APPENDIX 7-J

PROBABLE HYDROLOGIC CONSEQUENCES OF MINING AT BEAR CANYON MINE, EMERY COUNTY, UTAH

CO-OP MINING COMPANY
Bear Canyon Mine
Emery County, Utah

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PROBABLE HYDROLOGIC CONSEQUENCES OF MINING AT BEAR CANYON MINE EMERY COUNTY, UTAH

1.0 INTRODUCTION

The purpose of this document is to present an assessment of the probable hydrologic consequences of operating and reclaiming Bear Canyon Mine. Where possible, the impacts from potential future expansions will be addressed. Although data collected from the expansion areas are included in this document, it is recognized that baseline water monitoring requirements for proposed Federal Lease expansion areas have not been satisfied as of the date this document was submitted. When baseline monitoring in the proposed expansion areas is complete, this document will be revised and re-submitted.

This document is divided into five sections, including this introduction. Section 2.0 presents probable groundwater impacts and groundwater monitoring plans. A similar discussion of surface water impacts and monitoring is provided in Section 3.0. Conclusions and references are listed in Sections 4.0 and 5.0, respectively.

2.0 GROUNDWATER

2.1 BACKGROUND INFORMATION

Detailed information on groundwater and the physical resources that effect groundwater in the permit and adjacent areas is found in Chapters 6 and 7 of the M&RP and the Revised Hydrogeologic Evaluation of the Bear Canyon Mine Permit and Proposed Expansion Areas, (EarthFax Engineering, 1992). This information is summarized herein for convenience.

2.1.1 Climatology

The Bear Canyon Mine is located in an area of semiarid to subhumid climate (Danielson, 1981). According to the monthly climatological data collected by the Utah Climate Center (Table 2-1), temperatures at the Hiawatha Station have an average range during the period of record (1989 through 1991) from 7.5° to 70° F.

A new rain gauge was installed at the Bear Canyon Mine in August 1991 by Co-Op Mining Company (Table 2-2). Average precipitation measured at the Bear Canyon Mine station is 0.89 inches per month for the period from August 1991 to May 1992. Monthly average precipitation has ranged from 0.04 to 2.65 inches per month.

Wind velocities recorded at the nearby Huntington Research Farm are typically less than 15 mph, for years 1990 and 1991 (Table 2-3). Average wind velocities are estimated at 10 mph near the Bear Canyon portal area (Chapter 11, M&RP). Wind directions are generally controlled by the orientation of the canyons. The prevailing wind direction in the area of the Bear Canyon portal is west-southwest (Chapter 11, M&RP).

TABLE 2-1

Monthly Temperatures
Measured at the Hiawatha Station [a]

	January	February	March	April	May	June	July	August	September	October	November	December
1989	19.5	23.4	38.5	47.9	51.9	58.8	70.0	62.8	(M)	45.8	36.9	28.8
1990	23.2	26.7	37.5	46.1	50.5	63.3 [f]	67.3	65.40	60.5	45.5	7.5	16.9
1991	20.0	32.6	29.6	39.0	49.2	59.7	67.5	64.5	57.2	48.3	30.9	23.6
Avg	20.9	27.6	35.2	44.3	50.5	60.6	68.3	64.2	58.9	46.5	25.1	23.1

[a] Utah Climate Center (1992).
[f] Indicates 1 to 9 days of data are missing; a monthly value was calculated from available data.
(M) Indicates 10 or more days of data are missing; no monthly value was calculated.

TABLE 2-2

Bear Canyon Mine Precipitation Data

MONTH/YEAR	MONTHLY TOTAL (inches)	DAILY MAXIMUM (inches)	DAILY MINIMUM (inches)
Aug. 1991*	0.82	0.18	0.00
Sept. 1991	2.65	0.98	0.00
Oct. 1991	0.74	0.46	0.00
Nov. 1991	0.85	0.24	0.00
Dec. 1991	0.14	0.04	0.00
Jan. 1992	0.28	0.06	0.00
Feb. 1992	0.07	0.04	0.00
Mar. 1992	0.71	0.27	0.00
Apr. 1992	0.34	0.33	0.00
May 1992	2.25	0.67	0.00

* The installation date of reading gauge was in the month of August. The initial gauge reading was taken on Aug. 14, 1991.

TABLE 2-3

Huntington Research Farm Wind Data[a]

Date	Average mph	Maximum mph	Minimum mph	V-Direction[b] degree
March 1990	6.9 (m)	10.0 (m)	3.6 (m)	228 (m)
April	9.4	14.3	6.1	230
May	8.7	12.5	6.0	237
June	10.1	12.3	7.4	219
July	9.8 (m)	11.9 (m)	8.4 (m)	232 (m)
August	9.8	12.7	4.9	236
September	10.5 (m)	13.0 (m)	6.4 (m)	218 (m)
October	8.5	12.8	5.7	242
November	8.6 (m)	13.9 (m)	4.3 (m)	233 (m)
December	-	-	-	-
January 1991	5.7 (m)	11.6 (m)	1.9 (m)	237 (m)
February	8.3 (m)	9.1 (m)	7.6 (m)	311 (m)
March	7.7	11.7	3.0	299
April	10.2	14.2	6.5	316
May	9.5	15.7	5.9	309
June	9.4	12.0	5.2	301 (m)
July	9.6	12.9	6.5	301 (m)
August	9.9	13.0	6.9	308
September	9.5	12.7	3.0	307
October	9.5	14.7	4.0	307

(a) Utah Climate Center (1992).
(b) Azimuthal direction of wind .
(m) Indicates ten or more days of data are missing for the month.

TABLE 2-3 (Continued)

Huntington Research Farm Wind Data[a]

Date	Average mph	Maximum mph	Minimum mph	V-Direction[b] degree
November	6.8	14.4	3.0	285
December	5.8	12.3	2.3	247
January 1992	6.9	17.6	2.4	261
February	7.2	14.0	1.6	300
March	8.8	16.2	4.3	332

(a) Utah Climate Center (1992).

(b) Azimuthal direction of wind.

2.1.2 Hydrogeology

The North Horn Formation, Price River Formation, Castlegate Sandstone, Blackhawk Formation, Star Point Sandstone, and Mancos Shale outcrop in the permit area. The stratigraphic sequence reflects an oscillating, yet overall regressive depositional environment. This changing environment resulted in great thicknesses of discontinuous sandstone, coal, and mud/siltstone units. Table 2-4 presents the stratigraphic relationships and surface water yield of these geologic units.

The main coal-bearing strata in the Wasatch Plateau is the Blackhawk Formation. The Trail Canyon and the Bear Canyon mines produce coal from the upper Blind Canyon Seam and the lower Hiawatha Seam (EarthFax Engineering, 1992, p. 2-4). Co-Op Mining Company proposes to begin mining the Tank Seam (approximately 220 to 250 feet above the Blind Canyon Seam) in 1994. Regionally, the strata in the study area dip to the south and southeast at an angle of two to three degrees (Brown, et al., 1987); this dip direction was confirmed by the stratigraphy observed during in-mine drilling conducted in 1992, although dip angles determined from in-mine drilling ranged from 0.44 to 1.47 degrees. The Bear Canyon and Trail Canyon mines are located in a complex graben bounded by the Pleasant Valley Fault (on the west) and the Bear Canyon Fault (on the east), (Plate 1, EarthFax Engineering, 1992). Vertical displacements on both faults are approximately 100-150 feet. Brown, et al. (1987) describe a shattered zone within the graben, approximately two miles north of the current northernmost extent of the Bear Canyon Mine. In the portion of the graben within the permit area, only minor faults (vertical displacements of 20 feet or less) have been identified, with the exception of the Blind Canyon fault (Plate 1, EarthFax Engineering, 1992), which is estimated to have approximately 220 feet of vertical displacement (down to the west) in the vicinity of the Bear Canyon Mine (M&RP).

The Castlegate and the Star Point Sandstones are regionally continuous. Although the Castlegate Sandstone contains some water (Danielson, 1981), it is not considered to be a regional aquifer. The Star Point Sandstone together with the lower Blackhawk Formation

TABLE 2-4

Stratigraphic relationships, thicknesses, lithologies, and water-bearing characteristics of geologic units in the upper drainages of Huntington and Cottonwood Creeks (adapted from Stokes, 1964)

System	Series	Formations and members	Thickness (feet)	Lithology and water-bearing characteristics
Quaternary	Holocene and Pleistocene		0-100	Alluvium and colluvium; clay, silt, sand, gravel, and boulders; yields water to springs that may cease to flow in late summer.
Tertiary	Eocene and Paleocene	Flagstaff Limestone	10-300	Light-gray, dense, cherty, lacustrine limestone with some interbedded thin gray and green-gray shale; light-red or pink calcareous siltstone at base in some places; yields water to springs in upland areas. (See table 9.)
	Paleocene	North Horn Formation.	800±	Variegated shale and mudstone with interbeds of tan-to-gray sandstone; all of fluvial and lacustrine origin; yields water to springs. (See table 9.)
Cretaceous	Upper Cretaceous	Price River Formation	600-700	Gray-to-brown, fine-to-coarse, and conglomeratic fluvial sandstone with thin beds of gray shale; yields water to springs locally.
		Castlegate Sandstone	150-250	Tan-to-brown fluvial sandstone and conglomerate; forms cliffs in most exposures; yields water to springs locally.
		Blackhawk Formation	600-700	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-bedded 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	600-800	Dark-gray marine shale with thin, discontinuous layers of gray limestone and sandstone; yields water to springs locally.

(Blackhawk-Star Point aquifer) are considered by Lines (1981) to be a regional aquifer. However, evidence from recent drilling and testing of the Star Point Sandstone indicates that the regional aquifer lies below the Star Point/Mancos Shale contact (EarthFax Engineering, 1992, p. 2-13). Additionally, separate and distinct aquifers were defined in the Spring Canyon, Storrs, and Panther tongues of the Star Point Sandstone (EarthFax Engineering, 1992, pp. 2-21 and 2-22). Other groundwater occurring above the Star Point aquifers is contained in perched, discontinuous aquifers in the upper Blackhawk Formation, the Castlegate Sandstone, the Price River Formation, and the North Horn Formation (EarthFax Engineering, 1992, p. 2-11).

Data collected from pumping tests and core analyses from the Trail Mountain area (approximately 10 miles south-southwest of the Bear Canyon Mine) indicate that the transmissivity of the full thickness of the Blackhawk-Star Point aquifer probably ranges from about 20 to 200 ft^2/day (Lines, 1985). Slug tests performed on the three tongues of the Star Point Sandstone (Spring Canyon, Storrs, and Panther) within the permit area yielded transmissivities ranging from 1 to over 50 ft^2/day (EarthFax Engineering, 1992, Table 4-2, p. 4-8).

Average linear velocities of groundwater in the three Star Point Sandstone aquifers were calculated using slug test data (EarthFax Engineering, 1992, Table 4-2, p. 4-8) and ranged from 0.0036 to 0.191 feet per day. These velocities indicate that groundwater beneath the Bear Canyon Mine moves to the south and southeast at between 1.31 and 69.72 feet per year.

Outcrops within the permit area include the Price River Formation, Castlegate Sandstone, Blackhawk Formation, Star Point Sandstone, and the Mancos Shale. Danielson, et al. (1981) indicate that recharge to the Star Point-Blackhawk aquifer from direct infiltration of snowmelt to formations which outcrop below the North Horn Formation is small in comparison to recharge through low relief surfaces on the North Horn Formation. In the study area, exposures of formations below the North Horn Formation and above the coal outcrops are limited to steep canyons. Therefore, the potential for recharge through these formations to the regional groundwater system within the permit area is limited. Within the proposed expansion area, there are three springs associated with the perched aquifers above the coals mined by Co-Op Mining Company. No springs were found within the present permit area. A number of low volume springs (2 gpm or less) occur north of the permit area and issue from the perched aquifers lying above the coals (Appendix 7-M, M&RP). All other springs in the permit and adjacent areas discharge from the Star Point Sandstone or from colluvial slopes which cover the Star Point Sandstone. The two largest springs in the area (Big Bear Springs and Birch Springs) are associated with fault and joint zones and issue from the Panther Tongue of the Star Point Sandstone (Chapter 7, M&RP and EarthFax Engineering, 1992, pp. 2-14 and 2-17). These two springs have been developed and are used by the Huntington-Cleveland Irrigation Company and the North Emery Water Users Association for culinary purposes.

Table 2-5 presents flow rates measured during the initial sampling of each spring and mine water monitoring point. Locations of these monitoring points are presented on Plate 7-4 of this M&RP. Average flow rates measured at Co-Op Mining monitoring points in 1991 are presented in Table 2-6. Average 1991 annual flow rates at BP-1, SBC-9, and TS-1 are higher than initial flow rates, while the average annual flow rate at SBC-6 is lower. The increase in flow at SBC-9 is due to the progression of mining into a wetter area of the mine (Co-Op Mining Company, 1992a). The decrease in flow rate at SBC-6 is likely due to the drought conditions of the last several years (Section 2.1.1). The cause of the higher flow rates measured at BP-1 and TS-1 is unknown.

Springs FBC-2 through FBC-6A are located in proposed Federal Lease U-024316 and adjacent areas (Plate 7-4 of this M&RP). These springs issue from the North Horn Formation (Co-Op Mining Company, 1992a) and flow intermittently (Table 2-7). FBC-6A is the largest of seven small springs monitored at FBC-6 (Table 2-7). Water flowing from these springs is absorbed by colluvium within 10 to 70 feet of each spring. These springs are not known to contribute to stream flow in the area (Co-Op Mining Company, 1992a).

TABLE 2-5

Initial Spring and Mine Water Flow Rates

Source	Date	Flow (gpm)
BP-1 (Ballpark Spring)	5/90	0.15
CS-1 (Trail Co-Op Spring)	5/90	NM
NPDES (Mine Discharge)	4/91	60
PS-1 (Portal Spring)	5/90	Dry
Roof Drips above Su-1	2/85	3 - 5
Roof Drips above Su-3	10/84	3 - 5
SBC-1 (Mine Water Sump)	2/86	Dry
SBC-4 (Big Bear Spring)	10/84	NM
SBC-5 (Birch Spring)	10/84	NM
SBC-6 (CoOp Dev. Spr)	9/86	12
SBC-7 (#33 West Spring)	2/90	1
SBC-8 (#30 East Spring)	2/90	<1
SBC-9 (Sump Su-3)	10/84	NM
Su-1	10/84	NM
TS-1 (Trail Canyon Spring)	5/90	0.5

NM = Not Measured

TABLE 2-6

1991 Average Spring and Mine Water Flow Rates

Source	Flow (gpm)	Number of Samples
BP-1 (Field)	0.38	2
CS-1 (Trail Co-Op Spring)	16	2
NPDES (Mine Discharge)	78	9
PS-1 (Portal Spring)	Dry	2
SBC-4 (Big Bear Spring)	119	8
SBC-5 (Birch Spring)	31	8
SBC-6 (CO-OP Develop. Spring)	Dry	4
SBC-9 (Mine Sump Su-3)	114	5
TS-1 (Trail Canyon Spring)	12.6	2

TABLE 2-7

Initial Spring Water Flow Rates (proposed Federal Lease U-024316)

Spring	June 1990	August 1991	October 1992
FBC-2	0.25 gpm	12 gpm	Dry
FBC-3	Dry	1.5 gpm	Dry
FBC-4	0.25 gpm	8.7 gpm	0.5 gpm
FBC-5	Dry	8.5 gpm	0.6 gpm
FBC-6	Dry	9.8 gpm	1.5 gpm
FBC-6A	NM	NM	1.1 gpm

NM = Not measured.

Three monitoring wells (SBC-2, SBC-3, and WM-C) were initially included in the groundwater monitoring program. SBC-2 is located immediately outside the mine portal (Co-Op Mining Company, 1992a) and the location of SBC-3 is presented on Plate 7-4 of this M&RP. There is no location information for WM-C and only one sample has been collected from this well (February 1985). Therefore, data from WM-C are not presented and are excluded from this discussion. Monitoring of SBC-2 was discontinued in 1991 because the well caved and was lost (1991 Annual Report). SBC-3 was damaged in 1990 and surface water began leaking into the well. In March 1992, SBC-3 was repaired and sealed (Co-Op Mining Company, 1992a). Static water levels and analytical data collected from 1990 through March 1992, are not representative of SBC-3 and have been excluded from the data set. This well has been dry throughout the balance of the period of record (Co-Op Mining Company, 1992a).

Groundwater enters the Blind Canyon Seam of the Bear Canyon Mine through fractures and roof bolt holes. Typically, water encountered by roof bolt holes flows moderately at first. Over a period of one or two months, flow decreases and eventually stops. Sources of these short-lived flows are inferred to be localized perched aquifers which store a limited amount of water (EarthFax Engineering, 1992, p. 2-19). This flow pattern is typical of the mines (Deer Creek, Plateau, and others) in the area (Danielson, et al., 1981).

Inflows through seven of eight exploratory borings into the Tank Seam (drilled up from the mine workings in the Blind Canyon Seam) are less than 0.1 gpm. The remaining boring (near the intersection of 3rd West and the 3rd West Bleeders) flows at 0.5 gpm. Thus, inflows to the proposed Tank Seam workings are expected to be less than those encountered in the Blind Canyon Seam.

Prior to 1991, mine water inflow was small and often insufficient to meet the operational needs of the mine (Chapter 7, M&RP). During 1991, mining proceeded into the northern portion of the permit area and groundwater inflow to the mine increased. During 1991, Co-Op Coal Company began discharging between 30 and 60 gpm from the mine. By January, 1992, mine discharge increased to 300 gpm and continued at this rate through

March, 1992 (Co-Op Mining Company, 1992a). Present total mine inflow is approximately 500 gpm. Of this total, 200 gpm is used in the mining operations, and 300 gpm is discharged to Bear Canyon Creek.

This increase in mine inflow is attributed to interception of perched aquifers by mining. Tritium analyses were performed on samples from four groundwater monitoring points (Birch Springs, Big Bear Springs, a North Mains roof dripper, and floor water) in order to define the relative ages of the groundwater in the permit and adjacent areas. Tritium values for Birch Springs (1.12 TU), North Mains (1.0 TU) and the Second East Bleeders floor sump (1.73 TU) (Plate 2, EarthFax Engineering, 1992) are within the same order of magnitude, whereas the value for Big Bear Springs (17.4 TU) is an order of magnitude greater, suggesting that the source of Big Bear Springs is different from that of the mine inflow and Birch Springs.

According to Thiros and Cordy (1991), prior to above-ground nuclear weapons tests conducted from 1953 to 1969, the natural tritium concentration in precipitation was 8.7 TU. Assuming a half-life of 12.26 years, tritium levels in groundwater stored since 1952 would now be 0.95 TU, thus, water collected from SBC-9 (North Mains) sample is likely 100% pre-bomb groundwater (water stored since before 1953). Waters from SBC-5 (Birch Spring) and SBC-10 (floor water) are probably mixtures rich in stored pre-bomb groundwater, with a slight amount of post-bomb water.

There are three possible explanations for the relatively high concentration of tritium in the SBC-4 (Big Bear Springs) water: 1) The groundwater could be freshly recharged; current tritium concentrations in freshly fallen rain water in Utah range between 10 and 20 TU (Thiros, 1992); 2) it could be stored post-bomb water which originally had a very high concentration of tritium which has since decayed; or 3) water from Big Bear Springs could be a mixture of pre-bomb and post-bomb waters.

Because tritium concentrations in rainwater were greater than 1000 TU during periods of active above-ground testing (Fritz and Fontes, 1980), the age of water from Big Bear Spring cannot be determined. Regardless of the source(s) of recharge to Big Bear Spring, the concentrations of tritium in the remaining groundwater samples (SBC-5, SBC-9, and SBC-10) suggest that Birch Spring water and the mine inflow are of similar age (pre-1953), and are not significantly recharged by modern precipitation.

Data presented in the Revised Hydrogeologic Evaluation of the Bear Canyon Mine Permit and Proposed Expansion Areas (EarthFax Engineering 1992, pp. 2-21 and 2-22) indicate there are three separate piezometric surfaces associated with the Panther, Storrs, and Spring Canyon tongues of the Star Point Sandstone. These aquifers are separated by mudstones, which serve as aquitards. Groundwater flow within these aquifers generally follows the regional dip of the Star Point Sandstone(0.5 to 1.5 degrees to the south and southeast). Hydraulic gradients in the Spring Canyon, Storrs, and Panther aquifers are 0.046, 0.050, and 0.053 feet per foot, respectively.

2.1.3 Groundwater Quality

Spring- and mine-water monitoring stations are sampled at various intervals throughout the year as a part of the Co-Op Coal Company hydrologic monitoring program (Plate 7-4 of this M&RP). A summary of water-quality analyses for groundwater samples collected is presented in Chapter 7 of the M&RP and in the Annual Hydrologic Monitoring Report (Co-Op Mining Company, 1990 and 1991). Groundwater-quality samples are routinely collected in the permit and adjacent areas from the underground bleeders, monitoring wells, and springs associated with faults and joints in the Panther Tongue of the Star Point Sandstone.

Table 2-8 presents analytical data from the first sampling event for each spring and mine water monitoring point. Locations of these monitoring points are presented on Plate 7-4 of this M&RP. The general character of the groundwater in the permit and adjacent areas is that of a calcium-bicarbonate water that is slightly alkaline and contains low concentrations of total dissolved solids (TDS), nutrients, and metals. Table 2-9 presents the average

TABLE 2-8

Initial Spring and Mine Water Analytical Results
(all values except pH expressed as mg/l)

Source	Date	TDS	TSS	Acid.[a]	Hard.[b]	Alk.[c]	Ca	Mg	Fe	Na	K	HCO_3	SO_4	Cl	NO_3	pH
BP-1 (Ballpark Spring)	5/90	402	11	0	382	302	68	51.4	0.07	13	3.3	368	82	13	NA	8.1
CS-1 (Trail Co-Op S)	5/90	402	4	0	392	336	76	48.1	0.09	5	3.0	410	61	11	NA	8
NPDES (Mine Disch.)	4/91	464	46	NA	NA	NA	NA	NA	0.19	NA	NA	NA	NA	NA	NA	7.8
PS-1 (Portal Spring)	5/90	Dry														
Roof Drips above Su-1	2/85	235	1	0	NA	216	46	35.0	0.03	3	1.4	NA	66	4	0.06	8.1
Roof Drips above Su-3	10/84	380	17	0	NA	314	60	38.4	0.12	19	3.7	383	40	2	0.03	7.3
SBC-1 (Mine Water)	2/86	280	2	NA	292	232	51	40	0.04	4	3.0	232	49	3	0.09	8

(a) Acidity as $CaCO_3$.
(b) Hardness as $CaCO_3$.
(c) Alkalinity as $CaCO_3$.
NA = Not analyzed.

TABLE 2-8 (Continued)

Initial Spring and Mine Water Analytical Results
(all values except pH expressed as mg/l)

Source	Date	TDS	TSS	Acid.[a]	Hard.[b]	Alk.[c]	Ca	Mg	Fe	Na	K	HCO_3	SO_4	Cl	NO_3	pH
SBC-4 (Big Bear Spring)	10/84	362	11	0	NA	254	80	22	0.33	26	0.97	310	27	50	0.24	7.4
SBC-5 (Birch Spring)	10/84	440	6	0	NA	310	64	59	0.12	12	2.0	378	80	30	0.04	7.9
SBC-6 (CO-OP Dev. Spr.)	9/86	458	NA	NA	331	291	83	30	0.5	5	1.0	355	1	6	0.05	8
SBC-7 (#33 West Spring)	2/90	Dry														
SBC-8 (#30 East Spring)	2/90	Dry														
SBC-9 (Sump Su-3)	10/84	300	5	0	NA	234	36	36	0.19	29	4.4	285	55	8	0.06	7.3
Su-1	10/84	362	11	0	NA	254	80	22	0.33	26	0.97	309	27	50	0.24	7.4
TS-1 (Trail Cyn. Spring)	5/90	410	1	0	382	287	72.3	49	0.13	12	3.2	349	84	16	NA	8.1

(a) Acidity as $CaCO_3$.
(b) Hardness as $CaCO_3$.
(c) Alkalinity as $CaCO_3$.
NA = Not analyzed.

TABLE 2-9

1991 Average Groundwater Analytical Results
(all values except pH expressed as mg/l)

Source	TDS	TSS	Acid.[a]	Hard.[b]	Alka.[c]	Ca	Mg	Fe	Na	K	HCO_3	SO_4	Cl	NO_3	pH	Number of Samples
BP-1 (Field)	451	NA	NA	399	NA	82	47	0.56	11	3.8	437	62	11.0	NA	8.0	2
CS-1 (Trail Co-Op S)	380	NA	NA	309	NA	79	27	0.36	4.9	2.5	320	63	4.6	NA	7.9	2
NPDES (Mine Disch.)	371	13	NA	NA	NA	NA	NA	0.11	NA	NA	NA	NA	NA	NA	7.9	9
PS-1 (Portal Sp)	Dry															
SBC-4 (Big Bear Spring)	381	5	NA	347	291	84	34	0.15	4.9	2.0	352	65	7.8	ND	7.7	8
SBC-5 (Birch Spring)	485	0.9	0	440	276	102	45	0.06	6.5	2.4	382	126	12.0	0	7.5	8
SBC-6 (CO-OP Dev. Spr)	Dry															
SBC-9 (Mine Sump Su-3)	360	0.5	NA	325	275	77	35	0.17	4.2	1.7	355	57	4.4	ND	7.9	5
TS-1 (Trail Cyn Spring)	452	NA	NA	389	NA	83	44	0.17	13	3.0	399	84	11.6	NA	8.0	2

(a) Acidity as $CaCO_3$.
(b) Hardness as $CaCO_3$.
(c) Alkalinity as $CaCO_3$.
NA = Not analyzed.
ND = Not detected.

analytical results from 1991 groundwater sampling documented in the 1991 Annual Report. The general character of the groundwater in 1991 is also that of a slightly alkaline calcium-bicarbonate water that contains low concentrations of TDS, nutrients, and metals. Average iron concentrations increased significantly in BP-1 water. This is due to a single high value of 0.97 mg/l detected in October 1991 (1991 Annual Report).

Analytical results for groundwater sampled in 1991 and 1992 at proposed Federal Lease U-024316 monitoring points FBC-2 through FBC-6A are presented in Tables 2-10 and 2-11, respectively. The character of the groundwater defined in these initial surveys is similar to and within the range of chemical concentrations found in the present permit initially (Table 2-8) and in 1991 (Table 2-9). Sulfate and chloride concentrations increase from 1991 to 1992 in FBC-4, FBC-5, and FBC-6 waters. All other chemical concentrations did not change significantly from 1991 to 1992 in waters sampled at FBC-2 through FBC-6.

Figure 2-1 presents a Piper diagram of average analytical results of the sampling events in 1991 for 6 groundwater monitoring points: Birch Spring (SBC-5, eight samples), North Mains (SBC-9, five samples), Ball Park Spring (BP-1, two samples), Big Bear Spring (SBC-4, eight samples), Co-Op Spring (CS-1, 2 samples), and Trail Canyon Spring (TS-1, 2 samples). The Piper diagram is divided into three fields: cations, anions, and the combined field. Values are in percent milliequivalents, and are plotted in the anion and cation fields and projected into a combined field. Spatial relationships of samples that are similar among the three fields are indicative of hydraulic connection between waters. Spatial relationships among the six waters are not the same in all three fields; thus, it is inferred that the waters are not hydraulically connected. Birch Spring has the least similarity to the other waters. For example, Birch Spring water plots very close to mine water in the cation field, but it plots as an outlier in the anion field and in the combined field. This is due to a higher percentage of sulfate in Birch Spring water than in the mine water or the other spring water in the area. In fact, the mine water and BP-1 water have the lowest percentages of sulfate of the groundwater represented in the Piper diagram. Thus, the spatial relationships exhibited in the Piper diagram suggest that the mine water is of a higher quality than Birch Spring water. Furthermore, the difference

TABLE 2-10

1991 Spring and Mine Water Analytical Results (proposed Federal Lease U-024316)
(all values except pH expressed as mg/l)

Source	Date	TDS	TSS	Acid.[a]	Hard.[b]	Alka.[c]	Ca	Mg	Fe	Na	K	HCO_3	SO_4	Cl	NO_3	pH
FBC-2	8/91	352	NA	NA	305	NA	77.8	26.9	7.60	4.90	0.89	379	5.76	2.33	0.00	8.05
FBC-3	8/91	274	NA	NA	258	NA	72.4	18.8	0.22	3.50	0.84	307	12.3	2.43	0.38	8.00
FBC-4	8/91	396	NA	NA	326	NA	86.3	27.0	9.51	4.60	3.40	391	8.64	5.27	0.00	7.50
FBC-5	8/91	328	NA	NA	302	NA	81.7	23.9	1.24	5.80	2.91	367	13.0	7.20	0.00	8.00
FBC-6	8/91	272	NA	NA	261	NA	69.2	21.5	0.10	5.10	0.61	303	15.0	5.27	0.29	8.40

(a) Acidity as $CaCO_3$.
(b) Hardness as $CaCO_3$.
(c) Alkalinity as $CaCO_3$.
NA = Not analyzed.

TABLE 2-11

1992 Spring and Mine Water Analytical Results (proposed Federal Lease U-024316)
(all values except pH expressed as mg/l)

Source	Date	TDS	TSS	Acid.[a]	Hard.[b]	Alka.[c]	Ca	Mg	Fe	Na	K	HCO_3	SO_4	Cl	NO_3	pH
FBC-2	10/92	Dry														
FBC-3	10/92	Dry														
FBC-4	10/92	318	NA	NA	342	NA	66.1	42.9	0.00	6.83	0.27	314	90.0	10.0	0.43	7.26
FBC-5	10/92	149	NA	NA	319	NA	103.8	14.6	0.10	1.81	0.00	328	9.00	25.0	0.10	7.68
FBC-6	10/92	277	NA	NA	280	NA	60.4	31.3	0.67	3.83	2.64	368	28.0	15.0	0.04	7.80
FBC-6A	10/92	814	NA	NA	359	NA	94.1	30.0	0.60	3.91	89.7	410	35.0	25.0	0.09	7.82

(a) Acidity as $CaCO_3$.
(b) Hardness as $CaCO_3$.
(c) Alkalinity as $CaCO_3$.
NA = Not analyzed.

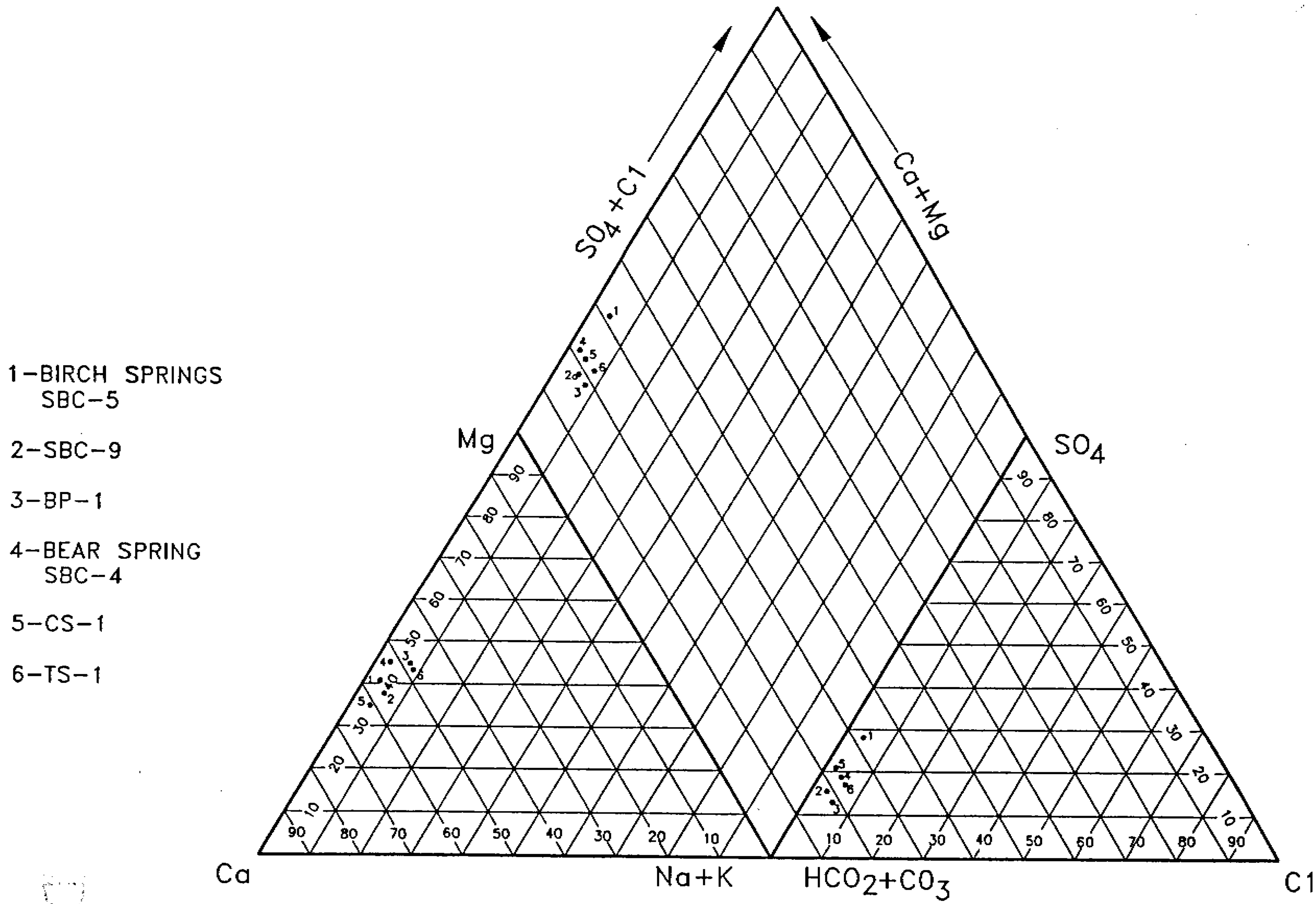

FIGURE 2-1. PIPER DIAGRAM OF AVERAGE GROUNDWATER ANALYTICAL RESULTS

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in spatial relationships in the different fields suggests the waters are not hydraulically connected.

Figure 2-2 presents a series of Stiff diagrams which characterize waters from the same six groundwater monitoring points used in Figure 2-1. The six waters display a similar Stiff pattern, that of a calcium-bicarbonate water. Additionally, the Stiff patterns indicate that SBC-9 (North Mains) water has the lowest sulfate concentration (1.18 meq) and SBC-5 (Birch Spring) has the highest sulfate concentration (2.62 meq) of the groundwater sampled. SBC-4 (Big Bear Spring) water has a sulfate concentration of 1.36 meq. SBC-9 also has the lowest chloride value of the groundwaters sampled. This relationship between the sulfate and chloride concentrations does not suggest that the mine water could diminish the quality of the spring water in the area.

The major portion of water inflow to the mine is used within the mine or for culinary purposes by Co-Op Mining Company. According to the Co-Op Bear Canyon Mining and Reclamation Plan, the water which flows from Big Bear Spring (also called Huntington Spring) and Birch Spring is used by the Huntington community for culinary purposes (Co-Op Mining Company, 1990). Water collected in Trail Canyon from TS-1 (Trail Canyon Spring) is also used by Trail Canyon residents for culinary purposes.

Wells in the permit and adjacent areas are either observation wells owned by Co-Op Mining, or exploration wells owned by Northwest Energy. Three new monitoring wells (DH-1A, DH-2, and DH-3, Plate 1, EarthFax Engineering, 1992) were drilled within the permit area for this study. DH-1A and DH-2 were drilled in late 1991 and DH-3 was drilled in early 1992. The three wells were completed in the Spring Canyon Tongue of the Star Point Sandstone, and were developed, tested, and sampled in May, 1992. The results of laboratory analyses of the monitoring well samples are summarized on Table 2-12 from the complete analytical reports (Appendix 7N-H, EarthFax Engineering, 1992).

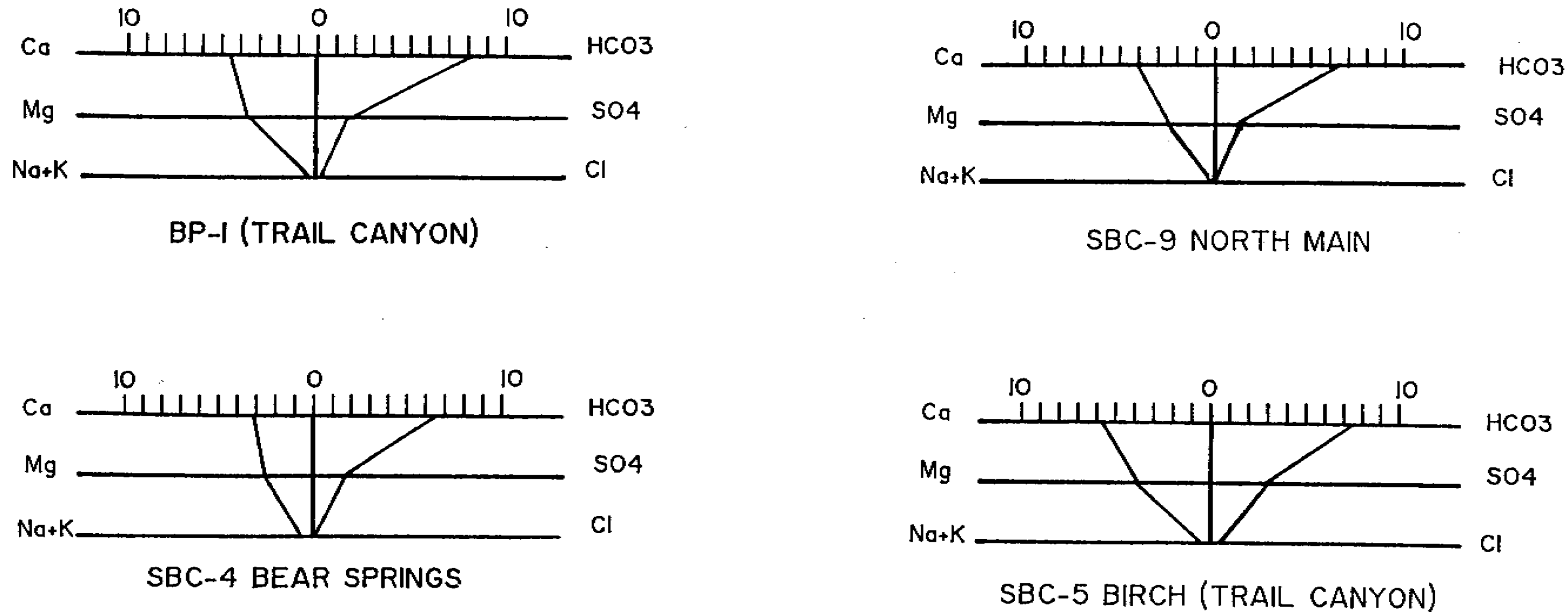

FIGURE 2-2. Stiff Diagrams of Spring Water Analytical Results

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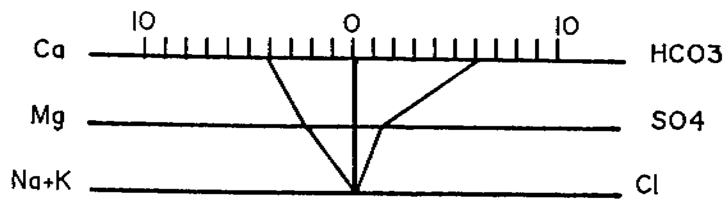
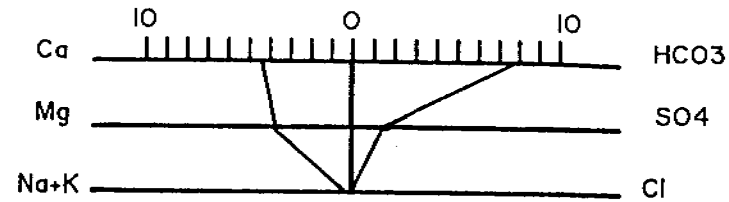


CS-1 CO-OP SPRING (TRAIL CANYON)



TS-1 TRAIL CANYON SPRING

FIGURE 2-2 (continued). Stiff Diagrams of Spring Water Analytical Results

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TABLE 2-12

Summary of Laboratory Analytical Results
for Groundwater From In-Mine Monitoring Wells

ANALYTE (mg/l)	DH-1A	DH-2	DH-3
Aluminum	0.2	<0.1	<0.1
Arsenic	<0.05	<0.05	<0.05
Barium	0.071	0.127	0.129
Cadmium	<0.01	<0.01	<0.01
Calcium	38.9	51.9	50.9
Chromium	0.025	<0.01	<0.01
Copper	<0.01	<0.01	<0.01
Iron	0.505	0.280	0.220
Lead	<0.01	0.030	<0.01
Magnesium	20.1	29.5	28.9
Manganese	0.062	0.101	0.232
Mercury	<0.0005	<0.0005	<0.0005
Molybdenum	0.058	0.010	<0.01
Nickel	<0.01	<0.01	<0.01
Potassium	31.2	1.5	2.6
Selenium	<0.0005	<0.0005	<0.0005
Sodium	14.1	8.8	15.2
Zinc	<0.01	<0.01	<0.01
Oil & Grease	2.0[a]	<0.5	<0.5

[a] Oil and Grease expected (hydraulic fluid leak on rig).

TABLE 2-12 (Continued)

Summary of Laboratory Analytical Results
for Groundwater From In-Mine Monitoring Wells

ANALYTE (mg/l)	DH-1A	DH-2	DH-3
TDS	285	330	339
Hardness as CaCO3	162	321	307
Boron	<0.05	0.064	0.061
Alkalinity as CaCO3	94	285	294
Bicarbonate	110	340	336
Carbonate	2.3	3.5	11.5
Hydroxide	0	0	0
Chloride	4.9	4.2	4.2
Fluoride	0.28	0.18	0.16
Ammonia	<0.2	0.64	0.22
Nitrate	0.42	0.74	<0.5
Phosphate	0.129	0.25	0.027
Sulfate	128	33	38
Sulfide	<0.1	<0.1	<0.1

Figure 2-3 presents Stiff diagrams of ions in groundwater from the in-mine wells. Waters from DH-1A and DH-3 have Stiff patterns similar to those of the calcium-bicarbonate spring water depicted on Figure 2-2. Water from DH-2 has a calcium, magnesium, sodium, potassium-sulfate pattern. This pattern is distinctly different from other groundwater that has been sampled in the permit and adjacent areas, and is presumed to be due to the dissolution of locally-occurring sulfate salts.

Groundwaters sampled from the in-mine wells have a TDS range of 285 to 339 mg/l. Dissolved iron and manganese concentrations range from 0.220 to 0.505 mg/l and from 0.062 to 0.232 mg/l, respectively.

Groundwater quality analyses (1991 Annual Report) were compared to the primary drinking water standards (40 Code of Federal Regulations (CFR) 141) and the secondary drinking water standards (40 CFR 143). In September 1991, a chromium concentration of 0.06 mg/l was detected in water sampled from SBC-5 (Birch Spring), exceeding the chromium standard of 0.05 mg/l. There were no analyses for silver.

One exceedance of the secondary drinking water standards was detected for the mine water samples; in August 1991, an iron concentration of 0.55 mg/l was detected in water from SBC-9 (Mine Sump #3), exceeding the iron standard of 0.3 mg/l. Additionally, exceedances of iron, manganese, and TDS standards were found in groundwater sampled in 1991. These exceedances constituted fifteen percent of iron, five percent of manganese, and ten percent of TDS analyses performed on these respective constituents. It should be noted that the secondary drinking water standards "represent reasonable goals for drinking water quality," (40 CFR 143) and are not mandatory standards.

2.2 POTENTIAL GROUNDWATER IMPACTS

Potential groundwater impacts that could result from mining and reclamation operations at the Bear Canyon Mine include:

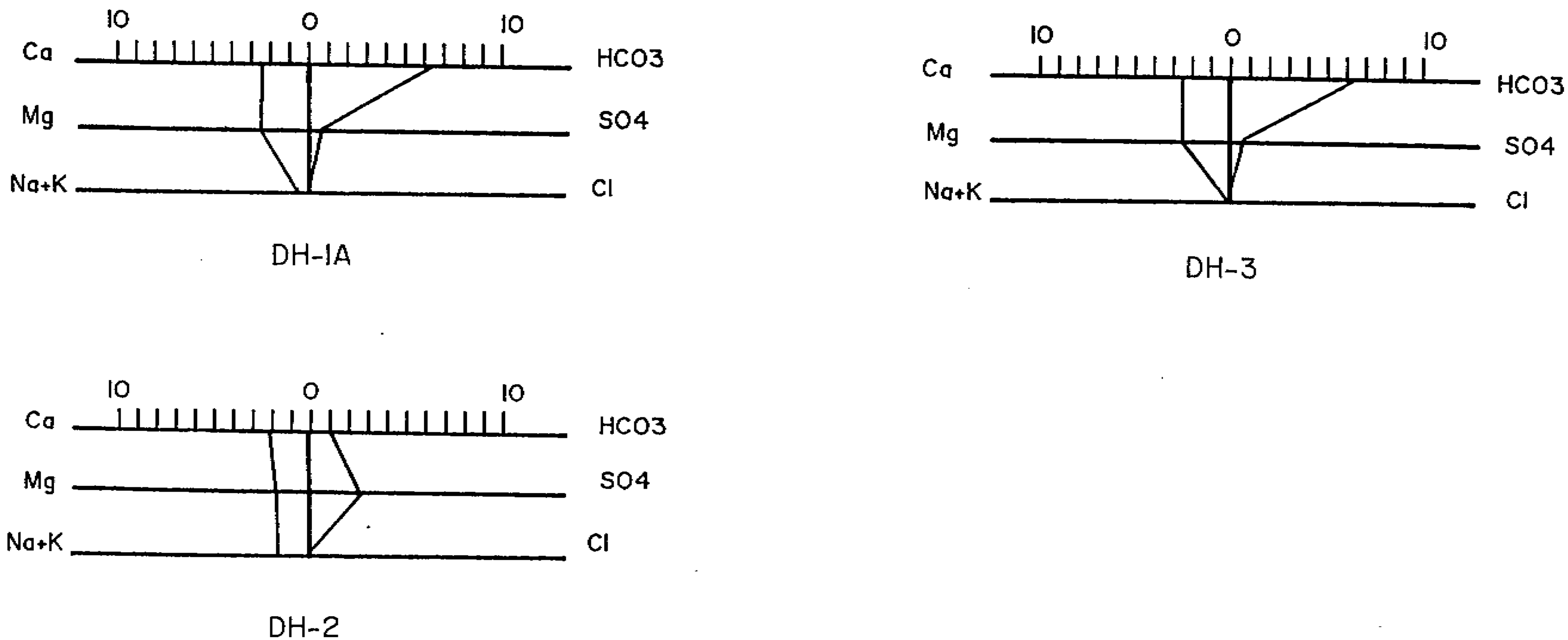

FIGURE 2-3. Stiff Diagrams of In-Mine Monitoring Well Analytical Results

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- o Contamination from acid- or toxic- forming materials;
- o Impacts to groundwater quantity; and
- o Impacts to groundwater quality:
  - * Contamination due to rock dust usage,
  - * Contamination due to the use of hydrocarbons, and
  - * Contamination from road salting.

2.2.1 Potential Contamination from Acid- and Toxic-Forming Materials

Information on acid- or toxic-forming materials monitoring is presented in Appendix 6-C of the M&RP. Evaluation of these data using Table 2 in the Guidelines for Management of Topsoil and Overburden (Leatherwood and Duce, 1988) revealed that there have been no poor or unacceptable (acid- or toxic-forming) materials encountered in the permit area. Co-Op Mining Company mined through a small, highly localized sulfur-bearing mineral zone in January and March, 1992, but no waste rock was produced as the sulfur-bearing minerals were sold with the coal (Co-Op Mining Company, 1992a). In addition, as noted in Section 2.1.3 of this PHC, the alkalinity of the groundwater in the area is approximately 300 times the acidity. No waste rock is expected to be produced in the future (Co-Op Mining Company, 1992a).

Given past experience at the mine and the generally alkaline nature of the groundwater, the probability of acid- and/or toxic-forming materials being found or produced from the mine in the future is low. However, if any of these materials are discovered in waste rock in the future through the on-going monitoring plan, these materials will be disposed of in accordance with the requirements of Utah Mining Regulations R645-301-731.300 and as outlined in Chapter 3 of the M&RP.

2.2.2 Groundwater Quantity Impact

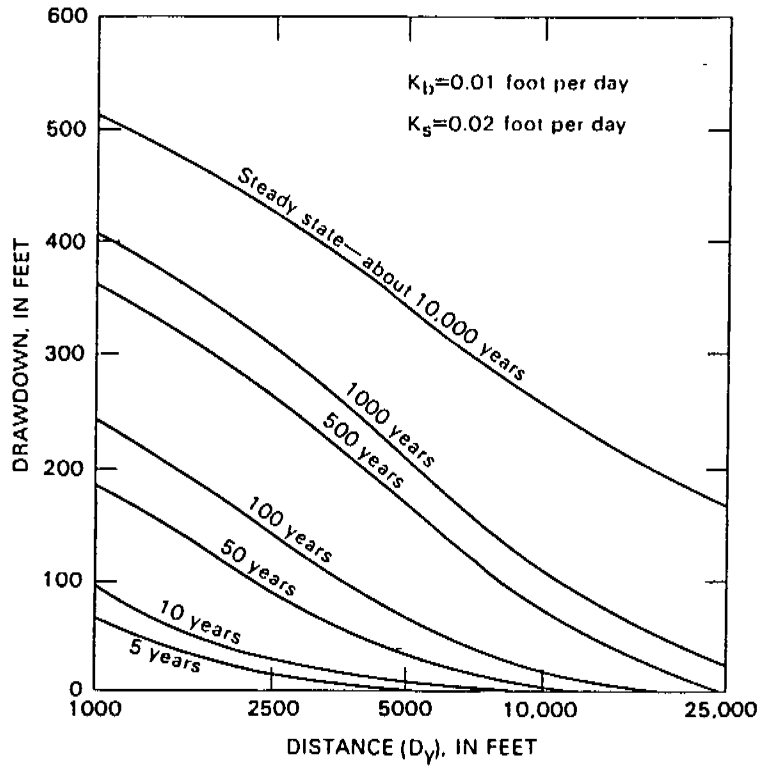
Mining will remove groundwater both from formations adjacent to the coal seams and from mine-water contained in the coal itself. The removal of water from the surrounding formations occurs when groundwater flows into the underground mine workings as the coal is removed. Drainage of water from faults and fractures produces the largest volume of water flowing into the mine (EarthFax Engineering, 1992, pp. 2-17 and 2-19). As noted in Section 2.1.2, the volume of groundwater flow into the mine has only recently increased sufficiently to produce water in excess of that needed for mine operations.

Groundwater flows into the Bear Canyon Mine at a rate of 500 gpm. 200 gpm are used in the mine operations and 300 gpm are discharged into Bear Creek. A minimum of one third of the water used in the mine operations is returned to the groundwater regime because the majority of this water is used for dust suppression within the mine. The balance of the mine water is utilized at the surface facilities for culinary water and dust suppression on surface roads (Co-Op Mining Company, 1992a).

The approximate *in situ* moisture content of coal mined in the Bear Canyon Mine is 5.3 percent water by weight (this does not include moisture added from dust suppression, Appendix 6-B, M&RP). This water leaves the mine in the coal as part of the mining process. Using an extraction rate of 432,140 tons of coal for 1991, approximately 18 acre-feet of water will be diverted annually in the coal from the groundwater system. Based on a long-term coal production rate of 500,000 tons per year, approximately 22 acre-feet of water per year will be diverted from the groundwater system. However, because most of this water is perched (not connected to surface springs), its removal will have little or no effect on spring flow in the area.

Springs presently monitored in proposed Federal Lease U-024316 issue from the North Horn Formation and are perched (EarthFax Engineering, 1992, p. 2-11) at least 1000 feet above the top of the Blind Canyon coal seam (Plate 7-4 in this M&RP). Thus, mine dewatering is not expected to impact these springs.

Figure 2-4 depicts drawdown expected at distances measured along the long (D_y) axis and the short (D_x) axis of the mine. Based on a mine life of 20 years (Co-Op Mining



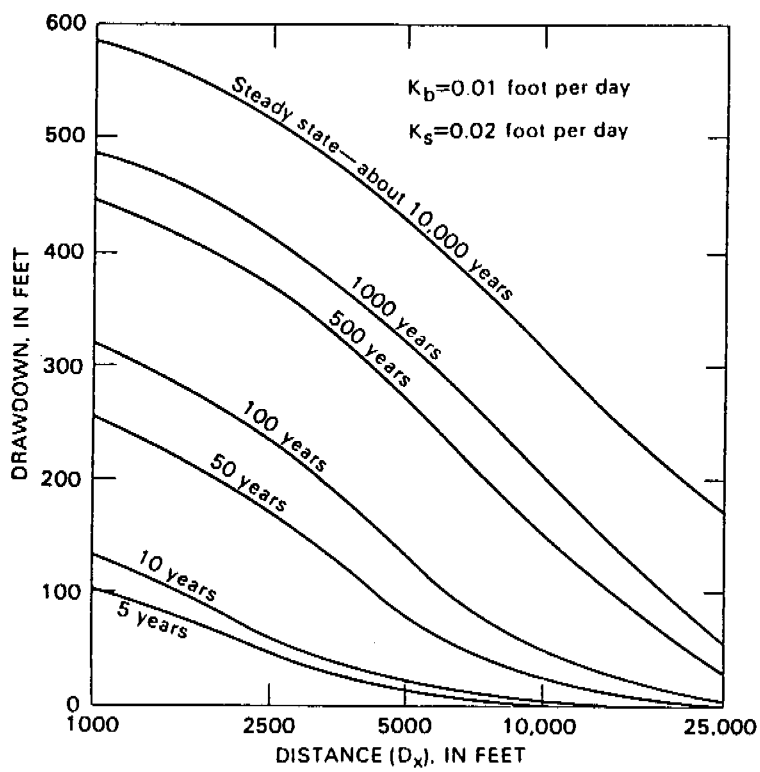


FIGURE 2-4. PREDICTED DRAWDOWN AS A FUNCTION OF DISTANCE (LINES, 1985)

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Company, 1992a), the maximum expected lateral limits of the cone of depression caused by dewatering of the Bear Canyon Mine would be approximately 9,000 feet (1.7 miles) from the mine boundary in the north and south directions and 15,000 feet (2.8 miles) from the mine boundary in the east-west directions. This drawdown terminates wherever the strata immediately above the coal seams being mined are truncated by canyons as in Bear, Blind, and Trail Canyons.

There are no water supply wells located in the permit and adjacent areas. As indicated in the baseline data discussed in Section 2.1.2 of this PHC, there are three springs located above the coal seam in the northern proposed expansion area. There are no water rights associated with these springs (EarthFax Engineering, 1992, p. 2-38).

Because the aquifers that supply springs above the Blind Canyon coal seam are perched, mining operations will have no effect on spring flow or spring water quality (EarthFax Engineering, 1992, pp. 2-23 thru 2-30). It is unlikely that Bear Canyon Mine will impact Birch and Big Bear Springs for six reasons:

1. Tritium data indicate that the source of groundwater inflow to the mine is not the same as the source of Big Bear Springs (the Panther Tongue of the Star Point Sandstone), but perched aquifers containing relict stored water (Section 2.1.2).

2. Stiff and Piper diagrams indicate that the mine water is of a higher quality than that of the other waters in the area and that Birch Spring and the mine water are not hydraulically connected (Section 2.1.3).

3. Information collected during the drilling of the three in-mine monitoring wells suggests that the mine workings may intercept groundwater from the Spring Canyon Tongue of the Star Point Sandstone. However, both Birch and Big Bear Springs issue from the Panther Tongue, which is the lowest tongue of the Star Point Sandstone and 400 feet below the Blind Canyon seam (EarthFax Engineering, 1992, p. 2-17 and Appendix 7N-G).

4. The mine and Birch Spring are separated by a complex zone of fractures and faults. The Blind Canyon Fault is a normal fault with 220 feet of vertical displacement and is located near the western limit of mining in the Bear Canyon Mine. This fault could act either as a conduit (if it has open voids) or as a

barrier (if it is filled with gouge) to groundwater flow. In either case, the fault would probably prevent groundwater from moving from the mine to Birch Spring. If the fault did not act as a barrier, it would convey the water moving within it to the surface as a spring. No such spring is present where the Blind Canyon fault intersects the surface, approximately 800 feet east of Birch Spring.

5. Birch Spring is approximately 8,500 feet from the North Mains section of the mine. The linear velocities calculated for the aquifers of the Star Point Sandstone range from 1.31 to 69.75 feet per year (Section 2.1.2). At the fastest calculated velocity, impact to water quality and quantity at Birch Spring from water in the mine would not occur for at least 122 years.

   Lines (1985) presented laboratory determinations of porosity (ranging from 2 to 17 percent) and horizontal hydraulic conductivities (ranging from 1.1×10^{-6} to 3.1×10^{-2} feet per day). Using these data and the maximum hydraulic gradient measured in the in mine drill holes of 0.053 feet per foot (Section 2.1.2), the fastest calculated velocity is 29.98 feet per year. At this velocity, the mine water would not impact Birch Spring for 283 years.

6. Three piezometric surfaces in the Spring Canyon, Storrs, and Panther Tongues of the Star Point Sandstone have been defined by EarthFax Engineering (1992, pp. 2-21 and 2-22) through drilling and testing (Plates 3, 4, and 5, EarthFax Engineering, 1992). The hydraulic gradients are to the south (parallel to the Blind Canyon Fault) and to the southeast (away from the Blind Canyon Fault) (Plate 1, EarthFax Engineering, 1992).

Discharge of groundwater from the underground workings and removal of groundwater in the coal is expected to continue through the life of the mining operation. To date, no negative impact to seeps or springs has been demonstrated. The springs which issue from the perched aquifers will probably remain unaffected by the dewatering. In addition, as noted above, impacts to groundwater availability from the Panther Tongue of the Star Point Sandstone (Birch and Big Bear Springs) in the permit and adjacent areas is unlikely.

2.2.3 Potential Groundwater Quality Impacts

Potential groundwater quality impacts include:

- Contamination due to rock dust usage;

- o Contamination due to usage of hydrocarbons; and
- o Contamination from road salting.

Rock Dust Usage Impact. The practice of using rock dust for the suppression of coal dust in the mine may potentially impact the groundwater flowing through the mine by dissolution of the rock dust constituents into the water. The use of gypsum rock dust can raise the TDS and sulfate concentrations in the groundwater. Until recently, Co-Op Mining Company used a non-gypsum rock dust. In 1990, use of gypsum rock dust began (Co-Op Mining Company, 1992a).

During January and March, 1992, TDS concentrations were detected that exceed the NPDES Permit guidelines for discharge from the Bear Canyon Mine. Gypsum used in rock dusting is considered to have contributed to the high TDS concentrations. Co-Op Mining Company now uses only lime dust in the Bear Canyon Mine (Co-Op Mining Company, 1992b). Due to the relative dryness of the mine, no future increase in TDS or sulfate concentrations in the groundwater is expected.

Impact of Hydrocarbons. Hydrocarbons (in the form of fuels, greases, and oils) are stored and used in the permit area. Groundwater contamination could result from spillage of hydrocarbon products during maintenance of equipment during operations, filling of storage tanks and vehicle tanks, or from tank leakage due to the rupture of tanks.

The probable future extent of the contamination caused by diesel and oil spillage is expected to be small for six reasons.

1. All above-ground storage tanks are bermed and inner and/or outer catchments are utilized in accordance with the 1992 Spill Prevention Control and Countermeasure Plan (SPCC).
2. No underground storage tanks exist at the site.
3. Because the tanks are located above ground, leakage from the tanks can be readily detected and repaired.

4. Spillage during filling of the storage or vehicle tanks is minimized to avoid loss of an economically valuable product.

5. The surface operations area is drained by a series of ditches, which feed into a sedimentation pond at the lower end of the disturbed area.

6. The 1992 SPCC Plan provides (and Co-Op Mining Company has implemented) inspection and operation measures to minimize the extent of contamination resulting from the use of hydrocarbons at the site.

There are no transformers in the mine permit area which contain polychlorinated biphenyls (PCBs).

Road Salting Impact. Co-Op Mining Company utilizes salt to maintain the roads within the permit area in the winter. Road salt could contaminate the groundwater if sufficient amounts of salt were stored on, or washed into recharge areas.

Co-Op Mining Company salts 2,100 feet of road in the winter (this will be increased to 4,200 feet with the addition of the proposed Tank Seam access road). The potential for impact to the groundwater is low and not likely to occur; however, because the steepness of the canyon allows very little recharge within the permit area. Salt is stored by Emery County outside the permit area (Co-Op Mining Company, 1992a).

3.0 SURFACE WATER

3.1 BACKGROUND INFORMATION

Detailed information on surface water and the physical resources that effect surface water is found in Chapter 7 of the M&RP and in the Revised Hydrogeologic Evaluation of the Bear Canyon Mine Permit and Proposed Expansion Areas (EarthFax Engineering, 1992). This information is summarized herein for convenience. These documents should be consulted for more detail.

3.1.1 Hydrology

The Bear Canyon Mine is located in the San Rafael River Basin. Within the permit area, Bear Creek is a perennial stream and Trail Creek is an intermittent stream. On the southern end of the permit area, ephemeral streams discharge into Huntington Creek, a perennial stream (Chapter 7, M&RP).

All streams in the permit and adjacent areas are classified by the Utah Department of Health as follows:

- 1C Protected for domestic use with prior treatment processes,
- 3A Protected for cold water aquatic life, and
- 4 Protected for agricultural uses including stock watering.

The primary source of water for the streams in the area is snowmelt (Danielson, 1981). Hence, peak flows generally occur in the late spring and early summer. The 1989 annual watershed yield of the Huntington Creek drainage measured upstream from the bridge to Deer Creek Mine is 21,449 ft^3 (Water Resources Division, USGS, 1992).

Seasonal variations in perennial stream flow monitored in Huntington Creek during 1989 range from 4,100 to 66,000 gpm, averaging 22,000 gpm. These extremes in flow rates are typical of high elevation locations in the western United States and are graphically displayed in the Revised Hydrogeologic Evaluation of the Bear Canyon Mine Permit and Proposed Expansion Areas (1992, Appendix 7N-B).

Flow rates for Bear Creek are monitored at BC-1, BC-2, and BC-3, while flow rates for Trail Canyon are monitored at UT-1 and LT-1. The sediment pond inlet is monitored at SP-1. Locations of these monitoring points are presented on Plate 7-4 of this M&RP. Flow rates measured during the initial monitoring of flow rates for each of these monitoring points are presented in Table 3-1. Monitoring points BC-3, SP-1, and UT-1 were dry. Table 3-2 presents the average annual flow rates for surface water in 1991. Average flow rates recorded at BC-2 during 1991 are higher than the initial flow (due to mine water discharge from the NPDES discharge point). Average flow rates at LT-1 are also higher than initial flows (due to one high flow rate recorded in October 1991). There is no corresponding increase at BC-1, and no cause for this increase is known.

Annual monitoring of proposed Federal Lease U-024316 surface water monitoring point FBC-1 began in 1990. In August 1991, the intermittent stream monitored at FBC-1 flowed through McCadden Hollow at the rate of 1.5 gpm. It was dry in June 1990 and October 1992 (Appendix 7-M of this M&RP).

3.1.2 Water Quality

Sediment Yield. Danielson (1981) collected water samples from Bear Creek during 1978 and 1979 in order to determine total suspended solids (TSS) concentrations and loads of the stream. Analyses of these samples yielded TSS concentrations of 8,860 and 2,140 mg/l and loads of 1.9 and 4.0 tons/day. Danielson attributes TSS concentrations in Bear Creek to erosion of shales and mudstones in the North Horn Formation by the springs that feed Bear Creek.

TABLE 3-1

Initial Surface Water Flow Rates

Source	Date	Flow (gpm)
BC-1 (Upper Bear)	11/84	26.0
BC-2 (Lower Bear)	12/84	26.8
BC-3 (Right Fork Bear)	1/86	Dry
LT-1 (Lower Trail)	5/90	29
SP-1 (S. Pond Inlet)	5/90	Dry
UT-1 (Upper Trail Creek)	5/90	Dry

TABLE 3-2

1991 Average Surface Water Flow Rates

Source	Flow (gpm)	Number of Measurements
BC-1 (Upper Bear)	27	7
BC-2 (Lower Bear)	100	7
BC-3 (Right Fork Bear)	Dry	7
LT-1 (Lower Trail Creek)	47	2
SP-1 (Sed Pond Inlet)	Dry	2
UT-1 (Upper Trail Creek)	Dry	2

Chemical Quality. Surface water quality samples are routinely collected in the permit and adjacent areas from stations located on Bear Creek and Trail Creek. Analytical data from these sources are summarized in Chapter 7 of the M&RP and the Annual Reports. Locations of these monitoring points are presented on Plate 7-4 of the M&RP.

Table 3-3 presents analytical results from the initial sampling of each surface water monitoring point. The general character of the surface water is that of a slightly alkaline calcium-bicarbonate water containing low concentrations of TDS, nutrients and metals. Three (BC-3, SP-1, and UT-1) out of the six surface water monitoring points have been dry, historically. The source of the high TSS concentration detected at BC-1, is unknown, but occurs upstream of the mine, and is not considered to be mine-related.

Chemical analyses presented in the 1991 Annual Report were averaged for each monitoring point and are presented in Table 3-4. These data indicate that the general character of the surface water is also that of a slightly alkaline calcium-bicarbonate water, low in concentrations of nutrients. However, average TDS, TSS, calcium, magnesium, iron, and sulfate concentrations in BC-1 and BC-2 are significantly higher than the corresponding initial concentrations. Comparison of initial and average 1991 analytical results for LT-1 water indicate that chemical concentrations at this station are relatively unchanged.

Table 3-5 presents 1991 and 1992 initial data for proposed Federal Lease U-024316 surface water monitoring point FBC-1. These chemical concentrations correlate closely to the chemical concentrations of LT-1 water (Tables 3-3 and 3-4).

Total dissolved solids content in BC-1, BC-2, and LT-1 waters measured in 1991 range from 404 to 1810 mg/l (1991 Annual Report). Anomalously elevated TDS concentrations (accompanied by high TSS, calcium, magnesium, iron, and sulfate concentrations) were detected in BC-1 and BC-2 water collected during February 1991. These elevated concentrations occur both upstream and downstream of the mine,

TABLE 3-3

Initial Surface Water Analytical Results
(all values except pH expressed as mg/l)

Source	Date	TDS	TSS	Acid.[a]	Hard.[b]	Alka.[c]	Ca	Mg	Fe	Na	K	HCO_3	SO_4	Cl	NO_3	pH
BC-1 (Upper Bear)	11/84	415	1620	0	NA	200	43	57.0	4.8	8.0	3.5	NA	161	4.0	0.47	8.1
BC-2 (Lower Bear)	10/84	375	13.5	0	NA	200	50	50.4	19.8	7.1	5.77	244.0	116	20.0	0.14	8.1
BC-3 (Rt Fk Bear)	1/86	Dry														
LT-1 (Lower Trail)	5/90	472	6	0	412	355	72.3	56.2	0.32	17.6	3.9	433.4	88.5	14.7	NA	8.1
SP-1 (S. Pond Inlet)	5/90	Dry														
UT-1 (Upper Trail Creek)	5/90	Dry														

(a) Acidity as $CaCO_3$.
(b) Hardness as $CaCO_3$.
(c) Alkalinity as $CaCO_3$.
NA = Not analyzed.

TABLE 3-4

1991 Average Surface Water Analytical Results
(all values except pH expressed as mg/l)

Source	TDS	TSS	Acid.[a]	Hard.[b]	Alka.[c]	Ca	Mg	Fe	Na	K	HCO_3	SO_4	Cl	NO_3	pH	Number of Samples
BC-1 (Upper Bear)	783	623	0	656	262	113	95	26.3	13	6.4	313	430	9.5	NA	8.0	4
BC-2 (Lower Bear)	793	342	0	613	308	51	113	4.0	11	5.2	370	323	9.3	NA	8.0	4
BC-3 (Rt. Fk. Bear)	Dry															
LT-1 (Lower Trail Cr.)	476	1	NA	398	NA	70	54	0.13	18.5	4.7	401	85	20.0	NA	8.0	2
SP-1 (S Pond Inlet)	Dry															
UT-1 (Upper Trail Cr)	Dry															

(a) Acidity as $CaCO_3$.
(b) Hardness as $CaCO_3$.
(c) Alkalinity as $CaCO_3$.
NA = Not analyzed.
NS = Not sampled.

TABLE 3-5

Surface Water Analytical Results (proposed Federal Lease U-024316)
(all values except pH expressed as mg/l)

Source	Date	TDS	TSS	Acid.[a]	Hard.[b]	Alka.[c]	Ca	Mg	Fe	Na	K	HCO_3	SO_4	Cl	NO_3	pH
FBC-1	7/91	468	NA	NA	445	NA	85.9	56.1	0.44	13.8	1.53	464	72.8	15.3	0.0	0.0
FBC-1	10/92	Dry														

(a) Acidity as $CaCO_3$.
(b) Hardness as $CaCO_3$.
(c) Alkalinity as $CaCO_3$.
NA = Not analyzed.

indicating that they are unrelated to mining activities. Additionally, these anomalies do not correlate with fluctuations in flow rate and may be related to "sloughing events" mentioned by Danielson (1981). These "sloughing events" are the result of the continuous erosion of shale and mudstone by the springs which flow from the North Horn Formation at the head waters of Bear Creek (Danielson, 1981).

Iron concentrations in the streams vary widely through time at the three stream locations (LT-1, BC-1 and BC-2), possibly due to dissolution of iron-bearing cement in the Blackhawk Formation. Iron concentrations have ranged from 0.03 to 98.9 mg/l during the period of record (1990 and 1991 Annual Reports) and proportionally correlate with TSS concentration.

Manganese concentrations in the permit area are low, ranging from below detection to 1.13 mg/l. High concentrations correlate with higher TSS concentrations (1990 and 1991 Annual Reports).

Changes in surface water quality from upstream (BC-1) to downstream (BC-2) of the Bear Canyon Mine during 1990 and 1991 were analyzed with a Student's t-test and the difference in the means of chemical concentrations were statistically insignificant (EarthFax Engineering, 1992, p. 2-6). This suggests that surface water quality does not change significantly as it flows past the mine. No comparison can be made for Trail Creek as the upstream monitoring point is consistently dry (1990 and 1991 Annual Report).

A comparison of surface water quality data (1991 Annual Report) with the national secondary drinking water standards indicates that the chemical quality of local surface water is typically within drinking water standards. No primary drinking water analytes were included in the surface water analysis suite.

Exceedances of secondary drinking water standards were found (iron, 4 out of 19 samples; manganese, 1 out of 19 samples; sulfate 1 out of 10 samples; and TDS, 3 out of

19 samples), however, these exceedances are typical of Bear Creek and other steams in the area prior to mining (Danielson, 1981). The sulfate exceedance (BC-1, February 28, 1991) is questionable in that BC-1 and BC-2 analyses are very similar in all other parameters. Yet, the sulfate analytical results differ for these two samples by two orders of magnitude. There were no exceedances of the secondary drinking water standards found in the analytical results for water collected at the NPDES mine water discharge point.

3.2 POTENTIAL SURFACE WATER IMPACTS

The potential surface water impacts that could result from mining and reclamation operations at the Bear Canyon Mine include:

- Contamination from acid- or toxic-forming materials;
- Increased sediment yield from disturbed areas;
- Flooding or stream flow alteration;
- Impacts to the chemical quality of surface water; and
- Impact to surface water quantity.

3.2.1 Potential Contamination from Acid- or Toxic-Forming Materials

As noted in Section 2.2.1 of this PHC, no poor or unacceptable (acid- or toxic-forming) materials have been found in the permit area. The small, highly localized sulfur-bearing mineral zone discussed in Section 2.2.1 produced no acid- or toxic-forming waste rock. Historically,alkalinity of the mine water ranges from 141 to 314 mg/l and acidity ranges from 0 to 7 mg/l (Chapter 7 of this M&RP, 1990 Annual Report, and 1991 Annual Report). Due to the naturally alkaline character of the ground and surface waters in the area and the lack of acid- or toxic- forming materials, the probability of an impact from acid-and toxic-forming materials is minimal. However, if any of these materials are discovered in the future through the on-going mine plan, these materials will be disposed of within the guidelines set down in R645-301-731.300 and in Chapter 3 of the M&RP.

3.2.2 Potential Increase in Sediment Yield

Mining activities may result in an increase in sediment yield downstream of the disturbed areas. Sedimentation control measures (such as sedimentation ponds, diversions, etc.) have been installed to minimize this impact. These facilities are regularly inspected (see Chapter 7 of this M&RP) and maintained.

Current monitoring (10/17/91) indicates that no significant increase of TSS concentrations occurs from BC-1 (9 mg/l), upstream of the mine discharge, to BC-2 (5 mg/l), downstream of the mine discharge. Although TSS concentrations vary greatly at these two sample points, the relationship is typically that of higher TSS concentration upstream of the mine discharge and lower TSS concentrations below the mine discharge (1990 and 1991 Annual Report). Thus, control measures at the mine are effective at controlling sediment yields before discharging to the surface water. As a result of ongoing inspection and maintenance of the sediment-control facilities, there is a very low probability that sediment yield will increase due to mining activities.

3.2.3 Potential for Flooding or Stream Flow Alteration

Runoff from all disturbed areas flows through sedimentation ponds or other sediment-control facilities prior to discharge to adjacent undisturbed drainages. Three factors indicate that these sediment-control facilities minimize or preclude flooding impacts to downstream areas as a result of mining operations:

1. The sediment-control facilities have been designed and constructed to be geotechnically stable. Thus, the potential is minimized for breaches of the sediment-control devices to occur that could cause downstream flooding.

2. The flow routing that occurs through these sediment-control devices reduces peak flows from the disturbed areas. This precludes flooding impacts to downstream areas.

3. By retaining sediment on site in the sediment-control devices, elevations of stream channels downstream from the disturbed areas are not artificially raised. Thus, the hydraulic capacity of the stream channels is not altered.

Following reclamation, stream channels will be returned to as close to their original configuration as possible (see Chapter 7 of this M&RP). The reclamation channels have been designed to safely pass the peak flow resulting from the 100-year, 6-hour storm in Bear Canyon and the 10-year, 6-hour storm in the ephemeral side drainages. Thus, potential for flooding of the reclaimed areas will be minimized. Interim sediment-control measures and maintenance of reclaimed areas during the post-mining period will prevent deposition of significant amounts of sediment in downstream channels following reclamation, thus maintaining the hydraulic capacity of the channels and preventing adverse flooding impacts.

The mine has been designed to prevent subsidence beneath perennial streams identified in Chapter 3 of this M&RP. Thus, no alteration of perennial stream flow patterns is anticipated.

Subsidence will occur in areas occupied by ephemeral stream channels. Although surface cracks that result from subsidence in the permit area tend to heal with time (DeGraff, 1978), ephemeral stream flows may be partially intercepted prior to completion of the healing process. In addition, the broad depressions created by subsidence may locally retain runoff that would normally discharge from an area. However, the following factors indicate that the impact of subsidence on ephemeral stream flow will be minimal:

1. Ephemeral stream flow in the area is sporadic, allowing significant periods of time for surface cracks to heal between flow events. As the cracks heal, the potential for interception of stream flow is minimized.

2. Ephemeral stream flow typically carries a high sediment load. This sediment will fill remaining cracks, thus accelerating the healing process and minimizing stream flow interception. Additionally, alluvial and colluvial deposits in the stream channels are unconsolidated and will assist in filling subsidence cracks that may occur.

3. The depressions created by subsidence are generally broad and changes in slope are not of sufficient magnitude to cause ponding. This is especially true in the steep terrain typical of the permit and adjacent areas.

The overburden thickness within the present permit area is 0 to 1500 feet. (Plate 7-4 of this M&RP). Maximum recorded cumulative subsidence within the permit area is 0.31 feet. Subsidence features in the area are associated with the coal outcrop (1991 Annual Report and Plate 3-3 of this M&RP). Within proposed Federal Lease U-024316 the thickness of overburden is 1000 to 1800 feet and no coal outcrops occur (Plate 7-4 of this M&RP). The effects of subsidence diminish with increased overburden thickness (Hustrulid, 1980). Thus, subsidence is not expected to impact stream flow patterns within proposed Federal Lease U-024316. Additionally, there will not be any surface facilities or portals in the proposed federal lease (Co-Op Mining Company, 1992a); thus, no disturbed areas will be created.

3.2.4 Potential Chemical Quality Impacts

Potential impacts to the chemical quality of surface water in the permit and adjacent areas include:

- Increased acidity, total suspended solids, and total dissolved solids;
- Contamination from hydrocarbon usage;
- Contamination from rock dust usage;
- Contamination from road salt; and
- Contamination from coal haulage.

<u>Acidity, Total Suspended Solids, and Total Dissolved Solids Impact.</u> As indicated in Sections 3.2.1 and 2.2.1 of this PHC, no significant impacts are expected to occur to the acidity of surface water in the permit and adjacent areas as a result of Co-Op mining and reclamation operations. Likewise, no significant impacts are expected to occur to TSS concentrations in the permit and adjacent areas (see Sections 3.2.2 and 3.2.3 of this PHC).

Historic TDS concentrations downstream of the mine water discharge point are generally lower than those found upstream. Average quarterly TDS concentrations for BC-1 and BC-2 measured during 1991 were 783 and 793 mg/l, respectively. The 10 mg/l difference in means was determined statistically insignificant through application of a Student's t-test (EarthFax Engineering, 1992 p. 2-6). The average TDS concentration measured during 1991 at the NPDES discharge point is 371 mg/l, which is significantly less than either Bear Creek average TDS concentration (1991 Annual Report). These data indicate that mine water does not decrease the quality of the surface water in the area.

Subsidence due to mining within proposed Federal Lease U-024316 is not expected to impact stream flow and no disturbed areas will be created within the lease due to mining activities (Section 3.2.3). Thus, impact to TDS concentrations is not expected to occur due to mining in this lease area.

Hydrocarbon Usage Impact. The potential impacts of hydrocarbon usage are contamination of soils and surface water resulting from spillage of hydrocarbon based products during maintenance of equipment or from tank leakage due to rupture of the tank. These potential impacts are presently being prevented and mitigated through the Co-Op Mining Company SPCC Plan (1992). These mitigations have been discussed in greater detail in Section 2.2.3 of this PHC. As a result of the implementation of this SPCC plan, the probability of spills and leaks of hydrocarbons contaminating the soil or surface water is low.

Rock Dust Usage Impact. The use of gypsum rock dust for the suppression of coal dust in the mine may potentially increase the sulfate and TDS concentrations of the water flowing into the mine. Mine water which has become enriched in the rock dust constituents will increase the concentrations of those constituents in surface water when discharged. Until recently, Co-Op Mining Company used a non-gypsum rock dust. In 1990, use of gypsum rock dust began.

During January and March, 1992, TDS concentrations of discharged mine water exceeded the NPDES Permit guidelines. Gypsum used in rock dusting is considered to have contributed to the high TDS concentrations. Co-Op Mining Company no longer uses gypsum dust in the Bear Canyon Mine (Co-Op Mining Company, 1992c). Due to the relative dryness of the mine, no future increase in TDS or sulfate concentrations in the mine discharge water is expected.

Road Salting Impact. Co-Op Mining Company utilizes salt to maintain the roads within the permit area in the winter. Road salt could contaminate the surface water if sufficient amounts of salt were washed into the creeks.

Co-Op Mining Company salts 2,100 feet of road (4,200 feet including the proposed Tank Seam access road) in the winter. The potential for impact to the surface water is low and not likely to occur for the following reasons:

1. 7,255 feet of road (including the Tank Seam access road) lie with the sediment control area.
2. Salt is stored by Emery County outside the permit area.
3. Mild winters have minimized the need for road salt.

Coal Haulage Impact. Coal is presently hauled from the loadout facility by independent trucking firms. Surface water could be impacted by coal spills that would either fall directly into Bear Creek or be washed down into the creek during a storm event. These spills could occur due to a vehicle accident involving a coal truck, or through failure to close the coal hoppers on the truck.

No vehicle accidents have occurred in which coal has been spilled and no coal spills have occurred outside of the sediment control area. All coal spills that have occurred have been due to failure to close the hoppers on the trucks. These spills were quickly and thoroughly cleaned (Co-Op Mining Company, 1992a). Thus, the impact of spills related to coal haulage is low, and the likelihood of occurrence is low also.

In addition to spills, wind may carry coal dust or small pieces of coal from the open top of the coal truck into creeks near the road. The potential impact from fugitive coal dust is presumed to be insignificant due to the small amounts lost during haulage in the permit and adjacent areas.

3.2.5 Potential Surface Water Quantity Impacts

Surface water availability may possibly be diminished through subsidence due to the pulling of pillars. Surface water availability is increased in Bear Creek due to mine-water discharges.

There is no evidence of surface water loss or diminishment related to subsidence at the Bear Canyon Mine (Chapter 3 of the M&RP). When subsidence occurs in the Wasatch Plateau area, the cracks seal rapidly (DeGraff, 1978), preventing the deep percolation and subsequent loss of water previously destined for springs and other water sources. Therefore, the probability of surface water availability being affected by the subsidence is low (see also Section 3.2.3 of this PHC). Subsidence is adequately monitored under the subsidence monitoring plan (Chapter 7 of this M&RP).

The effects of subsidence within the proposed Federal Lease U-024316 are expected to be less than those experienced within the present permit area due to the greater thickness of overburden and lack of coal outcrops (Section 3.2.3). Thus, impact to surface water availability is expected to be less than that experienced in the present permit area.

4.0 CONCLUSIONS

The potential impacts of these mining operations upon the hydrologic balance are summarized in Table 4-1. All of the potential impacts of mining on the hydrologic balance are being properly monitored and mitigation plans have been implemented.

TABLE 4-1

Summary of Potential Impacts and Mitigations

Potential Impact	Potential Effect	Potential Magnitude of Impact	Probability of Occurrence	Mitigation Measures
Leaching of acid- or toxic-forming materials	Degradation of surface and groundwater quality.	Low	Low	Monitoring, materials handled in approved manner.
Groundwater availability	Decrease in spring flow due to subsidence	Low	Low (no history of impact)	Monitoring
Groundwater availability	Interception of perched groundwater by mine workings	Low	High (ongoing)	Monitoring
Groundwater availability	Removal of water with coal	Low	High (ongoing)	Monitoring
Groundwater quality	Decrease in quality due to leaching of rock dust	Low	Low (Dryness of mine)	Monitoring, discontinued use of gypsum rock dust
Groundwater quality	Decrease in quality due to hydrocarbon usage	Low	Low	Monitoring, SPCC plan, inspections and maintenance
Sediment yield	Increase in TSS	Moderate	Low	Sedimentation ponds, diversions, interior sediments, control, monitoring
Flooding	Damage to downstream areas	Moderate	Low	Sedimentation ponds, diversion, monitoring
Stream flow alteration	Damage to streams due to subsidence	Low	Low	Protection of perennial streams, monitoring

TABLE 4-1 (Continued)

Summary of Potential Impacts and Mitigations

Potential Impact	Potential Effect	Potential Magnitude of Impact	Probability of Occurrence	Mitigation Measures
Groundwater quality	Decrease in quality due to road salting	Low	Low	Sedimentation ponds, monitoring, storing of salt off site by County
Surface water quality	Decrease in quality due to leaching of rock dust	Low	Low	Monitoring, discontinued use of gypsum rock dust
Surface water quality	Decrease in quality due to hydrocarbon usage	Low	Low	Monitoring, SPCC plan, inspections, maintenance
Surface water quality	Increase in TSS due to coal spills and wind blown coal dust	Low	Low	monitoring, sedimentation ponds
Surface water quality	Decrease in water quality due to road salting	Low	Moderate	Sedimentation ponds, monitoring
Surface water quality	Increase in flow of Bear Creek due to mine discharge	Low	High (ongoing)	Monitoring, underground. i.e., use of water

5.0 REFERENCES

Brown, T.L., Sanchez, J.D., and Ellis, E.G. 1987. Stratigraphic Framework and Coal Resources of the Upper Cretaceous Blackhawk Formation in the Wasatch Plateau Coal Field, Manti 30'x60' Quadrangle, Emery, Carbon, and Sanpete Counties, Utah. U.S. Geological Survey Map C-94-D. Washington, D.C.

Co-Op Mining Company. 1990. Annual Report. Bear Canyon and Trail Canyon Mines. Emery County, Utah.

Co-Op Mining Company. 1991. Annual Report. Bear Canyon and Trail Canyon Mines. Emery County, Utah.

Co-Op Mining Company. 1992a. Telephone conversation with Charles Reynolds, Co-Op Mining Company, Mindy Rosseland, EarthFax Engineering, Inc.

Co-Op Mining Company. 1992b. Telephone conversation with Wendell Owen, Co-Op Mining Company, Mindy Rosseland, EarthFax Engineering, Inc.

Danielson, T. W., M. D. ReMillard, and R. H. Fuller. 1981. Hydrology of the Coal-Resource Areas in the Upper Drainages of Huntington and Cottonwood Creeks, Central Utah. U. S. Geological Survey. Water Resources Investigations Open-File Report 81-539. Salt Lake City, Utah.

DeGraf, J.V. 1978. Geologic Investigation of Subsiding Tension Crack "Self-Healing" Phenomenon. Environmental Geology. U.S. Department of Agriculture, Forest Service. Fish Lake National Forest.

EarthFax Engineering. 1992. Revised Hydrogeologic Evaluation of the Bear Canyon Mine Permit and Proposed Expansion Areas. Appendix 7-N of the M&RP. Salt Lake City, Utah.

Fritz, Peter, and J.C. Fontes. 1980. Handbook of Environmental Isotope Geochemistry. Elsevier Scientific Publishing Company. New York, New York.

Hustrulid, W. 1980. Mine Subsidence Workshop. Salt Lake City, Utah.

Leatherwood, James and Duce, Dan. 1988. Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining. State of Utah Department of Natural Resources. Division of Oil, Gas, and Mining. Salt Lake City, Utah.

Lines, Gregory C. 1985. The Ground-Water System and Possible Effects of Underground Coal Mining in the Trail Mountain, Central Utah. U. S. Geological Survey Water-Supply Paper 2259. Alexandria, Virginia.

Mangum Engineering. 1992. Written communication from Charles Reynolds for Co-Op Mining Company, dated April 13, 1992, to Mr. Harry Campbell, Utah Division of Water Quality, Department of Environmental Quality. Bear Canyon Mine, Emery County, Utah.

Thiros, S.A. 1992. Telephone conversation with Sue Thiros, USGS, Mindy Rosseland, EarthFax Engineering.

Thiros, S.A. and Cordy, G.E. 1991. Hydrology and Potential Effects of Mining in the Quitchupah and Pines Coal-Lease Tracts, Central Utah. U.S. Geological Survey. Water-Resources Investigations Report 90-4084. Salt Lake City, Utah.

U. S. Environmental Protection Agency. 1990a. National Primary Drinking Water Regulations. 40 CFR 141. Washington, D. C.

U. S. Environmental Protection Agency. 1990b. National Secondary Drinking Water Regulations. 40CFR 143. Washington, D. C.

USGS. 1992. Discharge Data for Huntington Creek Station 09317997. Water Resources Division. Salt Lake City, Utah.

Utah Climate Center. 1992. Monthly Values Taken from Temperature Mean Monthly at Hiawatha Station. Utah State University. Logan, Utah.

Utah Climate Center. 1992. Wind Data Measured at the Huntington Research Farm. Utah State University. Logan, Utah.

Utah Water Quality Board. 1987. Standards for Quality of Water for the State of Utah.Salt Lake City, Utah.

<u>BTCA Area F</u> - OUTSLOPE OF UPPER STORAGE PAD & DOWNCAST PILE.

During construction of the Upper Storage Pad (Plate 7-1C) some fill was overcast down the face of the slope below. ~~The area covers approx 800 sq ft.~~ Also at the base of the cliff there is a pile of downcast material. The total area is approx 0.24 acres. The runoff volume for this area is calculated to be approx 0.0~~01~~3 acre ft.

Sediment and erosion control is presently maintained with the use of in-place erosion control matting and vegetation. With the extension of culvert C-8U in 1992, part of the drainage from the downcast pile will report to Sediment Pond A.

<u>BTCA Area G</u> - PORTAL ACCESS ROAD SWITCH BACK

This area covers a strip approx 25 ft wide by 160 ft long at the switchback of the portal access road. See Plate 7-1D. The runoff volume for this area is calculated to be less than 0.001 acre ft. The area is within AU-15.

Erosion and sediment control is performed by established vegetation.

<u>BTCA Area H</u> - TANK SEAM ACCESS ROAD CUT SLOPE ABOVE D-15U

This area, which is approx 0.028 acres (Plates 7-1C and 7-1E), includes the cut slope of the Tank Seam Access Road adjacent to ditch D-15U. The total flow from this area is 0.0035 acre-ft. The slope consists primarily of bedrock outcrop, minimizing the potential erosion on the slope. Areas where the slope demonstrates a high potential for erosion will be covered with erosion control matting, which will be maintained. Sediment and runoff will be controlled by a silt fence placed in ditch D-15U as shown on Plate 7-1C. Undisturbed drainage from area AU-3 and road drainage will also pass through the silt fence, with a maximum flow of 0.33 cfs. A typical silt fence installation is shown in Figure 7.2-15.

<u>BTCA Area I</u> - OUTSLOPE OF LOWER TANK SEAM ACCESS ROAD NEAR D-15U

This area, approx 0.048 acres (Plates 7-1C and 7-1E), includes the minimal amount of disturbed fill on the outslope of the lower Tank Seam Access Road across from D-15U and D-16U. The estimated volume of runoff from this area is 0.006 acre-ft, with a maximum slope length of 10 ft. Erosion will be controlled by the placement of erosion control matting on the slope, which will be maintained. To prevent excess water from crossing or saturating the fill, a berm will be maintained along the outer edge of the road, and the road sloped away from the fill material.

DRAFT

BTCA Area J - LOWER TANK SEAM ACCESS ROAD CUT SLOPE ABOVE D-16U

This area, which is approx 0.026 acres, includes the cut slope ajacent to ditch D-16U (Plate 7-1E). The total runoff volume from this area is estimated to be 0.003 acre-ft. The slope consists primarily of bedrock outcrop, minimizing the potential erosion on the slope. Areas where the slope demonstrates a high potential for erosion will be covered with erosion control matting, which will be maintained. Sediment and runoff will be controlled by the placement of a silt fence in ditch D-16U as shown on Plate 7-1E. Undisturbed drainage from area AU-2C and road drainage will also pass through the silt fence, with a maximum flow of 0.25 cfs. A typical silt fence installation is shown in Figure 7.2-15.

BTCA Area K - OUTSLOPE OF FILL AREA AROUND C-16U

This area is approx 0.23 acres, and includes the fill outslope of the lower Tank Seam Access Road around culvert C-16U (Plate 7-1E). The estimated volume of runoff from this area is 0.029 acre-ft, with a maximum slope length of 90 ft. Erosion and runoff will be controlled by the placement of erosion control matting on the slope, which will be maintained. To prevent excess water from crossing or saturating the fill slope, a berm will be maintained along the outer edge of the road, and the road will be sloped to drain water away from the slope.

DRAFT

BTCA Area L - LOWER TANK SEAM ACCESS ROAD CUT SLOPE ABOVE D-17U

This area, which is approx 0.019 acres, includes the cut slope ajacent to ditch D-17U (Plate 7-1E). The total runoff volume from this area is estimated to be 0.002 acre-ft. The slope consists primarily of bedrock outcrop, minimizing the potential erosion on the slope. Areas where the slope demonstrates a high potential for erosion will be covered with erosion control matting, which will be maintained. Sediment and runoff will be controlled by the placement of a silt fence in ditch D-17U as shown on Plate 7-1E. Undisturbed drainage from area AU-1B and road drainage will also pass through the silt fence, with a maximum flow of 0.43 cfs. A typical silt fence installation is shown in Figure 7.2-15.

BTCA Area M - OUTSLOPE OF FILL AREA AROUND C-17U

This area is approx 0.048 acres, and includes the fill outslope of the lower Tank Seam Access Road around culvert C-17U (Plate 7-1E). The estimated volume of runoff from this area is 0.006 acre-ft, with a maximum slope length of 50 ft. Erosion will be controlled by the placement of erosion control matting on the slope, which will be maintained. To prevent excess water from crossing or saturating into the slope, a berm will be maintained along the outer edge of the road above the slope and the road will be sloped to drain water away from the fill slope.

DRAFT

BTCA Area N - CUT AND FILL SLOPES IN AREA AU-1C

This area, which is approx 0.12 acres, includes the cut slope ajacent to ditch D-18U and the cut and fill slopes in the three switchbacks of the Tank Seam Access Road (Plate 7-1E). The total runoff volume from this area is estimated to be 0.015 acre-ft. The cut slopes consist primarily of bedrock outcrop, minimizing the potential erosion on the slope. Areas where the cut and fill slopes demonstrate a high potential for erosion will be covered with erosion control matting, which will be maintained. Sediment and runoff will be controlled by the placement of a silt fence in ditch D-18U as shown on Plate 7-1E. Undisturbed drainage from area AU-1A, AU-1C and road drainage will also pass through the silt fence, with a maximum flow of 0.65 cfs. A typical silt fence installation is shown in Figure 7.2-15. In order to prevent water from saturating or crossing the fill slopes, berms will be placed along the outside edge of the road and the road will be sloped to drain water away from the fill slopes.

BTCA Area O - OUTSLOPE BELOW FIRST TANK SEAM ROAD SWITCHBACK

This area is approx 0.04 acres, and includes the outslope of the first Tank Seam Access Road switchback (Plate 7-1E). The estimated volume of runoff from this area is 0.005 acre-ft, with a maximum slope length of 15 ft. Erosion will be controlled by the placement of erosion control matting on the slope, which will be maintained. To prevent water from crossing or saturating the slope, berms will be placed along the road, and the road sloped to drain water away from the fill slope.

DRAFT

BTCA Area P - TANK SEAM ACCESS ROAD TOPSOIL STOCKPILE

This area is approx 0.06 acres (Plate 7-1E). The estimated volume of runoff from this area is 0.008 acre-ft. Erosion and sediment will be controlled by a berm placed to totally contain runoff from the pile. The berm along the base of the pile (approx. 80 ft distance) will be a minimum of 2 ft high, with the ditch between the berm and topsoil pile a minimum of 2 ft bottom width, assuming 1H:1V side slopes. This will allow the berm to contain a volume of 0.011 acre-ft at the base of the pile, providing adequate protection for the topsoil.

BTCA Area Q - UPPER TANK SEAM ACCESS ROAD CUT SLOPE ABOVE D-21U

This area is approx 0.053 acres. It includes the cut slope ajacent to ditch D-21U (Plate 7-1E). The total runoff volume from this area is estimated to be 0.007 acre-ft. The slope consists primarily of bedrock outcrop, minimizing the potential erosion on the slope. Areas where the slope demonstrates a high potential for erosion will be covered with erosion control matting, which will be maintained. Sediment and runoff will be controlled by the placement of a silt fence in ditch D-21U as shown on Plate 7-1E. Undisturbed drainage from area AU-1A and road drainage will also pass through the silt fence, with a maximum flow of 0.14 cfs. Runoff will also pass through the silt fence adjacent to culvert C-17U prior to entering the natural drainage channels. A typical silt fence installation is shown in Figure 7.2-15.

DRAFT

BTCA Area R - UPPER TANK SEAM ACCESS ROAD CUT SLOPE ABOVE D-22U

This area is approx 0.06 acres. It includes the cut slope ajacent to ditch D-22U (Plate 7-1E). The total runoff volume from this area is estimated to be 0.008 acre-ft. The slope consists primarily of bedrock outcrop, minimizing the potential erosion on the slope. Areas where the slope demonstrates a high potential for erosion will be covered with erosion control matting, which will be maintained. Sediment and runoff will be controlled by the placement of a silt fence in ditch D-22U as shown on Plate 7-1E. Undisturbed drainage from area AU-1 and road drainage will also pass through the silt fence, with a maximum flow of 0.72 cfs. A typical silt fence installation is shown in Figure 7.2-15.

BTCA Area S - OUTSLOPE OF FILL AREA AROUND C-23U

This area is approx 0.07 acres, and includes the fill outslope of the upper Tank Seam Access Road around culverts C-22U, C-23U AND C-24U (Plate 7-1E). The estimated volume of runoff from this area is 0.009 acre-ft, with a maximum slope length of 35 ft. Erosion and runoff will be controlled by the placement of erosion control matting on the slope, which will be maintained. To prevent excess water from crossing or saturating the fill slope, a berm will be maintained along the outside edge of the road and the road will be sloped to drain water away from the fill slope.

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BTCA Area T - UPPER TANK SEAM ACCESS ROAD CUT SLOPE ABOVE D-23U

This area is approx 0.02 acres. It includes the cut slope ajacent to ditch D-23U (Plate 7-1E). The total runoff volume from this area is estimated to be 0.0025 acre-ft. The slope consists primarily of bedrock outcrop, minimizing the potential erosion on the slope. Areas where the slope demonstrates a high potential for erosion will be covered with erosion control matting, which will be maintained. Sediment and runoff will be controlled by the placement of a silt fence in ditch D-23U as shown on Plate 7-1E. Undisturbed drainage from area AU-2B and road drainage will also pass through the silt fence, with a maximum flow of 0.55 cfs. A typical silt fence installation is shown in Figure 7.2-15.

BTCA Area U - TANK SEAM PORTAL PAD

This area is approx 0.43 acres. It includes the Tank Seam portal pad and adjacent cut slope, as well as the area around the conveyor belt and borehole structure (Plate 7-1E). The total runoff volume from this area is estimated to be 0.05 acre-ft. Erosion and sediment will be controlled using silt fences placed in Ditch D-14D prior to the inlet of culvert C-12D and a silt fence placed below the belt and borehole structure prior to the outlet of C-12D (Plate 7-1E). A typical silt fence installation is shown in Figure 7.2-15.

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8.9 SELECTED OVERBURDEN MATERIALS OR SUBSTITUTES

There were approx 17 acres disturbed (pre-1977 disturbance) in Bear Canyon prior to time Co-Op Mining Company started its operation in 1981. See Plates 2-4. Approx 1.5 acres of this area are below the gate outside of the permit area. These acres were disturbed during mining activities that had terminated some 30 years prior. Because of this pre-law disturbance and construction of access roads, topsoil was only recovered from some areas and substitute plant growth material will have to be used over much of the reclaimed areas. Areas are summarized in Table 8.9-1.

Table 8.9-1 Disturbed Area Summary

MARK[1]	DESCRIPTION	Total ac.[1&2]	Recontour acres[1]	Pre-1977 acres[2]	New acres
TS-1	Ball Park Topsoil Pile	1.27	1.27	-0-	1.27
TS-2	Lower Haul Road	1.6	1.6	1.6	-0-
TS-3	Sed Pond B & Scale Office Pad	2.56	2.56	1.23	1.33
TS-4	Sed Pond A	0.75	0.75	-0-	0.75
TS-5	Main Pad Area	12.30	9.50	8.86	3.44
TS-6	~~Lower~~ Portal Access Road	~~1.26~~ 2.62	~~1.26~~ 2.62	0.01	~~1.25~~ 2.61
TS-7	~~Portal Access Road~~ Blind Canyon Seam Portal Area	~~3.06~~ 1.70	~~2.86~~ 1.50	0.51	~~2.55~~ 1.19
TS-8	Upper Storage Pad	0.74	0.70	-0-	0.74
TS-9	Shower House Pad	1.84	1.84	-0-	1.84
TS-10	Tank Seam Access Road	2.25	2.25	-0-	2.25
TS-11	Tank Seam Portal Pad	0.46	0.46	-0-	0.46
	TOTAL	~~25.38~~ 28.09	~~22.34~~ 25.05	12.21	~~13.17~~ 15.88

Notes: 1. See Plates 8-5.
2. See Plates 2-4.

for reclamation. The proposed topsoil pile location is shown on Plate 2-4B. Proposed designs and cross sections are shown on Plate 8-3.

The topsoil stockpile will be surrounded with a containment berm and protected as stated in Section 8.8.2.3. An as built survey will be made of the stockpile and submitted to the Division as Plate 8-3 upon completion.

8.9.5 Tank Seam Access Road and Portal Pad

A survey of topsoil material was performed in the area of the Tank Seam access road and portal pad area in 1992. Four sites were sampled and the soil was analyzed. These sites are designated on Plate 8-5E as TSA-1, TSA-2, TSA-3 and TSA-4 (See Appendix 8-A for test results). Results indicated highest organic matter accumulations in the top 0-6 inches. Test results also indicate that the material tested is suitable for final reclamation material at all depths. See discussion in Appendix 8-E. Soil depths were determined by the visible presence of organic matter and a distinct soil color change. The observations indicated a varying soil depth of 0 to 8 inches, the lesser depths being in the steep rocky areas. During construction, topsoil will be stripped at depths varying from 0 to 8 inches by visually observing the depth at which organic material is found in the soil. The estimated volume of topsoil which will be recovered and placed in the designated storage area is 1,100 cubic yards.

Topsoil will be recovered on the access road area during construction and relocated to the topsoil stockpile areas shown on Plate 8-5E. Plate 8-6 shows the details of the proposed topsoil stockpiles. Upon completion of the topsoil recovery and storage, the topsoil will be revegetated. A berm will be maintained around the piles to totally contain runoff from the piles. Typical dimensions of the berm are shown on Plate 8-6 and described in Appendix 7-K, BTCA area "P". An as-built survey will be made of the stockpile and submitted to the Division as Plate 8-6 upon completion.

8.9.~~5~~6 Topsoil Summary

The following table summarizes the information discussed in the previous Sections:

Table 8.9-3 Summary Table

Description	cu yd
Main Topsoil Pile	1,480
Ball Park Topsoil Pile	3,400
Shower House Pad Topsoil Pile	1,700
Tank Seam Road Topsoil Storage Areas	1,100
Total	~~6,580~~7,680
On-site Material	as required

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8.10 REDISTRIBUTION OF SOILS

Following backfilling and regrading (Section 3.6.4) and prior to topsoil redistribution, regraded land will be scarified by a ripper to a depth of 14 in. in order to reduce surface compaction, provide a roughened surface assuring topsoil adherence if required, and promote root penetration. Steep slope areas which must remain after abandonment will receive special ripping to create ledges, crevices, pockets, and screes. This will allow better soil retention and vegetation establishment.

Each of the reclamation areas are discussed below as labeled on Plates 8-5. Topsoil will be distributed on reclamation areas as required prior to seeding. Topsoil redistribution procedures will ensure an approx uniform thickness of 5 inches as indicated by Soil Survey - Nov 1990 (Appendix 8-B). Topsoil will be redistributed in the fall of the year (Sept-Oct) suitable for establishment of permanent vegetation. A very roughened seed bed will be left in all cases.

To minimize compaction of the topsoil following preparation and/or redistribution, travel on reclaimed areas will not be allowed. Co-Op will exercise care to guard against erosion during and after application of topsoil and will use mulch, tackifiers, and erosion control matting as defined in Section 9.5.

The soil stabilization methodology that will be used includes the placement of crushed and heavier material at the toe of road fill slopes, and the random placement of large rocks and boulders on the surface. This procedure will enhance the microclimate as well as make the reclaimed area more aesthetically compatible with the undisturbed surroundings. The detailed revegetation plan to be submitted in the last five year permit renewal prior to reclamation, will include maps showing the areas to receive matting.

TS-1 Ball Park Topsoil Pile. This area is described in Section 8.9.3. Reclamation plant growth material will come from in-place material.

TS-2 Lower Haul Road. Disturbance to this section is limited to the road impacts from added road base material, compaction and minor spills of coal material that occur from haul vehicles. This area is within the pre-1977 disturbance area and did not have topsoil recovered for reclamation purposes. With ripping, regrading and seedbed preparation as described in this plan additional plant growth material will not be required.

TS-3 Sediment Pond B and Scale House. Approx one half of this area is within the pre-1977 disturbed area. The embankment material from sed pond B is vegetated showing it's suitability as substitute plant growth material. The material over the culverted creek is seeded as a back yard for the scale house also indicating good suitability. With removal of the culvert this material will be available for distribution. The road material can be treated as in area TS-2.

TS-4 Sediment Pond A. The embankment material from sed pond A is vegetated indicating good suitability as substitute plant growth material.

TS-5 Main Pad Area. Covering approx 10.8 acres this is the largest of the disturbed areas. Approx one third of this area is covered with coal storage. All but approx two acres of this area is within the pre-1977 disturbed area and did not have topsoil recovered for reclamation purposes. Although the coal storage and traffic within this area will compact the fill material, testing shows that it is suitable as plant growth material. Fill used for the upper layer of recontouring material will come from the outer or eastern edge of the pad. This material was the topsoil prior to Mining.

TS-6 ~~Lower~~ Portal Access Road. This area was disturbed prior to initiation of Mining by Co-Op Mining Co. and did not have topsoil recovered for reclamation purposes. This area has received special attention in the past and is discussed in Appendix 8-D. This area will be treated the same as area TS-2.

TS-7 ~~Portal Access Road and~~ Portal Pad Area. Most of this area is within the pre-1977 disturbed area and did not have topsoil recovered for reclamation purposes. ~~This area has received special attention in the past and is discussed in Appendix 8-D.~~ Downcast material will be recovered for reclamation.

TS-8 Upper Storage Pad. This area did not have topsoil recovered for reclamation purposes. Non-toxic and non-acid forming materials are stored on the pad. Sources for contamination are minimal. This area will be treated the same as TS-7. Some material from the lower pad areas will be required to recover the highwalls. See Appendix 3-L.

TS-9 Shower House Pad. This area will have topsoil recovered for reclamation purposes. Sources for contamination are minimal. Following recontouring at the time of final reclamation, the topsoil material recovered prior to construction will be spread over the surface to attain an approx depth of 7 inches.

TS-10 Tank Seam Access Road. Topsoil material recovered during construction will be placed in the topsoil storage piles shown on Plate 8-5C, 8-5E and 8-6. Additional plant growth material will not be required.

TS-11 Tank Seam Portal Pad. Topsoil material recovered during construction will be placed in the topsoil storage pile shown on Plate 8-5E and 8-6.

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8.11 NUTRIENTS AND SOIL AMENDMENTS

Following final grading test samples will be taken to represent each of the reclamation areas shown on Plates 8-5. Table 8.11-1 shows the sample frequency for each reclamation area. Additional samples will be taken in the event that the initial sample indicates unsuitable material. Composite samples will be taken from 0 to 2 ft and from 2 ft to 4 ft at each sample location.

Chemical analysis for micronutrients will be conducted by testing soil extracts from the redistributed material as outlined in Table 8.9-1. All necessary fertilization and/or neutralizing compounds will be applied according to the results of the soil sampling and analysis program approved by the division.

8.11-1 Final Grading Test Sample Density

MARK	DESCRIPTION	Acreage	SAMPLE FREQUENCY
TS-1	Ball Park Topsoil Pile	1.27	1
TS-2	Lower Haul Road	1.65	1
TS-3	Sed Pond B & Scale Office Pad	2.56	1
TS-4	Sed Pond A	0.75	1
TS-5	Main Pad Area	12.30	5
TS-6	~~Lower~~ Portal Access Road	~~1.26~~2.62	~~1~~2
TS-7	~~Portal Access Road~~Blind Canyon Seam Portal Area	~~3.06~~1.70	~~2~~1
TS-8	Upper Storage Pad	0.74	1
TS-9	Shower House Pad	1.84	1
TS-10	Tank Seam Access Road	2.25	2
TS-11	Tank Seam Portal Pad	0.46	1

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BA-16
10/22/93

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MANGUM ENGINEERING
KAYSVILLE, UTAH
MINE: CO-OP

DATE REPORTED: January 8, 1993

Lab No.	Location	Depths	pH	EC mmhos/cm @ 25°C	Saturation %	Calcium meq/l	Magnesium meq/l	Sodium meq/l	SAR	Coarse Fragments > 2 mm, % by Vol.	Sand %	Silt %	Clay %	Texture
24432	TSA-1	0-6	7.3	1.09	38.4	8.37	4.00	1.60	0.64	32.0	41.5	36.7	21.8	LOAM
24433		6-12	7.8	1.33	40.2	3.80	6.70	3.50	1.53	2.6	15.1	59.4	25.5	SILT LOAM
24434		12-24	8.1	4.48	42.3	2.88	30.1	18.9	4.66	7.7	11.5	61.2	27.3	SILTY CLAY LOAM
24435	TSA-2	0-6	7.4	0.73	32.2	4.77	1.94	1.45	0.79	52.9	40.5	41.3	18.2	LOAM
24436		6-12	7.5	0.76	31.2	4.48	2.91	1.50	0.78	66.7	33.3	46.7	20.0	LOAM
24437		12-24	7.5	0.85	27.8	4.64	4.10	1.37	0.66	73.5	40.5	43.1	16.4	LOAM
24438	TSA-3	0-6	7.5	0.58	25.4	3.83	1.85	1.24	0.74	61.1	58.7	26.8	14.5	SANDY LOAM
24439		6-12	7.8	0.61	31.3	2.49	3.62	1.33	0.76	60.0	26.9	45.8	27.3	CLAY LOAM
24440		12-24	7.9	0.73	29.2	1.88	4.70	1.27	0.70	59.8	40.5	37.7	21.8	LOAM
24441	TSA-4	0-6	7.6	0.92	28.2	6.47	2.51	1.32	0.62	54.3	64.2	26.7	9.1	SANDY LOAM
24442		6-12	7.5	1.07	27.3	5.96	4.72	1.48	0.64	42.4	58.7	28.6	12.7	SANDY LOAM
24443		12-24	7.7	8.67	27.5	25.4	75.1	20.5	2.89	67.7	38.7	43.1	18.2	LOAM

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

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MANGUM ENGINEERING
KAYSVILLE, UTAH
MINE: CO-OP

DATE REPORTED: January 8, 1993

Lab No.	Location	Depths	Carbonate %	Organic Carbon %	P mg/kg	K PE meq/l	Alkalinity PE meq/l	Bulk Density g/cm3	Total Kjeldahl Nitrogen %	1/3 bar	15 bar	Available Water Capacity, in/in	Munsell Color Crushed-dry
24432	TSA-1	0-6	45.0	2.3	4.04	0.95	8.23	2.12	0.11	12.4	8.6	0.05	10YR 5/3
24433		6-12	57.4	1.0	0.85	1.25	5.02	1.99	0.06	16.5	9.5	0.14	10YR 7/2
24434		12-24	59.2	0.6	0.38	2.48	3.47	1.98	0.04	15.9	9.9	0.11	10YR 7/2
24435	TSA-2	0-6	48.8	2.0	1.08	0.35	5.25	1.93	0.08	11.4	6.1	0.05	10YR 7/3
24436		6-12	50.0	1.4	0.71	0.23	4.75	1.54	0.05	10.7	4.8	0.03	10YR 7/3
24437		12-24	50.6	1.0	1.42	0.24	3.96	2.24	0.04	10.3	4.5	0.07	10YR 6/3
24438	TSA-3	0-6	23.2	1.4	0.76	0.19	4.13	1.95	0.04	7.0	4.0	0.02	10YR 7/3
24439		6-12	9.2	1.1	0.22	0.20	3.20	2.19	0.03	10.0	6.3	0.03	10YR 7/2
24440		12-24	34.2	0.7	0.27	0.09	3.47	1.89	0.03	10.6	6.0	0.03	10YR 7/2
24441	TSA-4	0-6	27.8	3.4	1.80	0.47	6.45	1.78	0.10	6.9	3.8	0.03	10YR 6/3
24442		6-12	30.6	1.9	1.04	0.45	6.68	1.27	0.06	8.2	4.5	0.03	10YR 6/3
24443		12-24	45.4	2.0	0.27	1.08	2.80	1.88	0.05	10.4	5.4	0.03	10YR 6/3

Abbreviations for extractants: PE= Saturated Paste Extract, H2OSol= water soluble,ABPTA= Ammonium Bicarbonate-DPTA, AAO= Acid Ammonium Oxalate

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aggregata, Plains Pricklypear Opuntia polyacantha, Cheatgrass Bromus tectorum, and Bluebunch Wheatgrass Agropyron spicatum.

9.3.3.5 Bare Cliffs and Talus

Vegetation is nonexistent or sparse and consists of a few grasses and forbs. Cliffs separate the Grassland vegetation type of the plateau from the more vegetated areas of the canyon bottoms.

9.3.4 Shower House Pad Vegetation

In 1993, Co-Op will disturb additional area for constructing a shower house and employee parking area. The pre-disturbed vegetation data is described in Appendix 9-D. Sampling was performed in the fall of 1992. In the Spring of 1993, a reference area will be selected by a Co-Op staff member and a Division staff member. This area will be sampled during the peak of the growing season in 1993 and the data will be submitted to the Division as soon as the information is available.

9.3.5 Tank Seam Access Road Vegetation

Co-Op proposes to construct an access road to the Tank Seam. Construction of the Road is described in Appendix 3-H. The pre-disturbed vegetation data, sampled in the fall of 1992, is described in Appendix 9-E. A reference area was selected for the Tank Seam portal pad and access road, and is shown on Plate 9-1. Appendix 9-A contains sampling data from the reference area and a comparison to the pre-disturbed vegetation on the Tank Seam access road and portal pad is included in Appendix 9-E.

Reclamation of the area will follow the methods described in Chapter 3 and section 9.5. After construction is complete, downslopes and cut slopes will be hydroseeded using the final reclamation seed mix, and runoff and erosion will be controlled with matting and silt fences as described in Appendix 7-K.

9.3.56 <u>Vegetation Monitoring</u>

In order to monitor possible effects of subsidence on vegetation as required by lease stipulation, aerial photographs will be taken and evaluated every 5 years, starting in 1991. Photos will be made available for review upon request, and tabulated results will be incorporated as Appendix 9-C.

9.4 THREATENED AND ENDANGERED SPECIES

No plant species listed as threatened or endangered (U.S. Fish and Wildlife Service, 1982) or proposed for threatened or endangered status (Welsh and Thorne, 1979) was observed on the study area. No plants listed as threatened or endangered are known to occur in the Co-Op permit area (Thompson, personal communication, 1983). The U.S.D.A. Forest Service identified no threatened or endangered plants in there correspondence dated 29 Jan 1991 (Appendix 9-B). A survey on November 4, 1993 by Robert M. Thompson, USFS Botanist, revealed no threatened or endangered species within the proposed road extension area (letter, Appendix 9-B).

VEGETATION SAMPLING
OF
TANK SEAM ACCESS ROAD
REFERENCE AREA

Appendix 9-A

Prepared by

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Fieldwork: Patrick Collins
Dean Collins

Report Date: August 1993
Fieldwork Date: July 1993

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VEGETATION SAMPLING
OF THE
TANK SEAM ACCESS ROAD
REFERENCE AREA

SCOPE

The CO-OP Mining Company in collaboration with the State of Utah, Division of Oil, Gas & Mining (DOGM) selected a reference area as a standard for future revegetation. The purpose of this document is to provide data for the reference area to be compared with data from an area proposed for disturbance that was sampled in 1992 (called "The Proposed Disturbed Tank Seam Access Road"). This road has been proposed for disturbance to access projected new mining activities by the CO-OP Mining Company.

INTRODUCTION

General Site Description

The Tank Seam Access Road Reference Area is located in a native plant community in the same general area as part of the "Proposed Disturbed Tank Seam Access Road". The proposed disturbance and reference area lie within Bear Canyon, a branch of Huntington Canyon located near the city of Huntington, Utah. Slopes that surround the canyon are primarily dominated by pinyon-juniper and mountain brush communities. The sample area was on a east-facing exposure on a 38° slope. In their native, undisturbed state, the canyon bottoms are comprised chiefly of sagebrush/grass and riparian communities.

Bear Canyon maintains active mine facilities. Several areas have been disturbed as a result of the mine activities and some of these areas have been reclaimed and reseeded.

METHODS

Sampling methodologies of the reference area closely approximated those from sampling the proposed disturbed areas in 1992. These methods are reported below.

Quantitative and qualitative data were taken on the sample sites. Sampling was accomplished in July 1993.

Transect Placement

Transect lines were randomly placed in the reference area. At regular points on the transect lines a random number was generated which placed each sample location at right angles to the transect lines.

Cover and Composition

As was implemented in sampling the proposed disturbance area, the cover estimates for the reference area were made using ocular methods with meter square quadrats. Species composition and relative frequencies were also assessed from the quadrats. Additional information recorded on data sheets were: estimated precipitation, erosion, slope, exposure, grazing use, animal disturbance and other appropriate notes.

Woody Species Density

Density of woody plant species were recorded using the point quarter distance method and by using belt transects. In the point quarter method, the aforementioned regular points were placed on the sample sites and delineated into four quarters. The distances to the nearest woody plant species were then recorded in each quarter. The average point-to-individual distance was equal to the square root of the mean area per individual.

Sample Adequacy

Sampling adequacy for woody species density and cover was achieved using formulas from "Statistical Methods" (Snedocor and Cochran 1980), with the goal that at least 80% of the samples were within 10% of the true mean for the plant communities of the area. The formula used is given below.

$$nmin = \left[\frac{1.28\ (s)}{x\ (.1)}\right]^2$$

where,

nmin = minimum adequate sample
s = standard deviation
x = sample mean
.1 = confidence interval

Photographs

Color photographs of the sample area were taken at the time of sampling and were submitted with this report.

Raw Data

The raw data were also submitted with this report (and the previous report for the proposed disturbance area) which would facilitate future scrutiny of the data and further statistical testing if desired.

RESULTS

Total living cover of the site was estimated at 31.25% (Table 2). Grasses dominated the cover and comprised 67.26% of the living cover (Table 2). As in the proposed disturbed area, the dominate grass species was Salina wildrye (*Elymus salinus*) and was estimated at 19.40% cover. Winterfat (*Ceratoides lanata*), however, was the most common woody species followed by pinyon pine (*Pinus edulis*) and rabbitbrush (*Chrysothamnus nauseosus*). For a list of cover by species, refer to Table 3.

Woody species density was estimated at 628.72 individuals per acre (Table 4) by the point quarter method. The most abundant species was corymb buckwheat (*Eriogonum cormbosum*) followed by pinyon pine. For a stistical comparison of the proposed disturbed area and its reference area, refer to the sampling report for the "Proposed Disturbed Tank Seam Access Road" (March 1993).

TABLE 1: CO-OP MINE AREA
QUALITATIVE SAMPLING DATA SHEET AND
QUANTITATIVE/QUALITATIVE NOTES
1993

SITE NAME: Tank Seam Access Road Reference Area

AREA: BEAR CANYON

DATE: 21 July 1993

WORKERS: P. Collins, D. Collins

SLOPE: 38 deg.

EXPOSURE: E

ANIMAL USE/DISTURBANCE: Moderate deer use

EROSION: Negligible

COVER: (see quantitative data)

DOMINANT PLANT SPECIES OBSERVED: (see quantitative data)

NOTES:

1) (see report)

TABLE 2: Total cover and composition summary for the Tank Seam Access Road Reference Area at the CO-OP Mine.

TOTAL COVER	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE
Living Cover	31.25	9.20	20
Litter	14.60	12.73	20
Bareground	21.40	12.09	20
Rock	32.75	19.52	20
COMPOSITION			
Shrubs	28.49	32.20	20
Forbs	4.25	13.90	20
Grasses	67.26	33.36	20

TABLE 3: Species cover and frequency summary for the Tank Seam Access Road Reference Area at the CO-OP Mine.

SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
TREES & SHRUBS				
Chrysothamnus nauseosus	1.50	4.77	20	10.00
Ceratoides lanata	5.10	11.52	20	20.00
Eriogonum corymbosum	1.25	3.11	20	15.00
Pinus edulis	2.75	8.29	20	10.00
FORBS				
Erigeron sp.	0.50	2.18	20	5.00
Stanleya pinnata	0.75	3.27	20	5.00
GRASSES				
Elymus cinereus	19.40	10.17	20	95.00

TABLE 4: Woody species densities of the Tank Seam Access Road Reference Area at the CO-OP Mine.

	NUMBER/ACRE
Ceratoides lanata	130.77
Chrysothamnus nauseosus	45.90
Eriogonum corymbosum	248.97
Juniperus osteosperma	32.69
Pinus edulis	175.18
Yucca harrimaniae	13.20
TOTAL	628.72

COLOR PHOTOGRAPH

TANK SEAM ACCESS ROAD REFERENCE AREA

RAW DATA

CO-OP MINE
Tank Seam Access
PJ Reference Area
Exposure: E
Slope: 38 deg.

Sample Date: 21 July 1993	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00
TREES & SHRUBS										
Chrysothamnus nauseosus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	10.00
Eriogonum corymbosum	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00
Ceratoides lanata	0.00	0.00	0.00	25.00	0.00	0.00	0.00	0.00	0.00	0.00
Pinus edulis	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FORBS										
Erigeron sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00
Stanleya pinnata	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GRASSES										
Elymus salinus	20.00	15.00	25.00	20.00	40.00	25.00	20.00	25.00	10.00	10.00
COVER										
Total Living Cover	20.00	20.00	25.00	45.00	40.00	25.00	20.00	25.00	30.00	40.00
Litter	5.00	5.00	55.00	25.00	20.00	10.00	5.00	2.00	25.00	30.00
Bareground	20.00	15.00	10.00	20.00	20.00	20.00	55.00	3.00	10.00	10.00
Rock	55.00	60.00	10.00	10.00	20.00	45.00	20.00	70.00	35.00	20.00
% COMPOSITION										
Shrubs	0.00	25.00	0.00	55.56	0.00	0.00	0.00	0.00	66.67	50.00
Forbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00
Grasses	100.00	75.00	100.00	44.44	100.00	100.00	100.00	100.00	33.33	25.00

11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.00	0.00
30.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00
0.00	0.00	0.00	30.00	25.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.00	13.00	10.00	10.00	15.00	25.00	45.00	20.00	25.00	0.00

45.00	20.00	25.00	40.00	40.00	25.00	45.00	30.00	25.00	40.00
5.00	5.00	25.00	25.00	10.00	5.00	10.00	10.00	10.00	5.00
30.00	5.00	25.00	25.00	35.00	30.00	35.00	30.00	20.00	10.00
20.00	70.00	25.00	10.00	15.00	40.00	10.00	30.00	45.00	45.00

66.67	35.00	0.00	75.00	62.50	0.00	0.00	33.33	0.00	100.00
0.00	0.00	60.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33.33	65.00	40.00	25.00	37.50	100.00	100.00	66.67	100.00	0.00

CO-OP MINE
Tank Seam Access
PJ Reference Area
Exposure: E
Slope: 38 deg.
Sample Date: 21 July 1993

Mean	SDev	Freq	
			TREES & SHRUBS
1.50	4.77	10.00	Chrysothamnus nauseosus
1.25	3.11	15.00	Eriogonum corymbosum
5.10	11.52	20.00	Ceratoides lanata
2.75	8.29	10.00	Pinus edulis
			FORBS
0.50	2.18	5.00	Erigeron sp.
0.75	3.27	5.00	Stanleya pinnata
			GRASSES
19.40	10.17	95.00	Elymus salinus
			COVER
31.25	9.20		Total Living Cover
14.60	12.73		Litter
21.40	12.09		Bareground
32.75	19.52		Rock
			% COMPOSITION
28.49	32.20		Shrubs
4.25	13.90		Forbs
67.26	33.36		Grasses

STATISTICAL ANALYSES:

Proposed Disturbed Tank Seam Access Road
vs.
Tank Seam Access Road Reference Area

The CO-OP Mining Company in collaboration with the State of Utah, Division of Oil, Gas & Mining (DOGM) selected a reference area as a standard for future revegetation success. Group comparison statistical analyses were performed to compare the "Proposed Disturbed Tank Seam Access Road" with its reference area.

Student's t tests indicated the reference area to be significantly greater than the proposed disturbance area for both cover and woody species density (see following summary sheet). The differences could probably be explained in a few ways. Because of its length, the access road had a greater diversity of exposures, slopes, elevations and other general environmental conditions. Whereas, the reference area was in one general area -- with one exposure and all the samples recorded at approximately the same physiognomy. Furthermore, the overstory of the proposed disturbed area was not recorded. If it were recorded and added to the understory, the differences between the two sample areas could have likely been non-significant.

The woody species differences were due to the greater amount of shrubs in the reference area. When one compares the trees (pinyon pine and Utah juniper) the densities were similar. Again, the differences probably were a result of the diversity of environmental conditions on the proposed disturbed area when compared to the reference area.

For the above reasons, even with the differences, the reference area selected is probably an appropriate standard for final revegetation success. (The raw data, summation tables and report for the Tank Seam Access Reference Area were reported in Appendix 9-A.)

Statistical summary sheet for the Proposed Disturbed Tank Seam Access Road and Tank Seam Access Road Reference Area of the CO-OP Mine.

PROPOSED DISTURBED TANK SEAM ACCESS ROAD

Total Living Cover**	x= 19.50	s= 6.87	n= 40
Density	x= 124.27*	s= 22.48	n= 40
Aspect	variable		
Slope	variable		

TANK SEAM ACCESS ROAD REFERENCE AREA

Total Living Cover	x= 31.25	s= 9.20	n= 20
Density	x= 96.79*	s= 19.68	n= 24
Aspect	East		
Slope	38 deg.		

STATISTICAL ANALYSES

<u>COVER</u>:
Student's t-value = -5.564
Degrees of freedom = 58
Significance level = <.005

<u>DENSITY</u>:
Student's t-value = 4.774
Degrees of freedom = 62
Significance level = <.005

---
x = sample mean, s = sample standard deviation,
n = sample size, N.S. = nonsignificant,
* average distance in inches at each sample location.
** represents understory cover only.

Date: November 4, 1993

Co-op Mine
P.O. Box 1245
Huntington, Utah, 84528

Dear Sirs:

The area proposed for the new road extension on the south facing slope above the existing mine areas was inspected for threatened, endangered and sensitive plant species on Nov. 4, 1993 by Robert M. Thompson, USFS Botanist.

No habitat or population of any listed TE & S plant species were found within the proposed road extension area. This area is clear of any TE & S plant species.

Canyon Sweet Vetch, Hedysarum occidentals var. canone does occur on the mine property along Bear Creek bottom areas. This plant or its existing habitat will not be impacted by this proposed activity.

Robert M. Thompson

Robert M. Thompson
Botanist

Appendix 9-E

Tank Seam Access Road Vegetation

INTRODUCTION

The following pages are a copy of a report prepared by Patrick Collins, Ph.D., Biologist/Reclamation Specialist, of Mt. Nebo Scientific. The report presents an evaluation of the pre-disturbed vegetation in the area of the Tank Seam Access Road and pad and a comparison of the data to data collected from the selected reference area. The vegetation survey was performed in October, 1992, and the reference area was sampled in July, 1993.

Prepared by

MT. NEBO SCIENTIFIC RESEARCH & CONSULTING
330 East 400 South, Suite 6
P.O. Box 337
Springville, Utah 84663
(801) 489-6937

for

CO-OP MINING COMPANY
P.O. Box 1245
Huntington, Utah 84528

Report: Patrick Collins, Ph.D.

Fieldwork: Patrick Collins
Dean Collins

Report Date: March 1993
Fieldwork Date: October 1992

TABLE OF CONTENTS

VEGETATION SAMPLING OF THE PROPOSED DISTURBED TANK SEAM ACCESS ROAD

SCOPE

The purpose of this document is to provide baseline information of the existing vegetation of an area that is proposed for new disturbance.

INTRODUCTION

General Site Description

The CO-OP Mining Company has proposed to construct an access road in their permit area which will require disturbance to the native plant community. The proposed disturbance lies within Bear Canyon. Bear Canyon, a branch of Huntington Canyon, is located west of the city of Huntington in Emery County, Utah. Slopes that surround the canyon are primarily dominated by pinyon-juniper and mountain brush communities. In their native, undisturbed state, the canyon bottoms are comprised chiefly of sagebrush/grass and riparian communities.

Bear Canyon maintains active mine facilities. Several areas have been disturbed as a result of the mine activities and some of these areas have been reclaimed and reseeded.

METHODS

Quantitative and qualitative data were taken on the sample sites. Sampling was accomplished in October 1992, before appreciable frost that could affect the results.

Transect Placement

The corridor of the proposed disturbed access road had been previously surveyed and flagged. Regular points at 50 ft intervals were located along the entire length of the proposed road. Sampling quadrats were placed at these points.

Cover and Composition

Cover estimates were made using ocular methods with meter square quadrats. Species composition and relative frequencies were also assessed from the quadrats. Additional information recorded on data sheets were: estimated precipitation, erosion, slope, exposure, grazing use, animal disturbance and other appropriate notes.

Woody Species Density

Density of woody plant species were recorded using the point quarter distance method and by using belt transects. In the point quarter method, the aforementioned regular points were placed on the sample sites and delineated into four quarters. The distances to the nearest woody plant species were then recorded in each quarter. The average point-to-individual distance was equal to the square root of the mean area per individual.

Sample Adequacy

Sampling adequacy for woody species density and cover was achieved using formulas from "Statistical Methods" (Snedocor and Cochran 1980), with the goal that at least 80% of the samples were within 10% of the true mean for the plant communities of the area. The formula used is given below.

$$nmin = \left[\frac{1.28\ (s)}{x\ (.1)}\right]^2$$

where,
nmin = minimum adequate sample
s = standard deviation
x = sample mean
.1 = confidence interval

Photographs

Color photographs of the sample area were taken at the time of sampling and were submitted with this report.

Raw Data

The raw data were also submitted with this report which would facilitate future scrutiny of the data and further statistical testing if desired.

RESULTS

Rock was the major contingent for the ground cover and was estimated at 56.00%. Total living cover of the site was estimated at 19.50% (Table 2). Grasses dominated the cover and comprised of almost 75% of the living cover (Table 2). The dominate grass species was Salina wildrye (*Elymus salinus*) and was estimated at 10.58% cover. Mountain mahogany (*Cercocarpus ledifolius*) was the most common woody species followed by pinyon pine (*Pinus edulis*) and Utah Juniper (*Juniperus osteosperma*). For a list of cover by species, refer to Table 3.

Woody species density was estimated at 394 individuals per acre (Table 4) by the point quarter method. Again, the most abundant species was mountain mahogany followed closely by pinyon pine.

TABLE 1: CO-OP MINE AREA
QUALITATIVE SAMPLING DATA SHEET AND
QUANTITATIVE/QUALITATIVE NOTES
1992

SITE NAME: Reclaimed Pads

AREA: TRAIL CANYON

DATE: 10 October 1992

WORKERS: P. Collins, D. Collins

SLOPE: Approx. 30 deg.

EXPOSURE: N, E, S (predominately E)

ANIMAL USE/DISTURBANCE: Moderate deer use

EROSION: Slight

COVER: (see quantitative data)

DOMINANT PLANT SPECIES OBSERVED: (see quantitative data)

NOTES:

1) (see report)

TABLE 2: Total cover and composition summary for the Proposed Disturbed Tank Seam Access Road at the CO-OP Mine.

TOTAL COVER	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE
Living Cover	19.50	6.87	40
Litter	12.13	13.95	40
Bareground	12.38	9.86	40
Rock	56.00	19.18	40
COMPOSITION			
Shrubs	25.46	37.45	40
Forbs	0.00	0.00	40
Grasses	74.54	37.45	40

TABLE 3: Species cover and frequency summary for the Proposed Disturbed Tank Seam Access Road at the CO-OP Mine.

SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
TREES & SHRUBS				
Ceratoides lanata	2.13	5.11	40	20.00
Juniperus osteosperma	0.63	3.90	40	2.25
Pinus edulis	2.00	5.45	40	12.50
FORBS				
GRASSES				
Elymus cinereus	13.88	10.58	40	80.00
Stipa hymenoides	0.88	3.52	40	7.50

TABLE 4: Woody species densities of the Proposed Disturbed Tank Seam Access Road at the CO-OP Mine.

	NUMBER/ACRE
Cercocarpus ledifolius	177.08
Chrysothamnus nauseosus	14.76
Juniperus osteosperma	56.57
Pinus edulis	142.65
Pseudotsuga menziesii	2.46
TOTAL	393.51

COLOR PHOTOGRAPHS

SAMPLE AREAS FOR THE PROPOSED DISTURBED TANK SEAM ACCESS ROAD (OCT. 1992)

APPENDIX: RAW DATA

SITE: Tank Seam Access Road
(Proposed Disturbed)
AREA: CO-OP MINE - BEAR CANYON
SLOPE: 34 deg
EXPOSURE: N,E,S, Predominantly E
WORKERS: R & P Collins
DATE: 10 Oct 1992

	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00
SHRUBS										
Pinus edulis	0.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	0.00
Cercocarpus ledifolius	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00
Juniperus osterserma	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FORBS										
GRASSES										
Elymus salinus	20.00	5.00	25.00	20.00	0.00	35.00	25.00	10.00	5.00	20.00
Stipa hymenoides	0.00	0.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00
Total Living Cover	20.00	25.00	25.00	20.00	10.00	35.00	25.00	15.00	25.00	20.00
Litter	5.00	5.00	50.00	10.00	5.00	40.00	5.00	5.00	25.00	5.00
Bareground	15.00	10.00	10.00	35.00	20.00	15.00	5.00	5.00	20.00	50.00
Rock	60.00	60.00	15.00	35.00	65.00	10.00	65.00	75.00	30.00	25.00
% COMPOSITION										
Shrubs	0.00	80.00	0.00	0.00	0.00	0.00	0.00	33.33	80.00	0.00
Forbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grasses	100.00	20.00	100.00	100.00	100.00	100.00	100.00	66.67	20.00	100.00

11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	5.00	0.00	0.00	15.00	0.00	0.00	0.00	10.00	5.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.00	10.00	25.00	0.00	5.00	35.00	25.00	5.00	10.00	20.00	25.00	10.00	0.00
0.00	0.00	0.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
10.00	10.00	25.00	20.00	10.00	35.00	25.00	20.00	10.00	20.00	25.00	20.00	10.00
5.00	5.00	65.00	5.00	5.00	5.00	10.00	10.00	5.00	5.00	5.00	5.00	5.00
10.00	15.00	5.00	5.00	10.00	10.00	10.00	10.00	25.00	5.00	5.00	5.00	5.00
75.00	70.00	5.00	70.00	75.00	50.00	55.00	60.00	60.00	70.00	65.00	70.00	80.00
0.00	0.00	0.00	0.00	50.00	0.00	0.00	75.00	0.00	0.00	0.00	50.00	50.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100.00	100.00	100.00	100.00	50.00	100.00	100.00	25.00	100.00	100.00	100.00	50.00	50.00

24.00	25.00	26.00	27.00	28.00	29.00	30.00	31.00	32.00	33.00	34.00	35.00	36.00
0.00	0.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00
0.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25.00	0.00	30.00	20.00	10.00	5.00	10.00	10.00	10.00	25.00	20.00	20.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25.00	25.00	30.00	20.00	20.00	10.00	10.00	10.00	10.00	25.00	20.00	20.00	15.00
10.00	10.00	5.00	5.00	45.00	3.00	10.00	2.00	25.00	5.00	10.00	20.00	5.00
5.00	5.00	20.00	5.00	5.00	2.00	25.00	3.00	20.00	10.00	5.00	20.00	30.00
60.00	60.00	45.00	70.00	30.00	85.00	55.00	85.00	45.00	60.00	65.00	40.00	50.00
0.00	100.00	0.00	0.00	50.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100.00	0.00	100.00	100.00	50.00	50.00	100.00	100.00	100.00	100.00	100.00	100.00	0.00

SITE: Tank Seam Access Road

AREA: CO-OP MINE - BEAR CANYON
SLOPE: 34 deg
EXPOSURE: N,E,S, Predominantly E
WORKERS: R & P Collins
DATE: 10 Oct 1992

37.00	38.00	39.00	40.00	Mean	StDev	Freq	
							SHRUBS
0.00	0.00	15.00	0.00	2.00	5.45	12.50	Pinus edulis
0.00	20.00	0.00	20.00	2.13	5.11	20.00	Cercocarpus ledifolius
0.00	0.00	0.00	0.00	0.63	3.90	2.25	Juniperus osterspermа
							FORBS
							GRASSES
25.00	0.00	0.00	0.00	13.88	10.58	80.00	Elymus salinus
0.00	0.00	0.00	0.00	0.88	3.52	7.50	Stipa hymenoides
25.00	20.00	15.00	20.00	19.50	6.87		Total Living Cover
10.00	5.00	15.00	10.00	12.13	13.95		Litter
10.00	5.00	10.00	10.00	12.38	9.86		Bareground
55.00	70.00	60.00	60.00	56.00	19.18		Rock
							% COMPOSITION
0.00	100.00	100.00	100.00	25.46	37.45		Shrubs
0.00	0.00	0.00	0.00	0.00	0.00		Forbs
100.00	0.00	0.00	0.00	74.54	37.45		Grasses

CO-OP MINING COMPANY

P.O. Box 1245
Huntington, Utah 84528

(801) 381-5238
Coal Sales (801) 381-5777

August 11, 1994

Pamela Grubaugh-Littig
Utah Division of Oil, Gas & Mining
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203

RECEIVED
AUG 17 1994
DIV. [illegible]

Ms. Grubaugh-Littig,

Re: Tank Seam Permit Application, Bear Canyon Mine, ACT/015/025-93B, Emery County, Utah

#7 Copy Pam

Enclosed are three DRAFT copies of pages 3-86 and 3H-3, which are being submitted with minor modifications to the original pages which were approved on July 22, 1994.

Modifications to page 3-86 are being made at the request of Jesse Kelley by facsimile on August 9, 1994 to incorporation the Reclamation Management Cost into the proposed Bond.

Page 3H-3 is being modified to allow some flexibility in the road construction. Due to variations in the actual road grade, the 10 ft. number has been found to be too restrictive to allow the contours to vary. This situation was discussed with Jesse Kelley by telephone on August 11, 1994. Since the backhoe for which the reclamation has been bonded for has a reach of approximately 20', Co-Op wishes to modify the maximum allowable fill for small areas to 15'. The designs for the slopes will remain the same, but this will allow the road grade to vary slightly if it becomes necessary to raise the grade at these fill locations.

If you have any questions, please call Charles Reynolds at (801) 381-2450.

Thank You,

Wendell Owen

Wendell Owen,
Resident Agent

Enclosure(s)
cr

Summary of Reclamation Cost Estimate

a.	Seal Portals and Backfill	$ 35,000.00
b.	Removal of Structures	$ 62,202.90
c.	Soil Placement and Ripping	$ 76,398.32
d.	Channel Restoration	$ 51,045.00
e.	Revegetation	$ 44,119.78
f.	Monitor Well Plugging	$ 114.32
g.	Maintenance and Monitoring of Subsidence, Vegetation and Erosion (10 yr bond liability Period)	$ 39,143.20
h.	Hydrology Monitoring (10 yr bond liability period)	$ 29,630.00
i.	Supervision (20.2 weeks)	$ 14,285.44
j.	Mobilization and Demobilization	$ 2,500.00
		$354,438.96
	5.1% Reclamation Management Cost	$ 18,076.39
	10 pct contingency	$ 35,443.90
	(1990 dollars)	$407,959.25

Escalated Values	Escalation Factor
1991 - $413,140	1.27% (actual)
1992 - $422,271	2.21% (actual)
1993 - $432,996	2.54% (actual)
1994 - $441,700	2.01% (est)
1995 - $450,578	2.01% (est)
1996 - $459,634	2.01% (est)
1997 - $468,873	2.01% (est)
1998 - $478,297	2.01% (est)
1999 - $487,911	2.01% (est)

Bond will be posted in accordance with R645-301-820.

DRAFT

road cuts will be made into the slope towards the cut face rather than parallel to the slope, which will result in any rocks or sloughage dislodged by the equipment bucket during the road cutting to be contained within the berm. In the event blasting is required, which is described in Appendix 3-M, the blasts will be designed to drop the material into the cut area behind the berm. This will prevent material generated by the blast from migrating downslope into the undisturbed area. This procedure will be used to cut a pilot road until the first large fill area (Stations 8+00 and 9+00) is reached.

When small fill areas are reached (e.g. Station 6+00), a temporary silt fence will be installed at the base of the proposed fill for runoff control, and the same cutting procedure will be used to create an initial berm inside the silt fence with a backhoe after topsoil removal. The area inside the berm will then be prepared to allow the placement of the fill, as shown in Figure 3H-2. Fill material in these areas will be restricted to no more than 1~~0~~5' downslope from the road, allowing a backhoe to easily reach the material during reclamation. Rock fragments larger than 18 inches which are disturbed will be embedded into the surface of the fill as described in the slope stability analysis on page 3H-48. Remaining rock fragments will be temporarily placed in the storage area of the Upper Storage Pad until the large fill area is reached. Fill will be compacted in 18 inch lifts as described on page 3H-48. These areas are included in the disturbed area, and are designated as BTCA areas (See Plate 7-1E and Appendix 7-K). As soon as the fill material is in place, erosion control matting will be placed

Summary of Reclamation Cost Estimate

a.	Seal Portals and Backfill	$ 35,000.00
b.	Removal of Structures	$ 62,202.90
c.	Soil Placement and Ripping	$ 76,398.32
d.	Channel Restoration	$ 51,045.00
e.	Revegetation	$ 44,119.78
f.	Monitor Well Plugging	$ 114.32
g.	Maintenance and Monitoring of Subsidence, Vegetation and Erosion (10 yr bond liability Period)	$ 39,143.20
h.	Hydrology Monitoring (10 yr bond liability period)	$ 29,630.00
i.	Supervision (20.2 weeks)	$ 14,285.44
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		$354,438.96
	5.1% Reclamation Management Cost	$ 18,076.39
	10 pct contingency	$ 35,443.90
	(1990 dollars)	$407,959.25

Escalated Values	Escalation Factor
1991 - $413,140	1.27% (actual)
1992 - $422,271	2.21% (actual)
1993 - $432,996	2.54% (actual)
1994 - $441,700	2.01% (est)
1995 - $450,578	2.01% (est)
1996 - $459,634	2.01% (est)
1997 - $468,873	2.01% (est)
1998 - $478,297	2.01% (est)
1999 - $487,911	2.01% (est)

Bond will be posted in accordance with R645-301-820.

road cuts will be made into the slope towards the cut face rather than parallel to the slope, which will result in any rocks or sloughage dislodged by the equipment bucket during the road cutting to be contained within the berm. In the event blasting is required, which is described in Appendix 3-M, the blasts will be designed to drop the material into the cut area behind the berm. This will prevent material generated by the blast from migrating downslope into the undisturbed area. This procedure will be used to cut a pilot road until the first large fill area (Stations 8+00 and 9+00) is reached.

When small fill areas are reached (e.g. Station 6+00), a temporary silt fence will be installed at the base of the proposed fill for runoff control, and the same cutting procedure will be used to create an initial berm inside the silt fence with a backhoe after topsoil removal. The area inside the berm will then be prepared to allow the placement of the fill, as shown in Figure 3H-2. Fill material in these areas will be restricted to no more than 1~~0~~5' downslope from the road, allowing a backhoe to easily reach the material during reclamation. Rock fragments larger than 18 inches which are disturbed will be embedded into the surface of the fill as described in the slope stability analysis on page 3H-48. Remaining rock fragments will be temporarily placed in the storage area of the Upper Storage Pad until the large fill area is reached. Fill will be compacted in 18 inch lifts as described on page 3H-48. These areas are included in the disturbed area, and are designated as BTCA areas (See Plate 7-1E and Appendix 7-K). As soon as the fill material is in place, erosion control matting will be placed

DRAFT

Summary of Reclamation Cost Estimate

a.	Seal Portals and Backfill	$ 35,000.00
b.	Removal of Structures	$ 62,202.90
c.	Soil Placement and Ripping	$ 76,398.32
d.	Channel Restoration	$ 51,045.00
e.	Revegetation	$ 44,119.78
f.	Monitor Well Plugging	$ 114.32
g.	Maintenance and Monitoring of Subsidence, Vegetation and Erosion (10 yr bond liability Period)	$ 39,143.20
h.	Hydrology Monitoring (10 yr bond liability period)	$ 29,630.00
i.	Supervision (20.2 weeks)	$ 14,285.44
j.	Mobilization and Demobilization	$ 2,500.00
		$354,438.96
	5.1% Reclamation Management Cost	$ 18,076.39
	10 pct contingency	$ 35,443.90
	(1990 dollars)	$407,959.25

Escalated Values	Escalation Factor
1991 - $413,140	1.27% (actual)
1992 - $422,271	2.21% (actual)
1993 - $432,996	2.54% (actual)
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Bond will be posted in accordance with R645-301-820.

DRAFT

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DRAFT

CO-OP MINING COMPANY

P.O. Box 1245
Huntington, Utah 84528

(801) 381-5238
Coal Sales (801) 381-5777

August 18, 1994

Pamela Grubaugh-Littig
Utah Division of Oil, Gas & Mining
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203

RECEIVED
AUG 1 9 1994
DIV. OF OIL, GAS & MINING

Ms. Grubaugh-Littig,

Re: <u>Tank Seam Permit Application, Bear Canyon Mine, ACT/015/025-93B, Emery County, Utah</u>

Enclosed are three DRAFT copies of pages 3H-10, 4-11, 9-10, 9-10A and 10D-19.

Page 10D-19, a letter from the Division of Wildlife Resources, is being submitted in response to Stipulation 1 of the Tank Seam Permit Application.

In response to Stipulation 2, Table 4-1 (page 4-11) has been updated to state the current and post-mining land use of the Tank Seam Road area.

Page 3H-10 has been modified to include a commitment for interim stabilization of the cut slopes in response to Stipulation 4. In addition, information discussing interim revegetation previously contained on page 9-10 and 9-10A has been moved to page 3H-10 for clarity. Page 9-10A has been modified to include by reference the rate and type of mulch to be used in final reclamation, in response to Stipulation 5.

Due to scheduling with the Soil Conservation Service for a description of the current productivity of the reference area, Co-Op Mining Company requests an extension for the response to Stipulation 3 until September 10, 1994.

Upon approval, three finalized copies of the proposed pages will be submitted to the Division. If you have any questions, please call Charles Reynolds at (801) 381-2450.

Thank You,

Wendell Owen

Wendell Owen,
Resident Agent

Enclosure(s)
cr

meet the design specifications of the permanent ditches will be maintained along the pilot road, with silt fences placed just above the culvert inlets treating any runoff. Approximate silt fence locations are shown on Plates 7-1C and 7-1E. Upon completion of construction, final as-built contours will be submitted to the Division.

Final crowning of the road and installation of permanent ditches will be completed following initial road and pad contouring. The approximate proposed road and pad contours are shown on Plates 2-4C and 2-4E.

A slope stability analysis of the cut slopes and fill areas, as well as some discussion on the construction methodology, is on page 3H-44 following the cross sections.

Upon completion of regrading activities, interim stabilization of the cut slopes will be accomplished through hydroseeding as described in Appendix 3-G. Cut slopes will be seeded using the seed mix and mulch described in Tables 3G-1 and 3G-2. Downslopes will be seeded by hand prior to the placement of erosion control matting using the permanent seed mix shown in Table 9.5-3. This seed mix will be used in order to establish shrubs as well as grasses to aid in interum stability.

4.5 POST-MINING LAND USE

Table 4-1 Proposed Post-Mining Land Use

Land Use in Relation to Mine Features

Area	Present Ownership	Pre-mining Use	Proposed Post-mining Use	Alternate Use
Mine Site Exploratory Excavations	Private	Wildlife/ Grazing/ Recreation	Wildlife/ Grazing/ Recreation	Picnic Area
Conveyor, Pipeline and Power Line Route	Private	Grazing	Grazing	Wildlife Habitat
Main Access	Private	Service Road	Service Road	Wildlife Habitat
Tank Seam Access	Private	Wildlife	Wildlife	

Land Use in Relation to Physical Features

Area	Proposed Post-mining Use	Ability to Support Proposed Post-mining Use
Flatlands	Wildlife/Grazing Habitat/ Timber/Recreation	Adequate
Canyons	Wildlife/Grazing Habitat/ Recreation	Adequate
Moderate Elevation: North & East Slopes	Wildlife/Grazing Habitat	Adequate
High Elevation: Steep land North & East Slopes	Wildlife Habitat	Adequate
West and East Slopes	Wildlife Habitat	Moderate - Because of Harsh Natural Conditions

aggregata, Plains Pricklypear _Opuntia polyacantha_, Cheatgrass _Bromus tectorum_, and Bluebunch Wheatgrass _Agropyron spicatum_.

9.3.3.5 Bare Cliffs and Talus

Vegetation is nonexistent or sparse and consists of a few grasses and forbs. Cliffs separate the Grassland vegetation type of the plateau from the more vegetated areas of the canyon bottoms.

9.3.4 Shower House Pad Vegetation

In 1993, Co-Op will disturb additional area for constructing a shower house and employee parking area. The pre-disturbed vegetation data is described in Appendix 9-D. Sampling was performed in the fall of 1992. In the Spring of 1993, a reference area will be selected by a Co-Op staff member and a Division staff member. This area will be sampled during the peak of the growing season in 1993 and the data will be submitted to the Division as soon as the information is available.

9.3.5 Tank Seam Access Road Vegetation

Co-Op proposes to construct an access road to the Tank Seam. Construction of the Road is described in Appendix 3-H. The pre-disturbed vegetation data, sampled in the fall of 1992, is described in Appendix 9-E. A reference area was selected for the Tank Seam portal pad and access road, and is shown on Plate 9-1. Appendix 9-A contains sampling data from the reference area and a comparison to the pre-disturbed vegetation on the Tank Seam access road and portal pad is included in Appendix 9-E.

Reclamation of the area will follow the methods described in Chapter 3 and section 9.5. After ~~construction~~ regrading is complete, ~~downslopes and cut~~ slopes will be hydroseeded ~~using the final reclamation seed mix~~ as described in section 9.5.3.2 and using the mulching rate described in section 9.5.3.3, and runoff and erosion will be controlled with matting and silt fences as described in Appendix 7-K.

9.3.6 Vegetation Monitoring

In order to monitor possible effects of subsidence on vegetation as required by lease stipulation, aerial photographs will be taken and evaluated every 5 years, starting in 1991. Photos will be made available for review upon request, and tabulated results will be incorporated as Appendix 9-C.

9.4 THREATENED AND ENDANGERED SPECIES

No plant species listed as threatened or endangered (U.S. Fish and Wildlife Service, 1982) or proposed for threatened or endangered status (Welsh and Thorne, 1979) was observed on the study area. No plants listed as threatened or endangered are known to occur in the Co-Op permit area (Thompson, personal communication, 1983). The U.S.D.A. Forest Service identified no threatened or endangered plants in there correspondence dated 29 Jan 1991 (Appendix 9-B). A survey on November 4, 1993 by Robert M. Thompson, USFS Botanist, revealed no threatened or endangered species within the proposed road extension area for the Tank Seam (letter, Appendix 9-B).

State of Utah
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE RESOURCES

Michael O. Leavitt
Governor
Ted Stewart
Executive Director
Robert G. Valentine
Division Director

Southeastern Region
455 West Railroad Avenue
Price, Utah 84501-2829
801-637-3310
801-637-7361 (Fax)

August 15, 1994

Charles Reynolds
CO-OP Mining
P.O. Box 1245
Huntington, Utah 84528

Dear Mr. Reynolds:

The Division of Wildlife Resource has reviewed CO-OP Mining's proposal to develop a new road and mine access facilities in Bear Canyon. We do not believe that these activities will have a negative impact on Townsend's Big Eared bats as long as debris is not pushed off onto the escarpment, and the escarpment itself is not disturbed.

Thank you for the opportunity to comment on this proposal. If you have further questions please contact Bill Bates, Habitat Manager, or our staff.

Sincerely,

Miles Moretti gd

Miles Moretti
Regional Supervisor

copy: Susan White, DOGM
Ralph Miles, Habitat, DWR

B.C. 10D-19 8/15/94

meet the design specifications of the permanent ditches will be maintained along the pilot road, with silt fences placed just above the culvert inlets treating any runoff. Approximate silt fence locations are shown on Plates 7-1C and 7-1E. Upon completion of construction, final as-built contours will be submitted to the Division.

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State of Utah
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE RESOURCES

Michael O. Leavitt
Governor
Ted Stewart
Executive Director
Robert G. Valentine
Division Director

Southeastern Region
455 West Railroad Avenue
Price, Utah 84501-2829
801-637-3310
801-637-7361 (Fax)

August 15, 1994

Charles Reynolds
CO-OP Mining
P.O. Box 1245
Huntington, Utah 84528

Dear Mr. Reynolds:

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Thank you for the opportunity to comment on this proposal. If you have further questions please contact Bill Bates, Habitat Manager, or our staff.

Sincerely,

Miles Moretti
Regional Supervisor

copy: Susan White, DOGM
Ralph Miles, Habitat, DWR

State of Utah
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING

Michael O. Leavitt
Governor
Ted Stewart
Executive Director
James W. Carter
Division Director

355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203
801-538-5340
801-359-3940 (Fax)
801-538-5319 (TDD)

September 14, 1994

Mr. Wendell Owen
Co-Op Mining Company
P.O. Box 1245
Huntington, UT 84528

Re: Approval of Minor Changes to Tank Seam Permit Change, Bear Canyon Mine, Co-Op Mining Company, ACT/015/025-93B, Folder #3, Emery County, Utah

Dear Mr. Owen:

Supplemental information for the Tank Seam, received August 17, 1994, pages 3-86 and 3H-3, has been reviewed and is approved. Please submit three finalized copies of these pages by October 14, 1994.

Sincerely,

Pamela Grubaugh-Littig
Permit Supervisor

cc: Daron Haddock

CO-OP MINING COMPANY

P.O. Box 1245
Huntington, Utah 84528

(801) 381-5238
Coal Sales (801) 381-5777

Daron -

9/14

For Henry's review. Please let me know if this is okay. TAX

3

September 6, 1994

RECEIVED
SEP 12 1994
DIV. OF OIL, GAS & MINING

Pamela Grubaugh
Utah Division
3 Triad Center
Salt Lake City

Ms. Grubaugh-L

Re: Tank Seam ... on Mine, ACT/015/025-93B, Emer...

#2 Copy PAM

submi... ...h is being ... Approval.

Conse... f the Soil ... refer... Tank Seam ... 1994. ...ugust 18,

T... Pad Re... House ... ...wer House ...e Shower ...proposal.

U... Divisio... at (801 ... ed to the ... Reynolds

9/14

Pam,
I had Susan look at this. She said it is an adequate response to stip #3. We need to have them supply final copies of the submittal. Thanks
Daron

Thank You,

Wendell Owen

Wendell Owen,
Resident Agent

Enclosure(s)
cr

CO-OP MINING COMPANY

P.O. Box 1245
Huntington, Utah 84528

(801) 381-5238
Coal Sales (801) 381-5777

September 6, 1994

Pamela Grubaugh-Littig
Utah Division of Oil, Gas & Mining
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203

Stipulation #3 93B

RECEIVED
SEP 12 1994
DIV. OF OIL, GAS & MINING

Ms. Grubaugh-Littig,

Re: Tank Seam Permit Application, Bear Canyon Mine, ACT/015/025-93B, Emery County, Utah

Copy #2 Pam

Enclosed are three DRAFT copies of page 9A-36, which is being submitted in response to Stipulation 3 of the Tank Seam Approval.

This page consists of a letter from George Cooke of the Soil Conservation Service stating the productivity of the Tank Seam reference area. The data was collected by Mr. Cooke on August 18, 1994.

The letter also contains the productivity for the Shower House Pad Reference Area. The vegetation information for the Shower House Pad Reference Area is being submitted as a separate proposal.

Upon approval, three finalized copies will be submitted to the Division. If you have any questions, please call Charles Reynolds at (801) 687-2450.

Thank You,

Wendell Owen
Wendell Owen,
Resident Agent

Enclosure(s)
cr

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

350 NORTH 400 EAST
PRICE, UTAH 84501

August 19, 1994

Charles Reynolds
CO-OP Mining Company
P.O. Box 1245
Huntington, Utah 84528

Dear Mr. Reynolds:

The information on the reference areas is as follows:

Shower House Reference Area -
Grass Pinyon Shrub Site
The production is 900 lbs. herbage air dry per acre. The condition is good and the potential production will also be about 900 lbs. per acre.

The Tank Seam Reference Area -
Pinyon Juniper grass curlleaf mountain mahogony site. The production is 700 lbs. herbage air dry per acre. The condition is good to excellent and the potential production will also be 700 lbs. per acre.

George S. Cook

George S. Cook
Range Conservationist

DRAFT

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
350 NORTH 400 EAST
PRICE, UTAH 84501

August 19, 1994

Charles Reynolds
CO-OP Mining Company
P.O. Box 1245
Huntington, Utah 84528

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George S. Cook
George S. Cook
Range Conservationist

DRAFT

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

350 NORTH 400 EAST
PRICE, UTAH 84501

August 19, 1994

Charles Reynolds
CO-OP Mining Company
P.O. Box 1245
Huntington, Utah 84528

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DRAFT