Trail Mountain Coal Mine Permit Application

Permit No. C/015/0009

Amendment to Modify the Permit Area for the Trail Mountain Mine
in Compliance with State and Federal Regulations
June 7, 2011

Volume 2

CHAPTER 8

SOIL RESOURCES

Table of Contents

List of Tables

List of Plates

SOIL RESOURCES

8.1 SCOPE

The Trail Mountain Mine is a previously disturbed site, having been in operation since 1948. As such, no re-mining conservation or reclamation measures were taken and little stockpiling of soil from areas to be disturbed were done. Likewise, no pre-mining studies were conducted in the disturbed area. Accordingly, future reclamation plans will have to rely on existing soil to provide a suitable medium in which to establish new vegetation. The existing disturbed site has been compacted by heavy equipment and automobiles. Some sections have also been subjected to years of oil, gasoline, and diesel fuel spillage. Moreover, coal piles have existed at the site, causing crushed coal and coal dust to be mixed and compacted into the existing soil. Revegetation test plots will be set up to determine whether the existing soil can result in a successful revegetation program or a supplemental soil will be required.

As supplemental soil may be required for future reclamation, and because the mining property to be reclaimed was already disturbed, it was necessary to characterize the soil from adjacent reference areas. These were chosen in two locations; as near as possible to the disturbed area and in areas determined, as well as could be done, to correspond in both soil type and vegetative community type to that of the disturbed area. Future supplemental soils would likely have to equal or exceed the quality of these two reference soils.

8.2 METHODOLOGY

Revegetation test plots have been set up to determine the suitability of the existing disturbed soil as a growth medium. (see Vegetational Test Plots, Appendix 9-l).Soil sample data is also included in Appendices 9-1 and 9-2, along with the vegetation test plot data.

In the event that the soils on site cannot be used for revegetation, supplemental soil will be required.

The supplemental soils would likely have to equal or exceed the quality of the existing soil prior to disturbance. An estimate of this quality can be obtained from soil samples taken from two soil pits dug in soil types which have been disturbed previously by the Trail Mountain operations. The soil pits were sampled at each recognizable horizon down to sixty inches or to bedrock, whichever came first. Each horizon was described in the field according to thickness, color and soil structure.

These soil pits were located in the Riparian (streamside) and Grassland-Shrub plant communities. Only soil types similar to those already disturbed or expected to be disturbed were sampled to serve as a basis for the reclamation plan to be developed.

After collection, the soil samples were air dried and passed through a two millimeter screen (Tyler #l0 mesh). Rock percentages were obtained by weighing separately the total soil sample and the rocks separated out by the 2 mm screen.

Soil textural analysis was performed in the lab using the Boyoucos hydrometer method with 50 gram samples. A sample of each soil horizon was sent to the Utah State University's Soil and Water Testing Laboratory in Logan, Utah for selected chemical analyses. These analyses included a standard fertility test (pH, salinity by probe, phosphorus, potassium, texture, and lime); exchangeable cation percentage (CEC, Na, K, Ca, and Mg, extractable ion, saturation percent, and the water soluble ions listed above); and sodium absorption ratios (SAR) where the salinity was found to be high.

8.3 SOIL RESOURCE INFORMATION

8.3.1 Soils Identification and Descriptions.

Four main soil types occur in the mine ~~plan~~ and adjacent areas, plus various thin soils among rocky outcrops and on talus slopes, which are designated as rockland (map symbols RoG and RY, see ~~Figure~~ Plate 8-1). Two of the four developed soil types are dry stony soils of steep mountain slopes. These are designated by the map symbols AbG (Very stony sandy loam complex) and CoG (Stony sandy loam complex). A third soil type, designated SN (shaly colluvial land), is located on the top of

Trail Mountain in areas that will not be disturbed by mining activities and therefore will not be considered further. The fourth soil type, here designated by the map symbol R (for Riparian), is the principal soil type found in the disturbed area. In the soil pit located north of the Trail Mountain Mine disturbed area, it would be classified as an azonal soil or entisol, and probably an arent (from ar, L., to plow, meaning mixed horizons). However, the soil is also located within a mapping unit called the Kenilworth Series, which is also defined as a Xerollic Calciorthid Ardidisol.

This is the soil of the canyon bottom along the stream. It is characterized by numerous gravelly, silty, and sandy layers; but in the Reference Area it does not exhibit any soil profile development. It is in alluvial soil that has developed from gravelly outwash brought down by the canyon stream during infrequent floods plus collected finer fractions deposited by wind and talus erosion. It is a deep soil, exceeding 5 feet and often attaining 10 or more feet, as may be seen at some eroded banks along Cottonwood Creek. The soil pit dug in the Riparian Community reference area showed eight horizons (but no classic soil profile) including what appeared to be a buried soil profile from an earlier time.

The streamside, or canyon-bottom soils were referred to as the Kenilworth Series in a prior classification (USDA, USDI, and UAES, 1970), specifically to the KeE2 mapping unit. This was called the Kenilworth very stony sandy loam of 0 to 20 percent slopes. This soil is stony, well-drained, and moderately coarse textured. In its broader distribution, this soil type occupies high benches on old dissected outwash plains below very steep mountains. It forms in thick deposits of strongly calcareous (high lime) stony alluvium and supports a vegetative cover mostly of juniper and pinion. The land use is mainly for wildlife, recreation, and limited grazing.

In Cottonwood Canyon, at the site of the Trail Mountain Mine ~~plan~~ area, the presence of the canyon stream has led to a well-developed streamside plant community of narrow leaf cottonwood trees and a lush understory of grasses and forbs. This community is narrowly distributed along the stream course. Higher up, it transitions into the Pinion-Juniper Community of the east-facing steep slopes of Trail Mountain. Probably 25% or less of the Trail Mountain Mine disturbed area is located on soils of this canyon-bottom type within the Riparian Plant Community and its transition zone away

from the stream, but still in the canyon bottom.

Three of the above four soils that were found in the ~~approved Mine Plan~~ adjacent and permit area were also found on the Tract 2 Mine Plan Area (now relinquished). They were RoG (rocklands), CoG (stony sandy loam complex), and AbG (very stony sandy loam complex).

In addition, five other soil types were found within the boundaries of the Tract 2 Mine Plan Area (now relinquished) (data taken from the Soil Conservation Service and U.S. Forest Service, Price, Utah). The map symbols and soil types are: ACl (Argic Pachic Cryoborolls), TU (Typic Ustorthents), TC (Typic Cryorthents), AC3 (Argic Pachic Cryoborolls), and AC2 (Argic Pachic Cryoborolls). Refer to Soils Map 8-l for locations of these soil types. These soils are also located in areas that will be undisturbed by mining, and therefore will not be considered further.

8.3.2 Present and Potential Productivity of Existing Soils

The soils in the disturbed area support a streamside plant community of dominant narrow leaf cottonwood trees plus lesser numbers of Rocky Mountain Juniper, Chokecherry, Elderberry, and numerous understory species of shrubs, grasses, and forbs. The transition zone on the same soil, but away from the stream and not yet on the steep Pinion-Juniper covered canyon slopes, has more juniper and pinion pine and is more open. The understory is mostly grasses and sagebrush.

The area is useful mainly for wildlife, recreation, limited grazing and mining. No cultivation could be established because of the steepness of the canyon.

8.4 PRIME FARMLAND

No farmland exists in the area. The capability unit category in the canyon bottom is VIIs-SX (nonirrigated), which is soil near steep mountains on recently formed flood plains of streams. These soils are suited for range.

8.5 SOILS: PHYSICAL AND CHEMICAL PROPERTIES

Two soil pits were dug. The results of textural analysis from the Riparian Reference Area soil pit are shown in Table 8 1. Chemical tests are shown in Table 8 2.

This is the soil of mapping unit RI. The top layer, which is not necessarily an A horizon, is 9 to 10 inches thick and is mainly a sandy clay loam texture having only about 5% rock over 2 mm diameter and 95% fine soil particles. The finer soil fraction is 48% sand, 30% silt, and 22% clay. Deeper layers show increasing percentages of rock (mainly gravel) down to layer 5, which suddenly reverts to less than one percent rock. This layer is also thick (7 inches) suggesting an older soil A horizon buried by the present developing soil surface.

Table 8 2 shows pH values ranging from 8.0 to 8.4 and slight salinity at the surface, increasing with depth. It is highly calcareous soil, with an average phosphorus content of p = 2.0 ppm and a potassium content of K = 217 ppm by the standard soil fertility test.

The second soil pit was located in the Grassland Shrub Community on a steep northeast facing slope uphill from the coal loading piles of the disturbed area. This is the mapping unit CoG or RoG. It is a soil type that has been disturbed by the Trail Mountain Mine operations, but only slightly. Some of the lower steep hillside has been cut away to provide clean mine entrances and room for a coal pile. Probably only about 75% or more of the disturbed area is represented by this soil type.

The results of textural analysis are shown in Table 8 3 and of chemical analysis in Table 8 4. The Grassland Shrub soil was relatively shallow, bedrock being encountered at only 19 inches. The A horizon was 5 inches deep and consisted of 71.5% fine soil and 28% larger rock fragments by weight. The fine soil fraction was a loam soil of 40% sand, 35% silt, and 25% clay. Deeper layers increased rapidly in rocky material, silt, and clay fractions. The pH ranged from 8.2 to 8.7 and the salinity from .3 to 4 mmho/cm2. Phosphorus and potassium levels were much lower than the streamside soil of the canyon bottom.

8.6 USE OF SELECTED OVERBURDEN

Since the site is a previously disturbed site since 1948, and no further disturbance is proposed, no overburden will be handled.

8.7 PLANS FOR REMOVAL, STORAGE AND PROTECTION OF SOILS

Since the site has was previously disturbed no soils were removed, stored, or protected prior to 1982. Compliance work in 1982 - 1983, involved the use of an on site borrow area and resulting topsoil storage pile. Please refer to Appendix 8-1 for details on the borrow area. For any future disturbances, any soils encountered will be removed, stored, and protected.

8.8 PLANS FOR REDISTRIBUTION OF SOILS

In the event that the existing soil cannot be revegetated, supplemental soil will have to be hauled in for regrading of the disturbed site. Such soil should be tested for similarity to the existing soils and should equal or exceed the quality of the Riparian soil of Tables 8-1 and 8-2. This is the soil type of 25% or less of the disturbed area.

Once the buildings, mine equipment, coal piles and other structures and disturbances are removed, the existing disturbed area must be graded to the final configuration. If the existing soil is unsuitable for revegetation and supplemental soil must be brought in, a depth of not less than six inches should then be applied and graded in preparation for seeding. Existing soil should prove adequate for plant growth.

8.9 NUTRIENTS AND SOIL AMENDMENTS

Existing soil or soils hauled in for the restoration of the disturbed soils will have to be supplemented with commercial fertilizers containing nitrogen, phosphorus, and potassium. The exact mixture will

have to be determined following tests on the actual soil used, but a broadcast rate of about 50 pounds of phosphorus, 80 pounds nitrogen and 80 pounds of potassium per acre can be expected. Stabilization will be obtained by the use of an erosion control mat.

8.10 EFFECTS OF MINING OPERATIONS ON SOILS

The existing disturbed site has been compacted by heavy equipment and automobiles. Some sections have been subjected to oil, gasoline, and diesel fuel spillage. Crushed coal and coal dust from the coal piles have been mixed and compacted in the existing soil.

8.11 MITIGATION AND CONTROL PLANS

As a previously disturbed site, no soils had originally been saved for protection of the resource. A small amount of topsoil was salvaged during the hydrologic reconstruction on site, and has been stored and protected as shown on Figure 3-1. Should any future disturbance of undisturbed soils of good potential occur, the soils will be removed, stored, and protected.

8.12 BIBLIOGRAPHY

United States Department of Agriculture, U.S. Department of the Interior, and Utah Agricultural Experiment Station, 1970, Soil Survey, Carbon-Emery Area, Utah.

TABLE 8-1
RIPARIAN SOIL TEXTURAL ANALYSIS

	Horizons							
	1	2	3	4	5	6	7	8
Thickness (cm)	24	9	5	8	18	26	12	50
Color	Light gray-brown	Light brown	Bluish-black	Light Brown	Blue-black	Grayish-yellowish-brown	Light yellowish-brown	Grayish-brown
Structure	Blocky-platy	None	Blocky	None	Blocky	Platy	None	Blocky

Weight Percents of Bulk Soil

% Rock > 2mm*	4.80%	36.00%	20.50%	50.10%	0.80%	2.00%	55.00%	13.00%
% Soil < 2mm	95.20%	64.00%	79.50%	49.90%	99.20%	98.00%	45.00%	87.00%

Weight Percents of Soil Fractions < 2mm

"Old Method" (2nd Hydrometer Reading at 1 Hour)

% Sand	47.80%	68.60%	51.40%	77.00%	43.40%	38.80%	65.20%	49.40%
% Silt	29.80%	16.80%	28.50%	11.80%	33.80%	36.40%	17.20%	27.20%
% Clay	22.40%	14.60%	20.10%	11.20%	22.80%	24.80%	17.60%	23.40%
Texture Class	Sandy Clay Loam	Sandy Loam	Sandy Clay Loam	Sandy Loam	Loam	Loam	Sandy Loam	Sandy Clay Loam

"New Method" (2nd Hydrometer Reading at 2 Hours)

% Sand	47.80%	68.60%	51.40%	77.00%	43.40%	38.80%	65.20%	49.40%
% Silt	33.60%	18.60%	32.00%	13.00%	38.40%	38.20%	19.80%	30.20%
% Clay	18.60%	12.80%	16.60%	10.00%	18.20%	23.00%	15.00%	20.40%
Texture Class	Loam	Sandy Loam	Loam	Sandy Loam	Loam	Loam	Sandy Loam	Loam

* Tyler Screen, #10 mesh = 1.981 mm openings

TABLE 8-2
SOIL CHEMISTRY: RIPARIAN REFERENCE AREA

Horizon	Depth (cm)	Soil Texture Class	Acidity (pH)	Salinity (mmho/cm2)	Soil Fertility P (ppm)	Soil Fertility K (ppm)	Soil Fertility Lime *	CEC** (meq/100g)
1	0-24	Sandy Clay Loam	8.0	0.6	2.3	372	++	13.3
2	24-33	Sandy Loam	8.3	0.6	1.0	280	++	8.3
3	33-38	Sandy Clay Loam	8.2	0.6	2.4	340	++	10.0
4	38-46	Sandy Loam	8.4	0.5	1.0	152	++	6.6
5	46-64	Loam	8.2	0.6	2.5	293	++	22.8
6	64-90	Loam	8.2	0.4	2.5	196	++	18.5
7	90-102	Sandy Loam	8.0	2.0	1.2	38	++	8.2
8	102-152	Sandy Clay Loam	8.0	3.2	3.2	65	++	10.8

Horizon	Ammonium Acetate Extractable Ions (meq./100g) Na	K	Ca	Mg	Saturation Percentage	Water Soluble Ions (meq./100g) Na	K	Ca	Mg	meq/L in Sat. Ext. Chloride	Bicarbonate	SAR***
1	0.33	0.89	37.8	2.6	36.3	0.02	0.09	0.1	0.03	0.3	<0.5	0.08
2	0.44	0.64	36.9	2.1	27	0.02	0.07	<0.1	0.02	0.2	3.9	---
3	0.44	0.89	38.6	3.6	42.6	0.06	0.09	0.1	0.05	0.2	4.3	0.22
4	0.33	0.38	28.9	2.1	25.7	0.03	0.04	<0.1	0.03	0.2	3.6	---
5	0.44	0.7	44.7	5.1	48.7	0.07	0.04	0.1	0.07	<0.1	5	0.24
6	0.44	0.51	41.1	4.4	48.8	0.05	0.04	0.1	0.06	<0.1	3.4	0.18
7	1.42	0.19	34.2	3.1	28.8	0.09	0.01	0.3	0.19	5.3	2.6	0.18
8	0.54	0.19	37.3	4.9	39.1	0.21	0.02	0.6	0.48	11.7	2.5	0.29

* Lime is indicated relative. Here, ++ means lime is high.
** CEC = Cation Exchange Capacity
*** SAR = Sodium Adsorption Ration

TABLE 8-3
GRASSLAND-SHRUB TEXTURAL ANALYSIS

	Horizons				
	1	2	3	4	5
Thickness (cm)	24	9	5	8	18
Color	Reddish-brown	Yellowish-gray	Gray	Yellowish-gray	Gray
Structure	None	Gravelly	Caked Hard-pan	Clay	Clay

Weight Percents of Bulk Soil

% Rock > 2mm*	28.50%	46.40%	49.70%	40.30%	66.30%
% Soil < 2mm	71.50%	53.60%	50.30%	59.70%	33.40%

Weight Percents of Soil Fractions < 2mm

"Old Method" (2nd Hydrometer Reading at 1 Hour)

% Sand	40.20%	17.00%	10.80%	12.00%	14.20%
% Silt	35.20%	47.20%	46.00%	50.00%	52.00%
% Clay	24.60%	25.80%	43.20%	38.00%	33.80%
Texture Class	Loam	Silty Clay Loam	Silty Clay	Silty Clay Loam	Silty Clay Loam

"New Method" (2nd Hydrometer Reading at 2 Hours)

% Sand	40.20%	17.00%	10.80%	12.00%	14.20%
% Silt	38.80%	61.40%	51.80%	57.60%	56.80%
% Clay	21.00%	21.60%	37.40%	30.40%	29.00%
Texture Class	Loam	Silty Loam	Silty Clay Loam	Silty Clay Loam	Silty Clay Loam

* Tyler Screen, #10 mesh = 1.981 mm openings

TABLE 8-4
SOIL CHEMISTRY: GRASSLAND SHRUB REFERENCE AREA

Horizon	Depth (cm)	Soil Texture Class	Acidity (pH)	Salinity (mmho/cm2)	Soil Fertility P (ppm)	Soil Fertility K (ppm)	Soil Fertility Lime *	CEC** (meq/100g)
1	0-13	Loam	8.2	0.4	0.9	95	++	9.0
2	13-28	Silty Clay Loam	8.3	0.4	0.9	63	++	8.2
3	28-33	Silty Clay	8.5	0.3	0.6	80	++	7.6
4	33-39	Silty Clay Loam	8.7	0.3	0.4	53	++	4.5
5	39-50	Silty Clay Loam	8.7	0.4	0.6	75	++	6.3

Horizon	Ammonium Acetate Extractable Ions (meq./100g) Na	K	Ca	Mg	Saturation Percentage	Water Soluble Ions (meq./100g) Na	K	Ca	Mg	meq/L in Sat. Ext. Chloride	Bicarbonate	SAR***
1	0.33	0.26	36.6	2.3	32.4	0.02	0.01	0.1	0.03	0.3	3.2	0.08
2	0.44	0.32	34.7	3.6	38.6	0.02	0.01	0.1	0.06	<0.1	3.5	0.07
3	0.33	0.26	36.1	5.7	42.7	0.03	0.01	<0.1	0.07	0.2	2.5	---
4	0.33	0.19	36.7	4.9	48	0.02	0.01	<0.1	0.07	<0.1	2.5	---
5	0.33	0.26	37	6.4	49.4	0.03	0.01	<0.1	0.1	0.6	2.9	---

* Lime is indicated relative. Here, ++ means lime is high.
** CEC = Cation Exchange Capacity
*** SAR = Sodium Adsorption Ration

CHAPTER 9

VEGETATION RESOURCES

Table of Contents

List of Tables

List of Plates

List of Appendicies

VEGETATION RESOURCES

9.1 SCOPE

A preliminary survey of the mine plan and adjacent areas indicated that four plant community types were in the boundaries of the area which had been disturbed or might be disturbed by any further expansion of the mine. Sites for concentrated sampling were chosen. The following methods were utilized.

9.2 METHODOLOGY

9.2.1 Trees

The point-quarter method was used to determine tree density and frequency. Ten points along a 500 foot transect were used. The four nearest trees to each point (one in each of four quadrants) were measured for diameter and distance from the point. Four saplings were also measured for distance but not diameter at each point. Thus 40 trees and 40 saplings were measured in each of the four plant communities. Pinion and juniper trees were measured at one foot height for diameter, and all other trees were measured at breast height (diameter-breast-height = DBH). These tree measurements yielded tree and sapling density and frequency. Tree dominance in terms of basal area was obtained from DBH. Sapling data provided estimates of tree reproduction. Tree (canopy) cover was estimated by the line-intersect method along a 500-foot transect with in-out measurements having a 6-inch resolution.

9.3.2 Understory Vegetation

Cover, density, and frequency of understory plants plus non-living cover of litter, rock, and soil were measured by the quadrate method. The one-meter-square quadratus were spaced every ten feet along the selected transects. The Riparian and Conifer Communities were sampled with 30 quadratus each, the Grassland-Shrub Community was sampled with 50 quadratus, and the Pinion-Juniper Community was sampled with 50 quadratus, and the Pinion-Juniper Community was sampled with

51 quadratus. Living plants were determined to species and their percent of total area in each quadrate (cover) was estimated. The number of separate plants was also counted (density). These data were grouped by growth form into trees; shrubs and vines; grasses, sedges, and rushes; forbs; and cryptograms.

9.2.3 Reference Areas

Two reference areas are designated to be permanently marked and protected. One is in the Riparian Community, and one is in the Grassland Shrub Community. Their locations are marked on the vegetation map, Map A, Appendix 9-1.

9.2.4 Vegetation Map

A vegetation map was compiled with the aid of aerial photographs printed in a scale of approximately 528 feet-to-the-inch (1:6, 3346), assisted by ground-truthing surveys.* The most recent available aerial survey (1977) was used. The final map was later transferred to a contour map at the same scale. Area measurements were made for each community type by cutting up one of the maps and weighing the various pieces according to the community type. This gave percentages for each community type in the mine plan area and permitted calculating the acreages involved.

9.2.5 Sampling Adequacy

The date summarized for each sampled plant community was subjected to precision analysis using the statistic:

$$N = \left(\frac{ts}{px} \right)^2 \qquad (9\text{-}1)$$

in which:
- N = number of points, trees, quadratus, etc. which are necessary to sample within certain prescribed precision and confidence limits.
- t = student's t-value for two-tailed tests and N-1 degrees of freedom. Various confidence limits were tested, but the minimum acceptable level was 80%.
- s = standard deviation

$\bar{x}$ = the mean or average of a group of values

p = sampling precision, entered as a decimal but representing the percent variability around the true population mean.

In this test, N, the number of samples required to adequately sample the population at 80% confidence, and p = ±20% was calculated for each parameter (DBH, tree distance (density), sapling density, total plant cover, non-living cover, etc.). Precision was also calculated for these data using the actual number of samples used. This was done for 95%, 90%, and 80% confidence limits.

The interpretation of these precision tests is given in the following example. If N is calculated using the results of 30 samples, the 30 measurements are summed to obtain the mean (x) and standard deviation (s). The proper value of t is obtained from a t-table for N-1 = 29 degrees of freedom under the desired confidence limit column (95%, 90%, 80%, etc.). The value of p is also selected; assume p = .20 (which means the true population is to be estimated within ±20% precision). Assuming the example yielded an answer of N = 26, we could say that the 30 actual measurements constituted an adequate sample since only 26 were required to meet the criteria of ±20% with 80% confidence level. If we then said that x was the mean for the population, we would be within ±20% of the true mean in 80 out of 100 times that we sampled the population in the same way.

The true precision for our 30 samples could also be calculated by using

$$p = \frac{ts}{Nx} \qquad (9\text{-}2)$$

In the above example it would be less than .20 (±20% precision) because only 26 samples were needed to obtain p = ± .20; in fact, it would be p = ± .18 and the true precision is ±18% with 80% confidence.

Vegetation sampling is done within various confidence limits to suit different requirements. Higher values require more samples and increase costs. The value of 80% is accepted by the U.S.Bureau of

Land Management for estimating vegetation, productivity, etc. Likewise, p = (±20% precision) is normally accepted in vegetation sampling work.

9.3 EXISTING RESOURCES

9.3.1 General Site Description

The following discussion treats four of the five plant communities mapped within the Trail Mountain Mine ~~plan area boundaries~~ adjacent area. (See Figure 9-1 in Appendix 9). The fifth, consisting of aspen communities located on top of Trail Mountain, will not come under direct disturbance by coal mining activities ~~unless subsidence occurs when the mine is finally closed~~. ~~Although this might alter drainages, it is very unlikely because of the extent of relief above the coal seam.~~

Grassland-Shrub and Conifer communities on top of Trail Mountain are quite similar to those sampled below and are not expected to undergo perturbation from mining activities. The four sampled communities will be discussed in order of elevational scale; i.e. Riparian (streamside) in the bottom of the canyon, Pinion-Juniper above the Riparian, Grassland-Shrub above the mine mouth, and the Conifer Community directly west of the mine mouth and contiguous with the Grassland-Shrub Community. Discussions of these community types will be followed by a short treatment of the results of mapping, threatened and endangered species, and sampling adequacy.

9.3.2 Riparian (Streamside) Plant Community

9.3.2.1 General Description

The Riparian Community was sampled just north of the Trail Mountain Mine offices in Cottonwood Canyon beginning about 200 feet upstream from the office building. A 500 foot transect was run from that point along the west side of the stream to avoid the disturbances caused by the canyon road on the east side of the stream. Steep banks on each side of the stream are l0 to 30 feet high with slopes ranging from 40% to 90% where the stream has cut through old stream bed material. Vegetation is comparatively dense with a heavy understory of grasses, forbs, and scattered shrubs. Some 86 plant species were encountered in a survey of the stand. These are listed in

Table 9 1 by life form (trees, shrubs, grasses, forbs) with scientific and common names. The greatest species diversity occurred among the forbs, which have 48 species. Shrubs and vines were represented by 19 species, grasses and sedges by 10, and trees by 9. Narrow leaf cottonwood (Populous angustifolia) dominates the canopy layer and is reproducing vigorously with many seedlings and saplings appearing also in the understory. The total canopy cover measured on the line intercept was 40%, leaving 60% open space in this area next to the stream.

9.3.2.2 Riparian Tree Data

Table 9 2 summarizes the data taken by the point quarter method for 10 points along a 500 foot transect. A total of 40 trees and 40 additional saplings were measured. Three tree species came into the sample plus one large chokecherry (Prunus viginiana) reached tree size (DBH of 4 inches or more) in this case in the fourth quadrant of point 10. Tree density estimated from the sample was 87.8 trees per acre with 97.5% of these being narrowleaf cottonwood. Narrowleaf cottonwood dominated in all parameters of density, basal area, cover, and frequency with an importance value (IV) of 397.7 out of a possible 400 IV points for trees. Basal area and percent cover was not measured for seedlings and saplings, but narrowleaf cottonwood dominated the understory also with an importance value of 178.3 out of a possible 200 points for 89.2% of relative IV. The C x F index (cover x frequency), another measure of relative importance, also shows similar traits for the trees. Saplings of three species occurred in this community at a density of 892 per acre. Since fully grown trees occur at 88 per acre, it appears there is a natural mortality rate of about 90% among established tree seedlings in this community.

9.3.2.3 Riparian Understory Data

Table 9 3 summarizes the streamside species sampled in the understory with 30 one meter square quadratus. Forbs proved to be the most important life form followed by grasses, as may be seen by the importance values and the C x F index at the right of Table 9 3. Out of a possible 300 IV points, forbs had 142.3 (47.4%) to 111.8 (37.3%)

for grasses; and of a possible total of 10,000 C x F index points, forbs had 606.6 compared to 261 for grasses. Counts of the stems for each species show that grasses have higher density counts with about twice the number of stems as forbs (66.7% density for grasses and 31.5% for forbs). The most important species can be picked out by the IV values listed in Table 9 3. Poa pratensis (Kentucky bluegrass) had the highest individual IV value (80). This was followed by 47 for (Aster chilensis) 43.4 for scouring rush (Equisetum ervense), 318 for orchard grass (Doctylis glomerata), 16.4 for narrow leaf cottonwood seedlings, 15.2 for dandelion (Taraxacun afficionale)(, and ll.7 for western virgin's bower (Clematis ligusticifolia). The C x F index, however, shows that (Aster Chilensis) (CxF = 312.4 and scouring rush (C x F = 266.4) are very important compared to C x F = 176.8 for Kentucky bluegrass. This is based mainly on the high cover values measured for (Aster) and for scouring rush, as well as a high frequency of occurrence in the quadratus.

The overall average living understory cover was measured at 35.5% of total cover, and it ranged from 0.6% to 67% with litter contributing about 51% of non-living cover. Rock and exposed soil were of rather minor importance (2.6% and 8.6% of total cover respectively

9.3.3 Pinion-Juniper Plant Community

9.3.3.1 General Description.

This stand is located just north of the Trail Mountain Mine office on steep south- and east-facing slopes above the Riparian Community reference area. The measured transect was 500 feet long, running in a south-north direction along a 168° bearing line (magnetic). The slope in the sampling area is about 42% with an exposure of 78± EEN. Large boulders are scattered among the trees, which causes a variety of relief and abrupt changes in percent slope.There are 62 plant species in this community, as listed in Table 9-4. The dominant tree is pinion pine (Pinus edulis). Significant percentages of Rocky Mountain juniper (Juniperus acopulorum), limber pine (Pinus flexilis), and Douglas fir (Pseudotsuga menziesii) also occur. The

greatest species diversity occurs among the forbs (36 species) followed by shrubs (13 species), grasses (7 species), and trees (6 species).

9.3.3.2 Pinion-Juniper Tree Data

Table 9-5 summarizes the data for four species of trees occurring in the point quarter and line intercept sampling data. Density of trees was estimated from tree distance at 99.2 trees per acre. Seedlings and saplings are present at 133.9 trees per acre. The combined total for both trees and young trees is 233.1 trees per acre. Since full size trees represent about 43% of the combined total, a natural mortality rate of about 57% is suggested for tree seedlings in this community. Pinion pine showed the greatest values for density, basal area (dominance), cover, and frequency. The importance value (IV) of 239.6 for pinion pine far exceeds all the other trees, as does the C x F value of 2,380.5. Rocky Mountain juniper is the next most important tree species with an IV of 70.8 and C x F index of 447. These dominant species are followed by Douglas fir with an IV score of 59.3 and a C x F value of 240.

Tree reproduction indicates that seedlings and saplings of pinion juniper still dominate at an IV of 85.6 out of a possible 200; but Douglas fir, with an IV of 56.1, is more important than juniper at 43.8. Perhaps Douglas fir is increasing in this community. When both trees and reproduction are considered together, the density values show that Douglas fir is slightly more important than juniper and may indicate trends in successional directions, as do the importance values cited above.

9.3.3.3 Pinion-Juniper Understory Data

The data on understory vegetation for the Pinion-Juniper Community are summarized in Table 9-6. Grass species dominate the understory vegetation with a life form total importance value of 157.4 or 52.5% importance. Slender wheatgrass (Agropyron trachycaulum) was the most important species in the understory, with an importance value of 132.4 or 44.1% importance in comparison to all the other understory species. On the basis of cover and frequency, this translates to a C x F index of 1067.7 and a

total C x F index of 1067.7 and a total C x F index for grasses of 1104.6.

Lichens are the next most abundant life form in terms of cover and frequency (but not biomass or forage value), with an importance value of 30.4. This is followed by Utah serviceberry (A, e; amejoer utahensis) at 24.5. Hood's (Phlox hoodii) at 17.5, and Sandberg's bluegrass (Poa secunda) at 15.3.

Generally, the understory vegetation is rather sparse in density except for patches of slender wheatgrass. The average cover value for living plants was 23.4%, and ranged from 7.5% where mostly rock was exposed in the quadrate to 85% under bushes of Utah serviceberry. This leaves non-living cover averaging approximately 75% and consisting of rock (27.3% cover), litter (26%), and soil (22.6%).

9.3.4 Grassland-Shrub Community Data

9.3.4.1 General Description

This stand is located immediately above the Trail Mountain Mine mouth and loading areas on the steep, generally east-facing mountain slope. The stand runs around the brow of the hill and has exposures ranging from north-northeast to east. The soils are rather heavy, being silty clay to loamy silty clay soils dotted with many boulders and rocks caused by talus from the rocky cliffs above. The slopes range from 43% to about 48%, measured by clinometer.

The vegetation forms are mainly grasses with scattered shrubs and an occasional tree here and there, especially at the west end of the sampled stand.

Table 9-7 lists all plant species observed in this plant community. A total of 37 species are recorded, consisting of 3 trees, 11 shrubs, 6 grass and sedge species, and 17 forb species. Of the forbs, only one annual was observed (Lappula aredowskii). No extensive tree canopy exists except for the isolated trees, so no tree data was taken in this community.

9.3.4.2 Grassland-Shrub Understory Data

The summary data listed in Table 9-8 provide estimates from the vegetative sampling of cover, frequency, and density for two sites. Grasses and sedges were the most abundant as is indicated by the importance value (IV) and the C x F index on the right side of Table 9-8. The IV value is obtained by adding up the relative percentages of cover, frequency and density. The C x F index is obtained by multiplying the cover and frequency together. Thus, it is possible to obtain a total C x F value of 10,000. The higher the IV or the C x F index is, the more abundant and, consequently, the more important is the plant species or life form listed.

Based on these indices, grasses had an IV of about 146 out of a possible 300, or 53% importance. Slender sheatgrass, like the pinion-juniper stand discussed above, had the highest IP value (IP = 131 plus C x F = 1383.3). Slender wheatgrass was followed in importance by a forb called shrubby bedstraw (Galium multiflorum) at an IV of about 32, and the shrub called shadscale (Atriplex confertifolia) at an IV of about 20. Other species of somewhat less importance were sticky rabbitbrush (Chrysothamnus visidiflarus), snakeweed (Gutierrezia sarathrae), Sandberg's bluegrass (Poa secunda), Hood's phlox (phlos hoodii), and buckwheat (Eriogonum carymboxum).

Total cover (54.4%) was rather high due to the heavy grass cover (33.4%). Because of this high cover, there was less soil and rock exposed without living cover or litter above it.

9.3.5 Conifer Plant Community

9.3.5.1 General Description

This plant community is located west of the mine mouth on north-facing slopes of a rather large draw trending east and west up Trail Mountain's east slopes. The slopes range from 50 to 60% with an exposure to the north. The sampling transect extended along a line bearing 260° west. The forest-covered steep slopes are at the base of

steep cliffs which have contributed talus to the forest soil below. The soil is very rocky as with the contiguous Grassland-Shrub Community further east already described. The understory vegetation is sparse. A species list with a total of 43 species was compiled and appears in Table 9-9. Six trees, 9 shrubs, 6 grasses and sedges, and 22 forbs were found in the stand, of which some 26 species came into the sample transect.

9.3.5.2 Conifer Tree Data

Table 9-10 summarizes the tree data for the conifer stand. It shows white fir and Douglas fir to be co-dominant, with an IV value of 169 for white and 162 for Douglas fir. These accounted for almost 83% of the tree dominance and almost all of the total C x F index, as can be seen on the right side of Table 9-10. Douglas fir had the greatest amount of basal area, but white fir contributed the greater amount of canopy cover and was 10% more frequent.

Total density of trees was about 74 per acre, and Douglas fir and white fir were even although Douglas fir had almost twice as many seedlings and saplings. Both trees are reproducing themselves so this stand can be considered a climax community for this exposure, elevation and other static factors of soil, etc. Mountain red juniper showed good reproduction, but there were few tree-size individuals in the samples.

9.3.5.3 Conifer Understory

As in the Grasslands-Shrub Community immediately east of this stand, grass was the most important species in the understory (see Table 9-ll). Forbs were next in importance. Here again slender wheatgrass proved to be most ubiquitous, with an IV value of 106 and a C x F index of 446. The most important forbs were shrubby bedstraw (Galium multiflorum) and Hood's phlox at scores of 28 and 27 on the IV index respectively. The two shrubs of most importance were creeping barberry (Mahonia repens) and Utah serviceberry at IV scores of 15 and 14 respectively. The grass blue wildrye (Elymus glauca) and the sedge (Carex geyeri) were also of minor

importance at IV 231 and Iv 15, in that order. Density count was the factor that provided much of the dominance for the grasses, however, with 833 stems counted in 30 quadratus.

As was mentioned earlier, the understory cover was described as rather sparse. This observation is supported by the measured low total cover value of about 23%. Litter was abundant at 23%, but soil had about 34% of absolute cover exposure under the trees. With a tree canopy of 60.4% it is understandable that understory cover is meager. This, coupled with comparatively low precipitation in this area, influences the lower understory values.

9.3.6 Vegetative Productivity

Productivity data from the two plant communities adjacent to the disturbed area are shown in Tables 9-12 (Riparian) and 9-13 (Grassland-Shrub). These two communities have been disturbed in the past operations of the Trail Mountain Mine and are the only ones likely to receive any future disturbance. The data are shown for freshly cut or green weights and for air dry weights too. The following discussion concerns only the air dry weights. The Riparian community produced a total of 1,516 pounds per acre (air dry), while the Grassland-Shrub Community produced 910 lb/acre. Moisture in these productivity measurements accounted for 64 and 49 percents of the totals in the two communities so that the corresponding fresh weights were 4,236 and 1,774 lb/acre of total plant productivity. Since only understory plants were measured, tree data is for seedlings and saplings only. Even so, the Riparian Community outproduced the GRassland-Shrub Community by a factor of about two. The most abundant life form in both communities was grass with 36% of total productivity in the Riparian and 79% in the Grassland-Shrub Community. Forbs and shrubs were about equal in the Riparian Community at 30 and 31% (455 and 464 lb/acre) respectively. In the Grassland-Shrub Community, shrubs were the second most productive life form at 9% of the air dry total while forbs represented only about 1%.

In the present study several methods were used to obtain estimates of vegetation growth in the vicinity of the Trail Mountain Mine. These methods all involved sampling and using the results to

estimate the population values. Adequate sampling ensures that the population parameter will be estimated with acceptable precision. Any degree of precision can be obtained by increasing the sample size. Perfection can be achieved by measuring every member of the population. This is, of course, impractical and a compromise is always struck between the level of precision and the expense and time required to attain it.

9.3.7 Sampling Adequacy

The sampling adequacy and actual precision obtained for the various data obtained in the present study are summarized in Table 9-14. The minimum criterion for adequate sampling in these date is ±20% precision at the 80% statistical confidence level. This means that the true population mean has been estimated to within ±20% or better, and that if we say this is true we would be wrong only twenty times in a hundred from random causes alone.

Table 9-14 shows that in many cases the actual precision obtained in this study is much better than ±20%. These values are shown in Part B of the table where 29 of the 36 precision tests meet or exceed the ±20% precision standard. Three of the seven inadequate samples are very close to the acceptance level and the remaining four involve two density estimates of understory grasses and two estimates of tree canopy (% cover). The difficulty of counting grass stems is obvious and accounts for the one problem. The tree canopy estimates, which could benefit from additional sampling, are poorest in the two plant communities least likely to be disturbed by mining activities, the Conifer and Pinion-Juniper Communities. We believe no essential conclusions or recommendations advance in this vegetation report would be changed by additional sampling in these areas.

9.3.8 Reference Area Supporting Data

Two vegetation communities were assigned reference areas. These have been permanently marked, and are shown on Map A, Appendix 9-1. The riparian reference area represents the pre-disturbance condition of the parking area, coal loading facilities, and mine buildings area. (See Vegetation Map A, Appendix 9-1.) The grassland-shrub reference area represents the pre-mining grassland-shrub community--part of which still exists above the mine mouth. Both reference areas were sampled quantitatively. Data are included in Vegetation Resources, Chapter Nine.

9.4 THREATENED AND ENDANGERED SPECIES

No threatened or endangered species are observed in the mine ~~lease~~ adjacent areas. However, Hedysarum ocidentale var Canone is known to occur in areas to the south and east of the mine ~~plan~~ adjacent area in the Miller Canyon vicinity. Heydysarum Ocidentale var Canone does not occur ~~on~~ the ~~mine plan~~ adjacent area (Bob Thompson, USFS 1987). Several other species have been proposed to be listed in the past that occur in areas to the south and east in the Mancos Shale and Morrison Formation derived soils, and one species of grass (Festuca dasyclada) is found in Joe's Valley to the west; but are not known to occur in or contiguous to the ~~mine plan~~ adjacent area. Many of the species reported by Welsh, et al (1975) have since been delisted or dropped from the possibly threatened or endangered list by Welsh (1978).

9.5 EFFECTS OF MINING OPERATIONS ON VEGETATION

The mine has been in existence since 1948 and has undergone expansion in the last few years, which has removed vegetation and redistributed soil to its present location as fill for the parking lot and coal loading areas. This has had the effect of removing the Riparian and part of a stand of a Grassland-Shrub Community.

9.6 MITIGATION AND MANAGEMENT PLANS

The mine site was disturbed during development activities from 1948-1967. As such, no vegetative protection activities are planned for the disturbed areas. Any future disturbance will require the verification that threatened and endangered species do not exist on the ~~proposed~~ site. If any threatened and endangered species are found, the appropriate authorities will be contacted.

To mitigate the loss of approximately 2,000 feet of riparian community that was damaged when a portion of the North Fork of the Cottonwood Creek adjacent to the disturbed area of the Trail

Mountain Mine was culverted, Trail Mountain (During April, 1986) cut and collected approximately 3,500 12-18 inch long willow stems from local stock and cold storaged them.. During the latter of part of May, 1986 these willow stems were planted at intervals of approximately six feet apart on both sides of the North Fork of the Cottonwood Creek for a distance of two miles below the disturbed area of the mine site. This willow shoot enhancement project was conducted by Trail Mountain with the technical supervision of Mr. Larry Dalton of the Division of Wildlife Resources (1986).

9.7 REVEGATATION METHODS AND JUSTIFICATIONS

After cessation of coal mining activities at the Trail Mountain Mine, all disturbed areas will be revegetated. The revegatation plan contains one option; to use the existing soils with amendments. The plan assumes that the existing buildings will be removed, the mine entrances sealed, and the site regraded to the final surface configuration.

Seeding for the Riparian area will follow the rates and species listed in Table 3, page 35 Appendix 9-1 and seeding for the Grassland-Shrub area is listed in Table 2A, Appendix 9-1, p 34-A.
(See Reclamation Plan Seedbed Preparation: Grassland and Riparian Appendix 9-1.)

9.8 REVEGETATION MONITORING

The vegetation composition of the reseeded areas will be compared to that in the reference areas. Ninety percent stocking rate is acceptable under the present regulations. Subsequent reseeding for each year will be done until cover and productivity are within 90% of the approved reference areas.

9.9 BIBLIOGRAPHY

Arnow, L.A., A.M. Wyckoff, and B.J. Albee, 1977, Flora of the Central Wasatach Front, Utah. University of Utah Printing Service.

Curtis, J.T. and Grant Cottam, 1962, Plant Ecology Workbook; Workbook; Laboratory, Field and Reference Manual. Burgess Publishing Company.

Holmgren, A.H. and J.L. Reveal, 1966, Checklist of the Vascular Plants of the Intermountain Region. U.S. Forest Service Research Paper INT-32. Intermountain Forest and Range Experiment Station. Forest Service USDA. Ogden, Utah. 160 p.

Plummer, A. Perry, Donald R. Christensen, and Stephen B. Monsen, 1968, Restoring Big Game Range in Utah. Publications No. 68-3, Utah Division of Fish and Game.

Welsh, S.L. and G. Moore, 1973, Utah Plants, ( ). Brigham Young University Press. Provo, Utah 474 p.

Welsh, S.L., N.D. Atwood, and J.L. Reveal, 1978, Endangered, Threatened, Extinct, Endemic, and Rare or Restricted Utah Vascular Plants. Great Basin Nauralist 35:327-376.

Welsh, S.L., 1978 Endangered and Threatened Plants of Utah A Reevaluation. Great Basin Naturalist 38:1-17.

Table 9-1
SPECIES PRESENCE LIST: RIPARIAN PLANT COMMUNITY

Species* (Total =86)	Common Name
Trees	
*Abies concolor (*Gord. & Glen.) Lindl.	White Fir
Acer glabrum Torr.	Rocky Mountain Maple, Smooth Maple
Acer grandidentatum Nutt.	Bigtooth Maple
Betula occidentalis Hook.	Water Birch
Juniperus scopulorum Sarg.	rocky Mountain Juniper
Picea pungens Engelm.	blue Spruce
Pinus edulis Engelm.	Pinyon Pine
Populus angustifolia James	Narrowleaf Cottonwood
Pseddotsuga menziesii (Mirb.) Franco	Douglas Fir
Shrubs and Vines (19)	
Amelanchier alnifolia (Nutt.) Nutt.	Saskatoon Serviceerry
Amelanchier utahensis Koehne	Utah Serviceberry
Artemisia tridentata Nutt.	Big Sage
Cercocarpus ledifolius Nutt.	Curlleaf Mountain Mahogany
Chrysothamnus nauseosus (Pall.) Britton	Rubber Rabbitbrush
Chrysothamnus viscidiflorus (Hook.) Nutt.	Douglas or Yellowbrush Rabbitbrush
Clematis columbiana (Nutt.) Torr. & Gray	Columbian Clematis, Virgin's Bower
Clematis ligusticifolia Nutt.	Western Virgin's Bower
Cornus stolonifera Michx.	Redosier Dogwood
Gutierrezia sarothrae (Pursh) Britton	Broom Snakeweed
Holodiscus dumosus (Hook.) Heller	Bush Oceanspray
Mahonia repens G. Don	Oregon Grap, Creeping Barberry
Prunus virginiana L.	Chokecherry
Ribes cereum Dougl.	Wax Currant
Rosa Woodsii Lindl.	Wild Rose
Salix bebbiana Sarg.	Bebb Willow
Salix erigua Nutt.	Coyote Willow
Sambucus caerulea Raf.	Elderberry
Symphoricarpos oreophilus A. Gray	Mountain Snowberry
Grasses, Sedges, and Rushes (10)	
Agropyron Spicatum (Pursh) Scribn. & Smith	Bluebunch Wheatgrass
Agropyron trachycaulum (Link) Malte	Slender Wheatgrass
(a) *Bromus tectorum* L.	Cheatgrass
Carex sp. L.	Sedge
Dactylis glomeratat L.	Orcharg Grass
Elymus cinereus Scribn.& Smith	Wildrye
Juncus balticus L.	Artic Rush
Oryzopsis hymenoides (Roem. & Schult.) Ricker	Indian Ricegrass
Poa pratensis L.	Kentucky Bluegrass
Typha latifolia L.	Common Cattail

Table 9-1 Continued
SPECIES PRESENCE LIST: RIPARIAN PLANT COMMUNITY

Species*	Common Name
Forbs (48)	
Achillea millefolium L.	Yarrow
Aquilegia flavescens S. Wats.	Yellow Columbine
Arabis holboellii Hornem.	Rock Cress
Artemisia ludoviciana Nutt.	Louisiana Sage, Wormwood
Aster chilensis Nees.	Aster
Astragalus sp.	an unidentified white-flowered species
Astragalus convallarius Green	Tember Poisonweed
Astragalus lentiginosus Dougl. Var. *araneosus* (Sheld.) Barneby	Specklepod Locoweed
Astragalus tenellus Pursh.	Loosflower Milkkvetch
Castilleja applegatea Fern.	Indian Paintbrush
Castilleja linariaefolia Benth.	Wyoming Painted Cup
Chaenactis douglasii (Hook.) Hook. & Arn.	Chaenactis
Cirsium undulatem (Nutt>) Spreng.	Wavyleaf Thistle
Cirsium vulgare (Savi) Tenore	Thistle
Coryphantha vivipara Britton & Brown	Mammillaria
Cryptantha Humilis (Green) Payson	Cryptantha, Dwarf Catseye
Descurainia richardsonii (Sweet) O.E. Schulz.	Tansymustard
Dodecatheon pulchellum (Raf.) Merrill	Shooting Star
Equisetum arvense L.	Field Horsetail, Scouring Rush
Erysimum asperum (Nutt.) DC	Western Wallflower
Fragaria vesca L.	Strawberry
Galium aparine L.	Catchweek Bedstraw
Galium multiflorum Kellogg	Shrubby Bedstraw
Geranium fremontii Torr.	Fremont Geranium
Glycyrrhiza lepidota Pursh	American Licorice
Habenaria hyperborea (L.) R. Br.	Northern Green Bog Orchid
Hedysarum boreale Nutt.	Northern Sweetvetch
Ipomopsis aggregata V. Grant	Skyrocket Gilia, Scarlet Gilia
(a) *Lappula redowskii* (Hornem.) Green	Stick Seed
Lathyrus lanszwertii Kellogg	Thickleaf Sweetpea
Lipdium montanum Nutt.	Mountain Pepperweed
Lesquerella intermedia (S Wats.) Heller	Bladderpod
(a) *Lithospermum arvense* L.	Stoneseed
(a) *Malcolmia africana* (L.) R. Br.	African Mustard
Opuntia polyacantha Haw.	Plains Prickly Pear
Pestemon eatoni A. Gray	Eaton's Penstemon
Penstemon thompsoniae (A. Gray) Rydb.	Thompson's Penstemon
Phlox hoodii Rich.)	Hood's Phlox
Ranunculus cymbalaria Pursh	Rocky Mountain Buttercup
Senecio multilobatus Torr. & Gray	Lobeleaf Groundsel
(a) *Sisymbrium altissimum* L.	Tumblemustard
Solidago canadensis L.	Goldenrod
Stanleya pinnata (Pursh) Britton	Prince's Plume
Taraxacum officinale Weber	Common Dandelion

Table 9-1 Continued
SPECIES PRESENCE LIST: RIPARIAN PLANT COMMUNITY

Species*	Common Name
	Forbs (con't)
Trifolium repens L.	White Clover
Urtica dioica L.	Stinging Nettle
Valeriana edulis Nutt.	Edible Valerian
Viola adunca J.E. Smith	Violet

(a) annual
* Taxonomy according to Holmgren and Reveal, 1966; Welsh and More, 1973; and Arnow and Wyckoff, 1977.

Table 9-2
RIPARIAN TREE DATA*

Species	No. of Individuals	Density Trees/Acre	Relative % Density	Basal Area (in²)	Relative % Dominance	% Cover	Relative % Cover	% Frequency	% ΣF	Importance Value	Relative Importance	C x F Index†
Trees												
Populus angustifolia	39	85.6	97.5	2287.4	99.3	40	100	100	90.9	387.7	96.6	9090
Prunus virginiana	1	2.2	2.5	15.9	0.7	0	0	10	9.1	12.3	3.1	0
Totals	40	87.8	100	2303.3	100	40	100	110	100	400	99.7	9090
Saplings and Seedlings												
Populus angustifolia	38	847.4	95					100	83.3	178.3	89.2	
Picea pungens	1	22.3	2.5					10	8.3	10.8	5.4	
Juniperus scopulorum	1	22.3	2.5					10	8.3	10.8	5.4	
Totals	40	892	100					120	99.9	199.9	100	
Trees plus Saplings and Seedlings												
Populus angustifolia	77	933	96.2									
Picea pumgens	1	22.3	1.3									
Juniperus scopulorum	1	22.3	1.3									
Purnus virginiana	1	2.2	1.3									
Totals	80	979.8	100.1									

* Tree density and frequency by the point-quarter method; cover by the line intercept method.

† Maxium possible value is 100 x 100 = 10,000.

Table 9-3
RIPARIAN UNDERSTORY VEGETATION ANALYSIS: COVER FREQUENCY, AND DENSITY DATA FROM QUADRATS

Species	Average % Cover per Quadrat	Absolute Frequency	Number of Stems in 30 Quadrats	Relative % of Cover	% ΣF	% Density	Importance Value	% Importance	C x F Index*
Tree Seedling and Saplings*									
Betula occidentalis	0.07	3.3	1	0.20	0.49	0.03	0.72	0.24	0.10
Juniperus scopulorum	0.68	16.7	4	1.91	2.47	0.11	4.49	1.50	4.72
Populus angustifolia	3.93	33.3	14	11.06	4.92	0.38	16.36	5.45	54.42
Pseudotsuga menziesii	0.67	6.7	2	1.89	0.99	0.05	2.93	0.98	1.87
Subtotal	5.35	60.0	21	15.06	8.87	0.57	24.50	8.17	61.11
Shrubs									
Clematis ligustioifloia	1.17	50.0	37	3.29	7.39	1.01	11.69	3.90	24.31
Cornus stolonifera	0.07	3.3	0	0.20	0.49	0.00	0.69	0.23	0.10
Rosa woodsii	0.77	10.0	5	2.17	1.48	0.14	3.79	1.26	3.28
Symphoricarpos oreophilus	0.50	13.3	4	1.41	1.97	0.11	3.49	1.16	2.78
Subtotal	2.51	76.6	46	7.07	11.33	1.26	19.66	6.55	30.47
Grasses									
Daotylis glomerata	4.05	50	500	11.39	7.39	13.06	31.84	10.61	84.17
Poa pratensis	5.54	76.7	1,945	15.59	11.34	53.06	79.99	26.67	176.79
Subtotal	9.59	126.7	2,445	26.98	18.73	66.12	111.83	37.28	260.96

* Understory data measured by quadrats. See tree Tables for canopy data measured by point-quarter and line intercept methods.

Table 9-3 Continued
RIPARIAN UNDERSTORY VEGETATION ANALYSIS: COVER FREQUENCY, AND DENSITY DATA FROM QUADRATS

Species	Average % Cover per Quadrat	Absolute Frequency	Number of Stems in 30 Quadrats	Relative % of Cover	% ΣF	% Density	Importance Value	% Importance	C x F Index
Forbs									
Achillea millefolium	0.26	16.7	39	0.73	2.47	1.06	4.26	1.42	1.8
Aster chilensis	7.77	96.7	421	21.86	14.29	11.48	47.63	15.88	312.38
Artemisia ludoviciana	0.26	20	21	0.73	2.96	0.57	4.26	1.42	2.16
Astragalus lentiginosus	0.11	10	6	0.31	1.48	0.16	1.95	0.65	0.46
Castillea applegatei	0.33	10	9	0.93	1.48	0.25	2.66	0.89	1.38
Castillea linariaefolia	0.02	6.7	2	0.06	0.99	0.05	1.1	0.37	0.06
Cirsium undulatum	0.53	66.7	31	1.49	9.86	0.85	12.2	4.07	14.69
Equisetum arvense	6.51	90	431	18.32	13.3	11.76	43.38	14.46	243.66
Fragaria vesca	0.003	3.3	1	0.01	0.49	0.03	0.53	0.18	0.01
Galium multiflorum	0.03	3.3	2	0.08	0.49	0.05	0.62	0.21	0.04
Glycyrrhisa lepidota	0.12	13.3	7	0.34	1.97	0.19	2.5	0.83	0.67
Hedysarum boreale	0.17	6.7	3	0.48	0.99	0.08	1.55	0.52	0.48
Solidago canadensis	0.6		36	1.69	0.49	0.98	3.16	1.05	0.83
Habenaria hyperborea	0.03	3.3	3	0.08	0.49	0.08	0.65	0.22	0.04
Taraxacum officinals	1.26	53.3	139	3.55	7.88	3.79	15.22	5.07	27.97
Trifolium repens	0.01	3.3	3	0.03	0.49	0.08	0.6	0.2	0.04
Subtotal	18.01	403.3	1,154	50.69	60.12	31.46	142.27	47.44	606.67
Cryptogams									
Lichens	0.08	10	-	0.23	1.48	-	1.71	0.57	0.34
Subtotal	0.08	10	-	0.23	1.48	-	1.71	0.57	0.34
Total: Living Plants	35.54	676.60	3,666	100.03	100.53	99.41	299.97	100.01	959.55

Non-Living Cover	
Litter	50.56
Rock	2.63
Soil	8.6
Total	61.79

Table 9-4
SPECIES PRESENCE LIST: PINYON-JUNIPER PLANT COMMUNITY

Species (Total = 62)	Common Name
Trees (6)	
Abies concolor (gord. & Glend.) Lindl.	White Fir
Juniperus osteosperma (Torr.) Little	Utah Juniper
Juniperus scopulorum Sarg.	Rocky Mountain Juniper
Pinus edulis Engelm.	Pinyon Pine
Pinus flexilis James	Limber Pine
Pseudotsuga menziesii (Mirb.) Franco	Douglas Fir
Shrubs (13)	
Amelanchier utahensis (Nutt.) Nutt.	Utah Serviceberry
Artemisia tridentata Nutt.	Big Sage
Atriplex confertifolia (Torr. & Frem.) S. Wats.	Shadscale
Cercocarpus ledifolius Nutt.	Curlleaf Mountain Mahogany
Chrysothamnus nauseosus (Pall.) Britton	Rubber Rabbitbrush
Chrysothamnus viscidiflorus (Hook.) Nutt.	Douglas or Yellowbrush Rabbitbrush
Ephedra viridis (Cov.)	Green Ephedra, Mormon Tea, Joint Fir
Gutierrezia sarothrae (Pursh) Britton	Broom Snakeweek
Holodiscus dumosus (Hook.) Heller	Bush Oceanspray
Mahoia repens G. Don	Oregon Grape, Greeping arberty
Pachistima myrsinites (Pursh) Raf.	Mountain Lover
Physocarpus malvaceus (Green) Kuntze	Mallow Ninebark
Symphoricarpos oreophilus A. Gray	Mountain Snowberry
Grasses (7)	
Agropyron spicatum (Pursh) Scrib. & Smith	Bluebunch Wheatgrass
Agropyron trachycaulum (Link) Malte	Slender Wheatgrass
Bromus inermis Leyss.	Smooth Brome
Bromus tectorum L.	Cheatgrass
Oryzopsis hymenoides (Roem. & Schult.) Ricker	Indian Ricegrass
Poa secunda Presl	Sandberg's Bluegrass
Poa sp.	an unidentified bluegrass species

Table 9-4 Continued
SPECIES PRESENCE LIST: PINYON-JUNIPER PLANT COMMUNITY

	Species	Common Name
	Forbs (36)	
	Antennaria rosea Greene	Rose Pussytoes, Everlasting
	Arabis drummondii A. Gray	Drummond's Rock Cress
	Arabis holboellii Hornem.	Rockcress
	Arabis pendulina Greede	Rockcress
	Artemisia ludoviciana Nutt.	Louisiana Sage, Wormwood
	Chenopodium fremontii S. Watts	Fremont's Goosfoot, Pigweed
	Cirsium undulatum (Nutt.) Spreng	Wavyleaf Thistle
	Coryphantha vivipara Britton & Brown	Mammillaria
	Cryotantha humilis (Greene) Payson	Cryptantha, Dwarf Catseye
*	*Cryptogramma stelleri* (Gmel.) Prantl	Rockbrake
(a)	*Descurainia pinnata* (Walt.) Britton	Tansymustard
	Descurainia richardsonii (Sweet) O.E. schulz	Tansymustard
	Erigeron engelmannii A. Nels.	Englmann's Fleabane
	Eriogonum corymbosum Benth.	Buckwheat
	Galium aparine L.	Catchweed Bedstraw
	Galium multiflorum Kellogg	Shrubby Bedstraw
	Haplopappus nuttallii Torr. & Gray	Golden Weed
	Heterotheca villosa Welsh & Moore	Golden Aster
	Hymenopappus filifolius Hook.	Fineleaf Hymenopappus
	Ipomopsis aggregata V. Grant	Skyrocket Gilia, Scarlet Gilia
(a)	*Lappula redoskii* (Hornem.) Greene	Stickweed
	Lepidium montanum Nutt.	Mountain Pepperweed
	Leptodactylon pungens (Torr.) Nutt.	Preckly Phlox
	Leucelene ericoides (Torr.) Green	Fleabane
(a)	*Lithospermum arvense* L.	Stoneseed
	Opuntia polyacantha Haw.	Plains Prickly Pear
	Penstemon eatonii A. Gray	Eaton's Penstemon
	Penstemon thompsoniae (A. Gray) Rydb.	Thompson's Penstemon
	Petradoria pumila (Nutt.) Greene	Rock Goldenrod
	Phlox hoodii Rich.	Hood's Phlox
	Senecio integerimus Nutt.	Groundsel, Old Man
	Senecio multilabatus Torr. & Gray	Lobeleaf Groundsel
	Sisymbrium linifolium Nutt.	Tumblemustard
	Solidago canadensis L.	Goldenrod
	Stanleya pinnata (Pursh) Britton	Desert Prince's Plume
	Townsendia incana Nutt.	Hoary Townsendia

* *Fern*

(a) *annual*

Table 9-5
PINYON-JUNIPER TREE DATA*

Species	No. of Individuals	Density Trees/Acre	Relative % Density	Basal Area (In^2)	Relative % Dominance	% Cover	Relative % Cover	% Frequency	% ΣF	Importance Value	Relative Importance	C x F Index
Trees												
Juniperus scopulorum	6	14.9	15.0	433.0	10.9	3.1	14.9	60	30	70.8	17.7	447.0
Pinus edulis	27	66.9	67.5	2960.4	74.2	11.0	52.9	90	45	239.6	59.9	2380.5
Pinus flexilis	1	2.5	2.5	103.8	2.6	4.2	20.2	10	5	30.3	7.6	101.0
Pseudotsuga menziesii	6	14.9	15.0	490.6	12.3	2.5	12.0	40	20	59.3	14.8	240.0
Totals	40	99.2	100.0	3987.8	100.0	20.8	100.0	200	100	400.0	100.0	3168.5
Saplings and Seedlings												
Juniperus scopulorum	8	26.8	20.0					50.0	23.8	43.8	21.9	
Pinus edulis	19	63.6	47.5					80.0	38.1	85.6	42.8	
Pinus flexilis	2	6.7	5.0					20.0	9.5	14.5	7.2	
Pseudotsuga menziesii	11	36.8	27.5					60.0	28.6	56.1	28.1	
Totals	40	133.9	100.0					210.0	100.0	200.0	100.0	
Trees plus Saplings and Seedlings												
Juniperus scopulorum	14	41.7	17.5									
Pinus edulis	46	130.5	57.5									
Pinus flexilis	3	9.2	3.8									
Pseudotsuga menziesii	17	51.7	21.2									
Totals	80	233.1	100.0									

* Tree density, dominance, and frequency by the point-quarter method; cover by the line intercept method.

Table 9-6

PINYON-JUNIPER UNDERSTORY VEGETATION ANALYSIS: COVER FREQUENCY, AND DENSITY DATA FROM QUADRATS

Species	Average % Cover per Quadrat	Absolute Frequency	Number of Stems in 51 Quadrats	Relative % of Cover	% ΣF	% Density	Importance Value	% Importance	C x F Index
Tree Seedling and Saplings*									
Juniperus scopulorum	0.12	3.92	2	0.51	1.03	0.34	1.88	0.63	0.53
Pinus edulis	0.29	1.96	0	1.24	0.52	0	1.76	0.59	0.64
Pseudotsuga menziesii	0.53	3.92	5	2.26	1.03	0.85	4.41	1.38	2.33
Subtotal	0.94	9.8	7	4.01	2.58	1.19	8.05	2.6	3.5
Shrubs									
Amelanchier utahensis	4.00	23.5	7	17.09	6.18	1.19	24.46	8.15	105.62
Artemisia tridentata	0.08	2.0	1	0.34	0.52	0.17	1.03	0.34	0.18
Gutierresia sarothrae	0.01	2.0	1	0.04	0.52	0.17	0.73	0.24	0.02
Symphoricarpos oreophilus	0.02	3.9	1	0.09	1.03	0.17	1.29	0.43	0.09
Subtotal	4.11	31.4	10	17.56	8.25	1.70	27.51	9.16	105.91
Grasses									
Agropyron spicatum	0.59	7.84	21	2.52	2.06	3.58	8.16	2.72	5.19
Agropyron trachycaulum	11.27	84.31	363	48.16	22.17	61.95	132.28	44.09	1067.71
Orysopsis hymenoides	0.12	3.92	1	0.51	1.03	0.17	1.17	0.57	0.53
Poa secunda	1.01	27.45	22	4.32	7.22	3.75	15.29	5.10	31.19
Subtotal	12.99	123.52	407	55.51	32.48	69.45	148.74	52.48	1104.62

* Understory data measured by quadrats. See tree Tables for canopy data measured by point-quarter and line intercept methods.

Table 9-6 Continued
PINYON-JUNIPER UNDERSTORY VEGETATION ANALYSIS: COVER FREQUENCY, AND DENSITY DATA FROM QUADRATS

Species	Average % Cover per Quadrat	Absolute Frequency	Number of Stems in 81 Quadrats	Relative % of Cover	% ΣF	% Density	Importance Value	% Importance	C x F Index
Forbs									
Antennaria rosea	0.1	5.88	8	0.43	1.55	1.37	3.35	1.12	0.67
Arabis drummondii	0.04	7.84	5	0.17	2.06	0.85	3.08	1.03	0.35
Arabis pendulina	0.04	1.96	10	0.17	0.52	1.71	2.4	0.8	0.09
Aster chilensis	0.07	3.92	4	0.3	1.03	0.68	2.01	0.67	0.31
Chenopodium fremontii	0.02	3.92	2	0.09	1.03	0.34	1.46	0.49	0.09
Cirsium undulatum	0.1	1.96	1	0.43	0.52	0.17	1.12	0.37	0.22
Cryptantha humilis	0.01	1.96	1	0.04	0.52	0.17	0.73	0.24	0.02
Cryptogramma stelleri †	0.02	1.96	1	0.09	0.52	0.17	0.78	0.26	0.05
Descurainia richardsonii	0.07	5.88	37	0.3	1.55	6.31	8.16	2.72	0.47
Erigeron engelmannii	0.03	5.88	3	0.13	1.55	0.51	2.19	0.73	0.2
galium multiflorum	0.11	7.84	23	0.47	2.06	3.92	6.45	2.15	0.97
Haplopappus nuttallii	0.29	17.64	17	1.24	4.64	2.9	8.78	2.93	5.64
Lappula redowskii	0.01	1.96	2	0.04	0.52	0.34	0.9	0.3	0.02
Lepidium montanum	0.16	3.92	5	0.68	1.03	0.85	2.56	0.85	0.7
Penstemon eatoni	0.02	1.96	2	0.09	0.52	0.34	0.95	0.32	0.05
Phlox hoodii	0.92	31.37	31	3.93	8.25	5.29	17.47	5.82	32.42
Senecio integerremus	0.04	5.88	4	0.17	1.55	0.68	2.4	0.8	0.26
Senecio multilobatus	0.09	7.84	6	0.38	2.06	1.02	3.46	1.15	0.78
Subtotal	2.14	119.57	162	9.15	31.48	27.62	68.25	22.75	43.31

† Fern

Table 9-6 Continued

PINYON-JUNIPER UNDERSTORY VEGETATION ANALYSIS: COVER FREQUENCY, AND DENSITY DATA FROM QUADRATS

Species	Average % Cover per Quadrat	Absolute Frequency	Number of Stems in 51 Quadrats	Relative % of Cover	% ΣF	% Density	Importance Value	% Importance	C x F Index
Cryptogams									
Moss	0.57	23.53		2.44	6.19		8.63	2.88	15.1
Lichens	2.65	72.55		11.32	19.09		30.4	10.13	215.99
Subtotal	3.22	96.08		13.76	25.28		39.03	13.01	231.09
Total: Living Plants	21.35	380.32	586	99.99	100.07	99.96	291.58	100.00	1488.43
Non-Living Cover									
Litter	26.02								
Rock	27.27								
Soil	22.57								
Total	75.86								

Table 9-7
SPECIES PRESENCE LIST: GRASSLAND-SHRUB COMMUNITY

Species (Total = 37)	Common Name
Trees (3)	
Abies concolor (gord. & Glend.) Lindl.	White Fir
Juniperus scopulorum Sarg.	Rocky Mountain Juniper
Pseudotsuga menziesii (Mirb.) Franco	Douglas Fir
Shrubs (11)	
Amelanchier utahensis (Nutt.) Nutt.	Utah Serviceberry
Artemisia tridentata Nutt.	Big Sage
Atriplex confertifolia (Torr. & Frem.) S. Wats.	Shadscale
Cercocarpus ledifolius Nutt.	Curlleaf Mountain Mahogany
Chrysothamnus viscidiflorus (Hook.) Nutt.	Douglas or Yellowbrush Rabbitbrush
Ephedra viridis (Cov.)	Green Ephedra, Mormon Tea, Joint Fir
Gutierrezia sarothrae (Pursh) Britton	Broom Snakeweek
Holodiscus dumosus (Hook.) Heller	Bush Oceanspray
Physocarpus malvaceus (Green) Kuntze	Mallow Ninebark
Rosa woodsii Lindl.	Wild Rose
Symphoricarpos oreophilus A. Gray	Mountain Snowberry
Grasses and Sedges (6)	
Agropyron spicatum (Pursh) Scrib. & Smith	Bluebunch Wheatgrass
Agropyron trachycaulum (Link) Malte	Slender Wheatgrass
Carex geyeri Boott	Elk Sedge
Oryzopsis hymenoides (Roem. & Schult.) Ricker	Indian Ricegrass
Poa pratensis L.	Kentucky Bluegrass
Poa secunda Presl	Sandberg's Bluegrass

Table 9-7 Continued
SPECIES PRESENCE LIST: GRASSLAND-SHRUB COMMUNITY

	Species	Common Name
	Forbs (17)	
	Arabis drummondii A. Gray	Drummond's Rock Cress
	Aster chilensis Nees	Aster
	Cirsium undulatum (Nutt.) Spreng	Wavyleaf Thistle
	Coryphantha vivipara Britton & Brown	Mammillaria
	Cryotantha humilis (Greene) Payson	Cryptantha, Dwarf Catseye
	Eriogonum corymbosum Benth.	Buckwheat
	Galium multiflorum Kellogg	Shrubby Bedstraw
	Haplopappus nuttallii Torr. & Gray	Golden Weed
	Heuchera parvifolia Nutt.	Common Alumroot
	Hymenoxus richardsonii (Hook.) Cockerell	Hymenoxys
(a)	*Lappula redoskii* (Hornem.) Greene	Stickweed
	Lepidium montanum Nutt.	Mountain Pepperweed
	Penstemon humilis Nutt.	Low Penstemon
	Penstemon thompsoniae (A. Gray) Rydb.	Thompson's Penstemon
	Phlox hoodii Rich.	Hood's Phlox
	Sisymbrium linifolium Nutt.	Tumblemustard
	Stanleya pinnata (Pursh) Britton	Desert Prince's Plume

(a) *annual*

Table 9-8

GRASSLAND-SHRUB UNDERSTORY VEGETATION ANALYSIS: COVER FREQUENCY, AND DENSITY DATA FROM QUADRATS

Species	Average % Cover per Quadrat	Absolute Frequency	Number of Stems in 50 Quadrats	Relative % of Cover	% ΣF	% Density	Importance Value	% Importance	C x F Index
Trees*									
Abies concolor	1.1	2	1	2.02	0.48	0.2	2.7	0.98	0.97
Juniperus scopulorum	0.8	2	1	1.47	0.48	0.2	2.15	0.78	0.71
Pseudotsuga menziesii	0.64	4	3	1.18	0.97	0.59	2.74	0.99	1.14
Subtotal	2.54	8.0	5	4.67	1.93	0.99	7.59	2.75	2.82
Shrubs									
Amelanchier utahensis	1.24	10.0	4	2.28	2.42	0.79	5.49	1.99	5.52
Artemisia tridentata	0.20	2.0	1	0.37	0.48	0.20	1.05	0.38	0.18
Atriplex confertifolia	4.93	32.0	14	9.06	7.73	2.77	19.56	7.10	70.03
Chrysothamnus viscidiflorus	1.60	14.0	8	2.94	3.38	1.58	9.90	2.87	9.94
Gutierresia sarothrae	0.51	14.0	26	0.94	3.38	5.14	9.46	3.43	3.18
Rosa woodsii	0.20	2.0	1	0.04	0.48	0.20	0.72	0.26	0.02
Subtotal	8.68	74.0	54	15.63	17.87	10.68	46.18	16.03	88.87
Grasses and Sedges									
Agropyron spicatum	0.2	4	2	0.37	0.97	0.4	1.74	0.63	0.36
Agropyron trachycaulum	31.18	100	251	57.28	24.15	49.6	131.03	47.57	1383.31
Carex gyeri	0.3	4	3	0.55	0.97	0.59	2.11	0.77	0.53
Orysopsis hymenoides	0.1	2	1	0.18	0.48	0.2	0.86	0.31	0.09
Poa pratensis	0.04	2	1	0.07	0.48	0.2	0.75	0.27	0.03
Poa secunda	1.54	14	16	2.83	3.38	3.16	9.37	3.40	9.57
Subtotal	33.36	126	274	61.28	30.43	54.15	144.12	52.95	1393.89

** Understory data measured by quadrats*

Table 9-8 Continued

GRASSLAND-SHRUB UNDERSTORY VEGETATION ANALYSIS: COVER FREQUENCY, AND DENSITY DATA FROM QUADRATS

Species	Average % Cover per Quadrat	Absolute Frequency	Number of Stems in 50 Quadrats	Relative % of Cover	% ΣF	% Density	Importance Value	% Importance	C x F Index
Forbs									
Arabis drummondii	0.1	8	7	0.18	1.93	1.38	3.49	1.27	0.35
Aster chilensis	0.04	2	2	0.07	0.48	0.4	0.95	0.34	0.03
Cryptantha humilis	0.12	10	6	0.22	2.42	1.19	3.83	1.39	0.53
Cryptogramma stelleri	0.4	2	1	0.73	0.48	0.2	1.41	0.51	0.35
Erigeron engelmannii	1.3	14	13	2.39	3.38	2.57	8.34	3.03	8.08
Galium multiflorum	2.96	40	85	5.42	9.66	16.8	31.88	11.57	52.36
Haplopappus nuttallii	0.56	16	14	1.03	3.86	2.77	7.66	2.78	3.98
Hymenoxys richardsonii	0.2	4	4	0.37	0.97	0.79	2.13	0.77	0.36
Lepidium montanum	0.02	2	1	0.04	0.48	0.2	0.72	0.26	0.02
Phlox hoodii	0.52	18	25	0.96	4.35	4.94	10.25	3.72	4.18
Penstemon hmilis	0.02	2	1	0.04	0.48	0.2	0.72	0.26	0.02
Sisymbrium linifolium	0.13	10	12	0.24	2.42	2.37	4.85	1.76	0.58
Stanleya pinnata	0.12	4	2	0.22	0.97	0.4	1.59	0.58	0.21
Subtotal	6.49	132	173	11.91	31.88	34.21	77.82	28.24	71.05

Table 9-8 Continued

GRASSLAND-SHRUB UNDERSTORY VEGETATION ANALYSIS: COVER FREQUENCY, AND DENSITY DATA FROM QUADRATS

Species	Average % Cover per Quadrat	Absolute Frequency	Number of Stems in 50 Quadrats	Relative % of Cover	% ΣF	% Density	Importance Value	% Importance	C x F Index
Cryptogams									
Moss	0.44	16		0.81	3.86		4.67		
Lichens	3.1	58		5.7	14.01		19.71		
Subtotal	3.54	74		6.51	17.87		24.38		
Total: Living Plants	54.61	414.00	506	100.00	99.98	100.03			
Non-Living Cover									
Litter	8.72								
Rock	20.46								
Soil	16.39								

Table 9-9
SPECIES PRESENCE LIST: CONIFER PLANT COMMUNITY

Species (Total = 42)	Common Name
Trees (6)	
Abies concolor (gord. & Glend.) Lindl.	White Fir
Acer glabrum Torr.	Rocky Mountain Maple, Smooth Maple
Juniperus scopulorum Sarg.	Rocky Mountain Juniper
Pinus edulis Engelm.	Pinyon Pine
Pinus flexilis James	Limber Pine
Pseudotsuga menziesii (Mirb.) Franco	Douglas Fir
Shrubs (9)	
Amelanchier utahensis (Nutt.) Nutt.	Utah Serviceberry
Artemisia tridentata Nutt.	Big Sage
Cercocarpus ledifolius Nutt.	Curlleaf Mountain Mahogany
Chrysothamnus viscidiflorus (Hook.) Nutt.	Douglas or Yellowbrush Rabbitbrush
Holodiscus dumosus (Hook.) Heller	Bush Oceanspray
Mahonia repens G. Don	Oregon Grap, Creeping Barberry
Physocarpus malvaceus (Green) Kuntze	Mallow Ninebark
Ribes cereum Dougl.	Wax Currant
Symphoricarpos oreophilus A. Gray	Mountain Snowberry
Grasses and Sedges (6)	
Agropyron trachycaulum (Link) Malte	Slender Wheatgrass
Carex geyeri Boott	Elk Sedge
Dactylis glomeratat L.	Orcharg Grass
Elymus glauca Buckl.	Blue Wildrye
Elymus salina E. Jones	Salina Wildrye
Poa secunda Presl	Sandberg's Bluegrass

Table 9-9 Continued
SPECIES PRESENCE LIST: GRASSLAND-SHRUB COMMUNITY

Species	Common Name
Forbs (22)	
Antennaria parvifloia Nutt.	Pussytoes, Everlasting
Arabis drummondii A. Gray	Drummond's Rock Cress
Arabis pendulina Greede	Rockcress
Arabis pulchra M.E. Jones	Rockcress
Aster chilensis Nees	Aster
Castilleja linariaefolia Benth.	Wyoming Painted Cup, Indian Paintbrush
Chamaechaemactis scaposa (Eastw.) Rydb.	False Yarrow
Clematis pseudoalpina (Kuntze) A. Nels.	Buckwheat
Cryptantha Humilis (Green) Payson	Cryptantha, Dwarf Catseye
Erigeron engelmannii A. Nels.	Englmann's Fleabane
Erysimun Wheeleri (Rothr.) Rydb.	Wallflower
Galium multiflorum Kellogg	Shrubby Bedstraw
Haplopappus nuttallii Torr. & Gray	Golden Weed
Heuchera parvifolia Nutt.	Common Alumroot
Hymenoxus acaulis (Pursh) Parker	Hymenoxys
Malcolmia africana (L.) R. Br.	African Mustard
Pestemon eatoni A. Gray	Eaton's Penstemon
Penstemon thompsoniae (A. Gray) Rydb.	Thompson's Penstemon
Phlox hoodii Rich.	Hood's Phlox
Senecio multilobatus Torr. & Gray	Lobeleaf Groundsel
Sisymbrium altissimum L.	Tumblemustard
Stellaria jamesiana Torr.	Tuber Starwort

Table 9-10
CONIFER COMMUNITY TREE DATA

Species	No. of Individuals	Density Trees/Acre	Relative % Density	Basal Area (in²)	Relative % Dominance	% Cover	Relative % Cover	% Frequency	% ΣF	Importance Value	Relative Importance	C.x.F. Index
Trees												
Abies Concolor	16	29.5	40	843.52	35.41	34.6	57.4	80	36.4	169.2	42.3	2089.4
Juniperus scopulorum	1	1.8	2.5	23.75	1	2.2	3.6	10	4.5	11.5	2.9	16.2
Pinus edulis	7	12.9	17.5	380.88	15.99	0	0	40	18.2	51.7	12.9	0
Pinus flexilis						3.4	5.6		0	5.6	1.4	0
Pseudotsuga mensiesii	16	29.5	40	1133.98	47.6	20.2	33.4	90	40.9	161.9	40.5	1366.1
Totals	40	73.7	100	2382.13	100	60.4	100	220	100	399.9	100	3471.7
Saplings and Seedlings												
Abies Concolor	10	125.9	25					70	26.9	51.9		
Juniperus scopulorum	7	90.7	18					60	23.1	41.1		
Pinus edulis	2	25.2	5					10	3.8	8.8		
Pinus flexilis	2	25.2	5					20	7.7	12.7		
Pseudotsuga mensiesii	19	236.7	47					100	38.5	85.5		
Totals	40	503.7	100					260	100	200		
Trees plus Saplings and Seedlings												
Abies Concolor	26	155.4	32.5									
Juniperus scopulorum	8	92.5	10									
Pinus edulis	9	38.1	11.3									
Pinus flexilis	2	25.2	2.5									
Pseudotsuga mensiesii	35	266.2	43.8									
Totals	80	577.4	100.1									

Table 9-11

CONIFER UNDERSTORY VEGETATION DATA: COVER FREQUENCY, AND DENSITY DATA FROM QUADRATS

Species	Average % Cover per Quadrat	Absolute Frequency	Number of Stems in 30 Quadrats	Relative % of Cover	% ΣF	% Density	Importance Value	% Importance	C x F Index
Trees*									
Abies concolor	0.7	16.6	2	3	3.39	0.15	6.54	2.18	10.17
Juniperus scopulorum	0.76	16.6	5	3.31	3.39	0.38	7.08	2.36	11.22
Pinus flexilis	2	3.3	2	8.72	0.67	0.15	9.564	3.18	5.84
Pseudotsuga menziesii	2.73	10.6	3	11.9	2.16	0.23	4.29	4.76	25.7
Subtotal	6.19	47.1	12	26.93	9.61	0.91	27.47	12.48	52.93
Shrubs									
Amelanchier utahensis	2.35	16.6	4	10.24	3.39	0.30	13.93	4.64	34.71
Chrysothamnus viscidiflorus	0.03	3.3	1	0.13	0.67	0.08	0.88	0.29	0.09
Mahonia repens	1.30	20.0	66	5.67	4.08	4.95	14.70	4.90	23.13
Symphoricarpos oreophilus	0.13	6.7	2	0.57	1.37	0.15	2.09	0.70	0.78
Subtotal	3.81		73	16.61	9.51	5.48	31.60	10.53	58.71
Grasses and Sedges									
Agropyron trachycaulum	6.27	80	833	27.33	16.32	62.54	106.19	35.4	446.03
Carex geyeri	1.18	33.3	37	5.14	6.79	2.78	14.71	4.9	34.9
Dactylis glomerata	0.23	10	7	1	2.04	0.53	3.57	1.19	2.04
Elymus glauoa	1.13	33.3	128	4.93	6.79	9.61	21.33	7.11	33.47
Elymus salina	0.2	6.7	5	0.87	1.37	0.38	2.62	0.87	1.19
Subtotal	9.01	163.3	1,010	39.27	33.31	75.84	42.23	49.47	517.63

** Understory data measured by quadrats. See Tree Tables for canopy data measured by point-quarter and line intercept method.*

Table 9-11 Continued
CONIFER UNDERSTORY VEGETATION DATA: COVER FREQUENCY, AND DENSITY DATA FROM QUADRATS

Species	Average % Cover per Quadrat	Absolute Frequency	Number of Stems in 30 Quadrats	Relative % of Cover	% ΣF	% Density	Importance Value	% Importance	C x F Index
Forbs									
Castilleja linariaefolia	0.01	6.7	2	0.04	1.37	0.15	1.51	0.5	0.05
Chamaechaenactis scaposa	0.1	3.3	2	0.44	0.67	0.15	1.26	0.42	0.29
Cryptantha humilis	0.01	3.3	1	0.04	0.67	0.08	0.79	0.26	0.03
Erigeron engelmannii	0.12	3.3	3	0.52	0.67	0.23	1.42	0.47	0.35
galium multiflorum	1.44	60	130	6.28	12.24	9.76	28.28	9.43	76.87
Haplopappus nuttallii	0.03	3.3	1	0.13	0.67	0.08	0.88	0.29	0.09
Hemenoxys acaulis	0.44	10	6	1.92	2.04	0.45	4.41	1.47	3.92
Malcolimia africana	0.01	3.3	2	0.04	0.67	0.15	0.86	0.29	0.03
Penstemon thompsoniae	0.05	13.3	6	0.22	2.71	0.45	3.38	1.13	0.6
Phlox hoodii	1.28	80	76	5.58	16.32	5.26	27.16	9.06	91.07
Senecio multilobatus	0.27	13.3	10	1.18	2.71	0.75	4.64	1.55	3.2
Sisymbrium altissimum	0.01	3.3	1	0.04	0.67	0.08	0.79	0.26	0.03
Stellaria jamesiana	0.01	10	3	0.04	2.04	0.23	2.31	0.77	0.08
Subtotal	3.78	213.1	243	16.47	43.45	17.82	77.69	25.9	176.61

Table 9-11 Continued
CONIFER UNDERSTORY VEGETATION DATA: COVER FREQUENCY, AND DENSITY DATA FROM QUADRATS

Species	Average % Cover per Quadrat	Absolute Frequency	Number of Stems in 30 Quadrats	Relative % of Cover	% Σ F	% Density	Importance Value	% Importance	C x F Index
Cryptogams									
Moss	0.07	10		0.35	2.04		2.39	0.8	0.71
Lichens	0.08	10		0.35	2.04		2.39	0.8	0.71
Subtotal	0.15	20		0.7	4.08		4.78	1.6	1.42
Total: Living Plants	19.17	443.50	1,338	99.98	99.96	100.05	183.77	99.98	807.30
Non-Living Cover									
Litter	23.37								
Rock	19.23								
Soil	34.4								
Total	77								

Table 9-12

VEGETATIVE PRODUCTIVITY IN THE RAPARIAN PLANT COMMUNITY, TRAIL MOUNTAIN MIN PLAN AREA, JULY 18, 1981

(Table entries are grams/M^2)

Sample Number	TREES		SHRUBS		GRASSES		FORBS		ANNUALS		TOTALS	
	Fresh Weight	Air Dry	Fresh Weight	Air Dry	Fresh Weight	Air Dry	Fresh Weight	Air Dry	Fresh Weight	Air Dry	Fresh Weight	Air Dry
1	33	13	18	15	124	53	188	64	0	0	363	145
2	90	35	4	1	244	99	116	30	0	0	454	165
3	0	0	16	6	336	125	220	48	0	0	572	179
4	0	0	220	92	100	41	272	77	0	0	592	210
5	0	0	180	75	8	3	80	23	0	0	268	101
6	0	0	0	0	280	114	420	119	0	0	700	234
7	38	15	0	0	220	90	260	74	0	0	518	178
8	0	0	600	250	8	3	6	2	0	0	614	255
9	0	0	108	32	148	63	140	44	0	0	396	140
10	0	0	120	50	44	18	104	30	0	0	268	98
Averages (g/M^2)	16	6	127	52	151	61	181	51	0	0	475	170
Lb./Acre	143	54	1,132	464	1,346	544	1,614	455	0	0	4,236	1,516
Percent of Total	3	4	27	31	32	36	38	30	0	0	100	100

Table 9-13

VEGETATIVE PRODUCTIVITY IN THE GRASSLAND-SHRUB COMMUNITY, TRAIL MOUNTAIN MIN PLAN AREA, JULY 18, 1981

(Table entries are grams/M^2)

Sample Number	TREES		SHRUBS		GRASSES		FORBS		ANNUALS		TOTALS	
	Fresh Weight	Air Dry	Fresh Weight	Air Dry	Fresh Weight	Air Dry	Fresh Weight	Air Dry	Fresh Weight	Air Dry	Fresh Weight	Air Dry
1	0	0	22	11	188	105	68	32	0	0	278	148
2	0	0	6	4	138	75	6	2	0	0	150	81
3	0	0	35	18	100	54	0	0	0	0	135	72
4	0	0	0	0	168	91	2	1	0	0	170	92
5	0	0	3	2	30	16	45	17	0	0	78	35
6	0	0	3	1	230	125	42	16	0	0	275	142
7	0	0	71	36	190	103	34	13	0	0	295	152
8	0	0	0	0	210	114	10	4	0	0	220	118
9	0	0	23	7	176	92	24	7	0	0	223	106
10	0	0	18	9	56	30	95	36	0	0	169	75
Averages (g/M^2)	0	0	18	9	149	81	33	13	0	0	199	102
Lb./Acre	0	0	161	80	1,329	722	294	116	0	0	1,774	910
Percent of Total	0	0	9	9	75	79	17	1	0	0	100	100

Table 9-14
VEGETATION SAMPLING PRECISION

A. Number of Sampling Units Required for 20% Precision at the 80 % Confidence Level.

	Community			
	Riparian	Pinyon-Juniper	Grassland-Shrub	Conifer
Tree DBH, Basal Area, Dominance	13	9	-	8
Tree Density	33	6	-	19
Sapling Density	22	19	-	22
Canopy Cover (Tree)	24	97	-	37
Understory Cover				
Total Living Plants	8	22	9	30
Dominant Life Form*	19 (f)	49 (g)	13 (g)	39 (g)
Non-Living Total (litter, rock, soil)	3	2	11	3
Dominant Non-Living Category**	10 (L)	20 (R)	40 (S)	17 (S)
Understory Vegetation Density				
Total Living Plants	10	73	11	36
Dominant Life Form*	16 (f)	85 (g)	11 (g)	68 (g)

B. Actual Precision Obtained at 80% Confidence Level.

	Community			
	Riparian	Pinyon-Juniper	Grassland-Shrub	Conifer
Tree DBH, Basal Area, Dominance	± 11%	± 9%	-	± 9%
Tree Density	± 18%	± 7%	-	± 13%
Sapling Density	± 15%	± 13%	-	± 15%
Canopy Cover (Tree)	± 22%	± 44%	-	± 27%
Understory Cover				
Total Living Plants	± 10%	± 13%	± 9%	± 20%
Dominant Life Form*	± 16% (f)	± 19% (g)	± 10% (g)	± 22% (g)
Non-Living Total (litter, rock, soil)	± 5%	± 4%	± 9%	± 5%
Dominant Non-Living Category**	± 11% (L)	± 12% (R)	± 18% (S)	± 15% (S)
Understory Vegetation Density				
Total Living Plants	± 12%	± 24%	± 9%	± 22%
Dominant Life Form*	± 15% (f)	± 26% (g)	± 9% (g)	± 30% (g)

* t = trees, s = shrubs, g = grasses, f = forbs, c = cryptograms
** L = litter, R = rock, S = soil

CHAPTER 10

FISH AND WILDLIFE RESOURCES

Table of Contents

List of Figures

List of Tables

~~LIST OF APPENDICES~~

~~Appendix No. Description~~

~~10-1 Wildlife Resource Study~~

FISH AND WILDLIFE RESOURCES

10.1 SCOPE

Prior to any perturbation or manipulation of the environment, it is essential to conduct a pre manipulation study. This facilitates understanding the dynamics of the environment such that perturbation consequences can be predicted and avoided or considered in any situation requiring mitigation for ecological and/or economic reasons. Although the operation of the Trail Mountain Mine is different than most projects of this sort in that it is an existing operation, it is no exception when it comes to consideration of the potential impacts of continued operation.

The Trail Mountain Mine is a relatively small operation with reserves expected to last 7 to 10 years, and continued mining will potentially affect only an additional one square mile of habitat. It is unlikely that there will be an appreciable increase in traffic along the access road to the mine, and the affect on the stream should remain status quo. There is the possibility of subsidence in the newly mined area. The major issue is: what will continued operations do to the existing fish and wildlife resources living in or utilizing the area of concern? This area of potential impact contains distinct vegetation and cliff habitats potentially occupied by faunal components of concern to management agencies and vested interested groups. Therefore, it was essential that sufficient information on these biotic components be gathered, synthesized and analyzed to facilitate proper evaluation of the proposed action and its alternatives. The alternative in this case being no mining.

The objectives of the this chapter are two fold: (1) to present collected fish and wildlife resources information in sufficient detail to allow management decisions to be made in relationship to the magnitude of the potential disturbance from continued operation; and (2) to generate a wildlife protection plan that will meet the needs and requirements of the permitting agencies.

10.2 METHODOLOGY

This study was designed to quantitatively and qualitatively evaluate the fish and wildlife resources in habitats that might be potentially impacted by expansion and operation of the Trail Mountain Mine. The scope of work and intensity of effort on a given group of organisms was restricted due to the comments regarding low and high level efforts of the various regulatory and management agencies.

A thorough literature review was conducted in February, March and April, 1981. This task was of paramount importance since the study was restricted in scope to a synopsis and synthesis of previously collected data for species requiring a low level effort. Efforts were made to review pertinent unpublished theses and state and federal agency reports. Information was gleaned from visits to appropriate management agencies, particularly the regional UDWR office in Price. Subsequent information has been gathered since that time, through various studies that are presented in the appendices of this chapter.

The project site was initially visited in March and again in April to familiarize the researchers with specific edifice and vegetative areas. This facilitated proper determinations regarding placement of species into preferred habitats, habitat affinities and the potential impact of perturbation actions. The early visits were also necessary to check on any courtship behavior which might aid in determining the location and number of sites necessary to collect high level raptor date.

Using the information obtained from the initial visits and maps, it was determined that the entire area would be traversed and observed for raptor use and activity. Since so few raptors occurred in or utilized the area of concern, considerable effort was expended to determine raptor use in adjacent areas. This was thought necessary if adequate understanding was to be given to the low level of raptor presence and use in the present and proposed mining area.

All of the terrestrial vertebrate species observed or known to inhabit the potential area of concern or similar habitats were identified. The species were listed phylogenetically by habitat in tabular form and categorized as: (1) game species, (2) threatened or endangered species, (3) resident species, (4)

migratory species, (5) restricted range species, (6) ubiquitous species and/or (7) high interest species. Extensive field observations were made biweekly from mid April through July. This was initiated in April so observations could be made on courtship displays, territorial establishment and nest site selection of raptors. However, since only kestrel's were seen, concern was raised as to the timing of the observations. Were they too late? Had these reproductive activities already occurred and were the birds incubating eggs? Detailed cliff searches were conducted and the entire area of concern traversed on foot at sufficiently close intervals to flush not only raptors but the passerine types. One golden eagle in flight, at least two pair of kestrels and many passerines were observed, but raptor use was low. Nevertheless biweekly monitoring has occurred to determine if any raptors move into the area following fledgling in adjacent areas, or if any expand their hunting territories and fly over the area.

Although density data were not specifically determined, each species tabulated was placed into one of four categories: A = abundant, C common, u = uncommon or Ca = casual. This was determined by the in consultation with literature references and appropriate management personnel or people with expertise specific to the area, habitat, or species of concern.

Since no detailed data were available for the aquatic organisms inhabiting the stream, field work was conducted. Samples of the macroinvertebrates were taken by use of modified Serber nets and turning of rocks. Four replicate samples were taken both above and below the perturbation source for comparison. Fish were searched for, but none were found. The macroinvertebrate samples were sorted taxonomically and tabled.

10.3 EXISTING FISH AND WILDLIFE RESOURCES

Literature and field data were summarized for all terrestrial and aquatic vertebrates and aquatic macroinvertebrates of concern according to the level indicated in the scope of work. The species were categorized to determine habitat affinities and high interest status. The results are reported in tabular form (Tables 1 9). They are listed according to their various ecological classifications (Dalton et al. 1978; Durrant 1952; Hall and Kelson 1959; Hall 1981; Hayward et al. 1958). All

terrestrial vertebrate species whose ranges appear to overlap any or all of the potential area of impact are listed. No discussion is included in this section of the report. The high interest species of concern are discussed individually in a separate section of this chapter as are the overall impacts by action.

Generally speaking, the terrestrial portion of the proposed project area could potentially be inhabited by about 140 avian, 74 mammalian, 6 amphibian and 17 reptilian species. The stream could be inhabited by 20 different families in 9 orders of invertebrates. Some of these macroinvertebrates are high interest species since they provide forage to trout and other fishes in Lower Cottonwood Creek, a class 3 fishery. The high interest species are not mapped individually because their ranges are essentially ubiquitous and could not be meaningfully mapped. Their distribution is too broad to be of importance in a small area such as that of the Trail Mountain Mine. Only one endangered or threatened species was observed with the boundary or within sufficiently close proximity to the boundary to be considered.

10.3.1 Wildlife Habitats in ~~Mine Plan~~ Permit and Adjacent Area

There are five distinct terrestrial wildlife habitats plus the small stream in the Trail Mountain Mine ~~plan~~ permit and adjacent areas. Although these can be vegetatively divided into smaller units, the smaller units are not significant to wildlife distribution. The terrestrial habitats are: pinion juniper, grass aspen, cliff, mixed conifer, mixed mountain shrub and riparian. None of the habitats are unique or restricted to the area of the Trail Mountain mine ~~plan~~ permit and adjacent areas area nor are they considered crucial critical to the fauna inhabiting them in this area. The habitats in the portal vicinity have been destroyed by mining activity, but the activities have been confined to a relatively small area and are not proposed for expansion. The steepness of the canyon walls has and will restrict habitat use and disruption by man.

10.3.2 Wildlife

The wildlife section contains tables and discussions of each wildlife group.

Terms used in tables are defined as follows:

1. **Abundant**: Those organisms perennially observed in high numbers throughout the community the most obvious organisms in the community.

2. **Common**: These species are easily trapped or observed in the community.

3. **Uncommon**: Organisms that are not ordinarily encountered in the community.

4. **Casual**: These species are seldom identified or only occasionally observed.

5. **Resident**: Those species that are found in the community throughout the year.

6. **Summer only**: These species breed in the area and migrate elsewhere in the winter.

7. **Winter only**: Organisms that breed elsewhere and migrate into the communities listed.

8. **High Interest**: Any species that is endangered, threatened or of economic or recreational value.

9. **Game Species**: Any species that is hunted or trapped as a game animal and requires a hunting license.

10. **Endangered**: Any species that is in immediate danger of extinction.

11. **Threatened**: A species whose numbers are decreasing rapidly and likely to become endangered if the present trend continues.

12. **Raptors**: Any bird that seizes and carries its prey by force. Typically they are characterized by carnivorous habits, great powers of flight, seize their prey with sharp curved claws and have a short curved beak.

10.3.2.1 Aquatic Wildlife and Habitat and Value Determination

During the initial study, the aquatic macroinvertebrate wildlife found on site in Cottonwood Creek listed in Tables 10 1 were taken above the portal and loadout facilities, and the data in Table 10 2 were taken below the portal and loadout facilities. (See Figure 10-1). Additional macroinvertebrate studies on this area are summarized in the appendices portion of this Chapter.

The stream habitat is considered of critical value to the areas wildlife even through fish do not actually occupy the area of concern. It is a feeder stream to a class 3 fishery in Lower Cottonwood Creek.

10.3.2.2 Terrestrial Wildlife and Habitat and Value Determination

The classes of terrestrial vertebrate wildlife are listed separately by relative abundance status according to season of occupancy by habitat type in Table 10 3 through 10 5. These tables are constructed to accommodate sections 10.3.2.3 Mammals, 10.3.2.4 Birds, and 10.3.2.5 Reptiles and Amphibians. Of the wildlife habitats present ~~o~~in the ~~mine plan~~ permit and adjacent areas, riparian habitats, canyon bottomlands, and the high ridges where elk winter are considered by UDWR to be critical value habitats to wildlife and must be protected. The cliffs, talus slopes, mountain brush, and the aspen and conifer forests are considered high priority habitats. Critical habitats are those considered necessary to sustain the existence and perpetuation of one or more species of wildlife during crucial periods in their life cycle. High priority areas are intensive use areas but not restricted in area for the wildlife species of concern.

10.3.2.3 Mammals

Refer to Table 10-3.

10.3.2.4 Birds

Refer to Table 10-4.

10.3.2.5 Reptiles and Amphibians

Refer to Table 10-5.

10.3.3 Species of Special Significance

Refer to Table 10-6.

10.3.3.1 Threatened and Endangered Species

Refer to Table 10-7.

10.3.3.2 Raptors

10.4 EXPECTED IMPACTS OF MINING OPERATIONS ON FISH AND WILDLIFE

The known impacts of mining on fish and wildlife resources are many and varied according to the type, location and age of the mine and technology used to remove the coal. Additionally the floral and faunal components in the mining area determine the resultant impact. It is desirable that environmental protection be accomplished during all aspects of the life of the mine from construction through final reclamation, but the degree of environmental protection is often difficult to determine. This is particularly true in cases where mining operations that have been functioning for many years prior to serious environmental awareness and are asked to meet new improved standards. Such mining operations do not have the benefit of modern setting, design, construction, and technology and have often already impacted the environmental resources such that continued operation would not be of additional serious consequence. This is the case with the Trail Mountain Mine.

Continued operation of the Trail Mountain Mine will continue to impact the fish and wildlife resources in the area; therefore consideration of these continued impacts is warranted. Reclamation also needs to be considered since discontinuation of the Trail Mountain operation would potentially

facilitate a return of the habitat to its "normal state." The impacts of concern that have and could result in perturbations to the environment and ultimately relate to the stability of fish and wildlife in the area of concern are directly related to: (1) surface disturbance, (2) loss of habitat, (3) noise and (4) human activity. Both aquatic and terrestrial habitats are of concern since the portal, loading facilities and haul roads occupy riparian habitat adjacent to a small stream, and the mine underlies a variety of terrestrial communities that are potentially important habitats for several species that are considered of high interest to various management agencies because these species are of economic or recreation value.

There are two general ways to look at the impact: (1) by action and (2) by species or taxonomic group.

1) Impact by Action: Surface Disturbance

Surface disturbance in most mining operations is a major concern since extensive surface facilities are usually constructed to facilitate processing, loading and transporting coal once it is brought to the surface. Such is not the case with the Trail Mountain Mine. The impact has already occurred since the portal facilities and haul road are in existence and additional surface acreage will not be needed, even for ventilation shafts. Similarly mined areas in comparable habitats to the existing Trail Mountain Mine have experienced little subsidence. There is little or no visible surface ~~disturbance~~ impact, and it is probable that the integrity of the above ground terrestrial vertebrate communities to be undermined will remain status quo. Occurrence of occasional fractures and minor slippages will not impact the terrestrial wildlife in the area as they have not impacted other undermined and non disturbed areas.

There is no question that surface disturbance due to construction and operation of Trail Mountain Mine has in the past impacted the aquatic and terrestrial wildlife. However, since the mine has been in operation for some time, the fauna initially in

the area of impact have likely habituated, adapted, moved, or been lost. Therefore the operation will not create additional surface disturbance impacts to these faunal groups.

Habitat Loss

Obviously habitat loss is related to surface disturbance as are noise and human activity, but they are treated separately. Although approximately an additional 1300 acres is proposed for undermining, essentially no additional acreage will be lost for habitation and production by aquatic and terrestrial wildlife. Obviously the immediate vicinity of the mine portal, access and haul roads, loading and limited storage facilities has already been lost as habitat. There is a potential to reclaim all but the roads once the mine is discontinued, but the acreage is small and likely of little consequence to the overall density of terrestrial wildlife. As such it warrants little further consideration. The stream, however, is a different situation. The surface facilities have encroached upon and altered the stream. The riparian community at the portal and load out area has been lost. (See Chapter 7 for programs initiated by the mine to eliminate the problems of sedimentation load and for water quality data.) The stream is now culverted beneath the mine site, and is further protected by adequate runoff and sedimentation controls on the site.

Noise

Noise created from the operation of the mine is not expected to increase in the existing areas of disturbance associated with the mining activity. Therefore, the animals will detect no change with the expansion, and populations should remain status quo.

Human Activity

Since this is an existing mining operation, little increased human activity is expected; therefore, the impacts of human activity have likely stabilized in the area of concern. It is especially important that wildlife not be harassed during ~~crucial~~ critical periods in their life history. During winter, wildlife are often in a delicate energy state, and unnecessary disturbance by man causes them to use up critical and limited energy that often times results in mortality. In less severe cases, the fetus being carried by gestating mammals may be resorbed or aborted thus reducing reproductive success and productivity of the population. For this particular mine, this is a concern for mule deer. During breeding season, disturbance by man can negatively affect reproductive success by disrupting territorial selection or defense, interrupting courtship displays and disturbing mating animals. This is most likely to occur with mule deer as they move onto the wintering area and would be a significant impact on raptors if they were utilizing the area. During parturition, lactation, and early in the rearing process, young animals need to be undisturbed. It is during this time that young animals gain the strength and ability to elude predators and man. Undisturbed habitats allow the young animals to develop in a relatively unstressed situation and to utilize habitats that are secure from predators.

2) Impact by Species or Taxonomic Group

The perturbation rating used in this part of the application (Table 10-9) is explained in the methodology section. Basically, it is a scale ranging from 0 -10 with 0 being little or no impact and 10 being the loss of the species.

It is projected that the area of potential impact in the mine ~~plan~~ permit and adjacent areas could possibly be occupied by or provide habitat for approximately 245 species of wildlife according to the Utah Division of Wildlife Resources (UDWR)

publication No. 78 16: 74 mammal species, 140 bird species, 17 reptile species, 6 amphibian species, and 8 fish species. Sixty-one are of high interest to UDWR, and approximately 83 percent are protected by law. On site visits, however, reduced this potential number to approximately 187 species: 52 mammal species, 121 bird, 12 reptile, 2 amphibian and no fish species.

Similar proportions are protected and of high interest. The numerical data from on site visits are used as the base for this report; however, all species listed by UDWR have been considered.

Mammals

Based on literature and on site visits, the potential area of impact could provide habitat for approximately 51 species of mammal (Table 10-3). Approximately 30 percent are protected and considered of high interest to the State of Utah. As such, each might be considered in relation to the potential perturbations, but only those of major concern to management agencies or those likely to impacted are individually or collectively discussed.

Snowshoe Hare

The snowshoe hare is present in and dependent upon the mixed conifer and nearby aspen and riparian habitats year round. This combination of habitat types is limited in size and located in relatively inaccessible areas on the mine ~~plan~~ permit and adjacent areas. Therefore, the proposed actions are sufficiently removed that they will do little to harm the high priority value habitat type and the hare populations dependent upon it. The impact of the proposed actions rate as 0 for this species.

Mountain Cottontail

The entire project represents a substantial value use area for cottontails. Their young are born between April and July, which is considered a crucial

period for maintenance of cottontail populations, but due to the reproductive life history of the species and the extent of disturbance, the proposed actions are not likely to seriously alter the reproductive potential of the population.

Most of their habitat is relatively inaccessible, and what is not will readily be repopulated from the adjacent areas. Hunting pressure will likely not increase nor will illegal kills since increased human activity is not projected. The perturbation impact of the project on this species rates as 0.

Furbearers

Limited portions of the area of concern and adjacent areas provide substantial value habitats for a few species categorized by management agencies as furbearers: ermine, long tailed weasel, badger, and the stripped skunk. Obviously, the breeding and rearing activities of these non migratory species occurs within the proposed area of concern, and their den and burrow systems are crucial to maintenance of their populations, but it is highly unlikely that the proposed actions of this small project will seriously impact the stability of their populations. Although riparian habitats are important to these species, the species are wide spread and adaptable to the activities of man.

The marten and wolverine are possible inhabitants of the mine site, but even if present they would occupy the upper reaches of the area and would not be seriously impacted. The perturbation impact of the proposed actions on the furbearers rates as 0.

Small Mammals

Although small mammals do not qualify individually as high interest species, they represent a significant part of the ecosystem. The majorityare herbivores and are the primary source of food for higher trophic levels, particularly raptors, canids and felids. This trophic importance warrants consideration,

but since this project only involves the continuation of an ongoing operation, there will not be additional habitat loss. Subsidence is also projected to be minimal, so interruption of underground burrow systems is not a serious concern. The perturbation impact of the proposed actions on the small mammals rates as 0.

It is important to note that most small mammal species of importance to predators do not occupy the rocky, steep slopes characteristic of most of the ~~mining~~ permit and adjacent areas. Few, particularly diurnal species, were evidenced in on site visits. Those that were found were on the upper reaches that were relatively undisturbed by the mine. This paucity of prey likely accounts for the similar paucity of predators particularly raptors. No raptors other than kestrels were found to occupy the ~~mine plan~~ permit and adjacent areas. It was not until the narrow canyon widened 1 - 2 miles above the loading facility that sufficient numbers of ground squirrels and pocket gophers were found to support nesting raptors. Several goshawks were observed in this area above the mine. Admittedly raptors could have occupied or nested on the area of concern and readily gotten to these areas to feed, but in spite of extensive field efforts over a five month period, none were found.

Bobcat

The mine and adjacent areas provide substantial habitat for bobcats who are often associated with precipitous terrain. Although none were evidenced by observation or tracks, they are known to occupy or use all of the terrestrial habitats in the area of concern. Their primary source of prey is small mammals, birds, or other small animals, but since populations of these preys were low, few bobcats may be using the area. Nevertheless their crucial periods would be in February during parturition and May and June when initial foraging and play occurs. The former period is of little consequence

for this project, but the latter is of concern since young bobcats are not as secretive or wary of man as are cougars. They are less likely to avoid high human disturbance areas during these months and are open to human harassment and vulnerable to illegal kills. Such activities should not increase over past numbers, but the company will educate their employees and alert law enforcement officials to curb such actions. The perturbation impact of the project rates as 1 for this species.

Mountain Lion (Cougar)

The entire Trail Mountain Mine ~~plan~~ permit and adjacent areas provides substantial valuable, yearlong habitat for cougar. The animal ranges throughout the area, but its movements are often dictated by migration patterns of the primary food source, mule deer, and by human disturbance. Although cougar have been faced with a problem since the advent of the mine in that mule deer winter in the lower reaches of the canyon where human disturbance is highest, the impact is probably negligible due to the secretive nature of the species.

Cougar populations in the area of concern are not at or near saturation levels; therefore, the cougars can avoid the concentrated human activity areas and still maintain a status quo population. If populations of cougar in adjacent areas were at or near saturation, the project would have a depressant impact on the population. The perturbation impact of the project on this species rates as 1.

Mule Deer

The mule deer in the environs of concern utilize the entire area but seasonally concentrate in and more heavily utilize specific habitats and areas. During the summer, the mule deer concentrate in the mixed mountain shrub and grass aspen habitats in the mid to upper elevations of the mine ~~plan~~ permit

and adjacent areas. At this time, although crucial for reproduction, they are little impacted by the ongoing operation.

In winter a portion of the project, particularly the canyon bottom along the stream and haul and access road, represents critical value winter range for UDWR deer herd unit 35. According to UDWR, critical value sites must be protected from disturbance by man when the deer are physically present on the range. Vehicle strikes can readily occur and people can harass the animals when they are in a weakened energy state due to snow and cold. The perturbation impact of the project on mule deer rates as 3. It should be noted that vehicle speeds are now reduced during critical times, and employee training is conducted at least annually to help reduce this impact.

Rocky Mountain Elk

A portion of the proposed project site represents winter range for the Manti elk herd unit 12. This was substantiated by on site visits. The high ridges associated with the mine ~~plan~~ permit and adjacent areas are used during the winter and are rated as critical winter range by UDWR. According the UDWR such critical ranges must be protected from disturbance by man when elk are physically present on the range.

This is not difficult in the case of this project. The high ridges are not easily viewed from the road or portal facilities and are basically inaccessible to all vehicles but snowmobiles when the animals are present. The impact of the mine and its attendant activities will not significantly impact the herd. Harassment by snowmobile operators is not likely to be associated with mine activities beyond the fact that the road will be kept open to the portal. At that, it is a long distance from the portal by ~~an~~ negotiable terrain for snowmobilers to reach the elk. There are many easier ways, non project associated, to access the elk during the winter.

Elk often calve between the wintering grounds and summer area, so some calving might take place on the ridge top northwest of the mine. However, no elk calving areas are known or likely exist within the project boundaries. The perturbation impact of the project on this species rates at 0.

Moose

The project site represents substantial value, yearlong range for the Southeastern Utah moose herd Joe's Valley drainage, but it is doubtful that moose have used or are using the specific site or any area likely to be impacted by permitting the ongoing mine. Admittedly there is riparian habitat present within the project boundary, and on a regional basis winter ranges for moose are characterized as riparian habitats, but the riparian habitat within the project boundary is not likely the kind to support moose. The closest such habitat is 4-5 miles upstream or downstream and even that is questionable. In addition, the steep, rocky terrain surrounding the riparian habitat in the area of concern is not the type of habitat that would normally be associated with moose.

Although seasonal use areas for moose proximal to the proposed area of concern have not yet been determined, they are not likely to include the project area. The perturbation impact of the project on moose rates as zero (0).

Birds

Based on literature and on site visits, the potential area of impact could provide habitat for approximately 121 species of birds (Table 10 4). All birds species are protected and up to 29 species potentially inhabiting the area of concern are determined to be of high interest to the State of Utah. As such each high interest species might be considered in relation to the potential

perturbations, but only those of major concern to management agencies or those likely to be impacted are individually or collectively discussed.

Raptors General

The project and adjacent areas potentially provide substantial value habitat for many raptors: turkey vulture, bald and golden eagles, four species of falcons (prairie, American and arctic peregrine falcons, and American Kestrel), six species of hawks (goshawk, sharp shinned, Cooper's, red tailed, Swainson's hawks and Ferruginous hawk) and seven species of owls (barn, screech, flammulated, great horned, pygmy, long eared, and saw whet owls.). Since many of these species are of high federal interest due to 43 CFR,346.1 (n 1) and all are of high interest to the State of Utah, considerable high level effort was given to determine their status in the area of concern.

It was recognized that realistically, nesting habitat does not exist on the specific area of the project or adjacent areas for all species. However, if a species were to court, nest, or feed, on or adjacent to the project area, it would specify crucial periods when protection from disturbance would be necessary. This is particularly true for nesting aeries which need protection from significant or continual on line of sight disturbance within a one kilometer radius of the nest during the time the nest is occupied.

It is acknowledged that the current level of data relative to site specific use of the area by raptors is unsatisfactory and that there are potentially aeries that have not been identified. Therefore, cursory surveys were made of the site and the immediately adjacent area beginning in February and intensive surveys conducted beginning in April and continuing through July. The paucity of raptor use was surprising. (See Figure 10-2).

Golden Eagles

Golden eagles are common yearlong residents of the environs of the mine ~~plan~~ permit and adjacent areas, and although no known active aerie territories were associated with the project, it was believed by UDWR and the consultants that such existed. This belief was based upon the fact that seemingly suitable nesting habitat is widespread on the specific mine site and throughout the local area. No golden eagle nesting sites were found and although many eagles were observed courting and hunting in the valley near Wattis and Orangeville, only an occasional fly over occurred on site within a 3 - 5 mile radius. It is likely that the steep and narrow nature of the canyon and the surprising and decided lack of suitable and easily accessible prey preclude use of the specific area. Food is much easier seen and captured in other areas.

No high priority concentration areas or critical roost trees for golden eagles are known to exist nor were any found on the project area. The perturbation impact of the project rates as 0 for this species.

Northern Bald Eagle

The northern bald eagle is an ~~endangered~~ sensitive winter resident of the local area, but to date no known high priority concentration areas or critical roost trees have been found on or adjacent to the area. There is no known historic evidence of the northern bald eagle nesting on the mine ~~plan~~ permit or adjacent areas. The perturbation impact of the project rates as 0 for this species.

American Peregrine Falcon

This relatively low abundance species is potentially a yearlong resident of the mine ~~plan~~ permit and adjacent area. It uses cliff sites for nesting, but according to UDWR and on site surveys no suitable nesting habitat is found

on the mine ~~plan~~ permit or adjacent areas. The perturbation impact rates at 0.

Arctic Peregrine Falcon

The endangered arctic peregrine falcon is a winter resident (November 15 to March 15) of the local area but has not and was not observed to utilize the environs on or adjacent to the mine ~~plan~~ permit area. Its occasional presence is possible but the perturbation impact of the project rates as 0 for this species.

Prairie Falcon

This relatively abundant species is a known yearlong resident of the general environs of the mine ~~plan~~ permit and adjacent areas and is a cliff nesting falcon, but none were observed or found on or in the immediately proximate areas to the project. It is possible but doubtful that the current level of activity has precluded their use of the canyon. There is ample cliff habitat sufficiently distant and not visible from the surface disturbance areas to accommodate this species. It is more likely that the steep and narrow nature of the canyon and the paucity of prey renders the site specific area energetically undesirable. The perturbation impact on the project on this species rates as 0.

Kestrel

This species was found on and adjacent to the mine site and was actively resting and feeding within one hundred yards of the portal. This species likes riparian habitat and although quite adaptable to the activities of man is likely impacted slightly by such activities as occur on or near the portal. The stability of this falcon in the area is not in jeopardy, and the perturbation impact of the project rates as 1 for this species.

Blue Grouse

The blue grouse is a yearlong resident of the project area. In the fall and winter, they prefer the open stands of conifer and aspen in the higher elevations, but during the spring and summer they reverse migrate into the mountain brush and occasionally pinion juniper. These habitats are considered critical to the species as are the crucial periods of occupancy, but the habitats and birds are sufficiently removed from the significant perturbation sources near the portal and haul roads and relatively inaccessible to project personnel so that negative impacts on blue grouse will be minimal. The perturbation impact of the project on this species is considered as 0.

Ruffed Grouse

The ruffed grouse is a yearlong but not abundant resident of the project area. They potentially traverse all the habitats present but are often dependent of proximity of a quarter of a mile to a stream. They use staminate buds of aspen for food in winter and are; therefore, dependent upon it. This critical habitat type is sufficiently inaccessible and unperturbed and will remain so that stability of ruffed grouse should remain status quo. The perturbation impact of the project rates as 0 for this species.

Mourning Dove

Mourning doves normally inhabit the project and adjacent areas where they prefer the pinion juniper and riparian habitats for nesting. These high priority habitats are abundant in the project area, but maximal disturbance has occurred to and habitat lost in the riparian area near the portal. This has obviously reduced the potential mourning dove population, but it is likely insignificant on a total population, basis. Therefore, the perturbation impact of the project on this species rates as no more than 1.

Passeriformes

Many passeriform species of high interest occupy the area, primarily on a seasonal basis. Some are permanent. They serve as potential prey for predators and occupy important links in the trophic structure of all habitats present. Little is known about the passerines on the specific project site, but the impact of the project to the stability of any given species has already occurred if it is going to. The operation will not create additional habitat loss nor will human harassment increase. The perturbation impact of the project on this taxonomic group is rated as 0.

Reptiles and Amphibians

Based on literature and on site visits, the area of potential impact could provide habitat for 17 species of reptile and 6 species of amphibian (Table 10-5). All reptile and amphibian species are protected, but only two of the reptile and one of the amphibian species are considered of high interest to the State of Utah.

Utah Milk Snake

The Utah milk snake is a yearlong resident animal of the project area and potentially could occupy all habitats. It is secretive, mostly nocturnal, and is often found inside or under rotten logs, stumps, boards, rocks, or other hiding places. Since no such places are scheduled for removal or disturbance, and activity of the species is primarily nocturnal as it seeks small vertebrates for prey, little impact has likely occurred to this species and no additional impact is likely. Should any denning site be located, UDWR personnel will be notified. The impact of the project on this species rates as 0.

Utah Mountain Kingsnake

This species is a year round resident of the project area that prefers dense vegetation habitats near water. Little of this preferred habitat is present but

none is scheduled for destruction. This coupled with the nocturnal habits of the species render impact beyond that which has already occurred unlikely. The population of the species should remain status quo, so the perturbation impact of the project on this species rates as 0.

Tiger Salmander

The tiger salamander is a yearlong resident animal potentially occupying any moist underground habitat or similarly moist above ground areas such as rotten logs, cellars or animal burrows. It is dependent upon open water, primarily in pools or ponds for reproduction and larval development, and migrates to such areas on rainy or moist nights. Little of this habitat is present on site, and none that would cause migration across the transportation routes in numbers that if run over would seriously impact the population. The perturbation impact of the project on this species rates as 0.

Fish

Although there are no fish in Cottonwood Creek, its flow of water is considered by UDWR of value for reproductive success of spawning trout and growth of other fishes in section 2 of Lower Cottonwood Creek, a class 3 fishery for which it is a tributary water. Drift of macroivertebrates from this stream represent an important contribution of forage to trout and other fishes in Lower Cottonwood Creek.

Aquatic habitats associated with the mine ~~plan~~ permit and adjacent areas support three species of game and five non-game species of fish. All are protected, and four have been determined of high interest to Utah: yellowstone cutthroat, rainbow, and brown trout, plus the mottled sculpin. Mine plans do not include additional perturbations upon Cottonwood Creek. Sediments from the portal facility have seriously altered the stream habitat and caused the macroinvertebrate populations to be seriously reduced in numbers and diversity from the point of

impact downstream. Based upon site studies, the macroinverterate community above the portal is considered healthy while that below the pollution source is considered under stress and unhealthy. Population diversity and numbers are low, thus seriously reducing macroinvertebrate drift to the class 3 fishery in Lower Cottonwood Creek. The perturbation impact of the project on the macroinvertebrates is rated at 4 and ultimately high interest fish species as 3 and action is recommended. (Note: Corrective measures have been taken at the site to control sediment and protect the stream. Subsequent studies have shown the macroinvertebrate populations to be stabilized and not severely impacted.)

10.5 MITIGATION AND MANAGEMENT PLANS

Mitigation of mining impacts on wildlife is usually considered and the plans for implementation approved prior to any perturbation. Mitigation actions often follow one of three general forms: (1) design of facilities and access or transportation modes to minimize impacts, (2) operation of the mine and associated facilities to minimize impacts and (3) enhancement of wildlife habitat both in the vicinity of and away from the mine in order to mitigate losses that may occur from mining.

In new mine operations, it is easy to suggest, provide, and implement mitigative measures, but in the case of the Trail Mountain Mine, preconstruction design and mitigation does not apply nor can it be implemented without major additions or modifications that in and of themselves would likely cause more problems than status quo operation. The Trail Mountain Mine has been in operation sufficiently long and is sufficiently small that little can or should now be done to change the design of the portal facilities to lessen the impacts. Most non-avian terrestrial vertebrates of concern inhabiting and utilizing the area in question have likely habituated to the present facilities and level of operative disturbance by adjusting their behavior including migration so that change would be more impacting than status quo. Exceptions to this are where the impact is continual and could be easily mitigated. These are in the areas of harassment during critical stages of the life history of species and in sedimentation of the stream. This is of particular significance to mule deer and fish.

PacifiCorp will perform the following mitigation measures in order to minimize disturbances and impacts on wildlife and their habitats that could be impacted during continued operation of the mine. The mitigative measures will meet the requirements of R645-301-322 and will be consistent with the performance standards of R645-301-358.

PacifiCorp will make significant efforts to educate all employees associated with their on site mine operation to the intricate values of the wildlife resources within the current mine ~~plan~~ permit and adjacent areas. High interest species, critical habitats, and critical life history periods will be emphasized. This will be done by brochure and periodic printed reminders distributed at selected times. Each employee will be advised not to unnecessarily or without proper permits or licenses harass or take any wildlife including young thought to be abandoned. They will be advised not to unnecessarily stop vehicles to view wildlife and will be forbidden to leave the road by vehicle within the mine ~~plan~~ portal area. They will be encouraged to voluntarily establish a game alert program wherein they report violators of company rules or legal statutes to the proper company officials or authorities for reprimand or prosecution. They will be advised that they, as hunting and recreation users, stand to gain the most by preserving and conserving what they have in proximity to their places of work and abode.

The Company will maintain the relative inaccessibility of the mine ~~plan~~ permit and adjacent areas. No unnecessary, additional access roads will be built nor will off road vehicle use be allowed within the ~~permit~~ areas controlled by the company.

Discharge of firearms by employees will be prohibited on company controlled property during working hours.

In winter, a portion of the project, particularly the canyon bottom along the stream and haul and access road, is inhabited by mule deer, and the potential for road strikes and harassment when the animals are in a weakened energy state due to snow and cold is present. Drivers will be informed of the concerns for protection of wildlife and encouraged to reduce speed in the canyon between November 1 and May 15 when mule deer are abundant.

Although no fish occupy Cottonwood Creek, sedimentation of the stream has (in the past) been identified as a problem for class 3 fishery, Lower Cottonwood Creek into which Cottonwood Creek flows. PacifiCorp will take precautions to keep all forms of coal or other sediments generated by the operation of the mine from inadvertently entering the stream. Haulage vehicles and storage piles will be appropriately wetted to prevent airborne particulates. The roads will be maintained to prevent material from bouncing out. (See Chapter 7 for details on sedimentation and drainage controls).

All wildlife habitats will be maintained or improved if disturbed. This will be done by using native or other vegetation approved for reclamation, habitat improvement or screening. No new actions will be undertaken that compromise wildlife or their use areas without prior approval by the appropriate management or regulatory agency.

10-6 STREAM BUFFER ZONES DETERMINATION ~~FIELD (2)~~

PacifiCorp will set up buffer zones at the inlet and outlet of Cottonwood Creek to protect the aquatic environment (see Figure 10-3). The extent of the buffer zone will be from the culvert outlet downstream 50 feet with a width from the road on the east to 50 feet west of the stream. Above the culvert, the extent of the buffer zone will be from the culvert inlet to a point 50 feet above the disturbed area. The width will be from the road on the east to the disturbed area on the west. (This buffer zone proposal has been approved by DOGM.

Signs are posted indicating a buffer zone and indicate that the area should not be disturbed. A description of the signs is found in the operation section. (Chapter 3).

10.7 FISH AND WILDLIFE MONITORING

There are few species that will be significantly impacted by the proposed actions. There are no identified active aeries being occupied by high interest species of raptors, nor any readily accessible reproductive sites for game species that are critical to perpetuation of the species. However, should

raptors, moose, or any threatened or endangered species subsequently move into or be found in the mine area, appropriate DOGM,UDWR, and USFWS personnel will be notified and mutually agreed upon monitoring instituted.

The mitigation action planned is such that it will require little to no monitoring, but enforcement by company officials and management or law enforcement personnel will be necessary. An exception might be the activities planned to reduce sediment loads in the stream. This action lends itself to before and after comparisons to determine the effectiveness. Additional macroinvertabrate studies have been concluded and are now discontinued. Water quality monitoring is an ongoing program for the life of the operation.

PacifiCorp has made a commitment with the Utah Division of Wildlife Resources and with the United States Fish and Wildlife Services to jointly monitor occurrence of road killed mule deer in the mine ~~plan~~ permit and adjacent areas and access areas to the minesite.

When a road kill is sighted by anyone associated with Trail Mountain Mine, that person is to notify the Company mine management of such an occurrence. Mine management will promptly notify UDWR and/or USFWS of occurrence and location. UDWR and USFWS have an on going program in this area of monitoring the road kill of mule deer. They map areas of road kill and if they arrive at the site before the carcass of the animal has spoiled, they will dress the animal out and preserve the meat and dispense of it to needy organizations.

Mitigation measures were also employed for the loss of approximately 0.21 acres of riparian habitat due to the upstream culvert extension in 1990. This consisted of the installation of 20 rock check dams in the lower portion of Cottonwood Creek to enhance water retention and possible fish survival. See Appendix 7-13 for details on this mitigation.

10.8 PERTINENT LITERATURE

Bear, G.D. and R.M. Hansen. 1966. Food habits, growth and reproduction of white tailed jackrabbits in southern Colorado. Colo. St. Univ. Arg. Exp. Sta. Tech. Bull. 90. 59 pp.

Bee, J.W. 1947. Mammals of Utah County. Unpublished Masters Thesis, Brigham Young University. Provo, Utah. 316 pp.

Bernard, S.R. and K.F. Brown. 1977. Distribution of mammals, reptiles, and amphibians by BLM physiographic regions and A. W. Kuchler's associations for the eleven western states. BLM Tech. Note 301.

Cochran, G.A. and H.J. Stains. 1961. Deposition and decomposition of fecal pellets by cottontails. J. Wildl. Manage. 25:432 435.

Craighead, J.J. and F.C. Craighead. 1956. Hawks, owls, and wildlife. Wildlife Management Inst., Wash. D.C.

Dalton, L.B., et al. 1978. Species list of vertebrate wildlife that inhabit southeastern Utah. Utah Division of Wildlife Resources Publication, Salt Lake City, Utah, 78 16.

Eberhardt, L. and R.C. Van Etten. 1956. Evaluation of the pellet group count as a deer census method. J. Wildl. Mange. 20:70 74.

Emlen, J.T. 1977. Estimating breeding season bird densities from transect counts. Auk. 94(3):455 468.

Enderson, J.H. 1965. Roadside raptor count in Colorado.
Wilson Bull 77(1):82 83.

Fletcher, R. 1980. Reducing deer/vehicle accidents.
Forestry Research West.

Flinders, J.T. and R.M. Hansen. 1973. Abundance and dispersion of leporids within a shortgrass ecosystem.
J. Mammal. 54:289 291.

_____. 1975. Spring population responses of cottontails and jackrabbits to cattle grazing shortgrass prairie. J. Range Manage. 28:290 293.

Forsman, E.D., E.C. Meslow and M.J. Strub. 1977. Spotted owl abundance in young versus old growth forests, Oregon. Wildl. Soc. Bull. 5(2):42 47.

Giles, R.H., Jr. 1971. Wildlife management techniques. The Wildl. Soc. Wash. D.C. 633 pp.

Goodwin, H.A. 1974. Here today . . . gone tomorrow. In. Endangered species. Strohm, J. Ed. National Wildlife Federation. Washington D.C. 62pp.

Hahn, D.W. 1948. A method of censuring deer and its application in the Edwards Plateau of Texas. Tex. Game, Fish, and Oyster Comm., Austin. 24 pp.

Hall, E.R. 1981. The mammals of North America. Vol. I and II. John Wiley and Sons. New York. 1181 pp. + 90 pp. 1 index.

Hall, E.R. and K.R. Kelson. 1959. The mammals of North America Vol. I and II. Ronald Press. New York. 1083 pp. + 79 pp. index.

Hardy, R. 1937. Birds of pinon (sic) and shadscale near Price, Utah. Unpublished Masters Thesis, University of Utah. Salt Lake City,Utah. 139 pp.

Hayne, D.W. 1949. Two methods for estimating populations form trapping records. J. Mammal. 30:299 411.

Hayward, C.L. 1967. Birds of the upper Colorado River basin. Brigham Youn Sci. Bull. 9(2):62 pp.

Hayward, C.L., et al. 1976. Birds of Utah. Gr. Basin Nat. Memoirs. No.1. Brigham Young Univ. Press. Provo, Utah. 229 pp.

Hungerford, K.E. 1953. A ruffed grouse drumming count technique for northern Idaho conditions. Idaho forest wildlife and range expt. Stat. Research Note No.10. 3 pp (mimeo).

Idaho Fish and Game Dept. 1974. Interagency guidelines for big game range investigation in Idaho. Idaho Fish and Game Dept., Bureau of Land Mgmt., U.S. For. Ser. 54 pp.

Karpowits, J.F. 1981. Home range and movement of Utah Bobcats with reference to habitat selection and prey base. Unpublished Masters Thesis. Brigham Young Univ. Prove, Utah.

Kundaeli, J.H. and H.G. Reynolds. 1972. Desert cottontail use of natural micified pinion juniper woodland. J. Range Mange. 25:116 118.

Laycock, W.A. 1969. Enclosures and natural areas on rangelands in Utah. USDA For. Ser. Res. Pap. INT 62.

Lonner, T.N. 1975. Long Tom Creek study In Montana Dept. of Fish and Game, Helena. Montana cooperative elk logging study. Progress report for the period January 1 December 31, 1974.

Mackie, R.J. 1970. Range ecology and relations of mule deer, elk and cattle in the Missouri River Breaks, Montana. Wild. Mono.No. 20.

Meslow, E.C. and H.M. wight. 1975. Avifauna and succession in douglas fir forests of the Pacific northwest. P;. 266 277 in D.R. Smith ed. Proc. of the Symp. on Mgmt. of For. and Range Habitats for Nongame Birds, U.S. Dept. Ag. For. Ser. Gen. Tech.Rep. WO 1.

Montana Cooperative Elk Logging Study. 1979. Annual progress report for the period Jan. 1 Dec. 31, 1978. U.S Forest Service, Missoula, Montana.

Montana Department of Fish and Game. 1977. Montana cooperative elk logging study. Prog. rep. for the period January 1 December 31, 1976.

Pack, H.J. 1930. Snakes of Utah. Utah Agr. Exp. Sta. Bull. No. 221.30 pp.

Pickford, F.D. and E.H. Reed. 1943. Competition of elk and domestic livestock for summer range forage. J. Wildl. Mgmt. 7(3):328 332.

Plummer, A.P., D.R. Christensen and S.B. Monsen. 1968. Restoring big game range in Utah. Utah Div. Wildl. Resource Publ. No. 68 3.

Rappoport, A.G. et al. 1977. Mitigating the impacts to wildlife from SOCIOECONOMIC developments. Trans. of 42 N. Am. Wildlife and Nat. Resources Conference.

Rush, W.M. 1939. Handbook of big game management. (Unpublished).

Schmidt, K.P. 1953. A check list of North American amphibians and reptiles, 6th Ed., Amer. Cos. Ichthyologists and Herpetologists; Univ. Chicago Press, 280 pp.

Scott, R.N. Boner, T.C. and Smith, R. 1977. Ranking wildlife values on federal coal lands: Utah Division of Wildlife Resources (In Print).

Seton, E.T. 1927. Lives of game animals, Doubleday, Doran and Company, Inc., New York, Vol. 3, Part 1, pp. 5 51.

Smith, H.D., H.O. Tolley and C.D. Jorgensen. 1972. Estimation of small mammals using recapture methods: partitioning of estimator variables. Acta Theiologica 17(5):57 66.

Stebbins, R.C. 1954. Amphibians and reptiles of western North America. McGraw Hill, New York. 536 pp.

_____. 1966. A field guide to western reptiles and amphibians. Houghton Mifflin Co. Boston. 270 pp.

Stevens, D.R. 1966. Range relationships of elk and livestock, Crow Creek drainage, Montana. J. Wildl. Mgmt. 30(2):349 363.

Tanner, Vasco M. 1931. A synoptical study of Utah amphibia. Utah Academy of Sciences. Vol. VIII, 159 198 pp.

Tanner, Wilmer W. 1953. Herpetological notes, Herpetological, Vol. 9, 139 140 pp.

_____. 1957a. A taxonomic and distributional study of the western subspecies of the milk snake, Lampropeltis doliata. Trans. Kansas Acad. of Sci., Vol. 60, No.1, 12 42 pp.

_____. 1957b. A taxonomic and ecological study of the western skunk, Gr. Basin Nat., Vol. XVII, Nos. 3 4, 59 94 pp.

_____. 1975. Checklist of Utah amphibians and reptiles. Proceedings of the Utah Academy of Science, Arts and Letters. Vol. 52(1):4 8.

Tanner, Wilmer W., and B.H. Banta. 1966. A systematic review of the great basin reptiles in the collections of B.Y.U. and the Univ. of Utah. Gr. Basin Nta., 28(3 4):87 135.

Tanner, Wilmer W., D.L. Fisher and T.L. Willis. 1971. Notes on the life history of Ambystoma tigrinum nubulosum in Utah. Great Basin Nat. 31(4):213 222 pp.

Thomas, J.W., R.J. Miller, H. Black, J.E. Adick and C. Maser. 1976. Trans. 41 N. A. W. and Nature Res. Conf. 452 476.

Tyson, E.L. 1959. A deer drive vs. track census. Trans. No. AMer. Wildl. Conf. 24:457 464.

U.S. Forest Service. 1976. Final environmental statement for land use plan, Salina Planning Unit, Fishlake National Forest.

_____. 1976. Land use plan, Salina Planning Unit, Fishlake National Forest. Richfield Ranger District. Richfield, Utah.

Webster, D.A. 1975. Blue grouse ecology, habitat requirements and response to habitat manipulation in north central Utah. Wasatch Nat'l For., Special Report No.33. Utah Coop. Wildl. Res. Unit., 66 pp.

WESTECH. 1977. Environmental Assessment and Impact Evaluation of Southern Utah Fuel Company Property in Central Utah. Technical Report by WESTECH for Coastal States Energy Co.

WESTECH. 1979 Supplement to: Environmental Assessment and Impact Evaluation of Southern Utah Fuel Company Property in Central Utah. Technical Report by WESTECH for Coastal States Energy Co.

White, C.M. 1965. Roadside raptor count through Utah, Colorado, and Kansas. Kansas Ornith, Soc., Bull. 16(3):18 19.

Wood, J.E., T.S. Bickle, W. Evans, J.C. Germany and V.W. Howard, Jr. 1970. The Fort Stanton mule deer herd (some ecological and life history characteristics with special emphasis on the use of water). New Mexico St. Univ. Ag. Exp. Sta. Bull. 567.

Woodbury, A.M. 1931. The reptiles of Utah, Bull. Univ. Of Utah.21(5)P1 129.

Wyoming Game and Fish Department. 1976 Consideration for wildlife in industrial development and reclamation. Wyoming Game and Fish Department, Cheyenne, Wyoming.

Table 10-1

List of Macroinvertebrates Found in Cottonwood Creek Above Trail Mountain Mine Site.

Taxonomic Rank	Relative Abundance	Indicator of good stream condition
Class Turbellaria		
Order Tricladida	A	
Class Crustacea		
Order Ostracoda	U	
Class Insecta		
Order Ephemeroptera		
Family Baetidae		
Baetis	A	
Family Heptageniidae		
Cinygmula	C	X
Family Ephemerellidae		
Cphemerella grandis	C	X
Order Plecoptera		
Family Nemouridae		
Ampinemira	C	X
Family Perlodidae		
Isoperla	C	X
Order Trichoptera		
Family Hydropsychidae		
Hydropsyche	A	
Family Limnephilidae		
Hesperophylax	C	
Family Brachycentrus		
Brachycentrus	A	
Order Cloeoptera		
Family Elmidae	U	
Order Diptera		
Family Tipulidae		
Antocha monticola	C	
Dicranota	U	
Holorusia grandis	C	
Eriocera	U	
Family Pshchodidae		
Pericoma	U	
Family Chironomidae	U	
Family Empididae		
Hemerodromia	U	

A = Abundant - greater than $100/m^2$
C = Common - Between 99 and $10/m^2$
U = Uncommon - Less than $10/m^2$

Table 10-2

List of Macroinvertebrates Found in Cottonwood Creek Below Trail Mountain Mine Site.

Taxonomic Rank	Relative Abundance	Indicator of good stream condition
Class Oligochaeta	U	
Class Arachnida		
Order Hydracarina	C	
Class Insecta		
Order Ephemeroptera		
Family Baetidae		
Baetis	A	
Family Heptageniidae		
Cinygmula	C	X
Order Plecoptera		
Family Perlodidae		
Isogenoides ziinensis	U	
Isoperla	U	X
Order Trichoptera		
Family Hydropsychidae		
Hydropsyche	U	
Order Cloeoptera		
Family Dytiscidae	U	
Family Elmidae	U	
Order Diptera		
Family Simuliidae	U	
Family Chironomidae	U	

A = Abundant - greater than 100/m^2
C = Common - Between 99 and 10/m^2
U = Uncommon - Less than 10/m^2

Table 10-3

Species List and Classification of Mammals whose Published Ranges Overlap the Area Studied for the Trail Mountain Mine

A = Abundant
C = Common
U = Uncommon
Ca = Casual or Rare
R = Permanent Resident
S = Summer Only
W = Winter Only

Species Name	Pinyon-Juniper	Grass-Aspen	Cliff	Mixed Conifer	Mixed Mtn. Shrub	Observed on Site	High-Interest Species
Masked Shrew Sorex cinereus					UR		
Mirriam Shrew Sorex mirriami	UR	UR	UR		UR		
Dusky Shrew Sorex obscurus					UR		
Little Brown Myotis Myotis licifugus	CS	US	CS		CS		
Fringed Myotis Myotis thysanodes	US	US					
California Myotis Myotis californicus	US	US	US				
Small-Footed Myotis Myotis leibii		US	US		US		
Silver-Haired Bat Lasionycteris noctivagans					US		
Big Brown Bat Eptesicus fuscus					US		
Hoary Bat Lasiurus cinereus					US		
Townsend's Big-Eared Bat Plecotus townsendii	US	US			US		
Brasilian Free-Tailed Bat Tadarida brasiliensis	US	US	US		US		
Nuttall's Cottontail Sylvilagus nuttallii	UR		UR		UR		X
Desert Cottontail Sylvilagus audubonii	UR						X
Snowshoe Hare Lepus americanus		CR		CR			X
White-Tailed Jackrabbit Lepus townsendii		UR	UR		UR		X

A = Abundant
C = Common
U = Uncommon
Ca = Casual or Rare
R = Permanent Resident
S = Summer Only
W = Winter Only

Species Name	Pinyon-Juniper	Grass-Aspen	Cliff	Mixed Conifer	Mixed Mtn. Shrub	Observed on Site	High-Interest Species
Black-Tailed Jackrabbit Lepus californicus	CR						X
Least Chipmunk Eutamias minimus	AR	UR		CR	CR	X	
Cliff Chipmunk Neotamias dorsalis			CR			X	
Unita Chipmunk Neotamias umbrinus	CR	CR			CR	X	
Yellow-Billied Marmot Marmota flaviventris		CR	CR		CR	X	
White-Tailed Antelope Squirrel Ammospermophilus leucurus		CR				X	
Uinta Ground Squirrel Spermophilus armatus		AR			AR	X	
Golden-Manteled Ground Squirrel Spermophidus lateralis		UR			UR	X	
Rock Squirrel Spermophilus varegatus					CR	X	
Red Squirrel Tamiasciurus hudsonicus				CR		X	
Northern Flying Squirrel Glaucomys sabrinus		UR			CR		
Northern Pocket Gopher Thomomys talpoides		CR				X	
Great Basin Pocket Mouse Perognathus parvus	UR				UR	X	
Western Harvest Mouse Reithrodontomys megalotis	UR	UR			UR	X	
Deer Mouse Peromyscus maniculatus	AR	AR	AR	AR	AR	X	
Pinyon Mouse Peromyscus truei	CR					X	
Desert Woodrat Neotoma lepids	CR						
Bushy-Tailed Woodrad Neotoma cinerea			CR		CR		

A = Abundant
C = Common
U = Uncommon
Ca = Casual or Rare
R = Permanent Resident
S = Summer Only
W = Winter Only

Species Name	Pinyon-Juniper	Grass-Aspen	Cliff	Mixed Conifer	Mixed Mtn. Shrub	Observed on Site	High-Interest Species
Montane Vole Microtus montanus				CR	CR		
Porcupine Erethizon dorsatum	CR			CR	CR	X	
Coyote Canis latrans	CR	CR	CR	CR	CR		X
Red Fox Vulpes fulva	CaR				CaR		X
Gray Fox Urocyon cinereoargenteus			UR		UR		X
Black Bear Ursus americanus				CaR	CR		X
Ringtail Bassariscus astutus	UR		UR		UR		
Raccoon Procyon lotor	Ca				Ca		
Marten Martes americana				CaR			X
Ermine or Short-Tailed Weasel Mustels erminea		UR		UR			
Long-Tailed Weasel Mustela frenata	CR	CR	CR	CR	CR		X
Badger Taxidea taxus	CR	CR		CR	CR	X	X
Striped Skunk Mephitis mephitis	CR	CR	CR	CR	CR	X	X
Mountain Lion Felis concolor	UR	UR	UR	UR	UR		X
Bobcat Lynx rufus	CR	CR	CR	CR	CR		X
Wapiti or Elk Cervus elaphus					CW	X	X
Mule Deer Odocoileus hemionus	CR	CR	CR	CR	CR	X	X
Moose Alces alces		CaR		CaR			X

Table 10-4

Species List and Classification of Birds whose Published Ranges Overlap the Area Studied for the Trail Mountain Mine

A = Abundant
C = Common
U = Uncommon
Ca = Casual or Rare
R = Permanent Resident
S = Summer Only
W = Winter Only

Species Name	Pinyon-Juniper	Grass-Aspen	Cliff	Mixed Conifer	Mixed Mtn. Shrub	Observed on Site	High-Interest Species
Turkey Vulture Cathartes aura		US	US				X
Goshowk Accipiter gentilis		CR		CR		X	X
Sharp-Shinned Bawk Accipiter Striatus		US		US			X
Coopers Hawk Accipiter cooperii		US		US			X
Red-Tailed Hawk Buteo jamaicens		CR					X
Swainson's Hawk Buteo swainsoni		US					X
Rough-Legged Hawk Buteo lagopus		UW					X
Golden Eagle Aquila chrysaetos		CR	CR	CR	CR	X	X
Bald Eagle Haliaeetas leucocephalus	UW						
Prairie Falcon Falco mjexicanus	UR	UR					X
Peregrine Falcon Falco peregrinus		CaR					
Merlin Falco columbarius	CaW						X
American Kestrel Falco sparverius	CS	CS	CS		CS	X	X
Ferruginous Hawk Buteo regalis		US		US			X
Blue Grouse Dendragapus obscurus		UR		CR	UR		X
Ruffed Grouse Bonass umbellus		CR		CR	CR		X

A = Abundant
C = Common
U = Uncommon
Ca = Casual or Rare
R = Permanent Resident
S = Summer Only
W = Winter Only

Species Name	Pinyon-Juniper	Grass-Aspen	Cliff	Mixed Conifer	Mixed Mtn. Shrub	Observed on Site	High-Interest Species
Chukar Alectoris chucker	UR						X
Band-Tailed Pegeon Columba fasciata		CaS			CaS		
Mourning Dove Zenaidura macroura	CS	CS			CS	X	X
Yellow-Billed Cuckoo Coccyzus americanus					CaS		
Screech Owl Otus asio					UR		X
Flammulated Owl Otus flammeolus		UR		UR			X
Great Horned Owl Bubo virginiaus	CR	CR	CR	UR	CR		X
Pygmy Owl Glaucidium gnoma		UR	UR		UR		X
Spotted Owl Strix occidentalis					UR		X
Long-Eared Owl Asio otus					CR		X
Short-Eared Owl Asio flammeus		CR					X
Saw-Whet Owl Aegolius accdicus		UR		UR	UR		X
Poor-Will Phalaenoptilus nuttallii					CS		
Common Nighthawk Chordeiles minor	CS	CR			CS		
Black Swift Cypseloides niger			CaS				
White-Throated Swift Aerohautes saxatalis			US				
Black-Chinned Hummingbird Archilochus alexandri		US			US		
Broadtailed Hummingbird Selasphorus platycercus	CS	CS		CS	CS	X	

A = Abundant
C = Common
U = Uncommon
Ca = Casual or Rare
R = Permanent Resident
S = Summer Only
W = Winter Only

Species Name	Pinyon-Juniper	Grass-Aspen	Cliff	Mixed Conifer	Mixed Mtn. Shrub	Observed on Site	High-Interest Species
Rufous Hummingbird Selasphorus rufus		CS		CS	CS		
Calliope Hummingbird Stellula callipe		CaS		CaS	CaS		
Belted Kingfisher Megaceryle alcyon	CaS						
Common Flicker Colaptes cafer		CR		CR	CR	X	
Lewis' Woodpecker Melanerpes lewis					CaS		
Yellow-Bellied Sapsucker Sphyrapicus varius		CR		CR	UR		
Williamson's Sapsucker Sphyrapicus thyroideus				CaS			
Hairy Woodpecker Dendrocopos villosus		CR		CR	CR	X	
Downy Woodpecker Denrocopos pubescens					CR	X	
Northern Three-Toed Woodpecker Picoides tridactylus				CaR			
Eastern Kingbird Tyrannus tyrannus					CS		
Western Kingbird Tyrannus verticalis		US			CS		
Willow (Traill's) Flycatcher Empidonax traillii					CS		
Hammonds Flycatcher Epidonas hammondii				US			
Dusky Flycatcher Epidonax oberholseri					CS		
Gray Flycatcher Epidonax wrightii	CaS						
Western Flycatcher Epidonax difficilis		CS		CS	CS		
Western Wood Pewee Contopus sordidulus		CS		CS	CS		

A = Abundant
C = Common
U = Uncommon
Ca = Casual or Rare
R = Permanent Resident
S = Summer Only
W = Winter Only

Species Name	Pinyon-Juniper	Grass-Aspen	Cliff	Mixed Conifer	Mixed Mtn. Shrub	Observed on Site	High-Interest Species
Olive-Sided Flycatcher Nuttallornis borealis		US		US	US		
Violet-Green Swallow Tachycineta thalassina	US					X	
Tree Swallow Iridoprocne bicolor	US					X	
Barn Swallow Hirundo rustica			CS				
Cliff Swallow Petrochelidon pyrrhonota			CS				
Purple Martin Progne subis		US		US			
Gray Jay Perisoreus canadenis				CS		X	
Steller's Jay Cyanocitta stelleri	CR	CR		CR		X	
Scrub Jay Aphelocoma coerulescens					CR	X	
Black-Billed Magpie Pica pica	CR	CR		CR	CR	X	
Common Raven Corvus coras	CR					X	
Pinon Jay Gymnorhinus cyanocephala	CR				CR	X	
Clark's Nutcracker Nucifraga columbiana				CR		X	
Black-Capped Chickadee Parus atricapillus	CR	CR		CR	CR	X	
Mountain Chickadee Parus gambelii				CS	CW	X	
Juniper Titmouse Baeolophus ridgwayi	UR				UR		
Common Bushtit Psaltriparus minimus	UR	UR			UR		
White-Breasted Nuthatch Sitta carolinensis	UR	CR	UR	CR			

A = Abundant
C = Common
U = Uncommon
Ca = Casual or Rare
R = Permanent Resident
S = Summer Only
W = Winter Only

Species Name	Pinyon-Juniper	Grass-Aspen	Cliff	Mixed Conifer	Mixed Mtn. Shrub	Observed on Site	High-Interest Species
Red-Breasted Nuthatch Sitta canadensis			CR				
Brown Creeper Certhia familiaris	CW	CS		CS	CS		
House Wren Troglodytes aedon		CS			CS		
Rock Wren Salpinctes obsoletus			CR				
Catbird Dumetella carolinensis					CS	X	
Sage Thrasher Oreoscoptes monanus					CS		
Robin Turdus migratorius	CR	CS		CR	CS	X	
Hermit Thrush Catharus guttata		CS			CS		
Swainson's Thrush Catharus ustulata		CS		US	CS		
Veery Catharus fuscescens					US	X	
Mountain Bluebird Sialia currucoides	CS				CS	X	
Townsend's Solitaire Myadestes townsendi					CS		
Blue-Gray Goatcatcher Poioptila caerulea	CS	CS		US	CS		
Golden-Crowned Kinglet Regulus satrapa	UW			US	UW		
Ruby-Crowned Kinglet Regulus calendula				US	UW		
Northern Shrike Lanius excubitor	UW				UW		
Loggerhead Shrike Lanius lodovicianus	CS					X	
Starling Sturnus vulgaris	CR				CR	X	

A = Abundant
C = Common
U = Uncommon
Ca = Casual or Rare
R = Permanent Resident
S = Summer Only
W = Winter Only

Species Name	Pinyon-Juniper	Grass-Aspen	Cliff	Mixed Conifer	Mixed Mtn. Shrub	Observed on Site	High-Interest Species
Solitary Vireo Vireo solitarius	US	US			US		
Warbling Vireo Vireo gilvus		CS			CS	X	
Orange-Crowned Warbler Vermivora celata		CS			CS		
Virginia's Warbler Vermivora virginiae	US				CS		
Yellow Warbler Dendroica petechia		CS			CS	X	
Audubon's Warbler Dendroica auduboni					CS	X	
Black-Throated Gray Warbler Dendroica nigrescens	CS	CS			CS		
Mac Gillivray's Warbler Oporornis tolmiei					CR		
Yellowthroat Warbler Geothlypis trichas					US		
Yellow-Breasted Chat Icteria verens					CS	X	
Wilson's Warbler Wilsonia pusilla				CS	CS		
American Redstart Setophaga ruticilla		CaS			CaS		
Western Medowlark Sturnella neglecta	CR					X	
Bullock's Oriole Icterus bullockii					US		
Western Tanager Piranga ludoviciana		CS		CS			
Black-Headed Grosbeak Pheucticus melanocephalus	CS	CS		CS	CS		
Lazuli Bunting Passerina amoena					CS		
Evening Grosbeak Hesperiphona vespertina					US		

A = Abundant
C = Common
U = Uncommon
Ca = Casual or Rare
R = Permanent Resident
S = Summer Only
W = Winter Only

Species Name	Pinyon-Juniper	Grass-Aspen	Cliff	Mixed Conifer	Mixed Mtn. Shrub	Observed on Site	High-Interest Species
Cassin's Finch Carpodacus cassinii	US	US		US			
House Finch Carpodacus mexicanus					US		
Pine Grosbeak Pinicola enucleator		US		US			
Black Rosey Finch Leucosticte atrata	UW						
Pine Siskin Spinus pinus		CS		CS			
American Goldfinch Spinus tristis					CS		
Lesser Goldfinch Spinus psaltria					US		
Red Crossbill Loxia curvirostra				US			
Green-Tailed Towhee Chlorura chlorura	US				CS	X	
Rufous-Sided Towhee Pipilo erythrophthalmus					US		
Junco Junco hyemalis	UW	CS		CS		X	
Tree Sparrow Spizella arborea					UW		
Chipping Sparrow Spizella passerina		CS		CS	CS	X	
White-Crowned Sparrow Zonotrichia leucophrys		CS		CS			
Fox Sparrow Passerella iliaca					US		
Song Sparrow Melospiza melodia					US		

Table 10-5

Species List and Classification of Reptiles and Amphibians whose Published Ranges Overlap the Area Studied for the Trail Mountain Mine

A = Abundant
C = Common
U = Uncommon
Ca = Casual or Rare
R = Permanent Resident
S = Summer Only
W = Winter Only

Species Name	Pinyon-Juniper	Grass-Aspen	Cliff	Mixed Conifer	Mixed Mtn. Shrub	Observed on Site	High-Interest Species
Fence Lizard Sceloporus undulatus	US				US	X	
Sagebrush Lizard Sceloporus graciosus	CS		CS		CS	X	
Mountain Short-Horned Lizard Phrynosoma douglassi	CS	CS	CS		CS		
Rocky Mountain Rubber Boa Charina bottae					US		
Wandering Garter Snake Thamnophis elegans	CS	US			CS	X	
Western or Yellow-Bellied Racer Coluber constrictor	US				US		
Striped Whipsnake Masticophis taeniatus	US				US		
Gopher Snake Pituophis melanoleucus	CS				CS		
Milk Snake Lampropeltis triangulum	US				US		
Utah Mountain Kingsnake Lampropeltis Pyromelana	US				US		
Night Snake Hypsiglena torquata					US		
Midget Faded Rattlesnake Crotalus oreganus concolor	CS	US			US		
Western Spadefoot Toad Scaphiopus hammondi		US			US		
Woodhouse's Toad Bufo woodhousei		US			US		

Table 10-6

Game Animals in the Environs of Trail Mountain Mine in Emery County, Utah

Nuttall's Cottontail
Sylvilagus nuttallii

Desert Cottontail
Sylvilagus audubonii

Showshoe Hare
Lepus americanus

Black Bear
Ursus americanus

Mountain Lion
Felis concolor

Bobcat
Lynx rufus

Mule Deer
Odocoileus hemionus

Moose Alces alces

Wapiti or Rocky Mountain Elk
Cervus elaphus

Bandtail Pigeon
Columba fasciata

Mourning dove
Zenaidura macroura

Blue Grouse
Dendragapus obscurus

Ruffed Grouse
Bonasa umbellus

Chuckar
Alectoris chukar

Table 10-7

Endangered Species of the Environ of Trail Mountain Mine in Emery County, Utah

Bald Eagle*
Haliaeetus leucocephalus

Peregrine Falcon*
Falco peregrinus

* These species were endangered at the time this list was constructed. The Bald Eagle and Peregrine Falcon are no longer on the endangered species list. The Bald Eagle is now on the "Utah Species of Concern" list. The Peregrin Falcon has been delisted.

Table 10-8

Raptors of the Environ of Trail Mountain Mine in Emery County, Utah

Turkey Vulture
Cathartes aura

Goshawk
Accipiter gentilis

Sharp-Shinned Hawk
Accipiter striatus

Cooper's Hawk
Accipiter cooperii

Red-Tailed Hawk
Buteo jamaicensis

Swainson's Hawk
Buteo swainsoni

Rough-Legged Hawk
Buteo lagopus

Golden Eagle
Aquila chrysaetis

Bald Eagle
Haliaeetus leucocephalus

Prairie Falcon
Falcon mexicanus

Pregrine Falcon
Falco peregrinus

Merlin
Falco columberius

American Kestrel
Falco sparverius

Screech Owl
Otus asio

Flammulated Owl
Otus flammeolus

Great Horned Owl
Bubo virginianus

Ferruginous Hawk
Butes regalis

Pygmy Owl
Cidium gnoma

Spotted Owl
Strix occidentalis

Long-Eared Owl
Asio otus

Short-Eared Owl
Asio flammeus

Saw-Whet Owl
Aegolius acadicus

Table 10-9

Projected Impact of the Trail Mountain Mine and Associated Facilities on High Interest Species of Taxonomic Grups Using a Perturbation Rating Scale of 0 to 10. (low to high).*

	Perturbation Rating
Birds	
Turkey Vulture	0
Goshawk	0
Sharp-Shinned Hawk	0
Cooper's Hawk	0
Red-Tailed Hawk	0
Swainson's Hawk	0
Rough-Legged Hawk	0
Golden Eagle	0
Bald Eagle	0
Prairie Falcon	0
Pregrine Falcon	0
Merlin	0
American Kestrel	1
Blue Grouse	0
Ruffed Grouse	0
Chukar	0
Morning Dove	1
Screech Owl	0
Flammulated Owl	0
Great Horned Owl	0
Pygmy Owl	0
Spotted Owl	0
Long-Eared Owl	0
Short-Eared Owl	0
Saw-Whet Owl	0
Mammals	
Nuttall's Cottontail	1
Desert Cottontail	0
Snowshoe Hare	0
White-Tailed Jackrabbit	0
Black-Tailed Jackrabbit	0
Coyote	0
Red Fox	0
Gray Fox	0
Black Bear	0
Marten	0

Table 10-9 Continued

Mammals Continued	
Ermine	0
Long-Tailed Weasel	0
Badger	0
Striped Skunk	0
Mountain Lion (Cougar)	1
Bobcat	1
Mule Deer	3
Moose	0
Wapiti or Rock Mountain Elk	0
Fish	3
Macroinvertebrates	4

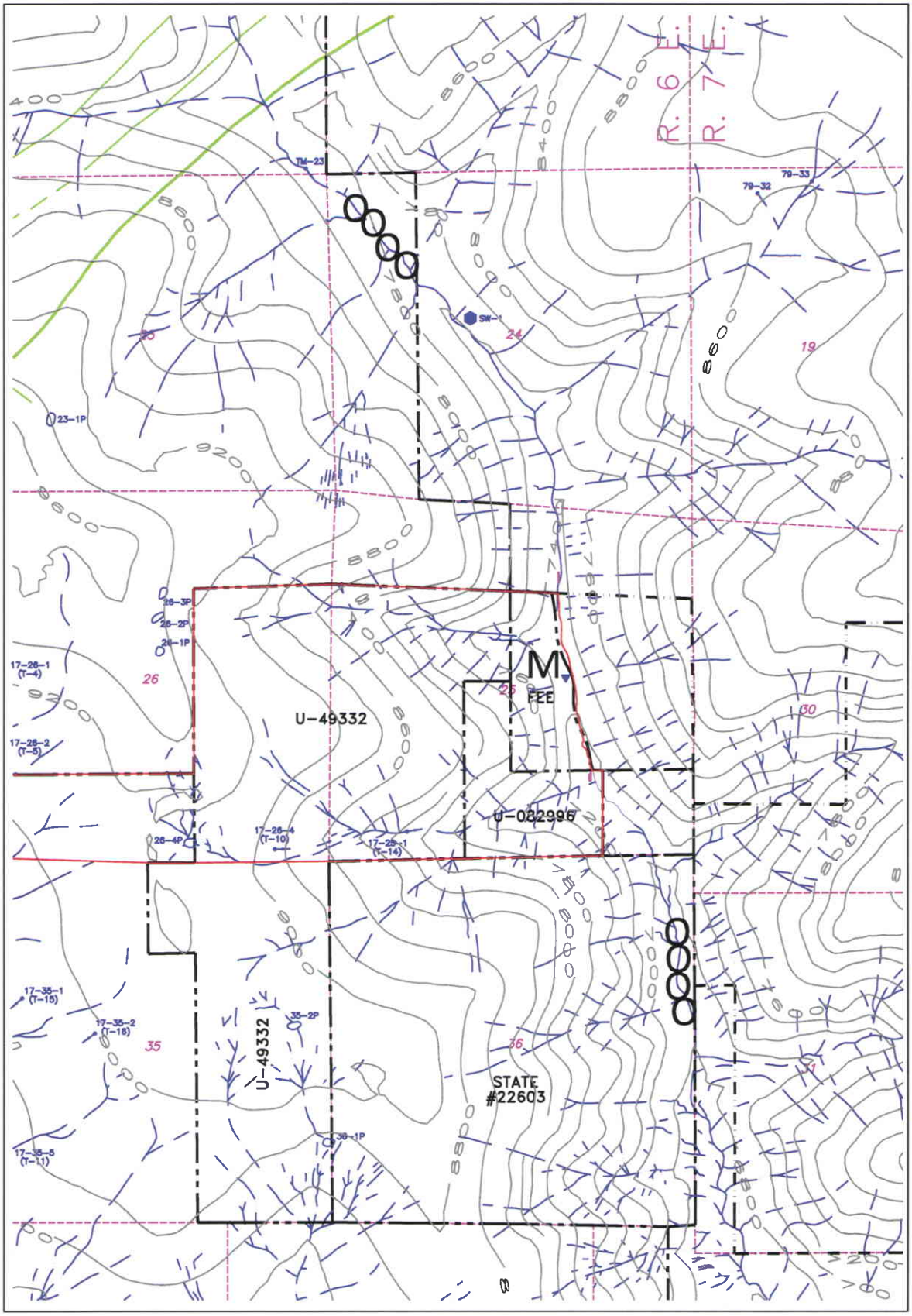

Figure 10-1: Macroinvertebrate Sampline Stations in Relation to Trail Mountain Mine Portal Mountain Mine Portal and Loading Facilities (T17S, R6E).

M = Portal Area

O = Sampling Area

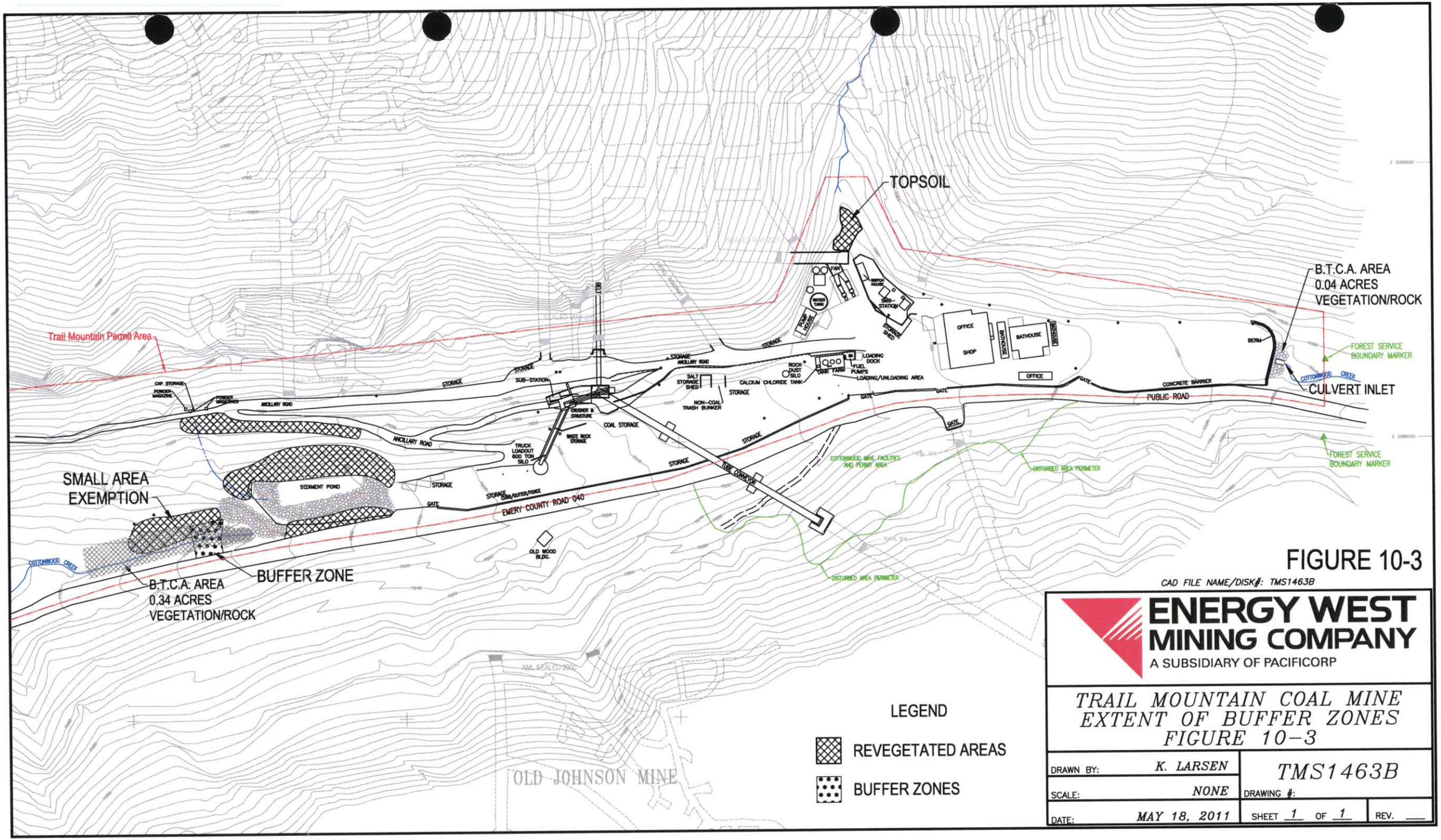

FIGURE 10-3

CAD FILE NAME/DISK#: TMS1463B

ENERGY WEST MINING COMPANY
A SUBSIDIARY OF PACIFICORP

TRAIL MOUNTAIN COAL MINE
EXTENT OF BUFFER ZONES
FIGURE 10-3

DRAWN BY:	K. LARSEN	TMS1463B	
SCALE:	NONE	DRAWING #:	
DATE:	MAY 18, 2011	SHEET 1 OF 1	REV.

CHAPTER 11

GEOTECHNICAL/SUBSIDENCE

Table of Contents

GEOTECHNICAL/SUBSIDENCE

11.1 SUBSIDENCE CONTROL PLAN

This section describes in detail the Applicant's plan to ensure minimal environmental impacts from mine-induced subsidence. The following subsections describe the principal factors involved in controlling subsidence impacts resultant from mining.

11.2 SUBSIDENCE DAMAGE PROBABILITY SURVEY

A survey has been conducted on that portion of Trail Mountain surface which could possibly be affected by the mining of coal from the Trail Mountain mining activities. It has been determined that there are renewable resources present in the area in the form of springs, water seeps, grazing land, timber, and wildlife. The water seeps and springs are limited and are an important resource for grazing and wildlife. Most of the streams within the permit area are ephemeral and or intermittent. The streams are fed by spring that emanate primarily in the North Horn formation. Some of the springs feed water troughs maintained for livestock and wildlife. The occurrence of the springs is discussed in the hydrology section and no further discussion will take place here; however, data collected suggest that the springs on the surface will not be affected by the subsidence.

No cabins or man made structures are present within the permit area with the exception of the buildings constructed in support of the mining operation. Subsidence won't occur in the area of these buildings. In lieu of renewable insurance covering damage to existing structures, the applicant, as an alternative, proposes to restore these resources to their pre-subsidence usefulness as mining continues. Since there are no structures or facilities that could be affected by subsidence, except for trails, there is no need for renewable insurance.

There are no oil, gas or water wells located within the permit area, nor are there any gas or oil pipelines or power transmission lines other than the one in Cottonwood Canyon which supplies power to the mine. Subsidence will not impact this power line.

11.3 MINING METHOD

The applicant intends to minimize surface effects of subsidence by adopting the longwall method of mining and mining the coal deposit as completely as possible. The longwall mining method allows almost total extraction of the coal and induces caving of the immediate and upper roof strata. PacifiCorp has established a comprehensive subsidence monitoring program of the areas undermined in the Deer Creek, Des-Bee-Dove and Cottonwood Mines located to the east. Data collected from this program allows predictions to be made as to the amount of subsidence that will be expected when the coal is mined. The subsidence prediction methods developed in that program are also applicable to the Trail Mountain Mine permit area because the geologic conditions are virtually identical.

11.4 SUBSIDENCE PREDICTION

Subsidence data collected on East Mountain indicate that the most important factors that influence subsidence listed in order of their importance isl; 1) width of the area undermined; 2) total thickness of coal extracted; and 3) the overburden thickness. Areas where only one longwall panel (<600 feet in width) has been extracted have shown little or no subsidence. Whereas areas where two adjacent longwall panels (total width >1,500 feet) have been mined subsidence is about 70 to 80% of the seam extraction height. The British National Coal Board (NCB) developed a method for predicting subsidence that has been widely accepted in the United States. This method utilizes graphs compiled from numerous field observations and takes into consideration the length and width of the mined-out area, thickness of coal extracted, and depth of cover. The method is claimed to be correct to +10%. in the majority of cases, assuming certain limiting conditions are met. The amount of total

subsidence experienced on East Mountain averages about 83% of the total subsidence predicted by the NCB model.

The angle of draw, which defines the limit between underground excavations and surface effects of subsidence, determines the amount of barrier that must be left around the mine to protect surface features. A recent study over coal mines in Utah and Colorado, undertaken by the USGS, indicates draw angles of 20° in mines with weak to moderately strong overburden 650 to 900 feet thick. This angle tends to steepen to 15° at depths of 900 to 1,000 feet in the Somerset area of Colorado. Data collected by PacifiCorp on East Mountain show draw angles to be steeper, ranging from 3° to 15°. Additional data has been collected regarding East Mountain subsidence using Time Domain Reflectometry technology (TDR), This method shows that subsidence reaches the surface almost immediately after mining. This method documents how rapidly caving propagates up the strata by cementing a coaxial cable in a bore hole extending from the surface of the ground down to mine level above a longwall panel. As mining progresses toward and underneath the bore hole, the cable is electronically interrogated which provides data showing the depth at which stress is present and where shearing of the cable propagates up the cable after mining. The data collected on East Mountain in this way showed no change in the cable prior to undermining by the longwall panel but immediately after mining passed below the cable shearing had begun to occur just above the mine level. Shearing propagated to the surface within six days of being undermined.

The subsidence data collected on East Mountain shows that about 90% of total subsidence occurs within the first year after being undermined. The areas that are undermined generally show no additional subsidence after the second year following the completion of mining.

On Trail Mountain the subsidence that is to be experienced will be between 60% and 90% of the mining height. Most of the subsidence will occur without any visible evidence on the surface. This is because most of the area on Trail Mountain has the North Horn Formation exposed on the surface and this formation contains an abundance of clay minerals that yield to subsidence with plastic

deformation and not fracturing. In rare occasions, tension fractures may develop on the surface along the sides or ends of a group of longwall panels. When undermining areas where the Castlegate sandstone is exposed on the surface, subsidence fractures at the surface will be common. This is because the Castlegate sandstone yields to subsidence through brittle deformation rather than plastic deformation.

11.5 SUBSIDENCE CONTROL

The applicant will conduct the underground mining operations so as to prevent subsidence from causing material damage to the surface and to maintain the value and reasonable foreseeable use of that surface in accordance with the subsidence control plan.

The applicant intends to control subsidence by mining as near complete and uniform extraction as possible. The use of longwall mining provides the most uniform and complete coal extraction possible. This minimizes the potential of tension fractures reaching the surface. Coal pillars in the longwall gate roadways will be sized to collapse after the longwall has mined beyond them. This will help form a uniform subsidence on the surface and minimize the impacts of subsidence.

The applicant shall leave a barrier of sufficient size to keep subsidence from occurring outside of the permit boundary taking into account the draw angle.

11.6 PUBLIC NOTICE

Any surface owners that may be affected by subsidence will receive a mining schedule which will detail the area in which mining is to take place and the planned date of that activity. This schedule will be included with the annual subsidence monitoring report for completeness.

11.7 SUBSIDENCE MONITORING PLAN

The applicant initially adopted a twofold approach to subsidence monitoring on East Mountain to the east of the permit area.

1.) aerial photogrammetry
2.) on-the-ground monumentation

After seven years of comparing the two types of surveys, it was determined that both effectively document the amount of subsidence which has occurred; however, the aerial photogrammetry method has the advantage of showing more detail because more data points can be monitored with less effort. Therefore, in 1987, with the concurrence of the Division, the applicant discontinued on-the-ground monumentation and now collects subsidence data solely by aerial photogrammetry. Subsidence within the permit area of Trail Mountain will be monitored photogrammetrically along with that on East Mountain.

The subsidence monitoring program on East Mountain, conducted since 1980, has produced data which not only documents the amount of subsidence that has occurred but also allows the applicant to predict the amount of subsidence that is likely to occur when mining in new areas.

11.8 AERIAL PHOTOGRAMMETRY

The applicant will maintain survey control aerial targets within the permit boundary necessary to allow the interpretation of coordinates on photos within ±1 foot. Following this procedure, the applicant shall conduct annually, an aerial photo survey of all areas which have been undermined. Elevations of control points within the photos will be determined by photogrammetric means to an accuracy of ±1 foot and compared to corresponding elevations derived from the baseline survey conducted in August 1993. The applicant shall continue monitoring all areas undermined until it is mutually agreed by the applicant and the Division that the subsidence in a given area has become

stable and no further monitoring is necessary. The findings of the survey shall be reported to the Division annually in a summary report. The prior owner of the Trail Mountain Mine (ARCO Coal) established a subsidence monitoring program that included on the ground conventional surveying. None of the subsidence stations established had more than one foot of subsidence occur. These data will; however, be factored into the future subsidence interpretations.

11.9 MITIGATION OF SUBSIDENCE DAMAGE

Should significant subsidence impacts occur, the applicant will restore to the extent technologically and economically feasible those surface lands that were reduced in reasonably foreseeable use as a result of such subsidence to a condition capable of supporting reasonably foreseeable uses that such lands were capable of supporting prior to subsidence.

Any roads, fences, stock ponds, earth dams, or water troughs which are materially damaged by subsidence will be repaired and regraded to restore them to their pre-subsidence usefulness.

In order to restore any land affected by the applicant's mining operations to a condition capable of supporting the current and post mining land uses stated herein, the applicant will replace water determined to have been lost or adversely affected as a result of the applicant's mining operations if such loss or adverse impact occurs prior to ~~final bond release~~ lease relinquishment. The water will be replaced; 1) from an alternate source in sufficient quantity and quality or, 2) relocated to maintain the current and post mining land uses as stated herein.

During the course of regular monitoring activities required by the permit, or as the applicant otherwise acquires knowledge, the applicant will advise the Division of the loss or adverse occurrence discussed above, within ten working days of having determined that it has occurred. Within ten working days after the Division notifies the Applicant in writing, that it has determined that the water loss is the result of the Applicant's mining operation, the Applicant will meet with the

Division to determine if a plan for replacement is necessary and, if so, establish a schedule for submittal of a plan to replace the affected water. Upon acceptance of the plan by the division the plan shall be implemented. The applicant reserves the right to appeal the Division's water loss determinations as well as the proposed plan and schedule for water replacement as provided by Utah Code Annotated 40-10-22(3)(a).

It is important to point out that the subsidence that has occurred on East Mountain or Trail Mountain has had no impact on the surface or groundwater present. This is due in part to the fact that the clay-rich strata in the North Horn formation form an effective aquiclude even when fractured. If fractures do form in this rock, the clays swell significantly when they become wet and seal off the fracture to groundwater movement. Although it is possible that subsidence could affect the ground water or surface water, prior experience suggests that it is unlikely.