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APPENDIX L

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

Prepared for

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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.

FIGURES

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.			No groundwater 38 hours after drilling.
				D&M 2-2	7 13 19	
9218.8	11.3					
9218.1	12		Weathered sandstone			
		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).			
9210.1	20			SPT 2-4	3 11 8	N=19

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 10 50	in 5" N=60+
9203.6	26.5		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 46	N=64
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					
9108.8	20.5	CL-CH	As before			
			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. DBM 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: 9-16-8

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.			
				SPT 4-3	34 50	in 5" N=80+
9160.1	16		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).	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**

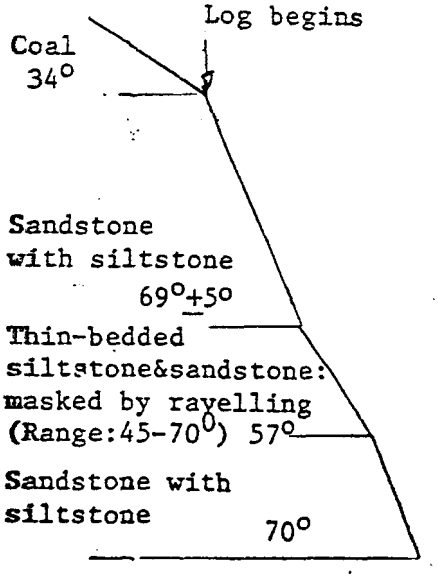
LOG OF CUT SLOPE

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. DBM 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. 1630-02 PAGE 1 OF

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	MASSIVE SANDSTONE OVERLAIN BY LOWER COAL STRATUM	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		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

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

FILLING ABBREVIATIONS			
N	NONE		

T_L, T_U = TERMINATIONS

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

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.

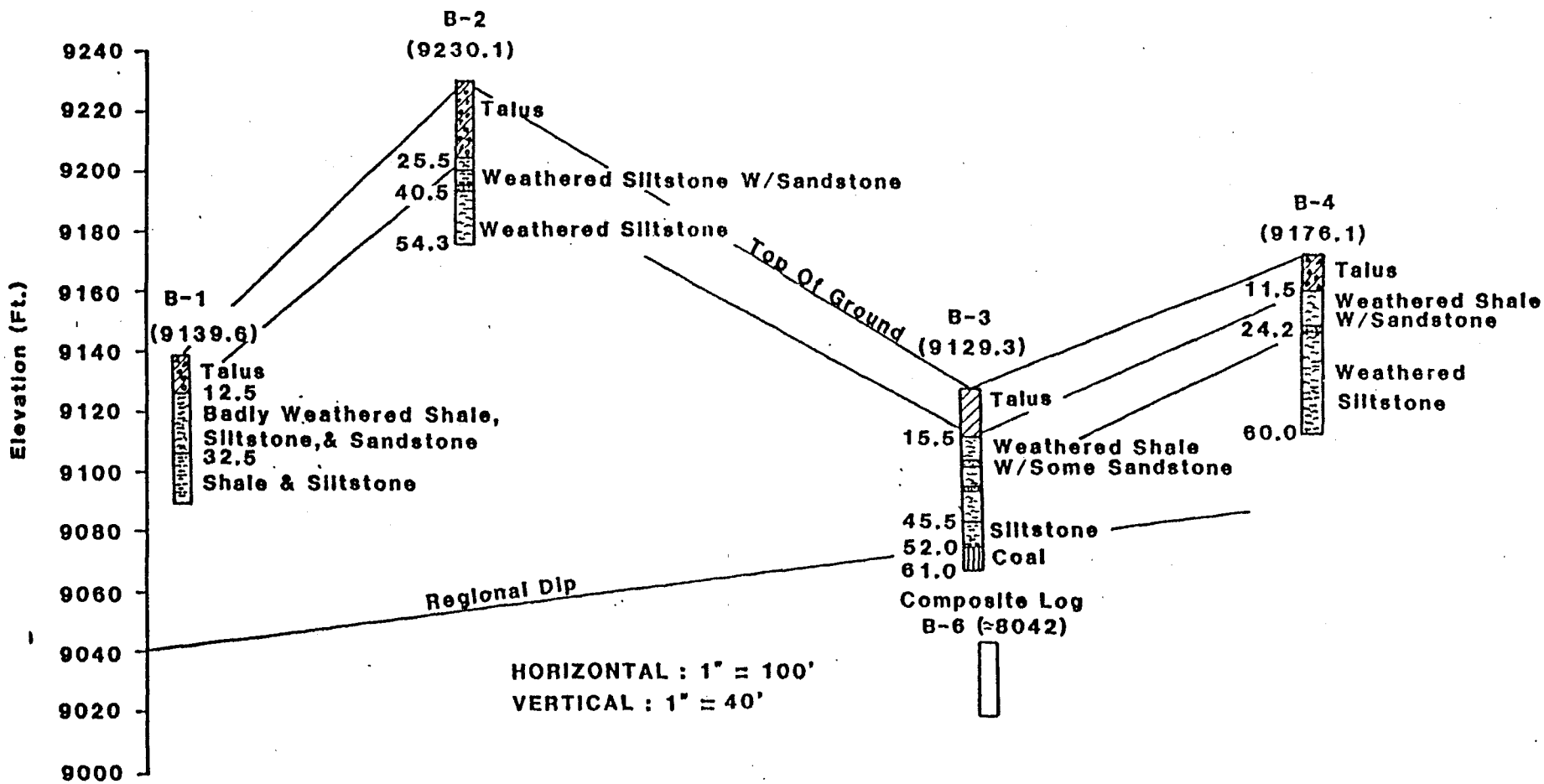
*Indicates areas that may require maintenance and (or) remedial work.

Figure 12

Geotechnical Mileage Log of Cut Slopes, cont.

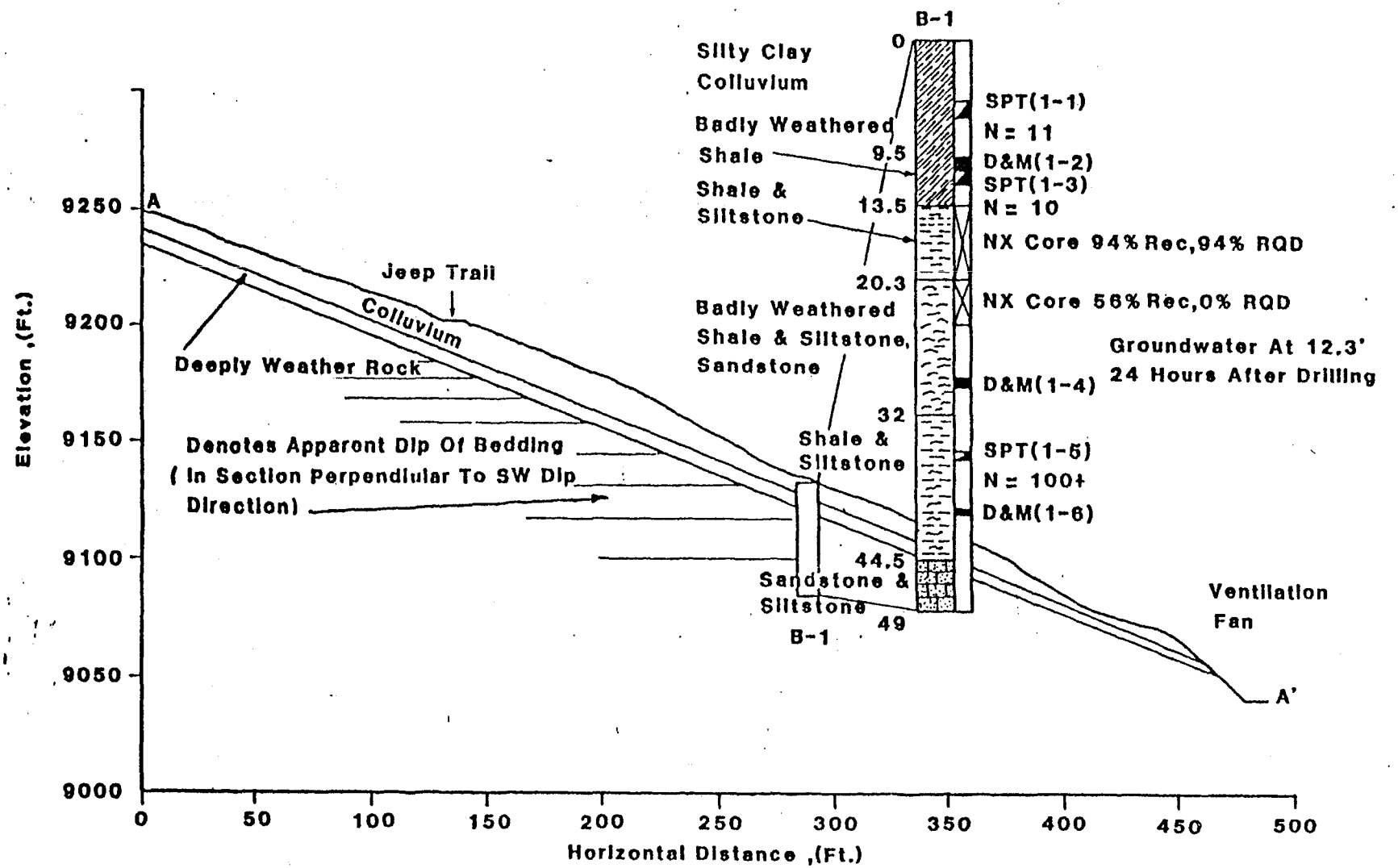
Odometer Mileage	Description
1.32	15' cut, 42° in weathered rock (top 6') and competent rock with dip into slope. Some ravelling will occur from the top of the cut. At mile 1.28, primary joint set strikes N10°E with dip of 85°E.
1.40	20' high cut, 35° in weathered rock, 55° in competent rock (sandstone/siltstone) 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

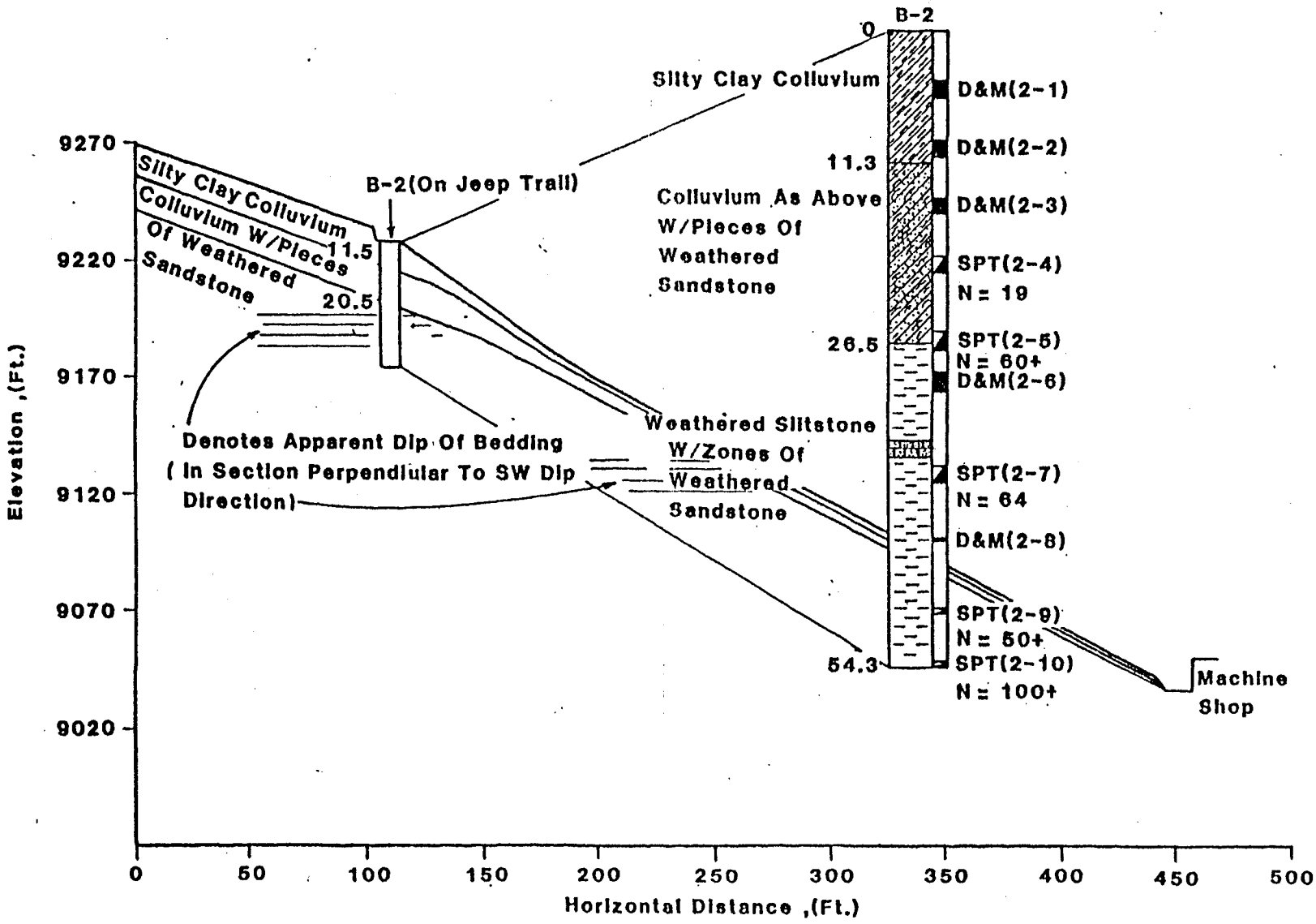
FIGURE 14



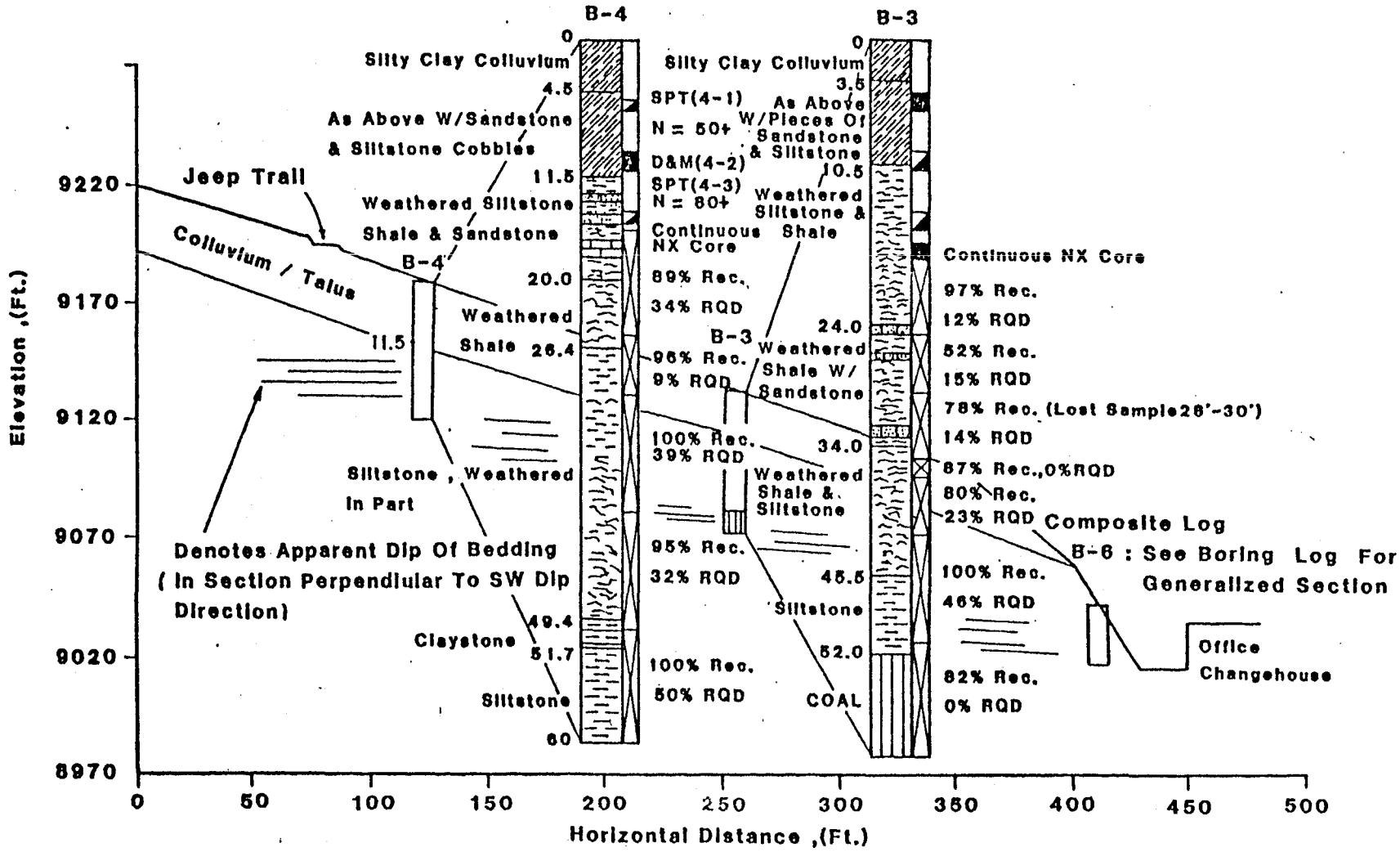
VALLEY CAMP OF UTAH , INC.
BELINA MINE , CARBON COUNTY

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



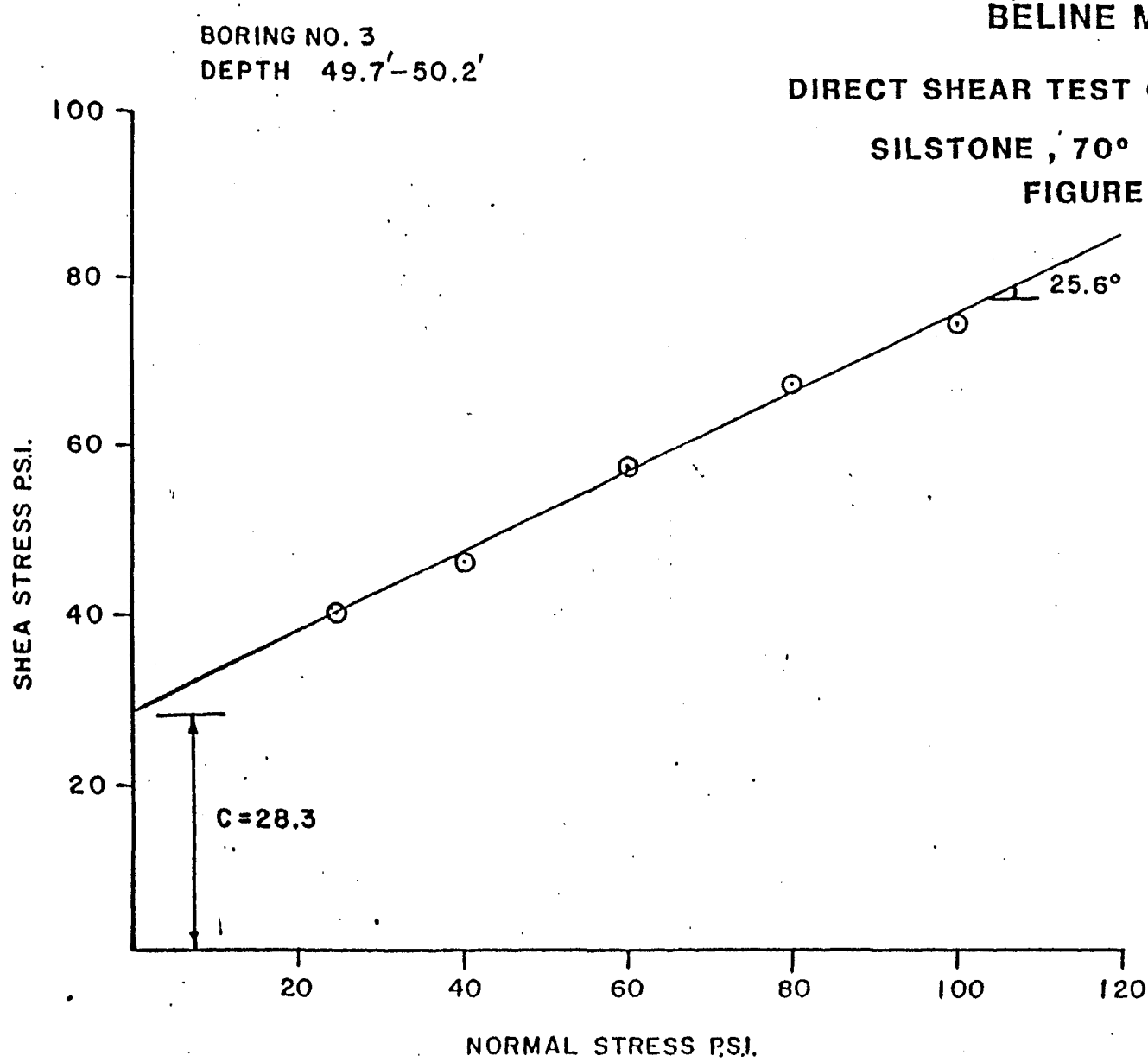
VALLEY CAMP OF UTAH ; INC.
BELINA MINE , CARBON COUNTY
UPPER PORTAL BACKSLOPE SECTION C - C'
FIGURE 17

VALLEY CAMP OF UTAH , INC.
BELINE MINE

DIRECT SHEAR TEST ON DISCONTIUITY :

SILSTONE , 70° OPEN JOINT

FIGURE 18

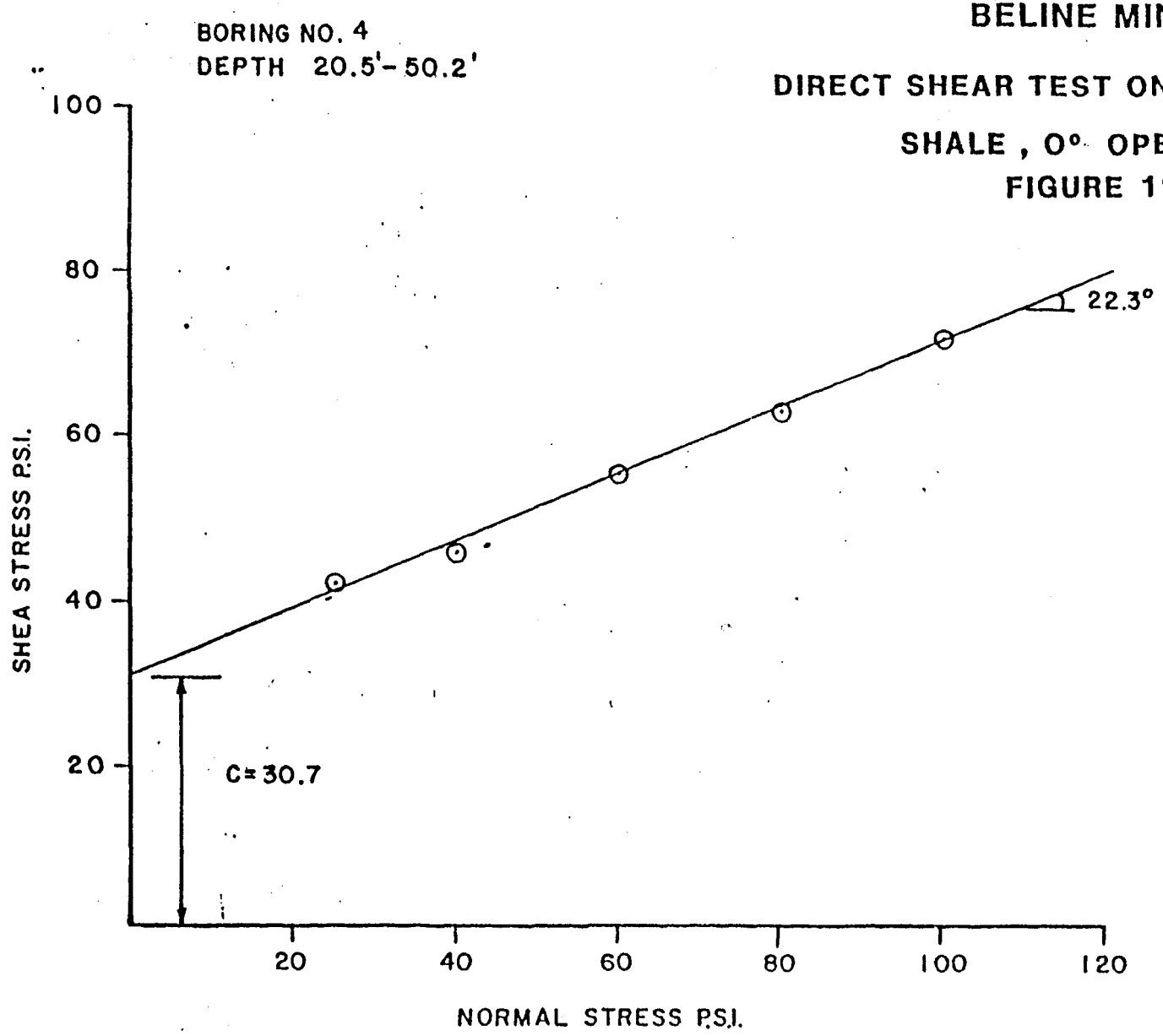


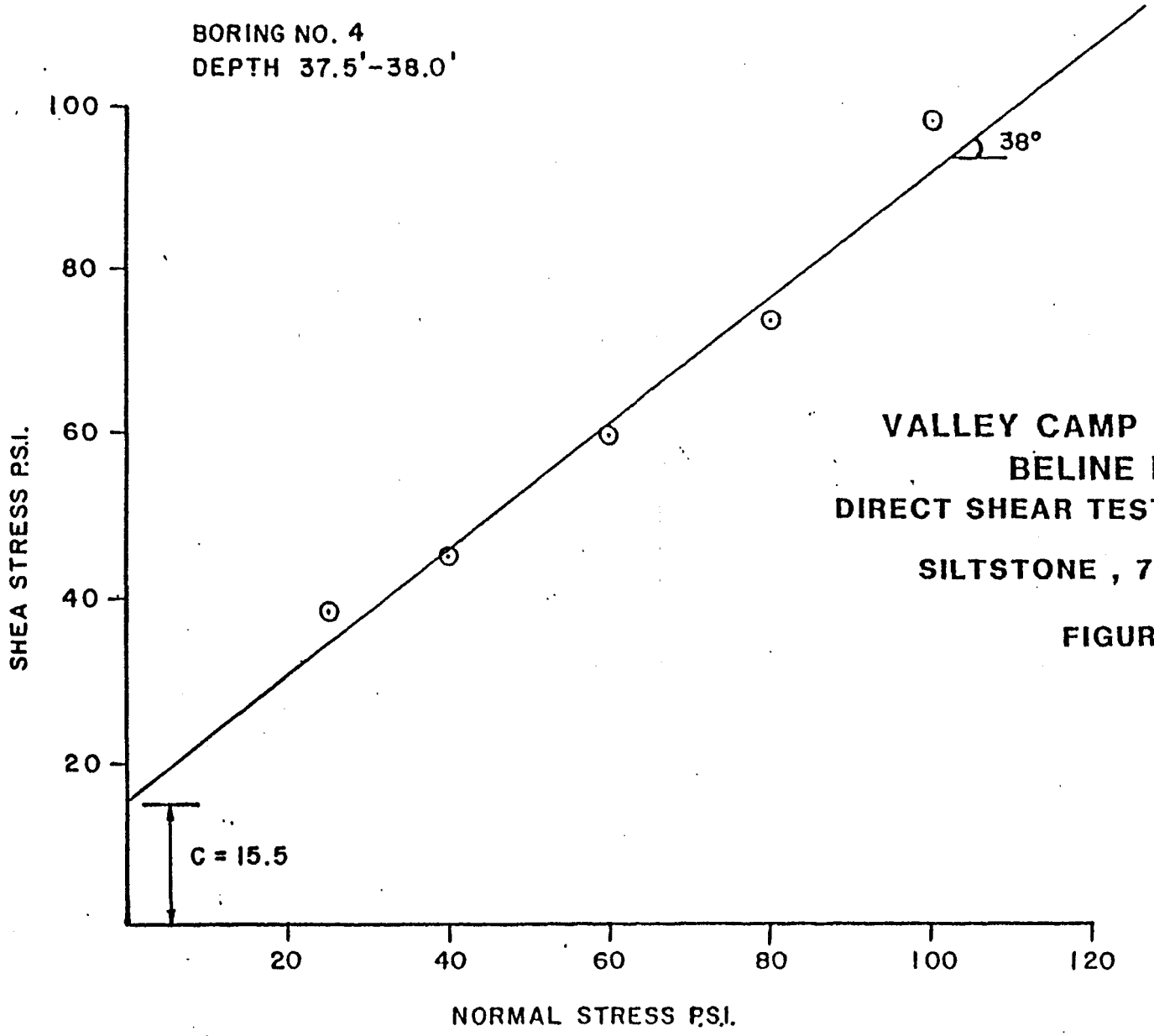
VALLEY CAMP OF UTAH , INC.
BELINE MINE

DIRECT SHEAR TEST ON DISCONTIUITY :

SHALE , 0° OPEN JOINT

FIGURE 19

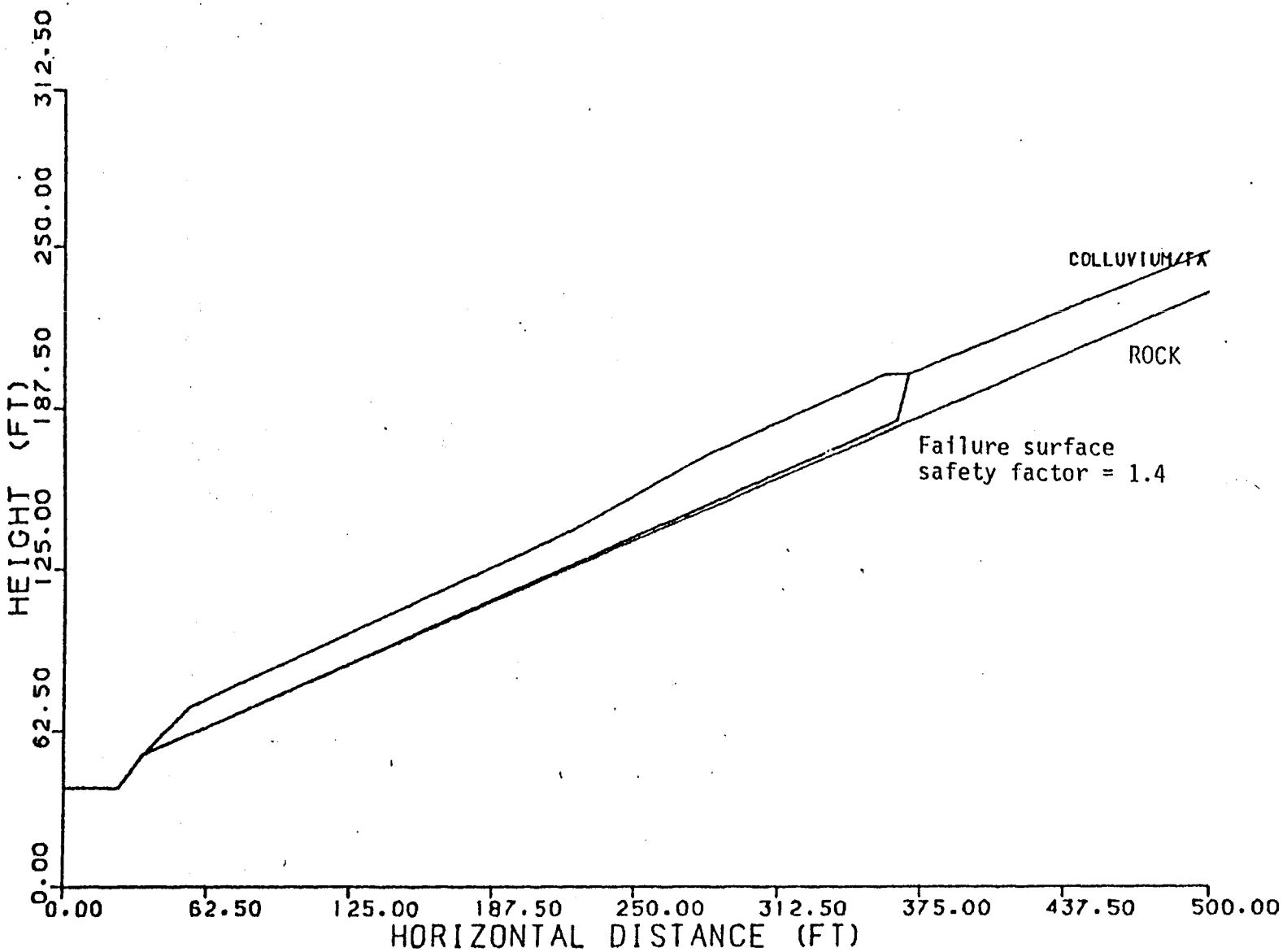




VALLEY CAMP OF UTAH , INC.
BELINE MINE
DIRECT SHEAR TEST ON DISCONTIUITY :

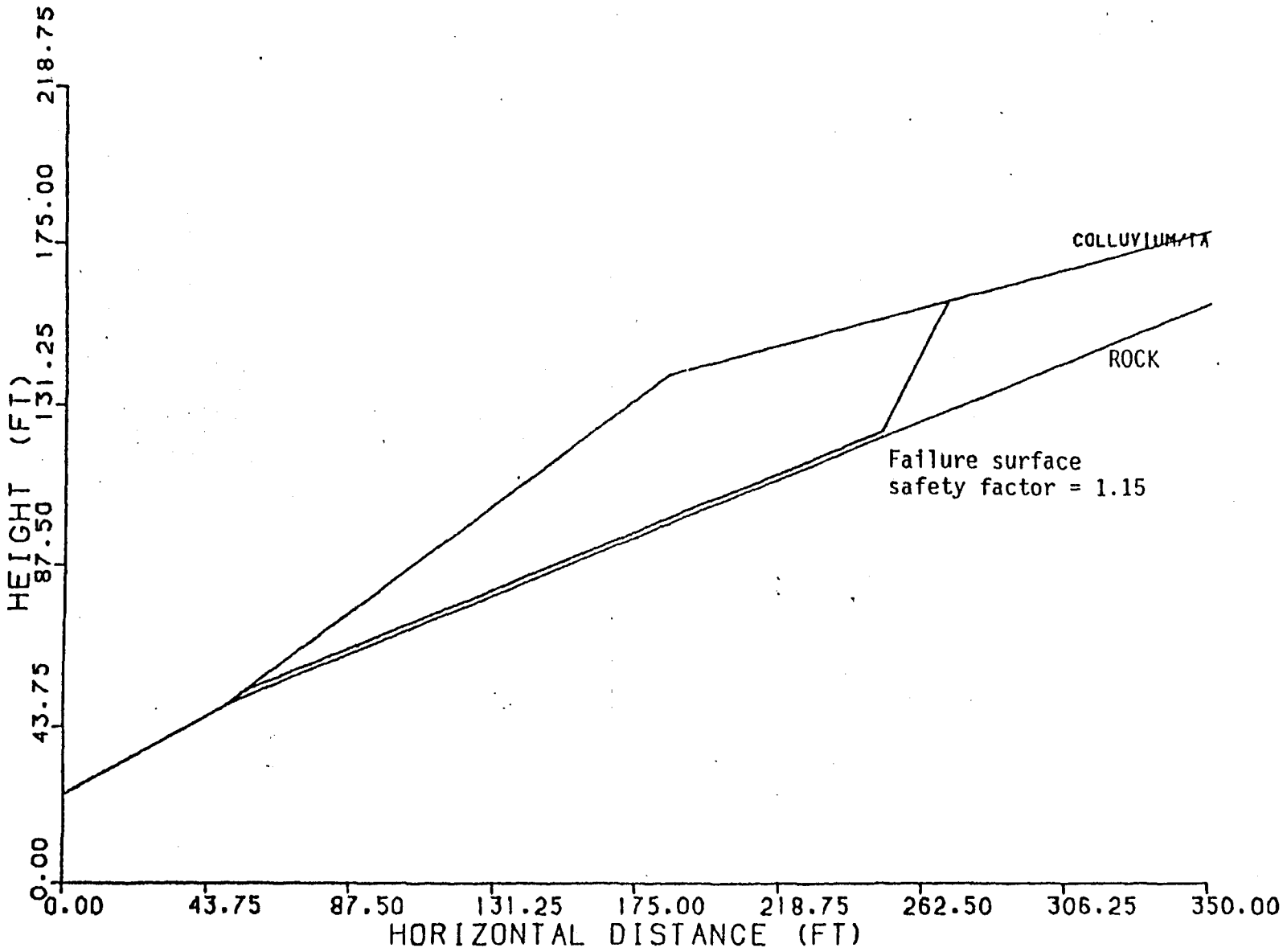
SILTSTONE , 77° OPEN JOINT

FIGURE 20



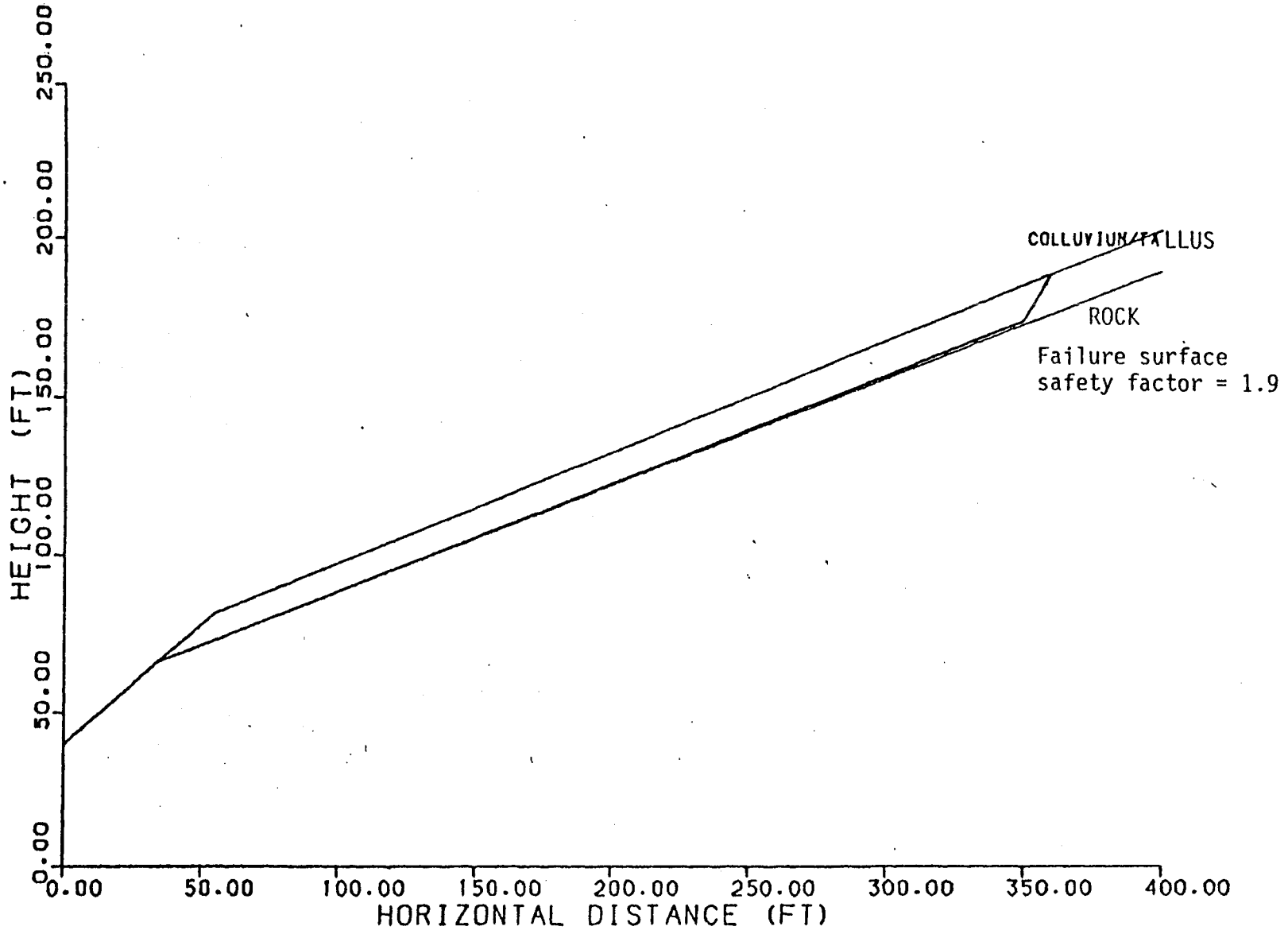
Valley Camp of Utah, Inc.
Belina Mine
Computer Generated Geologic
Model of Section A-A

Figure 21



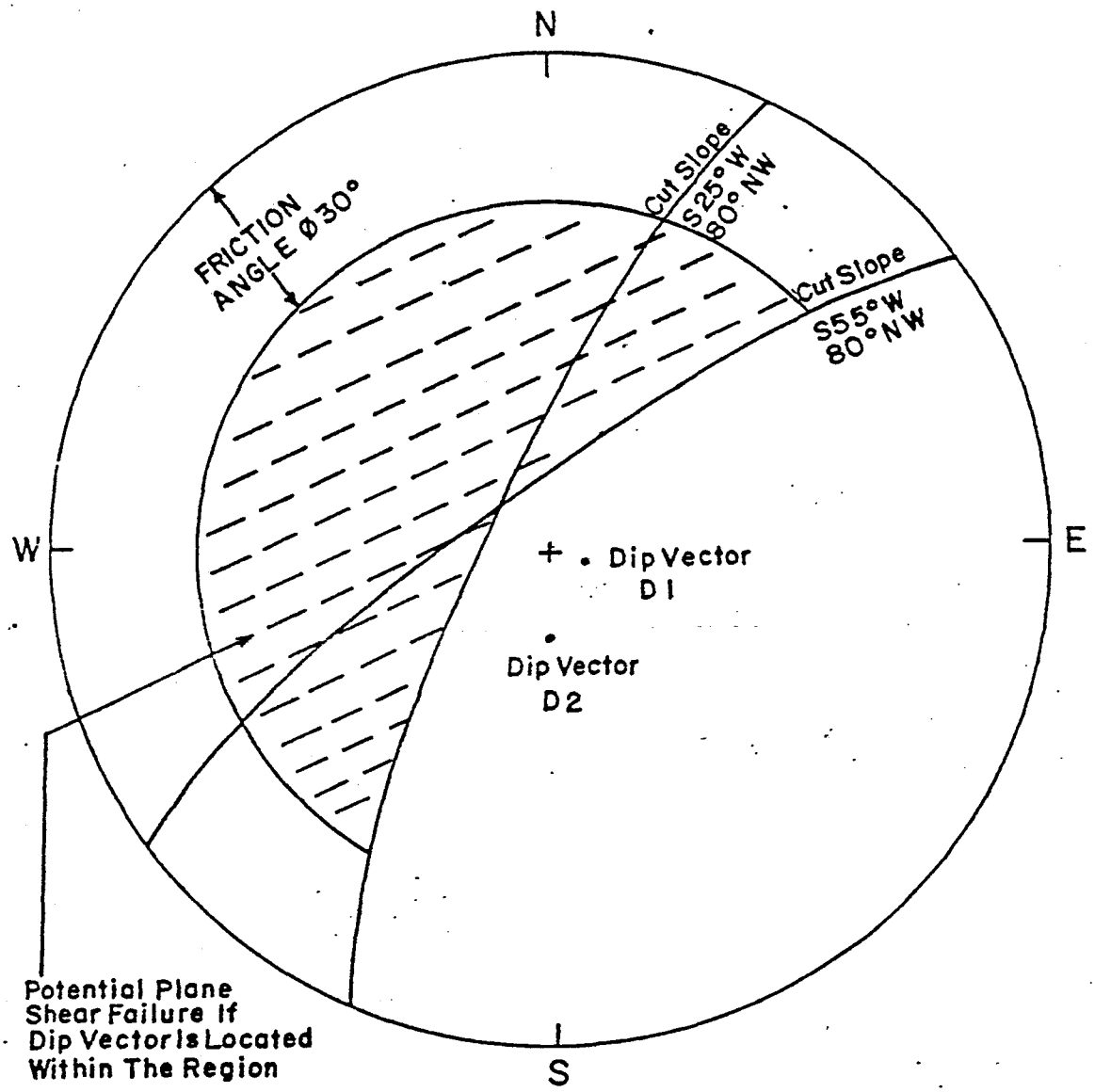
Valley Camp of Utah, Inc.
Belina Mine
Computer Generated Geologic
Model of Section B-B (most critical portion)

Figure 22



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

Figure 23

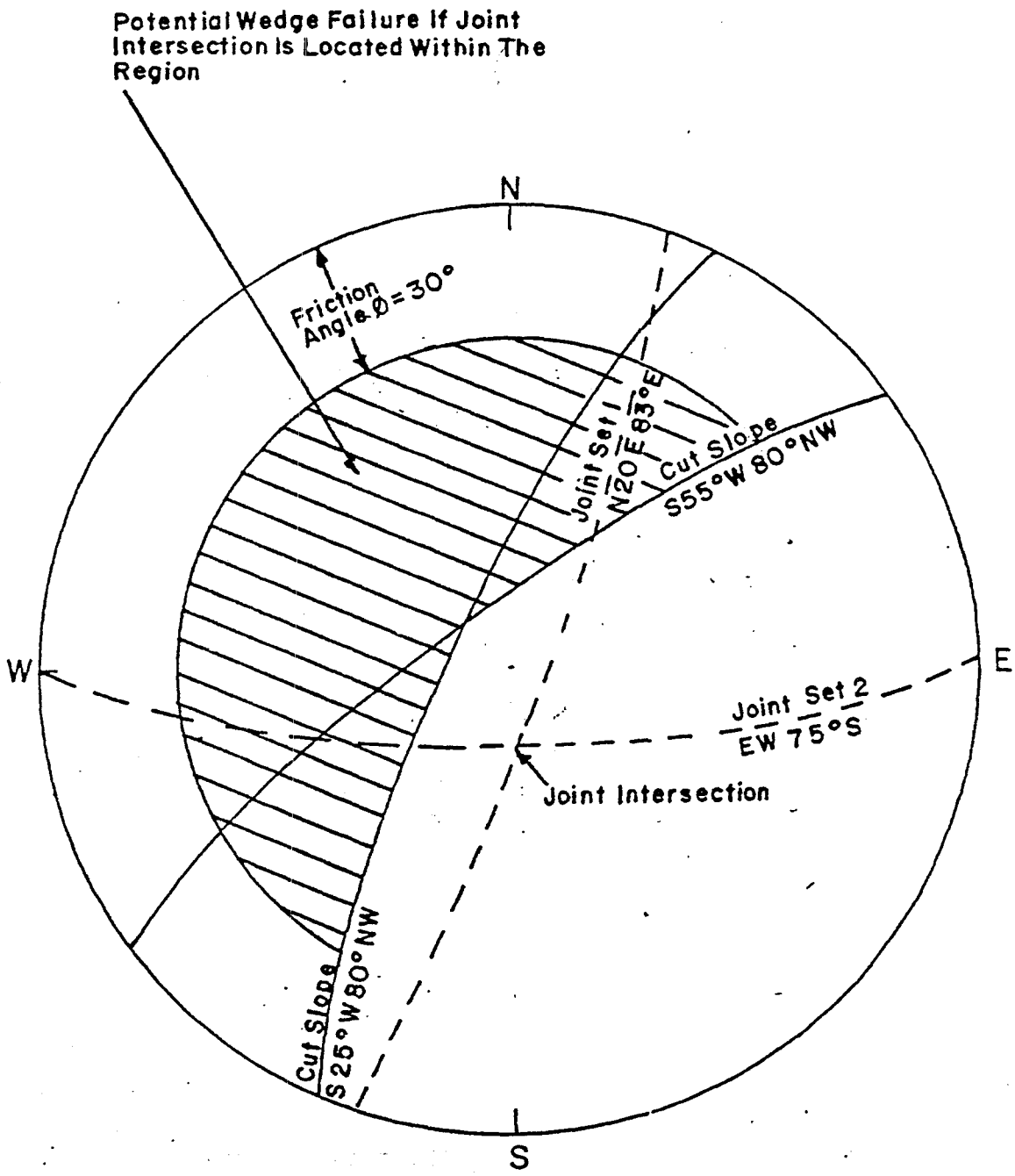


VALLEY CAMP OF UTAH , INC.

BELINA MINE

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

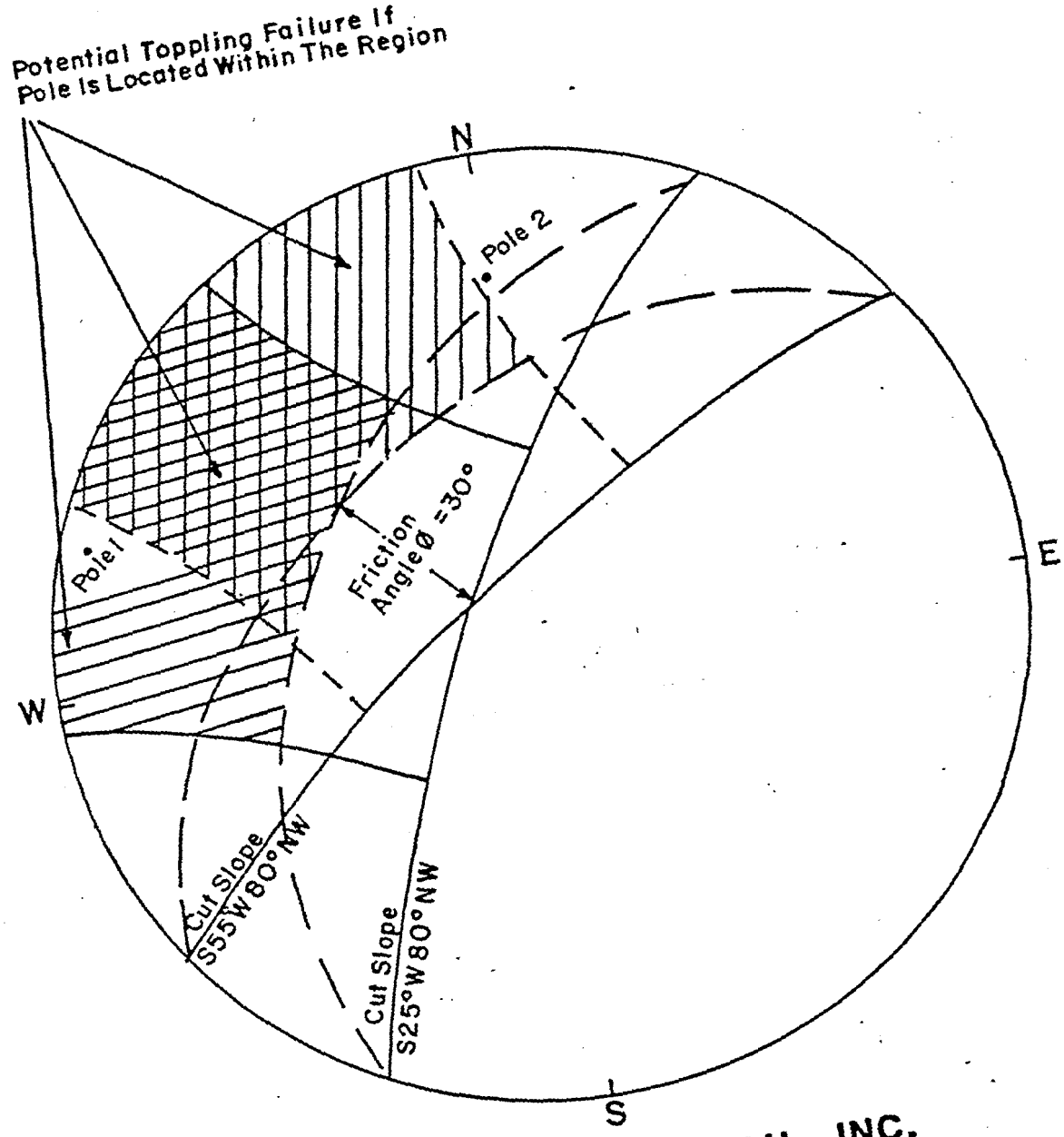
FIGURE 24



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

RECEIVED
FEB 27 1990
DIVISION OF
OIL, GAS & MINING

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
oron Sol.ppm USDA 60	.058	.013	.112
Ca.Carbonate Tons/1000Tons	2.07	3.87	4.39
alcium 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
opper ppm AB DTPA 1	.200	.270	.300
Iron ppm AB DTPA 1	51.500	45.600	44.900
agnesium 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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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
COFIELD ROUTE
ELPER, UTAH
84526

83-006763

AMPLE: 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
cid/Base Pot.Tons/1000 Tons	.39	.42	.34	.37	.57
ron Sol.ppm USDA 60	.258	.168	.241	.165	.117
Ca.Carbonate Tons/1000Tons	4.60	4.20	3.77	3.92	3.70
lcium 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
nductivity mmhos/cm @ 25	.75	.80	.84	.90	.78
pper ppm AB DTPA 1	.020	.090	.100	.150	.280
Iron ppm AB DTPA 1	56.500	54.200	63.500	74.100	58.900
gnesium 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	31.5
Selenium ppm AB DTPA 1	.005	.001	.001	<.001	<.001
Sodium Absorption Ratio	.081	.062	.080	.096	.05
Sodium Sol.Meq/l USDA 60	.69	.52	.65	.78	.4
Zinc ppm AB DTPA 1	1.770	1.950	1.800	7.100	7.500

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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
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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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

	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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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
83-006764

	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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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

83-006764

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/l	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

RESULTS OF VEGETATION SAMPLING AND MONITORING FOR THE UTAH AND BELINA REVEGETATION TEST PLOTS

1989

Prepared by

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Prepared for

VALLEY CAMP OF UTAH, INC.
Scofield Route
Helper, Utah 84526

Report by
Patrick D. Collins, Ph.D.

Fieldwork: Patrick D. Collins
P. Dean Collins

October 1989

INTRODUCTION

Following are second year results from vegetation monitoring of test plots for Valley Camp of Utah. The plots are located near Scofield, Utah. Quantitative data were also submitted in 1988 for the test plots.

The test plots were constructed in 1987 to test revegetation potential of available soil material on the mine area. The test plot design was developed by the State of Utah, Division of Oil, Gas & Mining (DOGM) and Valley Camp of Utah, Inc. Plot construction (layout and earthmoving work) was accomplished by (or under the direction of) Valley Camp of Utah. Seed, fertilizer and hydromulch by the specified design was applied by Mt. Nebo Scientific in October of 1987.

Two main areas were used as sites for the vegetation test plots. These areas were called the Utah Site and the Belina Site. The Utah Site is located south of the truck load-out pad and east of the railroad tracks on an old coal storage area. The Belina Site is on the slope south of the sediment pond.

Monitoring was initiated by sampling the vegetation on the two sites by Mt. Nebo Scientific in August of 1988 and 1989. An additional site that had been previously implemented by a different contractor was sampled and submitted to Valley Camp Co. and DOGM for comparisons in 1988. Results of the quantitative sampling are summarized in this report.

METHODS

Quantitative and qualitative data were taken on each of the two sites. Bi-directional random placement of sampling plots were designed to provide unbiased accuracy of the data compiled. A randomized block design was implemented to insure adequate representation of the entire plot. On the Utah site, three 12.5 meter transects were regularly placed on the plot to adequately cover the entire plot. Twenty sample points were then placed every 1.5 meters along these transects. A one meter buffer strip was placed around the entire plot where sample points were avoided to limit sample bias. There was only one treatment to be monitored on this plot.

The Belina Site, however, had four different treatments to be sampled. Therefore, a total of four areas or "subplots" were sampled. The subplots were labeled on the data summary tables by directional locations and treatments and are listed below:

1) NE Subplot, Light Soil A, Fertilized
2) NW Subplot, Light Soil A, Unfertilized
3) SE Subplot, Gray Soil B, Fertilized
4) SW Subplot, Gray Soil B, Unfertilized

Three transects were also placed on each of the subplots listed above. Eight sample locations were regularly placed on each treatment with a total of 40 samples for all treatments. A one meter buffer strip was also placed around each of the treatments where quadrat placement was avoided.

Cover estimates were made using ocular methods with meter square quadrats. Species cover, total cover, composition and relative

frequency were also assessed from the quadrats. Also recorded on data sheets were estimated precipitation, slope, exposure, grazing use, animal disturbance and other appropriate notes.

Sampling adequacy for cover on the Utah Site was achieved using formulas from Snedocor and Cochran (1980), insuring that 80% of the samples were within 10% of the true mean of the test plots. Sample number of the Belina Site was determined by L. Kunzler (DOGM). All sample means, standard deviations, and sample sizes were included in this report to enable the reviewers to apply further statistical tests if desired.

Plant species nomenclature follows Welsh et al. (A Utah Flora. 1987. Great Basin Naturalist Memoir No. 9). Sample design and methodologies were approved by a representative of the State of Utah, DOGM (L. Kunzler, Reclamation Biologist). Mr. Kunzler was present on site upon initiation of the test plot sampling in 1988.

RESULTS

Summary Tables

All results of the vegetation sampling for 1989 are shown on the summary tables (Tables 1 - 10). Included in these tables are:

1) percent cover and standard deviations (total living cover, mulch & litter, bare ground, & rock),
2) composition (% shrubs, forbs, & grasses),
3) cover and frequency by species,
4) sample sizes.

Nomenclature

Because the author decided to use the most recent nomenclature for plant species for the summary tables, and because some of the species on the original seed mix list have been changed, a list is provided below showing the old and new scientific names.

Old Name (on seed mix lists)	New Name (Welsh 1987)
Shrubs	
Amelanchier alnifolia	Amelanchier alnifolia
Artemisia tridentata var. vaseyana	Artemisia tridentata vaseyana
Chrysothamnus nauseosus albicaulis	C. nauseosus albicaulis
Rosa woodsii	Rosa woodsii
Sambucus coerulea	Sambucus coerulea
Symphoricarpos oreophilus	Symphoricarpos oreophilus
Forbs	
Achillea millefolium	Achillea millefolium
Artemisia ludoviciana	Artemisia ludoviciana
Linum lewisii	Linum perenne ssp. lewisii
Hedysarum boreale	Hedysarum boreale
Medicago sativa	Medicago sativa
Melilotus officinalis	Melilotus officinalis
Penstemon strictus	Penstemon strictus
Grasses	
Agropyron dasystachyum	Elymus lanceolatus
Agropyron smithii	Elymus smithii
Bromus marginatus	Bromus carinatus
Poa canbyi	Poa canbyi
Poa pratensis	Poa pratensis

The test plots will continue to be monitored according to the schedule accepted by the State of Utah, DOGM.

TABLE 1: 1989 SAMPLING RESULTS - BELINA PLOT
(NE Subplot, Light Soil A, Fertilized)

Total cover and composition for the revegetation test plots of Valley Camp of Utah. The table shows means, standard deviations and sample sizes.

COVER

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Total Living Cover	29.50	15.61	8
Mulch & Litter	11.63	6.87	8
Bareground	13.75	9.27	8
Rock	45.13	16.67	8

COMPOSITION

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Shrubs	1.91	3.51	8
Forbs	5.08	6.55	8
Grasses	93.02	9.63	8

*Sample size was determined by Division of Oil, Gas & Mining (see METHODS).

TABLE 2: **1989 SAMPLING RESULTS - BELINA PLOT**
(NE Subplot, Light Soil A, Fertilized)

Mean percent cover, standard deviation, sample size and relative frequency by species for the revegetation test plots of Valley Camp of Utah.

COVER BY SPECIES

SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
SHRUBS				
Artemisia tridentata	0.13	0.33	8	12.50
Picea pungens	0.13	0.33	8	12.50
FORBS				
Circium sp.	0.75	1.64	8	25.00
Linum lewsii	0.38	0.48	8	37.50
Urtica dioica	0.13	0.33	8	12.50
GRASSES				
Bromus carinatus	6.50	5.15	8	62.50
Dactylus glomeratus	3.38	4.15	8	50.00
Elymus lanceolatus	13.88	9.91	8	87.50
Elymus smithii	2.13	2.32	8	50.00
Elymus spicatus	0.25	0.66	8	12.50
Poa pratensis	1.88	4.96	8	12.50

TABLE 3: 1989 SAMPLING RESULTS - BELINA PLOT
(NW Subplot, Light Soil A, Unfertilized)

Total cover and composition for the revegetation test plots of Valley Camp of Utah. The table shows means, standard deviations and sample sizes.

COVER

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Total Living Cover	31.25	5.99	8
Mulch & Litter	14.38	7.68	8
Bareground	12.50	2.50	8
Rock	41.88	8.99	8

COMPOSITION

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Shrubs	--	--	--
Forbs	7.08	13.58	8
Grasses	92.92	13.58	8

*Sample size was determined by Division of Oil, Gas & Mining (see METHODS).

TABLE 4: **1989 SAMPLING RESULTS - BELINA PLOT**
(NW Subplot, Light Soil A, Unfertilized)

Mean percent cover, standard deviation, sample size and relative frequency by species for the revegetation test plots of Valley Camp of Utah.

COVER BY SPECIES

SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
SHRUBS	--	--	--	--
FORBS				
Circium sp.	0.25	0.66	8	12.50
Epilobium halleanum	0.63	1.65	8	12.50
Fragaria vesca	0.63	1.65	8	12.50
Urtica dioica	0.13	0.33	8	12.50
GRASSES				
Bromus carinatus	3.75	4.15	8	50.00
Dactylis glomerata	4.75	3.60	8	75.00
Elymus lanceolatus	15.50	8.99	8	100.00
Elymus smithii	1.25	2.17	8	25.00
Elymus spicatus	3.75	4.84	8	37.50
Elymus trachycaulus	0.63	1.65	8	12.50

TABLE 5: 1989 SAMPLING RESULTS - BELINA PLOT
(SE Subplot, Gray Soil B, Fertilized)

Total cover and composition for the revegetation test plots of Valley Camp of Utah. The table shows means, standard deviations and sample sizes.

COVER

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Total Living Cover	35.63	11.84	8
Mulch & Litter	8.13	3.48	8
Bareground	28.13	3.48	8
Rock	28.13	7.47	8

COMPOSITION

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Shrubs	--	--	8
Forbs	15.42	22.00	8
Grasses	84.58	22.00	8

*Sample size was determined by Division of Oil, Gas & Mining (see METHODS).

TABLE 6: **1989 SAMPLING RESULTS - BELINA PLOT**
(SE Subplot, Gray Soil B, Fertilized)

Mean percent cover, standard deviation, sample size and relative frequency by species for the revegetation test plots of Valley Camp of Utah.

COVER BY SPECIES

SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
SHRUBS	--	--	8	--
FORBS				
Epilobium halleanum	0.38	0.70	8	25.00
Hedysarum boreale	1.13	1.76	8	37.50
Machaeranthera canescens	0.63	1.65	8	12.50
Penstemon strictus	1.63	3.31	8	25.00
GRASSES				
Bromus carinatus	6.88	10.83	8	50.00
Dactylis glomerata	1.63	3.31	8	25.00
Elymus lanceolatus	8.75	8.91	8	62.50
Elymus smithii	9.63	5.57	8	87.50
Elymus spicatus	1.25	2.17	8	25.00
Poa pratensis	3.75	4.84	8	37.50

TABLE 7: 1989 SAMPLING RESULTS - BELINA PLOT
(SW Subplot, Gray Soil B, Unfertilized)

Total cover and composition for the revegetation test plots of Valley Camp of Utah. The table shows means, standard deviations and sample sizes.

COVER

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Total Living Cover	30.00	14.36	8
Mulch & Litter	5.00	0.00	8
Bareground	35.00	12.75	8
Rock	30.00	12.50	8

COMPOSITION

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Shrubs	--	--	8
Forbs	11.61	11.70	8
Grasses	88.39	11.70	8

*Sample size was determined by Division of Oil, Gas & Mining (see METHODS).

TABLE 8: **1989 SAMPLING RESULTS - BELINA PLOT**
(SW Subplot, Gray Soil B, Unfertilized)

Mean percent cover, standard deviation, sample size and relative frequency by species for the revegetation test plots of Valley Camp of Utah.

COVER BY SPECIES

SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
SHRUBS	--	--	--	--
FORBS				
Epilobium halleanum	0.63	1.65	8	12.50
Penstemon strictus	1.88	2.42	8	37.50
Urtica dioica	0.38	0.99	8	12.50
GRASSES				
Bromus carinatus	5.38	3.67	8	75.00
Dactylis glomerata	3.38	4.15	8	50.00
Elymus lanceolatus	7.13	5.16	8	75.00
Elymus smithii	7.50	11.18	8	62.50
Elymus spicatus	1.88	2.42	8	37.50
Poa pratensis	1.88	4.96	8	12.50

TABLE 9: 1989 SAMPLING RESULTS - UTAH PLOT
(Single plot design)

Total cover and composition for the revegetation test plots of Valley Camp of Utah. The table shows means, standard deviations and sample sizes.

COVER

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Total Living Cover	33.20	9.14	20
Mulch & Litter	6.95	5.48	20
Bareground	50.50	17.69	20
Rock	9.35	9.91	20

COMPOSITION

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Shrubs	2.94	4.14	20
Forbs	59.57	14.92	20
Grasses	37.50	14.09	20

* Sample size insures 80% accuracy within 10% of the true mean.

TABLE 10: **1989 SAMPLING RESULTS - UTAH PLOT**
(Single Plot Design)

Mean percent cover, standard deviation, sample size and relative frequency by species for the revegetation test plots of Valley Camp of Utah.

COVER BY SPECIES

SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
SHRUBS				
Artemisia tridentata	1.15	1.62	20	40.00
FORBS				
Artemisia ludoviciana	2.25	3.81	20	35.00
Chaenactis douglasii	0.30	1.10	20	10.00
Circium sp.	1.75	2.98	20	30.00
Eriogonum sp.	0.45	0.80	20	30.00
Gayophytum ramosissimum	0.10	0.44	20	5.00
Lappula occidentalis	1.00	2.00	20	35.00
Linum perenne ssp. lewisii	1.00	1.26	20	50.00
Melilotus officinalis	7.20	4.83	20	95.00
Penstemon strictus	0.10	0.44	20	5.00
Polygonum aviculare	0.60	0.86	20	35.00
Rumex cripus	0.30	0.56	20	25.00
Salsola iberica	2.15	2.20	20	60.00
Verbascum thapsus	2.20	2.16	20	55.00
GRASSES				
Bromus carinatus	1.65	2.15	20	40.00
Elymus lanceolatus	7.70	3.89	20	95.00
Elymus smithii	3.30	3.35	20	60.00

Vertebrate Species of Southeastern Utah

publ. no. 78-16

SPECIES LIST OF VERTEBRATE WILDLIFE

THAT INHABIT SOUTHEASTERN UTAH

Compiled by

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UTAH STATE DIVISION OF WILDLIFE RESOURCES

Douglas F. Day, Director

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The status and population trend for individual species is a product of the experience of the authors and others who have professional experience with the wildlife resource in southeastern Utah.

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364 total
84 M
241 B
14 F
19 R
64

SPECIES LIST OF VERTEBRATE WILDLIFE THAT INHABIT SOUTHEASTERN UTAH

Utah is believed to be inhabited by 734 species of vertebrate wildlife. Four hundred forty-five of these species are protected: 2 amphibians, 2 reptiles, 26 mammals, 58 fish and 357 birds. One hundred of the protected species are game species: 10 species of big game; 20, fish; 10, furbearers; 43, migratory game birds; 5, small game mammals; and 12, upland, small game birds. Table 1 provides a comparison of inhabitation by game species between Utah Division of Wildlife Resource's five regions.

Southeastern Utah is inhabited by 466 species of vertebrate wildlife in six biogeographic areas (Table 2). Three hundred forty-three of these species are protected: 2 amphibians, 26 mammals, 38 fish and 277 birds. Seventy-nine of the protected species that inhabit southeastern Utah are game species: 9 species of big game; 13, game fish; 9, furbearers, 35, migratory game birds; 4, small game mammals; and 9, upland, small game birds.

Southeastern Utah has been divided into six biogeographic areas. Each area allows an overlap of wildlife species that inhabit contiguous low and high elevation areas. This procedure was utilized to reduce any controversy that would normally arise from a "sharp line" drawn on a map.

A- Wasatch Plateau extending east from Skyline Drive to Highway 10 and bounded on the north by Highway 6 and on the south by Interstate 70.
B- West Tavaputs Plateau including all drainages into the Price River drainage from Soldier's Summit east along Reservation Ridge and including the drainages into Argyle, Nine Mile and Minnie Maud creeks; bounded on the east by the Green River and south and west by Highway 6.
C- East Tavaputs Plateau bounded on the east by the Colorado-Utah state line; on the south by Interstate 70; on the west by the Green River and on the north by Uintah-Ouray Indian Reservation and the Uintah-Grand county line.
D- San Rafael Swell and San Rafael Desert bounded by Highway 6 on the north; Highway 10 on the west; the Green River on the east and the Emery-Wayne county line on the south.
E- Henry Mountains and Burr Desert bounded on the north by Emery-Wayne county line; the Green and Colorado rivers on the east; Lake Powell on the south and Capitol Reef National Park and the Waterpocket Fold on the west.
F- Mountains and deserts of Grand and San Juan counties south of Interstate Highway 70 and north of the San Juan River bounded on the east by the Utah-Colorado border and on the west by the Green and Colorado rivers and Lake Powell.

Each species is listed by common name followed by the generic and specific nomenclature. The status for each species was determined by the authors after evaluation and consultation from several sources. The listing for mammals was developed from Sparks (1974), Burt and Grossenheider (1976) and Durrant (1952). The primary sources consulted in compiling the bird list were Behle and Perry (1975) and Hayward et al. (1976) although, Peterson (1969), Robbins et al. (1966) and Udvardy and Rayfield (1977) were also used.

Holden (1973), Bailey et al. (1970), Eddy (1969) and Sigler and Miller (1963) were consulted for preparation of the list of fishes.

The status of reptiles and amphibians was determined through discussion with local herpetologists. The phylogenetic listing is after Stebbins (1966). Tanner (1975) was consulted for species inhabiting Utah.

The following code letters are given for each species to describe its status.

K Status unknown - It is believed that these species are present, but little is known of their population dynamics.
C Common - These species are widespread and abundant.
U Uncommon - These species are widespread, but not abundant.
R Rare - These species are seldom identified during any one year.
O Occasional - These species are periodically identified during a long term period--10-50 years.
A Accidental - Distribution for these species does not normally include this area. Sightings are as far between as 50 to 100 years.
E Endangered - These species are endangered with extinction or extirpation from wildland in Utah.
T Threatened - These species are threatened with becoming endangered in Utah.
L Limited - These species are common but restricted to a particular use area or habitat type in Utah.
X Extirpated - These species have disappeared from wildland habitats in Utah.
P Protected - These species are protected by state or federal laws in Utah.
N Nonprotected - These species are not protected by any laws in Utah.

The following terminology is used to describe the seasonal status for avian species.

Transient - These species pass through southeastern Utah twice a year during their migratory travels.

Resident - These species occur yearlong in southeastern Utah.

Summer Resident - These species breed in southeastern Utah and migrate elsewhere for the winter.

Winter Resident - These species breed elsewhere but winter in southeastern Utah.

Note, the species marked with an asteric (*) are of high interest to the State and those marked with an exclamation mark(!) have potential to inhabit the environs of the project area.

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Fishes -- 38 species in southeastern Utah				
Family Clupeidae				
Threadfin Shad (Dorosoma petenense)	E,F	L-P	Stable	Lake-pelagic areas
Family Salmonidae				
* Cutthroat Trout (Salmo clarki)	A,B,D,F	C-P	Stable	Lakes-rocky shores, deep pelagic water; river-pools, riffles, and overhanging banks
* Rainbow Trout (Salmo gairdneri)	A,B,E,F,	C-P	Stable	Lake-littoral and pelagic areas rivers-pools, riffles, overhanging banks
* Brown Trout (Salmo trutta)	A,B,E,F	C-P	Stable	Lake-pelagic and littoral areas rivers-pools, riffles, and overhanging banks
* Brook Trout (Salvelinus fontinalis)	A,F	L-P	Stable	Lake-pelagic and littoral areas
Family Esocidae				
* Northern Pike (Esox lucius)	E,F	L-P	Unknown	Lake-littoral areas with submerged trees and brush
Family Cyprinidae				
Longfin Dace (Agosia chrysogaster)	E,F	K-P	Unknown	Unknown
Carp (Cyprinus carpio)	A,B,C,D,E,F	C-P	Stable	Lakes-littoral areas; quiet water areas in rivers, ponds, sloughs, creeks, and irrigation ditches
Utah Chub (Gila atraria)	A,B	L-P	Abundant	Irrigation ditches, ponds, sloughs, creeks, rivers, and lakes

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
* Leatherside Chub (Gila copei)	A,E	C-P	Stable	Pool and riffle areas
* Humpback Chub (Gila cypha)	B	E-P	Decreasing	Eddies and backwaters
* Bonytail Chub Gila elegans)	B,C,F	E-P	Decreasing	Main channels of large rivers
Roundtail Chub (Gila robusta)	B,C,D,E,F	C-P	Stable	Riffles and stagnant backwaters
Red Shiner (Notropis lutrensis)	B,C,D,E,F	C-P	Increasing	Riffles, pools, backwaters, and eddies
San Shiner (Notropis stramineus)	F	C-P	Increasing	Riffles, pools, backwaters, and eddies
Fathead Minnow (Pimephales promelas)	B,C,D,E,F	C-P	Stable	Pools and backwaters
* Colorado Squawfish (Ptychocheilus lucius)	B,C,D,E,F	E-P	Decreasing	Slow waters, eddies, backwaters, and large pools
* Longnose Dace (Rhinichtys cataractae)	A	U-P	Unknown	Pools and riffles
! Speckled Dace (Rhinichtys osculus)	A,B,C,D,E,F	C-P	Stable	Pools and riffles
Redside Shiner (Richardsonius balteatus)	A,B,D	C-P	Stable	Lakes, creeks and rivers
Family Catostomidae				
White Sucker (Catostomus commersoni)	E,F	U-P	Unknown	Unknown
Bluehead Sucker (Catostomus discobolus)	A,B,C,D,E,F	C-P	Stable	Pools, riffles and lakes

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Flannelmouth Sucker (Catostomus latipinnis)	B,C,D,E,F	C-P	Stable	Pools and riffles
! Mountain Sucker (Catostomus platyrhynchus)	A	L-P	Stable	Pools and riffles
* Humpback Sucker (Xyrauchen texanus)	B,C,D,E,F	T-P	Decreasing	Large rivers with strong currents
Family Ictaluridae				
* Black Bullhead (Ictalurus melas)	B,C,D,E,F	C-P	Stable	Pools, quiet water and lakes
* Yellow Bullhead (Ictalurus natalis)	E,F	R-P	Stable	Quiet water areas and lakes
* Channel Catfish (Ictalurus punctatus)	B,C,D,E,F	C-P	Stable	Pools, riffles, quiet water areas and lakes
Family Cyprinodontidae				
Plains Killifish (Fundulus kansae)	F	R-P	Stable	Quiet water areas
Family Poeciliidae				
Mosquito fish (Gambusia affinis)	F	R-P	Stable	Quiet water areas
Family Cottidae				
* Mottled Sculpin (Cottus bairdi)	A	C-P	Stable	Rocky riffles and pool areas
Family Percichtyidae				
* Striped Bass (Morone saxatilis)	E,F	C-P	Increasing	Lake-pelagic areas
Family Centrarchidae				
Green Sunfish (Lepomis cyanellus)	B,C,D,E,F	C-P	Stable	Quiet backwaters and lakes
* Bluegill (Lepomis macrochirus)	E,F	C-P	Stable	Lakes-littoral areas with rocky shores and submerged brush

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
* Largemouth Bass (Micropterus salmoides)	A,B,C,D,E,F	C-P	Stable	Rivers-quiet water areas; lakes-littoral rocky areas, with submerged brush
* Black Crappie (Pomoxis nigromaculatus)	E,F	C-P	Stable	Lake-littoral zone around submerged brush and trees, and pelagic areas
Family Percidae				
* Perch (Perca flavescens)	F	U-P	Unknown	Unknown
* Walleye (Stizostedion vitreum)	E,F	C-P	Stable	Lake-deep water around rocky bottoms
Amphibians -- 11 species in southeastern Utah				
Family Ambystomatidae				
! * Tiger Salamander (Ambystoma tigrinum)	A,B,C,D,E,F	C-P	Unknown	Quiet water of ponds, reservoirs, lakes, temporary rain pools and streams from arid sagebrush plains to rolling grasslands, mountain meadows and forests
Family Pelobatidae				
! Great Basin Spadefoot Toad (Scaphiopus intermontanus)	A,B,C,D,E,F	C-N	Unknown	Sagebrush flats, pinion-juniper woodlands to high elevations in spruce-fir communities

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Western Spadefoot Toad (Scaphiopus hammondi)	F	K-N	Unknown	Washes, alkali flats, foothills, mountain valleys, in open vegetation and shortgrass, where soil is sandy and/or gravelly
Family Bufonidae				
/ Western Toad (Bufo boreas)	A	K-N	Unknown	Desert streams, springs, grasslands, woodlands, and mountain meadows
Red Spotted Toad (Bufo punctatus)	D,E,F,	C-N	Unknown	Open grassland and rocky canyons
/ Woodhouse's Toad (Bufo woodhousei)	A,B,C,D,E,F	C-N	Unknown	Grassland, sagebrush flats, woods, desert streams, valleys, flood plains, farms, and city backyards
Great Plains Toad (Bufo cognatus)	C,D,E,F,	C-N	Unknown	Prairies, deserts, quiet water of streams, grasslands and sagebrush plains
Family Hylidae				
/ Chorus Frog (Pseudacris triseriata)	A,B,C,D,F	C-N	Unknown	Grassy pools, lakes, and marshes of prairies or mountains

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Canyon Tree Frog (Hyla arenicolor)	E,F	L-N	Unknown	Intermittant or permanent streams with rocky pools in canyons with cottonwoods or other trees
Family Ranidae				
* Bullfrog (Rana catesbeiana)	F	L-P	Unknown	Colorado River-usually quiet water where there is thick growth of aquatic vegetation
/ Leopard Frog (Rana pipiens)	A,B,C,D,E,F	C-N	Unknown	Springs, creeks, rivers, ponds, canals, reservoirs and wet meadows
Reptiles -- 36 species in southeastern Utah				
Family Iguanidae				
* Chuckwalla (Sauromalus obesus)	E,F	L-N	Unknown	Rocky hillsides
Collared Lizard (Crotaphytus collaris)	A,B,C,D,E,F	C-N	Unknown	Canyons, rocky gullies, mountain slopes and boulder strewn alluvial fans where vegetation is sparse
Leopard Lizard (Crotaphytus wislizenii)	A,B,C,D,E,F	C-N	Unknown	Arid and semi-arid plains with bunchgrass, sagebrush or other low desert shrub communities; avoids dense vegetation
Lesser Earless Lizard (Holbrookia maculata)	F	K-N	Unknown	Washes, sandy stream banks and sand dunes on shortgrass prairi and farmlands

ecies	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
! Eastern Fence Lizard (Sceloporus undulatus)	A,B,C,D,E,F	C-N	Unknown	Forest, woodlands, prairie, brushy flatlands, sand dunes, rocky hillsides and farmlands
Desert Spiny Lizard (Sceloporus magister)	D,E,F	C-N	Unknown	Shadscale deserts, pinion-juniper woodland, willows and cottonwoods.
! Sagebrush Lizard (Sceloporus graciosus)	A,B,C,D,E,F	C-N	Unknown	Variety of habitat types; sagebrush, pinion-juniper, low desert shrub and rocklands
! Tree Lizard (Urosaurus ornatus)	A,B,C,D,E,F	C-N	Unknown	Trees and rocks
! Side-blotched Lizard (Uta stansburiana)	A,B,C,D,E,F	C-N	Unknown	Inhabits a variety of habitat types; sandy washes with scattered rocks and low growing shrubs
Desert Horned Lizard (Phrynosoma platyrhinos)	E	K-N	Unknown	Along washes at the edge of dunes in saltbrush and sagebrush areas
! Short-horned Lizard (Phrynosoma douglassi)	A,B,C,D,E,F	C-N	Unknown	Desert grassland, sagebrush, pinion-juniper, pine-spruce and spruce-fir associations, extending from desert shrub to mountain habitats

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Family Xantusiidae				
* Utah Night Lizard (*Xantusia vigilis*)	E,F	L-N	Unknown	Dead clumps of yucca plants and woodrat middens
Family Teiidae				
Plateau Whiptail (*Cnemidophorus velox*)	F	K-N	Unknown	Mountains in pinion-juniper woodland and lower edges of ponderosa pine forests
Western Whiptail (*Cnemidophorus tigris*)	A,B,C,D,E,F	C-N	Unknown	Desert shrub communities where plants are sparse and there are open areas for running
Family Scincidae				
Many-lined Skink (*Eumeces multivirgatus*)	E,F	K-N	Unknown	Shortgrass prairie that extends into the mountains; often vacant lots, city dumps and backyards
Western Skink (*Eumeces skiltonianus*)	C	K-N	Unknown	Grasslands, woodlands and forests in rocky habitat near streams with abundant cover
Family Boidae				
Rubber Boa (*Charina bottae*)	A	C-N	Unknown	Grasslands, woodlands, and forests with rotting logs; often found under rocks and under the bark of fallen or standing dead trees

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Family Colubridae				
Smooth Green Snake (*Opheodrys vernalis*)	F	K-N	Unknown	Damp grassy environment
! Striped Whipsnake (*Masticophis taeniatus*)	A,B,C,D,E,F	C-N	Unknown	Brushlands, grasslands, sagebrush flats, pinion-juniper woodlands and open pine forests
Coachwhip (*Masticophis flagellum*)	E,F	K-N	Unknown	Utilizes a variety of habitats but avoids dense vegetation; rodent burrows, rocks and branches are used
! Racer (*Coluber constrictor*)	A,B,C,D,E,F	C-N	Unknown	Meadows, sparse brush and forest openings with semi-arid and moist areas; grassy places near rocks and logs are preferred
Corn Snake (*Elaphe guttata*)	F	K-N	Unknown	Stream and river bottoms, rocky wooded hillsides, coniferous forests, and farmland with rodent burrows, rocks and logs
! Ringneck Snake (*Diadophis punctatus*)	A	K-N	Unknown	Moist habitats usually in the mountains or along stream and river bottoms

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
! Gopher Snake (*Pituophis melanoleucus*)	A,B,C,D,E,F	C-N	Unknown	Lowlands to high mountains including desert, coniferous forest and farmland types; grassland and open brushland are prescribed
! * Milk Snake (*Lampropeltis triangulum*)	A,B,C,F	K-N	Unknown	Variety of habitats from lowlands to mountains; rotten logs and stumps are preferred
Common Kingsnake (*Lampropeltis getulus*)	E,F	K-N	Unknown	Variety of habitats from lowlands to mountains with rock outcrops and clumps of vegetation under rotting logs or rocks
! * Sonora Mountain Kingsnake (*Lampropeltis pyromelana*)	A	K-N	Unknown	Mountains, pinion-juniper woodlands, mountain brush, coniferous forests with rocks, logs and dense clumps of vegetation
Long-nosed Snake (*Rhinocheilus lecontei*)	F	K-N	Unknown	Prairies, brushland and irrigated parts of deserts
! Western Terrestrial Garter Snake (*Thamnophis elegans*)	A,B,C,D,E,F	C-N	Unknown	Variety of terrestrial and aquatic habitats from lowlands to mountains
! Common Garter Snake (*Thamnophis sirtalis*)	A,F	K-N	Unknown	Variety of habitats, usually near water

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Black-necked Garter Snake (*Thamnophis cyrtopsis*)	F	K-N	Unknown	Desert and grasslands
Western Black-headed Snake (*Tantilla planiceps*)	E,F	K-N	Unknown	Grasslands, woodlands and deserts; often found under rocks and logs
! Night Snake (*Hypsiglena torquata*)	A,B,C,D,E,F	C-N	Unknown	Plains, sagebrush flats, desert and woodlands; often found under rocks and surface litter
Family Crotalidae				
Hopi Rattlesnake (*Crotalus viridis nuntius*)	E	U-N	Unknown	Prefers rock piles and rodent burrows on grasslands, brushlands, woodlands and forests; avoids sparsely vegetated deserts
Prairie Rattlesnake (*Crotalus viridis viridis*)	F	U-N	Unknown	Prefers rock piles and rodent burrows on grass-lands, woodlands and forests; avoids sparsely vegetated deserts
! Midget Faded Rattlesnake (*Crotalus viridis concolor*)	A,B,C,D,E,F	C-N	Unknown	Prefers rock piles and rodent burrows on grasslands, brushlands, woodlands and forests; avoids sparsely vegetated deserts

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Birds -- 278 species in southeastern Utah				
Order Gaviiformes				
Family Gaviidae				
Common Loon (Gavia immer)	A,B,C,D,E,F	U-P transient and winter resident	Stable	Lakes of coniferous forests, open lakes, reservoirs and bays
Order Podicipediformes				
Family Podicipedidae				
Horned Grebe (Podiceps auritus) *	A,B,C,D,E,F	R-P transient and summer resident	Stable	Lakes, ponds and reservoirs
Eared Grebe (Podiceps nigricollis)	A,B,C,D,E,F	C-P summer resident	Stable	Lakes, bays and reservoirs
* Western Grebe (Aechmophorus occidentalis)	A,B,C,D,E,F	C-P summer resident	Stable	Sloughs, bays and reservoirs and lakes with emergent vegetation for nesting
Pied-billed Grebe (Podilymbus podiceps)	A,B,C,D,E,F	C-P summer resident	Stable	Ponds, lakes, streams and marshes
Order Pelecaniformes				
Family Pelecanidae				
* White Pelican (Pelecanus erythrorhynchos)	A,B,C,D,E,F	L-P transient and summer resident	Stable	Larger shallow bodies of water and large rivers
Family Phalacrocoracidae				
* Double-crested Cormorant (Phalacrocorax auritus)	A,B,C,D,E,F	U-P summer resident	Stable	Bays, lakes and rivers

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Order Ciconiiformes				
Family Ardeidae				
!*Great Blue Heron (Ardea herodias)	A,B,C,D,E,F	C-P resident	Stable	Marshes, shallow reservoirs, rivers, streams, shores and irrigation ditches
Green Heron (Butorides striatus)	B,E,F	R-P transient	Unknown	Marshes, wooded streams, rivers, small ponds and lake margins
Cattle Egret (Bubulcus ibis)	E,F	O-P transient	Unknown	Marshes, lake margins, and irrigated lands
! Snowy Egret (Egretta thula)	A,B,C,D,E,F	C-P summer resident	Stable	Marshes, ponds, lake margins and irrigated land
Black-crowned Night Heron (Nycticorax nycticorax)	A,B,C,D,E,F	C-P summer resident	Stable	Marshes, lake margins and shores
Least Bittern (Ixobrychus exilis)	D,E,F	U-P transient	Unknown	Densely vegetated marshes
American Bittern (Botaurus lentinginosus)	A,B,C,D,E,F	U-P summer resident	Stable	Densely vegetated marshe
Family Ciconiidae				
Wood Stork (Mycteria americana)	D,E,F	O-P transient	Unknown	Marshes, ponds and lake margins
Family Threskiornithidae				
*White-faced Ibis (Plegadis chihi)	A,B,C,D,E,F	C-P summer resident	Increasing	Marshes and irrigated land

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Order Anseriformes				
Family Anatidae				
* Whistling Swan (Olor columbianus)	A,B,C,D,E,F	O-P winter resident C-P transient	Stable	Lakes, large rivers and fields
* Trumpeter Swan (Olor buccinator)	B,C,D,E,F	R-P transient	Unknown	Lakes and large rivers
* Canada Goose (Branta canadensis)	A,B,C,D,E,F	C-P resident and transient	Increasing	Lakes, bays, marshes, rivers and grainfields
*White-fronted Goose (Anser albifrons)	A,B,C,D,E,F	R-P transient	Stable	Marshes, fields, lakes and bays
*Snow Goose (Chen caerulescens)	A,B,C,D,E,F	U-P transient	Stable	Marshes, grainfields, reservoir, ponds and bays
* Ross' Goose (Chen rossii)	A,B,C,D,E,F	O-P transient	Stable	Marshes, grainfields, prairies, ponds and bays
! * Mallard (Anas platyrhynchos)	A,B,C,D,E,F	C-P resident and transient	Stable	Marshes, irrigated land, grainfields, ponds, rive lakes, bays and reservoi extending from lowlands mountains
! *Gadwall (Anas strepera)	A,B,C,D,E,F	C-P resident and transient	Stable	Lakes, ponds, rivers and marshes
! * Pintail (Anas acuta)	A,B,C,D,E,F	C-P resident and transient	Stable	Marshes, grainfields, ponds, lakes and reservoirs

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
! *Green-winged Teal (Anas crecca)	A,B,C,D,E,F	C-P resident and transient	Stable	Marshes, lakes, ponds, rivers and bays
*Blue-winged Teal (Anas discors)	A,B,C,D,E,F	U-P resident and transient	Stable	Ponds and marshes
!*Cinnamon Teal (Anas cyanoptera)	A,B,C,D,E,F	C-P resident and transient	Stable	Stock ponds, rivers, marshes and lakes
*American Widgeon (Anas americana)	A,B,C,D,E,F	C-P resident and transient	Stable	Marshes, irrigated land, ponds, lakes and bays
* Northern Shoveler (Anas clypeata)	A,B,C,D,E,F	C-P resident and transient	Stable	Marshes, ponds and sloughs
!*Wood Duck (Aix sponsa)	A,B,C,D,E,F	R-P transient	Stable	Wooded rivers and ponds
*Redhead (Aythya americana)	A,B,C,D,E,F	C-P resident and transient	Stable	Marshes with some deep water, lakes and reservoirs
*Ring-necked Duck (Aythya collaris)	A,B,C,D,E,F	U-P transient	Stable	Coniferous lakes, wooded ponds, marshes and reservoirs
*Canvasback (Aythya valisineria)	A,B,C,D,E,F	C-P transient R-P summer resident	Stable	Marshes, lakes and reservoirs

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
*Greater Scaup (Aythya marila)	A,B,C,D,E,F	U-P transient	Stable	Lakes, rivers and ponds
*Lesser Scaup (Aythya affinis)	A,B,C,D,E,F	C-P transient	Stable	Marshes, ponds and lakes
*Common Goldeneye (Bucephala clangula)	A,B,C,D,E,F	U-P transient	Stable	Lakes and rivers
*Bufflehead (Bucephala albeola)	A,B,C,D,E,F	U-P transient	Stable	Lakes, ponds and rivers
*White-winged Scoter (Melanitta deglandi)	D	O-P transient	Stable	Large lakes and reservoirs. Recorded occurrence at Desert Lake WMA
*Ruddy Duck (Oxyura jamaicensis)	A,B,C,D,E,F	C-P resident and transient	Stable	Marshes, ponds, rivers and reservoirs
*Hooded Merganser (Mergus cucullatus)	A,B,C,D,E,F	R-P transient	Stable	Wooded lakes, ponds, rivers and reservoirs
*Common Merganser (Mergus merganser)	A,B,C,D,E,F	C-P transient U-P winter resident	Stable	Wooded lakes and rivers in summer; in winter, open rivers, lakes and ponds
*Red-breasted Merganser (Mergus serrator)	A,B,C,D,E,F	C-P transient	Stable	Lakes, reservoirs and rivers

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Order Falconiformes				
Family Cathartidae				
!*Turkey Vulture (Cathartes aura)	A,B,C,D,E,F	C-P summer resident	Stable	Usually seen in sky or perched on dead trees, posts, carrion or on groun
California Condor (Gymnogyps californianus)	A,B,C,D,E,F	X-P	Extirpated	Usually seen in sky or perched on dead trees, posts, carrion or on groun
Family Accipitridae				
!*Goshawk (Accipiter gentilis)	A,B,C,D,E,F	U-P resident	Stable	Mountain woodlands
! *Sharp-shinned Hawk (Accipiter striatus)	A,B,C,D,E,F	U-P resident and transient	Stable	Forests, thickets, scrubоak, desert riparian, mountain woodlands and aspen
!*Cooper's Hawk (Accipiter cooperii)	A,B,C,D,E,F	C-P summer resident and transient R-P winter resident	Stable	Broken woodlands, dry wooded canyons, riparian areas, pinion-juniper and conifers
!*Red-tailed Hawk (Buteo jamaicensis)	A,B,C,D,E,F	C-P resident	Stable	Open country, woodlands, mountains and deserts
*Red-shouldered Hawk (Buteo lineatus)	C,F	A-P transient	Unknown	Broken woodlands, primarily along lowland rivers and often close to cultivated fields
!* Swainson's Hawk (Buteo swainsoni)	A,B,C,D,E,F	U-P summer resident	Stable	Dry plains and rangeland with hills; open forest or alpine meadows with sparse trees

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
* Rough-legged Hawk (Buteo lagopus)	A,B,C,D,E,F	C-P winter resident	Stable	Open country, woodlands, deserts and marshes
* Ferruginous Hawk (Buteo regalis)	A,B,C,D,E,F	U-P summer resident R-P winter resident	Stable	Open desert; infrequentl marshes and farmlands are utilized
! * Golden Eagle (Aquila chrysaetos)	A,B,C,D,E,F	C-P resident	Stable	Open mountains, foot-hills, canyons and deser
*Bald Eagle (Haliaeetus leucocephalus)	A,B,C,D,E,F	E-P winter resident	Increasing	Lakes, rivers and marshe surrounded by open country with available perching sites
! *Marsh Hawk (Circus cyaneus)	A,B,C,D,E,F	C-P resident	Stable	Marshes, fields and prairies
Family Pandionidae				
*Osprey (Pandion haliaetus)	A,B,C,D,E,F	U-P transient	Stable	Rivers, lakes and large bodies of water
Family Falconidae				
! *Prairie Falcon (Falco mexicanus)	A,B,C,D,E,F	C-P resident	Stable	Canyons, open habitat in mountains, plains and deserts
*Peregrine Falcon (Falco peregrinus)	A,B,C,D,E,F	E-P resident	Unknown	Canyons, high cliffs, rivers, marshlands and deserts
*Merlin (Falco columbarius)	A,B,C,D,E,F	C-P winter resident	Unknown	Open country and foot-hills; often associated with flocking passerine

pecies	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
! * American Kestrel (Falco sparverius)	A,B,C,D,E,F	C-P summer resident U-P winter resident	Stable	Open country, prairies, deserts, wooded streams, farmland and cities
Order Galliformes				
Family Tetraonidae				
! * Blue Grouse (Dendragapus obscurus)	A,B,C,D,E,F	C-P resident	Stable	Coniferous forests, aspen, mountain brush, open slash and burns
! * Ruffed Grouse (Bonasa umbellus)	A,B	C-P resident	Stable	Aspen and coniferous forests near stream courses
! *Sage Grouse (Centrocercus urophasianus)	A,B,C,F	C-P resident	Stable	Sagebrush plains associated with pasture lands; sagebrush parks associated with wet meadows
Family Phasianidae				
* California Quail (Lophortyx californicus)	A,B,D,E,F	C-P resident	Stable	Mountain brush, woodland edges and farmlands near river bottoms
* Gambels Quail (Lophortyx gambelii)	D,E,F	C-P resident	Stable	Desert thickets, usually near water
* Chukar (Alectoris chukar)	A,B,C,D,E,F	C-P resident	Stable	Rocky, grassy or brushy slopes in arid mountains and canyons
* Ring-necked Pheasant (Phasianus colchicus)	A,B,C,D,E,F	C-P resident	Decreasing	Irrigated cropland, pastureland, wetlands and desert wa[illegible]

Species	Geographic Area Inhabited	Status	Population Trend	Habitat Use Area
* White-winged Pheasant (Phasianus colchicus)	E,F	L-P resident	Decreasing	Irrigated cropland, pastureland and wetlands near Hanksville and Bluff, Utah
Family Meleagrididae				
* Merriam's Turkey (Meleagris gallapavo)	F	L-P resident	Stable	Mountainous regions with Ponderosa pine, mixed conifer and aspen woodlands or mountain brush
Order Gruiformes				
Family Gruidae				
* Sandhill Crane (Grus canadensis)	A,B,C,D,E,F	R-P transient	Stable	In winter, prairies grainfields and marshes in summer, mountain meadows and marshes
Family Rallidae				
* Virginia Rail (Rallus limicola)	A,B,C,D,E,F	C-P resident	Stable	Marshes
* Sora Rail (Porzana carolina)	A,B,C,D,E,F	U-P resident	Stable	Marshes and wet meadows
* Common Gallinule (Gallinula chloropus)	A,D	R-P transient	Unknown	Marshes, wet meadows, lakes with bulrush or cattails and sedges
* American Coot (Fulica americana)	A,B,C,D,E,F	C-P resident and transient	Stable	Ponds, lakes, marshes, and agricultural lands adjacent to wetland habitats.
Order Charadriiformes				
Family Charadriidae				
Semipalmated Plover (Charadrius semipalmatus)	A,B,C,D,E,F	U-P transient	Stable	Shores of marshes, reservoirs and mudflats

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
*Snowy Plover (Charadrius alexandrinus)	A,B,C,D,E,F	U-P transient	Stable	Alkali and sand flats
! Killdeer (Charadrius vociferus)	A,B,C,D,E,F	C-P summer resident and transient	Stable	Fields and pastures, lawns, riverbanks, irrigated land, shores, plowed fields, alkali flats and gravel roads
! Mountain Plover (Charadrius montanus)	A,B,C,F	R-P transient	Stable	Semi-arid grasslands, plains and plateaus
American Golden Plover (Pluvialis dominica)	A,B,C,D,E,F	U-P transient	Stable	Prairies, mudflats and shores
Black-bellied Plover (Pluvialis squatarola)	A,B,C,D,E,F	C-P transient	Stable	Mudflats, open marshes and shores
Family Scolopacidae				
* Common Snipe (Capella gallinago)	A,B,C,D,E,F	C-P resident	Stable	Marshes, irrigation ditches, stream sides, and wet meadows
* Long-billed Curlew (Numenius americanus)	A,B,C,D,E,F	U-P summer resident and transient	Declining	Meadows, pastures and wetlands
* Willet (Catoptrophorus semipalmatus)	A,B,C,D,E,F	U-P summer resident and transient	Stable	Marshes, wet meadows and muddy shores
! Spotted Sandpiper (Tringa macularia)	A,B,C,D,E,F	C-P summer resident and transient	Stable	Pebbly lake shores, ponds and stream sides

Species	Biogeograph. Area Inhabited	Status	Population Trend	Habitat Use Area
Solitary Sandpiper (Tringa solitaria)	A,B,C,D,E,F	U-P transient	Stable	Stream sides, ponds and marshes
Greater Yellowlegs (Tringa melanoleuca)	A,B,C,D,E,F	U-P transient	Stable	Open marshes, mudflats, streams and ponds
Lesser Yellowlegs (Tringa flavipes)	A,B,C,D,E,F	C-P transient	Stable	Marshes, mudflats, shores and pond edges
Pectoral Sandpiper (Calidris melanotos)	A,B,C,D,E,F	U-P transient	Stable	Prairie pools and marshy shores
Baird's Sandpiper (Calidris bairdii)	A,B,C,D,E,F	U-P transient	Stable	Rainpools, pond margins mudflats and shores
Least Sandpiper (Calidris minutilla)	A,B,C,D,E,F	C-P transient	Stable	Grassy marshes, rain-pools, shores and alkal mudflats
Western Sandpiper (Calidris mauri)	A,B,C,D,E,F	C-P transient	Stable	Shores, beaches, mud-flats and open marshes
Sanderling (Calidris alba)	A,B,C,D,E,F	U-P transient	Stable	Lake shores
Short-billed Dowitcher (Limnodromus griseus)	A,B,C,D,E,F	U-P summer resident and transient	Stable	Mudflats, open marshes and ponds
Long-billed Dowitcher (Limnodromous scolopaceus)	A,B,C,D,E,F	C-P summer resident and transient	Stable	Mudflats, shallow pools and wetlands

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Marbled Godwit (Limosa fedoa)	A,B,C,D,E,F	C-P transient	Stable	Grasslands and meadows near lakes and shallow lake margins
Family Recurvirostridae				
American Avocet (Recurvirostra americana)	A,B,C,D,E,F	C-P summer resident and transient	Stable	Marshes, mudflats, alkaline lakes, shallow ponds and sloughs
Black-necked Stilt (Himantopus mexicanus)	A,B,C,D,E,F	C-P summer resident and transient	Stable	Grassy marshes, alkali mudflats, pools and shallow lakes
Family Phalaropodidae				
Wilson's Phalarope (Phalaropus tricolor)	A,B,C,D,E,F	C-P summer resident and transient	Stable	Shallow lakes, marshes, pools, shores and mudflats
Northern Phalarope (Phalaropus lobatus)	A,B,C,D,E,F	C-P summer resident and transient	Stable	Lakes and ponds
Family Laridae				
Glaucous Gull (Larus hyperboreus)	D	R-P transient	Stable	Recorded using marshlands at Desert Lake WMA
Herring Gull (Larus argentatus)	A,B,C,D,E,F	U-P transient	Stable	Lakes, farmlands and dumps
/ California Gull (Larus californicus)	A,B,C,D,E,F	C-P summer resident	Stable	Lakes, rivers, farmlands and dumps
/ Ring-billed Gull (Larus delawarensis)	A,B,C,D,E,F	C-P winter resident	Stable	Lakes, rivers, refuse dumps, fields and cities

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Franklin's Gull (Larus pipixcan)	A,B,C,D,E,F	C-P summer resident	Stable	Prairies, marshes, lakes and plowed fields
Bonaparte's Gull (Larus philidelphia)	A,B,C,D,E,F	U-P transient	Stable	Rivers, lakes and open marshes
Forsters Tern (Sterna forsteri)	A,B,C,D,E,F	C-P summer resident and transient	Stable	Marshes, lakes and reservoirs
Common Tern (Sterna hirundo)	A,B,C,D,E,F	U-P transient	Stable	Lakes and reservoirs
Black Tern (Chlidonias niger)	A,B,C,D,E,F	C-P summer resident and transient	Stable	Marshes, lakes and reservoirs
Caspian Tern (Hydroprogne caspia)	A,B,C,D,E,F	U-P transient	Stable	Large lakes and reservoirs
Order Columbiformes				
Family Columbidae				
* Band-tailed pigeon (Columba fasciata)	A,E,F	U-P summer resident and transient	Stable	Forests, canyons and foothills near mountain brush (acorns) and agricultural lands
Rock Dove (Columba lavia)	A,B,C,D,E,F	C-N resident	Stable	Cities, farms and cliffs
* Mourning Dove (Zenaida macroura)	A,B,C,D,E,F	C-P summer resident and transient	Stable	Farmlands, towns, open woods, grassland and deserts
White-winged Dove (Zenaidura asiatica)	E,F	A-P summer resident and transient	Unknown	Open woods and river bottoms

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Order Cuculiformes				
Family Cuculidae				
! *Yellow-billed Cuckoo (Coccyzus americanus)	A,B,C,D,E,F	K-P summer resident	Unknown	River thickets and willows
Order Strigiformes				
Family Tytonidae				
! *Barn Owl (Tyto alba)	A,B,C,D,E,F	K-P resident	Unknown	Woodlands, fields, farms, towns, canyons, cliffs and dirt banks
Family Strigidae				
! *Screech Owl (Otus asio)	A,B,C,D,E,F	U-P resident	Stable	Riparian communities and wooded canyons
! *Flammulated Owl (Otus flammeolus)	A,B,C,D,E,F	K-P summer resident	Unknown	Open pine and fir forests in mountains
! *Great Horned Owl (Bubo virginianus)	A,B,C,D,E,F	C-P resident	Stable	Ubiquitous
! *Pygmy Owl (Glaucidium gnoma)	A,B,C,D,E,F	K-P resident	Unknown	Wooded canyons in open coniferous, mixed woodlands and pinion-juniper forests
*Burrowing Owl (Speotyto cunicularia)	A,B,C,D,E,F	L-P resident	Declining	Open grassland, prairies, dikes, desert, farms and prairie dog colonies

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
* Spotted Owl (Strix occidentalis)	C,E	K-P Unknown	Unknown	Wooded canyons with narrow side canyons in the desert
* Long-eared Owl (Asio otus)	A,B,C,D,E,F	C-P resident	Stable	River woodlands, pinion-juniper forests, willow thickets and Russian olive trees
* Short-eared Owl (Asio flammeus)	A,B,C,D,E,F	C-P resident	Stable	Marshes, prairies, irrigated land and open country with short vegetation
* Saw-whet Owl (Aegolius acadicus)	A,B,C,D,E,F	K-P resident	Stable	Forest, conifers and groves
Order Caprimulgiformes				
Family Caprimulgidae				
Common Nighthawk (Chordeiles minor)	A,B,C,D,E,F	C-P summer resident	Stable	Treeless plains to mountains with open pine woods; often seen in fli over country side or tov
Lesser Nighthawk (Chordeiles acutipennis)	E	R-P summer resident	Unknown	Arid open scrub, dry grasslands, pastures and desert washes
Poor-will (Phalaenoptilus nuttallii)	A,B,C,D,E,F	C-P summer resident	Stable	Arid uplands with open pinion-juniper and spar: brush; riparian areas ar roadsides

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Order Apodiformes				
Family Apodidae				
!*Black Swift (Cypseloides niger)	A,B,C,D,E,F	U-P summer resident	Unknown	Open areas in mountain country
White-throated Swift (Aeronautes saxatalis)	A,B,C,D,F	C-P summer resident	Unknown	Open areas; wide ranging and breeds mainly in dry mountain canyons
Family Trochilidae				
! Black-chinned Hummingbird (Archilochus alexandri)	A,B,C,D,E,F	C-P summer resident	Unknown	Semi-arid country near water; semi-wooded canyons and slopes, mountain brush and riparian woodlands
! Broad-tailed Hummingbird (Selasphorus platycercus)	A,B,C,D,E,F	C-P summer resident	Unknown	Ubiquitous
! Rufous Hummingbird (Selasphorus rufus)	A,B,C,D,E,F	C-P summer resident and transient	Unknown	Forest edges, thickets in coniferous and deciduous forests, mountain brush and alpine meadows
! Calliope Hummingbird (Stellula calliope)	A,B,C,D,E,F	C-P summer resident	Unknown	High mountains, canyons and forest openings
! Rivoli's Hummingbird (Eugenes fulgens)	E,F	U-P summer resident	Unknown	High mountain forest openings, pine-oak forests and canyons

Species	Geographic Area Inhabited	Status	Population Trend	Habitat Use Area
Order Caraciiformes				
Family Alcedinidae				
!* Belted Kingfisher (Megaceryle alcyon)	A,B,C,D,E,F	U-P resident	Stable	Rivers, ponds and lakes
Order Piciformes				
Family Picidae				
! Common Flicker (Colaptes auratus)	A,B,C,D,E,F	C-P resident	Stable	Deciduous or mixed woodlands, open forest, farms towns, canyons and semi-open country
* Pileated Woodpecker (Dryocopus pileatus)	F	R-P resident	Unknown	Mature coniferous and mixed forests with many snags
Red-headed Woodpecker (Melanerpes erythrocephalus)	B	R-P resident	Unknown	Groves, farm country, riparian areas, towns and scattered trees
! Yellow-bellied Sapsucker (Sphyrapicus varius)	A,B,C,D,E,F	C-P resident	Unknown	In summer woodlands and aspen groves; in winter orchards and other trees
* Williamson's Sapsucker (Sphyrapicus thyroideus)	F	U-P summer resident	Unknown	Higher coniferous forests and burns
*Lewis Woodpecker (Asyndesmus lewis)	F	K-P summer resident and transient	Unknown	Scattered or logged forests, burns, cottonwood groves and ponderosa pine
! Hairy Woodpecker (Dendrocopos villosus)	A,B,C,D,E,F	C-P resident	Unknown	Mountain forests, woodlands and river groves

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
! Downy Woodpecker (Dendrocopos pubescens)	A,B,C,D,E,F	C-P resident	Unknown	Broken or mixed forest, willows, poplars, riparian woodlands, orchards and shade trees
! Northern Three-toed Woodpecker (Picoides tridactylus)	A,B,C,E,F	U-P resident	Unknown	Coniferous forests
Order Passeriformes				
Family Tyrannidae				
Western Kingbird (Tyrannus verticalis)	A,B,C,D,E,F	C-P summer resident	Stable	Open country with scattered trees, farms and roadsides
! Cassin's Kingbird (Tyrannus vociferans)	A,B,C,D,E,F	U-P summer resident	Unknown	Semi-open high country, scattered trees, pine-oak mountains and ranch groves
Eastern Kingbird (Tyrannus tyrannus)	A,B,C,D,E,F	C-P summer resident	Unknown	Wood edges, parklands, riparian areas, farms, shelter belts, orchards and roadsides
Ash-throated Flycatcher (Myiarchus cinerascens)	A,B,C,D,E,F	C-P summer resident	Stable	Semi-arid country, deserts, brush, pinion-juniper and open woods
Black Phoebe (Sayornis nigricans)	F	C-P resident	Unknown	Streamside woodlands, farmyards and towns with cliffs near water
Says Phoebe (Sayornis saya)	A,B,C,D,E,F	C-P resident	Unknown	Open arid country, deserts, bushy plains, prairie farms, canyon mouths and bu

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
! Willow (Traill's) Flycatcher (Empidonax traillii)	A,B,C,D,E,F	C-P summer resident	Unknown	Breeds in willow thickets in low valleys, along canyons or in high mountain meadows
! Hammond's Flycatcher (Empidonax hammondii)	A,B,C,E,F	U-P summer resident	Unknown	High coniferous forests
! Dusky Flycatcher (Empidonax oberholseri)	A,B,C,D,E,F	C-P summer resident	Unknown	Breeds in mountain brush with a scattering of trees
Gray Flycatcher (Empidonax wrightii)	A,B,C,D,E,F	K-P summer resident	Unknown	Breeds in sagebrush and pinion-juniper woodlands
! Western Flycatcher (Empidonax difficilis)	A,B,C,D,E,F	C-P summer resident	Unknown	Moist woods, mixed or coniferous forests, canyons, groves; must have water and shade
! Western Wood Peewee (Contipus sordidulus)	A,B,C,D,E,F	C-P summer resident	Unknown	Woodlands, pine-oak forests, open conifers and river groves
! Olive-sided Flycatcher (Contopus borealis)	A,B,C,D,E,F	U-P summer resident	Unknown	Coniferous forests, burns and clearings; in migration habitats used are varied; usually seen on tip of dead tree or branch

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Family Alaudidae				
! Horned Lark (*Eremophila alpestris*)	A,B,C,D,E,F	C-P resident	Unknown	Plains, desert, prairies, fields, sparse sagebrush flats, dirt roads, shores, alpine meadows, alkali flats and areas of sparse vegetation
Family Hirundinidae				
! Violet-green Swallow (*Tachycineta thalasssina*)	A,B,C,D,E,F	C-P summer resident	Unknown	Widespread when foraging; when nesting, open forests foothill woods, mountains, canyons, cliffs and towns
! Tree Swallow (*Iridoprocne bicolor*)	A,B,C,D,E,F	C-P summer resident	Unknown	Open country near water, marshes, mountain meadows, streams, lakes and wires; when nesting requires dead trees and snags, preferabl near water
! Bank Swallow (*Riparia riparia*)	A,B,C,D,E,F	C-P summer resident	Unknown	Usually near water; over fields, marshes, streams and lakes
! Rough-winged Swallow (*Stelgidopteryx ruficollis*)	A,B,C,D,E,F	C-P summer resident	Unknown	Near streams, lakes and washes
! Barn Swallow (*Hirundo rustica*)	A,B,C,D,E,F	C-P summer resident	Unknown	Open or semi- coun[illegible] [illegible] fi[illegible] [illegible] [illegible]

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
! Cliff Swallow (Petrochelidon pyrrhonota)	A,B,C,D,E,F	C-P summer resident	Unknown	Open to semi-wooded country, neat farms, cliffs, canyons, rivers or lakes
! * Purple Martin (Progne subis)	A,B,C,E,F	U-P summer resident	Unknown	Open forests of aspen and conifers
Family Corvidae				
! Steller's Jay (Cyanocitta stelleri)	A,B,C,D,E,F	C-P resident	Unknown	Conifers and pine-oak forests
! Gray Jay (Perisorius canadensis)	A,B,C,E,F	R-P resident	Unknown	Coniferous forests
Scrub Jay (Aphelocoma coerulescens)	A,B,C,D,E,F	C-P resident	Unknown	Foothills, oaks, mountain brush, river woods and pinion-juniper woodlands
! Black-billed Magpie (Pica pica)	A,B,C,D,E,F	C-P resident	Unknown	Foothills, ranches, sage-brush, river thickets, shelterbelts and prairie brush
! Common Raven (Corvus corax)	A,B,C,D,E,F	C-P resident	Unknown	Mountains, deserts, canyons and cliffs
! Common Crow (Corvus brachyrhynchos)	A,B,C,D,E,F	O-P transient	Unknown	Deciduous, mixed and open coniferous woodlands farmlands and river grove
Pinion Jay (Gymnorhinus cyanocephala)	A,B,C,D,E,F	C-P resident	Unknown	Pinion-juniper woodlands, but ranges into sagebrush
! Clark's Nutcracker (Nucifraga columbiana)	A,B,C,E,F	C-P resident	Unknown	High mountains in conifer near tree line

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Family Paridae				
! Black-capped Chickadee (Parus atricapillus)	A,B,C,D,E,F	C-P resident	Unknown	In summer aspen-conifer, mixed woodlands and forest edges; in winter woodlands along valley streams and tree rows
! Mountain Chickadee (Parus gambeli)	A,B,C,D,E,F	C-P resident	Unknown	In summer mountain forests and conifers; in winter riparian woodlands at lower elevations
Plain Titmouse (Parus inornatus)	A,B,C,D,E,F	C-P resident	Unknown	Pinion-juniper woodlands
Bushtit (Psaltriparus minimus)	A,B,C,D,E,F	C-P resident	Unknown	Oak woodlands, mountain brush, broad-leafed and mixed woods and pinion-juniper forest
Family Sittidae				
! White-breasted Nuthatch (Sitta carolinensis)	A,B,C,D,E,F	C-P resident	Unknown	Coniferous forests, pinion-juniper woodlands, oak brush, and riparian woodlands
! Red-breasted Nuthatch (Sitta canadensis)	A,B,C,E,F	C-P resident	Unknown	Conif[illegible]
! Pygmy Nuthatch (Sitta pusilla)	A,B,C,D,E,F	C-P resident	Unk[illegible]	[illegible]

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use A
Family Certidae				
Brown Creeper (Certhia familiaris)	A,B,C,E,F	C-P resident	Unknown	In summer mature montane mixed and coniferous forests; lower elevations in winter
Family Cinclidae				
Dipper (Cinclus mexicanus)	A,B,C,D,E,F	C-P resident	Unknown	Fast-flowing streams in or near mountains; lower levels in winter
Family Troglodytidae				
House Wren (Troglodytes aedon)	A,B,C,D,E,F	C-P summer resident	Unknown	Woodlands of mountains and valleys
Rock Wren (Salpinctes obsoletus)	A,B,C,D,E,F	C-P resident	Unknown	Desert to high mountain areas with talus slopes and cliffs
Canyon Wren (Catherpes mexicanus)	A,B,C,D,E,F	C-P resident	Unknown	Rocky cliffs, crevices, and rock slides
Bewick's Wren (Thryomanes bewickii)	A,B,C,D,E,F	C-P resident	Unknown	Under brush and pinion-juniper woodlands
Long-billed Marsh Wren (Cistothorus palustris)	A,B,C,D,E,F	L-P resident	Unknown	Cattail marshes
Family Mimidae				
Mockingbird (Mimus polyglottos)	A,B,C,D,E,F	U-P transient and summer resident	Unknown	Towns, farms, ranches, roadsides, brush and desert streamsides
Gray Catbird (Dumetella carolinensis)	A,B,C,D,E,F	U-P summer resident	Unknown	Undergrowth, brush or thickets along valley streams

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Brown Thrasher (Toxostoma rufum)	D,E,F	R-P resident	Unknown	Brushy places and thorny thickets
Bendire's Thrasher (Toxostoma bendirei)	F	R-P resident	Unknown	Desert scrub and farmlands
! Sage Thrasher (Oreoscoptes montanus)	A,B,C,D,E,F	C-P resident	Unknown	Sagebrush, rabbit-brush, brushy slopes and mesas
Family Muscicapidae				
! American Robin (Turdus migratorius)	A,B,C,D,E,F	C-P resident	Unknown	In summer towns, lawns, farmland, open forests, streamsides and any woode habitat; in winter berry-bearing trees
Varied Thrush (Ixoreus naevius)	E,F	O-P winter resident	Unknown	Deciduous and coniferous forests usually near wate
! Hermit Thrush (Catharus guttatus)	A,B,C,D,E,F	C-P summer resident and transient	Unknown	In summer mixed woodlands and open coniferous fores in winter woods, thickets and parks
! Swainson's Thrush (Catharus ustulatus)	A,B,D	C-P summer resident	Unknown	Willow thickets, river woodlands, aspens, forest undergrowth and conifers
! Veery (Catharus fuscescens)	A,B	U-P summer resident	Unknown	Streamside woodlands

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
! * Western Bluebird (Sialia mexicana)	A,B,C,D,E,F	U-P summer resident	Unknown	Scattered trees, open conifers, forests and farms
! * Mountain Bluebird (Sialia currucoides)	A,B,C,D,E,F	C-P resident	Unknown	In summer open areas where mountain meadows and pastures are interspersed with loose stands or single coniferous trees; in winter lower elevations, often open areas with available perching sites
! Townsend's Solitaire (Myadestes townsendi)	A,B,C,D,E,F	C-P resident	Unknown	In summer open coniferous forests in the mountains; in winter canyons, brushy slopes and junipers
Family Sylviidae				
! Blue-gray Gnatcatcher (Polioptila caerulea)	A,B,C,D,E,F	C-P summer resident	Unknown	Open mixed woods, streamside thickets, mountain brush and pinion-juniper woodlands
! Golden-crowned Kinglet (Regulus satrapa)	A,B,C,D,E,F	U-P resident	Unknown	In summer coniferous forests; in winter pinion-juniper and brush in lower elevations
! Ruby-crowned Kinglet (Regulus calendula)	A,B,C,D,E,F	C-P resident	Unknown	In summer coniferous forests; in winter other woodlands and thickets

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Family Motacillidae				
Water Pipet (Anthus spinoletta)	A,B,C,D,E,F	C-P resident	Unknown	In summer alpine zone; in migration and winter plains, bare fields, shores and irrigated field
Family Bombycillidae				
Bohemian Waxwing (Bombycilla garrulus)	A,B,C,D,E,F	U-P winter resident	Unknown	Widespread and feeds on berries
Cedar Waxwing (Bombycilla cedrorum)	A,B,C,D,E,F	C-P winter resident	Unknown	Open woodlands, Russian olive and other fruiting trees or orchards
Family Laniidae				
Northern Shrike (Lanius excubitor)	A,B,C,D,E,F	U-P winter resident	Unknown	Semi-open country or open country with look-out posts
Loggerhead Shrike (Lanius ludovicianus)	A,B,C,D,E,F	C-P resident	Unknown	Deserts and other open country with lookout posts, wires, scattered trees and low scrub
Family Sturnidae				
Starling (Stuirnus vulgaris)	A,B,C,D,E,F	C-P resident	Unknown	Cities, fields, orchards and woodlands
Family Vireonidae				
Gray Vireo (Vireo vicinior)	D,E,F	U-P summer resident	Unknown	Brushy mountain slopes, scrub oak and junipers
Solitary Vireo (Vireo solitarius)	A,B,C,D,E,F	U-P summer resident	Unknown	Streamside woodlands, pinion-juniper and Ponderosa pine forests

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
! Warbling Vireo (Vireo gilvus)	A,B,C,D,E,F	C-P summer resident	Unknown	Deciduous and mixed aspen woodlands near mountain and valley streams
Family Parulidae				
! Orange-crowned Warbler (Vermivora celata)	A,B,C,D,E,F	C-P summer resident and transient	Unknown	Brushy woodland clearings, hillsides, aspens and mountain brush; in migration streamside woodlands
! Nashville Warbler (Vermivora ruficapilla)	A,B,C,D,E,F	U-P transient	Unknown	Open mixed woods with undergrowth and at forest edges
Virginia's Warbler (Vermivora virginiae)	A,B,C,D,E,F	C-P summer resident	Unknown	Oak canyons, brushy slopes and pinion-juniper brushland
Lucy's Warbler (Vermivora luciae)	E,F	U-P summer resident	Unknown	Along desert streams in willows and cottonwoods
! Yellow Warbler (Dendroica petechia)	A,B,C,D,E,F	C-P summer resident	Unknown	Willows, aspens, streamside trees and shrubs or town shade trees
* Grace's Warbler (Dendroica graciae)	E,F	U-P summer resident	Unknown	Ponderosa pine-oakbrush communities of the mountains
! Magnolia Warbler (Dendroica magnolia)	A,B,C,D,E,F	U-P transient	Unknown	Coniferous forests

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Hermit Warbler (*Dendroica occidentalis*)	E,F	U-P summer resident and transient	Unknown	Coniferous forests; in migration other trees
Yellow-rumped Warbler (*Dendroica coronata*)	A,B,C,D,E,F	C-P summer resident	Unknown	In summer coniferous and mixed forests; in winter varied woods, river thickets, brush and gardens
Black-throated Gray Warbler (*Dendroica nigrescens*)	A,B,C,D,E,F	C-P summer resident	Unknown	In summer dry oak slopes, pinion-juniper woodlands, open mixed woods; in migration varied trees and brush
Townsend's Warbler (*Dendroica townsendi*)	A,B,C,D,E,F	U-P transient	Unknown	Coniferous forests
Northern Waterthrush (*Seiurus noveboracensis*)	B,C,D,E,F	U-P transient	Unknown	Swampy or wet woods, streamsides and lake-shores; in migration thickets
MacGillivray's Warbler (*Oporornis tolmiei*)	A,B,C,D,E,F	C-P summer resident	Unknown	Low dense undergrowth and shady, damp thickets
Yellowthroat (*Geothylpis trichas*)	A,B,C,D,E,F	L-P summer resident	Unknown	Cattail and bulrush marshes, willow thickets and streamsides
Yellow-breasted Chat (*Icteria virens*)	A,B,C,D,E,F	C-P summer resident	Unknown	Dense brush along water courses, willow thickets and [illegible]st canyons

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
! Wilson's Warbler (Wilsonia pusilla)	A,B,C,D,E,F	C-P summer resident	Unknown	Deciduous shrubbery or thickets, streamside growth, willows and fir thickets in the mountains
! American Redstart (Setophaga ruticilla)	A,B,C	U-P transient	Unknown	Open secondary deciduous woodlands and riparian woodlands
Family Ploceidae				
House Sparrow (Passer domesticus)	A,B,C,D,E,F	C-P resident	Unknown	Cities, farms and houses
Family Icteridae				
! Western Meadowlark (Sturnella neglecta)	A,B,C,D,E,F	C-P resident	Unknown	Open fields, meadows and plains
Yellow-headed Blackbird (Xanthocephalus xanthocephalus)	A,B,C,D,E,F	C-P summer resident	Unknown	Marshes with cattail and bulrushes; forages in fields and open country
Red-winged Blackbird (Agelaius phoeniceus)	A,B,C,D,E,F	C-P resident	Unknown	Breeds in marshes with emergent aquatic vegetation, forages in cultivated land and at the edge of water
Northern Oriole (Icterus galbula)	A,B,C,D,E,F	C-P summer resident	Unknown	Open woodlands, cottonwoods or other shade trees and riparian areas

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
* Scotts Oriole (Icterus parisorum)	C,D,E,F	U-P summer resident	Unknown	Pinion-juniper woodlands of desert mountains. oak slopes and cottonwood trees in canyons
Rusty Blackbird (Euphagus carolinus)	A	O-P transient	Unknown	Wooded marshes and riparian woodlands
Brewer's Blackbird (Euphagus cyanocephalus)	A,B,C,D,E,F	C-P resident	Unknown	Varied open country, lakeshores, irrigated pastures, feed lots, parks and cities
! Common Grackle (Quiscalus quiscula)	A,B,D	A-P transient	Unknown	Farms, fields, streamsides and wet woodlands
Brown-headed Cowbird (Molothrus ater)	A,B,C,D,E,F	C-P resident	Unknown	Farms, fields, barnyards wood edges and riparian woodlands
Family Thraupidae				
! Western Tanager (Piranga ludoviciana)	A,B,C,D,E,F	C-P summer resident	Unknown	Open coniferous, aspen or mixed forests; widespread in migration
Family Embarizidae				
Rose-breasted Grosbeak (Pheucticus ludovicianus)	F	O-P summer resident	Unknown	Broadleaf riparian areas and aspens
Black-headed Grosbeak (Pheucticus melanocephalus)	A,B,C,D,E,F	C-P summer resident	Unknown	Edges of second growth deciduous woods, pinion, riparian areas, orchards and parks

Species	Biogeographic Area Inhabit	Status	Population Trend	Habitat Use
Blue Grosbeak (Guiraca caerulea)	B,C,D,E,F	C-P summer resident	Unknown	Brushy and weedy places, willows and river thicke and other riparian areas
Lapland Longspur (Calcarius lapponicus)	A,B,C,D,E,F	R-P winter resident	Unknown	Fields, grasslands, saline flats, desert shrub; often seen with horned larks
Indigo Bunting (Passerina cyanea)	A,B,D	R-P summer resident	Unknown	Brush, farm lands and streamsides
Lazuli Bunting (Passerina amoena)	A,B,C,D,E,F	C-P summer resident	Unknown	Mountain brush, stream-side shrubs and farmland tree rows
Green-tailed Towhee (Chlorura chlorura)	A,B,C,D,E,F	C-P summer resident	Unknown	Low mountain brush, greasewood and pinion-juniper woodlands
Rufous-sided Towhee (Pipilo erythrophthalmus)	A,B,C,D,E,F	C-P resident	Unknown	Mountain brush, forest edges and city shrubs
Lark Bunting (Calamospiza melanocorys)	A,B,C,D,E,F	O-P transient	Unknown	Plains, prairies, desert shrub and sagebrush
Savannah Sparrow (Passercules sandwichensis)	A,B,C,D,E,F	C-P summer resident	Unknown	Grasslands, fields, saltgrass meadows and open country
* Grasshopper Sparrow (Ammodramus savannarum)	A,B,C,D,E,F	R-P transient	Unknown	Dry grasslands
LeConte's Sparrow (Ammospiza leconteii)	F	A-P transient	Unknown	Tall grass, weedy meadows and marshes

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Vesper Sparrow (Pooecetes gramineus)	A,B,C,D,E,F	C-P summer resident	Unknown	Alfalfa and grain fields, meadows, sagebrush and desert shrub
Lark Sparrow (Chondestes grammacus)	A,B,C,D,E,F	C-P summer resident	Unknown	Open country in sagebrush and desert shrub with available perch sites
Sage Sparrow (Amphispiza belli)	A,B,C,D,E,F	U-P summer resident	Unknown	Sagebrush, greasewood and other desert shrubs
Dark-eyed Junco (Junco hyemalis)	A,B,C,D,E,F	C-P resident	Unknown	In summer openings and edges of coniferous and mixed woodlands; in winte greasewood and undergrowt
Gray-headed Junco (Junco caniceps)	A,B,C,D,E,F	C-P summer resident	Unknown	Coniferous, mixed forests and mountain brush
Tree Sparrow (Spizella arborea)	A,B,C,D,E,F	U-P winter resident	Unknown	Willow thickets and brushy areas
Chipping Sparrow (Spizella passerina)	A,B,C,D,E,F	C-P summer resident	Unknown	Mountain coniferous and deciduous woodlands, valley woodlands, farms, orchards, parks and brushlands
Brewer's Sparrow (Spizella breweri)	A,B,C,D,E,F	C-P summer resident	Unknown	Sagebrush, greasewood and other desert shrubs or brushy areas
Harris Sparrow (Zonotrichia querula)	A,B,C,D,E,F	U-P winter resident	Unknown	Brushy edges of open woodlands, Russian olives and willows

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use
! White-crowned Sparrow (Zonotrichia leucophrys)	A,B,C,D,E,F	C-P resident	Unknown	In summer forest edges and clearings, low brush and mountain thickets; in winter widespread in the valleys, along fence rows, willows, brushy areas, corn and greasewood
White-throated Sparrow (Zonotricia albicollis)	E,F	R-P winter resident	Unknown	Coniferous and mixed woodlands, woodland undergrowth thickets and brush
Golden-crowned Sparrow (Zonotrichia atricapilla)	E,F	R-P winter resident	Unknown	Mountain brush and brushy areas in the lower valleys
Swamp Sparrow (Zonotrichia georgiana)	F	U-P winter resident.	Unknown	Marshes; in migration weedy fields
! Fox Sparrow (Zonotrichia iliaca)	A,B,C	K-P summer resident and transient	Unknown	Valley and mountain woodlands and brushy areas usually near water
! Lincoln's Sparrow (Zonotrichia lincolnii)	A,B,C	U-P summer resident R-P winter resident	Unknown	In summer willow thickets, brushy bogs; in winter lowland thickets, tall weeds and bushes
Song Sparrow (Zonotrichia melodia)	A,B,C,D,E,F	C-P resident	Unknown	Woodland edges, grasslands, cattail marshes, thickets and brushy fence rows

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Black-throated Sparrow (Amphispiza bilineata)	A,B,C,D,E,F	U-P summer resident	Unknown	Pinion-juniper, mountain brush and sagebrush
Family Fringillidae				
Evening Grosbeak (Coccothraustes vespertinus)	A,B,C,D,E,F	C-P winter resident	Unknown	Boxelders, Russian olive trees and fruiting shrubs
! Cassin's Finch (Carpodacus cassinii)	A,B,C,D,E,F	C-P summer resident U-P winter resident	Unknown	In summer, open conifer forests of high mountains in winter valleys
House Finch (Carpodacus mexicanus)	A,B,C,D,E,F	C-P resident	Unknown	Varied habitats; towns, ranches, open woods, mountain scrub, canyons, deserts and riparian area
! Pine Grosbeak (Pinicola enucleator)	A,B,C,E,F	U-P resident	Unknown	In summer coniferous forests; in winter mixed woods and fruiting trees
! Rosy Finch (Leucosticte arctoa)	A,B,C,D,E,F	C-P resident	Unknown	In summer alpine tundra, meadows and snowfields; winters in lowlands
! Pine Siskin (Carduelis pinus)	A,B,C,D,E,F	C-P resident	Unknown	Coniferous forests, along edges of second growth deciduous forests; in migration seen in large flocks in the lower valle

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
American Goldfinch (Carduelis tristis)	A,B,C,D,E,F	C-P resident	Unknown	Riparian woodlands, willows, cottonwoods, orchards, roadsides and sunflowers
! Lesser Goldfinch (Carduelis psaltria)	A,B,C,D,E,F	C-P resident	Unknown	Open brushy country, open woods, wooded streams and gardens
! Red Crossbill (Loxia curvirostra)	A,B,C,E,F	U-P summer resident	Unknown	Coniferous forests
Mammals -- 103 species in southeastern Utah				
Order Insectivora				
Family Soricidae				
*Dwarf Shrew (Sorex nanus)	B,C,D,E,F	R-N	Unknown	Open grass-covered areas which may have scattered brush, marshes, coniferous forests and openings in woods
! North Water Shrew (Sorex palustris)	A,B,C,E,F	C-N	Unknown	Along nearly all permanent streams in mountainous areas
! Merriam Shrew (Sorex merriami)	A,B,C,D,E,F	U-N	Unknown	Arid sagebrush or grassland areas, mountain mahogany, coniferous forests, aspen and cottonwoods
! Vagrant Shrew (Sorex vagrans)	A,B,C,F	C-N	Unknown	Marshes, bogs, wet meadows and along streams in forests

pecies	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
! Masked Shrew (Sorex cinereus)	A,B,D,E	C-N	Unknown	Moist sites in forests, open country and brushlan
! Dusky Shrew (Sorex obscurus)	A,B,C,F	C-N	Unknown	Marshes, coniferous forests and dry hillsides
* Gray (Desert) Shrew (Notiosorex crawfordi)	E,F	R-N	Unknown	Arid alluvial fans, brushy slopes, sagebrush and other low desert shrub communities
Order Chiroptera				
Family Vespertilionidae				
! Little Brown Myotis (Myotis lucifugus)	A,B,C,D,E,F	C-N	Unknown	Caves, mine tunnels, hollow trees or buildings usually near water
Fringed Myotis (Myotis thysanodes)	A,B,C,D,E,F	U-N	Unknown	Caves, old buildings, roc crevices, pinion-juniper and desert shrub
! Long-eared Myotis (Myotis evotis)	A,B,C,D,E,F	C-N	Unknown	Coniferous forests in hig mountains, around buildin or trees and occasionally caves
! Long-legged Myotis (Myotis volans)	A,B,C,D,E,F	C-N	Unknown	Buildings, small pockets, crevices in rock ledges and trees

Species	Biogr[illegible]ic Area Inhabited	Status	Population Trend	Habitat Use A[illegible]
Yuma Myotis (Myotis yumanensis)	A,B,C,D,E,F	U-N	Unknown	Caves, tunnels and buildings in arid areas
California Myotis (Myotis californicus)	A,B,C,D,E,F	C-N	Unknown	Mine tunnels, hollow trees, loose rocks, buildings, bridges; chiefly a crevice dweller (up to 6,000 feet in elevation)
Small-footed Myotis (Myotis leibii)	A,B,C,D,E,F	U-N	Unknown	Caves, mine tunnels, crevices in rocks and in buildings
Silver-haired Bat (Lasionycteris noctivagans)	A,B,C,D,E,F	C-N	Unknown	Forest areas, occasionall in caves or buildings
Western Pipistrelle (Pipistrellus hesperus)	A,B,C,D,E,F	C-N	Unknown	Caves, under loose rocks, crevices, in cliffs, buildings; arid areas nea water courses
Big Brown Bat (Eptesicus fuscus)	A,B,C,D,E,F	C-N	Unknown	Caves, tunnels, crevices, hollow trees, buildings and wooded areas
* Red Bat (Lasiurus borealis)	A,B,C,D,E,F	U-N	Unknown	Wooded areas; roosts in trees and occasionally enters caves
Hoary Bat (Lasiurus cinereus)	A,B,C,D,E,F	U-N	Unknown	Wooded areas
* Western Big-eared Bat (Plecotus townsendii)	A,B,C,D,E,F	C-N	Unknown	Caves, mine tunnels and buildings utilized for roosting; inhabits arid western desert shrub, pinion-juniper and pine forests

pecies	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Mexican Big-eared Bat (Plectus phyllotis)	F	R-N	Unknown	Caves in pine-oak forests between 5,000 to 8,500 feet elevation
*Spotted Bat (Euderma maculata)	Unknown	K-N	Unknown	Arid country; it occasionally enters buildings and caves
Pallid Bat (Antrozous pallidus)	A,B,C,D,E,F	C-N	Unknown	Caves, mine tunnels, crevices in rocks, buildings and trees are utilized for roosts; inhabits scattered desert shrub and pine-oak forests below 6,500 feet elevation
Family Molossidae				
Mexican Free-tailed Bat (Tadarida brasiliensis)	A,B,C,D,E,F	C-N	Unknown	Caves and buildings are utilized for roosts; inhabits lower and upper Sonoran Life Zones
Order Lagomorpha				
Family Ochotonidae				
Pika (Ochontona princeps)	A,B,C,E,F	C-N	Unknown	Talus slopes and rock-slides above 8,000 feet elevation
Family Leporidae				
! White-tailed Jackrabbit (Lepus townsendii)	A,B,C,D	C-N	Stable	Open, grassy or sage-brush areas at medium elevation
! *Snowshoe Hare (Lepus americanus)	A,B,C	C-P	Cyclic	Coniferous forests and aspen, riparian and brush types near conifers

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Black-tailed Jackrabbit (*Lepus californicus*)	A,B,C,D,E,F	C-N	Stable	Open grassland, sagebrush and desert shrub areas at low to medium elevations
*Mountain Cottontail (*Sylvilagus nuttallii*)	A,B,C,E,F	C-P	Stable	Thickets, sagebrush, loose rocks, cliffs and forests
*Desert Cottontail (*Sylvilagus audubonii*)	A,B,C,D,E,F	C-P	Stable	Open plains, foothills and low valleys with grass, sagebrush or scattered pinion-juniper
Order Rodentia				
Family Sciuridae				
Zuni Prairie Dog (*Cynomys gunnisoni*)	F	C-N	Stable	Mountain valleys, 5,000-12,000 feet elevation; open to slightly brushy country with scattered pinion-juniper
White-tailed Prairie Dog (*Cynomys leucurus*)	A,B,C,D,E,F	C-N	Stable	Valleys and flatlands where vegetation is sparse
*Abert Squirrel (*Sciurus aberti*)	F	L-P	Stable	Ponderosa pines
Red Squirrel (*Tamiasciurus hudsonicus*)	A,B,C,F	C-N	Stable	Coniferous forests in the mountains

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
*Spotted Ground Squirrel (Spermophilus spilosoma)	F	L-N	Unknown	Open forests, scattered brush and grassy areas with sandy soil is preferred
Rock Squirrel (Spermophilus variegatus)	A,B,C,D,E,F	C-N	Stable	Rocky canyons with boulder strewn slopes, riparian woodlands, and ditchbanks
Uintah Ground Squirrel (Spermophilus armatus)	A,B	C-N	Stable	Meadows and edges of fields near green vegetation up to 8,000 feet elevation
Golden-mantled Ground Squirrel (Spermophilus lateralis)	A,B,C	C-N	Stable	Mountain brush, open pine and spruce-fir forests to above timberline
Whitetail Antelope Squirrel (Ammospermophilus leucurus)	A,B,C,D,E,F	C-N	Stable	Arid areas of low desert and foothills with sparse vegetation
Yellow-billied Marmot (Marmota flaviventris)	A,B,C,E,F	C-N	Stable	Rocky sites or talus slopes along valleys or in foothills 5,000 to 9,000 feet elevation
*Northern Flying Squirrel (Glaucomys sabrinus)	A,B,C,F	C-N	Unknown	Coniferous and mixed forests in high mountains

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Least Chipmunk (*Eutamius minimus*)	A,B,C,D,E,F	C-N	Stable	Variety of habitat types including sagebrush, desert shrub, mountain bush, coniferous and mixed forest areas
Colorado Chipmunk (*Eutamius quadrivittatus*)	C,E,F	C-N	Stable	Coniferous forests, mountain brush areas, rocky slopes and ridges
Uintah Chipmunk (*Eutamius umbrinus*)	A,B,D,E,F	C-N	Stable	Coniferous forest and mountain brush areas up to timberline with rocky slopes
Cliff Chipmunk (*Eutamius dorsalis*)	A,B,C,D,E	U-N	Stable	Pinion-juniper slopes, riparian woodlands with rocky areas
Family Geomyidae				
Northern Pocket Gopher (*Thomomys talpoides*)	A,B,C,D,E,F	C-N	Unknown	Grassy prairies, alpine meadows, brush areas, open pine forests; generally restricted to the mountains
Valley or Botta Pocket Gopher (*Thomomys bottae*)	A,B,C,D,E,F	C-N	Unknown	Valleys and mountain meadows; prefers loam soil but may be found in sandy or rocky situations

pecies	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Ord Kangaroo Rat (*Dipodomys ordii*)	A,B,C,D,E,F	C-N	Unknown	Desert shrub, pinion-juniper and tamarisk communities; sandy soils preferred but found on hard soils
Baird Pocket Mouse (*Perognathus flavus*)	F	C-N	Unknown	Prefers short grass areas with sandy or rocky soils
Great Basin Pocket Mouse (*Perognathus parvus*)	A,D	C-N	Unknown	Sagebrush or greasewood and other desert shrub communities and pinion-juniper
Apache Pocket Mouse (*Perognathus apache*)	C,D,F	C-N	Unknown	Sparse brushlands and scattered pinion-juniper, usually 5,000-7,200 feet elevation
Family Castoridae				
* Beaver (*Castor canadensis*)	A,B,C,D,E,F	C-P	Increasing	Streams, lakes and irrigation systems with poplars, birch or willows on the bank
Family Cricetidae				
Western Harvest Mouse (*Reithrodontomys megalotis*)	A,B,C,D,E,F	C-N	Unknown	Grasslands, open desert, wetlands, irrigated farmland of dense vegetation near water
Canyon Mouse (*Peromyscus crinitus*)	A,B,C,D,E,F	C-N	Unknown	Rocky canyons and slopes with mountain brush

ecies	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Deer Mouse (Peromyscus manicalatus)	A,B,C,D,E,F	C-N	Unknown	All dry-land habitat and irrigated farmland within its range
Brush Mouse (Peromyscus boylei)	A,B,C,D,E,F	C-N	Unknown	Brushy areas of arid and semi-arid regions; prefers rocky sites
Pinion Mouse (Peromyscus truei)	A,B,C,D,E,F	C-N	Unknown	Rocky terrain in pinion-juniper areas
Northern Grasshopper Mouse (Onychomys leucogaster)	C,F	U-N	Unknown	Open country of grass, sagebrush or greasewood and sandy or gravelly soil
*White-throated Wood Rat (Neotoma albigula)	F	C-N	Unknown	Brushland with rocky cliffs and shallow caves
Desert Wood Rat (Neotoma lepida)	A,B,C,D,E	C-N	Unknown	Desert floors and rocky slopes with low desert vegetation or arid mountain brush
*Mexican Wood Rat (Neotoma mexicana)	F	C-N	Unknown	Rocks, cliffs and mountains
Bushy-tailed Wood Rat (Neotoma cinerea)	A,B,C,D,E,F	C-N	Unknown	High mountains with rimrock, rock slides and pines
Muskrat (Ondatra zibethicus)	A,B,C,D,E,F	C-N	Stable	Marshes, edge of ponds, lakes, streams and irrigation canals

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Meadow Vole (*Microtus pennsylvanious*)	A,D	C-N	Unknown	Moist areas with dense growth of grasses
Mountain Vole (*Microtus montanus*)	A,B,D,E	C-N	Unknown	Dense vegetation in sagebrush-grass communities
Richardson's Vole (*Microtus richardsoni*)	A	C-N	Unknown	Creekbanks and marshes in mountains to above timberline
Longtail Vole (*Microtus longicaudus*)	A,B,C,D,E,F	C-N	Unknown	In summer streambanks, mountain meadows with dry sites; in winter brushy areas
Sagebrush Vole (*Lagurus curtatus*)	C,F	C-N	Unknown	Scattered sagebrush with loose soil and arid conditions
Family Muridae				
Black Rat (*Rattus rattus*)	A,B,C,D,E,F	C-N	Unknown	Buildings and dumps
Norway Rat (*Rattus norvegicus*)	A,B,C,D,E,F	C-N	Unknown	Burrows along building foundations and beneath rubbish piles
House Mouse (*Mus musculus*)	A,B,C,D,E,F	C-N	Unknown	Buildings and occasionally in fields

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Family Zapodidae				
Western Jumping Mouse (*Zapus princeps*)	A	C-N	Unknown	Low meadows near streams with lush growth of grasses and forbs; found in various land habitats
Family Erethizontidae				
! Porcupine (*Erethizon dorsatum*)	A,B,C,D,E,F	C-N	Stable	Forested areas, occasionally away from trees if brush is available
Order Carnivora				
Family Canidae				
! Coyote (*Canis latrans*)	A,B,C,D,E,F	C-N	Stable	Ubiquitous
* Red Fox (*Vulpes fulva*)	A,B,C,D,E,F	C-N	Stable	Forest and open country preferred
* Kit Fox (*Vulpes macrotis*)	A,B,C,D,E,F	U-N	Stable	Open level, sandy ground preferred with low desert vegetation
! Gray Fox, (*Urocyan cinereoargenteus*)	A,B,C,D,E,F	C-N	Stable	Brush and open forests

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
*Gray Wolf (Canis lupus)	A,B,C,D,E,F	X-P	Extirpated	Wilderness forests
Family Ursidae				
*Black Bear (Ursus americanus)	A,B,C,E,F	C-P	Increasing	Mountainous areas
*Grizzly Bear (Ursus horribilis)	A,B,C,E,F	X-P	Extirpated	Remote mountainous regions
Family Procyonidae				
Ring-tailed Cat (Bassariscus astutus)	A,B,C,D,E,F	C-N	Stable	Near water on slopes with mountain brush, rocky ridges and cliffs
*Raccoon (Procyon lotor)	A,B,C,D,E,F	O-N	Increasing	Along streams, lake borders and near wooded areas or rock cliffs
Family Mustelidae				
*Short-tailed Weasel (Mustela erminea)	A,B,C,F	R-P	Stable	Brushy or wooded areas not far from water
*Long-tailed Weasel (Mustela frenata)	A,B,C,D,E,F	C-P	Stable	All land habitat types near water
*Mink (Mustela vison)	A,B,C,F	L-P	Unknown	Along streams and lakes
*Wolverine (Gulo luscus)	A,B	X-P	Extirpated	Remote mountain regions
*Black-footed Ferret (Mustela nigripes)	A,B,C,D,F	E-P	Unknown	Prairie dog towns
*Marten (Martes caurina)	A,B,C,F	R-P	Unknown	Coniferous forests at high elevations

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
*Badger (Taxidea taxus)	A,B,C,D,E,F	C-P	Stable	Open grasslands, deserts and high mountain forests where prey is available
*Striped Skunk (Mephitis mephitis)	A,B,C,D,E,F	C-P	Increasing	Semi-open country of prairie, brushlands or mixed woodlands within two miles of water
*Spotted Skunk (Spilogale gracilis)	A,B,C,D,E,F	C-P	Stable	Prairies or grasslands with brushy or sparsely wooded areas along streams with boulders
*River Otter (Lutra canadensis)	A,B,C,D,E,F	R-P	Unknown	Along streams and lake borders
Family Felidae				
*Bobcat (Lynx rufus)	A,B,C,D,E,F	C-P	Declining	Rimrock and mountain brush areas
*Canada Lynx (Lynx canadensis)	A,B,C,E,F	X-P	Extirpated	Forested areas in the mountains
*Cougar (Felis concolor)	A,B,C,D,E,F	C-P	Stable	Rugged mountains with forests, cliffs and ledges
Order Artiodactyla				
Family Cervidae				
*Mule Deer (Odocoileus hemionus)	A,B,C,D,E,F	C-P	Increasing	Coniferous forests, desert shrub, mountain brush, grassland with shrubs and other habitats where browse species are present

pecies	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
/ *Moose (Alces alces)	A	L-P	Increasing	Mountainous areas, forests, mountain brush and willow bottoms
/ *Rocky Mountain Elk (Cervus canadensis)	A,B,C,E,F	C-P	Increasing	Semi-open forests, mountain meadows (in summer), foothills, plains and valleys
Family Antilocapridae				
* Pronghorn Antelope (Antilocapra americana)	B,C,D,E,F	L-P	Stable	Open prairies and sagebrush or desert shrub plains
Family Bovidae				
*Desert Bighorn Sheep (Ovis canadensis nelsoni)	D,E,F	L-P	Increasing	Precipitous terrain on mountain and canyon slopes and rims with sparse growth of trees
* Rocky Mountain Bighorn Sheep (Ovis canadensis canadensis)	B,C	L-P	Increasing	Precipitous terrain on mountain and canyon slopes and rims with sparse growth of trees
* Bison (Bison bison)	E	L-P	Stable	Desert shrub plains of the Burr Desert and mountain brush forest habitats associated with steep mountain slopes of the Henry Mountains

T 1. List -- Gam- Spec--- and Region.. of Ir..ita Within Utah.

Game Species of Utah	REGION				
	Southeastern	Southern	Central	Northeastern	Northern
10 BIG GAME SPECIES					
Bison	x	x			
Black Bear	x	x	x	x	x
Cougar	x	x	x	x	x
Desert Bighorn Sheep	x	x			
Elk	x	x	x	x	x
Moose	x		x	x	x
Mountain Bighorn Sheep	x		x	x	x
Mountain Goat			x		
Mule Deer	x	x	x	x	x
Pronghorn Antelope	x	x	x	x	x
Subtotal	9	7	8	7	7
20 GAME FISH SPECIES					
Arctic Grayling		x		x	x
Black Bullhead	x	x	x	x	x
Black Crappie	x	x	x	x	x
Bluegill	x	x	x	x	x
Bonneville Cisco					x
Brook Trout	x	x	x	x	x
Brown Trout	x	x	x	x	x
Channel Catfish	x	x	x	x	x
Cutthroat Trout	x	x	x	x	x
Golden Trout			x	x	
Kokanee Salmon				x	x
Lake Trout		x	x	x	x
Largemouth Bass	x	x	x	x	x
Mountain Whitefish			x	x	x
Northern Pike	x	x			
Perch	x	x	x	x	x
Rainbow & Albino Trout	x	x	x	x	x
Smallmouth Bass			x	x	x
Striped Bass	x	x			
Walleye	x	x	x	x	x
White Bass		x	x		
Subtotal	13	16	16	17	17

Game Species of Utah	REGION				
	Southeastern	Southern	Central	Northeastern	Northern
9 FURBEARER SPECIES					
Badger	x	x	x	x	x
Beaver	x	x	x	x	x
Long-tailed Weasel	x	x	x	x	x
Marten	x	x	x	x	x
Mink	x	x	x	x	x
River Otter	x			x	x
Short-tailed weasel	x	x	x	x	x
Spotted Skunk	x	x	x	x	x
Striped Skunk	x	x	x	x	x
Subtotal	9	8	8	9	9
43 MIGRATORY GAME BIRD SPECIES					
American Widgeon	x	x	x	x	x
Band-tailed Pigeon	x	x	x		
Barrows Goldeneye	x	x	x	x	x
Black Brant		x			x
Black Duck		x	x		x
Blue-winged Teal	x	x	x	x	x
Bufflehead	x	x	x	x	x
Canada Goose	x	x	x	x	x
Canvasback	x	x	x	x	x
Cinnamon Teal	x	x	x	x	x
American Coot	x	x	x	x	x
Common Gallinule	x	x	x		x
Common Goldeneye	x	x	x	x	x
Common Merganser	x	x	x	x	x
Common Snipe	x	x	x	x	x
European Widgeon			x		x
Fulvous Tree Duck		x			x
Gadwall	x	x	x	x	x
Greater Scaup	x	x	x	x	x
Green-winged Teal	x	x	x	x	x
Harlequin Duck					x

Game Species of Utah	REGION Southeastern	Southern	Central	Northeastern	Northern
Hooded Merganser	x	x	x	x	x
Lesser Scaup	x	x	x	x	x
Mallard	x	x	x	x	x
Mourning Dove	x	x	x	x	x
Old Squaw		x	x		x
Pintail	x	x	x	x	x
Red-breasted Merganser	x	x	x	x	x
Redhead	x	x	x	x	x
Ring-necked Duck	x	x	x	x	x
Ross Goose	x	x			x
Ruddy Duck	x	x	x	x	x
Sandhill Crane	x	x	x	x	x
Shoveler	x	x	x	x	x
Snow Goose	x	x	x	x	x
Sora Rail	x	x	x	x	x
Surf Scoter			x		x
Trumpeter Swan		x	x		x
Virginia Rail	x	x	x	x	x
Whistling Swan	x	x	x	x	x
White-fronted Goose	x	x	x	x	x
White-winged Scoter	x	x	x		x
Wood Duck	x	x	x	x	x
Subtotal	35	40	39	31	42

5 SMALL GAME-MAMMAL SPECIES

Abert Squirrel	x				
Desert Cottontail	x	x	x	x	
Mountain cottontail	x	x	x	x	x
Pigmy Cottontail		x	x		x
Snowshoe Hare	x	x	x	x	x
Subtotal	4	4	4	3	3

Game Species of Utah	REGION				
	Southeastern	Southern	Central	Northeastern	Northern
12 SMALL GAME-UPLAND BIRD SPECIES					
Blue Grouse	x	x	x	x	x
California Quail	x	x	x	x	x
Chukar	x	x	x	x	x
Gambels Quail	x	x			
Hungarian Partridge			x		x
Merriam's Turkey	x	x			
Ring-necked Pheasant	x	x	x	x	x
Ruffed Grouse	x	x	x	x	x
Sage Grouse	x	x	x	x	x
Sharp-tailed Grouse					x
White-tailed Ptarmigan				x	x
White-winged Pheasant	x	x			
Subtotal	9	9	7	7	9
100 Total Game Species in Utah	78	83	81	73	86

Table 2. Classification of the 466 species of vertebrate wildlife that inhabit six biogeographic areas within Southeastern Utah.

	Biogeographic Areas[1]					
	A	B	C	D	E	F
FISH	14	20	15	15	24	31
Protected-Threatened	(0)	(1)	(1)	(1)	(1)	(1)
Protected-Endangered	(0)	(3)	(2)	(1)	(1)	(2)
Protected-Nongame	(10)	(11)	(9)	(10)	(12)	(16)
Protected-Game	(4)	(5)	(3)	(3)	(10)	(12)
AMPHIBIANS	6	5	6	7	7	10
Protected-Nongame	(1)	(1)	(1)	(1)	(1)	(2)
Unprotected-Nongame	(5)	(4)	(5)	(6)	(6)	(8)
REPTILES	18	14	15	14	21	28
Unprotected-Nongame	(18)	(14)	(15)	(14)	(21)	(28)
BIRDS	242	244	242	235	251	262
Protected-Extirpated	(1)	(1)	(1)	(1)	(1)	(1)
Protected-Threatened	(0)	(0)	(0)	(0)	(0)	(0)
Protected-Endangered	(2)	(2)	(2)	(2)	(2)	(2)
Protected-Nongame	(199)	(202)	(202)	(193)	(208)	(217)
Protected-Game	(39)	(38)	(36)	(38)	(39)	(41)
Unprotected-Nongame	(1)	(1)	(1)	(1)	(1)	(1)
MAMMALS	84	80	80	65	66	90
Protected-Threatened	(0)	(0)	(0)	(0)	(0)	(0)
Protected-Endangered	(1)	(1)	(1)	(1)	(0)	(1)
Protected-Extirpated	(2)	(2)	(2)	(0)	(2)	(2)
Protected-Game	(18)	(19)	(19)	(12)	(16)	(19)
Unprotected-Extirpated	(0)	(0)	(0)	(0)	(0)	(0)
Unprotected-Nongame	(63)	(58)	(58)	(52)	(53)	(62)
Total Protected Species	277	286	279	263	293	317
TOTAL:	364	363	358	336	369	421

[1] Biogeographic areas of southeastern Utah
A- Wasatch Plateau east of Skyline Drive
B- West Tavaputs Plateau
C- East Tavaputs Plateau
D- San Rafael Swell and Desert
E- Henry Mountains and Burr Desert
F- Mountains and Deserts south of I-70 in Grand and San Juan counties

VERTEBRATE SPECIES OF WILDLIFE HAVING HIGH INTEREST TO THE STATE OF UTAH

Class of Animal	Number of species		
	Statewide[1]	SER[2]	Valley Camp of Utah
Fish	33	20	2
Amphbians	3	2	1
Reptiles	10	4	2
Birds	104	95	23
Mammals	61	40	13
TOTAL	211	161	51

1. Utah Division of Wildlife Resources as the state of Utah's wildlife authority recognizes 211 species of vertebrate wildlife that inhabit the state as being of high interest. High interest wildlife represent all game species and all species having significant economic importance from either a comsumptive or nonconsumptive perspective or special asthetic, scientific or educational values. This list includes all federally listed threatened or endangered species of wildlife.
2. Evaluation of data presented in Utah Division of Wildlife Resources publication No. 78-16, " Species List of Vertebrate Wildlife That Inhabit Southeastern Utah" shows that 161 of the 211 species of the states high interest wildlife inhabit the Southeastern Region (SER) of the state on occasion or during different seasons of the year.

LITERATURE CITED

Bailey, R. M., J.E. Fitch, E.S. Herald, E.A. Lachner, C.C. Lindsey, C.R. Robins and W.B. Scott. 1970. A list of common and scientific names of fishes from the United States and Canada. American Fisheries Society Special Publication No. 6. 149 pp.

Behle, W.H. and M.L. Perry. 1975. Utah birds; guide, check-list and occurrence charts. Utah Museum of Natural History. University of Utah, Salt Lake City, Utah. 144 pp.

Burt, W.H. and R.P. Grossenheider. 1976. A field guide to the mammal. Houghton Mifflin Company. Boston, Massachusetts. 289 pp.

Durrant, S.D. 1952. Mammals of Utah. Museum of Natural History. University of Kansas, Lawrence, Kansas. 6:1-549.

Eddy, Samuel. 1969. The freshwater fishes. Wm. C. Brown Company Publishers. Dubugue, Iowa. 286 pp.

Hayward, C.L., C. Cottom, A.M. Woodbury and H.H. Frost. 1976. Great Basin Naturalist Memoirs: Birds of Utah. Brigham Young University Press. Provo, Utah. 229 pp.

Holden, P.B. 1973. Distribution, abundance and life history of the fishes of the upper Colorado River Basin. Utah State University. 59 pp.

Peterson, R.T. 1969. A field guide to western birds. Houghton Mifflin Company. Boston, Massachusetts. 366 pp.

Robbins, C.S., B. Bruun and H.S. Zim. 1966. A guide to field identification: birds of North America. Golden Press. New York City, New York. 340 pp.

Sigler, W.F and R.R. Miller. 1963. Fishes of Utah. Utah State Department of Fish and Game. Salt Lake City, Utah. 203 pp.

Sparks, E.A. 1974. Checklist of Utah wild mammals. Utah Division of Wildlife Resources Publication 74-3. Salt Lake City, Utah.

Stebbins, R.C. 1966. A field guide to western reptiles and amphibians. Houghton Mifflin Company. Boston, Massachusetts. 279 pp.

Tanner, W.W. 1975. Checklist of Utah amphibians and reptiles. Proceedings of the Utah Academy of Sciences, Arts and Letters. Vol. 52 (1):4-8.

Udvardy, M.D.F. and S. Rayfield. 1977. The Audubon Society field guide to North American birds -- western region. Published by Alfred A. Knopf, Inc. Chanticleer Press, Inc., New York. 855 pp.

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