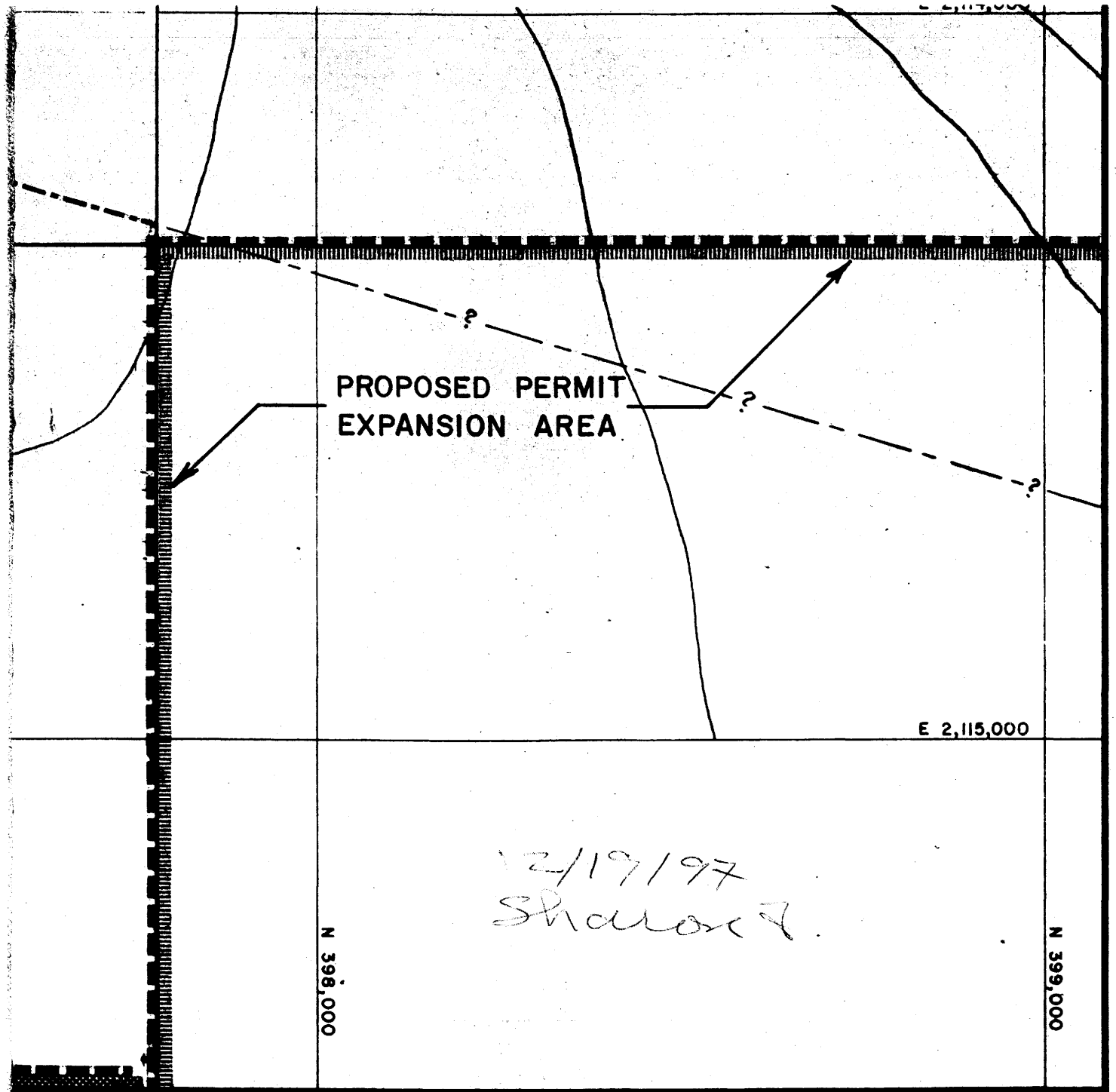


# C. W. MINING CO.

HUNTINGTON, UTAH

## BEAR CANYON - NO. 1 MINE

1989 MINE WATER SURVEY

| SCALE: | DRAWN BY: | DATE: |
|---|---|---|
| 1" = 200' | D. GUY | 12/1/89 |

BEAR CANYON | PLATE 7-1A

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# 6 GEOLOGY

## 6.1 SCOPE

This chapter describes the general geological conditions of the permit and adjacent areas and identifies whether the conditions are acceptable for recovery of the coal by underground methods. The following major topics are covered: methodology, regional geologic framework, stratigraphy and structure of the project vicinity, extent of coal reserves, coal quality and characteristics, characteristics of the adjacent units, and the geologic hazards and impacts of mining.

## 6.2 METHODOLOGY

The information used in preparing this chapter includes available literature from surrounding mines, and up-to-date mapping and reserve estimates by the Co-Op personnel. Physical and chemical analysis were performed in a certified laboratory.

## 6.3 REGIONAL GEOLOGIC FRAMEWORK

The mining site lies at the base of an erosional escarpment that forms the eastern face of the Wasatch Plateau, a subdivision of the Colorado Plateau, a subdivision of the Colorado Plateau physiographic province. East of the Wasatch Plateau is Castle

Valley, a relatively flat area over 80 mi long and 10 mi wide trending northeast-southwest. East of Castle Valley lies the San Rafael Swell, a great upfold marked by rings of hogback hills and intervening valleys.

The Wasatch Plateau is a high broad, flat area dissected by numerous streams. The high plateaus of Utah, which include the Wasatch Plateau, are thought to be a transition zone containing geologic structures common to both the Colorado Plateau Province and the Basin and Range Province to the west.

Co-Op mining site is located near the east central edge of what is known as the Wasatch Plateau coal field. The plateau edge is a steep cliff with a maximum relief of about 1,000 ft, coal outcrops appear in the canyon walls and along the cliffs. Rock types at the site are late Cretaceous in age and are generally composed of gray sandstone of fine to medium grain, interbedded with subordinate gray and dark gray carbonaceous shale and coal present with continental and/or transitional sediments. Marine sediments occur below the sequence and are exposed to the east of the escarpment in the castle valley.

Table 6-1 gives the generalized stratigraphic sequence and unit description of the Wasatch Plateau. The oldest rocks are of the early upper cretaceous age. The major commercial coal seams occur in the Blackhawk formation and are of Companion age.

Table 6-1 Generalized Section of Rock Formations, Wasatch Plateau Coal Field

| System | Series | Stratigraphic Unit | | Thickness (feet) | Description |
|---|---|---|---|---|---|
| TERTIARY | Eocene | Green River Formation | | – | Chiefly greenish lacustrine shale and siltstone. |
| | | Wasatch Group | Colton Formation | 300-1,500 | Varicolored shale with sandstone and limestone lense thickest to the north. |
| | Paleocene | | Flagstaff Limestone | 200-1,500 | Dark yellow-gray to cream limestone, evenly bedded with minor amounts of sandstone, shale and vo canic ash, ledge former. |
| | | | North Horn Formation (Lower Wasatch) | 500-2,500 | Variegated shales with subordinate sandstone, conglom erate and freshwater limestone, thickens to nort slope former. |
| CRETACEOUS | ? | | | | |
| | Maestrichthian | Mesaverde Group | Price River Formation | 600-1,000 | Gray to white gritty sandstone interbedded with sub ordinate shale and conglomerate, ledge and slo former. |
| | Campanian | | Castlegate Sandstone | 150- 500 | White to gray, coarse-grained often conglomeratic sand stone, cliff former, weathers to shades of brown. |
| | | | Blackhawk Formation *MAJOR COAL SEAMS* | 700-1,000 | Yellow to gray, fine- to medium-grained sandstone interbedded with subordinate gray and carbon eeous shale, several thick *coal* seams. |
| | | | Star Point Sandstone | 90-1,000 | Yellow-gray massive cliff-forming sandstone, often several tongues separated by Masuk Shale, thicke westward. |
| | Santonian | Mancos Shale | Masuk Shale | 300-1,300 | Yellow to blue-gray sandy shale, slope former, thick north and central plateau area, thins southward. |
| | | | Emery Sandstone *COAL (?)* | 50- 800 | Yellow-gray friable sandstone tongue or tongues, cl former, may contain *coal* (?) in south part plateau if mapping is correct, thickens to west a south. *Coal* may be present in subsurface to we |
| | Coniacian | | Blue Gate Member | 1,500-2,400 | Pale blue-gray, nodular and irregularly bedded marly mudstone and siltstone with several arenaceo beds, weathers into low rolling hills and badlan thickens northerly. |
| | Turonian | | Ferron Sandstone Member *MAJOR COAL SEAMS* | 50- 950 | Alternating yellow-gray sandstone, sandy shale and gray shale with important *coal* beds of Emery co field, resistant cliff former, thickens to the sou |
| | Cenomanian | | Tununk Shale Member | 400- 650 | Blue-gray to black sandy marine slope forming mu stone. |
| | | Dakota Sandstone | | 0- 60 | Variable assemblages of yellowgray sandy conglomerate shale and *coal*. Beds lenticular a discontinuous. |
| | Albian | *MINOR COAL* | | | |

Structurally, strata in the Eastern Wasatch Plateau generally dip southerly (sometimes slightly southeast or southwest) at low angles of 1 to 3 deg. Locally, near faults, the dip increases to about 20 deg. Three major north-south trending fault zones have been defined in the Wasatch Plateau Coal Field (Figure 6-1). Each zone is the product of a high angle block fault with extensive minor fracturing within the graben. The Joes Valley Fault is the largest zone. As shone in Figure 6-1, the zone lies several miles west of the Co-Op permit area. The Pleasant Valley Zone are vertical with between a few ft to 100 ft displacement (Doelling, 1972), although greater displacement occurs locally. The North Gordon Fault Zone, which occurs near the eastern boundary of the Wasatch Plateau field, is the least extensive of the zones. The trends of the faults have a complex pattern. Displacement is generally less than 800 ft (see plate 2-1 for a larger scale view of faults within the permit area).

## 6.4 GEOLOGY OF THE PROJECT VICINITY

Plates 2-4, 3-1, and 6-1 thru 6-8 show the topography of the area. The permit area is generally rugged, with elevations varying from 7,000 to about 10,000 ft above sea level. Slopes within the permit area vary from more than 210 pct (65 deg) east of Star Point to less than 4 pct (2 deg) on Gentry Ridge.

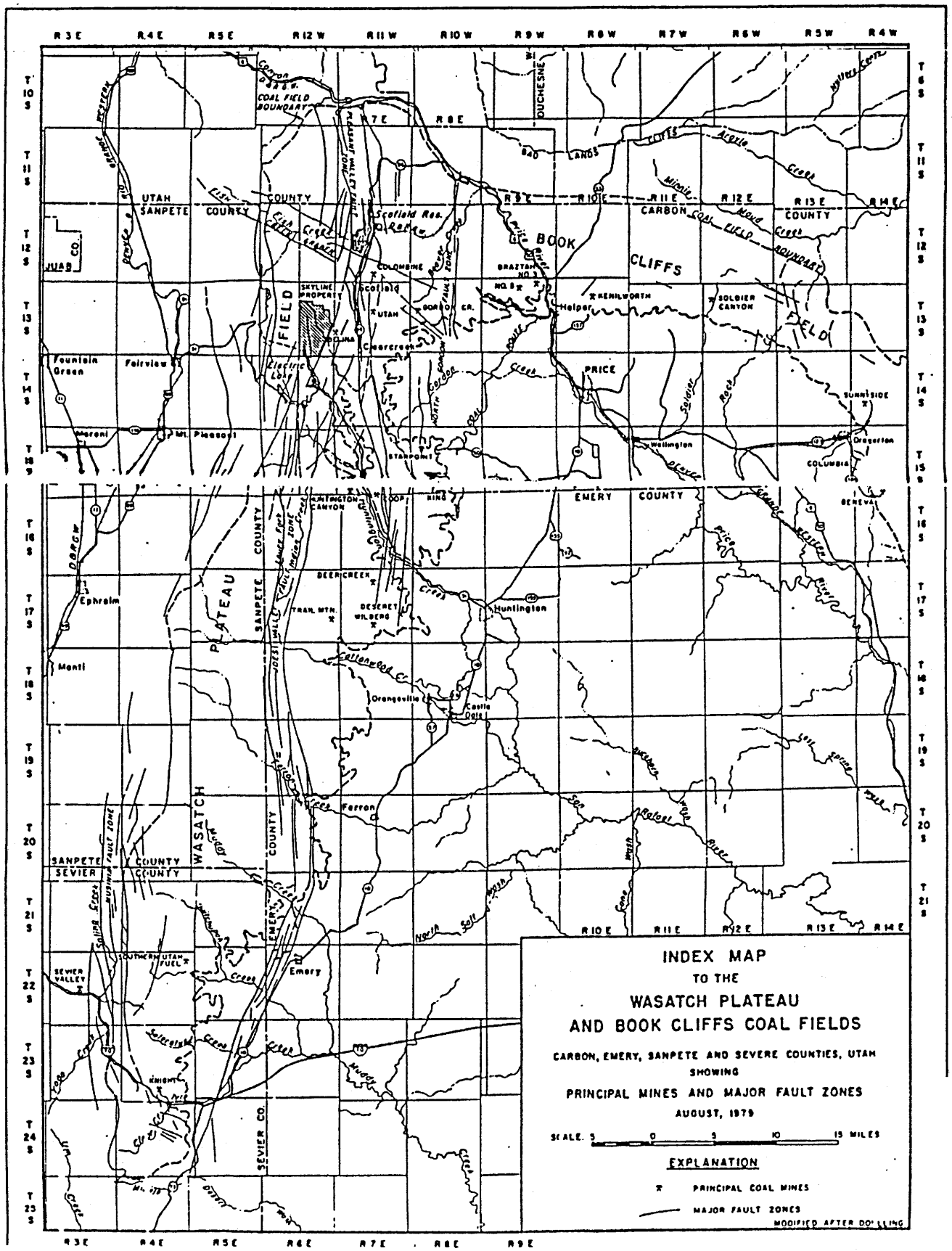



Figure 6-1 Wasatch Plateau and Book Cliffs Coal Fields

### 6.4.1 Stratigraphy

All of the geologic formations exposed on or adjacent to the permit area are Cretaceous members of the Mesaverde group, with the exception of the North Horn Formation, which is Tertiary (Table 6-1 & Figure 6-2). The minable coal seams are located in the Upper Cretaceous Blackhawk Formation.

#### 6.4.1.1 Star Point Sandstone

The Star Point Sandstone, the basal formation of the Mesaverde group (Doelling, 1972), is a light-colored, fairly well-sorted marine sand-stone of medium to fine grain (Spieker, 1931), North of the Wattis Canyon area the Star Point Sandstone divides into three tongues.

In the project vicinity, the tongues are essentially fused into one massive cliff-forming unit. The Star Point becomes thicker to the southeast, ranging to 400 to 460 ft near the eastern edge of the lease area to 600 ft or more near the central part of Huntington Canyon (Spieker, 1931).

#### 6.4.1.2 Blackhawk Formation

Overlying the Star Point Sandstone is the coal bearing Blackhawk consists of alternating Sandstone, shale, and coal beds, with thin

beds of argillaceous freshwater limestone occurring occasionally. The sequence represents deposition alternations between littoral and lagoonal sediments. The formation is approximately 1,000 ft thick, with the valuable coal seams located within the lower 400 ft (Doelling, 1972). The sandstone beds are fine to medium-grained (Spieker, 1972). The sands of the blackhawk are generally cemented by calcium carbonate or silica, with the exception of a few localized areas in which the cement is almost entirely clay. Iron is also present in the cement of all but the pure white sandstone (Spieker, 1931).

An exception to above mentioned sandstone is the Aberdeen Sandstone, a coarse-grained, white sand that is traceable from the northern part of the Wasatch Plateau coal field southward to the northwest slopes of Gentry Mountain (Spieker, 1931). The generally discontinues nature of the Blackhawk and apparent low specific water yield (Cordova, 1964) indicates that the water yielding capabilities of the Blackhawk are only of local importance.

Three general types of shale, all continental in origin, have been identified in the Blackhawk formation (Spieker, 1931): ordinary clay shale, carbonaceous shale, and smoke-gray shale. The ordinary clay shell is gray or green, granular, and normally soft at the outcrop; the carbonaceous shell is brown to black, massive, and laminated; and the smoke-gray shell is tough and leathery, and in its unweathered state is hard and homogeneous (Spieker, 1931).

Shale acts as an effective barrier to the vertical movement of water within the Blackhawk Formation. Therefore, a significant portion of the water that reaches the Blackhawk probably percolates downward until it reaches a shale layer, which causes horizontal movement to the surface or another "drain" (i.e. sandstone finger) within the formation.

#### 6.4.1.3 Castlegate Sandstone

The Castlegate Sandstone, generally considered the basal member of the Price River Formation (Spieker, 1931) consists of massive, highly resistant medium to coarse-grained sandstone beds containing, in places, conglomerate with a matrix of grit (Doelling, 1972). It is thought to be of marine origin (Paul Wier Company, 1977). Although the Castlegate overlies the Blackhawk Formation, it appears barren of coal in the plateau lease area.

#### 6.4.1.4 Price River Formation

The lithologic characteristics of the Price River Formation and the underlying Castlegate Sandstone are similar; however, the castlegate member is differentiated from the Price River Formation consists of medium to coarse-grained sandstone beds with occasional lenses of shale. Although the unit has a high porosity, its apparent low permeability (Cordova, 1964) reduces its water yielding capabilities except through fractures.

#### 6.4.1.5 North Horn Formation

The youngest geologic formation within the permit area is the North Horn Formation, which caps the Price River Formation on Gentry Mountain (Doelling, 1972). The North Horn, the lowest member of the Wasatch Group, consists of variegated shales, irregular beds of gray, brown, or cream colored sandstone of various textures, and thin beds of steel-gray and cream colored limestone (Spieker, 1931).

#### 6.4.1.6 Surficial Deposits

A few small areas in the eastern-most permit area are covered with Quaternary gravel. There are no alluvial deposits within the area to be affected by the mining. Likewise, the permit area is not prone to slides.

### 6.4.2 Structure

Structurally the strata in the Wasatch Plateau generally dip southerly (slightly southeast or southwest) at angles of 1 to 3 deg. Three major north-south trending fault zones have been defined in the Wasatch Coal Field. Each zone is the product of a high block fault with extensive minor fracturing within the graben. The Bear Canyon Mine is located in the Pleasant Valley Fault Zone. The vertical displacement between a few ft and 200 ft plus. A

major fault separates the Bear Canyon Mine from the Trail Canyon Mine. (Note: Geotechnical sections are located in Appendix 8-A and the mine is mapped on Plates 3-4 and 3-4a). Displacement on this particular fault is estimated to be 220 ft. During the mining of the bear canyon Seam several minor faults were discovered in the Trail Canyon Mine. These faults may effect the mining of other seams.

## 6.5 GEOLOGY OF THE COAL BEDS AND ADJACENT UNITS STRATIGRAPHY

All of the geologic formation exposed on or adjacent to the permit area are Cretaceous members of the Mesaverde group, with the exception of the North Horn Formation, which is Tertiary. The mineable coal seams are located in the Upper Cretaceous Blackhawk Formation.

### 6.5.1 Exploration and Drilling

#### 6.5.1.1 Test Borings

Co-Op has not done any test borings. A request was made to the Northwest Carbon for the information from Northwest Carbon concerning drilling North of the permit boundary which would be incorporated into the plan, but the request was not granted.

The applicant respectfully requests that the Division supply the applicant with the Utah Geological and Mineral Survey reports referred to in the ACR. See Appendix 6-A.

### 6.5.2 Geology

#### 6.5.2.1 General Stratigraphy

The exposed geologic column, in ascending order, consists of the Mancos Shale, the Star Point Sandstone, the coal-bearing Blackhawk Formation and the Castlegate Sandstone Member of the Price River Formation. All of these Geologic units are Cretaceous in age. The Star Point Sandstone through the Price River Formation composes the Mesaverde Group in this locality.

The Mancos Shale forms the initial steep slopes rising from the washes which in turn is overlain by the initial cliff-forming Star Point Sandstone (".... thick-bedded to massive beds separated by subordinate Mancos-like shale").

The Blackhawk Formation is composed of alternating sandstones, shales, mudstones and coal representing marine, transitional and terrestrial varieties of sedimentation. Deposition environments of the Blackhawk Formation include littoral, lagoonal, estaurine and swamp type environments. The Blackhawk outcrops to form a step and slope topography slightly less resistant than the Star Point

below and the Castlegate above. Multiple coal seams are found within the lower 350 ft of the Blackhawk.

The castlegate Member of the Price River Formation makes up a massive, resistant cliff-former above the Blackhawk.

#### 6.5.2.2 Structure

The Bear Canyon Fault, which is part of the north-south trending Pleasant Valley Fault Zone, is the only major structural feature in the study area which has any effect on the minability and continuity of the coal. Displacement on this particular fault is estimated by the author to be 200 ft+ in the vicinity of Bear Creek Camp ground on the north side of State Highway 31. The west side of the fault is down relative to the east side. In the vicinity of the Bear Canyon Mine Section 24, Township 16 South, Range 7 East and displacement at this point is apparently less than five ft. Strata immediately bordering the fault is disturbed and inconsistent in spatial attitude with equivalent strata in the study area east of the Bear Canyon fault. This will no doubt have a limiting effect on the extent to which coal can be mined in the immediate vicinity of the fault. The Bear Canyon fault marks the western boundary of the study area.

Strata east of the fault are nearly horizontal in attitude providing excellent mining conditions.

Coal outcrops slightly lower in elevation in the southern portion of the area than in the northern portion.

Small faults noted in the fields along outcrop were interpretated to be largely of non-tectonic origin (e.g. landslide and slump) by the author. Other faults observed did not express displacement of sufficient magnitude to be prohibitive to mining.

6.5.2.3 Coal

Multiple coal seams are found in the lower 350 ft of the Blackhawk Formation as was previously mentioned. In ascending order the seams are as follows: Hiawatha, Blind Canyon, Bear Canyon, and the upper beds, (Table 6-2).

None of the coal lies at depths of more than 1,800 in the study area. Depth should not be a limiting factor in mining.

It was noted in the field that strata situated at elevations consistent with the upper beds structural horizon were badly burned and not of economic importance.

Table 6-2 Coal Beds, Lower Huntington Canyon

| Layer | feet |
|---|---|
| Upper beds | 0-6 |
| Interval | 200 |
| Bear Canyon bed | 0-10 |
| Interval | 40-60 |
| Blind Canyon bed | 0-10 |
| Interval | 40-60 |
| Hiawatha | 5-8 |
| Star Point Sandstone | |

After Doelling, 1972
Authors note: Hiawatha to Blind Canyon interval can be as great as 110 feet.

The Blind Canyon and Bear Canyon seams were measured and observed at various points in the study area by the author, however, these seams were traceable only locally in Bear Canyon. Limited traceability of these two seams is attributed to the lenticular nature of the seams, the extent of slope debris acting as cover and/or depositional irregularities. H.H. Doelling indicates the Bear Canyon seam is present in Left Fork of Fish Creek Canyon (east of Bear Creek Canyon) with a thickness of 6.5 ft, however, this measurement was not verified. Doelling also has a 17.3 ft measurement in the Bear Canyon seam in Bear Canyon that was not verified in the field possibly because this particular exposure has since been covered by slope debris.

A small adit approximately 50 ft in length and interpreted as penetrating the Bear Canyon seam (measurement M-5), and a longer adit approximately 300 ft in length and interpreted as penetrating the Blind Canyon seam (measurement m-7), were discovered in Bear Creek Canyon, Section 24, Township 16 South, Range 7 East. The full extent and history of these workings is not known. The fact that these two seams are not traceable for any significant area beyond these old workings indicates the subordinate nature of the Bear and Blind Canyon seams.

The Bear Canyon Mine is located in the SW 1/4 of Section 24, Township 16 South, Range 7 East. Two seams were worked there, the upper of which was the Bear Canyon seam (elevation 7,340 ft). This interpretation is based on the seams stratigraphic position above the Star point Sandstone. The Blind Canyon seam apparently has pinched out or has been replaced in this locality. The mine lies on the west side of the Bear Canyon fault. The presence of the Hiawatha and Bear Canyon seams at the mine lend credence the author's opinion that these seams are probably present across canyon to the east where they were not traceable nor measurable due to slope cover.

The Hiawatha seam was identified throughout the majority of the study area based on its stratigraphic relationship with the underlying Star Point Sandstone. The Star Point Sandstone is continuous and conspicuous within the area covered by this report.

While the Hiawatha seam was not measured in left Fork of Fish Creek Canyon by this author or previous investigators (i.e. E.M. Spieker, H.H. Doelling), the presence of the Reichert Mine (Hiawatha seam-after Doelling) in Section 20, Township 16 South, Range 8 East suggests the interstitial presence of the Hiawatha seam in Left Fork. Where identified and measured, the Hiawatha seam achieved minable thickness in all but one instance (3.3 ft- measurement M-2). However, coal thickness at the outcrop is invariably thinner than the subsurface thickness in the area inspected. Specified work accomplished is shown on the geologic map (Plate 6-1) and columnar outcrop sections (Appendix 6-A).

Well consolidated sandstone forms the roof and floor of the Hiawatha seam in the majority of locations inspected along outcrop. This situation provides excellent mining conditions and high coal recovery percentages as is demonstrated by 90 to 96 percent recovery of the Hiawatha seam at the King Mine approximately five miles N.N.E. of the study area.

Doelling states that "extensive mining under gentry Mountain (a short distance due north of Bear Creek Canyon) reveals that the Hiawatha is continuous in the anticipated thickness".

### 6.5.4 Columns and Cross Sections

Available columns and cross sections from the permit area are

included in Appendix 6-A.

### 6.5.5 Coal Reserves

Estimated Coal reserves have been summarized in Table 3.4-1.

#### 6.5.5.2 Coal Characteristics

Copies of test results from coal samples taken within the permit area are included in Appendix 6-B.

### 6.5.6 Coal and Rock Sample Sites

Location of certain coal and rock sample locations are shown on Plate 3-4.

#### 6.5.6.1 Rock Characteristics

Copies of test results from rock/coal samples taken from within the permit area are included in Appendix 6-B.

## 6.6 MINING HAZARDS

Mine safety, fire protection and security are discussed in Section 3.4.5. Toxic materials and handling are discussed in Appendix 3-E. Environmental protection is included in Section 3.5

# Appendix 6-A

# COLUMNAR OUTCROP SECTIONS

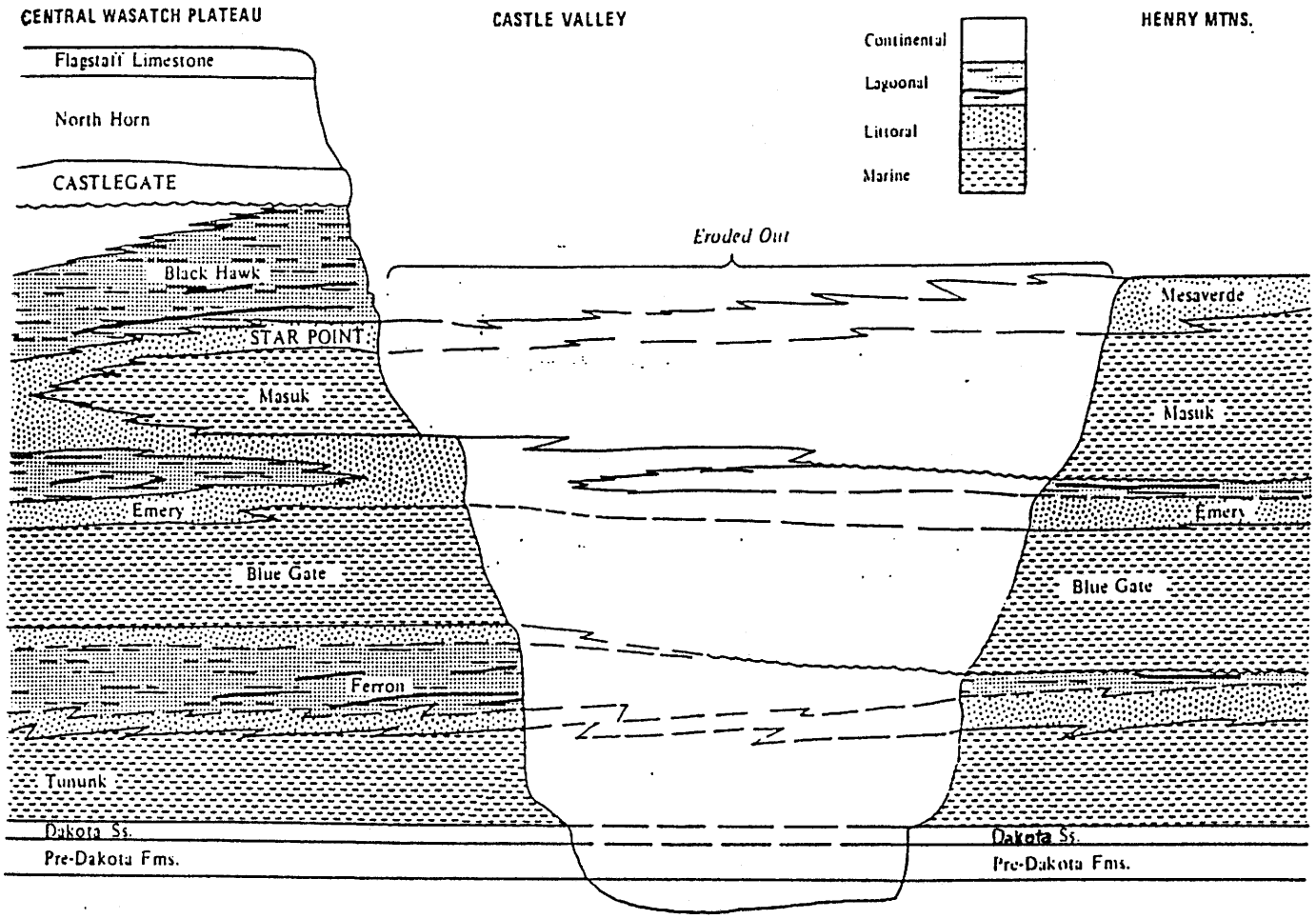



Figure 6A-1 Stratigraphic Correlation Diagram from Central Wasatch Plateau to the Henry Mountains

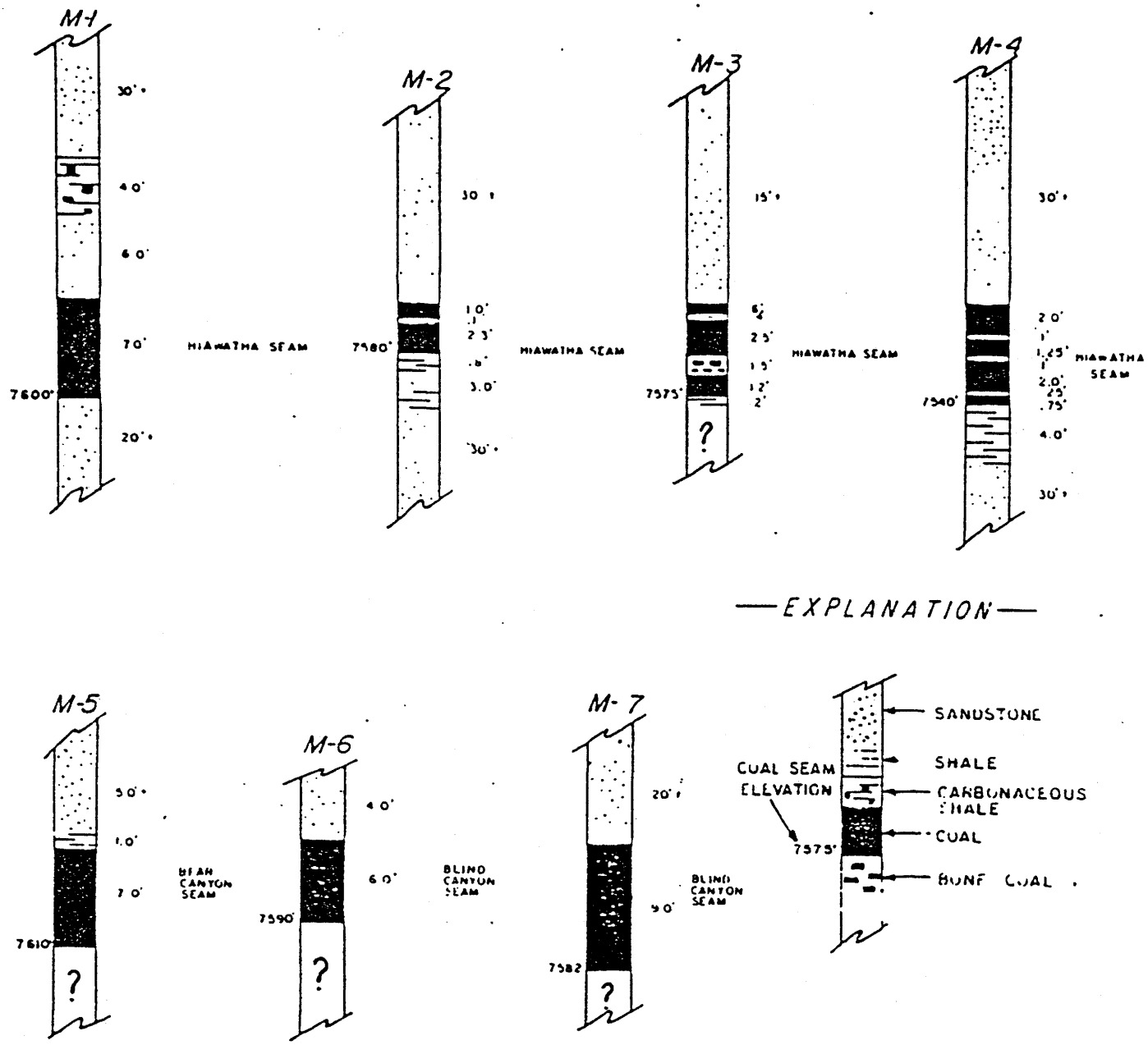



Figure 6A-2 Columnar Outcrop Sections, Lower Huntington Canyon, Emery County, Utah

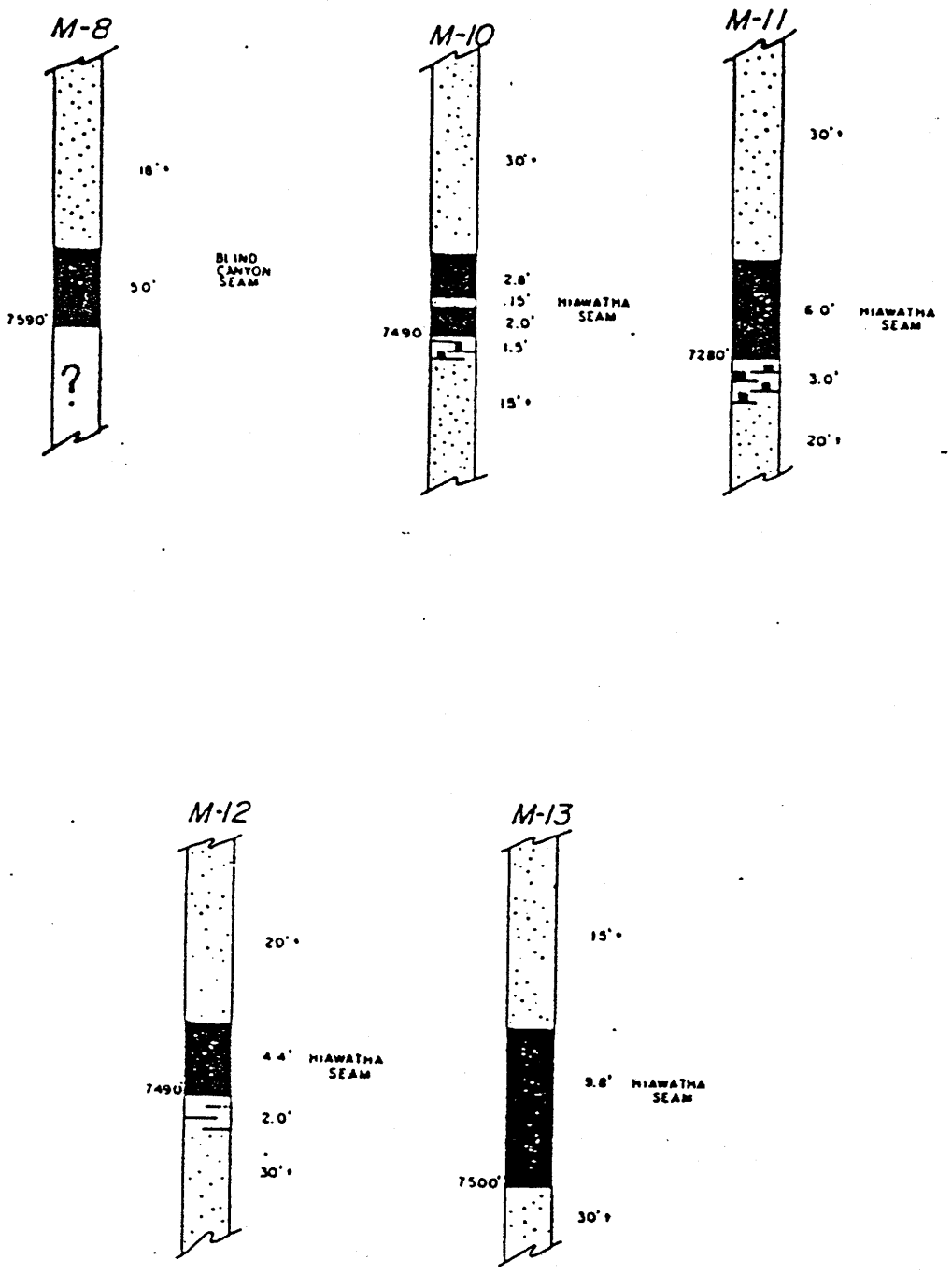



Figure 6A-2 Columnar Outcrop Sections, Lower Huntington Canyon, Emery County, Utah

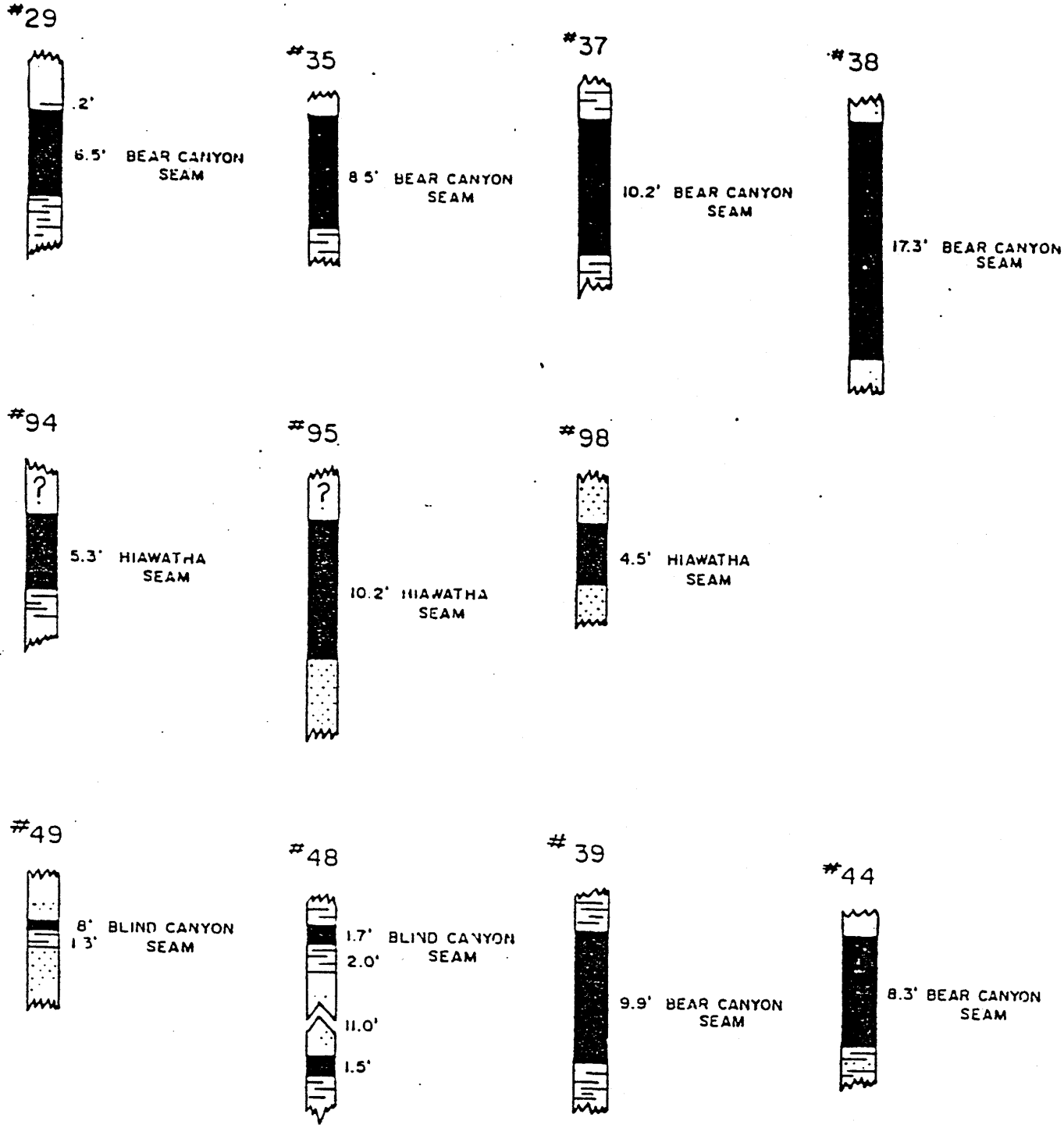



Figure 6A-2 Columnar Outcrop Sections, Lower Huntington Canyon, Emery County, Utah

## Blackhawk Formation

The Blackhawk in the Mesaverde Group of the Wasatch Plateau contains important coal seams in the lower half of the formation. The 700- to 1,000-foot unit, less resistant than the units that contain it, consists of alternating slope- and cliff-forming units (figure 6). The cliff-forming sandstones are generally yellow-gray or white-gray on fresh surfaces and weather to shades of tan, yellow or brown. In places they are reddened by the natural burning of nearby coal seams. Sands are fine- to medium-grained and cemented by either calcite or silica. In a few places they are argillaceous. Iron colors the cement. Occasionally the iron has been leached by organic acids from covering swamps and the sandstone is white.

Slopes of the formation are made of various types of shale [illegible] black; and smoke gray shale usually associated with the coal.

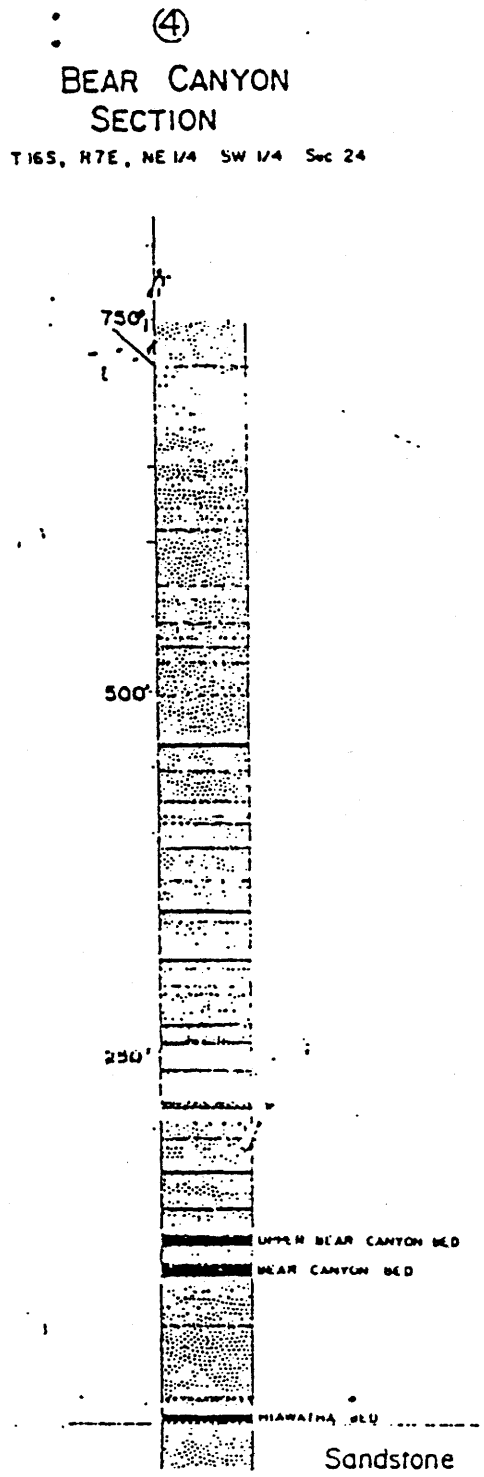
Other strata include friable shaley sandstones, usually thin and platy, that are cemented loosely by calcium carbonate. In some places the rock grades into an impure limestone.

The proportion of shale to sandstone is greater in the north part of the field as compared to the south, but total change in character of the formation is slight. In a section measured by Spieker (1931, p. 30-33) the unit consists of one-third shale and two-thirds sandstone. Key beds are local in extent and each area has its own grouping. An exception is the Aberdeen Sandstone Member. It underlies the Castlegate "A" coal bed and can be traced from the Gordon Creek area southward to Gentry Ridge near Wattis.

The lower contact of the Blackhawk was defined by Spieker (1931, p. 35) as "the clear-cut upper surface of the Star Point Sandstone," but Young (1955, p. 163) redefined the base as the bottom of the Spring Canyon Member. Young's work concentrated on the [illegible] coal field to the east but his reports add to the [illegible] of the Blackhawk on the Wasatch Plateau [illegible].

The redefined Blackhawk formation consists of some prominent littoral marine sandstone tongues and many lesser ones, all projecting eastward into the Mancos, where they lose their identity by grading into shale. Above each of them and below the next succeeding littoral marine sandstone, lagoonal deposits of sandstone, shale and coal were developed behind barrier bars, and where these deposits occur the underlying sandstone is almost everywhere white-capped. Division (of six members) is possible only where the basal littoral marine sandstones are developed at the extreme western end of the Book Cliffs at Storrs, Utah (simultaneously the northern end of the Wasatch Plateau field); only the basal sandstones of the Spring Canyon and Aberdeen members are present and between them is about 60 feet of coal-bearing rocks of the Spring Canyon Member. Above the basal sandstone of the Aberdeen Member are about 800 feet of undifferentiated coal measures of the Blackhawk, which are largely lagoonal but may include some inland floodplain deposits in the upper portion.

The commercial coal beds lie in the lower 250 to 350 feet of the formation; some thin units are in the upper part. Two of the more important coal beds are the Hiawatha and Castlegate "A" bed.



# Appendix 6-B

# COAL CHARACTERISTICS

## AVERAGE COAL ANALYSES, HIAWATHA NE QUADRANGLE

| | No. Analyses | As-received (percent) | |
|---|---|---|---|
| | | Average | Range |
| **BEAR CANYON BED** | | | |
| Moisture | 6 | 6.8 | 4.5-10.9 |
| Volatile matter | 6 | 43.8 | 37.4-46.0 |
| Fixed carbon | 6 | 45.7 | 44.9-46.0 |
| Ash | 6 | 4.5 | 3.8- 5.8 |
| Sulfur | 6 | 0.53 | 0.5- 0.6 |
| Btu/lb | 6 | 13,014 | 10,840-13,530 |
| **BLIND CANYON BED** | | | |
| Moisture | 10 | 4.8 | 3.8- 5.3 |
| Volatile matter | 9 | 41.7 | 40.2-44.7 |
| Fixed carbon | 9 | 44.3 | 39.2-48.3 |
| Ash | 10 | 8.9 | 5.8-12.4 |
| Sulfur | 8 | 0.58 | 0.5- 0.6 |
| Btu/lb | 9 | 12,492 | 11,700-13,080 |
| **HIAWATHA BED** | | | |
| Moisture | 370 | 5.6 | 0.7 -11.0 |
| Volatile matter | 357 | 42.3 | 36.3 -46.4 |
| Fixed carbon | 357 | 45.7 | 38.3 -52.7 |
| Ash | 359 | 6.2 | 3.3 -11.2 |
| Sulfur | 330 | 0.61 | 0.29- 1.1 |
| Btu/lb | 365 | 12,719 | 11,521-13,600 |

(AFTER DOELLING, 1972)

Sample No. WP-8-75 U.S.G.S. Serial No. D174679

Location Co-op Mine Face channel Sample

Sec. 22, T. 16 S., R. 7 E.

Seam Bear Canyon Seam Formation Blackhawk

Thickness Sampled 7' Date Sampled May 8, 1975

**Proximate Analysis**

| | AD | AR | Dry | MAF |
|---|---|---|---|---|
| M | 4.4 | 6.1 | | |
| VM | 45.6 | 44.8 | 47.7 | 50.8 |
| FC | 44.1 | 43.3 | 46.2 | 49.2 |
| Ash | 5.9 | 5.8 | 6.1 | |
| Btu/lb. | 13140 | 12910 | 13740 | 14640 |

**Ultimate Analysis**

| | AD | AR | Dry | MAF |
|---|---|---|---|---|
| H | 5.9 | 5.9 | 5.6 | 6.0 |
| C | 72.6 | 71.4 | 76.0 | 80.9 |
| N | 1.3 | 1.3 | 1.4 | 1.5 |
| O | 13.8 | 15.1 | 10.4 | 11.1 |
| S | 0.5 | 0.5 | 0.5 | 0.5 |

| FORMS OF SULFUR: | Sulfate | Pyritic | Organic |
|---|---|---|---|
| As-received | 0.02 | 0.16 | 0.30 |
| Moist.-free | 0.02 | 0.17 | 0.32 |
| M. and ash-free | 0.02 | 0.18 | 0.35 |

Free-swelling index No. 2 1/2

TRACE ELEMENTS BY VARIOUS DETERMINATIONS (Coal as received)

As (ppm) 1 F (ppm) <20 Hg (ppm) 0.03 Sb (ppm) 0.1 Se (ppm) 1.3

TRACE ELEMENTS, MOSTLY ATOMIC ABSORPTION ON ASH

MgO % 2.33 Cu (ppm) 97 Zn (ppm) 19

$Na_2O$ % 2.96 Li (ppm) 84 Mn (ppm) 200

[illegible] (ppm) <1 Pb (ppm) 25

DELAYED NEUTRON DETERMINATION OF URANIUM AND THORIUM

ppm Th 5.0247 ppm U

SEMIQUANTITATIVE 6-STEP SPECTROGRAPHIC ANALYSIS OF THE ASH

G=Greater than 10%; N=Not detected; L=Detected, but below limit of determination

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Fe % | 5.0 | Be (ppm) | N | Pb (ppm) | 30 | W (ppm) | N | Ho | N |
| Mg % | 1.5 | Bi | N | Pd | N | Y | 30 | Tm | N |
| Ca % | G | Cd | N | Pt | N | Zn | N | Yb | N |
| Ti % | 0.3 | Co | 10 | Sb | N | Zr | 200 | Lu | N |
| Cl % | --- | Cr | 70 | Sc | 15 | Ce | N | Th | 3 |
| Mn (ppm) | 150 | Cu | 70 | Sn | N | Ga | 20 | Nd | N |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| As (ppm) | N | La (ppm) | N | Sr (ppm) | 500 | Ge (ppm) | 20 | Al % | 7.0 |
| Au | N | Mo | 15 | Te | N | Hf | N | Na % | --- |
| B | 1500 | Nb | L20 | U | N | In | N | K % | N |
| Ba | 1500 | Ni | 20 | V | 70 | Li | N | P % | N |

LOOKED FOR ONLY WHEN La OR Ce FOUND:

| | | |
|---|---|---|
| Pr | | Fusibility of ash temp. °F. |
| Nd | | Initial Deform. ------2190 |
| Sm | | Softening ----------2250 |
| Eu | N | Fliud ----------2300 |

Ash Composition

AL203 -------11.0%
SO3 ---------~~1.9%~~ 8.4%
CL ---------<0.10%
CAO ---------24.0%
SIO2 --------~~25.0%~~ 24.0%
P205 --------0.74%
TIO2 --------0.71%
MnO ---------<0.020%
FE203 -------7.6%
K20 ---------0.17%

% Ash determined gravimetrically ashed at 525° C. -6.8%

# COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434

WESTERN DIVISION MANAGER
LLOYD W. TAYLOR, JR.

PLEASE ADDRESS ALL CORRESPONDENCE TO:
10775 EAST 51st AVE., DENVER, COLO. 80239
OFFICE TEL. (303) 373-4772


CO-OP MINING COMPANY
Box No. 300
Huntington, Utah 84528

June 25, 1979

Sample identification by

| | | |
|---|---|---|
| Kind of sample reported to us | Floor Rock | CO-OP Mining Co. |
| Sample taken at | xxxxx | Sample No. 57-2162 (CT&E Helper)<br>CO-OP Mine No. 2<br>Huntington Canyon |
| Sample taken by | CO-OP Mining Co. | |
| Date sampled | xxxxx | |
| Date received | 5-24-79 | |

Analysis report no. 72-82660

## SOIL ANALYSIS

| | |
|---|---|
| pH | 8.4 |
| Sodium | 5.4 |
| Calcium | .61 |
| Mangesium | 4.4 |
| Sodium Adsorption Ratio | 6.4 |
| Pyrite (as S-$CaCO_3$ eq t/1000T | 0.0 |
| Sand % | 65 |
| Silt % | 26 |
| Clay % | 9 |

6B-4 G. D. PALMER, Manager, Denver Laboratory


For Your Protection

Charter Member

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MOBILE, AL • NEW BETHLEHEM, PA • NEW ORLEANS, LA • NORFOLK, VA • PALISADE, CO • PIKEVILLE, KY • SALINA, UT • SO. HOLLAND, IL • TOLEDO, OH • VANCOUVER, B.C. CAN.

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WESTERN DIVISION MANAGER
GAIL D. PALMER

PLEASE ADDRESS ALL CORRESPONDENCE T
224 South Carbon Aven
Price, Utah 845
Phone: (801) 637-75

March 2, 1982

CO-OP MINING CO
P.O. Box 300
Huntington, Utah 84528

Sample identification
by
Co-op Mining Co.
#2

| | |
|---|---|
| Kind of sample reported to us | Coal |
| Sample taken at | xxxx |
| Sample taken by | Co-op Mining Co. |
| Date sampled | xxxx |
| Date received | 2-26-82 |

Analysis report no. 57-8990

## SHORT PROXIMATE ANALYSIS

| | As Received | Dry Basis |
|---|---|---|
| % Moisture | 4.70 | xxxxx |
| % Ash | 7.49 | 7.86 |
| Btu/lb | 12937 | 13575 |
| % Sulfur | 0.41 | 0.43 |

% Air Dry Loss = 3.07
Moisture, Ash-free Btu = 14733
Pounds of SO2 per 10^6 Btu = 0.63
Moist, Mineral matter free Btu * = 14088
(Based on as rec'd moisture)*
Pounds of Sulfur per 10^6 Btu = 0.32

JB/dt

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Jack Blair

JACK D. BLAIR, Manager, Price Laboratory

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# COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES 1919 SOUTH HIGHLAND AVE., SUITE 210 B, LOMBARD, ILLINOIS 60148 • (312) 953 9300

DAVE SELDON
MANAGER
SOUTHWEST DIVISION

PLEASE ADDRESS ALL CORRESPONDENCE TO:
224 S. CARBON AVE., PRICE, UT 84501
OFFICE TEL. (801) 637-7540

CO-OP MINING COMPANY
P.O.Box 300
Huntington, Utah 84528

November 10, 1983

Sample identification by

CO-OP Mining

Bear Canyon
Hiawatha Seam

| | |
|---|---|
| Kind of sample reported to us | Coal |
| Sample taken at | Bear Canyon |
| Sample taken by | Co-op Mining Co. |
| Date sampled | xxxx |
| Date received | 11-4-83 |

Analysis report no.57-14270

## SHORT PROXIMATE ANALYSIS

| | As Received | Dry Basis |
|---|---|---|
| % Moisture | 7.95 | xxxxx |
| % Ash | 9.55 | 10.37 |
| Btu/lb | 11641 | 12646 |
| % Sulfur | 0.50 | 0.54 |

| | |
|---|---|
| % Air Dry Loss = | 5.03 |
| Moisture, Ash-free Btu = | 14109 |
| Pounds of SO2 per 10^6 Btu = | 0.85 |
| Moist, Mineral matter free Btu * = (Based on as rec'd moisture)* | 12992 |
| Pounds of Sulfur per 10^6 Btu = | 0.43 |
| % Residual moisture = | 3.07 |

JB/cj

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Price Laboratory

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OVER 40 BRANCH LABORATORIES STRATEGICALLY LOCATED IN PRINCIPAL COAL MINING AREAS,
TIDEWATER AND GREAT LAKES PORTS, AND RIVER LOADING FACILITIES

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PLEASE ADDRESS ALL CORRESPONDENCE TO:
P.O. BOX 1020, HUNTINGTON, UT 84528
TELEPHONE: (801) 653-2311

CO-OP MINE
P.O. Box 300
Huntington, UT 84528

July 31, 1989

Sample identification by Co-op

| | | |
|---|---|---|
| Kind of sample reported to us | COAL | Co-op |
| Sample taken at | Co-op | North-west Top |
| Sample taken by | Co-op | 1 bag |
| Date sampled | | 12.0 lbs. |
| Date received | May 3, 1989 | (amended results) |

Sample: CS-1T

Analysis report no. 59-100973

## SOIL ANALYSIS

| | | |
|---|---|---|
| pH | 7.5 units | |
| Electrical conductivity | 1200 umhos/cm | (1.2 mmhos/cm) |
| Saturation percent | 46.4 | |
| Soluble calcium | 2.32 meq/l | |
| Soluble magnesium | 0.81 meq/l | |
| Soluble sodium | 1.08 meq/l | |
| Sodium adsorption ratio | 0.86 | |
| Exchangeable sodium percent | 0.01 | |
| Total nitrogen | 1.35 % | |
| Nitrate-nitrogen | 0.28 mg/kg | |
| Organic carbon | 75.44 % | |
| Boron | 0.19 mg/kg | |
| Selenium, total available | <0.1 ppm | |
| Available water capacity | 4.32 % | |

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

6B-7 Manager, Huntington Laboratory

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TELEPHONE: (801) 653-2311

CO-OP MINE
P.O. Box 300
Huntington, UT 84528

July 31, 1989

Sample identification by Co-op

| | | |
|---|---|---|
| Kind of sample reported to us | COAL | Co-op<br>North-west Top<br>1 bag<br>12.0 lbs.<br>(amended results) |
| Sample taken at | Co-op | |
| Sample taken by | Co-op | |
| Date sampled | | |
| Date received | May 3, 1989 | Sample: CS-1T |

Analysis report no. 59-100973

## SOIL ANALYSIS

| | |
|---|---|
| Max. acid potential | 17.2 tons $CaCO_3$/1000 tons |
| Neutralization potential | 13.8 tons $CaCO_3$/1000 tons |

(acid potential based on total sulfur of 0.55%; pyritic sulfur of .10% would yield an acid potential of 3.1)

| | |
|---|---|
| Coarse fragments | 97.7 % |

Particle size analysis:

| | |
|---|---|
| Sand | 90.4 % |
| Silt | 3.6 % |
| Clay | 6.0 % |

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

6B-8 Manager, Huntington Laboratory

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TELEPHONE: (801) 653-2311

CO-OP MINE
P.O. Box 300
Huntington, UT 84528

July 31, 1989

Sample identification by Co-op

| | | |
|---|---|---|
| Kind of sample reported to us | COAL | Co-op |
| Sample taken at | Co-op | North-west Middle |
| Sample taken by | Co-op | 1 bag |
| Date sampled | --------- | 13.75 lbs. |
| Date received | May 3, 1989 | (amended results) |

Sample: CS-1M

Analysis report no. 59-100974

## SOIL ANALYSIS

| | | | |
|---|---|---|---|
| pH | 7.6 | units | |
| Electrical conductivity | 900 | umhos/cm | (0.9 mmhos/cm) |
| Saturation percent | 48.9 | | |
| Soluble calcium | 1.90 | meq/l | |
| Soluble magnesium | 0.97 | meq/l | |
| Soluble sodium | 1.10 | meq/l | |
| Sodium adsorption ratio | 0.92 | | |
| Exchangeable sodium percent | 0.09 | | |
| Total nitrogen | 1.26 | % | |
| Nitrate-nitrogen | 0.24 | mg/kg | |
| Organic carbon | 72.58 | % | |
| Boron | 0.11 | mg/kg | |
| Selenium, total available | <0.1 | ppm | |
| Available water capacity | 4.7 | % | |

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

6B-9 Manager, Huntington Laboratory

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TELEPHONE: (801) 653-2311

CO-OP MINE
P.O. Box 300
Huntington, UT 84528

July 31, 1989

Sample identification by Co-op

| | | |
|---|---|---|
| Kind of sample reported to us | COAL | Co-op |
| Sample taken at | Co-op | North-west Middle |
| Sample taken by | Co-op | 1 bag |
| Date sampled | | 13.75 lbs. |
| Date received | May 3, 1989 | (amended results) |

**Sample: CS-1M**

Analysis report no. 59-100974

## SOIL ANALYSIS

| | |
|---|---|
| Max. acid potential | 22.2 tons CaCO3/1000 tons |
| Neutralization potential | 13.8 tons CaCO3/1000 tons |

(acid potential based on total sulfur of 0.71; pyritic sulfur of .21 would yield an acid potential of 6.6)

| | |
|---|---|
| Coarse fragments | 94.5 % |

Particle size analysis:

| | |
|---|---|
| Sand | 89.5 % |
| Silt | 8.5 % |
| Clay | 2.0 % |

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

6B-10 Manager, Huntington Laboratory

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TELEPHONE: (801) 653-2311

CO-OP MINE
P.O. Box 300
Huntington, UT 84528

July 31, 1989

Sample identification by Co-op

| | |
|---|---|
| Kind of sample reported to us | COAL |
| Sample taken at | Co-op |
| Sample taken by | Co-op |
| Date sampled | --------- |
| Date received | May 3, 1989 |

Co-op
North-west Bottom
1 bag
15.25 lbs.
(amended results)

**Sample: CS-1B**

Analysis report no. 59-100975

## SOIL ANALYSIS

| | | |
|---|---|---|
| pH | 7.4 | units |
| Electrical conductivity | 2600 | umhos/cm (2.6 mmhos/cm) |
| Saturation percent | 48.3 | |
| Soluble calcium | 9.54 | meq/l |
| Soluble magnesium | 3.20 | meq/l |
| Soluble sodium | 1.08 | meq/l |
| Sodium adsorption ratio | 0.43 | |
| Exchangeable sodium percent | <0.01 | |
| Total nitrogen | 1.23 | % |
| Nitrate-nitrogen | 0.16 | mg/kg |
| Organic carbon | 67.73 | % |
| Boron | 0.18 | mg/kg |
| Selenium, total available | <0.1 | ppm |
| Available water capacity | 5.49 | % |

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

6B-11

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TELEPHONE: (801) 653-2311

CO-OP MINE
P.O. Box 300
Huntington, UT 84528

July 31, 1989

Sample identification by Co-op

| | |
|---|---|
| Kind of sample reported to us | COAL |
| Sample taken at | Co-op |
| Sample taken by | Co-op |
| Date sampled | |
| Date received | May 3, 1989 |

Co-op
North-west Bottom
1 bag
15.25 lbs.
(amended results)

**Sample: CS-1B**

Analysis report no. 59-100975

## SOIL ANALYSIS

| | |
|---|---|
| Max. acid potential | 23.1 tons $CaCO_3$/1000 tons |
| Neutralization potential | 30.0 tons $CaCO_3$/1000 tons |

(acid potential based on total sulfur of .74%; pyritic sulfur of .23% would yield an acid potential of 7.2)

| | |
|---|---|
| Coarse fragments | 77.4 % |

Particle size analysis:

| | |
|---|---|
| Sand | 91.3 % |
| Silt | 2.7 % |
| Clay | 6.0 % |

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

6B-12 Manager, Huntington Laboratory

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TELEPHONE: (801) 653-2311

CO-OP MINE
P.O. Box 300
Huntington, UT 84528

July 26, 1989

Sample identification by Co-op

| | | |
|---|---|---|
| Kind of sample reported to us | COAL | Co-op |
| Sample taken at | Co-op | North Top |
| Sample taken by | Co-op | 1 bag |
| Date sampled | | 16.0 lbs. |
| Date received | May 3, 1989 | (amended results) |

**Sample: CS-2T**

Analysis report no. 59-100970

## SOIL ANALYSIS

| | | |
|---|---|---|
| pH | 8.0 | units |
| Electrical conductivity | 600 | umhos/cm (0.6 mmhos/cm) |
| Saturation percent | 48.0 | |
| Soluble calcium | 0.65 | meq/l |
| Soluble magnesium | 0.61 | meq/l |
| Soluble sodium | 1.70 | meq/l |
| Sodium adsorption ratio | 2.14 | |
| Exchangeable sodium percent | 1.86 | |
| Total nitrogen | 1.42 | % |
| Nitrate-nitrogen | 0.17 | mg/kg |
| Organic carbon | 73.57 | % |
| Boron | 0.07 | mg/kg |
| Selenium, total available | <0.1 | ppm |
| Available water capacity | 4.65 | % |

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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TELEPHONE: (801) 653-2311

CO-OP MINE
P.O. Box 300
Huntington, UT 84528

July 26, 1989

Sample identification by Co-op

| | | |
|---|---|---|
| Kind of sample reported to us | COAL | Co-op<br>North Top<br>1 bag<br>16.0 lbs.<br>(amended results) |
| Sample taken at | Co-op | |
| Sample taken by | Co-op | |
| Date sampled | | |
| Date received | May 3, 1989 | Sample: CS-2T |

Analysis report no. 59-100970

## SOIL ANALYSIS

| | |
|---|---|
| Max. acid potential | 19.1 tons $CaCO_3$/1000 tons |
| Neutralization potential | 5.0 tons $CaCO_3$/1000 tons |

(Acid potential based on total sulfur of 0.61% - pyritic sulfur would yield an acid potential of 2.2)

| | |
|---|---|
| Coarse fragments | 98.4 % |
| Particle size analysis: | |
| Sand | 97.1 % |
| Silt | 1.9 % |
| Clay | 1.0 % |

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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TELEPHONE: (801) 653-2311

CO-OP MINE
P.O. Box 300
Huntington, UT 84528

July 26, 1989

Sample identification by Co-op

| | | |
|---|---|---|
| Kind of sample reported to us | COAL | Co-op |
| Sample taken at | Co-op | North Middle |
| Sample taken by | Co-op | 1 bag |
| Date sampled | | 12.5 lbs. |
| Date received | May 3, 1989 | (amended results) |

Sample: CS-2M

Analysis report no. 59-100971

## SOIL ANALYSIS

| | | |
|---|---|---|
| pH | 7.8 | units |
| Electrical conductivity | 580 | umhos/cm (0.58 mmhos/cm) |
| Saturation percent | 47.8 | |
| Soluble calcium | 0.60 | meq/l |
| Soluble magnesium | 0.36 | meq/l |
| Soluble sodium | 0.72 | meq/l |
| Sodium adsorption ratio | 1.04 | |
| Exchangeable sodium percent | 0.26 | |
| Total nitrogen | 1.36 | % |
| Nitrate-nitrogen | 0.06 | mg/kg |
| Organic carbon | 71.88 | % |
| Boron | 0.11 | mg/kg |
| Selenium, total available | <0.1 | ppm |
| Available water capacity | 4.67 | % |

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

6B-15 Manager, Huntington Laboratory

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TELEPHONE: (801) 653-2311

CO-OP MINE
P.O. Box 300
Huntington, UT 84528

July 26, 1989

Sample identification by Co-op

| | | |
|---|---|---|
| Kind of sample reported to us | COAL | Co-op |
| Sample taken at | Co-op | North Middle |
| Sample taken by | Co-op | 1 bag |
| Date sampled | | 12.5 lbs. |
| Date received | May 3, 1989 | (amended results) |

Sample: CS-2M

Analysis report no. 59-100971

## SOIL ANALYSIS

| | |
|---|---|
| Max. acid potential | 20.6 tons CaCO3/1000 tons |
| Neutralization potential | 11.2 tons CaCO3/1000 tons |

(acid potential based on total sulfur of 0.66%; pyritic sulfur of .11% would yield an acid potential of 3.4)

| | |
|---|---|
| Coarse fragments | 94.1 % |
| Particle size analysis: | |
| Sand | 90.4 % |
| Silt | 7.6 % |
| Clay | 2.0 % |

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

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6B-16

F-464

**COMMERCIAL TESTING & ENGINEERING CO.**
GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 • (312) 953-9300
SINCE 1908
Member of the SGS Group (Société Générale de Surveillance)

PLEASE ADDRESS ALL CORRESPONDENCE TO:
P.O. BOX 1020, HUNTINGTON, UT 84528
TELEPHONE: (801) 653-2311

CO-OP MINE
P.O. Box 300
Huntington, UT 84528

July 26, 1989

Sample identification by Co-op

| | | |
|---|---|---|
| Kind of sample reported to us | COAL | Co-op |
| Sample taken at | Co-op | North Bottom |
| Sample taken by | Co-op | 1 bag |
| Date sampled | | 13.25 lbs. |
| Date received | May 3, 1989 | (amended results) |

**Sample: CS-2B**

Analysis report no. 59-100972

## SOIL ANALYSIS

| | | |
|---|---|---|
| pH | 7.5 | units |
| Electrical conductivity | 2700 | umhos/cm (2.7 mmhos/cm) |
| Saturation percent | 47.2 | |
| Soluble calcium | 10.62 | meq/l |
| Soluble magnesium | 3.06 | meq/l |
| Soluble sodium | 0.83 | meq/l |
| Sodium adsorption ratio | 0.31 | |
| Exchangeable sodium percent | <0.01 | |
| Total nitrogen | 1.28 | % |
| Nitrate-nitrogen | 0.42 | mg/kg |
| Organic carbon | 67.48 | % |
| Boron | <0.01 | mg/kg |
| Selenium, total available | <0.1 | ppm |
| Available water capacity | 4.94 | % |

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

6B-17 Manager, Huntington Laboratory

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OVER 40 BRANCH LABORATORIES STRATEGICALLY LOCATED IN PRINCIPAL COAL MINING AREAS, TIDEWATER AND GREAT LAKES PORTS, AND RIVER LOADING FACILITIES

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SINCE 1908
Member of the SGS Group (Société Générale de Surveillance)

PLEASE ADDRESS ALL CORRESPONDENCE TO:
P.O. BOX 1020, HUNTINGTON, UT 84528
TELEPHONE: (801) 653-2311

CO-OP MINE
P.O. Box 300
Huntington, UT 84528

July 26, 1989

Sample identification by Co-op

| | | |
|---|---|---|
| Kind of sample reported to us | COAL | Co-op<br>North Bottom<br>1 bag<br>13.25 lbs.<br>(amended results) |
| Sample taken at | Co-op | |
| Sample taken by | Co-op | |
| Date sampled | | |
| Date received | May 3, 1989 | Sample: CS-2B |

Analysis report no. 59-100972

## SOIL ANALYSIS

| | |
|---|---|
| Max. acid potential | 21.6 tons $CaCO_3$/1000 tons |
| Neutralization potential | 36.2 tons $CaCO_3$/1000 tons |

(acid potential based on total sulfur of 0.69%; pyritic sulfur of .14% would yield an acid potential of 4.4)

| | |
|---|---|
| Coarse fragments | 69.6 % |
| Particle size analysis: | |
| Sand | 88.4 % |
| Silt | 7.6 % |
| Clay | 4.0 % |

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Huntington Laboratory

6B-18

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OVER 40 BRANCH LABORATORIES STRATEGICALLY LOCATED IN PRINCIPAL COAL MINING AREAS, TIDEWATER AND GREAT LAKES PORTS, AND RIVER LOADING FACILITIES

# Appendix 6-C

# ROCK CHARACTERISTICS

Inter-Mountain Laboratories, Inc.
2506 West Main Street
Farmington, New Mexico 87401
Tel. (505) 326-4737

CO-OP MINING COMPANY
HUNNINGTON, UTAH
Mine: BEAR CANYON MINE

June 8, 1988



| Lab No. | Location | Depth | pH | EC mmhos/cm @ 25C | Saturation % | Calcium meq/l | Magnesium meq/l | Sodium meq/l | SAR | Sand % | Silt % | Clay % | Texture |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2231 | COAL SAMPLE | 0.0-0.0 | 7.5 | 1.03 | 63.8 | 4.94 | 3.36 | 1.15 | 0.56 | 94.5 | 3.7 | 1.8 | SAND |
| 2232 | ROOF ROCK | 0.0-0.0 | 8.1 | 0.84 | 25.1 | 2.80 | 3.67 | 1.95 | 1.08 | 90.4 | 9.4 | 0.2 | SAND |
| 2233 | FLOOR ROCK | 0.0-0.0 | 7.8 | 0.72 | 24.5 | 3.44 | 2.28 | 1.24 | 0.73 | 84.5 | 14.0 | 1.5 | LOAMY SAND |

6C-2

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage, Exch= Exchangeable, Avail= Available

Inter-Mountain Laboratories, Inc.

2506 West Main Street | Farmington, New Mexico 87401 | Tel. (505) 326-4737

CO-OP MINING COMPANY
HUNTINGTON, UTAH
Mine: BEAR CANYON MINE

June 8, 1989



| Lab No. | Location | Depths | Carbonate % | Total Sulfur % | T.S. AB t/1000t | Neut. Pot. t/1000t | T.S. ABP t/1000t | Pyritic Sulfur % | Organic Sulfur % | Nitrate-Nitrogen ppm | Boron ppm | Selenium ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2231 | COAL SAMPLE | 0.0-0.0 | 1.2 | 0.30 | 25.0 | 11.7 | -13.3 | <0.01 | 0.60 | 1.42 | 0.31 | 0.06 |
| 2232 | ROOF ROCK | 0.0-0.0 | < 0.1 | 0.04 | 1.25 | 504. | 503. | <0.01 | 0.04 | 1.51 | 0.44 | 0.02 |
| 2233 | FLOOR ROCK | 0.0-0.0 | 0.5 | 0.16 | 5.00 | 8.41 | 3.41 | 0.07 | 0.09 | 1.37 | 0.31 | <0.02 |

6C-3

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, PyrtOrg= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential

Inter-Mountain Laboratories, Inc.
2506 West Main Street
Farmington, New Mexico 87401
Tel. (505) 326-4737

CO-OP MINING COMPANY
HUNNINGTON, UTAH
Mine: BEAR CANYON MINE

June 6, 1988



| Lab No. | Location | Depths | Avail Na meq/100g | Exch Na meq/100g | Total Kjeldahl Nitrogen % | Pot Acidity t/1000t | 1/3 bar | 1 bar | 15 bar | Organic Carbon (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| 2231 | 6C-4 COAL SAMPLE | 0.0-0.0 | 78.0 | 77.9 | 0.78 | -0.01 | 13.4 | | 8.9 | Coal |
| 2232 | ROOF ROCK | 0.0-0.0 | 87.0 | 87.0 | 0.07 | -0.01 | 4.9 | | 3.5 | 7.67 |
| 2233 | FLOOR ROCK | 0.0-0.0 | 59.0 | 59.0 | 0.05 | 2.19 | 7.2 | | 4.2 | 6.44 |

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage, Exch= Exchangeable, Avail= Available

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made on the basis of drill hole logs, drilled for this study, detailed interpretation of geophysical well logs, conducted for this study, and on geologic field mapping.

An outline for the groundwater monitoring program for the Mine Plan area was then made based on the results of our study, by assessing the impact of mining on the local and regional groundwater hydrology. See Appendix 7-L for further information.

### 7.1.2 Regional Groundwater Hydrology

The occurrence, availability and movement of groundwater in the Mine Plan and surrounding areas are controlled by structural, stratigraphic and topographic factors, with snow-melt the source for most, if not all, of the groundwater in the Cottonwood-Huntington area (Danielson, et. al., U.S.G.S., 1981). According to this report, available data for the study area, which includes the permit area, indicate that the Star Point sandstone and the lower part of the Blackhawk formation, are an extensive aquifer, with many of the large springs in the Cottonwood-Huntington area, including Bear Springs, issuing from fault displacements of this aquifer. Our studies indicate; however, that the Bear Springs flow is derived from interception and channeling of water bearing zones from areas extending well to the north (up-gradient) of the site. This includes water bearing portions of the Star Point-Blackhawk contact cut by the fault to the north of the

Annual Report. An Annual Hydrologic Monitoring Report summarizing all data collected for the water yr (October through October) will be submitted to DOGM by March of the following calendar yr.

Quarterly Data Submission. All water monitoring data will be submitted to DOGM on a quarterly basis within 90 days or less of quarterly sampling collection.

Additional Well. An observation well (drilled 25 ft into the Star Point sandstone) is proposed to be drilled when mining reaches the northeast end of the permit area (Plate 7-4). This well will be for the collection of piezometric surface and water quality data, as encountered, and will be located such as to determine the extent or occurrence of groundwater within the depths of impact of the mining activities on the groundwater regime. Necessary permits will be obtained before drilling commences.

Groundwater encountered by this well will be sampled as specified above along with the other locations and used to correlate with the water quality data from Bear Springs, COP Development Springs, Huntington Spring, and Birch Springs to provide a check on estimates of groundwater contamination. These springs were selected since their flow is the sole use of groundwater to be possibly affected by mining activities in the permit area.

# Appendix 7-J

# PROBABLE HYDROLOGIC CONSEQUENCE DETERMINATION

## BALL PARK TOPSOIL PILE

The ball park covers 1.2 acres. Silt fences will be installed on the south east side, in line with the natural flow to treat runoff before it enters Bear creak.

## AREA SOUTH OF SHOP/BATH HOUSE & WAREHOUSE

This area lies between the shop/bath house & warehouse pad and ditch D-10U. The area is only a few feet wide, is partially vegetated, separated from the pad with a berm and a silt fence is installed and maintained in the drainage below the area.

# Appendix 7-L

# GENTRY MOUNTAIN CUMULATIVE HYDROLOGIC IMPACT ASSESSMENT

# GENTRY MOUNTAIN

# CUMULATIVE HYDROLOGIC IMPACT

# ASSESSMENT

Bear Canyon Mine, ACT/015/025

Deer Creek Mine Waste Rock Storage Facility, ACT/015/018

Hiawatha Mines Complex, ACT/007/011

Star Point Mines, ACT/007/006

Trail Canyon Mine, ACT/015/025

Carbon County and Emery County, Utah

**Revised August 1989**

AT102/47-73

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# I. INTRODUCTION

The purpose of this report is to provide a Cumulative Hydrologic Impact Assessment (CHIA) for Gentry Mountain, located in Carbon and Emery counties, Utah. This assessment encompasses the probable cumulative impacts of all anticipated coal mining in the general area on the hydrologic balance and whether the operations proposed under the application have been designed to prevent damage to the hydrologic balance outside the proposed mine plan area. This report complies with legislation passed under Utah Code Annotated 40-10-1 et seq. and the attendant State Program rules under UMC 786.19(c).

Gentry Mountain occurs within the Wasatch Plateau Coal Field, approximately 10 miles southwest of Price, Utah (Figure 1). The eastern margin of the Wasatch Plateau forms a rugged escarpment that overlooks Castle Valley and the San Rafael Swell to the east. Elevations along the eastern escarpment of the Wasatch Plateau range from approximately 6,500 to over 9,000 feet.

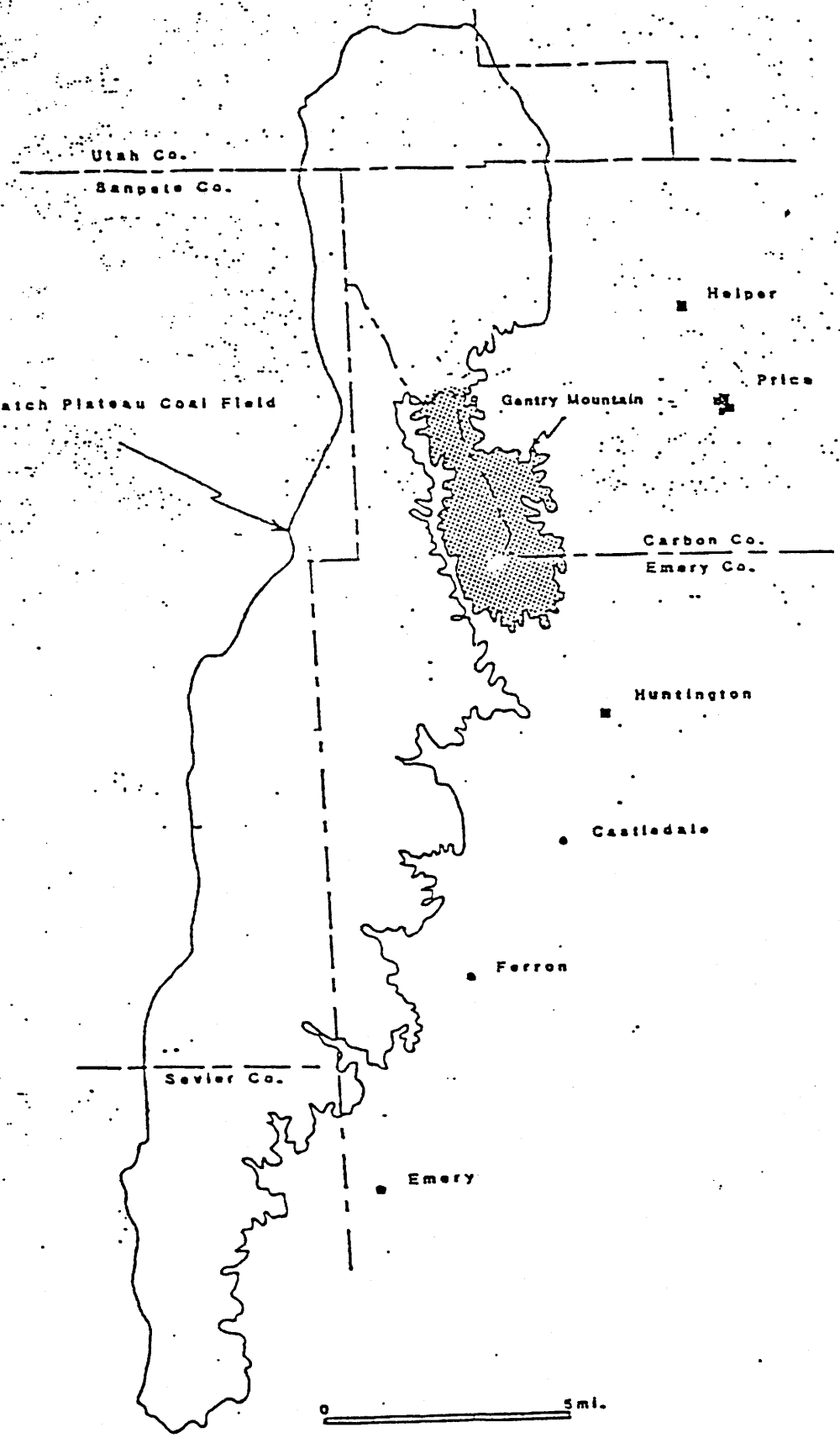
Precipitation varies from 40 inches at higher elevations to less than 10 inches at lower elevations. The area encompassed by the Wasatch Plateau may be classified as semiarid to subhumid.

## GEOLOGY

Outcropping rocks of the Wasatch Plateau Coal Field range from Upper Cretaceous to Quarternary in age. The rock record reflects an overall regressive sequence from marine (Mancos Shale) through littoral (Star Point Sandstone) and lagoonal (Blackhawk Formation) to fluvial (Castlegate Sandstone, Price River Formation and North Horn Formation) and lacustrine (Flagstaff Limestone) depositional environments. Oscillating depositional environments within the overall regressive trend are represented by lithologies within the Blackhawk Formation. The major coal-bearing unit within the Wasatch Plateau Coal Field is the Blackhawk Formation.

## VEGETATION

Vegetation of the Wasatch Plateau area is classified within the Colorado Plateau Floristic Division (Cronquist et al., 1972). The area occupies parts of both the Utah Plateaus and the Canyon Lands Floristic sections. Vegetation communities of the area include Desert Shrub (Shadscale) at the lowest elevations through Sagebrush, Sagebrush-Grassland, Pinyon-Juniper, Mountain Brush, Douglas Fir-White Fir-Blue Spruce and Engleman Spruce-Subalpine Fir.




7L-6

Figure 1. Wasatch Plateau Coal Field.

Desert Shrub communities are sparsely vegetated shrublands that, depending on elevation and soils, may be dominated by Shadscale (Atriplex confertifolia), Fourwing saltbush (A. canescens), Castle Valley clover (A. nuttallii) or Mat saltbush (A. corrugata) and can include Winter fat (Ceratoides lanata), Mormon tea (Ephedra spp.), Budsage (Artemisia spinescens), miscellaneous buckwheats (Erigonum spp.), Indian ricegrass (Oryzopsis hymenoides), Galleta grass (Hilaria jamesii), Grama grass (Bouteloua spp.), Needle and thread grass (Stipa comata), Sand dropseed (Sporobolus airodies) and Squirrel tail (Sitania hystrix). Greasewood (Sarcobatus vermiculatus) - Saltgrass (Distichlis stricta) can dominate bottomlands.

Many sagebrush communities of the area are relatively dense shrub stands of (Artemisia tridentata var tridentata) with very little understory growth. In relatively undisturbed Sagebrush communities, Rabbitbrush (Chrysothamnus nauseosus or C. viscidiflorus), Mormon tea, and several perennial grasses including Thickspike and Western wheatgrass (Agropyron dasystachyum and A. smithii), Great Basin wildrye (Elymus cinereus), Indian ricegrass and Dropseed species may be common.

In the Sagebrush-Grassland type, the typical Big sage may give way to Artemisia tridentata var vaseyana (Mountain big sage) with a co-dominant perennial grass understory. Salina wildrye (Elymus salinus) can be co-dominant in these communities and may dominate an herbaceous Grassland type. Black sage (A. nova) with Salina Wildrye or Western wheatgrass understory is also common.

Pinyon-Juniper woodlands occupy drier sites often with stoney to very rocky soils. Pinus edulis and Juniperus osteoperma are co-dominant in the overstory. Understory vegetation ranges from sparse to moderate ground cover on range sites in poor to excellent condition. Understory species include Sagebrush, Mountain mahogany (Cercocarpus montanus), Snowberry (Symphoricarpus oreophilus), and several perennial grasses including Slender wheatgrass (Agropyron trachycaulum), Salina wildrye, June grass (Koeleria cristata) and Indian ricegrass.

Dominant shrubs of the Mountain Brush communities will vary depending on elevation and aspect. The drier south and west facing slopes may support dense stands of Gambel's oak (Quercus gambellii). Other dominants of this community may include Serviceberry (Amelanchier utahensis), Mountain mahogany (Cercocarpus montanus or C. Ledifolius), Bitterbrush (Purshia tridentata) and Snowberry.

The range of the Douglas Fir-White Fir-Blue Spruce community is about 8,000 to 10,000 feet. Douglas Fir (Pseudotsuga mensiesii) is usually the dominant tree with White Fir (Abies concolor) and Blue Spruce (Picea pungens) usually limited to the most mesic sites, often along streams. With dense canopies, understory vegetation may be sparse. Common shrubs include Serviceberry (Amelanchier spp.), Oregon grape (Berberis repens), Chokecherry (Prunus virginiana), Rocky Mountain Maple (Acre glabrum), Mountain lover (Pachistima myrsinites) and Snowberry. Bluebunch wheatgrass (Agropyron spicatum), Mountain brome (Bromus marginatus), and Kentucy bluegrass (Poa pratensis) are common grasses. Aspen stands (Populus tremuloides) can be found throughout the zone, particularly in mesic sites and as successful communities.

Picea engelmannii and Abies lasiocarpa dominate the Spruce-Fir zone at the highest elevations of the hydrologic impact area. While receiving about the same precipitation as the Douglas Fir communities, lower evapo-transpiration with cooler temperatures can permit a more lush vegetation in the Spruce-Fir zone. Limber pine (Pinus flexilis) often occupies steep or rocky, drier sites of this zone.

Small riparian communities are found at all elevations within the impact assessment area. With greater water availability and cooler temperatures, the riparian zone often includes more mesic species, e.g., those from a higher vegetation zone. Shrub species from the Mountain shrub type may be found at most elevations.

Additional riparian zone shrubs include Narrowleaf cottonwood (Populus angustifolia), Redosier dogwood (Cornus stolonifera), Skunk bush (Rhus trilobata), river birch (Betula occidentallis) and various willows (Salix spp.). Grass species from the mesic zones may be represented (Mountain shrub and higher zones) along with fescues (Festuca spp.) and miscellaneous sedges (Carex spp.). Small wet areas around springs and seeps will often support a dense growth of grasses, sedges and willows.

## HYDROLOGY

Surface runoff from the Wasatch Plateau area flows either to the Price River Basin or the San Rafael River Basin. The Price River Basin, which includes about 1,800 square miles in six counties, is located primarily in Carbon and Emery counties in East-Central Utah. The San Rafael River Basin, which includes about 2,300 square miles in three counties, is located mainly in Emery County to the south of the Price River Basin. The Price River drainage originates in the Wasatch Plateau about 12 miles west and south of Scofield Reservoir. Downstream from the reservoir the river flows in a generally southeasterly direction. The drainage is bounded by the Book Cliffs on the northeast, the Wasatch Plateau on the west, and the San Rafael Swell on the south. The San Rafael River Basin occupies part of two physiographic sections of the Colorado Plateau - the High Plateaus to the north and west and Canyonlands to the south and east (Fenneman, 1946). Principal streams in the basin are

Huntington and Cottonwood creeks, which merge to form the San Rafael River, and Ferron Creek, which joins the San Rafael River within a mile of that confluence. The San Rafael River also flows in a southeasterly direction to eventually join the Green River, after travelling from its headwaters in the Wasatch Plateau.

The water quality of both the Price River and the San Rafael Rivers is good in the mountainous headwater tributaries, but deteriorates rapidly as flow traverses the Mancos Shale. The shale lithology typically has low permeability, is easily eroded and contains large quantities of soluable salts that are major contributors to poor water quality. Depending upon the duration of contact, water quality degrades downstream to where Total Dissolved Solids (TDS) levels of 4,000 milligrams per liter (mg/l) are not uncommon. The predominant ion leached from the Mancos Shale is sulfate ($SO_4$) with values over 1,000 mg/l common in the lower reaches of the Price River.

Ground water is present in all lithostratigraphic units within the Wasatch Plateau Coal Field. Ground water occurs under localized conditions that often form a system of "perched" aquifers and associated springs and/or seeps. Significant localized ground-water resources are associated with the North Horn Formation and Price River Formation. The U.S. Geological Survey has identified and formally designated the Star Point-Blackhawk aquifer as the only regional ground-water resource occurring in the Wasatch Plateau Coal Field (Danielson, et al., 1981 and Lines, 1984).

## II. CUMULATIVE IMPACT AREA (CIA)

Figure 2 delineates the CIA for current and projected mining in the Gentry Mountain area. The CIA encompasses approximately 112 square miles and includes Gentry Mountain, Wild Cattle Ridge and Star Point. The western and northern CIA boundaries are designated by drainages and drainage divides, whereas the southern and eastern boundaries are defined by T16S/T17S and R8E/R9E SLBM, respectively.

## III. SCOPE OF MINING

### STAR POINT MINES (PLATEAU MINING COMPANY)

The Plateau Mining Company permit area encompasses approximately 7,000 acres. There are three federal coal leases that are designated by the Bureau of Land Management as "Logical Mining Units" (LMUs): U-13097, SL-031286, and U-037045.

Mining operations began in 1916 when the Wattis Brothers and Mr. Browning bought 160 acres from the United States and developed the property for coal production. Coal was shipped in the autumn of 1917 when the railroad was completed, to the town of Wattis. The Lion Coal Company bought the coal interests in 1919. In 1967 Plateau Limited opened a new mine in the Hiawatha Seam. In 1971 United Nuclear purchased the mine and in July 1980 Plateau Mining Company bought the properties.

Historically, the Star Point #2 Mine (where mining has ceased) developed coal resources in the Hiawatha, Third, and Wattis seams by the room and pillar technique. During the permit term of 1987-1992, mining will occur in the Wattis and Third seams and development work is projected for the Hiawatha seam in the Star Point #1 Mine. Subsequent permit terms will involve further mining in all three of the coal seams through the year 2010. There will be room and pillar mining and longwall mining in the Wattis and Third seams and longwall mining in the Hiawatha seam.

There are certain areas where the cumulative effects of multiple seam mining will be experienced. The area of T15S R7E, Section 12, will have combined subsidence effects, and potentially, Section 18 of T15S R8E.

HIAWATHA MINES COMPLEX (U.S. FUELS COMPANY)

The Hiawatha Mines Complex permit area encompasses about 12,000 acres and is located adjacent to the Plateau Mining Company permit area. The Federal coal leases currently designated as LMUs are SL-025431 and U-026583. A large portion of the remainder of the coal is owned by U.S. Fuels. Coal is projected to be mined until the year 2014.

The Hiawatha Mines Complex is a consolidation of the original King, Hiawatha, Black Hawk, and Mohrland coal mines which began operating in the early 1900's. U.S. Fuels Company was organized in 1915 and began operating in 1916, when it took over the properties of the Consolidation Fuel Company, Castle Valley Coal Company, and Black Hawk Coal Company, all of which were located within the current permit boundary.

Mining has occurred throughout large portions of the permit area by the room and pillar technique: King 4 (A and B Seams), King 5 (B Seam), King 6 (A and Hiawatha Seams), King 7 (Hiawatha Seam), and King 8 (Upper Seam). Future longwall mining will be undertaken in the King 5 (A Seam) and King 8 (Upper Seam).

BEAR CANYON AND TRAIL CANYON MINES (CO-OP MINING COMPANY)

Co-Op Mining Company owns two mines located south of the Plateau Mining Company and Hiawatha Mines Complex permit areas.

The Bear Canyon Mine encompasses 1051 acres. Mining during the first five-year permit term will occur in the Bear Canyon coal seam and thereafter, in the Hiawatha seam. There are two federal coal leases designated as LMUs at the Bear Canyon Mine, U-024316 and U-024318. Production will be from room and pillar mining methods with secondary pillaring.

The Trail Canyon Mine, located immediately west of the Bear Canyon property, has been operated by Co-Op Mining Company since 1938. Production to date has been from the Bear Canyon coal seam. The Trail Canyon Mine was declared suspended during 1983 and will be reclaimed.

## DEER CREEK WASTE ROCK STORAGE FACILITY

The Deer Creek Waste Rock Storage Facility permit area encompasses 52.56 acres and is located approximately 2 miles northeast of the Deer Creek Mine. This area will store waste rock from the Deer Creek Mine for at least 30 years. Utah Power and Light Company is owner of all the land within the permit area.

# IV. STUDY AREA

## GEOLOGY

The Gentry Mountain CIA is characterized by cliffs, narrow canyons and pediments. Stratigraphic units outcropping within the area include, from oldest to youngest, the Mancos Shale, Starpoint Sandstone, Blackhawk Formation, Castlegate Sandstone, Price River Formation, North Horn Formation, Flagstaff Formation and Quarternary deposits. Lithologic descriptions and unit thicknesses are given in Figure 3.

Rocks in the study area strike northwest and dip approximately three degrees to the southeast. Four major normal faults or fault zones (Pleasant Valley Fault, Trail Canyon Fault, unnamed fault, Bear Canyon Fault) trend north in the western portion of the CIA (Figure 4). Displacements range from several feet to approximately 800 feet.

## HYDROLOGIC RESOURCES

## GROUND WATER

The ground-water regime within the CIA is dependent upon climatic and geologic parameters that establish systems of recharge, movement and discharge.

Snowmelt at higher elevations provides most of the ground-water recharge, particularly where permeable lithologies such as fractured or solution limestone are exposed at the surface. Vertical migration of ground water occurs through permeable rock units and/or along zones of faulting and fracturing. Lateral migration initiates when ground water encounters impermeable rocks and continues until either the land surface is intersected (and spring discharge occurs) or other permeable lithologies or zones are encountered that allow further vertical flow.

The Star Point Sandstone and lower portion of the Blackhawk Formation, Castlegate Sandstone, Price River Formation, North Horn Formation, Flagstaff Limestone, and Quarternary deposits are potential reservoirs or conduits for ground water in the CIA. Reservoir lithologies are predominantly sandstone and limestone. Sandstone reservoirs occur as channel and overbank, lenticular and tabular deposits, whereas limestone reservoirs have developed

| System | Series | Stratigraphic Unit | Thickness (feet) | Lithology and Water-Bearing Characteristics |
|---|---|---|---|---|
| Quarternary | Holocene and Pleistocene | Quarternary deposits | 0–100 | Alluvial and colluvium; clay, silt, sand, gravel, and boulders; yields water to springs that may cease to flow in late summer. |
| Tertiary | Paleocene | North Horn Formation | 300 ± | Varigated shale and mudstone with interbeds of tan-to-gray sandstone; all of fluvial and lacustrine origin; yields water to springs. |
| Cretaceous | Upper Cretaceous | Price River Formation | 200–250 | Gray-to-brown, fine-to-coarse, and conglomeratic fluvial sandstone with thin beds of gray shale; yields water to springs locally. |
| | | Castlegate Sandstone | 150–200 | Tan-to-brown fluvial sandstone and conglomerate; forms cliffs in most exposures; yields water to springs locally. |
| | | Blackhawk Formation | 1000 ± | Tan-to-gray discontinuous sandstone and gray carbonaceous shales with coal beds; all of marginal marine and paludal origin; locally scour-and-fill deposits of fluvial sandstone within less permeable sediments; yields water to springs and coal mines, mainly where fractured or jointed. |
| | | Star Point Sandstone | 350–450 | Light-gray, white, massive, and thin beaded sandstone, grading downward from a massive cliff-forming unit at the top to thin interbedded sandstone and shale at the base; all of marginal marine and marine origin; yields water to springs and mines where fractured and jointed. |
| | | Mancos Shale | 1000 ± | Dark-gray marine shale with thin, discontinuous layers of gray limestone and sandstone; yields water to springs locally. |

Figure 3. Stratigraphy of the Gentry Mountain Area (modified from Plateau Mining Company PAP, 1986, and Danielson, et al., 1981).

through solution processes and fracturing. Shale, siltstone and cemented sandstone beds act as aquacludes to impede ground-water movement. The Mancos Shale is considered a regional aquaclude that delimits downward flow within the CIA. Localized aquacludes include relatively thin, impermeable lithologies occurring within the stratigraphic section above the Star Point Sandstone.

The Star Point-Blackhawk aquifer is present and represents the only identified regional ground-water resource in the study area (Danielson, et al., 1981). Ground water associated with the Price River Formation and North Horn Formation may be characterized as occurring within an extensive "perched" aquifer zone and represents a significant hydrologic resource.

Faults and fractures act as effective conduits for ground water and allow unsaturated downward flow. Springs having significant discharges (10 gpm or greater) are most commonly located in proximity to major north-south trending fault or fracture zones (Figure 4). In particular, Bear Canyon Fault appears to act as a significant conduit for ground water. Mine workings contact with the Bear Canyon Fault at the 10th West Section in U.S. Fuels' King IV Mine has resulted in a sustained inflow of 900 to 1,000 gpm.

Other encounters with the Bear Canyon Fault in Plateau Mining Company's Star Point No. 1 Mine resulted in an initial high inflow rate that subsequently diminished. Three municipal wells (Huntington) have been developed adjacent to the Trail Canyon Fault near the junction of Wild Cattle Hollow and Gentry Hollow (Figure 4).

Data from seven boreholes located within and adjacent to the Star Point Mines permit area indicate ground water associated with the regional aquifer moves toward the south (Figure 4).

Approximately 325 seeps and springs occur within the CIA. Total spring discharge exceeds 1,500 gpm. One hundred eighty-nine springs discharge from the North Horn Formation and Price River Formation (1,200 gpm); 37 springs discharge from the Castlegate Sandstone (80 gpm); 53 springs discharge from the Blackhawk Formation and Star Point Sandstone (200 gpm); and eight springs discharge from the Mancos Shale (40 gpm). Analyses from spring samples indicate water quality progressively decreases from the North Horn Formation to the Mancos Shale.

Mine inflow is estimated to be 134 gpm in the Star Point Mines, 950 gpm in the Hiawatha Mines Complex, and less than 100 gpm in the Trail Canyon Mine and Bear Canyon Mine. The majority of mine inflow (80 percent) is from faults and fractures with a lesser amount from paleochannels and wall weeps. Mine inflow is discharged to Mud Water Canyon at Star Point Mines and to Cedar Creek and Miller Creek at the Hiawatha Mines Complex. Mine inflow is discharged to Bear Creek at the Bear Canyon Mine. No discharge occurs at the Trail Canyon Mine. Mine water within the CIA represents ground-water depletion from storage in the Blackhawk Formation and Star Point Sandstone and the interception of flow along faults/fractures.

## Surface Water

The CIA has been divided into six major drainage basins representing seventeen sub-drainage areas. The CIA encompasses drainage to both the San Rafael and Price River Basins (see Figure 5 and Table 1).

## Serviceberry Creek Drainage (1)

The Serviceberry Creek Drainage (1) includes the majority of disturbed area associated with the Plateau Mine. The mine exists in the headwaters of this creek drainage area of 6,135 acres. The average gradient of the creek within the CIA is 21 percent. Serviceberry Creek (1) is ephemeral within the CIA and eventually joins Miller Creek (16), east of the CIA, which is a perennial creek.

Vegetation communities in this drainage system include Douglas Fir-White Fir, Aspen, Mountain Brush, Sagebrush, including both Black sage and Big sage associations, Mixed Grass - Forb communities, and Pinyon - Juniper Woodlands. Riparian communities are generally small and may be dominated by willows, River birch or an occasional Cottonwood. Desert Shrub communities, particularly Shadscale, occupy the lowest elevations in the eastern section of the drainage system.

Mining has been confined to the extreme upper reaches of the watershed. The approximately 330 acres of surface disturbance associated with the surface facilities of the Plateau Mine has also been confined to the upper reaches of this watershed. All of Plateau's surface disturbance is treated by maintained sediment controls.

## Mud Water Canyon Drainage (2 and 3)

Approximately 2,978 acres drains Mud Water (2) and Los Angeles Canyon (2) to join 7,080 acres draining Seely, Corner, and First Water canyons (3) to form Gordon Creek of the Price River Basin. The average gradient in the headwaters of these drainages is 19 percent. Mining has occurred within the extreme headwater reaches of Mud Water (2), Los Angeles (2), and Seely canyons (3), and the South Fork of Corner Canyon (3). Presently, Mud Water, Seely, and the South Fork of Corner Canyon are perennial in their lower reaches, sustained by high elevation spring flow and mine water discharge (Mud Water Canyon).

Vegetation communities of the Mud Water Canyon Drainage area include Spruce-Fir, Douglas Fir-White Fir, Aspen, Mountain Brush, Sagebrush, including both Big sage and Black sage associations, Mixed Grass-Forb communities and shrub and grass-forb dominated riparian communities on the headwater streams.

Mining has not occurred beneath any stream channels, but has been restricted to the ridges separating the drainages.

Gentry Ridge Drainage (4, 5, 6, 7 and 8)

Approximately 7,777 acres drain Wild Cattle Hollow (6) and Gentry Hollow (7) to form Tie Fork Canyon (8) tributary to Huntington Creek. Approximately 5,516 acres drains areas directly tributary to Huntington Creek on Nuck Woodward Canyon (4). The average gradient of Gentry (7) and Wild Cattle Hollow (6) is 13 percent. Tie Fork Canyon's gradient is 44 percent. Miscellaneous side tributaries to Huntington creek (Pole Canyon, McElprang Canyon, Vicks Canyon, Grange Hole, Biddlecome Hollow) (5) have average gradients of 40-50 percent.

All of the ephemeral drainages are not within the range of current underground mining plans. Portions of the Gentry Hollow (7) and Wild Cattle Hollow (6) drainage areas will be mined under within current mining sequences. Portions of the Gentry Hollow drainage area have been mined under by the Hiawatha Mine. Wild Cattle Hollow's main channel will not be mined under but longwall panels of the current Plateau Mine sequence will abut the channel as the mine progresses in a southwesterly direction. Both Gentry Hollow and Wild Cattle Hollow are designated perennial creeks on the U.S. Geological Survey quadrangle map.

Vegetation communities of the Gentry Ridge Drainage area include Spruce-Fir, Douglas Fir-White Fir, Aspen, Mountain Brush, Sagebrush, including both Big sage and Black sage associations, Mixed Grass-Forb communities and a variety of riparian communities. The latter range from Cottonwood dominated associations along Huntington Creek to narrow bands of dense fir in the bottoms of steep canyons.

Bear Creek - Train Creek Drainage (9, 10, 11, 12 and 13)

Approximately 8,620 acres of drainage contribute to Trail Canyon (9), Bear Canyon (10), and three miscellaneous tributaries to Huntington Creek (11, 12, 13). The average gradient of Trail and Bear Canyon is approximately 20-25 percent. The average gradient of the miscellaneous tributaries ranges from 40 to 70 percent.

Bear Creek (10) is characterized by steep gradients, narrow canyons, and large sediment loads (28, 092 mg/l Total Suspended Sediments (TSS) measured during a major storm event). Trail Creek (9) is characterized by steep gradients, narrow canyons, and good water quality. Mining occurs above Trail Creek.

About 10 acres of mine surface disturbance occurs in both Bear and Trail canyons. An additional 3 acres are associated with the living quarters and surface facilities of Co-Op Mining Company. The Trail Canyon Mine is currently in the process of being permitted for reclamation. No future disturbance is planned for either mine, other than reclamation of the Trail Canyon site.

Vegetation communities in this drainage system include Spruce-Fir, Douglas Fir-White Fir, Aspen, Mountain Brush, Sagebrush, dominated by Black sage associations, Mixed Grass-Forb communities with Salina wildrye and Bluebunch wheatgrass dominants, Pinyon-Juniper Woodlands and a variety of riparian communities including the Huntington and Trail Creek Narrowleaf Cottonwood and willow associations.

Cedar Creek - Fish Creek Drainage (14 and 15)

Approximately 19,289 acres drain both the Cedar Creek (15) and Fish Creek (14) drainage areas. The average gradient of Fish Creek is 19 percent and the average gradient of Cedar Creek is 13 percent. Both Cedar Creek and Fish Creek are ephemeral drainages with Cedar Creek exhibiting perennial characteristics in certain reaches due to mine water discharge and spring flow. The Hiawatha Mines Complex permit area encompasses portions of the Right and Left of Cedar Creek. The Right Fork is ephemeral and the Left Fork exhibits perennial characteristics in certain reaches.

Vegetation communities in this drainage system include Spruce-Fir, Douglas Fir-White Fir, Aspen, Mountain Brush, Sagebrush, including both Black sage and Big sage associations, Mixed Grass-Forb communities, Pinyon-Juniper Woodlands, riparian communities which include Narrowleaf cottonwood, Sandbar willow (Salix exiqua) and River birch (Betula occidentallis), and Desert Shrub communities at the lowest elevations in the southeastern section of the drainage system.

Surface facilities associated with the Mohrland Mine of U.S. Fuels Company are adjacent to Cedar Creek, and a major mine discharge of 500-1,000 gpm occurs at the low point of the Mohrland Mine. Surface facilities disturb less than 25 acres of this drainage area.

Miller Creek - Sand Wash Drainage (16 and 17)

Miller Creek (16) and Sand Wash (17) encompass 18,053 acres of the CIA drainage area. Miller Creek has an average gradient of 15 percent and the Sand Wash has an average gradient of 17 percent. The upper reaches of Sand Wash and the Right and Left Forks of Miller Creek contain approximately 350 acres of the surface facilities disturbance of the Hiawatha Mines. These include permanent diversion of a portion of Miller Creek to accommodate the coal processing waste pile. Miller Creek has been mined under by the Hiawatha Mines Complex. Plateau Mining company will mine under the upper reaches of the North Fork of the Right Fork (NFRF) Miller Creek. NFRF is perennial and therefore, the North Fork of Miller Creek is also a perennial stream, whereas the Middle Fork and Left Fork of Miller Creek are ephemeral.

Vegetation communities in this drainage system include Spruce-Fir, Douglas Fir-White Fir, Aspen, Mountain Brush, Sagebrush, including both Black sage and Big sage associations, Mixed Grass-Forb communities, and Pinyon - Juniper Woodlands. Riparian communities are generally narrow bands at the edge of intermittent and perennial streams or springs and may be dominated by willows, River birch or an occasional Cottonwood. Riparian zones of the headwaters may be distinguished from the uplands primarily by density and vigor of vegetation. Desert Shrub communities, particularly Shadscale with Slender wheatgrass, occupy the lowest elevations in the southeastern section of the drainage system.

## V. POTENTIAL IMPACTS

### GROUND WATER

Dewatering and subsidence related to mining have the greatest potential for impacting ground-water resources in the CIA. The impact of changes in vegetation or ground-water recharge should be minimal since mining will disturb less than 1,000 acres of the 70,000 acre CIA. Disturbance of phreatophytic vegetation (primarily cottonwoods and some willow) is negligible. The impacts of coal waste disposal on water quality are discussed in the surface water section.

Dewatering. The volume of water being discharged from mines within the CIA (1,200 gpm) approximates the amount of water that is currently being withdrawn from the ground-water system. The current and projected withdrawal values may be totalled and compared to estimates of ground-water discharge and recharge within the CIA and thereby, allow an assessment of cumulative dewatering impacts.

Approximately 37,000 acres within the CIA overlie the coal resource and represent a potential recharge area (Figure 6). Average annual precipitation is approximately 20 inches over the potential recharge area and hence, the total annual precipitation over the outcropping recharge area is 64,000 acre-feet.

Table 2A gives estimates for the total annual discharge of springs from water-bearing rock units that overlie the coal resource. Discharge also occurs directly to perennial streams where channels intersect ground water within the Blackhawk Formation and Star Point Sandstone. Table 1 identifies the ten perennial streams that occur within the CIA. Nine of these streams intersect the lower Blackhawk Formation and Star Point Sandstone. A study conducted along the NFRF Miller Creek (16) indicates streamflow substantially increased (from 8 to 115 gpm) as a result of discharge from the Blackhawk Formation and Star Point Sandstone (Plateau Mining Company PAP, page 783-40). The results from the Miller Creek study suggest the other eight perennial streams that traverse the regional aquifer also sustain ground-water discharge (or base flow recharge). Accordingly, total base flow recharge to perennial streams within the CIA is estimated to be 900 gpm.

Table 2A. Precipitation and Spring Discharge Estimates for Areas above the Coal Resource, Gentry Mountain, CIA.

| Lithologic Unit(s) | Outcrop Area (Acres) | Normal Annual Precipitation on Outcrop (Acre-Feet) | Total Annual Discharge of Springs: Acre Feet | Total Annual Discharge of Springs: Percent of Normal Annual Precipitation on Outcrop |
|---|---|---|---|---|
| Undivided Flagstaff Limestone, North Horn Formation, Price River Formation | 19,500 | 34,125 | 1,900 | .05 |
| Castlegate Sandstone | 3,000 | 5,250 | 129 | .02 |
| Blackhawk Formation, Star Point Sandstone | 14,900 | 26,075 | 322 | .01 |
| TOTAL | 37,400 | 64,450 | 2,351 | .04 |

Table 2B. Estimated Ground-water Discharges to Perennial Streams and Wells and from Mines, Gentry Mountain, CIA.

| | |
|---|---|
| Discharge to Perennial Streams (9 total) | 990 gpm |
| Discharge to Huntington Municipal Wells (3 total) | 100 gpm |
| Discharge from mines (2 total) | 1,200 gpm |
| TOTAL | 2,200 gpm |

Table 2C. Approximate Atmospheric Discharges from Active Mines, Gentry Mountain, CIA.

| Mine(s) | Ventilation Rate (cfm) | Approximate Discharge Rate (gpm) |
|---|---|---|
| Bear Canyon | 150,000 | 10 |
| Star Point Mines | 650,000 | 44 |
| Hiawatha Mines Complex | 350,000 | 24 |
| TOTAL | 1,150,000 | 88 gpm |

Table 2B lists estimated ground-water discharges to perennial streams and wells and from mines. Table 2C approximates the amount of ground water discharged to the atmosphere by mine ventilation systems. Psychrometric formulas were utilized to derive ventilation discharge values and extrapolated to the mine elevations. Average relative humidity data from the Central Weather Station in the Manti-LaSal National Forest were also used in the physchrometric calculations.

Total ground-water discharge within the CIA (summed from Tables 2A, 2B, and 2C) is currently about 3,800 gpm, where 63 percent (2,400 gpm) of the total represents natural discharge to stream and springs and 34 percent (1,500 gpm) results from mining activities. The remaining 3 percent (100 gpm) may be attributed to well discharge.

Lines (1985) investigated the Trail Mountain area and indicated regional aquifer inflow to mines is derived from aquifer storage (80 percent) and aquifer discharge (20 percent). Extrapolating these percentages to the Gentry Mountain CIA (16 miles) allows depletion, due to present mining activities (7,200 acres mined) of regional aquifer storage and discharge to be estimated at 360 and 90 gpm, respectively. Assuming future mining encompasses 3,300 acres and will continue to encounter steady-state inflow from the regional aquifer, then depletion would increase to 471 gpm for storage and 118 gpm for discharge.

The Hiawatha Mines Complex has encountered major ground-water inflow associated with the Bear Canyon Fault. Diversion of flow from this conduit has altered and will continue to alter (deplete up to 1,000 gpm) recharge to the regional aquifer and, possibly, surface discharge in the Gentry Hollow area. Future development in the Hiawatha Mines Complex will retain a barrier pillar adjacent to the Bear Canyon Fault. Plateau Mining Company has proposed to access coal reserves beneath Gentry Ridge by driving a rock tunnel across the Bear Canyon Graben and associated western (unnamed) and eastern (Bear Canyon) boundary faults. Previous encounters with the Bear Canyon Fault (eastern) in the Star Point Mines have resulted in limited inflow. Data are not available to assess whether the western (unnamed) boundary fault acts as a significant groundwater conduit. A pressure grouting program will be initiated if the tunnel encounters inflow(s) that exceed 50 gpm for more than three months. Thus, tunnel development may result in a maximum diversion of flow from the two Bear Canyon boundary faults that will not exceed a total of 100 gpm.

Future mining-induced dewatering is projected to encompass 141 gpm and hence, the cumulative dewatering total would be approximately 1,650 gpm. Following the cessation of mining, the discharge of ground water to Mud Water Canyon (2), Cedar Creek (15), Miller Creek (16), and the atmosphere, will cease and workings will begin to flood.

The impact associated with the reduction in surface flow is considered temporary. Mine flooding will conceivably recharge regional aquifer storage and re-establish the natural ground-water conduit system that was operational prior to mining. The maximum time span required for complete mine flooding may be derived by assuming the final workings (10,500 acres) will remain open (average 5 foot height) and caving will not occur. Accordingly, for workings that experience inflow (Hiawatha Mines Complex, Bear Canyon Mine, Trail Canyon Mine, Star Point Mines) an upper limit of 20 years may

be derived for complete mine flooding. It should be noted that complete flooding will, undoubtedly, never be achieved because the hydraulic head generated as flooding proceeds will increase until the hydraulic properties of the roof, floor and rib are exceeded and flow within the rocks initiates.

Subsidence. Subsidence impacts are largely related to extension and expansion of the existing fracture system and upward propagation of new fractures. Inasmuch as vertical and lateral migration of water appears to be partially controlled by fracture conduits, readjustment or realignment in the conduit system will inevitably produce changes in the configuration of ground-water flow. Potential changes include increased flow rates along fractures that have been "opened", and diverting flow along new fractures or within permeable lithologies. Subsurface flow diversion may cause the depletion of water in certain localized aquifers and potential loss of flow to springs that will be undermined. Increased flow rates along fractures would reduce ground-water residence time and potentially improve water quality.

Mining will occur beneath approximately 80 springs that have a combined flow in excess of 400 gpm. Overburden thickness averages more than 1,000 feet beneath areas where springs are located. Diversion of spring flow is considered to be at overall low risk.

Mining will occur beneath a portion of NFRF Miller Creek where overburden thickness ranges from 500 to 825 feet. The risk for development of tension cracks within the stream channel is considered to be moderately high.

## SURFACE WATER

The cumulative impacts associated with mining within the CIA will be summarized by individually discussing impacts associated with the Star Point Mines, Hiawatha Mines Complex and Bear Canyon Mine and Trail Canyon Mine. Creeks or drainage areas which are referenced by (#) or discussed, are shown on Figure 5, Surface Water Drainage Map.

Star Point Mines. The Plateau Mining Company's surface facilities are primarily found in Sage Brush Canyon tributary to Serviceberry Canyon (1). Sage Brush Canyon and Serviceberry Canyon flow only in response to storm events.

The coal processing waste pile (Figure 4) at the Star Point Mines is at 7,400 foot elevation, annual precipitation is 12 inches, and the vegetation surrounding the waste pile are salt desert shrub and pinyon-juniper-sagebrush communities. The waste pile is not adjacent to any perennial streams or known ground-water resources. The mine presently produces 1.2 million tons of coal annually with a capacity of four million tons. Twenty percent of the material mined is processing waste.

Table 64 of the PAP indicates waste materials are sandy or coarse in nature, with a high organic matter content and have a relatively high cation exchange capacity for coarse textured materials. To date, six waste samples have been analyzed for acid-base potential. One sample had a potential to be acid-forming. The other samples tested had excess base, which should be sufficient to neutralize drainage or seepage from areas which could potentially form acid. The alluvium which underlies the coal waste is calcareous and will also neutralize any acid drainage from the refuse.

Selenium was the only parameter tested for in the waste which had concentrations above suspect levels. This suspect concentration is .1mg/kg and is for toxicities which may occur to animals feeding on vegetation grown on this material. The suspect value which may be detrimental to water quality is not known. Selenium in the coal waste should not be a concern to water quality because drainage from the pile should be minor. The waste, although hauled to the pile in a wet form is not a slurry, and most of the water associated with the waste evaporates in the dry climate of the area.

Data given in Table 64 indicate waste could contribute slightly to increasing TDS levels in surface or ground water. The electrical conductivities of four samples were saline (greater than 4mmhos/$cm^2$).

Although most water associated with the waste will evaporate, some water will inevitably percolate through the pile and underlying alluvial deposits. Eventually, seepage would contact the Mancos Shale and further degradation of water quality would take place. Accordingly, drainage from the waste pile would have little down gradient effect.

All surface water drainage is treated by running disturbed area drainage through sediment ponds. There are no water rights within or adjacent to the mine plan area that could be impacted by operation of surface treatment facilities. Runoff conveyance systems and treatment facilities have been designed to minimize the amount of area that is tributary to the sediment ponds. The quantity of runoff detained by sediment ponds is minimized by diversion of undisturbed waters (PAP, page 784-62).

The Plateau treatment facilities have operated in compliance with all NPDES discharge limitations except for TDS exceedence at the Mud Water Canyon Mine Water and Sediment Pond No. 8. Requests for modifications to the limits currently in effect have been made for these facilities but not yet granted by State Health and EPA. The current TDS limitation for the Mud Water Canyon (2) discharge is 650 mg/l TDS. The request to raise this limit to 1,450 mg/l (an average of the naturally occurring concentration of the Mud Water Canyon stream) has been made. The average annual flow for the period of 4/85 through 3/86 is approximately 129 gpm to Mud Watr Canyon, associated with the Mine Water Discharge (PAP, page 783-46). Of 15 TDS samples taken from the Mud Water Canyon

discharge in 1985, the TDS concentration varied from a low of 598 mg/l taken in late May to a high of 772 mg/l taken in late October. The sample mean was 689 mg/l with a standard deviation of 53 mg/l. TDS effluent concentrations at Pond No. 8 have been recorded as high as 3,913 mg/l on March 10, 1986. An undisturbed area sample taken on the same day near Pond No. 8 discharge was 6,024.0 mg/l. Plateau Mining Company is in the process of monitoring inflows to Pond No. 8 for a one-year period (PAP, page 784-79).

The effects of the discharge associated with Plateau Mining Company's mine water result in approximately 485.62 Tons/Yr of dissolved solids being added to the surface water system tributary to the Price River and to the Colorado River. This is based on average data for the period of 1/22/86 throuogh 12/18/86 taken from the mine water discharge point.

Of the potential discharge locations (Treatment Facility No. 1, Ponds 2 through 8, and Mud Water Canyon discharge) only five facilities have available water quality data. These include discharges from Ponds 4, 5, 6 and 8, and Mud Water Canyon discharge.

Summary of Water Quality Data

| Mean Values | Total Dissolved Solids (mg/l) | Total Suspended Solids (mg/l) | Period |
|---|---|---|---|
| Pond No. 4 | 1531.7 | 38.5 | 10/83- 9/85 |
| Pond No. 5 | 791.1 | 33.0 | 4/83-10/85 |
| Pond No. 6 | 1037.2 | 18.5 | 4/83- 9/85 |
| Pond No. 8 | 1846.3 | 25.0 | 7/85 |

All four of the facilities drain to an ephemeral drainage; Serviceberry Creek (1), and then to Price River, tributary to the Colorado River. Background TDS values for the lower parts of this drainage have been measured at 7,300 mg/l. The discharges from the ponds listed above are less than background TDS measured at Surface Water Station 10-1 in Sage Brush Canyon (1) downstream of the ponds. The average value for TDS at this station in 1985 was 1,932 mg/l. The values ranged from 599 mg/l on 6/13/85 to 3,168 mg/l on 6/27/85. The lowest TDS value is reflective of runoff occurring during a snowmelt period. Figure 14 in the Plateau PAP shows examples of this snowmelt dilution effect. The TSS data given in the above table indicates that Pond No. 4, 5, 6, and 8 have operated in compliance with the 70 mg/l limit identified in their NPDES permit.

Plateau Mining Company has committed to providing an adequate surface water reclamation plan for the Star Point Mine by October 1, 1987. This plan will identify the necessary measures to provide for contemporaneous reclamation of the disturbed areas preventing impacts to the quality and quantity of surface water. In addition, the use of adequate sediment controls mitigates the overall effects

of mining on the surface water system. The effects of discharging mine water into the Mud Water Canyon drainage will be determined by maintaining an effective monitoring system to determine if any adverse impacts to the environment would occur and could be prevented.

As mentioned in the previous section on subsidence, the Star Point Mines will mine a portion of the headwaters of the NFRF Miller Creek (16) and the risk for development of tension cracks within the stream channel is considered to be moderately high. Because of this potential impact, the Plateau Mining Company will be required to develop a sophisticated monitoring system to detect any changes in the hydrologic regime of this stream channel during and after mining. This monitoring system will include identification of gaining and losing reaches through stream surveys and the installation of a continuous monitoring system directly below the area of potential impact.

Plateau Mining Company will use one of the following engineering methods to mitigate any change to the hydrologic regime of the NFRF Miller Creek if an impact is detected through monitoring.

1. Seal the cracks in the stream channel with bentonite or other environmentally safe materials.
2. If cracks are too large, rags or some other material will be hand placed in them at a depth of approximately two feet to provide a stop point for bentonite pellets.
3. Concrete or epoxy mixtures.
4. Surface stabilization accomplished by hand tools.

Implementation of one of these engineering methods will occur following the diversion of surface flow around the impact area by culvert, flexible fabric tubing or plastic liners and an assessment and approval of the appropriate engineering method to mitigate impact to the stream channel.

Hiawatha Mines Complex. In the vicinity of the Hiawatha Mines Complex, the CIA is dissected by two drainage systems, Miller Creek (16) and Cedar Creek (15). The drainage area for Miller Creek above the confluence with Serviceberry Creek (1), is about 29,700 acres. Streamflow in Miller Creek is perennial from the headwaters of NFRF Miller Creek. Cedar Creek is also a perennial stream with a drainage area of approximately 5,300 acres. Cedar Creek receives approximately 800 gpm of discharge from the old Mohrland Mine portal located south of the Hiawatha Mines Complex.

Mine water is used by U.S. Fuels Company for fire prevention and dust suppression in King 4 Mine and by the town of Hiawatha for culinary purposes. These uses are covered by water rights claimed by U.S. Fuels Company for 4,758 gpm (3,746 gpm in surface water rights and 1,012 gpm in ground-water rights). Mine water dischage from the Mohrland Mine portal is regulated under the National Pollutant Discharge Elimination System (NPDES) permit UT-0023094.

Water is piped to the town of Hiawatha (20 gpm) and coal preparation facility (545 gpm) from the mines. The Left Fork of the North Fork of Miller Creek is diverted into an underground water storage reservoir that provides water for the town of Hiawatha. This water, together with the water intercepted in the mine, is stored in the mined-out section of the abandoned Hiawatha No. 2 Mine. Maximum storage volume in this underground reservoir is about 120 million gallons (368 acre-feet). Approximately 60 million gallons (184 acre-feet) are normally stored in this reservoir.

Water in excess of that used in the mining opeation is routed south by gravity to the Mohrland Mine Portal where it is collected and piped to the town of Hiawatha. Excess water is discharged into Cedar Creek (15). At the town of Hiawatha there are four water storage tanks with a combined capacity of 245,000 gallons (0.75 acre-feet). Water is treated and then stored in the 40,000 gallon (0.1 acre-feet) tank 5A near the preparation plant.

Coal processing waste piles (Figure 4) at Hiawatha Mines Complex are at 7,200 feet elevation and receive 12 inches of annual precipitation. The vegetation in the refuse area is a mixed salt desert shrub community. The waste piles have been in existence since the 1940's, encompass approximately 133 acres and include 4 slurry ponds. Table XIII-11 of the PAP indicates coal waste samples are above suspect levels for selenium with concentrations ranging from 1.93 to .91 mg/kg. However, the contribution of selenium to ground or surface waters by the coal waste should have minimal effects on water quality. Any seepage from the slurry ponds would flow to Miller Creek because of its proximity and the gradient to the creek. The amount of seepage compared to the flow of Miller Creek would dilute any diletarious concentration of selenium in seepage waters. The average flow of Miller Creek is 428 gpm.

Other parameters listed in table VIII-11 of the PAP were within acceptable limits, except for boron and iron in one sample from slurry pond 3 and 4, respectively. Boron should not pose a problem since this element is of concern in irrigated areas where toxicities can occur in crops. The water quality of adjacent Miller Creek has a high inherent salinity hazard for irrigation waters and should not be used for irrigation without intensive management. Again, the flow of Miller Creek would dilute any boron concentration in seepage water.

Iron is a product of pyrite weathering, and may indicate acid mine drainage. The pH of the sample with the high value was 7.35. At this pH, the material is still buffered and does not indicate acid-forming material. Iron at this pH is also not readily soluable, and therefore, iron should not pose a problem to receiving waters.

The coal waste was not analyzed for acid-base potential, but pH values indicate that the refuse is basic, with only one sample being neutral (pH 6.8). Existing water quality data from Miller Creek, which is adjacent to the waste pile, indicate there are no degrading effects from seepage of the coal waste piles or slurry ponds. Considering the time involved in oxidation of the waste, the calcareous nature of the soils and the buffering capacity of the water in Miller Creek, along with the alkalinity of the slurry pond water (PAP, page 81A), these factors should be great enough to neutralize any acid produced in the coal processing waste piles.

A comparison (PAP, page 81A) of slurry pond water and Miller Creek water sampled adjacent to the slurry ponds shows that the pond water is slightly higher in sulfates, iron, and TDS. Although the slurry water may degrade further with increased contact time with slurry sediments, any seepage should have little consequence on the water quality of Miller Creek. The natural quality of Miller Creek water is poor since it traverses the Mancos Shale. The contribution of salts into the Price River basin by the Mancos Shale has been well documented (Mundorff, 1972; Ponce, 1975; Laronne and Schumm, 1977).

Surface water at a higher elevation in the CIA has a low TDS concentration, usually less than 400 mg/1, and a low TSS concentration, usually less than 30 mg/1. Concentrations of dissolved sodium and chloride are usually less than 15 mg/1. The predominant dissolved chemical constituents are calcium and bicarbonate. Water quality during snowmelt runoff tends to be higher in calcium carbonate and water quality from ground-water discharge tends to have higher concentrations of magnesium and sulphate. Values of pH were fairly constant, ranging from 7.6 to 8.1.

The Utah State Board of Health has established water quality standards to protect against controllable pollution to beneficial use of water. For the Miller Creek basin (16), the pertinent water quality standards are for nongame fish (Class 3c) and irrigation of crops and stockwatering (Class 4) (Utah State Board of Health, 1978).

TDS levels of surface waters immediately below some of the active mine areas exceed the water quality standard for irrigation use, but the effects are mitigated by dilution from undisturbed surface waters. TDS concentrations in Miller Creek are within the water quality standards at the point that it flows out of the Hiawatha Mines Complex permit area; however, TDS concentrations increase about two-fold when comparing above-mining stations and below-mining stations.

Dissolved constituents continue to increase in Miller Creek as water flows across the Mancos Shale. At the junction of Miller Creek and Utah Highway 10 (about 10 miles east of the permit area), TDS concentrations average more than 3,200 mg/1, and the dominant dissolved chemical constituent is sulfate (Mundorff, 1972). The only parameter to exceed pertinent water quality standards is TDS.

The sodium adsorption ratio (SAR) for the area is low. For the headwater areas of the Miller Creek and Cedar Creek drainages, the SAR is less than 0.5. At the base of the Wasatch Plateau, the SAR values are usually between 0.8 and 2.0. On the Mancos Shale, the SAR values range between 1.0 and 4.0. Surface water derived from snowmelt flow usually has a lower SAR value, however, both sodium and SAR increase during the low flow period as streams traverse the Mancos Shale.

Both SAR and TDS combine to degrade irrigation water. All of the water in the study area exhibits a low sodium hazard for snowmelt flows, but Miller Creek at Utah Highway 10 shows a medium sodium hazard during low flow periods. This increase in TDS and SAR as streams cross the Mancos Shale is a natural nonpoint source of pollution.

TDS concentration in surface water below the elevation of coal mining activities are higher than in areas above coal mining activities. TDS increases are associated with increases in sulfate, chloride, magnesium and sodium concentrations. Current TDS levels do not exceed any existing recommended water quality criteria for current water uses. Future mining will cause an increase in TDS concentration, but this level will also be below state and federal water quality criteria. TDS loads (i.e., concentration multiplied by flow rate) are approximately 900 tons per year from nonpoint sources associated with existing mining operations on Miller Creek. Because no new surface disturbances are proposed, the TDS load should not increase in the future. There is no current active surface mining operation on Cedar Creek, but an increase of 180 tons per year from nonpoint sources is projected in relation to future mining operations on Cedar Creek.

Water chemistry of surface waters in the CIA naturally change from a calcium carbonate type to a magnesium type as streams traverse the Blackhawk Formation and the Mancos Shale. The Mancos Shale has a significant impact on surface water quality. TDS concentrations of streams that interact the Mancos Shale area are as much as 100 times higher than TDS levels of streams that interact overlying lithologies within the CIA. Most of these increases are natural and are probably caused by rain and leaching within stream channels or ground water flowing through the formation leaching available salts from the marine shales, and discharging into the surface waters. Impacts resulting from the surface facilities associated with mining in the CIA are overshadowed by the degradation of water quality from streams traversing the Mancos Shales.

Sulfate levels are presently below established water quality standards, and if projected estimates by the mine of sulfate increases are accurate, surface disturbances associated with the King 7 and 8 Mines will cause about a two-fold increase in sulfate concentrations. Projected sulfate concentrations will remain below water quality standards.

TSS concentrations are also higher downstream from surface facilities associated with mining. Most of the increased suspended sediment naturally settles out before Miller Creek or Cedar Creek leaves the permit area because of relatively flat stream gradients. In the Office of Surface Mining Technical Analysis a model was used to route the known water quantity and quality of Miller Creek (16) (at the town of Hiawatha) and of Serviceberry Creek (1) (near the town of Wattis) to the confluence of the two streams. According to the results of the model, the TDS concentration below the confluence of Serviceberry Creek and Miller Creek will exceed the water quality standard for irrigation use during the middle and late summer months. Most of the TDS concentration is caused by the Serviceberry Creek traversing the Mancos Shale, however.

Both concentrations of TSS and TDS are higher downstream than upstream of the mine site and can be attributed to both natural and mine-related causes. The Division considers the Mancos Shale as the major source for surface water contamination.

Bear Canyon Mine and Trail Canyon Mine. The Trail Canyon and Bear Canyon mines' surface facilities are primarily found in the Bear Creek-Trail Creek Drainage Areas (9, 10, 12). Both Trail Canyon and Bear Canyon are perennial streams which flow in response to storm events and maintain a base flow associated with perennial springs. The main concern in terms of water quality deterioration downstream is T.S.S. The TSS concentrations in Bear Creek (10) in 1984 varied from a high of 28,092 (mg/l) in May of 1984 to a low of 122 (mg/l) in September of 1984 with five monthly readings within the 1,000 - 2,000 mg/l range. The suspended sediment concentrations in Trail Creek (9) in 1984 varied from 1,400 mg/l in May of 1984 to a low of 1.0 mg/l. in February of 1984, with seven monthly readings below 100 mg/l. These high TSS values are associated primarily with natural climatic and erosional processes, although a proportion may be attributed to removal of vegetation from roads and mine pads and normal mine operations, e.g., loading coal. Sediment controls do exist for all surface disturbances in both canyons. Therefore, the impact associated with 20 acres of mining disturbance in Trail and Bear canyons is minimized by surface controls (i.e., sediment ponds, diversion ditches, filter fences, dugout ponds, etc.).

## VI. SUMMARY

Mine operations within the CIA currently intercept regional aquifer (450 gpm) and fault conduit flow (1,050 gpm) at an approximate rate of 1,500 gpm. Of this total, approximately 630 gpm are consumptively lost to mine ventilation (80 gpm) and evaporation at coal preparation facilities (545 gpm). The remaining 870 gpm are discharged, without interbasin transfer of water, to streams.

Mine water discharges, with the exception of Star Point Mines, meet required effluent limitation.

Future mining operations are designed to avoid interception of fault conduit flow and accordingly, inflow from the regional aquifer is estimated to increase from 450 gpm to 591 gpm. Approximately 80 percent of the inflow will be derived from storage and 20 percent from discharge. Consumptive use is not anticipated to increase. Mine water discharge (1,350 gpm) and ventilation losses (300 gpm) will be discontinued upon cessation of mining. Concommitantly, flooding of abandoned workings will initiate. An upper limit of 20 years has been estimated for complete flooding of workings and re-establishment of the premining ground-water system.

Division of spring flow is considered to be at overall low risk. However, reduction in flow along the upper reach of the NFRF Miller Creek is considered to be at moderately high risk. A generalized mitigation plan has been proposed for minimizing mining-induced impacts to NFRF Miller Creek. Division approval of the method implemented to restore the stream channel will be contingent upon an assessment of the mining induced impacts.

Sediment control measures have been and will be designed and implemented to reduce and stabilize contamination of surface waters.

Following cessation of mining and coal processing, waste piles will be adequately covered with topsoil and all disturbed areas will be stabilized and revegetated to prevent surface water contamination.

Future development in the Wild Horse Ridge and Mohrland areas and/or the recommencement of mining at the Trail Canyon Mine may result in further dewatering of the ground-water system. Permitting of new development will require implementation of sediment control measures that minimize impacts to surface water.

The designs proposed for all anticipated mining operations within the CIA are herein determined to be consistent with preventing damage to the hydrologic balance outside the proposed mine plan areas.

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community which produces a specific amount of vegetation.

The kind of vegetation is generally the combination of plants that grow on the site before the range or woodland was affected by grazing, cultivation or otherwise altered and is called the "potential vegetation". Normally the potential vegetation is the most productive combination of range or woodland plants that a site can support. Potential plant communities for the Bear Creek Canyon area obtained from clipping data, is not yet available from the Bureau of Land Management. As climate is a major factor in determining the potential plant community, different climatic regime have been defined to facilitate the grouping of soils into ecological sites and the naming of sites. In this survey area there are two climatic regimes used. These are defined generally as follows:

Upland Climatic Regime. The average annual precipitation is 16 to 20 inches. Approx 35 to 40 pct comes during the summer months. The growing period usually begins about April 1 and lasts until the first of November until moisture is depleted or the plants mature. The freeze-free season is 100 to 130 days, and the mean annual temperature is 47 to 50 °F.

Mountain Climatic Regime. The average annual precipitation is 12 to 16 inches. Approx 35 pct comes during the summer months. The growing season begins in the latter part of April

and concave-convex.

Vegetation is dominantly pinyon, Utah juniper, salina wildrye, squirrel tail, big sagebrush, Douglas-fir, and Rocky Mountain juniper.

Included in mapping are small areas of similar soil except with 20 pct gravel and cobbles in the surface layer.

In a typical profile the surface layer is brown, bouldery fine sandy loam and cobbly loam about 10 in. (25 cm) thick. The subsoil is light brown very stony loam about 28 in. (71 cm) thick. The substratum is light reddish brown cobbly fine sandy loam to a depth of 60 in. (1.5 m) or more.

Permeability is moderate. Available water capacity is 6 in. (15 cm) to a depth of 60 in. (1.5 m). Organic matter content in the surface layer is 4 pct. Effective rooting depth is about 60 in. (1.5 m). Surface runoff is medium and erosion hazard is moderate under potential native vegetation and high if vegetation is removed and the soil is left bare. This soil is used for range, wildlife habitat and mining operations.

Taxonomic classification is loamy-skeletal, mixed Typic Haploboralls.

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# CHAPTER 10

# FISH AND WILDLIFE RESOURCES

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# 10 FISH AND WILDLIFE RESOURCES

## 10.1 SCOPE

The purpose of this report is to inventory the wildlife resources in the Bear Canyon Mine permit Area and to evaluate the impact of the operation of the mine on those resources. The study includes birds, amphibians, reptiles, and mammals. Analysis entailed a review of the applicable literature, consultation with the relevant agencies, field analysis, and impact evaluation. Input and recommendations from the Utah Division of Wildlife Resources (UDWR) can be found in Appendix 10-A and 10-B.

In sum, this study uncovers min impact on wildlife from continued operation of the mine. Since the Bear Canyon Mine has been worked intermittently since 1896, the ecosystem has already stabilized to some degree with mining. There are no new surface disturbances associated with expansion in the Fee and Federal Lease Areas.

## 10.2 METHODOLOGY

### 10.2.1 Aquatic Resources

All water within the permit area is intermittent (Class 6). Runoff from the permit area flows into the Huntington Creek drainage. This is the only drainage which could potentially be affected by Co-Op's mining activities and the potential impact is expected to be insignificant. Bear Creek may receive some groundwater from the permit area while Huntington Creek eventually receives runoff from the disturbed areas.

The aquatic resource description of Bear Creek consists of a review of available information from previous surveys. Surveys have been conducted of both Bear and Huntington Creek although the potential for impact is considered to be minimal. Water quality determinations have been conducted by certified laboratories to establish baseline data and routine monitoring will continue as outlined in Chapter 7 on all surface and ground water within the permit area.

### 10.2.2 Terrestrial Resources

This research was designed to qualitatively evaluate the terrestrial vertebrate components in habitats which may be affected by the proposed expansion of the Bear Canyon mine. The following methodologies were used:

a. Conduct a literature review and detailed analysis of UDWR plan for the Bear Canyon Mine project and geographic area of concern.

A thorough literature review was conducted. The libraries at each of the major universities in Utah were surveyed. Special emphasis was given to location of published literature pertinent to the geographic area and habitat types in question. In addition, surrounding mine plans were reviewed for pertinent data.

Visits were also made to state and federal agencies that have jurisdiction or control over the study areas. All pertinent reports and management plans were reviewed, and appropriate personnel were questioned.

b. Contact the regulatory authorities to determine what wildlife information might be required.

The regulatory authorities were contacted by mail, phone, or personal visit to determine what wildlife information would be required.

c. Identify and cursorily inventory the terrestrial vertebrates by species for each of the habitats in the area of potential impact. Determine migratory utilization of the habitats.

Literature analysis and field observations were conducted to determine the probable and actual inhabitants of the area of potential impact and to identify habitats significant to their presence and/or persistence.

d. Categorize the status of each species and highlight those that deserve special attention because they are endangered or threatened or of economic or recreational value.

The methods and procedures essential to the accomplishment of this objective involved basically two things. First, all of the species observed or known to inhabit the potential areas of impact were identified to species through objectives a and d and listed phylogenetically in tabular form. Second, all species were categorized by: 1. habitat, 2. relative abundance, 3. resident species, 4. seasonal use, and/or 5. high interest species. The term "high interest species" designates those animals that require

special attention by scientists and/or public management agencies because they are either endangered, threatened, protected game, or of economic or recreational value. The reasons for this high interest designation include: 1. ranges are small, thus restricting population to perhaps a few, 2. although populations may be numerically large, ranges may be small within the entire represented area, 3. irrespective of population numbers or range, little is known of the current status and in some cases information suggests that populations are declining, 4. species are sensitive to impact and may be in danger of abnormal declines, 5. species are relict or may have aesthetic or scientific value, 6. economic or recreational importance, and 7. combinations of the above.

e. Evaluate and discuss in the report from the significant interactions on the terrestrial vertebrates present. High interest species are to be highlighted.

This objective is satisfied by discussions of the significant habitats, interactions, and potential results of the impacts on the terrestrial vertebrates. Appendix A outlines the procedures adopted by Co-Op as recommended by UDWR.

## 10.3 EXISTING WILDLIFE RESOURCES

### 10.3.1 WIldlife Habitat in the Mine Plan Area

The area of potential impact is covered by several important habitats that are used by species considered of "high interest" to various management agencies because of economic or recreation value. There are five major vegetation habitats from a faunal standpoint: pinyon-juniper, sagebrush, conifer, grass, and riparian.

Mine Site Location. This area is approximately 10 acres and is one area where surface construction will occur. It is covered primarily with pinyon and juniper trees, sagebrush, and rabbitbrush, with spruce trees in some of the side canyons. Basically it is a high, dry, desert environment.

Haul Road and Utility Corridors. Haul road and Utility corridors are both described as having the same general habitat as the Mine site with the addition of a narrow band of riparian habitat along Bear Creek.

## 10.3.2 Wildlife

### 10.3.2.1 Aquatic Wildlife Habitat and Value Determination

There are no perennial streams that run through the Bear Canyon Mine permit area, all water is ephemeral (Class 6). The ephemeral stream within the permit area is Bear Creek.

Bear Creek is a low-quality aquatic environment of little value to the aquatic resources of the area. A biological community most likely occurs in Bear Creek on an intermittent basis. Being present during a portion of those years when runoff is exceptionally high followed by wetter than usual summer and fall precipitation.

Even if the mine was removed, natural conditions would be stressful to aquatic life. Huntington Creek does receive runoff and/or groundwater from the permit area at some times during the yr, but because of Bear Canyon stream's quality, impact from mining will be minimal. All drainage from disturbed areas is passed through sedimentation ponds before discharge, reducing impact potential further.

### 10.3.2.2 Terrestrial Wildlife Habitat and Value Determination

Literature and field data were summarized for all terrestrial

vertebrates of concern, the species status, and potential perturbation. Appendix 10-C list all of the vertebrate species of southeastern Utah according to their various ecological classification. All species whose ranges appear to overlap any or all of the potential area of impact are listed.

The permit area could potentially be inhabited by 239 species of vertebrate wildlife as detailed in Appendix 10-A and 10-C. Some of these are considered high interest species for the habitats and local area of concern. High interest wildlife are defined as all game species, any economically important species, and any species of special aesthetic, scientific or educational significance. This included all federally listed threatened and endangered species of wildlife. UDWR has determined that the permit area is of critical value for the elk and mule deer.

10.3.2.3 Mammals

The area of potential impact is likely to be inhabited by 84 species of mammals. The names of these animals and their habitat affinities are listed in Appendix 10-A and 10-C. They represent 6 orders and 15 families of mammals. Twenty-five species are considered high-interest species, 14 of which are protected by state or federal code. The conifer and high elev mountain grass areas near the Northern extreme of the permit area are used as summer range and fawning areas for mule deer. They are also

utilized by cougar, bobcat, and possibly bear.

The low elev mountain grass and pinyon-juniper habitats in the foothills just above the Mine are utilized by elk, during winter and spring. The same area is used during spring, summer, fall and, as indicated by fallen antlers, during winter by a few of the larger deer. However, the major winter area for mule deer is in the pinyon-juniper and sagebrush habitats, along the lower hills and the entire foothill area. In all habitats, water is a critical resource and is possibly the limiting factor. The high interest species will be discussed individually in Section 10.4 of this report. It is doubtful that proposed expansions will seriously impact the other species sense no new surface disturbances are planned.

#### 10.3.2.4 Birds

Two species of involved birds are on the endangered species list: bald eagle (winter resident), and the peregrine falcon (thought to be a year-round resident in southeastern Utah). However, there are no known nesting sites for the peregrine falcon in this area. Because of the suspected transient nature or these birds, no problems are foreseen with the projected development. Further investigations were made during 1987 to confirm these assumptions. Potential areas of impact were pointed out and marked on a map. The areas designated for potential impact include the mine site

location and the haul road and utility corridor.

The more important bird species of the area are listed in Appendix 10-C.

### 10.3.2.5 Amphibians and Reptiles

The material used in this portion of the report was derived from literature and a discussion with Dr. W. W. Tanner (retired) an internationally known herpetologist specializing in the reptiles and amphibians of Utah.

Increasing elev rapidly reduces the number and kind of reptiles and amphibians. In Utah, the more northern latitude reduces numbers of reptiles and amphibians in much the same way as does the increase in elev.

The geographical and associated climatic factors have eliminated most desert species, leaving species that are adapted either to mountain habitats or mountain type habitats developed in the more northern areas. Thus, the reptiles and amphibians of Utah, and particularly those inhabiting the areas under the consideration, have arrived in Utah by means of dispersal lanes coming from the northeast and the southeast. With few exceptions, the species listed have wide distribution and are versatile in their adaptive abilities.

Literature pertaining to the amphibians and reptiles is extensive, but much of it refers to species occurring in the desert areas and has only limited reference to forms inhabiting high elev in Utah. Most of the publication dealing with species lists for the state are old.[1]

The most up-to-date listing for the area under consideration may well be a checklist of Utah amphibians and reptiles (Tanner, 1975), and Utah Division Publication No. 78-16 (Dalton, 1978) (Appendix 10-C) which references a contiguous and similar geographic area.[2]

Amphibians. Based on the literature review, it was determined that probably six species of amphibians inhabit the proposed area of concern which provides substantial value habitat for the three species listed. All amphibians are legally protected in Utah, but since the species listed are all widespread throughout similar habitats in Utah, none are treated as high interest species, and therefore, are not individually discussed.

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[1]V. Tanner, Amphibians, 1931; Woodbury, Reptiles, 1931, and Pack, Snakes, 1930

[2]Other recent literature pertinent to this report are: Schmidt (1953); Stebbins (1954 and 1966); W. Tanner (1953, 1957 a and b, 1966 with Banta, 1969 with Morris and 1972 with Fisher and Willis); and Woodbury (1952).

Reptiles. Based on a review of the literature, it was determined that probably 18 species of reptiles occupy the expansion area; this area is considered to be a substantial value habitat for all species. All reptiles have some protection under the Utah code, but since the species listed are all widespread throughout similar habitats in Utah, none are treated as high interest species and, therefore, are not individually discussed.

### 10.3.3 Species of Special Significance

#### 10.3.3.1 Threatened and Endangered Species

There are no endangered or threatened species of mammals in the mine plan area, nor are there any in proximity close enough to be considered (Figure 10-1). Co-Op is committed to notify the Division in the event any T & E species were observed on the permit area, as well as any critical habitat.

Official U.S. Fish and Wildlife Service Section 7 opinions relating to the aquatic resources of Huntington and Eccles Canyon drainages have indicated that no threatened or endangered species of fish or other aquatic organisms have been found in waters upstream of the lowest 2 or 3 mi of the Price or San Rafael rivers. The organisms of Trail Creek, as presently known, are all common and widely distributed throughout streams of Utah. The aquatic organisms of Bear Creek have representatives of several taxa

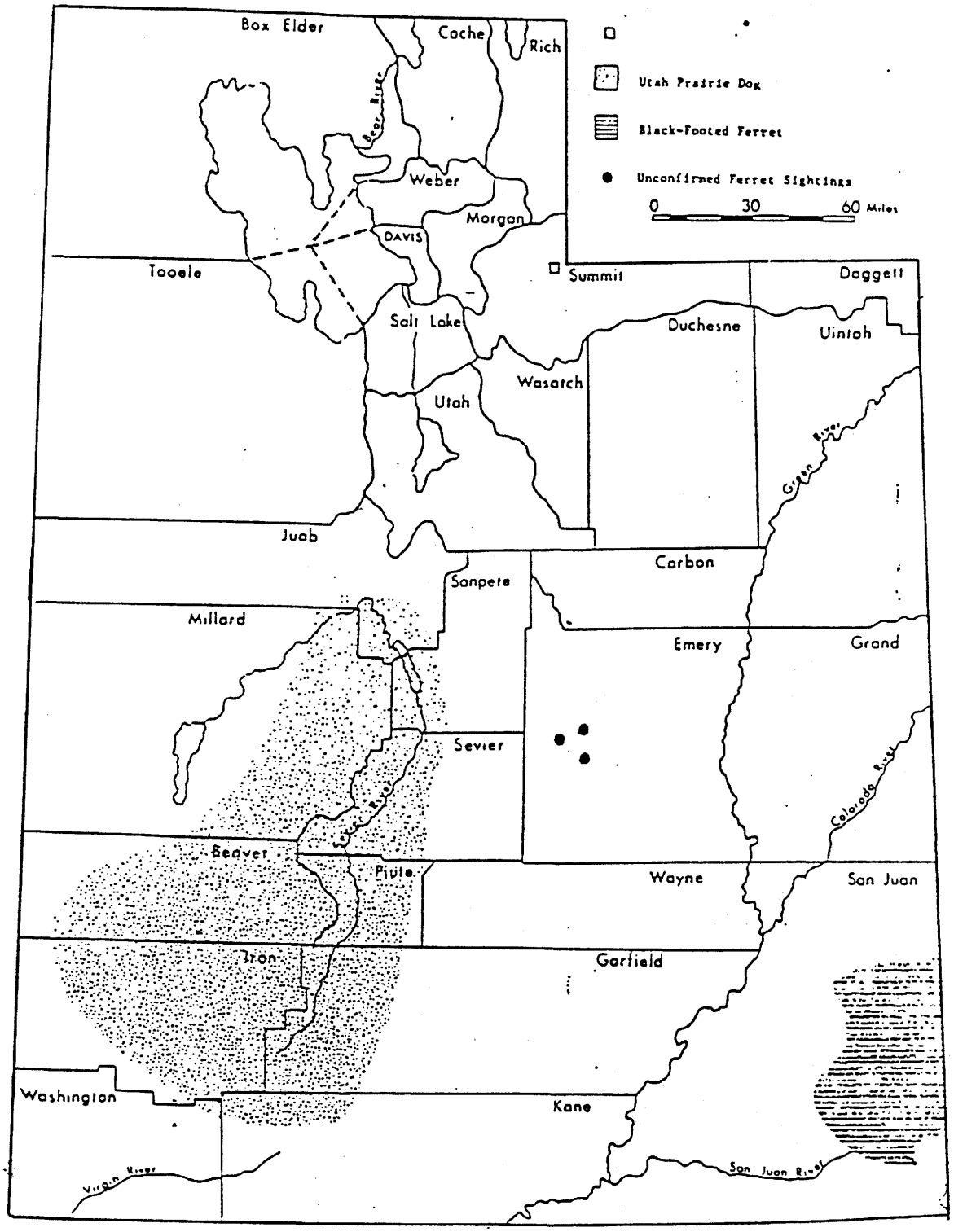


Figure 10-1 Endangered Mammalian Species in Relation to Permit Area

limited to low quality environs, but non, as far as is presently known, are rare in the inter-mountain region.

10.3.3.2 Raptors

Two species of endangered raptors may be found in the mine plan area. These are the bald eagle and peregrine falcon. There are no known roosting trees for golden eagles or nesting sites for other eagles or falcons within the permit area according to a survey conducted by the Raptor Biologist from the U.S. Fish and Wildlife Service.

Additional studies have been made during the raptor breeding seasons confirming the absence of raptor nesting sites in the Permit area (Appendix 10-D).

## 10.4 EXPECTED IMPACTS OF MINING OPERATIONS ON FISH AND WILDLIFE

### 10.4.1 Aquatic Wildlife

The mine is an existing mine and as such should have no additional impact on Bear Creek, which is furthermore of little value to the aquatic sources of the area. Natural conditions would be stressful to the aquatic life even if existing mining activities were removed.

Trail Creek is a marginal quality stream and as such should be protected. The only foreseeable impact from the Co-Op Mine project would be from subsidence of source aquifers causing a reduction in the total flow. There are no new planned surface disturbances adjacent to Trail Creek. Minimal disturbance will occur at the Bear Canyon Mine are, which is within the drainage of Huntington Creek. Since the creek is a considerable distance from the mine and since the areas of disturbance will be small, the impact will be insignificant. Subsidence, if it should occur, would have only a minor impact, and then not on Huntington Creek itself.

### 10.4.2 Terrestrial WIldlife

#### 10.4.2.1 Mammals

Only those mammals of major concern to management agencies are individually discussed briefly here, more detail can be found in Appendix 10-A and 10-C.

Elk. A portion of the project site represents winter range for the Manti elk herd--Unit 12. Elk that are thought by the Utah Division of Wildlife Resources (UDWR) to be stable and productive, use portions of the mine plan area at various times of the year for such necessary activities as wintering and feeding. This use, however, is marginal and not crucial. The minimal disturbance

caused by planned surface facilities will have no significant impact on the herd.

Mule Dear. Mule deer on the Bear Canyon Mine and the proposed expansion areas are considered part of herd unit 33 by UDWR. Historically, through 1977, this herd experienced the same general fluctuations as the other herd units of the state. Populations decreased in the early 1970's primarily due to severe climatic conditions, but took a general upswing through the summer of 1977. Then there were three consecutive yr of decline wherein the deer were forced to the extreme lower limits of their winter range by abnormally deep and long-lasting snow.

The animals utilize the entire area of potential impact but seasonally concentrate in, and more heavily utilize, specific habitat types. The high elev mountain brush-grass and conifer-aspen habitats near the Northern edge of the permit area are used for summer range and fawning. The low altitude mountain brush, mixed desert shrub, and pinyon juniper habitats are used as winter range during normal winters; during excessive snow the deer move off the impact area and go east well below the Permit Area. The browse in the wintering habitats in the impact area is in relatively good condition and can facilitate overwintering of deer in a normal yr.

Cougar. The entire Bear Canyon Mine and Haul Road area provide

yearlong habitat for cougar. Cougars could range throughout the area, but their movements are dictated by migration patterns, human disturbance, and availability of their primary food source, mule deer. Since cougars are not abundant and are known to be secretive, avoidance will be practiced when the females are accompanied by young learning to hunt and survive.

This period in the life cycle of the cougar, however, is difficult to determine since they are known to reproduce year-round. If cougar populations in the area of potential impact were high, this would be of major concern, but, since numbers are low and ranges extensive compared to the area of potential impact, the cougars will continue to avoid human activity areas and there will be little impact on the overall cougar population.

Bobcat. The mine and proposed expansion and adjacent areas provide habitats for bobcats. Although little is known about the Utah bobcat, one sensitive period would be late February when parturition occurs. May and June would also be a sensitive period because young bobcats, when learning to hunt, are not as secretive as the cougar, making them less likely to avoid high human disturbance areas during these months. However, since this is an ongoing mining operation, impact on bobcats should be unchanged.

Black Bear. Only the breakout and ventilation shaft portion for the mine and proposed expansion areas provide potential habitat for

black bear, which are neither abundant nor active year-round. Sensitive periods in the life cycle of the black bear are February and March when the cubs are born and during the early summer when they accompany their mother on initial foraging expeditions. Since the parturition occurs within the winter den, disturbance in the black bear habitat will be limited and there will be little impact during this sensitive period. The same is true of the initial foraging forays.

Mountain and Desert Cottontails. The entire mine and proposed expansion areas provide substantial value, yearlong habitats for cottontail rabbits. The young are born between April and July, which is considered a sensitive period, but the proposed actions will in all probability not seriously alter reproductive potential of the populations. Hunting pressure most likely will not increase nor will illegal kill, however, this would not matter since the hunted rabbit populations are more healthy and stable than non-hunted populations. Subsidence could potentially create a problem, but since it is limited to relatively small areas at a time, little overall impact will occur. It should be noted that disturbed vegetation leading to succession (if it occurs) would enhance reproductive potential of cottontail rabbits.

Snowshoe Hare. The snowshoe hare is present in and dependent upon the mixed conifer-aspen vegetation habitat year-round. This habitat type is limited in the permit area and the proposed actions

will do little to harm the habitat type and the dependent hare populations. Although the sensitive period for reproduction is from April 1 to August 15, there will be no serious long term impact on the snowshoe hare and there will be little change in population. Subsidence will not harm the aboveground dweller as it potentially could the subterranean inhabitants. Hunting will be the most influential activity of man upon snowshoe hares but there should not be much difference from prior yr and no long term impact.

Furbearers. Limited portions of the proposed mine lease and adjacent areas provide substantial value habitats for a few species categorized by management agencies as furbearers: ermine, long-tailed weasel, badger, and the striped skunk. Obviously, the breeding and rearing activities of these nonmigratory species occurs within the proposed impact area and their dens and burrow systems are important to maintenance of their populations; however, it is highly unlikely that there will be any serious long term impact created by the proposed actions of this specific project. After subsidence occurs, new burrows will be built or old ones reconstructed. These species are widespread and adaptable to the activities of man.

Small Mammals. Although small mammals do not qualify individually as high interest species, they represent a significant part of the ecosystem. The majority are herbivores and are the primary source

of food for higher tropic levels, particularly raptorial birds, canids, and felids. This tropic importance warrants consideration. Since this mining project only involves the expansion of an ongoing operation, there will be little habitat loss due to construction and operation of additional surface facilities. Therefore, subsidence and its impact on underground burrow systems is the primary concern. The potential exists for caving in burrows and/or changing burrow continuity due to fracturing of the strata. Although this would temporarily alter the population density and age structure, recovery would be imminent and rapid since the breeding population contiguous and within the localized area of impact would not be lost. Additionally, the population densities are more than adequate to supply the limited number of predators present, particularly raptorial birds, that utilize the resource.

#### 10.4.2.2 Birds

The greatest impact on birds will occur at the Mine Site area. However, because of the vast area of this same habitat type in Emery County and the status of the birds involved, no serious impacts are anticipated. Since the high elev sites included in the Permit area will be essentially undisturbed, no lasting impacts are expected.

#### 10.4.2.2 Amphibians

Because of the wide distribution pattern of the six amphibian species that might inhabit the mine permit area, it is doubtful that proposed action would seriously impact the whole population.

#### 10.4.2.3 Reptiles

The reptiles that inhabit the area under discussion are also found in many similar habitats; therefore the proposed action would not seriously impact the reptilian populations. If a denning site for any reptile species were discovered during the construction of the mine or portals, it should be preserved until proper procedures to move the den site to a new location were implemented by the proper UDWR personnel. This is relatively easy to do and should cause little concern.

## 10.5 MITIGATION AND MANAGEMENT PLANS

Mitigation of mining impacts on and management of wildlife are usually considered and the plans for implementation prior to any perturbation. These actions often follow one of three general forms:

a. Design of facilities and access or transportation modes to minimize impacts

b. Operation of the mine and associated facilities to minimize impact

c. Enhancement of wildlife habitat both in the vicinity of and away form the mine in order to mitigate losses that may occur.

Since no impact to the perennial waters of the permit area is expected in the foreseeable future due to the stream buffer zones and runoff control measures, no special mitigation plan concerning Bear or Trail Creek is presented here. Both creeks were monitored for water quality condition with monthly sampling in order to acquire a baseline description of the resource. This baseline provides a solid ground for future impact analysis and mitigation planning if the need arises.

In new mine operations it is easy to suggest, provide and implement mitigative and management measures, but in the case of the Bear Canyon Mine, which is already in operation preconstruction design and associated mitigation and management does not apply. The terrestrial wildlife inhabiting and utilizing the area of concern are accustomed to the present facilities and have adjusted their behavior, including migration patterns, so that change would be of more impact than would retaining the status quo.

Construction and operation of the scalehouse, stockpile area and road could potentially disturb wildlife. To minimize habitat

disturbance and loss, surface activity will be kept to a min.

The mine activities will take into consideration potential conflict with deer and elk reproductive activity and any small acreage involved will be restored as quickly as possible by redistribution of topsoil within the disturbed area, with immediate reseeding and replanting of native seeds and vegetation. Because of the small size of the area, natural reseeding will also occur from the surrounding area. The seral stage habitat created will be beneficial to deer, who readily utilize seral stages of mixed conifer-aspen forest.

The ballpark topsoil pile extension area is within mule deer wintering range. The area will be reseeded and revegetated with native species that are proven for their value as winter browse for mule deer and as a bird habitat. The most successful methods known to management agencies will be used. Care will be taken to control detrimental wildlife use while the area is stabilizing.

Construction of the Mine Site and Haul Road are sources of disturbance. Habitat would be lost temporarily during construction and permanently where the mine is located. Since this is in a wintering area the same community reestablishing and augmenting techniques would be used. The terrain is such that established trails do not exist.

Little riparian habitats exist within the area, there will be little impact by the proposed action. All water is intermittent but since water is such a limiting resource to game animals, care will be taken to prevent disturbance, erosion, or coal deposition in the ephemeral channels. Roads will be routed or acceptable crossings built to avoid disturbance or erosion. Coal will be wetted to prevent blowing if necessary.

As determined in consultation with UDWR, all hazards associated with the expansion and mine operation will be covered, buffered or fenced to prevent damage to wildlife of concern.

Since there are crucial critical periods in the life history of high interest species such as mule deer and elk, the applicant will communicate such to their employees who will be admonished to avoid all unnecessary disturbance and harassment of wildlife species. In addition, all employees will be required to view the film "Coal Mining and Wildlife": as a tool to educate the mine personnel on their role in safeguarding Utah's wildlife.

In any situation not previously mentioned where wildlife habitats are disturbed by this proposed action, reclamation will be implemented by the best available methods and agreeable to UDWR and the appropriate management agencies. The old road up Bear Creek is an example of mitigation which was completed by October, 1984.

### 10.5.1 Wildlife Mitigation

Co-Op, in order to mitigate the loss of approximately 10 acres of Mule deer winter range in association with the construction of the Bear Canyon Mine, has agreed to the following course of action with UDWR:

a. The reclamation of a major portion of the abandoned Bear Canyon county road approximately 2 acres (completed Fall 1984).

b. Contemporaneous reclamation of portions of Bear Canyon permit area - topsoil stockpiles, down slopes, power line corridor, etc. Approximately 3.2 acres (started Fall 1983, completion Fall 1985).

c. Enhancement of Bear Creek off permit. This work was accomplished in 1986 and constituted the enhancement of approximately 7 acres of stream channel. The work involved the installation of velocity dissipaters, planting of willows, and compatible wildlife browse species in the stream channel.

In addition, Co-Op has agreed that in the event that escarpment failure due to subsidence impacts any raptor nests within the permit area, that Co-Op will notify UDWR and the U.S. Fish and Wildlife Service and take whatever action is recommended

in order to mitigate such loss. At this time no raptor nest are at risk due to their absence from all areas of potential impact. Raptor nests will be safeguarded from subsidence by maintaining a min of a 100' barrier to the outcrop.

UDWR authorities will be consulted, in the event a need for pesticides becomes necessary to control rodents or insects during reclamation. No control measures will be used without prior approval by all parties concerned.

### 10.5.2 Stream Buffer Zone

Current surface facilities are in the upper reaches of the Bear Creek drainage, which is a tributary of Huntington Creek drainage. Appropriate sedimentation ponds have been constructed. This coupled with coal pile drainage ditches, clear water diversion, water bars, and wind erosion control measures within the permit area disturbed areas, will assure protection from mining impact of aquatic resources far downstream from the mine. Thus, no aquatic biological community determinations have been made relative to surface activities. Stream buffer zones are established along Bear Creek as determined by DOGM to insure protection of the stream channel. Stream buffer zone signs are in place at approximately 200 foot intervals along Bear Creek.

## 10.6 FISH AND WILDLIFE MONITORING

Bear Creek does not warrant a biological or habitat monitoring effort since it is naturally of poor quality. Water quality will be monitored as outlined in Chapter 7.

Trail Creek is a marginal quality stream and a baseline description of it's quality has been made and recorded. Data collected will be correlated with water quality and hydrology measurements discussed in Chapter 7. If subsidence should become evident in the drainage area that contributes to Bear Creek, or Trail Creek monitoring of aquatic macroinvertebrates and habitat changes will be instated using approved methodology to collect data as the base for impact evaluation.

Co-Op has monitored all existing power transmission lines in order to determine use by raptors. No use was observed, Co-Op will take all necessary measures to ensure the poles and/or structures are safe. All new poles and power transmission facilities will be constructed to be raptor protected. In April 1988 DOGM consented to allow suspension of raptor surveys unless new disturbances warrant a clearance survey (Appendix 10-D).

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# Appendix 10-A

# FISH AND WILDLIFE RESOURCE INFORMATION

UMC 783.20; FISH AND WILDLIFE RESOURCE INFORMATION
CO-OP MINE COMPANY, TRAIL AND BEAR CANYON MINING PROJECTS

General Wildlife Resource Information-All Species of Vertebrate wildlife

The mine plan area encompasses a portion of the Wasatch Plateau in Emery County, Utah. This area drains into the Huntington Creek and onto the San Rafael River, which flows into the Green River and ultimately into the Colorado River at a point upstream from Lake Powell. Generally speaking, the Wasatch Plateau is encompassed by cold desert (Canadian, Hudsonian and Alpine life zones), submontane (Transition life zone) and mountain (Canadian, Hudsonian and Alpine life zones ecological associations. These life zones could be inhabited on occasion and during different seasons of the yr by about 364 species of vertebrate wildlife--14 fish species, 6 amphibian species, 18 reptile species, 242 bird species and 84 mammal species. It is interesting to note that 83 percent of these species are protected.

The mine plan area itself is represented by the Transition and Canadian life zones and provides habitat for approximately 239 species of wildlife--5 fish species, 6 amphibian species, 17 reptile species, 136 bird species and 75 mammal species. Fifty-eight of these are of high interest to the State of Utah.

The Division Publication No. 78-16 "Species List of Vertebrate Wildlife that Inhabit Southeastern Utah" identifies those species having potential to inhabit the region as well as those inhabiting the environs of the mine plan area. It also identifies which species are considered to be of high interest for the habitats and local area represented.

High interest wildlife are defined as all game species; any economically important species; and any species of special aesthetic, scientific or educational significance. This definition would include all federally listed, threatened and endangered species of wildlife.

A ranking and display of wildlife habitats and use areas relative to high interest species of vertebrate wildlife has been developed (Table 1 and 2[3]). Critical wildlife use areas followed in respective importance by high-priority, substantial value and limited value wildlife use areas require various levels of protection from man's activities and developments. Wildlife habitats and use areas are ranked as being of critical or high-priority value to wildlife should be protected from surface disturbance, subsidence impacts and human or industrial

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[3]Tables referenced in this Appendix can be found in Appendix. 10-C

disturbance. This can be accomplished through development and implementation of a wildlife plan.

Critical wildlife use areas are "sensitive use areas" necessary to sustain the existence and perpetuation of one or more species of wildlife during crucial periods in their life cycles. These areas are restricted in area and lie within high-priority wildlife use areas. All stream sections, reservoirs, lakes and ponds identified by Utah Division of Wildlife Resources as Class 1 or 2 are classified as being critical. Biological intricacies dictate that significant disturbances cannot be tolerated by the members of an ecological assemblage on critical sites. Professional opinion is that disturbance to critical use areas or habitats will result in irreversible changes in species composition and/or biological productivity of an area.

High-priority wildlife use areas are "intensive use areas" for one or more species of wildlife. "Intensive use areas" are not restricted in area and in conjunction with limited value use areas form the substantial value distribution for a wildlife species. All stream sections, reservoirs, lakes and ponds identified by Utah Division of Wildlife Resources as Class 3 are classified as being of high-priority. In addition, wildlife use areas where surface disturbance or underground activities may result in subsidence that could interrupt underground aquifers and result in a potential for local loss of ground water and decreased flows in seeps and springs should be considered as being of high-priority to wildlife.

Substantial value wildlife use areas are "existence areas" for one or more species of wildlife. "Existence areas" represent a herd or population distribution and are formed by the merging of high-priority and limited value wildlife use areas for a species. All stream sections, reservoirs, lakes and ponds identified by Utah Division Resources as Class 4 are classified as being of substantial value.

Limited value wildlife use areas are "occasional use areas" for one or more species of wildlife. "Occasional use areas" are part of the substantial value wildlife use area for a species. All stream sections, reservoirs, lakes and ponds identified by Utah Division of Wildlife Resources as Class 5 or 6 are classified as being of limited value.

## MAPPING

### VEGETATION AND WILDLIFE HABITATS

It is recommended that the Company's primary effort be placed on identifying species of vegetation in each wildlife habitat within the various wildlife use areas for purposes of reclamation. The Division does not have site specific information relative to vegetation types at the mine plan area. However, there are nine

wildlife habitats present--riparian or wetland types, cliffs and tallus, sagebrush, pinion-juniper forest, shrubland, aspen forest, ponderosa forest, parkland and spruce-fir forest. The Company should identify each of these habitat associations on appropriately scaled maps.

It is believed that if satisfactory reclamation is achieved and man's disturbance does not continue or become a factor, that most species of wildlife displaced from the mine plan area will return. Without doubt, the key to success for enhancing or restoring wildlands will be development of habitats so that the post-mining condition as compared to the premining condition will have similar species, frequency and distribution of permanent plants in each vegetative type this will allow for natural plant succession. Additionally, other habitat features that represent the various life requirements for local wildlife must be provided.

WILDLIFE USE AREAS

There are maps available for you to copy at our Southeastern Regional Office in Price, Utah, that display high value use areas for high interest wildlife on or adjacent to the mine plan areas. This display includes stream sections and bodies of water, if any, utilized by high interest fish species. Also displayed are known seeps, springs, wetlands, and riparian zones. All vertebrate species of high interest wildlife and their distributions are discussed in the following narrative.

WATER

Due to demands of state and federal coal mining regulations, the company will probably be required to identify and appropriately monitor all surface waters for potential impacts from subsidence. This information should be correlated with the wildlife use area information due to the value of water to wildlife.

FISH AND WILDLIFE INVENTORY

AQUATIC USE AREAS

MACROPHYTES

From a position of the aquatic wildlife resource it is believed that there is no practicality for information relative to macrophytes to be addressed by the mine permit application; such information is not generally available.

MACROINVERTEBRATES

The results from studies of macroinvertebrates may be required for purposes of determining need for stream buffer zones (UMC 817.57) in stream sections supporting biological communities. Since

historic impacts from this mine's operation have impacted Huntington Creek and Trail Creek data relative to macroinvertebrates as a pollution index or a forage base for fishes or other predators dependent upon the aquatic resource need be presented.

Note, impact avoidance procedures that would protect the integrity of the aquatic resource need to be included with the mine permit application. Of importance would be facility designs and operational plans that will preclude further impacts on both streams and identification of procedures that will be utilized to keep any form of coal sediments or other pollution from entering Trail Creek and Huntington Creek. Snow removal is a significant contribution of sediments to local riverain systems. Deposition of coal particles in the aquatic system could have a variety of negative impacts on invertebrate and fish populations.

The results from long-term studies of macroinvertebrates in Huntington Creek and Trail Creek would be of value for the Company to demonstrate when impacts that resulted from accumulations of coal and other sediments in each creek have ceased. Other sediments have resulted from encroachment of the road upon Trail Creek. These accumulations of sediments will likely continue until coal particles cease to enter either creek and the encroachment problems elevated.

Studies relative to macroinvertebrates if desired or needed, must be conducted by a qualified, private consultant.

## FISH--SPECIES OCCURRENCE AND USE AREAS

Aquatic habitats associated with the mine plan area support three species of game and two species of nongame fish; all of which are protected. Of these fish, four species have been determined to be of high interest to Utah (Appendix A and reference Division Publication No. 78-16[4]).

The yellowstone cutthroat trout is an introduced species. It annually spawns between early May and mid-July. Most populations are sustained through natural reproduction; hatching is usually completed by mid-July.

The rainbow trout is an exotic species. Within Utah there are several different strains of this species. Generally speaking they spawn from mid-March through June; hatching is normally completed by late June. It is important to note that natural reproduction by this species is almost non-existent, since it is managed as a stocked population. This management scheme has resulted since

[4]See Appendix 10-C

their catchability is higher than other trout and the life expectancy of hatchery fish is short.

The brown trout is an exotic species. It's spawning period begins as early as mid-October and is normally completed by late December; hatching of eggs begins in the spring and is usually completed by late May. Most populations are sustained through natural reproduction and supplemental planting of fingerling brown trout.

The spawning period represents a crucial period for maintenance of trout populations; spawning areas are ranked as being of critical value. Such areas are characterized by clean, gravel zones that are at least six inches deep. These zones must also be covered by a min of six inch deep water flowing at a velocity of not less than on foot per second. These physical parameters are necessary for optimum spawning success.

Once the cutthroat or rainbow trout have spawned their eggs incubate in the reeds approximately 30 to 50 days--water temperatures ranging from 45 to 50 F. Brown trout eggs incubate throughout the winter which lasts approximately 100 to 150 days--water temperatures ranging from 35 or 40 F. During this crucial period water temperature affects the rate of embryonic develop-- the warmer the water the more quickly incubation is completed. It is also during this period that ongoing sedimentation can result in suffocation of the eggs. Fluctuations in stream flow also negatively affects incubation; wherever practicable, maintenance of a constant flow of water during the spawning period enhances reproductive success.

The mottled sculpin is a native species. It annually spawns in the spring between February and May. All of their populations are sustained through natural reproduction. The spawning period represents a crucial period for maintenance of sculpin population; spawning areas (nest) are ranked as being of critical value. Such areas for sculpin are characterized as a nest scooped out beneath a stone or other submerged object. Spawning areas must have clean, gravel or rubble zones. Both the adult fish attend and defend the nest. They are known to spawn in water temperatures ranging from 45 to 48 F.

The reach of Huntington Creek adjacent to the project area (stream section 3) is ranked as being of high-priority to Utah's cold water fishery management program and is a class 3 fishery. It supports natural reproduction of self-sustaining cutthroat and brown trout populations. Occasionally, fingerling transplants of both of these species supplement the population. The majority of trout in this stream section are hatchery planted, catchable sized rainbow trout. Section 3 of Huntington Creek is also inhabited by mottled sculpin and mountain sucker.

Although there are not fish in Trail Creek, its flow of water is

of great value for reproductive success of spawning trout in the lower reaches of Huntington Creek for which it is a tributary water. Additionally, drift of macroinvertebrates from this stream represent an important contribution of forage to trout and other fishes in Huntington Creek.

If project operations are planned of develop that would alter, destroy or discharge polluting effluents into any perennial waters, appropriate state and federal permits, a mitigation plan and results from high level studies of the salmonis fishery resource, if any, would be required of the Company. Achievement of mitigation would demand detailed studies of stream velocity correlated to flow, representatives of the stream channel profile, gradient, pool-riffle ratio, substrata types identifying percent representation of each type and surface water information required for SMC 779.16.

If modification of flows is anticipated, in stream flow requirements must be considered to meet the needs of the existing fisheries, "biological community" and maintenance of existing riparian or wetland zones. Such baseline information would allow for development of mitigation or reclamation plans that would allow for avoidance, lessening or mitigation of impacts to the fishery and maintenance of re-establishment of unique habitat types. This baseline information is not generally available and would necessitate the services of a qualified private consultant and/or contracting Utah's Division of Wildlife Resources since special permits would be required.

It is important to note that no species of fish having relative abundances so low as to have caused them to be federally listed as threatened or endangered inhabit the mine plan or adjacent area. The endangered humpback chub, bonytail chub and Colorado squawfish inhabit the Green and Colorado Rivers. Additionally, the humpback (razorback) sucker also inhabits those rivers; it is likely that this species will one day be federally listed as threatened. It is not believed that implementation and operation of the Company's project will impact any of these species.

## TERRESTRIAL USE AREAS

### WILDLIFE HABITAT TYPES

Of the nine wildlife habitat types present on the mine plan area wetlands and riparian habitats are ranked as being of critical value to all wildlife. Such zones are normally associated with drainage bottoms (ephemeral or intermittent), or perennial streams (UMC 700.5), seeps and springs within the upper Sonoran, Transition and Canadian life zones. Cliffs and their associated tallus areas that lie within the upper Sonoran and Transition life zones are ranked as being of high-priority value to all wildlife. When

compared to all other wildlife habitats the aforementioned situations are considered to represent unique habitat associations (Table 1).

Riparian and wetland areas are highly productive in terms of herbage produced and use by wildlife as compared to surrounding areas. Experience has shown that as much as 70 percent of a local wildlife population are dependent upon riparian zones. Cliffs and tallus are of special importance to many high interest wildlife. These unique habitat types must be identified in the permit application and protected due to their high value for all wildlife.

Quantitative (acreage) and qualitative (condition, successional stage and trend) data concerning the wildlife habitats in each ecological association should be included as part of the mine permit application. It is important to note that each legal section of land represented by the mine plan and adjacent areas has been ranked as to its value for the total wildlife resource. Section 13, 14, 15, 22, 23, 24, 25 and 26 of Township 16 South Range 7 East have been ranked as being of critical value to wildlife. These rankings were developed through an analysis of cumulative values for use areas of individual wildlife species inhabiting each legal section of land (Table 2).

AMPHIBIANS--SPECIES OCCURRENCE AND USE AREAS

Six species of amphibians, all of which are protected, are known to inhabit the biogeographic area in which the mine plan and adjacent areas are located. It is probable that all of these species inhabit the project area (reference the Division Publication No. 78-16). Only one species of the amphibians inhabiting the project area have been determined to be of high interest to the State of Utah (Appendix A).

The tiger salamander is a yearlong resident animal of the project area. The substantial value use area for the adult form is represented by any moist underground site or any similar habitat such as inside rotten logs, cellars or animal burrows. Such sites can be found within any wildlife habitat extending from the cold desert (upper Sonoran life zone) through the submontane (Transition life zone) and into the mountain (Canadian life zone) ecological association. The larva form, often referred to as a mud-puppy, is a gilled animal that must remain in water within the above described ecological associations. It is interesting to note that the larva may fail to transform into an adult, even after their second season, and they can breed in the larva condition.

Once the larva is transformed into the adult form the animal is primarily terrestrial. Salamanders do migrate to water in the spring for breeding and may remain there during much of the summer. Such an intensive use area would be ranked as being of high-priority value to the animal. In September the newly

transformed animals leave the water to find suitable places to spend the winter.

The tiger salamander breeds from March through June and is sexually mature after one yr. The male deposits a small tent-shaped structure containing a myriad of sperm on the pool bottom. During courtship the female picks up this structure in her cloaca; then the eggs are fertilized internally before of just at the time they are laid. The eggs, singly or in small clusters, adhere to submerged vegetation; after 10 to 12 days they hatch. Obviously, a critical period for maintenance of the population is when breeding salamanders, eggs or their larva are inhabiting a water.

Post-embryonic development of a salamander's larval form progresses at a pace somewhat controlled by water temperature; in some cold waters the larva may not transform into an adult and drying up of a pool may hasten the process.

Migration to or from water usually occurs at night, during of just after a rain storm. When inhabiting terrestrial sites the tiger salamander is most active at night, particularly on rainy nights, from March through September.

Larva, when small feed on aquatic invertebrates and become predacious to the point of cannibalism when they are larger. Food items for adults include insects, earthworms and occasionally small vertebrates.

No amphibians have relative abundances that are so low to have caused the animal to be federally listed as a threatened or endangered species.

REPTILES--SPECIES OCCURRENCE AND USE AREAS

Eighteen species of reptiles, all of which are protected, are known to inhabit the biogeographic area in which the mine plan and adjacent areas are located. It is probable that seventeen of these species inhabit the project area (Reference the Division Publication No. 78-16). Only two species of the reptiles inhabiting the project area have been determined to be of high interest to the State of Utah (Appendix A).

The Utah milk snake is a yearlong resident animal of the project area. It's substantial value use area encompasses all wildlife habitats extending from the upper Sonoran (cold desert life zone) through the submontane (Transition life zone) and into the mountain (Canadian and possibly Hudsonian life zone) ecological associations. Although its use area spans a multitude of habitats, the animal is extremely secretive, mostly nocturnal and is often found inside or under rotten logs, stumps, boards, rocks or within other hiding places. At night they can be found in the open where they hunt for small rodents, lizard and other small snakes.

Occasionally, the milk snake may take small birds or bird eggs.

The milk snake may live beyond twenty yr and it becomes sexually mature during its third spring season. After mating, which occurs during spring or early summer when they are leaving the den, female milk snakes produce clutches which average seven eggs. The eggs are secreted in a moist warm environment and then abandoned; incubation lasts 65 to 85 days. The site where an individual snake has deposited its clutch of eggs is of critical value to maintenance of the species.

The Utah mountain kingsnake is a yearlong resident animal of the project are. Its substantial value use area encompasses all wildlife habitats extending from the submontane (Transition life zone) into the mountain (Canadian and possibly Hudsonian life zones) ecological association. Little is known concerning this animal except that it frequents areas of dense vegetation and that it is often found near water. Its life history and food habits parallel that described for the Utah milk snake.

To date snake dens, which are protected and of critical value to snake populations, have not been identified on or adjacent to the project area. It is important to note that inventory for such has not been attempted. If the Company at some later time discovers a den it should be reported to the Utah Division of Wildlife Resources. If a den(s) is currently known, its location must be included with the permit application.

No reptiles have relative abundances that are so low to have caused the animal to be federally listed as a threatened or endangered species.

BIRDS--SPECIES OCCURRENCE AND USE AREAS

Two hundred forty-two species of birds, all of which are protected, are known to inhabit the biogeographic area in which the mine plan and adjacent areas are located. It is probable that one hundred thirty-six of these species inhabit the project area (Reference the Division Publication No. 78-16). Twenty-five species of the birds inhabiting the project area have been determined to be of high interest to the State of Utah (Appendix A).

Ducks commonly known as water fowl are not known to utilize the project area, but may on occasion or during different seasons of the year make limited use of the riparian area. All of these species are of high interest to the State of Utah. Generally speaking, the riparian and wetland habitats encompassed by the project and adjacent areas provide substantial valued habitats for waterfowl. Each species has different life requirements and makes various uses of the riparian and wetland habitats.

For those waterfowl that nest locally, the period March 15 through

July 15 is ranked as being of crucial value to maintenance of the population. Following incubation, which dependent upon the species may vary between 20 and 28 days and extend up until mid-August, the riparian and wetland habitats represent a high-priority brooding area. Additionally, the wetland habitat (large open water areas or dense marshland, none of which exist on the project area) is of high-priority for seclusion and protection of adult waterfowl during their flightless period when they moult. Males may begin the moult in early June and both sexes and the young are capable of flight by mid-August.

The project and adjacent areas provides substantial valued habitat for a multitude of raptors--turkey vulture, bald and golden eagles, four species of falcons (prairies, American and arctic peregrine falcons and American kestrel), five species of hawks (goshawk, sharp-shinned, Cooper's, red-tailed and Swainson's hawks) and seven species of owls (barn, screech, flammulated, great horned, pygmy, long-eared and saw-whet owls). Many of these species are of high federal interest pursuant to 43 CFR, 3461.1 (n-1). All of these species are of high interest to the State of Utah (Appendix A).

Realistically, nesting habitat does not exist on the project or adjacent areas for many of these species. However, if a species were to nest on or adjacent to the project area, it would have a specific crucial period during which the aerie would need protection from disturbance; this period of time lies between February 1 and August 15. Generally speaking, aeries represent a critical valued site and need protection from significant or continual disturbance within a one-half kilometer radius of the nest. This consideration need only be implemented during the period of time that the nest is occupied. Species specific protective stipulations for aeries are available from the Utah Division of Wildlife Resources and the U.S. Fish and Wildlife Service.

The current level of data relative to site specific use of the area by raptors is unsatisfactory. Likely, there are aeries that have not been identified. Many of these species are highly sensitive to man's disturbances. Therefore, it is recommended that intensive surveys be initiated on the mine plan and adjacent areas for determination of locations for raptor aerie territories. Such data needs to be merged with information provided within this report.

Golden eagles are a common yearlong resident of the mine plan area. There are no known active aerie territories associated with the project. (Note, an aerie territory is utilized by one pair of eagles but may contain several nest sites.)

It is believed that aerie territories for eagles may exist on the project area. This belief is based upon the fact that suitable nesting habitat is widespread on the mine plan area and throughout the local are. It is important to note that regularity of golden

eagle observations and the fact that their status is common has resulted in documentation of mostly opportunistic observations of aerie territories.

An active golden eagle nest site is extremely sensitive to disturbance within a one-half kilometer radius. This buffer zone is ranked as being of critical value to maintenance of the eagle population when the bird is actually utilizing the aerie; that period of time is normally between April 15 and June 15. The radius for a buffer zone may need to be increased to one kilometer if a disturbance were to originate from above and within direct line of sight to the eagle aerie.

To date there are no known high-priority concentration areas or critical roost trees for golden eagles on the project area. The mine plan and adjacent areas have been ranked as being of substantial value to golden eagles.

The northern bald eagle is an endangered winter resident (November 15 to March 15) of the local area. Note that no bald eagles are known to nest in Utah, however, historic data documents nesting activity by these birds in the State. There is no known historic evidence of the northern bald eagle nesting on the mine plan or adjacent areas.

The American peregrine falcon (relative abundance is endangered) and the prairie falcon (relative abundance is common) are yearlong residents of the mine plan and adjacent areas. Each of these species utilizes cliff nesting sites. To date there are no known aerie sites for cliff nesting falcons on the project area. However, suitable nesting habitat for the prairie falcon is widespread. Suitable nesting habitat for the American peregrine falcon cannot be found on the mine plan and adjacent areas. Since existence on the area by prairie falcons would not be unlikely, the project area has been ranked as being of substantial value to this cliff nesting falcon. However, the project area only is ranked as being of limited value to peregrine falcons.

For each falcon their aerie site while being utilized and a one-half kilometer radius would be ranked as being of critical value to maintenance of their populations. The falcon's period of use at the aerie site spans the spring and early summer period--prairie falcon, April 15 to June 30; peregrine falcon, March 1 to June 30.

The level of data relative to site specific use of the project area by cliff nesting falcons (not including the kestrel) is unsatisfactory and there could be aeries that have not been identified. Therefore, it is recommended that intensive surveys be initiated on the area for determination of locations for cliff falcon aerie sites.

The endangered arctic peregrine falcon is a winter resident (November 15 through March 15) of the local area. This species has not been observed to utilize the environs on or adjacent to the mine plan area, however, its occasional presence would not be unlikely. Therefore, the project area is ranked as being of limited value to this species.

The blue grouse is a yearlong resident of the project area. Adult birds prefer open stands of conifers. During winter the blue grouse feeds exclusively upon needles and buds of douglas-fir and spruce trees. Thus, this wildlife habitat (spruce-fir forest) is ranked as being of critical value to over-winter survival of the population during the crucial period of December through February.

Blue grouse annually exhibit what has been termed a reverse vertical migration. That is, during the spring months, they migrate from the high elev spruce-fir habitat to lower elev sagebrush, pinion-juniper or shrubland habitats. This movement is caused by a need of the birds to feed on early developing vegetation. Such movement also facilitates successful breeding, nesting and brooding of their young. Then as the yr progresses, they move to the higher elev.

The males are polygamous and will set up and defend territories for booming and breeding activities against other breeding males. Such territories are critical to maintenance of the population during the crucial period of mid-March through mid-June.

After breeding the female develops a nest site which is secreted on the ground; the nest is of critical value to maintenance of the blue grouse population. upon hatching, which occurs in late May and early June, the young accompanied by the hen immediately leave the nest. The young blue grouse while being brooded rely heavily on insects for their protein needs during the first several months of development. The adult bird also shifts its diet during this period to include a high proportion of insects. Brooding areas are ranked as being of high-priority value to blue grouse. The crucial period extends from hatching into mid-August.

As summer progresses into the fall season the grouse consumes large quantities of berries.

The ruffed grouse is a yearlong resident of the project area. These grouse are usually found in the continuum of habitats extending from aspen to shrubland types. But, during winter they often roost in dense stands of conifers. Generally speaking ruffed grouse prefer habitats lying with 0.25 mile of a stream course; such areas are ranked as being of high-priority value to their population. During winter the ruffed grouse feeds exclusively upon staminate aspen buds. Thus, this wildlife habitat (aspen forest) is ranked as being of critical value to over-winter survival of the population during the crucial period of December through February.

During the remainder of the yr their diet shifts to include a wide variety of plant and insect material.

Ruffed grouse do not exhibit any type of seasonal migration.

The males are polygamous and will set up and defend territories against other breeding males. The focal point for breeding activity is the drumming log; all such logs are ranked as being of critical value to grouse since they represent sites of historical use. Such territories are critical to maintenance of the population during the crucial period of early March through May.

After breeding the female develops a nest site which is secreted o the ground and deep within an aspen grove; the nest is of critical value to maintenance of the ruffed grouse population. Upon hatching, which occurs in late May and early June, the young accompanied by the hen immediately leave the nest. The young ruffed grouse while being brooded rely heavily on insects for their protein needs during the first several months of development. The adult bird also shifts its diet during this period to include a high proportion of insects. Brooding areas are ranked as being of high-priority value to ruffed grouse. The crucial period for brooding extends from hatching into mid-August.

The band-tailed pigeon is a summer resident of the project area. This bird is seldom observed to utilize the Wasatch Plateau, but when observed the species is only represented by a single bird, pairs or even less frequently a small flock. Since the band-tailed pigeon's use of the Wasatch Plateau is best described as "occasional", the environs associated with the project area only ranked as being of limited value to the bird. Nesting birds secret their nest in trees within the spruce-fir wildlife habitat. Peak on-nest activity occurs in late July and early August.

Mourning doves normally inhabit the project and adjacent areas, which represents a substantial valued use area for these birds, between May 1 and September 15 each yr. They nest throughout most of this period and each pair produces two clutches. The pinion-juniper and riparian habitats are ranked as being of high-priority value for nesting. Locally, mourning doves show two peaks in on-nest activity--early July and early August. Successful nesting activities and any water sources are critical to maintenance of the mourning dove population.

The yellow-billed cuckoo is a summer resident of the project area. This bird only nest in the riparian wildlife habitat, therefore, such areas are of critical value to maintenance of this species. Little is known concerning the yellow-billed cuckoo. Its nest is represented by a frail, saucer shaped structure of twigs and is always placed in bush or tree.

The black swift is a summer resident of the Wasatch Plateau. The

mountain ecological association represents the swift's substantial valued use area. Normally, the bird is associated with a small flock that represents a colony. Black swifts are usually observed soaring as pairs and they feed upon flying insects. A colony's nests are scattered along precipitous terrain where the nest is often secreted behind a waterfall. Such a moist habitat is not known to exist on the project area. Cliff and tallus wildlife habitats are ranked as being of high-priority value to the black swift. There is evidence that pair bonds are long lasting and that a nest be utilized in successive yr.

The belted kingfisher is a yearlong resident of the project area. It is found only along riverain systems and its substantial value use area extends from the cold desert through the submontane and into the mountain ecological associations. Therefore, the riparian wildlife habitat represents a high-priority valued use area for this bird. It feeds exclusively upon fish. The kingfisher's nest is always secreted within a burrow along stream banks, thus, dirt bank habitats along riparian areas are of critical value to this bird.

The pileated woodpecker is a species having high federal interest pursuant to 43 CFR 3461.1 (n-1). The spruce-fir and aspen wildlife habitats of the mountain ecological association represent this bird's substantial valued use area. It is important to note that the pileated woodpecker has never been documented to utilize the environs of the biogeographic area that surrounds the project site. In areas of the State where the bird is known to exist, it is a yearlong resident with a relative abundance considered to be rare.

The Williamson's sapsucker is another species having high federal interest pursuant to 43 CFR 3461.1 (n-1). Typically, the substantial valued use area for this species is the spruce-fir habitat of the Hudsonian life zone in the mountain ecological association. Therefore, the spruce-fir habitat of the Canadian life zone on the project site would only represent the substantial valued use area for the yellow-bellied sapsucker. The yellow-bellied sapsucker is a yearlong resident of the environs associated with the project area and it has a relative abundance considered to be common. Where as the Williamson's sapsucker has never been documented to utilize the environs of the biogeographic area that surrounds the project site. In areas of the State where the Williamson's sapsucker is known to exist, it is a summer resident with a relative abundance considered to be uncommon.

The Lewis woodpecker is also another species having high federal interest pursuant to 43 CFR 3461.1 (n-1). Its substantial valued use area is represented by riparian habitats characterized by cottonwood stands and ponderosa forests. These habitats do not exist on the project site. It is important to note that the Lewis woodpecker has never been documented to utilize the environs of the biogeographic area that surrounds the project site. In areas of

the State where the bird is known to exist, it is a summer resident or only a transient. Its relative abundance is unknown.

The purple martin is a summer resident known to inhabit the environs of the biogeographic area that surrounds the project site. In Utah its substantial valued use area is represented by open spruce-fir, aspen or ponderosa forest habitats of the mountain ecological association. The purple martin feeds on flying insects and may secret it's nest within any suitable above-ground cavity.

The western bluebird is an uncommon summer resident known to inhabit the environs of the biogeographic area that surrounds the project site. Where as the mountain bluebird is a common yearlong resident of the area. Both birds are cavity nesting species. The western bluebird nests from the pinion-juniper habitat of the submontane ecological association up into the lower forest habitats within the Canadian life zone of the mountain ecological association. The mountain bluebird utilizes the same continuum of habitats for nesting, but also extends its nesting use across the Canadian and Hudsonian life zones and into the Alpine life zone. During winter both species show aleviational and longitudinal migrations; they then utilize all habitats associated with the cold desert ecological association. Therefore, the substantial valued use area for each species spans a broad continuum of habitats. It is important to note that trees with cavities located on the project area can be of critical value to bluebirds.

Grace's warbler is a species having high federal interest pursuant to 43 CFR 3461.1 (n-1). It's substantial valued use area is shrublands and associated ponderosa forest habitats of the submontane and mountain ecological associations. This bird's nest is built twenty or more ft above ground in a ponderosa tree. It is important to note that the Grace's warbler has never been documented to utilize the environs of the biogeographic area that surrounds the project site. In areas of the State where it is known to exist, it is a summer resident with a relative abundance considered to be uncommon.

Scott's oriole is also a species having high federal interest pursuant to 43 CFR 3461.1 (n-1). It's substantial valued use areas are riparian habitats characterized by cottonwood stands and the continuum of habitats extending from the pinion-juniper forest into shrublands of the submontane ecological association. The oriole's nest is characterized as a grassy pouch and is hung in a tree. It is important to note that the Scott's oriole has never been documented to utilize the environs of the biogeographic area that surrounds the project site. In areas of the State where it is known to exist, it is a summer resident with a relative abundance considered to be uncommon.

## MAMMALS--SPECIES OCCURRENCE AND USE AREAS

Eighty-four species of mammals, of which 25 percent are protected, are known to inhabit the biogeographic area in which the project and adjacent areas are located. It is probable that seventy-five of these species inhabit the project area (Reference the Division Publication No. 78-16). Twenty-six species of the mammals inhabiting the project area have been determined to be of high interest to the State of Utah (Appendix A).

The red bat is a summer resident of the biogeographic area that surrounds the project site. The animal roosts in wooded areas (riparian woods and pinion-juniper forests) of the submontane ecological association. Such areas represent this animals substantial valued use area. An occasional individual has been known to utilize caves; those individuals could hibernate and remain over winter.

The western big-eared bat is a yearlong resident of the biogeographic area that surrounds the project site. This animal roosts and hibernates within caves, mine tunnels or suitable buildings located in the pinion-juniper, shrubland and low elev spruce-fir habitats of the submontane and mountain (Canadian life zone) ecological association. Such areas represent this bats substantial valued use area.

The snowshoe hare is a yearlong resident of the biogeographic area that surrounds the project site. Its relative abundance has been determined to be limited, since its substantial value use area is restricted to the spruce-fir and nearby aspen and riparian habitats of the mountain (Canadian and Hudsonian life zones) ecological association. Such areas are ranked as being of high- priority value to the animal during its breeding season which spans the period between early April and mid-August.

The cottontail rabbit (mountain cottontail inhabits sites lying between 7,000 and 9,000 ft in elev and the desert cottontail inhabits sites lower than 7,000 ft in elev) is a yearlong resident of the biogeographic area that surrounds the project site. The entire project area represents a substantial valued use area for cottontails. Their young are born between April and July. This is a crucial period for maintenance of the cottontail population.

The northern flying squirrel is a yearlong resident of the biogeographic area that surrounds the project site. Currently, its relative abundance is unknown. Its substantial valued use area is restricted to spruce-fir or other mixed conifer habitats of the mountain (Canadian and Hudsonian life zones) ecological association. This specie is the only nocturnal squirrel in Utah. The flying squirrel may build its nest within an old woodpecker hole or it may build an outside nest of leaves, twigs and bark. Mating occurs twice each yr-February through March and June through

July. After which, two to six young are born after a gestation period of 40 days-April through May and August through September. These periods are of crucial value to maintenance of their populations. During winter flying squirrels are gregarious; 20 or more have been known to den together.

Beaver are yearlong inhabitants of the biogeographic area that surrounds the project site. Their substantial valued area is restricted to riparian and adjacent aspen habitats (those located within 100 meters of the riparian zone) in the cold desert, submontane and mountain (Canadian life zone) ecological associations. These animals construct a conical shaped lodge in which a family group lives throughout the yr. The lodge is of critical value to maintenance of the beaver population. One litter of kits is produced each yr; they are born between late April and early July after a gestation period of 128 days. Kits and yearlings coinhabit the lodge with the adult pair. When they attain 2 yr of the age they are forced to leave; females can breed at 2.5 yr of age. Due to the animals dependency upon flowing water and the association riparian vegetation, the riparian wildlife habitat is ranked as being of critical value to beaver populations.

The red fox is a yearlong inhabitant of the biogeographic area that surrounds the project site. The substantial valued use area for the red fox would include all wildlife habitats extending from the cold desert through the mountain (Canadian life zone) ecological associations. Almost nothing is known of their populations dynamics. Without doubt a crucial period for this specie is when they are caring for young in the den. Dens while being inhabited are a critical use area. The gray wolf is a historic inhabitant of the biogeographic area.

The gray wolf is a historic inhabitant of the biogeographic area that surrounds the project site. Currently its relative abundance is so low that the animal is listed as endangered with extinction. The wolf's substantial valued use area would be represented by any remote habitat in any ecological association.

Black bears are inhabitants of the biogeographic area that surrounds the project site. Their substantial valued use area is represented by all natural wildlife habitats (excluding the pasture and fields and urban or parks types) extending from the submontane into the mountain (Canadian and Hudsonian life zones) ecological associations. These animals go into a semi-hibernation during winter. During this crucial period, which may last from December through March, the animal secrets itself in a den in order to conserve body energy reserves. The young are born in the den during January or February. Dens while being inhabited represent a critical valued use area for bears.

Many of the members of the family mustelidae are known to inhabit the biogeographic area that surrounds the project site. They are

all protected and classified as furbearers-short-tailed and long-tailed weasels, mink, wolverine, marten, badger, striped and spotted skunks. Additionally, raccoon and muskrat, although not furbearers, are also inhabitants of the biogeographic area that surrounds the project site. All of these species are of high interest due to their value in the fur market.

The substantial valued use area for short-tailed and long-tailed weasels, mink, muskrat and raccoons is the riparian habitat. Weasels, which are inhabitants of the project site, do make some use of other habitats that are proximal to riparian zones. Muskrats and raccoons are restricted to riparian habitats of the cold desert and submontane ecological association; thus, they are not found on the project area. The long-tailed weasel can be found from the cold desert up into the mountain (Canadian and Hudsonian life zones) ecological associations. The short-tailed weasel and mink populations extend their use from the submontane into the mountain ecological association. It is important to note that the weasel is restricted to the Canadian life zone; where as the mink utilize the Canadian and Hudsonian life zones.

The substantial valued use area for badger and skunks span all wildlife habitats other than dense forests in the cold desert, submontane and mountain (Canadian life zone) ecological associations. Skunks show some affinity for habitats proximal to water. Skunks and badgers are dependent upon a suitable prey source.

A crucial period for maintenance of all furbearers, raccoons and muskrat populations is when they have young in a nest, den or lodge. Such sites are critical for reproductive success.

Bobcat, Canada lynx and cougar are known to inhabit the biogeographic area that surrounds the project site. For all of these species a crucial period for maintenance of their population is when the female has her young secreted at a den site. Such sites are of critical value when being utilized. It is also crucial to their survival that a female accompanied by young not be killed or harassed.

The substantial valued use are for bobcats extends from the cold desert through the submontane and into the mountain (Canadian life zone) ecological association. The bobcat is normally associated with precipitous terrain, but has been observed in every wildlife habitat within the aforementioned ecological associations. Their primary prey source is represented by small mammals and birds or any other small animal they can catch. It is important to note that bobcats occasionally do kill the young of big game animals.

The substantial valued use area for the Canada lynx is restricted to the Canadian and Hudsonian life zones of the mountain ecological association. Normally, this cat would only be expected to utilize

riparian and forested wildlife habitats. The lynx is similar in predation habits to the bobcat.

The substantial valued use area for the cougar (locally known as mountain loin) extends from the submontane into the mountain (Canadian and Hudsonian life zone) ecological association. Due to the dependency of the cougar upon mule deer as a prey source, a ranking of the lion's seasonal distribution parallels that of the deer.

Mule deer are inhabitants of the biogeographic area that surrounds the project site. Their substantial valued use area spans all wildlife habitats extending from the cold desert through the submontane and mountain ecological associations. In some situations deer show altitudinal migrations in response to winter conditions. There are, however, habitats where deer reside on a yearlong basis (see attached map).

Migration of mule deer from summer range to winter range is initiated during late October; probably, the annual disturbance of the fall hunting season coupled with changing weather conditions is the initial stimulus. The onset of winter weather reinforces the deer's urge to migrate and continued adverse weather keeps the deer on the winter range.

A portion of the project site represents winter range for mule deer herd Unit 34. Winter ranges for mule deer are all ranked as being of high-priority value to the animal; these areas are usually inhabited between November 1 and May 15 each yr. During winters with severe conditions the higher elev portion of the winter range becomes unavailable to deer due to snow depth. Traditionally, some restricted portions of the winter range have shown concentrated use by the deer; these sites are ranked as being of critical value. It is important to note that all of the canyon bottoms associated with the project are of critical value to deer. Critical valued sites must be protected from man's disturbance when the deer are physically presented on the range.

Deer begin their migration back to summer range during mid-May and remain their throughout October. Summer ranges on the project area represent deer herd Unit 34. They are ranked as being of high-priority value to mule deer. In instances where extend of summer range is the major limiting factor for a deer herd, those summer ranges are ranked as being of critical value.

There are ranges that support mule deer on a yearlong basis. Most of these ranges are limited value to deer. However, there are some areas supporting yearlong use that are ranked as being of high-priority value to deer. There are no yearlong ranges for mule deer on the project site.

Mule deer fawn during the month of June. The continuum of wildlife

habitats extending from the pinion- juniper through the shrubland and into the aspen type probably represents the fawning area. All riparian areas are of critical value for fawning and maintenance of the deer population. To date no specific areas showing annual use for fawning are known. It is probable that such areas exist; they would be ranked as being of critical value to deer. It is important to note that June represents a crucial period for maintenance of deer populations.

Agriculture areas that are bisected by the access route to the project area are utilized yearlong by mule deer. Their use is sometimes intensified during the winter and spring periods.

Moose are inhabitants of the biogeographic area that surrounds the project site. Their substantial valued use area spans all wildlife habitats in the mountain ecological association except those associated with the Alpine life zone. In some situations moose show altitudinal migrations in response to winter conditions. There are, however, habitats where moose reside on a yearlong basis (see attached map).

Migration of moose from summer range to winter range is initiated during late November; probably , changing weather conditions is the initial stimulus. The onset of winter weather reinforces the moose's urge to migrate and continued adverse weather keeps the animal on the winter range.

A portion of the project site represents winter range for the Southeastern Utah moose herd- Hunting drainages. Winter ranges for moose that are characterized as riparian habitats are ranked as being of critical value, where as the remainder of the winter ranges are ranked as being of high-priority value to the animal. Note that all riparian areas associated with the project have shown use by moose. Winter ranges are usually inhabited by moose between December 1 and May 15 each yr. During winters with severe conditions the higher elev portion of the winter range becomes unavailable to moose due to snow depth. Critical valued sites must be protected from man's disturbance when the moose are physically present on the range.

Moose begin their migration back to summer range during mid-May and remain there throughout November. Summer ranges on the project area support animals from the Huntington drainages of the Southeastern Utah moose herd. Those summer ranges are ranked as being of high-priority value.

Ranges that support moose on a yearlong basis are ranked as being of critical value.

Moose calf during late May and June. Calving takes place in the riparian or adjacent forest habitats. Without doubt, all riparian areas are of critical value for calving and maintenance of the

moose population. To date no specific areas showing annual use for calving are known. It is probable that such areas exist; they would be ranked as being of critical value to moose. It is important to note that June represents a crucial period for maintenance of moose populations.

Rocky mountain elk are inhabitants of the biogeographic area that surrounds the project site. Their substantial valued use area spans all wildlife habitats extending from the submontane through the mountain ecological association. Elk do not show as strong of altitudinal migration as mule deer do in response to winter conditions, but they do migrate to wintering areas (see attached map).

Migration of elk from summer range to winter range is initiated during late October; probably, the annual disturbance of the fall hunting seasons coupled with the changing weather conditions is the initial stimulus. The onset of winter weather reinforces the elk's urge to migrate and continue adverse weather keeps elk on the winter range.

A portion of the project site represents winter range for the Manti elk herd--Unit 12. Winter ranges for elk are all ranked as being of high-priority value to the animal; these areas are usually inhabited between November 1 and May 15 each yr. During winters with severe conditions some portions of the winter range becomes unavailable to elk due to snow depth. Traditionally, some restricted portions of the winter range have shown concentrated use by the elk; these sites are ranked as being of critical value. The high ridges associated with the project are critical winter ranges for elk. Critical valued sites must be protected from man's disturbance when the elk are physically present on the range.

Elk begin their migration back to summer range during mid-May and remain there throughout October. Summer ranges on the project area support the Manti elk herd--Unit 12; they are ranked as being of high-priority value.

Elk calf during the month of June. Their preferred calving areas are best described as aspen forests with lush understory vegetation. All riparian areas on the summer range are of critical value for calving and maintenance of the elk population. To date no specific areas showing annual use for calving are known. It is probable that such areas exist; they would be ranked as being of critical value to elk. It is important to note that June represents a crucial period for maintenance of elk populations.

Currently, there are no other known high interest wildlife species or their habitat use areas on or adjacent to the project area. It is not unreasonable to suspect that in the future, some additional species of wildlife may become of high interest to the local area, Utah or the Nation. If such is the case, the required periodic

updates of project permits and reclamation plans can be adjusted and appropriate recommendations made.

# Appendix 10-B

# MITIGATION AND IMPACT AVOIDANCE PROCEDURES, GENERAL TO ALL WILDLIFE

SMC 780.16 OR UMC 784.21; FISH AND WILDLIFE PLAN
CO-OP MINE COMPANY, TRAIL AND BEAR CANYON MINING PROJECTS

MITIGATION AND IMPACT AVOIDANCE PROCEDURES
GENERAL TO ALL WILDLIFE

Utah Division of Wildlife Resources provides the following recommendations in order to minimize disturbances and impacts on wildlife and their habitats that could be impacted during developmental, operational and reclamation operations at the mining project. The recommendations address how enhancement of the wildlife resource and their habitats as discussed in UMC 783.20 can be achieved. They are also consistent with the performance standards of UMC 817.97. In instances where it would be necessary to restore or could be beneficial to enhance or develop high value habitats for fish and wildlife, recommended plant materials and rates of application are provided as "Appendix B" (UMC 817.97 and UMC 817.111 through 817.117). This list should prove useful in meeting the additional requirements to be imposed upon the operator if the primary or secondary land use will be for wildlife habitats (UMC 817.97 d 9). Additionally, "Appendix C" represents a list of commercial sources for plant materials.

The project and adjacent areas are represented by nine basic wildlife habitats which are inhabited on occasion and during different seasons of the yr by about 239 species of vertebrate wildlife. The wildlife habitats and use areas for the "high interest" species from this group of wildlife have been ranked into four levels of importance. The most valuable to an individual species or ecological assemblage are the critical sites followed in respective importance by high-priority, substantial value and limited value sites. Each type of use area requires various and specific levels of protection from man's activities. Additionally, due to the variability of vegetation communities in each use area, various and specific technologies in site development will need to be evaluated for possible mitigation, enhancements of wildland habitats or the required level of reclamation. It is recommended that all land clearing impacts be designed so that irregular shaped openings are created in contrast to openings that would have straight edges.

It is recommended that the Company make significant efforts to educate all employees associated with their coal handling operation of the intricate values of the wildlife resource associated with the project and adjacent areas and the local area. Each employee should be advised not to unnecessarily or without proper permits harass or take any wildlife. (Apprehension of wildlife violators has increased by nearly 250 percent during recent yr in the region). It is especially important that wildlife not be harassed during winter periods, breeding seasons and early in the rearing process. Exploration should be limited as much as possible during these crucial periods.

During winter wildlife are always in a depleted condition. Unnecessary disturbance by man causes them to use up critical and limited energy reserves which, often times, results in mortality. In less severe cases, the fetus being carried by mammals may be aborted or absorbed by the animal, thus reducing reproductive success of a population.

During breeding seasons, disturbance by man can negatively affect the number of breeding territories for some species of wildlife. Disturbance can also interrupt courtship displays and preclude timely interactions between breeding animals. This could result in reduced reproductive success and ultimate reductions in population levels.

Early in the rearing process, young animals need the peace and tranquility normally afforded by remote wildlands. It is also during this crucial period that young animals gain the strength and ability to elude man and other predators. This allows the young animal to develop in relatively unstressed situations and to utilize habitats that are secure from predators. Disturbance by man can compromise this situation and result in abandonment of the young by the female, increased accidents that result in mortality to young animals or increased natural predation. It is recommended that employees be cautioned against disturbing young animals or females with young if accidentally located.

Employees associated with coal handling operations should be instructed that when wildlife are encountered during routine work that they not stop vehicles for viewing purposes. Moving traffic is less disturbing to wildlife than traffic that stops or results in out-of-the-vehicle activities. If viewing is desirable, the vehicle should only be slowed, but not stopped.

Hunting and other state and federal wildlife regulations must be adhered to by sportsmen utilizing the project area.

## MITIGATION AND IMPACT AVOIDANCE PROCEDURES FOR AQUATIC WILDLIFE

There are no recommendations for a wildlife plan that would enhance any fishery. If ultimate operations are planned or occur that could physically or chemically impact any perennial stream beyond the impact of mere crossings, detailed reclamation plans will be required. Permanent culvert crossing s exceeding a width of eight ft must have a natural bottom and devices fro reducing stream velocity so that fish migration is not blocked. A reclamation plan for a stream or lake would have to provide for measurement of the physical characters of the water prior to disturbance. Such measurements should consider surface water information required in SMC 779.16, data on stream velocity, gradient, width, depth, pool-riffle ratio and substrata types.

Reclamation that would achieve development of a lake bed or stream channel similar in character to that which existed prior to disturbance should result in natural re-establishment of macroinvertebrates, macrophytes and a fish population. If merited, the Division could then introduce desired fishes into those waters. This would adequately mitigate for disturbance and temporary loss of aquatic resources. There would be no mitigation for displacement and possible loss of other wildlife species dependent upon the aquatic wildlife as a prey source. It is believed that impacts on such species would not be significant.

It is also recommended that adequate precautions be taken to keep all forms of coal or other sediments from being inadvertently deposited along or within perennial stream channels. Similar precautions should be taken to preclude deposition of coal particles or sediments in or along other drainages from which the material could be transported during a precipitation event into a perennial stream. This would include blow-coal from haulage trucks, railroads or other transportation systems and storage piles. Control of larger coal particles from the above sources is equally important to control of fugitive dust. If needed, haulage vessels or storage sites should be covered, or the surface of the coal appropriately sprayed in order to solidify it against wind movement. Travel speeds of haulage vessels could be reduced so that coal is not allowed to leave the transportation system. The impacts of coal or other sediments on aquatic ecosystems are many and varied; therefore, sediments must be kept out of those systems.

Utah Division of Wildlife Resources reaffirms all of the recommendations in UMC 817.41 through 817.57 and UMC 817.126 for protecting the State's waters and their associated riparian and wetland zones along with the aquatic wildlife resource.

## MITIGATION AND IMPACT AVOIDANCE PROCEDURES FOR TERRESTRIAL HABITATS

It is recommended that all wetland and riparian habitats be maintained. Roads and other facility developments should not destroy or degrade these limited, highly productive and unique habitats. Roads crossing through those areas should do so in a manner that is least damaging to the habitat. Wetlands and riparian habitats are ranked as being of critical value and are the most productive sites in terms of herbage and biota produced as compared to other local habitat types. It is probable that a majority of the vertebrate wildlife that inhabit the project area make some use of riparian or wetland areas.

It is important to note that roads and other surface facilities to be constructed should as far as practicable be placed at sites where they will not compromise wildlife or their use areas. Also, surface facilities, including roads, should be screened if possible

from wildlife use areas by vegetation or terrain.

In situations where wildland habitats have been or will be disturbed, reclamation is required. Also, there are sites where development or enhancement of wildland habitats through vegetation treatments and/or seedings and transplants of seedlings could benefit wildlife. "Appendix B" depicts the Division's recommendation for plant materials to be utilized for various wildlife habitats on wildland treatments that are intended to benefit wildlife. If circumstances arise where seed or seedling transplants for a recommended plant species are not available, suitable alternates are also recommended.

Seedling transplants from nursery stock as well as nearby rangelands would also be acceptable for some wildland treatments.

Appendix C represents an exhaustive list of commercial sources for plant materials for use in wildland treatments.

Temporary control of rodents may be required to ensure a successful rangeland treatment. It is recommended that the county agent be consulted in this area of concern. Poisoned oats are the most common and acceptable method for rodent control; however, only licensed persons may apply the treatment.

Currently, there are some new concepts in methodology for revegetation that are being successfully implemented in other parts of the nation and world. One promising method is a procedure where a large scoop removes, from a natural and stabilized site, a small area of earth intact with vegetation and subsurface soils for placement on a site to be restored. This same procedure can be utilized when disturbing pristine sites, except that the native vegetation is stored for use in latent reclamation. Another meritorious method for stimulating natural revegetation, in combination with other reclamation techniques, is to plan facility developments so that islands of natural, native vegetation remain. This will allow for natural vegetation to spread from the islands. These techniques can also be useful for enhancement of poor quality sites that currently exist on the mine plan area.

Encapsulation of seed and fertilizer for several releases over a period of yr after a single application is a new and possibly advantageous procedure. This technique along with soil stabilizing structures has been successfully used in South Africa. Dr. J. Van Wyk in the Department of Botany at Potchetstroom University in South Africa could provide additional information on this new technique.

There are also new specialized techniques coming to the forefront for stabilization of problem sites such as roadbanks and steep slopes. It is important that these sites be promptly and permanently revegetated in order to reduce siltation into local

riverain systems. This will mitigate for damage to aquatic wildlife populations and habitats from siltation. Enhancement of existing problem sites or reclamation of disturbed sites can mitigate for salt loading of local river systems. It is believed that natural, nonpoint sources represent 50 percent of the salinity in the upper basin of the Colorado River system into which this mine plan area drains.

It is recommended the Company make numerous contacts with appropriate agencies, institutions and persons to ensure that enhancement or reclamation projects achieve the required degree of permanency, plant diversity, extent of cover and capability of regeneration to ensure plant succession. Generally speaking, seeding should be accomplished as late in the fall as possible. Seedling transplants need to be coordinated with local soil moisture conditions which are usually at optimum in the early spring just as the snow melts.

It is paramount that suitable vegetation be maintained and/or re-established if the life requirements of wildlife are to be satisfied in the post-mining period. Success in this area of concern along with cessation of man's disturbances will likely result in a natural renovation and the resultant inhabitation by most wildlife species of an impacted site.

It is important to note that enhancement or reclamation projects that are to benefit wildlife must be properly designed so that all the life requirements of the target species are considered in conjunction with forage. Water must be provided or be present and thermal cover along with escape and hiding cover has to be in abundance. Loafing areas and travelways between the many types of use areas must also be provided. In order to meet these goals, a considerable degree of consultation will be required between the Company and Utah Division of Wildlife Resources.

As a service and also to ensure that the needs of wildlife are net, the various expertise within the Division of Wildlife Resources are available to the Company for consultation. For the most part, Larry Dalton, Resource Analyst, for the Southeastern Regional office at 455 West Railroad Avenue in Price, Utah 84501 (phone 637-3310) will coordinate any needed contacts. Richard Stevens, Wildlife Biologist, at the Great Basin Research Center, Box 704, in Ephraim, Utah 84627 (phone 283-4441) is available for consultation and site specific analysis concerning species for vegetation plantings, timing and techniques to achieve the best results.

In instances where revegetation projects are to be planned over coal waste areas, heavy metal uptake by the plants must be evaluated. It is recommended that the Company initiate an appropriated long-term monitoring program to determine the magnitude and resolutions, if needed, for this problem.

It is recommended that persistent pesticides not be utilized on the project area. Other alternate pesticides or forms of control should be utilized.

All hazards associated with the project operation should be fenced or covered to preclude use by wildlife; of special concern would be sites having potential to entrap animals or toxic materials.

## MITIGATION AND IMPACT AVOIDANCE PROCEDURES FOR AMPHIBIANS AND REPTILES

Enhancement or development of habitats that provides a diversity of vegetation will benefit amphibians and reptiles. It is important to note that all of these species are protected by Utah law. Due to the myriad and myths that surround these animals, it is urged that individual specimens not be destroyed. This is especially true for snakes since they are a valuable component of the ecosystem.

Snake dens are ranked as being of critical value to the population and are protected by law. If a den is located, it should be reported to the Utah Division of Wildlife Resources. Snake dens can be moved by the Division, but only with intensive efforts that may take a yr or more (snakes are caught and removed in the spring and fall). Thus, construction of facility developments may take place in denning locations if there is sufficient lead time to relocated the occupants.

## MITIGATION AND IMPACT AVOIDANCE PROCEDURES FOR AVIFAUNA

It is recognizable that development and operation of a mining project will in some cases negatively impact many avian species through physical destruction of habitats and continual disturbance that makes other habitats unavailable or less desirable to an individual bird. It is also true that impacts that are negative to one species may be beneficial to another species. It is recommended that the Company plant native and/or ornamental berry producing shrubs around surface facilities. When mourning doves are a target species, sunflowers or blazing star should be planted. This will provide food and cover for many of the smaller species of birds, resulting in enhancement of their substantial value and high-priority habitats. This action would also mitigate for disturbances and destruction of avifauna habitats at other sites associated with project operations.

It is important to note that the nest of all avifauna (except the house sparrow, starling, and rock dove) when active and their eggs are protected by federal (Federal Migratory Bird Treaty Act) or state laws (Utah Code 23-17-1 and 23-17-2). All avifauna utilize a nest during their reproductive process. Dependent upon the

species, some nests are well developed while others may be represented by only a scrape on the ground. These sites when being utilized are critical to maintenance of individual bird populations; each species has a specific crucial time period in which the nest is occupied. It is during this crucial period that the nest must be protected from disturbance.

Several species of raptors frequent the project are. Their nests when active should not be disturbed and abandoned stick nests are never to be damaged. Every effort should be made to eliminate man's disturbance within visual sight or one-half kilometer radius of an active raptor nest. This distance would have to be increased to a one-kilometer radius if the cause for disturbance were to originate within view and from above the nest. This effort is demanded in the instance of golden eagles and cliff nesting falcons since they are sensitive to disturbance and could abandon the nest. Termination of man's use of a site would not be required if eagles or falcons constructed their nest after mining had been initiated, since it would demonstrate the individual bird's willingness to tolerate mining activities and the associated disturbance by man.

Roost trees for eagles, if located, must not be disturbed or destroyed. Similarly, activities planned for high-priority concentration areas of eagles must be designed implemented so that they are not of significant disturbance to the birds.

As a general comment, whenever active raptor nest are observed or roost trees for eagles located, they need to be reported to the Utah Division of Wildlife Resources and the U.S> Fish and WIldlife Service.

Design and construction of all electrical power lines and other transmission facilities shall be designed in accordance with guidelines set forth in "Environmental Criteria for Electric Transmission System" published by the USDA and USDI in 1970 and/or the REA Bulletin 61-10 "Powerline Contacts by Eagles and Other Large Birds." It is also recommended that placement of utility poles over flat or rolling terrain be planned so that they are out of view of roads or at least 300 meters away from any roads. This will lessen opportunity for illegal killing of these valuable birds, since the poles can serve as suitable hunting perches for raptors. In some instances poles can result in an extension of raptor hunting territories, which would represent a beneficial impact.

During the crucial period of December through February spruce-fir forests and aspen forests need to be protected from man's disturbance so that blue grouse and ruffed grouse will not be impacted. Destruction of these wildlife habitats at any time of the yr need be minimized due to their value to wildlife.

During the spring period (mid-March through mid-June) care needs

to be taken that male blue grouse are not disturbed or precluded from establishing breeding territories. Similar precautions need be taken for male ruffed grouse (March through May) in the area of drumming logs.

Mature trees with natural cavities and dead snags need to be protected for use by cavity nesting birds. Trees with such a character are ranked as being of critical value to cavity nesting birds. The project should be planned so that three such trees are left standing per acre within 500 ft of forest openings or water and two such trees per acre in dense forested areas.

MITIGATION AND IMPACT AVOIDANCE PROCEDURES FOR MAMMALS

The lodges, nests and dens of all mammals or roosts in the instance of bat like mammals represent a critical use area for maintenance of their individual population. The crucial period for any species is when the lodge, den, nest or roost is occupied. Therefore, such sites for any mammal must be protected from disturbance during that period when it is being utilized.

Many species of mammals develop food caches in order to carry individual animals or family groups through periods when they cannot forage. Such sites are of critical value to maintenance of their populations and if located should not be destroyed or subjected to regular disturbance by man.

It is important to realize that within natural ecosystems there exists a predator-prey relationship. One specie of animal may represent a prey source for other species. Therefore, it is important that project operations be designed and implemented so as to not unnecessarily disturb or destroy any wildlife or their habitats.

Big game ungulates--mule deer, moose and elk--each have seasonal use areas ranked as being of critical value to an individual herd. Such sites need to be protected from any of man's activities or developments that could result in destruction, loss or permanent occupancy of the site by man or has facility developments. If these types of impacts cannot be avoided the site must ultimately be reclaimed and revegetated. Also, critical valued areas need protection from disturbance during their appropriate crucial period.

High-priority valued use areas for all wildlife and particularly big game ungulates need to be protected from man's activities or facility developments. Actions that would result in loss or permanent occupancy of significant acreage (25 or more acres) of habitat are of special concern. In any event impacts to high-priority valued areas should be limited and ultimate reclamation planned. Many impacts can be avoided simply by precluding exploration, developmental or other activities during

the period of time when a high interest specie is present.

Haulage of coal between the various mine projects and distribution points should be planned so that impacts to wildlife are lessened; of special concern is haulage of coal through wintering areas for big game. It is recommended that the Company develop coal haulage contracts that require personnel involved with coal haulage to use extreme caution so that accidental collisions between motor vehicles and big game are reduced. Without doubt, a reduction in speed across winter ranges would alleviate this problem during the period between November 1 and May 15 each yr.

At present the most successful and cost effective technique for reducing deer-highway mortality is a system of warning reflectors. This system (manufactured by Streiter Corporation, 2100 Eighteenth Avenue, Rock Island Illinois 61201 and known as "Swareflex") is only of value at night time, but it is during darkness that most deer-highway mortality occurs. Streiter Corporation describes the effect of the reflector system as follow: "The headlights of approaching vehicles strike the wildlife reflectors which are installed on both sides of the road. Unnoticeable to the driver, these reflect red lights into the adjoining terrain and an optical warning fence is produced. Any approaching wildlife is [are] alerted and stops or returns to the safety of the countryside. Immediately after the vehicle has passed, the reflectors become inactive, thereby permitting the animals to cross safely."

Installation of a wildlife warning reflector system, a reduction in speed of coal-haulage trucks and other mine related traffic and increased awareness of wildlife values by mine associated employees should result in a reduction of deer-highway mortality problems. Such a reduction would represent satisfactory mitigation.

In instances where conveyors, slurry lines or any other structure having potential to be a barrier to big game movement is to be developed, passage structures must be provided. Generally speaking overpass and underpass type structures are recommended in order to allow passage of big game to habitats either side of any barrier. These crossings should be placed at the points to be identified from intensive study of big game movements in relation to the mine plan area. Such study would not be required if the structure was adequately elevated to allow uninhabited passage of big game along its entire length.

Underpasses should have a min clearance of three meters maintained across a span of at least five meters. Overpasses should be designed as a circular earthen ramp with the barrier bisecting the ramp into two equal halves as follows:

On either side of the conveyor a half-round ramp with a slope no greater than 3:1 on a five meters wide path placed at an angle 90 degrees to the conveyor and tapering around to a slope of 5:1 at

paths adjacent and parallel to the conveyor. The platform over the conveyor should be concrete or some other material that would not echo when being crossed by big game and should be of character similar to rock or natural earth.

Soils associated with either crossing style should be of the A or B horizons to allow for development of vegetation. Vegetative cover must be established in association with all crossing sites. This will lessen anxiety of individual animals using the site through development of a natural appearing environment.

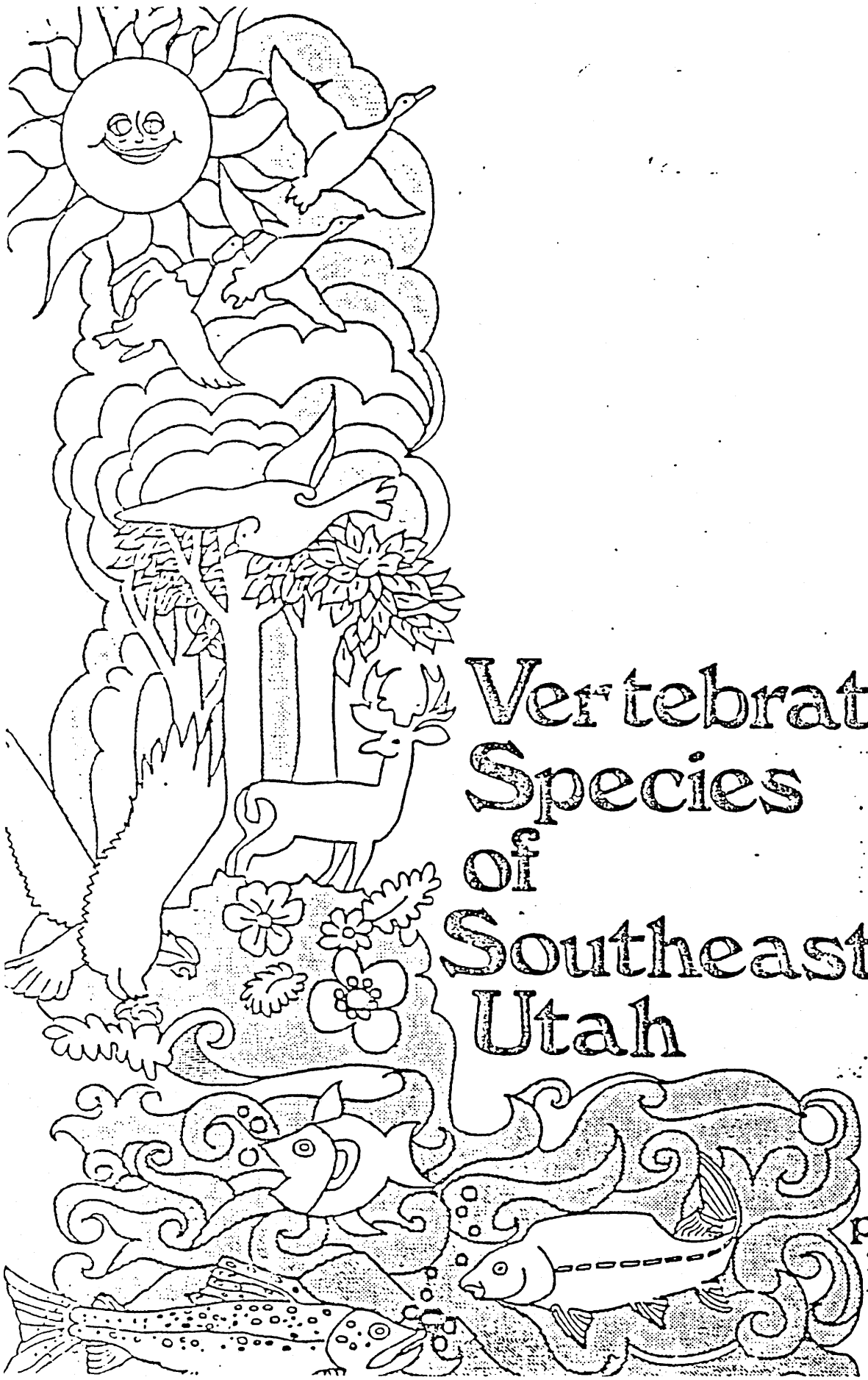
Mature pinion or juniper trees and an abundance of browse plants need to be placed proximal to crossing points in order to provide a safe travelway. The browse plants will also serve as a permanent attraction for big game to crossing points. Additionally, a mixture of grass and forb seeds should be broadcast over each crossing point to stabilize the soil and enhance the forage situation.

Appropriately sized boulders may need to be placed at crossing sites in order to control off-road vehicles utilized in outdoor recreation.

Industrial developments are encouraged on habitat use areas that are ranked as being of limited value to wildlife. It should be noted, however, that reclamation is ultimately expected on any wildlife use area, regardless of its value to wildlife.

# Appendix 10-C

## VERTIBRATE SPECIES OF SOUTHEASTERN UTAH



# Vertebrate Species of Southeastern Utah

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Agencies and individuals that have contributed information on species distribution within the southeastern region are acknowledged. Bureau of Land Management and U.S. Forest Service biologists provided information concerning local sightings and distribution of wildlife species. Species lists obtained from Arches and Canyonlands National parks were also helpful. Within the Utah Division of Wildlife Resources, local conservation officers and wildlife biologists provided valuable information on species within their districts or areas of experience. Thanks go to other Division personnel who assisted with review of this document.

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

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## SPECIES LIST OF VERTEBRATE WILDLIFE THAT INHABIT SOUTHEASTERN UTAH

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

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

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

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

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

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

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

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

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

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

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

Resident - These species occur yearlong in southeastern Utah.

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

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

Note, the species marked with an asteric (*) are of high interest to the State and those marked with an exclamation mark(!) have potential to inhabit the environs of the project area. *(High interest species are those defined as being of economic importance from either a consumptive or non-consumptive perspective, or having special aesthetic; scientific; educational or ecological significance.)*

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

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

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

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

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

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

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

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

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

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



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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



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

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

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

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

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

| Species | Biogeographic Area Inhabited | Status | Population Trend | Habitat Use Area |
|---|---|---|---|---|
| Family Alaudidae | | | | |
| Horned Lark (*Eremophila alpestris*) | A,B,C,D,E,F | C-P resident | Unknown | Plains, desert, prairies fields, sparse sagebrush flats, dirt roads, shore: alpine meadows, alkali flats and areas of sparse vegetation |
| Family Hirundinidae | | | | |
| Violet-green Swallow (*Tachycineta thalassina*) | A,B,C,D,E,F | C-P summer resident | Unknown | Widespread when foraging; when nesting, open forest foothill woods, mountains canyons, cliffs and towns |
| Tree Swallow (*Iridoprocne bicolor*) | A,B,C,D,E,F | C-P summer resident | Unknown | Open country near water, marshes, mountain meadows streams, lakes and wires; when nesting requires dea trees and snags, preferab near water |
| Bank Swallow (*Riparia riparia*) | A,B,C,D,E,F | C-P summer resident | Unknown | Usually near water; over fields, marshes, streams and lakes |
| Rough-winged Swallow (*Stelgidopteryx ruficollis*) | A,B,C,D,E,F | C-P summer resident | Unknown | Near streams, lakes and washes |
| Barn Swallow (*Hirundo rustica*) | A,B,C,D,E,F | C-P summer resident | Unknown | Open or semi-wooded country, farms, ranches, fields, marshes and lakes usually near man's habitation |

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

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

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

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

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

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

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

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

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

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

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

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

| Species | Area Inhabited | Status | Trend | Habitat Use Area |
|---|---|---|---|---|
| White-crowned Sparrow (Zonotrichia leucophrys) | A,B,C,D,E,F | C-P resident | Unknown | In summer forest edges and clearings, low bru and mountain thickets; winter widespread in t valleys, along fence r willows, brushy areas, corn and greasewood |
| White-throated Sparrow (Zonotricia albicollis) | E,F | R-P winter resident | Unknown | Coniferous and mixed woodlands, woodland undergrowth thickets and brush |
| Golden-crowned Sparrow (Zonotrichia atricapilla) | E,F | R-P winter resident | Unknown | Mountain brush and brushy areas in the lower valleys |
| Swamp Sparrow (Zonotrichia georgiana) | F | U-P winter resident | Unknown | Marshes; in migration weedy fields |
| Fox Sparrow (Zonotrichia iliaca) | A,B,C | K-P summer resident and transient | Unknown | Valley and mountain woodlands and brushy areas usually near wat |
| Lincoln's Sparrow (Zonotrichia lincolnii) | A,B,C | U-P summer resident R-P winter resident | Unknown | In summer willow thickets, brushy bogs; in winter lowland thickets, tall weeds and bushes |
| Song Sparrow (Zonotrichia melodia) | A,B,C,D,E,F | C-P resident | Unknown | Woodland edges, grass-lands, cattail marshes thickets and brushy fence rows |

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

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

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

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

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

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

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

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

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

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

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

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



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

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

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

List of Game Species and Region of Introduction within Utah.

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

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

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

5 SMALL GAME-MAMMAL SPECIES

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

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

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

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

[1] Biogeographic areas of southeastern Utah
A- Wasatch Plateau east of Skyline Drive
B- West Tavaputs Plateau
C- East Tavaputs Plateau 10C-71
D- San Rafael Swell and Desert
E- Henry Mountains and Burr Desert
F- Mountains and Deserts south of I-70 in Grand and San Juan counties

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

| Class of Animal | Number of species | | | |
|---|---|---|---|---|
| | Statewide[1] | SER[2] | Gordon Creek Wildlife Management Area | Chinook Coal Loadout Area |
| Fish | 33 | 20 | 0 | 0 |
| Amphbians | 3 | 2 | 1 | 0 |
| Reptiles | 10 | 4 | 2 | 2 |
| Birds | 104 | 95 | 27 | 20 |
| Mammals | 61 | 40 | 15 | 12 |
| TOTAL | 211 | 161 | 45 | 34 |

1. Utah Division of Wildlife Resources as the state of Utah's wildlife authority recognizes 211 species of vertebrate wildlife that inhabit the state as being of high interest. High interest wildlife represent all game species and all species having significant economic importance from either a comsumptive or nonconsumptive perspective or special asthetic, scientific or educational values. This list includes all federally listed threatened or endangered species of wildlife.

2. Evaluation of data presented in Utah Division of Wildlife Resources publication No.78-16, " Species List of Vertebrate Wildlife That Inhabit Southeastern Utah" shows that 161 of the 211 species of the states high interest wildlife inhabit the Southeastern Region (SER) of the state on occasion or during different seasons of the year.

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# Appendix 10-D

# WILDLIFE SURVEY INFORMATION

Raptor Survey 1987

The Co-Op Mine properties were surveyed in the spring of 1987. The survey was conducted in cooperation with the Utah Division of Wildlife Resources. The results of that survey are as follows:

| Species | Year | Nest ID# | Map Reference |
|---|---|---|---|
| Golden Eagle | 1987 | 282 | 187.282 |
| Unknown Buteo | 1981 | 79 | 281.79 |
| Unknown Buteo | 1981 | 78 | 281.87 |
| Unknown Buteo | 1981 | 83 | 281.83 |
| Unknown Buteo | 1981 | 80 | 281.80 |
| Unknown Buteo | 1981 | 81 | 281.81 |
| Unknown Buteo | 1981 | 84 | 281.84 |
| Unknown Buteo | 1981 | 85 | 281.85 |
| Unknown Buteo | 1981 | 86 | 281.86 |

A copy of Plate 3-3 is attached showing the survey area and nest locations.

Co-Op Mining requests to suspend all future raptor surveys on their properties until such time that a survey is warranted. This request is based on Appendix R-1, correspondance from UDWR and R-2, DOGM Guidelines for Raptor Surveys. Co-Op will suspend raptor surveys based on the above as of March 1988 unless DOGM objects.

STATE OF UTAH
NATURAL RESOURCES
Wildlife Resources

Norman H. Bangerter, Governor
Dee C. Hansen, Executive Director
William H. Geer, Division Director

Northeastern Region • 455 West Railroad Avenue • Price, UT 84501-2529 • 801-637-3310

March 23, 1988

Mr. Melvin A. Coonrod
Environmental Industrial Supply
P.O. Box 258
Elmo, UT 84521

Dear Mel:

In regards to Beaver Creek Coal Company's request for you to assist them at conducting an annual raptor survey, the following is offered for your consideration.

Annual surveys for permitted facilities are not normally required. Where raptor nests are known to exist within one-half mile of surface disturbed areas/facilities, annual monitoring to determine the status of just those nests was recommended during the first 5-year permit period. Once the impacts, if any, from a coal facility on a raptor nest are established, monitoring could be discontinued.

From a planning perspective, there is value for a coal company to conduct at least one permit-wide survey every five years on their actively mined property. This would facilitate future and appropriately timed surface disturbing developments. When adequate historical data is not available and a new surface disturbing development is planned at a coal mining complex, a raptor survey within one-half mile radius of such may be recommended.

Personnel conducting a survey during the raptor breeding season, which lies between early February and mid August, and who approach within one-half mile of a nest are required to secure a "Certificate of Registration" from the Division. Survey work that is accurate and comprehensive always results in disturbance (harassment) to the birds. Such is not allowed without appropriate authorization. A certificate of registration will only be issued to a qualified raptor ecologist and for a specific survey area. Additionally, the survey technique will require Division approval before the certificate is issued. Generally speaking, precipitous terrain will require use of a helicopter during mid May and a biologically trained backup observer must accompany the raptor ecologist. Survey of arboral areas can be conducted on-the-ground by a raptor ecologist. On-the-ground survey must occur prior to leaf-out.

Mel, adequate baseline raptor data exists for Beaver Creek's Trail Mountain and Huntington Canyon (Mill Fork) properties due to an intense helicopter survey in May of 1987. Also, the Mill Fork properties have undergone final

reclamation. No raptor survey work is needed in association with the Castle Valley loadout project due to a lack of raptor nesting habitat and the already existing facility. The 3/6 mines in the Gordon Creek area (Coal Canyon) have also undergone final reclamation, thus no raptor survey is needed. The 2/7 mines in the Gordon Creek area remain in an actively developing mining project. The small amount of precipitous terrain associated with the permit area has potential for raptor nests. Also, the arboral areas on that permit tract have a potential for raptor nests. Neither setting has been adequately surveyed in recent years. If the company has plans to expand into undisturbed areas, a comprehensive survey during this spring (1988) would behoove their interests. If no such plans exist or have potential to arise, there is no justification for a survey.

I hope this assessment will provide the needed guidance for Beaver Creek Coal Company's decision. If a decision to conduct inventory is made, a helicopter doing such work will be in the area in May. Coordination with DOGM (AMR Program) and possibly Castle Gate Coal Company could reduce cost for such an inventory. Please advise if I can be of further assistance.

Thank you for an opportunity to provide comment.

Sincerely,

Larry B. Dalton, Resource Analyst
Southeastern Region

LBD/dd

cc: Darrell Nish, DWR
Randy Radant, DWR
Lowell Braxton, DOGM
CLark Johnson, USFWS

Utah Division of Oil, Gas and Mining
Standards and Procedures for Raptor Surveys

The following should be considered a supplement to the Division's Fish and Wildlife Information Guidelines and will be incorporated into those guidelines when they are revised.

Before the Survey:

1. Consult with the Division to determine if a survey is necessary. This contact may be part of the normal wildlife consultation process for permit submission. If a survey is required, the following are general guidelines for surveys:

   a. New mine permit or activity involving long term disturbance: The minimum requirement for baseline information is a survey of suitable habitat within a .5 mile radius of surface disturbing construction or operations activities. Surface disturbance includes potential areas of subsidence on cliffs.

      A baseline survey of the entire permit area is recommended to prevent delays for clearances on amendments and permit renewals and may be required by the Division. Follow-ups on baseline surveys may be required for five year permit renewals.

   b. Short term disturbances, e.g. small construction projects or exploration: If disturbance is to occur in the breeding season of February 15 to July 15, survey suitable habitat within .5 mile radius of the disturbance. If there will be no disturbance during the breeding season, surveys can usually be limited to the actual disturbance site.

   c. Monitoring: Monitoring studies (i.e. methods, locations, scheduling) should be developed on a site by site basis. Except for special situations, survey flights are not required of the entire permit area or of all known nests. Monitoring will usually include reporting on known and new nests in the .5 mile buffer area around disturbances.

2. Contact (a) the Resource Analyst at the appropriate regional office of the Utah Division of Wildlife Resources; (b) the Field Supervisor, U.S. Fish and Wildlife Service, RM 2060, 1745 W. 1700 So., Salt Lake City, Utah 84104; and (c) the office of the appropriate federal land management agency, if applicable, for their most recent data on area raptors.

   These state and federal agencies share information on raptors but one or more may have different data if recent work has been done by an agency.

Baseline Survey:

1. In most cases a helicopter is necessary for a baseline survey of cliff raptor habitat or any large scale survey of tree nesting species. Fixed wing aircraft cannot, generally, fly slow and close enough for an adequate survey. Ground monitoring may be useful after nest areas are identified but should not be considered a substitute for baseline data collection from a helicopter.

STATE OF UTAH
NATURAL RESOURCES
Oil, Gas & Mining

Norman H. Bangerter, Governor
Dee C. Hansen, Executive Director
Dianne R. Nielson, Ph.D., Division Director

W. North Temple • 3 Triad Center • Suite 350 • Salt Lake City, UT 84180-1203 • 801-538-5340

April 28, 1988

TO: John Whitehead, Permit Supervisor

FROM: Brent Stettler, Reclamation Biologist Brent

RE: Review of Co-Op Mining Company's Annual Report of March 30, 1988, Bear Canyon Mine, ACT/015/025; and Trail Canyon Mine, ACT/015/021, Folder #2, Emery County, Utah

The Bear Canyon PAP, page 3-101, states: "All interim seeded areas will be inspected at the end of each growing season to determine the success of the seeding program... Standard methods, as outlined in Chapter 9, Vegetative Resources, will be applied to determine the degree of success for revegetation attempts."

Annual interim revegetation monitoring was not entirely satisfactory for the following reasons:

1. Sampling locations were not described or shown on a map.

2. Shrub density sampling was omitted in 1987. This should be completed in future years.

3. Concern for sample adequacy was neglected. Sampling consisted of only 40 points on the upper pond and 30 points on the lower pond. The Division's Vegetation Guidelines, page 11, recommends ten times as many sample points, depending on the size of the site and its homogeneity.

4. Methods were not stated or referenced back to the PAP. The reader is left to wonder what took place. Non-random selection of so few sample points may have biased the data markedly.

5. Results and discussion were limited to: "The survey indicated that the site is approximately 70 percent vegetative cover and appears stable. No additional seed appears necessary." The reader is left to do his own data reduction and analysis from copies of the attached field sheets.



an equal opportunity employer

My data reduction confirmed upper pond A as having more than 70 percent vegetative cover, as reported. However, Russian thistle (Salsola kali), an annual weed, comprised 67 percent of the total vegetative cover. Yellow sweetclover (Melilotus officinalis), a non-persistent biennial, comprised 20 percent of the total vegetative cover. Only 4 of 40 sample points fell on perennial grass (two Agropyron species). The condition of this interim revegetation site should not be considered stable, as reported. Additional seeding or cultivation will be required if the trend in future years is not toward a more desirable and permanent vegetative cover.

Revegetation appeared more successful on the lower pond, although the 50 percent vegetative cover departed from the figure reported. Lower pond vegetative cover consisted of 23 percent grass cover, 10 percent perennial forbs, over 13 percent Russian thistle, and 3 percent unknown.

Future interim revegetation monitoring should include a reasonable number of randomly-selected samples -- sufficient to provide meaningful data. Other interim revegetation sites (in addition to pond outslopes and new disturbance) should be sampled as well. Shrub density should be evaluated. More attention needs to be given to report writing. Methods and results sections would especially benefit from elaboration.

The Annual Report provides raptor survey results as Part Three. Co-Op Mining Company requests that future raptor nest surveys be suspended. The Division consents to this request, unless new disturbance warrants a clearance survey. In such a case, the survey must be coordinated with a Division of Wildlife Resources raptor ecologist.

djh
cc: M. Coonrod
1369R/25

# CHAPTER 11

# CLIMATOLOGY AND AIR QUALITY

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# 11 CLIMATOLOGY AND AIR QUALITY

## 11.1 SCOPE

This chapter describes general climatology and air quality of the Co-Op Mining Company (Co-Op) Permit area and the effects of mining on ambient air quality. Fugitive dust emission sources are identified, and an est of uncontrolled emissions is made. Existing and proposed controls are discussed along with an est of controlled emissions. Data is based on a 400,000 ton/yr production. A precipitation and wind monitoring plan is briefly described.

## 11.2 METHODOLOGY

The climatological data obtained from the U.S. Weather Bureau at Hiawatha, Utah, were incorporated with the data from the Hydrologic Atlas of Utah (Jeppson et. al, 1968). Wind information was gathered by personal communication with the Utah State climatologist (Appendix 11-A). Uncontrolled fugitive dust emissions were est by using emission factors provided by the Environmental Protection Agency at Denver, Colorado. The best available control technology (BACT) was used to est the total emissions.

## 11.3 EXISTING ENVIRONMENT

The climate of the Bear Canyon Mine area is typical of subalpine areas in the central region of Utah. In general, the summer season is short with max temp reading (°F) in the 80's and min readings in the 40's. Fall and spring seasons are erratic in nature with snow precipitation occurring as early as September and as late as the first part of June. Winters in this subalpine area are often severe, with recorded temp. of -20°F or below at times. Major snowfalls occur in the months of December, January, and February. Snow frequently remains on the ground from November until April in depths varying up to 6 ft. Winds are generally light to moderate with avg speeds below 21 m.p.h. The prevailing wind direction within the general area of the mine site is form the southwest. Winds are generally parallel to the canyon except during storm periods. Wind speed varies from canyon to canyon.

Est annual avg background total suspended particulate (TSP) in rural, central Utah is approx 20 $\mu g/m^3$ (AeroVironment, 1977). Because of the proximity to the existing mine, background TSP could be higher than the avg background total for typical rural areas.

### 11.3.1 Precipitation

Precipitation varies greatly in the vicinity of the permit area due to the Manti-LaSal Mountain Range. Local factors affecting precipitation in the area are altitude, topography, and geographic location relative to the west-to-east storm track. The normal annual precipitation at the center of the permit area is approx 8 in. to 10 in. greater that it is near the office area.

The nearest weather monitoring station is at Hiawatha, located about 5 mi northeast from the center of the permit area. The annual precipitation recorded at Hiawatha station is 13.18 in. Table 11-1 shows the precipitations recorded from 1916 to 1975. An isohyetal map from the Hydrologic Atlas of Utah shows an annual precipitation of 22 in. at the center of the permit area. (This is the source of the discrepancy referenced in the OSM completeness determination.) Approx 16 in. or 73% of this precipitation occurs as snow from October to April. The other 6 in. or 27% occurs from May to September as rainfall. Snow accumulation avg 4.5 ft; a max snow depth of 6 ft is to be expected.

Table 11-1 Precipitation Totals (in)

| Month | Mean | Greatest Daily | Year | Snow Mean | Snow Maximum Monthly | Snow Year |
|---|---|---|---|---|---|---|
| Jan | 0.87 | 0.92 | 1944 | 21.3 | 59.0 | 1969 |
| Feb | 0.98 | 1.29 | 1923 | 12.8 | 47.0 | 1969 |
| Mar | 0.99 | 1.20 | 1935 | 9.7 | 39.5 | 1952 |
| Apr | 0.91 | 1.33 | 1944 | 4.0 | 22.0 | 1965 |
| May | 1.05 | 2.00 | 1922 | 2.0 | 25.0 | 1964 |
| Jun | 1.04 | 2.14 | 1941 | 0.2 | 1.0 | 1925 |
| Jul | 1.22 | 1.20 | 1973 | 0.0 | 0.0 | - |
| Aug | 1.92 | 2.05 | 1946 | 0.0 | 0.0 | - |
| Sep | 1.26 | 1.73 | 1961 | 4.2 | 11.0 | 1965 |
| Oct | 1.20 | 1.54 | 1941 | 1.3 | 14.0 | 1961 |
| Nov | 0.73 | 1.35 | 1943 | 6.6 | 30.5 | 1951 |
| Dec | 1.01 | 1.53 | 1916 | 13.0 | 50.5 | 1951 |
| Annual | 13.18 | 2.14 | Jun 1941 | 74.5 | 59.0 | Jan 1969 |

Station: Hiawatha
Elevation: 7,220 ft
Period of Record: 1916 - 1975
Longitude: 110° 01'
Latitude: 39° 29'

### 11.3.2 Temperature

Temperature is seasonally variable and highly influenced by elevation. January temp vary from a mean min of approx 13°F to a mean max of approx 30°F. July temp vary from a mean min of 54°F to a mean max of 82°F (Jeppsen et al., 1968). Similar temp ranges are recorded at Hiawatha Station. Table 11-2 shows the temp recorded between 1922 and 1975. The avg annual temp is 45°F. July is the warmest month (avg 69°F) and January, the coldest (avg 23°F). Wide daily temp ranges are caused by relatively strong daytime warming and rapid night time cooling.

### 11.3.3 Evaporation and Relative Humidity

Potential evaporation is about 40 in/yr. Transpiration is less than 18 in/yr. Relative humidity ranges from a summer avg of 45% to a winter avg of 85%.

Table 11-2 Temperatures (°F)

| Month | Means: Daily Maximum | Means: Daily Minimum | Means: Monthly | Extremes: Record Highest | Extremes: Year | Extremes: Record lowest | Extremes: Year |
|---|---|---|---|---|---|---|---|
| Jan | 32.2 | 13.5 | 22.9 | 59 | 1971 | -16 | 1971 |
| Feb | 36.2 | 17.4 | 26.8 | 59 | 1971 | -18 | 1933 |
| Mar | 43.9 | 22.7 | 33.9 | 68 | 1966 | -10 | 1964 |
| Apr | 54.5 | 31.1 | 42.9 | 80 | 1928 | 7 | 1975 |
| May | 64.8 | 39.9 | 52.3 | 86 | 1936 | 18 | 1965 |
| Jun | 74.4 | 48.9 | 61.7 | 93 | 1961 | 26 | 1943 |
| Jul | 82.0 | 56.2 | 69.1 | 95 | 1931 | 35 | 1968 |
| Aug | 79.0 | 54.5 | 65.4 | 93 | 1940 | 33 | 1968 |
| Sep | 71.3 | 46.6 | 59.0 | 92 | 1934 | 19 | 1965 |
| Oct | 59.0 | 36.6 | 47.8 | 78 | 1933 | 10 | 1972 |
| Nov | 43.5 | 24.1 | 33.8 | 63 | 1975 | -2 | 1931 |
| Dec | 34.4 | 16.1 | 25.0 | 58 | 1959 | -12 | 1924 |
| Annual | 56.3 | 34.0 | 45.1 | 95 | Jul 1931 | -18 | Feb 1933 |

Station: Hiawatha
Elevation: 7,220 ft
Period of Record: 1922 - 1975

Longitude: 110° 01'
Latitude: 39° 29'

### 11.3.4 Wind Direction and Velocity

In general winds are light to moderate, with avg speeds below 20 mph[1]. Wind speed varies from canyon to canyon. At the Bear Canyon Portal area, the avg wind speed is est at 10 mph, directed from west-southwest. Tornadoes are very rare, but strong winds may occur, particularly in these mountain passes and canyons. The highest gust in the vicinity of the mine site is expected to be more than 100 mph. The gust would occur under extremely unstable conditions with active fronts. See Appendix 11-A.

### 11.3.5 Air Quality

The permit area has been designated a class II area for purposes of prevention of significant air quality deterioration. Particulate are the only pollutant that would contribute to air pollution as a result of mining activities. Increases in other pollutants such as sulfur dioxide, nitrogen oxides, carbon monoxide, and photochemical oxidants would be negligible.

An annual avg background level for total suspended particulate (TSP) in rural, central Utah areas of 20 micrograms per cubic meter ($\mu g/m^3$) has been est (AeroVironment, 1977). This is significantly below the Federal secondary standard of 60 $\mu g/m^3$. Because of proximity to existing mines, background TSP levels at the site

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[1]Arlo Richardson, Utah State Climatologist, Utah State University.

would be expected to be higher than avg for rural areas. The short term (24 hr) National Ambient Air Quality Standard (NAAQS) can be exceeded in rural Utah as a result of windblown dust. TSP data from three near-by monitoring stations are shown Table 11-3. The background visual range was est to be 37 mi (60 km) based on the background TSP est (AeroVironment, 1977).

## 11.4 EFFECTS OF THE MINING OPERATION ON AIR QUALITY

### 11.4.1 Estimates of Uncontrolled Emissions

The following sources of dust emissions have been identified:

a. topsoil removal and storage

b. access road

c. coal handling facilities

Table 11-4 shows an uncontrolled emission factor for each process operation. A total of 69.01 ton/yr of uncontrolled emission is est from the mining activities at the max coal production rate of 400,000 ton/yr.

Table 11-3 TSP Readings at Stations Near the Lease Area

| Location | Period of Observation | Max[1] 24-Hour Avg | AGM[2] ($\mu g/m^3$) |
|---|---|---|---|
| Price | 6/75-12/75 | 181 | 72 |
| Huntington Canyon | 1975 | 191 | 22 |
| Bear Creek Canyon | 1974 | 222 | 21 |

1. National Ambient Air Quality Standards for max 24 hr particulate concentrations are 150 $mg/m^3$ and 260 $\mu g/m^3$ for the secondary and primary standards, respectively.

2. National Ambient Air Quality Standard for the annual geometric mean (AGM) is 60 $\mu g/m^3$ for the primary standard.

Source: Adapted from Table 11-13 on page 11-37 of the Draft Environmental Statement Development of Coal Resources in Central Utah, prepared by the U.S. Department of the Interior.

Table 11-4 Dust Control Factors

| | Uncontrolled (ton per yr) | Factor (pct) | Controlled (ton per yr) |
|---|---|---|---|
| Haul Roads | 46.34 | 85 | 6.95 |
| Access Roads | 4.0 | 85 | 0.60 |
| Coal Storage | 10.5 | 50 | 5.25 |
| Conveyors | 40 | 99 | 0.4 |
| Crusher | 4 | 99 | 0.04 |
| Screens | 20 | 99 | 0.2 |
| Product Removal | 10 | 50 | 5.0 |
| TOTAL | 134.84 ton/yr | | 18.44 ton/yr |

### 11.4.2 Description of Control Measures Fugitive Dust Control Plan

The following subsections describe in detail the fugitive dust control measures that are in effect or are planned for the mine plan for each of the listed sources.

TOPSOIL REMOVAL AND STORAGE PILE

The operator currently implements a water spray program during operations involving topsoil removal and stockpiling. Revegetation of stockpile areas is initiated after topsoil has been replaced.

ACCESS ROADS

The roads leading to material supply, storage areas and the connecting road from the Bear Canyon Portal area to the coal loading area experience frequent use. When necessary, a soil stabilizing agent will be worked into the upper layer of the roadbed. A road grader is used periodically to remove accumulations of spilled materials from the roadbeds. Vehicular speed is limited to a max of 30 mph. Periodically, or as necessary during the operating life of the mine, the roads will be treated with water and/or nontoxic dust suppressants.

## COAL HANDLING FACILITIES

Principal sources of fugitive dust emissions related to the coal handling facilities have been identified as conveyor, crusher building, and coal storage. The proposed control measures for each of these sources are discussed individually below.

Conveyors. Conveyors, housing the main belts from the mine portals to the run of mine coal intermediate stockpile, will be covered. Transfer points in the raw coal/crusher area contain water sprays or other dust control methods as applicable. The conveyor discharge height is minimized.

Crusher Building. The primary crushers are enclosed and contain water sprays or other measures. Crushed coal is transported to the storage area conveyor.

Coal Storage Pile. The coal storage pile is periodically sprayed with water and/or nontoxic dust suppressants. The coal pile is oriented in an area to best protect it from the prevailing wind direction and minimize wind erosion.

### 11.4.3 Estimate of Controlled Emissions

Emission have been est for the max projected coal production of 400,000 ton/yr. The major portion of this coal is transported via conveyor.

Based on the control practice outlined in the EPA Region VIII Interim Policy paper on the Air Quality Review of Surface Mining Operation, the est total controlled emission is approx 9.461 ton/yr. Table 11-5 shows the est emissions by applying BACT to the uncontrolled emission est of Table 11-4.

### 11.4.4 Estimated Cost of Emission Control

The est cost of emission control consists of equipment capital cost and operating cost. Equipment capital cost includes; installed cost for water spray equipment, enclosures, telescoping chutes, and conveyor cover. The operating cost includes; direct costs of utilities, maintenance, and operating labor for chemical dust suppressants.

The existing emission controls are covers for conveyor silo and stacking tube, and treated coal haul road. The conveyor cover was installed at $15,000 and the stacking tube cover cost about $4,000. A water-spray truck cost about $20,000.

Table 11-5 Dust Control Calculations

Storage Pile (Coal)

Average size of pile — 5,000 ton (10,000 ton capacity, normally less than 1,000 ton)

Put through — 400,000 ton/yr

D = 9.125 s = 20
d = 175 (Hiawatha weather station -151 days snow cover - 39 additional days .01 in. or more rainfall)

e = .05 x 20/1.5 x 175/235 x 15/15 x 9.125/90 = 0.0525

0.0525 x 400,000 ton = 10.5 ton/yr

Control - Coal is sprayed with water as it is being mined in order to meet underground dust control requirements. Additional spray equipment are installed at the storage site to use as needed.

Crushing (primary only)

400,000 ton x 0.02 = 4,000 lbs = 4 ton/yr

Control - Enclosed and water sprays.

Screening

400,000 ton x 0.1 = 40,000 lbs = 20 ton/yr

Control - Bag house or water sprays.

Conveyor and Transfer Points

400,000 ton x 0.2 = 80,000 lbs = 40 ton/yr

Control - Enclosed and water sprays.

Roads (Haul) s = 15 S = 20 W = 190

E = 5 x 0.47945 = 2.39725 @ 38666.66 mi/yr = 46.34 ton/yr

Control - Water spray.

Roads (Access) s = 15 S = 10 W = 190

E = 2.5 x 0.47945 = 1.1986 @ 6,000 mi/yr = 4.0 ton/yr

Control - Water spray.

Product Removal

400,000 ton x 0.05 = 10 ton/yr

Control - Water spray.

The operating cost for soil stabilization depends on the kind of product used as dust suppressant. The manufacturer est the treatment cost varies from $300 to $1,000 per acre depending on the size of the project, rate of dilution, and distance from the source of supply. For the Co-Op Permit area, the application of a product such as Coherex from May to October would cost about $5,000.

Therefore, $39,000 is est for capital cost, and $5,000 is est for annual operating cost for emission control.

## 11.5 CLIMATOLOGICAL AND AIR QUALITY MONITORING

The annual precipitation within the lease area ranges from 13 in near the mine office to 15 in at the center of the lease area. Since the precipitation varies significantly within the lease area, the Co-Op is planning to install a precipitation gauge and will monitor it routinely. The monitoring result will be reported to USGS and USFS.

Air quality is being monitored at the lease area by U.P.&L. through Utah State University. Particulate are the only pollutant that might impact air quality at the mine area. Increases in concentrations of other pollutants such as sulfur dioxide, nitrogen oxide, carbon monoxide, and photochemical oxidants would be negligible. The main source of TSP would be coal particles which would settle out within short distances (one mi or less) downwind.

The mining operation would not be a "major source" under the prevention of significant deterioration (PSD) regulations because total annual controlled emissions of particulate matter are expected to be less than 250 ton/yr. Therefore, the requirement for a PSD permit and for air quality monitoring is not anticipated, based on the 7 July 1980, PSD Regulation 40CFR, Parts 51, 52, 53, and 124.

## 11.6 BIBLIOGRAPHY


AeroVironment, Inc., 1977, Assemblage of data on air quality in central and southern Utah and assessing the impact of coal development in this region on the air quality: Pasadena, Ca., Final Report.

Environmental Protection Agency (EPA), 1978, Memorandum 8EA: Denver, Co., U.S. EPA Region VIII.

Jeppson, R.W., Ashcroft, G.L., Huber, A.L., Skogerboe, G.V., and Bagley, J.M., 1968, Hydrologic Atlas of Utah, Utah Water Research Laboratory and State of Utah Department of Natural Resources, PRWG35-1, Utah State University, Logan, Utah.

Richardson, Arlo, Utah State Climatologist, Utah State University, Logan, Utah, in a personal communication in December 1980.

# Appendix 11-A

# AIR QUALITY MONITORS

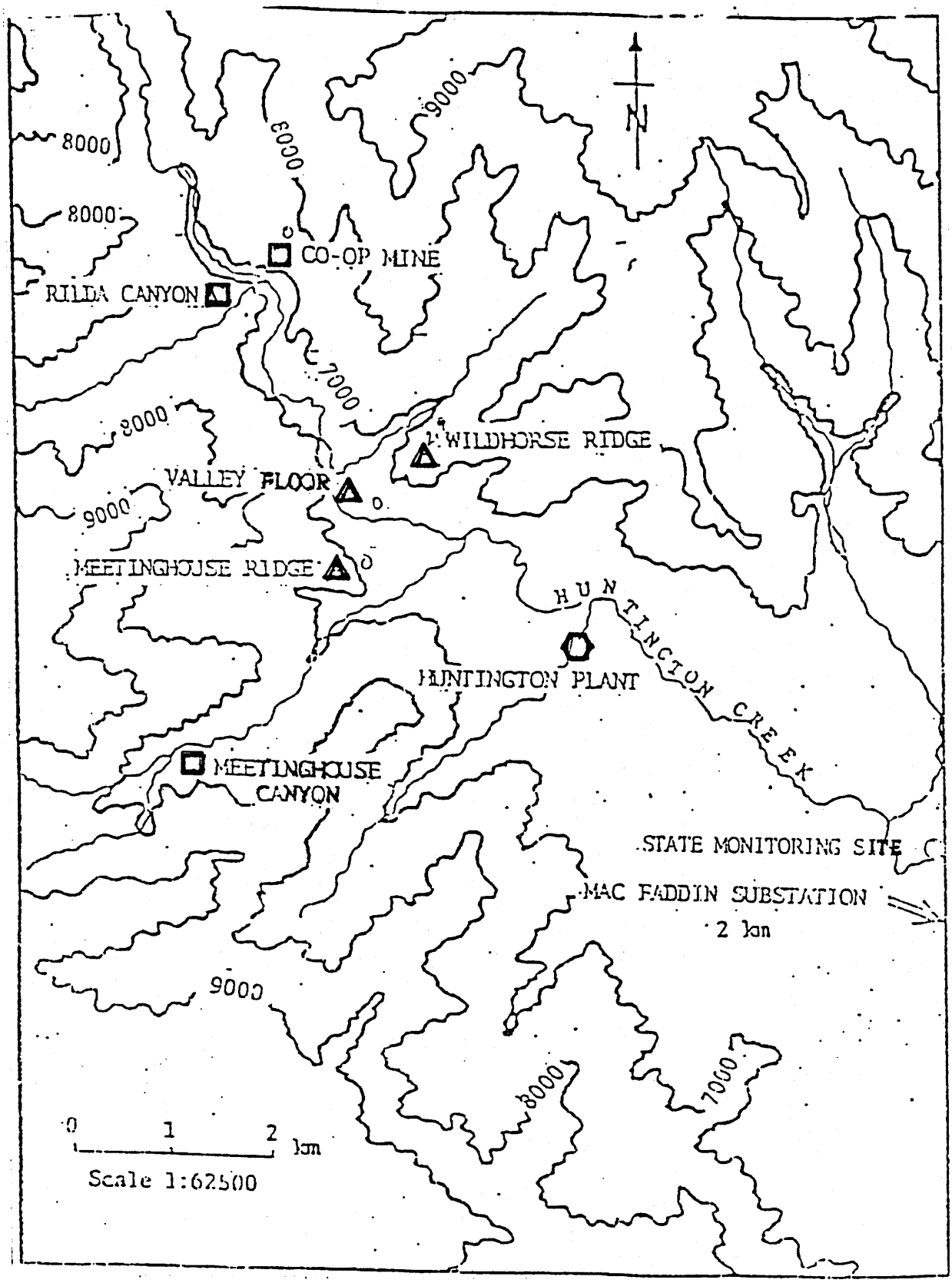


Figure 11A-1 Air Quality Monitor Locations, Huntington Canyon, Emery County, Utah

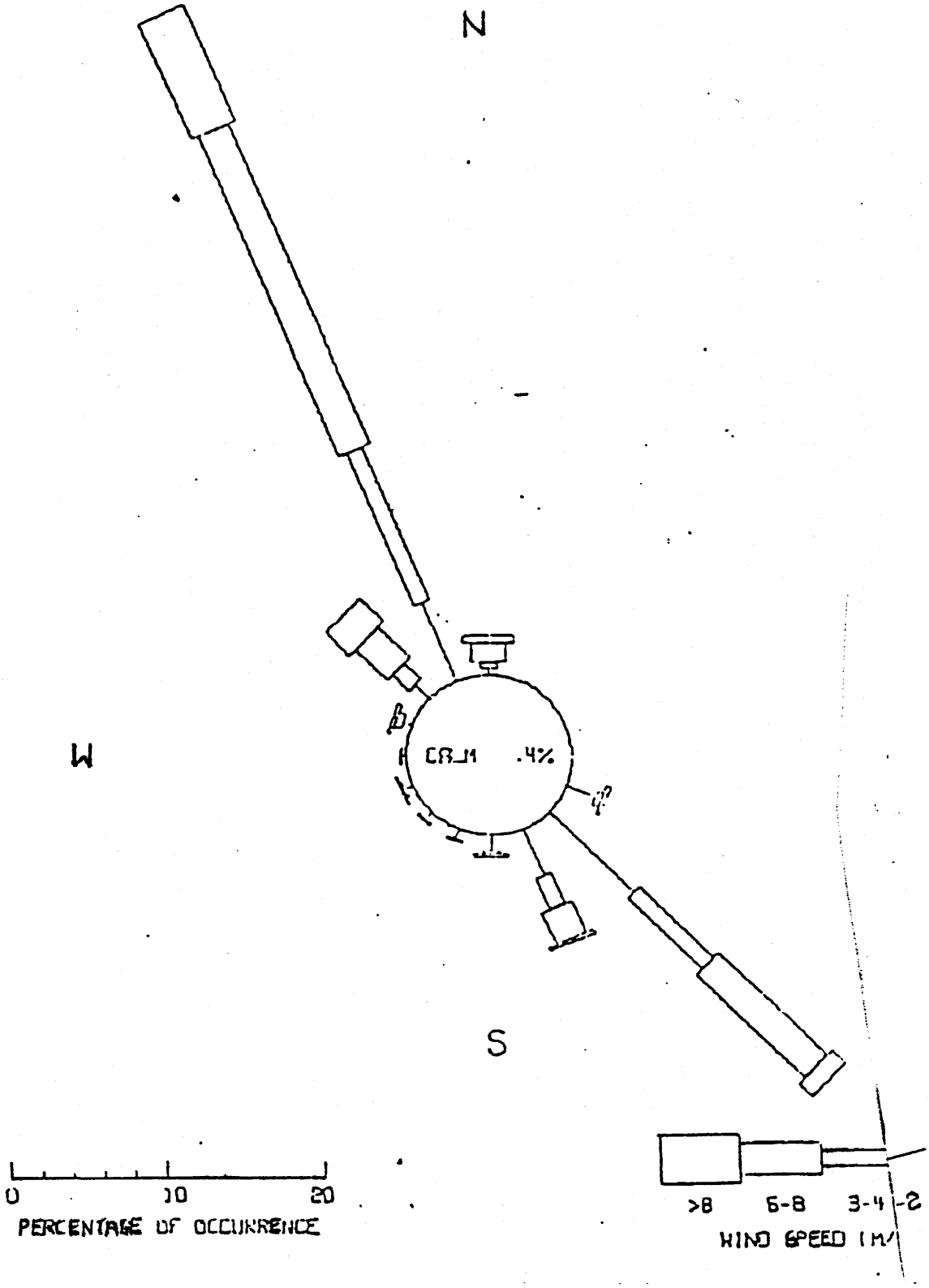


Figure 11A-2 Wild Horse Ridge, October 1977 thru April 1978, All times.

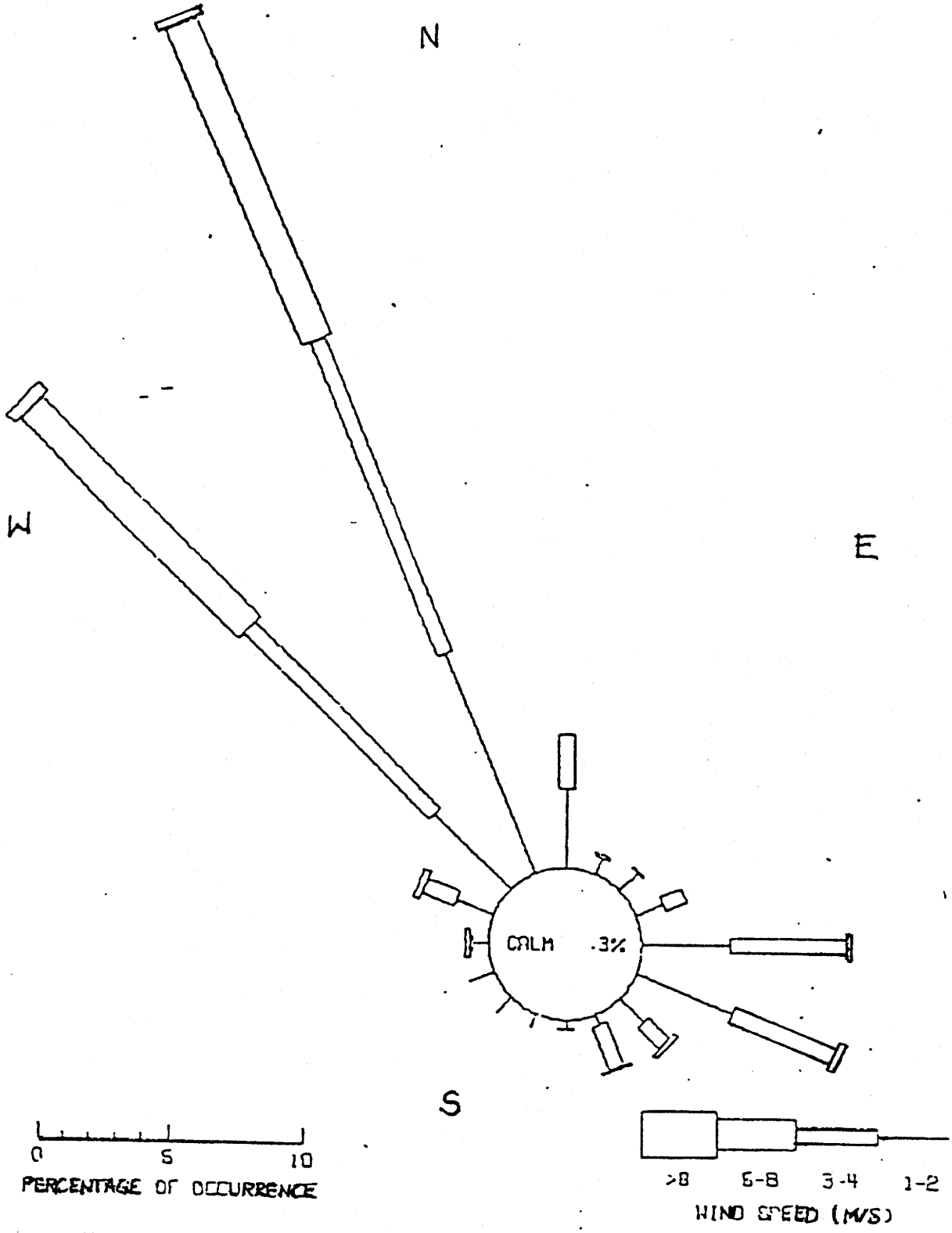


Figure 11A-3 Valley Floor, October 1977 thru April 1978, All times.

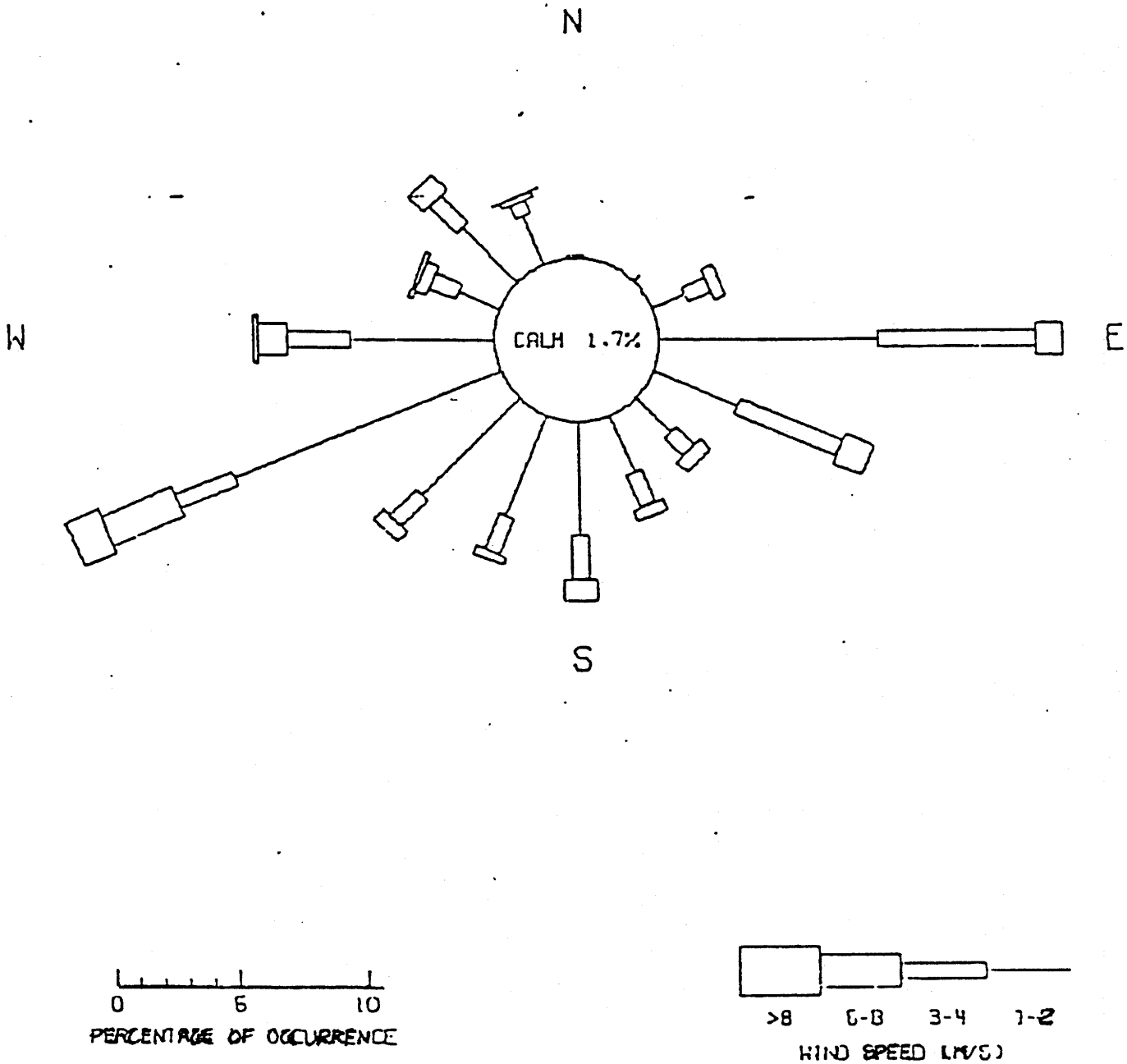


Figure 11A-4 Meeting House Ridge, October 1977 thru April 1978, All times.

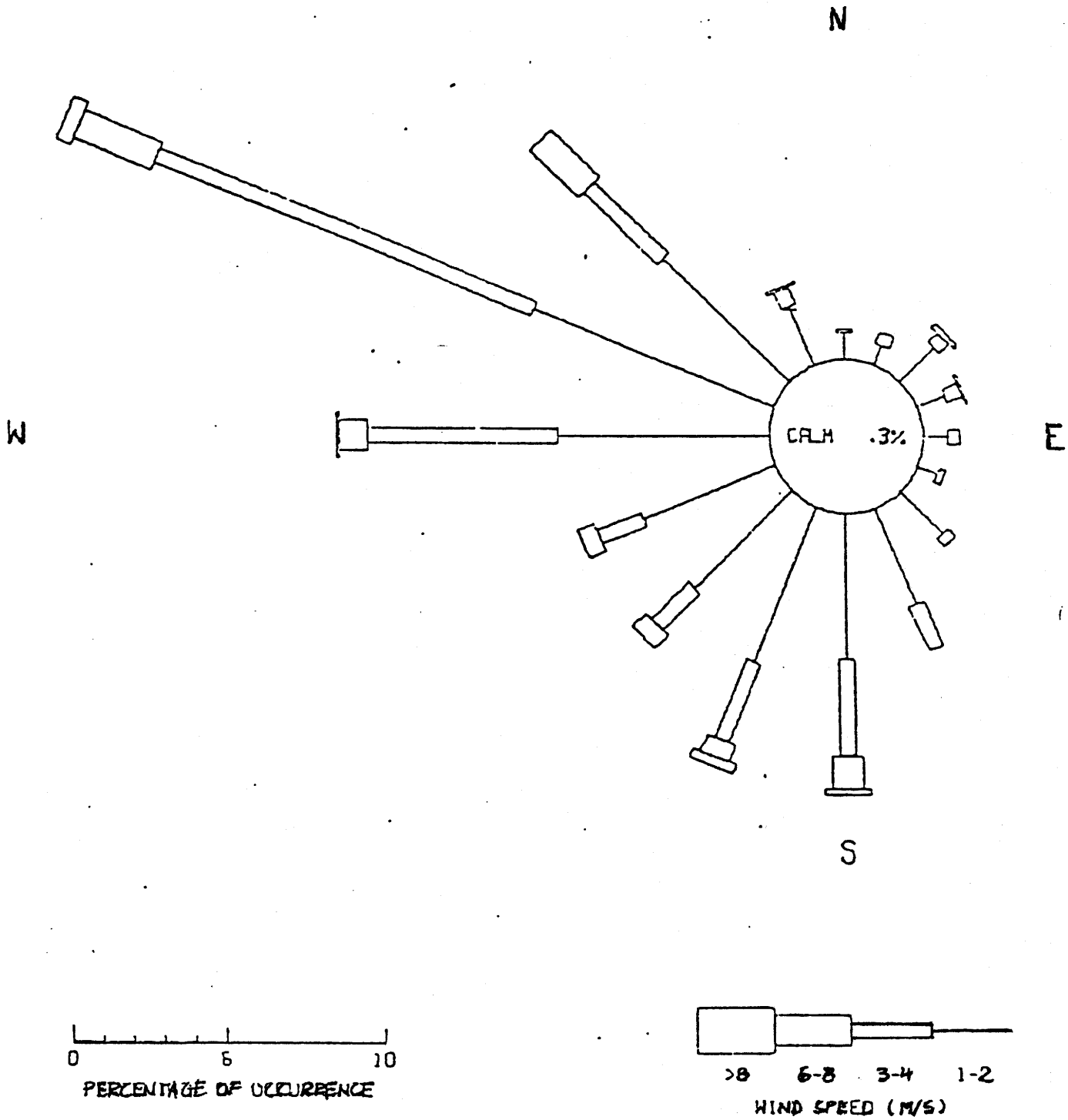


Figure 11A-5 Mac Faddin Station, December 1977 thru April 1978, All times.

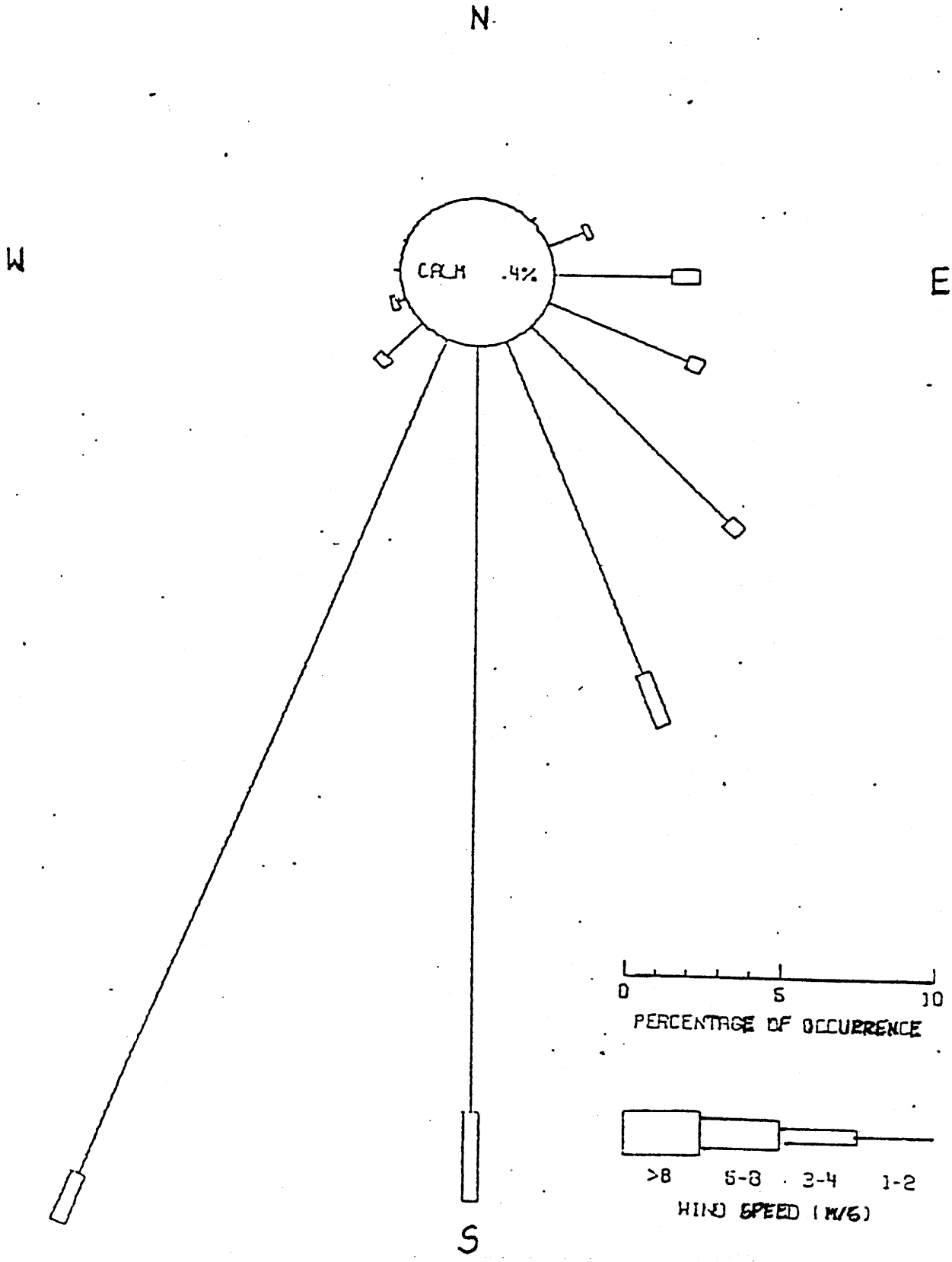


Figure 11A-6 Meeting House Canyon, December 1977 thru April 1978, All times.

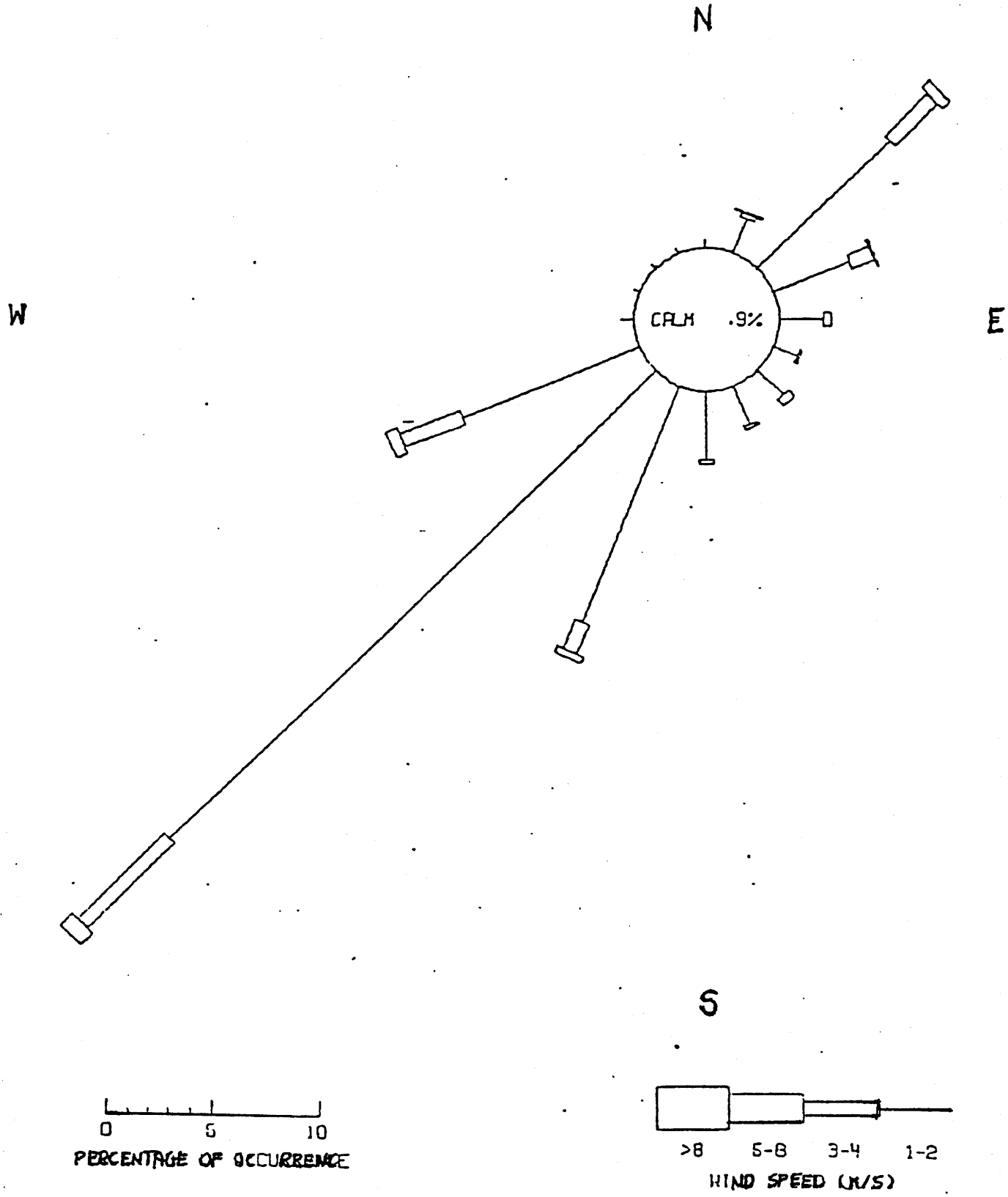


Figure 11A-7 Rilda Canyon, December 1977 thru April 1978, All times.

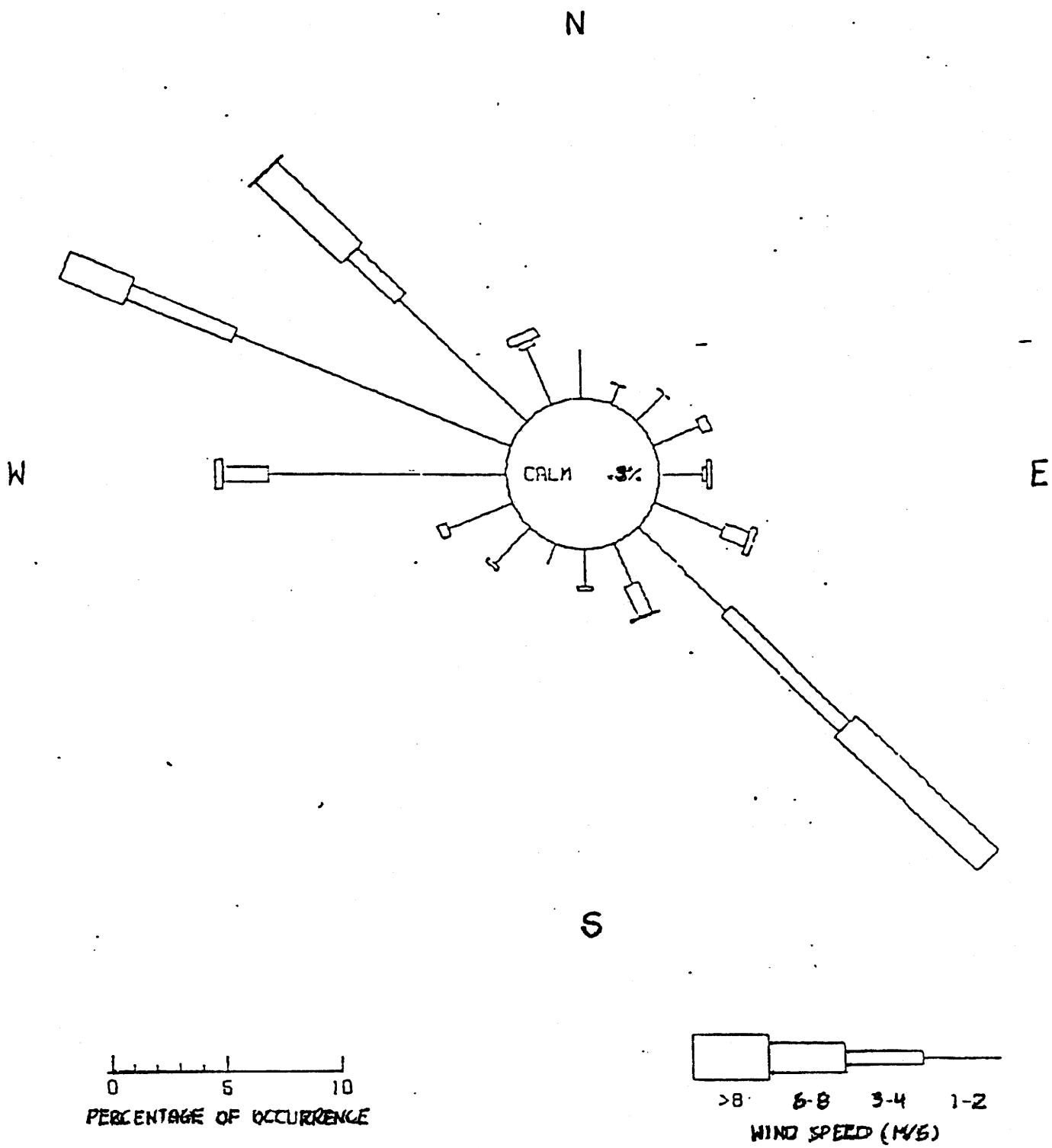


Figure 11A-8 Co-Op Mine, October 1977 thru April 1978, All times.

# Appendix 11-B

# APPROVALS

Scott M. Matheson
Governor

James O. Mason, M.D., Dr.P.H.
Executive Director
801-533-6111

DIVISIONS
Community Health Services
Environmental Health
Family Health Services
Health Care Financing

OFFICES
Administrative Services
Community Health Nursing
Management Planning
Medical Examiner
State Health Laboratory

STATE OF UTAH
# DEPARTMENT OF HEALTH
## DIVISION OF ENVIRONMENTAL HEALTH
150 West North Temple, P.O. Box 2500, Salt Lake City, Utah 84110-2500

Kenneth Lee Alkema, Directo
Room 474 801-533-6121

December 20, 1983
533-6108

Wendell Owen
Co-Op Mining Company
P. O. Box 300
Huntington, Utah 84528

RE: Approval Order for Modifications to Air Pollution Control at Coal Mine, Emery County

Dear Mr. Owen:

On October 28, 1983, the Executive Secretary published a notice of intent to approve the modifications to the air pollution control equipment for the surface operations at your coal mine in Emery County. The 30 day public comment period has expired, and no comments were received.

This air quality approval order authorizes the modifications as proposed in your notice of intent dated October 14, 1983, with the following operating conditions:

1. All emission control equipment shall be properly installed, maintained, and operated as proposed in the notice of intent dated May 5, 1980, and subsequent information dated October 14, 1983.

2. No visible emissions from any point shall exceed 20% opacity as measured by EPA test Method 9.

3. Annual production of coal shall not exceed 200,000 tons without prior approval from the Executive Secretary in accordance with Section 3.1, UACR.

4. Crushers, screens, conveyors, and all transfer points shall be controlled by water sprays to minimize fugitive emissions. The water sprays shall operate whenever the mine is operating.

5. The haul roads and access roads shall be water sprayed to minimize fugitive dusts at least twice per eight hour shift unless daily precipitation exceeds 0.05 inches for that day.



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6. The stockpile and loadout areas shall be sprayed (water or other suppressant) as dry conditions warrant or as determined necessary by the Executive Secretary.

7. A compliance inspection shall be performed within 30 days of the date of this approval order.

The fee for issuing this modified approval order is $179.17. (See enclosures for breakdown of costs.) The amount is payable to the Utah Department of Health, sent to the Executive Secretary of the Utah Air Conservation Committee, and is due within 30 days after the approval order date.

Sincerely,

Brent C. Bradford
Executive Secretary
Utah Air Conservation Committee

MK

MRK/ads
cc: EPA Region VIII (J. Philbrook)
Southeastern District Health Dept.
Enclosures (2)

4367

STATE OF UTAH
DEPARTMENT OF HEALTH

NORMAN H. BANGERTER, GOVERNOR

SUZANNE DANDOY, M.D., M.P.H., EXECUTIVE DIRECTOR

FEB 20 1986
533-6108

Melvin A. Coonrod
CO-OP Mining Company
P. O. Box 1245
Huntington, Utah 84528

RE: Approval Order for Bear Canyon Mine, Production Increase
Emery County CDS B

Dear Mr. Coonrod:

The above referenced project has been reviewed by the Executive Secretary, Utah Air Conservation Committee and found to be consistent with the requirements of the Utah Air Conservation Regulations (UACR) and the Utah Air Conservation Act. A 30 day public comment period was held and all comments received were evaluated. The conditions of this approval order reflect any changes to the Executive Secretary's original determination which resulted from the evaluation of the comments received. This air quality approval order authorizes the project with the following conditions:

1. CO-OP Mining Company shall install the proposed Bear Canyon mine expansion according to the information submitted to the Executive Secretary in the notice of intent dated June 3, 1985, and the follow-up correspondence dated November 18, 1985.

2. Visible emissions from any point or fugitive source in the installation or control facilities shall not exceed 20% opacity. Opacity observations of emissions from stationary sources shall be conducted in accordance with 40 CFR 60, Appendix A, Method 9. Opacity observations of mobile sources and intermittent sources shall use procedures similar to Method 9, but the requirement for observations to be made at 15 second intervals over a 6 minute period shall not apply. Opacity of any reading shall not exceed 20% for mobile and intermittent sources.

3. All unpaved haul roads and other operational areas in use shall be water sprayed to minimize fugitive dust as dry conditions warrant or as determined necessary by the Executive Secretary. Water treatment may be replaced by chemical dust suppression, provided a plan is approved by the Executive Secretary.



KENNETH L. ALKEMA, DIRECTOR • DIVISION OF ENVIRONMENTAL HEALTH

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4. Water or chemical dust suppression sprays shall be installed to control dust emissions from the following sources:

a. Mine Operations

b. Storage Piles

c. Crushing/Screening

d. Conveying

e. Load-out

5. All installations and facilities authorized by this approval order shall be maintained and operated in proper condition.

6. The Executive Secretary shall be notified upon start-up of the installation, as an initial compliance inspection is required.

7. Plant production shall not exceed 4500 hours per year without prior approval of the Executive Secretary in accordance with Section 3.1, UACR.

8. In addition to the requirements of this approval order, all provisions of 40 CFR 60.250 (NSPS Subpart Y ) shall apply to this installation.

9. For purposes of section 3.1.5 UACR a "continuous program of construction" shall be defined as normal operation achieved by July 1, 1987.

The fee for issuing this approval order is $1,019.40. The amount (see enclosure for breakdown of costs) is payable to the Utah Department of Health, sent to the Executive Secretary, Utah Air Conservation Committee, 2870 Connor Street, Salt Lake City, Utah 84109 and is due within 30 days after receipt of this approval order.

Sincerely,

Brent C. Bradford
Executive Secretary
Utah Air Conservation Committee

LRM/jg
0240A

CC: EPA Region VIII (Norm Huey)
Southeastern District Health Department
Enclosure