug Fir  
 Exposure: NNE  
 Slope: 16 deg.  
 Sample Date: 14 Jun 03

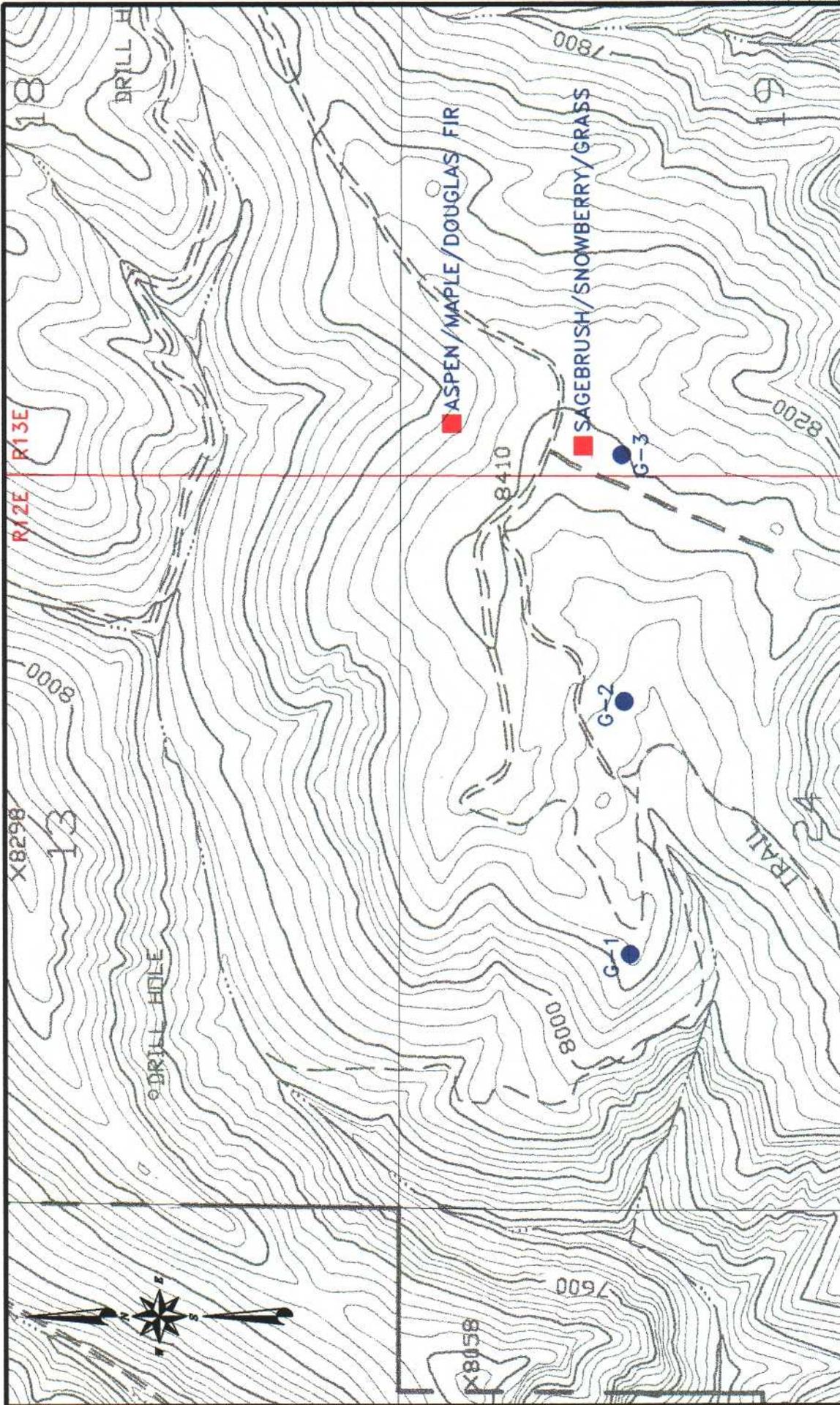
	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00
<b>OVERSTORY</b>								
<i>Acer grandidentatum</i>	20.00	15.00	15.00	0.00	50.00	10.00	55.00	80.00
<i>Populus tremuloides</i>	50.00	0.00	0.00	65.00	0.00	60.00	0.00	0.00
<b>UNDERSTORY</b>								
<b>TREES &amp; SHRUBS</b>								
<i>Acer grandidentatum</i>	20.00	0.00	10.00	0.00	0.00	0.00	35.00	0.00
<i>Juniperus communis</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Mahonia repens</i>	0.00	0.00	0.00	0.00	10.00	0.00	0.00	0.00
<i>Populus tremuloides</i>	5.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00
<i>Pseudotsuga menziesii</i>	0.00	20.00	0.00	0.00	0.00	0.00	0.00	5.00
<i>Rosa woodsii</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Symphoricarpos oreophilus</i>	5.00	0.00	8.00	20.00	5.00	0.00	0.00	5.00
<b>FORBS</b>								
<i>Achillea millefolium</i>	0.00	0.00	5.00	0.00	0.00	0.00	0.00	2.00
<i>Aquilegia caerulea</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Delphinium nelsonii</i>	0.00	0.00	0.00	0.00	5.00	0.00	0.00	2.00
<i>Erigeron engelmannii</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Galium bifolium</i>	1.00	0.00	5.00	25.00	5.00	15.00	0.00	0.00
<i>Osmorhiza depauperata</i>	4.00	2.00	0.00	0.00	5.00	0.00	0.00	2.00
<i>Penstemon watsonii</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Phlox longifolia</i>	0.00	0.00	0.00	0.00	5.00	0.00	0.00	3.00
<i>Smilacina stellata</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Taraxacum officinale</i>	0.00	5.00	2.00	5.00	5.00	0.00	0.00	0.00
<i>Thalictrum fendleri</i>	5.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Viola adunca</i>	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00
<b>GRASSES</b>								
<i>Elymus trachycaulus</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Poa fendleriana</i>	0.00	13.00	5.00	5.00	5.00	5.00	0.00	1.00
<b>COVER</b>								
Overstory	70.00	15.00	15.00	65.00	50.00	70.00	55.00	80.00
Understory	40.00	45.00	35.00	60.00	45.00	25.00	35.00	20.00
Litter	55.00	50.00	55.00	30.00	50.00	70.00	60.00	75.00
Bareground	4.00	3.00	9.00	9.00	4.00	4.00	4.00	4.00
Rock	1.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
<b>% COMPOSITION</b>								
TREES & Woody Plants	75.00	44.44	51.43	33.33	33.33	20.00	100.00	50.00
Forbs	25.00	26.67	34.29	58.33	55.56	60.00	0.00	45.00
Grasses	0.00	28.89	14.29	8.33	11.11	20.00	0.00	5.00
Overstory + Understory	110.00	60.00	50.00	125.00	95.00	95.00	90.00	100.00

9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00
0.00	0.00	50.00	70.00	50.00	0.00	0.00	80.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	75.00	20.00	75.00
18.00	0.00	0.00	10.00	0.00	0.00	20.00	0.00	10.00	0.00	5.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.00	0.00	5.00
0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	20.00	3.00	30.00
0.00	0.00	0.00	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
15.00	15.00	0.00	5.00	0.00	30.00	0.00	7.00	0.00	2.00	5.00
0.00	0.00	3.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.00	0.00	0.00	0.00	0.00	0.00	5.00	7.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00
0.00	5.00	0.00	0.00	5.00	0.00	0.00	8.00	0.00	0.00	0.00
5.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	5.00	0.00	5.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.00	5.00	5.00	0.00	0.00	10.00	0.00	5.00	0.00	2.00	0.00
5.00	5.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00	5.00
5.00	0.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00
0.00	5.00	10.00	0.00	25.00	5.00	10.00	20.00	5.00	14.00	0.00
0.00	0.00	50.00	70.00	50.00	0.00	0.00	80.00	75.00	20.00	75.00
65.00	35.00	20.00	45.00	55.00	45.00	45.00	60.00	65.00	25.00	50.00
30.00	45.00	70.00	50.00	35.00	35.00	35.00	38.00	30.00	70.00	45.00
4.00	19.00	9.00	4.00	9.00	18.00	19.00	1.00	4.00	4.00	4.00
1.00	1.00	1.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00
50.77	42.86	10.00	88.89	18.18	66.67	44.44	25.00	92.31	20.00	90.00
49.23	42.86	40.00	11.11	36.36	22.22	33.33	33.33	0.00	24.00	10.00
0.00	14.29	50.00	0.00	45.45	11.11	22.22	41.67	7.69	56.00	0.00
65.00	35.00	70.00	115.00	105.00	45.00	45.00	140.00	140.00	45.00	125.00

20.00	21.00	22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00	30.00
0.00	0.00	30.00	50.00	35.00	65.00	0.00	5.00	0.00	0.00	0.00
0.00	0.00	45.00	55.00	0.00	40.00	0.00	70.00	65.00	0.00	70.00
3.00	0.00	7.00	5.00	0.00	5.00	10.00	10.00	0.00	20.00	35.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	8.00	0.00	0.00	0.00	10.00	0.00	20.00	0.00	0.00
20.00	35.00	15.00	0.00	45.00	0.00	0.00	0.00	0.00	10.00	20.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	7.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00
1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	5.00	5.00	3.00	0.00	0.00	0.00	0.00
0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	5.00	3.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.00	5.00	0.00	8.00	0.00	20.00	15.00	15.00	0.00	0.00	5.00
0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	5.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	2.00
0.00	0.00	5.00	2.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00
2.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00
3.00	8.00	0.00	5.00	0.00	0.00	2.00	10.00	0.00	7.00	5.00
0.00	0.00	75.00	105.00	35.00	105.00	0.00	75.00	65.00	0.00	70.00
35.00	65.00	40.00	20.00	50.00	35.00	50.00	40.00	55.00	45.00	70.00
60.00	30.00	55.00	75.00	48.00	63.00	48.00	55.00	43.00	53.00	28.00
4.00	4.00	4.00	4.00	1.00	1.00	1.00	4.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
65.71	64.62	75.00	25.00	90.00	14.29	50.00	25.00	36.36	66.67	78.57
25.71	23.08	25.00	50.00	10.00	85.71	46.00	50.00	54.55	17.78	14.29
8.57	12.31	0.00	25.00	0.00	0.00	4.00	25.00	9.09	15.56	7.14
35.00	65.00	115.00	125.00	85.00	140.00	50.00	115.00	120.00	45.00	140.00

CANYON FUEL  
 Dugout - Reference Area  
 Aspen/Maple/ Doug Fir  
 Exposure: NNE  
 Slope: 16 deg.  
 Sample Date: 14 Jun 03

Mean	SDev	Freq	
			OVERSTORY
22.67	27.47		<i>Acer grandidentatum</i>
23.00	29.88		<i>Populus tremuloides</i>
			UNDERSTORY
			TREES & SHRUBS
7.43	9.92	53.33	<i>Acer grandidentatum</i>
1.00	5.39	3.33	<i>Juniperus communis</i>
0.77	2.39	10.00	<i>Mahonia repens</i>
3.43	7.24	30.00	<i>Populus tremuloides</i>
6.50	11.77	30.00	<i>Pseudotsuga menziesii</i>
0.33	1.80	3.33	<i>Rosa woodsii</i>
4.47	6.99	46.67	<i>Symphoricarpos oreophilus</i>
			FORBS
0.43	1.09	20.00	<i>Achillea millefolium</i>
0.43	1.33	10.00	<i>Aquilegia caerulea</i>
1.23	2.17	26.67	<i>Delphinium nelsonii</i>
0.17	0.90	3.33	<i>Erigeron engelmannii</i>
4.77	6.67	20.00	<i>Galium bifolium</i>
1.80	4.66	26.67	<i>Osmorhiza depauperata</i>
0.33	1.80	3.33	<i>Penstemon watsonii</i>
0.67	1.58	16.67	<i>Phlox longifolia</i>
0.17	0.90	3.33	<i>Smilacina stellata</i>
1.77	2.56	40.00	<i>Taraxacum officinale</i>
1.43	2.12	33.33	<i>Thalictrum fendleri</i>
0.93	2.21	20.00	<i>Viola adunca</i>
			GRASSES
0.33	1.25	6.67	<i>Elymus trachycaulus</i>
5.60	6.06	73.33	<i>Poa fendleriana</i>
			COVER
45.67	34.37		Overstory
44.00	13.87		Understory
49.53	14.06		Litter
5.40	5.00		Bareground
1.07	0.25		Rock
			% COMPOSITION
51.60	26.09		TREES & Woody Plants
33.65	19.35		Forbs
14.76	15.61		Grasses
89.67	35.19		Overstory + Understory



VEGETATION REFERENCE AREAS



*STATEMENT OF QUALIFICATIONS*  
2003

**PATRICK D. COLLINS, PH.D.**  
Botanist/Reclamation Specialist/  
Environmental Consultant

*Natural Resources & Reclamation Projects:*

Project: Steep Slope Reclamation & Revegetation Plans for the West Ridge Mine  
Funding Firm: West Ridge Resources, Price, UT

Project: Revegetation Monitoring Studies Associated with Bond Release in Trail Canyon, Utah  
Funding Firm: CO-OP Mining Company, Huntington, UT

Project: Revegetation Monitoring for Reclamation Research of Several Energy West Mines (1990-2002)  
Funding Firm: State of Utah, Abandoned Mine Program, Salt Lake City, UT.

Project: Reclamation & Revegetation of the Star Point Mine, Utah  
Funding Firm: Cyprus-Plateau Mining Company, Helper, UT

Project: Vegetation Mapping of the Entire Centennial Mine Permit Area  
Funding Firm: Andalex Resources, Price, UT

Project: Revegetation Success Studies for Bond Release at the Huntington No. 4 Mine, Wasatch Plateau.  
Funding Firm: Blackhawk Engineering, Price, UT.

Project: Straight Canyon Revegetation Project, Utah  
Funding Firm: State of Utah, Abandoned Mine Program, Salt Lake City, UT.

Project: Preliminary Revegetation Studies for Silver Mine Tailings Near Telluride, Colorado.  
Funding Firm: CH2M Hill, Denver, CO.

Project: Vegetation of the West Ridge Area, Book Cliff Mountains, Utah  
Funding Firm: Andalex Resources, Price, UT

Project: Vegetation Sampling at the Sunnyside Cogeneration Facility  
Funding Firm: Sunnyside Cogeneration Associates, Sunnyside, UT.

Project: Revegetation Success of the Alaskan Pipeline, Alaska  
Employer: Native Plants, Inc., Salt Lake City, UT

Project: Vegetation, Wildlife & Land Use Impacts in Barn Canyon, Utah  
Funding Firm: Cyprus-Plateau Mining Company, Helper, UT

Project: Environmental Studies for Permit to Conduct Large Mining Activities (NOI) at Pelican Point, Utah  
Funding Firm: Larson Limestone Company, UT

Project: Environmental Studies Associated with the Permit Application Package for the North Rilda Area.  
Wasatch Plateau, Utah.  
Funding Firm: Energy West Mining Company, Huntington, UT.

Project: Vegetation of the Dugout Canyon Mine, Utah  
Funding Firm: Soldier Creek Coal Co., Helper, UT

Project: Revegetation Success Studies for Bond Release at the Gordon Creek 3/6 Mines, Utah  
Funding Firm: Blackhawk Engineering, Price, UT.

Project: Revegetation Monitoring Studies at the Cottonwood, Deer Creek & DBD Mines  
Funding Firm: Energy West Mining Company, Huntington, UT.

Project: Vegetation of the Proposed Disturbance Area in Rilda Canyon, Utah  
Funding Firm: Energy West, Huntington, UT

Project: Vegetation & Soils of the Miller/Gordon Creek Tract  
Funding Firm: White Oak Mining Co., Helper, UT

Project: Vegetation of the Blue Blaze Mine Site  
Funding Firm: Blue Blaze Coal Company, Price, UT

Project: Vegetation of the Smoky Hollow Mine Site, Kane Co., Utah  
Funding Firm: Andalex Resources, Inc., Price, UT

Project: Vegetation Studies at the CO-OP Mine Area  
Funding Firm: CO-OP Mining Company, Huntington, UT

Project: Vegetation Mapping for Proposed Mine Development  
Funding Firm: Genwal Coal Company, Huntington, UT

Project: Vegetation and Soils Work for Mining & Reclamation Plan  
Funding Firm: Beaver Creek Coal Company, Price, UT

Projects: Ecological Studies of the Hunter Plant Area, Reclaimed Waste Rock Sites, and  
Cottonwood Fan Portal Area.  
Funding Firm: Utah, Power & Light Co., Huntington, UT

Project: Vegetation of Racehorse Flats, Huntington Canyon, Utah  
Funding Firm: Utah Power & Light Co., Huntington, UT

Project: Vegetation Sampling of the Elk Hills Naval Petroleum Reserve, Bakersfield, California  
Funding Firm: Sequoia Research Laboratory, Davis, CA

Project: Vegetation and Soils of the Emergency Lease Area of the Trail Mountain Coal Mine  
Funding Firm: Diamond Shamrock Corp., Trail Mountain Coal Mine

Project: On-site Construction of Reclamation Field Research Areas (Coarse Refuse, Slurry Pond,  
Coarse Slurry, & Surface Facility Areas)  
Funding Firm: U.S. Steel Mining Co., Inc., Sunnyside, UT.

Project: Environmental Studies for a Lignite Power Plant, Amador Co., Calif.  
Funding Firm: Vantaja Resources, Inc., La Jolla, CA

Project: Environmental Studies Associated with the Pumping of Excess Water from Utah Lake to Cedar  
and Rush Valleys.  
Funding Firm: Ford, Bacon and Davis & Horrocks Engineers for Utah Div. of Water Resources

Project: Revegetation of Cottonwood Canyon Road  
Funding Firm: Diamond Shamrock Corp.

Project: Revegetation Test Plots and Reclamation Techniques of the Wellington Coal Cleaning Plant, Utah  
Funding Firm: U.S. Steel Mining Co., Inc.

Project: Reclamation and Revegetation of the Trail Mountain Coal Mine, Utah  
Funding Firm: Diamond Shamrock Corp.

Project: Vegetation and Reclamation of the Wellington Coal Cleaning Plant, Utah  
Funding Firm: U.S. Steel Mining Co.

Project: Vegetation and Reclamation of the Geneva Mine, Utah  
Funding Firm: U.S. Steel Mining Co., Inc.

Project: Vegetation, Soils and Wildlife of the C & W No. 1 Mine, Utah  
Funding Firm: C & W Coal Producers, Salt Lake City, UT

Project: Vegetation, Soils and Wildlife of the Aletha No. 1 Mine, Utah  
Funding Firm: Mountain States Resources, First Western Coal Company, CA

Project: Vegetation, Soils and Wildlife of the Kinney No. 2 Mine, Utah  
Funding Firm: Sanders Exploration, Ltd., Park City, UT

Project: Vegetation, Soils and Wildlife of the Kristine Mine, Utah  
Funding Firm: Bishopsgate Coal Company, Salt Lake City, UT

Wetland/Riparian Projects:

Project: Influence of Increased Flows on Stream Geomorphology & Riparian Habitats Near Scofield, Utah.  
Funding Firm: Canyon Fuel Company, LLC, Helper, Utah.

Project: Riparian Plant Study for Box Canyon, Emery County, Utah  
Funding Firm: SUFCO Mine, Salina, UT.

Project: Vernal Pools Study for the Eagles Nest Estates, Amador Co., California  
Funding Firm: Eagles Nest Owners Association, Ione CA.

Project: Wetland and Riparian Restoration in San Juan County, Utah  
Funding Firm: OHM Remediation, Pleasanton, CA.

Project: Creation of Wetlands as a Water Treatment for Arsenic at the Seaton Mine, California.  
Funding Firm: Emma H. Rose Mining Company, San Francisco, California.

Project: Field Survey for Vernal Pools, North La Grange, California.  
Funding Firm: E.F. Theobald, Sutter Creek, California.

Project: Riparian Habitat Studies in Box Canyon, Wasatch Plateau, Utah.  
Funding Firm: Canyon Coal Company, Salina, Utah.

Project: Riparian Habitat Studies in Quitcupah Creek, Wasatch Plateau, Utah.  
Funding Firm: Canyon Coal Company, Salina, Utah.

Project: Riparian Habitat Studies Associated with the Central Utah Project, Diamond Fork  
Canyon, Wasatch Mountains, Utah.  
Funding Firm: Resource Management International, Sacramento, CA

Project: Classification of Springs and Seep on Trail Mountain, Wasatch Plateau, Utah  
Funding Firm: PacifiCorp, Salt Lake City, UT.

Project: Inventory of the Rare Plant: *Spiranthes diluvialis* Shev. on Sections of the Lake Fork & Uinta  
River, Utah.  
Funding Firm: Central Utah Project, CH2M Hill, UT

Project: Wetlands Mapping and Field Investigations in Utah and Juab Counties, Utah.  
Funding Firm: Resource Management International, Sacramento, CA

Project: Riparian/Wetland Impacts & Analyses for the Narrows Dam Project, Sanpete County.  
Funding Firm: Franson-Noble & Associates, American Fork, UT

Project: Vegetation, Wildlife and Preliminary Wetland Studies for the Brighton Ski Resort EIS  
Funding Firm: Bear West, Salt Lake City, UT

Project: Revegetation Monitoring of Upland & Riparian Areas for the Belina Mine, Utah  
Funding Firm: Earthfax Engineering, Midvale, UT

Project: Wetland/Vernal Pool Analysis and Restoration in Amador County, California  
Funding Firm: Thermal Electron, Boston, MA

Project: Vegetation, Wetland and Wildlife Studies in Snake Creek Canyon, Wasatch Co., Utah  
Funding Firm: Alpentech, Inc., Salt Lake City, UT

Project: Riparian & Upland Vegetation Sampling at the Horizon Coal Mine Site  
Funding Firm: Earthfax Engineering, Salt Lake City, UT

Project: Distribution & Ecology of Some Vernal Pools in Amador County, California  
Funding Firm: Echo Mining Co., Palos Verdes, CA

Project: Preliminary Environmental Considerations for Diverting Excess Water from the Bear River to the  
Portneuf River, Idaho  
Funding Firm: Ford, Bacon and Davis, Inc., Utah Division of Water Resources, Horrocks/Carollo  
Engineers, Salt Lake City, UT.

Rare Plant Inventory Studies:

Project: Rare Plant Inventory of the Eagles Nest Estates, Amador Co., California  
Funding Firm: Eagles Nest Owners Association, Ione California.

Project: Rare Plant Inventory of the 4<sup>th</sup> East Portal Area, Emery, Co., Utah  
Funding Firm: Consolidation Coal Company, Emery, UT

Project: Link Canyon Columbine Study, South Wasatch Plateau, Utah  
Funding Firm: Canyon Fuels, Salt Lake City, UT.

Project: Rare Plant Survey for Creutzfeld's Cryptanth (*Cryptantha creutzfeldii*), Canyon Sweetvetch  
(*Hedysarum occidentale* var. *canone*), Despain Footcactus (*Pediocactus despainii*), & Winkler  
Footcactus (*Pediocactus winkleri*).  
Funding Firm: Texaco Exploration & Production, Farmington, N.M.

Project: Plant Species Inventory for the Soldier Creek Mine  
Funding Firm: Earthfax Engineering, Midvale, UT

Project: Threatened & Endangered Species Survey Near the Cricket Mountains, Utah  
Funding Firm: Continental Lime, Inc., Salt Lake City, Utah

Project: Rare Plant Field Survey, North La Grange, California.  
Funding Firm: E.F. Theobald, Sutter Creek, California.

Project: Field Inventories of Irish Hill Buckwheat (*Eriogonum apricum* var. *prostratum*), Ione Buckwheat  
(*Eriogonum apricum* var. *apricum*), Ione Manzanita (*Eriogonum myrtifolia*), Bisbee Peak Rush-  
Rose (*Helianthemum suffrutescens*), and Parry's Horkelia (*Horkelia parryi*).  
Funding Firm: Various clients

Project: Inventory of the Rare Plant: *Spiranthes diluvialis* Shev. on Sections of the Lake Fork & Uinta  
River, Utah.  
Funding Firm: Central Utah Project, CH2M Hill, UT

Project: Threatened & Endangered Plant Survey of the San Rafael Swell, Utah  
Funding Firm: Bureau of Land Management, R.J. Kass

Project: Rare Plant Inventory Along Proposed Seismic Line in Colorado.  
Funding Firm: Endangered Plant Studies, Orem, UT

Project: Vegetation of the Blue Blaze Mine Site  
Funding Firm: Blue Blaze Coal Company, Price, UT

Project: Rare Plant Inventory and Seed Collections in the West Ridge Area, Book Cliff  
Mountains, Utah  
Funding Firm: Andalex Resources, Price, UT

Project: Canyon Sweet Vetch Inventory in Bear Creek Canyon, Wasatch Plateau, Utah  
Funding Firm: CO-OP Mining Company, Huntington, UT

Other Projects:

Project: Macroinvertebrate & Fish Sampling in James & Burnout Creek  
Funding Firm: Canyon Fuel, Skyline Mines, Helper, UT

Project: Raptor Monitoring in Carbon and Emery County  
Funding Firm: Texaco/Talon Resources

Project: Burrowing Owl Survey at the 4<sup>th</sup> East Portal and Adjacent Areas  
Funding Firm: Consolidation Coal Company

Project: Golden Eagle Survey Near the Levan Mine, San Pitch Mountains, Utah  
Funding Firm: Geneva Rock, Orem, UT

Project: Consulting Botanist for Natural Products Company  
Funding Firm: Murdock International, Springville, UT

Project: Macroinvertebrate & Fish Sampling in Winterquarters & Woods Canyons  
Funding Firm: Canyon Fuel, Skyline Mines, Helper, UT

Project: Vegetation & Wildlife Impacts from the Narrows Project, Juab County, Utah  
Funding Firm: Franson-Noble & Associates, American Fork, UT

Project: Macroinvertebrate & Fish Sampling in Eccles Creek  
Funding Firm: Canyon Fuel, Skyline Mines, Helper, UT

Project: Revegetation Plans and Soil Investigations at the Monticello Millsite, Utah  
Funding Firm: OHM Remediation Services Corp., Pleasanton, CA

Project: Various Environmental Studies on Several Project Areas  
Funding Firm: Nevada Power, Las Vegas, NV

Project: Habitat Types of the Curlew National Grassland, Idaho  
Funding Firm: U.S. Forest Service, Pocatello, ID

Project: Archaeology/Botanical Studies at Owens Valley, California  
Funding Firm: Dept. of Anthropology, Univ. of Calif., Davis, CA

Project: Ecological Studies at Bryce Canyon Park, Utah  
Employer: Weber State College and U.S. Park Service

Project: Ecologic and Floristic Studies of the Mt. Nebo Complex and the San Pitch Mountains, Utah  
Funding Firm: U.S. Forest Service, Provo, UT

Project: Various Environmental Studies  
Contracting Companies: Various Companies

### **BOTANIST/RECLAMATION SPECIALIST 1975 - 1978**

Company Employed: Sanders Exploration, Ltd.  
Address: Kaysville, Utah; Salt Lake City, Utah

Greenhouseman: Personally initiated and conducted greenhouse research on the growth of many native plants. The purpose of these studies was designed to help meet the demands of revegetating disturbed land. Research was done on seed dormancies, germination and growth rates. Seed for greenhouse use was often gathered on or near disturbed site. Germinated seeds were grown in root trainers where they were readily available for field transplanting. Species studied (from many different communities) were noted for their browse, habitat or establishment qualities.

Reclamation Manager: Responsible for the Land Reclamation Division of the geological company. This meant working for many different companies with all types of land rehabilitation problems (i.e. mines, drill sites, landscape, roads, revegetation test plots, etc.). Much office experience was involved and is summarized as follows: Managerial duties, crew supervision, project designing, budgets, promotional meetings, work orders, consulting, project accounting, research, varied professional reports, etc.

Botanist: Being a professional botanist has provided me with much field experience. Most of this work was accomplished throughout the states of Utah, Idaho, California, Colorado, Alaska and Nevada.

### **TEACHING EXPERIENCE:**

1989 Biology 101, Utah Valley Community College, Orem Utah.

1987 Guest Lecturer for Advanced Taxonomy, University of Utah.

1979 - 1987 While working on my M.S. and my Ph.D. degrees I have been employed by the University as a teaching assistant. Classes assisted were Quantitative Ecology (3 years), Rangeland Inventories and Watershed Management.

**EDUCATION:**

B.A. Weber State College, Ogden, Utah - 1976 - Botany  
M.S. Brigham Young University, Provo, Utah - 1980 - Botany  
and Range Science  
Ph.D. Brigham Young University, Provo, Utah - 1983 - Botany  
(Plant Ecology/Taxonomy)  
Graduate Major Professor: Dr. Kimball T. Harper

**PROFESSIONAL AFFILIATIONS:**

Society for Ecological Restoration  
Utah Native Plant Society

**PUBLICATIONS AND SELECTED PROFESSIONAL REPORTS: (available on request)**

Canyon Fuel Company, LLC  
Dugout Canyon Mine

Methane Degassification Amendment  
August 2003

**ATTACHMENT 3-2**  
**THREATENED, ENDANGERED, AND SENSITIVE SPECIES INFORMATION**

## Utah's State Listed Species by County

Disclaimer: This list was compiled using known species occurrences from the Utah Natural Heritage Program's Biological and Conservation Database; other species of special concern likely occur in Utah Counties. The list includes both current and historic records. (Last updated on October 24, 2002).

### Carbon County

<u>Common Name</u>	<u>Scientific Name</u>	<u>State Status</u>
ARIZONA TOAD	BUFO MICROSCAPHUS	SP
BALD EAGLE	HALIAEETUS LEUCOCEPHALUS	T
BLACK-FOOTED FERRET	MUSTELA NIGRIPES	E
BLUEHEAD SUCKER	CATOSTOMUS DISCOBOLUS	SP
BONYTAIL	GILA ELEGANS	E
BRAZILIAN FREE-TAILED BAT	TADARIDA BRASILIENSIS	SP/SD
BURROWING OWL	ATHENE CUNICULARIA	SP
COLORADO PIKEMINNOW	PTYCHOCEILUS LUCIUS	E
COMMON YELLOWTHROAT	GEOTHLYPIS TRICHAS	SP
FERRUGINOUS HAWK	BUTEO REGALIS	T
FLANNELMOUTH SUCKER	CATOSTOMUS LATIPINNIS	SP
GREATER SAGE-GROUSE	CENTROCERCUS UROPHASIANUS	SP/SD
HUMPBACK CHUB	GILA CYPHA	E
LONG-BILLED CURLEW	NUMENIUS AMERICANUS	SP/SD
MILK SNAKE	LAMPROPELTIS TRIANGULUM	SP
NORTHERN FLYING SQUIRREL	GLAUCOMYS SABRINUS	SD
NORTHERN GOSHAWK	ACCIPITER GENTILIS	SP
NORTHERN RIVER OTTER	LONTRA CANADENSIS	SP/SD
PEREGRINE FALCON	FALCO PEREGRINUS	E
RAZORBACK SUCKER	XYRAUCHEN TEXANUS	E
ROUNDTAIL CHUB	GILA ROBUSTA	T
SMITH'S BLACK-HEADED SNAKE	TANTILLA HOBARTSMITHI	SD
SMOOTH GREENSNAKE	OPHEODRYS VERNALIS	SP/SD
SOUTHWESTERN WILLOW FLYCATCHER	EMPIDONAX TRAILLII EXTIMUS	E
SWAINSON'S HAWK	BUTEO SWAINSONI	SP
TOWNSEND'S BIG-EARED BAT	CORYNORHINUS TOWNSENDII	SP/SD
WESTERN RED BAT	LASIURUS BLOSSEVILLII	SP/SD
WESTERN TOAD	BUFO BOREAS	SP
WILLIAMSON'S SAPSUCKER	SPHYRAPICUS THYROIDEUS	SD

### Key to State Status Field

<u>Symbol</u>	<u>Definition</u>
XNCT	<b>Extinct Species:</b> any wildlife species that has disappeared in the world.
XTRP	<b>Extirpated Species:</b> any wildlife species that has disappeared from Utah since 1800.
E	<b>State Endangered Species:</b> any wildlife species or subspecies which is threatened with extirpation from Utah or extinction resulting from very low or declining numbers, alteration and/or reduction of habitat, detrimental environmental changes, or any combination of the above. Continued long-term survival is unlikely without implementation of special measures.
T	<b>State Threatened Species:</b> any wildlife species or subspecies which is likely to become an endangered species within the foreseeable future throughout all or a significant part of its range in Utah or the world.
SP	<b>Species of Special Concern:</b> any wildlife species or subspecies that has experienced a substantial decrease in population, distribution and/or habitat availability.
SD	<b>Species of Special Concern:</b> any wildlife species or subspecies that occurs in limited areas and/or numbers due to a restricted or specialized habitat.
SP/SD	<b>Species of Special Concern:</b> any wildlife species or subspecies that has both a declining population and a limited range.
CS	<b>Conservation Species:</b> any wildlife species or subspecies, except those species currently listed under the Endangered Species Act as Threatened or Endangered, that meets the state criteria of Endangered, Threatened or of Special Concern, but is currently receiving sufficient special management under a Conservation Agreement developed and/or implemented by the state to preclude its listing above.

**County Lists of Utah's Federally Listed  
Threatened(T), Endangered(E), and Candidate(C) Species**

**Beaver County**

<u>Common Name</u>	<u>Scientific Name</u>	<u>Status</u>
California Condor - Historically	<i>Gymnogyps californianus</i>	E Experimental
Bald Eagle	<i>Haliaeetus leucocephalus</i>	T
Yellow-billed Cuckoo - Possibly	<i>Coccyzus americanus</i>	C
Utah Prairie Dog	<i>Cynomys parvidens</i>	T

**Box Elder County**

<u>Common Name</u>	<u>Scientific Name</u>	<u>Status</u>
Fat-whorled Pondsnail	<i>Stagnicola bonnevillensis</i>	C
Lahontan Cutthroat Trout - Introduced	<i>Oncorhynchus clarki henshawii</i>	T
June Sucker - Introduced	<i>Chasmistes liorus</i>	E
Bald Eagle	<i>Haliaeetus leucocephalus</i>	T
Yellow-billed Cuckoo - Possibly	<i>Coccyzus americanus</i>	C
Gray Wolf - Historically	<i>Canis lupus</i>	T Extirpated

**Cache County**

<u>Common Name</u>	<u>Scientific Name</u>	<u>Status</u>
Maguire Primrose	<i>Primula maguirei</i>	T
Bald Eagle	<i>Haliaeetus leucocephalus</i>	T
Yellow-billed Cuckoo - Possibly	<i>Coccyzus americanus</i>	C
Brown (Grizzly) Bear - Historically	<i>Ursus arctos</i>	T Extirpated
Canada Lynx - Possibly	<i>Lynx canadensis</i>	T

**Carbon County**

<u>Common Name</u>	<u>Scientific Name</u>	<u>Status</u>
Uinta Basin Hookless Cactus	<i>Sclerocactus glaucus</i>	T
Graham Beardtongue	<i>Penstemon grahamii</i>	C
Humpback Chub	<i>Gila cypha</i>	E
Bonytail	<i>Gila elegans</i>	E
Colorado Pikeminnow	<i>Ptychocheilus lucius</i>	E
Razorback Sucker	<i>Xyrauchen texanus</i>	E
Bald Eagle	<i>Haliaeetus leucocephalus</i>	T
Yellow-billed Cuckoo - Possibly	<i>Coccyzus americanus</i>	C
Mexican Spotted Owl - Possibly	<i>Strix occidentalis lucida</i>	T
Black-footed Ferret - Unconfirmed	<i>Mustela nigripes</i>	E Extirpated

**Daggett County**

<u>Common Name</u>	<u>Scientific Name</u>	<u>Status</u>
Ute Ladies'-tresses	<i>Spiranthes diluvialis</i>	T
Humpback Chub - Historically	<i>Gila cypha</i>	E
Bonytail - Historically	<i>Gila elegans</i>	E
Colorado Pikeminnow	<i>Ptychocheilus lucius</i>	E
Razorback Sucker - Historically	<i>Xyrauchen texanus</i>	E
Bald Eagle	<i>Haliaeetus leucocephalus</i>	T
Yellow-billed Cuckoo - Possibly	<i>Coccyzus americanus</i>	C
Black-footed Ferret - Unconfirmed	<i>Mustela nigripes</i>	E Extirpated
Brown (Grizzly) Bear - Historically	<i>Ursus arctos</i>	T Extirpated
Canada Lynx	<i>Lynx canadensis</i>	T

**CANYON FUEL COMPANY'S  
2003 GOB VENT BOREHOLE PROGRAM**

*Strix occidentalis lucida*  
**MEXICAN SPOTTED OWL SURVEY  
DUGOUT CANYON  
CARBON COUNTY**

**CONDUCTED  
MAY 20 TO JUNE 18, 2003**

**BY  
EIS ENVIRONMENTAL & ENGINEERING CONSULTING  
31 NORTH MAIN STREET  
HELPER, UTAH 84526  
(435) 472-3814  
FAX (435) 472-8780  
[www.eisenviro.com](http://www.eisenviro.com)**

**Canyon Fuel Company  
Dugout Canyon  
Mexican Spotted Owl Survey  
(*Strix occidentalis lucida*)**

## **Introduction**

Canyon Fuel Company has contracted EIS Environmental & Engineering Consulting (EIS) to conduct a survey for their 2003 Coal Exploration Program. The proposed area is located east of Price, Utah. This area consists of primarily of private land and a small portion managed by the Bureau of Land Management (BLM). Proposed activities include the drilling of up to six gob vent boreholes. These proposed drill holes and associated sites are required to be surveyed for the Mexican spotted owl (*Strix occidentalis lucida*). This species has been identified by the U.S Fish and Wildlife Service (USFWS) through past studies as occurring, or potentially occurring within the Canyon Fuel program area. Using established protocols, certified personnel of EIS conducted a field survey of the area. The survey for this Development Program was conducted from May 20 through June 18, 2003.

## **Methodology**

### **Mexican spotted owl (*Strix occidentalis lucida*)**

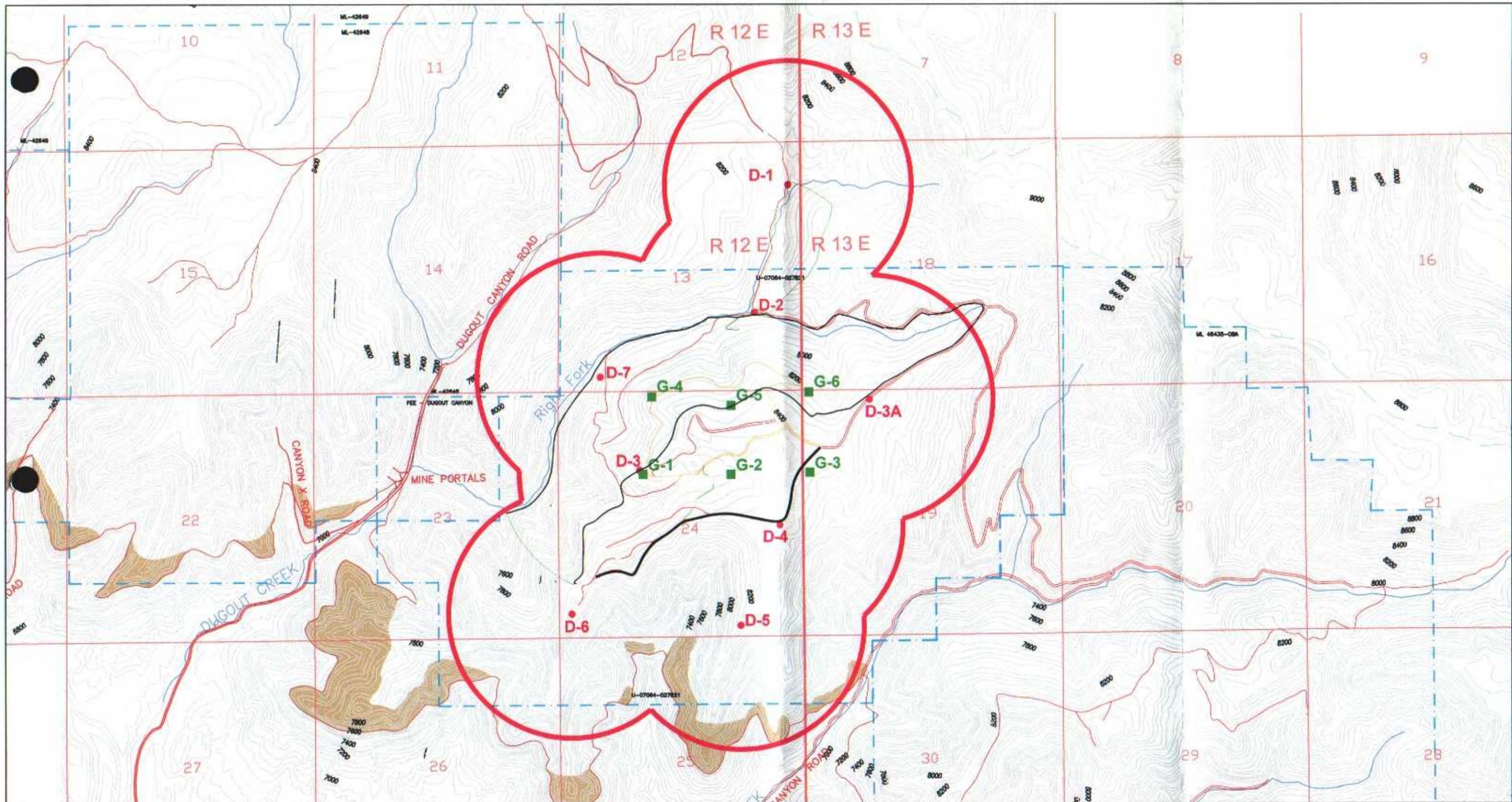
The inventory work on the project area was conducted from one half hour past sunset until one half hour before sunrise (period of highest owl activity) on May 20<sup>th</sup>, 27<sup>th</sup>, June 4<sup>th</sup>, 11<sup>th</sup>, and 18<sup>th</sup>, 2003. Following USFWS protocol, the area of concern was divided into seven calling points, each point being within 0.5 miles of the next. A calling point survey was conducted and each point was called for 20 minutes or more, unless a predator of MSO was encountered.

Calling procedures were as follows: surveyors called with their voice using the four-note hoot for one to two minutes, then listened for a return for five minutes. After five minutes, they would call using the four-note hoot and the whistle for one to two minutes, while listening for another five minutes. Finally they would call with the aggravated call, four-note hoot and/or whistle and listen for the remainder of the time. While listening for the last five minutes, a 1,000,000 candlepower spotlight was utilized to search treetops and cliff ledges for any sign of owls (i.e., eye-shine, whitewash, etc.).

## **Results**

Although suitable habitat did exist within the project area, a thorough search did not reveal the presence of any Mexican spotted owls. However, during the night of May 20<sup>th</sup>, a Great horned owl was heard. Northern saw whets were noted on May 20<sup>th</sup> at site D-2, May 27<sup>th</sup> and June 4<sup>th</sup> at D-6, June 4<sup>th</sup> at D-5 and June 11<sup>th</sup> at D-3.

Field inventory sheets are included in Attachment 1.



**LEGEND**

- Potential Gob Vent Bore Holes
- Call Point
- Burn



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Map Name:  
**MSO Location Map**  
DATE: JULY 2003  
SCALE: SCALE 1" = 2000'

PREPARED FOR:  
**Dugout Canyon Mine  
Canyon Fuel Company**  
Map Title:  
**PLATE 1**

DRAWN BY: NICOLE BUTKOVICH  
  
AUTOCAD REF:  
DUGOUTCANYON\FUEL\CANYONFUEL\_MSO.DWG



DEPARTMENT OF THE INTERIOR U.S. FISH AND WILDLIFE SERVICE		3-201 (1/97)	
<b>FEDERAL FISH AND WILDLIFE PERMIT</b>		<b>2. AUTHORITY-STATUTES</b> 16 USC 1539(A) 16 USC 703-712  REGULATIONS (Attached) 50 CFR 17.32 50 CFR 21.23 50 CFR 21.27	
<b>1. PERMITTEE</b>  ENVIRONMENTAL INDUSTRIAL SERVICES 31 NORTH MAIN HELPER, UT 84526 U.S.A.		<b>3. NUMBER</b> TE044836-0	
<b>4. RENEWABLE</b> <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		<b>5. MAY COPY</b> <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	
<b>6. EFFECTIVE</b> 08/03/2001		<b>7. EXPIRES</b> 12/31/2005	
<b>8. NAME AND TITLE OF PRINCIPAL OFFICER (If #1 is a business)</b> MELVIN A. COONROD		<b>9. TYPE OF PERMIT</b> THREATENED SPECIES	
<b>10. LOCATION WHERE AUTHORIZED ACTIVITY MAY BE CONDUCTED</b> ON LANDS SPECIFIED WITHIN THE ATTACHED SPECIAL TERMS AND CONDITIONS			
<b>11. CONDITIONS AND AUTHORIZATIONS.</b>  A. GENERAL CONDITIONS SET OUT IN SUBPART D OF 50 CFR 13, AND SPECIFIC CONDITIONS CONTAINED IN FEDERAL REGULATIONS CITED IN BLOCK #2 ABOVE, ARE HEREBY MADE A PART OF THIS PERMIT. ALL ACTIVITIES AUTHORIZED HEREIN MUST BE CARRIED OUT IN ACCORD WITH AND FOR THE PURPOSES DESCRIBED IN THE APPLICATION SUBMITTED. CONTINUED VALIDITY, OR RENEWAL, OF THIS PERMIT IS SUBJECT TO COMPLETE AND TIMELY COMPLIANCE WITH ALL APPLICABLE CONDITIONS, INCLUDING THE FILING OF ALL REQUIRED INFORMATION AND REPORTS.  B. THE VALIDITY OF THIS PERMIT IS ALSO CONDITIONED UPON STRICT OBSERVANCE OF ALL APPLICABLE FOREIGN, STATE, LOCAL OR OTHER FEDERAL LAW.  C. VALID FOR USE BY PERMITTEE NAMED ABOVE.  D. Further conditions of authorization are contained in the attached Special Terms and Conditions.			
<input checked="" type="checkbox"/> ADDITIONAL CONDITIONS AND AUTHORIZATIONS ALSO APPLY			
<b>12. REPORTING REQUIREMENTS</b> ANNUAL REPORT DUE: 12/31			
<b>ISSUED BY</b> 		<b>TITLE</b> ARD - ECOLOGICAL SERVICES	
		<b>DATE</b> 08/03/2001	

## EIS ENVIRONMENTAL & ENGINEERING CONSULTING STAFF



**Melvin A. Coonrod**  
Owner, EIS

Mel Coonrod has a Bachelors of Science Degree in Vertebrate Zoology and Chemistry, a Masters Degree in Silviculture, and Post-Graduate work in ecology. Mel has a wide range of experience in the environmental arena. Beginning as an instructor in two major universities, then into the private sector where he built the largest reforestation TSI contracting firm in the Intermountain West, planting in excess of one million trees per year. In the mid-1970's, he was hired by Getty Oil Company as an environmental coordinator; and completed the second Approved Mine Reclamation Plan in Utah. When Texaco purchased Getty Oil in 1981, Mel founded EIS Environmental Industrial Service. Under his direction, the firm has implemented numerous NEPA documents, PAP's, LBA's. reclamation and engineering plans throughout the west. The first two coal mines to receive Phase II Bond Release were projects in which EIS played a major role in both planning and implementation. Mel is licensed in engineering; landscape architecture; general contracting; and is certified for Threatened, Endangered, and Sensitive Species surveys; wetland delineation; raptor inventories; asbestos inspection; and numerous MSHA ratings. He is also a licensed pilot and a fully certified diver in open water, with scuba ratings in various areas.

In addition to his vast experience in a variety of fields, he has published a number of articles and has worked extensively with several government agencies in developing training films and literature used to instruct both industry and agency personnel in areas of reclamation and wildlife enhancement. Mel's philosophy relative to development is to create a win-win scenario, wherein the resource can be utilized in a cost-effective manner, while at the same time the environment can be enhanced to such a degree through cost-effective mitigation that there is no net loss for the life of the project.

Canyon Fuel Company, LLC  
Dugout Canyon Mine

Methane Degassification Amendment  
August 2003

**ATTACHMENT 3-3  
RAPTOR SURVEY**

Canyon Fuel Company, LLC  
Dugout Canyon Mine

Methane Degassification Amendment  
August 2003

**CHAPTER 4**  
**LAND USE AND AIR QUALITY**

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**LIST OF ATTACHMENTS**

- |                       |  |
|-----------------------|--|
| <b>Attachment 4-1</b> | Cultural Resource Survey and Inventory |
| <b>Attachment 4-2</b> | Surface Land Owner Agreement           |

## **410 LAND USE**

### **411 Environmental Description**

A statement of the conditions and capabilities of the land to be affected by mining and reclamation operations follows in this section.

#### **411.100 Premining Land Use**

The area is utilized for the landowners private use and as open range for livestock and wildlife.

#### **411.110 Land Use Map and Narrative**

Refer to the same section of the approved M&RP.

#### **411.120 Land Capability**

The major plant communities at the well sites are identified in Section 321. No cultivated lands lie within the well boundaries, due to the limiting terrain and lack of water for irrigation. Refer to Section 321.200, Table 3-1 of this submittal for forage production per acre for each well site.

The well site areas are located on the flatter mesa tops and rolling terrain. This type of terrain receives heavier pressure because of more available forage and easier movement by livestock.

#### **411.130 Land Use Description**

The wells are located on land administered by Milton & Ardith Thayn Trust and zoned by Carbon County for mining and grazing (MG-1).

No industrial or municipal facilities are located on or immediately adjacent to the well sites.

#### **411.140 Cultural and Historic Resources Information**

**Cultural and Historic Resource Maps** - Archaeological surveys were conducted in June 2003, of the well sites. Nothing was found that required future investigation. There are no cemeteries, public parks, or units of the National System of Trails or the Wild and Scenic Rivers System located within the well site boundaries. The report can be found in Attachment 4-1 of this submittal.

Dugout Canyon agrees to notify the Division and State Historical Preservation Office (SHPO) of previously unidentified cultural resources discovered in the course of operations. Dugout Canyon also agrees to have any such cultural resources evaluated in terms of NRHP eligibility criteria. Protection of eligible cultural resources will be in accordance with Division and SHPO requirements. Dugout Canyon will also instruct its employees that it is a violation of federal and state law to collect individual artifacts or to otherwise disturb cultural resources.

#### **411.200 Previous Mining Activity**

Dugout Canyon has no knowledge of the removal of coal or other minerals in the well site areas.

#### **412 Reclamation Plan**

##### **412.100 Postmining Land-Use Plan**

All uses of the land prior to the wells construction/operation and the capacity of the land to support prior alternate uses will remain available throughout the life of the sites.

Dugout Canyon intends the postmining land use to be livestock and wildlife grazing. Final reclamation activities will be completed in a manner to provide the lands able to parallel the premining land use.

#### **412.200 Land Owner or Surface Manager Comments**

Milton & Ardith Thayn Trust is the landowner. Canyon Fuel Company, LLC has a surface land owner agreement with the Thayne Trust for the drilling of degassification holes (Attachment 4-2).

#### **413 Performance Standards**

##### **413.100 Postmining Land Use**

Postmining land uses are discussed in Section 412.100. The postmining lands will be reclaimed in a timely manner and capable of supporting such uses (see Chapters, 2, 3, 5, and 7).

##### **413.200 Determining Premining Uses of Land**

Refer to Section 411.100.

##### **413.300 Criteria for Alternative Postmining Land Uses**

No alternative postmining land uses have been planned.

#### **414 Alternative Land Use**

No alternative postmining land uses have been planned.

## **420 AIR QUALITY**

### **421 Air Quality Standards**

Dugout Canyon activities will be conducted in compliance with the requirements of the Federal Clean Air Act and the Utah Air Conservation Rules.

### **422 Compliance Efforts**

See Fugitive Dust Control Plan, Section 424.

### **423 Monitoring Program**

Refer to the same section in the approved M&RP.

### **424 Fugitive Dust Control Plan**

Operational areas that are used by mobile equipment will be water sprayed to control fugitive dust. The application of water will be of sufficient frequency and quantity to maintain the surface material in a damp/moist condition unless it is below freezing.

### **425 Additional Division Requirements**

Refer to the same section of the approved M&RP.

Canyon Fuel Company, LLC  
Dugout Canyon Mine

Methane Degassification Amendment  
August 2003

**ATTACHMENT 4-1**  
**CULTURAL RESOURCE SURVEY AND INVENTORY**



# SENCO-PHENIX

## AN INTENSIVE CULTURAL RESOURCE SURVEY AND INVENTORY OF THE 2003 DUGOUT CANYON MINE DRILL HOLES AND ACCESS ROADS

Private Lands

Carbon County, Utah

PERFORMED FOR  
Dugout Canyon Mine of  
Canyon Fuel Company, LLC

In Accordance with BLM and  
Utah State Guidelines  
Antiquities Permit #U03SC455p

SPUT-455  
June 24, 2003

John A. Senulis

Direct Charge of Fieldwork

# UTAH SHPO COVER SHEET

Project Name: AN INTENSIVE CULTURAL RESOURCE SURVEY AND INVENTORY OF THE 2003  
DUGOUT CANYON MINE DRILL HOLES AND ACCESS ROADS

Dugout Canyon Mine of Canyon Fuels LLC.

State #U031SC0455p

Report Date: June 24, 2003

County (ies): Carbon

Principal Investigator/ Field Supervisor: John A. Senulis/John Senulis

Records Search/Location/Dates: June 6, 2003, Price River Field Office of the BLM

Acreage Surveyed: 56 acres

Intensive Acres: 56

Recon/Intuitive Acres: 0

U.S.G.S. 7.5 Quad: Pine Canyon, Utah (1972), Mount Bartles, Utah (1972)

Sites Reported	Number	Smithsonian Site #(s):
Archeological Sites:	0	
Revisit (No IMACS update)	0	
Revisit (IMACS update attch.)	0	
New Sites (IMACS attached)	0	
Archeological Site Total:	0	
Historic Structures:		
(USHS Site Form Attached)		
Total NRHP Eligible Sites,	0	

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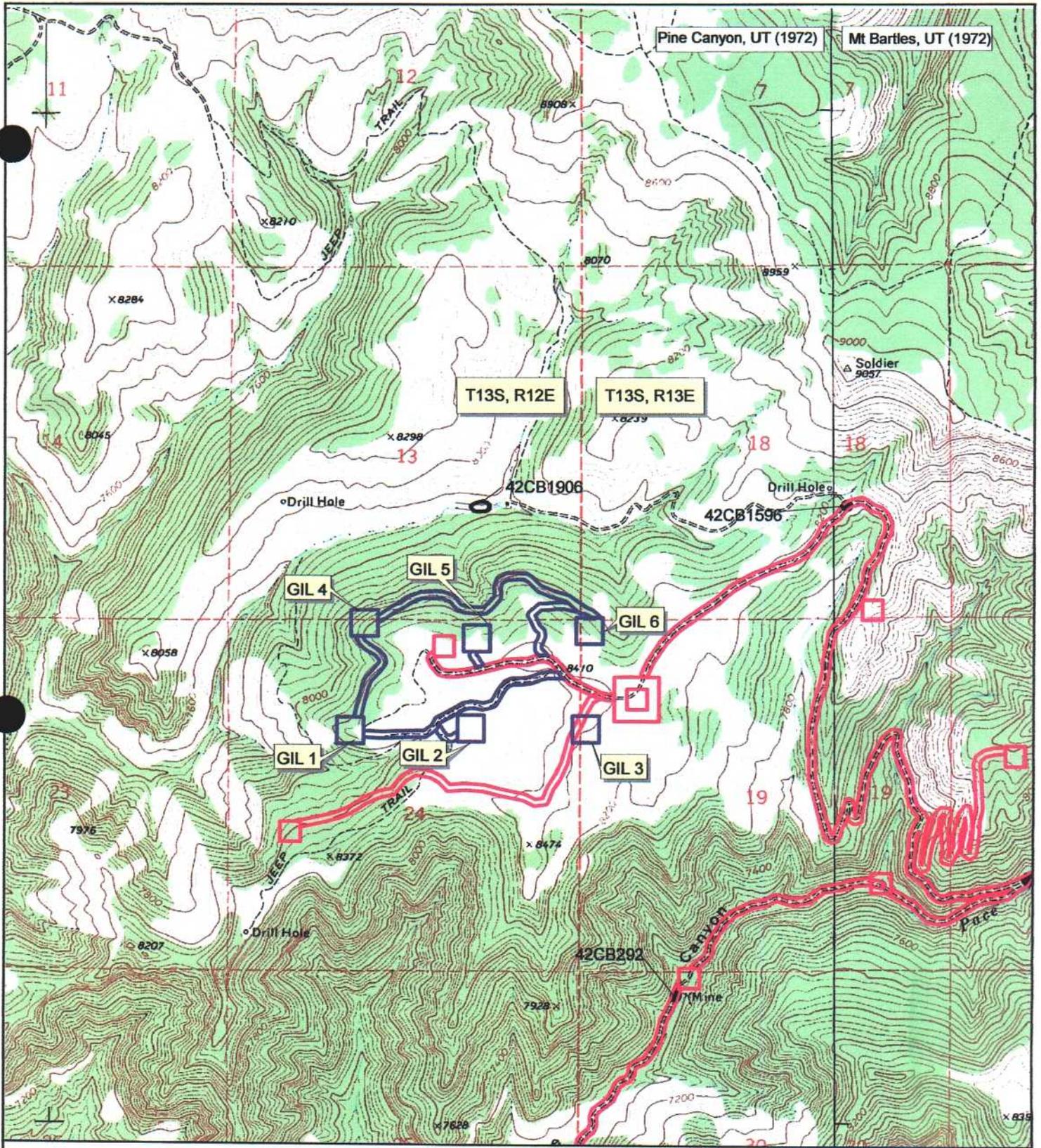
## Checklist of Required Items:

1. X 1 Copy of Final Report
2. X Copy of U.S.G.S. 7.5' map showing surveyed/excavated area
3. Completed IMACS Site Inventory Forms Including
  - \_\_\_\_\_ Parts A and B or C
  - \_\_\_\_\_ IMACS Encoding Form
  - \_\_\_\_\_ Site Sketch Map
  - \_\_\_\_\_ Photographs
  - \_\_\_\_\_ Copy of USGS 7.5' Quad with Smithsonian site Number
4. X Completed Cover Sheet

## Abstract

SENCO-PHENIX performed an intensive cultural resource survey on six proposed drill holes and connecting access roads for the Dugout Canyon Mine of Canyon Fuel LLC. The proposed drill holes and access roads are located on private land. The purpose of the survey was to identify and evaluate cultural resources that may exist within the project area.

No cultural resources were located and the potential for undetected remains is remote. A finding of no effect is appropriate and archeological clearance without stipulations is recommended.



**SENCO-PHENIX**



Scale 1:24,000  
1" = 2,000'

- Current Survey
- Previous Survey
- Eligible Sites
- Ineligible Sites

**Drill Holes & Access Roads**  
**Dugout Mine of Canyon Fuel, LLC**  
**Carbon County, Utah**  
**Sections 13, 24, T13S, R12E**  
**Sections 18, 19, T13S, R13E**  
**June 2003**  
**SPUT-455**

### Project Location

The project begins at a previously surveyed access road on a mesa above Dugout Creek Canyon. In Section 19, T13S, R13E, Carbon County, Utah. Access to the drill holes will mostly follow existing two-track dirt roads that were built to facilitate logging in the general area. A total of 1.7 miles were included in the study area. Seven 400 x 400 foot drill locations were surveyed in Section 24, T13S, R12E, and Sections 19, T13S, R13E. All drill locations were flagged. The proposed project is noted on the enclosed copy of U.S.G.S. Composite 7.5' Quad: Pine Canyon, Utah (1972) and Mount Bartles, Utah (1972).

### Environment

The project area is a mesa above Pace Canyon. The mesa is basically sagebrush flat intermixed with pockets of Pinyon-Juniper and stands of Aspen. The understory consists of mountain mahogany, rabbitbrush, ephedra, galleta grass, yucca, and serviceberry. There is no permanent water in the project area

### Previous Research

A file search by the Antiquities Section of the Utah Division of State History on April 25, 2002 updated by John Senulis of SENCO-PHENIX at the Price River Field Office of the BLM on June 6, 2003 revealed that the following projects are reported for the current project area:

- 1980, AERC surveyed several sample blocks in Sections 13 and 24, T13S, R12E and Sections 18, 19 and 30 T13S, R13E. They also surveyed the access road into the Snow Mine site. One archeological site was located:
  - 42CB292 The site was described as "Coal mine located in Pace Canyon consists of one known mine portal which has been closed. Site of historic Snow Mine in Pace Canyon which was active in 1906 but had its primary production period from 1932-1940." The site was relatively pristine at the time and still contained a standing coal loadout and foundation with depth potential. Avoidance was recommended pending further historic research. As noted the site has since been extensively modified.
- 1982, UARC surveyed five drill holes in the current project area. No cultural resources were located.
- 1983, Metcalf-Zier Archeologists surveyed several access roads and drill locations in Sections 13 and 24, T13S, R12E and Section 19, T13S, R13E. The only cultural resource located was an isolated prehistoric waste flake.
- 2002, SENCO-PHENIX surveyed several drill holes and an extensive series of roads. One cultural resource in the general project area was located.
  - 42CB1596 was a corral and Aspen art site. It was not recommended for nomination to the NRHP.

### Methodology

SENCO-PHENIX performed a Class III intensive walkover survey on June 11, 2003. John Senulis directed the field crew consisting of Jeanne Senulis and Cathy Dodt-Ellis. Meandering transects no further spaced than 15 meters were employed for the drill holes. The 400 x 400 foot drill holes were mostly in previously disturbed areas. The access roads were surveyed to a right of way of 30 meters. Exceptions to this were the steep sideslope on the northern loop road, which was surveyed in areas where there was some width and possibility of containing cultural resources. Special attention was given to those areas of subsurface soil exposure from animal burrowing and erosion.

All field notes and digital photographs are on file at the offices of SENCO-PHENIX in Price, Utah.

### Findings and Recommendations

No cultural resources were located and the potential for undetected remains is remote. A finding of no effect is appropriate and archeological clearance without stipulations is recommended.

These recommendations are subject to modification and review by the Utah SHPO.

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Fax 435.613.9116  
E-mail: senjohn@usa.net

SENCO PHENIX  
Archeological Consultants

## John A. Senulis

### Current Position

Owner and Principal Investigator of SENCO-PHENIX Archeological Consultants (1980-Present). Cultural Resource Management Consultants for Private Industry and Federal and State Agencies.

### Education

1966 - 1969 University of Utah Salt Lake City, Utah

#### Ph. D. Studies in Anthropology

- Completed All Requirements but Dissertation. National Science Foundation Traineeship and Teaching Associate.

1963 - 1966 Pennsylvania State University University Park, PA

#### Master of Arts Degree in Anthropology

- Teaching and Research Assistantships in Anthropology.

1958 - 1963 Pennsylvania State University University Park, PA

#### Bachelor of Arts Degree in Anthropology

- Archeological Field Supervisor in Central Mexico (Teotihuacan) Senior Year.

### Expertise

Prehistoric and Historic Archeology, Ethnohistory of the New World specializing in the Rocky Mountains and Great Basin (20 Years).

Cultural Resource Management including the identification, recordation, evaluation and mitigation of Prehistoric and Historic resources utilizing National Park Service methodology and the criteria of the National Register of Historic Places (30 Years).

Cultural Resource Management including the preparation of Prehistoric and Historic cultural contexts, impact analysis and mitigation plans for Environmental Impact Statements and Environmental Assessments (22 Years).

Meso-American Archeology and Ethnohistory utilizing Native American Codices (6 Years).

Academic Program Development emphasizing the various branches of Anthropology (5 Years).

### Professional Experience

1980 - 2003 SENCO-PHENIX, Salt Lake City and Price, Utah

#### Owner and Principal Investigator

- Direct charge of over 1,100 archeological surveys, documentation's of eligibility, test excavations and mitigations throughout the Rocky Mountains and Great Basin. Includes lands administered by the Bureau of Land Management, Forest Service, Bureau of Indian Affairs and various state agencies.

- Preparation of the cultural resource segments of various Environmental Impact Statements and Environmental Assessments.
- Project manager, photographer and author for mitigation documents for the Historic American Building Survey and the Historic American Engineering Record (HABS/HAER).

1980 Archeological Services, Laramie, Wyoming

**Survey Archeologist and Director of Planning and Development.**

- Direct charge of various surveys and test excavations. In charge of maintenance and development of a client base.

1974 - 1978 Rhode Island Historic Preservation Commission, Providence, RI.

**Senior Preservation Planner in Archeology**

- In general charge of the statewide Archeological Survey and various projects in Cultural Resource Management.

1970 - 1974 University of Rhode Island, Kingston, Rhode Island

**Instructor of Anthropology**

- Developed the Academic program in Archeology, Physical Anthropology, Linguistics and Visual Anthropology for a new BA Degree Program in Anthropology.

1969 - 1970 Utah State University, Logan, Utah

**Instructor of Anthropology**

- Developed the Academic program in Archeology including designing and supervising a Field School in Archeology.

1966 Department of Natural Resources, Ontario, Canada

**Contract Archeologist**

- Conducted test excavations at historic British Fort Lennox on the Richelieu River in Quebec, Canada.

**Selected Reports From Major Projects**

1997-2003 Archeological Survey, inventory, and site evaluations for well locations, access corridors for ConocoPhillips Company in the Price River Basin on BLM, SITLA and Private Land. Mitigation Plan, Documentations of Eligibility, Testing of several Fremont Period archeological sites.

1999-2001 Various well locations, access corridors, pipeline corridors for Chevron U.S.A., Inc., Shenandoah Energy Inc., Chandler & Associates, Medallion Exploration in the Uintah Basin of Utah.

*An Intensive Cultural Resource Survey and Inventory of Proposed Borrow Areas Along the Dugout Canyon Road, Creamer & Noble Engineers & Canyon*

Fuel Company, LLC., Price Resource Area, Bureau of Land Management and SITLA, Price, Utah.

*An Intensive Cultural Resource Survey and Inventory of the Proposed West Ridge C Canyon Access Road and Borrow Area, Carbon County, West Ridge Resources, Inc., Creamer & Noble Engineers, Price Resource Area, Bureau of Land Management, SITLA, and Private, Price, Utah. Prepared Cultural Resources Sections of E.A. on the same project.*

1997 Various well locations, roads, pipelines and powerlines for Chevron U.S.A., Inc., Snyder Oil Corporation, and Anschutz Corporation located in the Uinta Basin of Utah and in the Manti-LaSal National Forest in central Utah.

Fieldwork on the proposed West Ridge Coal Mine and access corridors for Andalex Resources. Included archeological testing of a Fremont Period site. Proposed project is located on lands administered by the Price Resource Area of the BLM.

*An Intensive Cultural Resource Survey and Inventory of a Seismic Prospect in Sevier County, Utah. 24.5 Miles of Seismic Lines in the Richfield District of the BLM, Utah, performed for 3-D Geophysical.*

*Archeological Block survey of 335 Acres for Proposed Wildlife Mitigation Area for Andalex Resources located on State lands within the Price Resource Area of the BLM.*

1996 *An Intensive Cultural Resource Survey and Inventory of the Leland Bench 3D Seismic Project, Snyder Oil Company through Western Geophysical, Ute Tribe, Uintah & Ouray Reservation, Fort Duchesne, Utah.*

1996 *An Intensive Cultural Resource Survey and Inventory of the Dugout Creek Road Reconstruction, Carbon County through Creamer & Noble Engineers, Price River Resource Area, Bureau of Land Management, Price, Utah.*

1995 *A Research Design for Prehistoric and Historic Archeological Site Discovery in the Red Wash Oil and Gas Field, CHEVRON U.S.A. Inc., Vernal District, Bureau of Land Management, Vernal, Utah.*

1994 *Documentation of Eligibility and a Damage Assessment for the Ruby Creek Stone Circle Site Complex, Phillips Petroleum, Billings Resource Area, Miles City District, Bureau of Land Management, Billings, Montana. Prepared Cultural Resources Sections of E.I.S. in 1991.*

1993, 1992, & 1991 *Archeological Class III Inventory of a Right-of-Way for Segments of a Proposed Buried Fiber Optic Cable, Oregon-Idaho Utilities, Malheur Resource Area, Jordan Resource Area of Bureau of Land Management, Malheur County, Oregon. Owyhee Resource Area, Boise District, Bureau of Land Management, Owyhee County, Idaho. Prepared Historic Context for Silver City, Idaho.*

1993 *An Intensive Cultural Resource Survey, Site Evaluation, Environmental Context and Discovery Plan for the Wahsatch Gathering System*, Union Pacific Resources through Bear West Company. Bear River Resource Area, Bureau of Land Management, Summit and Rich Counties, Utah; Kemmerer Resource Area, Bureau of Land Management, Wyoming. Information for E.A.

1992 & 1987 *An Intensive Cultural Resource Block Survey and Inventory of 1520 Acres in Wonsits Valley, Utah and Intensive Cultural Resource Survey and Inventory of Block Areas within the Wonsits Valley Oilfield*, CHEVRON U.S.A., Inc. Ute Tribal Lands, Uintah and Ouray Indian Reservation, Bureau of Indian Affairs, Uintah County, Utah. Information for E.A.

1991 *An Intensive Cultural Resource Survey and Inventory of the Hunter Creek Federal #1-27 Alternate Well Pads and Staging Areas*, CHEVRON U.S.A., Inc., Bridger-Teton National Forest, Jackson Hole, Wyoming. Prepared Cultural Sections for E.I.S.

1991 *An Increased Data Base for The Little Dell Cultural Resources Data Recovery Program*, U.S. Army Corps of Engineers, Salt Lake County, Utah.

1990 *Intensive Cultural Resource Survey and Inventory with Management Recommendations for the Historic Resources in the Champagne Creek Valley*, Idaho Gold Corporation. Idaho Falls District, Bureau of Land Management, Idaho Falls, Idaho. Incorporated in an E.I.S.

1989 *Intensive Cultural Resource Survey and Inventory of Historic and Prehistoric Resources located adjacent to the Historic Townsite of Tuscarora, Nevada*, Chevron Resources through Steffen, Robertson & Kirsten. Elko District, Bureau of Land Management, Elko, Nevada. Incorporated in an E.I.S.

1989 *Intensive Cultural Resource Survey and Inventory of the Grouse Creek Mine Expansion Adjacent to the Custer and Bonanza Historic Districts*, Grouse Creek Mining Company/James M. Montgomery Engineers, Challis National Forest, Custer County, Idaho. Incorporated in an E.I.S.

1989 *Intensive Cultural Resource Survey and Inventory of the Sandman Prospect Drill Holes and Block Survey*, BP Minerals through Steffen, Robertson & Kirsten, Winnemucca District of the Bureau of Land Management, Humboldt County, Nevada.

1989 *Intensive Cultural Resource Block Survey and Inventory of the Buffalo Valley Mine Expansion/Drilling and Trenching*, Chevron Resources through Steffen, Robertson & Kirsten, Battle Mountain District of the Bureau of Land Management, Lander and Humboldt Counties, Nevada. Incorporated in an E.I.S.

1989 *Intensive Cultural Resource Block Survey and Inventory of the Ali-Alk Prospect Exploration Area*, Atlas Precious Metals. Malheur Resource Area of the Bureau of Land Management, Malheur County, Oregon.

1989 *Intensive Cultural Resource Block Survey and Inventory of the Proposed Grassy Mountain Mine*, Atlas Precious Metals through Steffen, Robertson &

Kirsten, Malheur Resource Area of the Bureau of Land Management, Malheur County, Oregon.

*1988 Survey and Testing of Sites Along Portions of the Blue Forest Gathering System Pipeline*, Amoco Pipeline Company, Rock Springs District of the Bureau of Land Management, Sweetwater County, Wyoming.

*1987 Intensive Cultural Resource Survey and Inventory of the Carter Mountain Unit #1 Block Survey*, Exxon Company, U.S.A., Shoshone National Forest, Park County, Wyoming. Prepared Cultural Sections of E.I.S.

*1987 Intensive Cultural Resource Survey and Inventory of Proposed Borrow Pits, Dikes, and Haul Roads in the Great Salt Lake Desert*, AMAX Magnesium, Salt Lake District of the Bureau of Land Management, Tooele County, Utah.

1986 Mitigation Documentation for the Historic American Engineering Record: *Bullion Beck and Champion Mining Company Headframe, Eureka, Utah, Tintic Mining District; Jone's Mine, Scofield, Utah; Mutual Mine, Spring Creek, Helper, Utah; Sweet Mine, Gordon Creek, Utah.*

Canyon Fuel Company, LLC  
Dugout Canyon Mine

Methane Degassification Amendment  
August 2003

**ATTACHMENT 4-2**  
**SURFACE LAND OWNER AGREEMENT**

## SURFACE USE AGREEMENT

THIS SURFACE USE AGREEMENT (this "Agreement"), dated as of November \_\_\_\_, 1999 ("Effective Date"), is by and between Canyon Fuel Company, L.L.C., ("CFC"), whose mailing address is 6955 Union Park Center, Suite 540, Midvale, Utah 84047, and Milton and Ardith Thayn Trust ("Thayn"), whose mailing address is 7730 East Hwy 6, Price, Utah 84501.

### Recitals

Thayn is the surface owner of lands located in Carbon County, Utah, which are described on **Exhibit "A"** attached hereto (the "Thayn Lands"). CFC is a coal mining company and owns and operates the Soldier Canyon Mine and Dugout Canyon Mine (the "Mines"). CFC holds rights under Federal coal leases and pursuant to mine permits granted or to be granted by the Utah Division of Oil, Gas and Mining (the "Mine Permits") to develop and mine underground coal. Thayn has agreed to grant to CFC the nonexclusive use by CFC of the surface of the Thayn Lands to facilitate its coal mining operations in exchange for rights and services from CFC.

### Agreement

IN CONSIDERATION of the mutual covenants contained in this Agreement and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the parties agree as follows:

1. Grants and Services to Thayn.
  - (a) CFC shall lease to Thayn for farming and grazing the following lands and grazing and water rights described in **Exhibit "B"** attached hereto : (1) lands owned by CFC located in the Clark Valley (the "Clark Valley Lease Lands"); (2) water rights owned by CFC appurtenant to the Clark Valley Lease Lands (the "Clark Valley Water Rights"); (3) state and federal grazing rights held by CFC related to the Clark Valley Lease Lands (the "Grazing Rights"); and (4) water rights represented by 50 shares of water stock in the Wellington Canal Company owned by CFC (the "Water Shares"). The Clark Valley Lease Lands, the Clark Valley Water Rights, the Grazing Rights and the Water Shares shall all be leased to Thayn under the "Lease Agreement" attached hereto as **Exhibit "C."**

- (b) CFC hereby grants to Thayn, for the term of this Agreement and for so long thereafter as agreed in writing by the parties, the non-exclusive, limited use of the Dugout Canyon unimproved road lying north of the Dugout Canyon Mine as may be reasonable and necessary for Thayn's cattle ranching activities, provided that such use shall (i) not interfere with the regular activities of the Mines; (ii) comply with all CFC and applicable federal, state and local rules and regulations imposed on the use of the road; and (iii) not include use of the road by any third party including hunters, tourists or sight-seers.
- (c) Upon written notice to CFC, Thayn may request that CFC monitor the flow of springs, streams and seeps located on the Thayn Lands that Thayn reasonably believes may be impacted by CFC's underground mining operations. Upon receiving the written request, CFC shall meet with Thayn to discuss the monitoring sites and to reach a mutually acceptable schedule for such monitoring, provided that CFC shall only be required to monitor such sites for flow. Nothing in this Agreement shall modify CFC's water monitoring program as required by the Mine Permits.
- (d) Thayn shall have the non-exclusive right to submit bids as an independent contractor for earth-moving projects conducted on the Thayn Lands that CFC elects, in its sole discretion, to contract to a third party. Thayn shall have a preference for selection as the contractor for the project provided that Thayn can demonstrate to the reasonable satisfaction of CFC that (i) Thayn owns or has right to use the necessary equipment for the project, (ii) Thayn carries insurance coverage required by CFC's risk management procedures for the project, (iii) Thayn has the necessary licenses and permits to conduct the project, and (iv) Thayn's proposed bid is competitive with other bids solicited by CFC for the project. Notwithstanding the foregoing, nothing in this Agreement shall be construed to require CFC to use a third party contractor for any project on the Thayn Lands or to conduct a bid process to select a third party contractor for work conducted on the Thayn Lands or on behalf of Thayn.

2. Surface Use Grants to CFC. CFC shall have and is hereby granted an easement on, over, and through, and a right to use, the surface of the Thayn

Lands as may be necessary and appropriate for the following purposes in connection with mining coal by underground mining methods: (a) conduct subsidence and soil and water sampling, and carry out raptor, wildlife and other environmental studies; (b) conduct exploration drilling and analyses of subsurface conditions by all reasonable means; (c) place or install minor mechanical instruments such as geophones, geo-seismic lines and the like to monitor underground, mine-related activities and results; (d) drill production holes, place and relocate pipelines, and place surface facilities to develop, vent or remove coalbed methane gas, provided such use shall not interfere with regular activities of Thayn's ranching and hunting, and further provided, CFC shall coordinate such activities with Thayn to minimize disruption to Thayn's ranching and hunting activities; and (e) exclusively subside the surface of the Thayn Lands. Except as provided in Sections 3 and 5, CFC shall have no obligation to pay to Thayn any compensation for use of the Thayn Lands.

3. Compensation for Surface Facilities.

- (a) In the event CFC is required to place temporary or semi-permanent structures on the Thayn Lands (such as methane venting, exhausting equipment, methane drainage pump stations, pipelines and utilities) in connection with exercising its rights hereunder, CFC shall reasonably compensate Thayn for the use of the Thayn Lands for such structures at rates comparable to other operations in the area. (By way of example, coalbed methane venting and degasification wells are currently compensated at rates in the range of \$2,000 to \$3,500 per year until the well is plugged and reclaimed.) The parties shall use their best good faith efforts to negotiate compensation for any permanent structure placed on the Thayn Lands.
- (b) CFC shall pay Thayn \$2,000 for each exploration drill hole placed on the Thayn Lands. Thayn acknowledges that \$2,000 represents fair and reasonable compensation for each such drill hole, provided, however, if any such exploration drill hole is subsequently used for coalbed methane venting, Thayn shall be entitled to additional compensation in accordance with the provisions of Section 3(a).

4. Care of Thayn Lands.

- (a) CFC shall use and maintain the Thayn Lands in a careful, safe, and lawful manner and shall conduct its operations in compliance with all applicable federal, state and local laws, rules and regulations. CFC shall only use the Thayn Lands for the purposes set forth herein and shall not permit the use or occupancy of the Thayn Lands by any person other than CFC, its employees, agents and contractors.
- (b) CFC shall provide Thayn with written notice prior to undertaking any activities on the Thayn Lands. Thayn's concurrence shall be obtained regarding the location of any proposed material surface disturbance, including but not limited to drilling exploration boreholes. Thayn's permission shall not be unreasonably withheld.
- (c) CFC shall give special siting consideration to potential borehole locations near springs and seeps on the Thayn Lands.
- (d) CFC shall repair or replace any improvements upon the Thayn Lands damaged by CFC's operations. CFC shall reclaim all surface areas disturbed as a result of CFC's operations and shall implement a noxious weed control program for all such disturbed areas for a period of not less than four years from the date of reclamation reseeded.
- (e) All drilling or other similar activities and all CFC-related facilities, such as "mud pits," that could result in injury or death to livestock shall be fenced or otherwise isolated to protect livestock. CFC shall repair or reclaim to the extent technologically and economically feasible subsidence damage to the Thayn Lands that could be harmful to livestock.
- (f) CFC shall maintain insurance coverage for its activities conducted on the Thayn Lands consistent with coverages customary for the coal industry and in compliance with all applicable regulatory requirements and shall provide Thayn with a copy of all insurance certificates naming Thayn as an additional insured against CFC's operations conducted pursuant to this Agreement.
- (g) As required by and in conformance with applicable law, CFC shall replace any water supply owned and beneficially used by Thayn for

domestic, agricultural, or other legitimate use from an underground or surface source where the water supply has been adversely impacted by contamination, diminution, or interruption proximately resulting from CFC's mining operations.

5. Term.

- (a) This Agreement shall be for a term of years beginning on the Effective Date and continuing for a period for the life of the Mines plus two (2) years, but in no event longer than twenty (20) years. For purposes of this Agreement, the life of the Mines shall end upon permanent closure of the Mines and cessation of all operations for the production and sale of coal from the Mines.
- (b) CFC shall have no obligation to make any rental or other payment to maintain this Agreement in full force and effect. The parties acknowledge and agree that the Lease Agreement shall constitute full and fair consideration for this Agreement. In the event the Lease Agreement terminates or expires as provided therein prior to a date twenty (20) years from the Effective Date, CFC shall pay to Thayn the sum of \$5,000 annually on the anniversary date for the remaining term of this Agreement in lieu of the rights granted under the Lease Agreement ("Rental Payment").
- (c) The monetary payment terms set forth in Sections 3 and 5(b) of this Agreement ("Payment Terms") shall be adjusted for inflation on the seventh (7<sup>th</sup>) and fourteenth (14<sup>th</sup>) annual anniversaries after the Effective Date based on the cumulative changes in the Consumer Price Index (CPI), or other generally-recognized economic pricing index, for the preceding seven-year period. The proposed adjustments shall be calculated by CFC and communicated to Thayn in writing within thirty (30) days after the seventh and fourteenth anniversaries. All adjustments to Payment Terms shall be effective as of the seventh and fourteenth anniversary dates and shall otherwise apply prospectively and shall not apply to payments previously made under this Agreement. All other claims for adjustment of non-monetary terms of this Agreement, including allegations of non-compliance with any express term, shall be subject to the provisions of Section 7.

- (d) Nothing in this Section 5 shall, nor shall it be interpreted to, amend, modify or waive any term or provision of Section 2 that grants rights to CFC to the Thayn Lands. Thayn shall have no right to claim a default of or to terminate this Agreement based on the Payment Terms readjustment provisions of this Section 5.
6. Title. Thayn warrants generally the title to the surface of the Thayn Lands and represents that Thayn has all necessary right and authority to grant to CFC the property rights and privileges conveyed hereunder.
7. Breach of Obligations. If either party believes that the other party has not complied with any express term, obligation or covenant of this Agreement, then in such event such party shall notify the other party in writing setting out specifically the details regarding the alleged breach or default. The party in default shall have thirty (30) days after receipt of the notice within which to cure or commence to cure all or any part of the breach or default alleged by the other party. If the defaulting party fails to cure or commence to cure the alleged default or breach as required, then the non-defaulting party shall have the option, but not the obligation, to submit the matter to binding arbitration as provided in this Agreement.
8. Arbitration. Disputes arising under this Agreement between the parties based upon any alleged breach of any of the obligations hereunder, which the parties are unable to resolve, shall be finally settled in accordance with the provisions of the Utah Arbitration Act by a single arbitrator. The arbitrator shall have broad power to grant relief for any dispute submitted pursuant to this Section 8, including without limitation termination of this Agreement. The arbitration proceedings shall be conducted in Price, Utah. CFC shall be responsible for all costs incurred in arbitration, including all fees and expenses of the arbitrator. Either party may enforce any arbitration award by instituting an action in the appropriate state or federal district court.
9. Indemnification. CFC shall indemnify, defend and hold harmless Thayn from and against all claims, costs, losses and expenses of any and every kind or character (including without limitation, mechanic liens and additional taxes) that are caused by or arise out of CFC's operations conducted on the Thayn Lands pursuant to this Agreement, provided that Thayn shall not be indemnified for matters expressly covered by this

Agreement, including without limitation the grant to CFC to subside the surface as a result of its underground mining operations.

10. Assignment. CFC's rights under this Agreement may not be assigned or sublet without the prior written consent of Thayn, which consent shall not be unreasonably withheld, provided that CFC may assign or sublease its interest hereunder without consent if such assignment or sublease is to an affiliate, parent or subsidiary of CFC, or to a party which acquires all or substantially all of the assets of CFC or the Mines.
11. Notices. All notices shall be in writing and addressed as follows:

If to Canyon Fuel Company:

President  
Ark Land Company  
CityPlace One  
Suite 300  
St. Louis, MO 63141-7056  
(314) 994-2700

With a copy to:

Canyon Fuel Company, L.L.C.  
Soldier Canyon Mine  
P.O. Box 1029  
Wellington, UT 84542  
Attn: David G. Spillman  
(435) 636-2872

If to Thayn:

Milton and Ardith Thayn Trust  
7730 East Hwy 6  
Price, UT 84501  
Attn: David Thayn  
(435) 472-4251

Notices are sufficient if delivered by hand, sent by facsimile transmission or deposited in the United States mail, postage prepaid and addressed to the appropriate addresses.

12. CFC Permits. Thayn expressly agrees to not oppose CFC's application for or issuance of the Mine Permits or for such other permits or approvals necessary or required to conduct coal mining operations at the Mines that may relate to or involve the Thayn Lands. In the event that CFC's Mine Permits are materially revised to require access or use of the Thayn Lands not granted by this Agreement, the parties shall use their respective best good faith efforts to negotiate such required access or use.

IN WITNESS WHEREOF, the parties have executed this Agreement as of the Effective Date.

**CANYON FUEL COMPANY L.L.C.**

By James E. Floyd  
Its VP & Treasurer

**Milton and Ardith Thayn Trust**

By Milton Thayn  
Its Trustee

Missouri  
STATE OF UTAH )  
City ) ss:  
COUNTY OF Alfords

The foregoing instrument was acknowledged before me this 22 day of November, by James E. Floyd who being by me duly sworn did say that he is the VP & Treasurer of Canyon Fuel Company, L.L.C.,

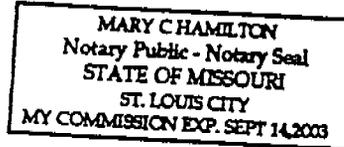
and that the foregoing Surface Use Agreement was signed on behalf of said limited liability company.

NOTARY PUBLIC

Mary C. Hamilton  
Residing at: City of St. Louis

My Commission Expires:

9-14-2003



STATE OF UTAH )  
 )ss:  
COUNTY OF CARBON )



The foregoing instrument was acknowledged before me this 15 day of NOVEMBER, by Milton Thayne, the signer of the foregoing Surface Use Agreement, who duly acknowledged to me that he executed the same as Trustee of and for the benefit of the Milton and Ardith Thayne Trust.

NOTARY PUBLIC

Dionne M. Oman  
Residing at: Price, UT

My Commission Expires:

12-15-2002

**EXHIBIT "A"**  
**to**  
**Surface Use Agreement**

**Thayn Lands**

**T13S, R12 E, Salt Lake Meridian, Utah**

Sec. 12: E/2 SE/4;

Sec. 13: E/2; SE/4 NW/4; E2 SW/4; NW/4 SW/4;

Sec. 24: All;

Sec. 25: NW/4.

**T13S, R13 E, Salt Lake Meridian, Utah**

Sec. 7: S/2SW/4, NW/4SW/4;

Sec. 18: S/2, NW/4, S/2NE/4, NW/4NE/4;

Sec. 17: SW/4, S/2SE/4, NW/4SE/4;

Sec. 19: All Except Lot 4;

Sec. 20: All;

Sec. 21: S/2, S/2N/2, NW/4NW/4;

Sec. 22: SW/4, S/2NW/4;

Sec. 27: W/2;

Sec. 28: All;

Sec. 29: All;

Sec. 30: All Except Lots 1 and 2;

Sec. 33: N/2N/2.

**EXHIBIT "B"**  
to  
**Surface Use Agreement**

**CLARK VALLEY LEASE LANDS**

(approximately 4,461 acres):

<u>Township</u>	<u>Range</u>	<u>Section</u>	<u>Description</u>
14 South	12 East	3	S½SE¼; S½SW¼
"	"	5	S½SE¼
"	"	8	NE¼NE¼; W½NE¼; SW¼; E½NW¼
"	"	9	SE¼
"	"	10	E½; SW¼; E½NW¼; SW¼NW¼
"	"	11	SE¼; NE¼; E½SE¼; SW¼SE¼; W½
"	"	13	W½; SW¼; S½NW¼; NE¼SW¼
"	"	14	All
"	"	15	E½; SW¼; E½NW¼
"	"	17	NW¼; SE¼; E½SW¼; NW¼SW¼
"	"	18	E½NE¼
"	"	20	N½NE¼
"	"	21	NE¼NW¼; W½NW¼; SE¼NE¼
"	"	22	NW¼

**CLARK VALLEY WATER RIGHTS**

Water Right No.  
(Irrigation &  
Stockwatering)

91-23  
91-85  
91-86  
91-409

Water Right No.  
(Stockwatering)

91-410 91-447  
91-411 91-448  
91-412 91-449  
91-413 91-450

**Exhibit B  
to Surface Use Agreement**

Water Right No.  
(Irrigation &  
Stockwatering)

Water Right No.  
(Stockwatering)

91-457	91-414	91-451
91-491	91-415	91-452
91-492	91-416	91-453
91-493	91-417	91-456
91-494	91-418	91-458
91-495	91-419	91-459
91-604	91-420	91-460
91-605	91-421	91-461
91-606	91-422	91-465
91-607	91-426	91-466
	91-427	91-467
	91-428	91-468
	91-429	91-469
	91-430	91-470
	91-443	91-591
	91-444	91-3729
	91-445	91-3730
	91-446	

**GRAZING RIGHTS**

BLM Grazing Allotment #4079 (North Clark Valley) Approx. (Acreage 9,480)  
Period of Use - March 20<sup>th</sup>-June 5<sup>th</sup>

State Grazing Permit #21722 (Approx. Acreage 680)

**WATER SHARES**

50 Shares of water stock in The Wellington Canal Company from Certificate No. 881

EXHIBIT "C"  
to  
Surface Use Agreement

LEASE AGREEMENT

THIS LEASE AGREEMENT (this "Lease") is made and entered into as of November \_\_\_\_, 1999 ("Effective Date"), by and between CANYON FUEL COMPANY, L.L.C. ("Lessor"), and MILTON AND ARDITH THAYN TRUST ("Lessee").

Recitals

- A. Lessor is the owner of certain lands and water and grazing rights located in Carbon County, Utah, and more particularly described in Exhibit "A" attached hereto: (1) lands located in Clark Valley ("Clark Valley Lease Lands"); (2) water rights appurtenant to the Clark Valley Lease Lands ("Clark Valley Water Rights"); (3) state and federal grazing rights related to the Clark Valley Lease Lands ("Grazing Rights"); and (4) water rights represented by 50 shares of water stock in the Wellington Canal Company ("Water Shares"). The Clark Valley Lease Lands, the Clark Valley Water Rights, the Grazing Rights and the Water Shares are collectively referred to as the "Lease Interests."
- B. The parties have entered into that certain Surface Use Agreement dated \_\_\_\_\_ ("Surface Use Agreement") whereby Lessee grants to Lessor rights to use the surface of Lessee's lands to facilitate Lessor's coal mining operations in exchange for this Lease, Lessee desires to lease from Lessor and Lessor and other consideration.

Agreement

NOW, THEREFORE, in consideration of the mutual promises and obligations herein contained, and for other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Lessor hereby leases to Lessee the Lease Interests subject to and conditioned upon the following agreement between the parties:

ARTICLE I  
AGREEMENT FOR WATER RIGHTS

1.1 Lessor's Right to Use Clark Valley Water Rights and Water Shares. Lessee shall have the right to use part or all of the Clark Valley Water Rights and the water represented by the Water Shares (collectively, the "Leased Water Rights") for the sole purposes of irrigation or stock watering on or for the benefit of the Clark Valley Lease Lands, or such additional uses

expressly allocated to the Leased Water Rights, upon the condition that Lessee notifies Lessor of its intention to use the Leased Water Rights at least one (1) month prior to the date of use by Lessee. Notwithstanding Lessee's exercise of its right granted hereunder, Lessee shall make beneficial use of the Leased Water Rights during the term of this Lease and shall take all necessary and reasonable actions so as to preserve the validity of the Leased Water Rights and prevent any reversion back to the State of Utah. Lessee's promise to make beneficial use of the Leased Water Rights provides an essential portion of the consideration given by Lessee to cause Lessor to enter into this Lease.

1.2 Interest in Clark Valley Water Rights. Lessor and Lessee expressly acknowledge that the interest of Lessee in the Leased Water Rights is that of a tenant, that Lessee shall acquire no ownership interest in the Leased Water Rights, and that Lessee shall have no right, title, or interest in the Leased Water Rights from and after the termination of this Lease. Lessee shall not in any way, intentionally or otherwise, directly or indirectly, take or encourage others to take any action which is inconsistent with or which will or may jeopardize the interests of Lessor in the Leased Water Rights.

1.3 Change of Diversion or Use. Without the prior written consent of Lessor, Lessee shall not file any change application or exchange application with the Utah State Engineer for purposes of changing the nature, point of diversion or use of the Leased Water Rights.

1.4 Voting Rights. Lessee shall have no right to vote the Water Shares and nothing contained in this Lease shall, nor shall it be interpreted to, grant to Lessee any rights to participate in meeting of the Wellington Canal Company or to act for or on behalf of Lessor as the record title owner of the Shares.

## ARTICLE II AGREEMENT FOR GRAZING RIGHTS

2.1 Conditions. Lessor shall have the right to use the Grazing Rights shall be subject to the following conditions:

- (a) Lessee shall comply with all applicable statutes and regulations and the terms and conditions of the Grazing Rights and shall perform all other duties or tasks necessary to preserve the Grazing Rights in good standing and prevent any cancellation or other loss of the Grazing Rights. Lessee shall preserve and protect the interest of the Lessor therein and shall not take any action which is inconsistent with or will jeopardize the interest of Lessor in the Grazing Rights. Lessee shall promptly provide Lessor with a copy of any notice of violation, cancellation, inquiry or rental requirement received by Lessee relating to the Grazing Rights and shall undertake all necessary and reasonable actions to

remedy, cure or otherwise remove the basis for the notice. Lessee shall fully cooperate with Lessor to perform such actions as are necessary and advisable to preserve in full force and effect the Grazing Rights.

- (b) Lessor shall remain responsible for and shall pay directly to the BLM and/or State, as appropriate, all fees, rents, costs, or other charges required by statute, regulation, or agreement to keep the Grazing Rights in good standing.
- (c) Lessee hereby expressly waives any right or claim that it may have pursuant to 43 C.F.R. Part 4100 as now enacted or as hereinafter amended to receive compensation for any interests lessee may have in authorized range improvements on the Grazing Rights; and Lessee expressly acknowledges that the mutual promises and obligations of Lessor as specified in this Lease shall be deemed to be adequate compensation for any interests that Lessee may have in authorized range improvements on the Grazing Rights.
- (d) The general terms and conditions of this Lease shall apply to Lessee's right to use the Grazing Rights and the lands governed thereby as though included within the Clark Valley Lease Lands. Any breach or failure by Lessee to satisfy the covenants or conditions relative to the Grazing Rights shall constitute a breach of this Lease.

2.2 Lessee's Cattle. At all times during the term of this Lease, Lessee shall own a minimum of forty percent (40%) of the cattle actively grazing on or using the Clark Valley Lease Lands. Lessee shall not permit grazing of third party livestock on the Clark Valley Lease Lands that would result in a breach of this provision.

### ARTICLE III GENERAL TERMS AND CONDITIONS

3.1 Term. The term of this Lease shall commence upon the Effective Date and continue for a primary term five (5) years or the equivalent of sixty (60) calendar months. Lessee at its option shall have the right to renew this Lease for three (3) additional extended terms of five (5) years each by giving Lessor written notice of Lessee's election to renew 60-days prior to the termination of the then effective term. Unless otherwise terminated, this Lease shall terminate at the end of the last extended term which termination in no event shall occur later than 20 years after the Effective Date.

3.2 Consideration.

- (a) Lessee shall have no obligation to pay any rental to maintain this Lease in full force and effect for the term hereof, the consideration for this Lease being represented by the covenants and obligations set forth in the Surface Use Agreement.
- (b) In the event that this Lease is terminated or expires prior to a date twenty (20) years from the Effective Date, Lessor shall pay to Lessee as continuing consideration for the Surface Use Agreement the sum of \$5,000 annually ("Rental Payment") in lieu of this Agreement, payable on the anniversary date of the Effective Date each year for twenty (20) years from the Effective Date, or until the Surface Use Agreement terminates as provided therein.

3.3 Use and Occupancy by Lessee. Lessee shall use the Clark Valley Lease Lands, Leased Water Rights the Grazing Rights and the water attributable to the Water Shares exclusively for the grazing of cattle and for the raising of forage for the feeding of livestock. Lessee shall not authorize or conduct mining, drilling operations or hunting on the Clark Valley Lease Lands or remove sand, gravel, dirt, minerals, water, or associated substances from the Clark Valley Lease Lands; shall not commit any waste upon the Clark Valley Lease Lands; and shall not conduct or allow any business, activity, or thing on the Clark Valley Lease Lands which is or becomes unlawful, prohibited, or a nuisance, or which may cause damage to lessor, to occupants of the vicinity, or to other third parties. Lessee shall comply with and abide by all laws, ordinances, and regulations of all municipal, county, state and Federal authorities which are now in force or which may hereinafter become effective with respect to the use and occupancy of the Clark Valley Lease Lands, the Leased Water Rights and the Grazing Rights. Lessee shall conduct operations of the Clark Valley Lease Lands in accordance with good grazing and range or husbandry practices with reference to practices of others in the geographic vicinity of the Clark Valley Lease Lands and in compliance with applicable law. Lessee shall not overgraze the Clark Valley Lease Lands. Lessee shall ensure that all main entrance gates are kept locked with locks provided by Lessor.

3.4 Use by Lessor. Use of the Clark Valley Lease Lands by Lessee shall be nonexclusive. Lessor shall be entitled, without compensation to Lessee, to use the Clark Valley Lease Lands or grant other parties the right to use the Clark Valley Lease Lands, including but not limited to rights for easements, licenses, and leases, but Lessor shall not grant rights for grazing or agricultural use of the Clark Valley Lease Lands to third parties or make use of the Clark Valley Lease Lands itself for such purposes. However, Lessor shall reimburse Lessee for any damages done to Lessee's crops as a result of the use of the Clark Valley Lease Lands by Lessor.

3.5 Improvements. Lessee shall not construct any permanent building on the Clark Valley Lease Lands and shall not construct any temporary building or advertising sign on the Clark Valley Lease Lands without the prior written consent of Lessor. Lessee shall provide

and/or pay for the labor, material, and equipment for any fences, gates, cattle guards, ditches, ponds, reservoirs, or other improvements for Lessee to make use of the Clark Valley Lease Lands, the Grazing Rights, or to make beneficial use of the Leased Water Rights. Unless otherwise agreed in writing, any improvements which Lessee shall make to the Clark Valley Lease Lands shall be made at no expense to Lessor and shall not be removed and shall remain on the Clark Valley Lease Lands upon the termination of this Lease unless otherwise directed by Lessor. Lessee may use whatever fences, gates, cattle guards, ditches, ponds, reservoirs, and other improvements which now exist on the Clark Valley Lease Lands.

3.6 Representation of Lessee. Lessee represents as follows:

- (a) Lessee is experienced in farming methods, farm equipment, and irrigation methods generally used in Carbon County Lessee shall cultivate grazing pastures and make beneficial use of the Clark Valley Water Rights and otherwise exercise Lessee's rights and privileges under this Lease.
- (b) Lessee has sufficient farming and construction equipment available for its use and shall continue to have such equipment available for its use during the term of this Lease for the construction and maintenance of ditches, roads, ponds, fences, and the performance of other tasks which may be needed to satisfy Lessee's obligations under this Lease.
- (c) Lessee has knowledge of the requirements necessary to preserve the Leased Water Rights in good standing and prevent any loss of nonuse or other reversion back to the State of Utah.

3.7 Right of Entry. At any time throughout the term of the Lease, Lessor shall have the right to enter upon the Clark Valley Lease Lands or any portion thereof for purposes of inspecting the same, determining whether Lessee is performing its obligations under the Lease, including but not limited to the obligation to make beneficial use of the Leased Water Rights, taking any action necessary or desirable to remedy any default by lessee in any of Lessee's obligations hereunder, showing or exhibiting the Clark Valley Lease Lands to existing or prospective mortgage lenders, purchasers, or lessees, placing "for sale" or "for lease" signs on the Clark Valley Lease Lands, performing environmental or analytical studies, or for any other purpose whatsoever.

3.8 Insurance. At all times during the term hereof, Lessee shall secure and maintain public liability insurance providing coverage against damage to persons or property resulting from acts or omissions of Lessor or Lessee respecting the Clark Valley Lease Lands, with limits of liability in such amounts as lessor may determine. All insurance required or permitted hereunder shall be written by reputable, responsible companies licensed in the State of Utah and shall name Lessor as insured. Lessor shall be furnished with copies of the insurance policies then

in force pursuant to this section, together with evidence that the premiums therefor have been paid.

3.9 Taxes. Throughout the term hereof Lessor shall pay all real property taxes, assessments, and special assessments, (all of which are hereinafter collectively referred to as "Taxes"), which are levied against or which apply with respect to the Clark Valley Lease Lands, the Grazing Rights or the Water Rights. Lessee shall pay all taxes, assessments, charges and fees which during the term hereof may be imposed, assessed, or levied by any governmental or public authority against or upon Lessee's use of the Clark Valley Lease Lands or any personal property, equipment, or fixtures kept or installed therein by Lessee.

3.10 Assignment and Subletting.

- (a) Lessee shall have the right to assign or sublet a portion of this Lease with the prior written consent of Lessor, which consent shall not be unreasonably withheld, provided, however, that such assignment or sublease shall expressly provide and require that Lessee own and maintain a minimum of forty percent (40%) of the cattle actively grazing on or using the Clark Valley Lease Lands (as required under Section 2.2 of this Agreement) and that such assignment or sublease shall automatically terminate if at any time Lessee breaches the covenant under Section 2.2. In the event of any such assignment or sublease with the consent of the Lessor, Lessee shall remain liable on all of its covenants and obligations hereunder unless the instrument whereby Lessor consents to the assignment or subletting contains a provision in which Lessor specifically releases Lessee from such further liability. Any purported assignment without the written consent of the Lessor shall constitute a default hereunder and shall be void and of no effect.
- (b) Lessor shall have the right to assign its interests under this Lease without the consent of Lessee. In the event Lessor assigns such interests, Lessor shall, from and after the Effective Date (irrespective of when the assignment occurs), be relieved of any and all liability or obligation to Lessee hereunder, and all such liability and obligation shall, as of the time of such assignment or on the Effective Date, whichever is later, automatically pass to Lessor's assignee, whether or not specifically assumed by it.

3.11. Default and Remedies. In the event Lessee breaches or fails to perform any of its obligations hereunder and Lessee does not within sixty (60) days, unless a lesser time is required by applicable law for the Grazing Rights, after the giving of written notice by Lessor cure the default or begin action to cure the default and thereafter diligently prosecute such action to completion if the default cannot be reasonably cured within sixty (60) days, or as required by applicable law, Lessor shall have the right, at its option, to exercise any of the following rights and remedies:

- (a) Lessor may itself perform or cause to be performed the obligation with respect to which Lessee is in default. In the event Lessor does so, its cost of such performance, including reasonable attorneys' fees and all expenses incurred by Lessor, plus interest thereon at the rate of eighteen percent (18%) per annum from the date of expenditure, shall be deemed to be additional rent and shall be immediately paid by Lessee.
- (b) Lessor may terminate this Lease, immediately enter the Clark Valley Lease Lands, and take possession of the Clark Valley Lease Lands, the Leased Valley Water Rights and the Grazing Rights with or without process of law, and remove all persons and property from the Clark Valley Lease Lands. No such action by Lessor shall be considered or construed to be a forcible entry. By taking such action, Lessor shall incur no liability to Lessee or to any other persons occupying or using the Clark Valley Lease Lands or using the Leased Water Rights or the Grazing Rights for any damage caused or sustained by reason of such entry and removal of persons and property, and Lessee hereby covenants and agrees to indemnify and save harmless Lessor from all costs, loss, or damage arising from or occasioned by such action. In the event Lessor terminates this Lease pursuant to this Subsection (b), it shall also have the right to recover from lessee all other amounts necessary to compensate Lessor for all damages caused by Lessee's default or which would be likely to result from such default.
- (c) Lessor may continue this Lease in effect and enforce all of its rights hereunder. If Lessor does so, it shall have the right to relet or sublet the Clark Valley Lease Lands, the Leased Water Rights, and the Grazing Rights or portions thereof, and any such reletting or subletting may be for a term which extends beyond the term of this Lease. Notwithstanding any election by Lessor to proceed under Subsections (a) or (b) above, so long as Lessee remains in default under this Lease, Lessor shall have the right at any time to terminate this Lease pursuant to Subsection (b) above and to exercise the rights therein provided. The remedies specified in this Section 3.11 are cumulative and are not intended to exclude any other remedy or means of redress to which Lessor may be entitled in the even of any default or threatened default by Lessee with respect to any of its obligations under this Lease.

3.12 Indemnification and Waiver. Lessee shall indemnify and shall hold harmless Lessor and all of Lessor's directors, partners, members, officers, agents, and employees, and each of them, from and against any and all obligations, debts, loss, damage, claims, demands, suits, controversies, costs, fees, liens, encumbrances, and liabilities whatsoever, including attorneys' fees, in any way resulting from or arising out of any failure by Lessee to abide by all of the terms of this Lease or any negligent or intentional act or omission by Lessee or any of its agents, employees, invitees, licensees, or contractors arising out of or in connection and occupancy of the

Clark Valley Lease Lands or use of the Leased Water Rights, or the Grazing Rights. Lessor shall not be responsible or liable for any loss or damage to Lessee or to Lessee's property or business that may be occasioned by or through the acts or omissions of persons occupying, using, or trespassing upon the Clark Valley Lease Lands. Lessee shall use the Clark Valley Lease Lands, the Leased Water Rights and the Grazing Rights at its own risk, and hereby releases Lessor, to the full extent permitted by law, from all claims of every kind or nature, including claims for loss of life, personal or bodily injury, or property damage.

3.13 Enforcement. If any action is brought to recover any rent under this Lease, or because of any breach of or to enforce or interpret any of the provisions of this Lease, or for recovery of possession of the Clark Valley Lease Lands, the party prevailing in such action shall be entitled to recover from the other party reasonable attorney's fees (including those incurred in connection with any appeal), the amount of which shall be fixed by the court and made a part of any judgment rendered.

3.14 Notices. Any notice required or permitted hereunder to be given or transmitted between the parties shall be either personally delivered or mailed, postage prepaid by certified or registered mail, addressed as follows:

TO LESSOR:           President  
                          Ark Land Company  
                          CityPlace One  
                          Suite 300  
                          St. Louis, MO 63141-7056

With a copy to:       Canyon Fuel Company, L.L.C.  
                          Soldier Canyon Mine  
                          P. O. Box 1029  
                          Wellington, UT 84542  
                          Attn: David G. Spillman  
                          (435) 636-2872

TO LESSEE:           Milton and Ardith Thayn Trust  
                          7730 East Highway 6  
                          Price, Utah 84501  
                          Attn: David Thayn  
                          (435) 472-4751

Any notice which is mailed shall be effective on receipt as evidenced by the registration certificate. Either party may, by notice to the other given as prescribed in this Section 3.14, change the above address for any future notices which are mailed under this Lease.

3.15 Liens and Encumbrances. Lessor shall keep the Clark Valley Lease Lands, Leased Water Rights, and Grazing Rights, free of all liens and encumbrances of every nature and kind arising after the Effective Date and shall proceed with all diligence to contest or discharge any lien or encumbrance that is filed or claimed.

3.16 Miscellaneous.

- (a) Neither this instrument nor any memorandum or notice concerning the same shall be recorded without the prior written consent of Lessor. Lessor may, at its option and at any time, file this Lease or a notice or short form concerning the same (which said notice or short form Lessee hereby agrees to execute upon Lessor's request) for record in Carbon County, Utah.
- (b) The captions which precede the sections of this Lease are for convenience only and shall in no way affect the manner in which any provision hereof is construed.
- (c) There are no representations or agreements between the parties except as set forth in this Lease, and this Lease supersedes any and all prior negotiations, agreements, or understandings between Lessor and Lessee in any way related to the subject matter hereof. None of the provisions of this Lease may be altered or modified except through an instrument in writing signed by both parties.
- (d) The liability of each person executing and delivering this Lease shall be joint and several. Each provision of this Lease to be performed by Lessee shall be construed to be both a covenant and a condition. To the extent permitted by the provisions hereof, all reservations, terms, conditions, and covenants herein contained shall be binding upon and shall inure to the benefit of the respective heirs, personal representatives, successors, and assigns of the parties hereto.
- (e) Time is of the essence to the provisions of this Lease. Any waiver, either express or implied, by Lessor or any breach by Lessee of any promise, condition or term hereof shall not be construed or claimed to be a waiver of any other breach of any condition, promise, or term of this Lease.
- (f) Nothing in this Lease shall, nor shall it be interpreted to, amend, modify or waive any provision of the Surface Use Agreement. Except for the express provision to make the Rental Payments under Section 3.2(b), any default under or termination of this Lease shall not affect in any manner the terms, conditions or validity of the Surface Use Agreement, it being the intent and understanding of the parties that the Surface Use Agreement and this Lease shall constitute separate and independent legal agreements, enforceable in accordance with their respective terms.

IN WITNESS WHEREOF the parties hereto have executed this Lease as of the Effective Date.

LESSOR:

LESSEE:

CANYON FUEL COMPANY, L.L.C.

MILTON AND ARDITH THAYN TRUST

By \_\_\_\_\_  
Its \_\_\_\_\_

By \_\_\_\_\_  
Its Trustee

STATE OF UTAH     )  
                                  )ss:  
COUNTY OF \_\_\_\_\_)

The foregoing instrument was acknowledged before me this \_\_\_ day of \_\_\_\_\_, by \_\_\_\_\_, who being by me duly sworn did say that he is the \_\_\_\_\_ of Canyon Fuel Company, L.L.C., and that the foregoing Lease was signed on behalf of said limited liability company.

NOTARY PUBLIC

Residing at: \_\_\_\_\_

My Commission Expires:  
\_\_\_\_\_

STATE OF UTAH     )  
                                  )ss:  
COUNTY OF CARBON )

The foregoing instrument was acknowledged before me this \_\_\_ day of \_\_\_\_\_, by

\_\_\_\_\_, the signer of the foregoing Lease, who duly acknowledged to me that he executed the same as Trustee of and for the benefit of the Milton and Ardith Thayne Trust.

NOTARY PUBLIC

Residing at: \_\_\_\_\_

My Commission Expires:  
\_\_\_\_\_

**EXHIBIT "A"**  
to  
**Lease Agreement**

**CLARK VALLEY LEASE LANDS**

(approximately 4,461 acres):

<u>Township</u>	<u>Range</u>	<u>Section</u>	<u>Description</u>
14 South	12 East	3	S½SE¼; S½SW¼
"	"	5	S½SE¼
"	"	8	NE¼NE¼; W½NE¼; SW¼; E½NW¼
"	"	9	SE¼
"	"	10	E½; SW¼; E½NW¼; SW¼NW¼
"	"	11	SE¼; NE¼; E½SE¼; SW¼SE¼; W½
"	"	13	W½; SW¼; S½NW¼; NE¼SW¼
"	"	14	All
"	"	15	E½; SW¼; E½NW¼
"	"	17	NW¼; SE¼; E½SW¼; NW¼SW¼
"	"	18	E½NE¼
"	"	20	N½NE¼
"	"	21	NE¼NW¼; W½NW¼; SE¼NE¼
"	"	22	NW¼

**CLARK VALLEY WATER RIGHTS**

Water Right No.  
(Irrigation &  
Stockwatering)

91-23  
91-85  
91-86  
91-409  
91-457

Water Right No.  
(Stockwatering)

91-410 91-447  
91-411 91-448  
91-412 91-449  
91-413 91-450  
91-414 91-451

**Exhibit A  
to Lease Agreement**

<u>Water Right No. (Irrigation &amp; Stockwatering)</u>	<u>Water Right No. (Stockwatering)</u>
91-491	91-415 91-452
91-492	91-416 91-453
91-493	91-417 91-456
91-494	91-418 91-458
91-495	91-419 91-459
91-604	91-420 91-460
91-605	91-421 91-461
91-606	91-422 91-465
91-607	91-426 91-466
	91-427 91-467
	91-428 91-468
	91-429 91-469
	91-430 91-470
	91-443 91-591
	91-444 91-3729
	91-445 91-3730
	91-446

**GRAZING RIGHTS**

BLM Grazing Allotment #4079 (North Clark Valley) Approx. (Acreage 9,480)  
Period of Use - March 20<sup>th</sup>-June 5<sup>th</sup>

State Grazing Permit #22966 (Replacing Permit #21722) (Approx. Acreage 680)

**WATER SHARES**

50 Shares of water stock in The Wellington Canal Company from Certificate No. 881

cc

Canyon Fuel Company LLC  
6955 Union Park Center, Suite 540  
Midvale, Utah 84047

RE: Soldier Canyon Mine  
Dugout Canyon Mine

Gentlemen:

The Milton and Ardith Thayn Trust ("Trust") is the record title owner of the surface to the lands described below that cover or otherwise relate to coal leases Canyon Fuel Company now or in the future intends to develop ("Lands"):

T13S, R12 E, Salt Lake Meridian, Utah

Sec. 12: E/2 SE/4;  
Sec. 13: E/2; SE/4 NW/4; E2 SW/4; NW/4 SW/4;  
Sec. 24: All;  
Sec. 25: NW/4.

T13S, R13 E, Salt Lake Meridian, Utah

Sec. 7: S/2SW/4, NW/4SW/4;  
Sec. 18: S/2, NW/4, S/2NE/4, NW/4NE/4;  
Sec. 17: SW/4, S/2SE/4, NW/4SE/4;  
Sec. 19: All Except Lot 4;  
Sec. 20: All;  
Sec. 21: S/2, S/2N/2, NW/4NW/4;  
Sec. 22: SW/4, S/2NW/4;  
Sec. 27: W/2;  
Sec. 28: All;  
Sec. 29: All;  
Sec. 30: All Except Lots 1 and 2;  
Sec. 33: N/2N/2.

Subject to the Surface Use Agreement dated effective November 22, 1999, between the parties, the Trust hereby consents to Canyon Fuel's underground mining activities below the Lands and access to the surface to repair subsidence.

Very truly yours,

Milton and Ardith Thayn Trust

By: Milton Thayn

## FIRST AMENDMENT TO SURFACE USE AGREEMENT

THIS FIRST AMENDMENT TO SURFACE USE AGREEMENT ("Amendment"), dated effective as of 13 August, 2001, is by and between Canyon Fuel Company, L.L.C. ("CFC") and Milton and Ardith Thayn Trust ("Thayn").

### Recitals

A. The parties have entered into that certain Surface Use Agreement dated as of November 22, 1999, between CFC and Thayn ("Surface Use Agreement"). All capitalized terms used in this Amendment, unless otherwise defined herein, shall have the meanings assigned to them in the Surface Use Agreement.

B. The parties now desire to amend the Surface Use Agreement consistent with the terms of this Amendment.

### Amendment

NOW, THEREFORE, for good and valuable consideration, the parties agree as follows:

1. The Surface Use Agreement is amended by addition of the following provisions:

a. Water Purchases. CFC may, at its option any time during the term of the Surface Use Agreement, purchase water from Thayn, for which Thayn holds beneficial use rights or otherwise controls, to conduct any of the activities permitted by the Surface Use Agreement on the Thayn Lands. CFC and Thayn will cooperate to make necessary filings with the Utah State Engineer to facilitate such water uses. The purchase price for the water is \$ .0125/ gallon and will be adjusted as provided in subparagraph (d) below. Thayn may determine at its discretion when water is available for purchase by CFC and CFC will be responsible for all costs and expenses to deliver the water to the location of usage. The purchase price for the water shall have no bearing on future determinations of the value of the Thayn water rights or water used on the Thayn Lands.

b. Interference with Hunting Activities.

(i) CFC will reimburse Thayn in an amount not to exceed \$10,000 annually for the loss of any revenue incurred by Thayn as a result of interference with, or the inability to conduct, deer and elk hunting and guide services on the Thayn Lands by Thayns' outfitters due to exploration or production drilling conducted by or on behalf of CFC on the Thayn Lands. For purposes of this provision, the deer hunting season includes the muzzle load, archery and rifle hunts. Thayn will provide CFC with a written claim for lost revenue describing the basis for the claim no later than 30 days after the end of a hunting season. The parties agree that the actual presence and ongoing operation of a drilling rig on the Thayn Lands during the elk or the deer hunting seasons will automatically constitute interference with hunting activities. In such event, upon written notice from Thayn, Arch will pay to Thayn \$3750 for the deer hunt season and \$3750 for the elk hunt season respectively impacted by the presence and operation of a drilling rig. Arch's maximum liability under this provision for each hunting season shall not

exceed \$5,000 for the elk hunt and \$5,000 for the deer hunt. The reimbursement payment will be readjusted as provided in subparagraph (d) below. Thayn acknowledges that the payment provided represents fair and reasonable compensation and Thayn waives any and all other claims against CFC for alleged damages arising out of interference with deer and elk hunting and guide services on the Thayn Lands.

(ii) CFC and Thayn have jointly established a 100-yard non-hunting buffer zone surrounding any drilling rig or active drilling operations. Thayn will inform hunters on the Thayn Lands of actual drilling locations and operations in an effort to create a safe operations buffer zone. CFC will prohibit its employees and employees of its contractors from carrying firearms, including muzzle loaders, archery equipment and rifles during the hunting seasons. Only road use necessary to conduct Arch's operations and activities under the Surface Use Agreement will be allowed during the elk and deer hunting seasons on the Thayn Lands in an effort to maintain a quality hunting environment.

c. Rezoning. Thayn will support and not oppose any rezoning of the Thayn Lands that is required by or results from mining or oil and gas operations conducted on the Thayn Lands, provided, however, that CFC will reimburse Thayn for all additional taxes, or other costs and expenses, incurred by Thayn as a result of such rezoning.

d. Adjustments to Payments.

(i) The purchase price for the water described in subparagraph (a) will be adjusted for inflation on the fifth annual anniversary date after the Effective Date, and every five years thereafter on the anniversary of the Effective Date based on the cumulative changes in the Consumer Price Index (CPI), or other generally-recognized economic pricing index, for the preceding five-year period.

(ii) The reimbursement payment described in subparagraph (b) will be adjusted for inflation on the fourth annual anniversary date after the Effective Date, and every four years thereafter on the anniversary of the Effective Date based on the then current fee arrangement with Thayn or on a written bona fide offer from a hunting outfitter who, if required by state law, is licensed. Allocation of the reimbursement payment between the deer and elk hunts shall be based on the terms of the offer.

(iii) The proposed adjustment shall be calculated by CFC and communicated to Thayn in writing within thirty (30) days after the applicable anniversary date. All adjustments shall be effective as of the then applicable anniversary date and shall otherwise apply prospectively and shall not apply to payments previously made under this Amendment.

2. Except as expressly provided in this Amendment, nothing herein shall, nor be interpreted to, amend, modify or waive any provision of the Surface Use Agreement. The parties acknowledge that the Surface Use Agreement is in full force and effect and currently in good standing. This Amendment may be executed in counterparts by the parties.

Executed and dated as of the Effective Date.

Canyon Fuel Company, L.L.C.

Milton and Ardith Thayn Trust

By: \_\_\_\_\_  
Its: \_\_\_\_\_

By: George M Thayn

RECEIVED  
MILTON AND ARDITH THAYN TRUST  
8/14/01

Canyon Fuel Company, LLC  
Dugout Canyon Mine

Methane Degassification Amendment  
August 2003

**CHAPTER 5**  
**ENGINEERING**

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## **510 INTRODUCTION**

This chapter provides a discussion of general engineering aspects, an operation plan, a reclamation plan, design criteria, and performance standards related to the degassification well sites. The activities associated with the construction and reclamation of the well sites have been or will be designed, located, constructed, maintained, and reclaimed in accordance with the operation and reclamation plans.

### **511 General Requirements**

The permit application includes descriptions of construction, maintenance, and reclamation operations of the proposed well sites with maps and plans. Potential environmental impact as well as methods and calculations utilized to achieve compliance with the design criteria are also presented.

### **512 Certification**

Where required by the regulations, cross sections and maps in this permit application have been prepared by or under the direction of, and certified by, qualified registered professional engineers or land surveyors. As appropriate, these persons were assisted by experts in the fields of hydrology, geology, biology, etc.

#### **512.100 Cross Sections and Maps**

Cross sections for the degassification well pads are shown on ss 5-2, 5-6, and 5-10 and typical road cross sections are shown on Figures 5-13 and 5-14.

### **512.200 Plans and Engineering Designs**

**Excess Spoil** - No excess spoil will be generated from the well sites.

**Durable Rock Fills** - No durable rock fills will exist at the well sites.

**Coal Mine Waste** - No coal mine waste will exist at the well sites.

**Impoundments** - Refer to Section 733.200 of this submittal.

**Primary Roads** - Short sections of road are required to access the three well sites. These access roads are classified as primary roads. Topsoil will be stripped from the road alignment and stored with the topsoil stripped from the pad area prior to grading the new access road.

**Variance from Approximate Original Contour** - No variance from approximate original contour is required for the well sites.

### **513 Compliance with MSHA Regulations and MSHA Approval**

#### **513.100 Coal Processing Waste Dams and Embankments**

No coal processing waste dams and embankments will exist at the well sites.

#### **513.200 Impoundments and Sedimentation Ponds**

Refer to Section 733.200 of this submittal.

**513.300 Underground Development Waste, Coal Processing Waste, and Excess Spoil**

No underground waste, coal processing waste, and excess spoil will exist at the well sites.

**513.400 Refuse Piles**

No refuse piles will exist at the well sites.

**513.500 Underground Openings to the Surface**

The well will be equipped with a valve that will be closed and locked when not in use. A typical well head is shown in Figure 5-16.

**513.600 Discharge to Underground Mine**

No discharge to the underground mine will occur at the well sites.

**513.700 Surface Coal Mining and Reclamation Activities**

No surface coal mining, or reclamation activities associated with surface coal mining will occur at the well sites.

**513.800 Coal Mine Waste Fire**

No coal waste will be developed, therefore, no coal waste fires will occur at the well sites.

## **514 Inspection**

### **514.100 Excess Spoil**

No excess spoil will be stored at the well sites.

### **514.200 Refuse Piles**

No refuse piles will exist at the well sites.

### **514.300 Impoundments**

Refer to Section 733.200 of this submittal.

## **515 Reporting and Emergency Procedures**

### **515.100 Slides**

Refer to Section 515.100 in the approved M&RP.

### **515.200 Impoundments Hazards**

No impoundments will exist at the well sites.

### **515.300 Temporary Cessation of Operations**

If temporary cessation of the mining operations does occur, the wells will remain open. Once liberation of the methane gas is completed, the wells will be sealed as discussed in Section 542.700 of this submittal.

## **520 OPERATION PLAN**

### **521 General**

See Figures 5-1, 5-5, and 5-9 for the contour map showing pre-disturbance and drilling phase contours. These figures also show the disturbed area boundary and the new access road contours. Figures 5-3, 5-7 and 5-11 show the layout of the well sites during the drilling phase. Figures 5-4, 5-8 and 5-12 show the layout of the well sites during the operational phase. These figures also show the area to be reclaimed at the completion of drilling. Cross sections for each site can be found on Figures 5-2, 5-6, and 5-10.

### **521.100 Cross Sections and Maps**

**Existing Surface and Subsurface Facilities Features** - No buildings are located on or within 1,000 feet of any of the well sites.

**Landowner, Right-of-Entry, and Public Interest** - The land which the wells will be drilled on is owned by the Milton and Ardith Thayn Trust. Canyon Fuels, LLC has reached an agreement with the Thayn trustees to allow access for the construction and drilling of the wells (see Attachment 4-2).

**Mining Sequence and Planned Subsidence** - Refer to Section 525.

**Land Surface Configuration** - Surface contours of undisturbed well sites are included in Figures 5-1, 5-5 and 5-9.

**Surface Facilities** - No permanent surface facilities will exist at the well sites.

### **521.200 Signs and Markers**

**Mine and Permit Identification Signs** - A mine and permit identification sign will be displayed at each well site. This sign will be a design that can be easily seen and read, will be made of durable material, will conform to local regulations, and will be maintained until after the release of all bonds for the well site areas. The sign will contain the following information:

- Mine name,
- Company name,
- Company address and telephone number
- MSHA identification number, and
- Permanent program permit identification number

**Perimeter Markers** - The perimeter of all areas affected will be clearly marked before beginning mining activities. The markers will be a design that can be easily seen and read, will be made of durable material, will conform to local regulations, and will be maintained until after the release of all bonds for the permit area.

**Buffer Zone Markers** - Stream buffer zone markers will not be required at any of the three well sites.

**Topsoil Markers** - Markers will be placed on all topsoil stockpiles. These markers will be a design that can be easily seen and read, will be made of durable material, will conform to local regulations, and will be maintained until topsoil is redistributed on the well sites.

**Construction Markers** - Not applicable.

### **522 Coal Recovery**

No coal recovery will be performed at the well sites.

### **523 Mining Methods**

No mining will be performed at the well sites.

### **524 Blasting and Explosives**

No explosives are to be used at the well sites.

### **525 Subsidence**

No subsidence will occur at the well sites, as a result of drilling and development of the degassification well sites. Subsidence could occur at the well site because of underground mining see Section 525 of the approved M&RP.

### **526 Mine Facilities**

#### **526.100 Mine Structures and Facilities**

No buildings exist or are proposed at the well sites; therefore, no existing building will be used in connection with or to facilitate this proposed coal mining and reclamation plan.

### **526.200 Utility Installation and Support Facilities**

No utilities are to be installed at the well sites. A portable methane exhaust unit will be temporarily installed to draw methane to the surface from the mined panel. The exhaust blower will be started by using propane from portable tanks. Once started and running, the unit will be powered by burning the extracted methane gas. Excess methane will be vented to the atmosphere. The blower is approximately 12-feet long by 6-feet wide and about 10-feet tall. It is not known how long the degassification of the longwall panel will take.

### **527 Transportation Facilities**

#### **527.100 Road Classification**

Well sites G-1, G-2, and G-3 will be developed near existing private roads as shown on Figures 1-1, 5-1, 5-5, and 5-9. The new access roads will be classified as primary roads and will be maintained by the permittee (see Figure 5-14).

#### **527.200 Description of Transportation Facilities**

The well sites were chosen close to existing roads in the area to limit surface disturbance. The existing roads were constructed and are maintained by the land owner. The existing roads are approximately 20 feet wide and are shown on Figures 5-1, 5-5, and 5-9. See Figure 5-13 for a typical cross section of the existing roads.

### **528 Handling and Disposal of Coal, Excess Spoil, and Coal Mine Waste**

No disposal of coal, excess spoil, and coal mine waste will occur at the well sites.

### **529 Management of Mine Openings**

The perimeter of the sites will be fenced with gates on the access roads. The well casing will have a valve that is closed and locked. The valve will also prevent access by animals or other material.

## **530 OPERATIONAL DESIGN CRITERIA AND PLANS**

### **531 General**

This section contains the general plans for the construction of sediment controls and general construction and maintenance of the well sites.

The decision to construct each well will be based on the amount of methane encountered during mining. If small amounts of methane are encountered and the mine's ventilation system can dilute the methane, no well will be drilled. The proposed well site locations are shown on Figure 1-1.

### **532 Sediment Control**

Sediment control measures for the well sites are described in Sections 732 and 742 of this submittal. Runoff control structures at the well sites have been designed to convey runoff in a non-erosive manner. Sediment yields in the well permit area are minimized by:

- Disturbing the smallest practicable area during the construction of the well site and
- Contemporaneously reclaiming areas suitable for such reclamation.

### **533 Impoundments**

No impoundments will exist at the well sites.

### **534 Roads**

Refer to Section 527 of this submittal.

### **535 Spoil**

No spoil will be generated at the well sites.

### **536 Coal Mine Waste**

No coal mine waste will be stored at the well sites.

### **537 Regraded Slopes**

#### **537.100 Division Approval**

No mining or reclamation activities will be conducted in the permit area that requires approval of the Division for alternative specifications or for steep cut slopes.

#### **537.200 Regrading of Settled and Revegetated Fills**

Upon completion of the well site, the areas not required for the exhaust blower will be regraded to approximate original contour. Because of the nature of the well site, settling is not anticipated. However, if settlement does occur, these areas will be regraded.

## **540 RECLAMATION PLAN**

### **541 General**

#### **541.100 Commitment**

Upon the permanent cessation of methane venting, Dugout Canyon Mine will seal the wells and permanently reclaim all affected areas in accordance with the R645 regulations and this reclamation plan.

#### **541.200 Surface Coal Mining and Reclamation Activities**

Not applicable.

#### **541.300 Underground Coal Mining and Reclamation Activities**

Upon completion of the methane venting activities the wells will be reclaimed.

#### **541.400 Environmental Protection Performance Standards**

The plan presented is designed to meet the requirements of R645-301 and the environmental protection performance standards of the State Program.

## **542 Narratives, Maps, and Plans**

### **542.100 Reclamation Timetable**

A timetable for the completion of each major step in the reclamation plan is presented in Figure 5-15.

### **542.200 Plan for Backfilling, Soil Stabilization, Compacting, and Grading**

Following completion of the venting activities, the well site will be prepared for contouring and soil distribution. Details regarding topsoil placement and revegetation are provided in Section 242 and Section 353, respectively.

**Sedimentation Pond Removal and Interim Sediment Control** - See Section 542.500 of this submittal.

### **542.300 Final Surface Configuration Maps and Cross Sections**

The sites will be regraded to the approximate original contour, the contours representing the pre-disturbance topography also represent the reclamation topography. Refer to Figures 5-2, 5-6, and 5-10 to see cross sections representing the final surface configuration.

### **542.400 Removal of Temporary Structures**

The well sites will not have surface structures.

#### **542.500 Removal of Sedimentation Pond**

No sediment pond will be constructed at the well sites.

#### **542.600 Roads**

The roads which existed prior to the drilling program will be retained after reclamation. The access roads established during the drilling program will be reclaimed after methane extraction has been completed. See Section 242 for additional detail concerning the reclamation plan.

#### **542.700 Final Abandonment of Mine Openings and Disposal Areas**

All openings will be sealed in accordance with Federal and State Regulations. The casings will be plugged at the bottom to hold concrete. A lean concrete mixture will be poured into the casing until the concrete is within five (5) feet of the surface. At that time the casing will be cut off at ground level and the rest of the casing will be filled with lean concrete. The concrete will be allowed to harden before final reclamation is completed.

#### **542.800 Estimated Cost of Reclamation**

Refer to the Appendix 5-6 of the existing M&RP. It is anticipated that the cost of reclamation of the well sites is adequately covered by the Dugout Canyon Reclamation Bond, refer to Chapter 8 for additional detail.

## **550 RECLAMATION DESIGN CRITERIA AND PLANS**

### **551 Casing and Sealing of Underground Openings**

Permanent sealing is described in Section 542.700.

### **552 Permanent Features**

#### **552.100 Small Depressions**

No permanent small depressions will be created as part of the well site construction and reclamation.

#### **552.200 Permanent Impoundments**

See Section 515.200 of this submittal.

### **553 Backfilling and Grading**

#### **553.100 Disturbed Area Backfilling and Grading**

**Approximate Original Contour** - The well sites will be returned to their approximate original contour after reclamation is completed.

**Erosion and Water Pollution** - Sediment controls will consist of gouging the surface to create depressions and mounds which store and impede the movement of water. As vegetation becomes established on the reclaimed surface, erosion potential will be further minimized.

**Post-Mining Land Use** - The disturbed area will be reclaimed in a manner that supports the approved post-mining land use. Refer to Sections 411 and 412 for additional detail.

#### **553.200 Spoil and Waste**

**Spoil** - No spoil will be generated within the well sites.

**Coal Processing Waste** - No coal processing waste will be generated within the well sites.

#### **553.250 Refuse Piles**

No refuse piles will exist at the well sites.

#### **553.300 Exposed Coal Seams, Acid and Toxic Forming Materials and Combustible Materials**

No coal seams will be left exposed at the well sites. All wells will be sealed according to Federal and State regulations.

#### **553.400 Cut and Fill Terraces**

No cut and fill terraces will be constructed at the well sites.

#### **553.500 Highwall From Previously Mined Areas**

No highwalls exist or will be built at the well sites.

**553.600 Previously Mined Area**

No previously mined areas exist at the well sites.

**553.700 Backfilling and Grading - Thin Overburden**

No surface mining and reclamation activities involving thin overburden will occur at the well sites.

**553.800 Backfilling and Grading - Thick Overburden**

No surface mining and reclamation activities involving thick overburden will occur at the well sites.

**553.900 Regrading of Settled and Revegetated Rills**

If settlement or rills occur at the well sites, they will be regraded and revegetated. Refer to Section 244.300.

**560 PERFORMANCE STANDARDS**

Dugout Canyon Mine well sites will be conducted in accordance with the approved permit and the requirements of R645-301-510 through R645-301-553.

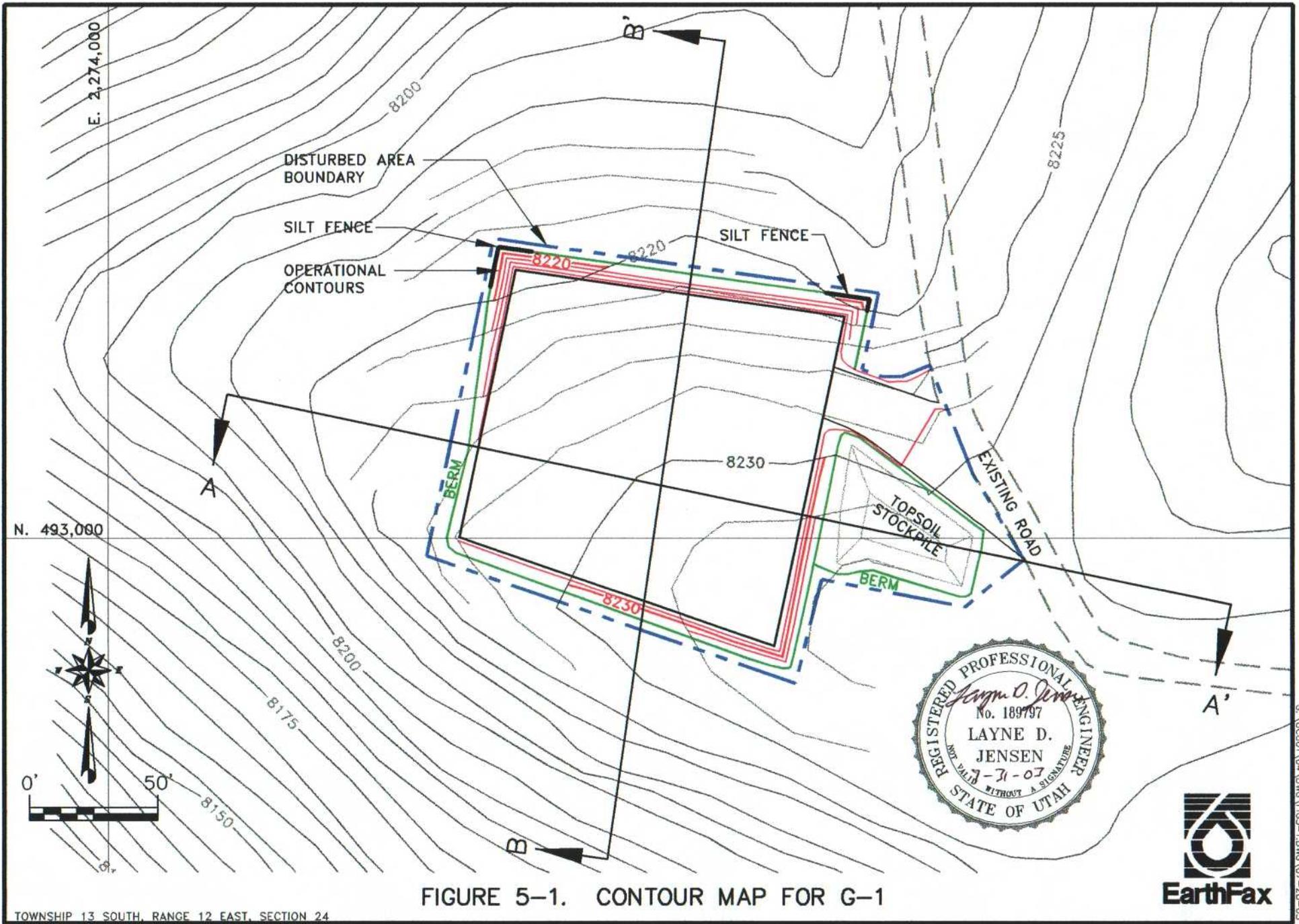


FIGURE 5-1. CONTOUR MAP FOR G-1

TOWNSHIP 13 SOUTH, RANGE 12 EAST, SECTION 24



G:\C0601\04\DMG\FIGS-1\DMG\07-28-03

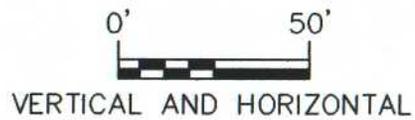
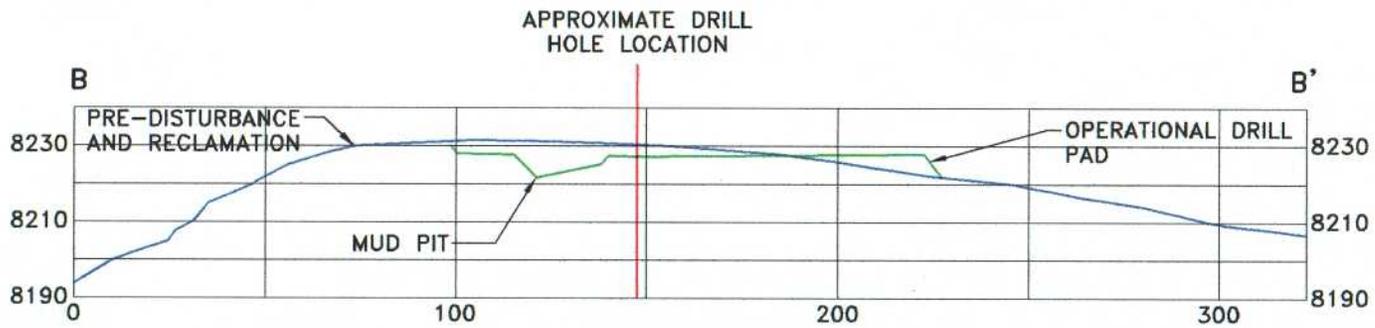
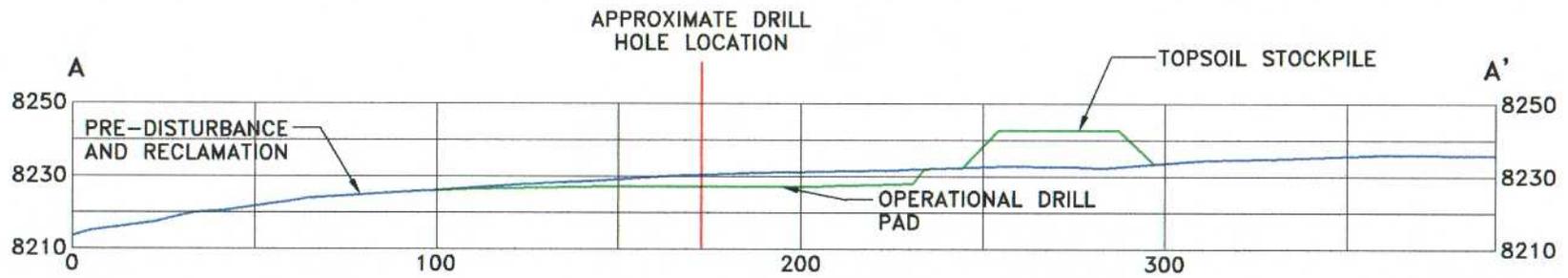
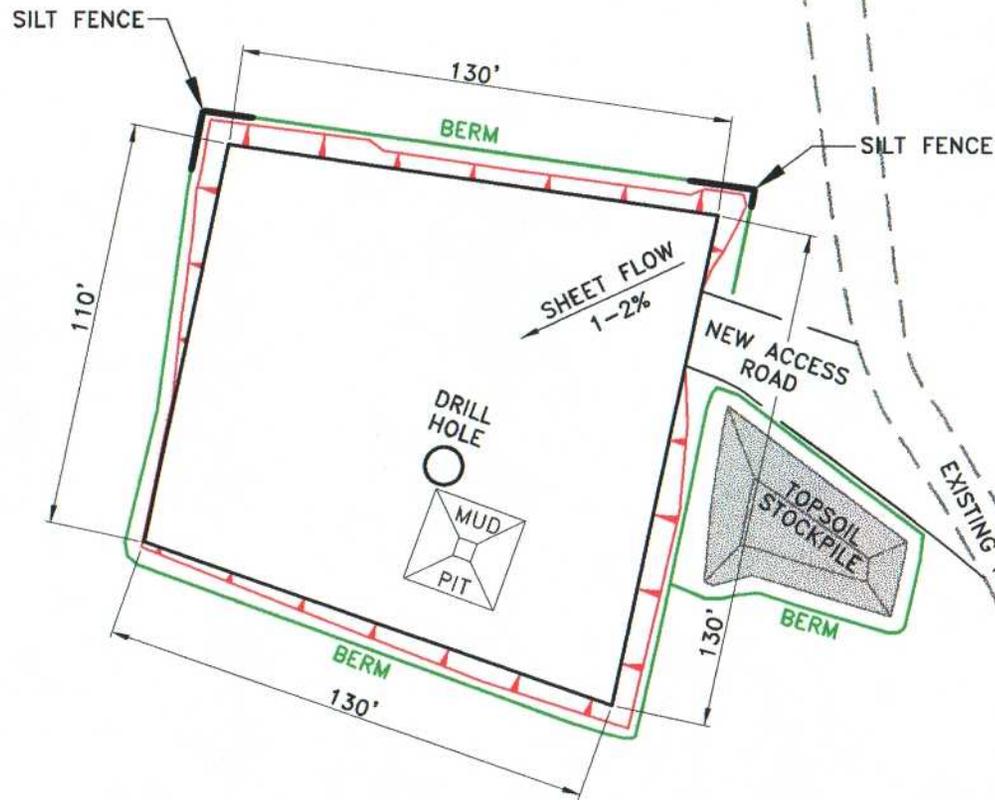


FIGURE 5-2. TYPICAL CROSS-SECTIONS FOR G-1





NOTES:

1. THE PAD WILL BE SURROUNDED BY A BERM WHICH WILL DIVERT RUNOFF FROM UNDISTURBED AREAS AWAY FROM THE DRILLING PAD AND DIRECT PAD RUNOFF TO A SILT FENCE AND/OR STRAW BALE DIKE, AT THE LOWEST POINT FOR TREATMENT.
2. A BERM WILL BE PLACED AT THE TOE OF THE FILL SLOPES.
3. DRILL HOLE AND MUD PIT LOCATION MAY VARY.
4. THE TOTAL DISTURBED AREA WILL BE FENCED.
5. PAD ELEVATION IS APPROXIMATELY 8227.0 FT.
6. A BERM WILL BE PLACED AROUND THE TOPSOIL STOCKPILE

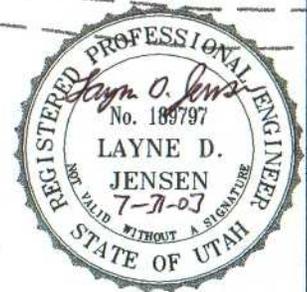
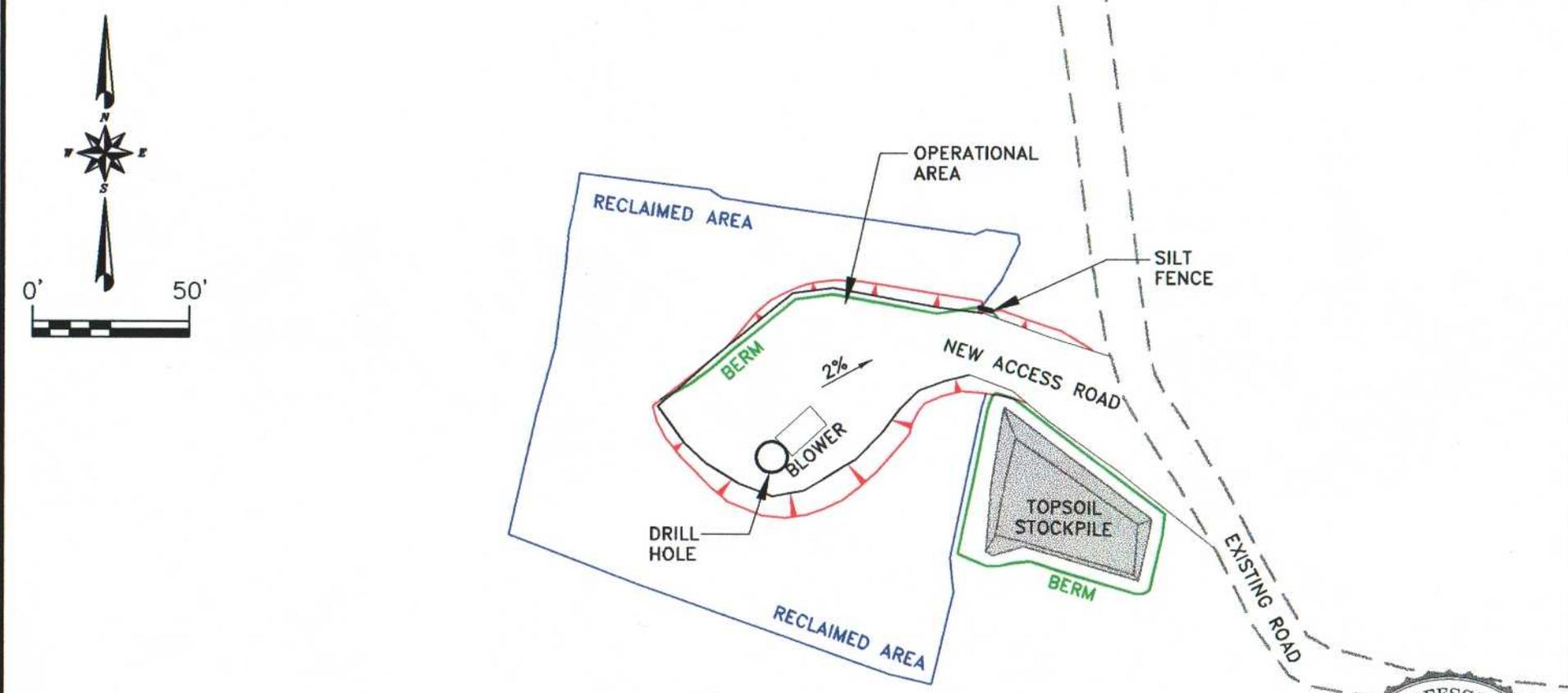


FIGURE 5-3 APPROXIMATE DRILLING LAYOUT FOR G-1





NOTES:

1. SILT FENCE AND/OR STRAW BALES LOCATED AT THE LOWEST POINT ON THE OPERATIONAL PAD.
2. RUNOFF FROM THE OPERATIONAL AREA AND ACCESS ROAD WILL BE TREATED BY THE PAD SILT FENCE.

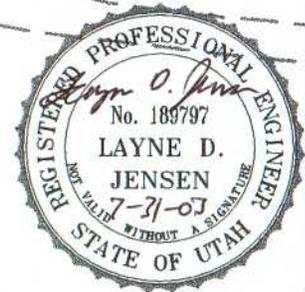


FIGURE 5-4 APPROXIMATE OPERATIONAL LAYOUT FOR G-1



G:\0801\04\DWG\FIGS-4.DWG\07-28-03

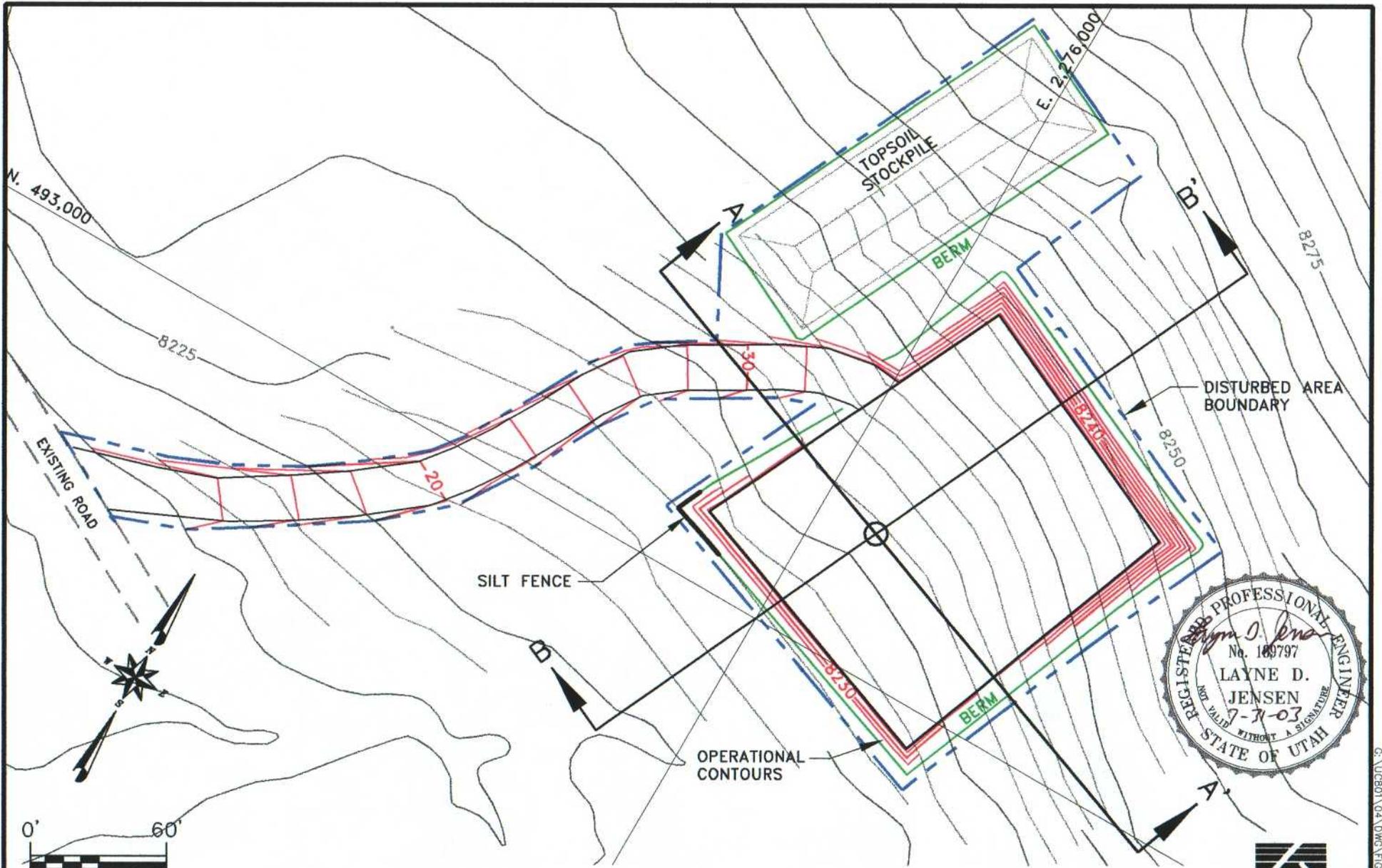


FIGURE 5-5. CONTOUR MAP FOR G-2

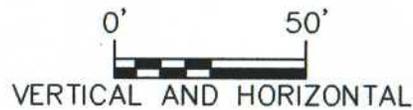
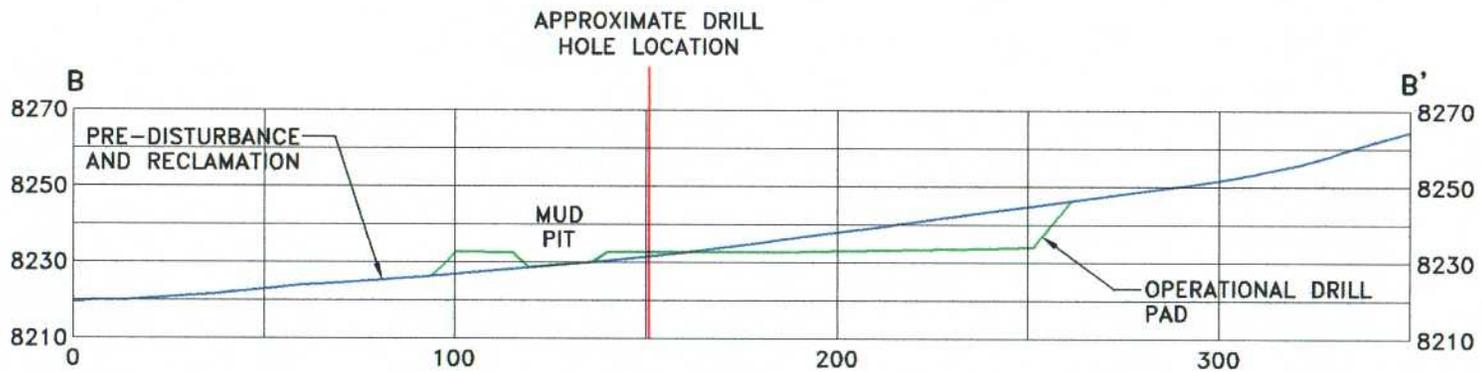
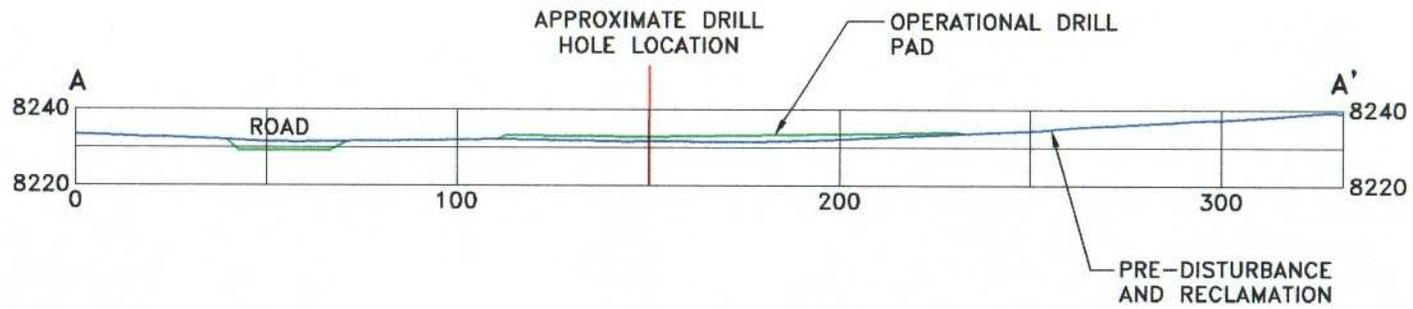
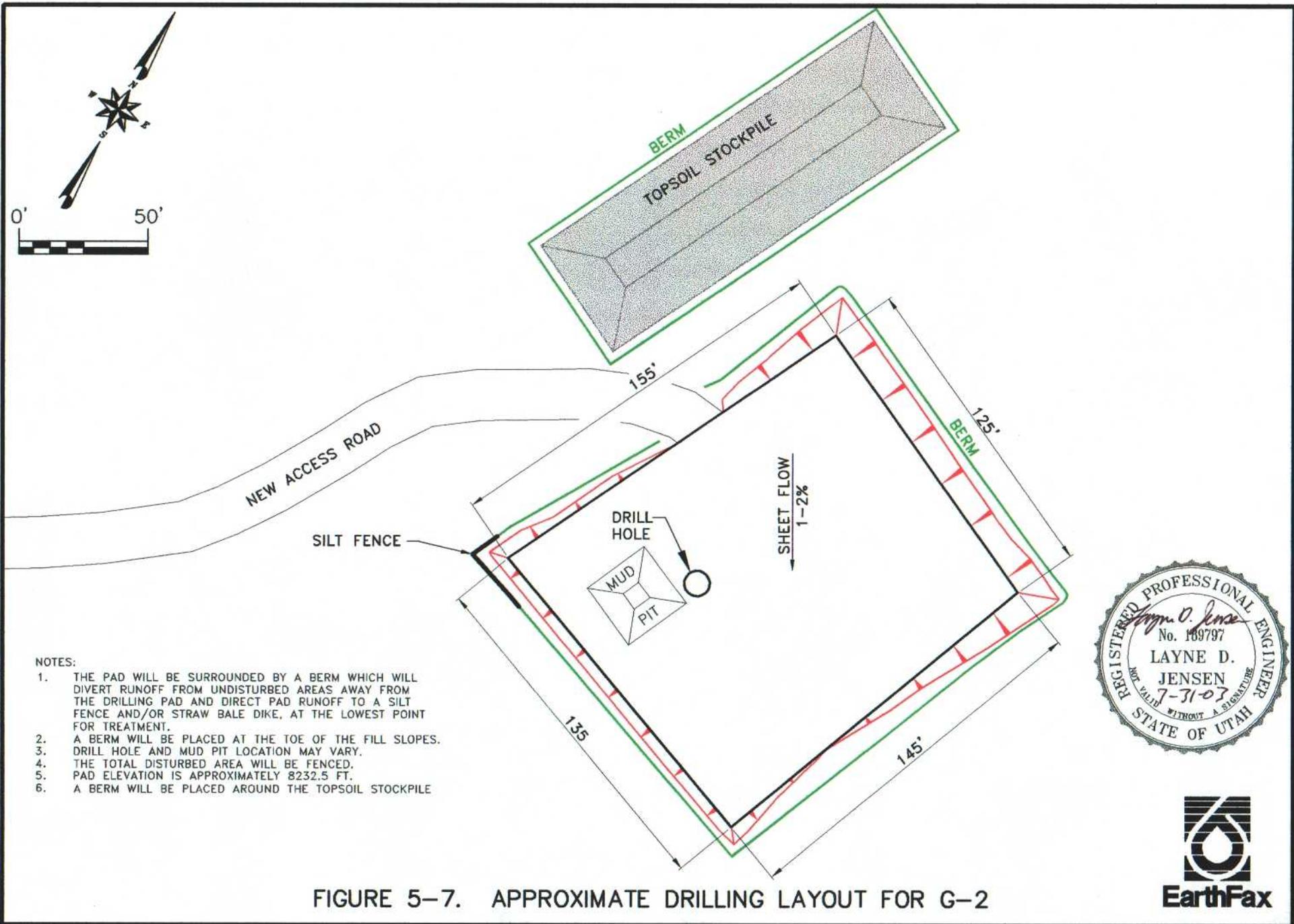


FIGURE 5-6. TYPICAL CROSS-SECTIONS FOR G-2





- NOTES:
1. THE PAD WILL BE SURROUNDED BY A BERM WHICH WILL DIVERT RUNOFF FROM UNDISTURBED AREAS AWAY FROM THE DRILLING PAD AND DIRECT PAD RUNOFF TO A SILT FENCE AND/OR STRAW BALE DIKE, AT THE LOWEST POINT FOR TREATMENT.
  2. A BERM WILL BE PLACED AT THE TOE OF THE FILL SLOPES.
  3. DRILL HOLE AND MUD PIT LOCATION MAY VARY.
  4. THE TOTAL DISTURBED AREA WILL BE FENCED.
  5. PAD ELEVATION IS APPROXIMATELY 8232.5 FT.
  6. A BERM WILL BE PLACED AROUND THE TOPSOIL STOCKPILE



FIGURE 5-7. APPROXIMATE DRILLING LAYOUT FOR G-2

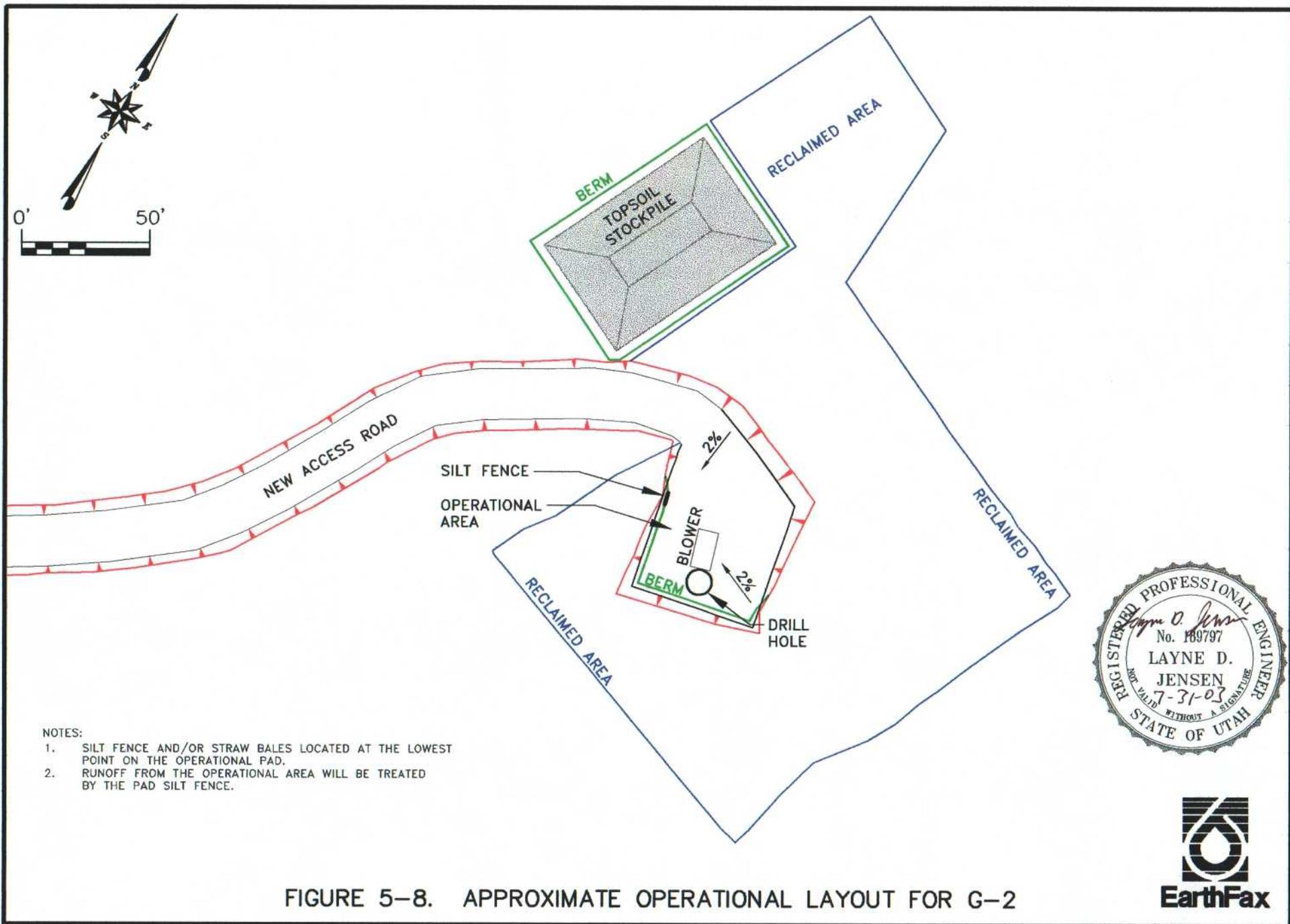


FIGURE 5-8. APPROXIMATE OPERATIONAL LAYOUT FOR G-2

C:\US0801\04\DWG\FIG5-8.DWG, 07-29-03

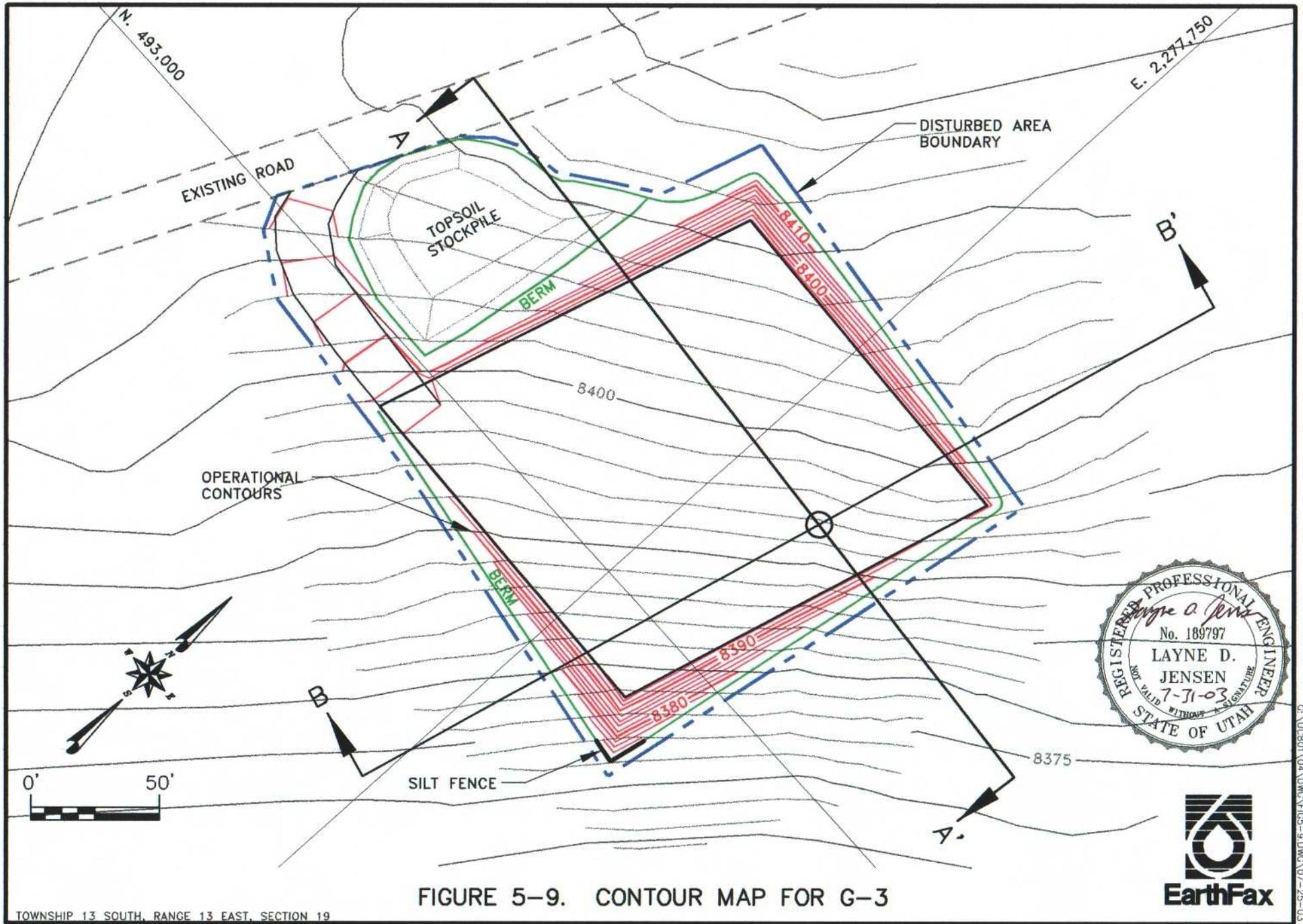


FIGURE 5-9. CONTOUR MAP FOR G-3

C:\JCS801\04\DWG\FIGS-9.DWG\07-25-03

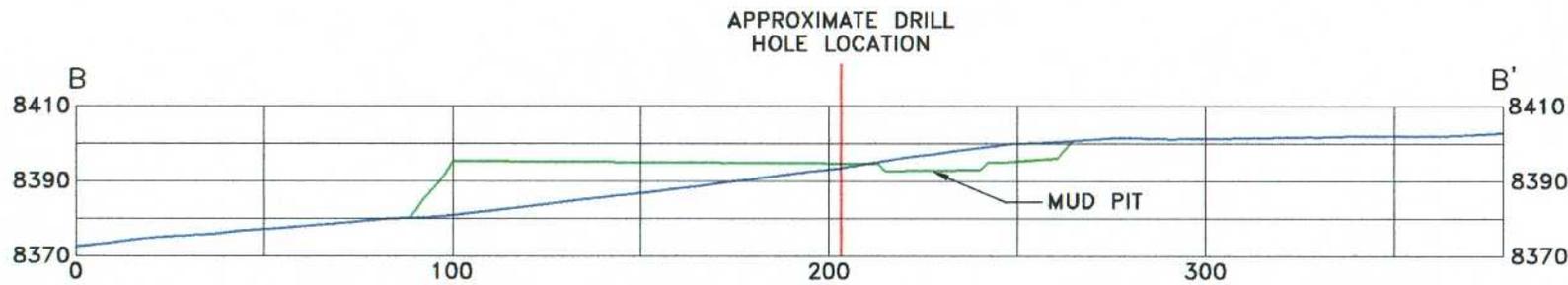
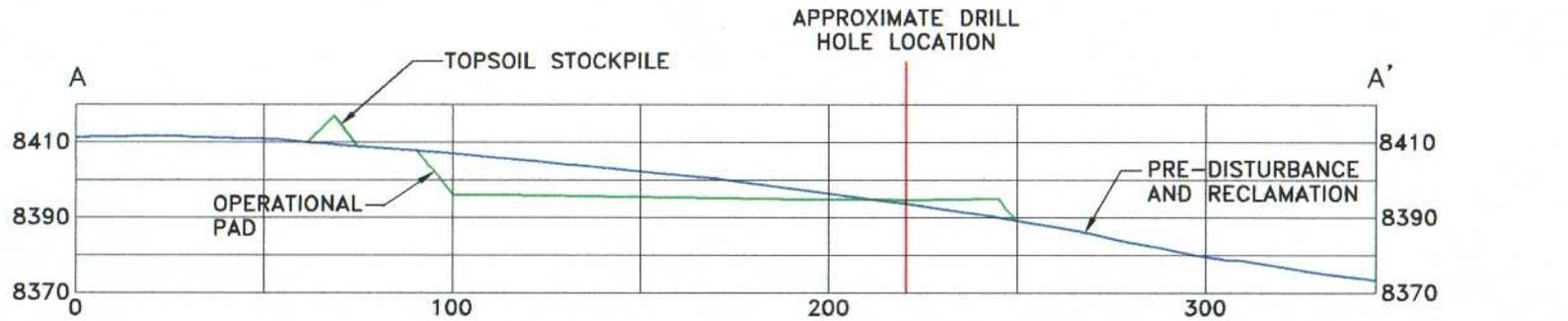
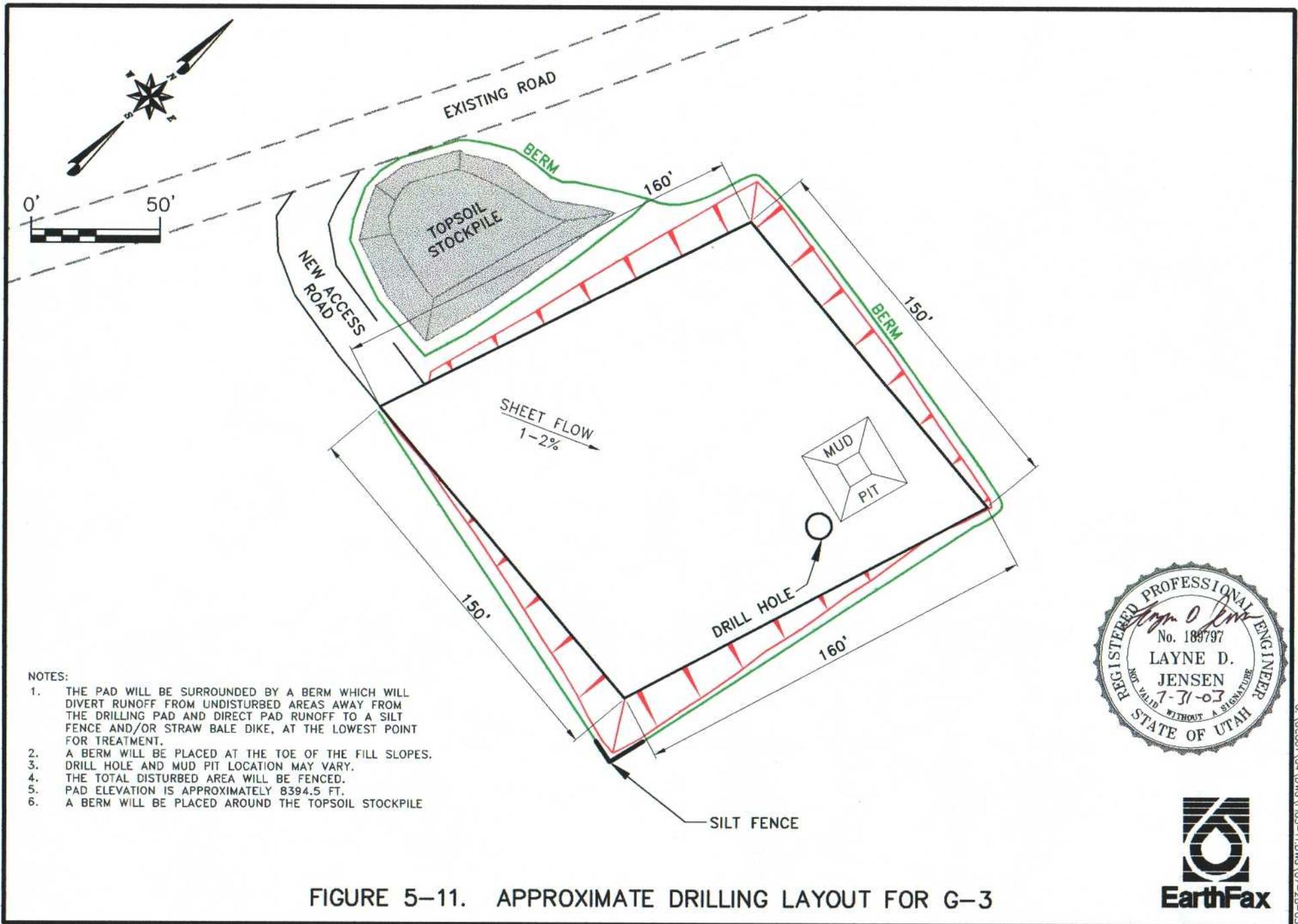


FIGURE 5-10. TYPICAL CROSS-SECTIONS FOR G-3

G:\UCB01\GA.DWG\FIG-5-10.DWG, 07-29-03

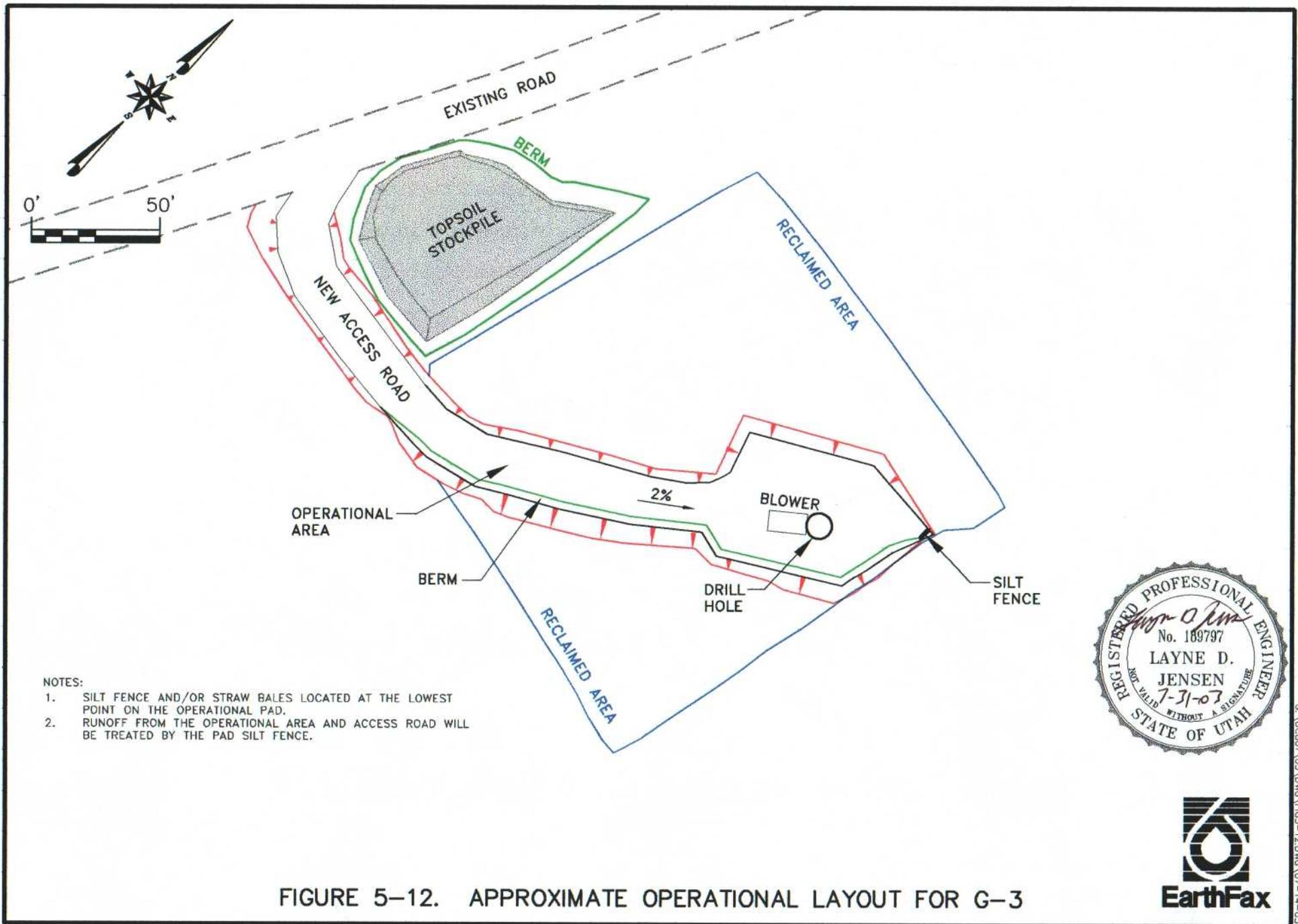


NOTES:

1. THE PAD WILL BE SURROUNDED BY A BERM WHICH WILL DIVERT RUNOFF FROM UNDISTURBED AREAS AWAY FROM THE DRILLING PAD AND DIRECT PAD RUNOFF TO A SILT FENCE AND/OR STRAW BALE DIKE, AT THE LOWEST POINT FOR TREATMENT.
2. A BERM WILL BE PLACED AT THE TOE OF THE FILL SLOPES.
3. DRILL HOLE AND MUD PIT LOCATION MAY VARY.
4. THE TOTAL DISTURBED AREA WILL BE FENCED.
5. PAD ELEVATION IS APPROXIMATELY 8394.5 FT.
6. A BERM WILL BE PLACED AROUND THE TOPSOIL STOCKPILE

FIGURE 5-11. APPROXIMATE DRILLING LAYOUT FOR G-3





NOTES:

1. SILT FENCE AND/OR STRAW BALES LOCATED AT THE LOWEST POINT ON THE OPERATIONAL PAD.
2. RUNOFF FROM THE OPERATIONAL AREA AND ACCESS ROAD WILL BE TREATED BY THE PAD SILT FENCE.

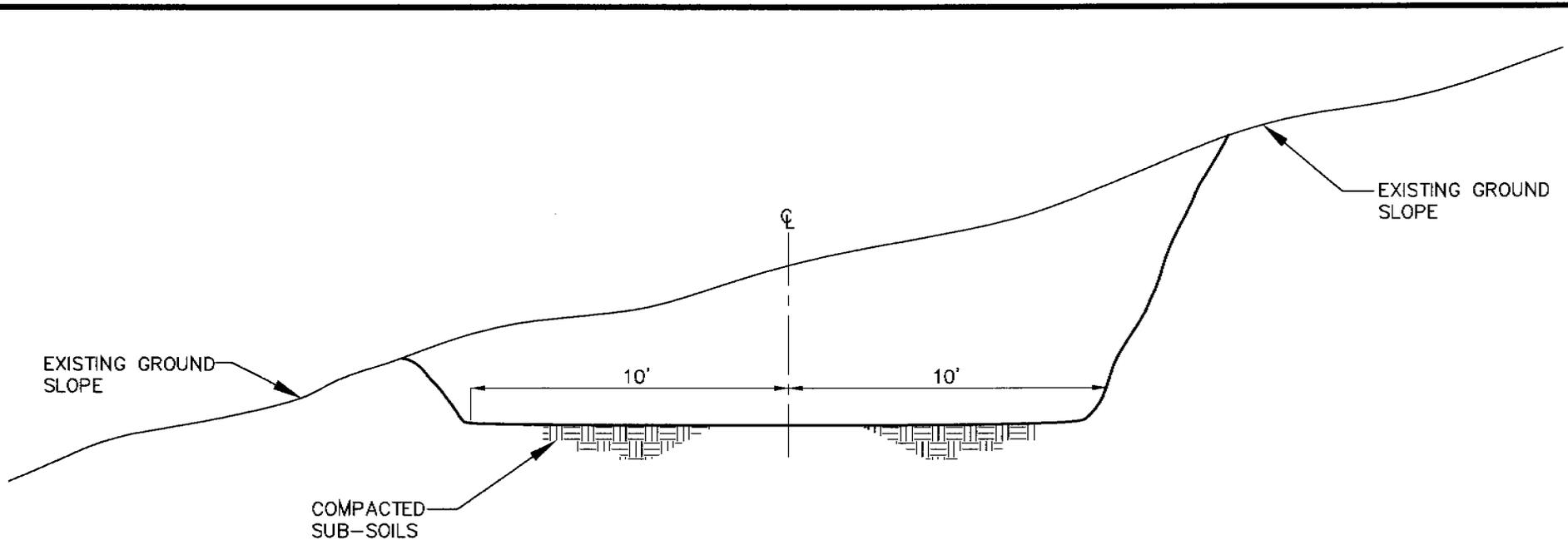


FIGURE 5-12. APPROXIMATE OPERATIONAL LAYOUT FOR G-3



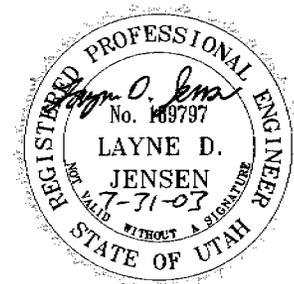
G:\UCB01\031\DWG\FIGS-12.DWG\07-14-03





NOTE:

THE ACCESS ROAD IS BELOW THE EXISTING SURFACE DUE TO TOPSOIL 7"-30" DEEP BEING REMOVED AND STOCKPILED PRIOR TO FINAL ROAD GRADING.

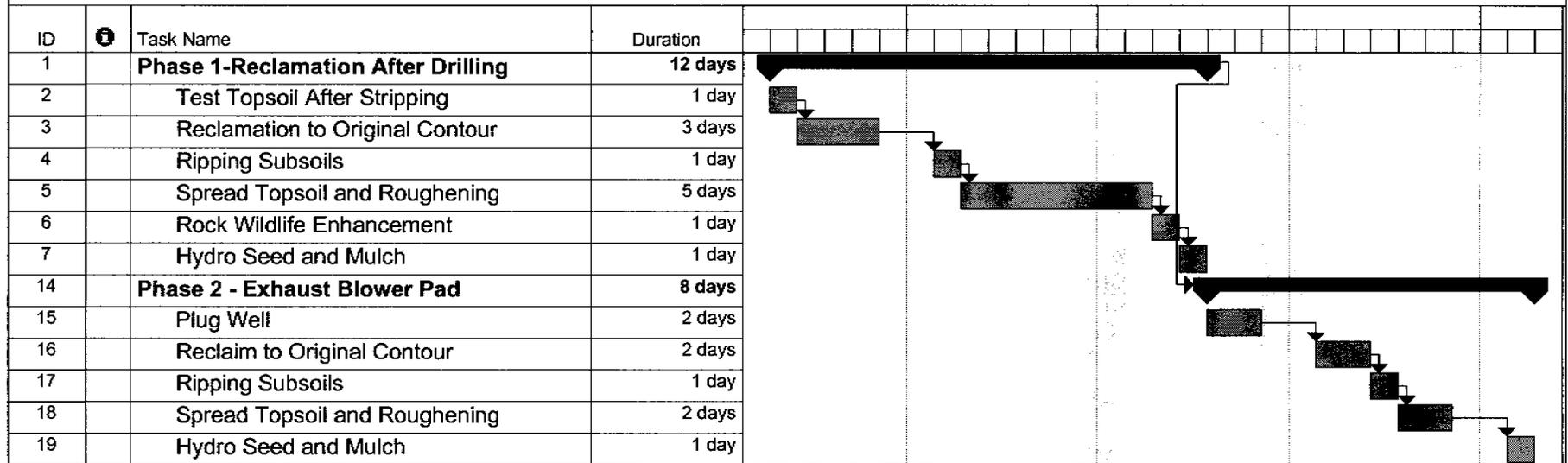


NOT TO SCALE

FIGURE 5-14. TYPICAL ACCESS ROAD CROSS SECTION



### De-Gasification Well Reclamation

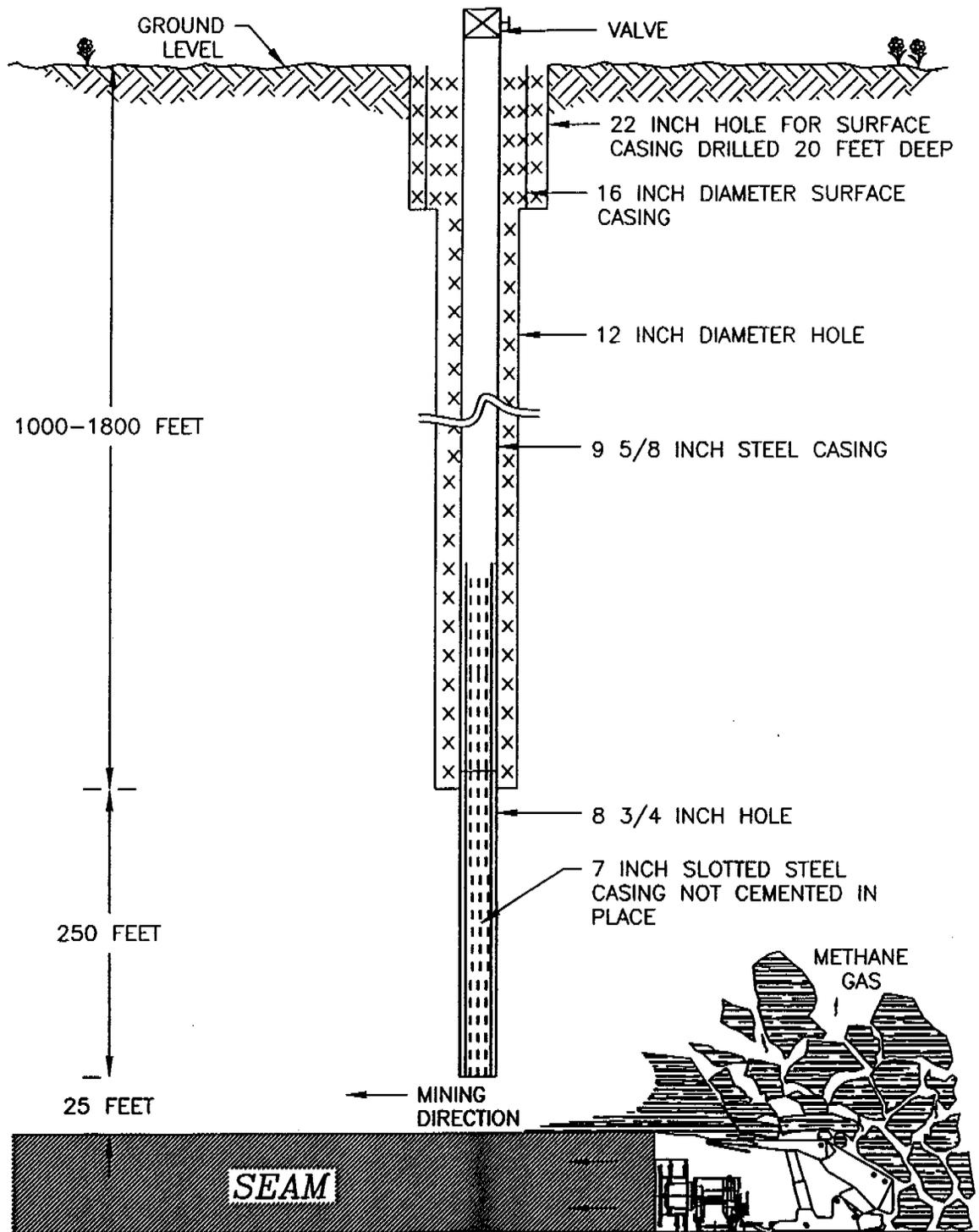


Project: Reclamation Time Table 20 Days  
 Arch Coal, Inc. : Dugout Canyon Mine  
 Date :07/30/03

Task		Milestone	
Split		Summary	
Progress		Project Summary	
		External Tasks	
		External Milestone	
		Deadline	

Figure 5-15

# TYPICAL WELL DESIGN



W.A. KOONTZ JAN 02

FIGURE 5-16. TYPICAL WELL DESIGN.

**CHAPTER 6**

**GEOLOGY**

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## **610 INTRODUCTION**

This chapter presents a description of the geologic resources in the area of the Dugout Canyon Mine. Most of this chapter has been compiled from the approved Geology section of the Dugout Canyon Mine, Mining and Reclamation Plan.

### **611 General Requirements**

The geologic resources in the Dugout Canyon Mine area are discussed in Sections 621 through 627 of the M&RP. Information pertaining to the well sites is discussed below.

### **612 Certification**

All maps, plans, and cross-sections presented in this chapter, required by the regulations, have been certified by a professional engineer.

## **620 ENVIRONMENTAL DESCRIPTION**

This section presents a description of the geologic resources in the Dugout Canyon Mine well site areas.

### **621 General Requirements**

This section presents the regional and site-specific geologic information for the Dugout Canyon Mine well sites.

### **622 Cross Sections, Maps and Plans**

Refer to Plate 6-1 of the approved M&RP for geology associated with well site locations.

### **623 Geologic Determinations**

The information required by the Division to make a determination of the acid and toxic forming characteristics of the well site strata is presented in Chapter 2, Appendix 2-4 of the approved M&RP. No acid or toxic forming materials will originate at the well sites.

### **624 Geologic Information**

#### **624.100 Regional Setting**

Refer to Section 624 of the approved M&RP.

#### **624.200 Test Boring and Drill Hole Data (overburden removed)**

No test boring or drill cores are planned at the well sites.

#### **624.300 Test Boring and Drill Hole Data (overburden not removed)**

No test boring or drill cores are planned at the well sites.

### **625 Additional Geologic Information**

It is not anticipated that any additional geologic data will need to be collected at the well sites.

### **626 Sampling Waivers**

A sampling waiver is not requested at this time for the well sites.

### **627 Description of the Overburden Thickness and Lithology**

Not applicable to this amendment.

## **630 OPERATION PLAN**

### **631 Casing and Sealing of Exploration Holes**

Not applicable to this amendment.

### **632 Subsidence Monitoring**

See Section 525 for additional information.

## **640 PERFORMANCE STANDARDS**

### **641 Exploration and Drill Holes**

The performance standards used in the casing and sealing of all exploration holes and drill holes are outlined in the approved M&RP, Section 542.700.

### **642 Monuments and Surface Markers of Subsidence Monitoring Points**

The performance standards used in the reclamation of all monuments and surface markers used in subsidence monitoring points are outlined in the approved M&RP, Section 525.

**CHAPTER 7**  
**HYDROLOGY**

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**LIST OF ATTACHMENTS**

**Attachment 7-1**      Hydrology Calculations

## **710 INTRODUCTION**

### **711 General Requirements**

This chapter presents a description of the following:

- Proposed operations and the potential impacts to the hydrologic balance;
- Methods of compliance with design criteria and the calculations utilized to show compliance; and
- Applicable hydrologic performance standards.

### **712 Certification**

All maps, plans, and cross sections presented in this chapter have been certified by a qualified, registered professional engineer.

### **713 Inspection**

Inspections are not required since no permanent impoundments will exist at the well sites.

## **720 ENVIRONMENTAL DESCRIPTION**

### **721 General Requirements**

This section presents a description of the pre-mining hydrologic resources within the well pad and their adjacent areas that may be affected or impacted by the proposed coal mining and reclamation operations.

## **722 Cross Sections and Maps**

### **722.100 Location and Extent of Subsurface Water**

Figure 7-1 in the approved M&RP shows a generalized hydrostratigraphic cross section of the permit and adjacent areas including the well sites. Section 724.100 of the approved M&RP provides baseline groundwater conditions.

### **722.200 Location of Surface Water Bodies**

Plate 7-2 in the approved M&RP shows the locations of surface-water bodies and existing or pending water rights. Section 724.200 of the approved M&RP provides baseline surface water conditions.

### **722.300 Locations of Monitoring Stations**

Plate 7-1 in the approved M&RP shows the location of surface water and groundwater monitoring stations.

### **722.400 Locations and Depth of Water Wells**

Refer to Section 722.400 and Plate 7-1 of the approved M&RP for information pertaining to the groundwater monitoring wells. Refer to Appendix 7-9 of approved M&RP for details pertaining to the Gilson well.

### **722.500 Surface Topography**

Surface topography features at the well sites and adjacent areas are shown on Figures 1-1, 5-1, 5-5 and 5-9.

### **723 Sampling and Analysis**

Refer to Section 723 of the approved M&RP.

### **724 Baseline Information**

Refer to Section 724 of the approved M&RP.

#### **724.100 Groundwater Information**

Refer to Section 724.100 of the approved M&RP.

#### **724.200 Surface Water Information**

Refer to Section 724.200 of the approved M&RP.

#### **724.300 Geologic Information**

Geologic information related to the well sites and adjacent areas is presented in Chapter 6 of this submittal and in the approved M&RP.

#### **724.400 Climatological Information**

Climatological data are summarized in Appendix 4-1 behind the Air Quality Permit of the approved M&RP and RA Attachment 7-5 of the Refuse Pile Amendment.

#### **724.500 Supplemental Information**

Refer to Section 724.500 of the approved M&RP.

### **724.600 Survey of Renewable Resource Lands**

Refer to Section 724.600 of the approved M&RP.

### **724.700 Alluvial Valley Floor Requirements**

Information regarding the presence or absence of alluvial valley floors in the well sites and adjacent areas is presented in Chapter 9 of this submittal and the approved M&RP.

### **725 Baseline Cumulative Impact Area Information**

The CHIA currently in place for the Dugout Canyon Mine covers the well sites. The hydrologic and geologic information required for the Division to develop a Cumulative Hydrologic Impact Assessment (CHIA) is presented in the approved M&RP.

### **726 Modeling**

No groundwater or surface water modeling was conducted in support of this submittal.

### **727 Alternative Water Source Information**

Not applicable.

### **728 Probable Hydrologic Consequences**

This section addresses the probable hydrologic consequences of construction and reclamation operations at the well sites. Mitigation measures are discussed generally in this section and in detail in Section 730 of the approved M&RP.

### **728.100 Potential Impacts of Surface and Groundwater**

Potential impacts of the well sites in this area on the quality and quantity of surface and groundwater flow may include contamination from materials associated with the drilling of the wells. The potential impact is addressed in Section 728.300 of this submittal and the approved M&RP.

### **728.200 Baseline Hydrologic and Geologic Information**

Baseline geologic information is presented in Chapter 6 of the approved M&RP. Baseline hydrologic information is presented in Section 724.100 and 724.200 of the approved M&RP.

### **728.300 PHC Determination**

**Potential Impacts to the Hydrologic Balance** - Potential impacts of the Dugout Canyon Mine on the hydrologic balance of the well sites and adjacent areas are addressed in the subsections of this submittal and the approved M&RP.

**Acid and Toxic Forming Materials** - No acid or toxic forming materials have been identified in the soils or strata of the Dugout Canyon Mine (Chapter 6, Section 623 of this submittal). Additional information is located in Appendix 6-2 of the approved M&RP and Section 542.500 of this submittal.

**Groundwater** - During drilling of the wells, the groundwater encountered will be affected. Drilling mud will be used to seal the groundwater aquifers. Once drilling is completed, the casing will be grouted in the well hole. This will seal the aquifers to prevent any groundwater from migrating down the outside of the casing into the mine.

**Potential Hydrocarbon Contamination** - Hydrocarbon products will not be stored at the well sites, however fuels, greases, and other oils may leak from equipment during drilling operations.

Absorbent materials will be used for the collection of leaked fuels, greases, and other oils. The saturated absorbent materials will be disposed of at an appropriate landfill facility.

### **729 Cumulative Hydrologic Impact Assessment (CHIA)**

The Cumulative Hydrologic Impact Assessment currently in place for the Dugout Canyon Mine includes the well sites and adjacent areas.

## **730 OPERATION PLAN**

### **731 General Requirements**

#### **731.100 Hydrologic - Balance Protection**

**Groundwater Protection** - The effect on groundwater at the well sites is expected to be minimal. Groundwater encountered during drilling will be sealed off, refer to Section 728.300.

**Surface Water Protection** - To protect the hydrologic balance, construction, maintenance, and reclamation operations will be conducted to handle earth materials and runoff in a manner that prevents, to the extent possible, additional contributions of suspended solids to stream flow outside the permit area, and otherwise prevent water pollution.

During initial drilling, the sites will be graded to ensure that storm runoff will flow towards the berms surrounding the entire drilling pad area. The berms will direct the runoff to the lowest point(s) within the pad area where a silt fence and/or straw bale dike(s) will treat the runoff (see Figures 5-1, 5-5, and 5-9). The berm placed at the top of the drilling pad cut slopes will divert runoff around the drilling pad. Thus reducing the runoff affected by the drilling pad.

After drilling, the pad size will be reduced for exhausting operations. The pad will be re-graded to cause the storm runoff to sheet flow towards a silt fence and/or straw bale dike. A berm will be placed at the top of the fill slope to direct any runoff from the operational pad to the silt fence and/or straw bale dike(see Figures 5-4, 5-8, and 5-12). The silt fences and/or straw bale dikes will be periodically inspected, and accumulated sediment will be removed as needed to maintain functionality. The sediment from the silt fence and/or straw bale dikes will be piled on the pad and will be used for fill during final reclamation of the well site. During the drilling phase a berm and silt fence will be installed at the toe of the fill slope as shown on Figures 5-1, 5-5, and 5-9 to treat any runoff from the drilling pad.

#### **731.200 Water Monitoring**

No water monitoring will be conducted at the degas well sites. Refer to approved M&RP for a description of water monitoring.

#### **731.300 Acid or Toxic Forming Materials**

No acid or toxic forming materials are anticipated at the well sites (see Section 728.300).

#### **731.400 Transfer of Wells**

Refer to Section 731.400 of the approved M&RP.

#### **731.500 Discharge**

No discharges to underground workings.

### **731.600 Stream Buffer Zones**

**Stream Channel Diversions** - No stream channel diversions are planned at the well sites.

**Buffer Zone Designation** - None of the drilling sites are adjacent to a stream, therefore the establishment of a stream buffer zone is not necessary.

### **731.700 Cross Section and Maps**

Not applicable.

### **731.800 Water Rights and Replacement**

Refer to Sections 728.300 and 731.800 of the approved M&RP.

### **732 Sediment Control Measures**

The sediment control measures within the well sites have been designed to prevent additional contributions of sediment to stream flow or to runoff outside the well sites. In addition, the well sites have been designed to minimize erosion to the extent possible.

The structures to be used for runoff control at the well sites are berms, silt fences and/or straw bale dikes.

### **732.100 Siltation Structures**

Berms, silt fences and straw bales dikes will be used to treat runoff.

### **732.200 Sedimentation Pond**

The drilling sites will not have sedimentation ponds.

### **732.300 Diversions**

Refer to Section 731.100 of this submittal.

### **732.400 Road Drainage**

No diversion ditches will be constructed along the primary roads leading to the well sites. See Figures 5-13 and 5-14 for typical road cross sections. The new access roads for Drill Sites G-1 and G-3 will have a water bar constructed at the base of the access road to divert water off the road prior to the runoff reaching the drilling pad. The new access road for Drill Site G-2 does not require a water bar since the access road slopes away from the drilling pad.

## **733 Impoundments**

### **733.100 General Plans**

Not applicable.

### **733.200 Permanent and Temporary Impoundments**

No permanent impoundments will exist at the well sites.

## **734 Discharge Structures**

A berm will surround the entire drill pad at each well site during the drilling phase. The berm will divert undisturbed runoff around the drilling pad and direct runoff from the pad to a silt fence/straw

bale dike at the lowest point within the well pad disturbed area. A silt fence and/or straw bale dike will be the discharge structure for each of the well sites during the operational phase.

#### **735 Disposal of Excess Spoil**

There will be no excess spoil generated at the well sites.

#### **736 Coal Mine Waste**

There will be no coal mine waste generated or stored at the well sites.

#### **737 Non-Coal Mine Waste**

There will be no non-coal mine waste disposed at the well sites.

#### **738 Temporary Casing and Sealing of Wells**

Refer to Section 542.700 of this submittal.

### **740 DESIGN CRITERIA AND PLANS**

#### **741 General Requirements**

This submittal includes general well site plans that incorporate design criteria for the control of drainage.

## **742 Sediment Control Measures**

### **742.100 General Requirements**

**Design** - Sediment control measures have been formulated to prevent additional contributions of sediment to stream flow or to runoff outside the well site area; and minimize erosion to the extent possible.

**Measures and Methods** - Sediment control methods will include silt fences, berms, and straw bales to reduce runoff and trap sediment.

### **742.200 Siltation Structures**

**General Requirements** - Additional contributions of suspended solids and sediment or runoff outside the well site area will be prevented to the extent possible using silt fences, berms, and straw bale dikes. Siltation structures(berms, silt fences and/or straw bale dikes) will be installed before the topsoil is removed from the well site. Construction activities will not occur during major precipitation events.

**Design** - All hydrology calculations were made using the 10-year, 24-hour precipitation event. Hydrology calculations are in Attachment 7-1. Locations of the berms and silt fences are shown on Figures 5-1, 5-4, 5-5, 5-8, 5-9 and 5-12.

### **742.300 Diversions**

No diversion ditches will be constructed as part of the drilling or operational phases.

**742.400 Road Drainage**

Refer to Section 732.400 of this submittal.

**743 Impoundments**

No impoundments will exist at the well sites.

**744 Discharge Structures**

No discharge structures have been planned or designed.

**745 Disposal of Excess Spoil**

There will be no excess spoil generated at the well sites.

**746 Coal Mine Waste**

**746.100 General Requirements**

There will be no coal mine waste used at the well sites.

**746.200 Refuse Piles**

There will be no refuse piles at the well sites.

**746.300 Impounding Structures**

Refer to Section 733.200 of this submittal.

**746.400 Return of Coal Processing Waste to Abandoned Underground Workings**

No coal processing waste will be generated at the well sites.

**747 Disposal of Non-Coal Mine Waste**

All non-coal mine waste will be disposed of at an approved landfill.

**748 Casing and Sealing Wells**

Refer to Section 542.700 of this submittal.

**750 PERFORMANCE STANDARDS**

**751 Water Quality Standards and Effluent Limitations**

Water encountered during drilling will flow into the mud pit and will not be discharged. If necessary the water will be pumped into a tank and hauled from the site for disposal at a licensed facility. Runoff water will be treated using silt fence and/or straw bale dikes prior to leaving the site.

**752 Sediment Control Measures**

All sediment control measures will be located, maintained, constructed and reclaimed according to plans and designs presented in Section 732, 742, and 760 of this submittal.

### **752.100 Siltation Structures and Diversions**

Siltation structures will be located, maintained, constructed and reclaimed according to plans and designs presented in Section 732, 742, and 763 of the submittal.

### **752.200 Road Drainage**

Refer to Section 732.400 of this submittal.

### **753 Impoundments and Discharge Structures**

Refer to Section 733.200 of this submittal.

### **754 Disposal of Excess Spoil, Coal Mine Waste and Non-Coal Mine Waste**

There will be no excess spoil or coal mine waste generated at the well sites. Refer to Section 747 of this submittal regarding non-coal waste disposal.

### **755 Casing and Sealing**

Refer to Section 542.700 of this submittal.

## **760 RECLAMATION**

### **761 General Requirements**

A detailed reclamation plan for the well sites is presented in Section 540. No structures will exist at the well sites.

## **762 Roads**

Refer to Section 542.600.

### **762.100 Restoring the Natural Drainage Patterns**

The natural drainage patterns will be restored after degassification is completed.

### **762.200 Reshaping Cut and Fill Slopes**

Cut and fill slopes will be reshaped at the well sites.

## **763 Siltation Structures**

### **763.100 Maintenance of Siltation Structures**

All siltation structures will be maintained until removed in accordance with the approved reclamation plan.

### **763.200 Removal of Siltation Structures**

When a siltation structure is removed, the land on which the siltation structure was located will be regraded and revegetated in accordance with the reclamation plan presented in Section 540.

## **764 Structure Removal**

A timetable for the reclamation of the sites is presented in Figure 5-15.

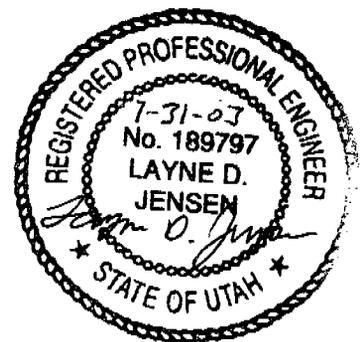
**765 Permanent Casing and Sealing of Wells**

Refer to Section 542.700 of this submittal.

Canyon Fuel Company, LLC  
Dugout Canyon Mine

Methane Degassification Amendment  
August 2003

**ATTACHMENT 7-1**  
**HYDROLOGY CALCULATIONS**



Berm Design for  
Drilling and Operational phases.

G-1

Berm Design

$P = 2.0''$   
10-24

Hydrologic soil group is assumed to be C since it is a mix of soils with Hydrologic soil group B and D.

CN = 87 (Dirt road) the topsoil stockpile will be seeded but I will assume there is no vegetation to be conservative

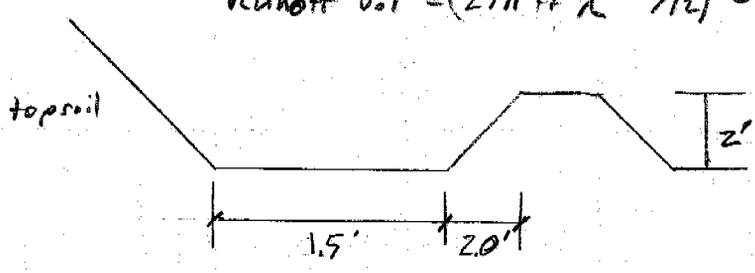
Runoff Depth =  $\frac{(P - 0.25)^2}{P + 0.8(S)}$

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

Runoff Depth =  $\frac{(2 - 0.25(1.49))^2}{2 + 0.8(1.49)} = \frac{2.9}{3.19} = 0.91''$

Topsoil stockpile area = 2591 ft<sup>2</sup>

Runoff Vol =  $(2591 \text{ ft}^2) \times \frac{0.91}{12} = 196 \text{ ft}^3$



Runoff flows to NW corner of stockpile

The volume of the containment will be calculated using the berm height and length to calculate a volume and then divided in half to account for the slope.

length of berm detaining water = 26'

Containment area =  $(2')(1.5') + (2)[\frac{1}{2}(2)(2)] = 7 \text{ ft}^2$

Containment Volume =  $\frac{1}{2} [(26' \times 7 \text{ ft}^2)] = 301 \text{ ft}^3$

105 ft<sup>3</sup> of extra capacity. Calculation for both drilling and operational phases

G-2

Berm Design

Hydrologic soil group = C

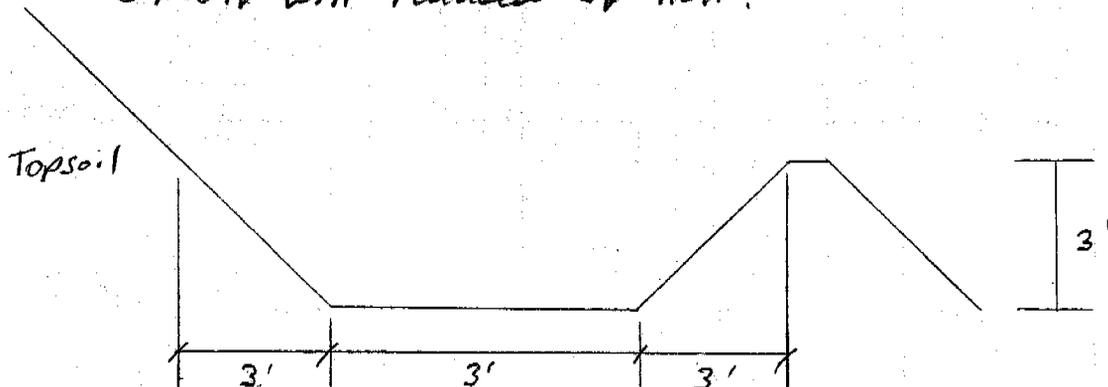
CN = 87

From G-1 Runoff Depth = 0.91"

Topsoil stockpile Area = 9512 ft<sup>2</sup>

Runoff Vol. = (9512 ft<sup>2</sup> × 0.91/12) = 721 ft<sup>3</sup>

Due to slope only the downstream end will store water  
The length of berm impounding water is approx 84'.  
However, due to the slope towards the SE corner the  
Capacity will reduced by half.



Containment Area = (3)(3) + 1/2 [(3)(3) + (3)(3)] = 18 ft<sup>2</sup>

Capacity = 1/2 [(84') (18 ft<sup>2</sup>)] = 756 ft<sup>3</sup>

This design will also work for the operational phase  
topsoil stockpile berm

Only the lower 1/4 of the berm needs to be this big.  
A 1' high berm around the rest is sufficient to  
direct runoff.

6-7

Berm Design

Hydrologic Soil Group = D mixture of topsoil with Hydrologic soil group of C + D.

CN = 89 (Dirt roads) Assuming non vegetated condition.  
∴ conservative estimate.

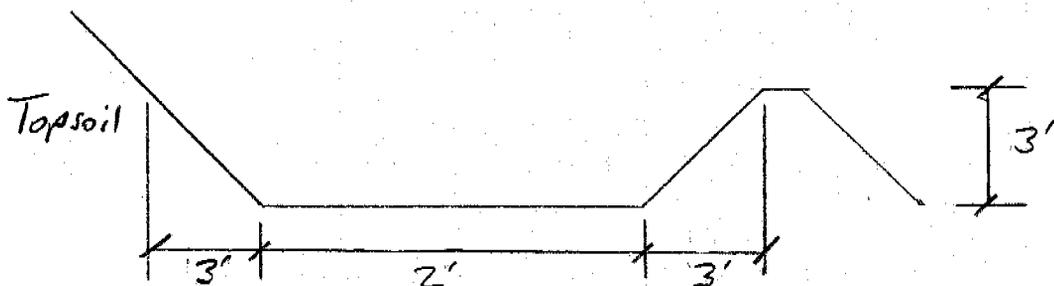
$$S = \frac{1000}{89} - 10 = 1.24$$

$$\text{Runoff Depth} = \frac{(2 - 0.2(1.24))^2}{2 + 0.8(1.24)} = \frac{3.07}{2.99} = 1.03''$$

$$\text{Topsoil stockpile area} = 5216 \text{ ft}^2$$

$$\text{Runoff Volume} = (5216 \text{ ft}^2) \left( \frac{1.03}{12} \right) = 448 \text{ ft}^3$$

Due to the slope only the downstream berm will store runoff. The length of berm impounding water is approximately 77'. Runoff flows to the SE corner. Due to slope storage capacity will be reduced by half.



$$\text{Containment Area} = (2 \times 3') + \frac{1}{2}((3)(3) + (3)(3)) = 14 \text{ ft}^2$$

$$\text{Berm Capacity} = \frac{1}{2}[(77' \times 14 \text{ ft}^2)] = 539 \text{ ft}^3 > 448 \text{ ft}^3 \therefore \text{ok}$$

The berm only needs to be 3' tall for 35' from the SE corner. The rest of the berm may be 1' tall.

This design applies to the drilling and operational phase topsoil stockpiles.

**CHAPTER 8**  
**BONDING AND INSURANCE**

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## **810 BONDING DEFINITIONS AND DIVISION RESPONSIBILITIES**

This chapter provides information regarding the bonding for reclamation of the well sites at the Dugout Canyon Mine. CFC has on file with the Division a bond or bonds payable to the Division for performance of all requirements of the State Program.

## **820 REQUIREMENTS TO FILE A BOND**

A description of the disturbed area location for each well site is found in Chapter 1, Table 1-1. Reclamation of the disturbed areas are discussed in Section 340 of this submittal. The performance bond period is for the duration of coal mining and reclamation operations including the extended period designated by the Division. The bond is in the form of a surety bond and is described in Section 860 of the M&RP.

## **830 DETERMINATION OF BOND AMOUNT**

The present bond of \$3,682,000 should be sufficient to assure the completion of the reclamation plan. The reclamation bond (direct and indirect costs) for the well sites is \$62,530 (2008 dollars). The most current formulas from the Office of Surface Mining, *Handbook for Calculation of Reclamation Bond Amounts*, April 2000 were used to determine the coverage necessary for reclamation (Means 2002). The reclamation plan and design criteria concerning the well sites can be found in Sections 540 and 550. The bonding information pertaining to the well sites will be incorporated into Appendix 5-6 of the approved M&RP upon approval of the bond. The bond coverage will be adjusted per the Division's determination of required bond coverage.

## **840 GENERAL TERMS AND CONDITIONS OF THE BOND**

Refer to Chapter 8 of the approved M&RP.

**850 BONDING REQUIREMENTS FOR UNDERGROUND COAL MINING AND RECLAMATION ACTIVITIES**

Refer to Chapter 8 of the approved M&RP.

**860 FORMS OF BONDS**

Refer to Chapter 8 of the approved M&RP.

**870 REPLACEMENT OF BONDS**

Refer to Chapter 8 of the approved M&RP.

**880 REQUIREMENTS TO RELEASE PERFORMANCE BONDS**

The applicant will comply with the requirements described in Section R645-301-880 of the Division regulations when applying for the release of performance bonds.

**890 TERMS AND CONDITIONS FOR LIABILITY INSURANCE**

Certificates of insurance issued for the Dugout Canyon Mine are included in Appendix 1-2 of the approved M&RP and the 2002 Annual Report. For additional information, refer to Chapter 8 of the approved M&RP.

**CHAPTER 9**  
**ALLUVIAL VALLEY FLOORS**

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## **302-321 ALLUVIAL VALLEY FLOOR DETERMINATION**

### **302-321.100 Scope of Investigation**

The purpose of this Chapter is to provide to the Division the results of an investigation which was performed to assess the potential valley floor (AVF) to exist within the permit and adjacent areas of the proposed Dugout Canyon Mine well sites. The scope of this investigation has involved:

- Geologic studies (detailed in Chapter 6 of the approved M&RP);
- Hydrologic studies (detailed in Chapter 7 of the approved M&RP);
- Land-use studies (detailed in Chapter 4 of the approved M&RP);
- Soils studies (detailed in Chapter 2 of the approved M&RP); and
- Vegetation studies (detailed in Chapter 3 of the approved M&RP).

These studies are summarized in this chapter as they relate to the potential for existence of an AVF within the permit or adjacent area. The individual chapters outlined above should be consulted for more detailed information.

### **302-321.200 Summary of Studies Performed**

**Mapping of Unconsolidated Stream-Laid Deposits** - Plate 6-1 in Chapter 6 of the approved M&RP presents a map of the surface geology of the well sites and adjacent areas. Included on this map are unconsolidated stream-laid deposits identified with map symbol "Qal". Note that the plans for the well sites do not involve the removal or significant disturbance of alluvial fill. The well sites are located in either the North Horn Formation or the Flagstaff Formation. The stream-laid deposits in Pine Canyon and Fish Creek Canyon are approximately 2.5 to 3.5 miles from the well sites.

Data presented in Section 728 of this submittal indicates that no significant impact to the availability of water in the permit or adjacent areas.

**Agricultural Activities** - As noted in Section 411 of this submittal and the approved M&RP, the only agricultural activities which occur within the permit and adjacent areas are grazing or range land. No irrigated agriculture occurs within the permit area.

**Flood Irrigation** - No flood irrigation occurs within the permit area. According to the approved M&RP, the nearest area of irrigated agriculture is located 4 miles southwest of the Dugout Canyon Mine and the well sites are east of the mine site.

**Subirrigation and Flood Irrigability** - Refer to the approved M&RP.

**Analysis of Aerial Photographs** - Refer to the approved M&RP.

### **302-321.300 Extent of Alluvial Valley Floors**

The studies summarized above indicate that no alluvium is present at any of the well sites.

Based on a review of the above studies, AVF's are not present within the proposed well sites, as indicated by:

- Flood irrigation or sub irrigation of stream-laid deposits have not historically occurred within the proposed well site disturbed areas; and
- Soil and topographic conditions within the proposed well site disturbed areas preclude future flood irrigation of the well sites.

### **302-322 OPERATIONS AFFECTING DESIGNATED ALLUVIAL VALLEY FLOORS**

Based on the information summarized in this chapter, no impacts will occur to designated alluvial valley floors due to the operation and reclamation of the well sites and adjacent areas.