APPENDIX L

Geotechnical Investigation of Cut Slopes at the Belina Mine Complex and Haul Road Carbon County, Utah

Prepared for

Valley Camp of Utah, Inc.
Helper, Utah

Prepared by

Morrison-Knudsen Co., Inc.
Boise, Idaho

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1.0 INTRODUCTION

1.1 GENERAL: At the request of Valley Camp of Utah, Inc.(Valley Camp), a geotechnical investigation was initiated on September 13, 1983 at the Belina Mine located in Carbon County near Helper, Utah. The purpose of this investigation was to evaluate the stability of cut slopes in the mine facilities area and on the 1.4 mile long haul road leading to the mine from Eccles Canyon.

1.2 SCOPE OF WORK: The geotechnical investigation consisted of a drilling and sampling program, field reconnaissance and mapping, laboratory testing, and computer assisted slope stability analyses. This report presents the data obtained during the course of the investigation, as well as conclusions and recommendations formulated from that data base and other information furnished by Valley Camp.

2.0 FIELD INVESTIGATION

2.1 GENERAL: The field investigation was directed toward evaluating the stability of cut slopes steeper than 2 horizontal:1 vertical. At the mine facilities site, three major cut areas were investigated: the backslope above the upper coal stratum portals; the backslope above the office/changehouse; and, the cut slope near the coal loadout chute. Numerous cut slopes on the haul road were also examined and/or mapped which were steeper than 2H:1V.

2.2 BACKSLOPE DRILLING PROGRAM: Soil and rock samples were required to evaluate the stability of the backslope above the upper portals and the office/changehouse. To obtain these samples, four exploratory borings were drilled to depths ranging from 49 feet to 61 feet below existing grade at location shown on the Geotechnical Investigation Site Plan (Figure 1).

Drilling was performed using a CME-750 drill machine mounted on an all-terrain vehicle and equipped with 6.0 inch diameter continuous flight hollowstem auger and NX-size coring tools. Disturbed samples of soil and soft rock were obtained for laboratory testing and logging purposes using a Standard Penetration Test (SPT) sampler, which is driven into soil or soft rock by a 140 pound hammer with a free-fall of 18 inches. The number of blows required to drive the sampler one foot (known as the "N-Value") is a measure of the relative density of cohesionless soils and the consistency of cohesive materials. Relatively undisturbed soil and soft rock samples for laboratory testing were extracted using a 3-inch o.d. Dames and Moore sampler with inner-liner brass rings, which serve to protect the samples during shipment to the laboratory.

The hollowstem auger was used as casing for NX coring tools. A 10 foot long double tube core barrel with a split inner barrel and carbide or diamond bits was utilized to obtain rock samples for logging and laboratory testing. Water was used as a drilling medium. Excessive water loss into pervious rock strata was experienced at all boring locations. Additives such as bentonite, cellulose, nut shell and DE-7 polymer did not significantly reduce the water loss. Only in borings in the vicinity of a 12,000 gallon

water storage tank, automatically resupplied by pumped water, could sufficient quantities of siphoned water be obtained to allow continuous coring operations.

Soil and soft rock samples were immediately sealed in plastic bags, placed in airtight containers, and stored in special foam-padded aluminum boxes. Rock samples were placed in standard cardboard core boxes; samples selected for laboratory testing were wrapped in plastic, sealed, wrapped in paper, and stored in a padded box.

All borings were thoroughly backfilled with soil after groundwater readings were taken. In the spring, Valley Camp personnel should check the bore holes and refill them if necessary.

2.3 FILL PAD BORING: At the request of Valley Camp an exploratory boring was drilled on the existing earth fill pad to obtain soil samples for later testing, which will determine the suitability of the fill for reclamation purposes. Valley Camp provided burlap bags with plastic inner bags for sample collection at 2.5-foot intervals. Samples were identified for location and depth. It is our understanding that sample shipment and subsequent laboratory testing will be performed under the direction of Valley Camp. The location of this boring is shown in Figure 1. It was backfilled in the same manner as the four backslope borings.

2.4 BORING LOGS: Boring logs were prepared for the four backslope exploratory borings, and are included in the report as boring nos. 1 through 4 (Figures 2 through 5). The fill pad boring was logged and is contained herein as boring no. 5 (Figure 6). Locations and top ground elevations of the borings were determined by Valley Camp personnel and are referenced to Belina Mine survey data points.

The boring logs include: the depths and elevations of major changes in soil and rock stratigraphic units; classification and description of natural soils in accordance with the Unified Soil Classification System; locations of disturbed, undisturbed, and cored soil and(or) rock samples; core sample

data, including the percentage of total core recovered and the percentage of core greater than 4 inches in length (rock quality designation, RQD); pertinent drilling information; and, groundwater data.

2.5 COMPOSITE LOGS OF CUT SLOPES: Two cut slopes in the mine facilities area exposed subsurface stratigraphic rock units and the orientation of fractures within those rock units. These cut slopes were logged in the same manner as an exploratory boring would be logged. The depths were estimated and fracture orientations were inferred from the same stratigraphic unit at several locations in the cut slope.

The composite log for the cut slope behind the office/changehouse building is included in this report as "B-6" (Figure 7), and the log of the cut slope near the coal loadout chute is included as "B-7" (Figure 8).

2.6 DETAIL LINE MAPS: Two detail line maps or detailed mappings of fracture orientations along a measured straight line were made in the cut slope near the loadout chute. The purpose of this mapping was to determine the orientation of primary and secondary joint sets and the nature of any infillings. These detail line maps are shown in Figures 9 and 10. The locations mapped are identified on the Geotechnical Investigation Site Plan (Figure 1), as "D1" and "D2".

Fracture orientations were determined using a hand-held Brunton compass.

2.7 GENERAL RECONNAISSANCE OF MINE FACILITIES AREA: Cut slopes in the mine facilities area were visually examined for evidence of tension cracks related to past and(or) potential slope movements, erosion or ravelling problems, and abnormal vegetation growth above the cut slopes that may indicate slope creep. The results of this reconnaissance are included in site descriptions contained in Section 3.0 of this report, Geology and Site Conditions.

2.8 RECONNAISSANCE OF CUT SLOPES ON THE HAUL ROAD: Detailed descriptions of cut slopes on the haul road were prepared in the field. They are

presented in this report as Figures 11 through 13, which are organized as an odometer mileage log that begins at the beginning of the road in Eccles Canyon. Specific references to these cut slope descriptions are contained in other parts of this report.

Joint and other fracture orientations were measured by Brunton compass, and in most cases, the strikes and dips recorded are actually averages of readings taken on four or more different rock surfaces.

3.0 GEOLOGY AND SITE CONDITIONS

3.1 GEOLOGY OF THE AREA: It is not the purpose of this report to present detailed geologic data of the Belina Mine Complex. However, the following brief overview of the regional geology does provide data pertinent to the geotechnical investigation of the Belina Mine cut slopes.

The Belina Mine lies within the Wasatch Plateau Coal Field, in an area in which all of the coal mined lies within 400 feet of the base of the Blackhawk Formation of Upper Cretaceous geologic age. Other than several coal strata, the lithology is predominately composed of yellow and gray sandstones and siltstones with some interbedded shales.

Structurally the mine lies between two northward striking, vertical displacement faults, on the upthrown block of a horst-like geologic feature. The nearer of the two faults passes less than one-half mile to the west, which may have determined the gentle southwestward dip of stratigraphic rock units at and near the Belina Mine. According to Valley Camp personnel and the observations made for this investigation, the magnitude of the dip is about 4°. Undoubtedly, other less significant faulting has occurred that affects site-specific geology. The approximate location of a possible strike-slip fault passing through the area is indicated in Figure 1 of this report. Mining personnel have indicated that at least one fault with minor vertical displacement has been encountered underground.

Two coal strata are mined at Belina and outcrops of each stratum are located on the enclosed site plan (Figure 1). Separate sets of portals penetrate the two strata.

A generalized backslope lithologic section is presented in this report as Figure 14, which represents data obtained from the four backslope borings.

3.2 BACKSLOPE ABOVE THE UPPER PORTALS: Boring nos. 1 and 2 were drilled in an area in which some slide activity has been experienced. The boring logs indicate that 13.5 to 26.5 feet of colluvium and talus overlie competent bedrock strata, predominately composed of gray siltstones that exhibit

various degrees of differential weathering. Permeability of the bedrock strata is quite high up to the depths penetrated by the borings. However, 20 hours after drilling, a static groundwater level was measured at 12.5 feet below existing grade at the location of boring no. 1. This boring could not be continuously cored because of excessive water loss into the formations at many different depths. Therefore, it is believed that the water level reading is the result of a zone of seepage water, noted on the log at 12.5 feet, filling a hole that was finally sealed with a layer of drilling mud. The sealing occurred after the hollowstem auger was pulled (i.e., rotated up and down to clear the augers) from the bottom of the hole. It does not appear that the backslope above the upper portals has a static phreatic surface within the depths penetrated by boring nos. 1 and 2.

Several tension cracks, approximately one inch wide and 3 to 5 feet long, were observed in an area about 50 feet southwest of boring no. 1. A water seep was trickling from the slope, before drilling began, about 10 to 15 feet below boring no. 1. Evidence of some slope erosion from this seep could be seen. In the vicinity of boring no. 2 there is a distinct lack of tree growth and evidence of recent slide activity, including some erosional scour. No tension cracks or water seeps were noted. An overview of the area suggests that a fault may pass through the natural drainageway in the vicinity of boring no. 2. This conjecture is based only on surface characteristics, the unusual thickness of colluvium and talus in boring no. 2, and conversations with Valley Camp mining personnel. The exploration borings were not deep enough to confirm the fault presence. Vertical displacement of the fault should not be significant, based upon visual observation of the upper coal stratum outcrop.

In general, the backslope above the upper portals appears to be in a nearly natural condition. The slide area seems to be more the result of natural weathering processes on a daylighting fault zone than a condition caused by mining activities.

Sections A-A' and B-B' (Figures 15 and 16) present simplified geologic cross sections through boring nos. 1 and 2, respectively. The sections also show

sample locations and types, as well as the existing slope configurations above and below the borings.

3.3 BACKSLOPE ABOVE THE OFFICE/CHANGEHOUSE: Boring logs 3 and 4 indicate that about 11 feet of colluvium and(or) talus overlie predominately gray siltstones, shales, and sandstones. The bedrock strata are quite pervious, and in some instances a ten foot core run required about 1000 gallons of water to complete. In most cases, core runs were made with water loss of 75 to 100%.

Tension cracks, erosional scour, or seepage zones were not observed in the vicinity of boring nos. 3 and 4. Surface vegetation was lush, and numerous large trees indicated no evidence of slope creep. Except for the steep cut slope behind the office/changehouse, the backslope appears to be virtually natural.

The composite log of the cut slope behind the office/changehouse (Figure 7) shows a section of competent bedrock units. The strike of the slope is approximately parallel to the regional dip direction (to the southwest at 4°±), which is a favorable cut slope orientation. The same cut slope continues to the northeast, and at a point above the waste water treatment plant some potential for ravelling of the upper coal stratum may exist which could precipitate a minor, shallow slide of overlying colluvium. Some ravelling of the coal stratum above the office/changehouse may also occur.

Section C-C' (Figure 17) presents the generalized geologic section of this slope.

3.4 CUT SLOPE NEAR THE COAL LOADOUT CHUTE: The log of this nearly vertical cut slope is referred to herein as "B-7" (Figure 8). Detail line maps (Figures 9 and 10) present further data on fracture orientations. The sandstone exposed in this cut is massive and extremely competent. The overlying coal, however, has been cut quite steeply for about a 3-foot thickness. The coal ravels from this portion of the section even in a light wind. The gentler slope above the coal appears to be nearly natural to the

elevation of the existing tree line, although some evidence of erosional scour can be observed.

3.5 CUT SLOPES ON THE HAUL ROAD: The haul road from Eccles Canyon traverses the east side of the ridge on which the Belina Mine is located. The regional bedding plane dip direction to the southwest presents a favorable orientation for the haul road cuts. Neither cut slopes perpendicular to the dip direction nor cut slopes parallel to the dip directions, have downdip bedding planes daylighting into the slope faces.

Primary and secondary joint sets are prominent in many of the cut slope faces and dips of the joints are generally quite steep, steeper than the inclination of the cut slopes. The steep dip in itself often precludes the possibility of plane shear failure because unfavorable joint planes do not daylight in the slope face.

The primary joint set generally strikes north-south (±10°) and has an average dip of about 80° to the east. The secondary joint set generally strikes east-west (±10°) and has an average dip of 75° to the north.

The descriptions of cut slopes contained in this report (Figures 11 through 13) indicate only four relatively minor areas in which regular maintenance or remedial measures may be required to stabilize cut slopes. These areas will be further discussed in sections 5.0 and 6.0 of this report.

4.0 LABORATORY TESTING

A laboratory testing program was established to determine the engineering properties of soil masses and jointed and intact rock masses. Test results were utilized to properly classify material types and to provide strength parameters for use in slope stability analyses.

4.1 MOISTURE AND DENSITY DETERMINATION: Moisture and density determinations were performed on thirteen specimens. These data, found in Table 1, provide information relative to the degree of saturation, compressibility characteristics, and the mass weight of various stratigraphic soil and rock units. These data are required for slope stability analysis.

4.2 ATTERBERG LIMITS TEST DATA: To properly classify soils in accordance with the Unified Soil Classification System, the liquid and plastic limits (two of the Atterberg limits) of seven representative soil samples were determined. These data also provide indications of the susceptibility of the soils to volume changes with changes in moisture content. Some references (e.g. NAVFAC, DM-7, Department of the Navy, 1972) also correlate these data with the angle of internal friction, ϕ, of a soil, and with certain consolidation characteristics.

Table 2 contains the results of these Atterberg limits tests.

4.3 UNCONFINED COMPRESSION TESTS: Nine specimens of soil and rock were tested in unconfined compression to determine the shear strength parameter, c (unit cohesion), of those materials when ϕ (angle of friction) is assumed to be 0. This is a quick, relatively inexpensive test method for obtaining values of c.

Test results are shown in tabulated form in Table 3. The modulus of elasticity is included, which is a function of the stress-strain curve, dependent on the sample stress history, moisture content, density and other factors. These data are also used in slope stability analyses.

4.4 TRIAXIAL COMPRESSION TESTS: Three samples were subjected to lateral confining pressures before an axial load was applied. These triaxial tests (unconsolidated, undrained) require a high degree of specimen homogeneity before the data points may be combined to provide accurate values for both Ø and c. In this case, the samples did not prove to be sufficiently homogeneous to provide such data, although ranges may be established for Ø and c.

These test data are also found in Table 3.

4.5 DIRECT SHEAR TESTS: Three multi-stage direct shear tests were performed on jointed rock specimens to evaluate the shear strength parameters Ø and c of the rock joints. In a rock slope stability analysis, these data provide parameters for a probable failure surface that would primarily follow existing joint patterns.

Test data are shown in Table 4, and more detailed direct shear test results are contained in Figures 18 through 20 of this report.

5.0 SLOPE STABILITY ANALYSIS

5.1 GENERAL: Recognized potential modes of slope instability consist of plane shear, wedge, circular, and toppling failures. Such failures are dependent upon many factors including the slope configuration, geologic discontinuities, and physical characteristics of the stratigraphic units.

Laboratory data and(or) stratigraphic information from exploratory borings, field reconnaissance, and field mapping were utilized to establish computer models or stereographic projections by which the stability of various cut slopes could be evaluated.

A computer program based on a limiting equilibrium analysis method (STABL, Siegel, 1977) was used to evaluate the two major Belina Mine slopes: the backslope above the upper portals, and the backslope above the office/changehouse. Stereographic projection techniques were used to evaluate the cut slope near the coal loadout chute and the major cuts along the haul road.

For the computer analysis the most important consideration is the selection of correct soil and rock shear strength parameters for each stratigraphic unit. For the backslopes, the worst-case unconfined compression test result of 8.5 psi was utilized for the colluvium/talus. A significant Ø angle was estimated to be 18° from NAVFAC, DM-7. This Ø value was used to calculate the value of c from the unconfined compressive strength test results. For the weathered siltstones, direct shear test results on jointed rock, along with unconfined compression tests of intact rock, were utilized to estimate the shear strength. Since rock joints were noticeably absent in the rock cores extracted in the drilling program, it was assumed that a potential failure surface would have to pass through some intact rock. Therefore, c was estimated to be a midrange value of 34.7 psi and Ø was estimated to be 38°. Groundwater and earthquake factors were not assumed to be significant factors in the analyses. Moist unit weights were used for both soil and rock.

5.2 ANALYSIS OF BACKSLOPE ABOVE UPPER PORTALS: The computer-generated geologic models of the A-A' and B-B' sections are included in this report as Figures 21 and 22. The most critical failure paths passed through the colluvium and(or) talus interface with the underlying bedrock surface. For section A-A', the corresponding factor of safety against slope instability was 1.4. For section B-B' the factor of safety was 1.15 at the steepest portion of the slope, just below boring no. 2. Failure surfaces extending into bedrock materials had very high factors of safety, in excess of 2.5.

5.3 ANALYSIS OF BACKSLOPE ABOVE THE OFFICE/CHANGEHOUSE: Figure 23 presents the computer-generated geologic model of the C-C' section. As in the analysis for the adjacent backslope described above, the most critical failure path passed through the colluvium and(or) talus interface with the bedrock. The lowest factor of safety obtained was 1.9.

5.4 ANALYSIS OF THE CUT SLOPE NEAR THE COAL LOADOUT CHUTE: Stereographic projections are long recognized methods of presenting kinematic tests for various modes of slope instability. Using the cut slope log "B-7" and detail line data, stereographic projections were prepared for potential shear plane, wedge and toppling failures (Figures 24 through 26). The massive sandstone in this cut is extremely competent and joint orientations generally appear to be favorable. Only that portion of the cut slope striking S25°W shows a slight potential for failure in a toppling mode. However, the adjacent portion of the cut confines this potential toppling section, causing the entire slope to be safe.

5.5 ANALYSIS OF THE HAUL ROAD CUT SLOPES: The potential failure plane described between odometer mileage readings 0.14 to 0.17 on Figure 11 does not pass the kinematic test for stability because the slope face is 3° steeper than the 65° dip of the secondary joint set. Relatively minor quantities of rock are found above the daylighting joint set.

The colluvium/talus described between odometer mileage readings 0.69 to 0.72 on Figure 12 indicates that the colluvium/talus is cut in the steepest portion of the slope to an angle of about 65°. The thickness of this

stratum is not known, but a stable slope configuration should be flatter, as evidenced by the results of the Belina Mine Complex backslope analysis.

The potential failure surface described at the 0.86 odometer reading on Figure 12 is located on a "nose", or peninsula-like rock feature. This type of rock mass is the most susceptible to natural weathering processes, and it is likely that the potential failure surface is a naturally occuring phenomenon than a result of "blast damage." In any case, the potential failure surface does not pass the kinematic test for stability.

At odometer reading 0.92 on Figure 12, highly fractured rock may be cut to a slope that is slightly steeper than long-term stability would dictate. There is no laboratory data available to substantiate this possibility.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 GENERAL CONCLUSIONS: Slope stability analyses have indicated that the cut slopes in the area of mine facilities are, in general, stable. The steeper portion of the backslope above the upper portals, represented by section B-B', is the only backslope that does not meet the required 1.3 minimum factor of safety established by the State of Utah for cut slopes steeper than 2 horizontal to 1 vertical. It should be reiterated that this so-called "unstable" condition may not be related to mining operations and may rather be associated with natural geologic discontinuities.

The vertical 3-foot high section of coal above the massive sandstone exposed in the cut slope by the coal loadout chute is too steep, and will probably ravel or weather to an angle of about 34°.

For the most part, the haul road cuts were found to be stable. Four haul road cut slopes described in section 5.5 appear to be too steep for long-term stability, although the cut slope at the 0.86 odometer reading may have had the potential failure surface develop long before the haul road was constructed.

6.2 GENERAL RECOMMENDATIONS

6.2.1 BACKSLOPE ABOVE THE UPPER PORTALS: In the vicinity of boring no. 2 (section B-B') the steep portion of the slope should be excavated to a flatter configuration, perhaps 23°, which is the slope angle of the more stable section A-A'.

Positive surface drainage must be directed away from the slope face, and the slope should be smoothed and revegetated. Seepage water should be controlled, possibly by gravel-lined diversion ditches.

In lieu of the above-mentioned remedial actions, seasonal maintenance of slope or slide debris should be anticipated.

6.2.2 BACKSLOPE ABOVE THE OFFICE/CHANGEHOUSE: Some ravelling may occur from the coal and siltstone strata, and maintenance provisions should be anticipated.

6.2.3 CUT SLOPE NEAR THE COAL LOADOUT CHUTE: The coal stratum above the massive sandstone should be flattened to a slope angle of about 34°. The gentler slope above the coal should be smoothed and revegetated to more properly control surface water runoff. A diversion ditch on the trail above the slope may further reduce the runoff erosion potential.

6.2.4 HAUL ROAD CUT SLOPES: Major cut slope failures on the haul road are not likely. More probably, natural weathering processes will remedy most of the stability problems over a period of years, during which time seasonal maintenance should be anticipated. However, flattening of the slopes identified in section 5.5 should alleviate much of the scheduled road maintenance. In any case, the identified slopes should be carefully observed with monthly regularity, and more often during the spring thaw period.

TABLES

Table 1

Moisture and Density Determinations

Boring No.	Depth (ft.)	Sample No.	Moisture (% of dry wt)	Wet Density (PCF)	Dry Density (PCF)
1	5.0-6.5	1-1*	18.7	146.6	123.5
1	11.5-11.8	1-3*	10.5	136.9	123.9
1	16.0-16.5	CORE	5.7	152.9	144.7
2	4.0-4.5	2-1	17.6	125.0	106.3
2	9.5-10.0	2-2	20.0	130.3	108.6
2	14.3-14.5	2-3	14.5	130.1	113.6
2	29.0-29.5	2-6	5.4	139.6	132.4
3	5.0-5.5	3-1	12.3	126.4	112.6
3	17.0-17.5	3-4	16.1	133.2	114.7
3	21.7-22.3	CORE	7.6	152.8	142.0
3	25.0-25.5	CORE	10.6	156.6	141.6
3	30.5-30.9	CORE	8.2	147.5	136.3
4	9.5-10.0	4-2	15.4	132.6	114.9

*Represents disturbed samples, and wet/dry density results may not be accurate.

Table 2

Atterberg Limits Test Data

Boring No.	Depth (ft.)	Sample No.	Liquid Limit (%)	Plastic Limit (%)	Plasticity* Index (%)	Group Classi-fication
1	5.0-6.5	1-1	38	27	11	ML
2	4.0-4.5	2-1	28	19	9	CL
2	9.5-10.0	2-2	35	19	16	CL
2	14.3-14.5	2-3	35	20	15	CL
3	5.0-5.5	3-1	36	18	18	CL
3	17.0-17.5	3-3	31	19	12	CL
4	9.5-10.0	4-2	29	18	11	CL

*Liquid Limit - Plastic Limit = Plasticity Index

Table 3

Unconfined Compression Tests

Boring No.	Depth (ft.)	Lithology	Density (pcf)	Compressive Strength (psi)	Young's Modulus (psi)
1	16.0-16.5	SILTSTONE	152.9	68*	7.3×10^3
2	4.0-4.5	SANDY CLAY	125.0	8.5	-
2	9.5-10.0	SILTY CLAY	130.3	48	1.3×10^3
2	29.0-29.5	SILTSTONE	139.6	120	5.2×10^3
3	5.0-5.5	SILTY CLAY	126.4	42	2.2×10^3
3	17.0-17.5	SHALE	133.2	90[1]	1.5×10^3
3	21.7-22.3	SHALE	152.8	428[2]	2.3×10^4
3	25.0-25.5	SHALE	156.6	130[3]	2.2×10^3
3	30.5-30.9	SHALE	147.5	61	1.1×10^3
3	59.6-60.0	COAL	76.8	1,540	1.3×10^5
4	9.5-10.0	SANDY CLAY	132.6	37	8.1×10^2
4	57.0-57.5	SANDSTONE	159.2	20,640	-

*Failure across healed fracture

[1]Confining pressure of 20 psi (triaxial test - uu)

[2]Confining pressure of 50 psi (triaxial test - uu)

[3]Confining pressure of 80 psi (triaxial test - uu)

Table 4

Direct Shear Test Results*

Boring No.	Depth (ft.)	Lithology	Type of Joint	Friction Angle, Ø (degrees)	Unit Cohesion c (psi)
3	49.7-50.2	SILTSTONE	70°, OPEN	25.6°	28.3
4	20.5-21.0	SHALE	0°, OPEN	22.3°	30.7
4	37.5-38.0	SILTSTONE	77°, OPEN	38.0°	15.5

*Shear strength parameters for each sample were determined by multi-stage tests, using five different normal stresses.

F I G U R E S

MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT
Valley Camp of Utah, Inc.
Belina Mine, Carbon County

Upper Portal Backslope

Boring Method: 6-in. continuous flight auger	Standard Penetration Test	Boring No. 1
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer / 30-in. Fall / 2-in. o.d. Split-barrel Sampler	Sheet 1 of 3
w=Moisture Content, % / D=Dry Density, pcf	Penetration Resistance: N=Blows per foot	Date: 9-13-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9139.6	0	CL	Silty Clay: dark brown; 15-20% fine sand; very wet; medium plasticity; medium stiff. Some organics. (Topsoil zone)			Location - N: 7,226.26 W: 10,102.57
9138.1	1.5	CL	Silty Clay: dark yellowish-brown; 20% fine sand; wet to very wet; medium plasticity; medium stiff.			(on slope above ventilation fan)
9136.1	3.5	CL	As above but mottled with dark grayish-brown and wet.			Hole cased to 13.5' with hollowstem auger.
9134.1	5.5	CL-CH & ML	Silty Clay: dark brownish-gray and dark gray; wet; medium to high plasticity; stiff. Some thin (1/8") coal seams, and zones of sandy silt.	SPT 1-1	3, 4, 7	N=11
9132.1	7.5	CH	Silty Clay: dark gray and gray; moist; high plasticity; very stiff.			
9130.1	9.5	CL	Silty and sandy clay: dark gray, yellowish brown, and brown; up to 25% fine sand; moist; low to medium plasticity; hard to very hard. Last 2-3" saturated from groundwater perched on sandstone stringer from 12.5 to 12.7'. (Weathered rock)	D&M 1-2	35, 38	
				SPT 1-3	23, 47	N=70 Groundwater @ 12.3' after 20 hours.
9126.1	13.5		Shale and Siltstone: silty and sandy clay; gray mottled with brownish-yellow; up to 25% fine sand; partings every 8"±; soft rock.	NX core Run #1		94% Recovery (diamond bit; bentonite and D7-E polymer)
9119.6	20					94% RQD (10 pieces)

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Figure 2

MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT
Valley Camp of Utah, Inc.
Belina Mine, Carbon County

Upper Portal Backslope

Boring Method: 6-in continuous flight auger	Standard Penetration Test		Boring No. 1
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer	30-in. Fall	2-in.o.d. Split-barrel Sampler	Sheet 2 of 3
w=Moisture Content, % D=Dry Density, pcf	Penetration Resistance: N=Blows per foot		Date: 9-13-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9119.6	20					
9113.3	20.3		As before (shale and siltstone)			56% Recovery (carbide bit; bentonite and D7-E; lost circulation at 21.5")
			Badly weathered sandstones and shales: brown and brownish yellow; very soft rock.	NX Core Run #2		0% RQD
						Added cellulose, nut shell and more bentonite to drilling water: began drilling w/ tricone bit at 23.9' lost circulation; continued drilling with hollowstem auger; tried tricone bit again at 29.0' and lost circulation immediately.
				D&M 1-4	72 in 3"	
9107.6	32					
9107.1	32.5		Zone of broken sandstone.			
		CL-ML	Shale and siltstone: silty clay; gray and dark gray; moist; low to medium plasticity; soft rock.			
				SPT 1-5	100	in 3" N=100+
9102.6	37					
9102.1	37.5		Possible sandstone			
		ML	Siltstone: sandy silt; dark brown and grayish brown; dry; slight plasticity; moderately soft rock.			
9099.6	40					

Figure 2a

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MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT

Valley Camp of Utah, Inc.
Belina Mine, Carbon County

Upper Portal Backslope

Boring Method: 6-in. continuous flight auger	Standard Penetration Test		Boring No. 1
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 3 of 3
w=Moisture Content, % D=Dry Density, pcf	Penetration Resistance: N=Blows per foot		Date: 9-13-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9099.6	40		As before (siltstone) D&M	1-6	100	in 1"
9095.1	44.5		Sandstone (poor recovery with hollowstem auger); soft to moderately hard rock.			
9093.6	46		Siltstone, as before.			
9091.6	48		Sandstone: hard rock.			
9090.6	49		(Refusal of hollowstem auger with carbide teeth, using CME-750 rig)			

Figure 2b

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MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT
Valley Camp of Utah, Inc.
Belina Mine, Carbon County

Upper Portal Backslope

Boring Method: 6-in. continuous flight auger	Standard Penetration Test		Boring No. 2
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 1 of 3
w=Moisture Content, % D=Dry Density, pcf	Penetration Resistance: N=Blows per foot		Date: 9-14-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9230.1	0	CL	Silty Clay: very dark brown; 15-20% fine sand; moist; medium plasticity; medium stiff.			Location - N: 7,561.28 W: 10,196.59 (Active slide area)
9227.6	2.5	CL	Sandy Clay: dark yellowish brown; some pieces of weathered sandstone (¼" diameter).			
9226.6	3.5	CL	Sandy Clay: brownish yellow mottled with brownish gray; 20-25% fine sand; pieces of weathered sandstone; medium plasticity; soft to medium stiff.	D&M 2-1	5, 9, 10	(33% recovered)
9224.1	6	CL& CH	Silty Clay: gray and dark gray becoming dark brownish gray; some pieces of weathered sandstone; medium and high plasticity; very stiff to hard.	D&M 2-2	7, 13, 19	No groundwater 38 hours after drilling.
9218.8	11.3		Weathered sandstone			
9218.1	12	CL& CH	As before but more zones of weathered sandstone.	D&M 2-3	5, 6, 10	
9214.1	16		Weathered sandstone pieces.			
9213.1	17	CL, CH, &SM	Silty and sandy clay: brownish yellow; wet; 5-35% fine sand; low (sandy clay) & high (silty clay) plasticity; stiff. Zones of badly weathered sandstone (SM).	SPT 2-4	3, 11, 8	N=19
9210.1	20					

Figure 3

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MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT
Valley Camp of Utah, Inc.
Belina Mine, Carbon County

Upper Portal Backslope

Boring Method: 6-in. continuous flight auger	Standard Penetration Test		Boring No. 2
Undisturbed Soil Sampler: 3-in.o.d. D&M sampler	140-lb. Hammer	30-in. Fall	2-in.o.d. Split-barrel Sampler	Sheet 2 of 3
w=Moisture Content, % / D=Dry Density, pcf	Penetration Resistance: N=Blows per foot		Date: 9-14-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9210.1	20	CL, CH, &SM	As before (silty and sandy clay with badly weathered sandstone)			
9206.1	24		Siltstone or sandstone: moderately hard rock; possible talus (no samples).			
9204.6	25.5	CL, CH,SM	As before with thin seams of siltstone	SPT 2-5	9	
9203.6	26.5				10	
					50	in 5" N=60+
			Weathered siltstone: sandy silt; gray; moist; 15-20% fine sand; soft to moderately hard rock.			
				D&M 2-6	16	
					29	
					40	
9197.6	32.5		As above but moderately hard to hard rock (harder than above)			
9194.6	35.5	SM& ML	Badly weathered siltstone & sandstone: brownish yellow and yellowish gray; wet; very soft rock.			
				SPT 2-7	39	
					18	N=64
					46	
9191.1	39		Siltstone or sandstone: moderately hard rock (no recovery).			

Figure 3a

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MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT
Valley Camp of Utah, Inc.
Belina MIne, Carbon County

Upper Portal Backslope

Boring Method: 6-in. continuous flight auger	Standard Penetration Test		Boring No. 2
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 3 of 3
w=Moisture Content, % D=Dry Density, pcf	Penetration Resistance: N=Blows per foot		Date: 9-14-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9190.1	40		As before.			
9189.6	40.5		Weathered siltstone: sandy silt; gray; moist; soft to moderately hard rock.	D&M 2-8	100 in 2"	Hollowstem auger used as casing at 44.0'; tried to hold water head with bentonite and cellulose to see if coring was possible; lost head of water within 30 seconds.
9182.1	48		Weathered siltstone: as above but mottled with yellowish brown and yellowish gray; somewhat harder.	SPT 2-9	50 in 2"	N=50+
			End of Boring	SPT 2-10	100 in 3.5"	N=100+
9175.8	54.3					

Figure 3b

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MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT
Valley Camp of Utah, Inc.
Belina Mine, Carbon County

Upper Portal Backslope

Boring Method: 6-in. continuous flight auger	Standard Penetration Test		Boring No. 3
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 1 of 3
w=Moisture Content, % D=Dry Density, pcf	Penetration Resistance: N=Blows per foot		Date: 9-15-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9129.3	0	CL	Silty Clay: dark brown to brown; 15 to 20% fine sand; moist; low to medium plasticity; organics upper 12".			Location - N: 7,786.38 W: 9,745.67 (on slope above changehouse)
9125.8	3.5	CL& CH w/ SM	Silty/sandy clay with sandstone: grayish brown; zones of hard weathered sand compose ≃ 20% of stratum; wet; medium and high plasticity; up to 30% fine sand in zones of sandy clay; very stiff t to hard.	D&M 3-1	14 21 25	Hollowstem auger set as casing at 18.5'
9121.3	8	CL, SM &ML	Badly weathered siltstone&sandstone: sandy clay matrix with pieces of moderately soft rock; brownish yellow and brownish gray.	SPT 3-2	8 23 19	No groundwater data hole plugged at 18' 24 hours after drilling. N=42
9118.8	10.5		Weathered siltstone: gray; moist; moderately soft rock.			
9117.3	12	CL	Silty Clay: brownish yellow; wet; low to medium plasticity; stiff. Zones of claystone ≃ 3-4" thick; hard.	SPT 3-3	7 11 19	N=30
9113.8	15.5	CL-CH	Weathered shale: brownish yellow becoming gray at 17.5'; moist; medium to high plasticity; very soft to soft rock.	D&M 3-4	25 29 23	in 2"
9109.3	20			NX Core Run#1		See following page for core data

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Figure 4

MORRISON KNUDSEN Mining Group BORING LOG	PROJECT Valley Camp of Utah, Inc. Belina Mine, Carbon County Upper Portal Backslope	
Boring Method: 6-in. continuous flight auger	Standard Penetration Test	Boring No. 3
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer / 30-in. Fall / 2-in. o.d. Split-barrel Sampler	Sheet 2 of 3
w=Moisture Content, % / D=Dry Density, pcf	Penetration Resistance: N=Blows per foot	Date: 9-15-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9109.3	20	CL-CH	As before			
9108.8	20.5		Weathered shale: gray and brownish yellow; some interbedded sandstone strata ≃ 1-2" thick; partings at 2-3"; soft rock. Joints: 20.5', moderately smooth, open, 10° dip; 21.7-22.3', closed 90° dip; 23.1-23.2' moderately smooth; 30° dip.	Cont. NX Core Run #1		97% Recovery 12% RQD (1 piece) (Carbide bit; "unlimited" water supply by siphon from 12,000 gal. potable water storage tank; water did not recirculate
9105.3	24		Sandstone: brownish yellow; moderately hard rock. Joints: 24.2-24.4' moderately rough, open, 80° dip; 24.6-24.7' moderately smooth, 45&60°; 24.7'24.9', open, moderately smooth, 90° dip.			
9104.4	24.9					
9103.5	25.8		Weathered shale: gray and brownish yellow; moist; soft rock.	NX Core Run #2		52% Recovery 15% RQD (1 piece)
9101.3	28		Badly weathered sandstone & shale: brownish yellow and gray; partings every ½ to 2". Joints: 26.0', open, rough, 75° dip.			
			Lost sample: very soft rock.			
9099.3	30		Weathered shale, siltstone&sandstone: gray and brownish yellow; soft rock partings ½-3".	NX Core Run #3		78% Recovery 14% RQD (2 pieces)
9096.3	33		Sandstone: brownish yellow; hard; thin-bedded (1.5-3").			
9095.3	34		Weathered shale and siltstone: gray and brownish yellow; soft rock; partings ½ to 2". Joints: 39.2', closed, 90°.	NX Core Run #4		87% Recovery 0% RQD
				NX Core Run #5		80% Recovery 23% RQD (2 pieces)
9089.8	39.5		As below			

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Figure 4a

MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT
Valley Camp of Utah, Inc.
Belina Mine, Carbon County

Upper Portal Backslope

Boring Method: 6-in. continuous flight auger	Standard Penetration Test		Boring No. 3
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 3 of 3
w=Moisture Content, % D=Dry Density, pcf	Penetration Resistance: N=Blows per foot		Date: 9-15-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9089.3	40		Weathered shale: gray and brownish yellow; soft rock. Joints: 40.7 & 41.3', open, rough, 20° dip. Partings every 2 to 12".	Cont. NX Core Run #5		As before
				NX Core Run #6		100% Recovery 46% RQD (8 pieces)
9083.8	45.5		Siltstone: gray and brownish yellow; moist; moderately hard rock. Joints: 48.5', open, rough, 0°; 49.5-49.8', 3 pieces, rough, 70°; 50.0', open, moderately smooth, 20°. Partings every 2 to 7".			
9078.3	51		Very soft weathered shale			
9077.3	52		Coal: thin bedded, moderately soft. Partings every 1 to 3"; highly fractured from 55.5' to 56.5'.	NX Core Run #7		82% Recovery 0% RQD
9068.3	61		End of Boring			

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Figure 4b

MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT
Valley Camp of Utah, Inc.
Belina Mine, Carbon County

Upper Portal Backslope

Boring Method: 6-in. continuous flight auger	Standard Penetration Test		Boring No. 4
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer / 30-in. Fall / 2-in. o.d. Split-barrel Sampler		Sheet 1 of 3
w=Moisture Content, % / D=Dry Density, pcf	Penetration Resistance: N=Blows per foot		Date: 9-16-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9176.1	0	CL	Fill: silty and sandy clays; dark gray and dark grayish brown; medium stiff.			Location - N: 8,031.57 W: 9,605.70
9174.6	1.5	CL	Sandy Clay: dark brown to brown; 25-30% fine sand; moist; low plasticity; stiff.			(on jeep trail east of potable water tank)
9171.6	4.5	SM	Sandstone cobble: top 6" badly weathered.	SPT 4-1	32 45	N=50+
9169.6	6.5	CL	Silty Clay: brownish yellow; 15-20% fine sand; wet; medium plasticity; stiff.			No groundwater 24 hrs. after drilling
9168.1	8	SM	Silty Sand: brownish yellow; 40-45% nonplastic fines; moist; dense (badly weathered sandstone cobble).			
9167.1	9	CL, ML, &SM	Silty/sandy clay, sandy silt, and silty sand: hard soil colluvium with pieces of rock.	D&M 4-2	16 25 50	in 2"
9165.6	10.5	ML	Weathered siltstone cobble: brownish gray; moderately soft rock.			
9164.6	11.5		Weathered siltstone with some sandstone: gray mottled with brownish gray and brownish yellow; soft rock.			
			Weathered shale & sandstone: brownish yellow and gray w/ brownish red; highly fractured; moderately hard rock. Joints(all open): 17.5-17.7', moderately smooth, 80°; 18.3-18.4', moderately rough, 90°, 19.1-19.3', moderately smooth, 20°&90°; (4 pieces).	SPT 4-3	34 50	in 5" N=80+
9160.1	16			NX Core Run #1		89% Recovery 34% RQD (4 pieces between 19.5' & 25')
9156.6	19.5		As below			

Figure 5

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MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT
Valley Camp of Utah, Inc.
Belina Mine, Carbon County

Upper Portal Backslope

Boring Method: 6-in. continuous flight auger	Standard Penetration Test		Boring No. 4
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 2 of 3
w=Moisture Content, % D=Dry Density, pcf	Penetration Resistance: N=Blows per foot		Date: 9-16-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9156.1	20		Weathered shale: gray, brownish gray, very dark gray and very dark grayish brown; moist; medium and high plasticity; zones of siltstone; soft rock. 2" thick highly fractured sandstone at 20.8'. Partings every 2 to 9".	Cont. NX Core Run #1		As before
9151.9	24.2		Siltstone: gray; moderately hard rock.			
9151.1	25		Sandstone: brownish yellow, gray and yellowish red; thin shale seams (1/8"); highly fractured in part; parts moderately hard.	NX Core Run #2		96% Recovery 9% RQD (1 piece, below 27')
9149.7	26.4		Badly weathered shale & siltstone: gray mottled with brownish yellow; highly fractured in part; very soft rock. Partings every ½ to 3" (some coal in partings). Joint: 29.6-29.8', open, smooth, 90°.			
				NX Core Run #3		100% Recovery 39% RQD (8 pieces, between 33 & 38')
9143.9	32.2		Siltstone: yellowish gray mottled with brownish yellow; up to 35% fine sand; moderately hard rock. Partings every 2-8" with leaf fossils. Parting with slickensides at 34': variable dip of partings above 34', 20° dip below 34'.			
9138.1	38		Weathered siltstone: dark gray and gray mottled with brownish yellow; many multi-piece irregular joints; cont....			
9136.1	40					

Figure 5a

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MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT
Valley Camp of Utah, Inc.
Belina Mine, Carbon County

Upper Portal Backslope

Boring Method: 6-in. continuous flight auger	Standard Penetration Test		Boring No. 4
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 3 of 3
w=Moisture Content, % D=Dry Density, pcf	Penetration Resistance: N=Blows per foot		Date: 9-16-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9136.1	40		Weathered siltstone, cont.. soft rock with zones of very soft rock. Partings every ½ to 3". Joints: 39.5-39.6', open, irregular, moderately smooth, 70-90° dip, 4 pieces.			
9133.1	43		Siltstone: yellowish gray; moderately hard rock. Partings every 2 to 5".	NX Core Run #4		95% Recovery 32% RQD (7 pieces, between 43-44' & 45-50')
9132.1	44	ML				
9131.1	45		Badly weathered siltstone: yellowish brown; weathered to soil in part; very soft rock. Partings every ¼ to 2".			
			Weathered siltstone: yellowish brown and gray; badly fractured from 47.5 to 48.0 and 49.0-49.4'. Partings every 2-10".			
9126.7	49.4		Claystone: dark gray; hard rock.			
9124.4	51.7			NX Core Run #5		100% Recovery 50% RQD (5 pieces)
9124.3	51.8		Weathered clay parting			
			Siltstone: gray and brownish yellow; moderately hard rock becoming softer. Partings generally every 2-3".			
9120.4	55.7		Siltstone: brownish yellow; zones of fine sandstone, badly fractured from 59.5 to 60.0'. Partings every 2-12". Joint: 57.5-57.8', open, rough, 60°, 4 pieces.			
911.61	60		End of Boring			

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Figure 5b

MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT

Valley Camp of Utah, Inc.
Belina Mine, Carbon County
Boring to Sample Fill on Pad

Boring Method: 6-in. continuous flight auger	Standard Penetration Test		Boring No. 5
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 1 of 2
w=Moisture Content, % D=Dry Density, pcf	Penetration Resistance: N=Blows per foot		Date: 9-17-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
8923.3	0	CL w/ coal	Fill: silty clay with coal; very dark grayish brown.	1		Location - N: 7526.24 W: 9092.96
8921.3	2	SM w/ CL	Fill: silty sand with silty clay; brownish yellow.	2		Purpose of hole was to obtain bag samples at 2.5' intervals for testing by Valley Camp to determine potential use of the fill for reclamation. Boring log is necessarily rough because of variations within the fill.
8917.3	6	CL	Fill: sandy clay; dark yellowish brown.	3		
8916.3	7	SM& CL	Fill: pieces of sandstone and sandy clay; brownish yellow.	4		No groundwater 24 hours after drilling.
8912.3	11	CL	Fill: silty clay; dark yellowish brown.	5		
				6		
8908.3	15	CL	Fill: silty and sandy clay with pieces of wood and roots; very dark grayish brown.	7		
				8		
8903.3	20					

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Figure 6

MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT

Valley Camp of Utah, Inc.
Belina Mine, Carbon County
Boring to Sample Fill on Pad

Boring Method: 6-in. continuous flight auger	Standard Penetration Test		Boring No. 5
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 2 of 2
w=Moisture Content, % D=Dry Density, pcf	Penetration Resistance: N=Blows per foot		Date: 9-17-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
8903.3	20		As before	9		
8901.3	22	CL w/ coal	Fill: silty clay with coal and coal tailings; very dark grayish brown.	10		
8897.3	26	CL	Fill: sandy clay; very dark grayish brown.	11		
				12		
8893.3	30					

Figure 6a

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MORRISON KNUDSEN Mining Group

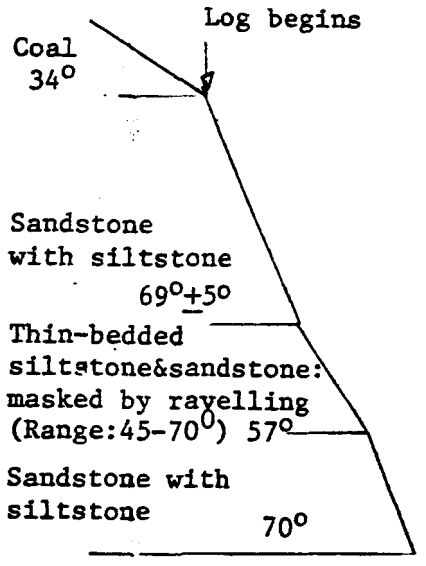
LOG OF CUT SLOPE

PROJECT

Valley Camp of Utah, Inc.
Belina Mine, Carbon County
Composite Log of Cut Slope
Behind Changehouse

Boring Method: 6-in. continuous flight auger	Standard Penetration Test			Boring No. 6
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 1 of 2
w=Moisture Content, % / D=Dry Density, pcf	Penetration Resistance: N=Blows per foot			Date: 9-17-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9042*	0		Sandstone: hard; fractured in part.			Composite log of cut slope behind the changehouse, at the center of the building. Depths shown in log are estimated only, from the base of the coal stratum.
9040.5	1.5		Siltstone			
9039.5	2.5		Sandstone: hard; joints strike N80W with dip 70-90°N.			
9038	4		Siltstone			
9037.5	4.5		Sandstone: hard, as before.			
9036	6		Shale and siltstone: hard.			
9034.5	7.5		Sandstone: as before, but secondary joint system strikes N20E and dips 80°E.			
9033	9		Alternating zones of sandstone and siltstone.			
9030	12		Coal			
9029.5	12.5		Sandstone: hard, as before.			
9028.5	13.5		Siltstone: thin-bedded (½ to 2"); soft rock. Source of erosion, ravelling, and undercut.			
9025	17		Sandstone and siltstone: 1-6" thick bedding; joints strike N10E, dipping 85°E.			
9022	20					



Generalized section

*Elevation estimated from topographic map

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Figure 7

MORRISON KNUDSEN Mining Group

LOG OF CUT SLOPE

PROJECT

Valley Camp of Utah, Inc.
Belina Mine, Carbon County
Composite Log of Cut Slope
Behind Changehouse

Boring Method: 6-in. continuous flight auger	Standard Penetration Test		Boring No. 6
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer	30-in. Fall	2-in.o.d. Split-barrel Sampler	Sheet 2 of 2
w=Moisture Content, % D=Dry Density, pcf	Penetration Resistance: N=Blows per foot		Date: 9-17-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9022	20		Sandstone with some siltstone: massive in part (bedding 1-3" thick, and up to 24" thick); primary joints strike N10E, dipping 85°E; secondary joints strike E-W with dip 85°N. The 24" thick bedding is actually very tight thin-bedded sandstone.			
9016	26		Bottom of slope cut			

Figure 7a

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MORRISON KNUDSEN **Mining Group**

LOG OF CUT SLOPE

PROJECT
Valley Camp of Utah, Inc.
Belina Mine, Carbon County
Composite Log of Cut Slope
East of Loadout Chute

Boring Method: 6-in. continuous flight auger	Standard Penetration Test			Boring No. 7
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 1 of 1
w=Moisture Content, % / D=Dry Density, pcf	Penetration Resistance: N=Blows per foot			Date: 9-17-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
8949*	0		Coal: cut almost vertically, ravels in light wind.			Composite log of vertical cut slope (at the center of the cut) near the coal loadout chute. Depths shown in log are estimated only, from the top of the "vertical" section.
8947	2		Weathered shale: dark yellowish brown.			
8945.5	3.5		Sandstone: massive; hard rock; yellowish brown.			Log of cut was made at point D1 of the first detail line (see boring location plan).
8938	11					
8937.8	11.2		Bedding plane filled with weathered sandstone.			
			Sandstone: massive, as before.			
			Base of cut			
8924	25					

*Elevation estimated from topographic map

Figure 8

MORRISON-KNUDSEN CO. W.O. NO. 1030-02 PAGE 1 OF 1

DATA SHEET FOR DETAIL LINE MAPPING

PROJECT Valley Camp BY B. Gale

LINE NO. D1 TREND S55°W PLUNGE 0° ELEV. 8929 LOCATION Belina DATE 9-17-83

LINE INTERCEPT (ft.)	ROCK TYPE	STRUCTURE TYPE	STRUCTURE STK	STRUCTURE DIP	GEOMETRY MD	GEOMETRY P	GEOMETRY LENGTH	GEOMETRY ± OVERLAP	GEOMETRY T_L	GEOMETRY T_U	GEOMETRY R	WIDTH ( )	FILLING	W	REMARKS
D1 (NE end)															
0		SJ	S60W	90		PL	5'		R	N	SM				
5		SJ	S25W	84E		PL	4'		N	R	SM	1.5"	Clay		
9	OVERLAIN BY	SJ	W	75N		WV	2"		R	N	RH				
11		SJ	S65W	80E		PL	14'		N	N	SM				
25		SJ	S	90		PL	3'		N	R	SM				
28		SJ	W	83N		PL	16'		N	N	SM	becoming RH			
39	MASSIVE SANDSTONE (OVERLAIN BY LOWER COAL STRATUM)	SJ	-	58E		--	--		R	R	--				
44		SJ	S15W	87W		PL	1'		N	R	SM				
45			BLAST DAMAGED JOINT												
45.5		SJ	S35W	86E		WV	1.5'		N	R	RH				
47			BLAST DAMAGED MASSIVE ROCK TO 62'												
62		SJ	S75W	54S		PL	2'		R	N	SM				
63			BLAST DAMAGED MASSIVE ROCK TO 83'												
83		SJ	S	84E		PL	2'		N	R	SM				
85			BLAST DAMAGED MASSIVE ROCK TO 90'												
90 (D1',	SW End:	at a point 14' NE of ℄ of loadout chute drive, perpendicular to ℄)													

ROCK TYPE ABBREVIATIONS			

STRUCTURE TYPE			
SJ	SINGLE JOINT		
FT	FAULT		
CT	CONTACT		

GEOMETRY

MD = MINIMUM DIP

P = PLANARITY: PL, WV R = ROUGHNESS: SM, RH

T_L, T_U = TERMINATIONS

H	>20°	R	IN ROCK
L	<20°	N	NONE
		E	ENECHELON

WATER: D = DRY, W = WET, F = FLOWING

FILLING ABBREVIATIONS

N	NONE				

Figure 9

DATA SHEET FOR DETAIL LINE MAPPING

PROJECT Valley Camp BY B. Gale

LINE NO. D2 TREND S25°W PLUNGE 0° ELEV. 8929 LOCATION Belina DATE 9-17-83

LINE INTERCEPT (ft.)	ROCK TYPE	STRUCTURE TYPE	STRUCTURE STK	STRUCTURE DIP	GEOMETRY MD	GEOMETRY P	GEOMETRY LENGTH	GEOMETRY ± OVERLAP	GEOMETRY T_L	GEOMETRY T_U	GEOMETRY R	WIDTH ( )	FILLING	W	REMARKS
D2 (N end)															
0	SANDSTONE, AS BEFORE ON D1	SJ	--	70N		PL	--		N	R	SM				
0		SJ	S25W	76W		PL	21'		N	N	SM				
21		SJ	N85E	73S		PL	--		N	R	SM	1.5"	Open		
21		SJ	S20W	80W		PL	7'		N	N	SM				
28		SJ	E	78S		WV	1'		N	R	SM	12"	Clay		
29		SJ	S15W	83E		PL	23'		N	R	SM				
51			BLAST DAMAGED FACE 2' LONG												
52		SJ	S15W	75E		PL	8'		N	R	SM				
60 (D2', S End; at a point 10' from D1 on the same slope)															

ROCK TYPE ABBREVIATIONS			

STRUCTURE TYPE			
SJ	SINGLE JOINT		
FT	FAULT		
CT	CONTACT		

GEOMETRY
MD = MINIMUM DIP
P = PLANARITY: PL, WV R = ROUGHNESS: SM, RH
T_L, T_U = TERMINATIONS

H	>20°	R	IN ROCK
L	<20°	N	NONE
		E	ENECHELON

WATER: D = DRY, W = WET, F = FLOWING

FILLING ABBREVIATIONS					
N	NONE				

Figure10

Geotechnical Mileage Log of Cut Slopes
Valley Camp of Utah, Inc.
Belina Mine Haul Road
Section 19, R7E, T13S, Carbon County, Utah

Odometer Mileage	Description
0.0	Road begins on north side of Eccles Canyon.
0.14-0.17	*Evidence of movement along secondary joint set on 20-25' high 68° cut slope. Secondary set strikes E-W with dip to N @ 65° (Primary N-S ± 10°, dip to E @ 75-90°) Strike of slope S53°E at this point. Bedding dips into slope (SW dip direction & 4° dip)
0.21	40' high cut (above slide area) with 65° slope angle. Upper portion has some overhanging rock, and cobble zone at top will produce some rockfall. Primary joints strike N-S ± 10°, dip to E 75-90° Secondary joints strike E-W ± 10°, dip to N 70-90° Bedding dips into slope
0.32	Same cut as above, but 30' high "nose" with weathered sandstone and siltstone cut at 45° to depth of 10', and competent sandstone cut to 60°. Primary joints of competent sandstone strike N10°W to N20°E, dip 72-78°E Secondary joints strike E-W ± 10°, dip N 60-65°. Bedding dips into slope
0.37	Center of 20' high 45-50° cut in competent sandstones.
0.42	10' high "nose" (with same joint sets as described below at mile 0.52) will weather/ravel to smoother slope.
0.44	Beginning of cut described at mile 0.52.
0.52	Center of 70°, 25' high (500' ± long) cut with 6' weathered rock on top of competent sandstone and siltstone. Parts of weathered rock section may be cut too steep, but natural weathering will remedy. Primary joints of sandstone strike N3°W, dip 84°E Secondary joints strike N80°W with dip 90° ± 5° Bedding dip is into the slope.

*Indicates areas that may require regular maintenance and (or) remedial work.

Figure 11

Geotechnical Mileage Log of Cut Slopes, cont.

Odometer Mileage	Description
0.57	Drainageway
0.61	65°, 12' high cut in competent rock with dip into the slope.
0.69-0.72	*25' high cut in possible colluvium/talus on 65° slope with concave face. May be a potential slide area: top of slope could be flattened but revegetation would be essential.
0.74	Major drainageway
0.86	*Possible blast damaged "nose" rock section. 15' high that may creep on an open, potential failure surface (which might continue beneath the road section) with a strike of $S60^{\circ}W$ and a dip of $42^{\circ}E$.
0.87	20' high cut in very competent sandstone. Strike of cut parallels primary joint set (N-S $\pm 5^{\circ}$ with dip of $82^{\circ}E$). Secondary set strikes E-W with 90° dip.
0.92	*Possible fault? Rock is highly fractured in $40-45^{\circ}$, 20' high cut. Evidence of soil creep and erosion. Soil cover will continue moving (perhaps 3-4' thickness)
0.97	Heavy soil cover on slope described at mile 1.02, but some competent rock strata still visible. Cut is 48°.
1.02	20' high, 60° cut in rock composed of sandstones and siltstones with 1-8" thick bedding. Most of cut is perpendicular to SW dip direction.
1.06	Drainageway
1.07	15' high, 55° cut in competent rock.
1.12	15' cut with weathered rock (top 5') over competent rock with dip into the slope.
1.23	Some ravelling evident at beginning of slope described at mile 1.32.

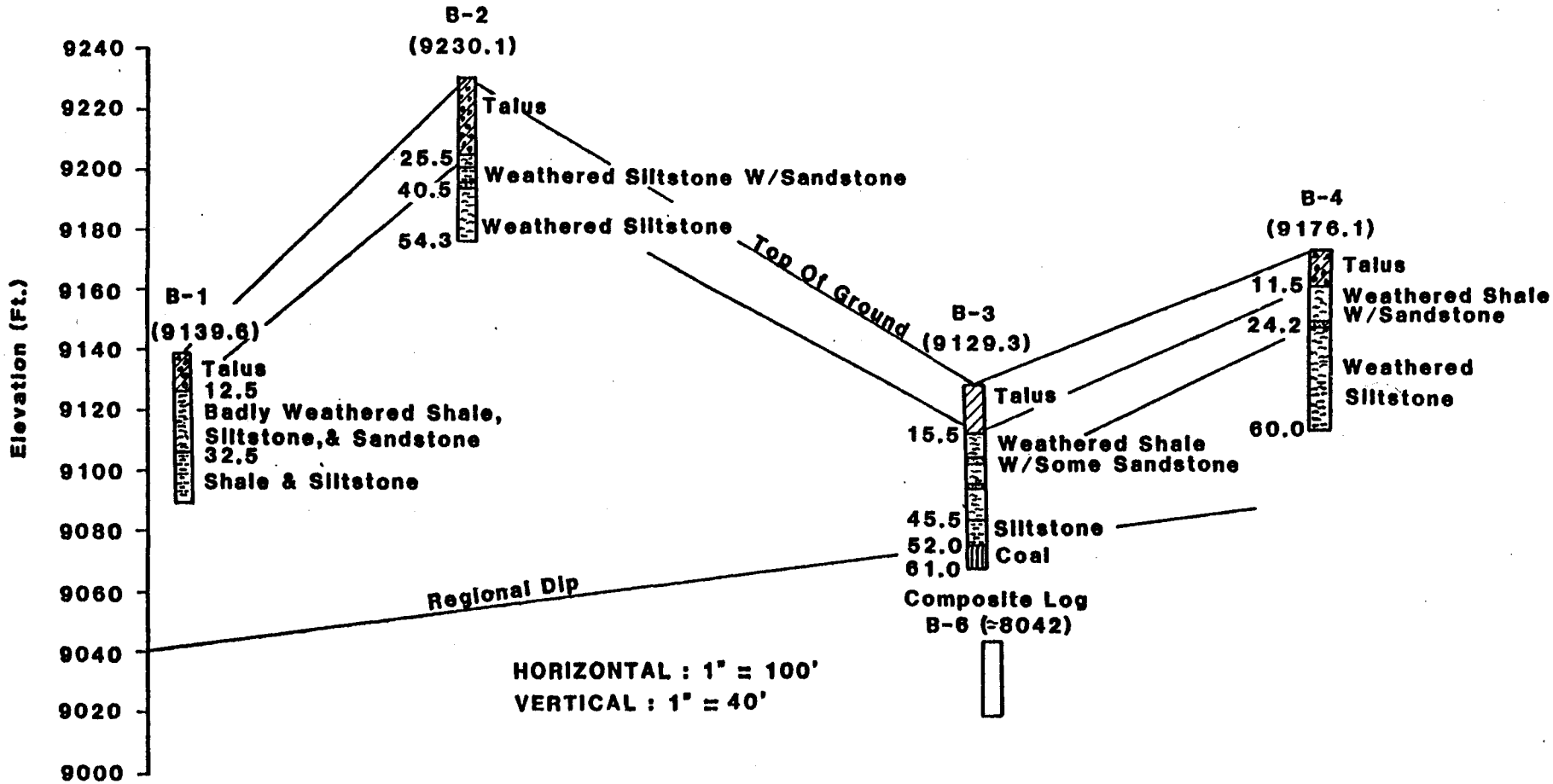
*Indicates areas that may require maintenance and (or) remedial work.

Figure 12

Geotechnical Mileage Log of Cut Slopes, cont.

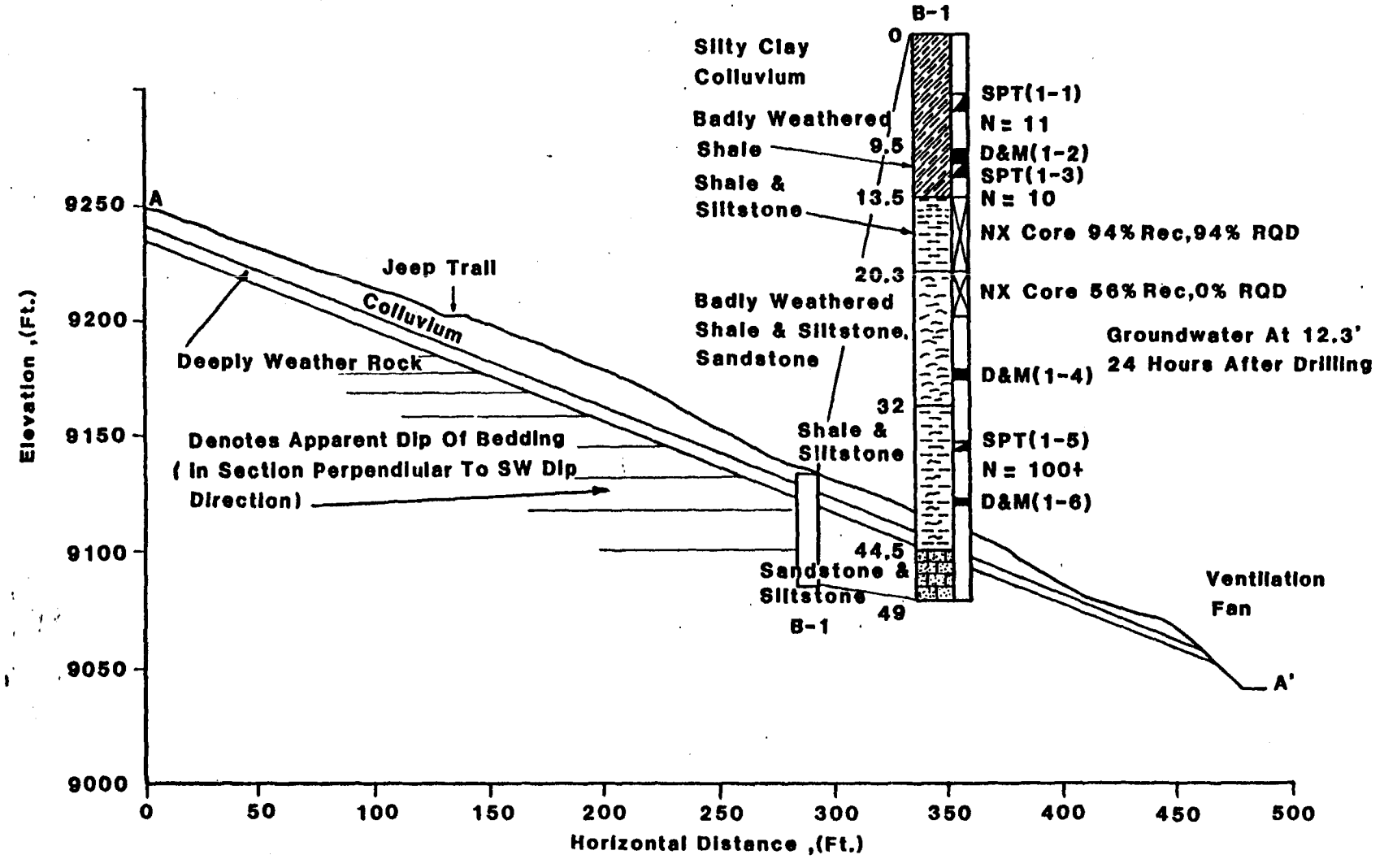
Odometer Mileage	Description
1.32	15' cut, 42° in weathered rock (top 6') and competent rock with dip into slope. Some ravelling will occur from the top of the cut. At mile 1.28, primary joint set strikes N10°E with dip of 85°E.
1.40	20' high cut, 35° in weathered rock, 55° in competent rock (sandstone/siltstone) with primary joint set striking parallel to the haul road (≈N-S) dipping at 85°E.
1.42	Fork in haul road leading to upper and lower portals of the Belina mine.

Figure 13



VALLEY CAMP OF UTAH, INC.
BELINA MINE, CARBON COUNTY
GENERALIZED BACKSLOPE SECTION

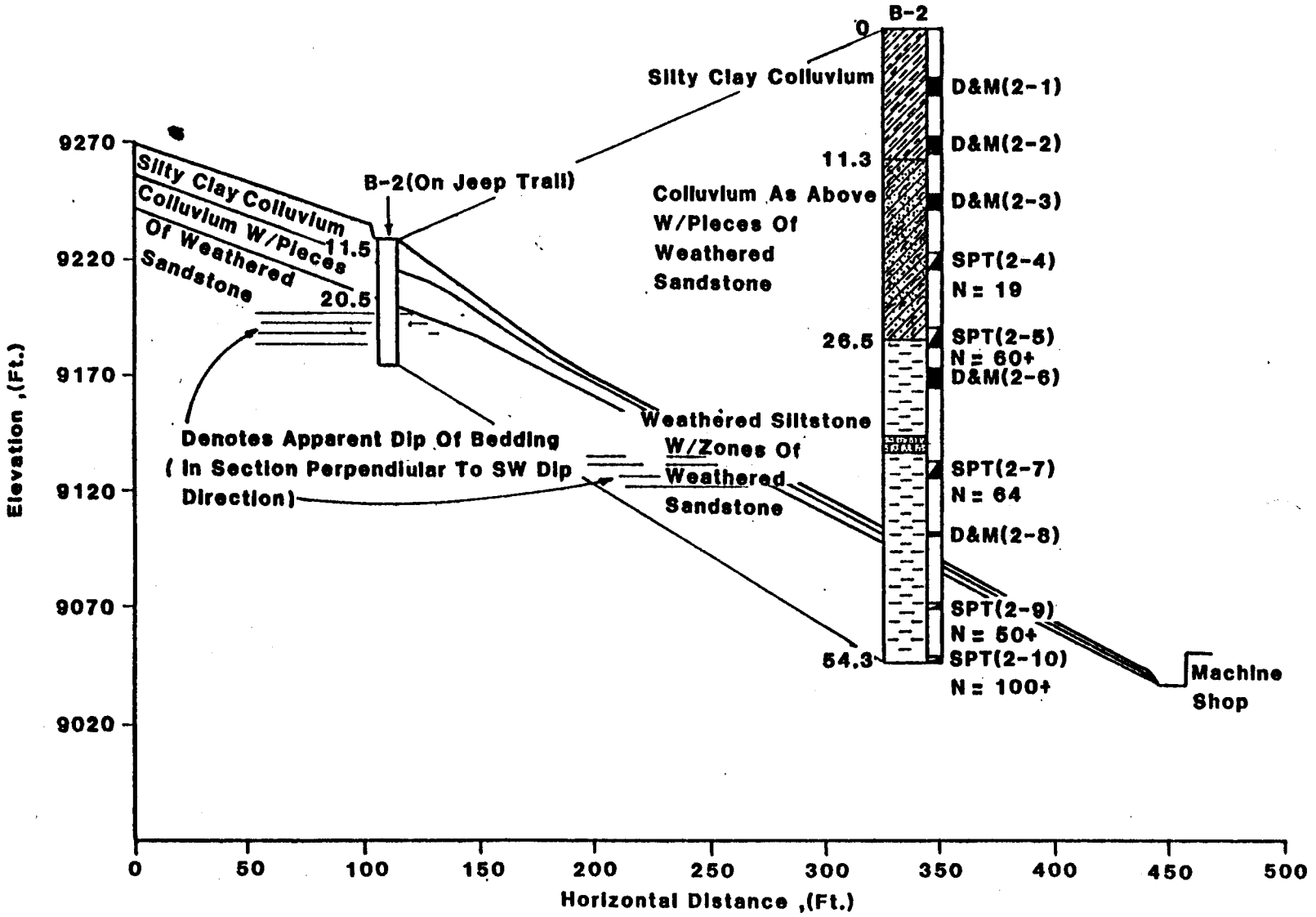
FIGURE 14



VALLEY CAMP OF UTAH , INC.
BELINA MINE , CARBON COUNTY

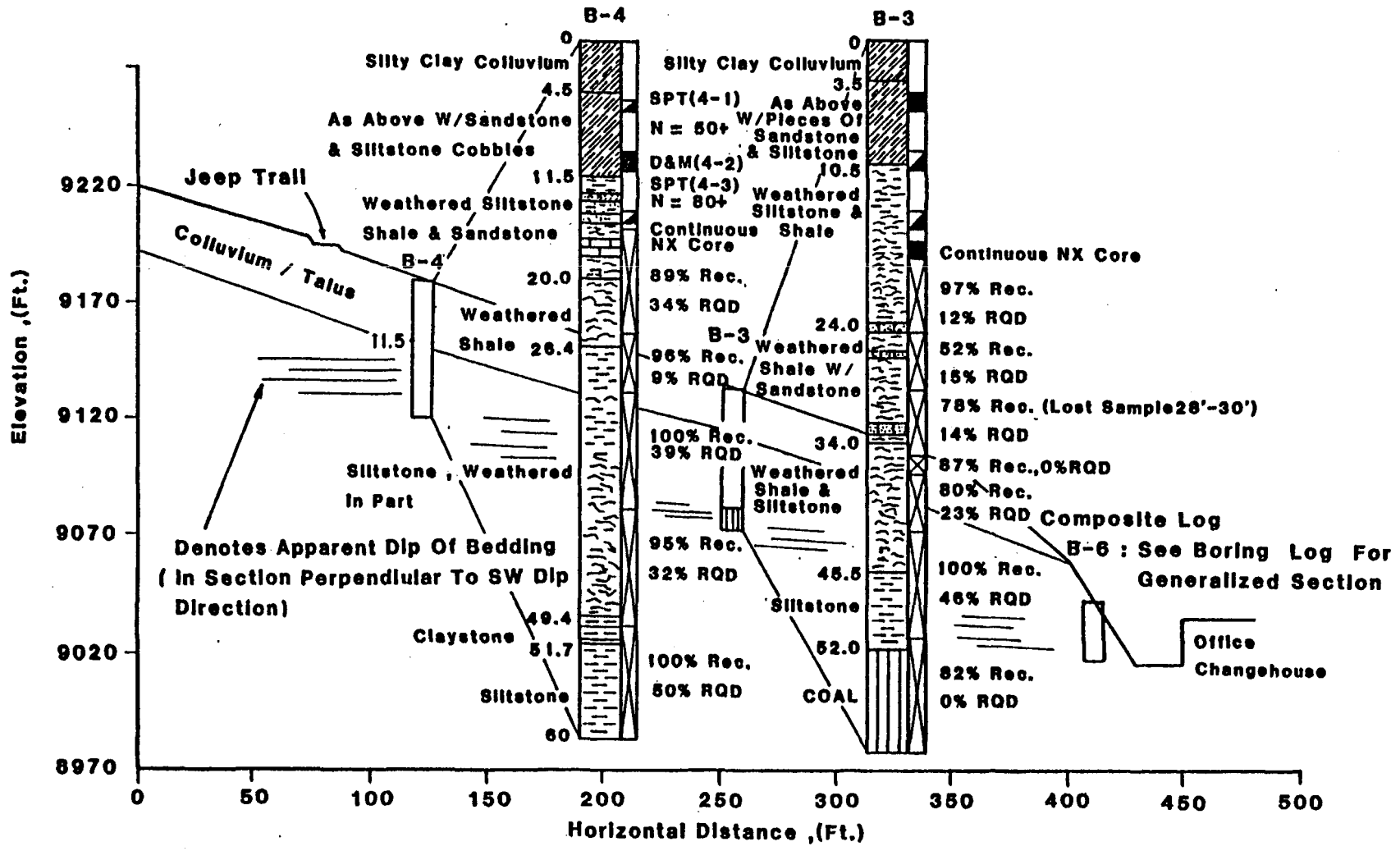
UPPER PORTAL BACKSLOPE SECTION A - A'

FIGURE 15



VALLEY CAMP OF UTAH , INC.
BELINA MINE , CARBON COUNTY
UPPER PORTAL BACKSLOPE SECTION B - B'
(ACTIVE SLIDE AREA)

FIGURE 16



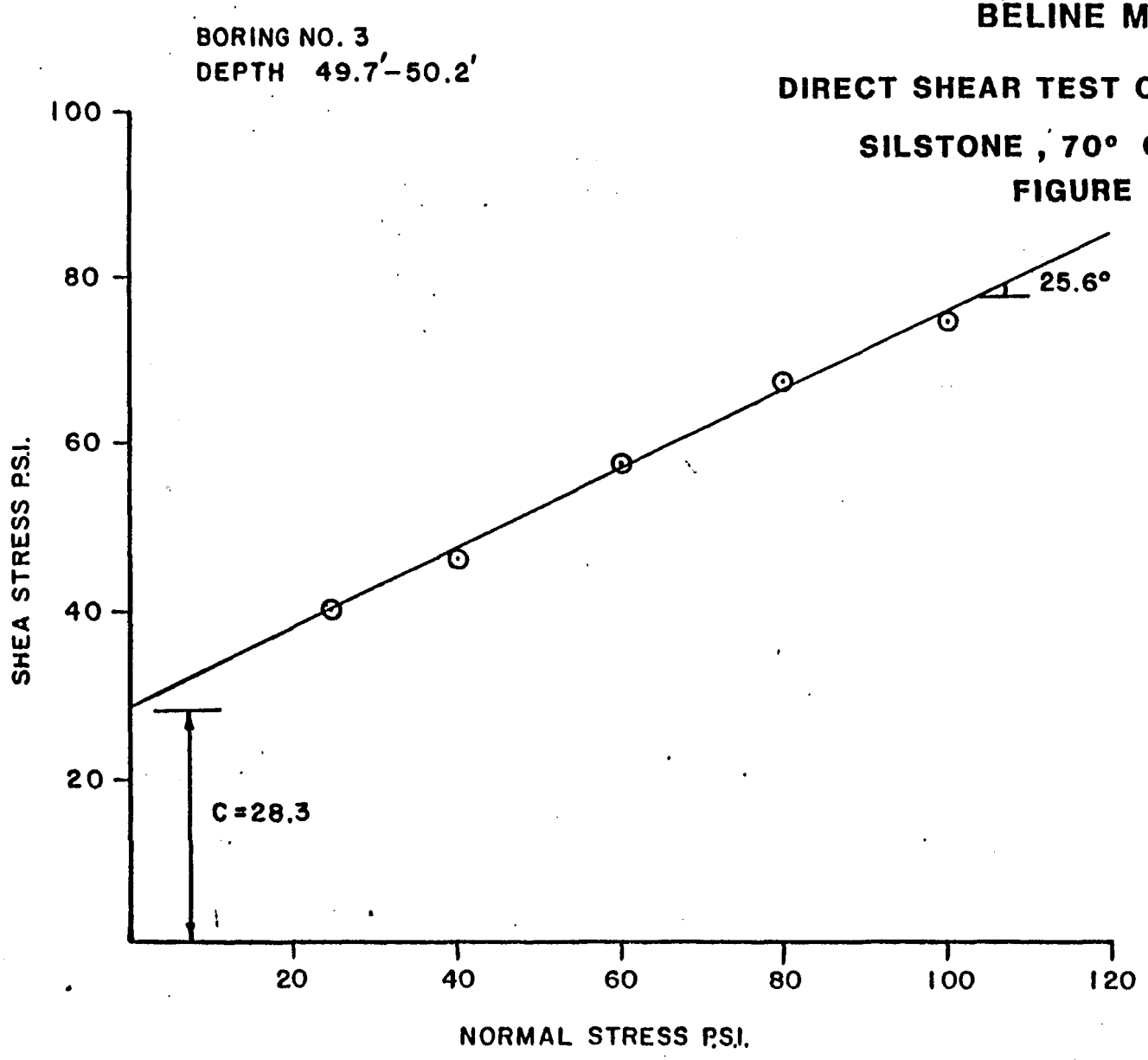
VALLEY CAMP OF UTAH ; INC.
BELINA MINE , CARBON COUNTY
UPPER PORTAL BACKSLOPE SECTION C - C'
FIGURE 17

VALLEY CAMP OF UTAH , INC.
BELINE MINE

DIRECT SHEAR TEST ON DISCONTIUITY :

SILSTONE , 70° OPEN JOINT

FIGURE 18

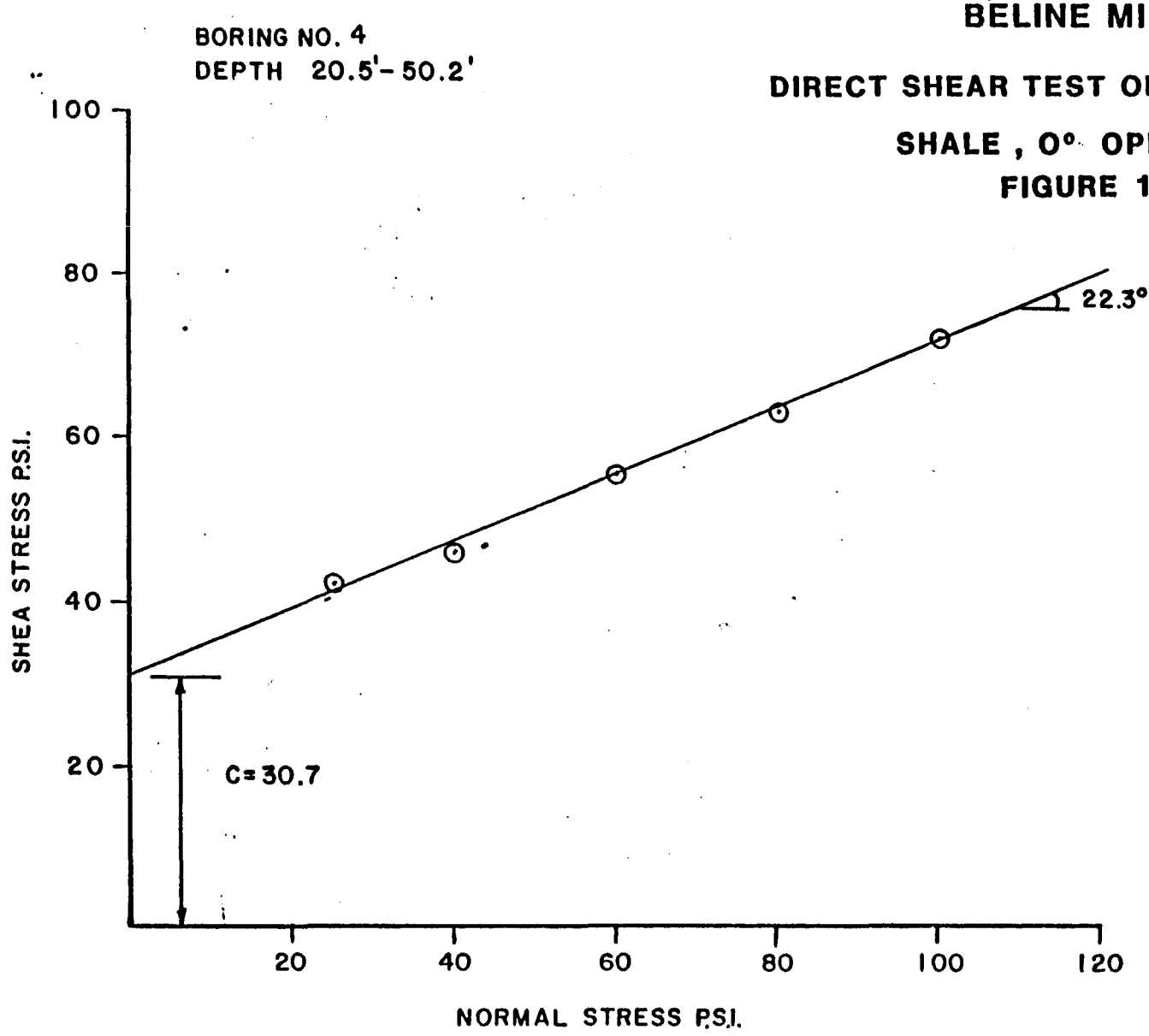


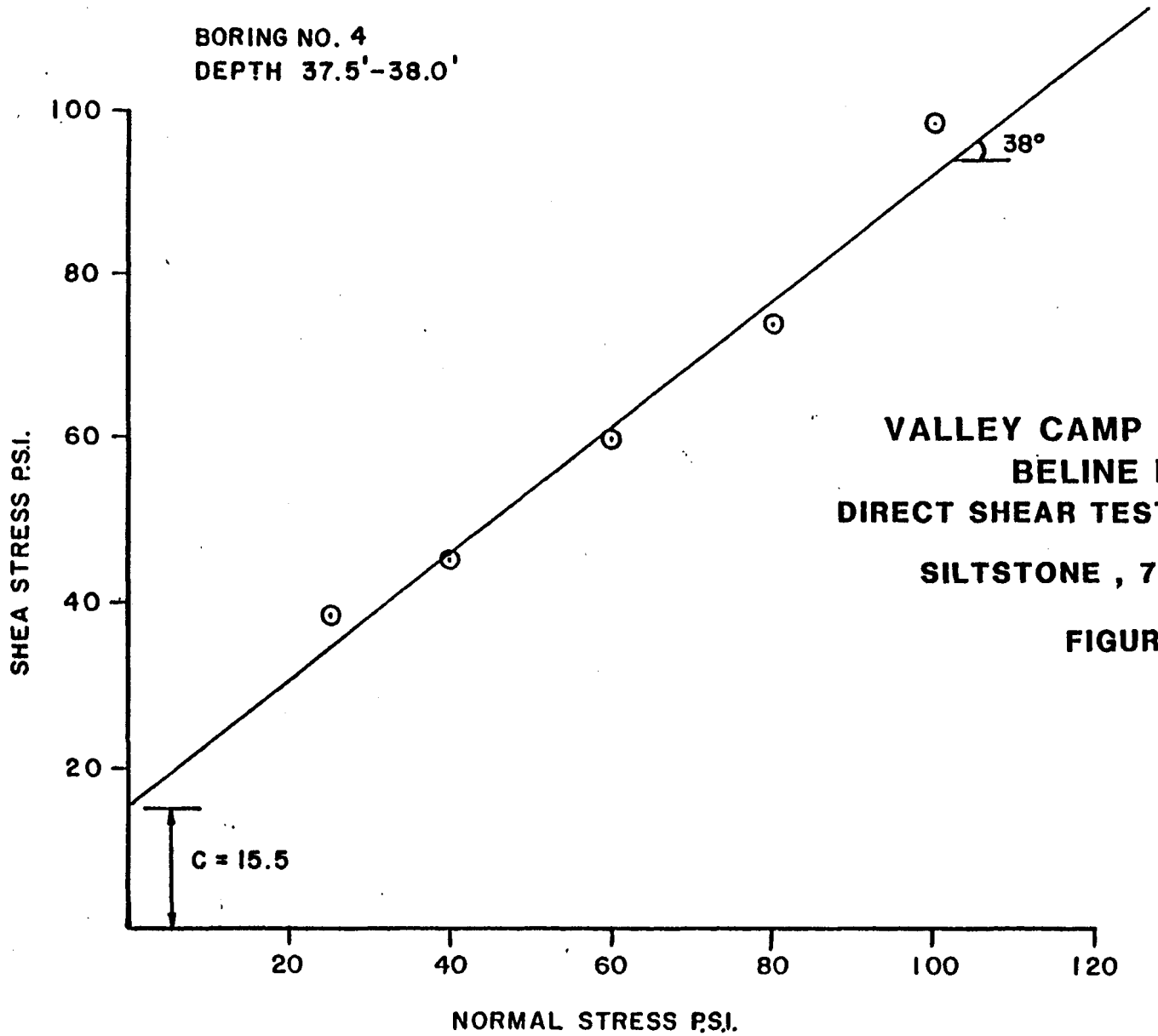
VALLEY CAMP OF UTAH , INC.
BELINE MINE

DIRECT SHEAR TEST ON DISCONTIUITY :

SHALE , 0° OPEN JOINT

FIGURE 19

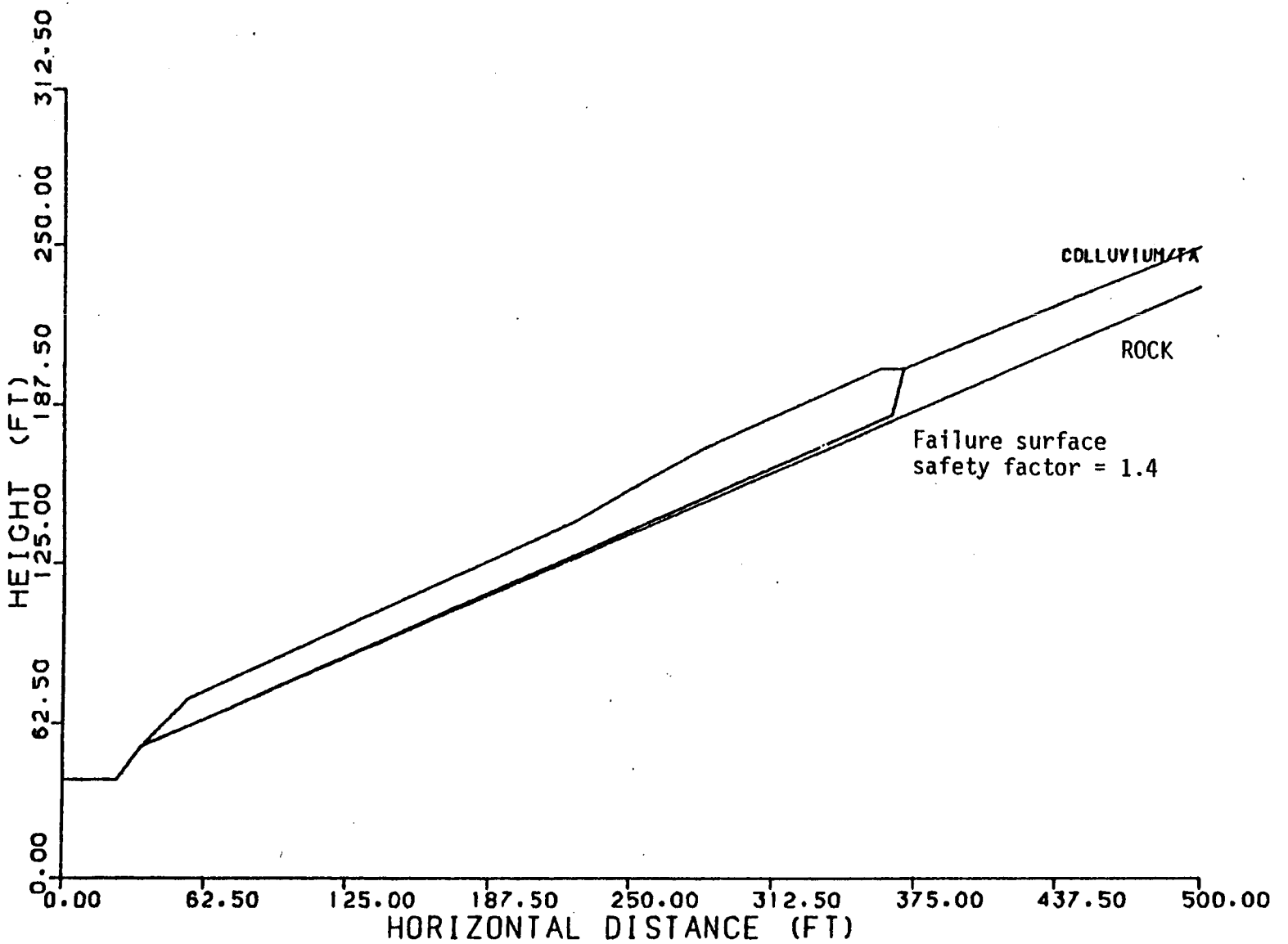




VALLEY CAMP OF UTAH , INC.
BELINE MINE
DIRECT SHEAR TEST ON DISCONTIUITY :

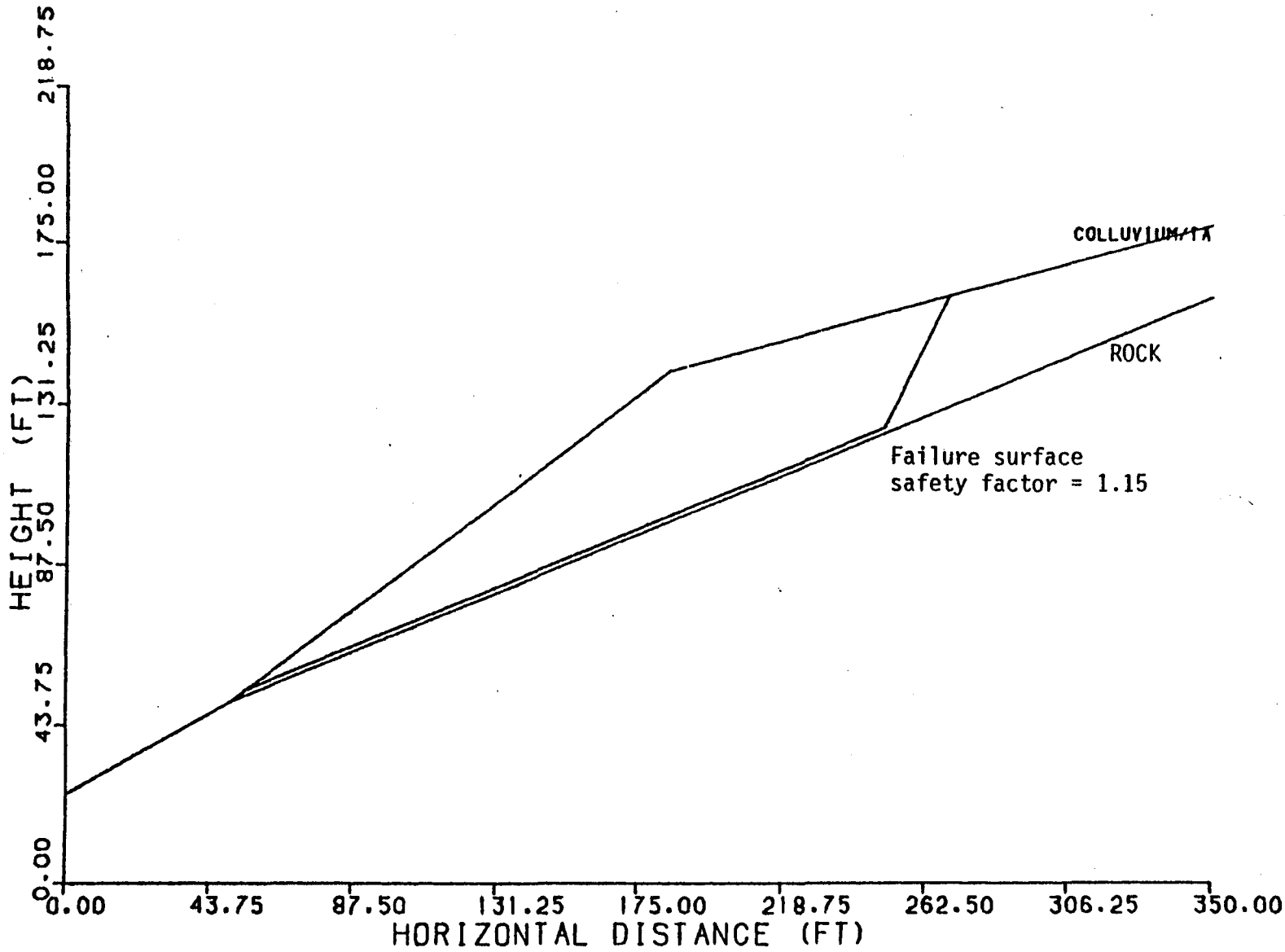
SILTSTONE , 77° OPEN JOINT

FIGURE 20



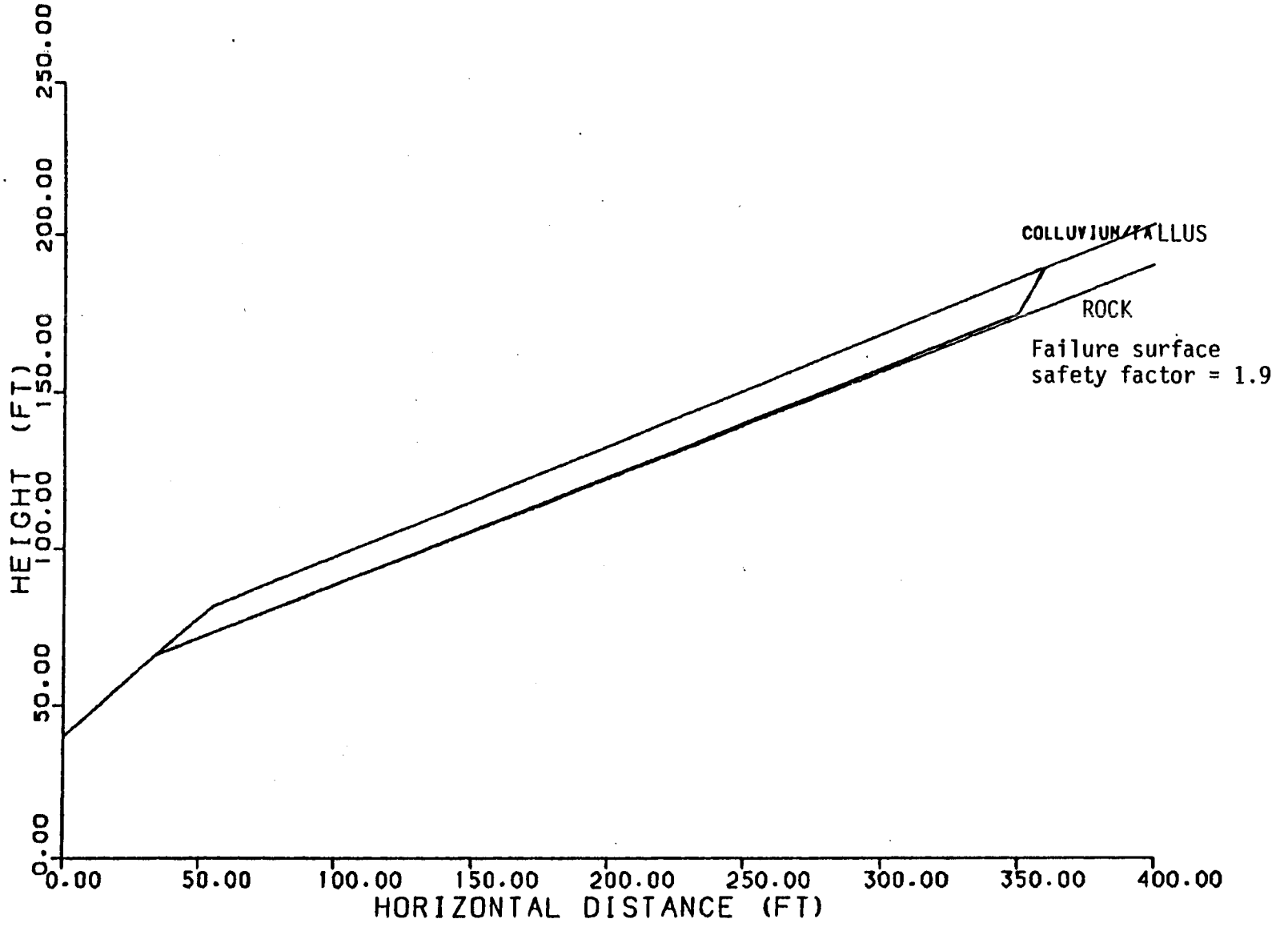
Valley Camp of Utah, Inc.
Belina Mine
Computer Generated Geologic
Model of Section A-A

Figure 21



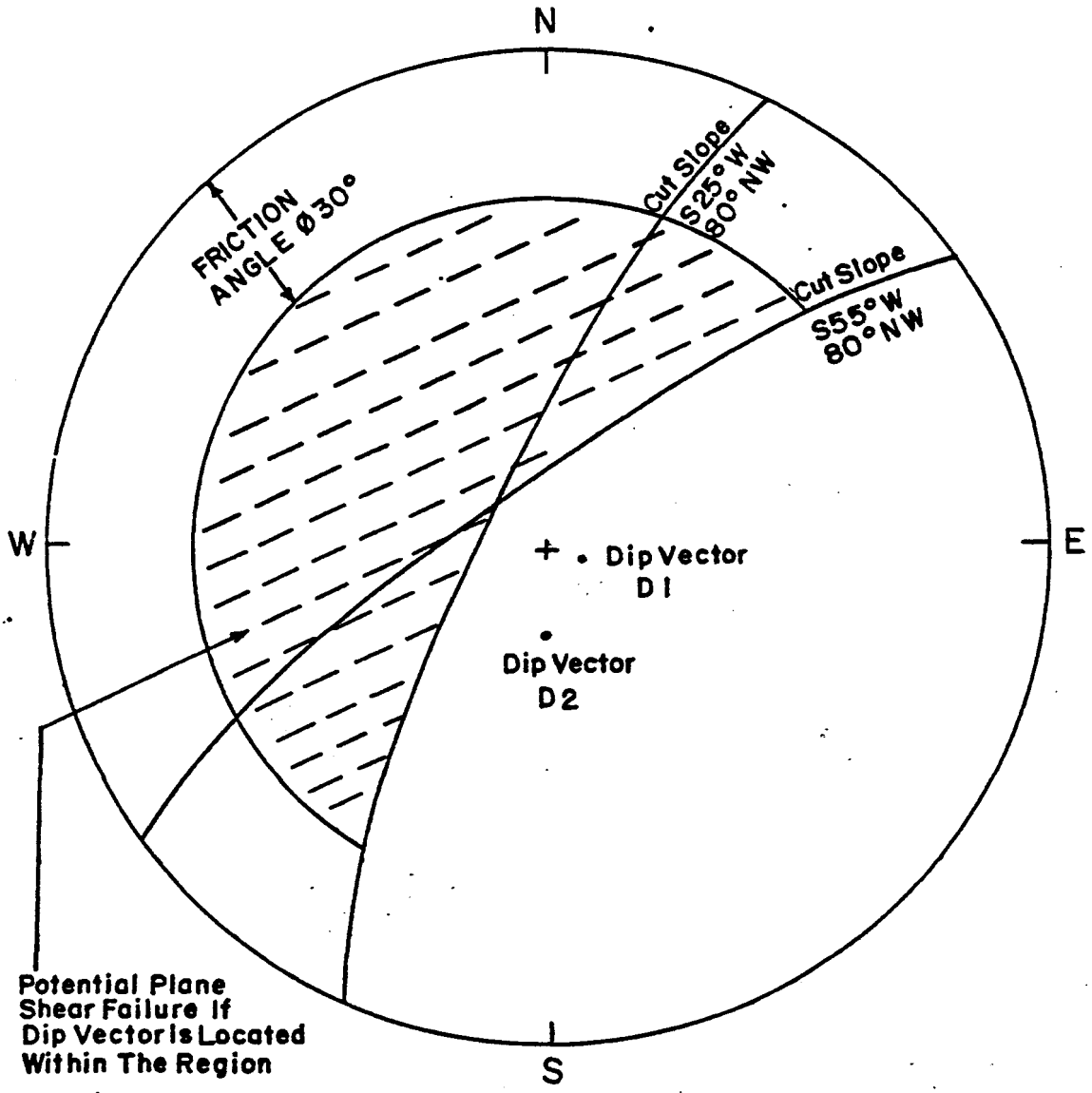
Valley Camp of Utah, Inc.
Belina Mine
Computer Generated Geologic
Model of Section B-B (most critical portion)

Figure 22



Valley Camp of Utah, Inc.
Belina Mine
Computer Generated Geologic
Model of Section C-C

Figure 23

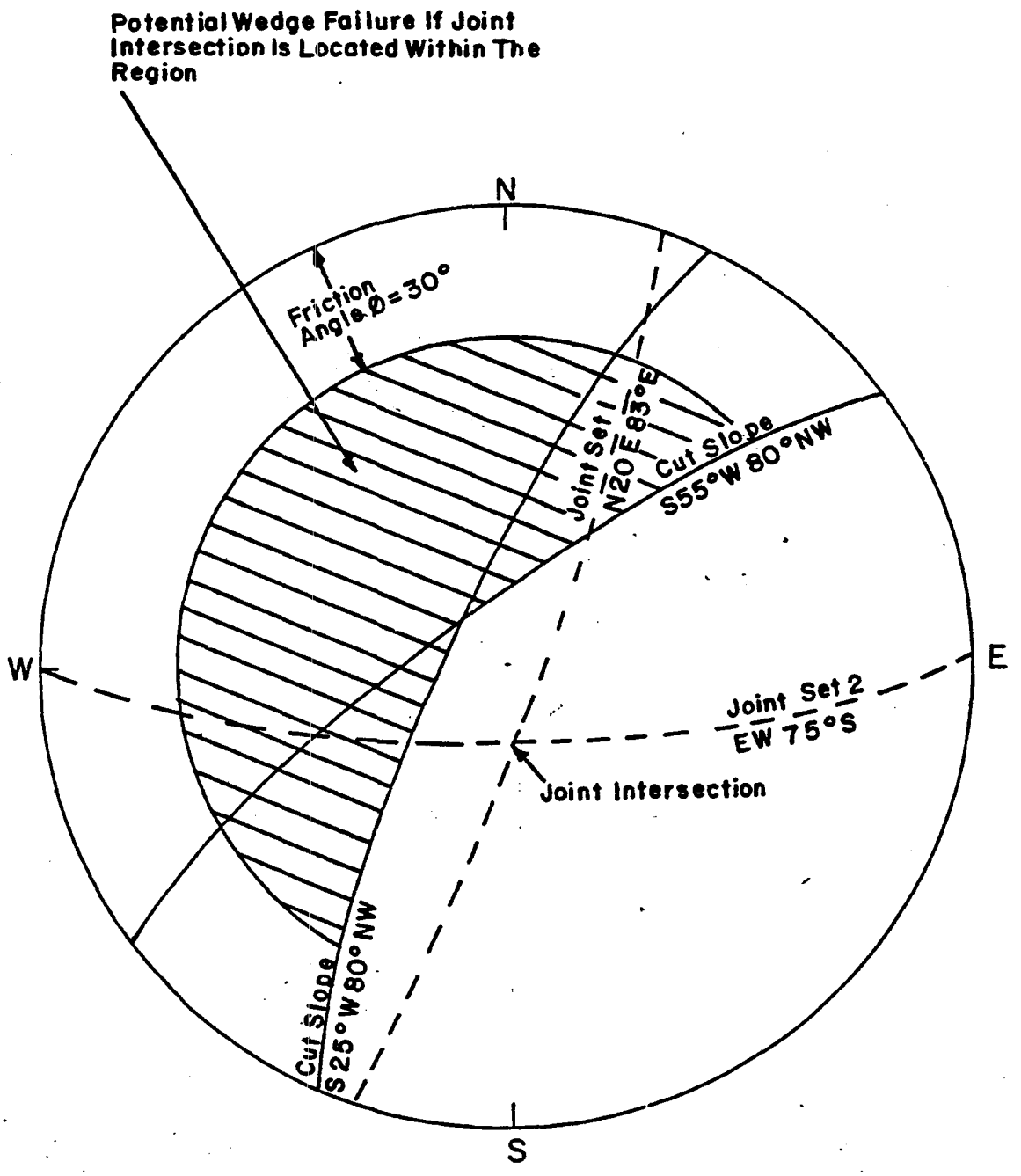


VALLEY CAMP OF UTAH , INC.

BELINA MINE

STEREOPLOT FOR PLANE SHEAR ANALYSIS FOR CUT SLOPE NEAR COAL LOADOUT CHUTE

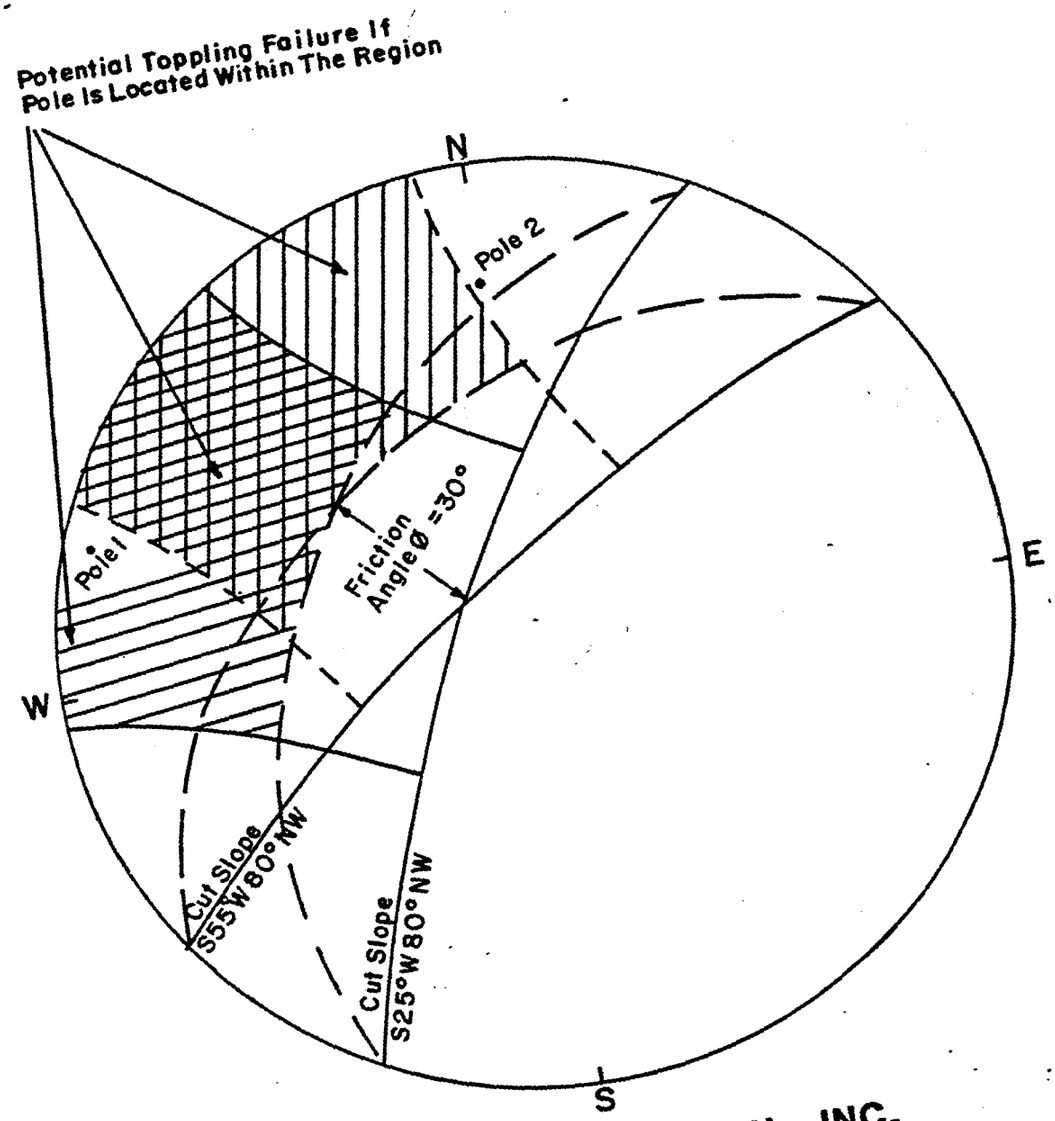
FIGURE 24



VALLEY CAMP OF UTAH , INC.
BELINA MINE

STEREOPLOT FOR WEDGE FAILURE ANALYSIS FOR CUT SLOPE NEAR COAL LOADOUT CHUTE

FIGURE 25



VALLEY CAMP OF UTAH , INC.
BELINA MINE

STEREOPLOT FOR POTENTIAL TOPPLING FAILURE FOR
CUT SLOPE NEAR COAL LOADOUT CHUTE

FIGURE 26

FORD CHEMICAL LABORATORY, INC.
Bacteriological and Chemical Analysis
40 West Louise Avenue
Salt Lake City, Utah 84115
Phone: 466-8761

METHODS OF ANALYSIS FOR SOIL & OVERBURDEN SAMPLES

Parameter	Units	Method of Extraction & Analysis
Texture Analysis		
Sand	%	Sieve Analysis; USDA, 1952; #18
Silt	%	Hydrometer; USDA, 1952; #18
Clay	%	Hydrometer; USDA, 1952; #18
Total Combustible Solids	%	Dry Ash: ASTM D 3174
Total Noncombustible Solids	%	Dry Ash; ASTM D 3174
pH - Paste	Units	Saturated Paste; USDA, 1969; #60
Iron - Total Fe	ppm	AB DTPA 1
Manganese Mn	ppm	AB DTPA 1
Sulfur		
Phyritic Sulfur	%	ASTM D 2492; #26
Sulfate Sulfur	%	ASTM D 2492; #26
Organic Sulfur	%	ASTM D 2492; #26
Total Sulfur	%	ASTM D 3177; #26
Major Ions (Salinity-Alkalinity)		
Calcium as Ca	ppm	Saturated Paste Extract, USDA #60
Chloride as Cl^{-1}	ppm	Saturated Paste Extract, USDA #60
Fluoride as F^{-1}	ppm	Saturated Paste Extract, USDA #60
Magnesium as Mg	ppm	Saturated Paste Extract, USDA #60
Nitrogen: Nitrate as NO_3^{-1}	ppm	Saturated Paste Extract, USDA #60
Phosphate as PO_4^{-3}	ppm	AB-DTPA 1
Potassium as K	ppm	Saturated Paste Extract, USDA #60
Sodium as Na	ppm	Saturated Paste Extract, USDA #60
Sulfate as SO_4^{-2}	ppm	ASTM D 2492; #26
Conductivity	um/hos/cm	Saturated Paste Extract, USDA #60
Sodium Adsorption Ratio (SAR)		Saturated Paste Extract, USDA #60
Total Carbonate as CO_3^{-2}	%	Acid Titration, (23c), USDA #60
Toxic Heavy Metals		
Arsenic as As	ppm	AB DTPA 1
Barium as Ba	ppm	AB DTPA 1
Boron as B	ppm	Saturated Paste Extract, USDA #60
Cadmium as Cd	ppm	AB DTPA 1
Chromium as Cr	ppm	AB DTPA 1
Copper as Cu	ppm	AB DTPA 1
Lead as Pb	ppm	AB DTPA 1
Mercury as Hg	ppm	Acid Extract; U.S. EPA, 1979; 245.5
Molybdenum as Mo	ppm	AB DPTA 1
Nickel as Ni	ppm	AB DPTA 1
Selenium as Se	ppm	AB DPTA 1
Zinc as Zn	ppm	AB DPTA 1
Radioactive		
Gross Alpha	ppbU	USGS, 1977
Gross Beta	piC/kg	USGS, 1977

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. 1

CERTIFICATE OF ANALYSIS
83-006765

	0 - 2 FT.	2 - 4 FT.	4 - 6 FT.	6 - 8 FT.
Moisture %	19.80	22.50	36.40	33.20
Molybdenum ppm AB DTPA 1	.075	.036	.055	.028
Neut./Potential Tons/1000Tons	4.07	3.04	2.48	3.14
Nitrate NO3-N ppm USDA 60	3.30	4.20	5.40	6.70
Organic Material % (WB)	4.70	3.90	4.50	3.36
PH USDA 60	7.50	7.40	7.45	7.80
Phosphorus ppm AB DTPA 1	20.60	31.40	4.50	16.20
Potassium ppm USDA 60	114.00	95.00	81.00	110.00
Pyritic Sulfur % ASTM D2492	.0140	.0133	.0125	.0150
Saturation %	22.50	21.90	19.30	24.60
Selenium ppm AB DTPA 1	.015	.010	.006	.002
Sodium Absorption Ratio	.047	.064	.087	.100
Sodium Sol.Meq/l USDA 60	.42	.51	.72	.85
Zinc ppm AB DTPA 1	1.650	2.400	1.900	2.300

FORD CHEMICAL LABORATORY, INC.

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Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. 1

DATE: 12/29/83

CERTIFICATE OF ANALYSIS

VALLEY CAMP OF UTAH
SCOFIELD ROUTE
HELPER, UTAH
84526

83-006765

SAMPLE: SOIL SAMPLES FROM BELINA PAD #1 COLLECTED 9-23-83 RECEIVED 9-23-83 FOR ANALYSIS UNDER P.O. #30-83-10-007831.

	0 - 2 FT.	2 - 4 FT.	4 - 6 FT.	6 - 8 FT.
1-Clay % USDA 18	12.80	28.20	85.50	60.20
Sand % USDA 18	65.80	53.50	27.50	27.30
1-Silt % USDA 18	21.40	18.30	14.00	12.50
Acid/Base Pot.Tons/1000 Tons	.43	.41	.39	.46
Boron Sol.ppm USDA 60	.057	.119	.089	.008
Ca.Carbonate Tons/1000Tons	4.50	3.45	2.87	3.60
Calcium Carbonate ppm USDA 60	4,500.00	3,450.00	2,870.00	3,600.00
Calcium Sol. Meq/l USDA 60	130.73	108.78	117.26	122.00
Conductivity mmhos/cm @ 25	.80	.77	.85	.95
Copper ppm AB DTPA 1	.250	.100	.300	.050
Iron ppm AB DTPA 1	66.500	68.300	59.200	77.500
Magnesium Sol. Meq/l USDA 60	15.81	15.33	14.26	17.26
Manganese ppm AB DTPA 1	14.500	12.600	10.500	6.650

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LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. 2

DATE: 12/29/83

CERTIFICATE OF ANALYSIS

VALLEY CAMP OF UTAH
SCOFIELD ROUTE
HELPER, UTAH
84526

83-006766

SAMPLE: SOIL SAMPLES FROM BELINA PAD #2 COLLECTED 9-23-83
RECEIVED 9-23-83 FOR ANALYSIS UNDER P.O. 30-83-10-007831.

	0 - 2 FT.	2 - 4 FT.	4 - 8 FT.
1-Clay % USDA 18	10.50	19.50	30.80
Sand % USDA 18	20.00	50.00	37.70
1-Silt % USDA 18	69.50	30.50	31.50
Acid/Base Pot.Tons/1000 Tons	.38	.37	.36
Boron Sol.ppm USDA 60	.058	.013	.112
Ca.Carbonate Tons/1000Tons	2.07	3.87	4.39
Calcium Carbonate ppm USDA 60	2,700.00	3,870.00	4,390.00
Calcium Sol. Meq/l USDA 60	95.30	117.26	127.64
Conductivity mmhos/cm @ 25	.90	.75	.69
Copper ppm AB DTPA 1	.200	.270	.300
Iron ppm AB DTPA 1	51.500	45.600	44.900
Magnesium Sol. Meq/l USDA 60	21.41	15.65	17.28
Manganese ppm AB DTPA 1	4.900	8.600	9.300

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Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. 2

CERTIFICATE OF ANALYSIS
83-006766

	0 - 2 FT.	2 - 4 FT.	4 - 8 FT.
Moisture %	23.00	34.60	40.20
Molybdenum ppm AB DTPA 1	.008	.010	.009
Neut./Potential Tons/1000Tons	2.32	3.50	4.03
Nitrate NO3-N ppm USDA 60	2.40	4.60	5.10
Organic Material % (WB)	3.60	5.40	4.80
pH USDA 60	7.20	7.30	7.50
Phosphorus ppm AB DTPA 1	16.50	26.40	25.40
Potassium ppm USDA 60	110.00	86.00	79.00
Pyritic Sulfur % ASTM D2492	.0123	.0120	.0115
Saturation %	23.40	18.70	25.10
Selenium ppm AB DTPA 1	.025	.017	<.001
Sodium Absorption Ratio	.039	.062	.063
Sodium Sol.Meq/l USDA 60	.30	.51	.54
Zinc ppm AB DTPA 1	.950	1.850	1.990

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Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. B-5

DATE: 12/29/83

CERTIFICATE OF ANALYSIS

VALLEY CAMP OF UTAH
SCOFIELD ROUTE
HELPER, UTAH
84526

83-006763

SAMPLE: SOIL SAMPLES FROM BELINA PAD COLLECTED 9-15-83 RECEIVED 9-23-83 FOR ANALYSIS UNDER P.O. 30-83-10-007831.

	0 - 2.5	2.5 - 5	5 - 7.5	7.5 - 10	10 - 12.5
1-Clay % USDA 18	54.50	38.60	51.90	22.50	48.90
-Sand % USDA 18	33.50	39.80	31.50	56.50	25.50
1-Silt % USDA 18	12.00	21.60	16.60	21.00	25.60
icid/Base Pot.Tons/1000 Tons	.39	.42	.34	.37	.57
Boron Sol.ppm USDA 60	.258	.168	.241	.165	.117
Ca.Carbonate Tons/1000Tons	4.60	4.20	3.77	3.92	3.70
alcium Carbonate ppm USDA 60	4,600.00	4,200.00	3,770.00	3,920.00	3,700.00
Calcium Sol. Meq/l USDA 60	127.74	123.75	115.26	118.26	128.74
onductivity mmhos/cm @ 25	.75	.80	.84	.90	.78
Copper ppm AB DTPA 1	.020	.090	.100	.150	.280
Iron ppm AB DTPA 1	56.500	54.200	63.500	74.100	58.900
agnesium Sol. Meq/l USDA 60	14.79	14.40	13.76	13.57	13.11
Manganese ppm AB DTPA 1	9.200	6.800	4.900	8.300	9.500

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Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. B-5

CERTIFICATE OF ANALYSIS
83-006763

	0 - 2.5	2.5 - 5	5 - 7.5	7.5 - 10	10 - 12.5
Moisture %	19.80	21.50	22.40	22.50	34.50
Molybdenum ppm AB DTPA 1	.166	.175	.116	.150	.132
Neut./Potential Tons/1000Tons	4.21	3.78	3.43	3.55	3.13
Nitrate NO3-N ppm USDA 60	2.10	4.60	1.80	2.50	1.95
Organic Material % (WB)	3.30	4.60	8.20	5.90	7.70
pH USDA 60	7.20	7.40	7.80	7.30	7.50
Phosphorus ppm AB DTPA 1	12.90	15.60	8.70	16.20	11.40
Potassium ppm USDA 60	112.00	95.00	86.00	69.00	72.00
Pyritic Sulfur % ASTM D2492	.0125	.0136	.0110	.0120	.0185
Saturation %	24.50	21.80	24.60	23.80	31.50
Selenium ppm AB DTPA 1	.005	.001	.001	<.001	<.001
Sodium Absorption Ratio	.081	.062	.080	.096	.053
Sodium Sol.Meq/l USDA 60	.69	.52	.65	.78	.43
Zinc ppm AB DTPA 1	1.770	1.950	1.800	7.100	7.500

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Test Hole No. B-5

CERTIFICATE OF ANALYSIS
83-006763

	12.5 - 15	15 - 17.5	17.5 - 20	20 - 22.5	22.5 -25
Organic Material % (WB)	5.50	6.80	4.85	10.50	6.80
PH USDA 60	7.80	7.44	7.90	7.50	7.45
Phosphorus ppm AB DTPA 1	10.50	14.50	21.60	15.50	11.50
Potassium ppm USDA 60	105.00	120.00	119.00	88.00	79.00
Pyritic Sulfur % ASTM D2492	.0122	.0165	.0180	.0135	.0124
Saturation %	27.10	20.70	21.50	28.20	20.40
Selenium ppm AB DTPA 1	<.001	<.001	<.001	<.001	<.001
Sodium Absorption Ratio	.060	.050	.060	.064	.084
Sodium Sol.Meq/l USDA 60	.47	.38	.50	.52	.65
Zinc ppm AB DTPA 1	2.200	1.300	1.450	1.220	2.100

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SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. B-5

CERTIFICATE OF ANALYSIS
83-006763

	12.5 - 15	15 - 17.5	17.5 - 20	20 - 22.5	22.5 -25
1-Clay % USDA 18	15.30	14.00	20.00	24.20	31.50
1-Sand % USDA 18	60.20	54.50	33.50	24.50	58.60
1-Silt % USDA 18	24.50	31.50	46.50	51.30	9.90
Acid/Base Pot.Tons/1000 Tons	.38	.51	.56	.42	.38
Boron Sol.ppm USDA 60	.098	.258	.410	.165	.137
Ca.Carbonate Tons/1000Tons	3.49	2.96	4.13	3.59	3.15
Calcium Carbonate ppm USDA 60	3,490.00	2,960.00	4,130.00	3,590.00	3,150.00
Calcium Sol. Meq/l USDA 60	109.73	99.10	122.50	114.42	102.79
Conductivity mmhos/cm @ 25	.88	.92	.88	.76	.80
Copper ppm AB DTPA 1	.030	.050	.100	.240	.250
Iron ppm AB DTPA 1	66.900	71.400	75.200	61.500	59.500
Magnesium Sol. Meq/l USDA 60	10.52	13.57	15.24	13.68	14.42
Manganese ppm AB DTPA 1	11.600	9.500	8.500	6.750	8.500
Moisture %	18.50	23.50	21.50	24.60	20.50
Molybdenum ppm AB DTPA 1	.085	.025	.016	.025	.185
Neut./Potential Tons/1000Tons	3.11	2.45	3.57	3.17	2.77
Nitrate NO3-N ppm USDA 60	2.80	4.40	3.50	1.80	2.85

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SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. B-5

CERTIFICATE OF ANALYSIS
83-006764

	25 - 27.5	27.5 - 30
Moisture %	31.40	29.50
Molybdenum ppm AB DTPA 1	.118	.037
Neut./Potential Tons/1000Tons	3.65	3.62
Nitrate NO3-N ppm USDA 60	6.40	5.30
Organic Material % (WB)	4.85	4.91
PH USDA 60	7.35	7.40
Phosphorus ppm AB DTPA 1	30.70	29.20
Potassium ppm USDA 60	96.00	91.00
Pyritic Sulfur % ASTM D2492	.0119	.0110
Saturation %	25.10	19.70
Selenium ppm AB DTPA 1	<.001	<.001
Sodium Absorption Ratio	.056	.061
Sodium Sol.Meq/l USDA 60	.45	.50
Zinc ppm AB DTPA 1	1.700	1.800

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SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. B-5

DATE: 12/29/83

CERTIFICATE OF ANALYSIS

VALLEY CAMP OF UTAH
SCOFIELD ROUTE
HELPER, UTAH
84526

83-006764

SAMPLE: SOIL SAMPLES FROM BELINA PAD COLLECTED 9-15-83 RECEIVED 9-23-83 FOR ANALYSIS UNDER P.O. 30-83-10-007831.

	25 - 27.5	27.5 - 30
1-Clay % USDA 18	22.00	17.10
-Sand % USDA 18	49.50	53.50
1-Silt % USDA 18	28.50	29.40
Acid/Base Pot.Tons/1000 Tons	.37	.34
Boron Sol.ppm USDA 60	.066	.098
Ca.Carbonate Tons/1000Tons	4.02	3.96
Calcium Carbonate ppm USDA 60	4,025.00	3,960.00
Calcium Sol. Meq/l USDA 60	120.25	119.01
Conductivity mmhos/cm @ 25	.74	.75
Copper ppm AB DTPA 1	.420	.460
Iron ppm AB DTPA 1	45.500	43.800
Magnesium Sol. Meq/l USDA 60	14.58	15.24
Manganese ppm AB DTPA 1	11.200	10.850

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Valley Camp of Utah, Inc.
Belina Mine Site
Clear Creek, Utah 84526

MINE: UTAH NO. 2

ANALYSIS BY: INTER-MOUNTAIN LABORATORIES, INC.

DATE: September 24, 1983

Lab No.	Hole No.	Depth Interval Ft.	pH	Cond. mmhos/ cm @ 25°C	Saturation %	Particle Size Sand %	Silt %	Clay %	Texture	Soluble Cations Ca Meq/1	Mg	Na	SAR (1)
22093	1	10 Ft. - 2 Ft.	7.3	0.79	34.3	50.4	38.9	10.7	Loam	5.29	1.71	1.22	0.65
22094	2	8 Ft. - 2 Ft.	7.4	1.08	30.5	59.5	30.7	9.8	Sandy Loam	7.75	2.35	1.32	0.59
22095	3	6 Ft. - 2 Ft.	5.5	0.31	32.2	44.0	42.5	13.5	Loam	1.81	0.41	0.97	0.92

Footnotes: (1) Sodium Adsorption Ratio

Valley Camp of Utah, Inc.
Belina Mine Site
Clear Creek, Utah 84526

MINE: UTAH NO. 2 ANALYSIS BY: INTER-MOUNTAIN LABORATORIES, INC. DATE: September 24, 1983

Lab No.	Hole No.	OM% (13)	K+ (14)	PO4 (15)	Fe ppm (2)	Zn ppm (3)	B ppm (4)	N ppm (5)	Mo ppm (6)	Cu ppm (7)	Mn ppm (8)	TS % (9)	AB (10)	NP (11)	ABP (12)
22093	1	1.9	123.	17.4	15.1	1.09	0.84	7.13	0.09	0.51	9.35	0.05	1.56	22.3	20.7
22094	2	2.5	69.	13.7	16.6	1.12	0.85	5.71	0.08	0.41	13.3	0.05	1.56	57.1	55.5
22095	3	4.5	68.	8.74	59.3	0.66	0.76	4.30	0.05	0.80	7.52	0.05	1.56	11.9	10.3

Footnotes:
(13) Organic Matter
(14) Potassium
(15) Phosphate as P
(2) Iron DTPA
(3) Zinc DTPA
(4) Boron
(5) Nitrate Nitrogen
(6) Ammonium Extractable Molybdenum
(7) Copper DTPA
(8) Manganese DTPA
(9) Total Sulfur Per Cent
(10) Acid Base
(11) Neutralization Potential
(12) Acid Base Potential in Tons Calcium Carbonate per 1000 Tons of Soil

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R614-301-200. SOILS.

The Reclamation Plan (See R614-301-540.), is divided into four areas: the Valcam Loadout Facility; General Office Area; Belina Haul Road; and the Belina Mine Site.

R614-301-220. Environmental Description.

R614-301-221. Prime Farmland Investigation.

The Mine Permit Area soils do not meet the requirements as: "The growing season is too short and without irrigation water the moisture requirement for prime farmland cannot be met." As per May 28,1982 letter by Mr. George D.McMillan, State Conservationist, USDA Soil Conservation Service, P.O. Box 11350, Salt Lake City, Ut. 84147. See Appendix R614-301-221. (PFI)

R614-301-222. thru 301-223. Soil Survey.

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Valley Camp of Utah, Inc. lease area soils are developed in vegetation types and topographic features similar in all major respects to the adjacent Skyline lease area soils. Based on previous extensive studies of the adjacent Skyline Lease Area, data for those studies were collected as follows:

Soils Analysis (methods)--At each vegetation site a soil pit was excavated to the parent material, or to a depth of 60 inches, whichever occurred first. The exposed soil profile provided information for classification of the soils into taxonomic units. Samples were taken from each of the horizons exposed in each pit and were analyzed for major chemical properties.

Soils were classified to family unit according to the system utilized for classification of soils by the Soil Conservation Service (Johnson 1975). Use of this method will allow for correlation of these soils to series level when the Soil Conservation Service and Forest Service complete the current mapping effort of adjacent areas.

Chemical analyses for micro-nutrients were made by testing a soil extract with DTPA solution and were measured by use of an atomic absorption analyzer. Ammonium acetate was used to extract sodium, magnesium, and calcium for atomic absorption analysis. The Kjeldahl method was used for determination of percent organic matter. All analyses were conducted in the Agronomy Laboratory at Brigham Young University.

Soil texture was determined by using a Bouyoucus hydrometer method, with sodium hexametaphosphate dispersing agent. Soil reaction was determined on a 1:1 soil/water mixture which was tested in a Corning pH meter Model 10. Salinity was analyzed by use of a Wheatstone conductivity cell on an extract of each soil sample. Carbonate content was estimated from observations of effervescence following application of a 10-percent solution of hydrochloric acid. The scale of effervescence follows the rating system suggested by the Soil Conservation Service (USDA Soil Survey Manual, 1937). Soil color was obtained by comparing a moist and a dry sample with the standard Munsel soil color

charts. Observations of soil structural units also follow the Soil Conservation Service suggested designation as outlined in the Soil Survey Manual.

Local climatic data suggest cryic and frigid temperature regimes. The cryic regime is typically conifer-aspen related, and includes some high meadows. These areas are too cold for cultivation of crop plants by ordinary means. Frigid designation is given to soils typical of sagebrush types; some crops can be grown on these soils. Most of the soils are in the ustic (moisture arriving in summer) regimes.

All soils have textures ranging from sandy loams to clay loams, and are considered neither unusual for the area in general or for the vegetation types these soils support. A comparison of spruce-fir and aspen soils, which as broad categories make up more than 80 percent of the lease area soils, shows that the pH and salinity measurements are probably normal for this climatic regime with the pH range from mildly acidic to neutral. There is a slight difference in soil reaction between spruce-fir (ph 5.0) and aspen (pH 6.0) soils. It is characteristic that the evergreen conifer types are more acidic than the deciduous forest of aspen.

Even the most saline soil measured in the lease area, with an EC x 10 measurement of 1.88, is considered extremely low when compared to agricultural soils. A slight difference between soils is noted when depths are compared. The solum of aspen extends to an average depth of 20 inches at nine locations and to 18 inches at seven locations of the spruce-fir type. This corresponds to the average depths of measurements in aspen of 19.9 inches and of 18.1 inches in spruce-fir soils. It is also apparent that soils in aspen communities are more fertile in the commonly applied fertilizer elements nitrogen, phosphorus, and potassium, and also in most micro-nutrients. The levels of iron, magnesium, and manganese are considered to be adequate for growth of native vegetation, even though somewhat below amounts reported for average soils in the Western United States (Shacklette, et al. 1971). Moderate amounts of zinc, calcium, and potassium indicate that adequate quantities of these minerals are present, except in sagebrush soils.

High amounts of calcium, especially in the B-horizon of spruce-fir soils are not considered a problem in immobilization of phosphorus due to the acid pH of these soils. Concentrations of calcium in sagebrush and aspen soils could become a problem in phosphorus relations if soils are altered to become more basic. Nitrate nitrogen is low in quantity, as was expected for these soil types. Average amounts of nitrate nitrogen are inadequate in all soils of the region, and in all horizons. All areas would respond to addition of nitrogen.

In summary, the most important fertilizer to be applied in reclamation is nitrogen. The addition of nitrogen should be timed with suitable moisture content in the soils, which usually occurs in the fall and spring.

The Soils Map (R614-301-223.100) of the area indicates soils mapping units of the lease area. These units are designated by upper case letter A through E and are mapped at an Order Three intensity. Adjacent soils are designated by lower case letters a through v and are mapped at an Order Two intensity. A dashed line is used to enclose these mapping units. Taxonomic classification of the soil sample is summarized as follows:

Map Unit	Taxonomic Classification	Sample Site
A	Loamy-skeletal, mixed Mollic Cryoboralfs	3
B	Fine loamy, mixed Argic Pachic Cryoborolls	11
C	Loamy-skeletal, mixed Argic Cryoborolls	12
D	A complex of units B and C	
E	A complex of units A, B, and C	
a	Loamy-skeletal, mixed Mollic Cryoboralfs	
b	Fine loamy, mixed Argic Pachic Cryoborolls	11
f	Similar to B with 30% of the soils having a slope greater than 60% and as much as 50% rock fragments less than 12 inches.	11
g	Coarse loamy, mixed Pachic Cryoborolls	10
h	Rock outcrops	
i	Loamy-skeletal, mixed Typic Cryoborolls	8
k	Course-loamy, mixed Cumulic Cryoborolls	6
l	Loamy-skeletal, mixed Typic Cryoborolls	5
m	Loamy-skeletal, mixed Typic Cryoboralfs	4
p	Coarse-loamy, mixed Mollic Cryofluvent	2
q	Coarse-loamy, mixed Cumulic Cryoborolls	1
r	Coarse-loamy, mixed frigid Typic Argiborolls	15
s	Complex of 10% r, 45% t, and 35% u	
t	Coarse-loamy, mixed frigid Mollic with 15% u and 5% q	17
u	Coarse-loamy, mixed frigid Typic Haploborolls with 5% r	18
v	Loamy-Skeletal, mixed Lithic Cryocrepts	7

Map Units A and a

These units consist of deep well drained soils that have formed in colluvium and residuum. They are on steep north-facing slopes ranging from 35 to 60 percent. Included is 5 percent rock outcrop and 5 percent similar soils.

The surface texture is loam or very fine sandy loam. Thickness of the mollic epipedon ranges from 2 to 4 inches. The A2 horizon ranges from striping of ped faces to a leached horizon 4 inches thick. Depth of the argillic horizon is 12 to 15 inches. Depth of the C horizon is 18 to 22 inches. Percent of rock fragment by volume in the upper 20 inches ranges from 5 to 15 percent. The lower portion ranges from 35 to 55 percent.

Erosion hazard is slight, but severe if disturbed due to surface textures and steep slopes.

The potential rating for borrow soil is poor due to thin surface layers, rock fragments content, and steep slopes.

Table 1. Soil Analysis Data, Profile Description, Sample Site 3 Mapping Unit:A,a

Vegetative Type: Spruce/Fir

Location: Permit Area

Horz.	Depth	Color Dry	Color Moist	Texture Sand	Texture Silt	Texture Clay	Class	Structure	Percent Rock Fgts.	Percent Org. Mat.
0*	2-0									
A1	0-3	10YR 5/2	10YR 3/2	33	55	12	sl	1mkpl / 2mgr	5gr	6.99
A2	3-7	10YR 7/2	7.5YR 5/4	48	37	15	l	2m sbk	5gr	0.44
B21	7-14	10YR 7/2	10YR 5/4	48	39	13	l	2m&f sbk	5gr	t
B22**	14-20	10YR 7/3	10YR 6/4	49	39	12	l	2m sbk	10gr, 5k	t
C	20-52+	10YR 8/4	10YR 6/6	43	39	16	l	m	5s	t

Horizon	pH	Effervescence	EC x 1000	Solubility ppm Ca	Solubility ppm Mg	Solubility ppm Na	SAR	Percent Moist. Satur.
0*								
A1	6.3	eo	0.67	86.9	10.4	10.7	0.14	61
A2	5.6	eo	0.31	44.8	4.8	9.9	0.19	26
B21	5.6	eo	0.29	41.8	4.6	11.8	0.23	24
B22**	5.4	eo	0.26	35.0	5.8	15.0	0.31	21
C	5.6	eo	0.31	27.8	4.2	20.8	0.48	21

Taxonomic Classification: Loamy-skeletal, mixed, mollic cryoboralfs.
*Decomposing spruce/fir needles and twigs
**20% 10YR 7/2 and 15% 10YR 6/8 weathering stains

Map Units B, b, and f

These units consist of deep well drained soils that have formed in residuum and colluvium. They are on steep mountain slopes and benches with slopes of 35 to 50 percent. Included is 4 percent moderately deep similar soils.

Surface texture ranges from loam to a fine sandy loam. The argillic horizon texture ranges from a loam to a clay loam. The texture of the C horizon is variable due to location of weathered sandstone fragments ranging from clay to loam to a sandy clay. There is 5 to 10 percent by volume of rock fragments throughout the profiles. Thickness of surface horizons ranges from 8 to 14 inches. Depth of the argillic horizon ranges from 12 to 18 inches. Depth of the C horizon ranges from 26 to 30 inches, and depth to bedrock ranges from 48 to over 60 inches.

Erosion hazard is moderate. Soil creep is evident. If disturbed, erosion hazard is severe due to steep slopes and a past history of down-slope movement.

Potential rating for borrow topsoil is poor due to steep slopes. Otherwise, this is a good source. Predominant vegetation is aspen.

Table 2. Soil Analysis Data, Profile Description, Sample Site 11 Mapping Unit: B,b,& f

Vegetative Type: Aspen

Location: Permit Area

Horz.	Depth	Color Dry	Color Moist	Texture Sand	Texture Silt	Texture Clay	Class	Structure	Percent Rock Fgts.	Percent Org. Mat.
A11	0-3		7.5YR 3/2	50	28	22	scl	2mgr		6.98
A12	3-9		7.5YR 3/2	53	27	20	scl	1f sbk		4.78
B1	9-14		7.5YR 3/2	53	25	22	scl	2c sbk		1.81
B2+	14-24		10YR 3/3	51	28	21	scl	3mpr	2gr	1.44
B3	24-48		10YR 4/3	50	28	22	scl	2c sbk	7gr	0.77
C	28-50		10YR 5/4	41	24	25	l	m	5gr 10k	0.41

Horizon	pH	Effervescence	EC x 1000	Solubility ppm Ca	Mg	Na	SAR	Percent Moist. Satur.
A11	6.9	eo	0.20	63.5	10.9	9.6	0.15	49
A12	7.0	eo	0.43	42.6	5.6	11.8	0.23	36
B1	7.1	eo	0.38	34.6	4.0	22.1	0.47	28
B2+	7.0	eo	0.33	27.8	3.0	17.8	0.43	25
B3	6.9	eo	0.32	27.5	2.7	19.8	0.48	25
C	6.7	eo	0.37	35.5	4.0	23.7	0.50	27
R*								

Taxonomic Classification: Fine loamy, mixed Argic Pachic Cryoborolls
*Sandstone

Map Unit C

This unit consists of moderately deep, well drained soils that have formed in residuum and colluvium. They are on steep mountain slopes of 35 to 50 percent. Included in this unit are 5 percent similar shallow soils, 5 percent rock outcrop, and 3 percent similar deep soils.

Surface texture is silt loam to clay loam. Thickness of the surface ranges from 7 to 11 inches. Depth to the argillic ranges from 15 to 20 inches. Depth to sandstone bedrock ranges from 30 to 40 inches. There is 0 to 5 percent rock fragment by volume in the upper 30 inches. The C horizon ranges from 35 to 55 percent rock fragment by volume.

Erosion hazard is moderate at present and severe if disturbed due to steep slopes.

Potential rating for borrow topsoil is poor due to steep slopes. The dark surface soil averages 20 inches in depth.

Present vegetation is predominantly a grass and forb mixture with a few snowberry and elderberry bushes.

Table 3. Soil Analysis Data, Profile Description, Sample Site 12 Mapping Unit: C
Vegetative Type:Grass/Forb/Elderberry

Location: Permit Area

Horz.	Depth	Color Dry	Color Moist	Texture Sand	Texture Silt	Texture Clay	Class	Structure	Percent Rock Fgts.	Percent Org. Mat.
A11	0-4	10YR 3/2	10YR 3/2	22	45	33	cl	2m gr	2gr	5.31
A12	4-8		7.5YR 3/2	32	38	30	cl	1m sbk 2fgr	2gr	4.19
B21	8-19		10YR 4/2	34	35	31	cl	2c sbk	4gr	2.52
B22+	19-29		10YR 4/2	34	36	30	cl	2m pr	5gr	2.23
C	29-33		10YR 5/5	39	34	27	l	m	10gr 15k	0.83
R*	33+									

Horizon	pH	Effervescence	EC x 1000	Solubility ppm Ca	Mg	Na	SAR	Percent Moist. Satur.
A11	6.7	eo	1.28	26.1	24.8	15.7	0.26	44
A12	6.5	eo	0.44	47.7	5.4	14.7	0.27	39
B21	6.8	eo	0.33	34.1	2.9	16.8	0.37	35
B22+	6.8	eo	0.32	31.5	3.2	18.4	0.42	34
C	6.7	eo	0.35	36.8	4.0	17.6	0.37	29
R*								

Taxonomic Classification: Loamy-skeletal, mixed Argic Cryoborolls *Sandstone

Map Unit g

This unit consists of moderately deep, well drained soils that have formed in colluvium. They are on steep mountain sides with slopes of 35 to 50 percent. Included in this unit is 6 percent of Map Unit k, Cumulic Cryoborolls, and 2 percent rock outcrop.

Surface texture ranges from a loam to a fine sandy loam. C horizon texture ranges from a loamy very fine sand to a fine sand. Percent rock fragment by volume ranges from 10 to 15 at the surface and 35 to 70 in the C horizon. Depth to sandstone bedrock ranges from 25 to 38 inches.

Erosion hazard is moderate at present and severe if disturbed due to surface texture and steepness of slopes.

The potential rating for borrow topsoil is poor due to slope steepness. Present predominant vegetation is aspen.

Table 4. Soil Analysis Data, Profile Description, Sample Site 10 Mapping Unit: g

Vegetative Type: Aspen

Location: Permit Area

Horz.	Depth	Color Dry	Color Moist	Texture Sand	Texture Silt	Texture Clay	Class	Structure	Percent Rock Fgts.	Percent Org. Mat.
A1	0-6	10YR 4/2	10YR 3/2	63	21	16	sl	3f gr	10gr	7.83
AC	6-20	10YR 5/2	10YR 3/2	64	22	14	sl	2f sbk 2mgr	10gr 5k	2.81
C	20-31	10YR 6/3	10YR 5/4	64	22	14	sl	1m sbk	20gr 30k	0.58
R*	31+								20s	

Horizon	pH	Effervescence	EC x 1000	Solubility ppm Ca	Mg	Na	SAR	Percent Moist. Satur.
A1	6.6	eo	0.67	97.1	13.8	6.9	0.09	41
AC	6.7	eo	0.47	65.6	6.6	9.4	0.15	30
C	6.4	eo	0.35	49.1	4.5	10.7	0.20	23
R*								

Taxonomic Classification: Coarse loamy, mixed Pachic Cryborolls *Sandstone

Map Unit h

This unit consists of rock outcrops with less than 5 percent soil associated within the area. The soils dispersed among the rocky areas are similar to those described in Table 14. Because of the similarities no chart of soils features has been prepared for this mapping unit.

Table 14. Soil Analysis Data, Profile Description, Sample Site 7 Mapping Unit: v

Vegetative Type: Sagebrush

Location: Permit Area

Horz.	Depth	Color Dry	Color Moist	Texture Sand	Texture Silt	Texture Clay	Class	Structure	Percent Rock Fgts.	Percent Org. Mat.
A1	0-5	10YR 4/2	7.5YR 3/2	51	31	18	l	2f gr	15gr 15k 10s	5.25
B2	5-16	10YR 5/3	10YR 4/3	50	33	17	vfsl	2f sbk	5gr 30k 15s	1.32
R*										

Horizon	pH	Effervescence	EC x 1000	Solubility ppm Ca	Mg	Na	SAR	Percent Moist. Satur.
A1	7.1	eo	0.83	133.4	16.8	12.5	0.14	41
B2	7.1	eo	0.54	84.5	11.7	12.0	0.16	31

Taxonomic Classification: Loamy-skeletal, mixed lithic Cryocrepts *Sandstone

Map Unit i

This unit consists of deep, well drained soils that have formed in residuum. They are on moderately steep mountain slopes of 15 to 35 percent. Included in this unit is 8 percent of similar soil with 4 to 8 inches of mollic epipedon and 3 percent of a similar soil with 16 to 26 inches of mollic epipedon.

Textures in the surface are loam to very fine sandy loam. Textures in the C horizon are very fine sandy loam to loamy fine sand. Thickness of the surface horizon ranges from 8 to 14 inches. Depth to the C horizon ranges from 20 to 40 inches. Rock fragment content by volume is 5 to 15 percent in the surface horizon, 15 to 30 percent in the B horizon and 35 to 50 percent in the C horizon.

Erosion hazard rating for the topsoil is fair due to the percent rock fragment and slope steepness. In some places where the surface layer is less than 20 inches the rating is poor.

At present the dominant vegetation is aspen and grass.

Table 5. Soil Analysis Data, Profile Description, Sample Site 8 Mapping Unit: I

Vegetative Type: Aspen

Location: Permit Area

Horz.	Depth	Color Dry	Color Moist	Texture Sand	Texture Silt	Texture Clay	Class	Structure	Percent Rock Fgts.	Percent Org. Mat.
O*	1-2									
A11	0-2	10YR 4/2	7.5YR 3/2	59	26	14	sl	1mkpl 2fgr	5gr	6.53
A12	2-10	10YR 5/3	7.5YR 3/2	58	25	17	sl	2fobk 2mgr	10gr 5k	3.51
B2	10-23	10YR 6/3	7.5YR 4/4	59	26	15	sl	2m sbk	20gr 10k	1.58
C	23-48	2.5YR 7/4	10YR 5/4	47	29	24	l	m	15gr 20k	t
CR**	48-60+								k100	

Horizon	pH	Effervescence	EC x 1000	Solubility ppm Ca	Mg	Na	SAR	Percent Moist. Satur.
O*								
A11	6.9	eo	0.96	121.4	17.4	9.47	0.11	67
A12	6.8	eo	0.49	55.4	6.1	10.2	0.17	29
B2	6.7	eo	0.33	40.3	2.9	15.2	0.31	22
C	6.3	eo	0.31	35.0	3.4	18.6	0.40	30
C	5.6	eo	0.31	27.8	4.2	20.8	0.48	21

Taxonomic Classification: Loamy-skeletal, mixed typic Cryoborolla.
*Decomposing leaves and twigs **Weathering conglomerate

Map Unit k

This unit consists of very deep, well drained soils that have formed in alluvium and colluvium. They are on toe slopes of steep and very steep mountain sides. Slopes range from 15 to 35 percent. Included is 3 percent of a similar soil with 15 to 25 percent cobbles throughout the profile.

Surface horizon textures are silt loam, loam, or very fine sandy loam. The C horizon textures are very fine sandy loam to loamy fine sand and begin at 30 to 36 inches depth. Rock fragment by volume ranges from 0 to 15 percent at the surface and 15 to 35 percent in the lower horizons.

Erosion hazard is moderate at present and will be moderate if disturbed due to the location of the fans.

The potential rating for topsoil is good. There is a thick surface and there are few rock fragments in the top 40 inches.

Prodominant vegetation at present is aspen, snowberry, and elderberry.

Table 6. Soil Analysis Data, Profile Description, Sample Site 6 Mapping Unit: k

Vegetative Type: Aspen

Location: Permit Area

Horz.	Depth	Color Dry	Color Moist	Texture Sand	Texture Silt	Texture Clay	Class	Structure	Percent Rock Fgts.	Percent Org. Mat.
A11	0-4	10YR 4/2	7.5YR 3/2	59	25	16	sl	3f gr	10gr	6.16
A12	4-14	10YR 5/3	5.5YR 3/2	48	34	18	l	2 f&m sbk	10gr 5k	1.07
AC	14-32	10YR 6/3	10YR 3/3	49	33	18	l	2m sbk	10gr 10k	2.72
C	32-48+	10YR 6/3	7.5YR 4/4	52	31	17	l	1 m&c sbk	10gr 15k	t

Horizon	pH	Effervescence	EC x 1000	Solubility ppm Ca	Solubility ppm Mg	Solubility ppm Na	SAR	Percent Moist. Satur.
A11	7.3	eo	0.84	111.8	18.6	14.1	0.16	45
A12	7.2	eo	0.33	40.0	4.6	14.1	0.28	29
AC	7.2	eo	0.32	41.0	4.8	14.6	0.29	27
C	7.4	eo	0.31	38.7	4.5	14.2	0.29	26

Taxonomic Classification: Coarse-loamy, mixed cumulic Cryoborolls.

Map Unit 1

This unit consists of moderately deep, excessively drained soils that have formed in residuum and colluvium. They are on very steep south facing mountain slopes of 60 percent and more. There is 30 percent rock outcrop and 10 percent shallow soils.

Surface texture is loam to very fine sandy loam. The mollic epipedon ranges from 7 to 11 inches in thickness. Depth to sandstone bedrock ranges from 24 to 40 inches. Percent rock fragment by volume ranges from 15 to 30 percent in the surface horizons and 35 to 65 percent in the lower horizons.

Erosion hazard is moderate at present and severe if disturbed due to the steep slopes and sparse ground cover.

The potential rating for topsoil is poor due to the thin surface layers, large percentage of rock fragments, and very steep slopes.

Predominant vegetation is sagebrush and grass.

Table 7. Soil Analysis Data, Profile Description, Sample Site 5 Mapping Unit: 1

Vegetative Type: Sagebrush

Location: Permit Area

Horz.	Depth	Color Dry	Color Moist	Texture Sand	Texture Silt	Texture Clay	Class	Structure	Percent Rock Fgts.	Percent Org. Mat.
A11	0-3	10YR 4/2	10YR 3/2	30	54	16	sl	2f gr	10gr 5k	2.66
A12	3-8	10YR 5/2	10YR 3/2	54	27	19	sl	1f sbk	10gr 10k	1.86
B	8-24	10YR 7/3	10YR 5/4	56	30	14	sl	2f sbk	10gr 30k 10s	t
C	24-31	2.5YR 7/4	10YR 5/5	52	25	28	scl	1m sbk	5gr 25k 15s	t
R	31+ *									

Horizon	pH	Effervescence	EC x 1000	Solubility ppm Ca	Mg	Na	SAR	Percent Moist. Satur.
A11	7.3	eo	0.72	112.5	17.6	12.0	0.14	34
A12	7.3	eo	0.54	72.4	11.2	12.5	0.18	30
B	7.4	eo	0.37	52.3	8.3	11.2	0.19	25
C	7.4	eo	0.40	49.0	8.5	17.6	0.30	34
R								

Taxonomic Classification: Loamy-skeletal, mixed typic cryoboralfs. * Sandstone

Map Unit m

This unit consists of deep, well drained soils that have formed in colluvium and residuum. They are on steep slopes that range from 35 to 60 percent. There is 8 percent similar soils included in this unit and 3 percent rock outcrop.

The surface texture is loam or clay loam. The surface is 6 to 10 inches thick. The C horizon begins at 18 to 20 inches. The percent of rock fragment by volume ranges from 5 to 10 in the upper 20 inches and 35 to 75 below 20 inches.

Erosion hazard is moderate at present and severe if disturbed due to steepness of slopes.

The potential rating for borrow topsoil is poor. There is a large rock fragment content, the surface layer is stony and the slopes are steep.

Present vegetation is mostly big sagebrush, snowberry, and an understory of grass.

Table 8. Soil Analysis Data, Profile Description, Sample Site 4 Mapping Unit: m

Vegetative Type: Sagebrush

Location: Permit Area

Horz.	Depth	Color Dry	Color Moist	Texture Sand	Texture Silt	Texture Clay	Class	Structure	Percent Rock Fgts.	Percent Org. Mat.
A1	0-8	10YR 5/2	10YR 4/2	32	14	54	cl	3f gr	5gr	4.21
B2	8-19	2.5YR 7/2	2.5YR 6/4	22	37	14	cl	3f abk	5gr	t
C1	19-28	2.5YR 7/5	10YR 5/8	38	28	34	cl	2m sbk	15gr 25k	t
C2	28-36	2.5YR 7/2	10YR 6/3**	71	11	18	sl	m	5gr 20k 50s	t

Horizon	pH	Effervescence	EC x 1000	Solubility ppm Ca	Mg	Na	SAR	Percent Moist. Satur.
A1	7.3	eo	0.88	156.5	8.6	14.4	0.15	56
B2	7.6	eo	0.38	62.2	2.7	11.8	0.20	41
C1	7.7	eo	0.47	81.4	4.3	12.5	0.18	35
C2	7.8	eo	0.44	74.2	2.9	8.8	0.14	28

Taxonomic Classification: Loamy-skeletal,mixed typic cryoboralf.
* 20% 10YR 6/8 weathering stains **10% 10YR 6/8 weathering stains

Map Unit p

This unit consists of deep, somewhat poorly drained soils that have formed in recent stream alluvium. These soils are on stream floodplains. Slopes range from 0 to 3 percent. There is 8 percent inclusion of soil with gravel layers at a depth of 40 inches and 2 percent inclusion of soils that are better drained.

The ground water table is high during spring runoff at 8 to 10 inches. Texture throughout the profile ranges from silt loam to loamy fine sand. Thickness of lenses ranges between 2 and 8 inches. There is an area of .5 acres where there is a gravel layer at 2 to 4 inches depth. This is believed to have been hauled into a corral area.

There is a rating of good potential for borrow topsoil where the water table is below 12 inches. Otherwise, wetness is restrictive.

At present, the predominant vegetation is a grass and forb mixture.

Table 9. Soil Analysis Data, Profile Description, Sample Site 2 Mapping Unit: p

Vegetative Type: Disturbed

Location: Permit Area

		Color		Texture					Percent	Percent
Horz.	Depth	Dry	Moist	Sand	Silt	Clay	Class	Structure	Rock Fgts.	Org. Mat.
A1	0-5	10YR 4/2	10YR 2/2	46	34	20	l	3f gr		6.67
AC	5-12	10YR 5/2	10YR 5/2*	32	41	27	l	2m sbk		5.77
C1**	12-25	10YR 5/2	10YR 4/3	47	33	20	sl	m		4.31
C2	25-57	10YR 6/2	10YR 4/1	59	26	15	sl	m	65 gr	1.96
C3	57-67+	10YR 6/2	10YR 5/2	72	15	13	sl	m	65 gr	2.25

				Solubility ppm				Percent-
Horizon	pH	Effervescence	EC x 1000	Ca	Mg	Na	SAR	Moist. Satur.
A1	6.2	eo	3.22	745.0	71.7	15.0	0.07	47
AC	7.2	eo	2.20	455.7	46.1	14.2	0.08	44
C1	7.0	eo	2.31	499.2	66.6	16.0	0.09	42
C2	7.2	eo	1.66	348.2	45.1	20.6	0.14	35
C3	6.8	eo	2.26	499.2	61.4	24.2	0.14	33

Taxonomic Classification: Coarse-loamy, mixed, mollic Cryofluvent *Mottles begin at 8 inches
**C horizons are stratified layers of sands and silts that vary in thickness and in texture.

Map Unit q

This unit is moderately deep to gravel, and moderately well drained. These soils have formed in recent alluvium, and areas on stream terraces. Slopes range from 0 to 3 percent. There is 10 percent inclusion of similar soils in this unit.

The ground water is high during spring runoff at 18 to 24 inches. The surface texture is silt loam to loam. The C horizon texture is loam to loamy very fine sand. Depth to the gravel ranges from 28 to 36 inches.

Erosion hazard is slight at present and will remain slight if disturbed.

There is a rating of fair potential for borrow topsoil. The course texture in some lenses may be too sandy and the increase of coarse fragments below 40 inches depth makes reclamation potential of the borrow area fair.

The present predominant vegetation is a mixture of sagebrush, grasses, and forbs.

Table 10 Soil Analysis Data, Profile Description, Sample Site 1 Mapping Unit: q

Vegetative Type: Sagebrush

Location: Permit Area

Horz.	Depth	Color Dry	Color Moist	Texture Sand	Texture Silt	Texture Clay	Class	Structure	Percent Rock Fgts.	Percent Org. Mat.
A11	0-5	10YR 4/2	10YR 2/2	45	31	24	l	3f gr		6.02
A12	5-14	10YR 4/2	10YR 2/2	73	4	23	scl	3f gr		3.06
AC	14-24	10YR 5/2	7.5YR 3/2	45	36	19	l	1m sbk/2f sbk		1.27
C1	24-31	10YR 5/2	10YR 3/2	48	31	21	l	2c gr		1.36
C2	31-42+	10YR 5/3	10YR 3/3	59	21	20	sl	1fsbk	60 gr 4k	1.01

Horizon	pH	Effervescence	EC x 1000	Solubility ppm Ca	Mg	Na	SAR	Percent Moist. Satur.
A11	6.9	eo	2.92	422.4	47.4	13.8	0.08	44
A12	7.3	eo	1.20	235.5	30.4	14.2	0.14	35
AC	7.1	eo	0.97	151.7	32.5	19.4	0.19	30
C1	7.2	eo	0.89	151.8	32.8	26.6	0.25	32
C2	7.3	eo	1.10	204.8	37.3	16.6	0.14	28

Taxonomic Classification: Coarse-loamy, mixed, cumulic cryoborolls.

Map Unit r

This type consists of well drained soils that have formed in colluvium and residuum. Slope ranges from 8 to 15 percent. Elevations range from 8000 to 8100 feet. Present vegetation is predominately stinging nettle.

Erosion is slight at present and erosion will be slight if disturbed.

Suitability rating for topsoil is fair due to depth to bedrock.

Range of characteristics include a surface layer 3 to 5 inches thick with 5 to 15 percent rock fragments by volume. The topsoil is 6 to 10 inches thick with 10 to 20 percent rock fragments by volume. Texture of the subsoil is loam or sandy clay loam. The substratum is moderately deep to bedrock at a depth of 30 to 36 inches. There is 35 to 55 percent rock fragment by volume and a texture of loam or sandy loam in the substratum.

Included in this unit are 10 percent of the soils described in Unit p and 5 percent of a deep similar soil.

Table 11 Soil Analysis Data, Profile Description, Sample Site 15 Mapping Unit: r

Vegetative Type: Stinging nettle

Location: Permit Area

Horz.	Depth	Color Dry	Color Moist	Texture Sand	Texture Silt	Texture Clay	Class	Structure	Percent Rock Fgts.	Percent Org. Mat.
A1	0-4	10YR 3/2	10YR2.5/1	33	47	20	Loam	2f gr	10 gr	7.04
B2+	4-12	10YR 5/3	7.5YR 3/2	31	44	25	Loam	2m pr	15 gr	1.40
C1	12-23	10YR 7/3	10YR 4/4	36	44	20	Loam	massive	30 gr 15 cob t	
C2	23-34	10YR 6/4	10YR 4/4	37	41	41	Loam	massive	25 gr 15 cob t	
R	33								5 stone	

Horizon	pH	Effervescence	EC x 1000	Solubility ppm Ca	Mg	Na	SAR	Percent Moist. Satur.
A1	7.28	eo	0.43	146.0	28.5	17.9	0.18	66
B2+	7.46	eo	0.27	36.2	5.9	6.9	0.14	34
C1	7.61	eo	0.20	20.2	4.4	9.4	0.25	28
C2	7.48	eo	0.26	22.9	4.5	13.9	0.35	26

Taxonomic Classification: Typic argiborolls, coarse-loamy, mixed, frigid

Map Unit s

This is a complex consisting of 45 percent of the soil described in Unit t, 35 percent of the soil described in Unit u, and 10 percent of the soil described in Unit r.

Map Unit t

This unit consists of well drained soils that have formed in residuum. Slopes range from 8 to 15 percent. Elevation ranges from 8000 to 9100 feet. Present vegetation is predominately Douglas Fir and Engelmann Spruce.

Erosion is slight to moderate at present and the erosion hazard will be moderate if disturbed.

Suitability rating for topsoil is fair due to depth to bedrock. Range of characteristics include a surface layer 1 to 4 inches thick with 0 to 5 percent rock fragments by volume. The subsoil is 15 to 20 inches thick with 0 to 5 percent rock fragments by volume. The texture of the subsoil is sandy loam or loam. The substratum is moderately deep to bedrock at a depth of 30 to 36 inches. There are 20 to 35 percent rock fragment by volume and a texture of loam to sandy clay loam in the substratum.

Included in this unit are 15 percent of the soil described in Unit u to 5 percent of the soil described in Unit q.

Table 12 Soil Analysis Data, Profile Description, Sample Site 17 Mapping Unit: t

Vegetative: Spruce/Fir

Location: Permit Area

Horz.	Depth	Color Dry	Color Moist	Texture Sand	Texture Silt	Texture Clay	Class	Structure	Percent Rock Fgts.	Percent Org. Mat.
A1	0-2	10YR 3/2	10YR 2/2	35	44	21	Loam	3f gr	0	7.82
B21	2-11	10YR 4/2	10YR 3/3	35	41	24	Loam	2f sbk	5 gr	3.09
B22+	11-20	10YR 5/2	7.5YR 3/3	32	44	24	Loam	1f sbk	3 gr	1.35
C	20-33	10YR 6/3.5	10YR 4/4	35	40	25	Loam	massive	20 gr 5 cob	0.27
R	33									

Horizon	pH	Effervescence	EC x 1000	Solubility ppm Ca	Mg	Na	SAR	Percent Moist.	Satur.
A1	7.20	eo	0.68	104.0	17.7	4.96	0.06	75	
B21	7.36	eo	0.32	50.7	8.5	5.60	0.10	41	
B22+	7.48	eo	0.21	31.4	4.4	6.24	0.14	36	
C	7.31	eo	0.19	29.3	4.8	7.68	0.17	30	

Taxonomic Classification: Mollic eutroboralfs coarse-loamy, mixed, frigid with 15% u and 5% q

Map Unit u

This unit consists of well drained soils that have formed in residuum. Slopes range from 2 to 8 percent. Elevations range from 8000 to 8900 feet. Present vegetation is predominately aspen.

Erosion is slight at present and the erosion hazard will be slight when disturbed.

Suitability rating for topsoil is fair due to depth to bedrock.

Range of characteristics include a surface layer 8 to 12 inches thick with 0 to 5 percent rock fragment by volume. The substratum is moderately deep to bedrock at a depth of 35 to 40 inches. Texture is clay loam or sandy clay loam. Rock fragments by volume range from 10 to 20 percent.

Included in this unit are 10 percent of a similar deep soil and 5 percent of the soil described in Unit t.

Table 13. Soil Analysis Data, Profile Description, Sample Site 18 Mapping Unit: u

Vegetative Type: Aspen

Location:Permit Area

		Color		Texture					Percent	Percent
Horz.	Depth	Dry	Moist	Sand	Silt	Clay	Class	Structure	Rock Fgts.	Org. Mat.
A11	0-3	10YR 3/2	10YR 2.5/2	33	41	26	Loam	3m gr	3 gr	7.15
A12	3-9	10YR 4/2	10YR 2.5/1	37	37	26	Loam	3m sbk	0	2.76
B21	9-15	10YR 5/3	7.5YR 3/2	35	41	24	Loam	2c sbk	0	0.61
B22	15-23	10YR 6/3	10YR 3/3	35	40	25	Loam	2m pr	5gr 10cob	t
C1	23-32	10YR 6/4	10YR 4/4	35	37	28	Clay Loam	1f sbk	15gr	t
C2	32-37	10YR 6/4	10YR 4/4	31	36	28	Clay Loam	massive	15gr	t
R	37									

				Solubility ppm				Percent	
Horizon	pH	Effervescence	EC x 1000	Ca	Mg	Na	SAR	Moist.	Satur.
A11	7.23	eo	0.80	134.0	19.30	4.96	0.05	57	
A12	7.33	eo	0.41	61.9	9.14	6.72	0.11	39	
B21	7.41	eo	0.28	36.5	5.49	7.52	0.15	32	
B22	7.45	eo	0.21	27.7	4.46	6.88	0.16	27	
C1	7.26	eo	0.23	32.5	6.03	10.20	0.21	27	
C2	7.16	eo	0.30	21.3	3.98	16.80	0.44	33	

Taxonomic Classification: Typic haploborolls

Map Unit v

This type consists of shallow, excessively drained soils that have formed in colluvium and residuum. They are on steep to very steep mountain sides. Slopes are 35 to 60 percent. Included is 3 percent of a moderately deep similar soil and 8 percent rock outcrop. Textures range from loam to loamy very fine sand. Depth to fractured bedrock is 14 to 20 inches. Rock fragments range from 35 to 55 percent.

Erosion is moderate at present and the erosion hazard will be severe if disturbed due to sparse vegetation and steep slopes.

The potential rating for borrow topsoil is poor due to steep slopes, thin surface layers and the amount of rock fragments.

Predominant vegetation is sagebrush with a grass understory.

(Welch,et.al.,Endangered Plant Studies, Inc.,1980)

Table 14. Soil Analysis Data, Profile Description, Sample Site 7 Mapping Unit: v

Vegetative Type: Sagebrush

Location: Permit Area

Horz.	Depth	Color Dry	Color Moist	Texture Sand	Texture Silt	Texture Clay	Class	Structure	Percent Rock Fgts.	Percent Org. Mat.
A1	0-5	10YR 4/2	7.5YR 3/2	51	31	18	l	2f gr	15gr 15k 10s	5.25
B2	5-16	10YR 5/3	10YR 4/3	50	33	17	vfsl	2f sbk	5gr 30k 15s	1.32
R*										

Horizon	pH	Effervescence	EC x 1000	Solubility ppm Ca	Mg	Na	SAR	Percent Moist. Satur.
A1	7.1	eo	0.83	133.4	16.8	12.5	0.14	41
B2	7.1	eo	0.54	84.5	11.7	12.0	0.16	31

Taxonomic Classification: Loamy-skeletal, mixed lithic Cryocrepts *Sandstone

R614-301-224. Subsitute Topsoil.

Refer to R614-301-231.200 thru 301-231.300.

R614-301-230. Operation Plan.

R614-301-231. General Requirements.

R614-301-231.100.

The Valcam Loadout Facility was established prior to the topsoil requirement; however, some "substitute topsoil" was harvested, analyzed, and approved. This material is stored at the Belina Mine Site.

The General Office Area and the Belina Haul Road were constructed pre-law.

The majority of the topsoil, at the Belina Mine Site, was moved prior to the topsoil requirements, however; the remaining topsoil salvaged has since been used for reclamation around the Belina Mine Site. The material has been stabilized with vegetation and erosion control measures.

The stockpile contains approximately 975 cu. yds. of "substitute topsoil", which came from the enlargement of the 002A sediment pond, near the truckscale at the Valcam Loadout Facility. The excavated material met the criteria of and was approved by the Division.

R614-301-231.200.

There are no plans at this time to obtain topsoil from an off-site source. A Vegetation-Supporting Material (VMS) derived from the site will be utilized. The major sources of this Vegetation-Supporting Material have been identified as:

The pad immediately above 004A Sediment Pond;

Selected areas in the Valcam Loadout Facility.

The estimated quantity of VMS available at the Belina Mine Site is 36,000 cubic yards, and 20,000 cubic yards at the Valcam Loadout Facility.

Reclamation personnel from Morrison-Knudsen Company reviewed the analyses of the proposed Vegetation-Supporting Material and found no indication that the materials are unsuitable for use as a Vegetation-Supporting Material. The physical and chemical properties of the materials are generally acceptable in comparison to the topsoil salvaged at surface mines in the

western states. The suitability criteria are those used by the Wyoming Department of Environmental Quality, Land Quality Division.

Selected samples show high clay content, but these zones are within 4 feet, vertically, of zones containing coarser textured material, high clay zones would be blended during the recontouring process. The "high clay zones" should not present any real problems as only minimal cutting of the interpad slope will be necessary as dipicted on the reclamation drawings.

A low pH (5.5) value occurs in one of the samples. This should not present a problem as the same sample shows a positive acid-base potential of 10.3 tons of calcium carbonate per 1000 tons of soil. The low pH may have resulted from the high iron content of the material causing an iron oxide coating on the undisturbed calcium carbonate nodules. This would temporarily reduce the rate of reaction, allowing a low pH in the presence of excess carbonate.

Toxic constituents are not present at critical levels. Boron levels are less than 0.5 ppm. Molybdenum and selenium concentrations are below 0.2 ppm. Conductivity and SAR are also relatively low.

All acid-base potentials are positive. Soil acidity should not be a problem. Plant nutrients are present at moderate levels. The soil materials will be tested after final placement and fertilizer applied if it is determined to be necessary.

Soil samples were taken from these areas and analyzed to determine acceptability. September 16, 1986, James S. Leatherwood, Reclamation Soils Specialist, determined these soils met suitability rating as per his memo to the Divisions Technical File. For these soil sample analysis used for determination of acceptability for See Soils Appendix R614-301-200.

R614-301-231.300.

See R614-301-321.200., Mt. Nebo Scientfic and Cedar Creek data.

R614-301-231.400.

The topsoil storage area at the Belina Mine Site is closely surrounded by dense forest exhibiting a medium amount of deadfall and heavy ground cover. This provides excellent protection against wind erosion as well as rapid snow melt in the spring.

Drainage control ditches encompass the storage area to direct any migration of material toward the bermed basin at the east end of the stockpile. The bermed basin also denies vehicle access on to the stockpile.

** R614-301-200. **

Straw bales are utilized on the north facing side of the stockpile to assist in containment, should a slope failure occur. The stockpile has been vegetated with the approved temporary seed mix.

R614-301-232. Topsoil and Subsoil Removal.

R614-301-232.100. thru 301-232.720.

No additional disturbance is planned for the Mine Permit Area, however, should new disturbance become necessary, the Vegetation-Supporting Materials involved will be handled in accordance with UDOGM Regulations.

R614-301-233. Topsoil Substitutes and Supplements.

R614-301-233.100. thru 301-233.400.

Refer to R614-301-231.200.

R614-301-234. Topsoil Storage.

R614-301-234.100. thru 301-234.320.

Refer to R614-301-231.100.

Reclamation of each disturbed area will take place during the first appropriate season following the time when that area becomes available for such activities. Certain affected areas, such as cut and fill slopes on roads, operation pads, and outside slopes of sediment ponds, which required disturbance early in the operational life of the mines, are stabilized and revegetated. Other affected areas occupied by support facilities will not be reclaimed until the conclusion of mining activities.

R614-301-242. Soil Redistribution.

R614-301-242.100.

After demolition, cleanup, and the loose coal placement has occured, slopes which require recontouring will be scalped of Vegetation-Supporting Material (VSM) with the aid of paddlewheel scrapers, dozers, and or backhoes. This material will be stockpiled on the lower pad area near the truck loop while

recontouring takes place. The qualifing materials harvested during construction of the Whisky Creek Channel will placed upon the newly configured slopes.

Once an area has been prepared (maximizing roughness) for Vegetation-Supporting Material, redistribution of the VSM will be spread as uniformly as possible over the area. All VSM, whether stored or reharvested during reclamation, will be disc or broken up prior to placement. Spreading of VSM will not occur unless planting and mulching can follow immediately.

VSM redistribution will begin as soon as ground conditions allow in the spring, followed immediately by seedbed preparation, fertilization if required, (See R614-301-300. SOILS), planting and mulching, Test plots have been implemented to demonstrate the suitability of in-situ materials and the necessary depth of cover needed. See Test Plot Program (Ref. R614-301-341.300).

Results from these test plots will be utilized at least in part as well as the Division Guidelines to determine actual specifications for revegation of the disturbed areas.

R614-301-242.110. thru 301-242.130.

Refer to R614-301-340. Reclamation Plan. (Methology)

R614-301-242.200. thru 301-242.320.

The regraded land will be treated if necessary to reduce potential slippage of the material and to promote root penetration. Refer to R614-301-232. Topsoil and Subsoil Removal for Topsoil Replacement.

R614-301-243. Soil Nutrients and Amendments.

Nitrate nitrogen is low in quantity for soil types in the Mine Permit Area. The most important fertilizer to add is nitrogen, (Welsh, 1980). Prior to revegetation, soil tests in accordance with UDOGM will be taken in all areas to be revegetated and will be fertilized, if necessary as per the Division's recommended treatment values determined by the soil testing and the test plot data.

R614-301-244.100. thru 301-244.200.

Refer R614-301-340. Reclamation Plan.

R614-301-244.300. thru 301-244.320. Rills and Gullies.

** R614-301-200. **

All rills or gullies over nine inches deep which occur, will be filled with straw, graded and reseeded, or otherwise stabilized. All slopes will be monitored for such failures and corrected immediately when detected.

R614-301-250. Performance Standards.

R614-301-251. thru 301-252.

All topsoil and Vegetation-Supporting Materials, will be stockpiled, maintained, and redistributed according to R614-301-230. thru 301-240.

R614-301-500. ENGINEERING.

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OIL, GAS & MINING

R614-301-510. Introduction.

R614-301-511. General Requirements.

R614-301-511.300. Reclamation.

R614-301-512. Certifications.

R614-301-512.100. Maps and Cross Sections.

All maps and cross sections specified under R614-301-512.100. thru 512.150. are prepared by, or under the direction of, and certified by a qualified, registered, professional engineer or land surveyor, with assistance from professionals of related fields. All maps and cross sections will be updated when necessary.

R614-301-512.200. Plans and Engineering.

R614-301-512.210. thru 301-512.260.

Excess spoil, durable rock fills, coal mine waste, impoundments, primary roads, and variance from approximate original contour will be certified by a qualified registered professional engineer.

R614-301-513. Compliance MHSA Regulations and Approvals.

R614-301-513.100. Coal Processing Waste Dams or Embankments.

There are no coal processing waste dams or embankments constructed within the Mine Permit Area.

R614-301-513.200. Impoundments/Sediment Ponds.

There are no impoundments/sediment ponds which meet the MSHA size or qualifying criteria within the Mine Permit Area.

R614-301-513.300. Disposal of Underground Developement Waste Coal Processing Waste, or Excess Spoil.

Disposal of underground development waste, coal processing waste, or excess spoil disposed of in the underground mine workings will be in accordance with a plan approved by MSHA and the Division.

R614-301-513.400. Refuse Piles.

There are no refuse piles associated with the Mine Permit Area.

R614-301-513.500. Surface Openings.

All openings from the underground will be capped, sealed, backfilled or otherwise properly managed consistant with MSHA, 30 CFR 75.1771 (ref. to R614-301-551.).

R614-301-513.600. Discharges Into An Underground Mine.

No water will be discharged into the mine(s) until approved by MSHA and the Division (ref. R614-301-731.511.4).

R614-301-513.700.

N/A

R614-301-513.800. Coal Mine Waste Fires.

There are no coal mine waste disposal areas associated with the Mine Permit Area.

R614-301-514. Inspections.

All engineering inspections will be conducted by a qualified registered professional engineer or other qualified professional specialist under the direction of the qualified engineer, except as described under R614-301-514.330.

R614-301-514.100. thru 301-514.114. Excess Spoil Inspections.

Monitoring of all excess spoil fill will be conducted by the qualified registered professional engineer or specialist through out the duration of the project, which includes foundation
** R614-301-500. **

preparation, removal of organic material and topsoil, underdrains, protective filter systems, final surface drainage systems, final grading and revegation of the fill(s).

R614-301-514.120. Excess Spoil Certified Reports.

Certified reports will be provided to the Division by the qualified registered professional engineer promptly after each inspection of the fill(s) indicating proper construction and maintainance as designed and that it is in accordance to the approved plan and R614-301 and R614-302 Rules. The report will include any structural instability, weakness, or hazardous condition.

R614-301-514.130. Excess Spoil Drainage System and Protective Filters Certified Reports.

R614-301-514.131.

Certified reports will include color photographs during and after construction, prior to being covered with the spoil. This pertains to segmented construction as well.

R614-301-514.132.

Excess durable rock spoil placed in single or multiple lifts where the underdrain system is constructed simulaneously with excess spoil placement by the natural segregation of dumped materials, in accordance with R614-301-535.300. and R614-301-745.300., color photographs will be taken of the underdrain as the underdrain system is being formed.

R614-301-514.133.

Photographs will be of adequate size, scale, and number to depict the site features.

R614-301-514.140. Inspection Reports.

Copies of all inspection reports will be kept at the General Office.

R614-301-514.200. Refuse Piles.

Valley Camp has not constructed any refuse piles.

** R614-301-500. **

R614-301-514.210.

N/A

R614-301-514.220. thru 301-514.224.

N/A

R614-301-514.230.

N/A

R614-301-514.240.

N/A

R614-301-514.250.

N/A

R614-301-514.300. Impoundments.

N/A

R614-301-514.310. Certified Inspections.

N/A

R614-301-514.311.

N/A

R614-301-514.312.

N/A

R614-301-514.313.

N/A

R614-301-514.320. Weekly Inspections.

** R614-301-500. **

N/A

R614-301-514.330. Quarterly Inspections.

Other impoundments, not subject to MSHA, 30 CFR 77.216 are monitored quarterly by a qualified person designated by the operator for appearance of structural weakness and other hazardous conditions.

R614-301-515. Reporting and Emergency Procedures.

R614-301-515.100.

At any time a slide occurs which may have a potential adverse effect on public health, safety or the environment, Valley Camp will notify the Division as soon as possible and will comply with the remedial measures required to stabilized the slide.

R614-301-515.200. Impoundment Hazards.

If during an examination or inspection of an impoundment, there is a potential hazard discovered the person(s), who have examined the impoundment will inform the Division of the finding and of the emergency procedures formulated for public protection and remedial action. If adequate procedures cannot be formulated or implemented, the Division will be notified immediately.

R614-301-515.300. Temporary Cessation.

R614-301-515.310. thru 301-515.311.

During a temporary cessation, provisions of the approved permit will be carrried out. All mine portals will be maintained and the surface facilities will be secured where there is no current operations.

R614-301-515.312.

N/A

R614-301-515.320.

** R614-301-500. **

Should a temporary cessation of coal mining and reclamation operations of 90 days or more occur, the division will be notified by registered letter, which will contain the following required information.

1. Exact number of surface acres,

2. Horizontal and vertical extent of subsurface strata in the Mine Permit Area prior to cessation,

3. extent and kind of reclamation of surface area which will have been accomplished, and identification of the backfilling, regrading, revegetation, environmental monitoring, portal closures and water treatment activities taking place during temporary cessation.

R614-301-515.322.

N/A

R614-301-516. Prevention of Slides.

N/A

R614-301-520. Operation Plan.

R614-301-521. General.

This plan includes maps, cross sections, narratives, descriptions, and calculations indicating how the relevant requirements are met. Also the permit describes and identifies the lands subject to coal mining and reclamation operations over the estimated life of the operations.

R614-301-521.100. Cross Sections and Maps.

Cross sections, maps and plans shows all relevant information required by the Division.

R614-301-521.110. Previously Mined Areas.

R614-301-521.111.

** R614-301-500. **

Pleasant Valley Mining District Map (R614-301-521.111.) shows the location and extent of known workings of active, inactive, or abandoned underground mines, including mine openings to the surface within the Mine Permit Area and adjacent areas. These maps are prepared and certified according to R614-301-512.

R614-301-521.112.

N/A

R614-301-512.120. Existing Surface and Subsurface Facilities and Features Maps.

R614-301-512.121.

The maps show all buildings and within 1000 feet of the Mine Permit Area, with identification of the current use of the buildings.

R614-301-512.122.

Location of all surface and subsurface man-made features within, passing through, or passing over the Mine Permit Area are depicted on the maps which are most applicable.

R614-301-521.123.

All public roads located in or within 100 feet of the Mine Permit Area are shown on Permit Area Base Map, (R614-301-100.)

R614-301-521.124.

All pertinent features of this section are exhibited on the following 100 scale maps;

1. Valcam Loadout Facility (R614-301-521.124.), Sheet 1
2. Belina Haul Road (R614-301-521.124.) Sheet 2
3. Belina Haul Road (R614-301-521.124.) Sheet 3

4. Belina Mines
(R614-301-521.124.)
Sheet 4

R614-301-521.125.

For the location of each sedimentation pond (001A thru 004A) and the filter pond (005A), see R614-301-521.124.

R614-301-521.130. Landowners and Right of Entry and Public Interest Maps.

R614-301-521.131.

All boundaries of lands and names of present owners of record of both surface and subsurface within the Mine Permit Area are shown on the Surface Ownership Map (R614-301-112.500.) and the Coal Ownership Map (R614-301-112.600.), respectively.

R614-301-521.132.

The permit boundary is shown on all applicable maps.

R614-301-521.133. thru 521.133.2.

N/A

R614-301-521.140. Mine Maps and Permit Area Maps.

R614-301-521.141.

See R614-301-521.111.

R614-301-521.142. Planned Subsidence Mining Methods.

The subsidence "Draw Angle" lines as well as the mine plan forecast exhibits past, present and future mining methods used to control and minimize subsidence related damage. See R614-301-525.

R614-301-521.143. Disposal Sites.

There are no disposal sites within the Mine Permit Area.
** R614-301-500. **

R614-301-521.150. Land Surface Configuration Maps.

All design related contour maps are 1" = 50' with 5' contours or 1" = 100' with 5' contours. The 1" = 50' maps that are related to operations are be identified by Title, Regulation No. R614-301-5..... and with a Sheet No. beginning with O for operations, for example, Sheet No. O-1 thru.... The reclamation maps are identified by Title, Regulation No. R614-301-5..... and with a Sheet No. beginning with R for reclamation, for example, Sheet No. R-1 thru....

R614-301-521.151.

All design related contour maps show contours at least 100' above and below the coal outcrop.

R614-301-521.152.

The maps showing previously mined areas have contour lines at least 100' beyond the limits of mining disturbances.

R614-301-521.160. Maps and Cross Sections of the Proposed Features for the Proposed Permit Area.

R614-301-521.161. thru 301-521.169.

At this point in time no new surface features are planned.

R614-301-521. Transportation Facilities Maps.

The transportation facilities are shown on the following maps;

1. Valcam Loadout Facility
   (R614-301-521.124.)
   Sheet 1

2. Belina Haul Road
   (R614-301-521.124.)
   Sheet 2

3. Belina Haul Road
   (R614-301-521.124.)
   Sheet 3

4. Belina Mines
   (R614-301-521.124.)
   Sheet 4

R614-301-521.200. Signs and Markers Specifications.

** R614-301-500. **

R614-301-521.210. thru 301-521.230.

Signs and markers are posted, maintained, and will be removed by Valley Camp and are uniform design that can be readily seen and read; durable; and conform to local laws and regulations.

R614-301-521.240. thru 301-521.244. Mine and Permit I.D. Signs.

Indentification signs are displayed at each point of access to the Mine Permit Area from public roads and display name, address, phone number, and UDOGM I.D. number of the permittee. Also these signs will be maintained until after the release of all bonds for the Mine Permit Area.

R614-301-521.250. Perimeter Markers.

R614-301-521.251. thru 301-521.252.

All perimeter markers are clearly marked with orange markings on trees, orange or red painted "tee" posts.

R614-301-521.260. Buffer Zone Markers.

R614-301-521.261.

Buffer zone signs are located so as to prevent disturbance by the surface facility operations and meet the requirements of R614-301-731.600..

R614-301-521.262.

N/A

R614-301-521.270. Topsoil Markers.

Topsoil signs are in place at the Belina Mine Site and at the Valcam Loadout Facility. The sign at Belina is 18" x 24" and reads;

BELINA MINE
TOPSOIL
STORAGE AREA
DO NOT DISTURB

The sign at Valcam is 18" x 24" and reads;

** R614-301-500. **

VALCAM LOADOUT FACILITY
VEGETATION-SUPPORTING MATERIAL
DO NOT DISTURB

R614-301-522. Coal Recovery.

Valley Camp of Utah, Inc. operates the Belina No. 1 Mine (currently idle), and the Belina No. 2 Mine, both of which are near the head of Whisky Canyon, approximately 4.5 miles south of Scofield, Utah. Mining is currently being conducted in accordance with the Permit approved February 10, 1977, and Utah Division of Oil, Gas, and Mining Permit ACT/007/001.

The Belina No. 1 Mine and the Belina No. 2 Mine are located in the Upper and Lower O'Connor Seams, respectively. Each seam ranges in thickness from 5 feet to 25 feet, with the average of each being approximately 16 feet. Also see R614-301-523.

R614-301-523. Mining Method(s).

The mine plan calls for mining in the upper 12 feet of each coal seam. Approximately 2 feet of the upper-most coal are left in place to aid roof support. The next 10 feet (first mining) below is mined using a continuous miner. The remaining bottom coal is then extracted during the retreat (second mining) from each mining section.

Development mining techniques include a main entry system, a sub-main entry system developed off the mains, and room and pillar panels which are developed off the sub-mains. Components of each are described as follows:

a. Main Entry System-South-Composed of 5 entries (4 intakes and 1 neutral belt line), and 3 return entries on each side.

b. Main Entry System-West-Consists of 5 entries, 2 intakes, 2 returns and 1 neutral belt line.

c. Sub-main systems developed using 3 entries, 1 intake, 1 neutral belt line and 1 return.

d. Room and pillar entries consist of Multi-entries, intakes, returns, and 1 neutral belt line.

e. Room and pillar entries (bottom coal) Mid 1989, utilizes multi-intakes, 1 neutral belt line and multi-returns.

Room and pillar mining has been the only production method employed thus far.

For safety and recovery maximization, the Upper O'Connor coal seam will be mined first in a particular location.
** R614-301-500. **

Other mining methods which would improve utilization of the resource by increasing recovery are presently being investigated.

At present, protection of the gas lines is provided by limiting pillar extraction under these lines. The size of the restricted area of mining is determined by a 35 degree draw angle from the gas lines down to the seams. It is hoped that negotiations with the gas company and Federal and State agencies will result in the assumption of a steeper angle of draw, thus increasing the recovery while providing adequate support for the gas lines.

Non-recovery areas within the Mine Permit Area are only those areas remaining between mined out sections used for ventilation barriers, property line barriers, areas where the seams are so thin that mining is uneconomical, areas where adverse mining conditions jepordize the safety of employees and areas within a 150 foot radius of all oil and gas wells located in the Mine Permit Area (State and Federal requirements).

The current mining plan is described as the "Double Lift" mining method. This method utilizes a Remote Control Continuous Miner developing seven entries incorporating 60'x 60'room (X-Cuts) centers. The double lift mining will leave 18' to 20' high pillars with cross-sectional dimensions of 40'x 40'.

For further details see the Ground Control Study For Double Lift Mining Panels; August 1989; Kenneth C. Ko & Associates report. Appendix (R614-301-523.) Labled "Confidential"

The current design production level is 450,000 tons per year for Belina No. 2 Mine, actual production rates are below the designed maximum capacity because of present market conditions.

The primary mining equipment includes:

Joy 12RC continuous miner
Joy 12CM continuous miners
Joy 10SC shuttle cars
ATS roof bolters
Long-Airdox feeder breakers
Mantrips

The coal is cut from the working face by a Joy 12CM or Joy RCCM miner. Joy 10SC shuttle cars transport the coal to a Long-Airdox feeder breaker, which reduces the coal to a size compatable for the belt conveyors transporting the coal to the surface stockpile, used by both mines.

A variety of loaders, ramcars, compressors, transformers, and other miscellaneous support equipment are also used underground.

An underground reclaimer belt transports the coal from the outside stockpile to a 30 ton truck loading bin. The coal is then hauled to the Valcam Loadout Facility by a contract trucking company. The contractor utilizes bottom-dump trailers pulled in tandem, or one bottom dump trailer during inclement weather. Because of the moisture content of the product, coal dust emitted

from haulage activities is not a problem. In the event coal dust does become a problem, the appropriate control measures will be taken.

Spillage is controlled by limiting the trucks to loads which will not spill over the tops of the trailers while cornering, and by instructing drivers to keep the trailer dump gates closed during return trips.

The Roof Control Plan has been approved by MSHA. Their approvals are based on specific site conditions, mining experience in the area, and geologic information available. The approved Roof Control Plan addresses size of underground openings, pillar size, roof support methods, cross-cut centers, and coal recovery methods.

The design and operation of the mines comply with accepted engineering practices, and with all regulatory requirements. Ventilation Plan, Roof control Plan, and all other MSHA required plans are on file with MSHA and in the Belina Mine Office.

COAL PROCESS SCHEMATIC

```
        :
        :  12CM Miner                    Beltline
        :    \   12SC Car     Crusher    /      Belina Stockpile
        :.....\ ____      \____      \    /   ___/
              *[____}=== [____}=== (*)>>>>>>IoI
        ......                              IoI
        :          Belina Reclaimer         IoI
        :          Truck Loadout   \________I I_________
                                    \   [__V_____V_____V___]
 Valcam Truck Dump                   U<<<<<<<<<<<<<<<<<<<<<<<<
              \                     I I
               \                   _I_I_
                \                   _V___    _____
  Crusher       \   / - - - []={_____}-{_____}
      /          \./   \           \___________Truck-Trailer
    (*)<<<<<<<<<[-]    \______Eccles Canyon-Highway to Valcam
    \ /
     V>>>>>>>>>>>>>>>>>>>>>>IoI
                           IoI
                           IoI Valcam Reclaimer
Valcam Train Loadout ______I I______/
                \     [_V____V____V_]
                 U<<<<<<<<<<<<<<<<<<<<
            _____  __V_  _____  _____
 ====<<____]-[____]-[____]-[____]==========
                \
                 \ Unit Train to Customer
```

R614-301-523.100.

N/A

R614-301-523.200. thru 301-523.220.

N/A

R614-301-524. thru 301-524.760. Blasting and Explosives.

There are no plans to conduct surface blasting within the Mine Permit Area.

R614-301-524.800.

In the event it becomes necessary to use explosives (on the surface) at this operation, all state and federal laws and regulations will be complied with.

** R614-301-500. **

R614-301-525. Subsidence Control Plan.

R614-301-525.100. thru 301-525.300.

A presubsidence survey within or adjacent to the Mine Permit Area conducted by Valley Camp of Utah, Inc. has demonstrated that areas for agricultural or silvicultural production of food and fiber and grazing lands are of such low production that they can be classified as non-renewable resource lands.

Aquifers and areas for the recharge of aquifers and other underground waters will suffer minimal adverse impacts from the mining activities. Should subsidence occur, the subsidence cracks will likely seal rapidly, preventing the deep percolation of water and subsequent loss of springs and other water sources (Hansen, 1980). See R614-301-700.

The Subsidence Base Map (R614-301-525.) shows survey monument information, gas line locations, power lines and other pertinent surface features.

These land uses were determined by use of Federal Government land use maps and private consultants. Refer to R614-301-200. and R614-301-300., and to Soil Map (R614-301-223.100.) and Vegetation Map (R614-301-323.100.) respectfully.

The only structures which could be damaged if subsidence occurs are the gas pipelines. These structures will be protected by limiting extraction directly under the pipelines and within an area including a 35 degree angle of draw from the lowest coal seam to be mined. These areas are shown on the Subsidence Base Map (R614-301-525.).

Pursuant to applicant's presently approved Subsidence Control Plan, a cooperative agreement was reached with the Manti-LaSal National Forest USDA to monitor subsidence on an annual basis by photogrammetry.

The basis for the "non-renewable resource land" label was the vegetative work cited elsewhere, when the quality of the rangeland was evaluated. Such a label actually applied to the agricultural portion of the definition of a "Renewable Resource", and not to aquifers and areas for the recharge of aquifers or silvicultural production. Material damage or diminution of value of aquifers are discussed in the Vaughn Hansen Associates Report (1980).

The forest land is classed as a renewable resource, and as such, will be afforded maximum subsidence protection in order to ensure future productivity.

Should material damage be incurred by the Mountain States Resources natural gas pipelines, despite the approved subsidence damage prevention measures, the applicant will repair the damage to the pipelines caused by subsidence from the applicant's mining activities or compensate the owner of the pipeline for such damage.

** R614-301-500. **

Any area roads which are materially damaged by subsidence will be repaired and re-graded to restore them to pre-subsidence usefullness.

A buffer zone of at least 150 feet is left around natural gas wells in the mine area. Subsidence should not cause damage to the wells.

Our plans call for an angle-of-draw of 35 degrees. If the monitoring study indicates a different angle-of-draw, our plans will be modified. The basis for the self-healing characteristics can be found in the Vaughn Hansen Associates Report.

Also included as part of the Subsidence Plan is approval from the MMS for using a 35 degree angle-of-draw for limited extraction. It is anticipated that the true draw angle will be determined when the actual subsidence data are available.

In 1987 the Manti-Lasal National Forest USDA withdrew from the subsidence program, and in 1988 Valley Camp committed to conducting aerial surveys annually to monitor subsidence. During 1988, both the aerial survey and the pedestrian survey were completed. The aerial survey may negate the need to perform the pedestrian survey in following years.

Subsidence Monitoring Plan

1. Flying

   Includes 2 flight lines, 14 exposures covering the entire mine site. 2 sets of prints.

2. Digital Terrain Modeling (DTM)

   Surface scan on 100' grid (6000 points) covering entire mine surface and contour lines for subsidence location on 1' intervals.

3. Infared

   1 set of contact prints.

4. Horizontal and vertical control.

   Precise Horizontal and vertical control will be established for each monument and verified as required for future flights.

All contours and spot elevations will meet an accuracy of 0.10± to insure exact subsidence locations.

If subsidence occurs in a area where the density of the trees hamper the analyse, field or pedistrian survey(s) will supplement the aerial survey.

One copy of the Subsidence Map and data will be submitted to the Division each year.

** R614-301-500. **

The Subsidence Monitoring Plan will continue at least five years following reclamation of the mined area. Concurrance of all involved parties would be necessary for any additional annual monitoring for subsidence.

R614-301-526. Mine Facilities.

R614-301-526.100. Mine Structures and Facilities.

The mine structures and supporting facilities are shown on the following 100 scale Reference maps:

1. Valcam Loadout Facility
   (R614-301-521.124.)
   Sheet 1

2. Belina Haul Road
   (R614-301-521.124.)
   Sheet 2

3. Belina Haul Road
   (R614-301-521.124.)
   Sheet 3

4. Belina Mine Site
   (R614-301-521.124.)
   Sheet 4

The mine structures and supporting facilities "As-built" details are shown on the following 50 scale design maps:

Valcam Loadout Facility

Title	Drawing No.	Sheet No.
Valcam Loadout Facility	R614-301-526.100.	O-1
Valcam Loadout Facility	R614-301-526.100.	O-2
Valcam Loadout Facility	R614-301-526.100.	O-3

General Office Area

Title	Drawing No.	Sheet No.
General Office Area	R614-301-526.100.	O-4

Belina Haul Road

Title	Drawing No.	Sheet No.
Belina Haul Road	R614-301-527.	O-5

** R614-301-500. **

Title	Drawing No.	Sheet No.
Belina Haul Road	R614-301-527.	O-6
Belina Haul Road	R614-301-527.	O-7
Belina Haul Road	R614-301-527.	O-8
Belina Haul Road	R614-301-527.	0-9
Belina Haul Road	R614-301-527.	O-10
Belina Haul Road	R614-301-527.	O-11

Belina Mine Site

Title	Drawing No.	Sheet No.
Belina Mine Site	R614-301-526.100.	O-12
Belina Mine Site	R614-301-526.100.	O-13
Belina Mine Site	R614-301-526.100.	O-14

The mine structures, surface facilities are depicted on the above mentioned maps. Nomemclature symbols for all constructed features is as follows:

1. C=culvert
2. D=ditch
3. S=structure

At this time only one modification has taking place, it being an upgrade to the truck/train loadout belt conveyor. No new disturbance to the present area was required, as the new drive unit is directly under the existing belt conveyor, where approximately 30 cu. yds. of concrete were placed to mount the drive unit. The old feeders have been replaced with cone feeders to enhance the live storage of the Valcam coal stockpile. This upgrade will allow Valley Camp to load a unit train in just under two hours, as stipulated in the new coal contract.

R614-301-526.200. Utility Installation and Support Facilities.

All utility installations associated with Valley Camp coal mining and reclamation operations will be conducted in a manner which minimizes damage, destruction, or disruption of services provided by oil, gas, and water wells; oil, gas, and coal-slurry pipelines, railroads; electric and telephone lines; and water and sewage lines which pass over, under, or through the Mine Permit Area, unless otherwise approved by the owner of those facilities and the Division.

** R614-301-500. **

R614-301-526.220. thru 301-526.222.

The support facilities are being operated in accordance with a permit issued for the mine or coal preparation plant to which it is incident or from which its operation results.

The support facilities are located, maintained, and used in a manner that prevent or control erosion and siltation, water pollution, and damage to public or private property; and to the extent possible using the best technology currently available to minimize damage to fish, wildlife, and related environmental values; and minimize additional contributions of suspended solids to streamflow or runoff outside the Mine Permit Area.

R614-301-526.300. Water Pollution Control Facilities.

There are three sedimentation ponds (001A, 002A, and 003A) at the Valcam Loadout Facility and one (004A) at the Belina Mine Site. All were constructed on parallel lifts and meet OSM requirements. Also at the Belina Mine Site is a concrete filter pond (005A). All sed-ponds are used to protect the quality of surface water run-off and the filter pond is used to insure the quality of the mine water discharge, all of which are maintained by the mine personnel. In addition to normal maintenance, any pond will be cleaned in which the sediment capacity is reduced by 60 percent. The sedimentation ponds within the Mine Permit Area will be removed and reclaimed at the end of the reclamation.

There are no overburden stockpiles in the Mine Permit Area. Earth material removed during the construction of the benches at the Belina No. 1 Mine pad was used to construct the Belina No. 2 Mine pad area.

R614-301-527. Transportation Facilities.

Only two roads in the Mine Permit Area are classified as primary, those being the Truck/Train-Truck Dump Road (Primary Road No. 1) at the Valcam Loadout Facility and the Belina Haul Road (Primary Road No.1) are shown on their respective area maps.

R614-301-528. Handling and Disposal of Coal, Overburden, Excess Spoil.

N/A

R614-301-529. Management of Mine Openings.

Any mine opening which is temporarily inactive will be properly guarded so as to prevent access into the opening and posted to identify the hazardous nature of the opening. The devices will be periodically inspected and maintained in good operating condition by the Valley Camp.

R614-301-530. Operational Design Criteria and Plans.

None of the sediment ponds nor the filter pond are above any old or new mine workings. See Hydrology R614-301-700.

R614-301-533. Impoundments.

See Hydrology R614-301-700. for details.

R614-301-534. Roads.

All roads are shown on the following maps: (These 100 scale maps are for reference only)

1. Valcam Loadout Facility
   (R614-301-521.124.)
   Sheet 1

2. Belina Haul Road
   (R614-301-521.124.)
   Sheet 2

3. Belina Haul Road
   (R614-301-521.124.)
   Sheet 3

4. Belina Mine Site
   (R614-301-521.124.)
   Sheet 4

The MK report Appendix (R614-301-534) exhibits the non-compliance of the Belina Haul Road which constituted a Division variance requiring Visual Movement Indicators (VMI's). The VMI'S are located in the unstable areas of the road, and are to be monitored during high precipitation cycles. Signs have been posted warning the employees and the public of the potential hazards of the road.

All roads within the Mine Permit Area are inspected and maintained by a contractor.

R614-301-535. Spoil.

** R614-301-500. **

There is no spoil disposal site within the Mine Permit Area to date.

R614-301-536. Coal Mine Waste.

There is no coal mine waste disposal site within the Mine Permit Area to date.

R614-301-537. Regraded Slopes.

N/A

R614-301-540. Reclamation Plan.

R614-301-541. General.

R614-301-541.100.

At such time that the mining activities are completed, Valley Camp will close, backfill or otherwise permanently reclaim all affected areas, in accordance with the R614 Rules and the approved permit.

R614-301-541.200.

N/A

R614-301-541.300.

All surface equipment, structures, or other facilities not required to support reclamation will be removed and the affected land reclaimed.

R614-301-541.400.

This Reclamation plan for the Mine Permit Area, shows how Valley Camp will comply with R614-301, and the environmental protection standards of the State Program.

R614-301-542. Narratives, Maps and Plans.

R614-301-542-100.

** R614-301-500. **

RECLAMATION SCHEDULE

At this time it is planned to Reclaim the Valcam Loadout Facility (VLF), General Office Area (GOA), Belina Haul Road (BHR) and the Belina Mine Site (BMS).

Step 1 (Yr. 1)

VLF	GOA	BHR	BMS
Demolition	-----	Demolition	Demolition

1. Remove all buildings and structures;
2. place rubble (concrete and coal contaminated material);
3. remove non-critical culverts, power poles, and etc.

Step 2 (Yr. 1)

VLF	GOA	BHR	BMS
Grading	-----	Grading	Grading

1. Recontour to achieve Approximate Original Contour;
2. scarify and disc in preparation for revegetation phase.

Step 3 (Yr. 1)

VLF	GOA*	BHR	BMS
Revegetation	Revegetation	Revegatation	Revegetation

1. Seed, fertilize, and mulch.

* If the General Office Area requires any area(s) to be reseeded for erosion control it could be done during this phase.

Step 4 (Yr. 2)

VLF	GOA	BHR	BMS
Plant Seedlings	-----	Plant Seedlings	Plant Seedlings

1. Plant all seedlings. (With a years growth of the grasses and forbs, survival rate of the seedlings should increase by virtue of the greater selection of foliage available to browsing animals at the time of planting).
2. The immediate area around the seedling bed will be scalped of vegetation to prevent moisture competition with existing foliage.

R614-301-542.200. thru 301-542.600.

** R614-301-500. **

The plan for backfilling, soil stabilization, compacting and grading, includes contour maps and cross sections exhibiting the anticipated final surface configuration of the disturbed areas, in accordance with the applicable regulations. All maps are prepared and certified as described under R614-301-512..

Prior to abandoning the Mine Permit Area or seeking bond release, an aerial survey will be done and used to generate final configuration contour maps to evidence all temporary facilities have been removed and reclaimed and all permanent structures are stable.

R614-301-542.600. thru 301-542.630. Roads.

Any road not to be retained for postmining land use will be closed during the last phase of reclamation.

R614-301-542.700. Final Abondonment of Mine Openings and Disposal Areas.

R614-301-542.710.

All portals will be backfilled and compacted as far inby as possible by mechanical means prior to the recontouring of each portal bench. See R614-301-553. for the anticipated final configuration cover depths.

R614-301-542.720. Disposal of Excess Spoil.

There are no disposal areas within the Mine Permit Area.

R614-301-542-730. Disposal of Coal Mine Waste.

There are no disposal areas within the Mine Permit Area.

R614-301-542.740. Disposal of Noncoal Mine Wastes.

R614-301-542.741.

All noncoal mine waste materials are transported from the Mine Permit Area by licensed contractors and disposed of in approved waste disposal areas.

R614-301-542.742.

** R614-301-500. **

Final disposal of noncoal mine wastes will be at state-approved solid waste disposal areas.

R614-301-550. Reclamation Design Criteria and Plans.

R614-301-551. Casing and Sealing of Underground Openings.

Permanent closure measures are designed to prevent access to the mine workings by people, livestock, wildlife, machinery and to keep acid or other toxic drainage from entering ground or surface waters.

Utah No. 2 Mine is located at the Valcam Loadout Facility and lies just east of the D&RGW railroad and north of the crusher building and is in the Upper O'Connor coal seam. This mine was officially closed September, 1989. Portals 1 thru 5 were removed and the openings were backfilled approximately 25' to 30' with the aid of heavy equipment. Portal 6 was backfilled, however, the portal headwall will remain to support the highwall until such time as reclamation is accomplished. At that time Portal 6 will be removed or be covered with at least four feet of compacted material and the highwall stabilized. Portal 7 will be sealed but remain until reclamation takes place as the beltline tailpiece for the crusher building is in the portal mouth.

R614-301-552. Permanent Features.

R614-301-552.100.

Small depressions will be left as needed to retain moisture, minimize erosion, create and enhance wildlife habitat, or assist revegetation.

R614-301-552.200.

There will be no permanent impoundments left within the Mine Permit Area.

R614-301-553. Backfilling and Grading.

All material placed will be in a controlled manner.

R614-301-553.100. thru 301-553.150.

Valcam Loadout Facility

** R614-301-500. **

The Valcam Loadout Facility reclamation will stabilize the slopes, minimize erosion, water pollution and support the approved postmining land use.

The disturbed areas will be backfilled and graded to achieve the approximate original contours. There will be no highwalls within this area and all slopes will be as approved by the Division, with the exception of the recontoured backslopes involved within the D&RGW Railroad right-of-way to which provided additional grade width for Coastal States Energy's spur track.

Culvert No. C-14-42 near the crusher building will be removed and the new channel will be established. See R614-301-760. and Valcam Channel Reclamation (Figure R614-301-760a.)

Culverts not required for the railroad right-of-way or access road will be removed during reclamation.

Maps which deal with this area are as follows:

Title	Drawing No.	Sheet No.
Valcam Loadout Facility	R614-301-550.	R-1
Valcam Loadout Facility	R614-301-550.	R-2
Valcam Loadout Facility	R614-301-550.	R-3

For vegetation see R614-301-340..

General Office Area

The general office and area around it will be retained for educational and or recreational purposes.

The map which deals with this area is as follows:

Title	Drawing No.	Sheet No.
General Office Area	R614-301-550.	R-4

Belina Haul Road

The Belina Haul Road reclamation will achieve stability of the slopes, and minimize erosion and water pollution and to support the approved postmining land use.

All asphalt and concrete will be scarified and crushed with heavy equipment to a point its compactibility is satisfactory as fill against the toe of the backslope in the first lift placed during reclamation.

** R614-301-500. **

All lifts will be overfilled, compacted and the loose material on the outslope incorporated in the next lift. This technique decreases the chance of superficial failures of the outslope and leaves the soil surface compatible for revegetation. Each lift will be keyed into the existing backslope where there is a potential for abnormal slippage, this will be determined at the time of reclamation.

Some large boulders will be left exposed along the route and any rocks to large to be used in the fill, with UDOGM approval could be placed at various locations along the reclaimed road for wildlife enhancement. Available logs (deadfall) can also be utilized for enhancement of the reclamation.

Where there are well traveled game trails crossing the Belina Haul Road, new trails will be placed on the fill slope in an effort to minimize erosion that could occur by the animals traversing the newly constructed areas and eventually creating trails.

The culverts will be removed and those drainages reestablished and armored with an approved riprap.

Culvert No. C-21-42 at the entrance gate in Eccles Canyon are to remain until the final phase of reclamation, at that time it will be removed and the channel reconstructed. This culvert lies within the UDOT Highway right-of-way. Valley Camp will advise UDOT of the intent to remove the culvert and will incorporate the State specifications to design and construct the cut slope within the right-of-way.

Culvert No. C-25-36 at the "Big Fill", which carries the drainage from the Bowl Area, will also be removed and the stream channel reconstructed on the natural ground as much as possible. The majority of the fill is to be removed and utilized during reclamation.

The areas along the road which are not able to be returned to the approximate original contour are so indicated on the Belina Haul Road 50 scale drawings.

Maps which deal with this area are as follows:

Title	Drawing No.	Sheet No.
Belina Haul Road	R614-301-550.	R-5
Belina Haul Road	R614-301-550.	R-6
Belina Haul Road	R614-301-550.	R-7
Belina Haul Road	R614-301-550.	R-8
Belina Haul Road	R614-301-550.	R-9
Belina Haul Road	R614-301-550.	R-10

** R614-301-500. **

Title	Drawing No.	Sheet No.
Belina Haul Road	R614-301-550.	R-11

Belina Mine Site

Disturbed areas will be backfilled and graded to achieve the approximate original contour to eliminate the highwalls to the extent possible. The postmining slopes will not exceed the angle of repose unless they meet the minimum long-term static safety factor of 1.3.

Slopes are designed to minimize erosion and water pollution both on and off the site and support the approved postmining land use.

The majority of fill material used to achieve the recontouring efforts at the Belina Mine Site will be obtained from the lower pad area and the 004A pond embankment and its foundation.

Final configuration of the postmining land is designed to stabilize the slopes, control erosion, conserve soil moisture and reestablish the area to conform with the surrounding land use.

The Whisky Creek rechannelization will have a stream bottom with a flood plane which is designed for high precipitation events. There will be four different quadrant areas in the stream bottom allowing a mean gradiant percent for velocity control thru the Belina Mine Site disturbed area.

Rechannelization will for the most part be established near the toe of the north facing slope thus leaving the new channel primarily on natural ground.

The reclaimed watershed reaches have their flows directed so as to be deenergized before entering the stream channel. All outslopes are to be lined with silt fence which will be held in place with hardwood stakes or the equivalent and installed as per UDOGM recommendations. See R614-301-760. and Belina Channel Reclamation (Figure R614-301-760a.)

The 50 scale Reclamation Maps which deal with this area are as follows:

Title	Drawing No.	Sheet No.
Belina Mine Site	R614-301-550.	R-12
Belina Mine Site	R614-301-550.	R-13
Belina Mine Site	R614-301-550.	R-14

For revegetation see R614-301-340..

R614-301-553.200. Spoil and Waste.
** R614-301-500. **

All spoil and waste materials will be placed in the most suitable locations within the affected area(s) to ensure stability and or to prevent leaching.

R614-301-553.210. thru 301-553.240.

R614-301-553.250. Refuse Piles.

N/A

R614-301-553.300.

Exposed coal seams, acid-and toxic-forming materials and combustible materials exposed, used, or produced during mining will be adequately covered with nontoxic and noncombustible materials, or treated, to control the impact on surface and ground water in accordance with the regulations, to prevent sustained combustion, and to minimize adverse effects of plant growth and the approved postmining land use.

R614-301-553.400. thru 301-553.420.

N/A

R614-301-553.500. Previously Mined Areas.

There are no remining operations within the Mine Permit Area.

R614-301-553.600. Approximate Original Contour.

Areas which Valley Camp is requesting UDOGM "Variance Approval" for "Retention of Highwalls" are shown the following maps:

The Belina Haul Road (R614-301-550.); Sheets R-5 thru R-11, and the Belina Mine Site (R614-301-550.); Sheets R-12 thru R14.

** R614-301-500. **

R614-301-800. BONDING AND INSURANCE.

R614-301-820. Requirement to File a Bond.

R614-301-820.100.

The permit renewal application under R614-301 has been approved, and prior to the permit being issued, Valley Camp of Utah, Inc. filed with the Division, on a form prescribed and furnished by the Division, a bond for performance made payable to the Division and conditioned upon the faithful performance of all the requirements of the State Program, the permit and the reclamation plan.

On November 17, 1989, the Utah Division of Oil, Gas and Mining and Valley Camp of Utah, Inc. entered into a Coal Reclamation and Bonding Agreement.

BOND TYPE (Form of Bond)	Performance
BOND (Bond Amount-Dollars)	2.3 Million
(Year-Dollars)	1989
INSTITUTION (Bank or Agency)	Federal Insurance Co. (CHUBB GROUP of Insurance Co.) 15 Mountain View Road, Warren, New Jersey 07060
POLICY OR ACCOUNT NUMBER	8099-56-50
LIABILITY INSURANCE (Exp)	Ongoing
(Insurance Company)	The Home Indemnity Company P.O. 5160 Manchester, New Hampshire 03108
POLICY OR ACCOUNT NUMBER	GL 99 48 43

For further details see Appendix R614-301-820.100. Reclamation Agreement.

R614-301-820.110. Areas to be covered by the Performance Bond.

R614-301-820.111. thru 301-820.114.

The bond covers the entire Mine Permit Area which is utilized by Valley Camp's coal mining and reclamation operations.

See R614-301-500 Reclamation maps for the effected and disturbed area boundaries.
** R614-301-500. **

R614-301-820.120.

Prior to any new surface disturbances, Valley Camp will adjust the performance bond to the amount approved by the Division.

R614-301-820.130. thru 301-820.224.

Valley Camp has filed and received the approval of the Division, a performance bond to cover the bond amount for the Mine Permit Area as determined in accordance with R614-301-830.

R614-301-820.300. thru 301-820.352. Period of Liability.

The performance bond liability is for the duration of the coal mining and reclamation operations and for a period which is coincident with Valley Camp's period of extended responsibility for successful revegetation provided in R614-301-356. or until achievement of the reclamation requirements of the State Program and permit, whichever is the later.

M A S S B A L A N C E V O L U M E S

VALCAM LOADOUT FACILITY

Cut	Fill
0-1 - 2,100	0-1 - 8,100
1-2 - 11,400	1-2 - 8,900
2-3 - 20,800	2-3 - 10,200
3-4 - 11,000	3-4 - 10,900
4-0 - 3,100	4-0 - 3,900
48,400 Cu. Yds.	42,000 Cu. Yds.

BELINA HAUL ROAD

Cut	Fill
68,000 Cu. Yds.	78,400 Cu. Yds.

BELINA MINE SITE

Cut	Fill
0-20 - 17,800	0-20 - 21,800
20-21 - 139,200	20-21 - 41,000
21-22 - 82,000	21-22 - 10,200
22-23 - 25,000	22-23 - 4,200
23-0 - 9,700	23-0 - 1,200
273,700 C. Yds.	78,400 Cu. Yds.