Mountain Coal Company
Mining and Reclamation Plan
Gordon Creek No. 2/7/8 Mines
Volume 3

CHAPTER 8

SOIL RESOURCES

GORDON CREEK No. 2/7/8 MINES

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GORDON CREEK No. 2/7/8 MINES

8.0 Preface

The Gordon Creek No. 2 Mine was opened in 1969 and all major surface disturbance occurred at that time. No topsoil was saved. The soils inventory for that mine was completed in 1980. Additional soils sampling was conducted in the fall of 1992 by E.I.S. Company of Elmo, Utah. Sample results are summarized in Appendix 8-2. Sample locations are shown on Plate 8-1.

The Gordon Creek No. 7 Mine was opened in 1984, and the No.8 Mine was opened in 1989. The soils inventory was conducted in June, 1983. The study included the No. 8 Mine area. Available topsoil was salvaged and stored for both the No. 7 and 8 Mine sites.

Due to the extreme differences in the time frames and original soils handling at these sites, the Soil Resources Sections of this Plan are presented separately for clarity. The Gordon Creek No. 2 Mine area is presented first, followed by the Gordon Creek No. 7/8 Mine area.

CHAPTER 8

SOIL RESOURCES

GORDON CREEK No. 2 MINE AREA

8.1 Scope

A soil inventory of the Gordon Creek No. 2 Mine was conducted to provide soil resource information to meet the requirements of the Utah Division of Oil, Gas & Mining and the Office of Surface Mining. The soil survey was performed in 1980 by James P. Walsh.

8.2 Methodology

Soil mapping of the Gordon Creek No. 2 Mine area (Plate 8-1) is a refinement of USDA Soil Conservation Service manuscript mapping. Map scale of Plate 8-1 is 1" = 500' (1:6000). Mapping was conducted during July, 1980. At that time much of the area was mapped as disturbed land.

Soil series descriptions and map unit descriptions are adapted from the Soil Conservation Service (SCS) to be site specific. Detailed pedon descriptions are presented for the three major soil series at the site. Pedons were described in fresh road cuts to 60 inches or to bedrock, whichever was the most shallow. Five map units are mapped and described.

The three major soil series were sampled at the site. Samples were analyzed by Colorado Agricultural Consultants of Brighton, Colorado.

Parameters tested were pH, electrical conductivity, saturation percent, soluble calcium, magnesium and

sodium, available potassium, texture class from percent sand, silt, clay and very fine sand, organic matter percent, phosphorous, lime, boron, ammonia and nitrate-nitrogen.

Present and potential uses of the soils of the site have been evaluated based on SCS Soil Survey Interpretation information. The soils have no potential as crop land or pasture land. The soils have not been evaluated by the SCS for their potential production as range land, but their capability groups are given.

The soils are evaluated as reconstruction material for drastically disturbed land. The evaluation method used is that of the SCS. Each horizon of each pedon is rated as seedbed quality material based on the field description and the analytical data. Recommended depths of stripping for each soil is given.

Soil names are names and classifications given in this report are tentative. The soils in this report are named for similar soils that are presently being mapped by the SCS in the area. In some cases, the described pedons are outside of the accepted range in characteristics for the series and those differences are noted in the text. The soils have not been correlated by the SCS. Classifications are based on morphology as described in the field, and to a lesser degree on the analytical data. Where analytical data does not support the field description, the soils are classified according to the field description.

8.3 Soil Resource Information for the Mine Plan Area

8.3.1 Soils Identification

The soils at the Gordon Creek No. 2 Mine were initially examined by stereoscopic method of aerial photographs. This allowed the consultant to determine slopes, land forms

and vegetation patterns. Soils were then examined in the field (see Section 8.2 Methodology). The soil descriptions were compared with recorded characteristics of the soils in adjacent counties and in the official Soil Conservation Service (SCS) series descriptions. Map units are comprised of soil series and inclusions found with an area to make them site specific.

8.3.2 Soil Series Descriptions

Benteen Series

The Benteen series consists of deep, well-drained soils. These soils formed in colluvium derived from sandstone and shale. Annual precipitation is 20 to 30 inches. The mean annual air temperature is less than 38°F, and the frost-free period is less than 60 days. The native vegetation is aspen, snowberry and perennial grasses.

The available water capacity is about 3.5 to 6.5 inches, and permeability is moderate. These soils are used for range land, wildlife habitat and watershed.

The Benteen series is a member of the fine-loamy (mixed) family of Argic Pachic Cryoborolls. A representative profile of Benteen loam 900 feet east and 900 feet north of the Southeast Corner of Section 18, Township 13 South, Range 8 East is:

A11 0 to 5 inches; gray brown (10YR 5/2) loam, black (10YR 2/1) moist; weak very thin platey and very fine angular blocky; loose, very friable, non-sticky and slightly plastic; noncalcareous; many very fine and fine roof, common medium roots; 12 percent gravels; diffuse boundary.

A12 5 to 9 inches; brown-dark brown (10YR 4/3 loam, very dark brown (10YR 3/2) moist crushed; moderate very fine subangular blocky structure; loose, very friable, slightly sticky and slightly plastic; noncalcareous; many fine and very fine, common medium roots; 15 percent gravels; diffuse boundary.

B21t 9 to 19 inches; brown (10YR 5/3) gravelly clay loam, dark brown (10YR 3/30) moist; moderate medium angular blocky; loose, very friable, sticky and plastic; calcareous; many very fine and fine roots; few very thin continuous clay films; 20 percent gravels; gradual smooth boundary.

B22t 19 to 22 inches; gray brown (10YR 5/2) gravelly heavy clay loam, dark brown (10YR 3/3) moist; moderate medium angular structure; loose, very friable, sticky and plastic; calcareous; common very fine and fine, many medium and few coarse roots; common thin continuous clay films on ped faces, some pore fillings; 20 percent gravels; arbitrary boundary.

B3 32 to 56 inches; gray brown (10YR 5/2) gravelly clay loam, dark brown (10YR 3/3) moist; moderate medium angular blocky structure; loose, very friable, sticky and plastic; calcareous; common very fine and fine, many medium and few coarse roots; 20 percent gravels.

The described pedon is deeper than allowed in the range of characteristics of the Benteen series.

Disturbed Land Material

The disturbed land material consists of generally nearly level to steep, deep, moderate well-drained materials. These materials are fill derived from sandstone and shale. Annual precipitation is 16 to 20 inches. The mean annual air temperature ranges from 38° to 45°F, and the frost-free period is 60 to 120 days. The native vegetation has been removed.

The available water capacity is moderate to low, and permeability is moderate. These soils were used for mining activities. A description of disturbed land fill material, 2000 feet west and 1500 feet north of the Southeast Corner of Section 18, Township 13 South, Range 8 East is:
pale brown (10YR 6/3) gravelly sandy loamy, brown-dark brown (10YR 4/3) moist; single-grained, loose, slightly sticky and slightly plastic; calcareous; ten percent gravel, five percent cobbles; five percent stones and five percent boulders.

Gappmeyer-Variant Series

The Gappmeyer Variant series consists of deep to very deep, moderately well to well-drained soils. These soils formed in colluvium derived from sandstone and shale. Annual precipitation is 16 to 20 inches. The mean annual air temperature ranges from 60° to 120°F, and the frost-free period is 60 to 120 days. The native vegetation is gamble oak, snowberry and aspen.

The available water capacity to a depth of 60 inches is six- or seven-inch, and permeability is moderately slow. These soils are used for water shed and wildlife habitat.

The Gappmeyer Variant series is a member of the loamy-skeletal, mixed family of Boralific Argiborolls.

A representative profile of Gappmeyer Variant loam 700 feet east and 1300 feet north of the Southwest Corner of Section 18, Township 13 South, Range 8 East is:

01/02 2 to 0 inches; decomposed and partially decomposed litter.

A1 0 to 12 inches; brown (10YR 5/3) loam; very dark brown (10YR 3/2) moist; weak fine granular structure; soft, slightly sticky and slightly plastic; noncalcareous; many very fine, fine and medium roots, common coarse roots; five percent gravels; clear wavy boundary.

A2 12 to 20 inches; very pale brown (10YR 7/3) clay loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; friable, slightly sticky and slightly plastic; noncalcareous; few fine and medium roots; five percent gravels; two percent cobbles; clear irregular boundary.

B2t 20 to 35 inches; pale brown (10YR 4/5) clay, brown-dark brown (10YR 4/5) moist; moderate medium subangular blocky structure parting to moderate medium granular; friable, sticky and plastic; noncalcareous; few very fine roots; many fragments of charcoal or coal; some yellowish brown (10YR 5/6) sandstone fragments, many weathered gravels, ten percent gravels, ten percent cobbles, five percent stones and two percent boulders; diffuse boundary.

B3t 35 to 53+ inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist crushed; moderate medium subangular blocky structure; firm, sticky and plastic; noncalcareous; many weathered gravels; no roots; few fine distinct yellowish brown (10YR 5/4) mottles; many fragments of charcoal or coal,

fifteen percent gravels, ten percent cobbles, five percent stones and two percent boulders.

The described pedon has less than the permitted volume of coarse fragments for the Gappmeyer Variant.

Patmos Series

The Patmos series consists of moderately deep, moderately permeable, well-drained soils. These soils formed in colluvium derived from sandstone and shale. Annual precipitation is 12 to 20 inches. The mean annual air temperature ranges from 38° to 45°F, and the frost-free period is 60 to 120 days. The native vegetation is salina wildrye, scattered bitterbrush, and oakbrush.

The available water capacity to a depth of 21 inches is about two to four inches, and permeability is moderate. These soils are used for range.

The Patmos series is a member of the loamy-skeletal mixed (calcareous) frigid family of Typic Ustorthents. A representative profile of Patmos gravelly loam, 52 percent slope, 600 feet west and 2000 feet north of the Southeast Corner of Section 18, Township 13 South, Range 8 East is:

A11 0 to 9 inches; gray brown (10YR 5/2) gravelly loam, dark gray brown (10YR) moist; weak very fine granular structure; soft, very friable; slightly sticky and plastic; calcareous; many very fine, fine and medium roots; layer of coal fragments in lower one to 1/12 inch of horizon; 25 percent gravels, five percent cobbles, gradual smooth boundary.

A12 9 to 18 inches; light yellowish brown (10YR 6/4) gravelly silty clay loam-clay loam, pale brown (10YR 6/3) moist; moderate strong fine subangular

blocky structure; slightly hard, very friable, sticky and plastic; calcareous; two inch thick streak of coal fragments at 11-inch depth; many very fine, fine and medium roots; few coarse roots; 25 percent gravels, ten percent cobbles; five percent stones and two percent boulders; abrupt irregular boundary.

C1 18 to 32 inches; light gray (10YR 7/1) gravelly very fine sandy clay loam, gray brown (10YR 5/2) moist; weak fine subangular blocky parting to fine granular; soft, very friable, slightly sticky and plastic; calcareous; irregular pockets of coals and bands darkened by organic matter; common fine, very fine and medium roots; 25 percent gravels, five percent cobbles, clear smooth boundary.

C2 32 to 38 inches; light gray (10YR 7/1) gravelly very fine sandy loam, pale brown (10YR 6/3) moist; moderate fine subangular blocky parting to fine granular; soft, very friable, slightly sticky and plastic; calcareous; common very fine, fine and medium roots; 25 percent cobbles, ten percent stones.

R 38-Plus-inches; sandstone, fractured.

Map Unit Descriptions

Map Unit: BeE - Benteen Loam, 30 to 50 Percent Slopes

This map unit is on mountain side slopes. The slope is 30 to 50 percent. The native vegetation is mainly aspen, snowberry and perennial grasses.

The unit is 75 percent Benteen Loam, and 25 percent other soils.

The Benteen soil is deep and well-drained. It is formed in colluvium derived from sandstones and shales. Typically, the surface layer is a gray brown or brown-dark brown loam about nine inches thick. The subsoil is a gray brown or brown gravelly clay loam about 23 inches thick. The substratum to a depth of 60 inches or more is a gray brown gravelly clay loam.

Permeability of the Benteen soil is moderate. Available water capacity is about 3-1/2 to 6-1/2 inches. Effective rooting depth is 40 inches to more than 60 inches. Runoff is medium and the erosion hazard for water is moderate. Wind erosion hazard is slight.

The unit is mainly used for range land, wildlife habitat, recreation and water shed. It is also used for mining activities in the mapped area.
The present plant community is mainly aspen, snowberry and perennial grasses. The potential productivity data is not available. This map unit is in Capability Unit VIIE, and is not evaluated for range site.

The area is about 90 percent fill material. Included in this map unit are about ten percent small area of Patmos and Podo soils; as well as areas of rock outcrops, road cuts and places where a thin layer of coal waste, fill or other disturbed materials overlie other soils.

Permeabiltiy of the fill material is moderate where it has not been compacted. Available water capacity is moderate to low. Runoff is rapid to extremely rapid and the erosion hazard for water is high.

The unit is mainly used for wildlife habitat and water shed. It is also used for mining activities.

The present plant community is mainly douglas fir and oakbrush. The potential productivity data is not available. This map unit is in Capability Unit VIIE nonirrigated, not evaluated for range site.

Map Unit: DL - Disturbed Land

This map unit is on the valley bottom and mountain side slopes. Slopes are nearly level to nearly vertical. The native vegetation has been removed.

The area is about 90 percent fill material. Included in this map unit are about ten percent small areas of Patmos and Podo soils; as well as areas of rock outcrops, road cuts and places where a thin layer of coal waste, fill or other disturbed materials overlie other soils.

Permeability of the fill material is moderate where it has not been compacted. Available water capacity is moderate to low. Runoff is rapid to extremely rapid and the erosion hazard for water is high.

The unit is used exclusively for mining. Before disturbance it was used for wildlife habitat, watershed and limited range.

The map unit is in Capability Unit VIIIE.

Map Unit: GpE - Gappmeyer Variant - Patmos Complex, 50 to 70 Percent Slopes

This map unit is on mountain side slopes on south and east facing slopes. The slope is 50 to 70 percent. The native vegetation is mainly oakbrush with occasional aspen.

The unit is 50 percent Gappmeyer Variant and 25 percent Patmos soils. Podo soils comprise about ten percent of the map unit. Other soils include 15 percent of the unit.
In other respects this map unit is similar to GaE.

Map Unit: PaE - Patmos Gravelly Loam, 50 to 70 Percent Slopes

This map unit is on mountain side slopes on south and west facing slopes. The slope is 50 to 70 percent. The native vegetation is mainly salina wildrye and sagebrush.

This unit is 85 percent Patmos stoney loam, and 15 percent Podo (a soil similar to Patmos, but deeper than 40 inches) and rock outcrops. The Patmos soil is on the steeper mountain side slopes and the Podo soil is on the ridge crests (the soil is similar to Patmos, but deeper than 40 inches on the lower slopes and swales). Included in this map unit is about five percent rock outcrops.

The Patmos soil is moderately deep and well-drained. It is formed in colluvium derived from sandstones and shale. Typically, the surface layer is gray brown gravelly loam about nine inches thick. The subsoil is a light yellowish brown gravelly silty clay loam about nine inches thick. The substratum to a depth of 32 inches is a light gray gravelly very fine sandy clay loam or very fine sandy loam.

Permeability of the Patmos soil is moderate. Available water capacity to a depth of 21 inches is two to four inches. Effective rooting depth is less than 40 inches. Runoff is rapid and the erosion hazard for water is high. Wind erosion hazard is slight.

The unit is mainly used for watershed shed and wildlife habitat. It is also used for mining activities in the mapped area.

The present plant community is mainly grasses and sagebrush. The potential productivity data is not available. This map unit is Capability Unit VIIS nonirrigated; it is not evaluated for range site.

8.3.3 Present and Potential Uses

Crops and Pasture Lands

None of the soils mapped at the site have potential for crops or pasture land.

The U.S. Department of Agriculture has the authority to identify farmlands of national, state or local importance. These farmlands are referred to as prime farmlands, farmlands of statewide importance and unique farmlands. The SCS has determined that there are no prime farmlands of statewide importance or unique farmlands in this permit area.

Range Lands

The soils of the site area have been used as range land in the past. Data on predicted forage production for range land soils during favorable, normal and unfavorable years for various sites are not available. Capability classes for the range land soils are VIIE and VIIS (See Table 8-1). The principal limitations are erosion and shallowness. Capability units show, in a general way, the ability of soils to support cultivated crops. Soils in Capability Class VII have very severe limitations that restrict their use largely to grazing, wood lands or wildlife habitat.

Table 8-1

Estimated Potential Production - Forage

Soil Series	Potential Production Favorable/Normal/ Unfavorable Years (lbs/ac)[s]	Sites	Soil Capability Class
Benteen	* N/A	All	VIIE
Gappmeyer	* N/A	All	VIIE
Patmos	* N/A	30%-50% Slopes	VIIS
		50%-70% Slopes	VIIE

* N/A -- Data Not Available

FIGURE 8-1

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

4012 Federal Building
125 South State Street
Salt Lake City, UT 84138

June 16, 1980

RECEIVED
JUN 27 1980
ENVIRONMENTAL AND
PERMITTING SERVICES

Mr. David Chenoweth
ARCO Coal Company
555 17th Street
P.O. Box 5300
Denver, CO 80217

Dear Mr. Chenoweth:

After site investigation the Soil Conservation Service has determined that no prime farmland occurs on Beaver Creek Coal properties, known as Gordon Creek #2 mine, Section 18, T. 13 S., R. 8 E., SLBM.

Further detailed information may be obtained through the Price Field Office.

Sincerely,

T. E. Hutchings
State Soil Scientist

cc:
Ed Burton, AC, Orem
Gary Moreau, DC, Price

8.4 Prime Farmland Investigation and Determination

In July, 1980, Beaver Creek Coal Company requested that SCS personnel in Price, Utah, review all the soils present within the Gordon Creek No. 2 Mine coal property boundary to determine if any qualified as Prime Farmland. At that time, the SCS made a field reconnaissance to confirm soil types. The field information was then checked against a State listing of prime farmland soils. At that time the State Soil Scientist determined there were no prime farmlands on Gordon Creek No. 2 Mine property (See Figure 8-1).

8.5 Soils, Physical and Chemical Properties of Soils and Results of Analysis

Method of Evaluation

The criteria for evaluating soil as a plant growth media are given in Table 8-2. The criteria includes sodium absorption ratio (SAR), electrical conductivity or salinity (EC), toxic materials, soil reaction (pH), available water holding capacity (AWHC), erosion factor (K), wind erosion group, texture, and percent coarse fragments.

Criteria are given for good, fair, or poor sources of reconstruction material (Table 8-2). A good rating means vegetation is relatively easy to establish and maintain, the surface is stable and resists erosion, and the reconstructed soil has good potential productivity. Material rated fair can be vegetated and stabilized by modifying one or more properties. Top dressing with better material or application of soil amendments may be necessary for satisfactory performance. Material rated poor has such severe problems that revegetation and stabilization is very difficult and costly. Top dressing with better material may be necessary to establish and maintain vegetation.

Table 8-2

Soil Reconstruction Material for Drastically Disturbed Area

Property	Limits Good	Fair	Restrictive Poor	Features
1. Sodium Absorption Ratio (SAR)	(5	5-12	12	Excess Sodium
2. Salinity (MMHOS/CM)	(8	8-16	16	Excess Salt
3. Toxic Materials	Low	Medium	High	Toxicity
4. Soil Reaction (pH)*	5.6-7.8	4.5-5.5	4.5	Too Acid
5. Soil Reaction (pH)	(7.9	7.9-8.4	8.4	Excess Lime
6. Available Water	).10	.05-.10	(.05	Droughty
7. Erosion Factor (K)	(.37	).37	---	Erodes Easily
8. Wind Erod. Group	)3	)3	1,2	Soil Blowing
9. USDA Texture	---	SCL,CL SICL	C ** SIC ** SC	Too Clayey
10. USDA Texture	---	LCOS,LS LFS, LVFS	COS, S	Too Sandy FS, VFS
11. Coarse Fragments				
3-10 in (7.6-25.4 cm)	(15	15-35	)35	Large Stones
)10 in (725.4 cm)	(3	3-10	)10	Large Stones

* Layer with high potential acidity should be rated poor.

** If in Kaolinitic family, rated one class better if experience confirms.

From National Soil Handbook, NSH - Part II (403.6(2)), 1978.

Soil Chemistry and Physical Properties

Chemical and physical data for project area soils were collected to evaluate the soils as reconstruction material for disturbed lands. Soil chemical and physical data from analysis by Colorado Agricultural Consultants are reported in Table 8-3. Other sources of information used to evaluate soils for reclamation are manuscript SCS soil survey information and soil survey interpretation records.

Soils were sampled by horizon and analyzed using standard agricultural techniques as specified in Table 8-3. The parameters tested were past pH, electrical conductivity, moisture saturation percentage, SAR, organic matter, plant available phosphorus and potassium, particle size distribution, nitrate-nitrogen, ammonia nitrogen, lime and boron. The techniques used were those of USDA Handbook 60 (1954) and American Society of Agronomy Monograph #9 (Black, 1965).

Suitability as a Source Material for Reclamation of Disturbed Lands

Table 8-4 is an evaluation of soil reconstruction material for each horizon on each project area soil type. The evaluation is based on the soil chemical and physical data in Table 8-3 and the criteria of Table 8-2.

The soils are rated good, fair or poor sources of seedbed quality material. The overall rating given for each horizon is the rating for the most limiting criteria.

Vegetation is difficult to establish on soils with high SAR which indicates potential instability and water transmission problems. All of the soils of the site were rated good for SAR.

Electrical conductivity is a measure of soil salinity. Excessive salts restrict plant growth, create problems in establishing vegetation and, therefore, also influence erosion and the stability of the surface. All of the soils of the site were rated good for EC.

Table 8-3

Soil Chemical and Physical Properties

Sample Depth (In)	PH	EC	SAT%	NA	CA	MG	SAR	AK	TEXT	SN	SI	CL	VFS	N	OM	P	LM	B	N13
Benteen / Hole: 13																			
0-5	6.8	1.8	39.8	3.49	9.04	1.67	1/5	650	LO	51	42	7	20	3	6.6	2	1.0	0.24	2.3
5-9	7.3	1.6	36.1	2.89	7.75	1.85	1.3	710	SILO	24	66	10	11	2	5.9	7	0.6	0.26	1.4
9-19	7.4	1.6	40.0	2.61	7.99	1.66	1.2	840	SILO	35	58	7	14	3	5.0	6	1.0	0.34	1.2
19-32	6.9	1.8	41.0	2.55	11,96	1.63	1.0	560	LO	45	42	13	8	7	3.5	1	0.7	0.35	0.9
32-56+	7.3	2.2	37.9	2.75	12.92	3.52	1.0	520	SILO	34	58	8	8	5	3.1	0	0.4	0.40	0.6
Disturbed Land Fill / Hole: 14																			
Grab	8.0	2.4	37.4	6.51	7.49	7.14	2.4	330	SNLO	71	17	12	7	4	0.8	0	4.1	0.36	0.5
Gappmeyer / Hole; 12																			
0-12	6.8	1.8	38.1	3.64	7.33	1.75	1.7	600	SNLO	58	36	6	17	3	5.2	63	0.5	0.14	2.1
12-20	7.2	1.0	44.0	3.16	4.55	1.52	1.8	610	SILO	36	51	13	16	1	1.6	13	0.2	0.13	0.9
20-35	7.0	1.0	35.2	±.42	3.82	4.55	0.8	1100	CLLO	28	47	25	14	1	3.3	8	0.7	0.18	1.1
35-53+	6.8	1.6	38.4	4.48	7.21	5.15	1.8	840	LO	24	47	29	11	1	2.7	3	0.7	0.16	0.8
Patmos / Hole: 15																			
0-9	7.6	1.6	42.2	2.47	10.38	1.58	1.0	410	SILO	37	52	11	14	3	2.7	0	1.7	0.24	0.6
9-18	7.7	1.9	39.4	2.65	11.57	1.69	1.0	270	SILO	33	60	7	11	3	2.4	0	6.8	0.32	0.4
18-32	7.6	1.6	41.7	2.50	10.07	1.60	1.0	260	SILO	34	54	12	22	3	3.0	0	4.6	0.24	0.4
32-38	7.9	2.0	32.2	3.23	12.37	2.06	1.2	170	SNLO	57	28	15	8	1	1.0	0	7.9	0.19	0.2

Table 8-4

Evaluation of Topsoil Material

Series	Sample Point[a]	Depth (In)	SAR	Salinity	Toxic Materials[e] (Boron)	Soil Reaction	Available Water Cap	Erosion Factor	Wind Erodibility Group[b]	USDA Texture[c]	Coarse Frags[d]	Overall Rating
Benteen	13	0-5	good	good	good	good	good	good	good	good	good	GOOD
		5-9	good	good	good	good	good	good	NA	good	good	GOOD
		9-19	good	good	good	good	good	good	NA	fair	good	FAIR
		19-32	good	good	good	good	good	good	NA	fair	good	FAIR
		32-56+	good	good	good	good	good	good	NA	fair	good	FAIR
Disturbed Land												
Fill	14	--	good	good	good	fair	good - fair	NA	NA	good	fair	FAIR
Gappmeyer	12	0-12	good	good	good	good	good	good	good	good	good	GOOD
		12-20	good	good	good	good	good	good	NA	fair	good	FAIR
		20-35	good	good	good	good	good	good	NA	poor	fair	POOR
		35-53+	good	good	good	good	good	good	NA	poor	fair	POOR
Patmos	15	0-9	good	good	good	good	good	good	good	good	good	GOOD
		9-18	good	good	good	good	good	good	NA	fair	fair	FAIR
		18-32	good	good	good	good	good	good	NA	fair	good	FAIR
		32-38	good	good	good	good	good	good	NA	good	fair	FAIR

[a]-evaluation based on OOEQ Guideline No. 3 for boron limits; less than 5 ppm boron is good.

[b]-from soil survey interpretation records, USDA SCS

[c]-from field description of soil texture; not taken from lab analysis.

[d]-from field description

[e]-evaluated based on field textures and estimated coarse fragments from U.S. Forest Service (1974)

NA - data not available

Table 8-5

Depths of Suitable Seedbed Material Available

(by map unit)

Mapping Unit	Component	Depth (IN)	Rating	Percent of Map Unit	Available Depth Suitable Material (restrictive features)
BeE	Benteen	9	good	75%	9 inches (slope)
		9-55±	fair		
	Other Soils	variable	variable	25%	9 inches (slope)
DL	Disturbed Land Fill	variable	fair	80%	variable (slopes) (large stones)
	Inclusions	variable	poor	10%	0 inches
GaE	Gappmeyer	12	good	75%	12 inches (slope)
	Variant	12-39	fair-good		
	Teton Midfork Adel, Podo	variable	variable	25%	12 to 6 inches
GpE	Gappmeyer	12	good	50%	12 inches (slope)
	12-39	fair-good			
	Patmos	9	good	25%	9 inches (slope)
	Podo	6	fair	10%	6 inches (slope)
	Other Soils	variable	variable	15%	6 inches (slope)
PaE	Patmos	9	good	85%	9 inches (slope)
	Podo	variable	variable	15%	9 to 6 inches to none
	Soil similar to Patmos, Rock Outcrops				

Toxic materials such as boron get into the food chain and are toxic to animals that eat the vegetation. All of the soils were rated good for boron.

Excessively high or low pH causes problems in establishing vegetation, and as a result, influence erosion and stability of the surface. The soils were mostly rated good for pH. The fill material was rated fair and the subsoil of the Patmos was rated fair.

The available water capacity also is important is establishing vegetation. Soils with low available water capacity may require irrigation for establishment of vegetation. AWHC was estimated based on field texture and percent coarse fragments (US Forest Service, 1974)). The Gappmeyer Variant, Benteen and Patmos soils are primarily rated good for AWHC.

The stability of the soil depends upon its erodibility by water and wind and its strength. Water erodibility is indicated by the "K" factor; wind erodibility is rated according to the wind erodibility group. The "K" values for soils of the project area are from the best data available in the SCS Soil Survey Interpretation Records and are rated good. Wind erodibility is based on SCS Soil Survey Interpretation Records for the surface horizons and the soil is rated good.

USDA texture also influences available water capacity and erodibility by wind or water. Texture influences soil structure, consistency, water intake rate, runoff, fertility, workability, and trafficability. Potential slippage hazards are related to soil texture and, although other factors also contribute, the ratings of soil texture represent one important factor. Soil texture for soils of the site are rated good to fair. Soil textures are poor for the subsoils of the Gappmeyer, and are fair for the subsoils of the Benteen and Patmos. The fill textures for soils of the site were described in the field and the evaluations are based on the field determinations.

Lab data on soil textures have been disregarded because it is thought that dispersion of silt and clay particles was not adequate, possibly because of high gypsum contents.
Coarse fragments influence the ease of excavation, stockpiling and respreading, and suitability for the final use of the land. A certain amount of coarse fragments can be tolerated depending upon the size and intended use of the reclaimed area. If the size of rock fragments exceeds ten inches (25 cm), the problems are more severe. Coarse fragments are evaluated based on pedon descriptions for soils of project areas. Coarse fragments in the fill material are rated fair and are a limiting factor for use of the fill. Coarse fragments in the subsoil of the Patmos soil are rated fair and are also a limiting factor.

Depths of Suitable Topsoil Available for Reclamation

The depths of material available for reclamation of project areas of proposed surface disturbance are listed on Table 8-5 by map unit. The table includes the map unit, map unit components, depth of horizon, rating (from Table 8-3) and percent of map unit, and the recommended depth of stripping and the restrictive features.

The main restrictive feature of map unit BeE is Slope. In most places slopes are too steep to operate equipment for topsoil salvage. Where slopes are gentle enough to allow soils to be salvaged, good seedbed material could be stripped only to nine inches. The subsoil of the Benteen could be salvaged to 60 inches to provide a fair source of reconstruction material. Other soils within the map unit are restricted to nine inches salvage depth.

The disturbed land fill material has fair characteristics for reclamation. The main restrictive features are slope and large stones. The percent of coarse fragments is probably variable and the chemistry of the fine earth fraction is fair. Reclamation of areas mapped as DL will have to contend with these features. Consideration

will be given to a method of sorting out coarse fragments in order to create a more suitable topsoiling material for final reclamation. Otherwise, map unit DL is no better than any other soil in the mine area as a source of material for reclamation.

The main restrictive features of map units GaE and GpE are slopes. In most places slopes are too steep to operate equipment for topsoil salvage. Where slopes are gentle enough to allow soils to be salvaged, good reconstruction material could be stripped to twelve inches. The Teton Midfork and Adel soils, which are included in map unit GaE, could also be stripped to twelve inches. Area of Podo soil should only be stripped to six inches. In map unit GpE the Patmos soils is a good source of reconstruction material to nine inches. Podo soils and the included soils should be stripped to six inches.

The main restrictive feature of map unit PaE are slope and large stones. The Patmos is a good source of reconstruction material to nine inches where slopes are gentle enough to permit stripping and where large stones are not excessive. Areas of the Patmos that have excessive large stones in the surface layer should be avoided. The soil similar to the Patmos, but deeper than 40 inches, could also be stripped to nine inches. The Podo could be stripped to six inches. Rock outcrops should be avoided.

8.6 Use of Selected Overburden Materials or Substitutes

All of the disturbance at the Gordon Creek No. 2 Mine was performed prior to enactment of the Surface Mining Control and Reclamation Control Act of 1977, or the Utah Regulatory program which established requirements for salvaging topsoil. 9.18 acres of portal and pad disturbances exists at the No. 2 Mine site. The disturbed area is comprised of roads and pads constructed by cut and fill methods. The original soil material remains in-place as fill material. Since no topsoil was salvaged from the original disturbance and no additional areas will be disturbed in future reclamation activities,

Mountain Coal Company is proposing to use the disturbed land fill material as a substitute seedbed material (topsoil). The following is a justification for the use of fill material during final reclamation.

As was discussed in Section 8.5, one soil sample was taken in the disturbed land fill during original soil investigations conducted by James P. Walsh and Associates during July, 1980. Chemical and Physical analysis from this sample indicated the material could be rated fair as a substitute source of seedbed material.

ACR comments were submitted by DOG&M to Mountain Coal Company in September, 1982, regarding the need for additional justification to use disturbed land fill as a substitute source of seedbed quality material (topsoil). As a result, Mountain Coal Company contracted Western Environmental, Inc. to conduct a more intensive sampling program in the disturbed land fill. The following is a discussion of that program.

8.6.1 Scope

An assessment of proposed topsoil substitute material on the Gordon Creek No. 2 Mine in Carbon County, Utah, was made by Western Environmental, Inc., in May, 1983. The assessment included the use of analytical sampling and field observations to obtain a gross estimate of volume of material suitable for a topsoil substitute.

8.6.2 Methodology

Fill material resulting from a road and pad cut on the Gordon Creek No. 7 Mine site is proposed for topsoil substitute. The above material was randomly sampled for chemical analysis. (Refer to Gordon Creek No. 2 Mine soils map, Plate 8-1 for Sample Locations.) A gross volume estimate was calculated using cross sections and topographical maps of the Gordon Creek No. 2 Mine provided by Beaver Creek Coal Company. Using the cross sections and maps, an average depth and area of the fill material was obtained and used to calculate a gross volume estimate.

8.6.3 Material Suitability

Wyoming Department of Environmental Quality, Land Quality Division Guideline No. 1 was used to determine the parameter limits of suitability for topsoil substitute material. See Table 8-6 for parameters and suitability limits within Guideline No. 1.

The results presented on Table 8-7 indicate few suitability problems with the material, if needed, for a topsoil substitute. The following is a discussion of suitability limits of the material by parameter.

Vegetation is difficult to establish on soils with high SAR, which indicates potential instability and water transmission problems. All sample locations are considered good for this parameter except sample location No. 3 which is considered unsuitable with a value of 30.3.

Electrical conductivity is a measure of soil salinity. Excessive salts restrict plant growth, create problems in establishing vegetation and, therefore, influence erosion and the suitability of the surface. Excessively high or low pH causes problems in establishing vegetation and, as a result influences erosion and stability of the surface (USDA, 1978).

All of the soils tested are rated good for low salt content. The pH of all soils tested is rated good.

Texture influences soil structure, consistency, water intake rate, runoff, fertility, workability and trafficability. Potential slippage hazard is related to soil texture and, although other factors also contribute, the ratings of soil texture represent one important factor (USDA, 1978). Texture is rated good for all material except sample location No. 3, No. 4 and No. 7 which are considered fair.

The most limiting factors of the material tested on this site for use as a topsoil substitute is coarse fragments. Coarse fragments influence the ease of excavation, stockpiling, respreading and suitability for the final use of the land. A certain amount of coarse fragments can be tolerated depending upon the size and intended use of the reclaimed area. If the size of rock fragments exceeds ten inches (25 cm), the problems are more severe (USDA, 1978). Coarse fragments are rated good for locations No. 1 and No. 2, fair for location No. 5, and poor for locations No. 3, No. 4, No. 6, No. 7 and No. 8.

8.6.4 Results and Discussion

The gross estimated volume of material available for use as a topsoil substitute is 37,000 bank cubic yards (23 acre-feet). No suitability problems of the material sampled is anticipated except the area surrounding sample location No. 3, where more analysis is needed to better define the extent of the possibly unsuitable material. This sample shows a high SAR content; therefore, within ninety (90) days of reclamation, additional tests will be run beginning with location No. 3 and extending outward, sampling every ten feet in four directions until suitable SAR values are obtained. All material found to be unsuitable will be disposed of on site beneath the backfill. Since this is the only location with a high SAR content, it is likely that the situation is very localized and represents a small amount of material. In summary, when the data is compared to Guideline No. 1 criteria, most of the material considered for a topsoil substitute in the Gordon Creek No. 2 Mine area is suitable for seedbed material.

Additional soil samples were taken on the No. 2 Mine site in the fall of 1992. As indicated in Appendix 8-2, no problems were noted with these soils. No additional soil sampling is proposed for this site prior to backfilling and placement of topsoil.

Over the period of 1984 - 1988 a number of small disturbed areas have been revegetated in the course of interim, and wildlife enhancement revegetation. With out exception all efforts on and adjacent to the permit area have proven successful; vegetation cover based on quantative and qualitative analyses have exceeded 70% within a two growing season period (See Annual Report. Vegetation data 1987-1988). The results of the survey indicate that using the methodologies outlined in Chapter 3 Section 3.5.4.4, on areas that have had soil substituted material (subsoils or native material left after soils have been removed) revegetation has been successful to a degree that would indicate no apparent problem in re-establishing vegetation on all disturbed areas. Past and future soil sampling, as described above, will further substantiate the suitability of the substitute topsoil. Future soil sampling is described in Chapter 3, Section 3.5.5.1.

8.7 Removal, Storage and Protection of Planned Topsoil Removal

N/A - The mining is completed at this site and reclamation has been initiated, with completion scheduled for 1995.

Table 8-6

Seedbed Quality Material Standards for Reclamation

Property	Limits			Restrictive Feature
	Good	Fair	Poor	
1. Sodium Absorption* Ratio (SAR)	6	6-10	10-15	Excessive Sodium
2. Salinity(EC) MMHOS/cm*	0-4	4-8	8-16	Excess Salt
3. Saturation Percentage*	25	80	80 25	
4. Soil Reaction (pH)*	6.0-8.4	8.4-8.8	8.8-9.0	Excess Line
5. USDA Texture*		SL, SIL, VFSL, FSL LFS	Cl, S	Too Clayey
6. Zinc and Boron **				
7. Coarse Fragment(wt %)*				
3-10 in (7.6-25.4 cm)		0-15	15-25 25-35	Large Stones
10 in (725.4 cm)		0-3	3-10 7-10	Large Stones

* From Wyoming Department of Environmental Quality - Guideline No. 1.

** Will vary according to soil type or various environmental factors.

Table 8-7

Analysis for Proposed Topsoil Substitutes

Mechanical Analysis

Sample Location Number	Sand %	Clay %	Silt %	Coarse Fragments	Texture
1	46	19	35	12.1	Loam
2	44	17	39	2	Loam
3	72	7	21	35.2	Sandy Loam
4	72	7	21	28.4	Sandy Loam

Sample Location Number	Lime % as Cacos	pH Paste	Organic Matter %	Saturation %
1	7.1	7.5	9.0	44.2
2	17.0	7.6	1.1	34.0
3	20.3	8.0	1.1	22.7
	19.6	7.8	2.8	23.8

Saturation Extract

	Elect	Cat Ions			
Sample Location Number	Cond MMHOS/cm	Ca	Mg	Na	SAR
		meq/liter			
1	0.88	3.80	2.34	2.44	1.39
2	1.62	15.00	2.10	0.35	0.12
3	4.10	2.41	1.10	40.1	30.3
4	1.14	3.47	3.99	3.95	2.04

Table 8-7 (Continued)
Analysis for Proposed Topsoil Substitutes
Mechanical Analysis

Sample Location Number	Sand %	Clay %	Silt %	Coarse Fragments	Texture
5	42	25	33	17.5	Loam
6	46	19	35	35.0	Loam
7	62	11	27	33.0	SandyLoam
8	48	17	35	26.5	Loam

Sample Location Number	Lime % as Cacos	pH Paste	Organic Matter %	Saturation %
5	5.8	7.7	2.5	43.5
6	8.7	7.6	4.9	32.1
7	14.2	7.8	5.0	26.3
8	8.3	7.9	4.1	31.5

Saturation Extract

Sample Location Number	Elect Cond MMHOS/cm	Cat Ions Ca	Mg	Na	SAR	
		meq/liter				
5		0.70	3.38	2.20	0.56	0.33
6		3.40	10.9	10.9	15.6	4.72
7		1.30	3.85	4.62	3.63	1.76
8		1.45	6.28	3.53	4.69	2.12

8.8 Plan for Redistribution of Soils

As discussed in Section 8.6, Mountain Coal Company proposed to redistribute fill material from road and pad areas back into highwall cut areas. Backhoes will be used to retrieve fill material. Waste materials (i.e. oil, grease) and other potentially toxic materials and fill surrounding them, will be identified visually and buried on site as required during final reclamation. The unsuitable material will be covered with a minimum of 4' of suitable material. Plant growth medium will be roughened to maximize surface roughness. This will be accomplished by use of a large backhoe bucket to create 2'-3' diameter irregularly placed depressions. Areas of compaction will be chiseled. If necessary, cloddy surface areas will be pulverized with a disc, clod buster (slope chain) and/or harrow. (See Section 3.5.5.1)

8.9 Soil Sampling During Reclamation

There are approximately 17.5 acres of disturbance to be reclaimed on the Gordon Creek Nos. 2,7 and 8 mines. To identify soil fertility problems and to provide a basis for determining necessary soil amendments, soil sampling will occur prior to the earthwork and soil redistribution, as described in Section 3.5.5.1. This will allow for reseeding immediately after placement of topsoil or substitute topsoil.

8.9.1 Nutrients and Soil Amendments

Unless the soil fertility analyses suggest a different rate, fertilizer will be placed on the seedbed at a rate of 50 lbs./acre nitrogen, 80 lbs./acre phosphorus, and 80 lbs./acre potassium.

Organic amendments will consist of applying wood fiber, hay and/or straw mulches onto the fill material used for final reclamation. By using these organic amendments a substrata will be provided to encourage microbial reinvasion. Research by Colorado State University on Western lands suggest that plant species such as Indian ricegrass provide good hosts for microbes. This species exists in Mountain Coal Company's permanent reclamation seed mixture and will be inoculated by seed distributors prior to planting.

8.10 Effects of Mining Operations on Soils, Nutrients and Soil Amendments to be Used

The Disturbed Land Fill which has been impacted by mining operations has some inherent problems that will be addressed prior to reclamation. These include large stones and compacted zones. The large stones will be removed by standard earth-moving equipment and commercial rock-picker implements. Compacted zones will be eliminated by deep chiseling prior to final reclamation.

Fertilizer application will be based on soil test analysis as discussed in Section 8.9.

8.11 Mitigation and Control Plans

No additional surface disturbance involving soils is anticipated at this time. Therefore, stripping and stockpiling soils will not occur at Gordon Creek No. 2 Mine. Every effort will be made to maintain the present area of disturbance so that no additional soil resources are impacted during reclamation.

8.12 Bibliography

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USDA, Soil Conservation Service. Soil Survey Staff, 1975. Soil Taxonomy - a basic system of soil classification for marking and interpreting soil surveys, USDA Agricultural Handbook No. 436.

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CHAPTER 8

SOIL RESOURCES

GORDON CREEK No. 7/8 MINE AREA

8.1a Scope

A soil assessment of the Gordon Creek No. 7/8 Mine area was conducted in June 1983 by Western Environmental, Inc. of Gillette, Wyoming. The survey area is approximately seven acres and located east of the No. 2 Mine area in the southwest quarter of Section 18 Township 13 South, Range 8 East. The assessment was conducted to provide information that is compatible to the original soils work accomplished by James P. Walsh and Associates in 1980.

8.2a Methodology

The methodology used in this soil assessment by Western Environmental, Inc. is compatible to the methodology contained in Section 8.2 of this Chapter.

8.3a Soil Resource Information for the Mine Plan Area

8.3a.1 Soils Identification

The soils in the proposed area of disturbance initially examined with stereoscopic aerial photographs provided by Beaver Creek Coal Company. This allowed the consultant to predetermine slopes, land forms, and vegetation patterns.

Soils were then examined in the field. The soil descriptions were compared with recorded characteristics of the soils in adjacent counties and in the official SCS series descriptions. To make them site specific, map units are comprised of soil series and inclusions found within an area.

8.3a.2 Soil Profile Descriptions

Site specific profile descriptions below were written for the major soils encountered on the survey area. Locations of the profile descriptions are shown on the soil survey map (Plate 8-1a). The SCS examined the proposed No. 8 Mine site prior to disturbance. A copy of their report is included in Appendix 8-1.

Gappmeyer-Variant Series

The Gappmeyer Variant series consists of deep to very deep, moderately well to well-drained soils. These soils formed in colluvium derived from sandstone and shale. Annual precipitation is 16 to 20 inches. The mean annual air temperature ranges from 60° to 120°F, and the frost free period is 60 to 120 days. The native vegetation is gamble oak, snowberry, and aspen.

The available water capacity to a depth of 60 inches is six or seven inches, and permeability is moderately slow. These soils are used for watershed and wildlife habitat.

The Gappmeyer Variant series is a member of the loamy-skeletal, mixed family of Boralific Argiborolls.

Typical Profile Description

Map Location No. 3.

01 & 02 0-2 inches. Partially decomposed and decomposed litter.

A1 0-12 inches. Brown (10YR 5/3) loam; very dark brown (10YR 3/2) moist; weak fine granular structure; soft,

slightly sticky, slightly plastic; noncalcareous; five percent gravels; clear wavy boundary.

B1 12-18 inches. Pale brown (10YR 6/3/) loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic, noncalcareous; 5 percent gravels; clear irregular boundary.

B2t 18-36 inches. Pale brown (10YR 5/3) moist; moderate medium angular blocky structure breaking to moderate fine subangular blocks; slightly hard, friable, sticky, plastic; 10 percent gravels, some cobbles and stones; diffuse wavy boundary.

B3 36-60+ inches. Pale brown (10YR 4/5) clay, brown (10YR 5/3) moist; moderate medium angular blocky, firm, sticky, plastic;noncalcareous; many weathered gravels; 20 percent gravels, 10 percent cobbles, some stones and boulders.

Patmos Series

The Patmos series consists of moderately deep, moderately permeable, well-drained soils. These soils formed in colluvium derived from sandstone and shale. Annual precipitation is 12 to 20 inches.. The mean annual air temperature ranges from 38° to 45°F, and the frost free period of 60 to 120 days. The native vegetation is salina wildrye, scattered bitterbrush, and oakbrush.

The available water capacity to a depth of 21 inches is about two to four inches, and permeability is moderate. These soils are used for range.

The Patmos series is a member of the loamy-skeletal mixed (calcareous) frigid family of Typic Ustorthents.

Typical Profile Description

Map location No. 2.

A11 0-8 inches. Greyish brown (10YR 5/2) gravelly loam, dark brown (10YR 3/3) moist; weak fine granular structure; soft, very friable, slightly sticky, plastic; calcareous; 25 percent gravels, 5 percent cobbles; gradual smooth boundary.

A12 8-18 inches. Pale brown (10YR 6/3) gravelly clay loam, brown (10YR 5/3) moist; weak fine and medium subangular blocky structure; slightly hard, very friable, sticky, plastic; calcareous; 25 percent gravels, 10 percent cobbles, 5 percent stones, some scattered boulders; clear irregular boundary.

C1 18-35 inches. Grey (10YR 5/1) dark sandy clay loam, gray (10YR 4/2) moist; weak fine subangular blocky structure parting to massive; soft, friable, slightly sticky, slightly plastic; calcareous; 25 percent gravels some cobbles; clear smooth boundary.

R 35-Plus-inches. Sandstone.

Benteen Series

The Benteen series consists of deep, well-drained soils. These soils formed in colluvium derived from sandstone and shale. Annual precipitation is 20 to 30 inches. The mean annual air temperature is less than 38°F, less than 38°F the frost free period is less than 60 days. The native vegetation is aspen, snowberry, and perennial grasses.

The available water capacity is about 3.5 to 6.5 inches, and permeability is moderate. These soils are used for range land, wildlife habitat and watershed.

The Benteen series is a member of the fine-loamy (mixed) family of Argic Pachic Cryoborolls.

Typical Profile Descriptions

Map location No. 1

A1 0-5 inches. Greyish brown (10YR 5/2) loam, very dark greyish brown (10 YR 3/2) moist; weak thin clay parting to very fine angular blocky structure; soft, very friable, nonsticky, slightly plastic; noncalcareous; 15 percent gravels; clear smooth boundary.

B2t 5-10 inches. Brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; moderate fine subangular blocky structure; soft, very friable, slightly sticky, slightly plastic; noncalcareous; 15 percent gravels; clear smooth boundary.

B3 10-18 inches. Brown (10YR 5/3) gravelly clay loam, dark brown (10YR 4/3) moist; moderate medium angular blocky structure; soft very friable, slightly sticky, plastic; noncalcareous; 15 to 20 percent gravels; clear smooth boundary.

C1 18-24 inches. Greyish brown (10YR 5/2) gravelly clay loam, very dark greyish brown (10YR 3/2) moist; weak medium angular blocky structure; slightly hard, sticky, plastic; noncalcareous; 20 percent gravels; clear smooth boundary.

C2 24-42 inches. Grey brown (10YR 5/2) gravelly clay loam, dark brown (10YR 3/3) moist; moderate medium angular blocky structure; slightly hard, very friable, sticky, plastic, calcareous; 20 percent gravels; gradual wavy boundary.

CR Mixed colluvial shale and sandstone.

The described pedon is deeper than allowed in the range of characteristics of the Benteen series.

8.3a.3 Map Unit Descriptions

The Map Unit Descriptions provided below are based on the previous soil survey accomplished by James Walsh and Associates. The slope for GaE - Gappmeyer Variant was adjusted from 30 to 50 percent to 10 to 30 percent slopes to fit the site specific conditions encountered in this survey.

Map Unit: BeE - Benteen Loam, 30 to 50 Percent Slopes

This map unit is on mountain side slopes. The slope is 30 to 50 percent. The native vegetation is mainly aspen, snowberry and perennial grasses.

The unit is 75 percent Benteen Loam, and 25 percent other soils.

The Benteen soil is deep and well-drained. It is formed in colluvium derived from sandstones and shales. Typically, the surface layer is a gray brown or brown-dark brown loam about nine inches thick. The subsoil is a gray brown or brown gravelly clay loam about 23 inches thick. The substratum to a depth of 60 inches or more is a gray brown gravelly clay loam.

Permeability of the Benteen soil is moderate. Available water capacity of about 3-1/2 to 6-1/2 inches. Effective rooting depth is 40 inches to more than 60 inches. Runoff is medium and the erosion hazard for water is moderate. Wind erosion hazard is slight.

The unit is mainly used for range land, wildlife habitat, recreation and watershed. It is also used for mining activities in the mapped area.

The present plant community is mainly aspen, snowberry and perennial grasses. The potential productivity data is not available. This map unit is in capability unit VIIE, and is not evaluated for range site.

Map Unit: GaE - Gappmeyer Variant, 10 to 30 Percent Slopes

This unit is located on low mountain side slopes and along drainage areas. The slope is 10 to 30 percent.

The unit is 75 percent Gappmeyer Variant and 25 percent other soils.

The Gappmeyer Variant series consists of deep to very deep, moderately well to well-drained soils. These soils formed in colluvium derived from sandstone and shale. Typically the surface layer is a brown to grey brown loam about ten inches thick. The subsoil is a grey brown or brown clay loam about 20 inches thick with a substratum of gravelly clay loam.

Permeability of the Gappmeyer Variant soil is slow. Available water capacity to a depth of 60 inches is about six and seven inches. Effective rooting depth is 40 inches or more. Runoff is medium and erosion hazard for water is moderate. Wind erosion hazard is slight.

The present plant community is mainly douglas fir and oakbrush. The potential productivity data is not available. This map unit is in capability unit VIIE nonirrigated, not evaluated for range site.

The unit is mainly used for wildlife habitat and watershed. It is also used for mining activities.

Map Unit: GpE - Gappmeyer Variant-Patmos Complex, 50 to 70 Percent Slopes

This map unit is on mountain side slopes on south and east facing slopes. The slope is 50 to 70 percent. The native vegetation is mainly oakbrush with occasional aspen.

The unit is 50 percent Gappmeyer Variant and 25 percent Patmos soils. Other soils include 25 percent of the unit.

The Gappmeyer Variant in this mapping unit is the same as the Gappmeyer Variant soil in mapping unit GpE.

The Patmos series consists of moderately deep, moderately permeable, well-drained soils. These soils formed in colluvium derived from sandstone and shale.

Map Unit: GpE - Gappmeyer Variant-Patmos Complex, 50 to 70 Percent Slopes (continued)

Typically the surface layer is dark grey brown to dark brown gravelly loam. The subsoil is a pale brown gravelly clay loam about 20 inches thick. The substratum to a depth of about 40 inches is a light grey brown to grey gravelly sandy loam.

Permeability of the Patmos series is moderate. Available water capacity to a depth of 21 inches is two to four inches. Effective rooting depth is less than 40 inches. Runoff is rapid and erosion hazard for water is high. Wind erosion is slight.

8.3a.4 Production of Soils

Potential production data is not available for the soils mapped in the area. The soil capability class of all the soils mapped for the report is VIIE; refer to Table 8-1a below taken from the original report.

Table 8-1a

Estimated Potential Production - Forage

Soil Series	Potential Production Favorable/Normal/ Unfavorable Years (lbs/ac)[a]	Sites	Soil Capability Class
Benteen	NA	All	VIIE
Gappmeyer Variant	NA	All	VIIE
Patmos	NA	All	VIIE

NA - Data not available

8.3a.5 Volumetric Estimate of Soil Resource

Table 8-2a shows estimated volumes of topsoil on the survey area. Average depths of suitable topsoil material used in the volumetric calculations are those presented in the original Gordon Creek No. 2 soils assessment. No significant difference was seen in the soils encountered on the survey area to warrant major adjustments in stripping depths.

The major limiting factor in salvaging the soil on the survey area is excessive slope. The Gappmeyer Variant, 10 to 30 percent slopes, mapping unit has slopes which can be stripped using conventional equipment. The other mapping units occurring on the survey area have slopes exceeding using conventional equipment.

Table 8-2a

Seedbed Quality Material Volumes on Survey Area

Survey Area 1

Mapping Unit	Component	Percent of Mapping Unit	Average Suitable Stripping Depth (Inches)	Mapping Unit Acreage	Total Estimated Volume (BCY)
BeE	Benteen	75%	9	1.3	Excessive
	(Inclusions)	25%	9		Slope
GaE	Gappmeyer	75%	12	3.1	5,001
	(Inclusions)	25%	12		
ρE	Gappmeyer	50%	12	3.1	Excessive
	Patmos	25%	9		Slope
	(Inclusions)	25%	6		
				7.5	5,001

* Note - The above available topsoil estimate is based on the total survey area and not the disturbed area.

8.3a.6 Use of Topsoil Substitutes

Wyoming Department of Environmental Quality, Land Quality Division Guideline No. 1 was used to determine the parameter limits of suitability for topsoil substitute material.

Potential topsoil material was sampled by Western Environmental, Inc. in May, 1983. The material considered for topsoil substitution was collected on the down slope side of the pioneered road to the pad. The results presented in Table 8-3a indicate no suitability problems with the material, if needed, for a topsoil substitute. See Table 8-4a for parameter suitability limits. The following is a discussion of suitability limits of the material by parameter.

Vegetation is difficult to establish on soils with high SAR which indicates potential instability and water transmission problems (USDA, 1978). None of the soils tested have high SAR; all are rated good for this parameter.

Electrical conductivity is a measure of soil salinity. Excessive salts restrict plant growth, create problems in establishing vegetation and, therefore, influence erosion and the stability of the surface. Excessively high or low pH causes problems in establishing vegetation and, as a result, influence erosion and stability of the surface (USDA 1978).

All of the soils tested are rated good for low salt content. The pH of all soils tested is rated good.

Texture influences soils structure, consistency, water intake rate, runoff, fertility, workability, and trafficability. Potential slippage hazard is related to soil texture, and although other factors also contribute, the ratings of soil texture represent one important factor (USDA, 1978). Texture is rated good for all material except sample location No. 4a which is considered fair.

Coarse fragments influence the ease of excavation, stockpiling respreading, and suitability for the final use of the land. A certain amount of coarse fragments can be tolerated depending upon the size and intended use of the reclaimed area. If the size of rock fragments exceeds ten inches (25cm). the problems are more severe (USDA, 1978). Coarse fragments are rated good for all the sample locations except No. 4a which is rated poor.

In summary, when the data is compared to the criteria in Table 8-4a, the material considered for a topsoil substitute is suitable for seedbed material.

Topsoil requirements and availability are summarized on Table 8-5A of this Chapter.

TABLE 8-3a

Analysis For Proposed Topsoil Substitutes

Mechanical Analysis

Sample Location Number	Sand %	Clay %	Silt %	Coarse Fragments	Texture
1a	20	31	49	7.0	silty clay loam
2a	50	23	27	12.8	sandy clay loam
3a	40	19	41	9.5	loam
4a	58	13	29	32.2	sandy loam

Sample Location Number	Lime % as Cacos	pH Paste	Organic Matter %	Saturation %
1a	13.2	7.7	2.6	44.3
2a	21.2	7.6	2.5	37.3
3a	17.9	7.9	1.5	35.3
4a	11.8	7.7	3.9	26.4

Saturation Extract

Sample Location Number	Elect Cond MMHOS/cm	Cat Ions Ca	Mg	Na	SAR
		meq/liter			
1a	2.14	6.59	6.05	7.29	2.90
2a	1.10	7.03	2.93	1.05	0.47
3a	0.75	3.02	2.37	0.87	0.53
4a	2.05	5.04	4.82	13.3	5.99

TABLE 8-4a

Seedbed Quality Material Standards for Reclamation

Property	Limits			Restrictive Feature
	Good	Fair	Poor	
1. Sodium Absorption[a] Ratio (SAR)	6	6-10	10-15	Excess Sodium
2. Salinity	0-4	4-8	8-16	Excess Salt
3. Saturation (EC) MMHOS/cma	25	80	80 25	
4. Soil Reaction (pH)[a]	6.0-8.4	8.4-8.8	8.8-9.0	Excess Lime
5 USDA Texture[a]		SL, SIL, VFSL, FSL LFS	Cl, S	Too Clayey
6. Zinc and Boron [b]				
7. Coarse Frag. (wt %)[a]	0-15	15-25	25-35	Large Stones
3-10 in. (7.6-25.4 cm)	0-3	3-10	7-10	Large Stones

[a] From Wyoming Department of Environmental Quality - Guideline No. 1.

[b] Will vary according to soil type or various environmental factors.

TABLE 8-5A

GORDON CREEK NO. 2/7/8 MINES

MASS BALANCE SUMMARY

	No.2	No.7	No.7	No.8
Soil Type	Topsoil Substitute	Topsoil	Subsoil	Topsoil
Stored Location	No.2/7 Road/Pad	No.2 Yard	No.7 Yard	No.7 Yard
Destination	No.2	No.7	No.7	No.7/8
Volume Available	37,000 cu.yds.	3,684 cu.yds.	8,000 cu.yds.	2,514 cu.yds.
Volume Required	7,405 cu.yds.	-------12,100 cu.yds.------		1,452 cu. yds.
Acres Disturbance	9.18 acres	-------7.50 acres----------		0.90 acres
Distribution Depth	6:	12"	12"	12"

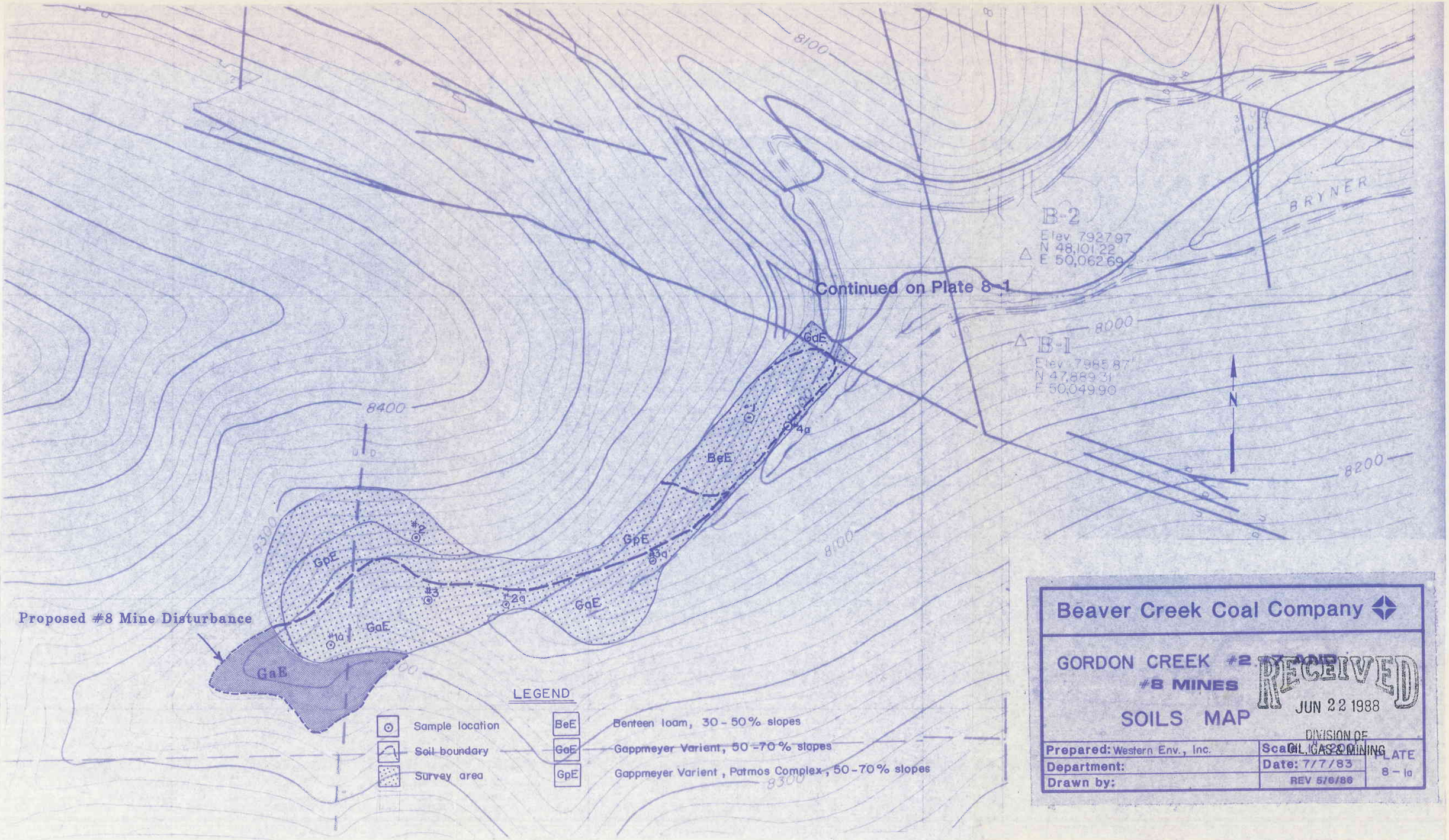
Summary:

7/8 Mines

(1) Total Topsoil available (7/8 Mines) - 6,198 cu. yds.
(2) Subsoil available (7 Mine) - 8,000 cu. yds.
(3) Total Growth Medium available (7/8 Mines) 12,198 cu. yds.
(4) Total Growth Medium required (7/8 Mines) - 13,552 cu. yds.

2 Mine

(1) Topsoil Substitute available (2 Mine) - 37,000 cu. yds.
(2) Total Growth Medium required (2 Mine) - 7,405 cu. yds.



Beaver Creek Coal Company

GORDON CREEK #2 EXPANDED
#8 MINES

SOILS MAP

RECEIVED
JUN 22 1988
DIVISION OF
OIL, GAS & MINING

Prepared: Western Env., Inc.	Scale: 1" = 200'	PLATE
Department:	Date: 7/7/83	8 - 1a
Drawn by:	REV 5/6/86	

CHAPTER 9
VEGETATION RESOURCES
GORDON CREEK NO. 2/7/8 MINES

CHAPTER 9
VEGETATION RESOURCES
GORDON CREEK No. 2/7/8 MINES

9.0 Preface

The Gordon Creek No. 2 Mine was opened in 1969 and all major surface disturbance occurred at that time. No vegetation studies or inventories were conducted prior to initial disturbance. Vegetation studies were conducted for this property in 1980 and 1981.

The Gordon Creek No. 7 Mine was opened in 1984. The vegetation study was conducted in 1983. The study was site specific to the proposed disturbance for the No. 7 Mine.

The Gordon Creek No.8 Mine was opened in 1989. Surface disturbance for the No.8 Mine construction occurred on approximately 0.90 acres within the Mixed Conifer vegetation type, as shown on Plate 9-1 of this submittal. The Division Vegetation Guidelines (p.5) stated that a separate reference area is not required for proposed disturbance of less than 1 acre. The No.8 Mine disturbance is only 0.9 acres.

A survey was conducted on the No.8 Mine site for Canyon Sweetvech prior to disturbance. The clearance and survey are summarized in Appendix 9-1 of this Chapter.

Due to the difference in the time frames of the studies, as well as the reference areas and vegetation types at the sites, the Vegetation Resources Sections of this Plan are presented separately for clarity. The Gordon Creek No. 2 Mine is presented first, followed by the Gordon Creek No. 7/8 Mine area.

It should be noted that information presented in the balance of this Chapter is for reference only in evaluating the Vegetative Resources. This information should not be

confused with the proposed Revegetation Plan (Chapter 3, Section 3.5.5) or the Revegetation Standards for Success (Chapter 3, Section 3.5.5.7).

While data is supplied for 2 reference areas, only the Oak Shrubland Reference Area will be used as the vegetative standard for success for all reclaimed sites, including the No. 2, No.7 and No. 8 Mines. References are made to production in this chapter, based on previous information requirements; however, revegetation success will only be based on cover, density and diversity as described in Chapter 3, Section 3.5.5.7.

The reference area will be resampled in July/August 1993, and results of this sampling will be submitted to the Division with the Annual Report for 1993.

CHAPTER 9

VEGETATION RESOURCES

GORDON CREEK No. 2 MINE

9.1 Scope

The vegetation resources data information for the Gordon Creek No. 2 Mine was prepared by Mountain Coal Company based upon studies performed by Espey, Huston and Associates, Inc. from July 30 to August 8, 1980. The study area included the entire 1630-acre lease area located in Carbon County, approximately 15 miles northwest of Price, Utah.

The major components of the study were the preparation of a vegetation map of the permit area, a qualitative and quantitative description of the vegetation within the study area, and the establishment of vegetation reference area. The study also included a site-wide examination to identify any threatened or endangered species which may be present on the lease area.

Based on a review of the results of those studies, it was decided by ARCO (Atlantic Richfield Company) personnel that some additional information was needed to supplement the initial work. The scope of the 1981 work was discussed with the Utah Division of Oil, Gas & Mining (DOG&M) in early-July to obtain their input and gain approval of the studies.

The 1981 studies performed by Stoecker-Keammerer and Associates consisted of obtaining cover, frequency and production data for two reference areas established in the oak shrubland type and the mountain grassland. The justification for establishing these reference areas is that they represent the vegetation types which will be established on the disturbed areas once they are reclaimed. All of the data was collected during the second week of July, 1981.

9.2 Methodology

9.2.1 Floristics

A floristic survey was conducted at the same time as the 1980 quantitative vegetation sampling. The purpose of the floristic survey was to determine and list the plant species present within the lease area, including any threatened or endangered species. This was accomplished by a walking reconnaissance of the mine area, noting species' occurrence and their distribution in the various communities. Plant identification was aided by the use of numerous references (Cronquist et al, 1972; Judd, 1962; McDougall, 1973; Parker, n.d.; Tidestrom, 1925; Weber, 1976; and Welsh and Moore, 1973).

9.2.2 Vegetation Map

The vegetation map (see Plate 9-1) of the Gordon Creek No. 2 Mine Permit Area was prepared using a combination of aerial photo interpretation and field checking. Black-and-white and color infrared aerial photographs (at a scale of approximately 1:12,000) were used to map the location and extent of the various vegetation types. The photo interpretation was augmented by field checking and aerial reconnaissance of the site. Community types were delineated based on two or more dominant species.

The vegetation types were also quantified in terms of acreage and percent of the study area (Table 9-1). The final map was prepared on a topographic mylar base at a scale of 1:6000 (1 inch = 500 feet). The aerial extent of the mapped plant community types was determined by planimetering their location on the 1:6000 vegetation map.

9.2.3 Reference Areas

Reference areas are land areas that are selected to represent the species' composition, topography, soils and aspect of affected communities within the permit area. During the 1980 study, a reference area for the douglas fir forest type was chosen and sampled. Subsequent examination and evaluation of existing vegetation patterns within the lease area suggest that it is unlikely that the douglas fir type occurred within the affected area. Since all the affected areas most likely consisted of a mosaic of oak shrublands and mountain grasslands and, since the douglas fir forest type most likely did not occur within the disturbed area, no attempt will be made to restore this type on currently affected areas. Therefore, no reference area for this type is needed. Earlier versions of this permit application included data for a douglas fir reference area. This data has been eliminated from this submittal. Reference areas for the oak shrubland and mountain grassland types were selected during the 1981 study. These reference areas were located within the permit area on sites which would not be disturbed throughout the life of the mine. Each reference area was one hectare (2.5 acres) in area (200m by 50m) and was selected to be characteristic of the vegetation type it represented. Locations of these two reference areas are shown on the vegetation map (Plate 9-1). It has now been decided by the Division and Mountain Coal Company that only the Oak-Shrubland Reference Area will be used as the vegetative standard for success on all reclaimed sites.

In July, 1983, a representative from the U.S. Department of Agriculture, Soil Conservation Service (SCS) viewed the reference areas and provided productivity estimates. Figure 9-0 is a letter containing that statement.

FIGURE 9-0

United States Department of Agriculture
Soil Conservation Service
350 North 4th East
Price, Utah 84501

July 20, 1983

Scott M. Raymond
Environmental Coordinator
Beaver Creek Coal Co.
P. O. Box AU
Price, Utah 84501

Dear Scott:

Listed below are the statements of productivity and range condition for the Dak reference area and the Salina wildrye reference area at the No. 2 Mine:

The oak vegetation site is producing about 1,800 lbs. per acre air dry. The site is in good condition.

The Salina wildrye site is producing about 900 lbs. per acre air dry. There is not too much known about the Salina wildrye site, but I feel this site is in good condition also.

George S Cook

George S. Cook
Range Conservationist

Table 9-1

Aerial Extent and Percent of Total Area

For Each Vegetation Type

Gordon Creek No. 2 Permit Area

Mapping Unit	Acres	Percent of Total Area
Aspen Woodland	440.3	27.01
Mixed Coniferous Forest	247.6	15.20
Cherry Thicket	15.0	0.92
Willow Thicket	15.0	0.92
Riparian Community	12.4	0.76
Oak Shrubland	306.5	18.81
Mixed Mountain Shrubland	47.9	2.94
Manzanita Shrubland	1.5	0.09
Big Sagebrush Shrubland	305.6	18.75
Bottomland Sagebrush Shrublands	19.9	1.22
Mountain Grassland	166.6	10.22
Wet Sedge Meadow	15.5	0.94
Disturbed Area	34.1	2.09
Open Water	2.1	0.13
TOTAL	1630.0	100.00

9.2.4 Vegetation Cover and Productivity

The two vegetation types most affected by mining operations are oak shrubland and mountain grassland. Cover and production data were gathered for these two types.

9.2.4.1 Cover

During 1981, cover data was collected using a quadrat approach. Individual 1.0 m^2 quadrats were randomly located in the reference areas. Random sampling was accomplished by using pairs of random coordinates. The first number of the pair was the measured distance along one side (long axis) of the reference area, and the second number was the paced distance perpendicular to the tape at the position of the first number. Random sampling locations within each of the reference areas are shown in Figures 9-1 and 9-2. In each quadrat, total vegetation cover (canopy cover) including shrub canopy, cover by bare soil and cover by letter and rock were visually estimated. For each quadrat, these three components added to 100 percent. Canopy cover for each species and cover by litter, rock, bare soil, lichens and mosses in the ground layer were also visually estimated. Because of overlap, these components added to more than 100 percent. Cover data was summarized by calculating mean values for each species and each component. Relative cover (percent of total cover) and frequency values were also determined.

9.2.4.2 Productivity

During 1981, production data was collected using a harvest method. Individual 1.0 m^2 quadrats were randomly located throughout each of the reference areas (Figures 9-1 and 9-2). Random locations were determined using pairs or random coordinates in the same manner used for locating cover

quadrats. In each of the clipped quadrats, grasses and semi-shrubs were fractionated on the basis of species; forbs were separated into annuals and perennials. Shrubs were not clipped except for low-growing species such as Oregon grape (Mahonia repens) and mountain lover (Pachystima myrsinites). Clipped samples were over-dried for 24 hours at 100°C and were weighed to the nearest milligram. Data was summarized by obtaining mean production values for each species or species group.

9.2.5 Density

During 1981, density data for shrubs was obtaining using a line-strip transect approach. Randomly located transects 15m by 3m were used to obtain shrub density data in the reference areas. Cover data for the shrub layer was obtained using a line intercept approach along the 15m line defining the center line of each line-strip transect.

Within each of the shrub line-strip transects, individual shrubs were tallied on the basis of height class in order to obtain some measure of community structure. For individuals with multiple stems, separate counts were made for the number of individuals per transect, as well as the number of stems per individual. Total density was calculated both on the basis of the number of individuals per hectare as well as the number of stems per hectare. Random sampling locations for the line-strip transects are shown in Figures 9-1 and 9-2.

9.2.6 Data Analysis

9.2.6.1 Definitions

During 1981, the following definitions applied to data gathering and reduction:

FIGURE 9-1

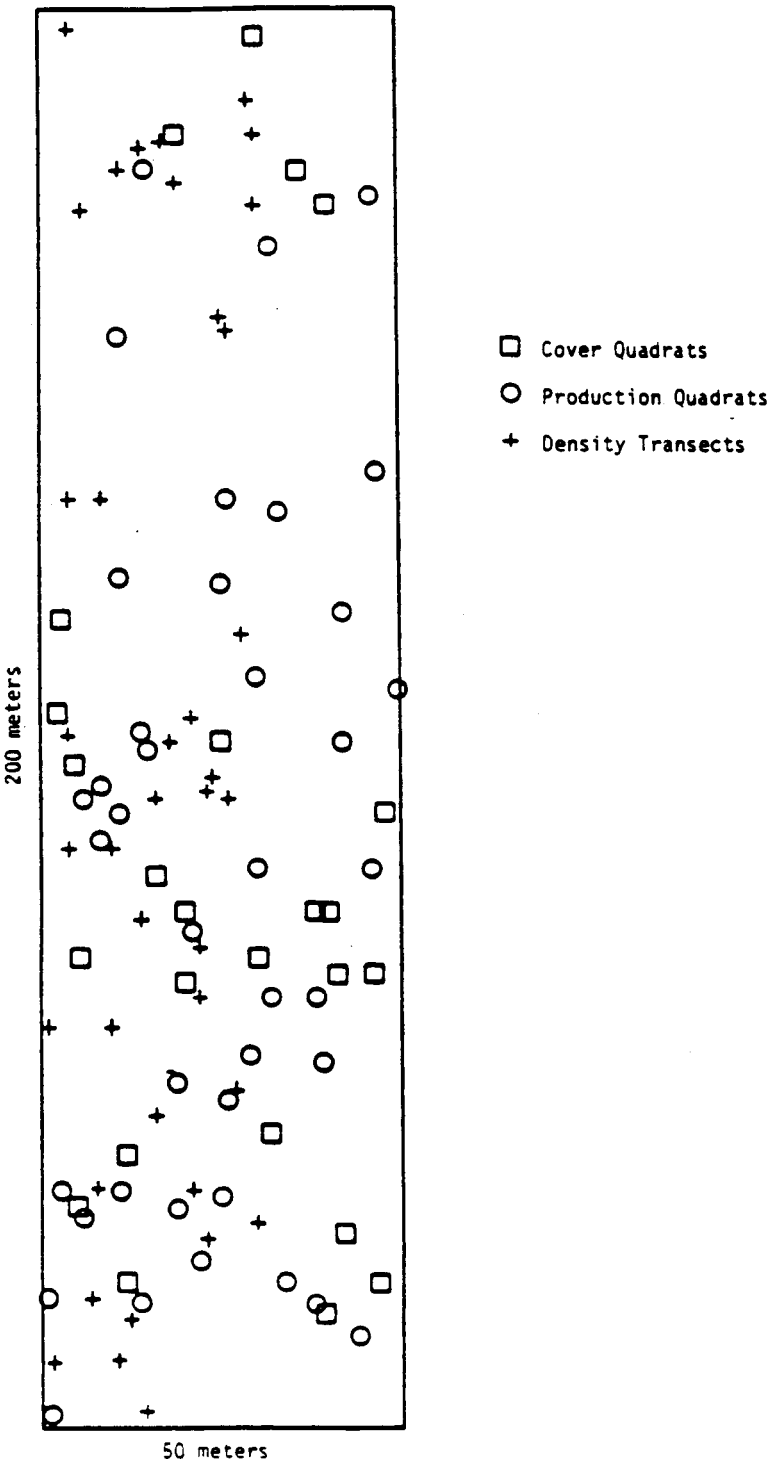


Figure 1. Sampling locations in the Bunchgrass Community Reference Area at Gordon Creek No. 2.

FIGURE 9-2

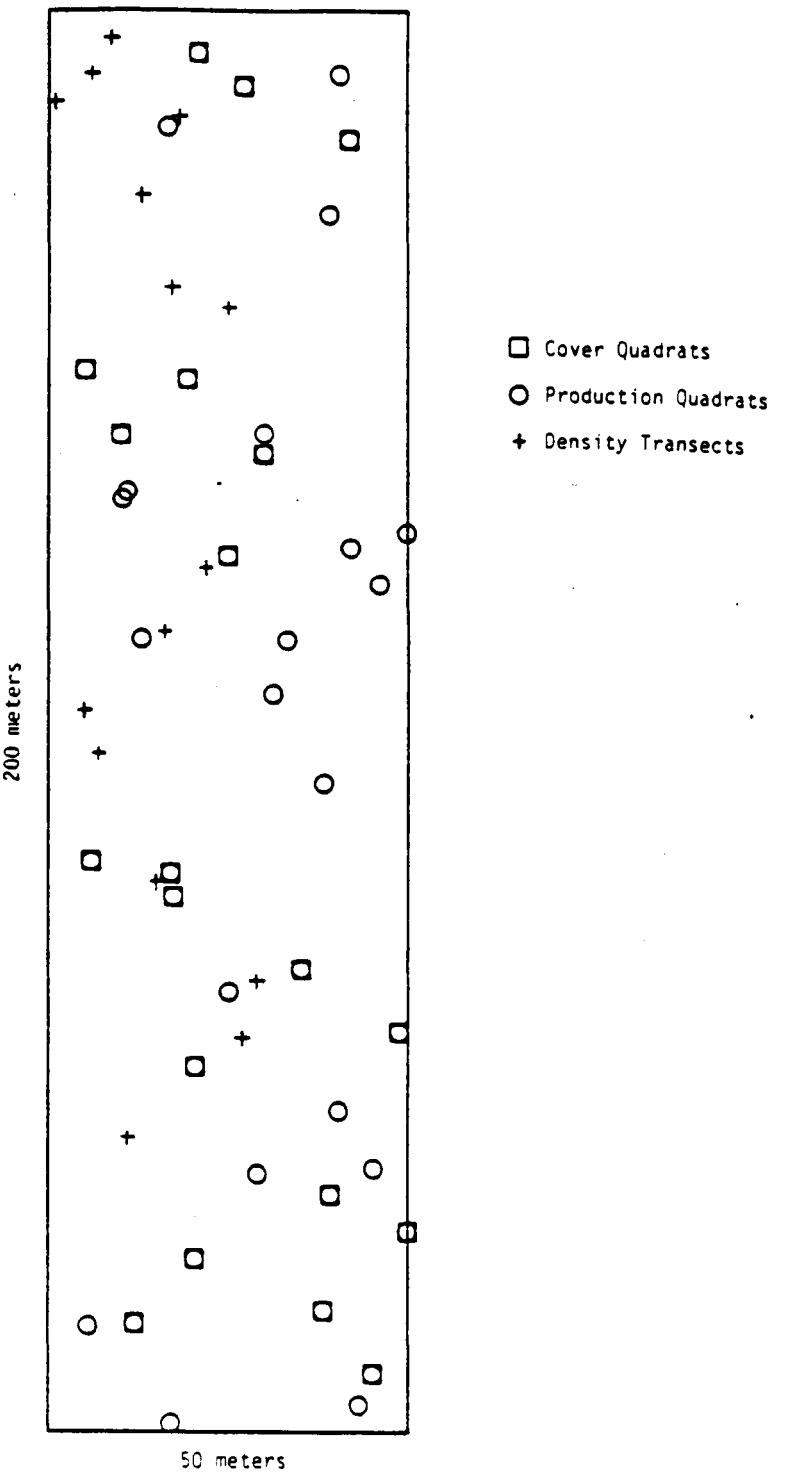


Figure 2. Sampling locations in the Mixed Mountain Shrubland Reference Area at Gordon Creek No. 2.

Relative Density =

$$\frac{\text{the number of sampled trees of species}}{\text{the total number of trees sampled}} \times 100$$

Frequency =

$$\frac{\text{the number of plots occupied by a species}}{\text{the total number of plots sampled}} \times 100$$

Relative Frequency =

$$\frac{\text{the number of plots occupied by a species}}{\text{the sum of all plots of all species}} \times 100$$

Total Basal Area =

a species density X a species relative basal area

Relative Basal Area =

$$\frac{\text{the total basal area of a species}}{\text{the sum of the total basal area for all species}} \times 100$$

Percent Importance =

$$\frac{\text{Relative Density} + \text{Relative Frequency} + \text{Relative Basal Area}}{3}$$

Data reduction for the quadrat sampling results were carried out as follows:

Frequency =

$$\frac{\text{number of quadrats a species occurs in}}{\text{the number of quadrats samples}} \times 100$$

Percent Cover =

$$\frac{\text{the total aerial coverage values}}{\text{the total number of plots sampled}}$$

Sample adequacy during 1981 was evaluated using the following formula (Chochran, 1977):

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

where

n_{ade} = adequate number of samples

t = t value (t-distribution) for a given level of confidence

(t = 1.645 for 90% Confidence; t = 1.282 for 80% confidence)

s^2 = sample variance estimate

d = the level of accuracy desired for the estimate of the mean (d = 0.1 in all calculations)

x = sample mean

9.3 Existing Vegetation Resources

9.3.1 General Site Description

The Gordon Creek No. 2 Mine study area is located along the eastern edge of the Wasatch Plateau in Carbon County, Utah. The elevation range is about 7600 to 9300 feet (2315 - 2830m).

Topographically, the study area consists of steep slopes on the face of the plateau and along drainages, flat surfaces on terrace or flood plains in valley bottoms and relatively gentle terrain o top of the plateau. The area is underlain by nearly flat sedimentary rocks of the Tertio-Cretaceous North Horn Formation and the Lower Tertiary Flagstaff Formation.

The study area has a highly continental climate, with large daily and seasonal variations in temperature. The lower elevations of the permit area are quite dry, with average annual precipitation of 14 inches or less, mostly falling as Spring rain showers.

Higher elevations receive more precipitation, much of it as snow which persists through the Winter.

9.3.2 Vegetation Types

The vegetation map for the Gordon Creek No. 2 Mine permit area (Plate 9-1) depicts 14 mapping units. The vegetation has been divided into two forest types (Aspen Woodlands and Mixed Coniferous Forests), seven shrubland types (Cherry Thickets, Willow Thickets, Oak Shrublands, Mixed Mountain Shrublands, Manzanita Shrublands, Big Sagebrush Shrublands, and Bottomland Sagebrush Shrublands), one shrub/forest type (Riparian Community), two grassland types (Mountain Grassland and Wet Sedge Meadow), disturbed areas, and open water areas. Five of these types (Aspen Woodlands, Mixed Coniferous Forests, Oak Shrublands, Big Sagebrush Shrublands and Mountain Grassland) account for 90 percent of the entire permit area (Table 9-1). The remaining nine types account for only ten percent of the area. Each of the mapping units is briefly described in the discussion below.

9.3.2.1 Oak Shrubland (Reference Area)

The oak shrubland types is the most extensive of the upland shrub types and covers 206 acres (18.8 percent) within the mapped area. It is the second most abundant of all the mapped types. Oak shrublands occur on steep slopes which tend to be drier than the slopes which support aspen woodlands and mixed coniferous forests. These slopes tend to be more south and west facing; however, the oak shrublands are not limited to these aspects. Major shrub species include Gambles oak (*Quercus gambelii*) and mountain snowberry (*Symphoricarpos oreophilus*). The major species is slender wheatgrass (*Agropyron trachycaulum*).

Cover, Frequency, Species Diversity

Table 9-2 summarizes the data deriving these parameters for the oak shrubland reference area. The major grass species in the type is slender wheatgrass, and the most common forb is a species of beard tongue (Penstemon sp.), Gambles oak and mountain snowberry. Approximately 92 percent of the relative cover within this type is provided by the shrub component.

The dominant shrub species in terms of density is Gambles oak, which has a total density of 47,946 individuals per hectare. Most of these individuals fall within the shortest height class (0.25m to 0.75m) (Table 9-3).

Productivity

Perennial forbs and Oregon grape (Mahonia repens) provide approximately 68 percent of the total biomass (Table 9-4). Mean total production was 11.9 grams per square meter (106 pounds per acre). Tall shrub components were not included in the production measurements.

Because of the very steep slope on which the reference area is located, there is very limited utilization by domestic livestock. Herb and low shrub production is limited. This limited production is not related to poor range condition, but rather to competition with the tall shrubs which characterize the oak woodland type. For this particular vegetation type, the reference area appears to be in at least good condition.

Sample Adequacy

Sample adequacy was attained for cover and shrub density (Table 9-5). In the oak shrubland reference area, sample adequacy was not attained for production; however, the maximum number of 40 samples required by the Utah DOG&M was obtained.

TABLE 9-2

Oak Shrubland Reference Area

Cover, Frequency and Species Diversity Summaries for Herb Layer Components

Based on Date from 20 lm^2 Quadrats. (1981 Data)

Community	Mean Cover (%)	Relative Cover (%)	Range of Cover Values	Percent Frequency	Relative Frequency (%)	I.V.*	Rank
PERENNIAL GRASSES AND SEDGES							
Agropyron trachycaulum	0.3	0.53	0-4	30.0	3.92	4.45	10
Bromus anomalus	0.1	0.01	0-1	5.0	0.65	0.65	26
Bromus ciliatus	0.1	0.01	0-1	5.0	0.65	0.65	26
Carex geyeri	0.1	0.01	0-1	5.0	0.65	0.65	26
Carex sp.	0.4	0.71	0-3	60.0	7.84	8.55	6
Elymus salinus	0.1	0.01	0-1	15.0	1.96	1.96	15
Poa pratensis	0.1	0.18	0-1	5.0	0.65	0.83	22
Poa sp.	0.1	0.18	0-1	5.0	0.65	0.83	22
Stipa lettermannii	0.2	0.35	0-3	10.0	1.31	1.66	16
Sub-Total	1.1	1.95					
FORBS							
Arenaria lateriflora	0.1	0.18	0-2	10.0	1.31	1.49	17
Artemisia ludoviciana	0.1	0.18	0-1	25.0	3.27	3.45	12
Aster sp.	0.1	0.01	0-1	10.0	1.31	1.31	18
Cheonpodium album	0.1	0.1	0-1	5.0	0.65	0.65	26
Descurainia pinnata	0.1	0.01	0-1	5.0	0.65	0.65	26
Erysimum asperum	0.1	0.01	0-1	10.0	1.31	1.31	18
Gayophytum ramossissimum	0.1	0.01	0-1	10.0	1.31	1.31	18
Helianthella uniflora	0.1	0.18	0-1	20.0	2.61	2.79	14

TABLE 9-2 (Continued)
Oak Shrubland Reference Area

Community	Mean Cover (%)	Relative Cover (%)	Range of Cover Values	Percent Frequency	Relative Frequency (%)	I.V.*	Rank
FORBS (Continued)							
Lactuca serriola	0.1	0.01	0-1	5.0	0.65	0.65	26
Penstemon sp.	1.2	2.12	0-6	70.0	9.15	11.27	3
Senecio integerrimus	0.1	0.01	0-1	5.0	0.65	0.65	26
Smilacina stellata	0.2	0.35	0-3	5.0	0.65	1.00	21
Solanum triflorum	0.3	0.53	0-3	35.0	4.58	5.11	9
Sub-Total	2.0	3.54					
SEMI-SHRUBS							
Mahonia repens	0.9	1.59	0-8	35.0	4.58	6.17	7
Pachystima myrsinites	0.6	1.06	0-5	60.0	7.84	8.90	5
Sub-Total	1.5	2.65					
SHRUBS							
Amelanchier itahensis	1.5	2.65	0-10	65.0	8.50	11.15	4
Artemisia tridentata	1.3	2.29	0-26	5.0	0.65	2.94	13
Cerocarpus montanus	2.0	3.53	0-30	20.0	2.61	6.14	8
Prunus virginiana	0.1	0.18	0-1	5.0	0.65	0.83	22
Purshia tridentata	0.1	0.18	0-2	5.0	0.65	0.83	22
Quercus gambelii	34.0	59.96	14-56	100.0	13.57	73.03	1
Rosa woodsii	0.3	0.53	0-2	30.0	3.92	4.45	10
Symphoricarpos oreophilus	12.8	22.57	0-38	80.0	10.46	33.03	2
Sub-Total	52.1	91.89					

TABLE 9-2 (Continued)
Oak Shrubland Reference Area

Community	Mean Cover (%)	Range of Cover Values (%)
SUM OF SPECIES COVER	56.7	42-71
Total Woody Cover	47.7	34-69
Total Herbaceous Cover	2.4	0- 8
Lichens	0.0	---
Mosses	0.1	0-1
Litter	93.6	55-100
Rock	3.6	0-33
Bare Soil	2.9	0-19

Evaluation of the herb layer and the ground layer as a single unit. The values in this section add to 100 percent for each quadrat.

Total Vegetation	48-5	38-65
Rock/Litter	48.7	31-61
Bare Soil	2.9	0-19

Number of Species per Square Meter	Mean ± S.D. **	Range
Herb Species	3.60 ± 2.11	10- 8
Woody Species	4.05 ± 1.15	2- 6
Total Species	7.65 ± 2.84	4-13

*Importance Value (I.V.) = Relative Cover ± Relative Frequency

** ± Values equal the standard deviation (S.D.)

TABLE 9-3

Oak Shrubland Reference Area

Cover, Frequency and Density Summaries for Shryb Species

Based on Data From 15 cm x 15m Line-Strip Transects. (1981 Data.)

Species	Height Class*	Mean Cover (%)	Relative (no. individuals per hectar) Cover (%)	Freuqency (%)	By Height Class	Total ± S.D.
Amelanchier utahensis	Total	0.7	7.77	100.0		4987±3436
	I				3407	
	II				800	
	III				533	
	IV				237	
Artemisia tridentata	Total	0.1	0.11	33.3		48± 204
	I				48	
Cercocarpus montanus	Total	0.1	1.11	53.3		1067±1629
	I				681	
	II				356	
	III				30	
Prunus virginiana	Total			6.7		104± 402
	I				74	
	II				30	
Purshia tridentata	Total	0.1	1.11	33.3		341± 671
	I				341	

TABLE 9-3 (Continued)

Oak Shrubland Reference Area

Species	Height Class*	Mean Cover (%)	Relative (no. individuals per hectare) Cover (%)	Freuqency (%)	By Height Class	Total ± S.D.
Quercus gambelii	Total	6.3	69.92	100.0		23067±8587
	I				14933	
	II				5111	
	III				2104	
	IV				919	
Rosa woodsii	Total	0.3	3.33	86.7		3615±3633
	I				3230	
	II				370	
	III				15	
Symphoricarpos oreophilus	Total	1.5	16.65	100.0		14726±8098
	I				14044	
	II				681	
TOTAL						47946±8776

Height Class I = 0.25m-0.75m
II = 0.76m-1.50m
III = 1.51m-2.25m
IV = 2.25m+

Table 9-4

OAK SHRUBLAND

Reference Area. Mean production ± the standard deviation (S.D.). Based on the data from 40 1m² quadrats. 1981 data.

Species	Mean ± S.D. (grams/m²)	Mean ± S.D. (lbs/acre)	Percent Total Biomass
PERENNIAL GRASSES AND SEDGES			
Agropyron trachycaulum	0.764 ± 1.879	7 ± 17	6.42
Bromus anomalus	0.006 ± 0.028	1 ± 1	0.05
Bromus ciliatus	0.010 ± 0.063	1 ± 1	0.08
Carex geyeri	0.051 ± 0.321	1 ± 3	0.43
Carex sp.	0.652 ± 1.429	6 ± 13	5.48
Elymus salinus	0.707 ± 1.742	6 ± 16	5.94
Poa pratensis	0.618 ± 1.831	6 ± 16	5.19
Poa sp.	0.245 ± 0.890	2 ± 8	2.06
Stipa lettermanni	0.206 ± 0.596	2 ± 5	1.73
Sub-Total	3.259 ± 4.030	29 ± 36	
ANNUAL FORBS	0.011 ± 0.043	1 ± 1	0.09
PERENNIAL FORBS	5.542 ± 5.085	49 ± 45	46.56
SEMI SHRUBS			
Gutierrezia sarothrae	0.049 ± 0.311	1 ± 3	0.41
Mahonia repens	2.528 ± 4.447	23 ± 40	21.24
Pachystima myrsinites	0.514 ± 0.772	5 ± 7	4.32
Sub-Total	3.091 ± 4.351	28 ± 39	
TOTAL PRODUCTION	11.903 ± 8.736	106 ± 78	

9.3.2.2 Mountain Grassland (Reference Area)

The mountain grassland type is the fifth most abundant type within within the mapped area. It covers 166 acres (10.2 percent of the area) and occurs on high, dry slopes. The major species include Salina wildrye (Elymus salinus) and Indian ricegrass (Oryzopsis hymenoides).

Cover, Frequency, Species Diversity

Table 9-6 summarizes the data deriving these parameters for the mountain grassland reference area. The dominant species within this vegetation type is salina wildrye. Approximately 86 percent of the cover is provided by perennial grasses and sedges. In terms of cover and frequency, major shrub species within this type are mountain mahogany (Cercocarpus montanus) and a species of wild buckwheat (Eriogonum corymbosum).

The total number of individual shrubs per hectare was 4633. Total number of stems per hectare was 17,678. The majority of shrubs occurs within the shortest height class (Table 9-7).

Productivity

Salina wildrye is the most productive species (Table 9-8). Approximately 92 percent of the total biomass is attributable to this species. Tall shrub components were not included in the production measurements. Mean total production was 68.4 grams per square meter (611 pounds per acre).

Sample Adequacy

Sample adequacy was attained for vegetation cover, herb production and shrub density in the mountain grassland reference area (Table 9-5).

TABLE 9-5

Evaluation of Sample Adequacy for Reference Areas

Gordon Creek No. 2 Mine

Community	Size (n)	Mean±Standard Deviation	Sample Level of Confidence (%)	d (two-tailed)	t	Sample Size (n_{adj})
VEGETATION COVER						
Mountain Grassland	25	19.92 ± 3.32	90	0.1	1.645	8
Oak Shrubland	20	48.45 ± 7.83	80	0.1	1.282	5
HERBACEOUS LAYER						
PRODUCTION (grams/m^2)						
Mountain Grassland	22	68.397±18.944	90	0.1	1.645	21
Oak Shrubland	40	11.903± 8.736	80	0.1	1.282	89
DENSITY (No. Ind./Plot)						
Mountain Grassland						
Shrubs						
Stems	40	20.85 ±12.03	90	0.1	1.645	91
Individuals	40	79.60 ±50.19	90	0.1	1.645	107
Oak Shrubland	15	216.13±39.49	15	0.1	1.282	6

TABLE 9-6

Mountain Grassland Community Reference Area

Cover, Frequency and Species Diversity Summaries for Herb Layer Components

Based on Date from 20 lm^2 Quadrats. (1981 Data)

Community	Mean Cover (%)	Relative Cover (%)	Range of Cover Values	Percent Frequency (%)	Relative Frequency	I.V.*Rank
PERENNIAL GRASSES AND SEDGES						
Agropyron spicatum	0.1	0.48	0-1	4.0	1.11	1.5913
Agropyron trachycaulum	0.4	1.94	0-5	16.0	4.44	6.38 8
Carex sp.	0.1	0.19	0-1	4.0	1.11	1.3015
Elymus salinus	16.7	80.99	9-26	100.0	27.78	108.77 1
Poa fendleriana	0.4	1.94	0-4	24.0	6.67	8.61 5
Stipa lettermannii	0.1	0.19	0-1	4.0	1.11	1.3015
Sub-Total	17.6	85.73				
Aster sp.	0.1	0.01	0-1	4.0	1.11	1.1121
Caulanthus crassicaulis	0.1	0.19	0-1	4.0	1.11	1.3015
Eriogonum umbellatum	0.1	0.48	0-2	8.0	2.22	2.7010
Erysimum asperum	0.1	0.19	0-1	4.0	1.11	1.3015
Haplopappus nuttallii	0.1	0.19	0-1	8.0	2.22	2.4111
Hymenoxys richardsonii	0.2	0.97	0-3	8.0	2.22	3.19 9
Penstemon sp.	0.1	0.19	0-1	8.0	2.22	2.4111
Physaria floribunda	0.1	0.19	0-1	4.0	1.11	1.3015
Sisymbrium linifolium	0.1	0.01	0-1	32.0	8.89	8.89 3
Stanleya viridiflora	0.3	1.45	0.3	20.0	5.56	7.01 7
Sub-Total	0.7	3.85				

TABLE 9-6 (Continued)

Mountain Grassland Community Reference Area

Community	Mean Cover (%)	Relative Cover (%)	Range of Cover Values	Percent Frequency	Relative Frequency (%)	I.V.*	Rank
SEMI SHRUBS							
Atremisia frigida	0.1	0.18	0-1	4.0	1.11	1.30	15
Guitierrezia sarothrae	0.6	2.91	0-6	20.0	5.56	8.47	6
Opuntia fragilis	0.1	0.01	0-1	4.0	1.11	1.11	21
Sub-Total	0.6	3.10					
SHRUBS							
Atremisia tridentata	0.1	0.01	0-1	4.0	1.11	1.11	21
Cercocarpus montanus	1.4	6.79	0-9	36.0	10.00	16.79	2
Eriogonum corymbosum	0.1	0.01	0-1	32.0	8.89	8.89	3
Purshia tridentata	0.1	0.01	0-1	4.0	1.11	1.11	21
Quercus gambelii	0.1	0.48	0-3	4.0	1.11	1.59	13
Sub-Total	1.5	7.27					
SUM OF SPECIES COVER	20.4		14-27				
Total Woody Cover	1.5		0-19				
Total Herbaceous Cover	18.6		11.26				
Lichens (Crustose)±	3.1		0-10				
Mosses	0.1		0-1				
Litter	53.1		22-81				
Rock	23.9		2-70				
Bare Soil	23.0		8-46				

TABLE 9-6 (Continued)

Mountain Grassland Community Reference Area

Community	Mean Cover (%)	Relative Cover (%)	Range of Cover Values	Percent Frequency	Relative Frequency (%)	I.V.*	Rank
Evaluation of the herb layer and ground layer as a single unit. The values in this section add to 100 percent for each quadrat.							
Total Vegetation	19.9	12-26					
Litter/Rock	57.1	36-74					
Bare Soil	23.0	8-46					
Number of Species per Square Meter	Mean ± S.D.**		Range				
Herb Species	2.51±1.05		1-5				
Woody Species	1.08±1.04		0-4				
Total Species	3.60±1.71		1-7				

*Importance Value (I.V.) = Relative Cover = Relative Frequency

** ±Values equal the standard deviation (S.D.).

TAL /

Mountain Grassland Community Reference Area
Cover, Frequency and Density Summaries for Shrub Species
Based on Data from 40 em x 15m Line-Strip Transects (1981 Data)

Species	Height Class* (%)	Mean Cover (%)	Relative Cover (%)	Frequency	Density (Ind./Hectare) By Height Class	Density (Ind./Hectare) Total ± S.D.	Density(Stems/Hectare) By Height Class	Density(Stems/Hectare) Total ± S.D.
Amelanchier utahensis	Total	0.1	6.45	30.0		294±667		717±2380
	I				283		589	
	II				6		89	
	III				6		39	
Artemisis tridentata	Total	0.1	2.58	17.5		50±118		61± 142
	I				50		61	
Cercocarpus montanus	Total	0.8	51.61	92.5		2383±1911		13928±11249
	I				1844		11833	
	II				411		1906	
	III				128		189	
Eriogonum corymbosum	Total	0.3	19.35	67.5		828±918		978±1211
	I				828		978	
Opuntia fragilis	Total	0.1	0.1	12.5		144±560		144±500
	I				144		144	

TABLE 9-7 (Continued)
Mountain Grassland Community Reference Area

Species Class*	Height Cover (%)	Mean Cover (%)	Relative (%)	Frequency Class	Density (Ind./Hectare) By Height S.D.	Density (Ind./Hectare) Total ± Class	Density (Stems/Hectare) By Height S.D.	Density (Stems/Hectare) Total ±
Pinus edulis	Total	0.1	0.1	2.5		6± 36		6± 36
	I				6		6	
Purshia tridentata	Total	0.3	19.35	60.0		628±987		1433±1773
	I				628		1433	
Quercus gambelii	Total	0.1	0.01	2.5		28±176		33±211
	I				28		33	
Symphoricarpos oreophilus	Total	0.1	0.65	15.0		272±976		378±1178
	I				272		378	
TOTAL						4633±2673		17678±11153

* Height Class I = 0.25m-0.75m
II = 0.76m-1.50m
III = 1.51m-2.25m
IV = 2.25m+

Table 9-8

MOUNTAIN GRASSLAND COMMUNITY

Reference Area. Mean production ± the standard deviation (S.D.). Based on the data from 20 $1m^2$ quadrats. 1981 data.

Species	Mean ± S.D. (grams/m^2)	Mean ± S.D. (lbs/acre)	Percent Total
Biomass			
PERENNIAL GRASSES AND SEDGES			
Agropyron trachycaulum	2.311 ± 9.810	21 ± 88	3.38
Elymus salinus	63.011 ± 21.275	562 ± 190	92.13
Oryzopsis hymenoides	0.232 ± 1.056	2 ± 9	0.34
Poa fendleriana	0.457 ± 1.443	4 ± 13	0.67
Sub-Total	66.011 ± 19.868	589 ± 177	
PERENNIAL FORBS	1.303 ± 2.554	12 ± 23	1.91
SEMI-SHRUBS			
Gutierrezia sarothrae	1.009 ± 2.756	9 ± 25	0.11
Mahonia repens	0.074 ± 0.347	1 ± 3	0.11
Sub-Total	1.083 ± 2.750	10 ± 25	
TOTAL PRODUCTION	68.397 ± 18.944	611 ± 169	

9.3.2.3 Aspen Woodland

The aspen woodland type occurring primarily on moist north-facing slopes, covers approximately 440 acres (27 percent), and is the most extensive vegetation type on the permit area. The major tree species is quaking aspen (Populus tremuloides).

9.3.2.4 Mixed Coniferous Forest

The mixed coniferous forest type occurs on north-facing slopes and covers approximately 247 acres (15.2 percent) within the study area. It is the second most common forest type and fourth in extent of all mapped types. Major species include douglas fir (Pseudotsuga menziesee), white fir (Abies concolor), sub-alpine fir (Abies lasiocarpa), Engelmann spruce (Picea engelmannii), and Colorado blue spruce (Picea pungens). On high ridges, both bristle cone pine (Pinus aristata) and limber pine (Pinus flexilis) occur.

9.3.2.5 Cherry Thicket

The cherry thicket type is limited in extent and covers only 15 acres (0.9) percent of the area. It occurs in the southwest quarter of Section 12 (Plate 9-1) on the steep slopes above Beaver Creek. The major species is choke cherry (Prunus virginiana). This species tends to occur throughout the upland mixed shrub types and only in limited areas does it grow in dense homogeneous.

9.3.2.6 Willow Thicket

The willow thicket type occurs along major stream courses such as Beaver Creek. The type is characterized by dense stands of willows (Salix ssp.)., and very moist to wet growing conditions. The type covers approximately 15 acres (0.9 percent) within the mapped area.

9.3.2.7 Riparian Community

The riparian community type also occurs along stream courses. However, it tends to have a somewhat different species composition. Both trees and shrubs characterize the type. Major species include cottonwood (Populus fremontii), red osier dogwood (Cornus stolonifera), mountain maple (Acer glabrum), and serviceberry (Amelanchier ssp.). The trees occur as scattered individuals. This type is limited in extent and covers only 12 acres (0.8 percent).

9.3.2.8 Mixed Mountain Shrubland

The mixed mountain shrubland type occurs on steep upland slopes and is characterized by a mixture of species. Major species include Gambles oak, mountain snowberry, serviceberry, choke cherry, and mountain mahogany. This type covers approximately 48 acres which is equivalent to 2.9 percent of the mapped area.

9.3.2.9 Manzanita Shrubland

The manzanita shrubland type occurs on exposed hillsides and is the most restricted type within the mapped area. It covers only 1.4 acres which is approximately 0.1 percent of the area. Major species include manzanita (Arctostaphylos patula) and mountain lover (Pachystima myrsinites).

9.3.2.10 Big Sagebrush Shrubland

The big sagebrush shrubland type is the second most prevalent shrubland type, covering 305 acres (18.7 percent of the area). It occurs on steep, dry upland slopes. Major shrub species include mountain big sagebrush (Artemisia tridentata ssp. vaseyana) and antelope bitterbrush (Purshia tridentata). The major grass species is salina wildrye.

9.2.3.11 Bottomland Sagebrush Shrubland

The bottomland sagebrush type occurs in lowland areas along Beaver Creek, and occupies only 20 acres (1.2 percent) within the mapped area. The major species is big sagebrush (Artemisia tridentata ssp. tridentata). The major difference between the big sagebrush shrubland and bottomland sagebrush shrubland types is the subspecies of big sagebrush which occurs as the dominant species. The subspecies tridentata grows to a much greater height than does the subspecies vaseyana.

9.3.2.12 Wet Sedge Meadow

The wet sedge meadow type is restricted in extent and covers 15 acres (0.9 percent) within the mapped area. It occurs along the upper portions of Beaver Creek and is usually found in association with abandoned beaver ponds. The major species are sedges (Carex spp.) and other semi-aquatic species.

9.3.2.13 Open Water

The open water type includes ponds which occur within the mapped area. The total area occupied by ponds is only 2.1 acres which is approximately 0.1 percent of the area.

9.3.2.14 Disturbed Areas

The disturbed areas within the mapped area primarily include those areas which are currently being used for mining activities. The total extent of this type is approximately 34 acres (2.1 percent of the area). This figure includes actual disturbance plus affected areas.

Sample Adequacy

Sample adequacy was attained for vegetation cover and herb vegetation cover and herb production in the bunchgrass reference area. Refer to Table 9-5.

9.3.3 Species List

The plant list resulting from the floristic survey is presented in Table 9-9. The table is arranged in alphabetical order by plant family. Species are identified in the table according to their common name, scientific name, growth form, and occurrence in (1) douglas fir forest, (2) sagebrush-grassland, (3) oak shrubland, and (4) wetland communities.

The list includes 88 species, 71 general and 31 families. Species identification was from Cronquist et al (1972, 1977), Welsh and Moore (1973), McDougall (1973), and Weber (1976).

TABLE 9-9

Plant Species Observed

Gordon Creek No. 2 Mine Permit Area

Carbon County, Utah

Common Name	Family Scientific Name	Growth Form	Wetland	Sagebrush Grassland	Oak Shrubland	Douglas Fir
MAPLE FAMILY	ACERACEAE					
Rocky Mountain Maple	Acer glabrum	Tree				x
Big Tooth Maple	Acer grandidentatum	Tree				x
AMARANTH FAMILY	AMARANTHACEAE					
Prostrate Pigweed	Amaranthus graecizans	Forb		x		
BARBERRY FAMILY	BERBERIDACEAE					
Oregon Grape	Mahonia repens	Shrub		x	x	x
BORAGE FAMILY	BORAGINACEAE					
Catseye	Crypthantha abata	Forb		x		
Houndstongue	Cynoglossum officinale	Forb		x	x	
Stickseed	Lappula occidentalis	Forb		x	x	x
HONEYSUCKLE FAMILY	CAPRIFOLIACEAE					
Elderberry	Sambucux coerulea	Shrub				x
Snowberry	Symphoricarpos vaccinoides	Shrub			x	x
PINK FAMILY	CARYOPHYLLACEAE					
Catchfly	Silene menziesii	Forb				x
Chickweed	Stellaria jamesiana	Forb				x

TABLE 9-9 (Continued)

Plant Species Observed

Common Name	Family Scientific Name	Growth Form	Wetland	Sagebrush Grassland	Oak Shrubland	Douglas Fir
GOOSEFOOT FAMILY	CHENOPODIACEAE					
Goosefoot	Chenopodium fremontii	Forb				x
Goosefoot	Chenopodium pratericola	Forb				x
Russian Thistle	Salsola kali	Forb		x		
SUNFLOWER FAMILY	COMPOSITAE					
Yarrow	Achillea millifolium	Forb		x	x	x
Fringed Sagewort	Artemisia frigida	Shrub		x		
Louisiana Sagewort	Artemisia ludiviciana	Shrub			x	
Big Sagebrush	Artemisia tridentata	Shrub		x		
White Rubber Rabbitbrush	Chrysothamnus nauseosus var. albucaulis	Shrub		x	x	
Mountain Low Rabbitbrush	Chrysothamnus viscidiflorus var. lanceolatus	Shrub		x	x	
Wavyleaf Thistle	Cirsium undulatum	Forb		x	x	
Smokeweed	Gutierrezia sarothrae	Shrub		x	x	
Orange Sneeze Weed	Helenium hoopesii	Form				x
	Machaeranthera canescens	Forb		x	x	
	Machaeranthera linearis	Forb		x	x	
Rag Weed Groundsel	Senecio ambrosioides	Forb				x
Decumbent Goldenrod	Solidago decumbens	Forb				x
Nuttail Horse Brush	Tetradymia nuttalli	Shrub		x		
Showy Goldeneye	Viguiera multiflora	Forb				x

TABLE 9-9 (Continued)
Plant Species Observed

Common Name	Family Scientific Name	Growth Form	Wetland	Sagebrush Grassland	OakDouglas Shrubland Fir
DOGWOOD FAMILY	CORNACEAE				
Red Osier Dogwood	Cornus stolonifera	Tree			x
MUSTARD FAMILY	CRUCIFERAE				
Black Mustard	Brassica nigra	Forb			x
Tansy Mustard	Descurainia sophia	Forb		x	xx
Plain Wall Flower	Erysimum asperum	Forb			x
Hedge Mustard	Sisymbrium sp.	Forb			x
CYPRESS FAMILY	CUPRESSACEAE				
Rocky Mountain Juniper	Juniperus scopulorum	Tree			xx
SEDGE FAMILY	CYPERACEAE				
Sedge	Carex sp.	Graminoid		x	x
OLEASTER FAMILY	ELEAGNACEAE				
Buffalo Berry	Shepherdia rotundifolia	Shrub			x
BEECH FAMILY	FAGACEAE				
Gamble's Oak	Quercus gambelii	Tree			x

TABLE 9-9 (Continued)

Plant Species Observed

Common Name	Family Scientific Name	Growth Form	Wetland	Sagebrush Grassland	Oak Shrubland	Douglas Fir
PINE FAMILY	PINACEAE					
Pinion Pine	Pinus edulis	Tree			x	
Douglas Fir	Pseuditsuga menzeisii	Tree			x	
PHLOX FAMILY	POLEMONIACEAE					
Longleaf Phlox	Phlox lonifolia	Forb				x
BUCKWHEAT FAMILY	POLYCONACEAE					
Winged Wild Buckwheat	Eriogonum alatum	Shrub		x		
Corymed Wild Buckwheat	Eriogonum microthecum var. foliosum	Shrub		x		
Prostrate Knotweed	Polygonum aviculare	Forb		x		
BUTTERCUP FAMILY	RANUNCULACEAE					
Red Baneberry	Actaea rubra	Forb			x	
Colorado Columbine	Aquilegia caerulea	Forb				x
Western Virgin's Bower	Clematis ligusticifolia	Forb				x
Rocky Mountain Virgin's Bower	Clematis pseudoalpina	Forb				x
Nelson Larkspur	Delphinium nelsonii	Forb				x
Fendler Meadowrue	Thalictrum fendleri	Forb				x

TABLE 9-9 (Continued)

Plant Species Observed

Common Name	Family Scientific Name	Growth Form	Wetland	Sagebrush Grassland	Oak Shrubland	Douglas Fir
ROSE FAMILY	ROSACEAE					
Utah Serviceberry	Amelanchier utahensis	Shrub			x	x
Alder-Leaf Mountain Mahogany	Cercocarpus montanus	Shrub			x	
Wild Strawberry	Fragaria americana	Forb				x
Ninebark	Physocarpus capitatus	Shrub				x
Choke Cherry	Prunus virginiana	Tree				x
Antelope Bitterbrush	Purshia tridentata	Shrub		x	x	
Nootka Rose	Rosa nutkana	Shrub				x
Woods Rose	Rosa woodsii	Shrub				x
WILLOW FAMILY	SALICACEAE					
Aspen	Populus tremuloides	Tree	x			x
Blue Willow	Salix subcoerulea	Shrub	x			x
Willow	Salix sp.	Shrub	x			x
SAXIFRAGE FAMILY	SAXIFRAGACEAE					
Wax Currant	Ribes cereum	Shrub			x	x
Sticky Currant	Ribes viscossissimum	Shrub				x
FIGWORT FAMILY	SCROPHULARIACEAE					
Watson Penstemon	Penstemon watsoni	Forb				x
Penstemon	Penstemon sp.	Forb				x
Lanceleaf Figwort	Scrophularia lanceolata	Forb				x

TABLE 9-9 (Continued)

Plant Species Observed

Common Name	Family Scientific Name	Growth Form	Wetland	Sagebrush Grassland	Oak Shrubland	Douglas Fir
POTATO FAMILY	SOLANACEAE					
Cutleaf Nightshade	Solanum triflorum	Forb		x		
NETTLE FAMILY	URTICACEAE					
Nettle	Urtica breweri	Forb		x	x	x
VIOLET FAMILY	VIOLACEAE					
Violet	Viola sp.	Forb				x

9.3.4 Total Acres in Plan Area, Acreage by Vegetation Type and Acreages of Types Affected

There are approximately 1630 acres within the lease area. A list of approximate acres of each vegetation type is given in Table 9-1. The total area of disturbance is approximately 34 acres. Of this total, approximately ten acres of disturbance occurs as a result of current mining operations. This area occurs on a south facing exposure and most likely supported a mosaic of mountain grassland and oak shrubland vegetation types.

9.4 Threatened or Endangered Species

Currently, eight species are listed as endangered or threatened in Utah. None of these threatened or endangered species, as defined and identified by the U.S. Department of the Interior, Fish and Wildlife Service (USDA, 1980) were observed in the Gordon Creek No. 2 Mine lease area. None of these species are known to occur in Carbon County.

No species are currently proposed as endangered or threatened in Utah (USDI, 1980). One hundred and sixty-three (163) plant taxa are currently under review (USDI, 1980). Of these species, three (Eriogonum corymbosum var. davidsii, Eriogonum lancifolium) and Hedysarum Occidental var. canone are known to occur in Carbon County (USDA, 1979). These species occur on the Mancos shale formation in salt desert shrub vegetation types at elevations of 4800 to 5700 feet, and on disturbed areas. These vegetation types are not known to occur in the Gordon Creek No. 2 Mine area; however, if they are found in the permit area, Mountain Coal Company will notify the Division.

9.5 Effects of Mining Operations on Vegetation

The mines are closed and ready for final reclamation. All surface disturbance and effects on vegetation have already taken place.

3.6 Mitigation and Management Plans

As noted previously, the Gordon Creek No. 2 Mine is closed and read for final reclamation. Therefore, mitigation and management measures have been designed to prevent additional impacts related to reclamation activities and to facilitate rapid return of the site to productive use after decommissioning.

The relatively small-scale disturbance associated with the former mining operation will be mitigated by reclaiming the disturbed sites with an approved seed mix. The plant mix has been selected to offer a diverse assemblage of herbaceous and woody species that are adapted to on-site conditions and are of known value for cover, forage, or both. The comprehensive reclamation procedure is fully described in Section 3.5, Reclamation Plan.

In an effort to protect newly seeded areas, no grazing will be allowed on reseeded areas.

3.7 Revegetation Methods

Seeding and planting of disturbed areas shall be conducted during the first normal period for favorable planting conditions after final preparation.

The disturbed areas will be regraded to rather steep slopes which will exclude most methods of machine planting. Therefore, areas to be planted will be "roughened" by raking (or other means) to help hold the seeds in place. The proper seed mixture will then be spread either by hand or machine. Mulch will be applied over the entire area. (See Section 3.5 for details).

The revegetated area will be monitored and, if success appears unlikely, alterations will be made with concurrence of the land owner until revegetation success is achieved.

9.8 Revegetation Monitoring

Reclamation monitoring is discussed under Section 3.5.5.5 of this Plan.

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CHAPTER 9
VEGETATION RESOURCES
GORDON CREEK No. 7/8 MINES

9.1a Scope

The vegetation resource data information was prepared by Native Plants, Inc. in Salt Lake City, Utah. The study area, Gordon Creek No. 7/8 Mines , is located approximately 15 miles northwest of Price in Carbon County, Utah.

The objectives of the study were to prepare a vegetation map of the permit area, and qualitatively and quantitatively describe the vegetation within the disturbance and study area. The study also included a site wide examination to identify any threatened or endangered species which may be present on the lease area.

9.2a Methodology

9.2a.1 Floristics

A floristic survey was conducted at the same time as the 1983 quantitative vegetation sampling. The purpose of the floristic survey was to determine a list the plant species present within the lease area including any threatened or endangered species. This was accomplished by a walking reconnaissance of the proposed disturbance area noting species occurrence and their distribution in the various communities. Plant identification was aided by the use of numerous reference (Cronquist et. al, 1972; Judd, 1962; McDougall, 1973; Parker, n.d.; Tidestrom, 1925; Weber, 1976; and Welsh and Moore, 1973).

9.2a.2 Vegetation Map

The vegetation map of the Gordon Creek No. 7 Mine area was prepared using a combination of air photo interpretation and field checking. Black-and-white and color infrared aerial photographs (at a scale of 1:12,000, approximately) were used to map the location an extent of the various vegetation types. The photo interpretation was augmented by some field checking although the higher elevations were inaccessible at the time of the field visit due to flooding and mud slides. Community types were delineated based on two or more dominant species.

The vegetation types were also quantified in terms of acreage and percent of the study area (Table 9-1a). The final map was prepared on a topographic mylar base at a scale of 1:600 (1 inch = 500 feet). See Plate 9-1a. The aerial extent of the mapped plant community types was determined by weighing the various communities from the 1:6000 vegetation map.

9.2a.3 Reference Areas

The Oak Shrubland Reference area will be used as the vegetative standard for success for all reclaimed sites, including the No. 2, No.7 and No.8 Mines, as discussed in Section 9.0 of this Chapter and in Chapter 3, Section 3.5.5.7. Information on reference areas is provided in Section 9.2.3 of this Chapter.

TABLE 9-1a

Aerial Extent and Percent of Total Area

Each Vegetation Type

Gordon Creek No. 7 Mine Area

Mapping Unit	Acres	Percent of Total Area
Aspen Woodland	93.9	14
Mixed Coniferous Forest	145.1	21
Oak Shrubland	116.3	17
Mixed Mountain Shrubland	48.0	7
Sagebrush Shrubland	177.1	26
Mountain Grassland	87.5	13
Disturbed Area	7.5	1
TOTAL	677.3	100

9.2a.4 Vegetation Cover and Productivity

The vegetation types most affected by mining operations are oak shrubland, mixed conifer, and aspen. Cover and production data were gathered from the oak and conifer. The aspen area was not sampled because of the small area which it represents.

9.2a.4.1 Cover

During 1983, cover data were collected using a quadrat approach. Individual 1.0m^2 quadrats were randomly located in the oak shrubland and 1/4m^2 quadrats in the mixed conifer. Random sampling was accomplished by using pairs of random coordinates. The first number of the pair was the measured distance along one side (long axis) of the disturbance area, and the second number was the paced distance perpendicular to the tape at the position of the first number. Random sampling locations within each of the reference area are shown on Plate 9-2a. In each quadrat, total vegetation cover (canopy cover) including shrub canopy, cover by bare soil, and cover by litter and rock were visually estimated. For each quadrat these three components added to 100 percent. Canopy cover for each species and cover by litter, rock, bare soil, and cryptograms in the ground layer were also visually estimated. Because of overlap, these components added to more than 100 percent. Cover data were summarized by calculating means values for each species and each component.

9.2a.4.2 Productivity

During 1983, production data were collected using a harvest method. Individual 1.0m^2 quadrats in the oak and 1/4m^2 in the conifer and were randomly located throughout each of the reference areas. Random locations were determined using pairs or random coordinates in the same manner used for locating cover quadrats. In each of the clipped quadrats

plants were separated by life form. Shrubs were clipped only when they occurred as seedlings. Clipped samples were oven dried for 48 hours at 100°C and were weighed to the nearest milligram. Data were summarized by obtaining mean production values for each species or species group.

9.2a.5 Density

During 1983, density data for shrubs were obtained using a line-strip transect approach. Randomly located transects 15 m by 3 m were used to obtain shrub density data in the oak shrubland.

Within each of the shrub line-strip transects, individual shrubs were tallied on the basis of height class in order to obtain some measure of community structure. For individuals with multiple stems (i.e. oak) separate counts were made for the number of stems per individual. Total density was calculated both on the basis of the number of individuals per hectare as well as the number of stems per hectare. Random sampling locations for the line-strip transects are shown on the mylar map. Density for the mixed conifer type was obtained using the point quarter method (Cottom and Curtis, 1856).

9.2a.6 Data Analysis

9.2a.6.1 Definitions

See Section 9.2.6.1 of this Chapter.

9.3a Existing Vegetation Resources

9.3a.1 General Site Description

The Gordon Creek No. 7/8 Mine area is located along the eastern edge of the Wasatch Plateau in Carbon County, Utah. The elevation range is about 8,300 ft. to 9,200 ft.

Topographically, the study area consists of steep slopes on the face of the plateau and along drainages, flat surfaces on terraces of the floodplains in valley bottoms, and relatively gentle terrain on top of the plateau. The area is underlain by nearly flat sedimentary rocks of the Tertio-Cretaceous North Horn Formation and and the Lower Tertiary Flagstaff Formation.

The disturbance area is approximately one percent of the total lease area. The disturbance area is located on relatively steep slopes (50 percent) with north and south aspects. In the Spring of 1983 several seeps appeared in the area that previously had not been present. Two natural mud slides also occurred during the Spring of 1983 on the north facing slope and several sloughages occurred along the existing road.

9.3a.2 Vegetation Types

The vegetation map for the Gordon Creek No. 7/8 Mine area depicts six mapping units. The vegetation has been divided into two forest types (Aspen Woodlands and Mixed Coniferous Forests), three shrubland types (oak Shrublands, Mixed Mountain Shrublands, and Sagebrush shrublands), a grassland type (Mountain Grassland and Wet Sedge Meadow) and disturbed areas. Each of the mapping units is briefly described in the discussion which follows.

9.3a.2.1 Oak Shrubland

The oak shrubland type covers 122 acres within the mapped area. It is the third most abundant of all the mapped types. Oak shrublands occur on steep slopes which tend to be drier and have more shallow soil than the slopes which support aspen woodlands and mixed coniferous forests. These slopes tend to be more south and west facing, however, the oak shrublands are not limited to these aspects. Major shrub species include Gambles oak (Quercus gambelii) and mountain snowberry (Symphoricarpos oreophilus). The major species is Thickleaf peavine (Lathyrus lanszwertii).

Cover, Frequency, Species Diversity

Table 9-2a summarizes cover and species frequency in the oak shrubland disturbance area. The major grass species in the type is western wheatgrass, and the most common forb is peavine and beardtongue (Penstemon sp.). Gambles oak and mountain snowberry contribute approximately 70 percent of the cover within this type. Total cover was 82 percent which is very high compared to the reference area (49 percent). This is probably due to the unusual amount of precipitation in 1982 and 1983. The dominant shrub species in terms of density is Gambles oak, which has a total density of 8,178 stems per hectare (Table 9-3a). Snowberry had the next highest density of 3,089 plants per hectare. Total shrub density was 14,289 plants per hectare.

Productivity

Perennial forbs provide approximately 70 percent of the total biomass (Table 9-4a). Mean total production was 94.3 grams per square meter (841 pounds per acre). Tall shrub components were not included in the production measurements.

Because of the very steep slope on which the disturbance area is located, there is very limited utilization by domestic livestock. The particular vegetation type appears to be in excellent range condition due to the high water year. A list of species encountered on site is given in Table 9-5a. A summary of minimum sample size is given in Table 9-6a.

TABLE 9-2a

Oak Shrubland

Mean Cover and Frequency for 15, 1 m^2 Plots.

Species	Mean Cover	Range	Percent Frequency
GRASSES			
Agropyron smithii	.4	0-4	13
Bromus sp.	1.6	0-8	40
Bromus tectorum	2.1	0-30	13
Poa pratensis	2.8	0-15	7
Carex sp.	1.3	0-6	40
Subtotal	8.3		
FORBS			
Achillea millifolium	6.4	0-15	73
Artemisia ludoviciana	1.7	0-17	20
Circium sp.	.1	0-2	7
Galium Boreal	1.2	0-8	27
Lathyrus lanszwertii	38.1	0-80	87
Penstemon spp.	10.2	0-30	80
Smilacina Stellata	1.3	0-20	7
Viola adunca	.3	0-5	7
Subtotal	59.3		
SHRUBS			
Amelanchier utahensis	.7	0-10	7
Mahonia repers	3.7	0-15	53
Prunus virginiana	2.7	0-40	7

TABLE 9-2a (continued.)

Species	Mean Cover	Range	Percent Frequency
Quercus gambelii	48.3	0-85	93
Rosawoodsii	3.3	0-20	40
Symphoricarpos oreophilus	21.4	0-60	67
Subtotal	80.1		
Sum of Species Cover	147.7		

	Mean Cover	Standard Deviation
Cryptogram	0	
Litter	82.0	6.2
Rock	7.7	5.0
Bareground	9.3	3.2
Cover based on 100 percent of each quadrat		
Total Vegetation Cover	81.8	6.7
Litter	12.3	5.1
Rock	3.0	2.9
Bareground	2.9	2.4

TABLE 9-3a.

Oak Shrubland

Shrub Density Taken from 15, 3 x 15 m Quadrat.

Species	Height Class	Density (#/Hectare)	Standard Deviation	Percent Frequency
Total		1,289	1,342	80
Amelanchier utahens	III	616		
	IV	460		
Cercocarpus monanus	III	104	251	20
Prunus virginiana	IV	73	200	13
Purshia tridentata	I	429	507	67
Quercus gambelii	Total	8,178	1,511	100
	I	1,244		
	II	622		
	III	778		
	IV	5,689		
Rosa woodsii	I	3,089	1,311	100
Symphoricarpos Oreophilus	I	822	1,400	47
TOTAL		14,289	1,511	

** Height Class

I = .25 m - .75 m
II = .76 m - 1.5 m
III = 1.6 m - 2.25 m
IV = 72.25 m

9.3a.2.2 Mountain Grassland

The mountain grassland covers 88 acres and occurs on high dry slopes. The major species include Salina Wildrye (Elymus salinus) and Indian ricegrass (Oryzopsis hymenoides).

9.3a.2.3 Aspen Woodland

The aspen woodland type occurs primarily on moist north-facing slopes and covers approximately 94 acres. The aspen woodland within the disturbance area covers approximately 1.7 acres. This area was not quantitatively sampled because of the small area which it occupies. The aspen community is on a steep, south-facing slope (50 percent). Choke cherry, snowberry, and serviceberry are co-dominants in this community. The forb layer consists primarily of peavine. Herbaceous growth again was lush in late-June, 1983 due to above average precipitation. A list of species encountered on site is provided in Table 9-7a.

9.3a.2.4 Mixed Coniferous Forest

The mixed coniferous forest type occurs on north-facing slopes and covers approximately 145 acres (15.2 percent within the study area). It is the second most common forest type and fourth in extent of all mapped types. Major species include Douglas-fir (Pseudotsuga menziesii), white fir (Abies concolor), subalpine fir (Abies lasiocarpa), Englemann spruce (Picea engelmannii), aspen and Colorado blue spruce (Picea Pungens). On high ridges, both bristle cone pine (Pinus aristata) and limber pine (Pinus flexilis) occur.

The mixed coniferous forest within the disturbance area covers approximately 2.7 acres. The dominant species are sub-alpine fir mixed with aspen. Tree density was 645 individuals per acre (Table 9-8a). Fifty-seven (57) percent

of the trees were aspen and the remainder were sub-alpine fir. The prevalence of aspen probably indicates a transitional change toward a fir community.

Understory cover and production were sparse as would be expected in a closed canopy community. At the time of sampling, sheep were in the area and much of the understory vegetation had been cropped. Also, due to the late-spring, many species were not fully developed.

Understory vegetation cover was 9.8 percent (Table 9-9a). Forbs contributed to 8.5 percent of the cover. Thickleaf peavine, meadowrue (Thalictrum chilensis) comprised the dominant understory vegetation.

Total production was 18.8 pounds per acre (Table 9-10a). The forb component contributed to 17.2 pounds of the total understory production. A list of species encountered on-site is given in Table 9-11a.

TABLE 9-4a

Oak Shrubland

Average Production Obtained from 40, 1m^2 Clipped Quadrats.

	Mean ($g \cdot m^2$)	Standard Deviation	Mean (lbs./A)	Standard Deviation
Grasses and grass-like	19.16	17.34	170.97	154.73
Forb	66.01	47.32	589.04	422.25
Shrub	9.14	10.66	81.56	95.12
TOTAL	94.30	48.11	841.47	429.30

Table 9-5a

Oak Shrubland Species List

Scientific Name	Common Name
GRASSES	
Agropyron smithii	Western wheatgrass
Bromus Sp.	Brome
Bromus tectorum	Cheatgrass
Poa pratensis	Kentucky bluegrass
Poa secunda	Sandburg bluegrass
Carex geyeri	Elk sedge
Carex sp.	Sedge
FORBS	
Achillea millifolium	Yarrow
Artemisia ludoviciana	Locoweed
Clematis sp.	Clematis
Circium sp.	Thistle
Descusrainia pinnata	Pinnate tansymustard
Erysemum asperum	Wallflower
Fragaria virginiana	Strawberry
Galium boreale	Northern bedstraw
Gilia aggregata	Scarlet gilia
Helianthella uniflora	One Flower helianthella
Hymenoxys richardsonii	Pingue Hymenoxys
Lathtyrus lanszwertii	Thickleaf peavine
Penstemon sp.	Beardtongue
Phlox longifolia	Longleaf phlox
Senecio integerrimus	Lambstongue grounsel
Smilancina stellata	Solom Seal
Viola adunca	Hook violet

Table 9-5a (Continued)
Oak Shrubland Species List

Scientific Name	Common Name
SHRUBS	
Amelanchier utahensis	Utah serviceberry
Chrysothamnus viscidiflorus	Low rabbit brush
Cerocarpus montanus	True mountain mahogany
Eriogonum umbellatum	Sulfur eriogonum
Mahonia repens	Oregon grape
Prunus virginiana	Choke cherry
Purshia tridentata	Bitterbrush
Quercus gambelii	Gamble Oak
Rosa woodsii	Woods rose
Symphoricarpos oreophilus	Snowberry

TABLE 9-6a

Evaluation of Sample Adequacy

Mixed Conifer & Oak Shrubland Disturbance Area

Community	Sample Size	Mean	Standard Deviation	Percent Level of Confidence	t	Minimum Sample Required
VEGETATION COVER						
Oak Shrubland	15	81.8	6.7	80	.1	1
Mixed Conifer	40	9.8	8.8	80	.1	130
PRODUCTIVITY 9(g/m^2)						
Oak Shrubland	40	94.3	48.1	80	.1	43
Mixed Conifer	40	2.1	3.7	80	.1	497
SITY						
Oak Shrubland (#4/45m^2)	15	64.3	6.8	80	.1	2
Mixed Conifer (x of 4 points)	10	2.4	.6	80	.1	10

TABLE 9-7a

List of Disturbed Species

Encountered in the Aspen Community

Scientific Name	Common Name
GRASSES	
Bromus sp.	Brome
Poa partensis	Kentucky bluegrass
Poa reflexa	Nodding bluegrass
Poa secunda	Sandburg bluegrass
Carex geyeri	Elk sedge
Carex sp.	Sedge
FORBS	
Achiellea millifolium	Yarrow
Artemisia ludoviciana	Louisiana sage
Astragalus sp.	Locoweed
Clematis sp.	Clematis
Fragaria americana	Wild strawberry
Galium boreale	Bedstraw
Geranium sp.	Geranium
Helianthella uniflora	One flower helianthella
Helenium hoopsii	Orange sneezeweed
Lathyrus lanszwertii	Thickleaf peavine
Penstemon sp.	Beard tongue
Senecio sp.	Groundsel
Smilacina stellata	Solom seal
Stellaria sp.	Starwort
Thalictrum fendleri	Meadowrue
Viola adunca	Hook violet

TABLE 9-7a (Continued)
List of Disturbed Species
Encountered in the Aspen Community

Scientific Name	Common Name
SHRUBS AND TREES	
Amelanchier utahensis	Utah serviceberry
Juniperus osteosperma	Utah Juniper
Mahonia repens	Oregon grape
Pachistima myrsenitis	Mountain lover
Populus tremuloides	Quaking aspen
Prunus virginiana	Choke cherry
Quercus gambelii	Gamble Oak
Rosa woodsii	Woods rose
Symphoricarpos oreophilus	Snowberry

TABLE 9-8a

Density of Aspen and Sub-Alpine Fir
Mixed Conifer Community

Species	Average ft^2	Individual per Acre
Abis lasiocarpa	159.2	274
Populus tremuloides	117.4	371
TOTAL	67.6	645

9.3a.2.5 Mixed Mountain Shrubland

The mixed mountain shrubland type occurs on steep upland slopes and is characterized by a mixture of species. Major species include Gambles oak, mountain snowberry, service berry, choke cherry, and mountain mahogany. This type covers approximately 48 acres.

9.3a.2.6 Sagebrush Shrubland

The sagebrush type is the most prevalent shrubland type, covering 177 acres (18.7 percent of the area). It occurs on steep and dry upland slopes. Major shrub species include mountain big sagebrush (Artemisia tridentata ssp. vaseyana) and antelope bitterbrush (Purshia tridentata). The major grass species is salina wildrye.

9.3a.2.7 Disturbed Areas

The disturbance area is approximately 8.4 acres, or one percent of the lease area.

TABLE 9-9a

Mixed Conifer Community Understory Vegetation

Mean Cover and Frequency Values

Species	Mean Cover	Range	Percent Frequency
GRASSES			
Poa reflexa	.6	0-5	45
Subtotal	.6		
FORBS			
Achillea millifolium	.2	0-1	20
Fragaria americana	.2	0-5	10
Galium boreale	.9	0-5	50
Geranium sp.	.5	0-5	18
Helenium hoopsii	.2	0-5	5
Lathyrus lanszwertii	1.9	0-40	25
Mitella sp.	.8	0-13	25
Osmorhiza chilensis	1.2	0-10	35
Ranunculus jovis	.3	0-3	18
Taraxacum officinale	.1	0-1	13
Thalictrumfendleri	1.7	0-12	48
Urtica sp.	.3	0-3	10
Viola adunca	.2	0-2	13
Subtotal	8.5		

TABLE 9-9a (Continued)
Mixed Conifer Community Understory Vegetation
Mean Cover and Frequency Values

Species	Mean Cover	Range	Percent Frequency
SHRUBS AND TREES			
Abies lasiocarpa	.9	0-25	15
Mahonia repens	.6	0-8	18
Pachistima myrsinites	.1	0-3	3
Physocarpus malvacius	.1	0-5	3
Populus tremuloides	.1	0-4	5
Subtotal	1.8		
Sum of species cover	10.9		
Cryptograms	.1		
Litter	82.9		
Rock	2.1		
Bareground	9.3		
Cover, based on 100 percent for each quadrat			
Total vegetation cover	9.8		
Litter	79.0		
Rock	2.3		
Bareground	8.6		

TABLE 9-10a

MIXED CONIFER COMMUNITY

UNDERSTORY PRODUCTION VALUES

	g/l/4m^2	lbs/A
GRASS	.02	.18
FORB	1.93	17.22
SHRUB	.16	1.43
TOTAL	2.11	18.83

TABLE 9-11a
Mixed Conifer Community
List of Species Encountered

Scientific Name	Common Name
GRASSES	
Poa reflexa	Nodding Bluegrass
FORBS	
Achillea millifolium	Yarrow
Aquilegia coerulia	Colorado Blue Columbine
Clematis sp.	Clematis
Fragaria americana	Wild Strawberry
Galium boreale	Bedstraw
Geranium sp.	Geranium
Helenium hoopesii	Orange Sneeze Weed
Lathyrus lanszwertii	Thickvine Sweet Pea
Lomatium aculatum	Biscuitroot
Mitella sp.	Miterwort
Osmorphiza chilensis	Spreading Sweet Root
Ranunculus jovis	Buttercup
Senecio sp.	Groundsel
Stellaria sp.	Starwort
Taraxacom officinale	Common Dandelion
Thalictrum fendleri	Meadowrue
Thermopsis sp.	Thermopsis
Urtica sp.	Stinging Nettle
Viola adunca	Hook Violet

TABLE 9-11a (Continued)
Mixed Conifer Community
List of Species Encountered

Scientific Name	Common Name
SHRUBS & TREES	
Abies lasiocarpa	Subalpine Fir
Acer glabrum	Rocky Mountain Maple
Mahonia repens	Oregon Grape
Pachystima myrsinites	Mountain Lover
Populus tremuloides	Quaking Aspen
Sambucus cerulea	Elderberry
Symphoricarpos oreophilus	Mountain Snowberry

TABLE 9-12a

Similarity of Oak Shrubland Reference and Disturbance Area
Minimum Sample Size is Also Demonstrated

	$\bar{X}$	S	N	N_{min}	$\bar{X}$	S	N	N_{min}	t-Value	t'
Cover	81.8	6.7	15	7.1	48.5	7.8	20	5	13.54	.8655
Density (plants/45 m^2)	64.3	6.8	15	1.8	216.1	39.5	15	6	14.67	.8660
Productivity (g/m^2)	94.30	48.11	40	43	11.9	8.7	40	89		
Aspect	N-NE									
Slope	53%									

% Similarity: 55.6

9.4a Threatened or Endangered Species

Currently, eight species are listed as endangered or threatened in Utah. None of these threatened or endangered species, as defined and identified by the U.S. Department of the Interior, Fish and Wildlife Service (USDI, 1980) were observed in the Gordon Creek No. 7/8 Mine area. None of these species are known to occur in Carbon County.

One hundred and sixty-three (163) plants taxa are currently under review (USDI, 1980). Of these, two (Eriogonum corymbosum var. davidsii and Eriogonum lancifolium) are known to occur in Carbon County (USDI, 1979). Both species occur on the Mancos shale formation in salt desert shrub vegetation types at elevations of 4900 to 5700 feet. These vegetations types do not occur in the Gordon Creek No. 7/8 Mine area.

A survey was also done on the proposed No.8 Mine site for Canyon Sweetvech in 1988. The clearance and results of the survey are summarized in Appendix 9-1.

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SECTION 10

FISH AND WILDLIFE RESOURCES

10.1 Scope

This report summarizes fish and wildlife studies conducted for Beaver Creek Coal Company by Native Plants, Inc. (NPI) and Western Resource Development Corporation at the Gordon Creek No. 2 and No. 7 Mines, Carbon County, Utah. The purposes of the investigations were to comply with requirements for fish and wildlife studies of mining-affected areas for the Utah Division of Oil, Gas and Mining (DOG&M) and to provide Beaver Creek Coal Company with data useful in planning future mining activities and long-term reclamation programs.

In meeting these basic objectives, the fish and wildlife studies were designed to supply the following types of information: (1) species composition and diversity of the various habitat types; (2) seasonal patterns of distribution an relative abundance; (3) habitats or areas of special value to wildlife, such as big game winter range or movement corridors and raptor nest sites; and (4) the actual or potential status of species listed as threatened, endangered, rare, or of particular interest by the Utah Division of Wildlife Resources (DWR) of the U.S. Fish and Wildlife Service (FWS).

Data was obtained during field trips to the study area in early-September, early-October, and mid-November 1980, and late-February, late-April, late-May, late-June/early-July, and mid-August, 1981, by Western Resource Development Corporation and again in late-June 1983 by Native Plants, Inc.

10.1.1. Location and Ecological Setting

The Gordon Creek No. 2 and No. 7 Mines study area is located along the eastern edge of the Wasatch Plateau in Carbon County, Utah. (See Figure 1-2 near the front of the Plan.) Topographically, the disturbance area consists of steep slopes on the face of the plateau and along major drainages, flat surfaces on terraces or flood plains in the valley bottoms, and relatively gentle terrain on top of the plateau (Figure 10-1). The area is underlain by nearly flat-lying sedimentary rocks of the Tertio-Cretacerous North Horn Formation and the Lower Tertiary Flagstaff Formation.

The study area has a highly continental climate, with large daily and seasonal variations in temperature. The lower elevations of the permit area are quite dry, with average annual precipitation of 14 inches or less, mostly falling as Spring and late-Summer rain showers. Higher elevations receive more precipitation, much of it as snow which persists through the Winter.

The vegetation of the study area is highly variable, due to differences in elevation and exposure. Major habitats include Slope Bunchgrass, Big Sagebrush, Mountain Shrub, Mixed Riparian, Aspen, Middle Elevation Conifer, High Elevation Conifer, and Subalpine Meadow associations. Most of the major habitats are represented by phases with different plant dominants; detailed descriptions of major and minor habitats are presented in Section 10.3.1.

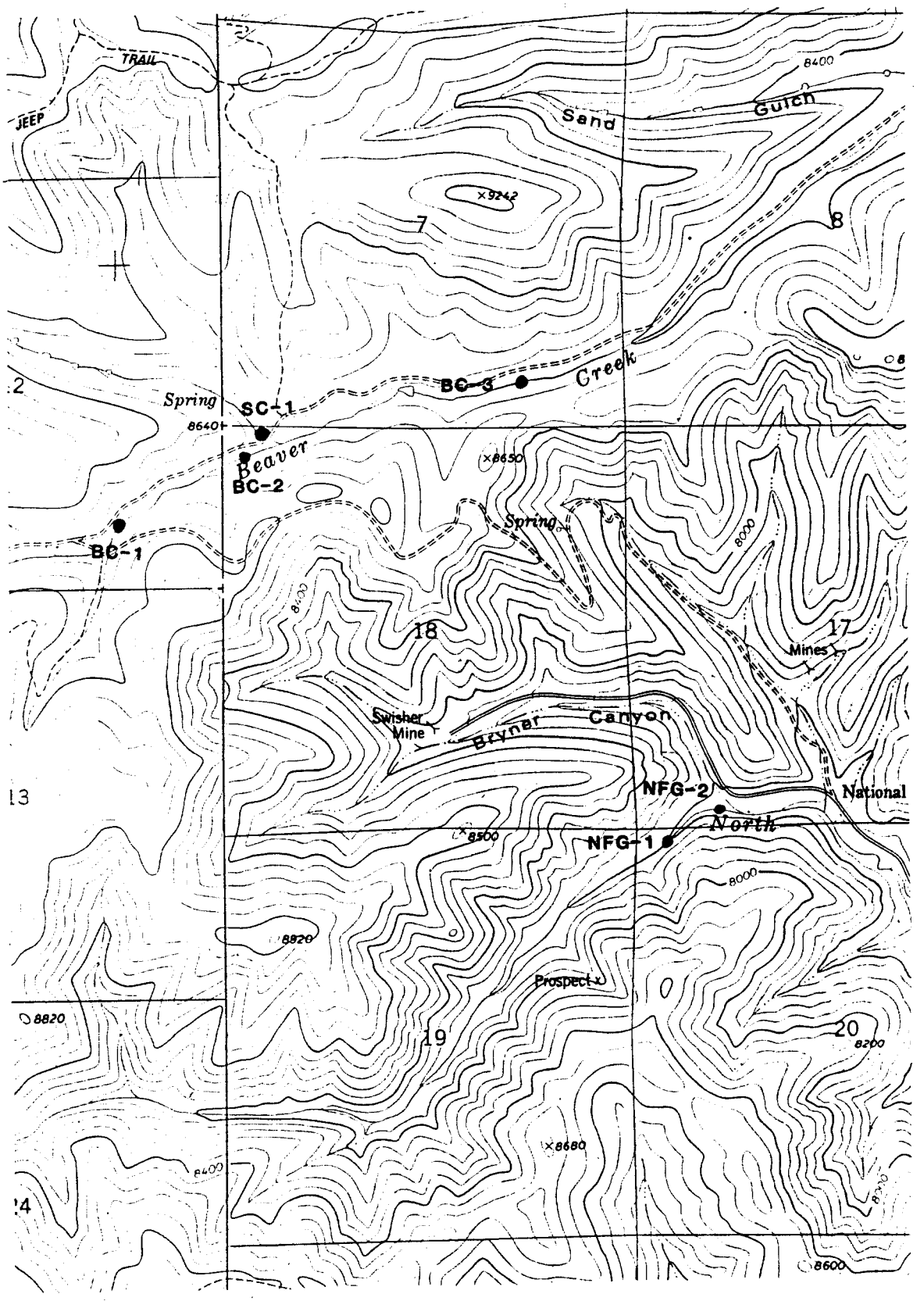


Figure 10-1. The general study area for the Gordon Creek No. 2 Mine fish and wildlife investigations, 1980-1981. (Source: USGS 7.5' topographic quadrangle map, Jump Creek, Utah).

10.2 Methodology

10.2.1 Literature Review

One of the initial steps in the fish and wildlife studies was to review open-file data and range maps available from the DWR Regional Office in Price, Utah. The purpose of this effort was two-fold: first, it provided a regional backdrop of wildlife information; second, it was helpful in identifying areas of concern to DWR, thus ensuring that their needs and preferences were addressed.

The other major purpose of the literature review was to obtain pertinent publications on the distribution and status of vertebrates in the study region (i.e., the Wasatch Plateau). These books, articles, and monographs provided information on species likely to occur in the area and served as a basis for evaluating the representation in the Gordon Creek No. 2 and No. 7 Mines area.

In March, 1981, DWR provided detailed wildlife information for the Gordon Creek No. 2 Mine site as requested by Beaver Creek Coal Company, pursuant to UMC 783.20. The DWR also prepared a wildlife plan representing their recommendations for mitigation and impact avoidance procedures, pursuant to UMC 784.21. The information compiled by DWR in preparing their response to Beaver Creek Coal Company's request comprises a substantial portion of this report, as does DWR's 1978 publication on vertebrate species of southeastern Utah. Specific elements from these DWR documents are cited throughout this report as DWR (1981a), DWR (1981b), and DWR (1978).

10.2.2 Terrestrial Studies

The methods used during field work were designed to provide descriptive and quantitative data for terrestrial wildlife in the

mine plan area. Wildlife data collected for the Gordon Creek No. 2 and No. 7 Mines studies followed a stratified approach based on habitat types. In many instances, wildlife habitats did not strictly coincide with plant communities, being based on topographic, as well as vegetational factors. Therefore, some plant community units were combined or split to best reflect wildlife utilization. The correlation between plant communities and wildlife habitats is discussed in Section 10.3.1.

The methods employed in addressing the various groups of terrestrial vertebrates were discussed informally with Larry Dalton of DWR in Price, Utah, in September, 1980, prior to initiating field studies. These methods are summarized in the following sections.

10.2.2.1 Mammals

For the purpose of field study, this diverse group of organisms was divided into large mammals, medium-sized mammals and small mammals.

Large mammals consist of large herbivores and large carnivores. For the Gordon Creek No. 2 and No. 7 Mine studies these species were studied through a combination of systematic transects and opportunistic sightings. Road surveys were conducted during each field session to obtain data on abundance, distribution and habitat use; this data was augmented with walked transects across each habitat type. Walked transects afforded an opportunity to evaluate differential habitat uses from indices such as pellet-group densities and percent browse utilization. Opportunistic sightings during their wildlife efforts were particularly useful for species either too uncommon or furtive to be regularly encountered during systematic surveys or restricted to limited habitats. Aerial surveys were initially proposed, but were dropped at the request of the DWR.

Medium-sized mammals such as predators, lagomorphs (rabbits and hares), and large rodents were also surveyed by a combination of systematic and opportunistic techniques. Road transects at dawn and dusk were important for predators and lagomorphs, most of which are most active at these times (i.e., "crepuscular"). Data on signs of the crepuscular species and on actual observation of diurnal species was recorded in conjunction with various daytime field efforts.

Small mammals, which may be used as indicators of ecosystem quality and reclamation success, were to have been surveyed using Sherman livetraps set in lines through each habitat type. As for the aerial surveys, DWR specified that this technique not be used. Therefore, small mammal information presented in this report is drawn almost exclusively from DWR (1978) and Durrant (1952).

10.2.2.2 Birds

The most efficient grouping of birds for field studies and baseline reports is raptors, upland fowl, water birds and small birds, or songbirds.

Raptors were observed and recorded opportunistically throughout the field program. Daytime surveys were best for hawks and eagles, while dawn/dusk surveys resulted in most sightings of owls. In addition, areas of potential importance -- e.g., cliffs, riparian areas and abandoned buildings -- were specifically searched in an attempt to locate nest sites. Raptor surveys followed the standard survey techniques described by Call (1978).

Upland game bird surveys were conducted in conjunction with other field programs and relied primarily on chance encounters of the birds of their sign. Special effort was placed on determining if upland fowl breed in the study area

or are present in sufficient numbers to offer recreational value.

Water birds (waterfowl, shore birds, wading birds) were surveyed in a similar approach as other large birds -- e.g., opportunistically during all field programs plus specific visits to suitable habitats, such as ponds and slow-moving streams. As with the upland game birds, emphasis was placed on determining the extent to which the study area provided breeding sites and the importance of these species as a recreational resource.

"Small birds" are a heterogeneous group. For the Gordon Creek No. 2 and No. 7 Mine wildlife studies this group included perching birds, woodpeckers, hummingbirds, swifts and frogmouths. In late-Summer, Fall and Winter surveys, the presence, distribution and abundance of small birds were determined along walked transects in each habitat type and by opportunistic sightings during the initial site reconnaissance. During the breeding season (Spring and early-Summer) quantitative data was obtained by counting the number of breeding pairs (territorial males) of each species within numerous plots located systematically along transect routes through each habitat type. Audio identification was emphasized during this census to avoid problems of differential detectability of species (as a function of conspicuousness and activity patterns) and visual penetrability of habitats (e.g., a dense willow thicket versus an open stand of mountain brush).

The small bird transects were not permanently established routes, because the emphasis was on obtaining data from a large number of plots throughout each habitat type rather than on repeated surveys of a smaller number of plots. The reasons for selecting this technique are that (1) habitats in the study area are heterogeneous and a larger sample size

is necessary to adequately describe the avifauna of each, and (2) year-to-year variability within the complex habitats probably would mask any long-term trends in density, diversity and composition.

10.2.2.3 Reptiles and Amphibians

These species were surveyed in combination with other field efforts. For most reptiles, opportunistic sightings provided sufficient detail on abundance and distribution. Amphibians, however, were surveyed by visiting potential breeding sites such as ponds or marshy areas during the Spring breeding period when they could be identified by their vocalizations.

10.2.3 Aquatic Studies

Field and lab methods used in the Gordon Creek No. 2 and No. 7 Mine aquatic studies were selected to assist Beaver Creek Coal Company's environmental staff in describing the biotic and abiotic components of study area streams, discerning possible impacts of the existing mining operation, and recommending future mitigation and monitoring programs. Biotic components specifically included sampling for macroinvertebrates and evaluating the fisheries' potential. Abiotic components includes field techniques for testing water quality, as well as descriptions of substrate and channel morphology. Studies were conducted in November, 1980, and April and June, 1981. Additional aquatic information for Beaver Creek was provided in 1985, and is included in Appendix 7 of this Mine Plan.

10.2.3.1 Sample Site Selection

Aquatic studies involved six stream sample sites: four in the Beaver Creek system and two in the North Fork Gordon

Creek system. The sites were selected to provide information from representative stream reaches, above and below substantial tributaries.

The sites on North Fork Gordon Creek were located about 250m above and 50m below the confluence with the unnamed tributary (hereafter referred to as Bryner Creek) which flows past the Gordon Creek No. 2 and No. 7 Mines. This confluence is located in extreme southwestern Section 17 at the word "North" on Figure 10-1.

The two sites in Beaver Creek were located upstream of the unnamed stream which is tributary in extreme northwestern Section 18 at the word "Beaver" on Figure 10-1. A third site was located on the unnamed tributary itself (hereafter called Spring Creek) and the fourth site was about 1km further downstream in southern Section 7. Figure 10-1 shows the locations of the aquatic sampling sites.

10.2.3.2 Habitat Quality

Basic physiochemical characteristics of surface water related to aquatic ecosystem quality were evaluated using standard field equipment during both the Spring and Winter surveys. Chemical characteristics at all sample sites were determined with a Hach Fish Culturist water chemistry kit, while temperature was measured with a mercury thermometer submersed for at least five minutes.

10.2.3.3 Aquatic Invertebrates

Biological community surveys involved use of a 0.5mm mesh Surber sampler to collect aquatic invertebrates. At each sample site the substrate was agitated within a one-cubic-foot area to dislodge invertebrates, which were swept by the stream current into a trailing net. Surber

samples were collected from a riffle, a run and a pool at each site. The composite samples were fixed in the field and returned to the lab for enumeration and identification to the lowest practicable taxonomic level (usually genus). Identification was based on standard reference works for the region (e.g., Baumann et al, 1977; Merritt and Cummins, 1978; Pennal, 1978).

Non-game fish were to be sampled with a dip net to determine species composition and relative abundance, but none were observed during either survey.

10.3 Existing Fish and Wildlife Resources

10.3.1 Wildlife Habitats in the Mine Plan Area

Wildlife habitat types were identified and described during the initial field visits to the Gordon Creek No. 2 and No. 7 Mines. As discussed in Section 10.2.2, wildlife habitats do not strictly correspond to vegetation community types. In most studies, more wildlife habitats are recognized than are plant communities, because (1) wildlife values generally can be differentiated at the phase (subcommunity) level and (2) some habitats, such as rock outcrops. cliffs, and scree slopes, are not plant-related at all.

Habitats distinguishable at the Gordon Creek No. 2 and No. 7 Mine sites are described below.

10.3.1.1 Big Sagebrush

This habitat type, identified mainly as sagebrush shrubland and mountain grassland onland on the vegetation map. (Plate 9-1), consisted of two distinct phases of subtypes in the Gordon Creek No. 2 and No. 7 Mine study area. At lower

elevations, Big Sagebrush (Artemisia tridentata cf. tridentata) occurred as dense, essentially monotypic stands on terraces adjacent to major drainages. The availability of green sapwood throughout the Winter probably makes these areas fairly attractive to large herbivores during periods when browse is unavailable or snow is too deep at higher elevations.

Atop the plateau, Big Sagebrush (Artemisia tridentata cf. vasayana) occurred as relatively small stands on slopes adjacent to valley bottoms, particularly on south-facing exposures. Other shrubs associated with this community type included Antelope Bitterbrush (Prushia tridentata) Rubber Rabbitbrush (Chrysothamnus nauseosus), and Silver Sagebrush (Artemisia cana).

10.3.1.2 Mountain Shrub

One of the most widespread habitats, especially on steep slopes at lower elevations, was a highly variable mixture of shrub species typical of mountainous areas in the region. In general, two basic phases could be defined; these apparently were controlled by slope aspect.

The Xeric Phase was prevalent on south-facing slopes. Characteristically, these areas were dominated by open stands of Gambles Oak (Quercus gambelii), with varying amounts of Alder-leaf Mountain Mahogany (Cercocarpus montanus), Serviceberry (Amelanchier hensis), Snowberry (Sumphoricarpos oreophilous), Antelope Bitterbrush, and Rubber Rabbitbrush. Conspicuous herbaceous species during early Fall were a Tansy-Aster (Machaeranthera sp.) and Salina Wildrye (Elymus salinus). At higher elevations, some south-facing slopes were strongly dominated by Greenleaf Manzanita (Arctostaphyllos patula), an evergreen shrub of particular value to wildlife.

The Mesic Phase, typically occurring on north-facing slopes was dominated by dense stands of Gambles Oak or Wasatch Maple (Acer grandidentatum). Associated woody plants included isolated clumps of Quaking Aspen (Populus tremuloides), scattered Douglas Fir (Pseudotsuga menziesii) and White Fir (Abies concolor) (often appearing to represent a later successional stage), and Shrubs such as Choke Cherry (Prunus virginiana var. melanocarpa), Serviceberry (Amelanchier alnifolia), Snowberry, Woods Rose (Rosa woodsii), Oregon Hollygrape (Mahonia repens), and Mountain Lover (Pachystima myrsinites). The variable herbaceous stratum was dominated by Mountain Brome (Bromus marginata), Nodding Brome (Bromus anomalis), and perennial forbs such as Aster, Erigeron, Fragaria, Frasera, Galium, Geranium, Lathyrus, Thalictrum, and Vicia.

One of the most widespread habitats, especially on steep slopes at lower elevations, was a highly variable mixture of shrub species typical of mountainous areas in the region. In general, two basic phases could be defined; these apparently were controlled by slope aspect.

The Vegetation Map (Plate 9-1) refers to both of these habitat phases as Oak Shrubland, while areas of Greenleaf Manzanita are mapped separately as Manzanita Shrubland.

10.3.1.3 Slope Bunchgrass

This rather widespread habitat was compositionally similar to Xeric Mountain Shrub habitat, except for the near absence of woody species. The dominant plant was the bunchgrass Salina Wildrye. The casual distinction between these two Xeric communities is not clear, but it probably is related to soil moisture and texture. This habitat type is identified as Mountain Grassland on the Vegetation Map (Plate 9-1).

10.3.1.4 Middle Elevation Conifer

This widespread habitat type was limited to mesic sites, such as north-facing slopes and along drainages, typically appearing as isolated clumps scattered through larger areas of Aspen or Mesic Mountain Shrub. Mature White Firs and Douglas-Firs were visually and numerically dominant throughout. Prominent understory species were Mountain Snowberry, Oregon Hollygrape, Currants (Ribes cereum and R. montigenum), Mallow Ninebark (Physocarpus malvaeus), Woods Rose, Aster, Fragaria, and Heuchera. This habitat type and the next are combined on the Vegetation Map (Plate 9-1) as Mixed Coniferous Forest.

10.3.1.5 High Elevation Conifer

Atop the Wasatch Plateau especially at elevations of 8,500 feet or higher, coniferous forests were dominated by Engelmann Spruce (Picea engelmannii), Subalpine Fir (Abies lasiocarpa), and Douglas-Fir. Understory species were similar to those described above for Middle Elevation Conifer Forests. Although comprising a significant portion of the Gordon Creek No. 2 and No. 7 Mines study area, High Elevation Conifer habitats did not occur in any affected area.

10.3.1.6 Aspen

Dense stands of mature Quaking Aspen occurred as a Mosaic in moist sites, either on north slopes among Mesic Mountain Shrubs and Middle Elevation Conifers or along forest edges adjacent to High Elevation Conifers. In both occurrences, the understory was similar to other Mesic habitats; prominent species included Mountain Snowberry, Mountain Lover, Oregon Holly-Grape, Frageria, Geranium, Lathyrus, Thalictrum, and Vicia. In the north-slope phase of this

community type, Wasatch Maple often was sufficiently common to be considered a condominant. The Vegetation Map (Plate 9-1) depicts the Aspen Woodland as a separate habitat type.

10.3.1.7 Mixed Riparian

Streams at lower elevations in the Gordon Creek No. 2 and No. 7 Mine study area generally were characterized by Riparian vegetation dominated by larger deciduous shrubs: Mountain Maple (Acer glabrum), Redtwig Dogwood (Seida sericea (Cornus stolonifera), Elderberry (Sambucus cf. coerulea), Choke Cherry, and Willow (Salix) species. This assemblage was most common in shaded areas, where the stream was closest to the base of the north-facing slopes. More open sites often lacked a distinct riparian community, instead being dominated by species occurring on adjacent Xeric hill sides. Trees frequently were absent altogether, but some sites did support large Plains Cottonwoods (Populus deltoides) and Box Elders ((Acer negundo).

At higher elevations, Aspen and Conifers (including Blue Spruce (Picea pungens) often occurred as part of the riparian complex. Riparian areas may be found on the Vegetation Map (Plate 9-1) near the water courses.

10.3.1.8 Subalpine Moist Meadow

Moist Meadows commonly were the dominant Riparian habitat type above 8500 feet. These open areas supported dense stands of mesic grasses, such as Foxtail (Alopecurus geniculatus), Red-Top (Agrostic gigantea), Canada Wildrye (Elumus canedensis), Reed Canarygrass (Phalaris arundinaceae), Bluegrass Poa species, and Sedge Carex species. Moist Meadow areas were not treated and are shown as Wet Sedge Meadow communities on the Vegetation Map (Plate 9-1).

10.3.1.9 Aquatic Ecosystems

The two major aquatic habitats within the study area are North Fork Gordon Creek and Beaver Creek.

North Fork Gordon Creek originates from two unnamed intermittent tributaries about 5km southwest of the mine sites at an elevation of about 8750 feet. Within the study area, North Fork Gordon Creek is augmented by a number of minor intermittent tributaries, particularly the so called Bryner Creek, flowing past the mine site (Figure 10-1). Between the upper limits of permanent water at 8750 feet and the confluence with Bryner Creek at about 7550 feet, North Fork Gordon Creek covers approximately 3.5 miles of stream length, with a mean gradient of 340 feet/mile, or 6.5 percent. The stream has few meanders, but is characterized by scattered beaver ponds. Riparian vegetation is poorly developed along much of its length.

Beaver Creek originates at 9200 feet about 4km west of the mine sites, first being mapped as a perennial stream at an elevation of 8950 feet, 0.8km below its upper end. According to the U.S. Geological Survey (USGS) topographic map (Figure 10-1), Beaver Creek is fed by a perennial stream ("Spring Creek") within the study area. During the 1980 and 1981 field studies, however, this tributary was dry above the spring (8550 feet) except during snow melt. Between the upper limits of permanent water and its confluence with Sand Gulch near the northern end of the study area at 8300 feet, Beaver Creek has a mean gradient of 650 feet/mile, or 12 percent. Much of the stream length is characterized by active or abandoned beaver ponds, willow thickets, and wet meadows with fairly well-developed meanders in some broader sections.

10.3.2 Wildlife

10.3.2.1 Aquatic Wildlife Habitat Value Determination

Based on benthic macroinvertebrate and aquatic habitat surveys and on data provided by DWR (1981a), North Gordon Creek is of limited value as a fishery because it does not support game species. Beaver Creek, however, is ranked by DWR as being of substantial value as a Salmonoid fishery, with a self-sustaining population of introduced Yellowstone Cutthroat Trout (Salmo clarki). Non-game fish species listed by DWR for Beaver Creek in the study area are the Mottled Sculpin (Cottus bairdi), Mountain Sucker (Catastomus (Pantosteus) platyrhynchus), and Speckled Dace (Rhinichthys osculus). No fish were seen in Beaver Creek during the April or June surveys, suggesting that populations are fairly small in the study area, probably due to the low flows and low gradients (the latter reflected by fairly high temperatures). Fish surveys were not conducted because the mining project is not expected to affect the stream. This was recognized by DWR in their evaluation of wildlife in the study area (DWR 1981a).

The greatest value of both Beaver Creek and North Fork Gordon Creek aquatic habitats in the area probably is the water, cover, food and breeding sites they provide to a variety of terrestrial vertebrates (see the following section).

10.3.2.2 Terrestrial Wildlife and Habitat Value Determination

As used in this report, "value" incorporates both ecological and economic criteria. Examples of criteria used in evaluating value include considerations such as whether a species is an indicator of environmental stress, critical to

the food web as a prey or predator, important for monitoring programs (see Section 10.7), or represents a significant hunting or trapping resource. High value habitats are those which support especially high diversities or densities of wildlife, attract species not otherwise found in the area, or are important to high value wildlife species (as defined above).

Information provided by DWR (1981a) indicates that the most important habitat types in the study area are the Mixed Riparian zones along Beaver Creek and North Fork Gordon Creek and the Subalpine Moist Meadows atop the plateaus. The reasons for classifying Mixed Riparian as the highest priority wildlife habitat are the availability of water and the structural and compositional diversity of the plant community. The second point directly, or indirectly affects a number of factors such as feeding sites, nesting sites, resting or roosting sites, and quantity and quality of food items (such as herbage, seeds, fruit, invertebrates and small vertebrates). Moist Meadows also possess many of the ecological qualities, although they lack structural diversity.

Other high priority habitats listed by DWR (1981a) are seeps or springs which provide water, and cliffs which afford nesting sites for many species of raptorial birds (see Section 10.3.2.4 below).

Site-specific field work conducted by Beaver Creek Coal Company wildlife consultants tend to support DWR's designation of Riparian and Moist Meadow habitats as "crucial", because they are limited in extent, attract species not otherwise present, and support high densities of small animals. However, all habitats are important by some criteria. Thus, for example, Xeric Mountain Shrub provides valuable winter forage for Deer and Elk, while Middle and High Elevation Conifers and Aspen proved thermal and hiding cover for the same species.

Certainly, one of the most important habitats in the vicinity of the Gordon Creek study area is the Mosaic or chained Pinion/Juniper and pasture maintained by DWR to provide high priority and crucial, critical Winter range for Deer and Elk (Figure 10-8). The high quality of these areas is related to the combination of shrubs for Winter browse in the chained areas, palatable grasses and legumes for nutritious early-Spring forage in the pastures, and thermal and hiding cover in unchained Pinion/Juniper along drainages. The value of these areas is discussed further in subsequent sections on big game and impacts.

The following sections summarize the wildlife resources of the study area, with emphasis on ecological (i.e., animal-habitat) relationships. Important and other prevalent wildlife species are discussed in the following sections, which are organized by taxonomic group.

10.3.2.3 Mammals

According to DWR (1978) 84 species of mammals are known to occur in the Wasatch Plateau region, of which 68 are expected to inhabit the study area. Twenty-five (25) mammal species are considered by DWR (1981a) to be of high interest to the State of Utah. These species and other species prominent in the study area, are described below.

Two Bat species of special interest to Utah are the Red Bat (Lasiurus borealis), which roosts in wooded areas and the Western Big-Eareed Bat (Plecotus townsendii), which roosts in caves, rock overhangs, tunnels or abandoned buildings. See Appendix Table 1 for a complete listing of Bat species potentially present in the study area.

High interest (small game) Lagomorphs observed in the study area are the Mountain Cottontail (Sylvilagus nuttallii) and

Snowshoe Hare (Lepus americanus). Based on DWR information (1981a), the entire study area provides "substantial" habitat for the cottontail, while the Mosaic of Spruce/Fir Aspen, and Riparian zones at the highest elevations provides "high priority" breeding habitat to the hare. Lowest elevation Pinion/Juniper habitats may support a few Desert Cottontail (Sylvilagus audubonii) which DWR reports to occur below 7000 feet in most areas (1981a).

One Sciurid of high interest to Utah is the Northern Flying Squirrel (Glaucomus sabrinus), for which both the Middle Elevation and High Elevation Conifer stand types potentially provide substantial habitat in the study area. Other prominent Sciurids observed during field studies, but not classified as being of special concern to Utah, are the Red Squirrel (Tamiasciurus hudsonicus), which was common in Mixed Conifers; the Rock Squirrel (Spermophilus variegatus) (often mistaken for a tree squirrel) in Mountain Brush; the Uintah Ground Squirrel (Spermophilus armatus) in in Dry Meadows; the Golden Mantled Ground Squirrel (Spermophilus lateralis) and Uintah Chipmunk (Eutamias umbrinus) in most higher elevation habitats; and the Least Chipmunk (Eutamias minimum) in virtually every habitat. Sign (burrows) probably belonging to another species -- Northern Pocket Gopher (Thomomys talpoides) -- frequently were observed in meadows and forest clearings, especially in the Beaver Creek drainage.

One of the most important groups of terrestrial vertebrates are the small Rodents, such as the Cricetine and Microtine Mice, Jumping Mice and Pocket Mice. These species are a vital link in the food web, particularly since they provide the vast bulk of prey for virtually all mammalian and avian predators. Small mammals were not addressed in this study however, because DWR would not permit a live-trapping sampling program. However, Appendix Table 1 provides a list

of species expected to occur in the study area, based on known geographic ranges and ecological preferences.

The Beaver (Castor canadensis) is a resident of the Wasatch Plateau region and beaver dams were present on both Beaver Creek and North Fork Gordon Creek during site-specific field investigations. Muskrat (Ondatra zibethicus), which also inhabit aquatic habitats in the region, were observed along Beaver Creek within the study area.

Small Carnivores of high interest (as fur bearers) to Utah include a number of Mustelids: Wolverine (Gulo luscus), Badger (Taxidea taxus), Martin (Martes caurina), Mink (Mustela vison), Long-Tailed Weasel (Mustela mephitis), and Spotted Skunk (Spilogale putorius). This group also includes two Procyonids: the Raccoon (Procyon lotor) and the Ringtail (Bassariscus astutus).

Based on habitats within the study area, all of these species may occur, although only the Long-Tailed Weasel was actually observed. Appendix Table 1 summarizes the habitat preferences of the small Carnivores reported by DWR (1978) as potentially present.

Larger Carnivores reportedly present in the region (DWR, 1978) are the Black Bear (Ursus americanus), Mountain Lion (Felis concolor), Bobcat (Lynx rufus), Canada Lynx (Lynx canadensis), Coyote (Canis latrans), Red Fox (Vulpes vulpes) and Gray Fox (Urocyon conereoargenteus). Black Bear are known to occur and appear to be especially common in wooded valley bottoms, based on diagnostic sign and sightings by Beaver Creek Coal Company personnel. Mountain Lions are likely to occur within rugged areas along deeper valleys providing the most suitable habitat for denning.

Both the Coyote and Bobcat are known to occur within the study area, based on diagnostic sign and direct observation. These species inhabit a broad range of lower elevation habitats, such as Mountain Shrubs, Middle Elevation Conifers and Mixed Riparian zones. Summer range apparently is not limited to the vicinity of Gordon Creek No. 2 and No. 7 Mines by Deer and Elk, but it is important in supplying energy reserves to meet Winter energy deficiencies (Klein, 1968; Baker and Hobbs, 1982).

Both the Mule Deer and American Elk migrate to Winter ranges in the region during October or November, depending on the weather. Generally Deer exhibit a greater altitudinal migration than Elk.

Lower elevations southeast of the study area were mapped by DWR (1982a) as high priority and crucial/critical Winter range for Deer (Figures 10-9a and 10-9b). These areas include natural and chained Pinion/Juniper, Sagebrush and agricultural areas. During April, 1981, a herd of over 500 Mule Deer was regularly observed in pastures on either side of the access road on Highway 139, Section 27 and 36, Township 13 South, Range 8 East.

Use of the chained Pinion/Juniper and pastures by Deer undoubtedly varies from year to year, depending on the timing and severity of storms, temperature extremes, and depth of snow accumulation. Generally the extent of altitudinal migration is only as great as necessary to provide the requisite thermal and nutritional levels for a positive energy balance. Thus, while the pastures are used during "typical" Winters, the chained Pinion/Juniper -- most of which lies to the east and further from the mountains -- is used during "severe" Winters and, therefore, is considered crucial/critical (Figure 10-9b). The attractiveness of the chained Pinion/Juniper in severe

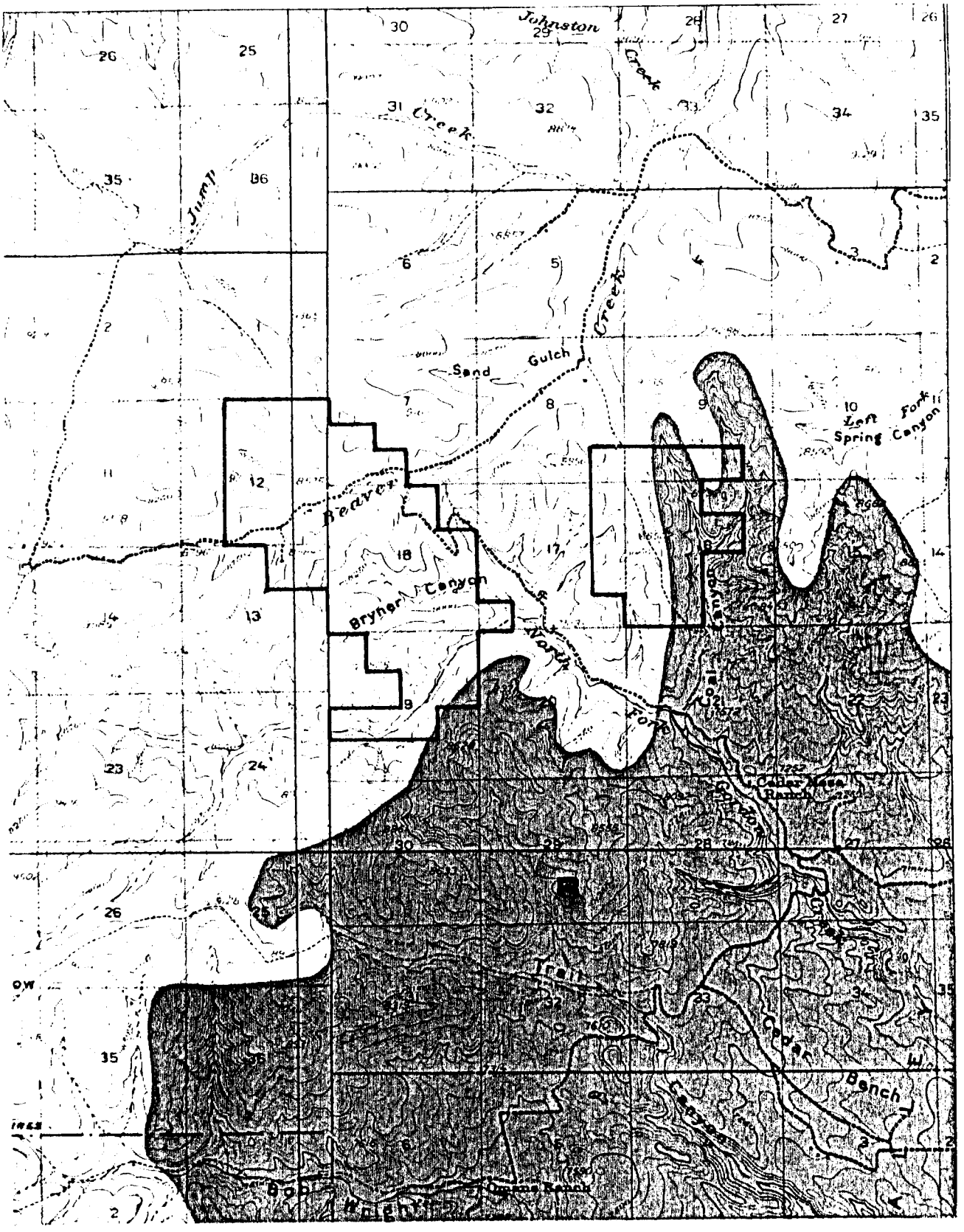


Figure 10-9a. High priority winter range (R) for Mule Deer relative to the Gordon Creek No. 2 Mine study area (left block). Source: DWR (1981a).

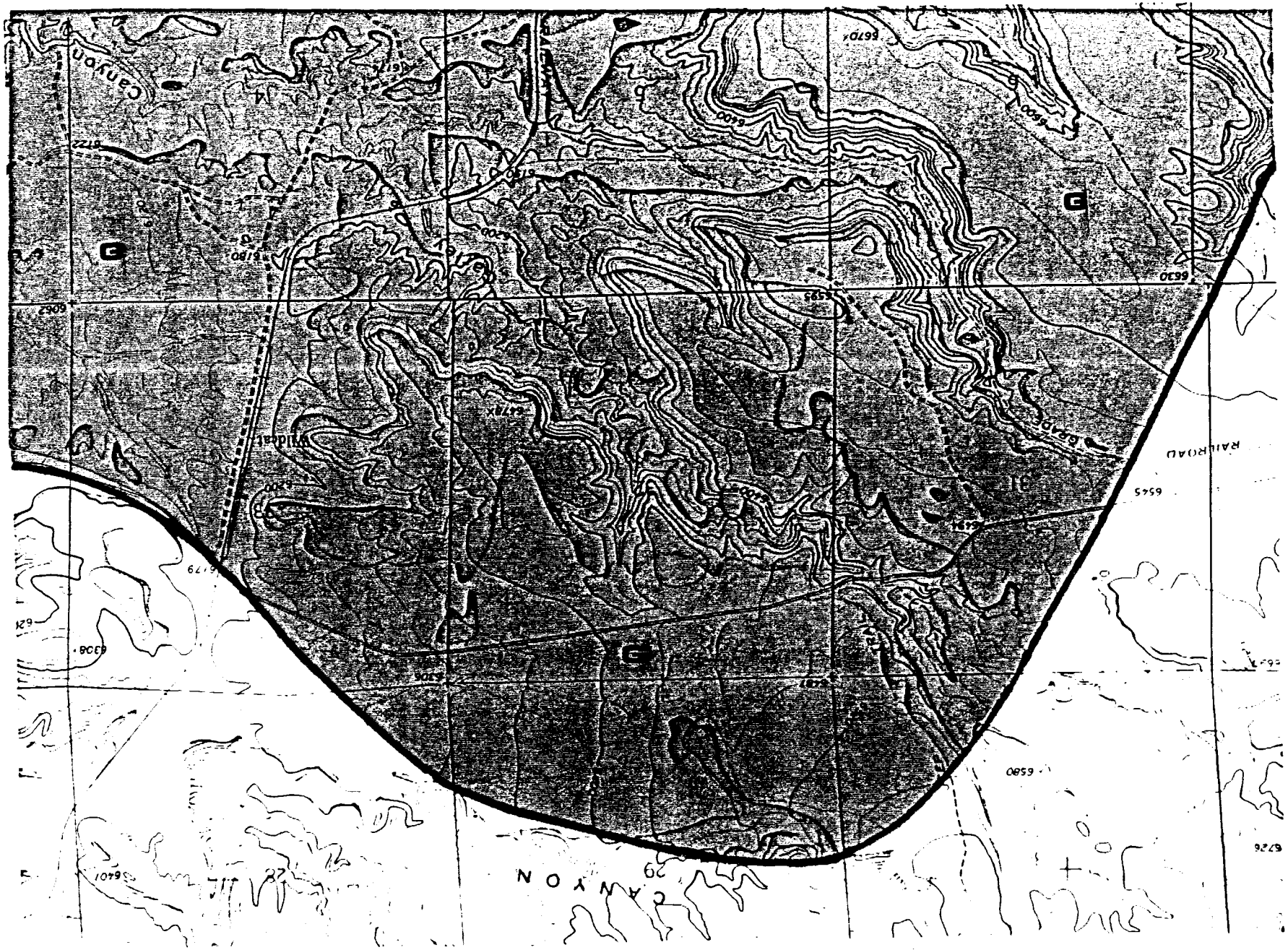


Figure 10-9b. Crucial-critical winter range (G) for Mule Deer along the access/haul road east of the Gordon Creek No. 2 [illegible] study area. Source: DWR (1981a). Much of the area is sagebrush grassland [illegible] chained pinyon/juniper.

Winters is that the higher density of shrubs provides nutritious sapwood above the snow, while the pastures may be devoid of green tissue, or at least have it unavailable due to snow cover.

During even the most severe Winters, the pastures gradually become the most desirable habitat as the newly emergent forbs and grasses provide highly palatable herbage. The proximity to the pastures to unchained Pinion/Juniper along drainages and the lower slopes of the mountain front provide important thermal and hiding cover during daylight hours.

Mule Deer habitat preference indices (HPI) were calculated for Winter range habitats within the permit area to judge the relative importance of the difference habitat types. These values were calculated by dividing the percent frequency of sample plots containing Deer pellet groups by the percentage of total Winter range covered by each habitat type within the permit area (Table 10-1). Of the five habitat type samples, Mixed Riparian had the highest preference index, probably due to the availability of browse and cover, as well as adjacent thermal and escape cover in Middle Elevation Conifer stands. Xeric mountain shrub, Middle Elevation Conifer and Sagebrush types had nearly equal HPI values. Xeric Mountain Shrub and Sagebrush types are important components of the Winter range due to the high availability of browse species and southern exposures. Deer apparently make minimal use of the Slope Bunchgrass type, probably because of the scarcity of wood species and competition with domestic livestock.

Part of the study area has been classified as high priority and crucial - critical Winter range for the Elk Herd Unit 12 (Manti) by the Utah DWR (1981a). Aerial trend counts indicate the Elk population has been increasing and age ratios suggest that herd productivity has been stable (Table 10-2).

TABLE 10-1

Big Game Winter Range Habitat Preference Indices

Gordon Creek No. 2, No. 7, No. 3 and No. 6 Mines

1980-1981

Habitat	Percent[1] Habitat	Percent of Plots With Sign	Habitat Preference Index
Slope Bunchgrass	37	0	0
Xeric Mountain Shrub	22	50	2.3
Middle Elevation Conifer	15	30	2.0
Sagebrush	12	20	1.7
Mixed Riparian	7	40	5.7
Pinion/Juniper[2]	7	-	-

1 Estimated for permit area Winter range.

2 Pinion/Juniper was not present in the No. 2 Mine study area.

These areas generally are used by Elk between November 1 and May 15 each year. Portions of the Elk Winter ranges receiving concentrated use during severe Winter conditions are classified as crucial - critical Winter ranges. Winter habitats used by Elk fall into two categories. During mild Winter, many Elk tend to stay at higher elevations. The larger body size of this species enables it to withstand colder temperatures than Deer, while its longer legs let it move more easily through snow. High elevation (low priority) Winter range in the study area includes slope bunchgrass, high elevation conifers, aspen, and subalpine moist meadows.

During more severe Winters, Elk migrate to lower elevations where they may overlap broadly with Deer. DWR (1981a) reports that high priority Elk Winter range includes the pastures described for Deer earlier in this Section (see Figure 10-8) and adjacent Xeric Pinion/Juniper and shrub and Grassland areas (Figure 10-10). Crucial - critical Winter range is mapped by DWR as occurring at higher elevations to the west and southwest (Figure 10-10). While this situation may seem anomalous, it probably is related to snow cover. That is, exposed slopes such as those dominated by Slope Bunchgrass and Xeric Mountain Shrub habitats tend to be more free of snow during severe Winters than flatter areas at slightly lower elevations.

Elk calving and Deer fawning occurs in the Wasatch Plateau region in late-May and June. Although no specific sites have been identified in the study area by DWR (1981a) or Beaver Creek Coal Company wildlife consultants, all Riparian zones and other Mesic habitat types with hiding cover should be considered potential calving and fawning areas.

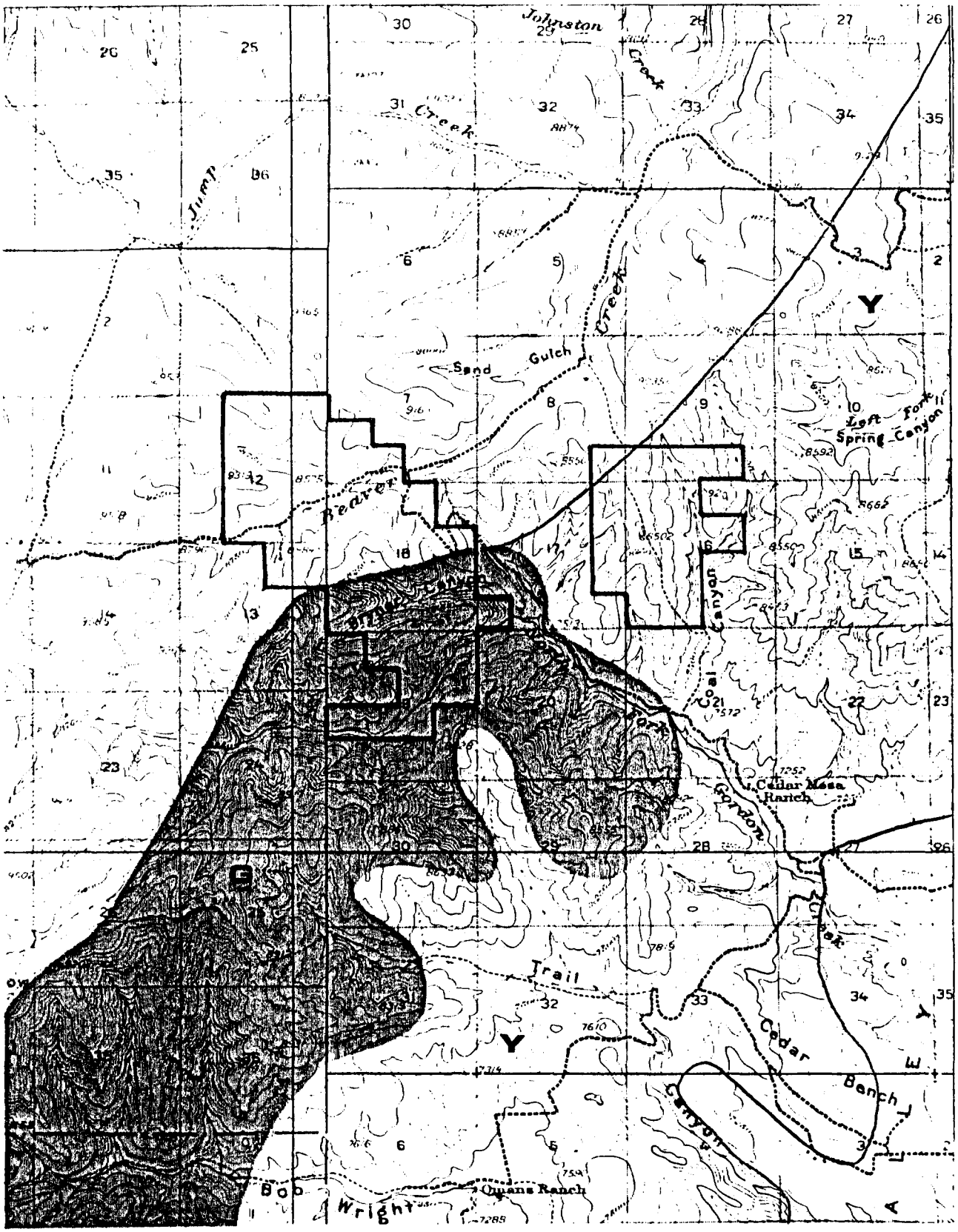


Figure 10-10. High priority (Y) and crucial-critical (G) winter range for American Elk relative to the Gordon Creek No. 2 Mine study area (left block). Source: DWR (1981a).

TABLE 10-2
Aerial Trend Counts and Herd Classifications
American Elk in Herd Unit 12 (Manti), Utah, 1971-1980

YEAR	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Aerial Trend Count Pre-Season	550	775	623	906	1269	1283	1278	1291	1106	1459
Herd Classification Pre-Season										
Calves/100Cows	54	60	57	55	50	60	55	52	51	56
Bulls/100 Cows	24	21	18	12	14	25	20	18	14	12

The Moose population in the reion is the result of six transplants into the Fish Creek drainage on the north end of the Manti Mountain in Carbon County. The transplants, which totalled 43 animals, occurred in January and February, 1973, 1974 and 1978. A portion of the project site has been mapped as Winter range for the Southeastern Utah Moose herd. Typical Winter range habitats include riparian zones and moist meadows. These areas generally are used from December 1 through mid-May each year. Moose normally do not show a large altitudinal migration in response to Winter weather, and some habitats may be occupied by Moose on a year-long basis. Between May, 1973, and February, 1978, four Moose observations were recorded in Beaver Creek (DWR, 1980a). Due to the low density of Moose within the region, estimates of relative habitat use were not possible during field studies for Beaver Creek Coal Company. Indeed, no Moose or their sign were encountered despite fairly frequent field visits by wildlife consultants during the 1980 and 1981 field studies.

Because of the DWR's unwillingness to permit aerial surveys, the topographic relief of the site and poor access to most of the areas by roads, it was not possible to estimate the populations of big game during the 1980 and 1981 field study. Even where population estimates are possible, however, they are of limited value for two major reaons. First, the animals have such large daily and seasonal ranges that periodical censuses do not accurately indicate the number of animals using a given area -- either on any one day or throughout the year. Secondly, the variables affecting population size and distribution are so numerous that estimating the herd size tells little about the influence of a single factor (such as the operation of a coal mine).

10.3.2.4 Birds

Approximately 140 species of birds are potentially present in the study area during at least part of the year (Appendix Table 2), of which 30 are listed by DWR (1981a) as being of high State interest. These species, which include game birds and raptors are discussed below, as are prominent small birds which were observed or expected in the study area.

Gamebirds include Waterfowl, Upland Fowl (gallinaceous birds) and Doves. Waterfowl do not provide a significant recreational resource in the study area because of the limited surface water. However, Beaver Creek and adjacent wetgrass areas atop the plateau may receive seasonal use by puddle ducks. Species observed during the field studies were the Mallard Anas platyrhynchos, Green Winged Teal Anas crecca and Blue Winged Teal Anas discors. Other water birds or shore birds present during the Summer are the American Coot Fulica americana (or "Mud Hen"), Wilson's Phalarope Steganopus tricolor, Spotted Sandpiper Actitis maculata and Common Snipe Capella gallinago. The Mallard and Green Winged Teal nest along Beaver Creek, apparently utilizing Moist Meadows adjacent to beaver ponds on nest sites.

Upland fowl potentially provide a more important recreation resource with both the Blue Grouse Dendragapus obscurus and Ruffed Grouse Bonasa umbellus inhabiting the study area. Blue Grouse concentrate in open stands of spruce and fir during the Winter, where they feed on needles and buds. Thus, both Middle and High Elevation Conifer Forests provide potential crucital-critical Winter range (DWR 1981a). Other habitat types occupied by this species include Low Elevation Pinion/Juniper and Mountain Shrubland in the Spring and High Eelevation Conifer-Aspen-Meadow Mosaic in Summer and Fall. Blue Grouse were not observed during field studies in the study area, and booming males were heard along slopes adjacent to Beaver Creek in Spring, 1981.

Ruffed Grouse occupy a fairly broad range of habitats, especially Aspen and Mountain Shrubland, although Conifers often are used during the Winter. The DWR (1981a) reports that deciduous zones within 9.25 miles of a stream provide high priority habitat for Ruffed Grouse overall, while Aspen forests afford crucial/critical habitat during the mid-Winter period (the birds apparently rely on aspen staminate buds as a Winter food source). Ruffed Grouse were observed during Summer, 1981, in an Aspen grove about 300m northwest of the Gordon Creek No. 2 Mine.

Other game birds in the region are the Band-Tailed Pigeon (Columba fasciata) and Mourning Dove (Zenaida macroura). The Pigeon is uncommon in the Wastach Plateau, usually occurring as isolated stragglers or small flocks at irregular intervals in Spruce or Fir habitats (DWR, 1981a). The Dove is a much more likely inhabitant of the region with Pinion/Juniper and Riparian habitats potentially providing high priority nesting habitat. However, site-specific field studies indicate a fairly low abundance of Mourning Doves in the study area.

Raptors observed by Beaver Creek Coal Company wildlife consultants were the Golden Eagle (Aquila chrysaetos), Red-Tailed Hawk (Buteo jamaicensis), Goshawk (Accipiter gentilis), Sharp-Shinned Hawk (Accipiter straitus), American Kestrel (Falco sparverius), Great Horned Owl (Bubo virginiana) and Long Earred Owl (Asio otus).

No Hawk or Owl nests were found in the study area during a raptor survey conducted for Beaver Creek Coal Company in the 1980 breeding season (Springer and Truett, 1980). However the raptor consultants did feel that Red-Tailed Hawks almost certainly were breeding in the area based on courtship behavior. Field studies during the 1981 breeding season confirmed that Redtails breed on the site, with definite nesting areas located about 1km northwest and 2km southeast of the Mine site (Figure 10-11). The northwestern pair generally hunted in ,eadow and Forest Mosaics atop the plateau along Beaver Creek (with Uintah Ground Squirrels probably serving as the major prey item), while the southeastern pair tended to hunt in Slope Bunchgrass and Forest Mosaics along the ridgetops adjacent to the North Fork Gordon Creek.

Goshawks bred in 1981 1km southwest and 2km northwest of the Mine site (Figure 10-11). Both pairs hunted in Conifers near their nesting areas, where they probably fed primarily on songbirds and, if they were lucky, Blue Grouse and Ruffed Grouse.

Great Horned Owls bred in an Aspen grove about 0.5km northwest of the Mine site (Figure 10-11). Three Owlets were observed on July 2, 1981. A pair of Long-Earred Owls probably nested about 1.5km south of the Mine site in dense riparian vegetation along North Fork Gordon Creek (Figure 10-11), based on the presence of adult birds in this preferred habitat type during the breeding season (April 23, 1981). Other probable breeders, for which exact nesting areas could not be defined were Sharp-Shinned Hawks in the Riparian and Conifer edge and American Kestrels on sandstone ledges, both adjacent to North Fork Gordon Creek southeast of the study area.

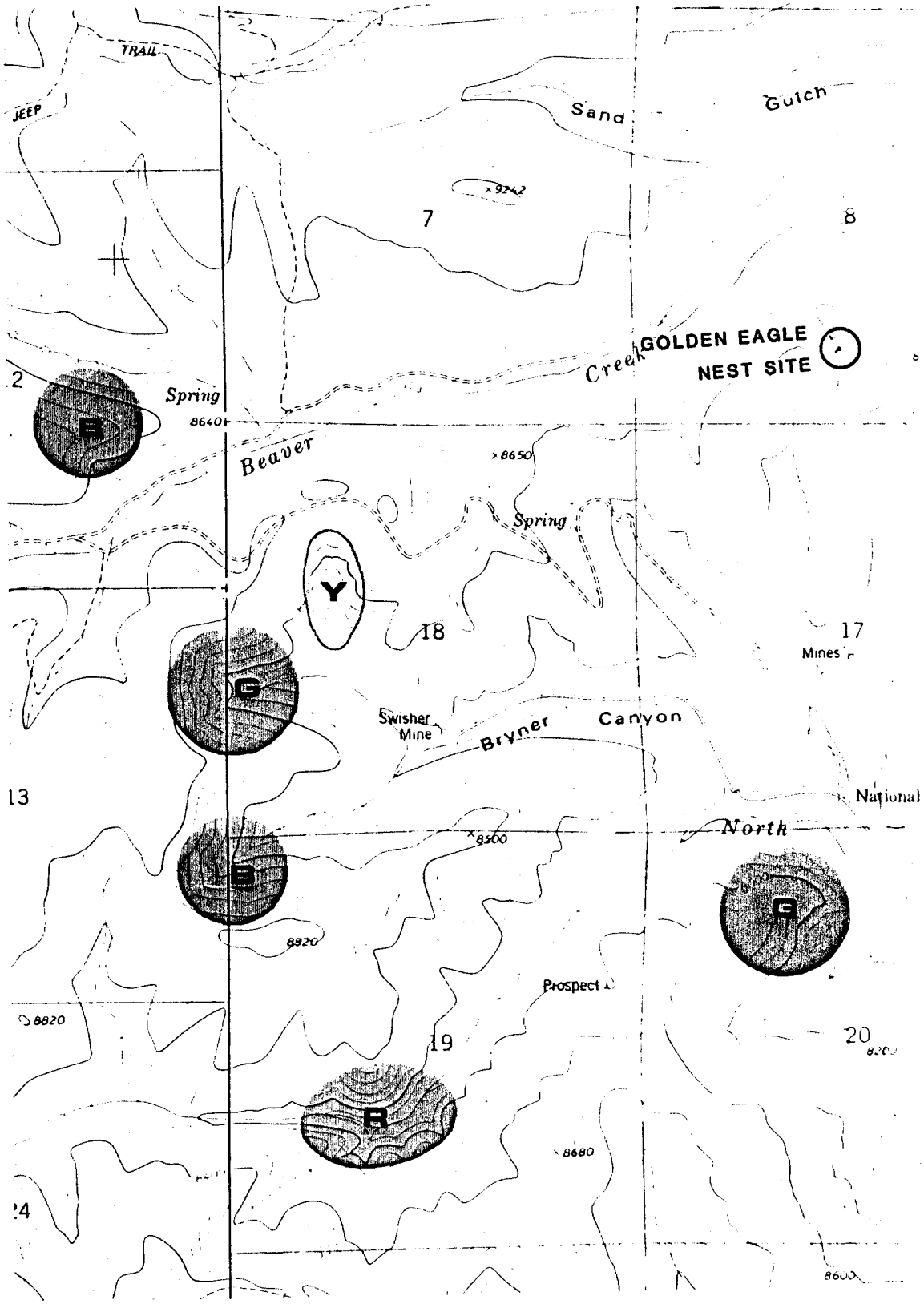


Figure 10-11. Nesting areas for Red-tailed Hawks (G), Goshawks (B), Great Horned Owls (Y), and Long-eared Owls (R) in the Gordon Creek No. 2 Mine study area, 1981.

Springer and Truett (1980) reported a Golden Eagle nest on a cliff face in southeastern Section 8, about 3km northeast of the Mine site (Figure 10-11). Two adult eagles were seen regularly in the vicinity of the cliff and their feeding ranges apparently included the permit area. However, subsequent studies in Summer, 1980, failed to reveal the presence of young eagles, although the adults continued to be observed. In 1981, a pair of eagles again frequented the cliff, but persistent observation again failed to produce sighting of nesting behavior or young birds. Therefore, it is assumed that the eagles represented a non-breeding pair in which one or both of the birds was either too young or too old for successful reproduction. Non-breeding pairs are not uncommon among the larger raptors.

DWR (1981a) classifies the study area as "substantial" habitat for the raptor species present, as well as for others potentially present but not observed (Appendix Table 2). Raptors are of particular concern to DWR for three principal reasons. First, they are predators on small mammals and, hence, important in maintaining ecosystem balance. Secondly, because they are high-order predators and have large home ranges they are valuable indicators of environmental stress, sensitive to disturbance from rather far-removed activities and, consequently, logical keystone species in on-going monitoring programs. Lastly, the public at large is interested in raptors and, therefore, exerts considerable pressure for their protection.

Although public and regulatory concern is focused on game birds and raptors, small birds comprise the vast majority of species and avian biomass present in virtually any ecosystem. Approximately 125 species of Small Birds are potentially present in the study area (Appendix Table 2), including Cuckoos, Frogmouths, Swifts, Hummingbirds, Fly Catchers, and Songbirds.

During field studies in 1980 and 1981, three habitat types -- Aspen Forest, Conifer Forest and Riparian Woodland -- consistently supported the greater density and diversity of small Birds.

ASPEN FORESTS provided habitats for a variety of species, particularly hole-nesters, for which Aspen is especially attractive owing to its soft wood. Typical breeding species include the Common Flicker (Colaptes auratus), Hairy Woodpecker (Picoides villosus), Downy Woodpecker (Picoides pubescens), Yellow-Bellied (Rednapped) Sapsucker (Sphyrapicus (varius) nuchalis), Western Wood PeWee (Contopus sordidulus), Western Flycatcher (Emphidonax difficilis), Dusky Flycatcher (Emphidonax oberholseri), Violet-Green Swallow (Tacycineta thalassina), Tree Swallow (Irdoprocne bicolor), Black Capped Chickadee (Parus atricapillus), Mountain Chickadee (Parus gambeli), White Breasted Nuthatch (Sitta carolinensis), House Wren (Troglodytes aeden), American Robin (Turdus migratorius), Mountain Bluebird (Sialia currucoides), Townsend's Solitaire (Maydestes townsendii), Warbling Vireo (Vireo gilvus), Yellow Rumped Warbler (Dendroica coronata), Orange Crowned Warbler (Vermivora celata), and Gray Headed Junco (Junco caniceps).

As indicated in Table 10-3, the six Aspen survey sites supported fourteen breeding species, with a total mean diversity of 14/ha.

CONIFEROUS FORESTS support almost as many small birds species, with regular breeding inhabitants including the Hairy Woodpecker, Olive-sided Flycatcher (Nuttalornis borealis), Hammond's Flycatcher (Epidonax Hammondii), Steller's Jay (Cyanocitta stelleri), Clark's Nutcracker (Nucifraga columbiana) (at higher elevations), Mountain Chickadee, Red Breasted Nuthatch (Sitta canadensis),

Pygmy Nuthatch (Sitta pygmaea) (at lower elevations), Yellow Rumped Warbler, Western Tanager (Piranga ludoviciana), Gray Headed Junco, Chipped Sparrow (Spizella passerina), Red Crossbill (Loxia curvirostra) and Pine Siskin (Carduelis pinus).

Table 10-4 shows that the six Middle Elevation Conifer survey sites supported thirteen small Bird species, with a mean total density of 13.8/ha.

MIXED RIPARIAN zones included many elements of both the Aspen and Conifer stands described above, plus a number of species endemic to the Tall Mesic Shrubs or the mixture of Tall Shrubs, Conifers and Deciduous trees. Species showing a strong preference for Riparian areas were the Willow Flycatcher (Empidonax traillii), Gray Catbird (Dumetella carolinensis), Swainson's Thrush (Catharus ustulatus), Yellow Warbler (Wilsonia pusilla), Black Headed Grosbeak (Pheucticus melanocephalus), Rufous-Sided Towhee (Pipilo erythrophthalmus), Song Sparrow (Melospiza melodia), and Lasuli Bunting (Passerina amoena). Especially common birds from the aspen and conifer habitats included the Downy Woodpecker, Yellow Bellied Sapsucker, Western Flycatcher, American Robin, Townsend's Solitaire, Mountain and Black Capped Chickadees, House Wren, Warbling Vireo, Yellow Rumped Warbler and Western Tanager.

As shown in Table 10-5, the twelve Mixed Riparian survey sites had the highest number of breeding species (fifteen) -- perhaps attributable to the large sample size -- and the highest mean total density (19.5/ha).

TABLE 10-3

Small Bird Breeding Data

Aspen Habitat Type, Gordon Creek No. 2 and No. 7 Mines

May, 1981

Species	Density[1]	Frequency[2]	Relative[3] Abundance
Warbling Vireo	2.7	100	19.3
House Wren	1.7	83	12.1
Yellow Rumped Warbler	1.7	83	12.1
Western Tanager	1.3	67	9.3
Orange Crowned Warbler	1.3	67	9.3
Gray Headed Junco	1.0	50	7.1
Hammond's Flycatcher	1.0	50	7.1
Mountain Chickadee	0.7	33	5.0
Black Capped Chickadee	0.7	33	5.0
Chipping Sparrow	0.7	33	5.0
White Breasted Nuthatch	0.3	17	2.1
American Robin	0.3	17	2.1
Townsend's Solitaire	0.3	17	2.1
Black Headed Grosbeak	0.3	17	2.1
TOTAL	14.0		99.7

1 Number of breeding pairs (inferred from singing males) per hectare, n = 6, plot size = 100 m by 50 m

2 Percent of total plots in which each species occurred.

3 Percent of total bird observations comprised by each species.

TABLE 10-4

Small Bird Breeding Data

Middle Elevation Conifer Type, Gordon Creek No. 2 and No. 7 Mines

May, 1981

Species	Density[1]	Frequency[2]	Relative[3] Abundance
Hammond's Flycatcher	2.3	100	16.7
Western Tanager	2.0	83	14.5
Yellow Rumped Warbler	1.7	83	12.3
Ruby Crowned Kinglet	1.3	67	9.4
Hermit Thrush	1.3	67	9.4
Gray Headed Junco	1.3	67	9.4
American Robin	1.0	50	7.2
Chipping Sparrow	1.0	50	7.2
Mountain Chickadee	0.7	33	5.1
Red Breasted Nuthatch	0.3	17	2.2
Townsend's Solitaire	0.3	17	2.2
Chipping Sparrow	0.3	17	2.2
Black Headed Grosbeak	0.3	17	2.2
TOTAL	13.8		100.00

1 Number of breeding pairs (inferred from singing males) per hectare, n = 6, plot size = 100 m by 50 m

2 Percent of total plots in which each species occurred.

3 Percent of total bird observations comprised by each species.

TABLE 10-5

Small Bird Breeding Data

Mixed Riparian Type, Gordon Creek No. 2 and No. 7 Mines

May, 1981

Species	Density[1]	Frequency[2]	Relative[3] Abundance
Yellow Warbler	2.7	75	13.8
Warbling Vireo	2.1	58	10.8
Black-Capped Chickadee	1.8	50	9.2
House Wren	1.8	50	9.2
Song Sparrow	1.5	42	7.7
Black Headed Grosbeak	1.5	42	7.7
Wilson's Warbler	1.2	33	6.2
MacGillivray's Warbler	1.2	33	6.2
American Robin	1.2	25	6.2
Western Flycatcher	1.2	25	6.2
Willow Flycatcher	0.9	25	4.6
Green Tailed Towhee	0.9	25	4.6
Lazuli Bunting	0.6	17	3.1
Rufous-sided Towhee	0.6	17	3.1
Swainson's Thrush	0.3	8	1.5
TOTAL	19.5		100.1

Less productive habitats were the Mesic Mountain Shrub, Xeric Mountain Shrub, Sagebrush and Slope Bunchgrass types. Of these, mesic mountain shrub was by far the best, probably due to the diversity of feeding and nesting sites provided by the dense, tall shrubs -- and the typically interspersed Aspen and Conifers. For example, the six sample sites had twelve breeding species and a mean total density of 8.9/ha (Table 10-6).

The other three types were substantially less productive, owing to the limited structural diversity of the vegetation. Of these, only the Xeric Mountain Brush had significant breeding populations of four species and 4.0/ha mean total densities (Table 10-7).

In ten sample plots, Slope Bunchgrass failed to produce a single territorial Song Bird. Sagebrush, Subalpine, Moist Meadow and High Elevation Conifer habitats were not consensused because they do not occur near the affected mine area.

Winter residents included many of the breeding species listed above, plus large influxes of White Crowned Sparrows (Zonotrichia leucophyrs) and Dark Eyed Junco (Junco hyemalis) in virtually every habitat type. Appendix Table 2 provides additional information on species actually or potentially occurring in the study area.

TABLE 10-6

Small Bird Breeding Data

Mesic Mountain Shrub Type, Gordon Creek No. 2 and No. 7 Mines

May, 1981

Species	Density[1]	Frequency[2]	Relative[3] Abundance
Green Tailed Towhee	1.6	83	18.0
Willow Flycatcher	1.3	67	14.6
Black Headed Grosbeak	1.0	50	11.2
Bewick's Wren	1.0	50	11.2
House Wren	0.7	33	7.9
MacGillivray's Warbler	0.7	33	7.9
Virginia's Warbler	0.7	33	7.9
Orange Crowned Warbler	0.7	33	7.9
Blue Gray Flycatcher	0.3	17	3.4
Yellow Warbler	0.3	17	3.4
Gray Headed Junco	0.3	17	3.4
Rufous-sided Towhee	0.3	17	3.4
TOTAL	8.9		100.2

1 Number of breeding pairs (inferred from singing males) per hectare, n = 6, plot size = 100 m by 50 m

2 Percent of total plots in which each species occurred.

3 Percent of total bird observations comprised by each species.

TABLE 10-7

Small Bird Breeding Data

Xeric Mountain Shrub Type, Gordon Creek No. 2 and No. 7 Mines

May, 1981

Species	Density[1]	Frequency[2]	Relative[3] Abundance
Green Tailed Towhee	2.8	90	70.0
Virginia's Warbler	0.6	30	15.0
Black Headed Grosbeak	0.4	20	10.0
Dusky Flycatcher	0.2	10	5.0
TOTAL	4.0		100.0

1 Number of breeding pairs (inferred from singing males) per hectare, n = 6, plot size = 100 m by 50 m

2 Percent of total plots in which each species occurred.

3 Percent of total bird observations comprised by each species.

10.3.2.5 Reptiles and Amphibians

Three groups of cold-blooded terrestrial vertebrates are expected in the study area.

XERIC SITES, especially at lower elevations, provide habitat for several lizards and snakes, with the Short Horned Lizard (Phyrnosoma douglassi), Collared Lizard (Crotaphytus collaris), Fence Lizard (Sceloporus undulatus), Tree Lizard (Urosaurus ornatus), Striped Whip Snake (Masticophis taeniatus), and Racer (Coluber constrictor) most likely to be present in significant numbers.

MESIC SITES, especially at higher elevations, probably are inhabited by a few snakes, most notably the Bull Snake (Pituophis malanoleucus), and Western Terrestrial Garter Snake (Thamnophis elegans).

AQUATIC SITES, including ponds and wet meadows, could be utilized for breeding by amphibians such as the Tiger Salamander (Ambystoma tigrinum), Western Toad (Bufo boreas), and Western Chorus Frog (Pseudacris triseriata). The only reptiles observed during site-specific field studies were the Western Toad and Western Chorus Frog in Beaver Creek and a Short Horned Lizard on a grassy slope east of the No. 2 Mine portal area.

Appendix Table 3 provides a complete list of reptiles in the Wasatch Plateau region and potentially present in the study area.

10.3.2.6 Aquatic Organisms

No fish were seen or collected in either North Fork Gordon Creek or Beaver Creek. See Section 10.3.2.1 for a discussion of the ichthyofauan report as presented by DWR (1981a).

The Benthic Macroinvertebrate community of North Fork Gordon Creek was surveyed in late-April, 1981. Data was collected at stations above and below Bryner Canyon in order to evaluate possible effects of draining through the Mine-affected area.

SITE NFG-1 was located about 250m above the Bryner Creek confluence in the vicinity of remnants of an earlier mining episode. The main flow pattern was riffle, although a few small pools were formed behind large boulders and along the banks. Mean water depth was 35cm, and stream width averaged 2.1m. In the sample area, rubble dominated the substrate, but sand, gravel and a few boulders were also present. Slow-velocity areas had a small amount of silt on the substrate. Riparian vegetation was scattered and provided an incomplete canopy. Primary Riparian species were Quaking Aspen, Blue Spruce and Willows on the north bank and Gambles Aak and Quaking Aspen on the south bank. Banks were eroded and void of vegetation on several bends in the site area.

Twenty taxa of seven major groups were found at Site NFG-1 in three pooled Surber samples (Table 10-8). The Midge (Chironomidae (Diptera)) and the Mayfly (Cinygmula sp. (Heptageniidae) were the most common Aquatic Invertebrates collected (33.9 percent and 21.2 respectively). Early instars of the Stonefly family Perlodidae, the Mayfly Baetis sp. (Beatidae), the Caddisfly Hydropsyche sp. (Hydropsychidae) and Oligophleboides sp. (limnephilidae) and the Cranefly Antocha sp. (Tipulidae were moderately common (2.4 percent, 5.7 percent, 12.1 percent, 16.0 percent and 2.0 percent, respectively).

Moderately high readings of alkalinity, hardness and pH were obtained. Dissolved oxygen and water temperature were not abnormal (Table 10-9).

TABLE 10-8

Aquatic Invertebrates Collected

Two Sampling Sites, North Fork Gordon Creek

April, 1981

Organism	NFG-1 Number	Percent	NFG-2 Number	Percent
Oligochaeta	3	0.2	8	14.5
Hydracarina	4	0.3		
Plecopters				
Perlodidae	32	2.4	1	1.8
Cultus sp.	1	0.1		
Isdogenoides sp.	2	0.2		
Ephemeropters				
Heptageniidae				
Cinygmula sp.	281	21.2	1	1.8
Ephemerellidae				
Ephemerella sp.	17	1.3		
Baetidae				
Baetis sp.	75	5.7	35	63.6
Trichoptera				
Hydropsychidae				
Hydropsyche sp.	160	12.1		
Limnephilidae				
Hesperophylax sp.	20	1.5	5	9.1
Oligophleboides sp.	212	16.0		
Brachycentridae				
Brachycentrus sp.	1	0.1		
Coleoptera				
Elmidae				
Optioservus sp.	3	0.2		
Dystiscidae				
Copelatus sp			1	1.8
Diptera				
Chironomidae	440	33.9	3	5.5
Ceratopogonidae	3	0.2	1	1.8
Stratiomyidae				
Euparyphus sp.	8	0.6		
Tipulidae				
Tipula sp.	8	0.6		
Hexatoma sp.	1	0.1		
Antocha sp.	38	2.9		
Dicranota sp.	5	0.4		
TOTAL NUMBER TAXA	20		8	
TOTAL NUMBER ORGANISMS	1323		55	

SITE NFG-2 was located about 30m below a water withdrawal point and old concrete abutments. Several pools were within the area sampled, but riffles were the dominant flow pattern. Average stream width and depth were 2.8m and 20cm, respectively. Rubble and gravel were the primary substrate types in the riffles, while sane and silt were the main substrate in the pools and had partially filled the interstitial spaces among rubble in the riffles. Dense Willow stands provided an almost complete canopy over the stream in the study area.

The Aquatic Invertebrate community of Site NFG-2 was much less diverse and had significantly fewer members than Site NFG-1 (Table 10-8). In the three pooled Surber samples Baetis sp. was the most abundant organism (63.6 percent); Oligochaeta and Hesperophylax s;. (Limnephilidae) were moderately common (14.5 and 9.1 percent, respectively). All other taxa were represented by less than five individuals.

Dissolved oxygen, alkalinity and pH were slightly higher than at Site NFG-1 (Table 10-9). Hardness and water temperature were not different.

The Aquatic Invertebrate communities were significantly different at the two sites. The probable reason for the change was the increased sediment load at the lower site to which the unpaved access/haul road may contribute. However, much of the siltation is probably natural, since the stream and its tributaries drain areas of relatively erosion prone soils. In addition, "riparian" vegetation changes from Aspen, Conifers and dense Shrubs to more open stretches often dominated by Sagebrush with only scattered trees.

The conclusion that the shift in Macroinvertebrates in related to siltation is supported by the ecologies of certain key species. The best example is the reversed

TABLE 10-9

Physiochemical Characteristics

Two Sampling Sites, North Fork Gordon Creek

April, 1981

Parameter	Site NFG-1	NFG-2
Dissolved Oxygen (mg/l)	7.8	8.0
Alkalinity (mg/l)	205.4	239.7
Hardness (mg/1)	325.3	325.3
pH	8.5	8.7
Water Temperature	7.0	7.0

abundances of Cinygmula sp., which is best suited for clinging to coarse substrata, and Baetis sp., which is ambulatory and, thus, able to move freely along a silty bottom. Macroinvertebrates in the Beaver Creek drainage were sampled in late-April and mid-June, 1981, at stations about 1km above (BC-1), less than 50m above (BC-2), and about 1km below the confluence with an unnamed tributary in extreme northwestern Section 18 (See Figure 10-1). For convenience, the unnamed tributary is referred to in this report as "Spring Creek"; the site of this tributary is identified as SC-1.

SITE BC-1 was located near the western edge of the study area in southeastern Section 2. Both Beaver Creek and the intermittent tributary joining it near BC-1 were essentially dry above the juncture itself.

Riparian vegetaion through this strecth was primarily Wet Grasses (Subalpine Moist Meadow), but Aspen and Conifers were scattered along the creek and provided a spotty canopy. Substrate was mainly gravel and small rubble with a thin silt overburden in slow stretches. The dominant flow pattern was riffle, but the low gradient reduced velocity to about 0.5 m/second. Mean stream width and depth were 60cm and 5cm, respectively.

The Invertebrate community was composed of sixteen taxa. Chironomidea were the most common organism (7.19 percent of sample). All other taxa occurred in comparatively low numbers but the Planarian Polycelis coronata, Oligochaetes, the Stonefly Zapada, the Mayflies Beatis and Cinygmula, and Caddisfly Rhyacophila, and the Cranefly Dicranota were represented in moderate numbers (Table 10-10). The water at BC-1 was slightly alkaline and temperature was 14^{o}C in June (Table 10-11).

TABLE 10-10

Aquatic Invertebrates Collected

Beaver Creek and Unnamed Tributary

April and June, 1981

	BC-1		BC-2		BC-3		SC-1	
Organism	#	%	#	%	#	%	#	%
Tricladia								
Planariidae			47	8.1				
Polycelis coronata	52	3.0						
Dugesia sp.	3	0.2						
Nematoda	3	0.2	1	0.2			1	0.1
Oligocaeta	92	5.3	101	17.4	10	2.7	151	12.0
Hirudinea								
Erpobdellidae								
Erpobdella sp.					1	0.3		
Ostracoda					1	0.3		
Amphipoda								
Gammaridae								
Crangonyx sp.					75	20.3		
Hydracarina	1	0.1					1	0.1
Collembola								
Isotomidae								
Isotomurus plaustris					1	0.3		
Plecoptera								
Perlodidae								
Isoperla patricia					2	0.5		
Nemouridae					1	0.3		
Zapada sp.	47	2.7						
Zapada cinctipes							5	0.4
Chloroperlidae	17	1.0					3	0.2
Ephemeroptera								
Beatidae								
Baetis sp.	137	7.8	255	44.0	11	3.0	647	51.2

TABLE 10-10 (Continued)
Aquatic Invertebrates Collected
Beaver Creek and Unnamed Tributary
April and June, 1981

	BC-1		BC-2		BC-3		SC-1	
Organism	#	%	#	%	#	%	#	%
Ephemerellidae								
Ephemerella sp.					2	0.5		
Heptageniidae								
Cinygmula sp.	47	2.7	59	10.2	27	7.3	85	6.7
Trichoptera								
Rhyacophilidae								
Rhyacophila sp.	41	2.3	29	5.0			2	0.2
Hydropsychidae								
Hydropsyche sp.								
-larvae			1	0.2	46	12.4		
-pupae					6	1.6		
Limnephilidae								
Hesperophylax sp.	5	0.3	11	1.9	50	13.5	11	0.9
Oligophlebodes sp.							1	0.1[2]
Coleoptera								
Dytiscidae					1	0.3		
Agabus sp.								
-adult			2	0.3				
-larvae			1	0.2	2	0.3		
-pupae			1	0.2	1	0.3		
Elmidae								
Zaitzevia sp.								
-larvae					6	1.6		

TABLE 10-10 (Continued)
Aquatic Invertebrates Collected
Beaver Creek and Unnamed Tributary
April and June, 1981

	BC-1		BC-2		BC-3		SC-1	
Organism	#	%	#	%	#	%	#	%
Diptera								
Chironomidae								
-larvae	1256	71.9	41	7.1	99	26.8	291	23.0
-pupae	2	0.1	2	0.2	1	0.3		
Ceratopogonidae							20	1.6
Psychodidae							1	0.1
Tipulidae -pupae					1	0.3		
Tipula sp.	7	0.4	2	0.3	3	0.8	6	0.5
Ormosia sp.	1	0.1	2	0.3				
Dicranota sp.	33	1.9	6	1.0	1	0.3	37	2.9
Hexatoma sp.			1	0.2	13	3.5	1	0.1
Stratiomydidae					7	1.9		
Euparyphus sp.					7	1.9		
Simuliidae								
Simulium sp.			8	1.4				
Prosimulium sp.	2	0.1	8	1.4				
Empididae								
-larvae			1	0.2				
-pupae			1	0.2				
Gastropoda					1	0.3		
Pelecypoda					1	0.3		
Sphaeriidae								
TTOAL NUMBER TAXA	16		18		22		16	
TOTAL NUMBER ORGANISM	1746		580		370		1236	

TABLE 10-11

Physiochemical Water Characteristics of Samping Sites

Beaver Creek and Unnamed Tributary

April and June, 1981

	Site			
Parameter	BC-1	BC-2	BC-3	SC-1
Dissolved Oxygen (mg/l)	6.0	5.0	6.0	7.4
Alkalinity (mg/l)	274.0	274.0	308.0	-----
Hardness (mg/l)	257.0	257.0	274.0	257.0
pH	8.0	8.0	8.0	7.7
Water Temperature	14.0	17.5	20.0	1.0

SITE BC-2 was located just below several active and inactive beaver ponds and just above the confluence with Springs Creek. The banks at and above BC-1 were eroded and unstable, apparently partly due to realignment of the stream because of the Beaver activity. Heavy use of the area by livestock probably contributed to this condition. Riparian Blue Spruce, Subalpine Fir and Willows provided a partial canopy; branches from terrestrial fall-in and broken beaver dams cluttered the stream, but there were relatively few leaf packs. Gravel and rubble were the most common substrate constituents and silt covered coarse substrate in slow-velocity reaches. The slight gradient and meandering character of the stream near BC-2 resulted in several pools, but the dominant flow patter was riffle. Mean stream width and depth were 50cm and 10cm, respectively. Depth of pools die not exceed 45cm.

The Mayfly Baetis sp. was the most abundant organism collected at BC-2 (44.0) percent, but six taxa (Planariidae, Oligochaeta, Cinygmula sp., Rhycophila sp., Hesperophylax sp., and Chironomidae) occurred in moderate numbers.

The water at BC-2 remained slightly alkaline, but the slower flows and limited shading resulted in warmer temperatures of 17.5^{o}C in June (Table 10-11).

SITE BC-3 was located in an area where the valley was broader and the stream was incised. The most common vegetation on the flood plain was Sagebrush and shade was provided only where the stream ran along the root of a forested north-facing slope. Poor bank stability resulted in a layer of fine sediments over the native gravel rubble substrate. In pools the substrate was primarily sand and silt. Mean stream width was 90cm; depth ranged from 10cm in riffle runs to 50cm in pools. Several tree limbs were in the water, but there was little leaf litter.

At least twenty-two invertebrate taxa were collected at BC-3 and no single taxon dominated the community. Chironomids, the most common form, and the Amphipod Crangonyx, accounted for only 26.8 percent and 20.3 percent of the Invertebrates collected. Five taxa (Oligochaeta, Baetis sp., Cinygmula sp., Hydropsyche sp.) were moderately abundant (Table 10-10).

Chemical characteristics of the water at BC-3 were not significantly different from those recorded at upstream sites, except that the water temperature was slightly higher at 20°C (Table 10-11).

SITE SC-1 was located on the unnnamed tributary ("Spring Creek"), approximately 50m above its confluence with Beaver Creek and just below the spring which provides most (about 75 percent) of its flow, and its unofficial name. Above the spring, most of the flow was from snow melt during both the late-April and mid-June surveys. The stream was marked by several abandoned and barely distinguishable beaver ponds, none of which appeared to have held water for a number of years (based on vegetational re-establishment). Scattered Blue Spruce shaded portions of the stream, and grasses retained the banks. The substrate was primarily sand and gravel interspersed with a few larger stones. Width was not greater than 60cm and depth did not exceed 6cm. The main flow patter was run; no true pools were present in the sampled stretch.

The Mayfly Baetis sp. and Chironomids were the most common (51.2 percent and 23.0 percent, respectively) of the sixteen taxa collected at the site. Oligochaeta, Cinygmula sp., Ceratopogonidae, and Dicranota sp., were found in moderate numbers. A Caddisfly Oligophlebodes, and a Mothfly Psychodidae were unusual occupants of the creek (Table 10-10).

The chemical characteristics of the water in the unnamed tributary were similar to those of Beaver Creek; the markedly colder temperature (1^{o}C) was related to its proximity to a spring and the fact that data was recorded in April at that site versus June at the Beaver Creek site.

The invertebrate community of the creek changed notably in a downstream direction. Site BC-1 produced the greatest number of organism, but community diversity was lower than at downstream sites. Downstream communities were not dominated by one or two taxa as was BC-1. The invertebrate community of the unnamed tributary was more similar to that of BC-1 than to BC-2 and BC-3.

The differences in community composition and structure probably were at least partially attributable to the overall character of the aquatic habitat. Site BC-1 was in a typical Subalpine zone, but at BC-2 and BC-3 the creek had emerged into a more open, Sagebrush dominated terrestrial area with more erodible streambed material. Between BC-1 and BC-3, several beaver ponds interrupted flow patterns, contributed to higher water temperatures, and altered the nutrient production and transport capabilities of the stream.

Relatively low diversity and Chironomid dominance of the BC-1 Invertebrate community was partially a function of the ephemeral character of the stream in its upper reaches.

Streams subject to periodic desiccation are less likely to support a diverse community than perennial streams and only those forms adapted to survival in such areas are likely to be successful.

Although sedimentation was greater at BC-2 and BC-3 than at BC-1, the greater physical stability of the system in the

lower reaches contributed to greater community diversity. Moreover, sediment transport probably did not exceed threshold tolerances of most invertebrates occupying the lower reaches. Additionally, the reduced Riparian canopy below BC-1 and the beaver ponds enhanced autochthonous productivity for the benefit of the invertebrate communities in the lower reaches. Such a change in the energy dynamics of the system would allow forms unable to survive the "oligotrphic" upper reaches to survive the more nutrient-enriched lower reaches.

Site BC-1 had no taxa unique to it, but two forms (Hydracarina and Chloroperlidae) were shared only with Site SC-1. In contrast, at least fourteen taxa were fould only at Sites BC-2 and/or BC-3. An explanation may be that Oligophlebodes sp. and Psychodidae are not particularly common forms. However, differences between the communities of the unnamed tributary and Sites BC-2 and BC-3 may be an artifact of season samples rather than actual differences. Each form peculiar to Site SC-1 very likely occurs in Beaver Creek but had already hatched when Beaver Creek was sampled six weeks later.

Seven forms (Oligochaeta, Baetis sp., Cinygmula sp., Hesperophylax sp., Chironomidae Tipula sp., and Dicranota sp.) were common to all sites. Each is a relatively large group, has representatives in a variety of habitats, and is widely distributed.

More intensive sampling of Beaver Creek and its unnamed tributary probably would reduce the number of taxa limited to particular reaches, but the patterns discerned would remain similar.

10.3.3 Species of Special Significance

In addition to the prevalent terrestrial Vertebrates described above, including those listed by DWR as being of high priority to Utah, are a number of species which are of special significance for legal reasons. These include species listed by FWS as "threatened" or "endangered" at the national level or as "Migratory Birds of High Federal Interest."

10.3.3.1 Threatened and Endangered Species

Listed "t and e" species potentially present in the study are the American Peregrine Falcon Falco peregrinus anatum, which breeds in Utah; Arctic Peregrine Falcon Falco peregrinus tundrius, which migrates through Utah, and Bald Eagle Haliaeetus leucocephalus, which Winters in Utah.

None of the species is likely to occur in the study area, because habitats are marginal. However, areas of potential occurrence include Riparian Forests for the Bald Eagle, cliff areas in the region for the American Peregrine Falcon, and upland areas for the Arctic Peregrine Falcon. Bald Eagles are known to use Riparian Woodlands along lower Gordon Creek and the Price River as Winter roosts (DWR 1981a). In the event any T and E Species are observed on site, the U.D.W.R. will be notified.

10.3.3.2 Migratory Birds of High Federal Interest

This group of especially significant species is comprised of 22 bird species identified by FWS as occurring in the Uintah-Southwestern Utah Coal Production Region (see Section 10.2.2.2 for a summary of criteria used in compiling this list);

1. Bald Eagle
2. Golden Eagle
3. Ferrunginous Hawk
4. Cooper's Hawk
5. Peregrine Falcon
6. Merlin
7. Osprey
8. Spotted Owl
9. Burrowing Owl
10. Flammulated Owl
11. Sandhill Crane
12. Great Blue Heron
13. Long-billed Curlew
14. Band-tailed Pigeon
15. Williamson's Sapsucker
16. Lewis' Woodpecker
17. Black Swift
18. Western Bluebird
19. Scott's Oriole
20. Grace's Warbler

Based on information provided by DWR (9178, 1981a) and site-specific field surveys, seven of these species are actually or potentially present in the study area, besides the Bald Eagle, Golden Eagle, Peregrine Falcon, and Band-Tailed Pigeon previously discussed in this report.

The most likely listed raptors are the Flammulated Owl Otus flammeolus and Cooper's Hawk Accipter cooperii, which occur in the Wasatch Plateau and prefer wooded country, such as Riparian and Conifer Forest. The Prairie Falcon Falco mexicanus is a potential breeder as well, with the availability of cliffs for nesting and open areas for hunting within a relatively short distacnce.

Williamson's Sapsucker Sphyrapicus thyroideus was determined to breed in the study area during site-specific field studies. The presence of this species is not surprising because the open Aspen/Conifer Mosaic provides preferred nesting habitat (Crocket and Haddow, 1974; Crockett and Hansley, 1978) and it has been reported as breeding in "all the mountainous counties of the State" (Hayward et al, 1976:120). Although no nests were located, the status of Williamson's

Sapsucker as a breeder was inferred from observations of courting adults in Spring and juveniles (in the same area) in late-Summer. The area in which the Sapsuckers were observed was an open Aspen stand about 0.5km west of the mine site in southwestern Setion 18. The nest, though not located, is believed to have been in an open stand of mature Aspen about 3/8-mile west and northwest of the mine site.

The Black Swift Cypseloides niger also breeds in the Wasatch Plateau (DWR, 1978), generally on cliff sites near or behind a waterfall. The near absence of Mesic cliff sites in the study area greatly reduces the likelihood that the Black Swift is present as a breeder. However, it would not be surprising for Black Swifts to use the area for hunting because they are wide-ranging in their search for insect prey. White Throated Swifts Aeronautes saxatalis were common along cliffs in the study area, but this species is of no special status in Utah.

The Purple Martin Progne subis is known to occur during the Summer in open Conifer or Aspen Forests in the Wasatch Plateau region. Because these preferred habitats are widespread in the study area, Purple Martins should be expected to occur occasionally. However, none was observed during site-specific field studies in 1980-1981.

The Western Bluebird Sialia mexicana is the other listed species which would not be particularly surprising in the study area, based on known occurrence elsewhere in the Wasatch Plateau and habitat preference (i.e., open Conifers, from Pinion/Juniper to Spruce/Fir). This species most likely would occur as isolated pairs in the breeding season or as small

flocks at lower elevations in the Winter; none was observed during field studies. As noted previously, the closely related Mountain Bluebird is a common resident in the study area, utilizing Aspen cavities for breeding and open Pinion/Juniper for winter foraging.

10.4 Potential Impacts on Fish and Wildlife

Wildlife impacts typically can be categorized into three groups: loss of modification of habitat; disturbance; and mortality.

The limited amount of surface disturbance associated with the Gordon Creek No. 2 and No. 7 Mines will result in a total habitat loss of about 16.68 acres during the life of the mines. With the mines in existence, this loss of habitat has already occurred. Virtually all of the mine activity is confined to the Mountain Brush and Middle Elevation Conifer habitat types, and it does not appear that this loss of habitat has had a significant impact on wildlife in the permit area.

Disturbance of furtive species results from the levels of notice and activity associated with an operational mine. Thus, most large species of Birds and Mammals (including, for example, Deer, Carnivores and Raptors) tend to avoid the mine site, at least during working hours. Most of these species are likely to move freely around the mine site on weekends and to quickly reinhabit the area after decommissioning.

Two types of mortality potentially are associated with operation of the Gordon Creek No. 2 and No. 7 Mines: Raptor electrocution on unsafe power poles and Mammal road kills.

A Raptor hazard survey was conducted for Beaver Creek Coal Company in conjunction with baseline field studies. The results of this survey indicate that the four-phase line running from the substation at the abandoned townsite of National (Figure 10-1) represents a potential hazard because of the closeness of two conductors on one side of the cross arm (Figure 10-14). However, the actual hazard probability is slight because (1) the positioning of the poles relative to adjacent topography would tend to limit use; (2) most of the Raptors commonly present in the area are not frequent users of power line perches; and (3) the least safe pole designs are near the active mine, where Raptor use probability is minimal. This conclusion was confirmed by Raptor Biologists, Ron Joseph and Bruce Waddell, of the U.S. Fish and Wildlife Service (FWS), who visited the site in August, 1981.

The power poles below National are somewhat safer, with three well separated phase lines. However, the ground wire should be clipped to form a 4- to 6-inch gap below the cross arm to eliminate the risk. These poles also appeared to receive little use in the study area. A few km to the east, along the haul/access road, these poles are a more prominent feature on the flat landscape (Figure 10-15) and appeared to receive somewhat more use -- probably especially during the Winter.

The power poles below National belong to Utah Power & Light Co., and Beaver Creek Coal Company has no authority nor responsibility to modify these poles. The newly installed poles for the Gordon Creek No. 7 Mine were fitted with approved raptor protection in August, 1984, as requested by the 7/30/84 letter (Bouchek to Guy).

In the summer of 1989, all power poles from the lower sub-station (near Consumers) to the No.2 Mine site sub-station were checked for raptor use. No evidence of use was noted; however, at the request of the Division, a 4" gap was cut in each of the pole ground wires as added protection against raptor electrocution. As mentioned above, all other mine site (No.7 Mine poles were fitted with raptor guards, with the exception of 3 poles in the No.2 Mine yard. These poles were examined by officials of U.S.F.W. and D.W.R. in June of 1989, and the concensus was that pole modifications were not required due to the location, pole configuration and unlikely probability of raptor use. On August 3, 1989 these poles were once again examined by D.W.R. officials (Mr. Dalton and Mr. Merritte). Once again Beaver Creek Coal Company was requested to continue to evaluate raptor usage on the poles, but not to modify the poles without further justification.

Mule Deer road kills along the Gordon Creek haul/access road have been monitored by Beaver Creek Coal Company. In the interval from May, 1980, to May, 1981, only two Deer road kills were recorded; this represents a very small percentage of both the wintering herd and the total population of the game management unit. Most of the road kill problem is along a stretch beginning about 1- to 1.5-km below the turnoff to Beaver Creek Coal Company's Gordon Creek No. 3 and No. 6 Mines. The major factor contributing to

mortalities in this stretch is that the road passes through an area of Sagebrush, chained Pinion/Juniper, and pasture maintained by DWR as Winter habitat (Figure 10-8). The Winter herd in this area was about 500 animals in 1980 and 1981 and Deer remained until late-Spring despite the unusually mild Winter (probably to take advantage of emergent alfalfa and range grasses).

Another factor in the higher road kill rish through the "Cedar Bench" section may be that since the road is fairly straight and flat, trucks tend to go faster than through hilly and curvy sections nearer the mines. Also, much of the road near the mines is bordered by a low cliff, which serves as an effective barrier to Deer movement. Figures 10-16a, b and c, show areas of heaviest Deer crossings, based on track count in Winter, 1980 and 1981, and analyses of vegetation and topographical features. Steep cliff faces adjacent to the haul/access road serve as effective barriers along part of Upper North Fork Gordon Creek.

In 1987 the Utah Division of Wildlife Resources assumed the annual concensus of road kills on the mine haulage road. This data is available upon written request from the U.D.W.R. - S.E. Region - Attention: Mr. Larry Dalton.

Impacts to aquatic ecosystems have been minor. North Fork Gordon Creek apparently has sustained a change in the character of the Macroinvertebrates as a result of an increased suspended load below Bryner Canyon. Much of this appears to be naturally related to soil erodibility, although the adjacent road and the water collection point undoubtedly are contributors. The increased siltation below Bryner Canyon has had much less influence on the quality of the North Fork Gordon Creek aquatic ecosystem than the low and variable flows.

Beaver Creek has been essentially unaffected by mining or exploratory drilling programs in the Beaver Creek valley. This situation is not expected to change with continued operation. (See Appendix 7 for an Aquatic Baseline Survey of this area.)

The potential impact of undermining and showing pillars in the area below Beaver Creek is discussed under Appendix 6 of the M.R.P.

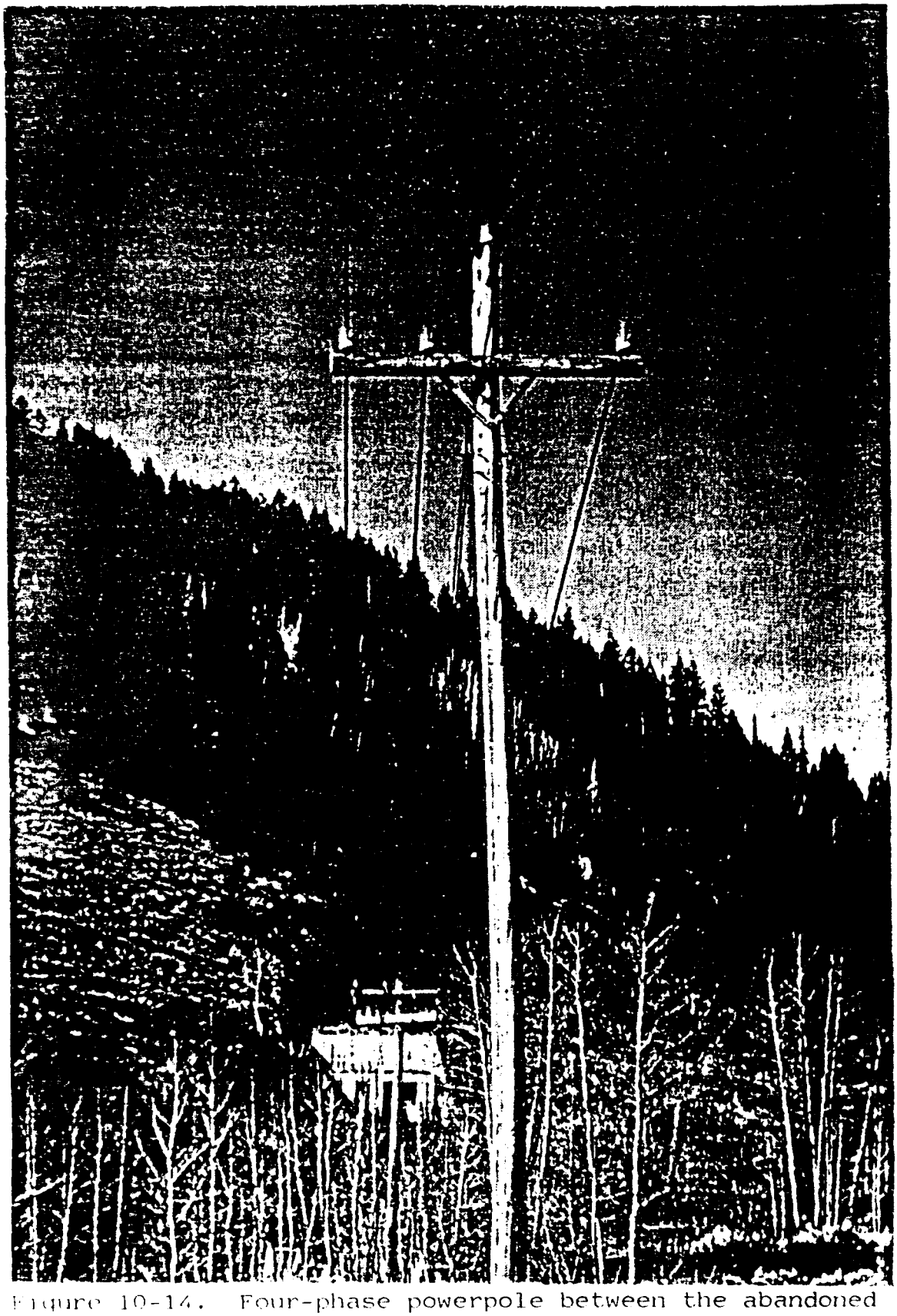


Figure 10-14. Four-phase powerpole between the abandoned townsite of National and the mouth of Bryner Canyon. The two left hand conductors are close enough to pose a potential bird hazard (but see text discussion).

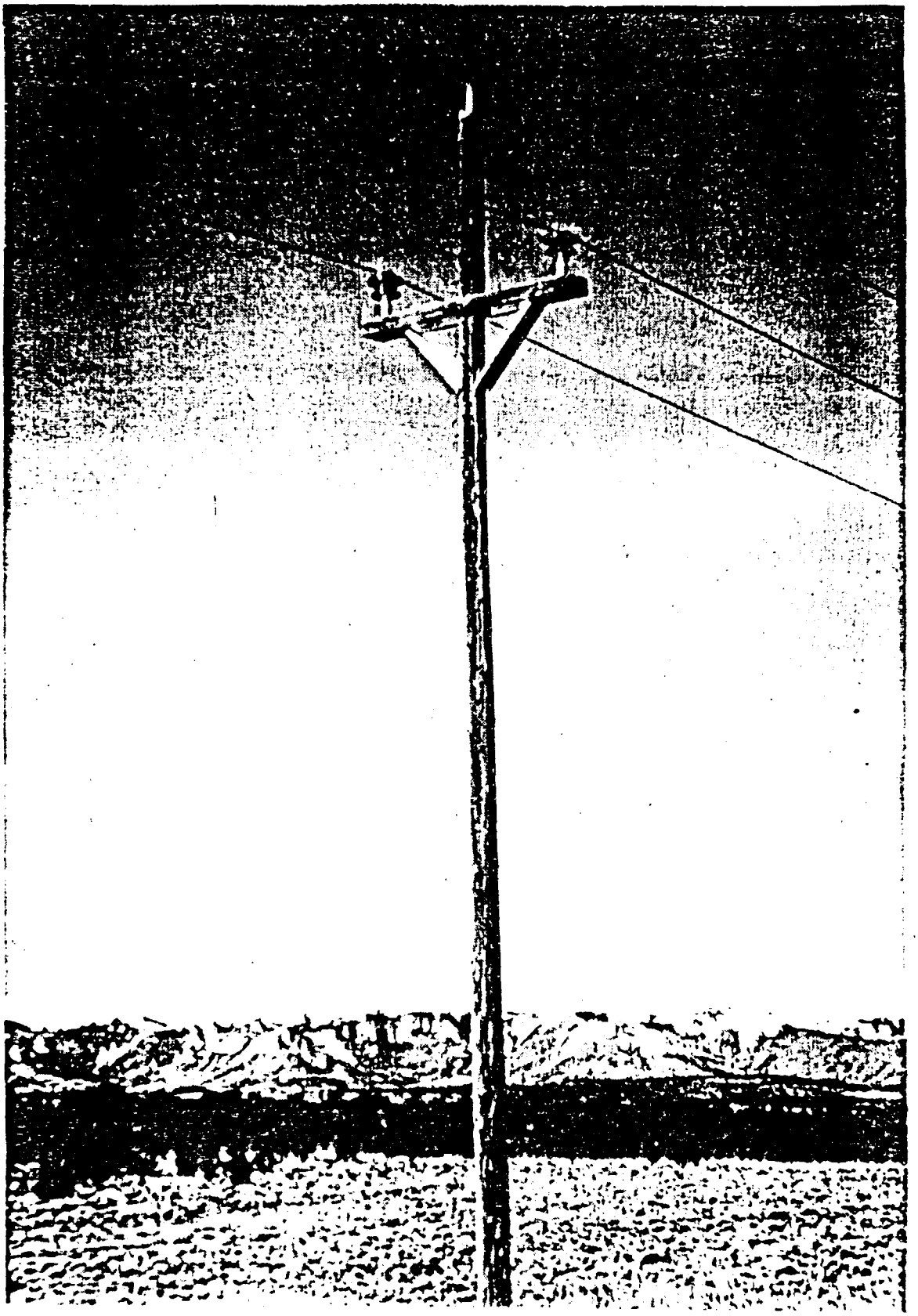
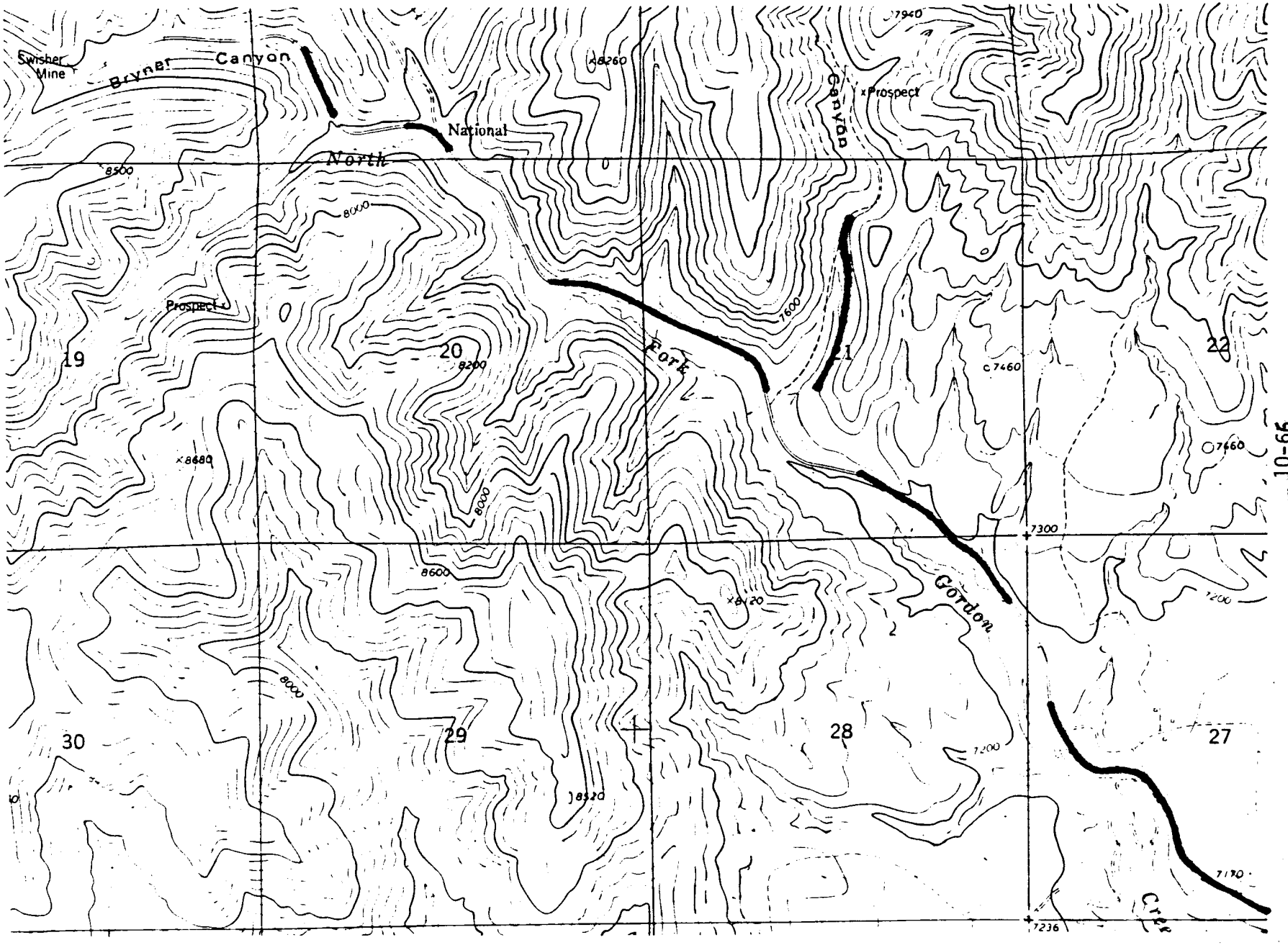


Figure 10-15. Typical three-phase powerpole along the access haul road east of the study area. This configuration is raptor-proof, except for the upward extension of the ground wire to the crossarm (see text discussion).



10-65

6/26/89

Figure 10-16a. Areas of frequent deer crossings (▬) along the upper section of the Gordon Creek No. 2 Mine ha[illegible]ccess road (left fork). Steep rock faces and [illegible]d cuts serve as movement barriers in parts of t[illegible] road segm[illegible]t.

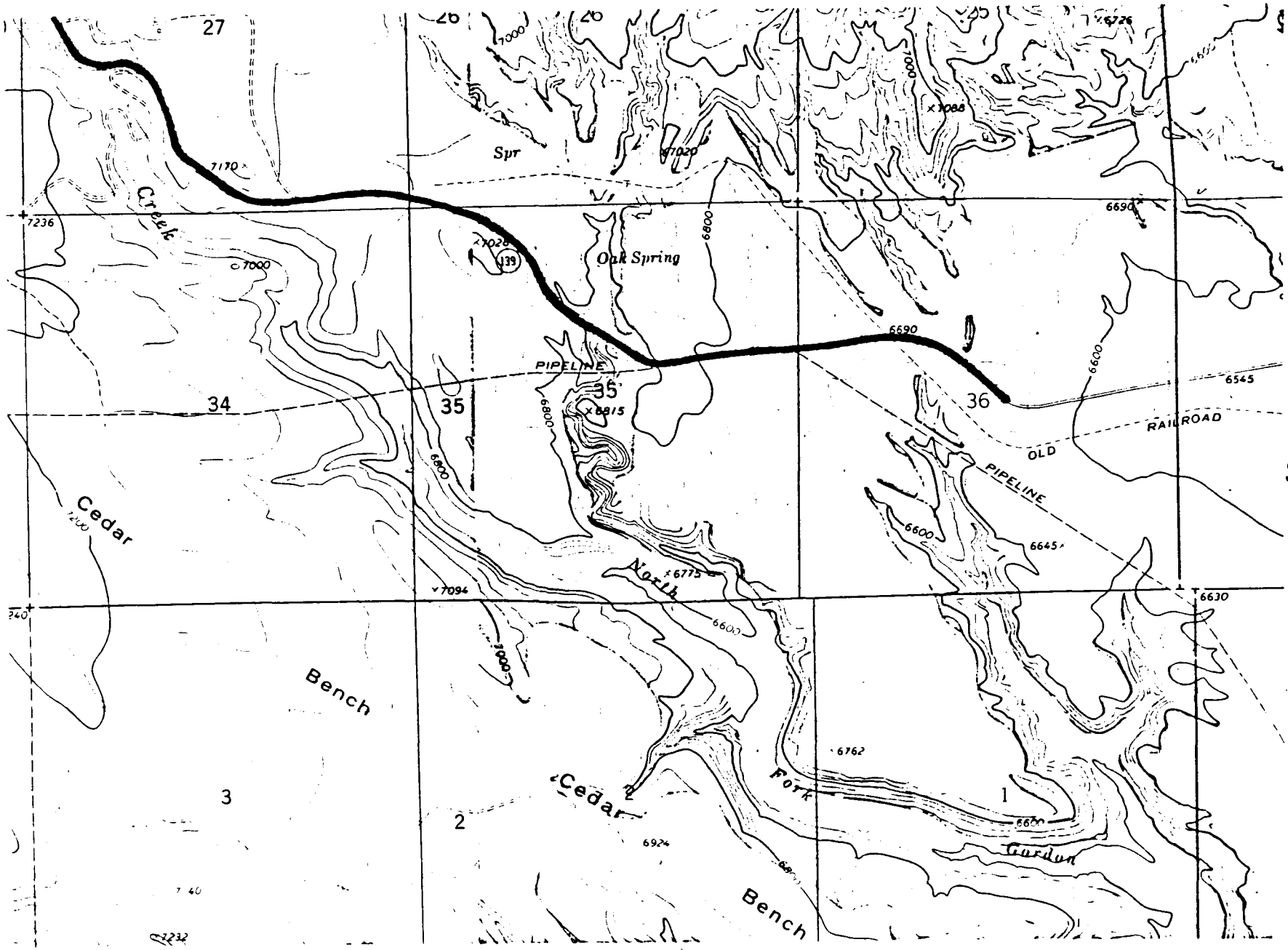


Figure 10-16b. Areas of frequent deer crossings (▬) along the middle section of the Gordon Creek haul/access road. Flat areas in the northwestern corner and on Cedar Bench are pastures maintained by DWR.

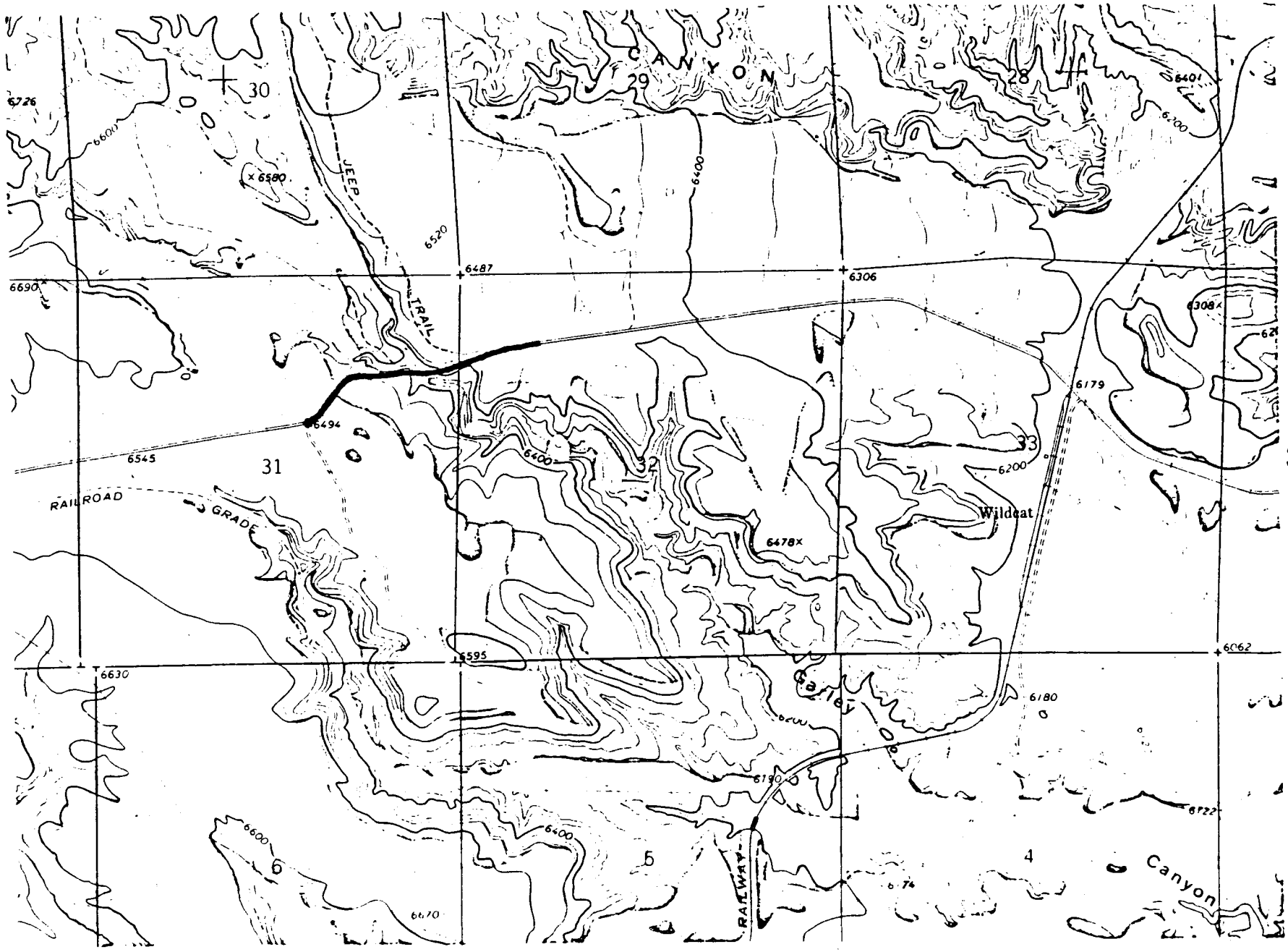


Figure 10-16c. Areas of frequent deer crossings (▬) along the lower section of the Gordon Creek haul/access road. The drainage (Garley Creek) is a movement corridor within chained pinyon/juniper maintained by DWR.

The surface disturbance associated with the development of the No. 7 Minee is approximately 7.5 acres. This increases the total disturbed area for the Gordon Creek No. 2 and No. 7 Mine area to approximately 16.68 acres. The total disturbance is classified as insignificant according to the Utah Division of Wildlife Resources. Significant disturbances are considered by DWR to be 25 acres or more. The habitat types to be affected by the proposed disturbance are Mountain Shrub (3.1 acres), Middle Elevation Conifer (2.7 acres) and Aspen Woodland (1.7 acres). Approximately 0.4 acres of the above habitats are of a Riparian nature.

Baseline studies indicate that the No. 7 Mine disturbance is located within an area identified as crucial - critical Winter range for Elk. Potential impacts appear to be minimal since the proposed disturbance occupies a very small amount of that range.

DWR has stated that the No. 7 Mine conveyor system and access road may represent a barrier to big game movement. Impacts of this nature are minimized by the relatively short length of the conveyor/access road corridor (approximately 1600 feet) as well as the specific measures described in Sections 10.5 and 3.4.1.1.

The FWS has stated that the No. 7 Mine disturbed area will encroach upon an active Raptor territory. This is based upon the siting of two nests within the proposed area of disturbance. According to FWS the nests were assumed to be those of an Accipiter and although no nest-related activity has ever been observed, the condition of one of the nests indicated some maintenance. Exploration related to this project has destroyed both nests. Mitigation measures undertaken under the exploration project are discussed in Section 10.5.

The U.S. Fish and Wildlife Service also has identified the No. 7 Mine disturbed area as having a possible impact on potential habitat for the Williamson Sapsucker. This is based upon an apparent siting of that species in a large stand of Aspen located near the Right Fork of Bryner Canyon. Again, impacts should be minimal since the disturbance of potential Williamson Sapsucker habitat is limited when compared with the remaining available habitat (approximately 1.7 acres disturbed out of 534 acres of available Aspen habitat).

10.5 Mitigation and Management Plans

The mitigation and management procedures for protection and enhancement of wildlife in the No. 7 Mine area are the same as those described in Section 3.4.6.2 and 10.5 of the Gordon Creek No. 2 and No. 7 Mines Permanent Program Permit to Mine. Those measures are summarized in Table 10-1.

Several additional mitigation measures are being proposed to address specific impacts from the No. 7 Mine. These are summarized in Table 10-2 and discussed in the paragraphs below.

The mitigation and management plans focus on minimizing impacted related to continued mining activities and facilitating rapid return to the site to suitable habitat after decommissioning.

Many of the mitigation and impact avoidance procedures utilized in the following sections have been drawn from information provided to Beaver Creek Coal Company by DWR (1981a). A number of these measures also were proffered by

Beaver Creek Coal Copmpany in their interim submittal to DOG&M, which was prepared prior to receipt of DWR's document.

10.5.1 Terrestrial Habitats and Wildlife

DWR (1981b) emphasized three basic aspects to mitigation and impact avoidance for the terrestrial habitats at the Gordon Creek No. 2 Mine: habitat and wildlife protection; reclamation; and wildlife management.

Habitat protection measures center on avoiding especially important or sensitive areas such as Riparian zones, and not using persistent pesticides which would diminish the long-term health of an ecosystem.

Reclamation is particurlarly important as a means of controlling erosion and restoring disturbed areas to protective wildlife habitat. Recommended procedures in achieving the reclamation goal include: (1) planting a diverse mixture of native grasses, forbs, and (where appropriate) woody species; (2) using seedling stock rather than relying solely on seeds for trees or shrubs; (3) planting vegetation to create an edge effect by clumping selected shrub or tree species; (4) actually transplanting stock or turf from new disturbed sites to reclaimed sites; and (5) leaving islands of natural vegetation in new disturbed sites.

Wildlife management is important for minimizing harmful effects (e.g., fencing animals out of areas containing toxic substances) and preventing damage to newly reclaimed areas (e.g., excluding large Herbivores and possibly controlling Rodents).

Direct impacts on springs and seeps on, or adjacent to the permit area are not expected based on past mining experience in the area. However, if mining operations negatively impact these features, Beaver Creek Coal Company will plan to mitigate these impacts through one or a combination of the following measures:

(1) Direct replacement or rapair of affected structure;
(2) Establishment of comparable structure (quality and quantity);
(3) Construction of holding ponds, watering troughs, or other devices to provide additional water from runoff or precipitation events;
(4) Enhancement of reparian areas through reclamation.

See Section 7 for a discussion of the permit area hydrology. Specific types of mitigation, impact avoidance, and wildlife management procedures recommended by DWR (1981b) and Beaver Creek Coal Company consultants include the following.

10.5.1.1 Mammals

For small Mammals, most of which are secretive and have small home ranges, mitigation will be almost totally related to habitat protection and reclamation (i.e., ways of minimizing short- and long-term habitat loss). For larger species, such as big game Carnivores and Ungulates, the problem is complicated by their large home ranges, seasonal movements and sensitivity to disturbance.

Disturbance-related impacts will be mitigated to a significant extent by Beaver Creek Coal Company policies against harassing or hunting wildlife in the permit area. These policies will continue throughout the operation of the mines. Further, "employee awareness" programs will specifically inform mine personnel of especially sensitive periods or habitats such as Deer fawning seasons and areas, Bear dens, critical Winter areas, and so forth. In addition, these sensitive aspects of the ecosystems will be avoided during future exploration, operation and reclamation activities.

10.5.1.2 Birds

Like small Mammals, Song Birds and other small species are most sensitive to habitat loss, and mitigation will, therefore, focus on habitat protection and reclamation. In addition, active nests or nest trees will not be disturbed.

For Raptors and Game Birds which, like large mammals are more wide-ranging and susceptible to disturbance, an employee awareness program will ensure that active nests or other crucial - critical use areas are avoided during the sensitive season and that the birds are not harassed or killed. The potential Raptor electrocution hazard posed by some power line pole configurations has been determined by FWS Raptor Biologist, Ron Joseph, to not require corrective modification (see Section 10.4). Various other modifications have been made to the power poles, as described in Section 10.4.

10.5.1.3 Reptiles and Amphibians

Besides minimizing habitat loss and restoring native vegetation, the principal mitigation measures for reptiles will be to avoid killing individuals and to not disturb or destroy Snake dens, Amphibian breeding ponds and other sensitive use area.

10.5.2 Aquatic Habitats

Habitat loss or deterioration of the North Fork Gordon Creek aquatic ecosystem has been limited by constructing sediment ponds to protect the stream from an increased sediment load from the mine-affected area via Bryner Creek. Additional details of these procedures for protecting stream quality are provided in Sections 3.2.8, 3.2.9, 7.2.3 of the Plan.

Table 10-12 GENERAL MEASURES UNDERTAKEN TO MITIGATE IMPACTS TO FISH AND WILDLIFE

Mitigation Measure	Impact Addressed	Location of Discussion *
Minimization of Disturbance	Destruction of Habitat Sedimentation of Streams	Section 3.4.6.2 - GCMRP Section 10.5 - GCMRP Section 3.4.1.1 - SWL
Company Policy Against Harassment	Harassment of Wildlife	Section 3.4.6.2 - GCMRP Section 10.5 - GCMRP Section 3.4.1.1 - SWL
Employee Awareness Programs	Harassment of Wildlife Destruction fo Habitat Sedimentation of Streams Wildlife Roadkills	Section 3.4.6.2 - GCMRP Section 10.5 - GCMRP Section 3.4.1.1 - SWL
Traffic Control (i.e. speed limits, signs, etc.)	Wildlife Roadkills	Section 3.4.6.2 - GCMRP Section 10.5 - GCMRP Section 3.4.1.1 - SWL
Power Pole and Power Line Design	Raptor Electrocution	Section 3.4.6.2 - GCMRP Section 10.5 - GCMRP
Sedimentation Pond Design and Construction	Sedimentation of Streams	Section 3.4.6.2 - GCMRP Section 10.5 - GCMRP Section 3.4.1.1 - SWL Section 3.4.3.2 - SWL
Diversion Design and Construction	Sedimentation of Streams	Section 3.4.6.2 - GCMRP Section 10.5 - GCMRP Section 3.4.1.1 - SWL Section 3.4.3.2 - SWL

* GCMRP - Gordon Creek No. 2 Mine Permanent Program Application; SWL - Southwest Lease (No. 7 Mine)

Table 10-12 GENERAL MEASURES UNDERTAKEN TO MITIGATE IMPACTS TO FISH AND WILDLIFE (cont.)

Mitigation Measure	Impact Addressed	Location of Discussion *
Roadway Dust Control	Sedimentation of Streams	Section 3.4.6.2 - GCMRP Section 10.6 - GCMRP
Minimization of Areas Fenced To Preclude Wildlife	Barriers to Wildlife Movement	Section 3.4.1.1 - SWL
Contemporaneous Revegetation	Destruction of Habitat Sedimentation of Streams	Section 3.4.6.2 - GCMRP Section 10.5 - GCMRP Section 3.5.5.2 - SWL
Permanent Revegetation	Habitat Destruction Sedimentation of Streams	Section 3.4.6.2 - GCMRP Section 10.5 - GCMRP Section 3.5.5.2 - SWL
Permanent Reclamation an Site Abandonment	Destruction of Habitat Sedimentation of Streams Harassment of Wildlife Barriers to Wildlife Movement Wildlife Roadkills	Section 3.4.6.2 - GCMRP Section 10.5
Periodic Water Quality, Wildlife and Subsidence Monitoring	Sedimentation of Streams Destruction of Habitat	Section 10.7 - GCMRP Section 10.6 - SWL

* GCMRP - Gordon Creek No. 2 Mine Permanent Program Application; SWL - Southwest Lease (No. 7 Mine)

Table 10-13 SITE SPECIFIC MEASURES UNDERTAKEN TO MITIGATE IMPACTS TO FISH AND WILDLIFE

Mitigation Measure	Impact Addressed	Location of Discussion *
Location of Portals in Area Requiring Least Disturbance	Destruction of Habitat Sedimentation of Streams	Section 3.2.1 - SWL Section 3.4.1.1 - SWL
Location of Portals Near Existing Disturbance	Destruction fo Habitat Sedimentation of Streams Harassment of Wildlife	Section 3.2.1 - SWL
Use of Overland Conveyor Rather Than Haul Road	Destruction of Habitat Sedimentation of Streams Wildlife Roadkills	Section 3.2.6 - SWL
Conveyor Design - Construction 40 Inches Above Ground Level	Barrier to Wildlife Movement	Section 3.2.6 - SWL Section 3.4.1.1 - SWL
Conveyor Design - Elk Crossings	Barrier to Wildlife Movement	Section 3.2.6 - SWL Section 3.4.1.1 - SWL Section 10.5 - SWL
Fencing Design	Barrier to Wildlife Movement	Section 3.4.1.1

* GCMRP - Gordon Creek No. 2 Mine Permanent Program Application; SWL - Southwest Lease (No. 7 Mine)

Impacts to Elk crucial - critical Winter range are mitigated by minimizing disturbance to that habitat/range as well as attempting to provide points of passage along the access road/conveyor corridor. Mitigation factors emphasizing minimal disturbance included establishing the portals in the near proximity of the existing Gordon Creek No. 2 Mine disturbance and the construction of an overland conveyor rather than a haul road (discussed in Section 3.2.6).

Also, two crossing areas have been established along the conveyor/access road corridor to allow passage of Elk across the canyon. The crossing locations and designs were chosen after consultation with DWR, DOG&M and BLM. It should be noted that the locations of these points were chosen without the support of field data. The crossing designs and construction plans are provided in Section 3.4.1.1.

If the conveyor is determined to be a significant barrier to Elk migration appropriate mitigation measures will be applied. Alternatives for these are attempting to divert the Elk movement around the disturbed area by establishing feeding stations outside the disturbed area perimeter or by adjusting the conveyor to address the specific impacts on migration. Selection of appropriate mitigation will be discussed with the regulatory authority prior to implementation.

Wildlife migration through the No. 7 Mine area should not be hindered by fences. Presently, Beaver Creek mining or reclamation plans do not call for precluding wildlife using fencing. Any fencing used at the No. 7 Mine that may be in a location that will inhibit wildlife migration will follow specifications that will accommodate wildlife passage. Also, the overland conveyor from the portal to the No. 2 Mine load-out area is designed to accommodate the passage of Deer.

Minimizing disturbance to the Aspen Woodland habitat is the proposed mitigation for impacts to the Williamson Sapsucker. Beaver Creek estimates that 1.7 acres out of a total 534 acres of Aspen Woodland which occurs within the permit area will be disturbed. This corresponds to 0.3 percent of the total habitat type that will be disturbed.

Ultimately, permanent reclamation to return the area of disturbance to its pre-mining land use is the most important mitigation effort. Section 10.5.1 of the Gordon Creek No. 2 Mine Permanent Program Application discusses specific wildlife enhancement alternatives to be used. The permanent revegetation plan provides a variety of species that will increase habitat diversity providing nutritional and cover benefits for wildlife.

SPECIAL CONDITION NO. 6 Two additional mitigation measures are being implemented under the BLM exploration permit (3400, U-8319, U-066) that preceded this application as well as permits from DWR (Beaver Creek Coal Company Certificate of Registration) and FWS (83-12) for removal of one nest in the area of exploration (discussed in Section 10.4). These procedures are discussed in the paragraphs below.

Two artificial nests have been established up Bryner Canyon from the No. 7 Mine disturbance. The nests are intended for the use of Raptors and replace two inactive nests that were removed due to the proximity of the mine. Supervision of the Utah Division of Wildlife, U.S. Fish and Wildlife Service and DOG&M was obtained for this project.

On July 6, 1989 the two artificial nests where checked to see if there was any maintance or use of the structures. There was no evidence of recent use by raptors, however, approximately 1300' directly above the mine site on the South side of Bryner Canyon a new nest was observed with three Juvinal Fleged Red tailed hawks in occupancy. This new nest site is approximately one half the distance from the mine to the artificial nest site.

Also, to partially mitigate the relatively minor loss of wildlife habitat caused by construction of the pad area, Beaver Creek has established approximately four acres of Riparian

area through a combination of efforts:

(1) 3.5 acres at Desert Lake (Shoemaker Wash Project);
(2) Beaver enhancement along the North Fork of Gordon Creek;
(3) 0.5 acres during final reclamation at the Gordon Creek No. 3/6 Mines.

It should be noted that the commitments to establish the artificial nests in upper Bryner Canyon and the Riparian habitat at Gordon Creek No. 3 Mine were agreed to by Beaver Creek as compensation for approval of the Southwest Lease (No. 7 Mine) Exploration Plan. Because the long range mitigation procedures discussed above could not be achieved during exploration and due to the timing and large scope of the project, the Company felt that this type of mitigation was necessary. Beaver Creek Coal Company will carry out those commitments under the agreements made in those permits. However, for this permit it is felt that the mitigation measures listed in Tables 10-1 and 10-2 fulfill the requirements of 817.97.

10.6 Stream Buffer Zone Determination

The Gordon Creek No. 2 and No. 7 Mines are located along an intermittent unnamed creek ("Bryner Creek") which is tributary to North Fork Gordon Creek about 1 km east (downstream). North Fork Gordon Creek does not support other Game or Non-Game Fish. The slight contribution from the improved haul/access road (which is effectively controlled by watering) and the natural soil erosion contribution will not adversely affect the stream's value to terrestrial species.

Beaver Creek is an important stream, since it supports at least a limited Cutthroat Trout fishery. The mining operation has not impacted Beaver Creek, nor should it do so in the future since surface disturbance is limited to Bryner Canyon drainages.

10.7 Fish and Wildlife Monitoring

Beaver Creek Coal Company will conduct wildlife monitoring throughout the operational life of the Gordon Creek No. 2 and No. 7 Mines. The monitoring will utilize the services of full-time environmental specialist and, as necessary, professional consultants to evaluate the on-going success of operational mitigation measures, ensure that threatened or endangered species and sensitive or critical use areas remain undisturbed by future activities, deal with unforeseen difficulties which might arise, and participate in reclamation efforts upon completion of the project.

Two aspects of the monitoring program have already been initiated by Beaver Creek Coal Company: (1) monthly observations of specific stations along Bryner Canyon to monitor sediment load; (2) routine reporting by selected personnel of any road kills along the access corridor. Additional monitoring on Beaver Creek to assess impacts of second mining are discussed in Appendix 6 of this MRP.

In addition to the above, wildlife use of the Elk crossing for the conveyor/access road was to be monitored to attempt to gain additional information concerning frequency of use, as well as impacts on migration. This program has been cancelled due to unavailibility of equipment. Approved by Division on 1/9/87.

AMENDMENT TO
APPROVED Mining & Reclamation Plan
Approved, Division of Oil, Gas & Mining

by B. Stettler **date** 10/3/88

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APPENDIX - TABLE 1

Mammals in or Near the Gordon Creek No. 2 Mine Study Area

Carbon County, Utah - 1980--1981

Species	Status	Relative Abundance*	Habitat Preference*
SORICIDAE			
Northern Water Shrew			
Sorex palustris	potential	uncommon	riparian
Merriam's Shrew			
Sorex merriama	potential	uncommon	ubiquitous
Vagrant Shrew			
Sorex vagrans	likely	common	riparian, meadows
Masked Shrew			
Sorex cinereus	likely	common	moist sites
Dusky Shrew			
Sorex obscurus	likely	common	conifers, meadows
VESPERTILIONIDAE			
Little Brown Myotis			
Myotis lucifugus	likely	common	caves, riparian
Small Footed Myotis			
Myotis leibii	likely	uncommon	caves, cliffs
Long Legged Myotis			
Myotis volans	likely	common	cliffs, trees
Long Earred Myotis			
Myotis evotis	likely	common	conifers
Fringed Myotis			
Myotis thysanodes	likely	uncommon	caves, cliffs
Yuma Myotis			
Myotis yumanensis	likely	uncommon	caves
California Myotis			
Myotis californicus	likely	common	caves, cliffs
Silver Haired Bat			
Lasionycteris noctivagans	likely	common	conifers
Western Pipistrelle			
Pipistrellus hesperus	likely	common	caves, cliffs
Big Brown Bat			
Eptesicus fuscus	likely	common	caves, cliffs
Red Bat			
Lasiurus borealis	likely	uncommon	conifers, riparian
Hoary Bat			
Lasiurus cinereus	likely	uncommon	conifers, riparian
Western Big Earred Bat			
Plecotus townsendii	likely	common	caves, cliffs

* Includes on-site observation and DWR regional information

APPENDIX - TABLE 1 (Continued)

Species	Status	Relative Abundance*	Habitat Preference*
LEPORIDAE			
White Tailed Hare			
Lepus townsendii	potential	common	sagebrush, grassland
Snowshoe Hare			
Lepus americanus	likely	common	conifers, aspen
Black Tailed Hare			
Lepus californicus	potential	common	sagebrush, grassland
Mountain Cottontail			
Sylvilagus nuttallii	observed	common	conifers
Desert Cottontail			
Sylvilagus audubonii	potential	common	sagebrush, brushland
SCIURIDAE			
Red Squirrel			
Tamiascuirus hudsonicus	observed	common	conifers
Rock Squirrel			
Spermophilus variegatus	observed	common	ubiquitous
Uintah Ground Squirrel			
Spermophilus armatus	observed	common	dry meadows
Golden Mantled Ground Squirrel			
Spermophilus lateralis	observed	common	ubiquitous
Northern Flying Squirrel			
Glaucomys sabrinus	potential	common	conifers
Yellow Bellied Marmot			
Marmota flaviventris	likely	common	rocky areas
Least Chipmunk			
Eutamius minimus	observed	common	ubiquitous
Uintah Chipmunk			
Eutamius umbrinus	observed	common	ubiquitous
Cliff Chipmunk			
Eutamius dorsalis	likely	common	pinion/juniper
GEOMYIDAE			
Northern Pocket Gopher			
Thomomys talpoides	present	common	meadows
Valley Pocket Gopher			
Thomomys bottae	potential	common	meadows
HETEROMYIDAE			
Great Basin Pocket Mouse			
Perognatuus parvus	potential	common	pinion/juniper
Ord's Kangaroo Rat			
Dipodomys ordii	potential	common	pinion/juniper

APPENDIX - TABLE 1 (Continued)

Species	Status	Relative Abundance*	Habitat Preference*
CASTORIDAE			
Beaver			
Castor canadensis	potential	common	aquatic
CRICETIDAE			
Western Harvest Mouse			
Reithrodontomys megalotis	potential	common	sagebrush, grassland
Deer Mouse			
Peromyscus maniculatus	likely	abundant	ubiquitous
Canyon Mouse			
Peromyscus crinitus	likely	common	rocky areas
Brush Mouse			
Peromyscus boylii	likely	common	brushlands
Pinion Mouse			
Peromyscus truei	likely	common	pinion/juniper
Bushy Tailed Wood Rat			
Neotoma cinerea	likely	common	ubiquitous
Muskrat			
Ondatra zibethicus	likely	common	aquatic
Meadow Vole			
Microtus pennsylvanicus	likely	common	meadows
Mountain Vole			
Microtus montanus	likely	common	meadows
Richardson's Vole			
Microtus richardsoni	likely	common	meadows
Long Tailed Vole			
Microtus longicaudus	likely	common	meadows,brushland
MURIDAE			
Norway Rat			
Rattus norvegicus	potential	common	mine areas
House Mouse			
Mus musculus	potential	common	mine areas
ZAPODIDAE			
Western Jumping Mouse			
Zapus princeps	likely	common	riparian, meadows
ERETHIZONTIDAE			
Erethizon dorsatum	observed	common	wooded areas

APPENDIX - TABLE 1 (Continued)

Species	Status	Relative Abundance*	Habitat Preference*
CANIDAE			
Coyote			
Canis latrans	present	common	ubiquitous
Red Rox			
Velpes vulpes	likely	common	ubiquitous
Gray Fox			
Urocyon cinereoargenteus	likely	common	riparian, conifers
URSIDAE			
Black Bear			
Ursus americanus	present	common	ubiquitous
PROCYONIDAE			
Ring Tailed Cat			
Bassariscus astutus	potential	common	riparian, brushland
Raccoon			
Procyon lotor	potential	irregular	riparian
MUSTELIDAE			
Short Tailed Weasel			
Mustela ermineae	potential	uncommon	ubiquitous
Long Tailed Weasel			
Mustela frenata	potential	uncommon	meadows, riparian
Marten			
Martes caurina	likely	uncommon	conifers
Wolverine			
Gulo luscus	potential	common	sagebrush, meadows
Badger			
Taxidea taxus	potential	common	sagebrush, meadows
Spotted Skunk			
Spilogale putorius	likely	common	riparian, brushland
Striped Skunk			
Mephitis mephitis	likely	common	ubiquitous
FELIDAE			
Bobcat			
Lynx rufux	present	common	ubiquitous
Canada Lynx			
Lynx canadensis	potential	rare	conifers, aspen
Cougar			
Felis concolor	likely	uncommon	ubiquitous

APPENDIX - TABLE 1 (Continued)

Species	Status	Relative Abundance*	Habitat Preference*
CERVIDAE			
Mule Deer			
Odocoileus hemionus	observed	common	ubiquitous
Moose			
Alces alces	potential	uncommon	meadows, aquatic
American Elk			
Cervus elaphus	observed	common	ubiquitous

APPENDIX - TABLE 2

Birds in or Near the Gordon Creek No. 2 Mine Study Area

Carbon County, Utah - 1980--1981

Species	Status	Relative Abundance*	Habitat Preference*
PODICIPEDIDAE			
Pied Billed Grebe	Potential-		
Podilymbus podiceps	summer	uncommon	wet areas
ANATIDAE			
Mallard	Observed-		
Anas platyrhynchos	summer	uncommon	wet areas
Green Winged Teal	Observed-		
Anas discors	summer	uncommon	wet areas
CATHARTIDAE			
Turkey Vulture	Observed-		
Cathartes aura	summer	common	ubiquitous
ACCIPITRIDAE			
Goshawk	Observed-		
Accipiter gentilis	resident	common	conifers, aspen
Sharp Shinned Hawk	Observed-		
Accipiter striatus	resident	uncommon	wooded areas
Cooper's Hawk	Potential-		
Accipiter cooperii	resident	uncommon	wooded areas
Red Tailed Hawk	Observed-		
Bueteo jamaicensis	resident	common	ubiquitous
Swainson's Hawk	Likely-		
Bueteo swainsoni	summer	uncommon	ubiquitous
Rough Legged Hawk	Likely-		
Bueteo lagopus	winter	uncommon	ubiquitous
Golden Eagle	Observed-		
Aquila chrysaetos	resident	common	ubiquitous
Bald Eagle	Potential-		
Haliaeetus leucocephalus	winter	irregular	ubiquitous
Northern Harrier	Likely-		
Circus cyaneus	resident	uncommon	open areas
FALCONIDAE			
Prairie Falcon	Likely-		
Falco mexicanus	resident	uncommon	open areas
Peregrine Falcon	Potential-		
Falco peregrinus	migrant	irregular	open areas

* Includes on-site observation and DWR regional information.

APPENDIX - TABLE 2 (Continued)

Species	Status	Relative Abundance*	Habitat Preference*
Merlin	Potential-		
Falco columbarius	winter	uncommon	open areas
American Kestrel	Observed-		
Falco sparverius	resident	uncommon	open areas
TETRAONIDAE			
Blue Grouse	Observed		
Dendragapus obscurus	resident	common	conifers, aspen
Ruffed Grouse	Observed-		
Bonasa umbellus	resident	common	brushlands, aspen
Sage Grouse	Potential-		
Centrocercus urophasianus	resident	uncommon	sagebrush
PHASIANIDAE			
California Quail	Potential-		
Lophortyx californicus	resident	common	brushlands
Chukar Partridge	Potential-		
Alectoris chukar	resident	common	rocky areas
Ring Necked Pheasant	Potential-		
Phasianus colchicus	resident	common	agricultural
ARDEIDAE			
Great Blue Heron	Potential-		
Ardea herodian	summer	uncommon	wet areas
Snowy Egret	Potential-		
Egretta thula	summer	irregular	wet areas
Black Crowned Night Heron	Potential-		
Nycticorax mycticorax	summer	irregular	wet areas
GRUIDAE			
Sand Hill Crane	Potential-		
Grus canadensis	migrant	irregular	meadows
RALLIDAE			
Sora Rail	Potential-		
Porzana carolina	resident	uncommon	meadows
American Coot	Observed-		
Fulica americana	summer	uncommon	wet areas
SCOLOPACIDAE			
Common Snipe	Observed-		
Capella gallinago	summer	uncommon	meadows

APPENDIX - TABLE 2 (Continued)

Species	Status	Relative Abundance*	Habitat Preference*
CAPRIMULGIDAE			
Whip-Poor-Will	Potential-		
Phalaenoptilus nuttalli	resident	uncommon	wooded areas
Common Night Hawk	Observed-		
Chordelies minor	summer	uncommon	ubiquitous
APODIDAE			
Black Swift	Potential-		
Cypseloides niger	summer	uncommon	rocky areas
White Throated Swift	Observed-		
Aeronautes saxatalis	summer	common	rocky areas
TROCHILIDAE			
Black Chinned Hummingbird	Observed-		
Archilochus alexandri	summer	uncommon	brushlands
Broad Tailed Hummingbird	Observed-		
Selasphorus platycercus	summer	common	ubiquitous
Rufous Hummingbird	Likely-		
Selasphorus rufus	summer	common	ubiquitous
Calliope Hummingbird	Likely-		
Stellula calliope	summer	common	conifers, aspen
ALCEDINIDAE			
Belted King Fisher	Potential-		
Megaceryle alcyon	resident	uncommon	aquatic
PICIDAE			
Common Flicker	Observed-		
Colaptes auratus	resident	common	wooded areas
Yellow Bellied Sapsucker	Observed-		
Sphyrapicus varius	resident	common	riparian, aspen
Williamson's Sapsucker	Observed-		
Sphyrapicus thyroideus	summer	uncommon	aspen, conifers
Hairy Woodpecker	Observed-		
Picoides villosus	resident	common	aspen, conifers
Downy Woodpecker	Observed-		
Picoides pubescens	resident	common	riparian, aspen
Northern Three-Toed Woodpecker	Observed-		
Picoides tridactylus	resident	uncommon	conifers

APPENDIX - TABLE 2 (Continued)

Species	Status	Relative Abundance*	Habitat Preference*
TYRANNIDAE			
Eastern Kingbird	Potential-		
Tyrannus tyrannus	summer	common	agricultural
Western Kingbird	Likely-		
Tyrannus verticalis	summer	common	pinion/juniper
Cassin's Kingbird	Potential-		
Tyrannus vociferans	summer	uncommon	pinion/juniper
Ash Throated Flycatcher	Observed-		
Myiarchus cinerascens	summer	uncommon	pinion/juniper, riparian
Willow Flycatcher	Observed-		
Empidonax traillii	summer	uncommon	riparian
Hammond's Flycatcher	Observed-		
Empidonax hammondii	summer	common	conifer
Dusky Flycatcher	Observed-		
Empidonax obserholseri	summer	common	aspen, brushland
Gray Flycatcher	Potential-		
Empidonax wrightii	summer	irregular	dry wooded areas
Western Flycatcher	Observed-		
Empidonax difficilis	summer	common	moist wooded areas
Olive Sided Flycatcher	Observed-		
Nuttallornis borealis	summer	uncommon	conifers
Western Wood Pewee	Observed-		
Contopus sordidulus	summer	common	aspen
Say's Phoebe	Likely-		
Sayornis saya	resident	uncommon	open areas
ALAUDIDAE			
Horned Larke	Potential-		
Eremophila alpestris	resident	uncommon	open areas
HIRUNDINIDAE			
Violet Green Swallow	Observed-		
Tachycineta thalassina	summer	common	wooded areas
Tree Swallow	Observed-		
Iridoprocne bicolor	summer	common	wooded areas
Rough Winged Swallow	Potential-		
Stelgidopteryx ruficollis	summer	common	wet areas
Barn Swallow	Potential-		
Hirundo rustica	summer	common	ubiquitous

APPENDIX - TABLE 2 (Continued)

Species	Status	Relative Abundance*	Habitat Preference*
Cliff Swallow	Observed-		
Petrochelidon pyrrhonata	summer	common	rocky areas
Purple Martin	Potential-		
Progne subis	summer	uncommon	open forests
CORVIDAE			
Steller's Jay	Observed-		
Cyanocitta stelleri	resident	common	conifers, aspen
Gray Jay	Potential-		
Perisorius canadensis	resident	irregular	conifers
Scrub Jay	Potential-		
Aphelocoma coerulescens	resident	common	pinion/juniper
Black Billed Magpie	Observed-		
Pica pica	resident	uncommon	ubiquitous
Common Raven	Observed-		
Corvus corax	resident	common	ubiquitous
Common Crow			
Corvus brachyrhynchos	likely	irregular	ubiquitous
Pinion Jay	Observed-		
Gymnorphinus cyanocephalus	resident	common	pinion/juniper
Clark's Nut Cracker	Observed-		
Nucifraga columbiana	resident	common	conifers
PARIDAE			
Black Capped Chickadee	Observed-		
Parus atricapillus	resident	common	wooded areas
Mountain Chickadee	Observed-		
Parus gambeli	resident	common	aspen, conifer
Plain Titmouse	Observed-		
Parus inoranatus	resident	uncommon	pinion/juniper
Bushtit	Likely-		
Pslatriparus minimus	resident	common	pinion/juniper
SITTIDAE			
White Breasted Nuthatch	Observed-		
Sitta carolinensis	resident	common	wooded areas
Red Breasted Nuthatch	Observed-		
Sitta canadensis	resident	uncommon	conifers
Pygmy Nuthatch	Observed-		
Sitta pygmae	resident	uncommon	conifers
CERTHIDAE			
Brown Creeper	Observed-		
Certhia familiaris	resident	common	wooded areas

APPENDIX - TABLE 2 (Continued)

Species	Status	Relative Abundance*	Habitat Preference*
American Coot *Fulica americana*	Observed-summer	uncommon	wet areas
SCOLOPACIDAE			
Common Snipe *Capella gallinago*	Observed-summer	uncommon	meadows
Spotted Sandpiper *Actitis maculata*	Observed-summer	uncommon	wet areas
PHALAROPODIDAE			
Wilson's Phalarope *Steganopus tricolor*	Observed-migrant	uncommon	wet areas
Northern Phalarope *Lobipes lobatus*	Potential-migrant	uncommon	wet areas
COLUMBIDAE			
Band Tailed Pigeon *Columba fasciata*	Potential-summer	irregular	brushland
Mourning Dove *Zenaida macroura*	Observed-summer	uncommon	ubiquitous
CUCULIDAE			
Yellow Billed Cuckoo *Coccyzus americanus*	Potential-summer	irregular	riparian
STRIGIDAE			
Screech Owl *Otus asio*	Likely-resident	uncommon	riparian
Flammulated Owl *Otus flammeolus*	Potential-resident	irregular	conifers
Great Horned Owl *Bubo virginianus*	Observed-resident	common	ubiquitous
Pygmy Owl *Galucidium gnoma*	Potential-resident	irregular	wooded areas
Long Earred Owl *Asio otus*	Potential-resident	uncommon	wooded areas
Short Earred Owl *Asio flammeus*	Potential-resident	uncommon	open areas
Saw-Whet Owl *Aegolius acadicus*	Potential-resident	irregular	conifers

APPENDIX - TABLE 2 (Continued)

Species	Status	Relative Abundance*	Habitat Preference*
CINCLIDAE			
Dipper	Potential-		
Cinclus mexicanus	resident	uncommon	riparian
TROGLODYTIDAE			
House Wren	Observed-		
Troglodytes aedon	summer	common	aspen, conifers
Rock Wren	Observed-		
Salpinctes obsoletus	resident	common	rocky areas
Canyon Wren	Observed-		
Catherpes mexicanus	resident	uncommon	rocky areas
Bewick's Wren	Potential-		
Thryomanes beiwckii	resident	common	pinion/juniper
Marsh Wren	Potential-		
Cistothorus palustris	migrant	irregular	wet meadows
MIMIDAE			
Mockingbird	Potential-		
Mimus polyglottos	migrant	irregular	brushlands
Gray Catbird	Observed-		
Dumetella carolinensis	summer	uncommon	riparian
Sage Thrasher	Potential-		
Oreoscoptes montanus	resident	common	sagebrush
TURDIDAE			
American Robin	Observed-		
Turdus migratorius	resident	common	ubiquitius
Hermit Thrush	Observed-		
Catharus gattatus	summer	common	conifers
Swainson's Thrush	Observed-		
Catharus ustulatus	summer	uncommon	riparian, aspen
Veery	Likely-		
Catharus fuscenscens	summer	uncommon	riparian
Mountain Bluebird	Observed-		
Sialia currucoides	resident	uncommon	open woodlands
Western Bluebird	Potential-		
Sialia mexicana	resident	uncommon	open woodlands
Townnsend's Solitaire	Observed-		
Myadestes townsendii	resident	common	wooded areas
SYLVIDAE			
Blue Gray Gnatcatcher	Observed-		
Polioptila caerulea	summer	uncommon	pinion/juniper

APPENDIX - TABLE 2 (Continued)

Species	Status	Relative Abundance*	Habitat Preference*
Golden Crowned Kinglet	Likely-		
Regulus satrapa	resident	uncommon	conifers
Ruby Crowned Kinglet	Observed-		
Regulus Calendula	resident	common	wooded areas
BOMBYCILLIDAE			
Bohemian Waxwing	Likely-		
Bombycilla garrulus	winter	uncommon	ubiquitous
Cedar Waxwing	Likely-		
Bombycilla cedrorum	winter	uncommon	ubiquitous
LANIIDAE			
Northern Shrike	Likely-		
Lanius excubitor	winter	uncommon	open areas
Logger Head Shrike	Likely-		
Lanius ludovicianus	resident	common	open areas
STURNIDAE			
Starling	Potential-		
Sturnus vulgaris	resident	common	agricultural
VIREONIDAE			
Solitary Viero	Observed-		
Vireo solitarius	resident	uncommon	conifers
Warbling Vireo	Observed-		
Vireo gilvus	summer	common	aspen, riparian
PARULIDAE			
Orange Crowned Warbler	Observed-		
Vermivora celata	summer	uncommon	wooded areas
Nashville Warbler	Likely-		
Vermivora ruficapilla	migrant	uncommon	riparian,brushland
Virginia's Warbler	Likely-		
Vermivora virginiae	summer	common	riparian,brushland
Yellow Warbler	Observed-		
Dendroica petechia	summer	common	riparian
Yellow Rumped Warbler	Observed-		
Dendroica coronata	summer	common	conifers, riparian
Black Throated Gray Warbler	Observed-		
Dendroica nigrescens	summer	uncommon	pinion/juniper
Townsend's Warbler	Likely-		
Dendroica townsendi	migrant	uncommon	conifers

APPENDIX - TABLE 2 (Continued)

Species	Status	Relative Abundance*	Habitat Preference*
MacGillivray's Warbler	Observed-		
Oporornis tolmiei	summer	uncommon	riparian,brushland
Common Yellow Throat	Likely-		
Geothylpis trichas	summer	uncommon	wet areas
Yellow Breasted Chat	Likely-		
Icteria virens	summer	common	riparian,brushland
Wilson's Warbler	Observed-		
Wilsonia pusilla	summer	common	riparian
American Redstart	Likely-		
Setaphaga ruticilla	migrant	uncommon	riparian
PLOCIEDAE			
House Sparrow	Potential-		
Passer domesticus	resident	common	agricultural
ICTERIDEA			
Western Meadowlark	Potential-		
Sturnella neglecta	resident	uncommon	open areas
Yellow Headed Blackbird	Potential-		
Xanthocephalus xanthocephalus	migrant	uncommon	wet areas
Red Winged Blackbird	Potential-		
Agelaius phoeniceus	resident	uncommon	wet areas
Brewer's Blackbird	Potential-		
Euphagus cyanocephalus	resident	uncommon	agricultural
Common Grackle	Potential-		
Quiscalus quiscula	migrant	irregular	agricultural
Brown Headed Cowbird	Likely-		
Molothrus ater	resident	uncommon	wooded areas
Northern Oriole	Likely-		
Icterus galbula	summer	common	riparian
THRAUPIDEA			
Western Tanager	Observed-		
Piranga ludoviciana	summer	common	wooded areas
FRINGILLIDAE			
Black Headed Grosbeak	Observed		
Pheucticus melanocephalus	summer	common	riparian,brushlands
Evening Grosbeak	Likely-		
Hesperiphona vespertina	resident	uncommon	wooded areas

APPENDIX - TABLE 2 (Continued)

Species	Status	Relative Abundance*	Habitat Preference*
Lazuli Bunting *Passerina amoena*	Observed-summer	uncommon	riparian
Indigo Bunting *Passerina cyanea*	Potential-summer	irregular	riparian
House Finch *Carpodacus mexicanus*	Likely-resident	uncommon	conifers
Cassin's Finch *Carpodacus cassinii*	Observed-resident	uncommon	conifers
Pine Grosbeak *Pinicola enucleator*	Likely-resident	uncommon	conifers
Rosy Finch *Leucosticte arctoa*	Likely-resident	irregular	ubiquitous
American Gold Finch *Carduelis tristis*	Likely-resident	common	riparian,agricultural
Lesser Gold Finch *Carduelis pslatria*	Likely-resident	common	riparian,brushland
Pine Siskin *Carduelis pinus*	Observed-resident	common	conifers,riparian
Red Crossbill *Loxia curvirostra*	Observed-resident	common	conifers
Rufous Sided Towhee *Pipilo erythrophthalmus*	Observed-resident	uncommon	riparian
Green Tailed Towhee *Pipilo chlorura*	Observed summer	common	brushlands
Dark Eyed Junco *Junco hyemalis*	Observed-winter	common	ubiquitous
Gray Headed Junco *Junco caniceps*	Observed-resident	common	conifers, aspen
Savannah Sparrow *Passerculus sandwichensis*	Potential-summer	uncommon	wet meadows
Vesper Sparrow *Pooecetes gramineus*	Potential-summer	uncommon	open areas
Lark Sparrow *Chondestes grammacus*	Potential-summer	uncommon	brushlands
Black Throated Sparrow *Amphispiza bilineata*	Potential-summer	uncommon	brushlands
Sage Sparrow *Amphispiza belli*	Potential-summer	uncommon	sagebrush
Tree Sparrow *Spizella aborea*	Likely-winter	uncommon	brushlands

APPENDIX - TABLE 2 (Continued)

Species	Status	Relative Abundance*	Habitat Preference*
Chipping Sparrow *Spizella passerina*	Observed-summer	common	conifers
Brewer's Sparrow *Spizella breweri*	Potential-summer	irregular	sagebrush
Harris' Sparrow *Zonotrichia querula*	Potential-winter	irregular	brushland,riparian
White Crowned Sparrow *Zonotrichia leucophrys*	Observed-resident	common	conifers,riparian
Fox Sparrow *Zonotrichia iliaca*	Potential-resident	irregular	riparian
Lincoln's Sparrow *Melospiza lincolnii*	Likely-resident	uncommon	wet meadows
Song Sparrow *Melospiza melodia*	Observed-resident	common	riparian

APPENDIX - TABLE 3

Reptiles and Amphibians in or Near

Gordon Creek No. 2 Mine Study Area

Carbon County, Utah - 1980--1981

Species	Status	Relative Abundance*	Habitat Preference*
AMBYSTOMATIDAE			
Tiger Salamander			
Ambystoma tigrinum	likely	common	aquatic
PELOBATIDAE			
Great Basin Spade Foot Toad			
Sacphiopus intermontanus	likely	common	ubiquitous
BUFONIDAE			
Western Toad			
Bufo boreas	observed	uncommon	ubiquitous
Wood House Toad			
Bufo woodhouseii	likely	common	ubiquitous
HYLIDAE			
Western Chorus Frog			
Pseudacris triseriata	observed	uncommon	aquatic,wet meadows
RANIDAE			
Leopard Frog			
Rana pipiens	likely	common	aquatic
IGUANIDAE			
Collared Lizard			
Crotaphytus collaris	likely	common	rocky areas
Leopard Lizard			
Crotaphytus wislizenii	potential	common	rocky areas
Eastern Fence Lizard			
Sceloporus undulatus	likely	common	rocky areas
Sagebrush Lizard			
Sceloporus graciosus	potential	common	brushland
Tree Lizard			
Urosaurus orantus	likely	common	brushland
Side Blotched Lizard			
Uta stansburiana	potential	common	open areas
Short Horned Lizard			
Phryonosoma douglassi	observed	common	open areas
TEIDAE			
Western Whip Tail			
Cnemidophorus tigris	likely	common	open areas

*Includes on-site observation and SWR regional information

APPENDIX - TABLE 3 (Continued)

Species	Status	Relative Abundance*	Habitat Preference*
BOIDAE			
Rubber Boa			
Charina bottae	likely	common	ubiquitous
COLUBRIDAE			
Striped Whip Snake			
Masticophis taeniatus	likely	common	ubiquitous
Racer			
Coluber constrictor	likely	common	open areas
Ring Necked Snake			
Diadophis punctatus	potential	irregular	moist areas
Bull Snake			
Pituophis melanoleucus	likely	common	ubiquitous
Milk Snake			
Lamproteltis triangulatum	potential	irregular	ubiquitous
Sonora Mountain King Snake			
Lamproteltis pyromelana	potential	irregular	wooded areas
Wandering Garter Snake			
Thamnophis elegans	likely	common	ubiquitous
Common Garter Snake			
Thamnophis sirtalis	potential	irregular	moist areas
Night Snake			
Nypsiglena torquata	potential	common	brushlands
CROTALIDAE			
Western Rattle Snake			
Crotalus viridis	likely	common	rocky, open areas

CHAPTER 11
CLIMATOLOGY
AND
AIR QUALITY

CHAPTER 11

CLIMATOLOGY AND AIR QUALITY

11.1 Existing Environment

11.1.1 Climate

The climate of the Price, Utah, area is varied and strongly influenced by topography. The climate can be characterized as arid, specifically, dry continental. The prevailing local low-level meterological influences are mountain-valley breeze systems. The low amount of annual precipitation is a result of the Sierra Nevada and Cascade Mountain Ranges which act as natural barriers and prevent moist maritime air from the North Pacific from reaching the interior basins to the east.

On a more local scale, the Wasatch Mountains to the west of Castle Valley and the Tavaputs Plateau to the north provides a shelter from storms associated with westerly and northerly winds. Areas on the lee side of the Wasatch Range generally receive less than ten inches of precipitation annually.

Tables 11-1 and 11-2 contain monthly and annual totals of temperature and precipitation, respectively, for four stations: Hiawatha, Soldier Summit, Emery, and Price, Utah. Average annual temperature at Emery and Price are 46.2°F and 49.6°F, respectively. The temperature ranges from a mean minimum monthly value of 24.o°F for Emery and 23.3°F for Price in January and a mean maximum in July of 68.4°F at Emery and 74.3°F at Price. Annual precipitation averages 7.22 inches at Emery and 9.25 inches at Price.

Table 11-1

Mean Monthly Temperatures (of)(1931-1955[1]

Location	Elevation (Feet)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Hiawatha	7,230	23.1	26.6	33.5	45.7	52.6	61.6	69.4	67.2	60.3	58.6	34.1	26.1	45.7
Soldier Sum.	7,477	17.4	20.3	27.6	37.6	46.1	53.3	61.4	59.9	52.3	42.0	28.6	21.0	39.0
Emery	6,200	24.0	28.2	36.3	45.6	53.7	61.3	68.4	66.2	59.3	48.7	35.5	27.0	46.0
Price	5,567	23.2	29.6	39.2	49.5	58.6	66.9	74.3	72.2	64.4	52.1	37.0	27.8	49.6
Castle Dale	5,680	Annual mean temperature = 48.8°F												
Ferron	5,925	Annual mean temperature = 47.7°F												

Table 11-1
Mean Monthly Precipitation (inches) 1931-1955[1]

Location	Elevation (Feet)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Hiawatha	7,230	1.00	0.85	1.03	0.83	1.04	1.02	1.27	1.88	0.99	1.27	0.73	1.07	12.98
Soldier Sum.	7,477	1.69	1.54	1.47	1.11	1.04	0.97	1.36	1.65	0.98	1.24	1.20	1.67	15.92
Emery	6,200	0.51	0.38	0.47	0.36	0.50	0.55	0.80	1.26	0.73	0.76	0.32	0.58	7.22
Price	5,567	0.74	0.59	0.69	0.61	0.66	0.73	0.95	1.10	0.83	0.91	0.48	0.96	9.25
Castle Dale	5,680													8.39
Ferron	5,925													7.92

At Hiawatha and Soldier Summit, January is the coldest month (23.1°F and 17.4°F, respectively) and July is the warmest (69.4°F and 61.4°F, respectively). Annual precipitation is higher at these sites due to their proximity to mountainous terrain (12.98 and 15.92 inches, respectively).

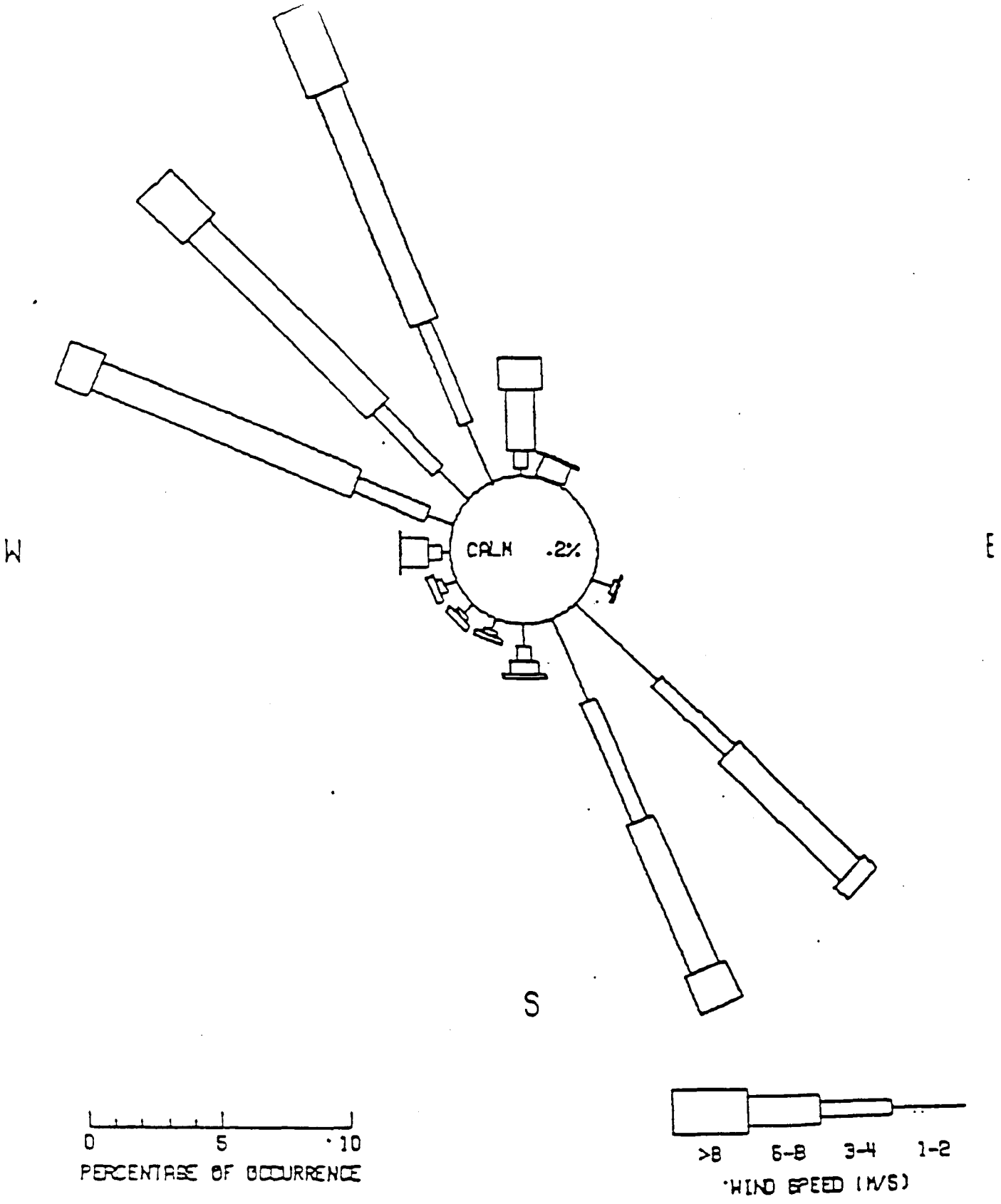
Winters in the area are cold and dry with total snowfall averaging between 10 and 20 inches. The area averages 225 days-per-year of clear skies, 105 days partly cloudy, and 35 days cloudy. The growing season ranges from 110 to 135 days. [3]

Winds are generally light to moderate all seasons of the year. Strongest winds generally occur in the Spring with moderate to strong southerly flow for several days at a time. The prevailing Castle Valley area winds are from the north through north-northwest during Autumn, Winter and early-Spring months with a shift to the south-southeast during late Spring and Summer. [4] Depending on the proximity to the mountain and canyons, a particular location in Castle Valley may experience pronounced diurnal wind flow patterns. Daytime flow may be influenced by up-slope easterly winds caused by greater heating of the eastern face of the Wasatch Plateau than in the valley. At night the northwesterly drainage flow from the mountains to the valley may prevail. In summary, no one wind direction or diurnal wind flow pattern is applicable for all locations in Castle Valley. The further a location is from a canyon or mountain, the weaker the diurnal wind flow pattern to be expected.

Utah Power & Light Company has recorded continuous meteorological data at three sites in Huntington Canyon near the Huntington Station Power Plant. The 1978 wind roses from Wild Horse Ridge, Valley Floor, and Meetinghouse Ridge are contained in Figures 11-1, 11-2 and 11-3, respectively. The elevation, approximate distance, and direction of each site from the Permit area are as follows:

Meteorological Network	Approximate Elevation	Distance and Direction From Huntington Power Plant
Wild Horse Ridge	7500 feet	18 km S
Valley Floor	6500 feet	18 km S-SW
Meetinghouse Ridge	7500 feet	19 km SW

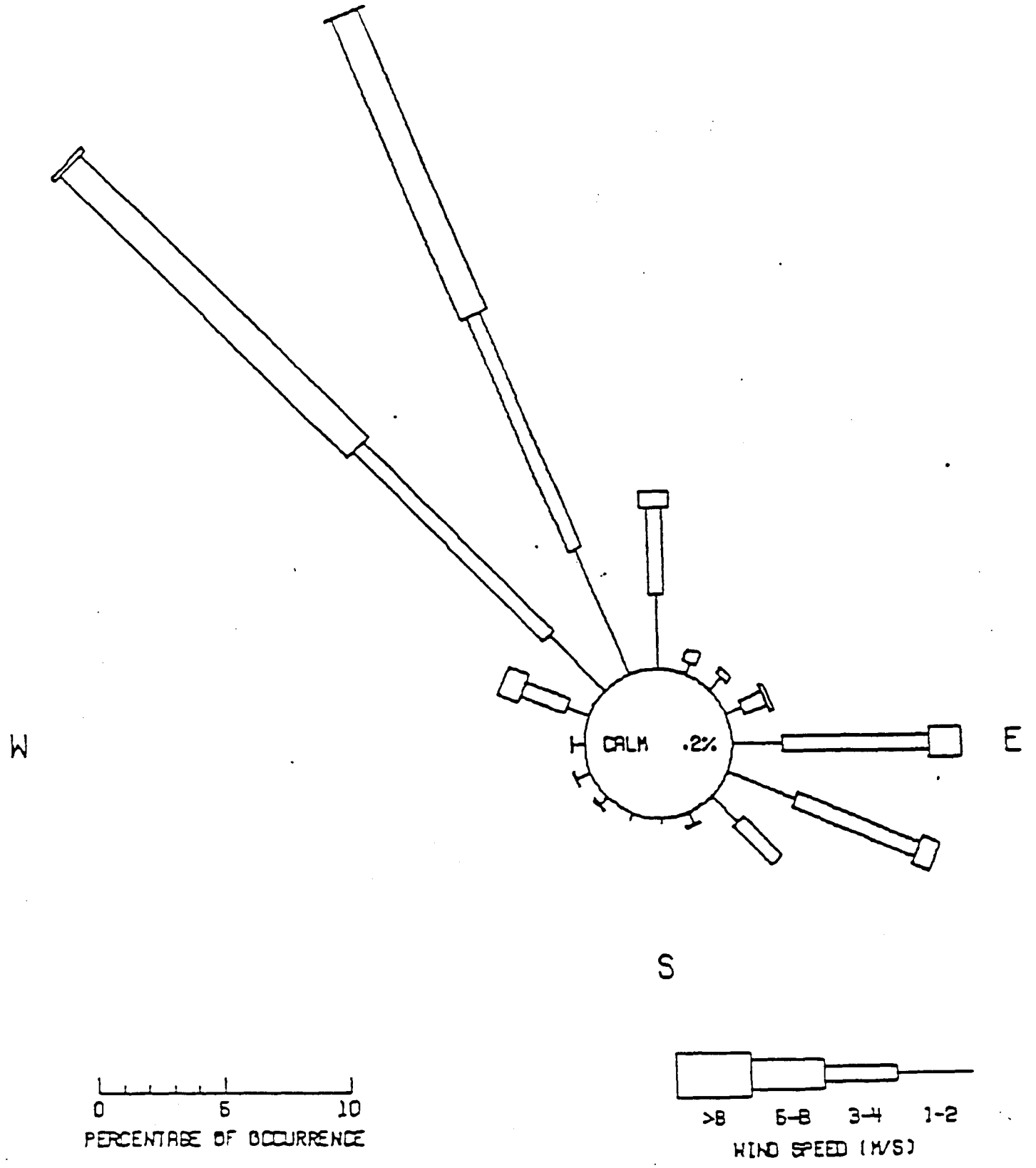
Relative humidity is highest in the Castle Valley during Winter and lower in Summer. The average relative humidity is 75 percent to 40 percent in Winter and Summer months, respectively. Mean annual relative humidity is 55 percent.[5] (As a result of low annual precipitation totals, low mean annual relative humidity, high percentage of sunshine, evaporation rates are expected to be rather high in this plateau desert region.)



WILD HORSE RIDGE JAN-DEC 1978

ALL TIMES

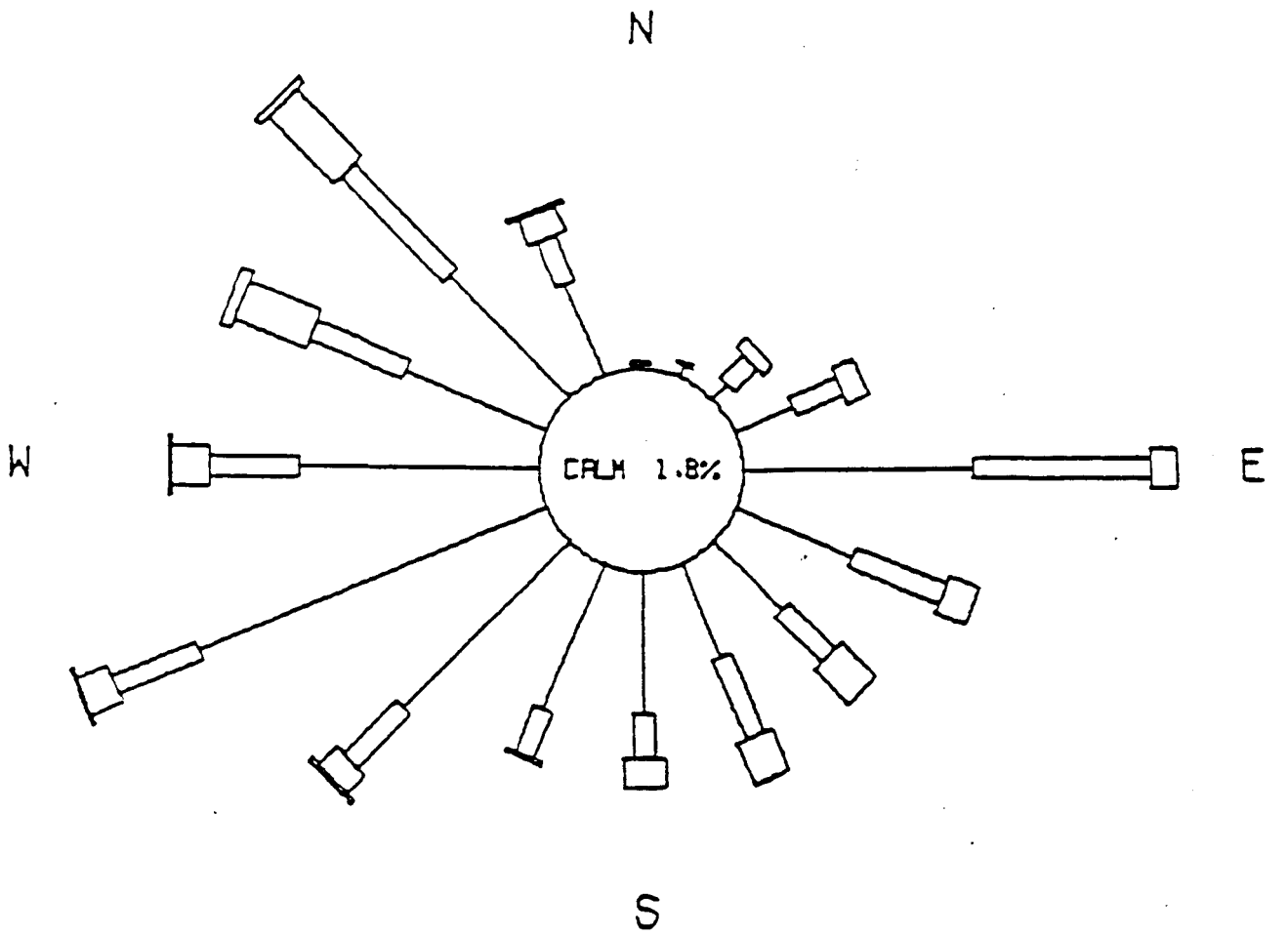
Figure 11-1 Wind Rose for Wild Horse Ridge



VALLEY FLOOR JAN-DEC 1978

ALL TIMES

Figure 11-2 Wind Rose for Valley Floor



MEETINGHOUSE RIDGE JAN-DEC 1978

ALL TIMES

Figure 11-3 Wind Rose for Meetinghouse Ridge

11.1.2 Air Quality

Regional impacts from coal mining operations on particulate air quality is expected to be minimal due to the rapid fallout of particles with distance from the source and the existence of relatively small mining operations in Castle Valley. The closest Class I air quality and visibility protection area is the Capitol Reef National Park. The closest mining source to the northern boundary of Capitol Reef is approximately 40 km to the north. Sites such as Hunter Power Plant, Castle Dale, Huntington Station Power Plant and Price are about 70 km, 80 km, 94 km and 120 km north-northeast of the northern-most boundary of Capitol Reef National Park, respectively.

The regional annual particulate impact from coal development in Castle Valley on Capitol Reef National Park is expected to be less than the Class I increment standard of 10 ug/m^3. Tables 11-3 and 11-4 contain regional total suspended particulate air quality data over a five-year period from both State of Utah and Utah Power & Light Company operated networks. The regional annual particulate concentration (including background) is generally low at all sites, except Price, where the annual standard (60 ug/m^3) has been exceeded each year (1975 - 1978). Price represents an urban monitoring location and higher concentrations are caused by human activity and traffic on roadways leading to proposed new mines in Castle Valley. Since Price has no major industries located within, or near the city, air quality standards are exceeded as a result of background sources such as transported dust.

Reduction in visibility in Castle Valley results from light scattering by particles suspended in air. Since particulate concentration in Castle Valley is significant at times, the contribution of various particles was measured by an integrating nephelometer from August, 1970, through August, 1972. A scanning electron microscope determined the contribution of various particles to light scattering.

Results are soil dust (63 percent), soot (31 percent), fly ash (three percent) and particles -X (three percent). The high percentage of soil dust indicates that dust is easily transported throughout the Castle Valley area.

11.2 Effects of Mining Operation on Air Quality

11.2.1 Estimate of Uncontrolled Emissions

Mining is completed at this operation, and all structures have been removed. The only future activity will be the final site reclamation and any necessary maintenance until bond release. A minor amount of dust may be created during the earthmoving and reclamation process; however, activities will be confined to the disturbed are and will likely last less than 3 months total.

Dust emissions will be minimized by the use of a water truck and sprays as needed during the reclamation process. The reclaimed area will be seeded and hydromulched upon completion.

TABLE 11-3

State of Utah, Total Suspended Particulate Monitoring Sites in Castle Valley

Station	Year	Annual Geometric Mean Concentration (ug/m^3)	24-Hour Maximum Concentration (ug/m^3)
Price (east edge of College of Eastern Utah Campus)	1975	72	181
	1976	74	306
	1977	69	406
	1978	61 (3/4 yr. of data recov.)	303
Huntington Canyon Site (between Huntington Canyon & City of Huntington)	1974	22	183
	1975	22	191
	1976	28	150
	1977	34	150
	1978	33 (1/2 yr. of data recov.)	150
Castle Dale (about 65 km S-SW of Price)	1977	49	*665
	1978	40	170
	1979	44	121
	1980	38	125

*Total suspended particulate 24-hour standards were exceeded due to locally high wind speeds transporting particulates. Each site had daily Hi-Vol readings.

TABLE 11-4

Total Suspended Particulate Readings at Stations in Castle Valley (Operated by Utah Power & Light Company)

Period of Observation	Station Location	Annual Geometric Mean (mg/m^3)	Notes and Comments
1974	Hunter Station, UT	25	1) 6 year average Geometric Mean = 26.2 ug/m^3
1975	(2-3 miles west	25	
1976	of Power Plant)	34	
1977		34	
1978		19	2) Extreme value 106 ug/m^3 (1979)
1979		20	
1975	Meetinghouse Cyn, UT	12	Site moved from a location near the Huntington Cyn Power Plant up toward Huntington Cyn (in late-1974).
1976	(approximately 1.0 mile	16	
1977	from Huntington Cyn	--	
1978	and W-NW of Huntington	20	
1979	Station)	18	
(Aug-Dec) 1975	West Station (West of	39	1) Site moved in 8/75 from previous location in the City of Huntington to a site west of the city where traffic does not influence concentrations. 2) Hi-Vol 24-hour concentration of 200 $ug./m^3$ in 4/78.
(Jan-Dec) 1976	city of Huntington, UT)	35	
1977		35	
1978		30	
1979		30	

1 = National Ambient Air Quality Standard for maximum 24-hour primary and secondary standards are 150 ug/m^3 and 60 ug/m^3, respectively.

2 = National Ambient Air Quality Standard for the Annual Geometric Mean is 60 ug/m^3 for the primary standard.

11.3 References

1) Brown, Merle, 1960: The Climate of Utah. Salt Lake City, 14 pp.
2) Ibid.
3) Utah Power & Light Company, 1973: Emery Operations Station Applicant's Environmental Analysis - Volume I. Salt Lake City, p. 26.
4) Utah Power & Light Company, 1974: Emery Generating Station Applicant's Environmental Analysis - Volume II. Salt Lake City, p. 50.
5) Utah Power & Light Company, 1973: Emery Operations Station Applicant's Environmental Analysis - Volume I. Salt Lake City, p. 26.
6) U.S. Department of the Interior, 1978: Development of Coal Resources in Central Utah - Draft Environmental Statement, Regional Analysis Part I, Salt Lake City, p. IV-11.
7) State of Utah Bureau of Air Quality, 1981: Personal Communication with Robert Dalley, February 19.
8) University of Utah Research Institute, Environmental Studies Laboratory, 1981: Personal Communication with Dr. Frank Anderson, February 23.
9) Utah Power & Light Company, 1973: Emery Operation Station Application's Analysis - Volume I. Salt Lake City, p. 51.