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ATTACHMENT 2-1
SOIL INVENTORY AND ASSESSMENT

Soil Inventory and Assessment
Gas Ventilation Borehole Sites
GVH 5A, 7, 8, and 9
Aberdeen Mine
Carbon County, Utah

Prepared For:

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Andalex Resources, Inc.
Soil Inventory and Assessment
Gas Ventilation Borehole Sites GVH 5A, 7, 8, and 9
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Andalex Resources, Inc.

Soil Inventory and Assessment

Gas Ventilation Borehole Sites GVH 5A, 7, 8, and 9

Aberdeen Mine

INTRODUCTION

This soil inventory and assessment was conducted by Daniel M. Larsen, Soil Scientist, Environmental Industrial Services, for Andalex Resources, Inc. The project consists of four gas ventilation borehole sites above the Aberdeen Mine located about 15 miles northeast of Price, Utah. Each drill site is about one acre in size and marked with a stake at the center. The sites are identified as GVH 5A, GVH 7, GVH 8, and GVH 9. They are located in Section (Sec.) 31, Township (T.) 12 South (S), Range (R.) 10 East (E) and Sec, 36, T.12S, R.11E.

The objective was to determine the characteristics of the soil resources and assess the suitability for reclamation at each site. Soil limitations and specific management concerns were to be noted. Specifically, the amount of soil to be salvaged as topsoil was to be identified, including the thickness and distribution at each site. Subsoils and underlying materials were also to be evaluated for potential salvage, segregation from topsoil, and limitations as plant growth material.

Topsoil, in the general sense, is considered as the dark colored (mollic) surface soil layer for this project area. It includes the A-horizon and suitable dark colored B-horizon soils. Some of the B-horizons are similar to the dark colored A-horizons but often show an increase in clay and have a more blocky structure.

SETTING

The drill sites are located at about 8,300 to 8,500 feet in elevation on a general northwest back slope of the Book Cliffs. Slopes at the sites range from about 5 to 10 percent gradient. The general vegetation consists of sagebrush openings with patches and strips of aspen. Annual precipitation is about 18 to 20 inches.

Soil parent materials are composed of sandstone and shale (clay layer).

The area is at the transition of frigid and cryic soil temperature régimes. Where aspen is present it is clearly cryic, but in the openings it is either frigid or cryic.

PROCEDURES

Fieldwork was conducted on October 10, 2005. A total of 17 backhoe pits were excavated at the four sites. A pit was located near each center stake, along with four to five additional pits within each 200 X 200 foot drill site area. Some spot-checking was also done by use of a soil spade.

Soil descriptions, photographs, soil samples, and notes were obtained at each site. A full soil description and soils samples were taken at each soil pit located near the center of the sites. Soil samples were identified by the drill site numbers (GVH 5A, 7, 8, and 9) and the depth interval that the sample was taken. These were primarily from the central soil pit, Pit No.1, at each site. Two additional soil samples were obtained where suitable soil extended to greater depths in outlying soil pits than was present at the representative soil pit at the center.

The soil samples each consisted of about six pounds of soil and were collected in one gallon size plastic freezer bags. A small portion of each sample was used to determine soil colors, texture by feel, plasticity, and reaction. The remainder was sent to Inter-Mountain Laboratories, Inc., Sheridan, Wyoming for analysis of parameters required by the Utah State Division of Oil, Gas, and Mining.

BACKGROUND SOILS INFORMATION

The area is included in the Soil Survey of the Carbon Area, Utah issued in June 1988 by the Soil Conservation Service. This is general soil survey information intended for planning purposed and is given here as background reference to tier more detailed information.

Table 1: Soil Map Units of the Carbon Area Soil Survey:

Site	Map Unit	Description
GVH 5A	117	Trag – Beje - Senchert Complex
GVH 7	105	Senchert Family – Senchert Complex
GVH 8	63	Midfork Family – Podo Association
GVH 9	7	Beje – Trag Complex

Classification:

Trag	Fine-loamy, mixed, Typic Argiborolls
Beje	Loamy, mixed, Lithic Argiborolls
Senchert	Fine-loamy, mixed, Pachic Argicryolls
Midfork	Loamy-skeletal, mixed, Typic Haplocryolls
Podo	Loamy, mixed, calcareous, frigid Lithic Ustorthents

DRILL SITE SOIL RESOURCES

Some general features apply to the soils in the project area. They have all formed from sandstone and shale and are well drained. The surface soils are dark colored and commonly have

loam and clay loam textures. The percentage of very fine sand is the major portion of the total sand fraction, giving the loam textures characteristics similar to silt loam and the clay loam textures characteristics similar to silty clay loam. The upper 3 to 5 inch layer typically has fine granular structure. The soil then changes to a more blocky structure, although the color remains about the same as the upper 5 inches. An increase in clay with depth coincides with stronger and larger blocky structure. The dark colored soil includes both A and B-horizon materials. Lighter brown subsoils are patchy and thin over very stony and/or clayey substrata. Sandstone and clay layers are commonly at about 24 to 40 inches in depth. The soils have moderate to moderately slow permeability and have moderate erodibility. The clayey substrata is slowly permeable.

Table 2:
Summary of Topsoil Available at Gas Ventilation Drill Sites (over a 200X200 foot pad site)

Site	Representative Topsoil	Range in Thickness	Average	Depth Determining Factor	Approx. volume (cu. yds.)
GVH 5A	Very dark grayish brown loam and clay loam. Low rock fragment content	14-24	20	High rock fragment content, bedrock, or clay.	2470
GVH 7	Very dark grayish brown and dark brown loam and clay loam. Low rock fragment content	24-30	26	High rock fragment content	3210
GVH 8	Nearly black to very dark grayish brown clay loam. About 20 to 35 percent rock fragments (Gr, Co, ST).	8-32	20	Very high rock content, bedrock, and/or clay	2470 (including rock fragments)
GVH 9	Very dark grayish brown and dark brown laom and clay loam silt loam and silty clay loam. Mostly low rock fragment content. Up to 40 percent rock fragment in spots on north side.	12-36	22	Heavy, dense, clay	2716

GVH 5A

This site has soils which range from about 14 to 40 inches over sandstone bedrock. Dark colored topsoils are 14 to 24 inches thick. The site averages about 20 inches of salvageable topsoil.

The thinner soils (14 to 18 inches) are along the southern third of the site where the vegetation is mostly grass compared to dense sagebrush over most of the site.

Surface soils are very dark grayish brown loam grading to clay loam. Subsoils consist of both clayey layers (shale) and stony sandstone layers. The clay layer is discontinuous as noted in the soil pits, but may be present at greater depths below sandstone lenses where it was not observed.

The typical soils are similar to the Senchert soil family. These soils classify as fine loamy, mixed, Pachic Argicryolls. Inclusions consist of soils less than 20 inches to bedrock, soils with thinner dark colored surface layers, and soils with higher rock fragment content.

GVH 7

This site supports a dense sagebrush stand has thick dark colored loam to clay loam surface soils. Subsoils are also loam to clay loam but have with an increase in rock fragments over sandstone bedrock, which is at about 30 to 40 inches in depth. The upper 24 to 30 inches has about 5 to 10 percent rock fragments while the lower part of the soil profile has about 30 to 50 percent above the bedrock.

This site is similar to GVH 5A but has a thicker dark colored surface layer, deeper soils, and less clay in the subsoil and substrata.

The soils are fine loamy to fine silty, mixed, superactive Pachic Haploborolls.

GVH 8

This site is in an aspen stand on a 10 percent slope. It is on a slight convex knoll having a northwest aspect. The surface is relatively stone free, however, the soils have gravel to boulder sized rock fragments. Surface soils are very dark colored loam to clay loam. Underlying materials consist of sandstone and clay layers.

Topsoils are generally 18 to 30 inches thick. On the northwest corner only 8 to 15 inches of dark colored soil was present over a very stony layer. The soils are similar to Midfork (loamy-skeletal, mixed, Typic Haplocryolls) and Senchert (fine-loamy, mixed, Pachic Argicryolls).

GVH 9

This site is located in a sagebrush opening along a slight ridge with a shallow dip along the south half and a higher spot along the north edge. The soils are relatively stone free except for stony spots along the north side of the site. The soils typically have a dark colored loam to clay loam surface layer that is about 19 to 30 inches thick over lighter colored clay. The clay substrate is extremely hard when dry, very firm moist, and very sticky when wet.

SOIL TESTING RESULTS

Soil testing results are presented in the "Soil Analysis Report" tables submitted by Inter-Mountain Laboratories, Inc. An additional copy has been prepared showing data and interpretation notes.

A significant factor from the soil testing is showing the high amount of very fine sand in the sand fraction in particle size analysis of most of the samples. Very fine sand is similar to silt and is generally grouped with silt for interpretations and classification. The upper 6 to 9 inches of soil at each site had percentages of silt plus very fine sand of about 54 to 70 percent. Although these soils are noted as having a texture of loam they are more like silt loam for interpretations. The soils noted as clay loam on the soil analysis report are also high in very fine sand and are more like silty clay loam.

Soil reaction ranged from 6.5 to 8.1, which is considered good for plant growth. One sample, GVH8, 0 to 6 inches, had a high saturation percentage which appears to be related to the highest organic matter content; identified at 6.6 percent organic matter.

EC (electrical conductivity) ranged from 0.19 to 0.64 dS/M. These values are all less than 4.0, so would be rated as good.

Calcium carbonate equivalent was high in sample GVH8, 37 to 65 inches. This soil sample had calcium carbonate equivalent of 19.6 percent. All other soil samples ranged from 0.6 to 3.4 percent.

SUITABILITY ASSESSMENT

Suitability assessment is based on guidelines from the Utah State Division of Oil, Gas and Mining (Table 4, January 2003). The sites have identifiable topsoils of a dark color (mollic) typical of what would be considered topsoil. These dark colored soils would rate good to fair. Soil texture of clay loam, which is common in the lower portion of the topsoil layer, would give the soil a rating of fair; while loam is rated as good. A K-factor greater than 0.37 is considered poor. Some of the soils may rate as fair based on a K-factor of 0.37 however none of the soils are expected to have a higher value (poor).

Underlying materials would rate as poor to unacceptable based on high rock fragment content or high clay content.

Soil Samples for Andalex Resources, Inc.
Gas Ventilation Borehole Sites
October 10, 2005
Aberdeen Mine, Carbon County, Utah

1	GVH 5A	0-9 inches
2	GVH 5A	9-19 inches
3	GVH 5A	26-36 inches
4	GVH 5A	24-33 inches (Pit 3)
5	GVH 7	0-6 inches
6	GVH 7	6-12 inches
7	GVH 7	12-24 inches
8	GVH 7	24-33 inches
9	GVH 8	0-6 inches
10	GVH 8	6-18 inches
11	GVH 8	18-32 inches
12	GVH 8	37-65 inches
13	GVH 9	0-9 inches
14	GVH 9	9-21 inches
15	GVH 9	22-36 inches
16	GVH 9	22-38 inches (Pit 4)

Field Soil Profile Description Notations

This is a guide to assist in understanding the notations on the soil description forms. These are not all inclusive but are meant to apply to common situations in the mountains and foothills of central Utah.

Horizon: Standard letter designations used for soil layers. Commonly used designations are:

- A — Surface layer usually of dark color due to accumulation of organic matter; topsoil.
- B — Altered soil layer, often associated with subsoil.
  - BT – Increase in clay
  - BK – Increase in carbonates
  - BW – Color or structure change
- C — Relatively unaltered parent materials from which the soils have formed.
- R — Hard bedrock; as sandstone
- CR — Soft bedrock; as shale

A "B" horizon may have dark colors and have high to moderate amounts of organic matter but be designated as a "B" horizon due to soil changes as noted above.

Depth: Depth interval of the soil layer. Usually expressed in inches unless noted otherwise.
Color: Dry and moist odors are based on the Munsell Soil Color Chart and give the hue, value, and chroma. Connotative color descriptions may be added.

Texture: Texture and texture modifier abbreviations

S	Sand	SCL	Sandy	CB	Cobbly	GR	Gravely
LS	Loamy Sand	CL	Clay Loam	CBV	Very Cobbly	GRV	Very Gravely
SL	Sandy Loam	SICL	Silty Clay Loam	CBX	Extremely Cobbly	GRX	Extremely Gravel
L	Loam	SIC	Silty Clay	CN	Channery	SH	Shaley
SIL	Silt Loam	C	Clay	CNV	Very Channery		
SI	Silt			CNX	Extremely Channery		

Structure:

Grade		Size		Type	
W	Weak	VF	Very Fine	PL	Platy
M	Moderate	F	Fine	GR	Granular
S	Strong	M	Medium	SBK	Subangular Blocky
		CO	Coarse	ABK	Angular Blocky
		VCO	Very Course	PR	Prismatic
				W	Weak Massive
				S	Strong Massive
				SG	Single Grained

Consistency:

Dry		Moist		Wet	
LO	Loose	LO	Loose	NS	Non Sticky
SO	Soft	VFR	Very Friable	SS	Slightly Sticky
SH	Slightly Hard	FR	Friable	S	Sticky
H	Hard	FI	Firm	VS	Very Sticky
VH	Very Hard	VFI	Very Firm	NP	Non Plastic
EH	Extremely Hard	EFI	Extremely Firm	SP	Slightly Plastic
				P	Plastic
				VP	Very Plastic

Reaction:

Effervescence (10% HCL)		pH	Reaction Class
		5.1 – 5.5	Strongly Acid
		5.6 – 6.0	Moderately Acid
EO	Non-Effervescent	6.1 – 6.5	Slightly Acid
SE	Slightly Effervescent	6.6 – 7.3	Neutral
EM	Moderately Effervescent	7.4 – 7.8	Mildly Alkaline
ES	Strongly Effervescent	7.9 – 8.4	Moderately Alkaline
EV	Violently Effervescent	8.5 – 9.0	Strongly Alkaline
		> 9.0	Very Strongly Alkaline

Horizon Boundaries:

Distinctness		Topography	
A	Abrupt (<2 cm thick)	S	Smooth (the boundary is a plane with few or no irregularities)
C	Clear (2 to 5 cm thick)	W	Wavy (the boundary has undulations in which depressions are wider than they are deep).
G	Gradual (5 to 15 cm thick)	I	Irregular (the boundary has pockets that are deeper than they are wide)
D	Diffuse (>15 cm thick)	B	Broken (at least one of the horizons or layers separated by the Boundary is discontinuous and the boundary is interrupted).

Rock Fragments: Expressed in percent by volume by size.

GR	Gravel	BL	Boulders
CB	Cobbles	CN	Channers
ST	Stones	FL	Flagstone

Roots: Roots are described in terms of quantity and size. Quantity is given first followed by the size class.

Quantity		Size	
F	Few	VF	Very Fine
C	Common	F	Fine
M	Many	M	Medium
		CO	Course

Quantity classes of roots are defined in terms of numbers of each size per unit area. One (1) square centimeter for very fine and fine roots and one (1) square decimeter for medium and coarse roots.

Few:	Less than 1 per unit area of the specified size
Common:	1 to 5 per unit area of the specified size
Many:	more than 5 per unit area of the specified size

The size classes are:

Very Fine:	Less than 1 mm in diameter
Fine:	1 to 2 mm in diameter
Medium:	2 to 5 mm in diameter
Coarse:	5 mm or larger in diameter

Roots larger than 10 mm in diameter may be described separately.

SOIL ANALYSIS REPORT

Inter-Mountain Laboratories, Inc.

1633 Terra Avenue
Sheridan, WY 82801

Report ID: 010509795

Soil Analysis Report

Environmental Industrial Services
31 North Main Street
Helper, UT 84526

Client Project ID: Andalex Res/Gas

Set #0105S09795

Date Received: 10/17/05

Report Date: 11/11/05

Lab Id	Sample Id	Depths (Inches)	pH s.u.	Saturation %	EC @ 25°C dS/m	Calcium meq/L	Magnesium meq/L	Sodium meq/L	Potassium meq/L	SAR
)105S09795	1-GVH5A	0 - 9	6.5	54.4	0.50	3.33	0.69	0.16	0.42	0.11
)105S09796	2-GVH5A	9 - 19	6.6	43.6	0.31	2.06	0.47	0.14	0.15	0.12
)105S09797	3-GVH5A	26 - 36	7.0	45.3	0.24	1.02	0.46	0.37	0.08	0.44
)105S09798	4-GVH5A	24 - 33 p3	6.5	36.4	0.25	1.20	0.40	0.42	0.10	0.47
)105S09799	5-GVH7	0 - 6	7.3	53.6	0.48	3.30	0.41	0.19	0.50	0.14
)105S09800	6-GVH7	6 - 12	7.2	55.4	0.61	4.80	0.48	0.11	0.46	0.06
)105S09801	7-GVH7	12 - 24	7.0	46.0	0.64	4.97	0.48	0.13	0.37	0.08
)105S09802	8-GVH7	24 - 33	7.4	41.9	0.25	1.95	0.27	0.11	0.04	0.10
)105S09803	9-GVH8	0 - 6	7.0	58.7	0.43	2.75	0.99	0.24	0.22	0.18
)105S09804	10-GVH8	6 - 18	7.2	45.5	0.29	1.70	0.65	0.19	0.10	0.18
)105S09805	11-GVH8	18 - 32	7.4	45.8	0.27	1.65	0.66	0.21	0.08	0.19
)105S09806	12-GVH8	37 - 65	8.1	44.3	0.20	0.93	0.47	0.21	0.02	0.25
)105S09807	13-GVH9	0 - 9	7.0	44.2	0.34	2.26	0.49	0.07	0.17	0.06
)105S09808	14-GVH9	9 - 21	8.1	44.2	0.22	1.21	0.53	0.13	0.05	0.14
)105S09809	15-GVH9	22 - 36	7.1	53.2	0.19	0.86	0.43	0.31	0.04	0.38
)105S09810	16-GVH9	22 - 38 p4	6.9	46.6	0.24	1.49	0.50	0.11	0.08	0.11

These results only apply to the samples tested.

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

Reviewed By: Joey Sheeley
Joey Sheeley, Soils Lab Supervisor

nter-Mountain Laboratories, Inc.

Report ID: 010509795

1633 Terra Avenue
Sheridan, WY 82801

Soil Analysis Report

Environmental Industrial Services
31 North Main Street
Helper, UT 84526

Notes added by D. Larsen

Client Project ID: Andalex Res/Gas

Set #0105S09795

Date Received: 10/17/05

Report Date: 11/11/05

Lab Id	Sample Id	Depths (Inches)	pH s.u.	Saturation %	EC @ 25°C dS/m	Calcium meq/L	Magnesium meq/L	Sodium meq/L	Potassium meq/L	SAR	Overall Rating
0105S09795	1-GVH5A	0 - 9	6.5	54.4	0.50	3.33	0.69	0.16	0.42	0.11	G
0105S09796	2-GVH5A	9 - 19	6.6	43.6	0.31	2.06	0.47	0.14	0.15	0.12	F cL Texture
0105S09797	3-GVH5A	26 - 36	7.0	45.3	0.24	1.02	0.46	0.37	0.08	0.44	P sic Texture
0105S09798	4-GVH5A	24 - 33 p3	6.5	36.4	0.25	1.20	0.40	0.42	0.10	0.47	G
0105S09799	5-GVH7	0 - 6	7.3	53.6	0.48	3.30	0.41	0.19	0.50	0.14	F cL Texture
0105S09800	6-GVH7	6 - 12	7.2	55.4	0.61	4.80	0.48	0.11	0.46	0.06	F cL Texture
0105S09801	7-GVH7	12 - 24	7.0	46.0	0.64	4.97	0.48	0.13	0.37	0.08	G
0105S09802	8-GVH7	24 - 33	7.4	41.9	0.25	1.95	0.27	0.11	0.04	0.10	F cL Texture
0105S09803	9-GVH8	0 - 6	7.0	58.7 Fair	0.43	2.75	0.99	0.24	0.22	0.18	F High saturation %
0105S09804	10-GVH8	6 - 18	7.2	45.5	0.29	1.70	0.65	0.19	0.10	0.18	F cL Texture
0105S09805	11-GVH8	18 - 32	7.4	45.8	0.27	1.65	0.66	0.21	0.08	0.19	F cL Texture
0105S09806	12-GVH8	37 - 65	8.1	44.3	0.20	0.93	0.47	0.21	0.02	0.25	P-F C Texture; high carbonate
0105S09807	13-GVH9	0 - 9	7.0	44.2	0.34	2.26	0.49	0.07	0.17	0.06	G
0105S09808	14-GVH9	9 - 21	8.1	44.2	0.22	1.21	0.53	0.13	0.05	0.14	F cL Texture
0105S09809	15-GVH9	22 - 36	7.1	53.2	0.19	0.86	0.43	0.31	0.04	0.38	P C Texture
0105S09810	16-GVH9	22 - 38 p4	6.9	46.6	0.24	1.49	0.50	0.11	0.08	0.11	F cL Texture

6.5 To 9.1 all Good Balance 6.5 + 8.2

36.4 To 58.7 all Good except 1 High Om. @ 6.6%

0.19 To 0.64 all G < 4

0.06 To 0.44 all G < 4

These results only apply to the samples tested.

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

Reviewed By: Joey Shelley

Joey Shelley, Soils Lab Supervisor

Inter·Mountai[illegible]oratories, Inc.

1633 Terra Avenue
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Soil Analysis Report

Environmental Industrial Services

31 North Main Street

Helper, UT 84526

Client Project ID: Andalex Res/Gas

Set #0105S09795

Date Received: 10/17/05

Report Date: 11/11/05

Lab Id	Sample Id	Depths (Inches)	Sand %	Silt %	Clay %	Texture	Very Fine Sand %	Nitrogen Nitrate ppm	Available Potassium ppm	Available Phosphorus ppm	Organic Matter %	CO3 Equivalent %
0105S09795	1-GVH5A	0 - 9	49.0	31.0	20.0	LOAM	36.7	<0.02	389	28.7	5.6	0.7
0105S09796	2-GVH5A	9 - 19	34.0	38.0	28.0	CLAY LOAM	19.7	<0.02	239	14.8	2.3	0.6
0105S09797	3-GVH5A	26 - 36	18.0	42.0	40.0	SILTY CLAY	14.5	0.14	104	9.03	0.9	0.8
0105S09798	4-GVH5A	24 - 33 p3	43.0	35.0	22.0	LOAM	18.4	<0.02	201	19.6	1.6	0.6
0105S09799	5-GVH7	0 - 6	31.0	35.0	34.0	CLAY LOAM	18.5	<0.02	562	42.8	3.3	3.4
0105S09800	6-GVH7	6 - 12	28.0	39.0	33.0	CLAY LOAM	19.7	0.68	461	7.30	4.2	2.6
0105S09801	7-GVH7	12 - 24	31.0	47.0	22.0	LOAM	22.0	0.02	345	44.9	3.9	0.9
0105S09802	8-GVH7	24 - 33	29.0	44.0	27.0	CLAY LOAM	20.6	<0.02	166	50.6	1.5	0.8
0105S09803	9-GVH8	0 - 6	39.0	37.0	24.0	LOAM	21.9	0.02	314	49.5	6.6	1.0
0105S09804	10-GVH8	6 - 18	38.0	32.0	30.0	CLAY LOAM	19.1	<0.02	246	54.7	3.5	0.8
0105S09805	11-GVH8	18 - 32	39.0	31.0	30.0	CLAY LOAM	16.6	0.72	198	8.73	2.9	0.8
0105S09806	12-GVH8	37 - 65	14.0	38.0	48.0	CLAY	8.9	1.38	81.0	1.36	0.5	19.6
0105S09807	13-GVH9	0 - 9	34.0	44.0	22.0	LOAM	26.2	<0.02	291	52.2	3.9	0.8
0105S09808	14-GVH9	9 - 21	28.0	40.0	32.0	CLAY LOAM	21.5	<0.02	194	6.38	2.0	0.6
0105S09809	15-GVH9	22 - 36	19.0	29.0	52.0	CLAY	13.5	<0.02	140	1.96	0.7	0.9
0105S09810	16-GVH9	22 - 38 p4	26.0	40.0	34.0	CLAY LOAM	20.1	<0.02	237	50.6	2.4	0.7

These results only apply to the samples tested.

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

Reviewed By: Joey Sheeley

Joey Sheeley, Soils Lab Supervisor

ıter-Mountain [redacted]oratories, Inc.

Report ID: 010509795

1633 Terra Avenue
Sheridan, WY 82801

Soil Analysis Report

Environmental Industrial Services
31 North Main Street
Helper, UT 84526

Client Project ID: Andalex Res/Gas

Set #0105S09795

Date Received: 10/17/05

Report Date: 11/11/05

Lab Id	Sample Id	Depths (Inches)	Sand %	Sand -vfs%	Silt %	Clay %	Texture	Very Fine Sand %	vfs silt	Nitrogen Nitrate ppm	Available Potassium ppm	Available Phosphorus ppm	Organic Matter %	CO3 Equivalent %	Particle Size Class	
105S09795	1-GVH5A	0 - 9	49.0	12.3	31.0	20.0	LOAM	36.7	67.7	<0.02	389	28.7	5.6	0.7	Fine silty	1
105S09796	2-GVH5A	9 - 19	34.0	14.3	38.0	28.0	CLAY LOAM F	19.7	57.7	<0.02	239	14.8	2.3	0.6	Fine silty	2
105S09797	3-GVH5A	26 - 36	18.0	3.5	42.0	40.0	SILTY CLAY P	14.5	56.5	0.14	104	9.03	0.9	0.8	clayey(fine)	3
105S09798	4-GVH5A	24 - 33 p3	43.0	24.6	35.0	22.0	LOAM	18.4	53.4	<0.02	201	19.6	1.6	0.6	Fine loamy	4
105S09799	5-GVH7	0 - 6	31.0	12.5	35.0	34.0	CLAY LOAM F	18.5	53.5	<0.02	562	42.8	3.3	3.4	Fine loamy	5
105S09800	6-GVH7	6 - 12	28.0	8.3	39.0	33.0	CLAY LOAM F	19.7	58.7	0.68	461	7.30	4.2	2.6	Fine silty	6
105S09801	7-GVH7	12 - 24	31.0	9.0	47.0	22.0	LOAM	22.0	69.0	0.02	345	44.9	3.9	0.9	Fine silty	7
105S09802	8-GVH7	24 - 33	29.0	8.4	44.0	27.0	CLAY LOAM F	20.6	64.6	<0.02	166	50.6	1.5	0.8	Fine silty	8
105S09803	9-GVH8	0 - 6	39.0	17.1	37.0	24.0	LOAM	21.9	58.9	0.02	314	49.5	(6.6)*	1.0	Fine loamy	9
105S09804	10-GVH8	6 - 18	38.0	18.9	32.0	30.0	CLAY LOAM F	19.1	51.1	<0.02	246	54.7	3.5	0.8	Fine loamy	10
105S09805	11-GVH8	18 - 32	39.0	22.4	31.0	30.0	CLAY LOAM F	16.6	47.6	0.72	198	8.73	2.9	0.8	Fine loamy	11
105S09806	12-GVH8	37 - 65	14.0	5.1	38.0	48.0	CLAY P	8.9	46.9	1.38	81.0	1.36	0.5	19.6 F	Clayey(fine)	12
105S09807	13-GVH9	0 - 9	34.0	7.8	44.0	22.0	LOAM	26.2	70.2	<0.02	291	52.2	3.9	0.8	Fine silty	13
105S09808	14-GVH9	9 - 21	28.0	6.5	40.0	32.0	CLAY LOAM F	21.5	61.5	<0.02	194	6.38	2.0	0.6	Fine silty	14
105S09809	15-GVH9	22 - 36	19.0	5.5	29.0	52.0	CLAY P	13.5	32.5	<0.02	140	1.96	0.7	0.9	Clayey(fine)	15
105S09810	16-GVH9	22 - 38 p4	26.0	5.9	40.0	34.0	CLAY LOAM F	20.1	60.1	<0.02	237	50.6	2.4	0.7	Fine silty	16

Loam G
CL F
C P
SiC P

* High O.M. relates to high saturation percent

0.6 To 19.6
<15 G

Note all high when treated as silt example #1 67.7% Silt+vfs 12.3 5.5 20.9 Fine silty

These results only apply to the samples tested.

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

Reviewed By: Joey Sheeley
Joey Sheeley, Soils Lab Supervisor

Inter·Mountain Laboratories, Inc.

1633 Terra Avenue
Sheridan, WY 82801

Report ID: 010509795

Soil Analysis Report

Environmental Industrial Services

31 North Main Street

Helper, UT 84526

Client Project ID: Andalex Res/Gas

Date Received: 10/17/05

Set #0105S09795

Report Date: 11/11/05

Lab Id	Sample Id	Depths (Inches)	pH s.u.	Saturation %	EC @ 25°C dS/m	Calcium meq/L	Magnesium meq/L	Sodium meq/L	Potassium meq/L	SAR
0105S09803	9-GVH8	0 - 6	7.0	58.7	0.43	2.75	0.99	0.24	0.22	0.18
0105S09803D	9-GVH8	0 - 6	7.0	60.9	0.44	2.83	1.04	0.19	0.25	0.14
0105S09809	15-GVH9	22 - 36	7.1	53.2	0.19	0.86	0.43	0.31	0.04	0.38
0105S09809D	15-GVH9	22 - 36	7.2	53.6	0.21	1.06	0.54	0.30	0.03	0.34

These results only apply to the samples tested.

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

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nter-Mountain[illegible]oratories, Inc.

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31 North Main Street
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Set #0105S09795

Date Received: 10/17/05

Report Date: 11/11/05

Lab Id	Sample Id	Depths (Inches)	Sand %	Silt %	Clay %	Texture	Very Fine Sand %	Nitrogen Nitrate ppm	Available Potassium ppm	Available Phosphorus ppm	Organic Matter %	CO3 Equivalent %
)105S09803	9-GVH8	0 - 6	39.0	37.0	24.0	LOAM	21.9	0.02	314	49.5	6.6	1.0
)105S09803D	9-GVH8	0 - 6	41.0	35.0	24.0	LOAM	23.4	0.02	317	51.7	6.4	1.1
)105S09809	15-GVH9	22 - 36	19.0	29.0	52.0	CLAY	13.5	<0.02	140	1.96	0.7	0.9
)105S09809D	15-GVH9	22 - 36	21.0	27.0	52.0	CLAY	15.2	<0.02	136	1.79	0.8	0.9

These results only apply to the samples tested.

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

Reviewed By: Joey Sheeley

Joey Sheeley, Soils Lab Supervisor

UTAH OIL GAS AND MINING

GUIDELINES FOR MANAGEMENT OF TOPSOIL & OVERBURDEN

GUIDELINES FOR MANAGEMENT of TOPSOIL and OVERBURDEN

R645-301-200 SOILS

Utah Oil Gas and Mining

STATE OF UTAH
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING
1594 W. North Temple, Suite 1210
P.O. Box 14501
Salt Lake City, Utah 84114-5801
(801) 538-5340

DRAFT
June 2003

Table 2. Field Parameters For Baseline Soil Characterization

Test to be Performed	Reported As	Suggested Methods
Texture	% sand, silt, clay	U.S. Department of Agriculture, Natural Resource Conservation Service, 1998. Field Book for Describing and Sampling Soils, Version 1.1. p 2-28 -2-31.
Structure/Consistence	grade, size, type	Ibid. p 2-38 through 2-51.
Visual Estimate % Coal	% area & size fragments	Ibid. p 2-20, 2-26, 7-1, 2-29, and 2-37.
Internal Rock	% volume & size fragments	Ibid. p2-32 through 2-37 and p2-20 and p 2-26.
Surface Rock	% cover & size fragments	Ibid. loc cit.
Soil Color	Hue Value/Chroma	Ibid. p 2-7 through 2-15.
Bulk Density	g/cm^3	Soil Science Society of America. 1986. Series No. 5. Methods of Soil Analysis: Part 1 - Physical and Mineralogical Methods. Chapter 13. p 367. Excavation Method.
Chemical Response	pH	U.S. Department of Agriculture, Natural Resource Conservation Service, 1998. Field Book for Describing and Sampling Soils, Version 1.1. p 2-64.
	EC	Ibid. p 2-66.
	Effervescence	Ibid. p 2-65.
	Gypsum	U.S. Salinity Laboratory Staff. 1954. Diagnosis and improvement of saline and alkali soils. USDA Handbook 60. Method 22a. p102.

Table 3. Analytical Methods For Baseline Soil Characterization

Test to be Performed	Reported As	Suggested Methods[1]
pH	saturated paste standard units	Soil Science Society of America. 1996. Series No. 5. Methods of Soil Analysis Part 3 - Chemical Methods. Chapter 14, page 420 and Chapter 16, page 487.
Saturation %	%	USDA-NRCS.1996. Soil Survey Laboratory Methods Manual.(SSIR No 42) v 3.0, Method 8A, page 402.
EC_e	dS/m @ 25°C (or mmhos/cm)	Ibid. Chapter 14, pp 420 - 422 and pp 427 - 431.
Soluble Na, K, Mg, Ca	meq/L	Ibid. Chapters 14 pp 420-422 (saturation extract);Chapter 19 pp 555-557; Cha 20 pp586-590 (spectroscopic methods).
Available NO_3-N	mg/Kg	Soil Science Society of America. 1996. Series No. 5. Methods of Soil Analysis Part 3 - Chemical Methods. Chapter 38. p 1129 (KCl extraction). For analysis follow: Sims, J.R. and G.D. Jackson. 1971. Rapid Analysis of Soil Nitrate with Chromotropic Acid. Soil Sci. Soc. Am. Proc. 35-603-606.
Available Phosphorus	mg/Kg	Soil Science Society of America. 1996. Series No. 5. Methods of Soil Analysis: Part 3 - Chemical Methods. Chapter 32, page 895. ($NaHCO_3$ Extraction.)
Particle Size Analysis	% very fine sand, sand, silt, clay	Soil Science Society of America. 1986. Series No. 5. Methods of Soil Analysis Part 1 - Physical and Mineralogical Methods. Chapter 15 pp 398 and 404-409 (Hydrometer Method).
Organic Matter	%	Western States Laboratory Proficiency Testing Program Soil and Plant Analytica Methods. 1998. v 4.10. p 86. (Loss on Ignition, convert %LOI to OM by regression intercept value as noted in method)
$CaCO_3$ %	%	Ibid. p. 99 (Soil Carbonates, Gravimetric Determination after extraction with 3 HCl.) Total Inorganic Carbon = %$CaCO_3$ x 0.12.
Extractable Potassium	meq/100 g^{-1}	Western States Laboratory Proficiency Testing Program Soil and Plant Analytica Methods. 1998. v 4.10. p 73

[1] Laboratories vary in their capabilities. Specify these recommended methods to the laboratory. Use of other methods should be discussed with the Division.

Table 4. Soil and Spoil Suitability/Unsuitability Evaluation

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

[a] For clay textured soils unacceptable is SAR >14. For sandy textured soils unacceptable is >20.

[b] For most Western soils, the SAR to ESP relationship is usually 1:1, up to ESP ≈ 20. If SAR>20, then determine ESP. (Evangelou, 2000.)

[c] s=sand, l= loam, si= silt, c= clay, v= very, f= fine, co=coarse, g=gravel

[d] Available Water Capacity is adjusted for texture and SAR.

[e] K factor recommendations from the USDA Soil Conservation Service.1978. National Soils Handbook Notice 24. (3/31/78). NSH Part II –403.6(a). For Prime Farmland soils, the K factor times the percent slope should be a value of five or less for minimal erosion hazard.

SOIL DESCRIPTION

AND

DIAGRAMS

SCS-SOILS-232G

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Andalex Res., Inc.

SOIL DESCRIPTION

Soil type Like Sanchert more vfs than normal

File No. GVH5A

Area Aberdeen Mine | Carbon Co., Utah | Date 9/9/05 | By: Dan Larsen | Stop No. p1

Classification Fine-loamy, mixed superactive Pachic Argicryoll.

Location Near center stake at GVH5A S 34, T12S, R11E

N. veg. (or crop) Sagebrush | Climate Cryic

Parent material Sandstone and shale

Physiography Gently sloping upper mountain slope.

Relief Gentle | Drainage Well drained | Salt or alkali —

Elevation 8480 ft. | Gr. water | Stoniness —

Slope 3-5% | Moisture

Aspect NW | Root distrib. | % Clay *

Erosion Slight | % Coarse fragments * | % Coarser than V.F.S. *

Permeability Moderate to slow

Additional notes

Samples Taken:
GVH5A 0-9"
9-19"
26-36"

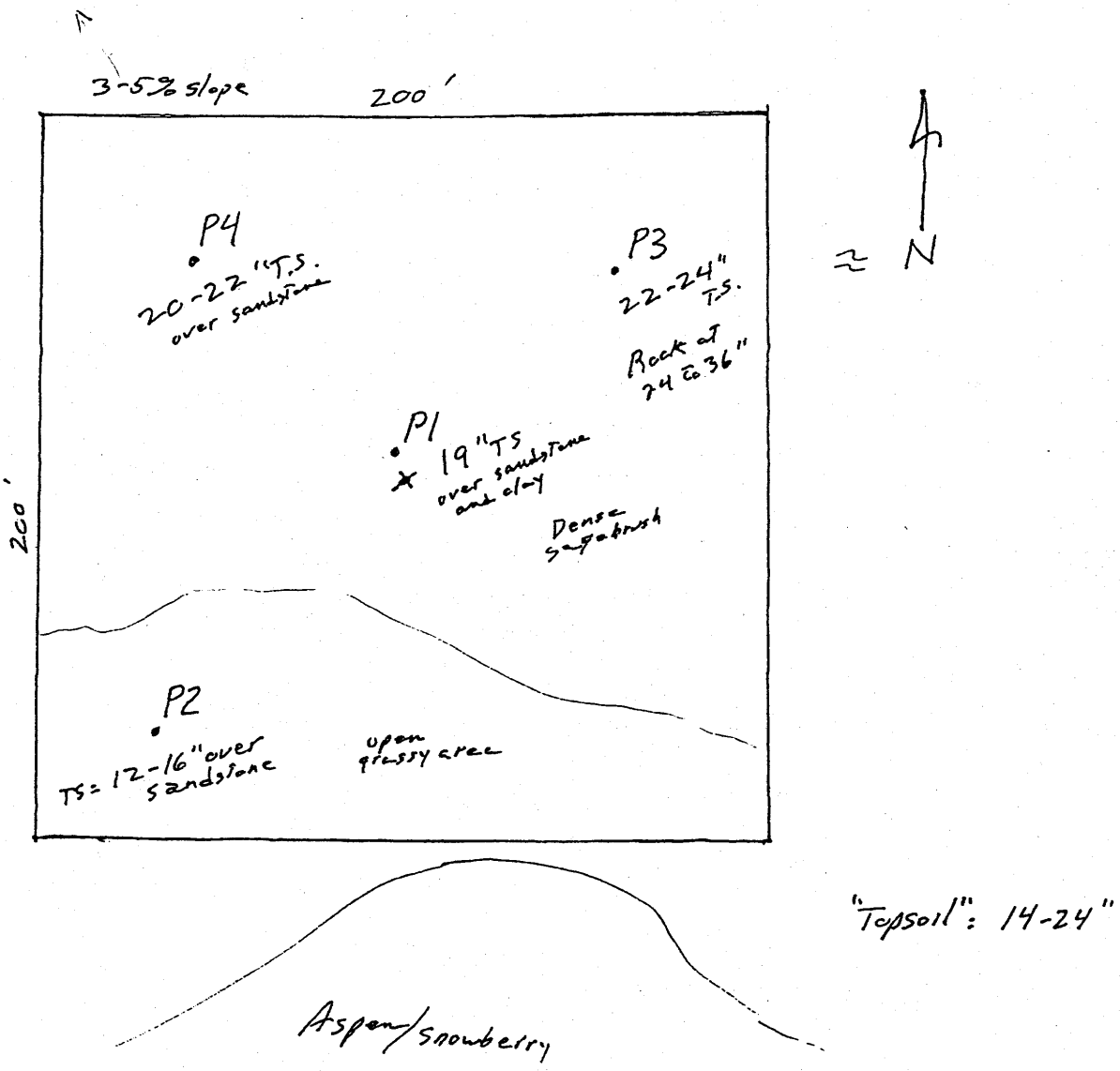
GVH5A 24-33" from pits 3 & 4, similar to 9-19" layer in pit #1

* Control section average

Horizon	Depth inches	Color Dry	Color Moist	Texture (Lab) Field est.	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction 10% HCL Lab pH	Boundary	% Rock Fragments	Root Distribution		
A1	0-5		10YR 3/2 - 7.5YR 3/2	SIL	MFGR	SO	FR	S/P	eo	gw	<5% gr	MVF-M		
A2	5-9		"	(L)* SIL	MFGR & MFSBK	SH	FR-FI	S/P	eo 6.5	gw	"	"		
BT1	9-19		7.5YR 3/2 - 10YR 3/2	(CL)* SIL	M Fa M SBK	SH	FI	S/P	eo 6.6	cw	5 gr 2 co	CF-M		
BT2	19-26	High rock fragment layer	" mixed color 5YR 5/4	SIL	"	SH	F	S/P	eo 7.0	cw	20 gr 30 co 5 st	FcW		
BT3	26-36			(SIC) SIC	S F-M SBK	H	VFI	VS/VP	eo	cw	10 gr 10 co			
R	36-48	sandstone bedrock									R 90-100%			

(L) is 67.7% Si + vfs
(CL) is 28% clay; borderline

GVH5A



"Topsoil": 14-24"

SCS-SOILS-232G

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Andalex Resources, Inc.

SOIL DESCRIPTION

Soil type

File No. GVH 7

Area Aberdeen Mine Carbon Co., Utah | Date 10/10/05 | By: Dan Larsen | Stop No. 71

Classification Fine-loamy (to fine-silty) mixed, superactive Pachic Haploxeroll

Location Near center stake at GVH7, west of Right Fork of Summit Cr. S31, T12S, R11E

N. veg. (or crop) Sagebrush | Climate

Parent material Sandstone

Physiography Mountain slope, sloping ridge

Relief Gentle slope | Drainage Well drained | Salt or alkali

Elevation ≈ 8380 | Gr. water | Stoniness

Slope 7% | Moisture

Aspect NW | Root distrib. | % Clay *

Erosion Slight | % Coarse fragments * | % Coarser than V.F.S. *

Permeability Moderate

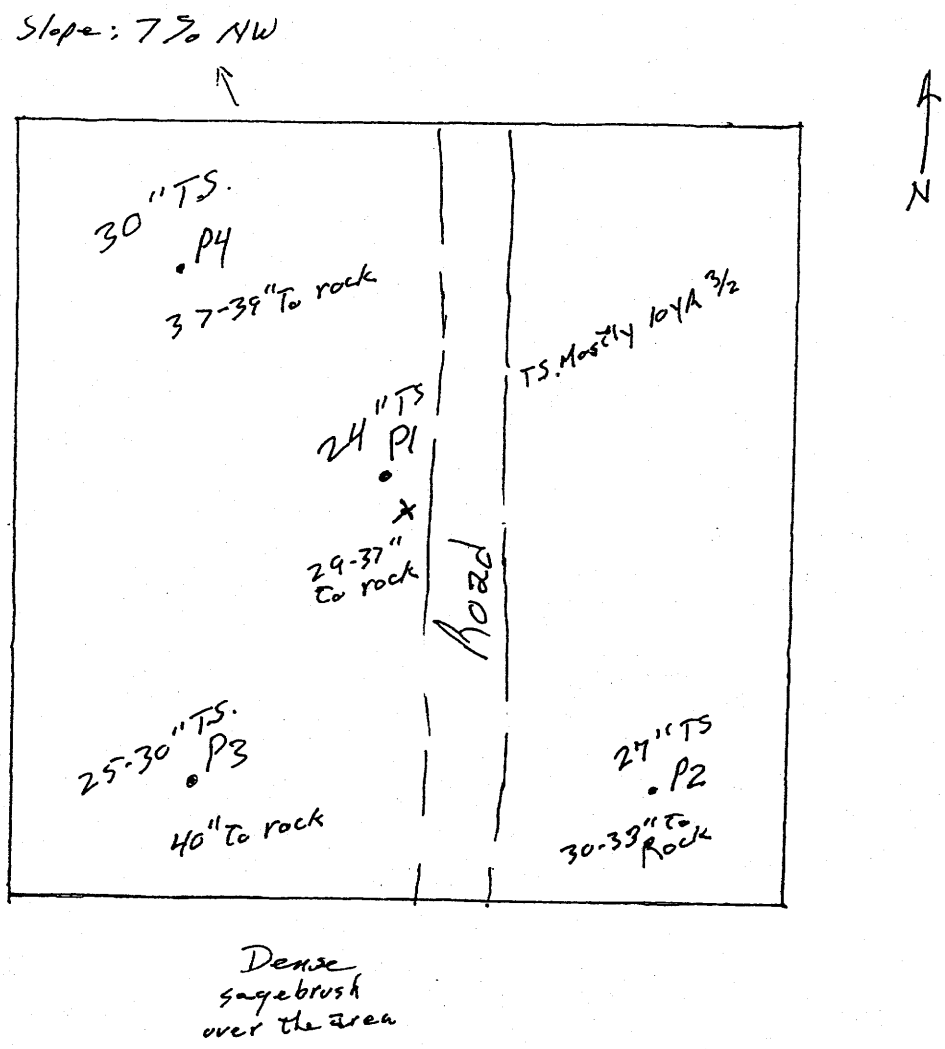
Additional notes

Samples Taken:
GVH7 0-6"
6-12"
12-24"
24-33"

* Control section average

Horizon	Depth inches	Color Dry	Color Moist	Texture (Lab) Field est.	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction Lab pH	Boundary	% Rock Fragments	Root Distribution		
O	½-0	Loose and decomposing organic materials							eo					
A1	0-3		10YR 3/2-3/1	SIL	M-St VFGR	L	VFR	S/P	eo	cw	5gr	M VF-M		
A2	3-6		10YR 3/2	(CL) SIL	MMGR + WMPL	L-SH	VFR	S/P	eo 7.3	cw	"	m F-M		
B	6-12		10YR 3/2	(CL) SIL	MF SBK	SH	FR	S/P	eo 7.2	gw	"	c F-M		
B	12-24		10YR 3/2	(L) SIL	MF-M SBK	SH	FI	S/P	eo 7.0	gw	10gr	F-c F		
B	24-33		10YR 3/3	(CL) SIL	MMSBK	H	FI-VFI	S/P	eo 7.4		25gr 10co 10st	very few		
R	33-39	Parts of soil sandstone rock	10YR 4/3	SIL	OM									
		Depth to hard rock ranges from 33 to 39 inches.												

GVH7


Slope: 7% NW
N
30" TS.
P4
37-39" To rock
TS. Mostly 10YR 3/2
24" TS
P1
29-37" To rock
Road
25-30" TS.
P3
40" To rock
27" TS
P2
30-33" To Rock
Dense sagebrush over the area

SCS-SOILS-232G

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Andalex Resources, Inc. SOIL DESCRIPTION

Soil type Midfort / Sanchont area - Not a clear classification

File No. GVH8

Area Aberdeen Mine Carbon Co., UTah | Date 10/10/85 | By: Dan Larsen | Stop No. P1

Classification Loamy-skeletal, mixed Pachic Argicryoll

Location Near the center stake at GVH8 S36, T12S, R10E

N. veg. (or crop) Aspen, snowberry, lupine, etc | Climate Cryic

Parent material Sandstone and shale (clay)

Physiography Rolling mountain top, slight knoll

Relief moderately sloping | Drainage Well drained | Salt or alkali

Elevation about 8440 ft. | Gr. water | Stoniness

Slope 10% | Moisture

Aspect NW | Root distrib. Very good to 32 inches | % Clay *

Erosion Slight | % Coarse fragments * | % Coarser than V.F.S. *

Permeability Moderately slow - slow

Additional notes

Samples Taken:
GVH8 0-6 inches
6-18
18-32
37-65

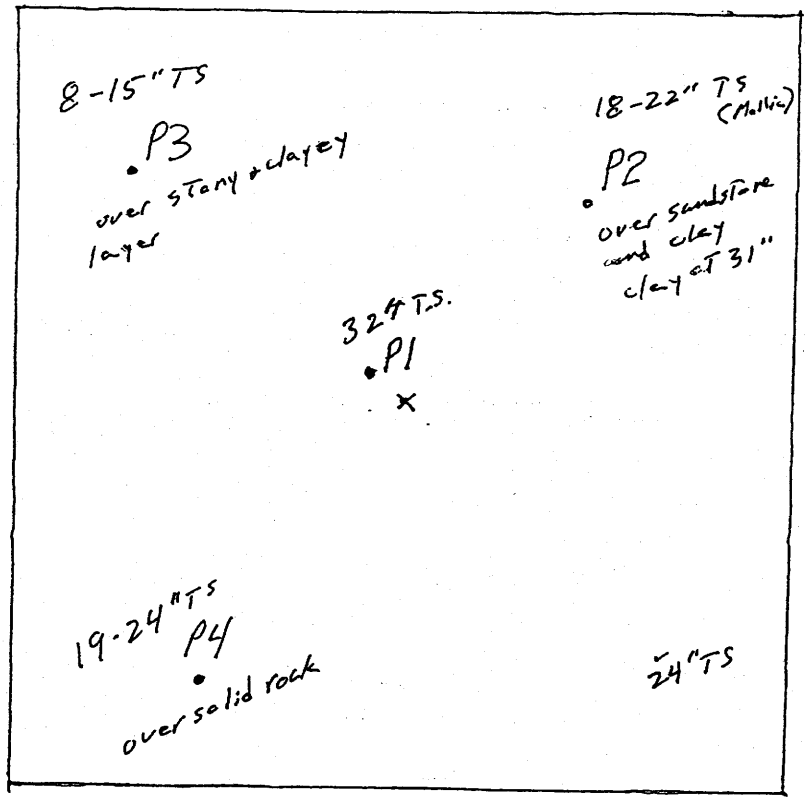
Lower clay layer is very contrasting - High in carbonates

* Control section average

Horizon	Depth inches	Color Dry	Color Moist	Texture (Lab.)	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Lab pH Reaction	Boundary	% Rock Fragments	Root Distribution	Carbonates
A	0-6		Black 10YR 2/1	Heavy SiL (CL)	SF-M GR	SO	VFR-FR	S/P	7.0 eo	CW	5-10 gr 5-10 co 15 st-blk	MVF-M CC	
AB	6-18		Very dark gray 10YR 3/1	" (CL)	M-S MGR-FM SBK	SH-H	FR-FI	S/P	7.2 eo	gw	"	CF Mac	
BT	18-32		10YR 3/1-3/2	SICL (CL)	MMSBK	H	FI	VS/VP	7.4 eo	CW	"	CF	
BC	32-37	sandstone layer		Pockets of	MMSBK OM					CW	70-80% Fine Sandstone		
II C or IIBT	37-65		5YR 4/4-3/4 and 2.5Y 5/4-6/4	(C) SIC-C	SMABK-SBK	VH	VF	VS/VP	es 8.1		none in clay matrix		Common white patches and streaks

GVH 8

Slope: about 10% NW
Veg: Aspen-Snowberry



N

Ave: about 20" of "Topsoil"

Range: 8 to 32"

SCS-SOILS-232G

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Andalex Resources, Inc.

SOIL DESCRIPTION

Soil type In Seinchert area but finer texture

E18

File No. GVH 9

Area Aberdeen Mine Carbon Co., Utah | Date 10/10/05 | By: Pam Larsen | Stop No. P1

Classification Fine, mixed, superactive Pachic Argicryoll

Location Near center stake at GVH9 S36, T12S, R10E

N. veg. (or crop) Sagebrush, grass, forbs | Climate

Parent material Shale (clay)

Physiography Slight swale along a weak ridge of a north trending mountain slope

Relief Moderately sloping | Drainage Well drained | Salt or alkali

Elevation About 8500 | Gr. water | Stoniness

Slope 10% | Moisture Upper 8" mostly dry, moist below

Aspect mostly North | Root distrib. Upper 22 inches | % Clay*

Erosion Moderate | % Coarse fragments* <5% | % Coarser than V.F.S.*

Permeability Slow

Additional notes - Aspen strip to the east

Samples Taken:

GVH9 0-9 inches

9-21

22-36 (clay)

also sampled pit 4

GVH9 22-38

much like 9-22 inch

layer in pit #1

Subsoil is very clayey

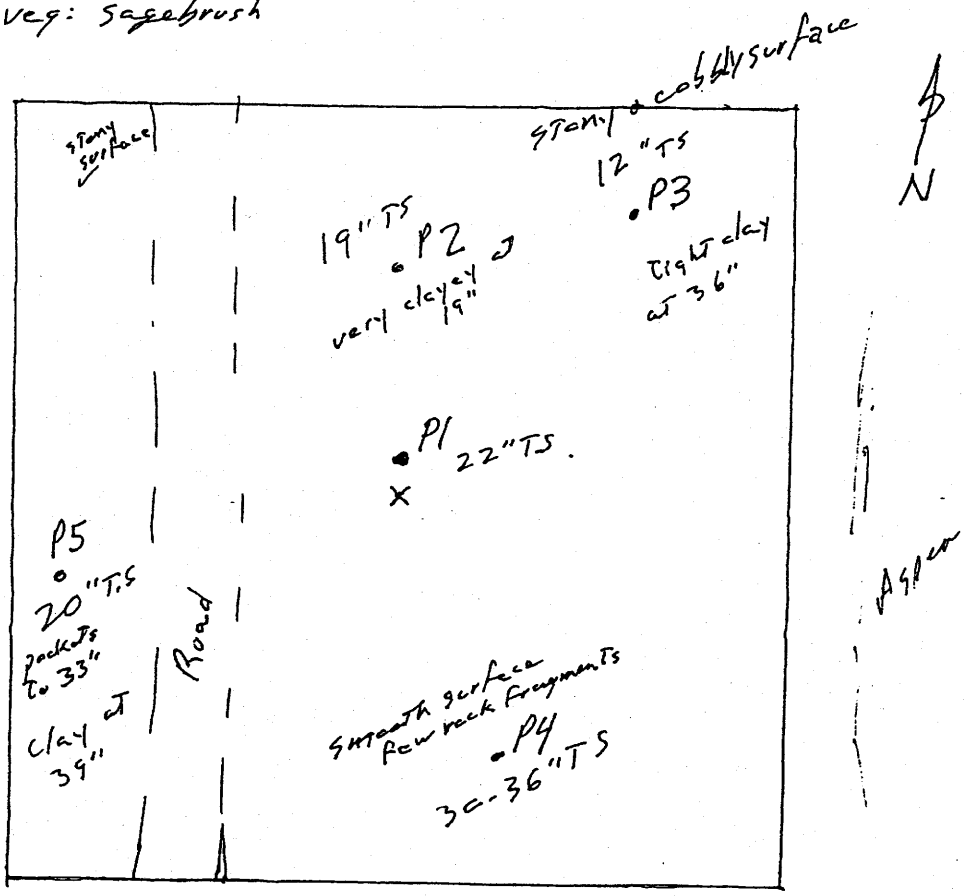
* Control section average

Horizon	Depth inches	Color Dry	Color Moist	(Lab) Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Lab pH Reaction	Boundary	% Rock Fragments	Root Distribution		
A1	0-3		10YR 3/2	(L)* SIL	MVFPL & GR	SO-SH	FR	S/P	ec	CS	<5%	MVF-F		
A2	3-9		10YR 3/2	Heavy SIL (CL)	SMGR-FSBK	SH	FI	S/P	ec 7.0	gw	"	CF-M		
AB or BT	9-22		10YR 3/3	Heavy SIL-SICL	SF-M SBK	H	FI	S/P	ec 8.1	gw	"	FF		
BT	22-40		7.5YR 4/3 + 10YR 4/3	(C) C	SM-C ABC-SBK	X-VH	X-VFI	VS/VP	ec 7.1	gw	"	VFF		
C	40-60		7.5YR 4/4 mixed (red portion) and 2.5Y 5/4	C-SIC	SM-C SBK+ ABK	X-VH	X-VFI	VS/VP	e		"			

*(L) is 70.2% si+vfs
(CL) is 61.5% si+vfs

GVH9

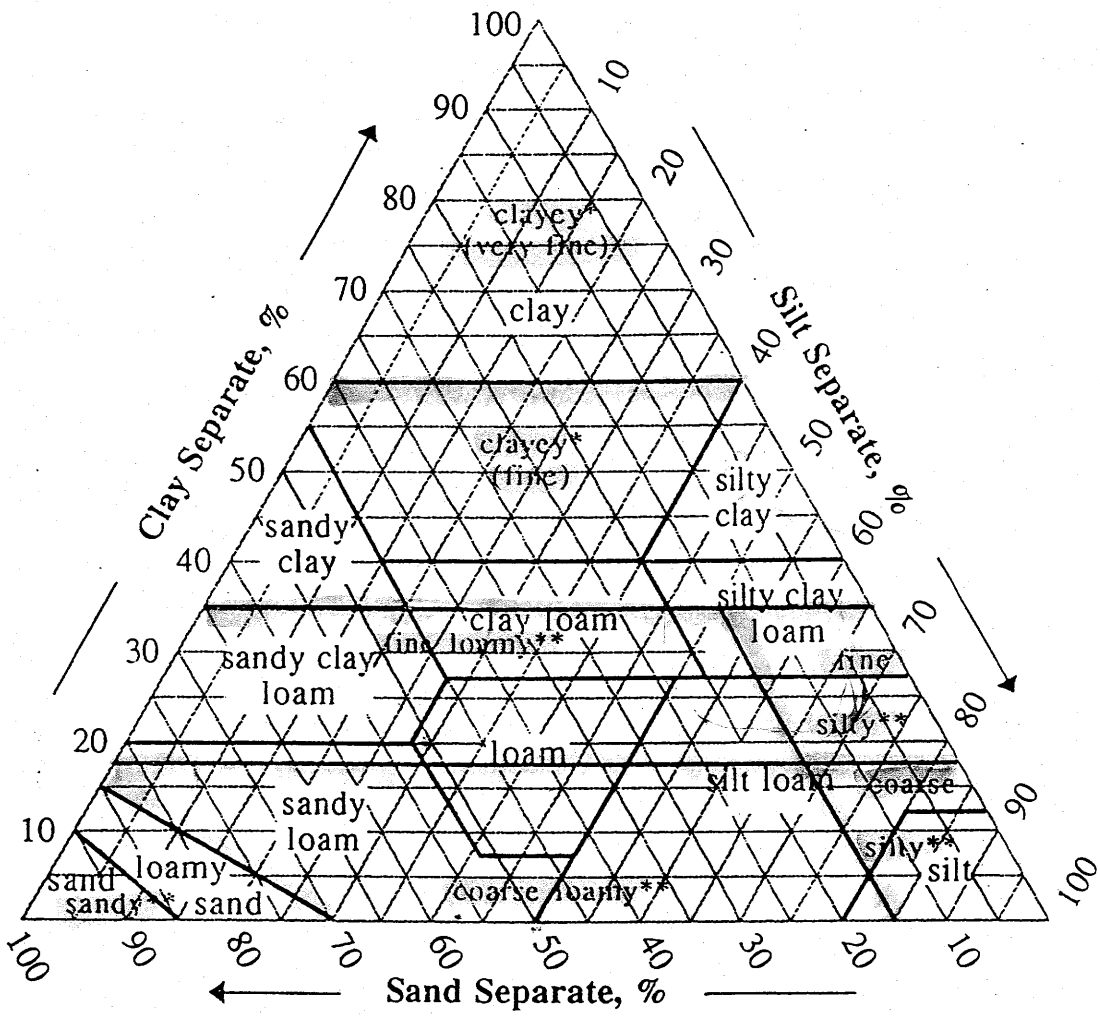
Slope: NW (general) about 10%
Veg: Sagebrush



Surface shape S to N
North side is on a slight rise and has rock at the surface.
Deeper soils on south 1/2

APPENDIX IV

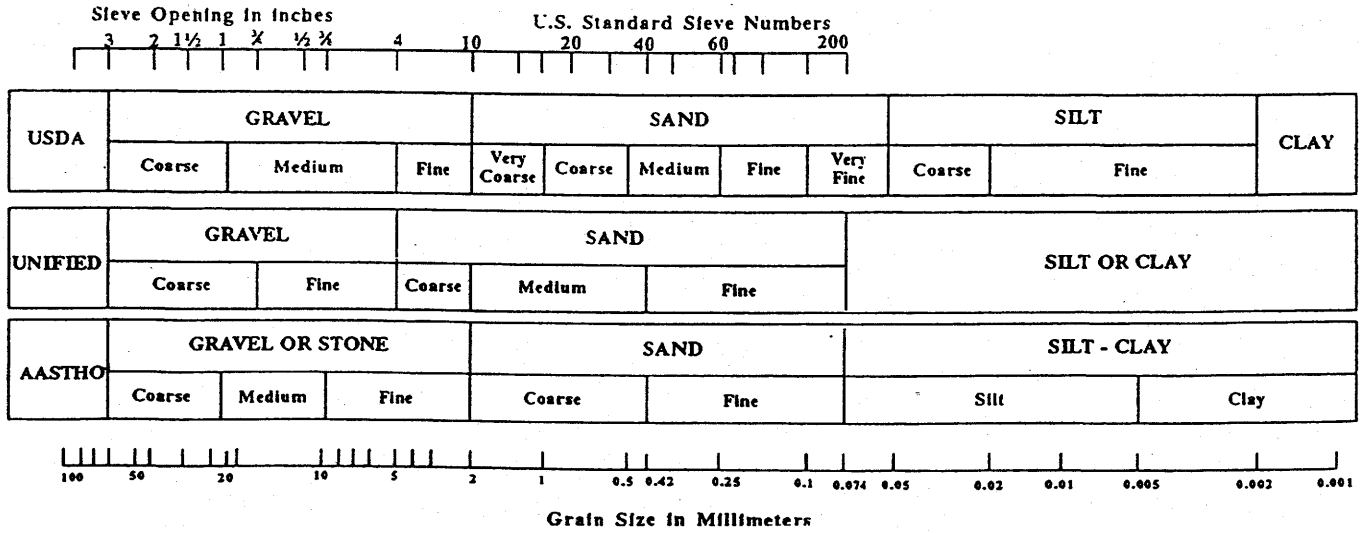
GUIDE FOR TEXTURAL CLASSIFICATION IN SOIL FAMILIES



* Clay-size carbonate is treated as silt.

** Very fine sand (0.05 - 0.1 is treated as silt for family groupings; coarse fragments are considered the equivalent of coarse sand in the boundary between the silty and loamy classes.

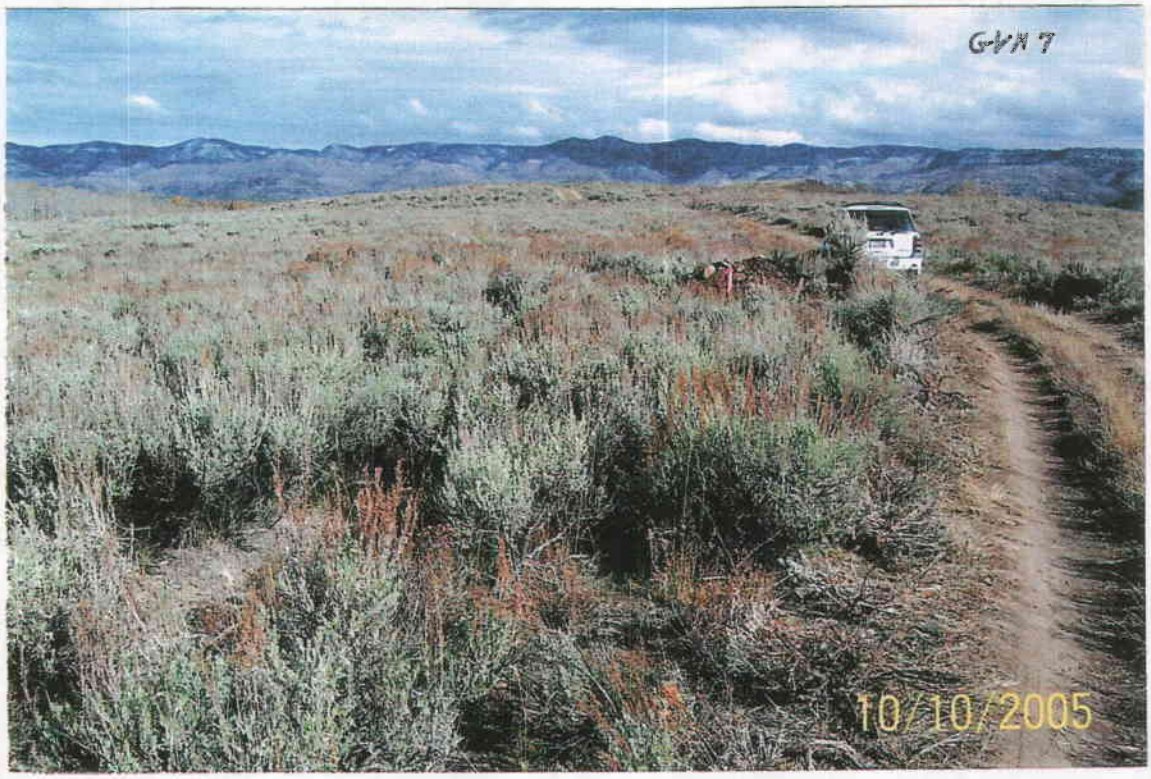
COMPARISON OF PARTICLE SIZE SCALES



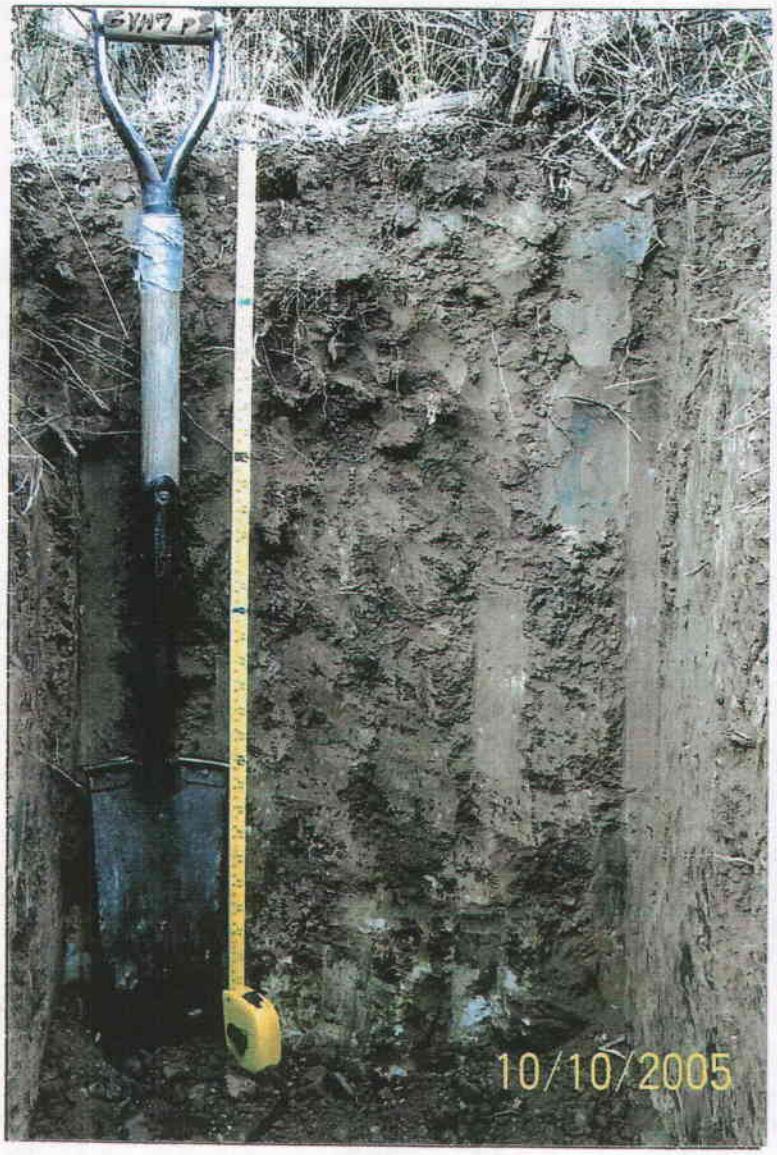
PHOTOS

GVH5A

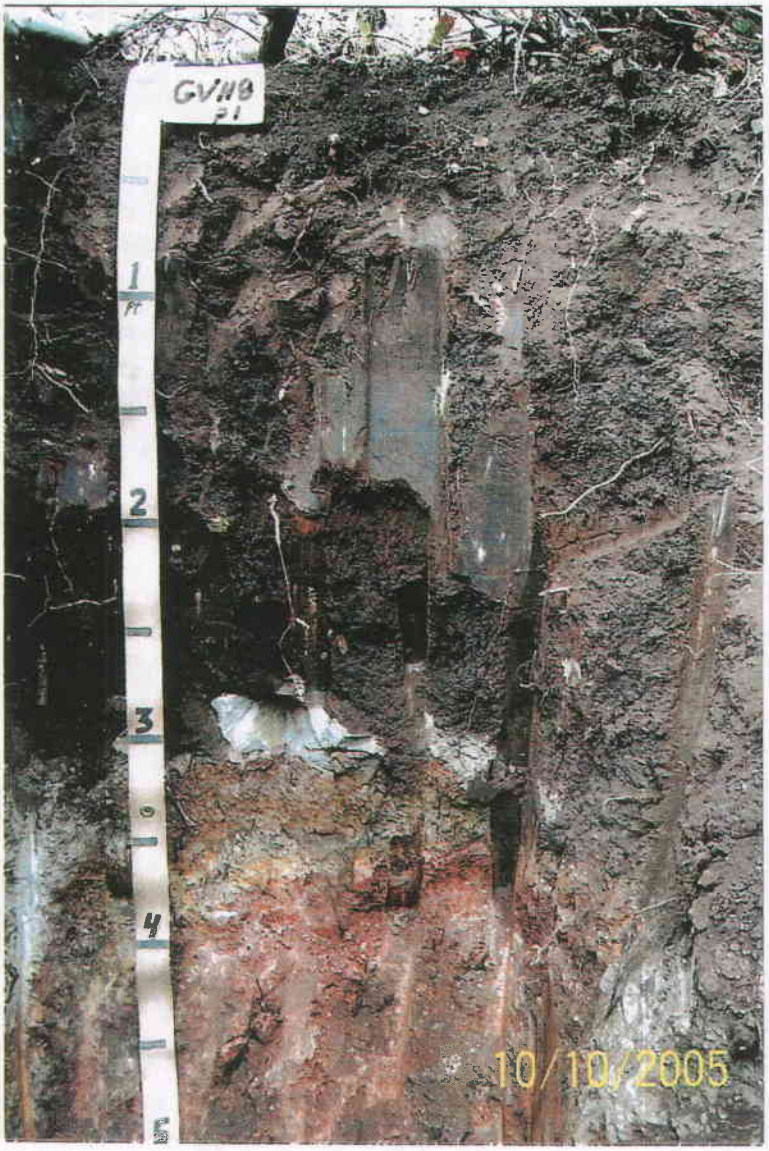
GVH 5A



GVH 7

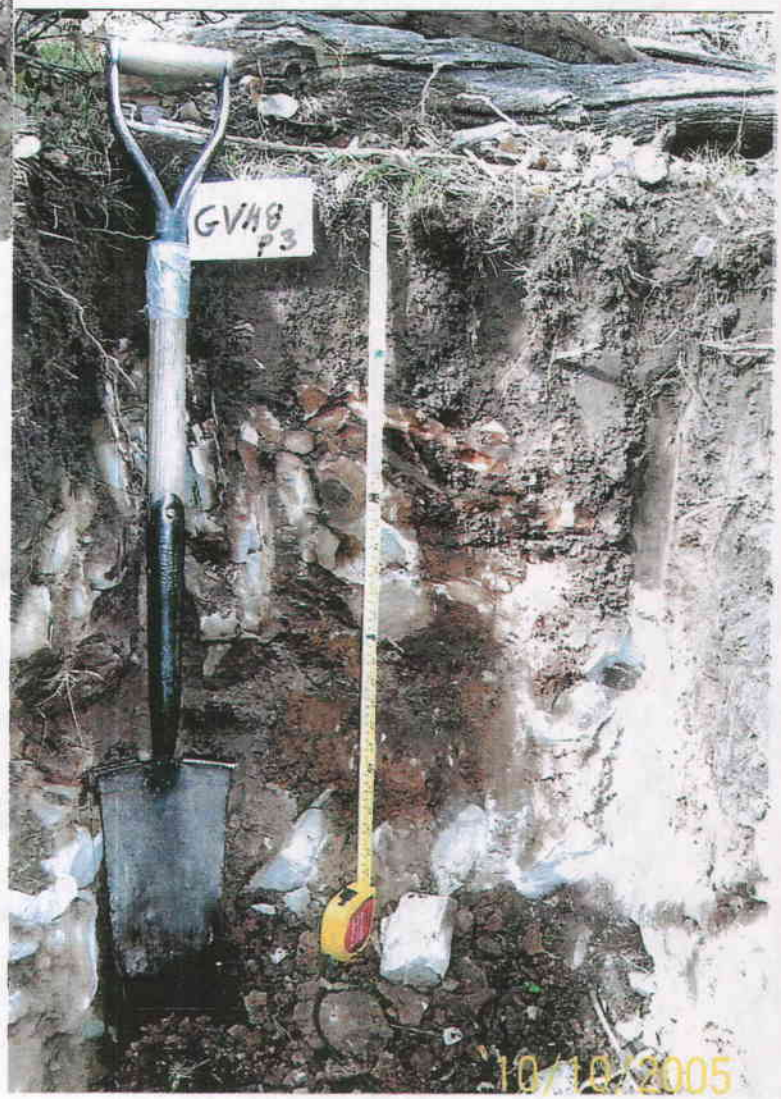


GVH7



GVH8

GVH 8

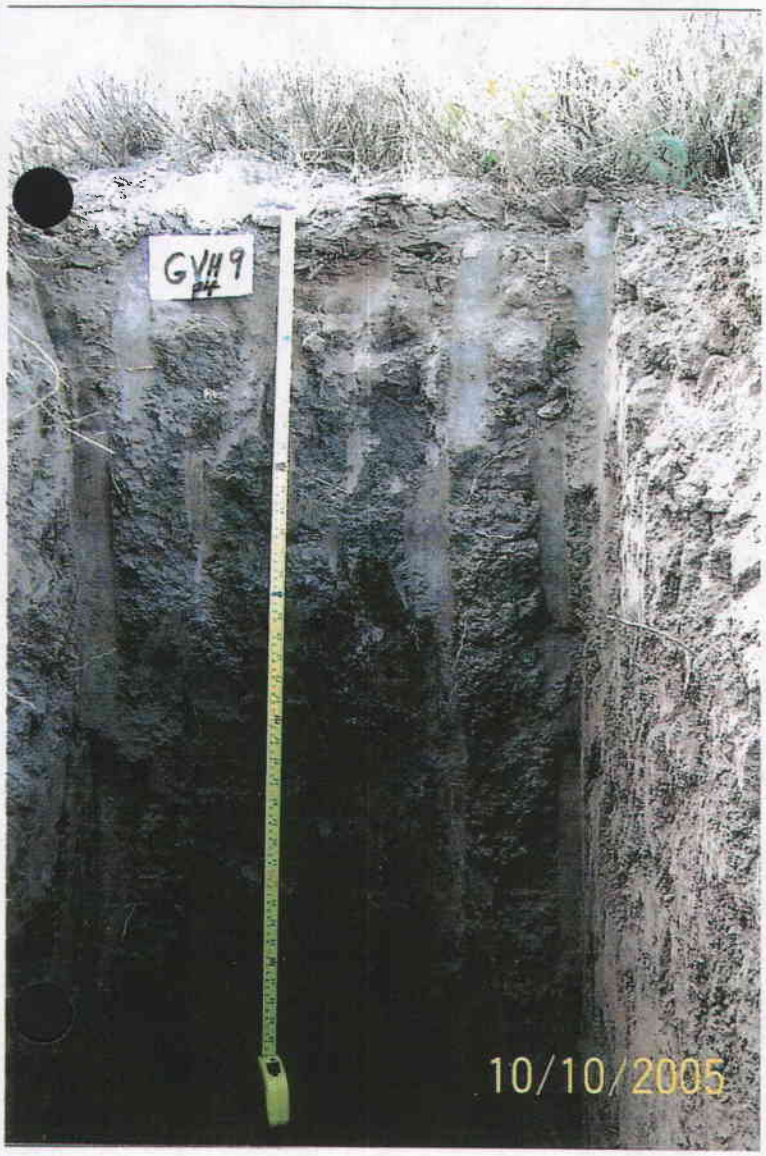


GVH9 P1

GVH 9

GVH 9

GVH 9



GVH 9

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Attachment 3-2	Threatened, Endangered, and Sensitive Species Information
Attachment 3-3	2005 Raptor Survey (Moved to Confidential Folder)
Attachment 3-4	Photos of GVH Sites

310 INTRODUCTION

This chapter presents a description of the biological resources found on the completed Centennial Project gob gas vent hole sites GVH#1, GVH#3, GVH#4, GVH#5 and GVH#6 as well as the proposes sites GVH#5A, GVH#7, GVH#8, and GVH#9. Details for each of the sites are provided in this Appendix.

311 Vegetation, 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 Section 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. Since vegetation reference areas, typically used for reclamation plans, are not available for Gob Gas Vent Holes 1, 3, 5 and 6, the range site method will be used. For the range sites to be used for GVH hole numbers 1, 3, 5 and 6, ANDALEX has provided productivity values, ecological site descriptions (ESD) and determinations that the sites are in fair to better condition as estimated by NRCS methods, and is included in Attachment 3-1. An Order I soil and vegetation survey has been conducted for GVH-4, this site and proposed sites, GVH-5A, GVH-7, GVH-8 and GVH-9.

Soil Surveys are included in Attachment 2-1 and Vegetation Surveys are included in Attachment 3-1 for the proposed sites.

321.100 Plant Communities Within the Proposed Permit Area

Plate 19A of the M&RP shows the sites to be generally in the sagebrush-grass, aspen and oak brush communities. Vegetation specific to each of the sites is provided in this Appendix. A qualitative vegetative inventory (analysis) was completed during the summer

of 2005. (See Attachment 3-1)

Also, ARI has taken photographs of the proposed sites prior to disturbance. These photo locations are identifiable and repeatable. Although the photo locations were not staked, landmarks in the photos provide for identification as well as direction and location. The photos are included in Attachment 3-4.

321.200 Land Productivity Prior to Mining

TABLE 3-1
Land Productivity

Well No.	Range Site	Productivity (lbs.) Per Acre
GVH-1	High Mountain Loam	1800
GVH-3	High Mountain Loam	1800
GVH-4	High Mountain Loam	1800
GVH-5	High Mountain Loam	1800
GVH-6	High Mountain Loam	1800
GVH-5A	High Mountain Loam	1800
GVH-7	High Mountain Loam	1800
GVH-8	High Mountain Loam	1800
GVH-9	High Mountain Loam	1800

322 Fish and Wildlife Information

Fish and wildlife information associated with the degas wells is provided in this chapter. A summary of the fish and wildlife resource information for th permit and adjacent areas is contained in Section 322.100 through 322.200 of the approved M&RP.

322.100 Level of Detail

The scope and level of detail within the "Gob Gas Vent Holes" amendment are sufficient to design the protection and enhancement plan for wildlife and fish associated with the degas wells. Additional information pertaining to fish and wildlife in the permit area is located in the M&RP.

322.200 Site-Specific Resource Information

Raptors - An aerial raptor nest survey was done of the area by the Utah Division of Wildlife

Resource personnel in 2004. The results of the survey are provided in Appendix D of the M&RP. An additional survey has been done in 2005, and is included with this submittal in the Confidential Binder for the Centennial Project.

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 and the lack of a food source would force the bats to seek habitat and nourishment elsewhere.

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. This is based on research and analysis by Mt. Nebo Scientific of Springville, Utah and EIS of Helper Utah. The Bureau of Land Management has also reviewed the access and drill sites and has stated that although this area represents important habitat for both Mule deer and Elk, it is not characterized as crucial or critical.

There are no known groundwater or surface water flows to the Colorado or Green Rivers with potential for impact by the drilling of the degas wells. Potential adverse affects to the four Colorado River endangered fish species (refer to Table 3-3) would not be likely since there is no direct route to the Colorado River or Green River from the proposed well locations. Per the Windy Gap Process consumption estimates for the degas wells are as follows: Drilling - approximately 100,000 gallons per hole; road watering - approximately 5,000 gallons per day for 70 days per year; evaporation from ventilation - zero, drill holes will not intersect the coal seam being mined, therefore no access to mine ventilation until after area is sealed; coal preparation - zero, no coal preparation at degas sites (see Sections 522 and 523); sediment pond evaporation - zero, no sediment pond at degas sites (see Section 732.200); subsidence effects on springs - zero, no anticipated subsidence at degas sites (see Section 525); alluvial aquifer abstraction into mines - zero, no alluvial aquifer abstractions associated with degas drill holes (see Sections 513.500 and 600); postmining inflow to workings - zero, no workings for postmining inflow associated with degas wells (see Sections 513.500 and 600); coal moisture loss - zero, no coal therefore no moisture loss (See Sections 522 and 523). The overall impact of the mining operations, (including the degas holes) is shown on Table 3-4. Based on these calculations, the mining operation has a net positive impact to the Colorado River Drainage by the addition of 45.001 ac.ft./year.

Table 3-3
Federal and State Listed, Threatened, Endangered and Candidate Species
Plants and Wildlife
Carbon County, Utah
October, 2002

CARBON

Graham Beardtongue	*Penstemon grahamii*
Uinta Basin Hookless Cactus	*Schlerocactus glaucus*
Bonytail[4, 10]	*Gila elagans*
Colorado Pikeminnow[4, 10] E	*Ptychocheilus lucius*
Humpback Chub[4, 10] E	*Gila cypha*
Razorback Sucker [4, 10] E	*Xyrauchen texanus*
Bald Eagle [3] T	*Haliaeetus leucocephalus*
Mexican Spotted Owl [4] T	*Strix occidentalis lucida*
Western Yellow-billed Cuckoo	*Coccyzus americanus occidentalis*
Black-footed Ferret [6] E	*Mustela nigripes*

1 Nests in this county of Utah
2 Migrates through Utah, no resident populations.
3 Wintering populations (only five known nesting pairs in Utah).
4 Critical habitat designated in this county.
5 Critical habitat proposed in this county
6 Historical range.
7 Experimental nonessential population
8 Introduced, refugia population.
9 Candidate species have no legal population under the Endangered Species Act. However, these species are under active consideration by the Service for addition to the Federal List of Endangered and Threatened Species and my be proposed or listed during the development of the proposed project.
10 Water depletions from any portion of the occupied drainage basin are considered to adversely affect or adversely modify the critical habitat of the endangered fish species, and must be evaluated with regard to the criteria described in the pertinent fish recovery programs.

For additional information contact: U.S. Fish and Wildlife Service, Utah Field Office, 2369 West Orton Circle, Suite 50, West Valley City, Utah 84119 Telephone (801) 975-3330.

Table 3-4
Potential Water Depletion
to
Colorado River Drainage

The following calculations are intended to define the potential depletion or addition of water to the Colorado River Drainage System, as a result of mining at this operation. It should be noted that the criteria is based on the U.S. Fish and Wildlife Service Windy Gap Process, and only those parameters that apply to this operation have been calculated.

Projected Water Depletion

1- Bathhouse/Office
   a. 140 people @ 35 gpd/ea x 240 days/yr = 1,176,000 gal/yr

2- Ventilation
   a. Evaporation
      1) 450,000 cfm = 236,520 M cf/yr
      2) 2.5 gallon/M cf = 591,300 gal/yr

3- Drilling GVH Wells
   a. 5 holes/yr @ 100,000 gal/hole = 500,000 gal/yr

4- Road Watering (GVH Sites)
   a. 5,000 gpd x 70 days/yr = 350,000 gal/yr

Total Loss = 2,617,300 gal/yr
8.033 ac ft/yr

Projected Water Addition

1- Mine Discharge
   a. 100 gpm x 120 days/yr = 17,280,000 gal/yr

Total Gain = 17,280,000 gal/yr
53.034 ac ft/yr

Summary

Projected Depletion =	-8.033 ac ft/yr
Projected Addition =	+53.034 ac ft/yr
Total Addition =	+45.001 ac ft/yr

Note: Moisture loss from mined coal and use of sprays have not been included, since the spray water is derived from perched aquifers and is recycled within the mine. Any excess water from the perched aquifers is eventually discharged, resulting in the addition to streamflow.

333 Plan to Minimize Disturbances and Adverse Impacts

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

- Well sites will be fenced per landowner requirements and suitable for wildlife protection.
- Minimizing the total area of disturbance.
- Yearly raptor surveys during operations.
- Utilizing existing roads where possible.
- Water used for drilling and dust suppression is pumped from mine.
- Providing erosion protection and dust control as needed on roads.
- Design, construction and operation of well sites to minimize adverse impacts.
- Coordination and planning with the interdisciplinary wildlife team.
- Reclamation of disturbed areas when no longer needed.

333.100 Minimize Disturbance to Endangered or Threatened Species

Andalex Resources, Inc. will apply all methods necessary to minimize disturbances or any adverse effects to threatened or endangered species. Note that T&E species are not anticipated to be discovered, however, should ARI determine that such species exist, the regulatory authority will be notified and appropriate remedial action taken. Also, See Section 322.200.

333.200 Species and Habitats

All species and habitats within the permit area will be protected to the best of Andalex Resources, Inc. ability. Note that T&E species are not anticipated to be discovered, however, should ARI determine that such species exist, the regulatory authority will be notified and appropriate remedial action taken.

333.300 Protective Measures

Refer to Section 333.300 of the approved M&RP, and Section 333 above. All well sites will be fenced and road construction will be minimized by utilizing existing roads where possible.

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.

ATTACHMENT 3-1
VEGETATION INVENTORY
NRCS LETTER

VEGETATION OF THE GAS VENT HOLES: GVH-04, GVH-05A, GVH-07, GVH-08, GVH-09 & REFERENCE AREAS 2005

FOR THE CENTENNIAL MINE

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INTRODUCTION

Andalex Resources has proposed to drill a number of boreholes at strategic locations to vent "gob" gas as a safety procedure prior to mining the areas beneath them. The drilling activities will necessitate disturbing about one acre of the vegetation at each drill site. The purpose of this document is to summarize the findings of quantitative sampling the plant communities proposed for disturbance along with "reference areas" chosen for future revegetation success standards. The vegetation data of the reference areas may be compared to the data of the reseeded drill sites now, as well as in the future when the boreholes have fulfilled their purpose and the drill sites are reclaimed. A sensitive species survey was also conducted on each site during the growing season of 2005.

METHODS

Methodologies used for this study were performed in accordance with the guidelines supplied by the State of Utah, Division of Oil, Gas and Mining (DOGM). Quantitative and qualitative data were taken on the vegetation of the areas proposed for disturbance and their respective reference areas between June 16 and September 20, 2005.

Proposed drill sites were surveyed, mapped and staked in the field by Andalex Resources prior to the field work performed for the vegetation surveys. The reference areas chosen were approximately one-acre in size and were marked in the field using a GPS instrument. The coordinates for the proposed GVH drill pads and reference areas are given below. A map showing these locations has been included in this report (see 2005 Vegetation Sample Areas).

GPS COORDINATES FOR CENTENNIAL MINE VEGETATION SAMPLE SITES

Site Name	Waypoint Name	Zone	Easting	Northing	Notes
GVH-04	ANGVH4	12S	0521726	4397745	
GVH-05A	ANGV5B	12S	0523291	4398220	Original site number was changed and adjusted for this report.
GVH-07	AGVH08	12S	0522386	4398208	Original site number was changed and adjusted for this report.
GVH-08	AGVH09	12S	0521952	4398209	Original site number was changed and adjusted for this report.
GVH-09	AGVH10	12S	0521533	4398202	Original site number was changed and adjusted for this report.
Reference Area (GVH-04, GVH-05A, GVH-07, GVH-09)	AGVH4R	12S	0521661	4397608	
Reference Area (GVH-08)	AGVH9R	12S	0522002	4398050	Original site number was changed and adjusted for 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 sites. 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., 2003).

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.

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

where,

nMIN	= minimum adequate sample
t	= appropriate confidence t-value
s	= standard deviation
x	= sample mean
d	= desired change from mean

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.

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 its respective reference area.

Photographs

Color photographs of the sample areas were taken at the time of sampling and have been submitted with this report.

Threatened & Endangered Plant Species

Prior to recording quantitative data on the plant communities, a sensitive plant species survey was conducted. To initiate the study, appropriate agencies were consulted and other sources were reviewed (sensitive species files at *Mt. Nebo Scientific, Inc.*) for potential plant species that are known to be rare, endemic, threatened, endangered or otherwise sensitive in the 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

Below are the results from sampling each vegetation study site for this report. Locations of these sites are shown on the Vegetation Sample Areas map. Color photographs of each sample site have also been provided later in this document.

GVH-04

Because of the necessity to also create an access road to this drill site, the plant communities associated with both the proposed drill pad and new road were sampled. Since the communities

were the same for each disturbance type here, the data were combined summarized to create a larger data set.

Table 1 shows the percent cover of each of the plant species encountered in the sample quadrats at the GVH-04 site. The dominant plant species in this area were big sagebrush (*Artemisia tridentata*), viscid rabbitbrush (*Chrysothamnus viscidiflorus*) and Salina wildrye (*Elymus salinus*).

The total living cover for this sagebrush/grass community was estimated at 58.13% (Table 2-A). Shrubs dominated the composition comprising 50.69% of the total living cover, followed by forbs and grasses at 31.79% and 17.52%, respectively (Table 2-B). Woody species density in this community was 12,787 individuals per acre (Table 3) and was dominated by the same woody species prevalent in the cover measurements described above.

GVH-05A

Drill pad GVH-05A was located in the general vicinity of an earlier constructed drill pad called GVH-05. The location of GVH-05A was shifted slightly to the west of where it was originally marked in the field, but the change did not affect the plant community type to be impacted by the proposed disturbance – the sagebrush/grass type.

The dominant plant species of this site were big sagebrush, Kentucky bluegrass (*Poa pratensis*), and viscid rabbitbrush (Table 4). The total living cover of the site was 59.75% (Table 5-A).

Shrubs dominated the composition constituting 49.91% of the total living cover, followed by grasses at 34.25% and forbs at 15.84% (Table 5-B). The woody species density for GVH-05A was estimated at 5,786 individuals per acre and was comprised of big sagebrush, snowberry (*Symphoricarpos oreophilus*), and viscid rabbitbrush (Table 6).

GVH-07

This proposed drill site supported another sagebrush/grass plant community. The dominant plant species in the cover data as shown on Table 7 were big sagebrush, viscid rabbitbrush, Kentucky bluegrass and bluebunch wheatgrass (*Elymus spicatus*). The total living cover of GVH-07 was estimated at 60.25% (Table 8-A). Shrubs again dominated the composition of this site where they represented 57.58% of the total living cover, followed by grasses at 34.41% and forbs at 8.00% (Table 8-B). The woody species density of this site was estimated at 6,944 plants per acre with the same three species as mentioned in the previous sites represented in this measurement – big sagebrush, viscid rabbitbrush and snowberry (Table 9).

GVH-08

The proposed drill pad of this site supported an aspen/grass plant community type. The plants in this area seemed to have been affected by some environmental stress conditions such as the recent droughts of Utah, possibly in conjunction with grazing pressures. Many of the aspen trees (*Populus tremuloides*) showed stress with some of the older trees dead or dying, but there seemed

to be rejuvenation occurring by saplings present in these clonal communities probably due to the recent increase in the precipitation patterns of the area.

The most common overstory species by cover and frequency was aspen; understory dominants were snowberry and Kentucky bluegrass (Table 10). The living cover was comprised of 13.75% overstory and 56.50% understory, or a total combined living cover of 70.25% (Table 11-A). The cover composition breakdown consisted of 43.96% trees/shrubs, 32.91% grasses, and 23.13% forbs (Table 11-B). Total woody species density was 2,646 plants per acre and was dominated by snowberry and aspen (Table 12).

GVH-09

Once again, the proposed drill site here was located within a sagebrush/grass plant community, however, this one had been previously impacted by a dirt road and was also the possible site of an old sheep camp or salt-lick area for cattle. In other words, the plant community was not that of a native, pristine community, so along with native species, it also supported several "weedy" species such as dandelion *(Taraxacum officinale)*, hound's tongue (*Cynoglossum officinale*) and knotweed (*Polygonum aviculare*). The dominant species by cover and frequency were sagebrush, Aster (*Aster* sp.) yarrow (*Achillea millefolium*) and dandelion (Table 13).

Total living cover of this area was 54.00% (Table 14-A). Due to impacts previously mentioned, the cover composition consisted of more forbs (42.78%) than the other sagebrush/grass

communities described in this report. Shrubs comprised 35.06% of the total living cover, whereas, grasses 22.16% (Table 14-B). Total woody species density of the site was 3,678 individuals per acre and, much like the above sagebrush/grass communities, consisted of big sagebrush, viscid rabbitbrush, and snowberry (Table 18).

Sagebrush/Grass Reference Area

A native, undisturbed sagebrush/grass plant community was chosen to represent future revegetation success standards for those sites that had been proposed for disturbance and also supported this same community type (GVH-04, GVH-05A, GVH-07,GVH-09). Even though this reference area was a sagebrush/grass plant community and similar to the other communities sampled, the species composition of each of the proposed disturbed sagebrush/grass communities described in this report varied somewhat. Still, this site could be an appropriate reference area for the proposed disturbed sagebrush/grass communities at the time of final revegetation (more about this in the DISCUSSION section of this report).

The dominant plant species of this reference area by cover and frequency were big sagebrush, viscid rabbitbrush, larkspur (*Delphinium nelsonii*), Watson's penstemon (*Penstemon watsonii*), and Salina wildrye (Table 16). The total living cover for the sagebrush/grass reference area was estimated at 62.25% (Table 17-A). Within this total living cover measurement, 52.13% of it were from shrubs, 34.58% were forbs, and 13.29% were grasses (Table 17-B). Woody species density was estimated at 13,025 individuals per acre and was dominated by viscid rabbitbrush, big sagebrush, and snowberry (Table 18).

Aspen/Grass Reference Area

The aspen/grass reference area chosen for future standards was located in the vicinity of the proposed disturbed aspen/grass community, or GVH-08 (see Vegetation Sample map). This community had an overstory cover of aspens at 24.25% (Tables 19 & 20-A). Dominant understory species were snowberry, lupine (*Lupinus argenteus*), Kentucky bluegrass, and aspen (Table 19). The total living understory cover in this community was 52.00%, while the total combined overstory and understory cover was 76.25% (Table 20-A). Trees and shrubs dominated the cover composition at 58.95%, whereas forbs and grasses were nearly equally represented at 20.79% and 20.26%, respectively (Table 20-B). The total woody species density was estimated at 3,702 individuals per acre and was dominated by snowberry, broom snakeweed (*Gutierrezia sarothrae*) and aspen (Table 21).

Threatened & Endangered Plant Species Survey

Each proposed disturbed area was surveyed in the field for canyon vetch (or any other threatened, endangered, unusual, rare or sensitive plants). This survey was done prior to recording the quantitative data used to describe the major plant communities of the study areas. In addition, more searching for sensitive species was done during quantitative sampling of the areas.

State databases revealed only one potential sensitive species to be located in the vicinity of the

proposed disturbed borehole sites. This plant was canyon vetch (*Hedysarum occidentale* var. *canone*). No rare, endemic, threatened or endangered or otherwise sensitive species were found in the study areas.

DISCUSSION

Statistical analyses were employed to compare the total living cover and density measurements of the proposed disturbed drill sites with their reference areas (Fig. 1 and Fig. 2). Since many of the plant communities proposed for disturbance were generally a sagebrush/grass type, only one reference area for this type was chosen. There was another reference area chosen for revegetation success standards for the drill pad that would disturb an aspen/grass community (see Vegetation Sample Area map).

In all but one of the statistical analyses, when **total living cover** of the proposed disturbed area was compared with the reference area, the differences were not significant (Fig. 1). For GVH-09, however, the cover was significantly less than the sagebrush/grass reference area. Reasons for this difference was probably a consequence of the present condition of the vegetation at GVH-09. As explained in the RESULTS section above, this site had been previously disturbed. This fact may be considered at the time final reclamation, but there will probably not be a problem with achieving the standards set by using an undisturbed sagebrush/grass community as the reference area.

When **woody species densities** of each site were compared statistically the test results varied. For the proposed disturbed sagebrush/grass sites (GVH-04, GVH-05A, GVH-07, GVH-09), only the density value for GVH-04 was *not* significantly different than its reference area. In all other sagebrush/grass community types, the reference area had significantly greater densities than the proposed disturbed areas (Fig. 2). These and other differences were not apparent until later, when the field data were summarized in spreadsheets and statistical test could be employed. The one sagebrush/grass site where its density value was *not* significantly different when compared to the reference area was GVH-04, probably because of the very close proximity to each other. Because of this, environmental variables (exposure, soils, slope, elevation, grazing practices, etc.) of these two areas were nearly exactly the same.

Although similar with respect to dominant plant species and some of the aforementioned environmental variables, the other proposed disturbed sagebrush/grass sites occupied areas where some of these variables were slightly different. These dissimilarities may be the reason for the differences in total density and other data parameters such as species composition. Additionally, although species diversity indices were not required for comparisons at this phase of the permitting process, a cursory review of the data sets suggests that diversity of the reference area chosen for the proposed disturbed sagebrush/grass areas may be greater than the proposed disturbed areas.

The differences between the data of some to the proposed disturbed drill sites when compared with the reference area are mentioned here because the following question arises – *does the*

reference area chosen for the sagebrush/grass community provide too stringent or unfair standards for future revegetation success for some sites? If the answer to this question is *yes*, then the following actions could be considered by the mine operator and regulatory agency. First, the differences noted in the data sets at this time such as woody species density, species composition and species diversity could be taken into consideration at the time sampling is conducted for future final revegetation comparisons. If the reclaimed drill sites do not meet all the requirements of the current reference area, the success standards could then be adjusted proportionately (as calculated by the data sets in this document). Another possible solution would be to select additional sagebrush/grass reference areas for GVH-05, GVH-07 and GVH-09. This could be done soon (i.e. the growing season of 2006), or later (closer to when final revegetation work is planned). Finally, based on the data herein, specific success standards could be dictated at this time that would be used for final revegetation success standards. For example, one could set a standard for woody species density at some specific value such as 2,500 plants per acre for the reclaimed sagebrush/grass sites. Species diversity values could also be set using the data sets reported in this document with the stipulation that they be approved by the regulatory agency beforehand. These topics could be entertained following submittal and review of this report.

Table 1: Centennial Mine. Total Living Cover and Frequency by Plant Species. Site: GVH-04 (Proposed Disturbed Sagebrush/Grass).

	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Artemisia tridentata	15.33	13.38	80.00
Chrysothamnus viscidiflorus	13.48	11.07	80.00
Symphoricarpos oreophilus	1.80	3.75	22.50
FORBS			
Achillea millefolium	0.68	2.00	12.50
Astragalus sp.	0.13	0.56	5.00
Clematis hirsutissima	0.05	0.31	2.50
Collinsia parvifolia	0.18	0.83	5.00
Cymopteris longipes	0.30	1.12	7.50
Delphinium nelsonii	6.93	3.96	85.00
Erigeron engelmannii	0.50	1.50	10.00
Gilia leptomeria	2.08	3.06	40.00
Lupinus argenteus	0.13	0.78	2.50
Penstemon watsonii	2.20	4.01	35.00
Phlox longifolia	0.88	1.90	17.50
Potentilla concinna	0.13	0.78	2.50
Taraxacum officinale	0.85	2.13	17.50
Viola nuttallii	2.85	2.96	55.00
GRASSES			
Elymus salinus	4.98	5.02	62.00
Festuca ovina	0.70	2.62	7.50
Poa compressa	0.13	0.78	2.50
Poa secunda	2.18	3.35	35.00
Stipa columbiana	1.70	3.42	25.00

Table 2: Centennial Mine. Total Cover, Composition, and Sample Size. Site: GVH-04 (Proposed Disturbed Sagebrush/Grass).

	Mean Percent	Standard Deviation	Sample Size
A. TOTAL COVER			
Understory	58.13	11.05	40
Litter	16.55	7.22	40
Bareground	23.10	12.57	40
Rock	2.23	5.35	40
B. COMPOSITION			
Shrubs	50.69	16.14	40
Forbs	31.79	13.16	40
Grasses	17.52	10.89	40

Table 3: Centennial Mine. Woody Species Density. Site: GVH-04 (Proposed Disturbed Sagebrush/Grass).

SPECIES	**Individuals Per Acre**
Artemisia tridentata	5114.81
Chrysothamnus viscidiflorus	7192.71
Symphoricarpos oreophilus	479.51
TOTAL	12787.03

Table 4: Centennial Mine. Total Living Cover and Frequency by Plant Species. Site: GVH-05A (Proposed Disturbed Sagebrush/Grass).

UNDERSTORY			
SHRUBS	Mean	SDev	Freq
Artemisia tridentata	18.75	13.68	90.00
Chrysothamnus viscidiflorus	9.50	11.61	50.00
Symphoricarpos oreophilus	2.25	4.32	25.00
FORBS			
Aster sp.	1.25	5.45	5.00
Astragalus sp.	0.50	1.50	10.00
Cynoglossum officinale	0.25	1.09	5.00
Lupinus argenteus	2.25	4.32	25.00
Penstemon watsonii	4.25	4.55	55.00
Taraxacum officinale	0.50	2.18	5.00
GRASSES			
Elymus spicatus	2.50	4.33	30.00
Poa pratensis	11.75	9.39	75.00
Stipa columbiana	6.00	9.82	30.00

Table 5: Centennial Mine. Total Cover, Composition, and Sample Size. Site: GVH-05A (Proposed Disturbed Sagebrush/Grass).

	Mean Percent	Standard Deviation	Sample Size
A. TOTAL COVER			
Understory	59.75	9.81	20
Litter	24.60	9.99	20
Bareground	14.45	9.17	20
Rock	1.20	0.40	20
B. COMPOSITION			
Shrubs	49.91	19.53	20
Forbs	15.84	13.04	20
Grasses	34.25	14.82	20

Table 6: Centennial Mine. Woody Species Density. Site: GVH-05A (Proposed Disturbed Sagebrush/Grass).

SPECIES	**Individuals Per Acre**
Artemisia tridentata	4050.15
Chrysothamnus viscidiflorus	1012.54
Symphoricarpos oreophilus	723.24
TOTAL	5785.93

Table 7: Centennial Mine. Total Living Cover and Frequency by Plant Species. Site: GVH-07. (Proposed Disturbed Sagebrush/Grass).

UNDERSTORY			
SHRUBS	Mean	SDev	Freq
Artemisia tridentata	18.00	13.91	85.00
Chrysothamnus viscidiflorus	16.50	9.10	90.00
Symphoricarpos oreophilus	0.25	1.09	5.00
FORBS			
Antennaria dimorpha	0.25	1.09	5.00
Lupinus argenteus	0.50	2.18	5.00
Penstemon watsonii	3.50	7.43	20.00
Taraxacum officinale	0.50	2.18	5.00
GRASSES			
Elymus spicatus	8.75	12.83	50.00
Poa pratensis	9.75	11.34	65.00
Stipa columbiana	2.25	4.32	25.00

Table 8: Centennial Mine. Total Cover, Composition, and Sample Size. Site GVH-07 (Proposed Disturbed Sagebrush/Grass).

	Mean Percent	Standard Deviation	Sample Size
A. TOTAL COVER			
Understory	60.25	10.30	20
Litter	18.75	9.93	20
Bareground	19.05	12.92	20
Rock	1.95	2.91	20
B. COMPOSITION			
Shrubs	57.58	17.97	20
Forbs	8.00	13.25	20
Grasses	34.41	16.27	20

Table 9: Centennial Mine. Woody Species Density. Site: GVH-07 (Proposed Disturbed Sagebrush/Grass).

SPECIES	**Individuals Per Acre**
Artemisia tridentata	3211.66
Chrysothamnus viscidiflorus	3472.07
Symphoricarpos oreophilus	260.41
TOTAL	6944.14

Table 10: Centennial Mine. Total Living Cover and Frequency by Plant Species. Site: GVH-08 (Proposed Disturbed Aspen/Grass).

OVERSTORY	Mean	SDev	Freq
Populus tremuloides	13.75	17.60	50.00
UNDERSTORY			
SHRUBS			
Amelanchier utahensis	0.25	1.09	5.00
Artemisia tridentata	1.50	4.50	15.00
Chrysothamnus viscidiflorus	1.65	3.77	20.00
Populus tremuloides	4.50	5.89	40.00
Rosa woodsii	0.25	1.09	5.00
Symphoricarpos oreophilus	16.50	20.74	60.00
FORBS			
Achillea millefolium	2.75	4.60	30.00
Collomia linearis	0.10	0.44	5.00
Cynoglossum officinale	0.75	1.79	15.00
Lupinus argenteus	3.50	5.02	40.00
Potentilla concinna	0.25	1.09	5.00
Taraxacum officinale	5.50	7.89	50.00
GRASSES			
Elymus spicatus	1.50	3.20	20.00
Elymus trachycaulus	0.50	2.18	5.00
Poa pratensis	15.25	17.28	50.00
Stipa columbiana	1.75	3.63	20.00

Table 11: Centennial Mine. Total Cover, Composition, and Sample Size. Site: GVH-08 (Proposed Disturbed Aspen/Grass).

	Mean Percent	Standard Deviation	Sample Size
A. TOTAL COVER			
Overstory (o)	13.75	17.60	
Understory (u)	56.50	13.24	20
Litter	23.20	10.82	20
Bareground	18.50	12.60	20
Rock	1.80	1.60	20
o + u	70.25	21.76	20
B. COMPOSITION			
Trees & Shrubs	43.96	32.54	20
Forbs	23.13	17.75	20
Grasses	32.91	25.35	20

Table 12: Centennial Mine. Woody Species Density. Site: GVH-08 (Proposed Disturbed Sagebrush/Grass).

SPECIES	**Individuals Per Acre**
Amelanchier utahensis	33.07
Artemisia tridentata	99.22
Chrysothamnus viscidiflorus	165.37
Populus tremuloides	826.86
Rosa woodsii	264.59
Symphoricarpos oreophilus	1256.82
TOTAL	2645.84

Table 13: Centennial Mine. Total Living Cover and Frequency by Plant Species. Site: GVH-09. (Proposed Disturbed Sagebrush/Grass).

UNDERSTORY	Mean	SDev	Freq
SHRUBS			
Artemisia tridentata	15.75	17.56	60.00
Chrysothamnus viscidiflorus	2.75	4.87	30.00
Symphoricarpos oreophilus	0.90	2.21	15.00
FORBS			
Achillea millefolium	4.75	6.42	45.00
Aster sp.	7.75	12.99	40.00
Circium sp.	0.25	1.09	5.00
Cynoglossum officinale	0.25	1.09	5.00
Lupinus argenteus	0.95	2.29	15.00
Penstemon watsonii	0.75	1.79	15.00
Polygonum aviculare	3.75	7.56	25.00
Taraxacum officinale	4.75	10.54	30.00
GRASSES			
Elymus spicatus	2.25	4.02	30.00
Elymus trachycaulus	0.75	3.27	5.00
Poa pratensis	8.15	9.51	50.00
Poa secunda	0.25	1.09	5.00

Table 14: Centennial Mine. Total Cover, Composition, and Sample Size. Site: GVH-09 (Proposed Disturbed Sagebrush/Grass).

	Mean Percent	Standard Deviation	Sample Size
A. TOTAL COVER			
Understory	54.00	11.25	20
Litter	18.30	9.19	20
Bareground	25.80	15.40	20
Rock	1.90	2.21	20
B. COMPOSITION			
Shrubs	35.06	28.26	20
Forbs	42.78	33.08	20
Grasses	22.16	18.65	20

Table 15: Centennial Mine. Woody Species Density. Site: GVH-09 (Proposed Disturbed Sagebrush/Grass).

SPECIES	**Individuals Per Acre**
Artemisia tridentata	2206.97
Chrysothamnus viscidiflorus	1195.44
Symphoricarpos oreophilus	275.87
TOTAL	3678.28

Table 16: Centennial Mine. Total Living Cover and Frequency by Plant Species. Reference Area: Sagebrush/Grass.

	Mean	SDev	Freq
TREES & SHRUBS			
Amelanchier utahensis	0.13	0.78	2.50
Artemisia tridentata	19.28	15.27	90.00
Chrysothamnus viscidiflorus	11.20	11.14	70.00
Symphoricarpos oreophilus	2.68	4.28	32.50
FORBS			
Achillea millefolium	0.20	0.90	5.00
Antennaria dimorpha	0.13	0.78	2.50
Arabis holboellii	0.08	0.47	2.50
Astragalus sp.	0.13	0.56	5.00
Collinsia parvifolia	0.05	0.31	2.50
Cymopteris longipes	3.10	2.43	65.00
Delphinium nelsonii	5.93	5.08	70.00
Erigeron engelmannii	1.30	2.52	25.00
Eriogonum sp.	0.13	0.78	2.50
Gilia leptomeria	0.80	2.23	12.50
Lupinus argenteus	0.63	1.65	12.50
Penstemon watsonii	4.90	4.39	67.50
Phlox longifolia	1.03	2.17	22.50
Potentilla concinna	0.25	1.09	5.00
Senecio multilobatus	0.08	0.47	2.50
Taraxacum officinale	1.33	2.07	32.50
Viola nuttallii	0.83	1.82	17.50
GRASSES			
Elymus salinus	4.38	5.27	50.00
Festuca ovina	2.25	5.58	22.50
Poa secunda	0.88	2.47	12.50
Stipa columbiana	0.63	2.00	10.00

Table 17: Centennial Mine. Total Cover, Composition, and Sample Size. Reference Area: Sagebrush/Grass (GVH-04).

	Mean Percent	Standard Deviation	Sample Size
A. TOTAL COVER			
Understory	62.25	8.51	40
Litter	17.55	8.27	40
Bareground	16.30	11.66	40
Rock	3.90	5.30	40
B. COMPOSITION			
Shrubs	52.13	18.41	40
Forbs	34.58	15.32	40
Grasses	13.29	12.03	40

Table 18: Centennial Mine. Woody Species Density. Reference Area: Sagebrush/Grass.

SPECIES	**Individuals Per Acre**
Amelanchier utahensis	81.41
Artemisia tridentata	5535.70
Chrysothamnus viscidiflorus	6105.55
Symphoricarpos oreophilus	1302.52
TOTAL	13025.18

Table 19: Centennial Mine. Total Living Cover and Frequency by Plant Species. Reference Area: Aspen/Grass (GVH-08).

	Mean	SDev	Freq
OVERSTORY			
Populus tremuloides	24.25	17.77	75.00
UNDERSTORY			
SHRUBS			
Artemisia tridentata	1.25	3.49	15.00
Chrysothamnus viscidiflorus	6.00	10.07	35.00
Populus tremuloides	6.50	11.84	35.00
Rosa woodsii	4.75	11.01	25.00
Symphoricarpos oreophilus	12.75	17.06	50.00
FORBS			
Achillea millefolium	0.25	1.09	5.00
Cynoglossum officinale	0.25	1.09	5.00
Lupinus argenteus	9.25	6.76	85.00
GRASSES			
Bromus carinatus	0.50	2.18	5.00
Elymus spicatus	1.50	4.50	15.00
Poa pratensis	8.25	13.44	50.00
Stipa columbiana	0.75	1.79	15.00

Table 20: Centennial Mine. Total Cover, Composition, and Sample Size. Reference Area: Aspen/Grass (GVH-08).

	Mean Percent	Standard Deviation	Sample Size
A. TOTAL COVER			
Overstory (o)	24.25	17.77	20
Understory (u)	52.00	13.55	20
Litter	27.10	14.70	20
Bareground	19.65	18.42	20
Rock	1.25	0.89	20
o + u	76.25	18.43	20
B. COMPOSITION			
Trees & Shrubs	58.95	28.06	20
Forbs	20.79	18.28	20
Grasses	20.26	19.17	20

Table 21: Centennial Mine. Woody Species Density. Reference Area: Aspen/Grass (GVH-08).

SPECIES	**Individuals Per Acre**
Artemisia tridentata	185.12
Gutierrezia sarothrae	879.32
Populus tremuloides	833.04
Rosa woodsii	462.80
Symphoricarpos oreophilus	1342.12
TOTAL	3702.40

FIG. 1. A statistical comparison (Student's t-tests) of the **total living cover** between the proposed disturbed GVH sites and their reference areas.

	$\bar{x}$	s	n	t	df	SL
GVH-04 (S/G)						
Proposed Disturbed:	58.13	11.05	40			
Reference Area:	62.25	8.51	40			
t-test				-1.868	78	N.S.
GVH-05A (S/G)						
Proposed Disturbed:	59.75	9.81	20			
Reference Area:	62.25	8.51	40			
t-test				-1.019	58	N.S.
GVH-07 (S/G)						
Proposed Disturbed:	60.25	10.30	20			
Reference Area:	62.25	8.51	40			
t-test				-0.799	58	N.S.
GVH-08 (A/G)						
Proposed Disturbed:	70.25	21.76	20			
Reference Area:	76.25	18.43	20			
t-test				-0.941	38	N.S.
GVH-09 (S/G)						
Proposed Disturbed:	54.00	11.25	20			
Reference Area:	62.25	8.51	40			
t-test				-3.173	58	$p<0.01$

$\bar{x}$ = mean
S/G = sagebrush/grass community
A/G = aspen/grass community
s = standard deviation
n = sample size
t = Student's t-value
df = degrees of freedom
SL= Significance Level
N.S.=Non-Significant

FIG. 2. A statistical comparison (Student's t-tests) of the **woody species density** between the proposed disturbed GVH sites and their reference areas.

	$\bar{x}$	s	n	t	df	SL
GVH-04 (S/G)						
Proposed Disturbed:	12787.03	6969.89	40			
Reference Area:	13025.18	8609.87	40			
t-test				-0.136	78	N.S.
GVH-05A (S/G)						
Proposed Disturbed:	5785.93	2694.85	20			
Reference Area:	13025.18	8609.87	40			
t-test				-3.657	58	$p<0.01$
GVH-07 (S/G)						
Proposed Disturbed:	6944.14	3217.85	20			
Reference Area:	13025.18	8609.87	40			
t-test				-3.043	58	$p<0.01$
GVH-08 (A/G)						
Proposed Disturbed:	2645.94	2361.07	20			
Reference Area:	3702.40	2706.98	20			
t-test				-1.315	38	N.S.
GVH-09 (S/G)						
Proposed Disturbed:	3678.28	2117.18	20			
Reference Area:	13025.18	8609.87	40			
t-test				-4.765	58	$p<0.01$

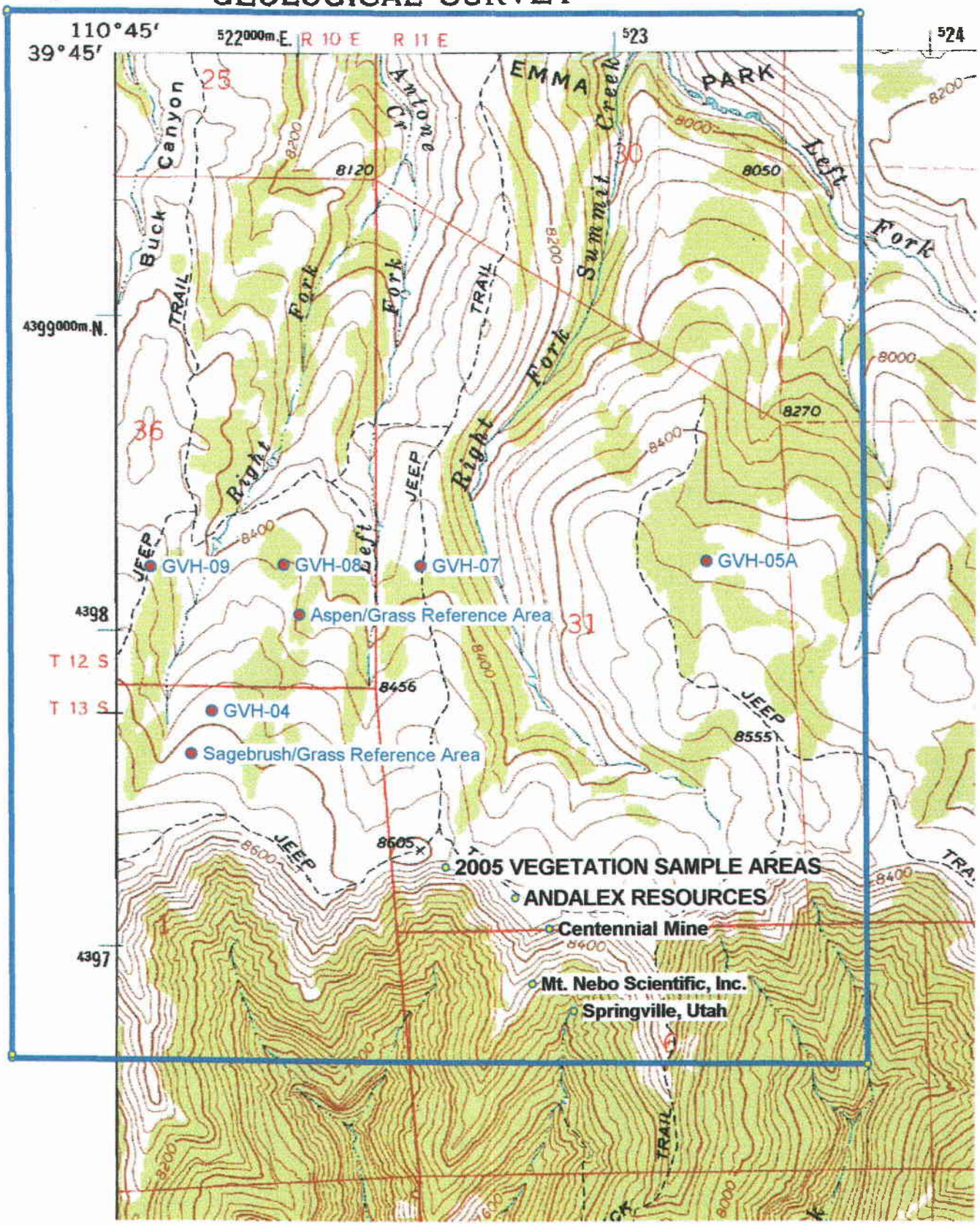
$\bar{x}$ = mean
S/G = sagebrush/grass community
A/G = aspen/grass community
s = standard deviation
n = sample size
t = Student's t-value
df = degrees of freedom
SL= Significance Level
N.S.= Non-Significant

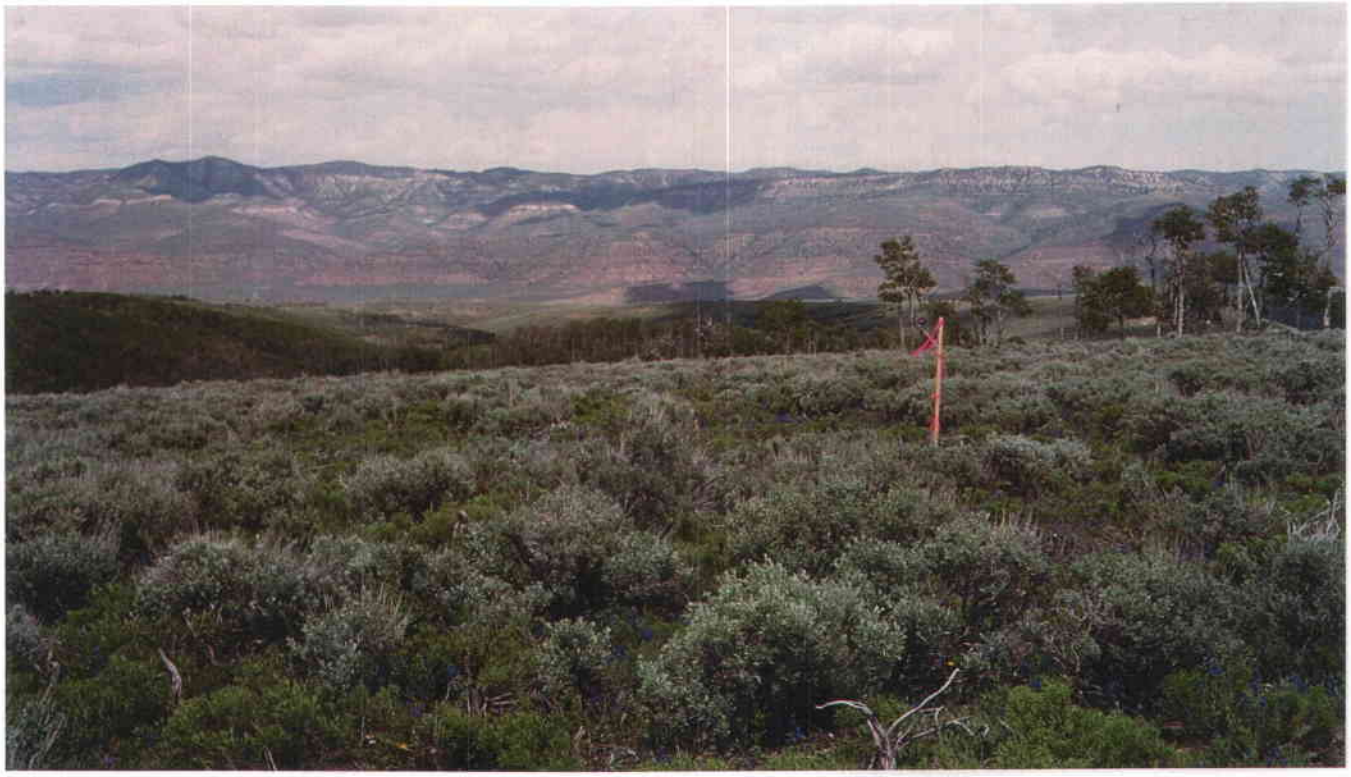
DEADMAN CANYON, UT

7.5 Minute Series Quadrangle Map

3863 IV SE (MATTS SUMMIT)

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY



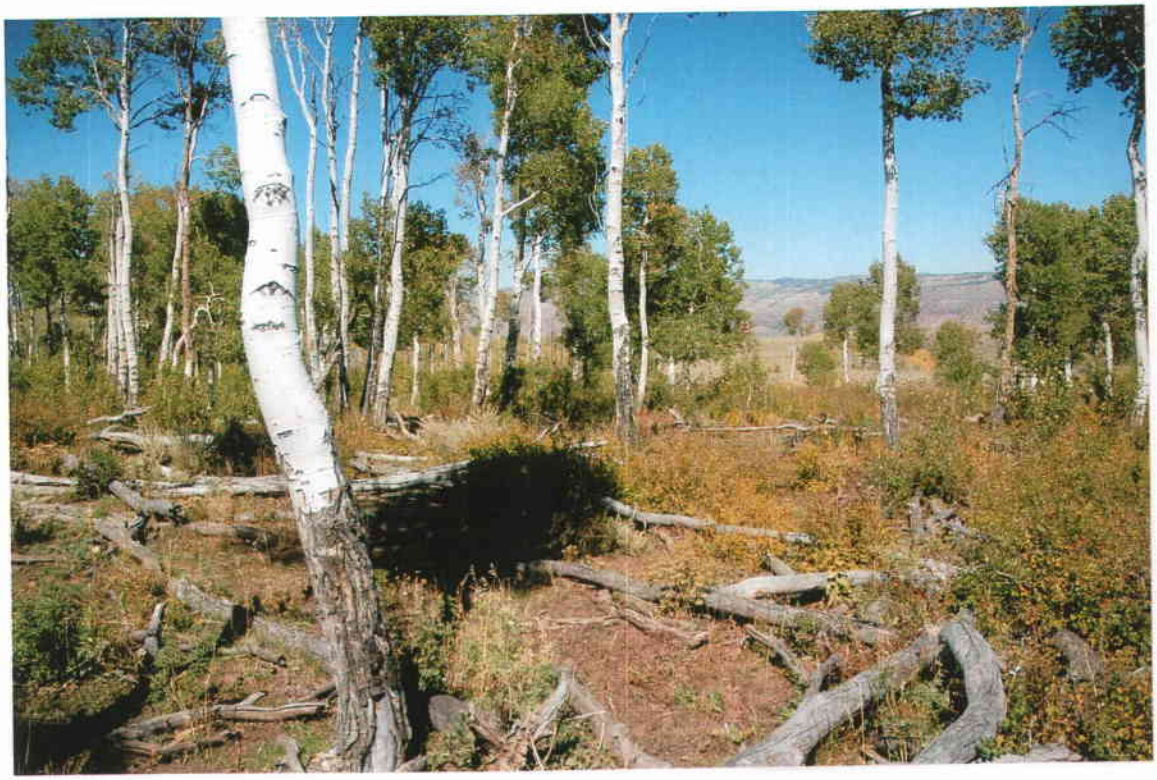


GVH-04

GVH-04 Access Road

GVH-05A

GVH-07



GVH-08

GVH-09

Sagebrush/Grass Reference Area

Aspen/Grass Reference Area

APPENDIX

(Raw Data)

ANDALEX
Centennial Mine
Proposed Disturbed GVH-4
Access Road & Drill Site
Exposure: N
Slope: 8 deg.
Sample Date: 16 June 2005

CONTINUED SITES IN TAB B

1 thru 20 Drill Pad

	1.00	2.00	3.00	4.00	5.00	6.00	7.00
TREES & SHRUBS							
Artemisia tridentata	29.00	7.00	40.00	5.00	0.00	5.00	12.00
Chrysothamnus viscidiflorus	0.00	10.00	0.00	20.00	11.00	20.00	13.00
Symphoricarpos oreophilus	0.00	0.00	0.00	10.00	0.00	5.00	0.00
FORBS							
Achillea millefolium	0.00	0.00	0.00	5.00	5.00	2.00	0.00
Astragalus sp.	2.00	3.00	0.00	0.00	0.00	0.00	0.00
Clematis hirsutissima	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Collinsia parvifolia	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cymopteris longipes	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Delphinium nelsonii	7.00	15.00	10.00	10.00	8.00	0.00	10.00
Erigeron engelmannii	0.00	0.00	0.00	0.00	0.00	5.00	0.00
Gilia leptomeria	0.00	0.00	0.00	5.00	5.00	0.00	0.00
Lupinus argenteus	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Penstemon watsonii	8.00	3.00	0.00	15.00	3.00	0.00	0.00
Phlox longifolia	0.00	0.00	5.00	0.00	0.00	5.00	0.00
Potentilla concinna	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Taraxacum officinale	1.00	0.00	5.00	0.00	0.00	5.00	0.00
Viola nuttallii	3.00	7.00	5.00	0.00	3.00	3.00	5.00
GRASSES							
Elymus salinus	0.00	0.00	5.00	0.00	0.00	5.00	5.00
Festuca ovina	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Poa compressa	5.00	0.00	0.00	0.00	0.00	0.00	0.00
Poa secunda	0.00	5.00	0.00	0.00	0.00	5.00	0.00
Stipa columbiana	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COVER							
Total Living Cover	55.00	50.00	70.00	70.00	35.00	60.00	45.00
Litter	13.00	23.00	8.00	9.00	19.00	19.00	24.00
Bareground	30.00	25.00	20.00	20.00	45.00	20.00	30.00
Rock	2.00	2.00	2.00	1.00	1.00	1.00	1.00
% COMPOSITION							
Shrubs	52.73	34.00	57.14	50.00	31.43	50.00	55.56
Forbs	38.18	56.00	35.71	50.00	68.57	33.33	33.33
Grasses	9.09	10.00	7.14	0.00	0.00	16.67	11.11

8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00
0.00	15.00	29.00	0.00	3.00	15.00	5.00	25.00	10.00	0.00
10.00	15.00	20.00	10.00	20.00	20.00	0.00	15.00	25.00	25.00
2.00	0.00	0.00	0.00	0.00	15.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	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	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.00	5.00	10.00	0.00	10.00	10.00	10.00	5.00	10.00	10.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.00	5.00	0.00	5.00	2.00	0.00	5.00	5.00	5.00	15.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.00	2.00	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	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	0.00
0.00	5.00	1.00	5.00	0.00	0.00	5.00	5.00	5.00	5.00
13.00	5.00	8.00	10.00	10.00	5.00	8.00	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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.00	10.00	2.00	10.00	0.00	5.00	7.00	5.00	0.00	10.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45.00	65.00	70.00	50.00	50.00	70.00	50.00	65.00	65.00	65.00
19.00	14.00	19.00	24.00	14.00	14.00	14.00	24.00	14.00	30.00
35.00	20.00	10.00	25.00	1.00	15.00	35.00	10.00	20.00	4.00
1.00	1.00	1.00	1.00	35.00	1.00	1.00	1.00	1.00	1.00
26.67	46.15	70.00	20.00	46.00	71.43	10.00	61.54	53.85	38.46
37.78	30.77	15.71	40.00	34.00	14.29	60.00	23.08	38.46	46.15
35.56	23.08	14.29	40.00	20.00	14.29	30.00	15.38	7.69	15.38

20 thru 40 Access Road

18.00	19.00	20.00	21.00	22.00	23.00	24.00	25.00	26.00	27.00
20.00	43.00	10.00	10.00	15.00	40.00	0.00	0.00	0.00	10.00
5.00	0.00	15.00	20.00	15.00	5.00	40.00	30.00	20.00	0.00
0.00	10.00	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	0.00	0.00	0.00	0.00	0.00	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
5.00	5.00	10.00	5.00	5.00	5.00	0.00	10.00	10.00	10.00
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	3.00	0.00	5.00	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	5.00	0.00	2.00	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	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	5.00	0.00	0.00
5.00	0.00	0.00	5.00	5.00	5.00	5.00	0.00	0.00	0.00
5.00	5.00	5.00	5.00	10.00	0.00	0.00	0.00	5.00	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	5.00	10.00	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	15.00	10.00	0.00
50.00	75.00	55.00	50.00	55.00	75.00	55.00	65.00	50.00	40.00
15.00	15.00	10.00	24.00	9.00	15.00	4.00	25.00	9.00	9.00
30.00	5.00	30.00	25.00	35.00	9.00	40.00	9.00	40.00	50.00
5.00	5.00	5.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50.00	70.67	45.45	60.00	54.55	73.33	72.73	46.15	40.00	25.00
40.00	16.00	27.27	30.00	18.18	26.67	18.18	30.77	30.00	25.00
10.00	13.33	27.27	10.00	27.27	0.00	9.09	23.08	30.00	50.00

28.00	29.00	30.00	31.00	32.00	33.00	34.00	35.00	36.00	37.00
38.00	20.00	5.00	7.00	20.00	30.00	20.00	20.00	10.00	20.00
0.00	5.00	45.00	15.00	15.00	35.00	10.00	10.00	5.00	10.00
0.00	0.00	0.00	8.00	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	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	0.00	0.00	2.00	0.00
10.00	15.00	10.00	5.00	7.00	5.00	10.00	5.00	0.00	5.00
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	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	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	18.00
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	5.00	0.00	10.00	0.00	0.00	0.00
10.00	0.00	5.00	0.00	10.00	0.00	15.00	5.00	0.00	0.00
0.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00	13.00	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	0.00	3.00	5.00	0.00	5.00	0.00	0.00
65.00	45.00	75.00	50.00	60.00	75.00	65.00	50.00	40.00	70.00
19.00	14.00	9.00	9.00	14.00	15.00	20.00	14.00	19.00	20.00
15.00	40.00	15.00	40.00	25.00	9.00	14.00	35.00	40.00	9.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
58.46	55.56	66.67	60.00	58.33	86.67	46.15	60.00	37.50	52.86
18.46	33.33	20.00	20.00	20.00	6.67	30.77	20.00	30.00	40.00
23.08	11.11	13.33	20.00	21.67	6.67	23.08	20.00	32.50	7.14

ANDALEX
Centennial Mine
Proposed Disturbed GVH-4
Access Road & Drill Site
Exposure: N
Slope: 8 deg.
Sample Date: 16 June 2005

38.00	39.00	40.00	Mean	SDev	Freq	
						TREES & SHRUBS
0.00	45.00	30.00	15.33	13.38	80.00	*Artemisia tridentata*
5.00	0.00	0.00	13.48	11.07	80.00	*Chrysothamnus viscidiflorus*
5.00	0.00	0.00	1.80	3.75	22.50	*Symphoricarpos oreophilus*
						FORBS
0.00	0.00	0.00	0.68	2.00	12.50	*Achillea millefolium*
0.00	0.00	0.00	0.13	0.56	5.00	*Astragalus sp.*
0.00	0.00	0.00	0.05	0.31	2.50	*Clematis hirsutissima*
0.00	0.00	0.00	0.18	0.83	5.00	*Collinsia parvifolia*
0.00	5.00	5.00	0.30	1.12	7.50	*Cymopteris longipes*
3.00	0.00	0.00	6.93	3.96	85.00	*Delphinium nelsonii*
0.00	0.00	5.00	0.50	1.50	10.00	*Erigeron engelmannii*
0.00	0.00	0.00	2.08	3.06	40.00	*Gilia leptomeria*
5.00	0.00	0.00	0.13	0.78	2.50	*Lupinus argenteus*
0.00	0.00	0.00	2.20	4.01	35.00	*Penstemon watsonii*
0.00	5.00	5.00	0.88	1.90	17.50	*Phlox longifolia*
0.00	0.00	5.00	0.13	0.78	2.50	*Potentilla concinna*
10.00	0.00	0.00	0.85	2.13	17.50	*Taraxacum officinale*
7.00	10.00	0.00	2.85	2.96	55.00	*Viola nuttallii*
						GRASSES
0.00	0.00	15.00	4.98	5.02	62.00	*Elymus salinus*
0.00	0.00	0.00	0.70	2.62	7.50	*Festuca ovina*
0.00	0.00	0.00	0.13	0.78	2.50	*Poa compressa*
0.00	0.00	0.00	2.18	3.35	35.00	*Poa secunda*
10.00	5.00	0.00	1.70	3.42	25.00	*Stipa columbiana*
						COVER
45.00	70.00	65.00	58.13	11.05		Total Living Cover
45.00	14.00	14.00	16.55	7.22		Litter
9.00	15.00	20.00	23.10	12.57		Bareground
1.00	1.00	1.00	2.23	5.35		Rock
						% COMPOSITION
22.22	64.29	46.15	50.69	16.14		Shrubs
55.56	28.57	30.77	31.79	13.16		Forbs
22.22	7.14	23.08	17.52	10.89		Grasses

ANDALEX
Centennial Mine
Reference Area GVH-4
Sagebrush/Low Rabbit Brush
Exposure:
Slope:

Sample Date: 16 June 2005	1.00	2.00	3.00	4.00	5.00	6.00	7.00
TREES & SHRUBS							
Amelanchier utahensis	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Artemisia tridentata	45.00	20.00	5.00	10.00	25.00	0.00	40.00
Chrysothamnus viscidiflorus	0.00	0.00	10.00	10.00	5.00	25.00	10.00
Symphoricarpos oreophilus	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FORBS							
Achillea millefolium	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Antennaria dimorpha	0.00	0.00	0.00	0.00	0.00	5.00	0.00
Arabis holboellii	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Astragalus sp.	0.00	0.00	0.00	0.00	0.00	0.00	2.00
Collinsia parvifolia	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cymopteris longipes	5.00	8.00	5.00	0.00	5.00	5.00	3.00
Delphinium nelsonii	0.00	5.00	5.00	5.00	0.00	5.00	0.00
Erigeron engelmannii	8.00	2.00	0.00	0.00	2.00	5.00	0.00
Eriogonum sp.	0.00	0.00	0.00	5.00	0.00	0.00	0.00
Gilia leptomeria	0.00	0.00	0.00	5.00	0.00	0.00	0.00
Lupinus argenteus	0.00	0.00	5.00	5.00	0.00	0.00	0.00
Penstemon watsonii	7.00	0.00	15.00	5.00	10.00	5.00	5.00
Phlox longifolia	0.00	5.00	0.00	2.00	3.00	0.00	0.00
Potentilla concinna	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Senecio multilobatus	0.00	0.00	0.00	3.00	0.00	0.00	0.00
Taraxacum officinale	0.00	0.00	5.00	0.00	0.00	0.00	0.00
Viola nuttallii	0.00	0.00	0.00	0.00	5.00	0.00	0.00
GRASSES							
Elymus salinus	0.00	0.00	5.00	0.00	0.00	5.00	0.00
Festuca ovina	0.00	0.00	0.00	5.00	5.00	0.00	0.00
Poa secunda	5.00	10.00	0.00	0.00	0.00	0.00	5.00
Stipa columbiana	0.00	0.00	0.00	0.00	5.00	0.00	5.00
COVER							
Total Living Cover	70.00	50.00	55.00	55.00	65.00	55.00	70.00
Litter	20.00	15.00	10.00	25.00	10.00	15.00	20.00
Bareground	5.00	30.00	30.00	15.00	5.00	25.00	5.00
Rock	5.00	5.00	5.00	5.00	20.00	5.00	5.00
% COMPOSITION							
Shrubs	64.29	40.00	27.27	36.36	46.15	45.45	71.43
Forbs	28.57	40.00	63.64	54.55	38.46	45.45	14.29
Grasses	7.14	20.00	9.09	9.09	15.38	9.09	14.29

8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45.00	20.00	0.00	15.00	10.00	10.00	15.00	10.00	28.00	45.00
0.00	20.00	50.00	0.00	10.00	28.00	10.00	5.00	0.00	0.00
0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	5.00	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	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	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	0.00	0.00	0.00	0.00	2.00	0.00	0.00
5.00	5.00	5.00	5.00	5.00	5.00	5.00	0.00	0.00	0.00
5.00	5.00	0.00	10.00	2.00	7.00	5.00	10.00	10.00	10.00
0.00	0.00	0.00	0.00	0.00	5.00	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	7.00	0.00	0.00	0.00	5.00	5.00
5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00
5.00	5.00	5.00	15.00	10.00	0.00	10.00	5.00	5.00	0.00
0.00	0.00	0.00	5.00	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	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	0.00	2.00	5.00	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	5.00	0.00
5.00	10.00	0.00	0.00	0.00	10.00	5.00	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	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	10.00
75.00	65.00	65.00	65.00	50.00	65.00	55.00	55.00	70.00	75.00
10.00	8.00	19.00	19.00	30.00	25.00	30.00	5.00	15.00	15.00
10.00	25.00	15.00	15.00	15.00	5.00	10.00	10.00	10.00	5.00
5.00	2.00	1.00	1.00	5.00	5.00	5.00	30.00	5.00	5.00
60.00	61.54	76.92	30.77	40.00	58.46	45.45	27.27	47.14	60.00
33.33	23.08	23.08	69.23	60.00	26.15	45.45	54.55	45.71	26.67
6.67	15.38	0.00	0.00	0.00	15.38	9.09	18.18	7.14	13.33

18.00	19.00	20.00	21.00	22.00	23.00	24.00	25.00	26.00	27.00
5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30.00	15.00	5.00	0.00	40.00	20.00	25.00	60.00	15.00	30.00
0.00	20.00	0.00	20.00	25.00	5.00	10.00	5.00	15.00	0.00
5.00	0.00	5.00	0.00	10.00	10.00	5.00	0.00	10.00	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	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	5.00	0.00	5.00	0.00	5.00	5.00	3.00
10.00	15.00	15.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00
0.00	0.00	0.00	0.00	0.00	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
10.00	10.00	10.00	10.00	5.00	5.00	10.00	5.00	5.00	2.00
0.00	0.00	5.00	0.00	0.00	3.00	5.00	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	0.00	0.00
0.00	0.00	0.00	5.00	0.00	2.00	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	10.00	10.00	0.00	0.00	10.00	0.00	0.00	10.00	0.00
0.00	0.00	0.00	15.00	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	10.00
0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00
65.00	70.00	55.00	55.00	80.00	65.00	60.00	80.00	70.00	65.00
25.00	20.00	35.00	19.00	4.00	30.00	19.00	8.00	25.00	30.00
5.00	5.00	5.00	25.00	15.00	4.00	20.00	10.00	4.00	4.00
5.00	5.00	5.00	1.00	1.00	1.00	1.00	2.00	1.00	1.00
61.54	50.00	18.18	36.36	93.75	53.85	66.67	81.25	57.14	53.85
38.46	35.71	63.64	36.36	6.25	30.77	25.00	12.50	28.57	30.77
0.00	14.29	18.18	27.27	0.00	15.38	8.33	6.25	14.29	15.38

28.00	29.00	30.00	31.00	32.00	33.00	34.00	35.00	36.00	37.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.00	15.00	5.00	5.00	0.00	10.00	5.00	15.00	15.00	40.00
20.00	15.00	5.00	25.00	10.00	15.00	30.00	0.00	20.00	5.00
12.00	0.00	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	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	0.00	0.00	0.00	0.00	0.00
2.00	5.00	0.00	0.00	5.00	0.00	5.00	0.00	0.00	0.00
3.00	10.00	15.00	15.00	5.00	10.00	10.00	10.00	10.00	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	0.00	0.00	0.00	0.00	0.00
0.00	0.00	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	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	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	0.00	5.00	5.00	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	15.00	20.00	0.00	5.00	10.00	0.00	10.00	15.00	0.00
0.00	5.00	10.00	10.00	30.00	0.00	0.00	0.00	0.00	5.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50.00	65.00	65.00	60.00	60.00	50.00	60.00	40.00	65.00	65.00
19.00	8.00	15.00	9.00	9.00	9.00	14.00	4.00	25.00	30.00
30.00	25.00	19.00	30.00	30.00	40.00	25.00	55.00	8.00	4.00
1.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00
70.00	46.15	15.38	50.00	16.67	50.00	58.33	37.50	53.85	92.31
30.00	23.08	38.46	33.33	25.00	30.00	41.67	37.50	23.08	0.00
0.00	30.77	46.15	16.67	58.33	20.00	0.00	25.00	23.08	7.69

ANDALEX
Centennial Mine
Reference Area GVH-4
Sagebrush/Low Rabbit Brush
Exposure:
Slope:
Sample Date: 16 June 2005

38.00	39.00	40.00	Mean	SDev	Freq	
						TREES & SHRUBS
0.00	0.00	0.00	0.13	0.78	2.50	*Amelanchier utahensis*
15.00	45.00	15.00	19.28	15.27	90.00	*Artemisia tridentata*
0.00	0.00	20.00	11.20	11.14	70.00	*Chrysothamnus viscidiflorus*
10.00	0.00	10.00	2.68	4.28	32.50	*Symphoricarpos oreophilus*
						FORBS
0.00	0.00	0.00	0.20	0.90	5.00	*Achillea millefolium*
0.00	0.00	0.00	0.13	0.78	2.50	*Antennaria dimorpha*
0.00	0.00	0.00	0.08	0.47	2.50	*Arabis holboellii*
0.00	0.00	0.00	0.13	0.56	5.00	*Astragalus sp.*
0.00	0.00	0.00	0.05	0.31	2.50	*Collinsia parvifolia*
3.00	5.00	0.00	3.10	2.43	65.00	*Cymopteris longipes*
15.00	5.00	0.00	5.93	5.08	70.00	*Delphinium nelsonii*
0.00	5.00	0.00	1.30	2.52	25.00	*Erigeron engelmannii*
0.00	0.00	0.00	0.13	0.78	2.50	*Eriogonum sp.*
0.00	0.00	10.00	0.80	2.23	12.50	*Gilia leptomeria*
0.00	0.00	0.00	0.63	1.65	12.50	*Lupinus argenteus*
10.00	0.00	0.00	4.90	4.39	67.50	*Penstemon watsonii*
0.00	0.00	0.00	1.03	2.17	22.50	*Phlox longifolia*
0.00	0.00	0.00	0.25	1.09	5.00	*Potentilla concinna*
0.00	0.00	0.00	0.08	0.47	2.50	*Senecio multilobatus*
2.00	0.00	0.00	1.33	2.07	32.50	*Taraxacum officinale*
0.00	0.00	5.00	0.83	1.82	17.50	*Viola nuttallii*
						GRASSES
0.00	5.00	5.00	4.38	5.27	50.00	*Elymus salinus*
0.00	0.00	0.00	2.25	5.58	22.50	*Festuca ovina*
0.00	0.00	0.00	0.88	2.47	12.50	*Poa secunda*
0.00	0.00	0.00	0.63	2.00	10.00	*Stipa columbiana*
						COVER
55.00	65.00	65.00	62.25	8.51		Total Living Cover
19.00	10.00	25.00	17.55	8.27		Litter
25.00	20.00	9.00	16.30	11.66		Bareground
1.00	5.00	1.00	3.90	5.30		Rock
						% COMPOSITION
45.45	69.23	69.23	52.13	18.41		Shrubs
54.55	23.08	23.08	34.58	15.32		Forbs
0.00	7.69	7.69	13.29	12.03		Grasses

ANDALEX
Centennial Mine
Site GVH-5A
Sage/Grass
Exposure:
Slope:

Sample Date: 20 Sept 2005	1.00	2.00	3.00	4.00	5.00	6.00	7.00
UNDERSTORY							
SHRUBS							
Artemisia tridentata	5.00	15.00	15.00	10.00	0.00	25.00	10.00
Chrysothamnus viscidiflorus	5.00	15.00	0.00	0.00	0.00	0.00	20.00
Symphoricarpos oreophilus	5.00	0.00	15.00	10.00	0.00	0.00	0.00
FORBS							
Aster sp.	0.00	0.00	0.00	0.00	25.00	0.00	0.00
Astragalus sp.	5.00	5.00	0.00	0.00	0.00	0.00	0.00
Cynoglossum officinale	0.00	0.00	0.00	0.00	0.00	5.00	0.00
Lupinus argenteus	0.00	0.00	0.00	10.00	0.00	0.00	0.00
Penstemon watsonii	5.00	5.00	10.00	10.00	0.00	0.00	0.00
Taraxicum officinale	0.00	0.00	0.00	0.00	0.00	10.00	0.00
GRASSES							
Elymus spicatus	10.00	0.00	0.00	0.00	0.00	0.00	15.00
Poa pratensis	0.00	10.00	20.00	0.00	30.00	25.00	10.00
Stipa columbiana	0.00	0.00	0.00	10.00	0.00	0.00	0.00
COVER							
Understory	35.00	50.00	60.00	50.00	55.00	65.00	55.00
Litter	55.00	35.00	30.00	14.00	4.00	25.00	19.00
Bareground	9.00	14.00	8.00	35.00	40.00	8.00	25.00
Rock	1.00	1.00	2.00	1.00	1.00	2.00	1.00
% COMPOSITION							
Shrubs	42.86	60.00	50.00	40.00	0.00	38.46	54.55
Forbs	28.57	20.00	16.67	40.00	45.45	23.08	0.00
Grasses	28.57	20.00	33.33	20.00	54.55	38.46	45.45

8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00
30.00	15.00	45.00	50.00	25.00	0.00	20.00	30.00	20.00	5.00
0.00	25.00	0.00	0.00	15.00	35.00	15.00	15.00	0.00	35.00
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	0.00
0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	10.00	0.00
5.00	0.00	0.00	5.00	15.00	10.00	5.00	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	5.00	0.00	0.00	10.00	0.00
30.00	10.00	10.00	10.00	10.00	0.00	0.00	15.00	15.00	0.00
0.00	15.00	0.00	0.00	0.00	25.00	20.00	0.00	0.00	30.00
65.00	65.00	65.00	75.00	65.00	75.00	65.00	60.00	65.00	70.00
25.00	20.00	25.00	20.00	25.00	20.00	20.00	20.00	20.00	20.00
8.00	14.00	9.00	4.00	9.00	4.00	14.00	18.00	14.00	9.00
2.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00	1.00
46.15	61.54	69.23	80.00	61.54	46.67	61.54	75.00	30.77	57.14
7.69	0.00	7.69	6.67	23.08	13.33	7.69	0.00	30.77	0.00
46.15	38.46	23.08	13.33	15.38	40.00	30.77	25.00	38.46	42.86

ANDALEX
Centennial Mine
Site GVH-5A
Sage/Grass
Exposure:
Slope:
Sample Date: 20 Sept 2005

18.00	19.00	20.00	Mean	SDev	Freq	
						UNDERSTORY
						SHRUBS
35.00	5.00	15.00	18.75	13.68	90.00	*Artemisia tridentata*
0.00	0.00	10.00	9.50	11.61	50.00	*Chrysothamnus viscidiflorus*
0.00	0.00	0.00	2.25	4.32	25.00	*Symphoricarpos oreophilus*
						FORBS
0.00	0.00	0.00	1.25	5.45	5.00	*Aster sp.*
0.00	0.00	0.00	0.50	1.50	10.00	*Astragalus sp.*
0.00	0.00	0.00	0.25	1.09	5.00	*Cynoglossum officinale*
0.00	5.00	15.00	2.25	4.32	25.00	*Lupinus argenteus*
5.00	0.00	0.00	4.25	4.55	55.00	*Penstemon watsonii*
0.00	0.00	0.00	0.50	2.18	5.00	*Taraxicum officinale*
						GRASSES
5.00	0.00	0.00	2.50	4.33	30.00	*Elymus spicatus*
5.00	15.00	20.00	11.75	9.39	75.00	*Poa pratensis*
0.00	20.00	0.00	6.00	9.82	30.00	*Stipa columbiana*
						COVER
50.00	45.00	60.00	59.75	9.81		Understory
35.00	35.00	25.00	24.60	9.99		Litter
14.00	19.00	14.00	14.45	9.17		Bareground
1.00	1.00	1.00	1.20	0.40		Rock
						% COMPOSITION
70.00	11.11	41.67	49.91	19.53		Shrubs
10.00	11.11	25.00	15.84	13.04		Forbs
20.00	77.78	33.33	34.25	14.82		Grasses

ANDALEX
Centennial Mine
Site GVH-07
Sage/Grass
Exposure: NW
Slope: 3 deg

Sample Date: 20 Sept 2005	1.00	2.00	3.00	4.00	5.00	6.00	7.00
UNDERSTORY							
SHRUBS							
Artemisia tridentata	25.00	20.00	10.00	55.00	25.00	10.00	0.00
Chrysothamnus viscidiflorus	5.00	15.00	30.00	10.00	15.00	25.00	15.00
Symphoricarpos oreophilus	5.00	0.00	0.00	0.00	0.00	0.00	0.00
FORBS							
Antennaria dimorpha	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lupinus argenteus	0.00	0.00	10.00	0.00	0.00	0.00	0.00
Penstemon watsonii	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Taraxicum officinale	0.00	0.00	0.00	0.00	0.00	0.00	10.00
GRASSES							
Elymus spicatus	35.00	0.00	15.00	0.00	0.00	0.00	15.00
Poa pratensis	0.00	15.00	0.00	0.00	25.00	10.00	0.00
Stipa columbiana	0.00	0.00	0.00	10.00	0.00	0.00	0.00
COVER							
Understory	70.00	50.00	65.00	75.00	65.00	45.00	40.00
Litter	15.00	35.00	15.00	20.00	10.00	30.00	45.00
Bareground	14.00	1.00	18.00	4.00	24.00	20.00	13.00
Rock	1.00	14.00	2.00	1.00	1.00	5.00	2.00
% COMPOSITION							
Shrubs	50.00	70.00	61.54	86.67	61.54	77.78	37.50
Forbs	0.00	0.00	15.38	0.00	0.00	0.00	25.00
Grasses	50.00	30.00	23.08	13.33	38.46	22.22	37.50

8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00
45.00	20.00	15.00	5.00	25.00	5.00	0.00	25.00	10.00	20.00
15.00	20.00	0.00	30.00	20.00	20.00	20.00	15.00	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	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	25.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	50.00	10.00	10.00	0.00	0.00	10.00	0.00	15.00
5.00	0.00	0.00	5.00	5.00	15.00	40.00	10.00	10.00	10.00
5.00	15.00	0.00	0.00	0.00	0.00	0.00	5.00	10.00	0.00
70.00	65.00	65.00	50.00	60.00	40.00	60.00	65.00	65.00	70.00
20.00	14.00	10.00	4.00	30.00	9.00	9.00	20.00	20.00	15.00
9.00	20.00	24.00	45.00	9.00	50.00	30.00	14.00	14.00	14.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
85.71	61.54	23.08	70.00	75.00	62.50	33.33	61.54	69.23	28.57
0.00	15.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35.71
14.29	23.08	76.92	30.00	25.00	37.50	66.67	38.46	30.77	35.71

ANDALEX
Centennial Mine
Site GVH-07
Sage/Grass
Exposure: NW
Slope: 3 deg
Sample Date: 20 Sept 2005

18.00	19.00	20.00	Mean	SDev	Freq	
						UNDERSTORY
						SHRUBS
0.00	20.00	25.00	18.00	13.91	85.00	*Artemisia tridentata*
20.00	10.00	10.00	16.50	9.10	90.00	*Chrysothamnus viscidiflorus*
0.00	0.00	0.00	0.25	1.09	5.00	*Symphoricarpos oreophilus*
						FORBS
5.00	0.00	0.00	0.25	1.09	5.00	*Antennaria dimorpha*
0.00	0.00	0.00	0.50	2.18	5.00	*Lupinus argenteus*
15.00	0.00	20.00	3.50	7.43	20.00	*Penstemon watsonii*
0.00	0.00	0.00	0.50	2.18	5.00	*Taraxicum officinale*
						GRASSES
10.00	0.00	5.00	8.75	12.83	50.00	*Elymus spicatus*
0.00	35.00	10.00	9.75	11.34	65.00	*Poa pratensis*
0.00	0.00	0.00	2.25	4.32	25.00	*Stipa columbiana*
						COVER
50.00	65.00	70.00	60.25	10.30		Understory
9.00	25.00	20.00	18.75	9.93		Litter
40.00	9.00	9.00	19.05	12.92		Bareground
1.00	1.00	1.00	1.95	2.91		Rock
						% COMPOSITION
40.00	46.15	50.00	57.58	17.97		Shrubs
40.00	0.00	28.57	8.00	13.25		Forbs
20.00	53.85	21.43	34.41	16.27		Grasses

ANDALEX
Centennial Mine
Site GVH-08
Aspen Grove
Exposure: N
Slope: 3 deg

Sample Date: 19 Sept 2005	1.00	2.00	3.00	4.00	5.00	6.00	7.00
OVERSTORY							
Populus tremuloides	40.00	0.00	0.00	10.00	0.00	40.00	0.00
UNDERSTORY							
SHRUBS							
Amelanchier utahensis	5.00	0.00	0.00	0.00	0.00	0.00	0.00
Artemisia tridentata	20.00	0.00	5.00	0.00	0.00	0.00	0.00
Chrysothamnus viscidiflorus	8.00	5.00	0.00	0.00	5.00	0.00	0.00
Populus tremuloides	0.00	15.00	5.00	10.00	0.00	0.00	0.00
Rosa woodsii	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Symphoricarpos oreophilus	5.00	0.00	15.00	10.00	45.00	40.00	10.00
FORBS							
Achillea millefolium	0.00	5.00	0.00	0.00	0.00	0.00	0.00
Collomia linearis	2.00	0.00	0.00	0.00	0.00	0.00	0.00
Cynoglossum officinale	0.00	0.00	0.00	0.00	0.00	5.00	0.00
Lupinus argenteus	15.00	0.00	0.00	0.00	5.00	0.00	5.00
Potentilla concinna	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Taraxacum officinale	0.00	0.00	5.00	10.00	5.00	0.00	20.00
GRASSES							
Elymus spicatus	0.00	0.00	0.00	0.00	0.00	10.00	0.00
Elymus trachycaulus	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Poa pratensis	15.00	0.00	10.00	0.00	0.00	0.00	35.00
Stipa columbiana	0.00	0.00	10.00	10.00	5.00	10.00	0.00
COVER							
Overstory	40.00	0.00	0.00	10.00	0.00	40.00	0.00
Understory	70.00	25.00	50.00	40.00	65.00	65.00	70.00
Litter	20.00	50.00	10.00	10.00	15.00	15.00	10.00
Bareground	9.00	24.00	35.00	45.00	15.00	19.00	19.00
Rock	1.00	1.00	5.00	5.00	5.00	1.00	1.00
% COMPOSITION							
Shrubs	54.29	80.00	50.00	50.00	76.92	61.54	14.29
Forbs	24.29	20.00	10.00	25.00	15.38	7.69	35.71
Grasses	21.43	0.00	40.00	25.00	7.69	30.77	50.00
Overstory + Understory	110.00	25.00	50.00	50.00	65.00	105.00	70.00

8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00
0.00	10.00	15.00	50.00	0.00	0.00	25.00	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	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	10.00	0.00	0.00	10.00	10.00	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	30.00	75.00	50.00	0.00	25.00	0.00	0.00
0.00	10.00	0.00	0.00	0.00	0.00	10.00	0.00	10.00	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	5.00	0.00	5.00	0.00
0.00	5.00	10.00	0.00	0.00	0.00	0.00	0.00	5.00	10.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30.00	15.00	10.00	0.00	0.00	0.00	0.00	5.00	5.00	5.00
0.00	0.00	0.00	0.00	0.00	5.00	0.00	10.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.00	0.00	0.00
40.00	40.00	30.00	35.00	0.00	0.00	0.00	0.00	25.00	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	15.00	50.00	0.00	0.00	25.00	0.00	0.00	10.00
70.00	70.00	65.00	65.00	75.00	65.00	40.00	55.00	50.00	45.00
15.00	25.00	25.00	30.00	20.00	30.00	15.00	35.00	9.00	30.00
14.00	4.00	9.00	4.00	4.00	4.00	40.00	9.00	40.00	24.00
1.00	1.00	1.00	1.00	1.00	1.00	5.00	1.00	1.00	1.00
0.00	0.00	23.08	46.15	100.00	92.31	37.50	72.73	0.00	0.00
42.86	42.86	30.77	0.00	0.00	0.00	37.50	9.09	50.00	44.44
57.14	57.14	46.15	53.85	0.00	7.69	25.00	18.18	50.00	55.56
70.00	80.00	80.00	115.00	75.00	65.00	65.00	55.00	50.00	55.00

ANDALEX
Centennial Mine
Site GVH-08
Aspen Grove
Exposure: N
Slope: 3 deg
Sample Date: 19 Sept 2005

18.00	19.00	20.00	Mean	SDev	Freq	
						OVERSTORY
50.00	0.00	25.00	13.75	17.60	50.00	*Populus tremuloides*
						UNDERSTORY
						SHRUBS
0.00	0.00	0.00	0.25	1.09	5.00	*Amelanchier utahensis*
0.00	0.00	0.00	1.50	4.50	15.00	*Artemisia tridentata*
0.00	15.00	0.00	1.65	3.77	20.00	*Chrysothamnus viscidiflorus*
15.00	0.00	0.00	4.50	5.89	40.00	*Populus tremuloides*
0.00	0.00	0.00	0.25	1.09	5.00	*Rosa woodsii*
15.00	10.00	0.00	16.50	20.74	60.00	*Symphoricarpos oreophilus*
						FORBS
0.00	15.00	0.00	2.75	4.60	30.00	*Achillea millefolium*
0.00	0.00	0.00	0.10	0.44	5.00	*Collomia linearis*
0.00	0.00	0.00	0.75	1.79	15.00	*Cynoglossum officinale*
0.00	15.00	0.00	3.50	5.02	40.00	*Lupinus argenteus*
5.00	0.00	0.00	0.25	1.09	5.00	*Potentilla concinna*
0.00	0.00	0.00	5.50	7.89	50.00	*Taraxacum officinale*
						GRASSES
5.00	0.00	0.00	1.50	3.20	20.00	*Elymus spicatus*
0.00	0.00	0.00	0.50	2.18	5.00	*Elymus trachycaulus*
0.00	0.00	50.00	15.25	17.28	50.00	*Poa pratensis*
0.00	0.00	0.00	1.75	3.63	20.00	*Stipa columbiana*
						COVER
50.00	0.00	25.00	13.75	17.60		Overstory
40.00	55.00	50.00	56.50	13.24		Understory
35.00	30.00	35.00	23.20	10.82		Litter
24.00	14.00	14.00	18.50	12.60		Bareground
1.00	1.00	1.00	1.80	1.60		Rock
						% COMPOSITION
75.00	45.45	0.00	43.96	32.54		Shrubs
12.50	54.55	0.00	23.13	17.75		Forbs
12.50	0.00	100.00	32.91	25.35		Grasses
90.00	55.00	75.00	70.25	21.76		Overstory + Understory

ANDALEX
Centennial Mine
Site GVH-08 **Reference Area**
Aspen Reference Area
Exposure: E
Slope: 7 - 10 deg

Sample Date: 20 Sept 2005	1.00	2.00	3.00	4.00	5.00	6.00	7.00
OVERSTORY							
Populus tremuloides	15.00	50.00	35.00	0.00	0.00	55.00	0.00
UNDERSTORY							
SHRUBS							
Artemisia tridentata	0.00	0.00	0.00	0.00	5.00	0.00	0.00
Chrysothamnus viscidiflorus	10.00	0.00	0.00	10.00	25.00	30.00	10.00
Populus tremuloides	30.00	10.00	0.00	0.00	0.00	5.00	0.00
Rosa woodsii	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Symphoricarpos oreophilus	0.00	0.00	15.00	0.00	0.00	0.00	35.00
FORBS							
Achillea millefolium	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cynoglossum officinale	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lupinus argenteus	15.00	15.00	25.00	20.00	10.00	5.00	0.00
GRASSES							
Bromus carinatus	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Elymus spicatus	0.00	0.00	0.00	0.00	5.00	0.00	0.00
Poa pratensis	0.00	0.00	5.00	10.00	0.00	10.00	0.00
Stipa columbiana	0.00	0.00	0.00	0.00	0.00	0.00	5.00
COVER							
Overstory	15.00	50.00	35.00	0.00	0.00	55.00	0.00
Understory	55.00	25.00	45.00	40.00	45.00	50.00	50.00
Litter	30.00	4.00	40.00	55.00	9.00	8.00	24.00
Bareground	14.00	70.00	14.00	4.00	45.00	40.00	25.00
Rock	1.00	1.00	1.00	1.00	1.00	2.00	1.00
% COMPOSITION							
Shrubs	72.73	40.00	33.33	25.00	66.67	70.00	90.00
Forbs	27.27	60.00	55.56	50.00	22.22	10.00	0.00
Grasses	0.00	0.00	11.11	25.00	11.11	20.00	10.00
Overstory + Understory	70.00	75.00	80.00	40.00	45.00	105.00	50.00

8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00
25.00	40.00	10.00	20.00	50.00	0.00	25.00	0.00	25.00	35.00
0.00	5.00	0.00	0.00	0.00	15.00	0.00	0.00	0.00	0.00
30.00	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	10.00	0.00	45.00	20.00
0.00	25.00	0.00	0.00	10.00	45.00	10.00	5.00	0.00	0.00
0.00	0.00	25.00	60.00	10.00	0.00	35.00	40.00	15.00	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	0.00	0.00	0.00	0.00
0.00	5.00	5.00	0.00	5.00	10.00	5.00	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	20.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00
5.00	0.00	20.00	0.00	10.00	0.00	10.00	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
25.00	40.00	10.00	20.00	50.00	0.00	25.00	0.00	25.00	35.00
35.00	55.00	55.00	65.00	35.00	70.00	70.00	60.00	65.00	45.00
14.00	35.00	14.00	9.00	55.00	25.00	25.00	35.00	30.00	45.00
50.00	9.00	30.00	25.00	5.00	4.00	4.00	4.00	4.00	9.00
1.00	1.00	1.00	1.00	5.00	1.00	1.00	1.00	1.00	1.00
85.71	54.55	54.55	92.31	57.14	85.71	78.57	75.00	92.31	77.78
0.00	9.09	9.09	0.00	14.29	14.29	7.14	16.67	7.69	11.11
14.29	36.36	36.36	7.69	28.57	0.00	14.29	8.33	0.00	11.11
60.00	95.00	65.00	85.00	85.00	70.00	95.00	60.00	90.00	80.00

ANDALEX
Centennial Mine
Site GVH-08 **Reference Area**
Aspen Reference Area
Exposure: E
Slope: 7 - 10 deg
Sample Date: 20 Sept 2005

18.00	19.00	20.00	Mean	SDev	Freq	
						OVERSTORY
30.00	40.00	30.00	24.25	17.77	75.00	*Populus tremuloides*
						UNDERSTORY
						SHRUBS
0.00	0.00	0.00	1.25	3.49	15.00	*Artemisia tridentata*
0.00	0.00	0.00	6.00	10.07	35.00	*Chrysothamnus viscidiflorus*
0.00	0.00	10.00	6.50	11.84	35.00	*Populus tremuloides*
0.00	0.00	0.00	4.75	11.01	25.00	*Rosa woodsii*
0.00	5.00	0.00	12.75	17.06	50.00	*Symphoricarpos oreophilus*
						FORBS
5.00	0.00	0.00	0.25	1.09	5.00	*Achillea millefolium*
5.00	0.00	0.00	0.25	1.09	5.00	*Cynoglossum officinale*
15.00	15.00	15.00	9.25	6.76	85.00	*Lupinus argenteus*
						GRASSES
0.00	10.00	0.00	0.50	2.18	5.00	*Bromus carinatus*
0.00	0.00	0.00	1.50	4.50	15.00	*Elymus spicatus*
40.00	0.00	50.00	8.25	13.44	50.00	*Poa pratensis*
0.00	5.00	0.00	0.75	1.79	15.00	*Stipa columbiana*
						COVER
30.00	40.00	30.00	24.25	17.77		Overstory
65.00	35.00	75.00	52.00	13.55		Understory
25.00	40.00	20.00	27.10	14.70		Litter
9.00	24.00	4.00	19.65	18.42		Bareground
1.00	1.00	1.00	1.25	0.89		Rock
						% COMPOSITION
0.00	14.29	13.33	58.95	28.06		Shrubs
38.46	42.86	20.00	20.79	18.28		Forbs
61.54	42.86	66.67	20.26	19.17		Grasses
95.00	75.00	105.00	76.25	18.43		Overstory + Understory

ANDALEX
Centennial Mine
Site GVH-09
Sage/Grass
Exposure: E
Slope: 3 deg

Sample Date: 19 Sept 2005	1.00	2.00	3.00	4.00	5.00	6.00	7.00
UNDERSTORY							
SHRUBS							
Artemisia tridentata	0.00	0.00	0.00	25.00	0.00	0.00	0.00
Chrysothamnus viscidiflorus	0.00	0.00	5.00	5.00	15.00	0.00	0.00
Symphoricarpos oreophilus	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FORBS							
Achillea millefolium	15.00	0.00	15.00	0.00	10.00	15.00	5.00
Aster sp.	0.00	0.00	0.00	35.00	5.00	0.00	40.00
Circium sp.	0.00	0.00	0.00	0.00	0.00	5.00	0.00
Cynoglossum officinale	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lupinus argenteus	0.00	0.00	0.00	0.00	0.00	0.00	7.00
Penstemon watsonii	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Polygonum aviculare	15.00	10.00	30.00	0.00	0.00	10.00	10.00
Taraxacum officinale	20.00	45.00	5.00	0.00	5.00	0.00	0.00
GRASSES							
Elymus spicatus	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Elymus trachycaulus	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Poa pratensis	0.00	0.00	0.00	0.00	0.00	10.00	8.00
Poa secunda	0.00	0.00	0.00	0.00	5.00	0.00	0.00
COVER							
Understory	50.00	55.00	55.00	65.00	40.00	40.00	70.00
Litter	5.00	5.00	4.00	10.00	4.00	4.00	19.00
Bareground	40.00	39.00	40.00	24.00	55.00	55.00	10.00
Rock	5.00	1.00	1.00	1.00	1.00	1.00	1.00
% COMPOSITION							
Shrubs	0.00	0.00	9.09	46.15	37.50	0.00	0.00
Forbs	100.00	100.00	90.91	53.85	50.00	75.00	88.57
Grasses	0.00	0.00	0.00	0.00	12.50	25.00	11.43

8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00
0.00	10.00	15.00	25.00	20.00	15.00	25.00	15.00	35.00	15.00
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	8.00	0.00	5.00	0.00
0.00	20.00	0.00	0.00	0.00	5.00	5.00	0.00	0.00	5.00
35.00	15.00	5.00	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	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	7.00	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	10.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	15.00	5.00	5.00	0.00	5.00
0.00	0.00	0.00	0.00	15.00	0.00	0.00	0.00	0.00	0.00
25.00	20.00	10.00	20.00	0.00	0.00	0.00	25.00	10.00	25.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
65.00	65.00	40.00	60.00	50.00	45.00	50.00	45.00	55.00	50.00
19.00	24.00	19.00	24.00	29.00	28.00	30.00	19.00	25.00	24.00
15.00	10.00	40.00	15.00	20.00	25.00	15.00	35.00	10.00	25.00
1.00	1.00	1.00	1.00	1.00	2.00	5.00	1.00	10.00	1.00
0.00	15.38	37.50	41.67	40.00	55.56	66.00	33.33	72.73	30.00
61.54	53.85	37.50	25.00	30.00	11.11	24.00	0.00	9.09	10.00
38.46	30.77	25.00	33.33	30.00	33.33	10.00	66.67	18.18	60.00

ANDALEX
Centennial Mine
Site GVH-09
Sage/Grass
Exposure: E
Slope: 3 deg
Sample Date: 19 Sept 2005

18.00	19.00	20.00	Mean	SDev	Freq	
						UNDERSTORY
						SHRUBS
0.00	60.00	55.00	15.75	17.56	60.00	*Artemisia tridentata*
15.00	5.00	0.00	2.75	4.87	30.00	*Chrysothamnus viscidiflorus*
0.00	5.00	0.00	0.90	2.21	15.00	*Symphoricarpos oreophilus*
						FORBS
0.00	0.00	0.00	4.75	6.42	45.00	*Achillea millefolium*
0.00	0.00	0.00	7.75	12.99	40.00	*Aster sp.*
0.00	0.00	0.00	0.25	1.09	5.00	*Circium sp.*
0.00	0.00	0.00	0.25	1.09	5.00	*Cynoglossum officinale*
5.00	0.00	0.00	0.95	2.29	15.00	*Lupinus argenteus*
5.00	0.00	5.00	0.75	1.79	15.00	*Penstemon watsonii*
0.00	0.00	0.00	3.75	7.56	25.00	*Polygonum aviculare*
0.00	0.00	0.00	4.75	10.54	30.00	*Taraxacum officinale*
						GRASSES
10.00	0.00	5.00	2.25	4.02	30.00	*Elymus spicatus*
0.00	0.00	0.00	0.75	3.27	5.00	*Elymus trachycaulus*
0.00	0.00	10.00	8.15	9.51	50.00	*Poa pratensis*
0.00	0.00	0.00	0.25	1.09	5.00	*Poa secunda*
						COVER
35.00	70.00	75.00	54.00	11.25		Understory
29.00	25.00	20.00	18.30	9.19		Litter
35.00	4.00	4.00	25.80	15.40		Bareground
1.00	1.00	1.00	1.90	2.21		Rock
						% COMPOSITION
42.86	100.00	73.33	35.06	28.26		Shrubs
28.57	0.00	6.67	42.78	33.08		Forbs
28.57	0.00	20.00	22.16	18.65		Grasses

George S. Cook
Society for Range Management
Certified Professional in Range Management
#CPOL-371 Telephone: 435-637-0937
P.O. Box 505
Wellington, UT 84542

April 20, 2005

Andelex Resources, Inc.
Michael W. Glasson, P.G.
P.O. Box 902
Price, UT 84501

Dear Sir:

Range Site Information from the Carbon County Soil Survey GVH site #2 and #2 Alternate located on sheet number 10 of the Carbon County Soil Survey T.12 S. R. 11 E. Sec. 31.

GVH Site #2 is located in mapping unit number 105-Sencert Family-Sencert complex. GVH site #2 located on the Sencert Family of this mapping unit. The range site for the Sencert Family soil is High Mountain Loam (Thurber Fescue). The High Mountain Loam (Thurber Fescue) range site produces 1,800 pounds per acre. The range site is in fair condition.

GVH Site #2 Alternate is located in mapping unit 104 Sencert Family, 3 to 15 percent slopes. GVH Site #2 Alternate is located on104 Sencert Family site. The Range site for this soil is High Mountain Loam (Thurber Fescue). The productivity of this range site is 2,100 pounds per acre. The range site is in good ecological condition.

.

Sincerely,

George S. Cook, CPRM

ATTACHMENT 3-2
THREATENED, ENDANGERED, AND SENSITIVE SPECIES INFORMATION

EIS ENVIRONMENTAL & ENGINEERING CONSULTING

31 North Main Street * Helper, Utah 84526
Office – (435) 472-3814 * Fax – (435) 472-8780 * Toll free – (800) 641-2927
eisec@preciscom.net * www.eisenviro.com

January 17, 2006

Blackhawk Engineering, Inc.
Mr. Dan Guy
1056 West 2060 North
Helper, Utah 84526

RE: Mexican Spotted Owl Habitat : Andalex Proposed Project Area.

Dear Mr. Guy:

Please find attached a map showing suitable habitat for the Mexican Spotted Owl (MSO) in regards to your proposed project area.

A Memorandum from the Utah Field Supervisor of the USFWS, dated November 21, 2002 states that:

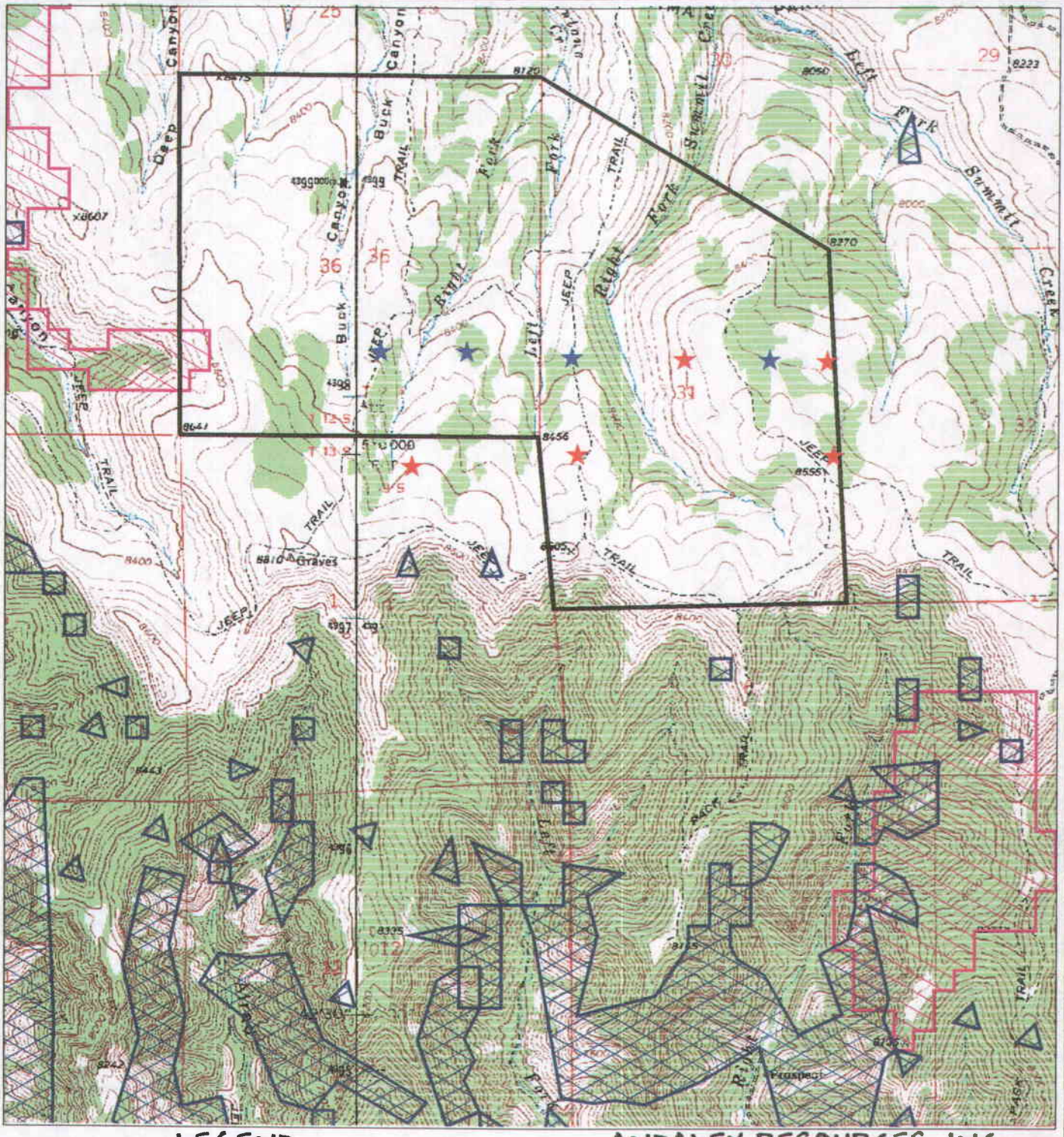
1. "The 1997 model should be used as a first-cut analysis tool to identify potentially rugged areas that may provide suitable owl habitats..."
2. "The 2000 model predicts the location of breeding and roosting habitat within rugged canyon habitat..."
3. "Buffers should be applied to the 2000 model, as follows, and used when evaluating potential project impacts...
   a. A 0.5-mile radius should buffer all pixels, including isolated pixels. Habitat within this radius should be evaluated and surveyed for owls, according to protocol.
   b. Implement the '2X2 Rule', any canyon habitat where the canyon is less than 2 km wide and at least 2 km long should be considered and managed as Protected Habitat. Canyons meeting the 2X2 Rule should also be assessed for the need for owl surveys."

A general consensus of opinion indicated the MSO nesting sites are normally located on the steeper slopes, at mid-canyon levels below 8,000 ft in elevation. The area of proposed disturbance would approach the maximum limit in elevation where MSOs have been located. Based on the 1997 and 2000 habitat models, there is no suitable nesting habitat within this area (Plate I). On January 13, 2006, Mr. Melvin A Coonrod of EIS visited and surveyed the area in question. Mr. Coonrod found that no nesting and/or roosting MSO habitat is located within the project area. Based on this information, it would be reasonable to conclude that surveys in this area are not warranted.

If you have any questions or concerns, please feel free to call (435) 472-3814.

Respectfully,

Melvin A. Coonrod
Owner/Principle Consultant
EIS Environmental & Engineering Consulting



LEGEND

- Proposed Project Area
- 1997 Model
- 2000 Model

Proposed Vent Holes

- Existing
- Proposed

ANDALEX RESOURCES, INC.

PROPOSED VENT HOLES

Section 36 : T. 12 S., R. 10 E. §

Section 31 : T. 12 S., R. 11 E.

Environmental Industrial Services

Environmental & Engineering Consulting

31 North Main Street
Helper, Utah 84526
(435) 472-3814
Fax (435) 472-8780
eisec@preciscom.net

N

Proposed Project Area

Mexican Spotted Owl Suitable Habitat

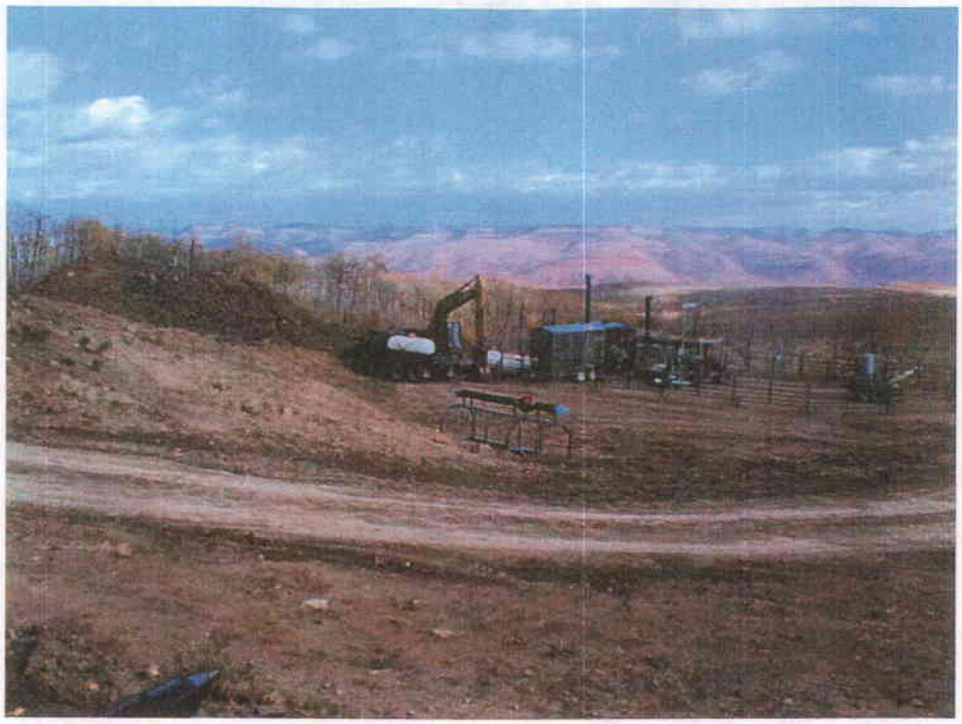
CREATED ON: 01-17-2006

SCALE: 1:2,000' | DRAWN BY: KJN | REVISED: MM-DD-YY

PLATE 1

ATTACHMENT 3-3
2005 RAPTOR SURVEY
(Relocated to Confidential Binder)

ATTACHMENT 3-4
PHOTOS OF GVH SITES



GVH-1
ACCESS ROAD

GVH-1
SITE

GVH-3
ACCESS ROAD

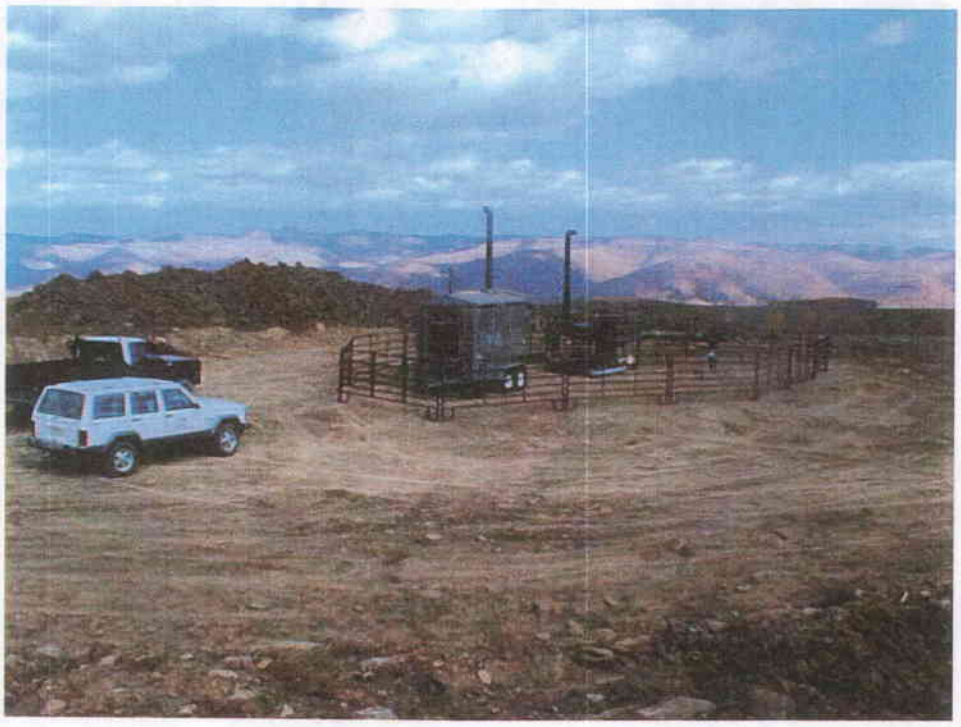
GVH-3
SITE

GVH-04

GVH-04 Access Road

GVH-4
ACCESS ROAD

GVH-4
SITE



GVH-5
SITE

GVH-5
TOPSOIL/RECLAIMED AREA

GVH-6
SITE

GVH-6
RECLAIMED AREA

GVH-05A

GVH-07

GVH-08

GVH-09

LIST OF ATTACHMENTS

Attachment 4-1 Cultural Resource Survey and Inventory
Attachment 4-2 Surface Land Owner Notification (Moved to Confidential Binder)

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, including hunting 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.

411.130 Land Use Description

The wells are located on land administered by Dave R. & Mildred Cave, et al., and Mathis Land, Inc. 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

Archeological surveys will be conducted on any future proposed well sites as soon as weather and ground conditions allow. The Cultural Resource Survey will be included in Attachment 4-1 of this application. For Gob Gas Holes 1, 3, 4, 5 and 6, preliminary research and file search has been conducted by Senco-Phenix of Price, Utah and the research indicates that there is a very low probability of the occurrence of cultural resources at the proposed drill sites. Senco-Phenox has also completed a Cultural Resource Survey of the proposed sites GVH#5A, GVH#7, GVH#8 and GVH#9. Results of this survey are included in Attachment 4-1. (Confidential Binder)

Andalex Resources, Inc. agrees to notify the Division and State Historical Preservation Office (SHPO) of previously unidentified cultural resources discovered in the course of operations. Andalex also agrees to have any such cultural resources evaluated in terms

ATTACHMENT 4-1
CULTURAL RESOURCE SURVEY
(Relocated to Confidential Binder)

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.

Designs and other information herein presented will be of a general nature or in the form of typicals, since the proposed sites are not yet accessible for detailed surveying or studies. Site specific information will be provided in this chapter as it becomes available.

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 will be provided upon completion of surveys. Typical road cross sections are shown on Figures 5-5.

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.

Ancillary Roads - Short sections of road may be required to access certain well sites. 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. When possible, well sites will be placed on existing roads.

As shown on Figure 1-1, proposed GVH sites 7, 8 and 9 are located on existing access roads. GVH-8 can be accessed via an existing road along the fence line without crossing either the Right or Left Fork of Antone Creek.

Approximately 800' of new access road will be constructed to site GVH-5A. This road will be constructed according to the approved plan. The road will be constructed with a berm on the downhill side and slightly sloping to the pad area; therefore, runoff from the road will be contained on the pad area.

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 5-4.

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.

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 and Support Facilities

No utilities are to be installed at the well sites. A portable exhaust unit will be temporarily installed to draw gob gas 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 gas. Excess gob gas 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 will be developed near existing private roads whenever possible. The new access roads will be classified as ancillary roads and will be maintained by the permitee.

527.200 Description of Transportation Facilities

The well sites have been chosen close to existing roads whenever possible in the area to limit surface disturbance. The existing roads were constructed and are maintained by the land owner. The existing roads are approximately 16 feet wide. See Figure 5-5 for a typical cross section of the existing roads.

The following is a description of each of the roads used to access the GVH Sites:

Right Fork of Deadman Canyon - This road is located in the bottom of Deadman Canyon north of the Centennial Project Minesite surface facilities. The road was existing,

constructed by the surface owner; however, it did require minor drainage control upgrades in the form of 18" and 24" culverts, and slight widening of sharp turns for drilling equipment access. This road is approximately 12,300' long with an average slope of 11.79% and is approximately 16' wide. The road runs from the Centennial Minesite to the top of the ridge. The road is native rock and gravel surfaced, and is protected from runoff by a combination of berms, road ditches and culverts. This road will remain in place upon completion of the drilling project.

GVH-5 - This road runs from the top of Deadman Canyon to the GVH-5 Site. This is an existing road, approximately 16' wide, 4400' in length, with an average slope of approximately 5.00%. The road is constructed on native material and protected from runoff by berms, ditches and culverts as needed.. There are no plans to remove or reclaim this road.

GVH-1 - This is a short section of road running from Road GVH-5 to the GVH-1 Site. The road was constructed on native material by ARI, and is approximately 16' wide, 300' in length and has an average slope of 3.33%. The drainage is controlled by ditches and berms, with runoff retained on the pad. This road will be removed and reclaimed unless requested otherwise by the landowner.

GVH-6 - This is a constructed access road running from Road GVH-5 to the GVH-6 Site. The road is approximately 16' wide, 4300' long and has an average slope of 2.67%. It is constructed on native material, with gravel used as needed on soft areas. Drainage is controlled by a combination of ditches and berms. This road will be removed and reclaimed unless otherwise directed by the landowner.

Ridge Road - This is an existing road along the ridge above the Right and Left Forks of Deadman Canyon. The road is approximately 16' wide, 7100' long and has an average grade of 3.10%. It runs westward from the top of the Right Fork of Deadman Canyon to the turnoff to the road to GVH-9. The road is constructed on native material and being on the ridgeline, has need for only minimal drainage control in the form of ditches where needed. This road will remain in place after the project is completed.

GVH-3 - This is an existing road from the Ridge Road to the GVH-3 Site. The road is approximately 16' wide, 1200' long and has an average grade of 4.17%. The road is constructed on native material and hydrologic controls consist of berms and ditches. This road is not scheduled for removal after the project is completed.

GVH-7 - This section of road is from GVH-3 to GVH-7 and is a continuation of the existing road to GVH-3. This section is approximately 16' wide, 1600' long and at an average grade of 8.13%. The road is constructed on native material and hydrologic controls are primarily from ditches. This road is also scheduled to remain after the project.

GVH-8 - This is a road from the Ridge Road , north along the fence line and then west to the GVH-8 site. The road is existing; however, it will require some upgrading to provide

access for a drill rig. The upgrade will consist of grading and slight widening as needed. The road is to be approximately 16' wide, 2500' long , and will have an average grade of approximately 5.33%. The road is on native material and runoff is controlled by ditches. Since this is an existing road, it will not be removed unless requested by the landowner.

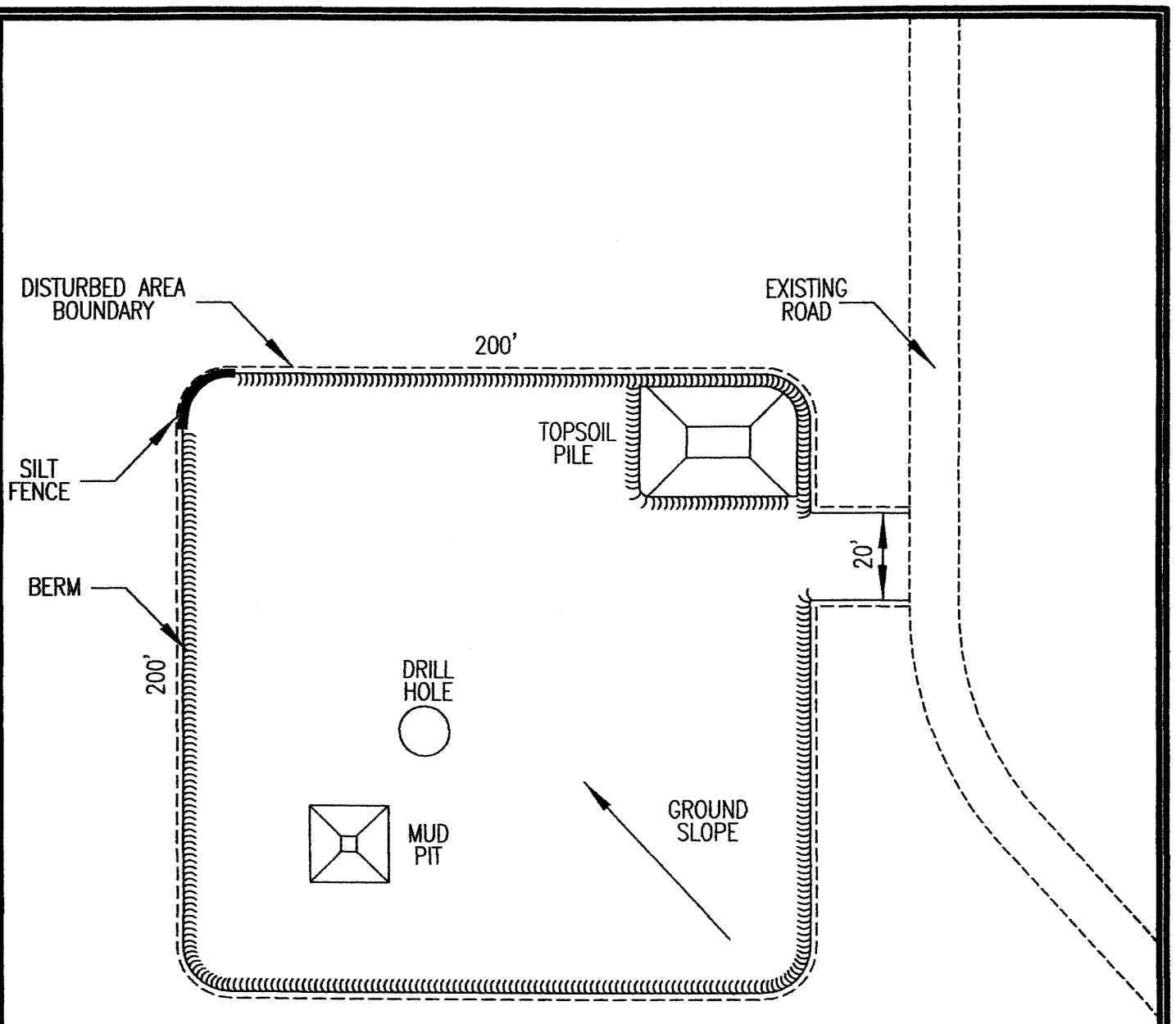
GVH-4 - This road runs from the Ridge Road to the GVH-4 Site. This road was constructed by ARI, and is approximately 16' wide, 1100' long at an average grade of approximately 3.64%. The road was constructed on native material, and runoff is controlled by ditches and berms with containment on the pad. This road will be removed and reclaimed unless otherwise requested by the landowner.

GVH-9 - This is an existing road from the Ridge Road to the GVH-9 Site. The road is approximately 16' wide, 3500' long and has an average grade of approximately 8.14%. The road is constructed on native material and runoff is controlled by ditches and berms. Since this is also an existing road, it will not be removed unless requested by the landowner.

All roads described above are shown on Figure 1-1 of this Appendix.

528 Handling and Disposal of Coal, Excess Spoil, and Coal Mine Waste

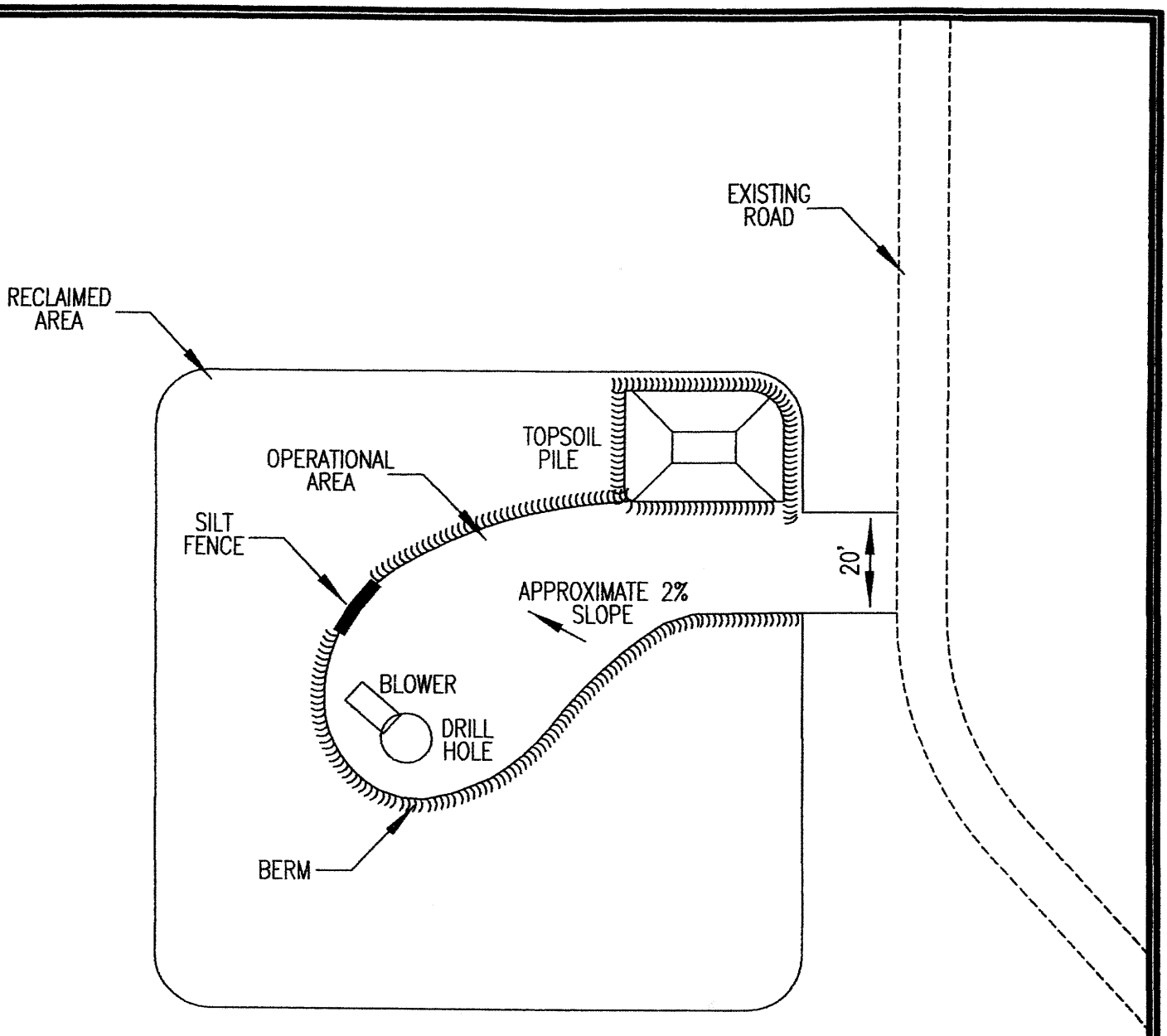
No disposal of coal, excess spoil, and coal mine waste will occur at the well sites.



TYPICAL GOB GAS VENT HOLE
DRILLING PLAN
SCALE: 1" =50'

REGISTERED
#154168
DAN W. GUY
2/23/05
PROFESSIONAL ENGINEER

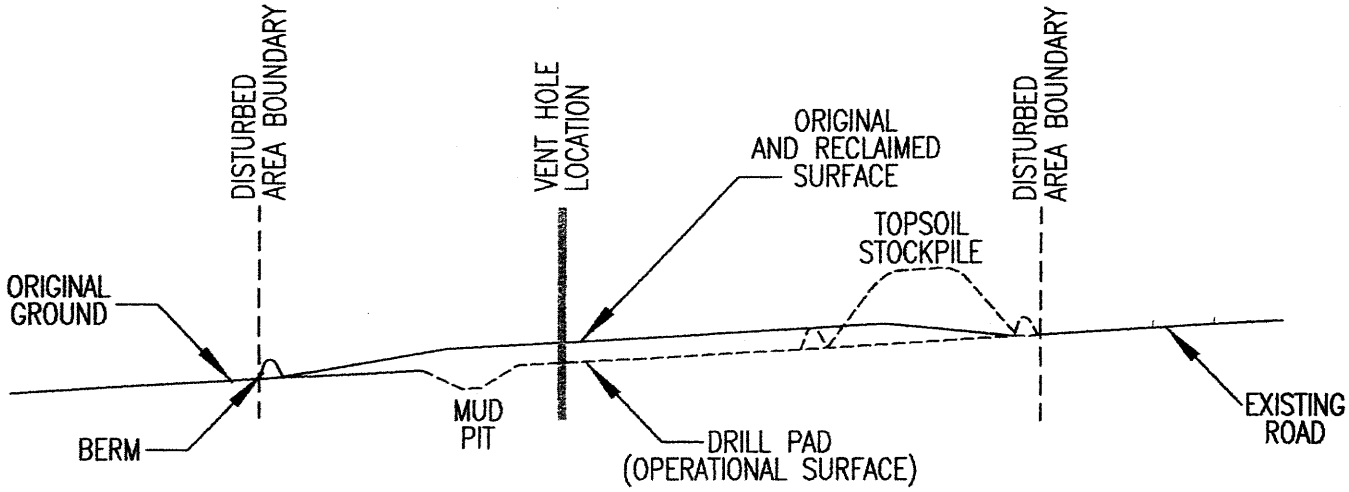
FIGURE 5-1



TYPICAL GOB GAS VENT HOLE
OPERATIONAL PLAN
SCALE: 1" =50'

UTAH REGISTERED
#154168
DAN W. GUY
2/23/05
PROFESSIONAL ENGINEER

FIGURE 5-2



TYPICAL GOB GAS VENT HOLE
PAD CROSS SECTION
SCALE: 1" =50'

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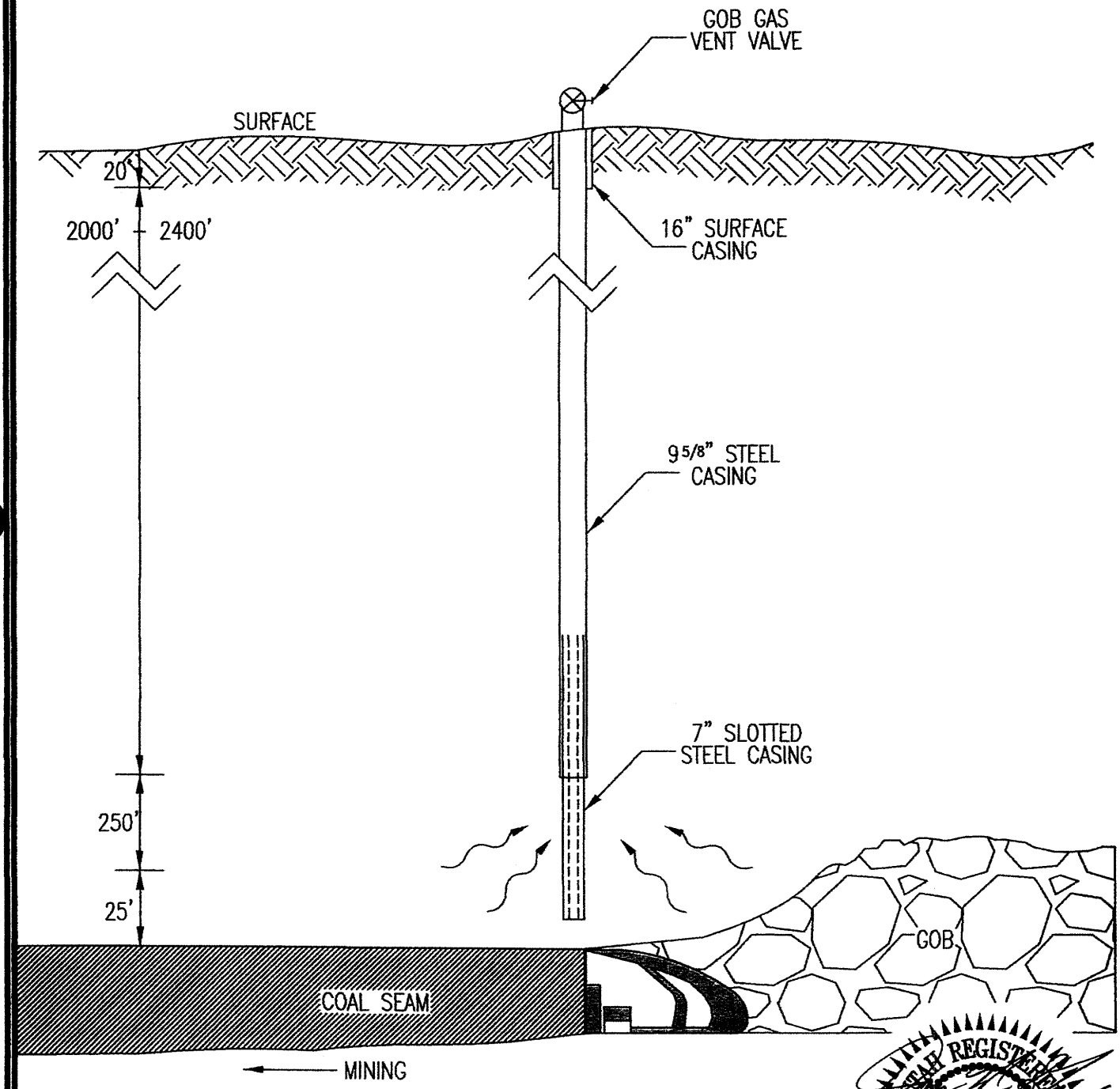
2/23/05
PROFESSIONAL ENGINEER

FIGURE 5-3

TYPICAL GOB GAS VENT HOLE



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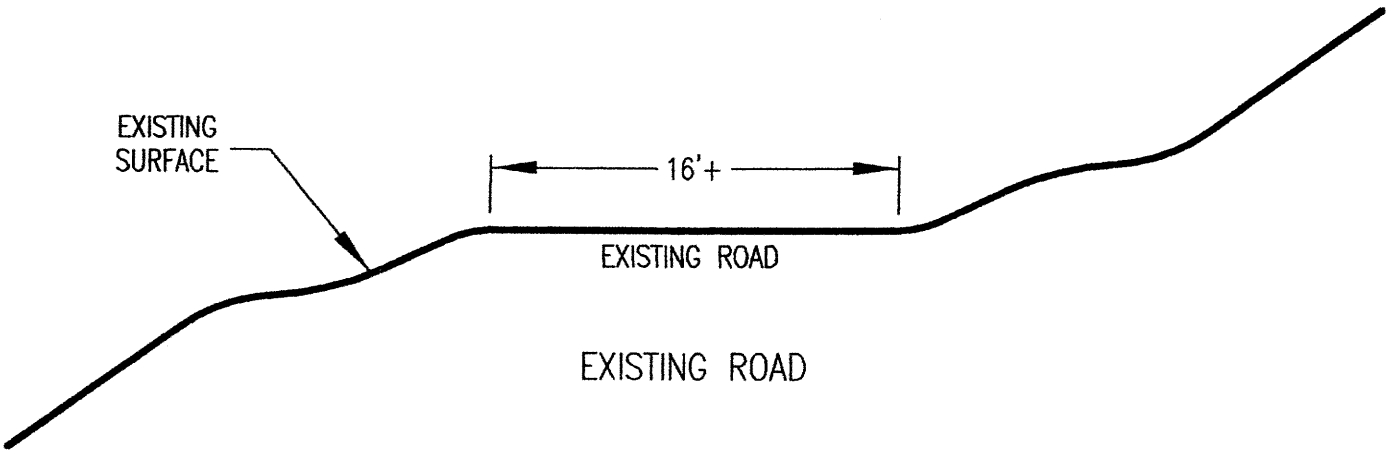
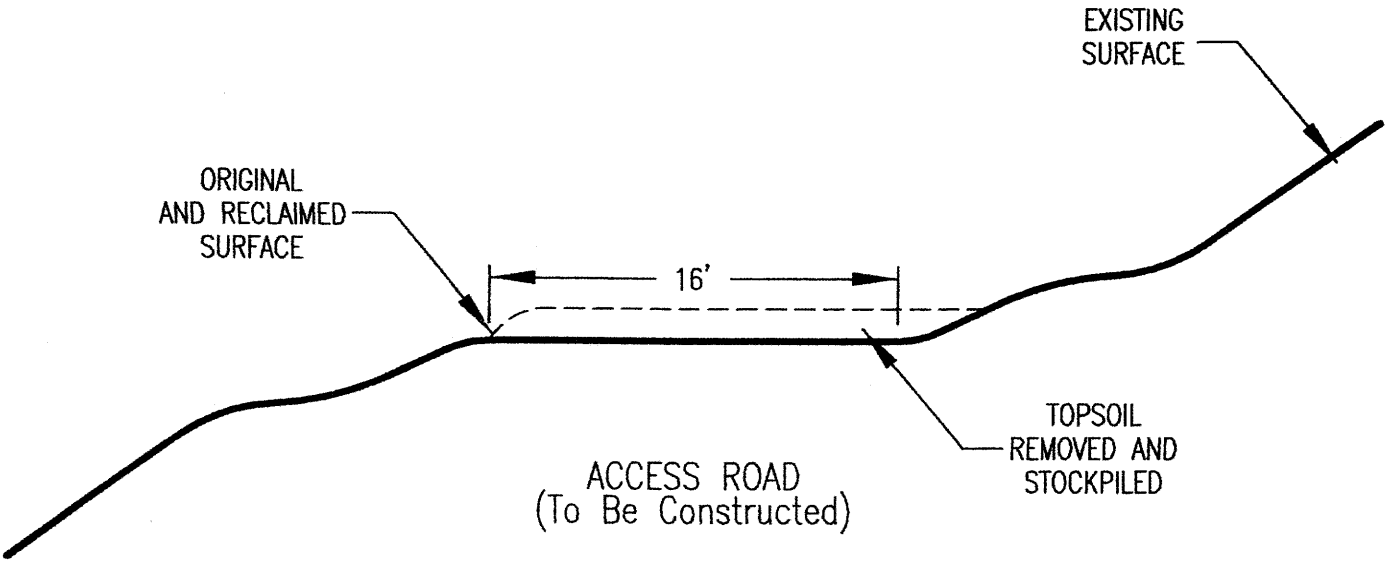
PROFESSIONAL ENGINEER

FIGURE 5-4

TYPICAL ROAD CROSS SECTIONS



EXISTING ROAD



ACCESS ROAD
(To Be Constructed)

FIGURE 5–5

810 BONDING DEFINITIONS AND DIVERSION RESPONSIBILITIES

This chapter provides information regarding the bonding for reclamation of the completed and proposed gob gas vent hole sites at the Centennial Project. Andalex, Resources, Inc. has on file with the Division a bond 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 area 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 existing reclamation bond of $1,080,000 is sufficient to assure the completion of the reclamation plan.

The bonding requirements for the Centennial Project, including the existing and proposed well sites, have been updated and included in Appendix B of the M.R.P. These calculations show the total required bond amount of $1,048,000.00 in 2009 dollars; therefore, the existing bond posted for this site is considered adequate.

840 GENERAL TERMS AND CONDITIONS OF THE BOND

Refer to Chapter 8 and Appendix B 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 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 Centennial Project are included in Appendix B of the approved M&RP.