CHAPTER 7

GROUNDWATER HYDROLOGY

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APPENDIXES

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

TM 92D date 1/5/93

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7.1 GROUND WATER HYDROLOGY

7.1.1 SCOPE

The scope of this study consisted of an investigation of the ground water hydrology in the Trail Canyon area, following the Utah Division of Oil, Gas & Mining (DOGM) permit application guidelines. Information on existing ground water resources and regional ground water hydrology was compiled from available literature, personal communications, and site investigations. It should be noted that limited information is available specifically for the Trail Canyon area. This is the site of 3 old coal mines, all of which are now abandonded and inaccessible. There is virtually no historical data concerning mine water available on these old mines. Ground water resources are also very limited in this canyon; therefore, this review will concentrate primarily on the existing, limited data and available data from the active mining in the nearby Bear Canyon.

7.1.2 METHODOLOGY

This section outlines the basic methodology of the ground water hydrology investigations. The major tasks constituting the general approach are listed below:

1. Literature Review - Published information on the geology and hydrology of the general area was collected and reviewed. The sources of the information included U.S. Geological Survey

investigation report, data obtained by Co-Op, and data from prior mining and engineering investigations in the general area.

2. SITE SPECIFIC INVESTIGATIONS - An on-site examination was made of the limited ground water resources in Trail Canyon area. A review was also made of the hydrologic monitoring data in an effort to determine the primary source of the intermittent flow of Trail Creek. Finally, the past and post-mining operations of the site were examined for potential impact on hydrology.

3. MONITORING PROGRAM - The need for a ground water monitoring program was assessed. Monitoring of 7 different locations, including 5 spring locations, all shown on plate 7-1 will be made on a regular basis as defined in Section 7.2.4.

7.1.3 EXISTING GROUND WATER RESOURCES

Unlike Bear Canyon, ground water in Trail Canyon is very limited, and appears to exist mostly in unconfined conditions, except for the small spring located in the old portals. Data indicates that the flow in Trail Creek is intermittent, and has as its major source, snowmelt and direct runoff. The unconfined ground water in the upper reaches of the canyon may exist for short periods as local perched zones, and in shallow alluvial deposits and colluvial and residual soil deposits near the ground surface. These areas may appear as seeps, where localized, but are not found to be consistent in flow or quality. The vast majority of the surface flow in the canyon appears to be generated more directly through overland or shallow subsurface flow from snowmelt or direct precipitation.

The only ground water that appears to be generated from a confined condition is in the form of 2 small springs in the power part of the canyon. One spring is located on the north side of the canyon in an old abandonded portal in the Hiawatha Seam. The other is located on the south side of the canyon in one of the old Community Mine portals, also in the Hiawatha Seam. The flows from these springs are approximately 5-8 and 20-25 gpm, respectively, and have remained fairly consistent over many years that residents have lived in this canyon. The source of the springs appears to be the underlying Starpoint Sandstone, which is recognized as an important regional aquifer in this area. The springs are captured at their surface source, and used for culinary water at the townsite. Any water not used overflows at the pumphouse and flows down Trail Creek.

7.1.3.1 REGIONAL GROUND WATER HYDROLOGY

Danielson et. al. (1981) presents the results of themost recent U.S.G.S. hydrologic studies in the Huntington Creek drainage with emphasis on the coal field areas.

The occurrance, availability, and movement of ground water in the permit and adjacent areas is controlled by structural, stratigraphic, and topographic factors. Snow melt is the source for most, if not all, of the ground water in the study area (Danielson, et. at., 1981). The same report states that, for the Cottonwood-Huntington area of this report, available data indicates the Star Point sandstone and, locally, the lower part of the Black Hawk formation is indicated to be an extensive aquifer. The same report states that many of the large springs in the general area issue from this aquifer, including Bear Springs where it has been faulted. Data obtained from recent Co-Op investigations in nearby Bear Canyon indicates minor to no perched water within the lower portion of the Blackhawk Formation and essentially no ground water in the underlying Star Point-Blackhawk aquifer.

In general, the strata of the Wasatch Pateau yield little groundwater. Overall, these strata have low hydraulic conductivities and specific yields have been measured between about 0.2 and 0.7 percent. Potential yields from individual wells have been estimated between 5 and 50 gallons per minute (Price and Wadell, 1973). The higher yeilds come from strata like the Star Point Sandstone. Yield from some of the perched water zones could also be high locally. However, because of their limited distribution, perched zones probably cannot supply dependable amounts of water over long periods of time.

Groundwater recharge seems to occur in upland areas from snow melt and discharge in low areas as stream, spring or seep flows (see Section 7.2.2.2). This is confirmed by hydrogen isotope (deuterium) studies in the Huntington Canyon Basin, conducted by the U.S. Geological Survey (Danielson, 1981). This study showed that rain water in the basin contained deuterium values that ranged from 54.4 to -84.6 and averaged -75.3, while snow samples contained deuterium values that ranged from -121.2 to -147.1 and averaged -136. Deuterium samples were also taken for spring and stream samples and showed that most if not all of the groundwater is derived from snow.

See Figure 7.1.-1 for the General Stratigraphic Relationships of Geologic Units in the Trail Canyon Permit Area.

7.1.3.2 MINE PLAN AREA AQUIFERS

As mentioned earlier, there are only 2 small springs issuing from the Starpoint Sandstone outcrops in Trail Canyon. These springs are located in old portals, and likely are the collective result of all of the water encountered in the old mines. It is likely that the source of the water is in the Starpoint Sandstone; however, it could be from smaller perched aquifers within the mining area. Springs occurring within the Starpint Sandstone in the surrounding area are generally much larger than those occurring in Trail Canyon; however, the consistent nature and longevity of the Trail Canyon springs indicate that they are fed by a regional aquifer such as the Starpoint Sandstone.

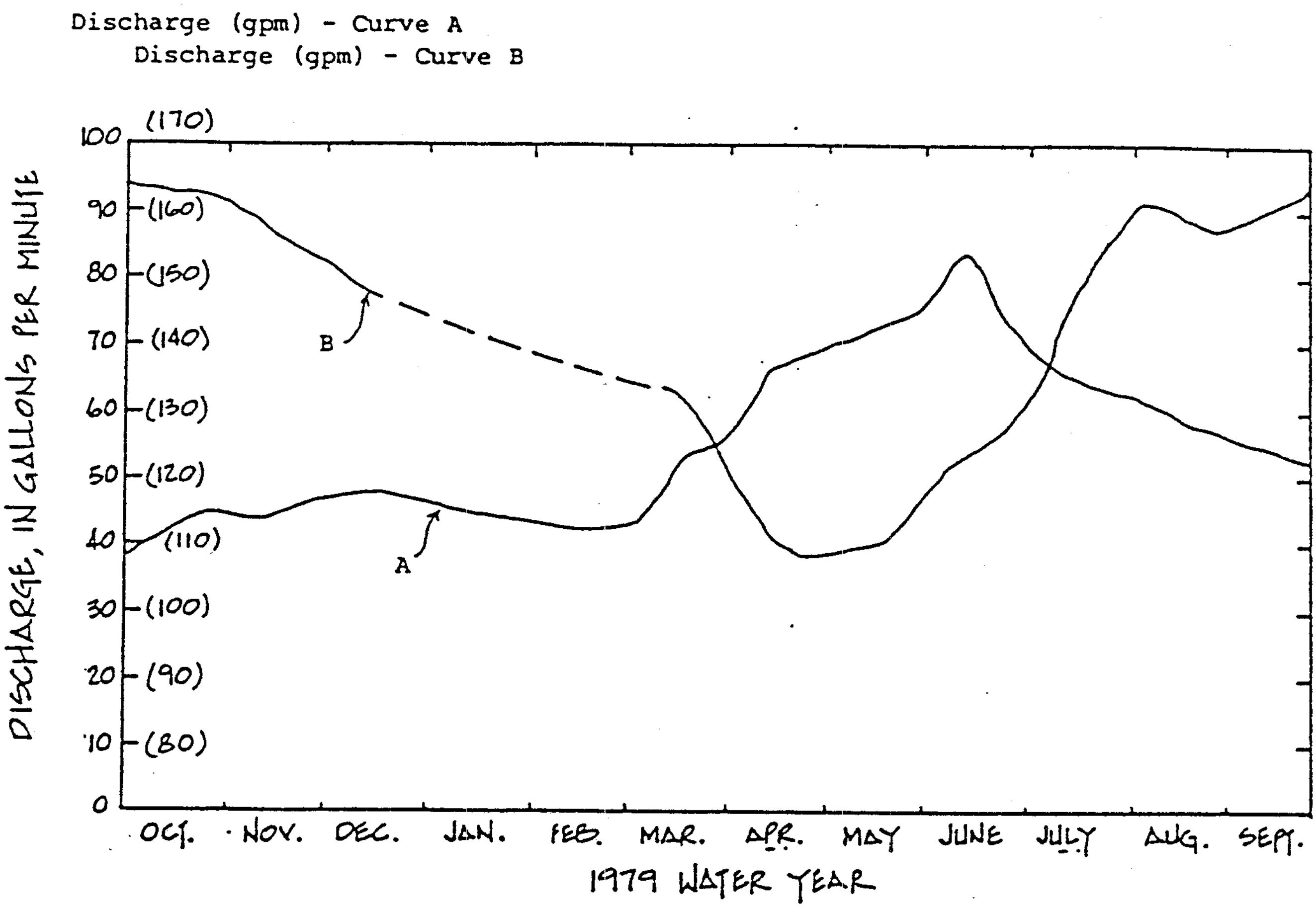
System	Series	Formations and members	Thickness (feet)	Lithology and water-bearing characteristics
Quaternary	Holocene and Pleistocene		0-100	Alluvium and colluvium; clay, silt, sand, gravel, and boulders; yields water to springs that may cease to flow in late summer.
Tertiary	Eocene and Paleocene	Flagstaff 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.
		Masuk Member Mancos Shale	600-800	Dark-gray marine shale with thin, discontinuous layers of gray limestone and sandstone; yields water to springs locally.

* General Stratigraphic Relationships of Geologic Units in Trail Canyon Permit Area

* From Danielson, et. al. (1981)

Figure 7.1-1

Our interpretation of the local ground water regime is that the Bear Creek fault and, to a lesser extent, the fault through Birch Springs are effective in draining the Star Point-Blackhawk aquifer through the Bear Creek drainage. Spring characteristics of the Starpoint-Blackhawk aquifer are represented by Figure 7.1-2 (Danielson et. al). The maximum discharge corresponds closely with the period of maximum seasonal runoff. Figure 7.1-2 also presents the maximum discharge for Bear Springs with a peak considerably later in the season. It appears from this that the springs emerging from the Star Point-Blackhawk aquifer respond quickly to surface runoff due to ready access to the aquifer through vertical joint systems, etc. The delay of maximum discharge of Bear Springs is due to its fault control and to receiving its major supply of water from higher site elevations north of the permit area and to delayed recharge from snow melt, (i.e. relatively flat topography at upper drainage portions in deeper soil cover which decreases surface runoff). Hydraulic connection between the Bear Spring fault and the adjacent fault to the west allows discharge to the surface at Bear Springs. This could account for the fact that a large percentage of the available ground water in the general area is discharged in Bear Canyon, and since Trail Canyon is located west of the above mentioned faults, it receives (and thus discharges) a much smaller amount of the available water from the aquifer(s). See Figure 7.1-3 for a general overview of the fault systems and spring locations in this area.



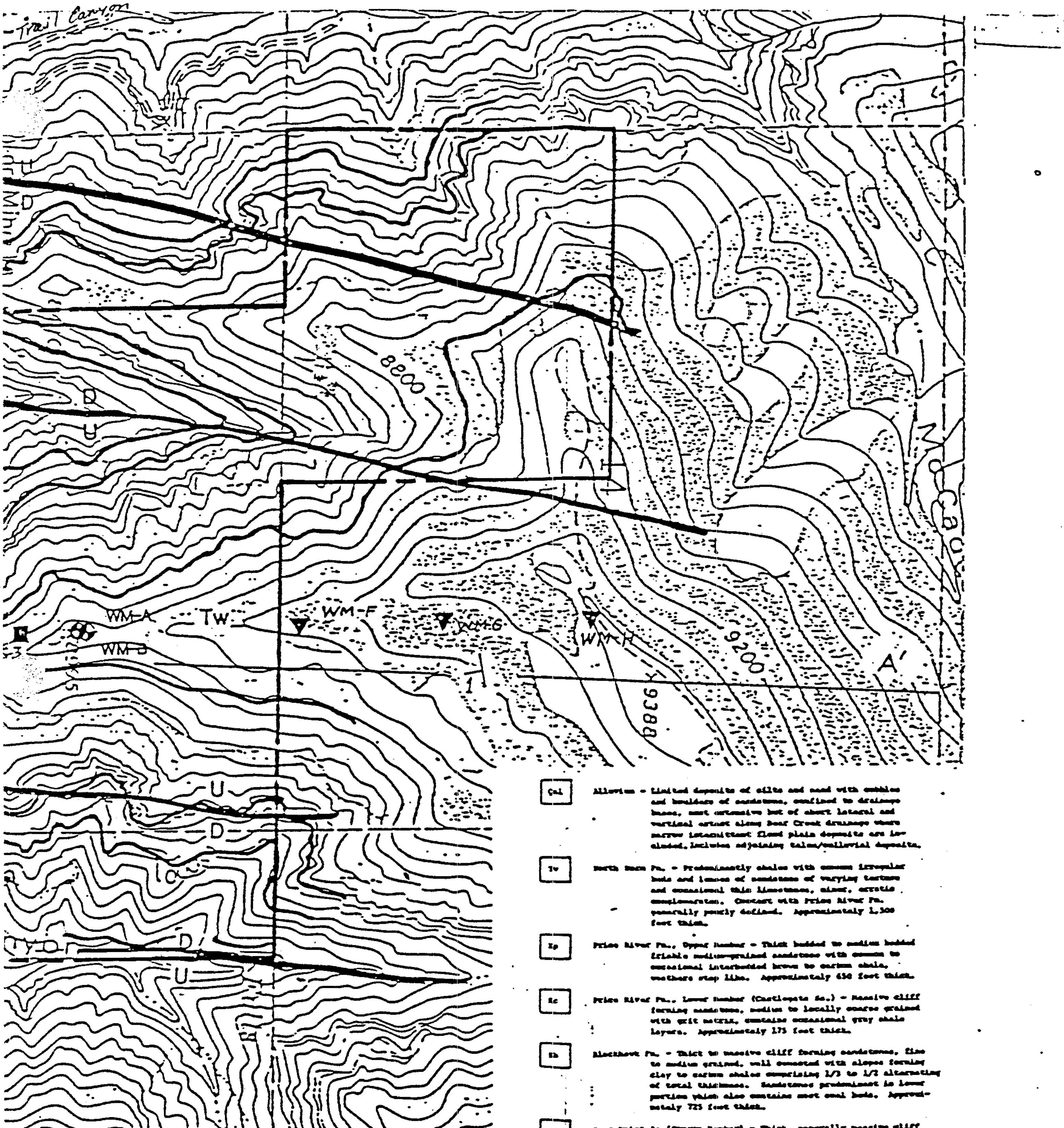
Curve A: Discharge of Spring (D-17-6) 23aaa-51, Water Year 1979 (Danielson, et. al., 1981)*

Curve B: Discharge of Bear Creek Spring, 1983-84.

* Presented by Danielson, et. al., as representative of springs issuing from Star Point-Blackhawk aquifer.

DWN.	R&M CONSULTANTS, INC. ENGINEERS GEOLOGISTS PLANNERS SURVEYORS	FLOW CHARACTERISTICS OF REPRESENTATIVE STAR POINT-BLACKHAWK AQUIFER AND BEAR SPRINGS	F.B.
CKD.			GRID
DATE			PROJ.NO. 46108
SCALE			DWG.NO.

Figure 7.1-2



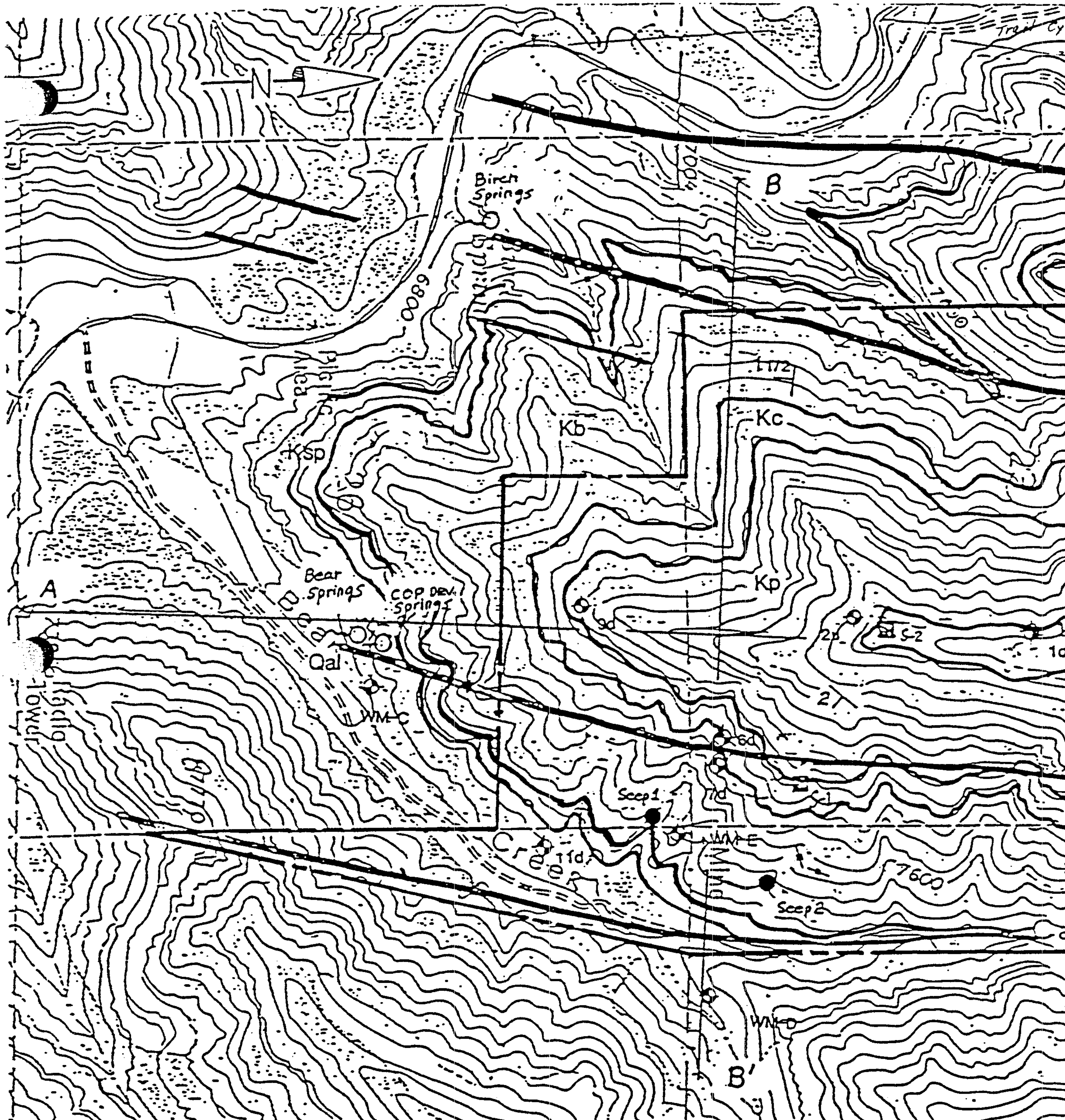
E&M CONSULTANTS, INC.
ENGINEERS PLANNERS SURVEYORS GEOLOGISTS

CO-OP MINING CO.
HUNTINGTON, UTAH

GEOLOGIC MAP

SCALE	DRAWN BY	DATE
1"=1000'	L.S.	1/1/85

Figure 7.1-3



Permit Boundary

Approximate formation contact.

U / D Approximate fault contact, with relative displacement shown.

Vertical/steeply dipping joint(s).

Bedding attitude.

Spring.

Drill Hole

Proposed Observation Well

Intermittent Seep

Surface Projection of Mine Sump and related roof drip area

Figure 7.1-3 (cont.)

7.1.4 GROUND WATER DEVELOPMENT AND MINE DEWATERING

The 2 small springs issuing from the portals in Trail Canyon have been developed by Co-Op Mining Co. and are presently used as the culinary water supply for the townsite. There are no plans to develop any additional ground water sources in this area. All of the mines in this canyon are abandonded and sealed (or inaccessible). The only water issuing from the mines is the above mentioned springs that are captured and used as culinary water. No further mining is planned in this canyon; therefore, there are no plans for any mine dewatering.

7.1.5 AFFECTS OF MINING OPERATIONS ON THE GROUND WATER HYDROLIC BALANCE

The mining operations in this canyon are finished, and all portals are sealed or inaccessible. There are no available data as to the amount of water encountered in past mining; however, the small flows issuing from the lower most portal sites indicate that the upper mine was relatevely dry, and the lower seam mines had only minor amounts of water. Based on this, it is unlikely that mining has had a significant impact on the ground water hydrology in the past. This area is scheduled for final reclamation in 1986. At that time, Trail Canyon will be used only as a townsite, and no further mining or mining related activities will occur there; therefore, there will be no further impacts from mining on the ground water hydrologic balance.

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7.2 SURFACE WATER HYDROLOGY

7.2.0 SCOPE

The purpose of this section is to provide information on the surface hydrology characteristics of the Co-Op Mining Company's Trail Canyon Mine permit area and the surrounding region. This section will also present a plan for complying with the requirements of the regulations of the Division of Oil, Gas & Mining and the office of Surface Mining.

Information from field reconnaissance and a review of data from various sources was used in compiling this surface water hydrology section. Data sources included information from the Co-Op Mining Co., reports by the U.S. Geological Survey, U.S. Forest Service, and mine application permits on file with DOGM.

7.2.1 REGIONAL AND ADJACENT AREAS

The San Rafael River Basin of the Upper Colorado River Region is generally classified as an arid basin. The upper drainages along the Wasatch Plateau receive enough snow precipitation to be classified as semi-arid to sub-humid with the amount of precipitation increasing with altitude.

There are eight major reservoirs in the basin. Seven are mainly for irrigation with a total capacity of 85,000 acre-feet and one, with a capacity of 30,530 acre-feet, is used as the water supply for a power plant. Diversions during irrigation season, April to November, from Huntington, Cottonwood, and Ferron Creeks nearly deplete flows downstream from these diversions. The flows downstream during this period are mainly irrigation return flows along with some groundwater seepage.

At points of major diversions on the Huntington, Cottonwood, and Ferron Creeks the water quality is excellent for irrigation, with dissolved-solids concentrations of less than 500 milligrams per liter. But water at the mouths of these creeks has markedly larger dissolved-solids concentrations. This is mainly due to two factors: 1) in the area between major diversions and the mouths of the creeks, they cross a belt of exposed Mancos Shale 10 to 15 miles wide, 2) this area is also where practically all the intensive irrigation in the San Rafael River Basin is practiced. (Mundoff, 1982)

The upper drainage of Huntington Creek encompasses about 200 square miles of maountainous country in the Wasatch Plateau. About 90 percent of the area is higher than 8,000 feet. The average channel gradient along the stream in the area is about 100 feet per mile. In its lower reaches the stream is in deep, narrow canyons, and surface relief between the stream channel and the top of adjacent canyon walls is typically 2,000 feet or more. (Danielson, 1981)

7.2.1.1 QUANTITY AND QUALITY OF SURFACE WATER

According ta Danielson, "...about 65 percent of the annual discharge at the Huntington Creek station (0931800) occurs during the snowmelt period (April-July). Because most of the streamflow is derived from snowmelt, annual discharge at the guaging station correlates will with the April 1 snowpack water content," as shown in Figure 7.2.-1. Figure 7.2-2 shows the discharge rate into Huntington Creek of the Tie Fork and Crandall Canyon streams, both major tributaries to Huntington Creek. Approximately 80 percent of the discharge from these streams is during the snowmelt from April to July. Table 7.2-1 is provided to show discharges on a daily basis for a few years, water years 1966-70 (Water Supply Paper #2125).

As part of the Danielson study, chemical analyses were performed on selected surface water samples from the area. Table 7.2.-2 is a tabulation of the results. It should be noted that none of the analyzed chemical constituents were found in concentration that exceeded the drinking water standards of the U.S. Environmental Protection Agency (1976). Danielson also noted that, "The predominant dissolved chemical constituents in water in Huntington Creek upstream from guaging station 0931800 were calcium and bicarbonate...The predominant dissolved chemical constituents in water in tributaries Huntington Creek were usually calcium, magnesium, and bicarbonate. However, during periods of base flow the concentrations of suphate in water at the mouths (of the tributaries)...were significantly higher than sulphate concentration in water in Huntington Creek...Water from the Star Point commonly contains slightly higher concentration of both dessolved solids and sluphate than water from younger rocks in the area."

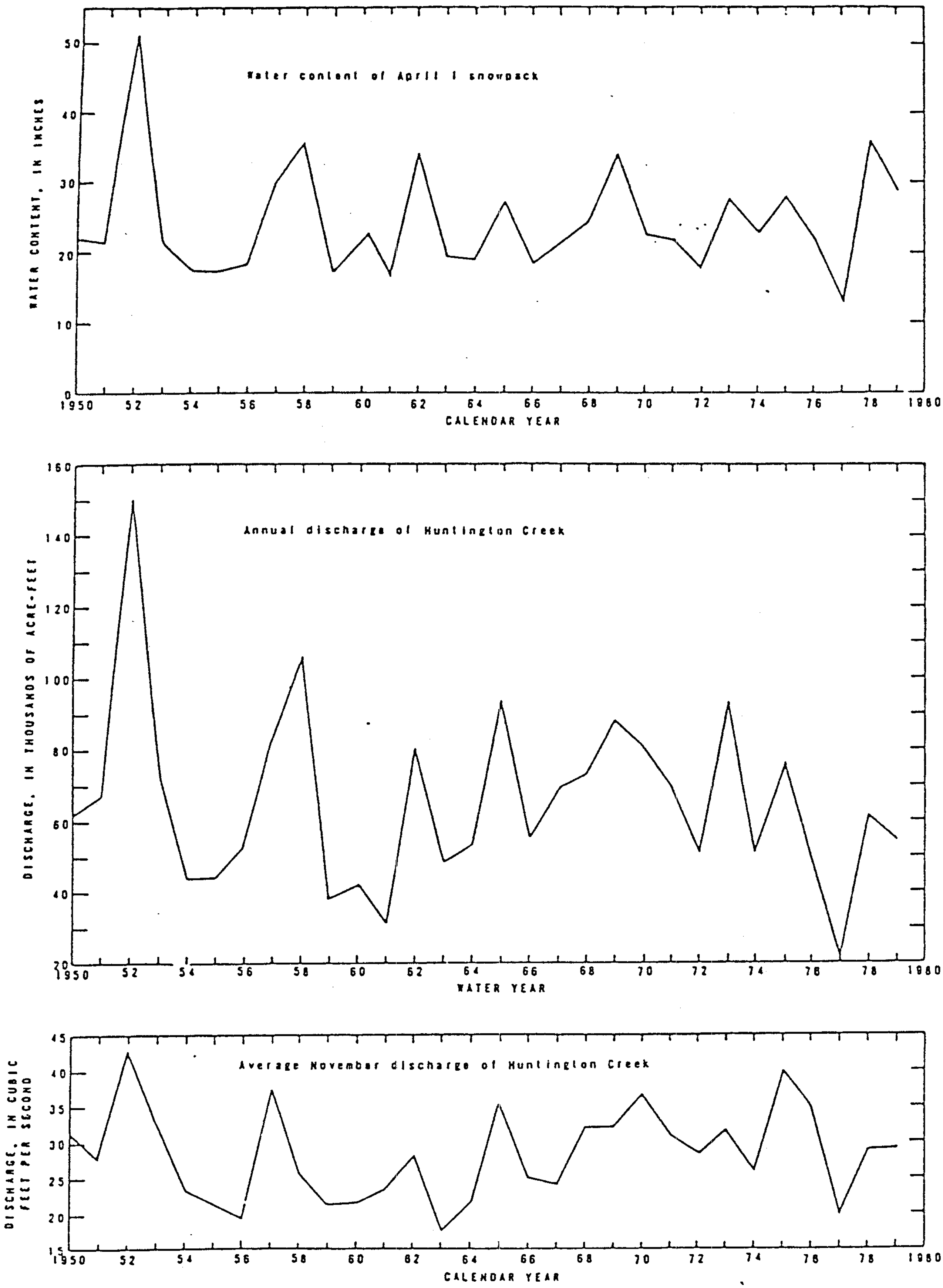

Figure 7.2-1 --Water content of April 1 snowpack at the Huntington Horseshoe snow course and the annual discharge of Huntington Creek at gaging station 09318000, 1950-79.

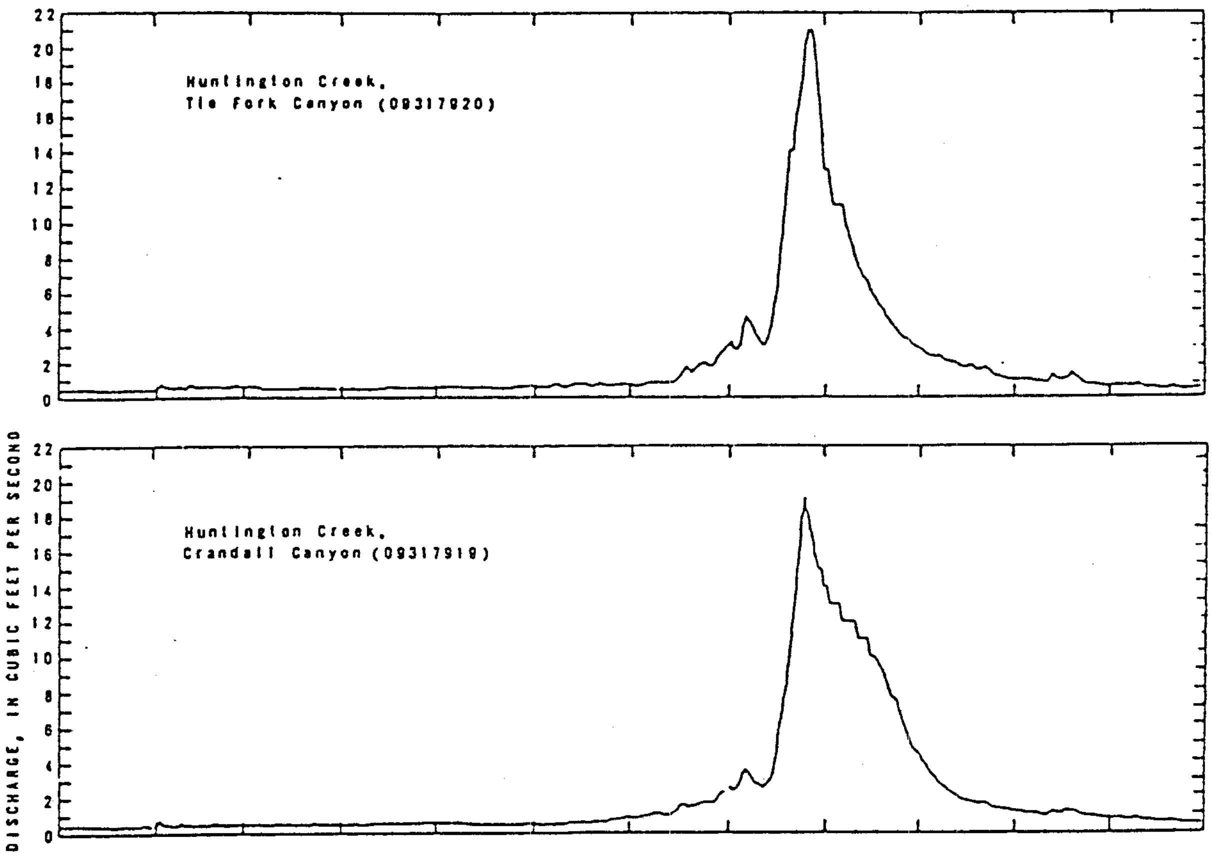

Figure 7.2-2 —Stream discharge at gaging stations in the drainage of Huntington Creek, water year 1979.

TABLE 7.2-1

09318000 HUNTINGTON CREEK NEAR HUNTINGTON, UTAH

LOCATION.--Lat 39°22'17", long 111°03'43", in SW¼NE¼SE¼ sec.6, T.17 S., R.8 E., Emery County, on left bank 300 ft (revised) downstream from farm road bridge, 1 mile upstream from Fish Creek, and 7 miles northwest of Huntington.

DRAINAGE AREA.--190 sq mi, approximately.

PERIOD OF RECORD.--May 1909 to September 1917, October 1918 to November 1920 (fragmentary), April 1921 to May 1930, October 1930 to September 1970.

GAGE.--Water-stage recorder. Altitude of gage is 6,210 ft (from river-profile map). Prior to Apr. 30, 1913, nonrecording gage 5 ft downstream at different datum. May 1, 1913, to Sept. 10, 1917, water-stage recorder at site 95 ft upstream at same datum as preceding gage.

AVERAGE DISCHARGE.--55 years (1910-17, 1921-29, 1930-70), 96.7 cfs (70,060 acre-ft per year).

EXTREMES.--Maximums and minimums (discharge in cubic feet per second, gage height in feet).

Annual maximum discharge (*) and peak discharges above base (400 cfs), water years 1966-70

Date	Time	Disch.	G.H.	Date	Time	Disch.	G.H.	Date	Time	Disch.	G.H.
July 11, 1966	1300	*387	3.97	May 30, 1968	2300	724	4.74	Sept.10, 1969	0400	757	4.65
				June 19, 1968	0100	548	4.31	Sept.15, 1969	1500	617	4.35
May 22, 1967	2230	604	4.42	July 30, 1968	2030	*1,640	6.33				
Sept. 8, 1967	2200	556	4.34	Aug. 1, 1968	1730	408	3.92	May 19, 1970	0100	*817	4.83
Sept. 9, 1967	2100	*782	4.83					June 10, 1970	1700	622	4.48
				May 13, 1969	2300	*777	4.71				
May 21, 1968	2400	526	4.32	July 19, 1969	1900	644	4.55				

Annual minimum discharge, water years 1966-70

Wtr yr	Date	Disch.	G.H.	Wtr yr	Date	Disch.	G.H.
1966	Mar. 3, 1966	11	2.07	1969	Jan. 24, 1969	7.8	1.70
1967	Feb. 20, 1967	6.1	1.96	1970	Feb. 19, 1970	8.7	1.64
1968	Nov. 27, 1967	12	2.03				

Period of record: Maximum discharge, 2,500 cfs Aug. 2 or 3, 1930 (gage height, 7.5 ft, from floodmark), from rating curve extended above 600 cfs; minimum recorded, 2 cfs Nov. 5, 1926.

REMARKS.--Records good except those for winter periods and those for periods of no gage-height record, which are fair. Small diversions for irrigation above station, including transmountain diversions to tributaries of San Pitch River (Sevier Lake basin). Slight regulation by small reservoirs above station.

REVISIONS.--WSP 1925: Drainage area.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1965 TO SEPTEMBER 1966

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	51	37	32	35	38	28	79	167	130	143	112	78
2	62	36	36	30	39	27	96	179	124	150	87	64
3	73	36	39	31	30	21	101	192	143	146	97	58
4	70	36	39	34	34	24	87	206	150	143	108	56
5	78	36	38	36	37	27	77	220	146	141	82	57
6	78	36	35	36	40	33	78	228	143	132	82	58
7	78	36	34	36	45	36	84	246	141	141	79	70
8	78	36	38	36	40	36	97	255	146	139	79	58
9	76	36	37	36	38	36	116	268	148	132	81	57
10	73	35	38	36	25	37	122	284	155	120	79	58
11	60	35	36	36	23	37	108	255	146	135	79	60
12	60	36	30	36	22	36	94	217	137	128	79	61
13	60	37	37	36	21	37	98	187	132	110	79	57
14	58	35	37	36	20	40	94	172	132	103	78	62
15	60	35	27	36	19	41	106	162	141	103	78	62
16	68	36	33	33	19	41	122	172	160	103	81	57
17	66	44	35	29	20	37	148	182	162	104	81	55
18	62	38	38	25	21	37	150	177	146	108	81	56
19	60	37	40	23	22	38	128	182	141	101	86	56
20	58	36	40	22	22	37	120	172	143	97	82	52
21	57	34	41	27	23	37	114	172	152	96	79	52
22	57	30	41	31	26	34	110	172	150	94	78	51
23	57	40	35	32	27	35	106	162	146	92	73	51
24	56	39	30	33	29	36	118	152	143	96	52	50
25	55	39	31	34	30	36	137	162	139	84	52	48
26	62	30	33	35	28	38	140	146	135	86	54	47
27	64	28	35	36	29	44	157	132	128	92	51	49
28	39	25	37	36	27	48	150	135	124	89	48	55
29	37	29	38	36	------	52	150	150	128	94	49	55
30	37	30	40	37	------	58	160	146	132	101	52	55
31	36	------	39	36	------	66	------	137	------	99	60	------
TOTAL	1,886	1,053	1,119	1,033	786	1,170	3,459	5,791	4,245	3,493	2,356	1,703
MEAN	60.8	35.1	36.1	33.3	28.0	37.7	115	187	142	113	76.0	56.8
MAX	78	44	41	38	45	66	160	284	162	150	112	78
MIN	36	25	27	22	19	21	77	132	124	84	44	47
AC-FT	3,740	2,090	2,220	2,050	1,560	2,320	6,860	11,490	8,420	6,930	4,670	3,380

CAL YR 1965 TOTAL 47,126 MEAN 135 MAX 646 MIN 15 AC-FT 97,440
WTR YR 1966 TOTAL 28,092 MEAN 77.0 MAX 284 MIN 19 AC-FT 55,720

09318000 HUNTINGTON CREEK NEAR HUNTINGTON, UTAH--CONTINUED

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1966 TO SEPTEMBER 1967

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	52	24	22	19	22	25	36	58	353	244	152	110
2	73	24	24	19	18	27	34	57	346	236	159	110
3	73	24	24	19	18	27	34	57	342	235	139	91
4	57	24	19	19	18	27	36	57	342	220	124	89
5	45	23	22	19	16	27	38	56	371	200	118	89
6	40	26	30	19	16	24	37	68	375	188	118	87
7	35	26	28	19	18	28	38	79	346	170	118	86
8	32	27	27	19	17	25	41	104	334	160	124	106
9	32	21	22	19	18	31	38	124	314	150	124	110
10	32	28	20	19	20	28	38	135	308	145	118	81
11	32	27	20	19	18	29	41	126	311	148	120	78
12	32	28	20	19	18	30	40	97	336	150	118	59
13	38	24	20	19	17	30	37	90	339	150	114	56
14	35	27	20	19	17	29	37	81	357	154	110	55
15	32	27	20	19	16	27	40	89	368	159	120	55
16	29	27	20	19	16	32	44	135	346	171	120	54
17	27	27	20	19	17	33	41	196	334	174	120	53
18	27	27	20	19	18	37	44	288	339	144	116	53
19	27	24	20	19	17	36	52	353	368	137	116	53
20	27	26	20	20	16	32	46	412	386	126	116	52
21	27	28	20	21	17	31	44	434	378	110	116	61
22	27	27	19	22	18	33	41	465	378	137	120	70
23	27	23	19	22	18	35	38	493	386	150	120	81
24	27	18	19	23	19	35	37	485	364	157	116	64
25	27	17	19	22	20	36	38	457	353	141	118	64
26	27	24	19	22	21	36	36	427	342	139	118	64
27	27	21	19	22	23	35	58	465	332	135	124	63
28	27	25	19	22	24	34	66	461	314	137	122	64
29	27	29	19	22	------	36	62	446	291	152	118	63
30	25	26	19	23	------	33	58	415	274	157	122	61
31	25	------	19	23	------	34	------	382	------	154	122	------
TOTAL	1,070	749	648	625	515	962	1,270	7,592	10,335	5,030	3,780	2,178
MEAN	34.5	25.0	20.9	20.2	18.4	31.0	42.3	245	345	162	122	72.6
MAX	73	29	30	23	24	37	66	493	386	244	159	118
MIN	25	17	19	19	16	24	34	56	274	110	110	52
AC-FT	2,120	1,490	1,290	1,240	1,020	1,910	2,520	15,060	20,500	9,980	7,500	4,320

CAL YR 1966 TOTAL 26,501 MEAN 72.6 MAX 286 MIN 17 AC-FT 52,560
WTR YR 1967 TOTAL 34,754 MEAN 95.2 MAX 493 MIN 16 AC-FT 68,930

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1967 TO SEPTEMBER 1968

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	59	29	19	22	22	30	46	114	539	188	146	65
2	55	29	18	21	22	31	50	145	539	176	121	72
3	55	21	19	19	22	31	43	161	548	166	74	70
4	55	25	20	19	22	32	40	184	548	161	65	89
5	54	32	21	18	22	31	41	207	626	154	70	92
6	58	27	22	17	22	31	41	221	626	150	69	91
7	53	26	22	16	22	32	34	191	543	150	69	91
8	53	26	23	16	22	31	36	174	497	141	75	96
9	53	26	23	16	22	30	34	184	434	137	68	108
10	53	27	23	16	22	30	38	191	397	135	75	106
11	53	26	23	16	22	28	42	184	386	124	80	108
12	48	26	23	17	22	27	50	202	386	116	84	112
13	48	26	23	18	22	31	53	191	434	112	87	112
14	48	26	23	19	22	29	45	168	461	104	104	112
15	46	24	23	20	22	28	51	154	465	118	69	87
16	47	26	21	20	22	30	52	157	473	122	80	87
17	47	26	19	21	22	30	49	159	461	122	58	86
18	47	23	20	21	22	29	44	194	491	126	60	86
19	46	22	22	21	22	29	42	230	510	122	50	86
20	45	24	22	21	22	24	42	311	493	124	46	82
21	45	24	21	21	23	28	42	393	457	144	45	82
22	45	21	20	21	24	29	61	438	423	152	47	78
23	45	22	19	21	24	30	61	382	397	148	52	76
24	45	23	18	21	25	30	64	304	364	135	45	76
25	41	24	19	22	27	32	61	272	328	137	43	74
26	36	16	19	22	28	32	61	304	278	141	56	74
27	33	17	20	22	29	30	63	371	241	139	59	72
28	32	19	21	22	29	32	61	449	236	139	68	72
29	28	20	22	22	30	34	86	514	230	122	67	80
30	28	20	22	22	------	41	99	560	213	143	65	82
31	31	------	23	22	------	43	------	582	------	126	65	------
TOTAL	1,432	725	653	612	679	957	1,532	8,291	13,048	4,268	2,177	2,604
MEAN	46.2	24.2	21.1	19.7	23.4	30.9	51.1	267	435	138	70.2	86.8
MAX	59	32	23	22	30	43	99	582	626	188	146	112
MIN	28	16	18	16	22	24	34	114	213	104	43	65
AC-FT	2,840	1,440	1,300	1,210	1,350	1,900	3,040	16,450	25,880	8,470	4,320	5,170

CAL YR 1967 TOTAL 35,097 MEAN 96.2 MAX 493 MIN 16 AC-FT 69,610
WTR YR 1968 TOTAL 36,978 MEAN 101 MAX 626 MIN 16 AC-FT 73,350

* NOTE.--NO GAGE-HEIGHT RECORD OCT. 9 TO NOV. 8, JAN. 6 TO FEB. 14.

09318000 HUNTINGTON CREEK NEAR HUNTINGTON, UTAH--CONTINUED

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1968 TO SEPTEMBER 1969

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	75	72	25	26	26	33	62	335	489	171	102	63
2	74	72	25	26	26	30	63	389	449	154	101	63
3	68	72	25	26	26	28	64	417	427	150	99	65
4	74	35	25	26	26	31	60	420	404	145	104	78
5	72	31	25	26	26	30	67	411	386	141	102	67
6	68	32	26	26	26	28	74	502	375	135	99	63
7	68	27	26	26	26	31	61	624	346	135	99	76
8	68	28	26	26	26	29	59	591	332	161	110	56
9	67	34	26	26	26	22	58	598	318	159	104	58
10	65	32	26	26	26	25	65	631	298	154	110	101
11	63	28	26	26	26	27	74	658	272	152	112	75
12	63	30	26	26	27	26	84	659	251	148	110	47
13	63	30	26	26	27	25	91	656	247	148	101	44
14	60	24	26	26	27	30	82	652	235	146	86	43
15	84	27	26	26	27	29	72	631	247	143	84	47
16	80	28	26	26	27	34	64	545	272	137	86	42
17	76	26	26	26	27	35	62	554	272	130	86	43
18	76	29	26	26	26	35	82	569	266	130	89	42
19	72	31	26	26	30	34	93	574	244	150	93	40
20	64	26	26	26	31	32	109	569	226	145	91	39
21	64	24	26	26	32	34	143	559	213	132	72	42
22	61	28	26	26	30	34	187	573	199	126	70	45
23	61	30	26	26	28	35	225	535	196	108	69	41
24	61	22	26	26	31	34	258	503	291	102	67	44
25	60	24	26	26	30	30	246	516	259	101	67	80
26	59	21	26	26	29	34	210	539	235	96	67	78
27	58	23	26	26	23	36	190	591	213	87	65	75
28	59	23	26	26	32	40	199	600	204	89	64	74
29	58	23	26	26	------	43	236	582	191	116	76	64
30	70	23	26	26	------	48	287	578	184	120	75	64
31	74	------	26	26	------	50	------	548	------	104	67	------
TOTAL	2,105	955	801	806	768	1,012	3,627	17,109	8,541	4,117	2,741	1,759
MEAN	67.9	31.8	25.8	26.0	27.4	32.6	121	552	285	133	88.4	58.6
MAX	84	72	26	26	32	50	287	659	489	171	112	101
MIN	58	21	25	26	23	22	58	335	184	87	65	39
AC-FT	4,180	1,890	1,590	1,600	1,520	2,010	7,190	33,940	16,940	8,170	5,440	3,490

CAL YR 1968 TOTAL 38,029 MEAN 104 MAX 626 MIN 16 AC-FT 75,430
WTR YR 1969 TOTAL 44,341 MEAN 121 MAX 659 MIN 21 AC-FT 87,959

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1969 TO SEPTEMBER 1970

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	63	60	30	25	30	36	26	110	493	182	136	85
2	64	55	29	25	30	38	26	113	495	170	104	77
3	67	36	29	25	30	36	55	125	505	156	101	73
4	64	33	36	25	30	35	49	146	473	150	100	72
5	59	33	29	25	33	36	42	177	513	152	108	107
6	60	33	30	25	37	34	42	213	457	148	113	97
7	75	35	30	25	34	38	45	239	450	159	109	84
8	70	31	30	25	33	39	41	223	482	139	105	79
9	58	33	30	25	32	39	58	224	485	137	83	75
10	74	33	30	25	37	38	79	224	549	141	89	83
11	75	30	30	25	36	38	84	238	470	119	92	90
12	75	32	30	25	37	38	73	245	410	116	105	93
13	72	31	30	25	37	36	72	259	376	108	111	97
14	72	30	30	25	35	35	73	301	342	101	111	91
15	76	30	30	25	35	37	70	322	319	129	110	87
16	79	35	39	30	34	35	67	405	311	125	108	87
17	84	26	30	30	34	34	68	503	318	124	109	86
18	85	25	32	30	29	31	65	584	332	115	108	86
19	78	26	35	30	23	32	66	623	367	114	110	85
20	63	38	34	35	36	34	62	572	377	178	115	85
21	42	30	34	35	47	35	64	495	375	176	116	74
22	46	27	35	40	36	34	63	468	352	183	109	75
23	44	25	34	43	37	33	62	493	345	176	77	73
24	44	26	35	39	36	33	63	490	300	172	73	72
25	48	29	33	37	36	32	108	500	263	171	70	69
26	41	29	34	37	36	31	129	491	265	173	71	65
27	38	24	20	37	36	30	129	492	250	143	74	64
28	43	24	25	28	37	29	118	521	230	140	73	63
29	60	30	25	30	------	29	114	488	220	132	72	63
30	56	30	25	30	------	27	112	469	200	142	71	65
31	59	------	25	30	------	26	------	500	------	140	82	------
TOTAL	1,916	961	939	916	963	1,054	2,123	11,258	11,344	4,511	3,015	2,402
MEAN	61.8	32.0	30.3	29.5	34.4	34.1	70.8	363	378	146	97.3	80.1
MAX	85	60	36	43	47	39	129	623	549	183	116	107
MIN	38	24	20	25	23	26	24	110	200	101	70	63
AC-FT	3,800	1,910	1,860	1,820	1,910	2,100	4,210	22,330	22,500	8,950	5,980	4,760

CAL YR 1969 TOTAL 44,296 MEAN 121 MAX 659 MIN 20 AC-FT 87,860
WTR YR 1970 TOTAL 41,406 MEAN 113 MAX 623 MIN 20 AC-FT 82,130

TABLE 7.2-2

Chemical Analyses of Selected Surface Water Samples 1977-79

Concentration: In milligrams per liter, unless otherwise indicated; <, less than.
Site No. Shown on plate 1.
Discharge: Measured except E, estimated.
Specific conductance: In micromhos per centimeter at 25 degrees Celsius.
Other data available: SQS, semiquantitative determination of trace elements reported in table 12.

Stream	Site No.	Date	Temperature (degrees C)	Discharge (ft^3/s)	Alkalinity (as $CaCO_3$)	Bicarbonate	Dissolved boron (µg/L)	Dissolved calcium	Carbonate	Dissolved chloride	Dissolved fluoride
Huntington Creek	21	8-15-77	15.0	16	140	200	10	49	0	2.5	0.1
		6-6-78	5.5	45	160	190	20	49	0	2.9	.1
Spring Creek	22	8-15-77	15.0	0.25	110	140	20	38	0	2.9	.1
		6-6-78	4.5	25.0	130	160	10	45	0	2.9	.1
Left Fork of Huntington Creek	23	8-15-77	19.5	1.8	110	130	40	50	0	3.5	.1
Lake Canyon	24	8-15-77	15.0	1.6	160	200	20	57	0	2.1	.1
Left Fork of Huntington Creek	34	10-12-77	4.0	8E	170	210	5	54	1	2.3	.1
		7-28-78	16.1	–	130	160	20	45	1	1.7	.1
		10-17-78	3.4	10E	190	–	20	49	–	2.1	.1
		7-18-79	8.0	70	130	–	30	40	–	1.7	.1
		10-15-79	11.0	45E	131	160	20	36	–	1.5	.1
	39	10-12-77	5.6	10E	200	240	10	55	1	2.8	.1
		7-26-78	–	–	140	170	10	44	0	1.7	.1
		10-17-78	4.7	12E	180	–	20	50	–	2.8	.1
		7-19-79	7.5	80	140	–	40	41	–	1.8	.1
		10-15-79	10.0	45E	146	178	20	38	–	1.7	.1
Huntington Creek	41	7-26-78	18.5	–	140	170	30	47	0	2.6	.1
		10-17-78	5.5	30E	180	–	30	51	–	3.4	.1
		7-19-79	7.5	100	140	–	70	43	–	2.2	.1
		10-15-79	9.5	65	153	186	20	41	–	2.1	.1
Crandall Canyon (gaging station 09317919)	51	10-12-77	3.0	1.0E	220	270	30	59	1	7.8	.2
		7-26-78	18.2	–	190	230	20	54	0	3.8	.1
		10-18-78	4.9	.7E	230	–	30	53	–	4.7	.1
		7-19-79	9.5	1.9	200	–	40	48	–	4.4	.1
		10-15-79	6.0	.54	–	288	20	54	–	4.7	.1
Wild Cattle Hollow	61	10-13-77	7.5	70E	200	240	10	67	0	5.0	.1
		7-27-78	10.1	–	210	250	20	60	0	5.5	.1
		10-17-78	6.0	1E	250	–	50	64	–	5.2	.1
		7-19-79	9.0	1.5	210	–	30	48	–	4.1	.1
		10-15-79	8.0	.25	249	303	20	62	–	4.8	.1
Tie Fork (gaging station 09317920)	67	10-13-77	6.3	.43	190	230	30	63	1	4.4	.1
		6-9-78	5.3	8.8	–	–	–	68	–	3.6	–
		7-26-78	16.3	–	200	240	20	53	–	4.4	.1
		10-17-78	6.4	50E	250	–	30	64	–	4.6	.1
		7-19-79	12.5	1.8	200	–	50	49	–	4.3	.1
		10-15-79	8.0	.51	–	302	20	58	–	4.5	.1
Huntington Creek	68	7-27-78	16.1	420	150	170	20	47	4	2.2	.1
		10-18-78	6.0	30E	180	–	30	51	–	3.2	.1
		7-19-79	12.0	105	150	–	30	51	–	2.4	.1
		10-15-79	9.5	70E	156	190	30	42	–	2.3	.1
	69	7-27-78	15.8	–	150	180	20	46	0	2.1	.1
		10-18-78	5.7	30E	190	–	30	53	–	3.0	.1
		7-19-79	11.5	110	140	–	20	40	–	2.1	.1
		10-16-79	6.5	70E	159	194	20	44	–	2.2	.1
Little Bear Canyon	70	7-27-78	15.5	–	230	280	30	54	0	5.6	.1
		10-18-78	7.1	.5E	190	230	40	65	–	6.3	.2
		7-19-79	13.5	1.0	240	–	40	47	–	6.5	.1
		10-16-79	5.0	.75	276	337	30	58	–	6.2	.1
Huntington Creek	71	7-27-78	17.6	–	140	170	20	49	0	4.7	.1
		10-18-78	5.6	30E	180	–	20	52	–	3.1	.1
		7-19-79	13.5	110	140	–	50	40	–	2.2	.1
		10-16-79	7.0	70E	160	195	20	43	–	2.3	.1
Mill Fork	76	7-27-78	18.2	–	250	300	30	53	0	7.9	.1
		7-19-79	14.5	14	250	–	60	46	–	9.4	.2
		10-16-79	6.0	.04	295	360	40	58	–	10	.1
Huntington Creek	77	7-28-78	13.2	–	150	180	20	49	0	2.5	.1
		10-18-78	5.7	30E	160	–	30	50	–	4.6	.1
		7-19-79	14.0	110	140	–	50	40	–	2.3	.1
		10-16-79	8.0	75E	157	191	20	44	–	2.4	.1
Rilda Canyon	78	7-15-76	12.0	.50	279	340	40	62	–	11	.2
		7-26-78	15.2	–	230	280	40	59	0	6.6	.1
		10-18-78	6.4	.35E	350	–	80	73	–	8.6	.2
		7-18-79	11.5	2.0	170	–	60	50	–	7.6	.2
		10-16-79	7.0	< 1.0	336	410	50	75	–	10	.2
Huntington Creek	80	8-15-77	17.0	25	160	200	30	43	0	3.8	.1
		6-6-78	6.0	360	150	180	10	50	0	2.7	.1
Meetinghouse Canyon	84	8-6-79	18.5	.21	180	–	50	39	12	5.8	.2
Deer Creek	86	8-26-79	8.6	.26	270	–	110	110	–	7.2	.2
	87	7-28-78	15.2	–	210	260	60	55	0	22	.7
		7-18-79	17.0	1.0	230	0	120	65	–	16	.2
Huntington Creek (gaging station 09318000)	88	6-9-77	15.0	–	160	190	30	55	0	3.9	.1
		8-15-77	19.0	13	170	210	40	57	0	15	.2
		6-6-78	6.5	360	160	190	20	51	0	9.1	.1
		11-14-78	2.5	16	210	250	50	60	0	6.8	.1
		6-13-79	13.0	216	140	–	20	52	2	3.3	.2
		11-11-79	0	19	250	–	20	59	0	4.4	.1
Cottonwood Creek	103	10-13-77	2.8	1.0E	180	210	30	66	7	7.6	.1
		7-27-78	10.0	–	220	270	30	57	0	8.2	.1
		10-19-78	4.7	.28	284	–	40	59	–	8.6	.1
		7-18-79	14.0	.97	240	–	60	47	–	9.9	.2
		10-16-79	5.0	–	287	350	30	60	–	9.4	.1
Cottonwood Creek (gaging station 09324200)	104	10-13-77	2.3	1.0E	220	260	30	56	1	7.8	.1
		7-27-78	12.4	–	220	270	30	46	0	8.2	.1
		10-19-78	4.7	.8E	260	–	50	52	–	9.8	.1
		7-18-79	16.0	97	210	–	50	37	–	9.9	.2
		10-16-79	5.0	.51	277	330	30	51	4	9.5	.1
Grimes Wash	107	8-26-79	13.3	.10	260	–	40	78	–	12	.2
	108	9-29-76	14.5	< .01	256	312	110	97	0	22	.2

Concentration													
Hardness (as $CaCO_3$)	Noncarbonate hardness (as $CaCO_3$)	Dissolved iron (µg/L)	Dissolved magnesium	Dissolved potassium	Dissolved silica	Dissolved sodium	Dissolved solids	Dissolved sulfate	Dissolved strontium (µg/L)	Sodium adsorption ratio	pH (units)	Specific conductance	Other data available
180	20	-	1.3	0.8	3.3	2.9	154	5.7	-	0.1	8.2	330	-
180	20	-	.9	1.3	3.1	2.5	193	20	-	.1	7.8	300	-
120	3	-	5.5	.8	2.7	2.0	130	8.9	-	.1	7.5	220	-
140	8	-	6.6	.7	3.9	1.6	147	7.5	-	.1	7.5	230	-
150	42	-	5.8	1.2	22	2.8	191	41	-	.1	7.3	300	-
180	13	-	8.5	.6	3.9	1.9	179	6.6	-	.1	8.0	290	-
200	31	-	17	.8	5.2	1.5	192	6.5	-	0	8.7	340	-
150	15	-	8.7	.6	2.7	1.5	147	6.1	-	.1	8.8	240	-
170	2	20	12	.7	3.3	1.7	176	4.2	100	.1	8.7	303	-
130	1	10	7.6	.5	3.1	1.2	140	7.7	-	0	7.8	273	-
140	4	10	11	.5	1.0	1.6	136	5.5	-	.1	8.1	270	-
220	25	-	21	1.2	5.6	3.3	220	12	-	.1	8.4	420	-
150	12	-	10	.7	2.6	1.7	152	6.6	-	.1	8.4	260	-
200	15	< 10	17	.9	3.7	2.8	197	11	120	.1	8.4	400	-
140	0	10	8.7	.7	3.0	1.5	150	8.8	-	.1	7.9	285	-
140	0	10	12	.5	1.4	1.7	150	7.2	-	.1	8.1	267	-
170	31	-	13	1.1	3.4	2.2	169	15	-	.1	8.8	300	SOS
190	9	40	15	1.1	3.5	2.6	201	16	100	.1	8.3	380	-
150	6	60	9.4	.8	3.0	1.4	154	10	-	.1	7.8	307	-
160	3	20	13	.7	2.1	1.9	165	12	-	.1	8.1	290	-
290	68	-	35	2.0	7.0	7.2	287	35	-	.2	8.6	470	SOS
220	33	-	21	1.3	5.6	4.3	234	30	-	.1	8.6	480	-
250	22	10	29	1.3	6.1	4.9	273	35	180	.1	7.8	500	-
220	23	0	25	1.2	5.2	5.2	240	31	-	.1	7.9	450	-
260	22	20	30	1.4	6.2	5.3	282	38	-	.1	8.2	470	-
260	61	-	22	1.4	6.5	4.4	251	26	-	.1	8.3	520	-
260	57	-	26	1.3	5.8	3.8	266	38	-	.1	7.8	390	-
280	29	< 10	29	1.3	6.1	4.5	273	26	200	.1	7.9	550	-
210	0	0	21	1.1	5.4	3.3	224	15	-	.1	7.6	426	-
270	17	40	27	1.4	6.0	4.3	281	26	-	.1	8.0	485	-
310	120	-	36	1.8	6.9	3.8	265	35	-	.1	8.6	500	SOS
250	-	-	19	3.3	-	2.6	185	13	-	-	8.6	410	-
250	55	-	29	1.6	5.9	3.8	247	30	-	.1	8.8	450	-
290	62	20	32	1.8	6.7	3.0	289	38	270	.1	8.2	543	-
230	29	10	26	7.3	6.3	3.9	234	23	-	.1	8.1	450	-
270	25	40	31	1.8	6.3	4.1	293	38	-	.1	8.2	501	-
170	21	-	12	.8	2.9	1.9	166	11	-	.1	8.5	260	-
200	18	40	17	1.1	3.6	3.1	201	19	120	.1	8.4	378	-
170	23	10	11	.8	3.2	1.8	174	13	-	.1	8.0	308	-
160	7	10	14	.8	2.2	2.1	171	14	-	.1	8.3	301	-
160	17	-	12	.8	2.9	1.8	165	10	-	.1	8.2	280	-
210	21	30	18	1.2	3.5	3.4	209	18	120	.1	8.3	380	-
140	1	10	10	.6	3.1	1.7	154	12	-	.1	7.9	273	-
170	8	10	14	.8	2.1	2.1	175	14	-	.1	8.1	309	-
290	62	-	38	1.8	6.6	7.1	291	39	-	.2	8.7	500	-
210	22	< 10	12	1.8	6.8	7.4	250	36	250	.2	8.2	575	-
270	34	10	38	1.8	6.5	8.1	292	40	-	.2	7.8	548	-
300	25	< 10	38	1.7	6.7	7.5	326	42	-	.2	8.2	538	-
180	36	-	13	.9	2.9	2.0	175	18	-	.1	8.8	270	-
200	24	30	18	1.1	3.2	3.1	205	16	120	.1	8.6	370	-
150	5	10	11	.4	3.1	2.0	155	12	-	.1	8.1	296	-
170	5	20	14	.8	2.1	2.1	174	13	-	.1	8.2	302	-
280	39	-	37	2.0	7.1	11	318	52	-	.3	8.7	440	-
280	34	0	41	5.2	6.8	10	327	58	-	.3	8.0	514	-
340	47	10	48	3.0	7.4	12	391	75	-	.3	8.3	612	-
170	24	-	12	.9	2.8	2.2	170	11	-	.1	8.4	285	-
200	39	30	18	1.2	3.2	3.6	203	25	120	.1	8.3	390	-
140	-	10	10	.8	3.1	1.7	154	12	-	.1	8.4	302	-
170	11	< 10	14	.8	2.0	2.3	176	16	-	.1	8.2	316	-
380	98	20	54	2.5	8.2	17	424	100	-	.4	-	-	-
310	82	-	40	2.0	6.4	10	326	63	-	.2	8.9	500	-
410	65	20	54	3.1	8.8	18	429	99	430	.4	8.1	840	-
290	120	-	39	1.1	6.7	13	292	72	-	.3	8.1	620	-
420	82	20	56	3.2	8.6	18	503	130	-	.4	8.1	730	-
180	17	-	18	1.7	4.3	4.1	196	22	-	.1	8.3	332	-
170	27	-	12	.6	3.0	2.1	173	14	-	.1	7.8	280	-
230	50	0	32	3.9	5.3	10	260	43	310	.3	8.6	438	-
410	140	190	33	1.1	6.4	19	< 372	32	-	.4	8.4	490	-
380	170	-	59	4.0	10	29	476	160	-	.6	8.8	650	SOS
360	130	0	47	4.1	7.9	25	474	170	-	.6	8.1	790	-
200	43	-	15	1.1	3.4	4.6	200	23	-	.1	8.3	390	-
250	73	-	25	1.9	5.8	13	289	67	-	.4	8.1	478	-
180	21	-	12	.8	4.0	2.9	183	14	-	.1	7.8	290	-
250	44	20	24	1.4	5.7	9.2	278	47	160	.3	8.2	470	-
140	3	10	3.1	.5	3.2	4.2	175	21	190	.2	8.4	365	-
230	34	10	21	1.4	4.7	5.8	251	33	150	.2	8.3	435	-
330	150	-	41	2.0	7.0	10	276	32	-	.2	8.5	540	-
300	81	-	39	1.7	6.7	12	306	47	-	.3	7.8	470	-
300	54	20	38	1.8	6.9	12	317	40	330	.3	8.6	620	-
280	38	10	39	1.8	6.9	18	319	52	-	.5	7.9	640	-
310	23	20	39	2.0	6.8	14	355	51	-	.3	8.0	583	-
310	94	-	41	2.1	7.0	11	286	32	-	.3	8.5	540	SOS
280	58	-	40	1.8	6.5	12	294	45	-	.3	8.3	470	-
290	31	10	39	2.0	6.9	12	319	40	330	.3	8.7	512	-
240	35	0	37	2.1	6.2	18	290	53	-	.5	8.0	610	-
290	15	20	40	2.1	6.7	15	343	52	-	.4	8.4	550	-
370	110	150	43	1.4	8.0	22	< 384	63	-	.5	8.3	580	SOS
580	320	20	82	4.8	8.9	31	763	360	700	.6	8.0	1,200	-

7.2.1.2 WATER USES

Most of the surface water from the drainage is diverted for use as crop irrigation. The only other major use is supply water to the Huntington Powerplant. The reservoirs in the area have been built to supplement this use. Some water in the area, particularly springs, is used for livestock watering or as culinary water.

Water rights have been obtained by Co-Op Mines in sufficient quantities for all of the mine's needs. Appendix 7-D contains a listing of water rights in the area and Plate 7-3 indicates their various locations.

7.2.2 MINE PLAN AREA SURFACE WATER

The channel of Trail Creek is straddled by the mine plan area with the majority of the area, disturbed and undisturbed, east of the creek. Trail Creek is an intermittant stream with flows often absent or frozen during the winter.

Two small springs are present in the permit area, one on the north side of the canyon and one on the south. Each of the springs are located in old portals in the Hiawatha Seam which overlies the Starpoint Sandstone. The flow from the springs is collected and used for culinary water at Trail Canyon site.

The streamflow in Trail Creek is neither continuous nor consistent, as evidenced by the water monitoring summary in Table 7.2-4. This indicates that the majority of the Trail Creek flow is the result of snowmelt and direct runoff. The lack of significant, consistent spring flows in the area indicate that the stream is not being fed primarily by a regionally recharged aquifer such as the Starpoint Sandstone.

The quality of the water is also variable; however, as can be seen from Table 7.2-4, it is not unusually high in suspended sediments, as is the case in nearby Bear Canyon. This further supports the theory that the major source of the streamflow is due to snowmelt and direct runoff, since even locally recharged water zones in the North Horn formation (as exist above Bear Canyon) produce springs that are consistently high in suspended sediments due to erosion of the shales and mudstone.

Table 7.2-3 lists the results of field determinations from various tributaries to Huntington Creek. The sources of these springs are primarily in the Starpoint Sandstone, and as a result, the flows and quality are quite consistent.

The following is a tabulation of sediment loading for various perennial streams in the Huntington Canyon area:

Stream	Site No.	Date	Concentration (mg/1)	Load (Tons per day)
Huntington Creek	88	8-13-78	104	27
(guaging station		11-17-78	72	2.5
0931800)		6-13-79	114	66
		8- 7-79	44	15
Crandall Canyon	51	8-12-78	49	.14
(guaging station		11-18-78	60	.08
09317919)		6-14-79	15	.41
		8- 6-79	56	.15
Tie Fork Canyon	67	8-13-78	12	.03
(guaging station		11-18-78	57	.12
09317920)		6-14-79	38	.68
		8- 6-79	66	.17
Bear Creek	81	10-25-78	8,860	1.9
		6-14-79	2,140	4.0
Deer Creek	87	6-14-79	609	3.1

Concerning the unusually high sediment loads in Bear Creek, Danielson stated the following:

> "Bear Creek transported loarge quantities of suspended sediment during 1978 and 1979. Springs emerging from the North Horn Formation in the headwaters of Bear Creek continuously erode the shales and mudstone and permit sloughing of large amounts of fine-grained material from the escarpment."

As part of Co-Op Mining Company's monitoring program, water samples from Trail Creek, both above and below the mine plan area, have

TABLE 7.2-3

Field determinations of discharge, specific conductance, pH, water temperature and alkalinity at selected springs -- Continued

LOCATION	GEO-LOGIC UNIT	DATE OF SAMPLE	ALTI-TUDE	DIS-CHARGE (GAL/MIN)	SPE-CIFIC CON-DUCT-ANCE (UMHOS)	PH (UNITS)	TEMPER-ATURE (DEG C)	ALKA-LINITY FIELD (MG/L) AS $CACO_3$
(D-16-7)26ADC-S1	211SRPN	78-04-27	7120.00	110	--	--	--	--
	211SRPN	78-05-26	7120.00	110	--	--	--	--
	211SRPN	78-06-09	7120.00	120	--	--	--	--
	211SRPN	78-06-23	7120.00	130	--	--	--	--
	211SRPN	78-07-06	7120.00	150	--	--	--	--
	211SRPN	78-07-28	7120.00	150	--	--	--	--
	211SRPN	78-08-10	7120.00	160	--	--	--	--
	211SRPN	78-08-30	7120.00	155	--	--	--	--
	211SRPN	78-10-13	7120.00	165	--	--	--	--
	211SRPN	78-10-25	7120.00	160	--	--	--	--
	211SRPN	78-11-01	7120.00	155	--	--	--	--
	211SRPN	78-12-13	7120.00	145	--	--	--	--
	211SRPN	79-03-07	7120.00	135	--	--	--	--
(D-16-7)26BCA-S1	211SRPN	78-05-25	6860.00	23	--	--	--	--
	211SRPN	78-08-10	6860.00	19	--	--	11.0	--
	211SRPN	78-10-11	6860.00	19	--	--	11.0	--
	211SRPN	78-11-07	6860.00	19	--	--	10.5	--
	211SRPN	78-12-13	6860.00	19	--	--	10.0	--
	211SRPN	79-06-14	6860.00	10	--	--	11.0	--
	211SRPN	79-06-28	6860.00	10	720	8.0	11.0	--
	211SRPN	79-07-20	6860.00	9.3	660	7.0	11.5	--
	211SRPN	79-08-22	6860.00	21	750	--	10.5	--
	211SRPN	79-09-17	6860.00	19	750	--	10.5	--
	211SRPN	79-10-16	6860.00	20	680	--	11.5	--
(D-16-7)26CBB-S1	211SRPN	78-08-10	6950.00	57	--	--	11.0	--
	211SRPN	78-10-11	6950.00	57	--	--	10.0	--
	211SRPN	78-11-07	6950.00	57	--	--	10.0	--
	211SRPN	78-12-13	6950.00	57	--	--	10.0	--
	211SRPN	79-05-10	6950.00	44	--	--	--	--
	211SRPN	79-06-28	6950.00	30	820	7.6	10.5	--
	211SRPN	79-07-16	6950.00	27	710	7.0	12.5	--
	211SRPN	79-09-18	6950.00	65	760	--	9.5	--
	211SRPN	79-10-18	6950.00	60	750	--	11.0	--

	211SRPN	78-07-06	7120.00	150	--	--	--	--
	211SRPN	78-07-28	7120.00	150	--	--	--	--
	211SRPN	78-08-10	7120.00	160	--	--	--	--
	211SRPN	78-08-30	7120.00	155	--	--	--	--
	211SRPN	78-10-13	7120.00	165	--	--	--	--
	211SRPN	78-10-25	7120.00	160	--	--	--	--
	211SRPN	78-11-01	7120.00	155	--	--	--	--
	211SRPN	78-12-13	7120.00	145	--	--	--	--
	211SRPN	79-03-07	7120.00	135	--	--	--	--
(D-16-7)26BCA-S1	211SRPN	78-05-25	6860.00	23	--	--	--	--
	211SRPN	78-08-10	6860.00	19	--	--	11.0	--
	211SRPN	78-10-11	6860.00	19	--	--	11.0	--
	211SRPN	78-11-07	6860.00	19	--	--	10.5	--
	211SRPN	78-12-13	6860.00	19	--	--	10.0	--
	211SRPN	79-06-14	6860.00	10	--	--	11.0	--
	211SRPN	79-06-28	6860.00	10	720	8.0	11.0	--
	211SRPN	79-07-20	6860.00	9.3	660	7.0	11.5	--
	211SRPN	79-08-22	6860.00	21	750	--	10.5	--
	211SRPN	79-09-17	6860.00	19	750	--	10.5	--
	211SRPN	79-10-16	6860.00	20	680	--	11.5	--
-16-7)26CBB-S1	211SRPN	78-08-10	6950.00	57	--	--	11.0	--
	211SRPN	78-10-11	6950.00	57	--	--	10.0	--
	211SRPN	78-11-07	6950.00	57	--	--	10.0	--
	211SRPN	78-12-13	6950.00	57	--	--	10.0	--
	211SRPN	79-05-10	6950.00	44	--	--	--	--
	211SRPN	79-06-28	6950.00	30	820	7.6	10.5	--
	211SRPN	79-07-16	6950.00	27	710	7.0	12.5	--
	211SRPN	79-09-18	6950.00	65	760	--	9.5	--
	211SRPN	79-10-18	6950.00	60	750	--	11.0	--

TABLE 7.2-3
Continued

(D-16-7)27ADC-S1	211SRPN	78-08-10	7000.00	15	--	--	11.0	--
	211SRPN	78-10-11	7000.00	5.8	--	--	11.0	--
	211SRPN	78-11-07	7000.00	4.9	--	--	10.0	--
	211SRPN	78-12-13	7000.00	5.4	--	--	10.0	--
	211SRPN	79-05-10	7000.00	.0	--	--	--	--
	211SRPN	79-06-28	7000.00	.0	--	--	--	--
	211SRPN	79-08-22	7000.00	2.0	870	--	10.0	--
	211SRPN	79-09-18	7000.00	3.4	780	--	10.0	--
	211SRPN	79-10-18	7000.00	3.1	730	--	11.5	--
16-7)35ABC-S1	111ALVM	78-10-13	6620.00	22	--	--	--	--
	111ALVM	78-11-08	6620.00	20	--	--	--	--
	111ALVM	78-12-11	6620.00	23	--	--	--	--
	111ALVM	79-05-11	6620.00	26	--	--	--	--
	111ALVM	79-06-28	6620.00	20	960	8.1	10.5	--

TABLE 7.2-4

CHEMICAL ANALYSES OF WATER SAMPLES TAKEN BY CO-OP MINING COMPANY FROM TRAIL CREEK

Will be supplied upon completion

been chemically analyzed for the past 2 years. The results are presented in Table 7.2-4. During the snowmelt (April-July) there is an increase in suspended sediments, as expected, due to the increased flows. A comparison of these results with those of Table 7.2-3 and the above tabulation of streams in the Huntington Canyon area, indicates that Trail Creek exhibits characteristics different from each, and more typical of an intermittant stream dependent upon snowmelt and direct runoff for its flow.

It should be noted that although the lower monitoring station in Trail Canyon indicates a constant flow typical of a perennial stream, the upper station does not. This can be acounted for by examining the overflows at the pumphouses for the culinary water. The springs are located between the upper and lower monitoring stations, and any water not used by the townsite is allowed to overflow and flow down Trail Creek. The creek is therefore classified as intermittant based on it's natural condition, such as exists above the upper monitoring station.

7.2.3 EFFECTS OF MINING ON SURFACE WATER

The Trail Canyon area is no longer the site of an operating mine. the only effects from the operation would be from possible water contamination due to uncontrolled runoff from old coal storage or other disturbed areas, or from the dwellings within the canyon. The site is presently protected by various hydrologic controls (drainage ditches, diversions, sediment pond, catch basin, etc.) to minimize possible effects on the surface water. Trail Canyon is projected to be reclaimed in 1989. This reclamation will further enhance the protection of the surface water by removing old mining structures, coal piles and pads, and by regrading and revegetating disturbed areas. As a further protection measure, the sewage system for the proposed Trail Canyon City will be re-evaluated and improved as necessary.

As indicated in the previous section, the flow in Trail Canyon is intermittant and is thought to be fed primarily by snowmelt and direct runoff. The absence of significant springs in the area indicates that any impacts on the surface hydrology from the old mine workings would be minimal or non-existant.

Since Trail Creek runs through the pre-law mine yard and residential area, it has been adversely affected over the years. The main affect has been the accumulation of moderate amounts of coal material and trash in and around the stream bed. Some cleanup of this area has already been instituted at this site; however, the final reclamation of the site will complete the restoration. This will be accomplished by cleaning any visible coal accumulations or trash from the stream bed, regrading areas of bank erosion or instability, and revegetating the unstable or disturbed areas of the channel. Further, long-term maintenance and protection of the stream will be assured by the establishment of Trail Canyon City, which will be responsible for structures within it's boundaries.

7.2.4 Monitoring Plans

In the past, Co-Op has monitored two stations on Trail Creek, one above (north) of the mine plan area and one below (south). Five springs are also monitored. Sample point SP-1, at the exit of the sediment pond inlet culvert, upstream from the entrance to the sediment pond will be used to demonstrate that reclaimed drainage meets applicable state and federal water quality limitations and will be used to evaluate when the sediment pond can be removed. Sampling point CO-1, at the outlet of Culvert TCC-6 will be monitored to show that sediment controls above this point are adequate and demonstrate no degradation to Trail Creek. A total of ten locations shown on Plate 7-1 and listed with monitoring schedule on Table 7.2-7 are to be monitored.

Water monitoring samples will be taken on a quarterly basis (June, Aug, Oct, and Feb) up until reclamation is completed and for two years following reclamation, and bi-annually (2 per annum, June and Oct) for the succeeding years until bond release. Monitoring of field measurements listed in Table 7.2-5 will be taken during each sample period. Monitoring data through 1986 for both surface and ground water are located in Appendix 7-A-1. See Annual Report for monitoring data after 1986.

Baseline monitoring (Table 7.2-5) will continue for the first 7 sites for 1988.

All field measurements will be made by qualified personnel, using standard, accepted methods. All laboratory tests will be performed by a qualified, accredited laboratory, using standard, accepted tests and equipment. Results will be submitted to DOGM in the quarterly Water Monitoring Report within 30 days following the end of each quarter, or as required by DOGM.

The sedimentation pond will continue to be monitored per NPDES Permit requirements. Any discharge from the pond will be sampled and reported to the regulatory authority in accordance with the NPDES discharge Permits reporting procedure.

7.2.5 Surface Water Control and Diversions

The vast majority of the disturbed area of the Trail Canyon Mine is on the east side of Trail Canyon (same side as the mine portal and to the south). The runoff from this east side disturbed area is collected and channeled to the Sedimentation Pond. The small amount of runoff from the road area adjacent to the reclaimed area is diverted around the reclaimed area through the undisturbed drainage along the road (Plate 7-4D).

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There are presently 3 large culverts in place along the main drainage Trail Creek. It is proposed to leave these culverts in place, since the area is to become a permanent residential area, and will continue to use existing access roads. The culverts will be fitted with trash racks. There are no other modifications or restoration activities proposed for the main Trail Creek channel. Support calculations for all remaining culverts are shown in Section 7.3.4].

7.2-5 Surface Water Baseline, Operational and Postmining Water Quality Parameter List

Field Measurements:

*	-	Water Levels or Flow	*	-	pH
*	-	Specific Conductivity (umhos/cm)			
*	-	Temperature (C°)			
*	-	Dissolved Oxygen (ppm) (perennial streams only)			

Laboratory Measurements: (mg/l) (Major, minor ions and trace elements are to be analyzed in dissolved form only.)

#	*	-	Total Settleable Solids	
#	*	-	Total Suspended Solids	
	*	-	Total Dissolved Solids	
	*	-	Total Hardness (as $CaCO_3$)	
		-	Aluminum (Al)	
		-	Arsenic (As)	
		-	Boron (B)	
	*	-	Carbonate (CO_3^{-2})	
	*	-	Bicarbonate (HCO_3^-)	
		-	Cadmium (Cd)	
	*	-	Calcium (Ca)	
	*	-	Chloride (Cl^-)	
		-	Copper (Cu)	
	*	-	Iron (Fe)	(Total and Dissolved)
		-	Lead (Pb)	
	*	-	Magnesium (Mg)	
	*	-	Manganese (Mn)	(Total and Dissolved)
		-	Molybdenum (Mo)	
		-	Nitrogen: Ammonia (NH_3)	
		-	Nitrite (NO_2)	
		-	Nitrate (NO_3^-)	
	*	-	Potassium (K)	
		-	Phosphate (PO_4^{-3})	
		-	Selenium (Se)	
	*	-	Sodium (Na)	
	*	-	Specific Conductivity (umhos/cm)	
	*	-	Sulfate (SO_4^{-2})	
		-	Zinc (Zn)	
	*	-	Oil and Grease	
	*	-	Cation-Anion Balance	

Sampling Period:
- -Baseline
- *Operational, Postmining
- #Construction

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Table 7.2-6
SURFACE WATER SAMPLING

	Baseline	Operational	Postmining
Type of Sampling Site	Surface Water Bodies	Surface Water Bodies	Surface Water Bodies
Field Measurements (see Table 1)	Performed during water level/flow measurements.	Performed during water level/flow measurements.	Performed during water level/flow measurements.
Sample Frequency	Quarterly for lakes, reservoirs and impoundments (water level and quality); monthly flow measurements and quarterly water quality measurements (one sample at low flow and high flow each) for perennial streams. Monthly flow and water quality measurements during period of flow for intermittent streams. Sampling for ephemeral streams determined at pre-design conference.	Quarterly for lakes, reservoirs and impoundments (water level and quality); monthly flow measurements and quarterly water quality measurements (one sample at low flow and high flow each) for perennial streams. Monthly flow and water quality measurements during period of flow for intermittent streams. Sampling for ephemeral streams determined at pre-design conference.	Two per annum for perennial streams (high & low flow); two per annum during snowmelt and rainfall for intermittent streams.
Sampling Duration	Two years (one complete year of data before submission of PAP.	Every year until two years after surface reclamation activities have ceased.	Every year until termination of bonding.
Type of Data Collected and Reported	Flow and/or water levels and water quality.	Flow and/or water levels and water quality.	Flow and/or water levels and water quality per operational parameters.
Comments	All field measurements should be performed concurrently with water level/flow measurements.	All field measurements should be performed concurrently with water level/flow measurements.	All field measurements should be performed concurrently with water level/flow measurements

TABLE 7.2-6 (continued)

	Baseline	Operational	Postmining
Comments		For every fifth year preceding repermitting, one sample at low flow and high flow each should be taken for baseline water quality parameters.	
		The construction monitoring program will be conducted on a site-specific basis in addition to the operational monitoring.	

Table 7.2-7 Water Monitoring Matrix

Location	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Upper Trail Creek UT-1					oper.					oper.		
Lower Trail Creek LT-2					oper.					oper.		
Portal Spring PS-1					oper.					oper.		
Trail Canyon Spring TS-1					oper.					oper.		
Co-Op Spring CS-1					oper.					oper.		
Ball Park Spring BP-1					oper.					oper.		
Birch Spring SBC-5					oper.					oper.		
Sed. Pond Inlet SP-1					oper.					oper.		
Culvert TCC-6 Outlet CO-1				See	Note #4							
Sealed Mine Entries and Access				See	Note #5							

Notes:

1. See Tables 7.2-5 and 7.2-6 for listing of water quality monitoring parameters.
2. oper. = operational
   base. = baseline
3. Baseline parameters to be taken in 1993 at all locations.
4. Sampling will occur during storm events or spring runoff at outlet to culvert TCC-6 when flows occur and tested for oper.
5. Unplanned discharges will be sampled on a quarterly basis until bond release.

   a. Chemical analysis will be made to determine whether discharges are in compliance with the effluent standards of UMC 817.42 and all other applicable state and federal regulations.

   b. Treatment will be provided if necessary to any discharges that are not in compliance with applicable effluent standards during the period of discharge.

crossing the disturbed area, runoff from the undisturbed areas above is diverted around the site into Trail Creek, where possible (Plate 7-1).

7.2.5.1 Sedimentation Ponds

One sediment pond has been constructed to hold runoff from disturbed areas of the permit area to facilitate settling and filtering of contaminated surface water. A complete evaluation of the sediment pond including all calculations, is presented in Appendix 7-A.

The discharge from the sediment pond into the Trail Canyon stream channel, flows through a concrete spillway to an existing natural drainage course which is rip-rapped with large rocks and boulders from 4 in. to greater than 2 ft. medium diameter.

Plate 7-2 shows the required plan and section of the Sedimentation Pond.

7.2.5.1.1 Pond Slope Stability Analysis

A slope stability analysis is contained in Appendix 7-B. The analysis of the sediment pond included the condition under which the most conservative factor of safety would be derived. For purposes of analysis the soil was assumed saturated by water occasionally held in the pond. A statement of pond certification is also included as Appendix 7-C of this chapter.

7.2.5.1.2 POND MAINTENANCE

All embankments of temporary impoundments, the surrounding areas and diversion ditches, disturbed or created by construction shall be graded, fertilized, seeded and mulched to comply with the requirements of UMC 817.111-.117 immediately after the embankment is complete. Areas in which the vegetation is not successful, or where rills and gullies develop shall be repaired and revegetated.

In addition, all dams and embankments shall be routinely maintained during the liability period. Any vegetative growth will be cut where necessary to facilitate inspection and repairs. Ditches and spillways shall be cleaned at least annually. Any combustible materials present on the surface shall be removed and all other appropriate maintenance procedures followed.

When the sediment level in the pond reaches the 60% sediment cleanout level, the pond will be cleaned. Sediment taken from the pond will be hauled to the Bear Canyon site (permit # ACT/015/025) and placed in the sediment material storage area designated in the Bear Canyon permit and treated in accordance with the Bear Canyon Mine Reclamation Plan (see Appendix 3-K of the Bear Canyon MRP).

7.2.5.2 DIVERSION STRUCTURES

A number of ditches and culverts are utilized in the mine plan area. Ditches are used to: divert "undisturbed" runoff around the disturbed area and back into natural drainage channels, collect "disturbed" runoff and convey it to the sedimentation ponds, and to convey runoff collected next to roads between culverts. Culverts are used to: transfer undisturbed runoff underneath roads and into natural drainage, carry undisturbed runoff through disturbed areas, and move disturbed

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runoff across areas of high erosion. Berms are also utilized in the mine plan area to direct water flow and separate drainage.

All existing ditches, berms, and culverts are shown on the "Surface Hydrology Map", Plate 7-1. Typical sections of berms and ditches are also shown on this plate - culvert sizes are shown on Plates 7-4.

The mine site is scheduled to be reclaimed shortly after approval of this plan. At that time, most of the existing culverts, ditches and berms are scheduled to be removed or relocated. Since the existing structures have been in place for a number of years, and since they are scheduled to be removed in the near future, no supporting calculations have been provided in this section. Rather, support calculations and design details are provided in Section 7.3 of this chapter, for all diversions and culverts projected to remain in place after reclamation. The existing structures are operational at this time, and will be maintained to remain operational until reclamation is under way.

7.3 RECLAMATION HYDROLOGY[1]

7.3.1 POST-MINING REHABILITATION

Upon completion of mining activities, the disturbed area in Trail Canyon will be reclaimed. The upper road to the portals and substation will be modified to a bermed terrace. The lowest section of the upper road will be removed and recontoured. All culverts along this road will be removed, and side drainage will

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[1]Modifications following reclamation work in 1989 can be found in Appendix 3-G, "Post Reclamation Issues."

be allowed to flow across the former road area at these crossings. The crossings will be excavated to the underlying sandstone ledge. Drainage sizes will be based on natural drainage above and below the crossing. Each of the upper road crossings will be fitted with a loose-rock check dam as shown on Plates 7-4 and detailed in figure 7.3-4. The 6 in. M.D. rip-rap is shown only for the apron of check dams. The discharge from the check dams and apron will be onto the sandstone ledge as described above.

The middle road to the coal pad area will be modified to act as a drainage ditch. Drainage from this area will flow to culvert and into Trail Creek. Runoff from the townsite and upper access road (substantial roads) will flow to Trail Creek as it did originally. All disturbed areas (except remaining roads) will be revegetated, and disturbed area diversion ditches and the sediment pond will remain until revegetation is complete. All culverts and other controls no longer needed for runoff control will be removed.

7.3.2 RESTORATION OF NATURAL CHANNELS

Upon reclamation, natural drainages will be allowed to return to their previous courses, with the exception of those which will continue to flow to the sediment pond. Erosion controls will be provided where side drainages cross reclaimed sections of the road if necessary.

7.3.3 SEDIMENTATION POND AND DIVERSION

One disturbed runoff diversion is proposed to be left in-place to collect runoff from the mine site area. This diversion will continue to direct flow from the disturbed (reclaimed) area to the sediment pond until bond release. Sizing of the diversion is shown in section 7.3.5.

The sediment pond will remain in place until bond release, or until revegetation of disturbed areas is deemed adequate. The pond is then to be removed and the diversion (TCD-1) directed to their natural drainage. Details of pond design and stability are shown in Appendix 7-A and 7-B. Existing and future pond configurations are shown on Plates 7-2 and 7-4.

Reclamation of the pond will consist of removing the pond spillway and inlet culvert. The berm along the West edge of the inlet area will then be pulled back to fill in the hole left by the culvert removal. The area will be graded as shown on Plate 7-4D to allow runoff from this area to flow toward the reclaimed pond area and eventually to Trail Creek and/or the Highway 31 drainage. Material in the West and South bank of the pond will be excavated and used to fill the cuts along the North end of the pond and the toe of the slope along the East edge of the Pond. Care will be taken to protect the existing vegetation in the bottom of the pond, where no regrading will occur. Where possible, the existing surface topsoil containing vegetation, will be stripped separately and used as topsoil on the fill slopes. The subsoil of the fill slopes will be compacted using a backhoe by tamping with the bucket and/or driving on the slope. The top 2 feet of the slopes will not be compacted, in order to enhance vegetation growth. Final contours are shown on Plate 3-2D. The maximum constructed slope will be 1V:2H, allowing for a minimum safety factor of 3.18 assuming saturated conditions (See Appendix 7-B for slope stability analysis). Contour furrowing as described in Appendix 7-G will be used on the slopes to aid in erosion control and enhance vegetative growth. Any large boulders encountered will be placed on the surface of the slopes for added roughness.

A silt fence will be placed on the West and South sides (downslope side) of the area prior to any reclamation (Plate 7-4D). The silt fence will be maintained during and after reclamation of the pond, until final bond release.

After the area has been regraded, the entire area will be reseeded using the final reclamation seed mix shown in Table 9.5-3.

SEDIMENT POND INLET PROTECTION PLAN

The Sediment Pond Inlet and Ditch are to be rebuilt during final reclamation of the site; however the following interim measures are proposed to ensure proper operation of the disturbed area conveyance ditch and inlet structure.

General - The inlet structure to the sediment pond is shown in Figure A. All coal on the east bank of Section A will be removed, and the ditch will be rip-rapped according to the final reclamation plan. Section B is a moderately sloping, revegetated area with little evidence of erosion and will remain as-is until final reclamation. Section C is a slightly steeper sloping area leading into the pond. This area shows signs of erosion and consists of a deep ditch with nearly vertical side slopes and a rubble bottom. A 170 ft. by 30 in. cmp culvert will be installed in Section C as described in the following section.

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Culvert - Culvert sizing calculations are shown on the attached Table A. Projected flows were taken from post-mining ditch TCD-1, Table 7.3-3. Ditch slopes were surveyed in the field, and are shown on the longitudinal profile in attached Figure B. A section view of the culvert installation is shown on attached Figure C, and a typical trash rack is shown in Figure D. The culvert will be installed in the existing ditch over a bedding of at least 3 in. of -3/4 in. of gravel. The culvert will be covered with material from the ditch and surrounding berms. An 18 in. berm will be left on the west side of the covered culvert to ensure that runoff from the small disturbed area east of the culvert is conveyed to the pond.

A minimum of 15 in. D_{50} rip-rap will be placed over a -3/4 in. gravel bed with a minimum depth of 18 in. A trash rack will be placed at the inlet of the culvert. A rock headwall will be placed at the culvert inlet to provide a minimum of 24 in. protection above the pipe. The headwall will either be grouted or consist of a minimum 15 in. diameter, hand placed rocks.

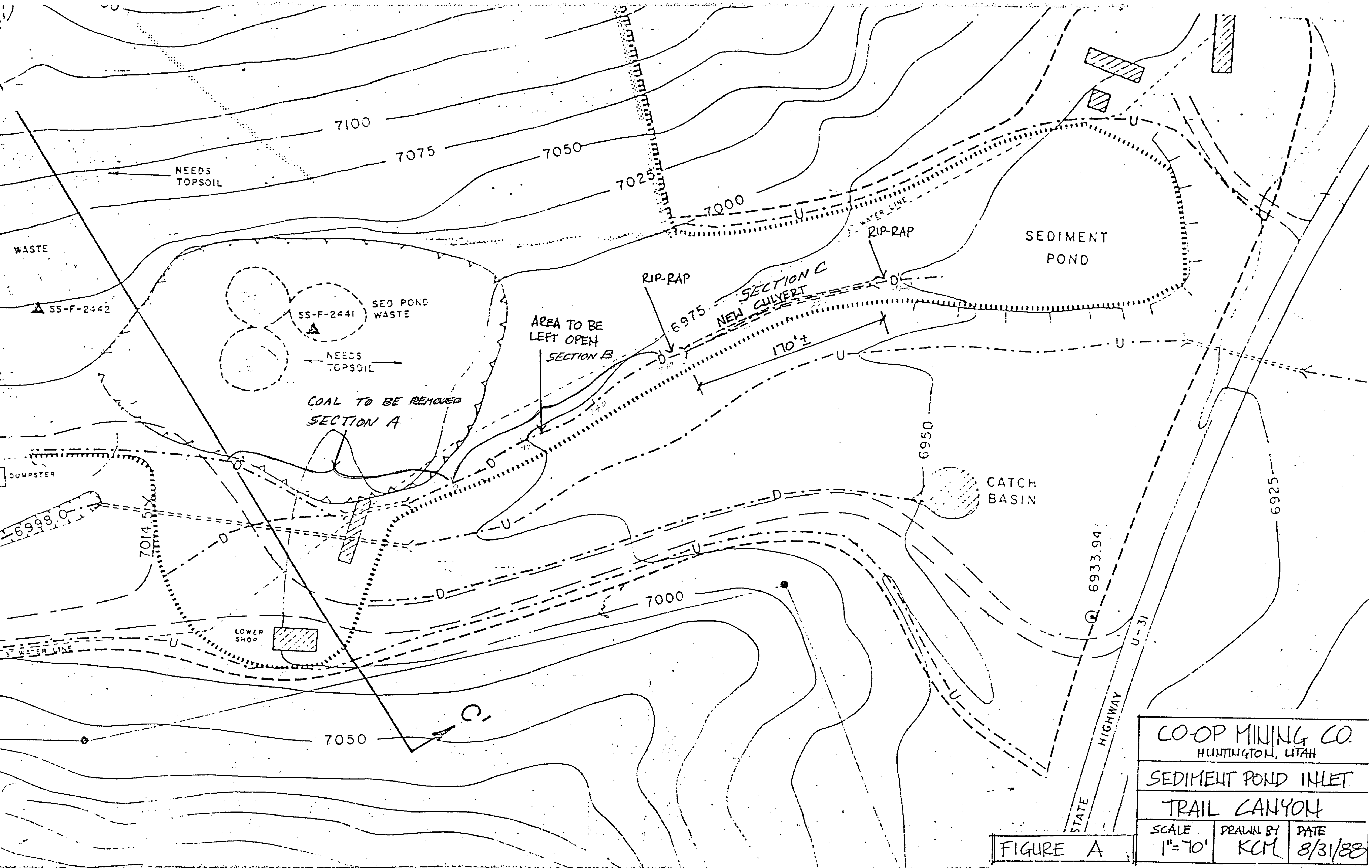
Reclamation - The reclamation plan for this area is shown on Plate 7-4D and described in Section 7.3.3 of the mine plan. The culvert is to be removed, and the ditch reconstructed and rip-rapped as proposed in the mine plan (Plate 7-4D, ditch TCD-1).

TABLE A

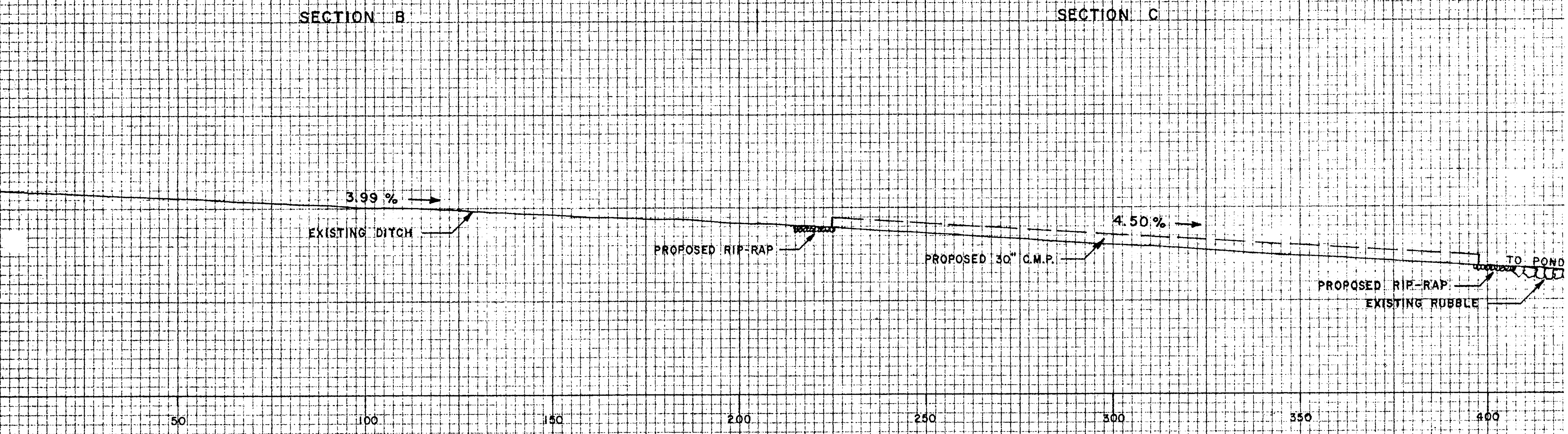
SEDIMENT POND INLET
CULVERT SIZING CALCULATIONS

Culvert	Sediment Pond Inlet
*Drainage Areas	B, H, K1, K2, J, 1/2L
*Q10 Flow (cfs)	24.27
Velocity (fps)	10.08
**Rip-rap (m.d.)	15 in.
Slope (%)	4.50
Diameter	30 in.
***Required Headwater	34.5 in.
Available Headwater	54 in.

Notes;
* From Table 7.3-1
** From Table 7.3-1
*** From Table 7.3-1


7100
7075
7050
7025
7000
6975
6950
6925
6933.94
6998.0
7014.5
NEEDS TOPSOIL
WASTE
SS-F-2442
SS-F-2441
SED POND WASTE
NEEDS TOPSOIL
COAL TO BE REMOVED
SECTION A
AREA TO BE LEFT OPEN
SECTION B
RIP-RAP
RIP-RAP
SECTION C
NEW CULVERT
170' ±
WATER LINE
SEDIMENT POND
CATCH BASIN
DUMPSTER
LOWER SHOP
WATER LINE
C'
STATE HIGHWAY
U-31
CO-OP MINING CO.
HUNTINGTON, UTAH
SEDIMENT POND INLET
TRAIL CANYON
SCALE 1"=70'
DRAWN BY KCM
DATE 8/31/88
FIGURE A

10/14/88



SCALE: 1"=25'

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DAN W. GUY
10/5/88
STATE OF UTAH

CO-OP MINING CO
TRAIL CANYON
SED. POND INLET
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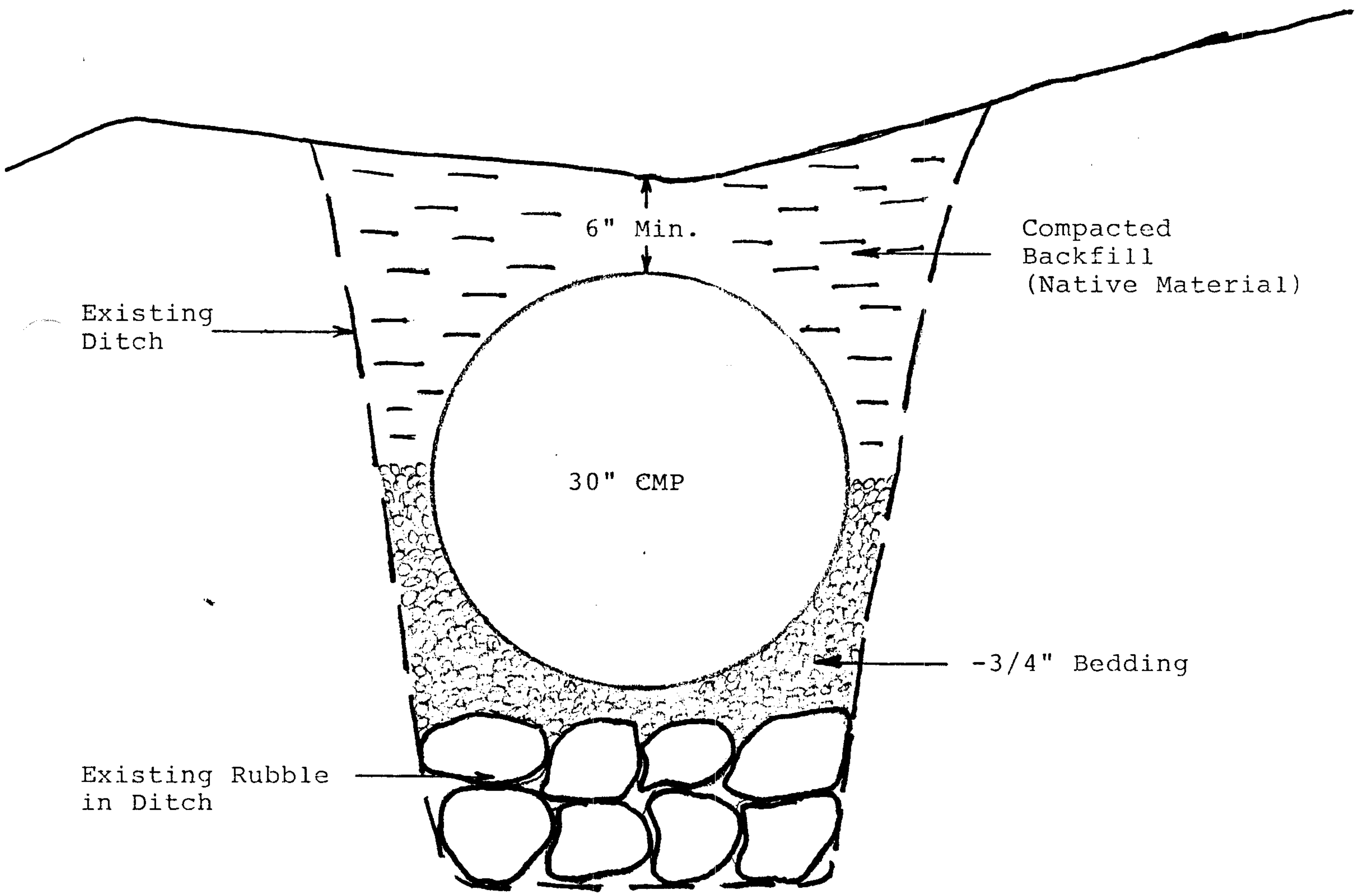
Figure C

Sediment Pond Inlet
Culvert Installation

Scale: 1"=1'

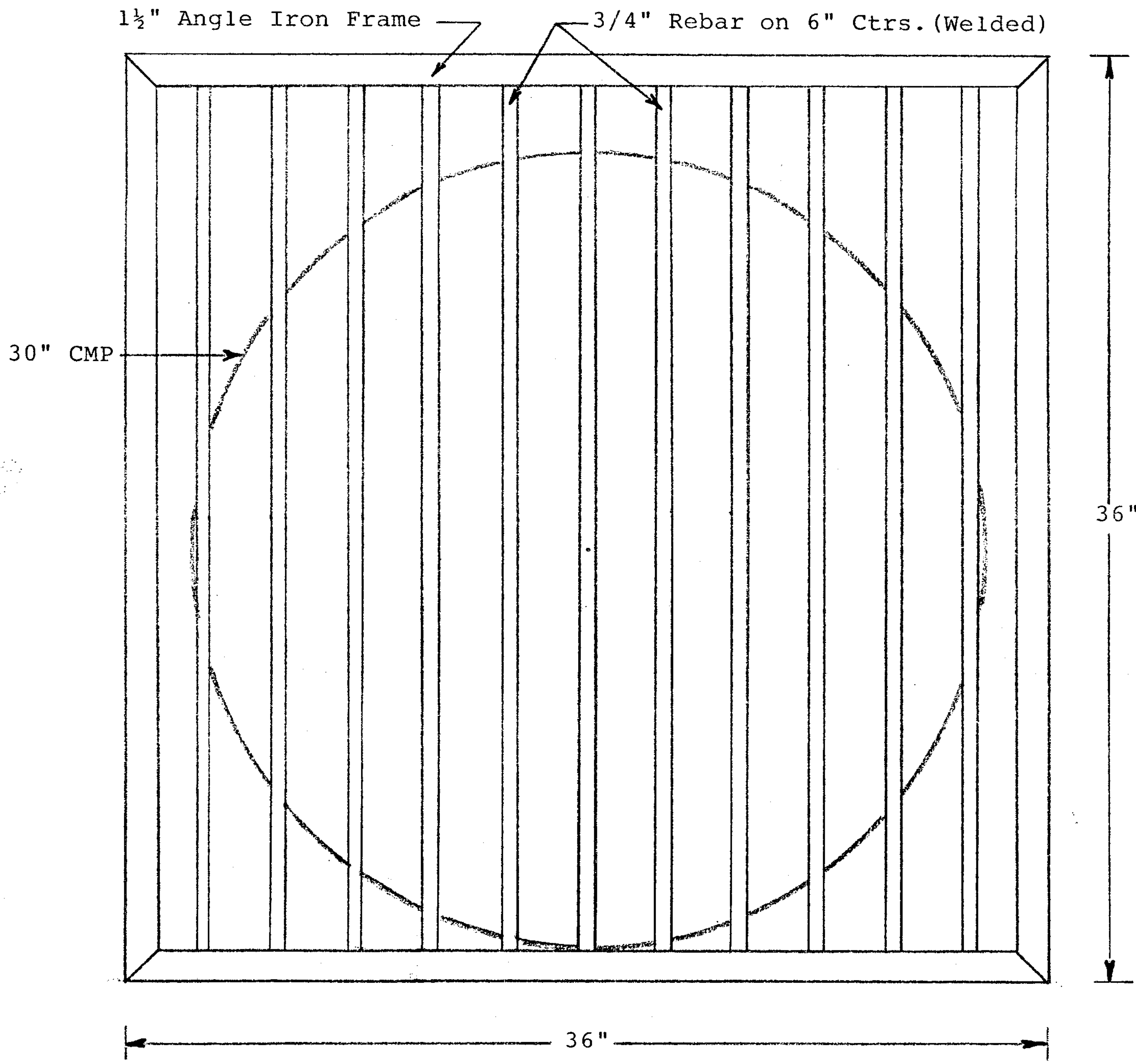


View Looking Upstream

Figure D

Trash Rack

Scale: 1"=1/2'



Note: Trash Rack is spot-welded or bolted to culvert. 10/31/88

7.3.4 Post Mining Culvert Design

The following culverts/structures are projected to remain in place after reclamation and until bond release.

TCC-4	54" x 220' CMP at the lower road crossing of Trail Creek
TCC-6	24" x 60' CMP at the end of Ditch TCD-4

The culverts are designed to carry the expected runoff from a 50 yr-24 hr. storm. This 50 yr design has been agreed to during on-site and subsequent discussions with DOGM and Co-Op. Calculations and culvert sizing is shown on Tables 7.3-2 and Figure 7.3-1. The location of each of the culverts are shown on the "Post-Mining Hydrology" maps, Plates 7-4.

Culvert TCC-4 exists in Trail Creek at the South end of the Residential Exclusion area and extends underneath a portion of the lower pad area. This culvert is to remain in place in order to maintain the stability of the access road and the Trail Creek crossing into the Residential Area as shown on Plate 7-4C. Culvert TCC-6 is placed at the outlet of TCD-4, and conveys runoff from BTCA Area 3 across the residential road to Trail Creek as shown on Plate 7-4B.

A temporary culvert not listed above will be installed at the end of TCD-1 where it flows off the lower pad during the winter of 1989/90. The designs for this culvert are shown in Table A and described in Section 7.3.3.

COPD has committed to maintain the culverts and ditches (Appendix 3-B) within the Trail Canyon Residential Exclusion area, which are adequately sized to pass expected flows up to the 50 yr-24 hr event. Since these structures are in the exclusion area and do not directly serve drainage control for the bonded areas, designs are not included in this plan.

7.3.5 POST MINING DIVERSION DESIGN

Two disturbed diversions (TCD-1 and TCD-2) are projected to remain in place after reclamation to direct runoff to the sediment pond. When the sediment pond is removed, TCD-1 will be extended and rip-rapped to Trail Creek (Plates 7-4). The diversion structure (TCD-4) coming down from the middle pad will also remain in place. These diversions will be maintained in place until bond release. Diversions within the residential exclusion area are maintained by C.O.P. Coal Development Company (Appendix 3-B) with the exception of TCD-2, which extends into the bottom of the residential area.

The location of each of these diversion structures is shown on Plates 7-4. TCD-4 is shown on Figure 7.3-6. See Tables 7.3-2 and 7.3-3 for culvert sizing and ditch sizing and rip-rap.

Diversion TCD-1 is located near the base of the side slope along the east edge of the road and lower pad recreation area. Erosion will be minimized with the installation of 9 in. M.D. rip-rap as required in Table 7.3-3. Diversion TCD-2 does not indicate any erosive flow, and therefore, will not be rip-rapped. The undisturbed diversions along the main road are within the residential exclusion area (no liability) and will not be rip-rapped. These diversion structures only carry undisturbed and road drainage.

The undisturbed drainage along the west side of the road (TCU-1) will flow directly to the highway drainage as shown on Plate 7-4D. The small catch basin on the east side of the access road at the southern end of the property will be removed and the undisturbed drainage extended to Trail Creek (TCU-2). There will be no ditch maintained along the east side of the access road adjacent to BTCA Area 7; however, any drainage from this area will flow onto the reclaimed picnic area or into the Highway 31 drainage. Drainage from the picnic area is described in Appendix 7-G (BTCA Area "7").

MIDDLE TO LOWER PAD DRAINAGE

An access road presently exists leading from the lower (residential area) to the middle pad. This road is shown as the lower boundary of drainage areas "H" and "I" on Plates 7-4. The road will be modified to create a wide, moderately sloped ditch to convey drainage from the middle pad to the lower level.

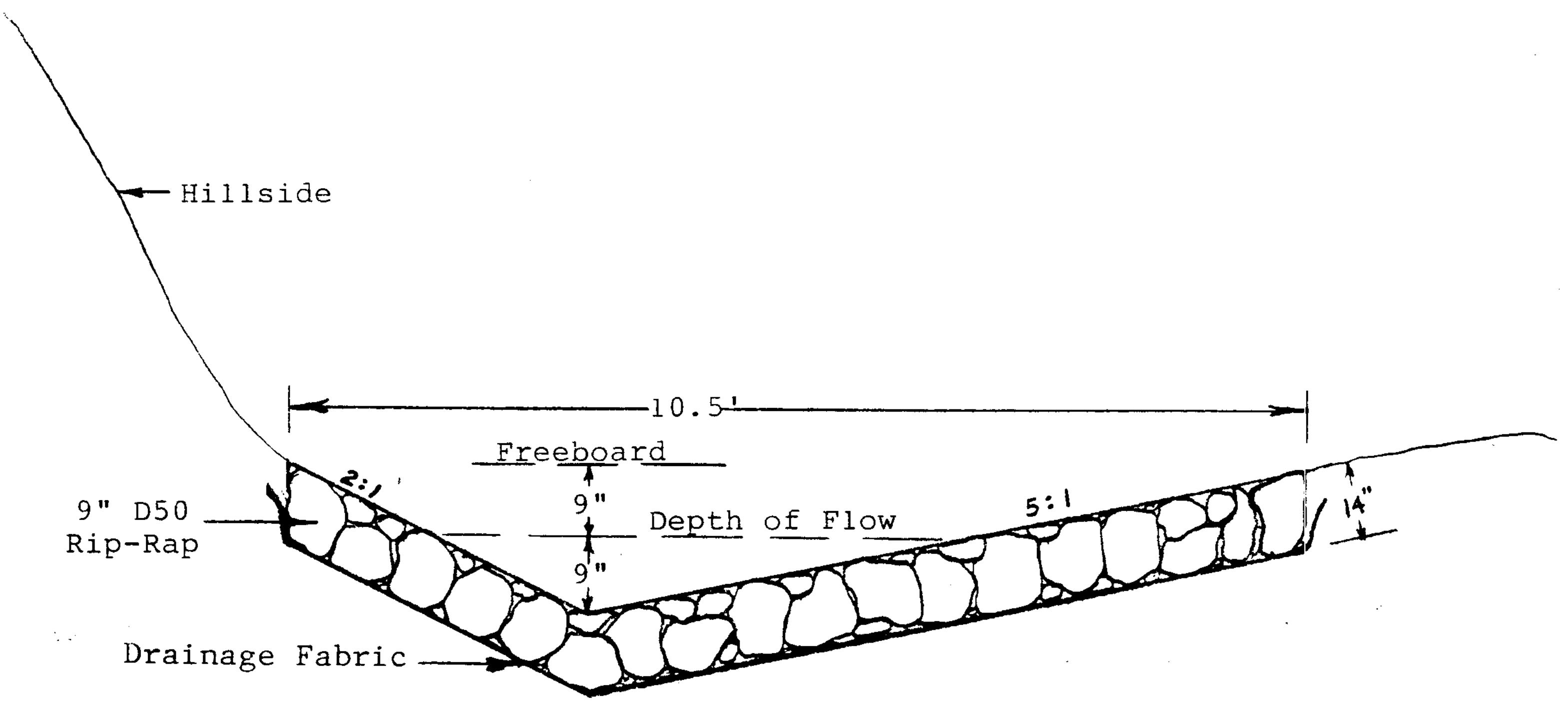
The middle pad will be sloped and a 36 in. high earthen berm will be placed to direct drainage into the ditch, as shown on plate 7-4C. A Sediment trap (Figure 7.3-8) and a loose-rock check dam will be placed on the middle pad to act as energy dissipators from drainage above. The reclaimed ditch will have a maximum slope of 10.2 pct with an avg. slope of 6.5 pct. The ditch (TCD-4) is sized to carry a 100 yr - 24 hr event from the drainage area which is consistent with storm design for other permanent structures at the site. Due to the potentially erosive velocities, the channel will be rip-rapped with 9 in. D_{50} rock, overlying a drainage fabric, where there is no bedrock for erosion protection. Rip-rapping is sized according to Figure 7.3-2. Six loose-rock check dams will be placed at approx 100 ft o.c., along the bedrock channel bed length (Plate 7-4C, Figure 7.3-9).

The overall drainage plan is shown on Plates 7-4. The ditch (Figure 7.3-6) will discharge into a 24 in, culvert (TCC-6, Figure 7.3-7), which will in turn discharge onto the bedrock/9 in. D_{50} rip-rapped area and then into Trail Creek. An energy dissipator basin approx 25 ft square will be installed at the bottom of ditch TCD-4 at the inlet to the culvert TCC-6. The culvert will be fitted with a trash rack consisting of 3/4 in. rebar on approx 4 in. centers (Figure 7.3-7). The ditch design is shown on Table 7.3-3 and culvert design on Table 7.3-2.

Figure 7.3-6

Proposed Ditch TCD-4

Scale: 1"=2'



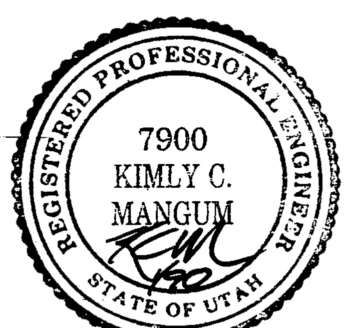


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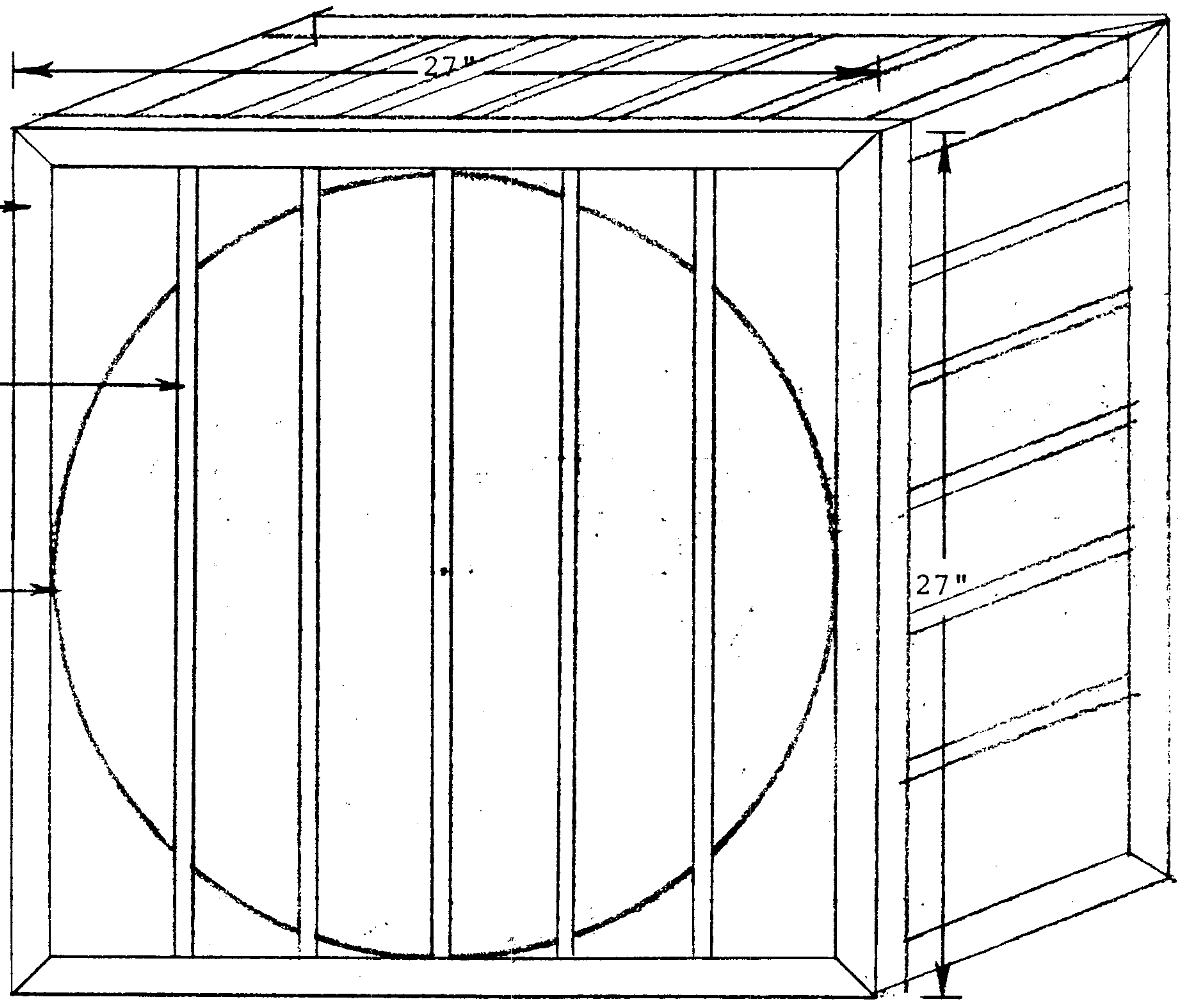
Figure 7.3-7

Trash Rack for TCC-6

Scale: 1"=1/2' APPROX



Note: Trash Rack is spot-welded or bolted to culvert.

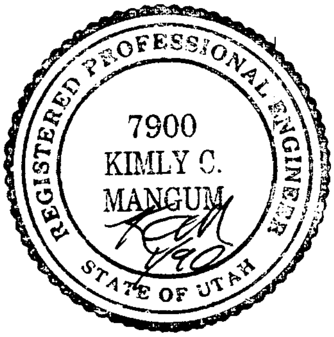


Figure 7.5-8
Middle to Lower Pad Drainage
/ SEDIMENT TRAP

Scale: 1"=4'

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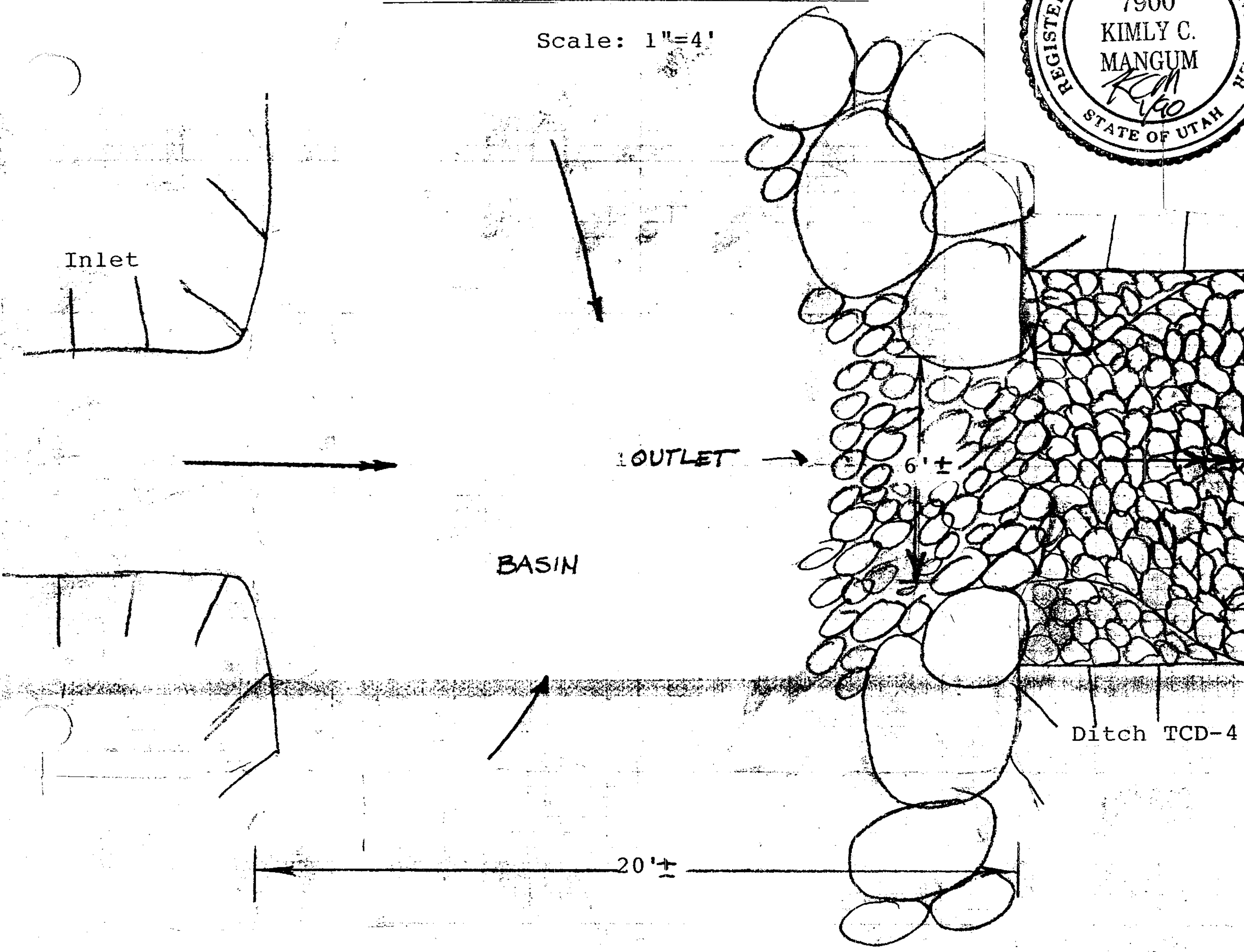
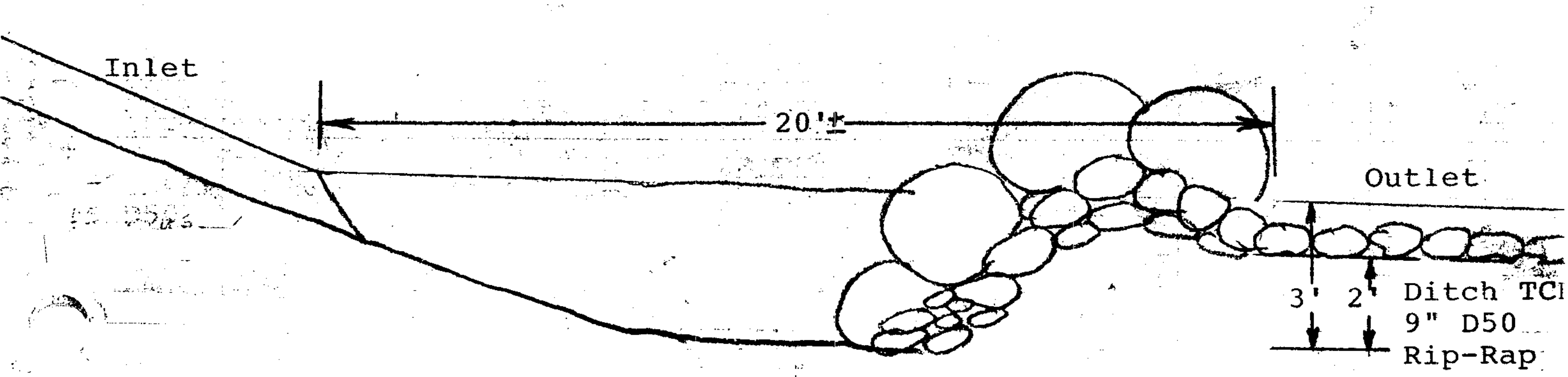


TOP VIEW



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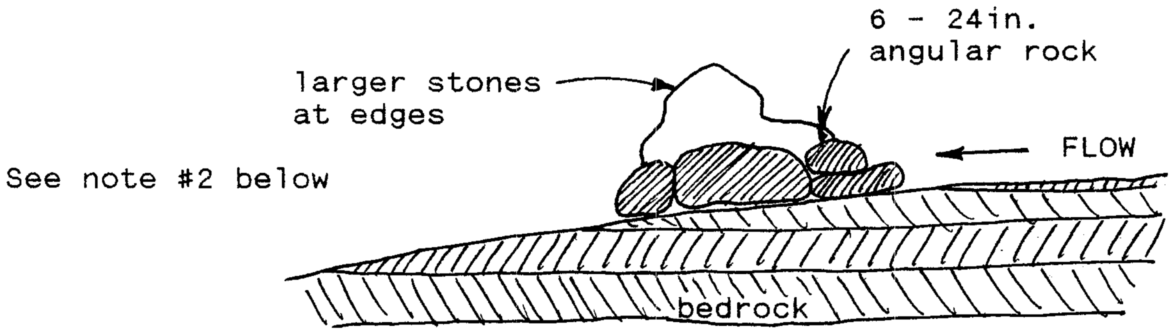
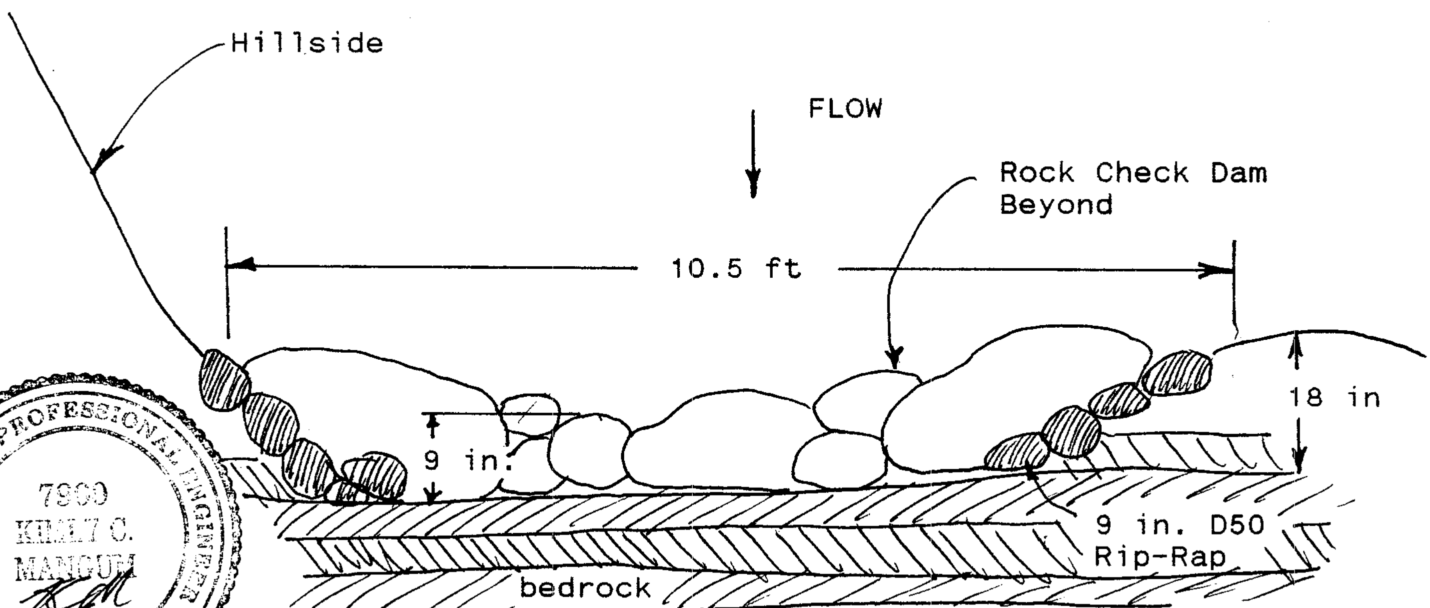
SIDE VIEW



CROSS SECTION OF ROCK CHECK DAM/
SEDIMENT CONTROL STRUCTURE



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KIMLY C.
MANGUM
STATE OF UTAH

CROSS SECTION OF DITCH

Scale: 1 in. = 2 ft

Note:
1. Reference Figure 7.3-6.
2. A 10 ft long apron shall be installed below the check dam where no bedrock exists. Apron shall be made of 9 in. D50 rip-rap over a fabric filter blanket.

Figure 7.3-9 Proposed Ditch TCD-4, Rock Check Dams

Calculations for runoff to the diversions are based on the areas and flows from Table 7.3-1. Design criteria and adequacy for the diversions are shown in Table 7.3-3.

7.3.6 RIP-RAP LOCATION AND SIZING

Rip-rap will be required at the following locations:

1. Outlet of Culvert TCC-4 - 18 in med. diam.
2. Outlet of Culvert TCC-6 - 9 in. med. diam.
3. Portions of Ditch TCD-1 - 9 in. med. diam.
4. Reclaimed Ditch TCD-4 - 9 in. med. diam.
5. Channels on slope above TCD-1 - 4 in. med. diam.

Rip-rap will be well graded, with the majority of the stones of the median diameter as shown. The material will be of a solid, non-slaking angular rock. Typical rip-rap will be placed on a bedding of a filter blanket or a bed of graded gravel 1.5 times the diameter of the median size stone.

The rip-rap sizes are taken from the chart on Figure 7.3-2, using the velocities given in Table 7.3-2 and 7.3-3. The chart is based on spherical stone diameters. The use of angular material will provide even greater resistance to movement and thus increase the effectiveness of the control.

APRON DIMENSIONS ON CULVERTS

The aprons to be placed at TCC-4 are based on actual, velocities, site conditions and proven performance. The in place culvert apron area will be improved by adding rip-rap for approx 20 ft down steam. The only disturbance anticipated during reclamation to the areas associated with culvert TCC-4 will be the addition of rip-rap, which will be done by hand and will improve stability during heavy runoff events. The 18" rip-rap which has become established in the stream bed since installation of the culvert will not be disturbed.

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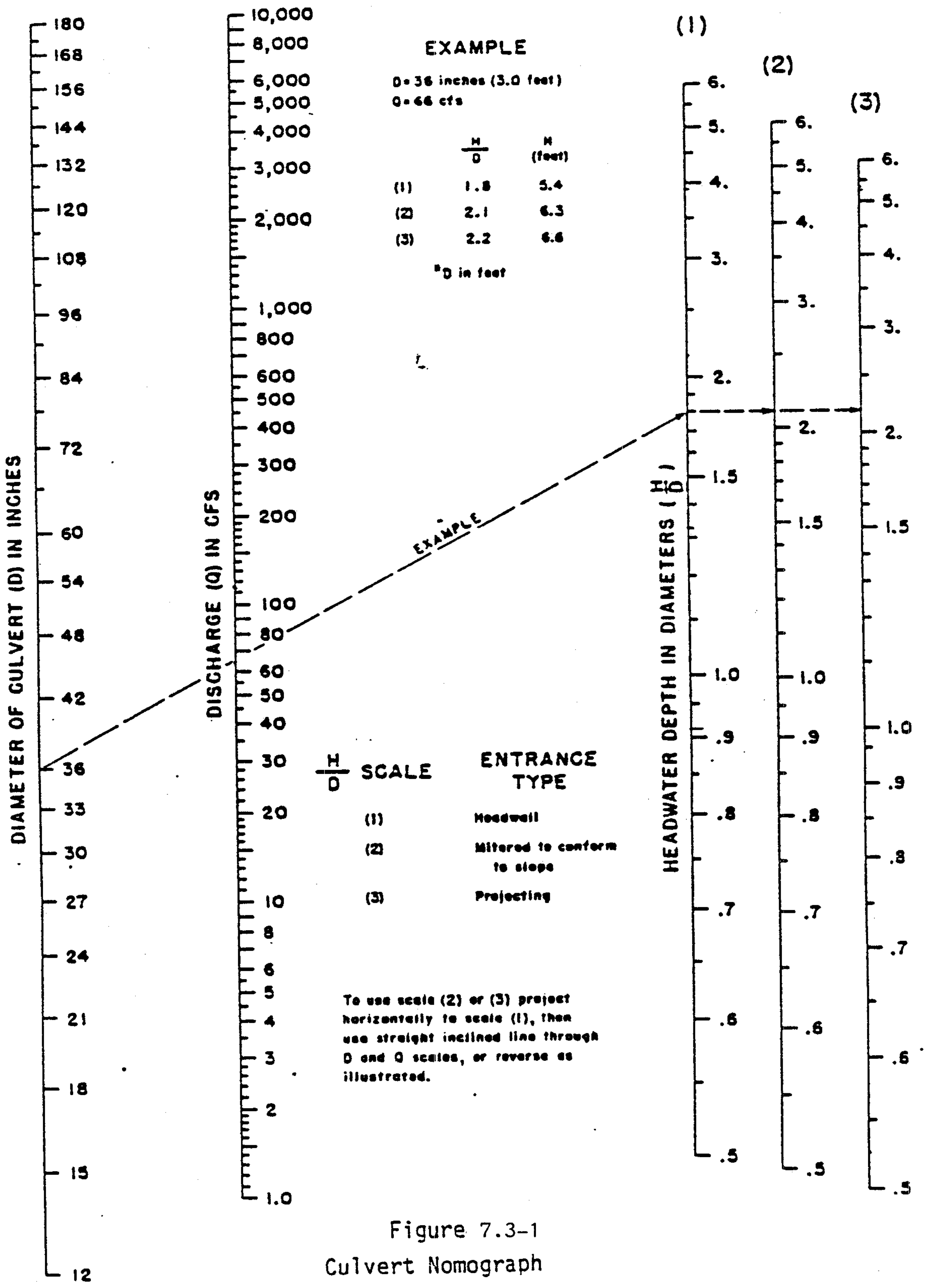

Figure 7.3-1

Culvert Nomograph

Headwater depth for corrugated-metal pipe culverts with entrance control. (U.S. Bureau of Public Roads.) 288-D-2909.

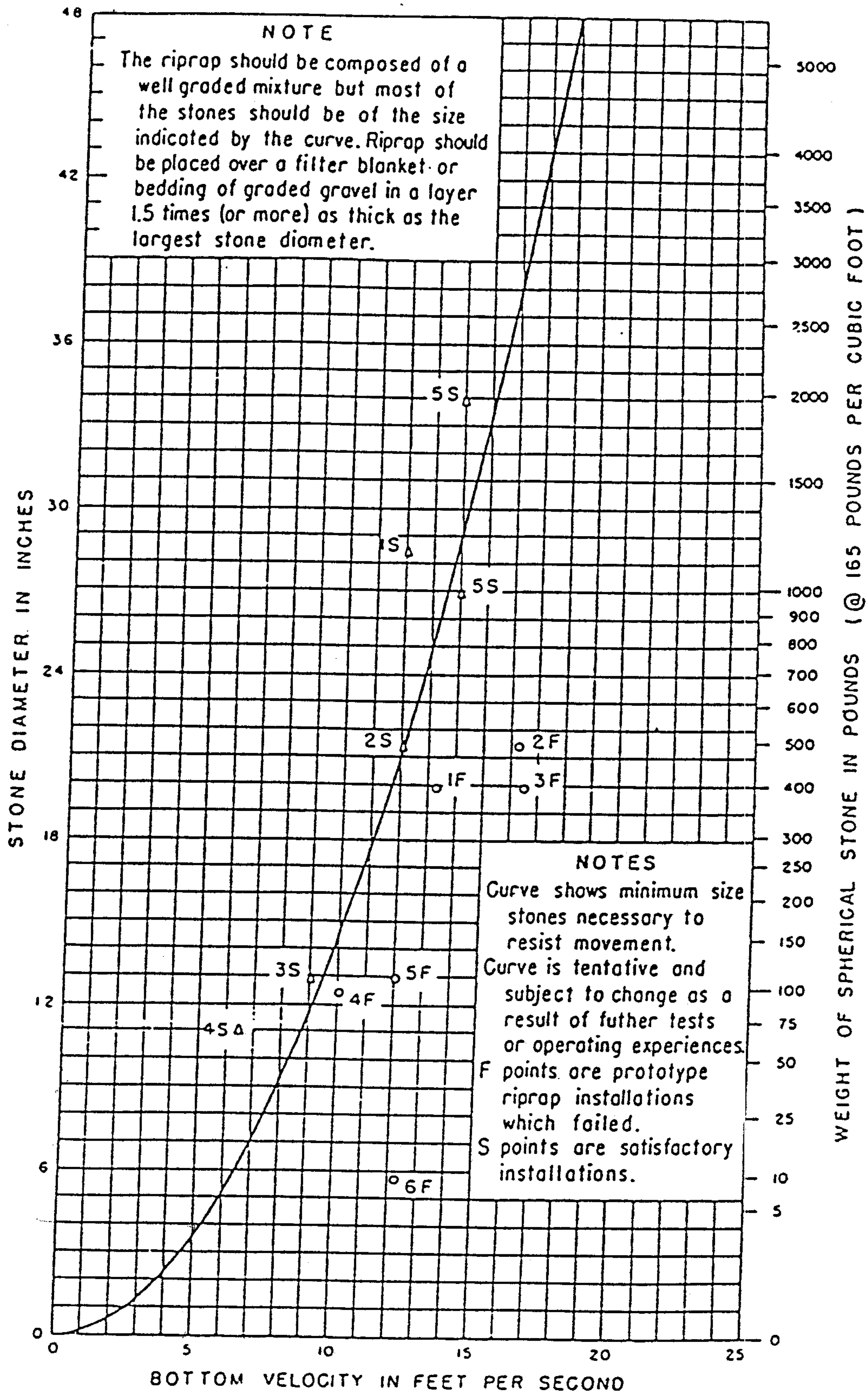

FIGURE 165.—*Curve to determine maximum stone size in riprap mixture.*

From: Peterka, A.J., "Hydraulic Design of Stilling Basins and Energy Dissipators", U.S. Bureau of Reclamation, Engineering Monograph No. 25.

-Figure 7.3-2

BY KCM DATE 8/89 SUBJECT Typical Culvert Headwall and Trash Rack SHEET NO. .... OF........

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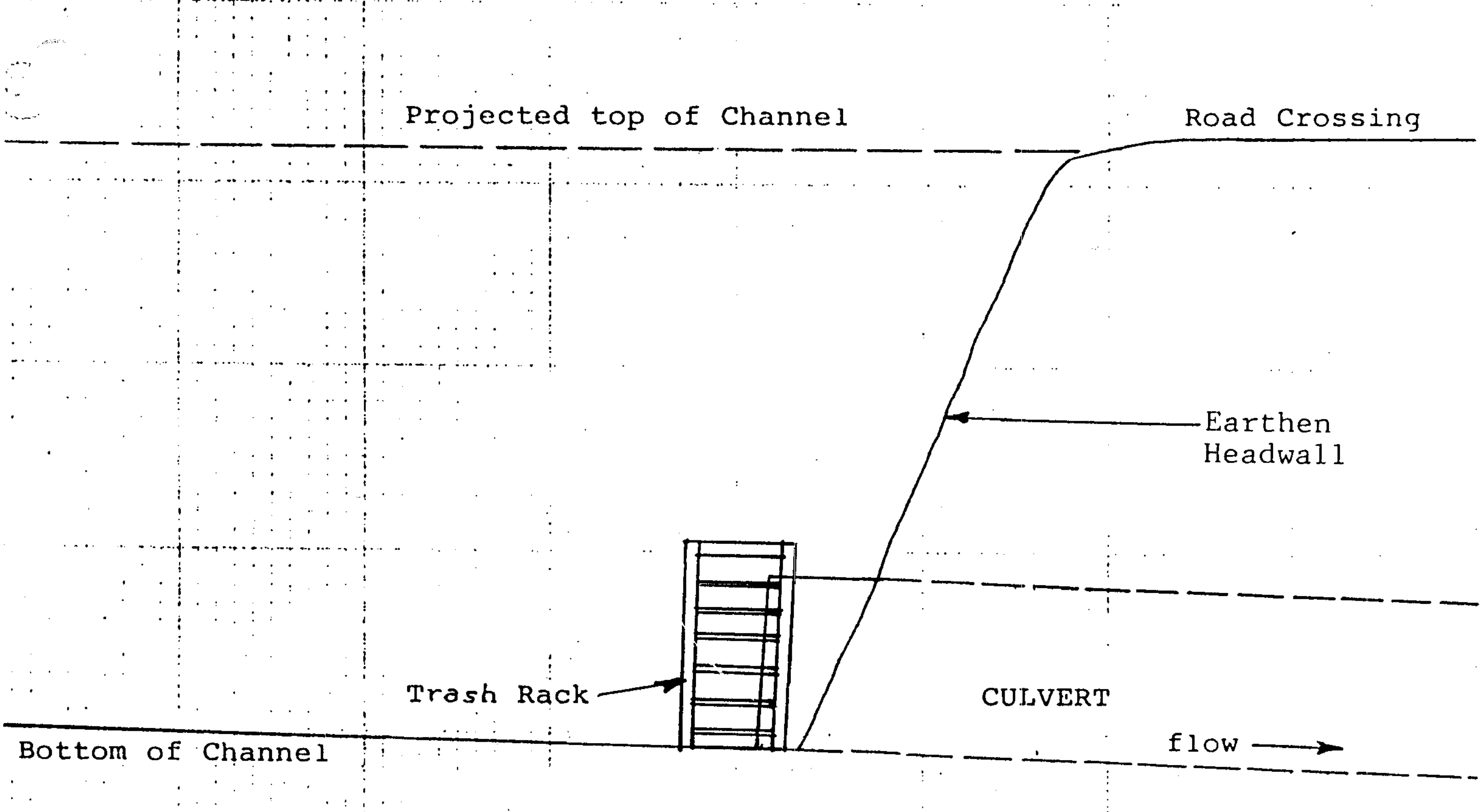
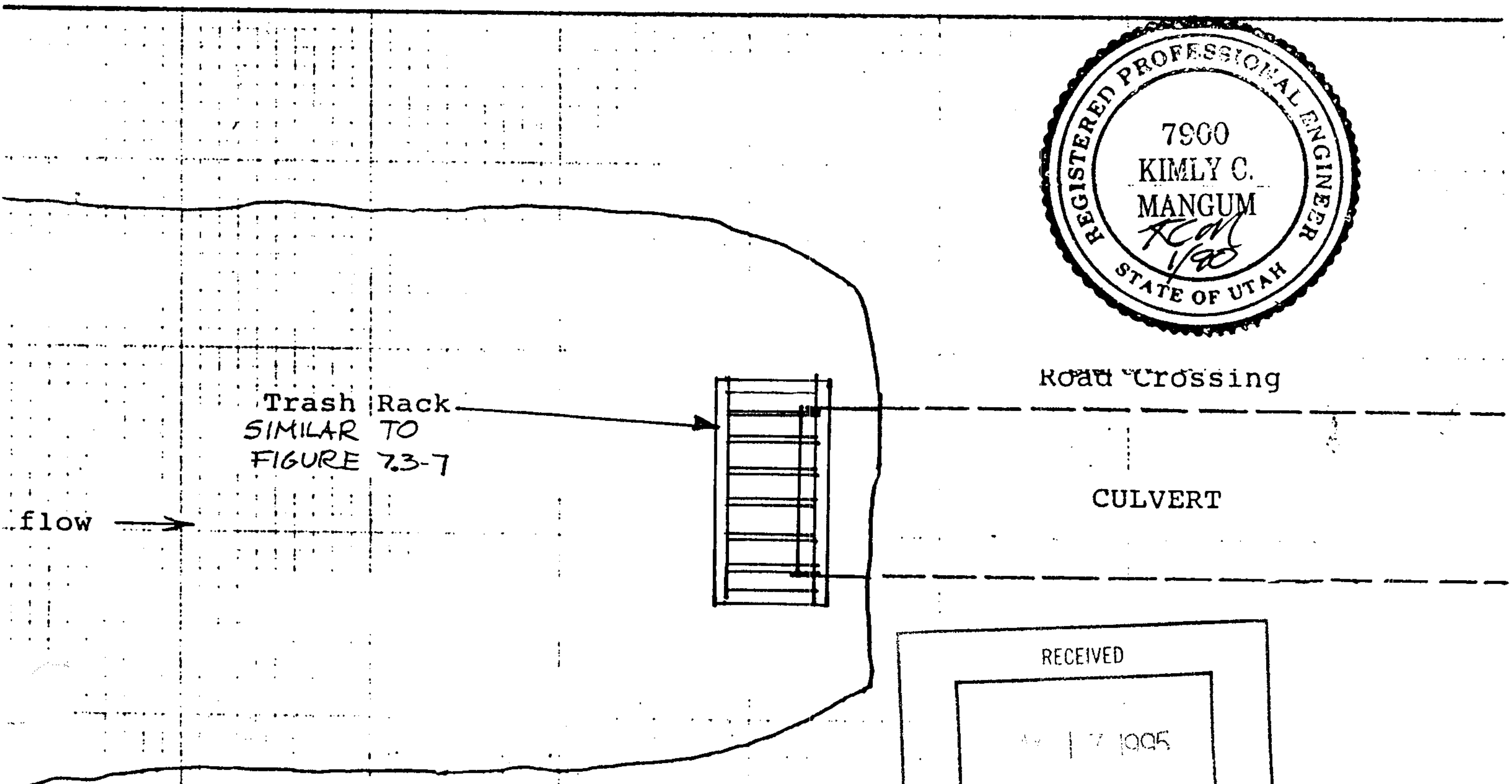
SCALE: 1"=5'



SECTION VIEW



PLAN VIEW
Fig. 7.3-3

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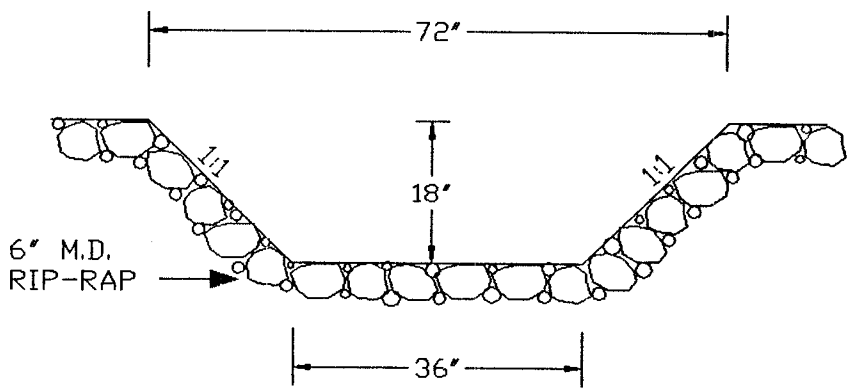
FIGURE 7.3-4

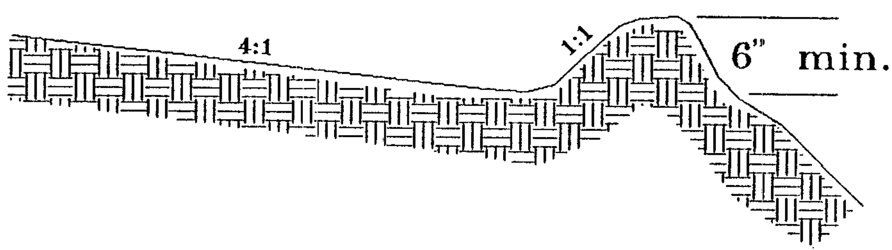
Upper Road Ephemeral Drainage Crossing



TYPICAL SECTION
SCALE: 1" = 2'

FIGURE 7.3-5

"Picnic Area" Berm Design



NOTE: Minimum height of 6" allows a minimum freeboard of 3.5". Design based on SCS Type II Distribution and runoff of 0.07 acre ft for a conservative flow of 0.5 cfs and a slope of 0.07 ft/ft.

Scale: 1" = 2'

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by TM 97D date 1/5/93

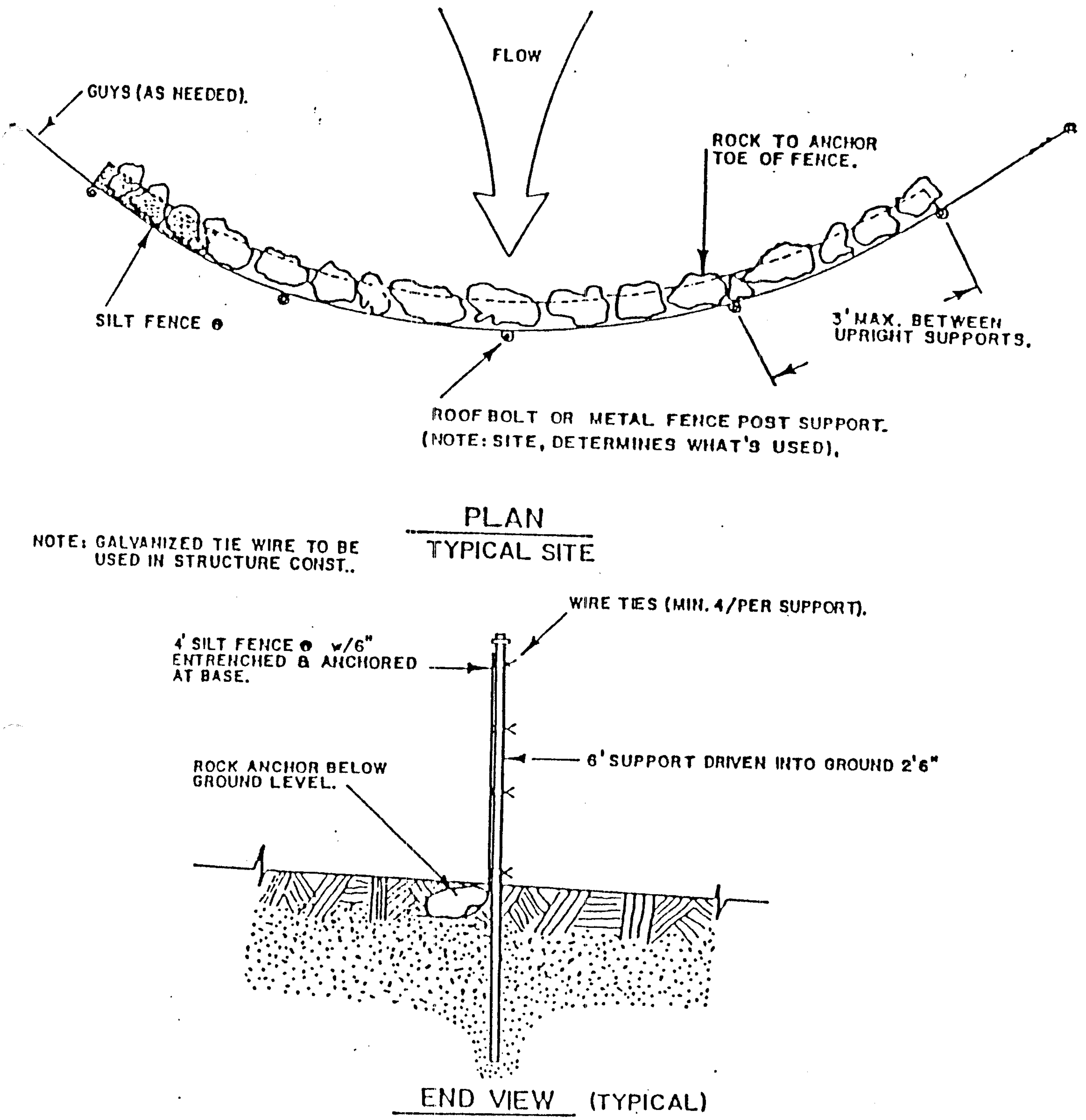

FIGURE 7.3-5A Typical Silt Fence Installation

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11/01/92
TM 920 date 1/5/93

TABLE 7.3-1

DRAINAGE AREAS FOR POST MINING HYDROLOGY

Area	A	B	C_1	C_2	D	E	F	G
Acres	11.48	4.32	23.05	37.65	12.30	~~196,151~~ → ×640 = 2880.	8.35	6.01
Sq. Miles	.018	.007	.036	.060	.019	4.50	.013	.009
Hyd. Length (ft.)	2004	957	1973	2446	1738	16,143	459	810
Slope (%)	62.5	65.6	58.9	70.4	73.6	13.4	44.1	32.5
S	6.67	6.67	6.67	6.67	6.67	6.67	6.67	1.63
t_L (hrs)	.121	.066	.124	.134	.100	1.391	.044	.039
t_c (hrs)	.202	.109	.206	.224	.166	2.32	.074	.064
qp' (CSM)	800	960	780	760	850	170	1000	1000
*Q_{10} (in.)	.10	.10	.10	.10	.10	.10	.10	1.05
**Q_{50} (in.)	.29	.29	.29	.29	.29	.29	.29	1.50
***Q_{100} (in.)	.40	.40	.40	.40	.40	.40	.40	1.80
*q_{p10} (cfs)	1.44	0.67	2.81	4.56	1.62	76.50	1.30	9.45
**q_{p50} (cfs)	4.18	1.95	8.14	13.22	4.68	221.85	3.77	13.50
***q_{p100} (cfs)	5.76	2.68	11.24	18.24	6.48	306.00	5.20	16.20

* Calculated runoff and peak flow for 10 yr.-24 hr. storm.

** Calculated runoff and peak flow for 50 yr.-24 hr. storm.

*** Calculated runoff and peak flow for 100 yr.-24 hr. storm.

12/12/86

10/31/88

TABLE 7.[illegible]-1(cont.)

Area	H	I	J	K_1	K_2	L	M	N
Acres	5.78	1.07	3.00	3.04	3.33	3.62	48.21	0.46
Sq. Miles	.009	.002	.005	.005	.005	.006	.075	0.001
Hyd. Length	397	398	559	199	379	910	981	1000
Sloped	86.7	54.3	74.8	54.3	41.4	41.7	71.0	8.00
S	1.63	1.63	1.63	1.63	1.63	1.63	6.67	1.63
t_L (hrs)	.013	.017	.019	.010	.019	.037	.064	.090
t_c (hrs)	.022	.028	.032	.016	.031	.062	.107	.153
q_p (csm)	1000	1000	1000	1000	1000	1000	960	875
*Q_{10}(in.)	1.05	1.05	0.10	1.05	1.05	1.05	0.10	1.05
**Q_{50} (in.)	1.50	1.50	0.29	1.50	1.50	1.50	0.29	1.50
***Q_{100} (in.)	1.80	1.80	0.40	1.80	1.80	1.80	0.40	1.80
*qp_{10}(cfs)	9.45	2.10	0.50	5.25	5.25	6.30	7.20	0.92
qp_{50}(cfs)	13.50	3.00	1.45	7.50	7.50	9.00	20.88	1.31
qp_{100}(cfs)	~~[illegible]~~ 16.20	3.60	2.00	9.00	9.00	10.80	28.80	1.58

* Runoff and peak flow for 10 yr.-24 hr. storm.

** Runoff and peak flow for 50 yr.-24 hr. storm.

Based on 10 yr.-24 hr. event of 2.25", 50 yr.-24 hr. event of 2.90", and 100 yr.-24 hr. event of 3.18". Runoff curve no. 60 for undisturbed land and 86 for disturbed. Taken from Figure 2.26, p. 85, "Applied Hydrology and Sedimentology for Disturbed Areas", 1983, Barfield, Warner & Haan. Peak flow calculated using SCS-TR55 Method from same reference, Figure 2.40, p. 115.

10/31/88

TABLE 7.3-2

Post-Mining Culvert Sizing

50 yr - 24 hr Event

Culvert	TCC-4	TCC-6
Dr. Areas	A,B,C,D, E,F,G,H,I	A,B,H,I, L/2
Flow (cfs)	287.79	27.13
Velocity (fps)	16.67	7.68
Rip-rap (m.d.)	38 in.**	9 in.
Slope (%)	8.5	10.20
Diameter	54 in.	42 in.
Required Headwater	156 in.	26 in.
Available Headwater	238 in.	42 in.

Note: * Existing earthen headwall will remain for Culvert TCC-4. Headwalls to culvert TCC-6 will be rip-rapped.

** Existing 18" riprap, originally sized for the 10 yr. 24 hr. Event, will not be disturbed (See section 7.3.6).

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Table 7.3-2A

SPECIAL PROVISIONS - TECHNICAL

SECTION 611 (CONT.)

RIPRAP GRADATIONS

Riprap Designation	% Smaller Than Given Size By Weight	Intermediate Rock Dimension (Inches)	Mean Rock Diameter D_{50} (Inches)
Type V	70-100	8	
	50-70	6	
	35-50	4	4
	2-10	2	
Type VL	70-100	12	
	50-70	9	
	35-50	6	6
	2-10	2	
Type L	70-100	14	
	50-70	12	
	35-50	9	9
	2-10	3	
Type M	70-100	21	
	50-70	18	
	35-50	12	12
	2-10	4	
Type H	70-100	30	
	50-70	24	
	35-50	18	18
	2-10	6	
Type VH	100	30	
	50-70	27	
	35-50	24	24
	2-10	9	

Source: Denver Design Manual

TABLE 7.3-3

<u>Summary of Post-Mining Ditch Sizes</u>

Ditch	TCD-1*	TCD-2**	TCD-4
Drainage Areas	J,K1,K2,L	K2	A,B,H,I,L/2
Flow (cfs)	17.30	5.25	27.13**
Velocity (fps)	7.76	3.69	7.68
Rip-rap (m.d.)	9 in.	Soil	9 in.
Slope (%)	7.5	2	10.2
Depth of Ditch (ft)	2.50	1.5	1.50
Depth of Flow (ft)	2.00	1.19	0.75
Manning's N	0.032	0.032	0.032
Bottom Width (ft)	0.01	0.00	0.01
X-Sectional Area (ft^2)	3.26	1.42	1.96
Wetted Perimeter (ft)	5.10	3.37	5.75
Hydraulic Radius (ft)	0.63		0.37

Based on a triangular ditch with 1:1 slope sides. See Plates 7-4 for location of rip-rap.

Note: * Flow from TCD-2 will be directed along road thru residential area, and into TCD-1. Flow shown collects along ditch and only reaches the amount shown near the end on the lower pad. Rip-rap shown will be placed on slopes greater than 7.5 pct on the lower pad.

** Calculations for TCD-2 performed by "FlowMaster", version 3.3, 1991, Haestad Methods, Inc., and are shown on page 7-51A.

Reference: "Applied Hydrology and Sedimentology," 1983, Barfield, Warner & Haan, Oklahoma Technical Press. Also Technical Deficiency Document, 9 April.

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: TCD-2

Comment: DITCH DESIGN

Solve For Depth

Given Input Data:

Bottom Width.....	0.00 ft
Left Side Slope..	1.00:1 (H:V)
Right Side Slope.	1.00:1 (H:V)
Manning's n......	0.032
Channel Slope....	0.0200 ft/ft
Discharge........	5.25 cfs

Computed Results:

Depth............	1.19 ft
Velocity.........	3.69 fps
Flow Area........	1.42 sf
Flow Top Width...	2.38 ft
Wetted Perimeter.	3.37 ft
Critical Depth...	1.11 ft
Critical Slope...	0.0288 ft/ft
Froude Number....	0.84 (flow is Subcritical)

Open Channel Flow Module, Version 3.3 (c) 1991
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Primary Road Drainage

This section presents the designs for ditches TCU-1 and TCU-2, which carry runoff along the primary road above BTCA Area "7" and BTCA Area "8".

Ditch TCU-1 flows along the West side of the road between the residential exclusion area and BTCA Area "8" (Plate 7-4D) and drains into the Highway 31 drainage. The ditch carries a portion of the runoff from Watershed M (Table 7.3-1). TCU-2 flows along the East side of the road in the same area, and drains into Trail Creek. The diversions carry only undisturbed and road drainage, so runoff treatment is not required.

Designs for these diversions are shown following. The "PEAK" hydrograph generation program was used to determine the peak flows from the watersheds. Calculations for Watershed M were based on the watershed information in Table 7.3-1 and were calculated using an SCS Type II distribution. The road watershed calculations were also performed using "PEAK". Both diversions are sized for the 10 year 24 hour storm event of 2.25 inches.

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MAR ... 995

Table 7.3-4

Peak Flow Calculations for TCU-1 and TCU-2

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: M

STORM:	WATERSHED:
Distribution = SCS Type '2'	Land Slope = 71.0000 PCT
Precip. Depth = 2.25 in	Curve Number = 60.00
Duration = 24.00 hr	Channel Length = 981.00 ft
Number of Lines = 1695	Time of Conc. = 0.1072 hr
	Area = 48.21 Acres
	D = 0.0143 hr

OUTPUT SUMMARY

Runoff depth = 0.1094 in
Initial Abstraction = 1.3333 in
Peak Flow = 1.71 cfs (0.0352 iph)
At T = 12.57 hrs

INPUT SUMMARY FOR W.S.: ROAD

STORM:	WATERSHED:
Distribution = SCS Type '2'	Land Slope = 9.3000 PCT
Precip. Depth = 2.25 in	Curve Number = 86.00
Duration = 24.00 hr	Channel Length = 687.00 ft
Number of Lines = 1726	Time of Conc. = 0.1052 hr
	Area = 0.72 Acres
	D = 0.0140 hr

OUTPUT SUMMARY

Runoff depth = 1.0375 in
Initial Abstraction = 0.3256 in
Peak Flow = 0.78 cfs (1.0684 iph)
At T = 12.52 hrs

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: TCU-1

Comment: Ditch Design

Solve For Depth

Given Input Data:

Bottom Width.....	0.00 ft
Left Side Slope..	1.50:1 (H:V)
Right Side Slope.	1.50:1 (H:V)
Manning's n......	0.030
Channel Slope....	0.0800 ft/ft
Discharge........	1.71 cfs

Computed Results:

Depth............	0.49 ft
Velocity.........	4.83 fps
Flow Area........	0.35 sf
Flow Top Width...	1.46 ft
Wetted Perimeter.	1.75 ft
Critical Depth...	0.60 ft
Critical Slope...	0.0250 ft/ft
Froude Number....	1.73 (flow is Supercritical)

Open Channel Flow Module, Version 3.3 (c) 1991
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

95A

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: TCU-2

Comment: Ditch Design

Solve For Depth

Given Input Data:

Bottom Width.....	0.00 ft
Left Side Slope..	1.50:1 (H:V)
Right Side Slope.	1.50:1 (H:V)
Manning's n......	0.033
Channel Slope....	0.0800 ft/ft
Discharge........	0.78 cfs

Computed Results:

Depth............	0.38 ft
Velocity.........	3.69 fps
Flow Area........	0.21 sf
Flow Top Width...	1.13 ft
Wetted Perimeter.	1.35 ft
Critical Depth...	0.44 ft
Critical Slope...	0.0336 ft/ft
Froude Number....	1.50 (flow is Supercritical)

Table 7.3-5

Ditch TCU-1 and TCU-2 Summary

Ditch	TCU-1	TCU-2
Drainage Area	M Partial	Misc. Road
Flow (cfs)	1.71	0.78
Velocity (fps)	4.83	3.69
Rip-rap (m.d.)	Soil	Soil
Slope (%)	8.0	8.0
Min. Depth of Ditch (ft)	0.67	0.5
Depth of Flow (ft)	0.49	0.38
Minimum Freeboard (ft)	0.18	0.12
Manning's N	0.03	0.033
Bottom Width (ft)	0	0
Side Slopes	1.5:1	1.5:1

NOTE: Calculations for TCU-1 and TCU-2 were performed by "FlowMaster", Version 3.3, 1991, Haestad Methods, Inc., and are shown on pg. 7-51D and 7-51E

LICENSED PROFESSIONAL ENGINEER
No. 136686
KIMLY C.
MANGUM
STATE OF UTAH
95

7.3.7 POST-MINING MAINTENANCE AND MONITORING

All drainage controls, culverts, ditches, ponds, silt fences etc., left in place after reclamation, (See Plate 7-4) will be maintained as necessary to remain operational as required or until bond release. Maintenance may include: cleaning culverts, trash racks, ditches, regrading areas of erosion, replacement of erosion controls, and such other measures as may be necessary to maintain the integrity of the hydrologic control system. Monitoring of surface water will continue until bond release as discussed in Section 7.2.4.

As stated previously the sediment pond will remain in place until bond release, or until revegetation of related disturbed areas is deemed adequate. When removed, the area will be regraded as shown on Plate 7-4 and revegetated as discussed in Section 3.6. Ditch TCD-1 will be extended to Trail Creek and a silt fence will be installed.

Due to the relative isolation and small size of certain areas, all drainage does not pass through the sediment pond. These areas require the use of alternative sediment controls. These drainage controls, shown on Plate 7-4, have been designed utilizing the best available sediment control technology. The resulting designs have been reviewed and monitored during construction by Co-Op and DOGM personnel.

Alternate sediment controls for these "B.T.C.A." areas are discussed in Appendix 7-G.

Photographs will be taken as reclamation is completed and place in Appendix 7-F. All structures within the Trail Canyon community will ultimately become the responsibility of the community.

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

TM 92D date 1/5/93

7.4 References

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APPENDIX 7-A-1

WATER MONITORING RESULTS

Station: Lower Trail Part I

Parameter (mg/l)	01/17/85	02/25/85	03/20/85	04/18/85	05/06/85	06/17/85	Mean
Bicarbonate	347.00	306.00	306.00	279.00	268.00	249.00	292.50
Calcium	73.00	68.00	71.00	62.00	62.00	59.00	65.83
Carbonate	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chloride	23.00	20.00	24.00	18.00	12.00	8.00	17.50
Flow (gpm)	6.70	12.20	29.00	128.00	68.00	72.00	52.65
Iron	0.02	0.13	0.03	0.12	0.65	0.64	0.26
Magnesium	60.00	59.00	58.00	51.00	39.00	36.00	50.50
Nitrogen, Nitrate	1.09	1.23	1.98	0.60	0.49	0.17	0.92
pH (Lab)	8.10	8.10	8.10	8.00	8.10	8.30	8.11
pH (Field)	8.10	8.00	8.00	8.00	8.10	8.20	8.06
Potassium	5.30	4.70	5.70	3.40	2.40	2.00	3.91
Sodium	15.00	15.00	13.00	10.00	13.00	9.00	12.50
Solids, Dissolved	445.00	495.00	495.00	435.00	360.00	310.00	423.33
Solids, Suspended	4.00	4.00	4.00	36.00	162.00	128.00	56.33
Sulfate	99.00	107.00	119.00	95.00	54.00	35.00	84.83
Temperature (Celsius)	1.00	1.00	1.00	3.00	3.00	4.00	2.16
Cations (meq/l)	9.37	9.02	9.03	7.81	6.93	6.35	8.08
Anions (meq/l)	9.66	8.93	9.29	8.08	6.83	5.94	8.12
Cat/An Balance (%)	1.55	0.52	1.45	1.69	0.74	3.34	1.54

Station: Lower Trail Part II

Parameter (mg/l)	07/22/85	08/20/85	09/24/85	10/17/85	11/07/85	12/04/85	Mean
Bicarbonate	279.00	342.00	232.00	356.00	354.00	336.00	316.50
Calcium	65.00	71.00	69.00	79.00	81.00	78.00	73.83
Carbonate	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chloride	10.00	21.00	15.00	18.00	19.00	18.00	16.83
Flow (gpm)	97.00	67.00	47.00	47.80	32.00	29.80	53.43
Iron	1.11	0.06	0.62	0.09	0.11	0.07	0.34
Magnesium	45.00	68.00	45.00	67.00	63.00	59.00	57.83
Nitrogen, Nitrate	0.65	0.74	1.11	0.61	0.56	0.67	0.72
pH (Lab)	8.30	8.10	8.30	8.10	8.30	8.10	8.20
pH (Field)	8.20	8.40	8.20	8.10	8.20	8.10	8.20
Potassium	3.00	7.00	6.00	5.00	5.00	4.00	5.00
Sodium	9.00	16.00	9.00	13.00	13.00	19.00	13.16
Solids, Dissolved	360.00	476.00	452.00	498.00	486.00	452.00	454.00
Solids, Suspended	214.00	10.00	122.00	8.00	18.00	6.00	63.00
Sulfate	50.00	105.00	107.00	80.00	95.00	91.00	88.00
Temperature (Celsius)	5.00	6.00	4.00	4.00	2.00	3.00	4.00
Cations (meq/l)	7.41	10.00	7.69	10.15	9.92	9.68	9.14
Anions (meq/l)	6.91	9.63	7.31	9.30	9.61	9.14	8.65
Cat/An Balance (%)	3.52	1.93	2.57	4.37	1.59	2.87	2.80

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Station: Upper Trail   Part I

Parameter (mg/l)	01/17/85	02/25/85	03/20/85	04/18/85	05/06/85	06/17/85	Mean
Bicarbonate	284.00	FROZEN	FROZEN	224.00	227.00	213.00	237.00
Calcium	59.00			46.00	56.00	44.00	51.25
Carbonate	0.00			0.00	0.00	0.00	0.00
Chloride	17.00			9.00	7.00	6.00	9.75
Flow (gpm)	0.50			62.00	56.00	52.00	42.62
Iron	0.27			0.35	1.04	0.56	0.55
Magnesium	48.00			32.00	27.00	28.00	33.75
Nitrogen, Nitrate	1.82			0.07	0.11	0.02	0.50
pH (Lab)	8.20			8.30	8.10	8.20	8.20
pH (Field)	8.00			8.20	8.00	8.00	8.05
Potassium	1.70			1.40	1.10	3.00	1.80
Sodium	12.00			5.00	10.00	7.00	8.50
Solids, Dissolved	340.00			305.00	276.00	254.00	293.75
Solids, Suspended	4.00			108.00	262.00	184.00	139.50
Sulfate	84.00			43.00	25.00	17.00	42.25
Temperature (Celsius)	0.00			2.00	3.00	3.00	2.00
Cations (meq/l)	7.46			5.18	5.48	4.88	5.75
Anions (meq/l)	7.92			5.64	5.26	4.79	5.90
Cat/An Balance (%)	3.00			4.20	2.06	1.00	2.56

Cu Mining Company

Station: Upper Trail Part II

Parameter (mg/l)	07/22/85	08/20/85	09/24/85	10/17/85	11/07/85	12/04/85	Mean
Bicarbonate	187.00	238.00	255.00	DRY	258.00	FROZEN	234.50
Calcium	40.00	42.00	48.00		54.00		46.00
Carbonate	0.00	6.00	6.00		4.00		4.00
Chloride	6.00	13.00	14.00		14.00		11.75
Flow (gpm)	37.50	42.00	38.00		6.20		30.92
Iron	0.62	0.11	0.04		0.07		0.21
Magnesium	31.00	48.00	49.00		48.00		44.00
Nitrogen, Nitrate	0.10	0.04	0.22		0.01		0.09
pH (Lab)	7.70	8.40	8.50		8.40		8.25
pH (Field)	8.00	8.10	8.00		8.00		8.02
Potassium	1.00	2.00	2.00		2.00		1.75
Sodium	1.00	10.00	10.00		8.00		7.25
Solids, Dissolved	258.00	320.00	370.00		328.00		319.00
Solids, Suspended	110.00	2.00	2.00		6.00		30.00
Sulfate	23.00	56.00	47.00		58.00		46.00
Temperature (Celsius)	4.00	6.00	4.00		4.00		4.50
Cations (meq/l)	4.10	6.53	6.91		7.04		6.14
Anions (meq/l)	4.39	6.42	6.60		6.85		6.06
Cat/An Balance (%)	2.45	0.83	2.30		1.37		1.73

Inter-Mountain Laboratories, Inc.

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

CO-OP Mining Co.
P.O. Box 1245
Hunnington, UT 84528

Date: August 15, 1986
Re: Water Analysis
Laboratory No: F3093

Sample Site: C-S1
Date Sampled: 7-24-86
Date Received: 7-28-86

Lab pH, s.u.	8.0
Lab Conductivity, umhos/cm	546
Total Dissolved Solids (180), mg/l	338
Total Dissolved Solids (calc), mg/l	352
Boron, mg/l	0.05
Nitrate - Nitrite as "N", mg/l	0.13
Ammonia Nitrogen as "N", mg/l	0.04
Ortho Phosphorus, mg/l	<0.01
Sodium Adsorption Ratio	0.12
Total Alkalinity as CaCO3, mg/l	281
Total Hardness as CaCO3, mg/l	341

	MG/L	MEQ/L
Bicarbonate as HCO3	**343**	**5.62**
Carbonate as CO3	0.0	0.00
Chloride	6.0	0.17
Sulfate	62	1.29
Calcium	67	3.34
Magnesium	42	3.49
Potassium	2.2	0.06
Sodium	5.1	0.22
Major Cations		7.11
Major Anions		7.08
Cation Anion Difference		0.21%

Trace Metals (Dissolved Concentrations), mg/l

Aluminum	<0.1	Lead	<0.02
Arsenic	<0.005	Manganese	<0.02
Barium	<0.5	Mercury	<0.001
Cadmium	<0.002	Molybdenum	<0.02
Chromium	<0.02	Nickel	<0.01
Copper	<0.01	Selenium	<0.005
Iron	<0.05	Zinc	0.01

Inter-Mountain Laboratories, Inc.

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

Sample Site:	CS-1	Date:	Sept. 9, 1986
Date Sampled:	08/12/86 @ 1155	Mine:	Co-op
Date Received:	08/15/86	Lab No:	F3323

Lab pH	7.7
Lab Conductivity, umhos/cm @ 25C	684
Total Dissolved Solids (180), mg/l	326
Total Dissolved Solids (calc), mg/l	398
Boron, mg/l	0.15
Fluoride, mg/l	0.09
Hydrogen Sulfide, mg/l	<0.04
Ortho-Phosphate, mg/l	<0.01
Ammonia Nitrogen as N, mg/l	0.03
Nitrate + Nitrite as N, mg/l	0.07
Sodium Adsorption Ratio	0.11
Total Alkalinity as CaCO3, mg/l	323
Total Hardness as CaCO3, mg/l	392

	mg/l	meq/l
Bicarbonate as HCO3	394	6.46
Carbonate as CO3	0	0.00
Chloride	5	0.14
Sulfate	68	1.41
Calcium	75	3.77
Magnesium	50	4.07
Potassium	2	0.05
Sodium	5	0.22
Major Cations		8.11
Major Anions		8.01
Cation Anion Difference		0.63 %

Trace Metals (Dissolved Concentrations), mg/l

Aluminum	<0.1	Lead	<0.02
Arsenic	<0.005	Manganese	<0.01
Barium	<0.5	Mercury	<0.001
Cadmium	<0.002	Molybdenum	<0.02
Chromium	<0.02	Nickel	<0.01
Copper	<0.01	Selenium	<0.005
Iron	<0.05	Zinc	<0.01

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Sample Site:	C-S	Date:	28 October, 1986
Date Sampled:	09/24/86 @ 1515	Mine:	Co-op
Date Received:	09/30/86	Lab No:	F3597

Lab pH	7.8
Lab Conductivity, umhos/cm @ 25C	701
Total Dissolved Solids (180), mg/l	422
Total Dissolved Solids (calc), mg/l	401
Boron, mg/l	0.04
Fluoride, mg/l	0.13
Hydrogen Sulfide, mg/l	<0.04
Ortho-Phosphate, mg/l	<0.01
Ammonia Nitrogen as N, mg/l	0.09
Nitrate + Nitrite as N, mg/l	0.24
Sodium Adsorption Ratio	0.13
Total Alkalinity as CaCO3, mg/l	332
Total Hardness as CaCO3, mg/l	391

	mg/l	meq/l
Bicarbonate as HCO3	**405**	**6.64**
Carbonate as CO3	**0**	**0.00**
Chloride	**6**	**0.17**
Sulfate	**62**	**1.29**
Calcium	80	4.00
Magnesium	46	3.82
Potassium	3	0.06
Sodium	6	0.25
Major Cations		8.13
Major Anions		8.10
Cation/Anion Difference		0.18 %

Trace Metals (Dissolved Concentrations), mg/l

Aluminum	0.6	Lead	<0.02
Arsenic	<0.005	Manganese	<0.02
Barium	<0.5	Mercury	<0.001
Cadmium	0.004	Molybdenum	<0.02
Chromium	0.04	Nickel	0.02
Copper	<0.01	Selenium	<0.005
Iron	0.58	Zinc	0.08

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Sample Site: CS-1
Date Sampled: 10/01/86 @ 1320
Date Received: 10/8/86

Date: 29 October, 1986
Mine: Co-op
Lab No: F3737

Lab pH:	7.7
Lab Conductivity, umhos/cm @ 25C	700
Total Dissolved Solids (180), mg/l	402
Total Dissolved Solids (calc), mg/l	398
Boron, mg/l	0.05
Fluoride, mg/l	0.10
Hydrogen Sulfide, mg/l	0.10
Ortho-Phosphate, mg/l	<0.01
Ammonia Nitrogen as N, mg/l	0.03
Nitrate + Nitrite as N, mg/l	<0.01
Sodium Adsorption Ratio	0.13
Total Alkalinity as CaCO3, mg/l	331
Total Hardness as CaCO3, mg/l	387

	mg/l	meq/l
Bicarbonate as HCO3	404	6.63
Carbonate as CO3	0	0.00
Chloride	7	0.20
Sulfate	64	1.33
Calcium	69	3.45
Magnesium	52	4.30
Potassium	3	0.07
Sodium	6	0.25
Major Cations		8.06
Major Anions		8.14
Cation/Anion Difference		0.49 %

Trace Metals (Dissolved Concentrations), mg/l

Aluminum	<0.1	Lead	<0.02
Arsenic	<0.005	Manganese	<0.02
Barium	<0.5	Mercury	<0.001
Cadmium	<0.002	Molybdenum	<0.02
Chromium	0.02	Nickel	<0.01
Copper	<0.01	Selenium	<0.005
Iron	<0.05	Zinc	<0.01

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CO-OP Mining Co.
P.O. Box 1245
Hunnington, UT 84528

Date: August 15, 1986
Re: Water Analysis
Laboratory No: F3094

Sample Site: G-S1
Date Sampled: 7-24-86
Date Received: 7-28-86

Lab pH, s.u.	7.9
Lab Conductivity, umhos/cm	662
Total Dissolved Solids (180), mg/l	430
Total Dissolved Solids (calc), mg/l	419
Boron, mg/l	0.04
Nitrate - Nitrite as "N", mg/l	0.15
Ammonia Nitrogen as "N", mg/l	0.25
Ortho Phosphorus, mg/l	<0.01
Sodium Adsorption Ratio	0.14
Total Alkalinity as CaCO3, mg/l	319
Total Hardness as CaCO3, mg/l	398

	MG/L	MEQ/L
Bicarbonate as HCO3	389	6.38
Carbonate as CO3	0.0	0.00
Chloride	5.0	0.14
Sulfate	83	1.72
Calcium	88	4.37
Magnesium	44	3.59
Potassium	1.8	0.05
Sodium	6.5	0.28
Major Cations		8.29
Major Anions		8.24
Cation/Anion Difference		0.30%

Trace Metals (Dissolved Concentrations), mg/l

Aluminum	<0.1	Lead	<0.02
Arsenic	<0.005	Manganese	<0.02
Barium	<0.5	Mercury	<0.001
Cadmium	<0.002	Molybdenum	<0.02
Chromium	<0.02	Nickel	<0.01
Copper	<0.01	Selenium	<0.005
Iron	<0.05	Zinc	<0.01

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Sample Site: GS-1
Date Sampled: 08/12/86 @ 1030
Date Received: 08/15/86

Date: Sept. 9, 1986
Mine: Co-op
Lab No: F3320

Lab pH	7.7
Lab Conductivity, umhos/cm @ 25C	650
Total Dissolved Solids (180), mg/l	372
Total Dissolved Solids (calc), mg/l	389
Boron, mg/l	0.04
Fluoride, mg/l	0.09
Hydrogen Sulfide, mg/l	<0.04
Ortho-Phosphate, mg/l	<0.01
Ammonia Nitrogen as N, mg/l	0.02
Nitrate + Nitrite as N, mg/l	1.10
Sodium Adsorption Ratio	0.15
Total Alkalinity as CaCO3, mg/l	296
Total Hardness as CaCO3, mg/l	373

	mg/l	meq/l
Bicarbonate as HCO3	362	5.93
Carbonate as CO3	0	0.00
Chloride	5	0.13
Sulfate	83	1.72
Calcium	65	3.24
Magnesium	51	4.21
Potassium	2	0.05
Sodium	7	0.28
Major Cations		7.78
Major Anions		7.78
Cation/Anion Difference		0.00 %

Trace Metals (Dissolved Concentrations), mg/l

Aluminum	<0.1	Lead	<0.02
Arsenic	<0.005	Manganese	<0.02
Barium	<0.5	Mercury	<0.001
Cadmium	<0.002	Molybdenum	<0.02
Chromium	<0.02	Nickel	<0.01
Copper	<0.01	Selenium	<0.005
Iron	<0.05	Zinc	<0.01

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Sample Site:	G-S	Date:	28 October, 1986
Date Sampled:	09/24/86 @ 1410	Mine:	Co-op
Date Received:	09/30/86	Lab No:	F3598

Lab pH:	7.9
Lab Conductivity, umhos/cm @ 25C	724
Total Dissolved Solids (180), mg/l	452
Total Dissolved Solids (calc), mg/l	424
Boron, mg/l	0.02
Fluoride, mg/l	0.12
Hydrogen Sulfide, mg/l	<0.04
Ortho-Phosphate, mg/l	<0.01
Ammonia Nitrogen as N, mg/l	0.07
Nitrate + Nitrite as N, mg/l	0.10
Sodium Adsorption Ratio	0.30
Total Alkalinity as CaCO3, mg/l	318
Total Hardness as CaCO3, mg/l	401

	mg/l	meq/l
Bicarbonate as HCO3	388	6.36
Carbonate as CO3	0	0.00
Chloride	8	0.21
Sulfate	83	1.73
Calcium	70	3.49
Magnesium	55	4.52
Potassium	4	0.10
Sodium	14	0.60
Major Cations		8.71
Major Anions		8.30
Cation/Anion Difference		2.41 %

Trace Metals (Dissolved Concentrations), mg/l

Aluminum	0.1	Lead	<0.02
Arsenic	<0.005	Manganese	<0.02
Barium	<0.5	Mercury	<0.001
Cadmium	<0.002	Molybdenum	<0.02
Chromium	0.04	Nickel	0.02
Copper	<0.01	Selenium	<0.005
Iron	0.05	Zinc	<0.01

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Sample Site:	GS-1	Date:	29 October, 1986
Date Sampled:	10/01/86 @ 1455	Mine:	Co-op
Date Received:	10/8/86	Lab No:	F3738

Lab pH:	7.7
Lab Conductivity, umhos/cm @ 25C	719
Total Dissolved Solids (180), mg/l	398
Total Dissolved Solids (calc), mg/l	417
Boron, mg/l	0.05
Fluoride, mg/l	0.11
Hydrogen Sulfide, mg/l	<0.04
Ortho-Phosphate, mg/l	<0.01
Ammonia Nitrogen as N, mg/l	0.04
Nitrate + Nitrite as N, mg/l	<0.01
Sodium Adsorption Ratio	0.16
Total Alkalinity as CaCO3, mg/l	322
Total Hardness as CaCO3, mg/l	397

	mg/l	meq/l
Bicarbonate as HCO3	393	6.45
Carbonate as CO3	0	0.00
Chloride	6	0.18
Sulfate	86	1.80
Calcium	64	3.19
Magnesium	58	4.76
Potassium	2	0.06
Sodium	7	0.31
Major Cations		8.32
Major Anions		8.43
Cation/Anion Difference		0.66 %

Trace Metals (Dissolved Concentrations), mg/l

Aluminum	<0.1	Lead	<0.02
Arsenic	<0.005	Manganese	<0.02
Barium	<0.5	Mercury	<0.001
Cadmium	<0.002	Molybdenum	<0.02
Chromium	0.02	Nickel	<0.01
Copper	<0.01	Selenium	<0.005
Iron	<0.05	Zinc	<0.01

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CO-OP Mining Co.
P.O. Box 1245
Hunnington, UT 84528

Date: July 9, 1986
Re: Water Analysis
Laboratory No: F2539

Sample Site: Upper Trail
Date Sampled: 06/15/86 @ 1310
Date Received: 06/20/86

Lab pH:	8.1
Lab Conductivity, umhos/cm @ 25C	393
Total Dissolved Solids (180), mg/l	276
Total Dissolved Solids (calc), mg/l	216
Total Suspended Solids, mg/l	130
Nitrate + Nitrite as "N", mg/l	0.05
Sodium Adsorption Ratio	0.16
Total Alkalinity as CaCO3, mg/l	195
Total Hardness as CaCO3, mg/l	207

	mg/l	meq/l
Bicarbonate as HCO3	238	3.90
Carbonate as CO3	0	0.00
Chloride	5	0.14
Sulfate	14	0.29
Calcium	61	3.04
Magnesium	13	1.11
Potassium	1	0.02
Sodium	5	0.23

Major Cations	4.40
Major Anions	4.33
Cation/Anion Difference	0.80 %

Trace Metals (Total Concentrations), mg/l

Iron	2.96
Manganese	0.09

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CO-OP Mining Co.
P.O. Box 1245
Hunnington, UT 84528

Date: August 15, 1986
Re: Water Analysis
Laboratory No: F3087

Sample Site: Upper Trail
Date Sampled: 7-24-86
Date Received: 7-28-86

Lab pH, s.u	7.9
Lab Conductivity, umhos/cm	433
Total Dissolved Solids (180), mg/l	240
Total Dissolved Solids (calc), mg/l	232
Total Suspended Solids, mg/l	130
Settleable Solids, ml/l	0.1
Boron, mg/l	0.05
Nitrate + Nitrite as "N", mg/l	0.56
Ammonia Nitrogen as "N", mg/l	0.05
Ortho Phosphorus, mg/l	0.01
Sodium Adsorption Ratio	0.20
Total Alkalinity as CaCO3, mg/l	206
Total Hardness as CaCO3, mg/l	226

	MG/L	MEQ/L
Bicarbonate as HCO3	251	4.12
Carbonate as CO3	0.0	0.00
Chloride	8.2	0.23
Sulfate	21	0.44
Calcium	40	2.00
Magnesium	31	2.51
Potassium	2.3	0.06
Sodium	6.9	0.30
Major Cations		4.87
Major Anions		4.79
Cation/Anion Difference		0.83%

Trace Metals (Dissolved and Total Concentrations),mg/l

	Diss.	Total		Diss.	Total
Aluminum	<0.1	2.7	Lead	<0.02	<0.02
Arsenic	<0.005	<0.005	Manganese	<0.02	0.05
Barium	<0.5	<0.5	Mercury	<0.001	<0.001
Cadmium	<0.002	<0.002	Molybdenum	<0.02	<0.02
Chromium	<0.02	<0.02	Nickel	<0.01	<0.01
Copper	<0.01	<0.01	Selenium	<0.005	<0.005
Iron	0.09	2.23	Zinc	0.03	0.73

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Sample Site: Upper Trail
Date Sampled: 10/01/86 @ 1320
Date Received: 10/08/86

Date: 29 October, 1986
Mine: Co-op
Lab No: F3743

Lab pH:	8.3
Lab Conductivity, umhos/cm @ 25C	550
Total Dissolved Solids (180), mg/l	292
Total Dissolved Solids (calc), mg/l	297
Total Suspended Solids, mg/l	<1
Nitrate + Nitrite as "N", mg/l	0.01
Sodium Adsorption Ratio	0.27
Total Alkalinity as CaCO3, mg/l	248
Total Hardness as CaCO3, mg/l	284

	mg/l	meq/l
Bicarbonate as HCO3	303	4.96
Carbonate as CO3	0	0.00
Chloride	12	0.35
Sulfate	34	0.70
Calcium	57	2.84
Magnesium	34	2.83
Potassium	1	0.03
Sodium	10	0.45

Major Cations	6.15
Major Anions	6.01
Cation/Anion Difference	1.15 %

Trace Metals (Total Concentrations), mg/l

Iron	0.45
Manganese	0.02

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CO-OP Mining Co.
P.O. Box 1245
Hunnington, UT 84528

Date: August 15, 1986
Re: Water Analysis
Laboratory No: F3095

Sample Site: T-S1
Date Sampled: 7-24-86
Date Received: 7-28-86

Lab pH, s.u	8.0
Lab Conductivity, umhos/cm	746
Total Dissolved Solids (180), mg/l	486
Total Dissolved Solids (calc), mg/l	469
Boron, mg/l	0.05
Nitrate + Nitrite as "N", mg/l	0.48
Ammonia Nitrogen as "N", mg/l	0.04
Ortho Phosphorus, mg/l	<0.01
Sodium Adsorption Ratio	0.28
Total Alkalinity as CaCO3, mg/l	351
Total Hardness as CaCO3, mg/l	436

	MG/L	MEQ/L
Bicarbonate as HCO3	428	7.02
Carbonate as CO3	0.0	0.00
Chloride	17	0.49
Sulfate	88	1.83
Calcium	81	4.05
Magnesium	57	4.68
Potassium	3.0	0.08
Sodium	13	0.58
Major Cations		9.39
Major Anions		9.35
Cation/Anion Difference		0.27%

Trace Metals (Dissolved Concentrations),mg/l

Aluminum	<0.1	Lead	<0.02
Arsenic	<0.005	Manganese	<0.02
Barium	<0.5	Mercury	<0.001
Cadmium	<0.002	Molybdenum	<0.02
Chromium	<0.02	Nickel	<0.01
Copper	<0.01	Selenium	<0.005
Iron	<0.05	Zinc	0.03

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Sample Site:	TS-1	Date:	Sept. 9, 1986
Date Sampled:	08/12/86 @ 1115	Mine:	Co-op
Date Received:	08/15/86	Lab No:	F3321

Lab pH:		7.6
Lab Conductivity, umhos/cm @ 25C		781
Total Dissolved Solids (180), mg/l		468
Total Dissolved Solids (calc), mg/l		462
Boron, mg/l		0.05
Fluoride, mg/l		0.13
Hydrogen Sulfide, mg/l		<0.04
Ortho-Phosphate, mg/l		<0.01
Ammonia Nitrogen as N, mg/l		0.01
Nitrate + Nitrite as N, mg/l		0.40
Sodium Adsorption Ratio		0.27
Total Alkalinity as CaCO3, mg/l		350
Total Hardness as CaCO3, mg/l		439
	mg/l	meq/l
Bicarbonate as HCO3	427	7.00
Carbonate as CO3	0	0.00
Chloride	15	0.42
Sulfate	85	1.77
Calcium	76	3.81
Magnesium	60	4.97
Potassium	3	0.08
Sodium	13	0.57
Major Cations		9.43
Major Anions		9.19
Cation/Anion Difference		1.29 %

Trace Metals (Dissolved Concentrations), mg/l

Aluminum	<0.1	Lead	<0.02
Arsenic	<0.005	Manganese	<0.02
Barium	<0.5	Mercury	<0.001
Cadmium	<0.002	Molybdenum	<0.02
Chromium	<0.02	Nickel	<0.01
Copper	<0.01	Selenium	<0.005
Iron	<0.05	Zinc	<0.01

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Sample Site:	T-S	Date:	28 October, 1986
Date Sampled:	09/24/86 @ 1540	Mine:	Co-op
Date Received:	09/30/86	Lab No:	F3599

Lab pH		7.6
Lab Conductivity, umhos/cm @ 25C		808
Total Dissolved Solids (180), mg/l		510
Total Dissolved Solids (calc), mg/l		472
Boron, mg/l		0.07
Fluoride, mg/l		0.16
Hydrogen Sulfide, mg/l		0.05
Ortho-Phosphate, mg/l		<0.01
Ammonia Nitrogen as N, mg/l		0.07
Nitrate + Nitrite as N, mg/l		0.15
Sodium Adsorption Ratio		0.29
Total Alkalinity as CaCO3, mg/l		354
Total Hardness as CaCO3, mg/l		442
	mg/l	meq/l
Bicarbonate as HCO3	432	7.08
Carbonate as CO3	0	0.00
Chloride	18	0.50
Sulfate	84	1.74
Calcium	89	4.45
Magnesium	53	4.39
Potassium	3	0.08
Sodium	14	0.60
Major Cations		9.52
Major Anions		9.32
Cation/Anion Difference		1.06 %

Trace Metals (Dissolved Concentrations), mg/l

Aluminum	<0.1	Lead	<0.02
Arsenic	<0.005	Manganese	<0.02
Barium	<0.5	Mercury	<0.001
Cadmium	<0.002	Molybdenum	<0.02
Chromium	0.04	Nickel	<0.01
Copper	<0.01	Selenium	<0.005
Iron	0.05	Zinc	0.06

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Sample Site:	TS-1	Date:	29 October, 1986
Date Sampled:	10/01/86 @ 1340	Mine:	Co-op
Date Received:	10/8/86	Lab No:	F3739

Lab pH:	7.6
Lab Conductivity, umhos/cm @ 25C	812
Total Dissolved Solids (180), mg/l	524
Total Dissolved Solids (calc), mg/l	473
Boron, mg/l	0.06
Fluoride, mg/l	0.14
Hydrogen Sulfide, mg/l	<0.04
Ortho-Phosphate, mg/l	<0.01
Ammonia Nitrogen as N, mg/l	0.04
Nitrate + Nitrite as N, mg/l	0.30
Sodium Adsorption Ratio	0.29
Total Alkalinity as CaCO3, mg/l	357
Total Hardness as CaCO3, mg/l	442

	mg/l	meq/l
Bicarbonate as HCO3	435	7.13
Carbonate as CO3	0	0.00
Chloride	16	0.46
Sulfate	85	1.77
Calcium	86	4.29
Magnesium	55	4.56
Potassium	3	0.09
Sodium	14	0.60
Major Cations		9.54
Major Anions		9.36
Cation/Anion Difference		0.95 %

Trace Metals (Dissolved Concentrations), mg/l

Aluminum	<0.1	Lead	<0.02
Arsenic	<0.005	Manganese	<0.02
Barium	<0.5	Mercury	<0.001
Cadmium	0.002	Molybdenum	<0.02
Chromium	0.04	Nickel	0.01
Copper	<0.01	Selenium	<0.005
Iron	<0.05	Zinc	0.72

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Farmington, New Mexico 87401
Tel. (505) 326-4737

CO-OP Mining Co.
P.O. Box 1245
Hunnington, UT 84528

Date: July 9, 1986
Re: Water Analysis
Laboratory No: F2538

Sample Site: Lower Trail
Date Sampled: 06/15/86 @ 1340
Date Received: 06/20/86

Lab pH:	8.1
Lab Conductivity, umhos/cm @ 25C	387
Total Dissolved Solids (180), mg/l	296
Total Dissolved Solids (calc), mg/l	220
Total Suspended Solids, mg/l	122
Nitrate + Nitrite as "N", mg/l	0.12
Sodium Adsorption Ratio	0.16
Total Alkalinity as CaCO3, mg/l	200
Total Hardness as CaCO3, mg/l	206

	mg/l	meq/l
Bicarbonate as HCO3	244	4.00
Carbonate as CO3	0	0.00
Chloride	6	0.16
Sulfate	14	0.29
Calcium	62	3.09
Magnesium	12	1.03
Potassium	1	0.02
Sodium	5	0.23

Major Cations	4.37
Major Anions	4.45
Cation/Anion Difference	0.91 %

Trace Metals (Total Concentrations), mg/l

Iron	3.11
Manganese	0.09

Inter-Mountain Laboratories, Inc.

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Tel. (505) 326-4737

CO-OP Mining Co.
P.O. Box 1245
Hunnington, UT 84528

Date: August 15, 1986
Re: Water Analysis
Laboratory No: F3088

Sample Site: Lower Trail
Date Sampled: 7-24-86
Date Received: 7-28-86

Lab pH, s.u.	8.0
Lab Conductivity, umhos/cm	558
Total Dissolved Solids (180), mg/l	320
Total Dissolved Solids (calc), mg/l	314
Total Suspended Solids, mg/l	86
Settleable Solids, ml/l	0.2
Boron, mg/l	0.08
Nitrate + Nitrite as "N", mg/l	0.55
Ammonia Nitrogen as "N", mg/l	0.05
Ortho Phosphorus, mg/l	0.01
Sodium Adsorption Ratio	0.26
Total Alkalinity as CaCO3, mg/l	256
Total Hardness as CaCO3, mg/l	297

	MG/L	MEQ/L
Bicarbonate as HCO3	312	5.12
Carbonate as CO3	0.0	0.00
Chloride	9.2	0.26
Sulfate	44	0.92
Calcium	53	2.64
Magnesium	40	3.29
Potassium	4.6	0.12
Sodium	10	0.44
Major Cations		6.49
Major Anions		6.30
Cation Anion Difference		1.49%

Trace Metals (Dissolved and Total Concentrations), mg/l

	Diss.	Total		Diss.	Total
Aluminum	<0.1	1.6	Lead	<0.02	<0.02
Arsenic	<0.005	<0.005	Manganese	<0.02	0.05
Barium	<0.5	<0.5	Mercury	<0.001	<0.001
Cadmium	<0.002	<0.002	Molybdenum	<0.02	<0.02
Chromium	<0.02	<0.02	Nickel	<0.01	<0.01
Copper	<0.01	<0.01	Selenium	<0.005	<0.005
Iron	0.12	1.70	Zinc	0.07	0.41

Inter-Mountain Laboratories, Inc.

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

Sample Site: Lower Trail
Date Sampled: 10/01/86 @ 1435
Date Received: 10/08/86

Date: 29 October, 1986
Mine: Co-op
Lab No: F3744

Lab pH:	8.1
Lab Conductivity, umhos/cm @ 25C	732
Total Dissolved Solids (180), mg/l	424
Total Dissolved Solids (calc), mg/l	430
Total Suspended Solids, mg/l	<1
Oil & Grease, mg/l	<5
Nitrate + Nitrite as "N", mg/l	0.30
Sodium Adsorption Ratio	0.37
Total Alkalinity as CaCO3, mg/l	324
Total Hardness as CaCO3, mg/l	393

	mg/l	meq/l
Bicarbonate as HCO3	395	6.48
Carbonate as CO3	0	0.00
Chloride	18	0.52
Sulfate	79	1.65
Calcium	56	2.79
Magnesium	62	5.07
Potassium	4	0.11
Sodium	17	0.73

Major Cations	8.70
Major Anions	8.65
Cation/Anion Difference	0.29 %

Trace Metals (Total Concentrations), mg/l

Iron	0.20
Manganese	0.03

Inter·Mountain Laboratories, Inc.

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

Sample Site:	BS-1	Date:	Sept. 9, 1986
Date Sampled:	08/12/86 @ 1230	Mine:	Co-op
Date Received:	08/15/86	Lab No:	F3322

Lab pH:		7.7
Lab Conductivity, umhos/cm @ 25C		650
Total Dissolved Solids (180), mg/l		334
Total Dissolved Solids (calc), mg/l		367
Boron, mg/l		0.08
Fluoride, mg/l		0.12
Hydrogen Sulfide, mg/l		<0.04
Ortho-Phosphate, mg/l		<0.01
Ammonia Nitrogen as N, mg/l		0.31
Nitrate + Nitrite as N, mg/l		0.05
Sodium Adsorption Ratio		0.21
Total Alkalinity as CaCO3, mg/l		309
Total Hardness as CaCO3, mg/l		365
	mg/l	meq/l
Bicarbonate as HCO3	376	6.17
Carbonate as CO3	0	0.00
Chloride	10	0.29
Sulfate	49	1.02
Calcium	59	2.94
Magnesium	53	4.35
Potassium	2	0.05
Sodium	9	0.40
Major Cations		7.74
Major Anions		7.48
Cation/Anion Difference		1.71 %

Trace Metals (Dissolved Concentrations), mg/l

Aluminum	<0.1	Lead	<0.02
Arsenic	<0.005	Manganese	<0.02
Barium	<0.5	Mercury	<0.001
Cadmium	<0.002	Molybdenum	<0.02
Chromium	<0.02	Nickel	<0.01
Copper	<0.01	Selenium	<0.005
Iron	<0.05	Zinc	<0.01

Inter·Mountain
Laboratories, Inc.

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

CO-OP Mining Co.
P.O. Box 1245
Hunnington, UT 84528

Date: August 15, 1986
Re: Water Analysis
Laboratory No: F3092

Sample Site: B-S1
Date Sampled: 7-24-86
Date Received: 7-28-86

Lab pH, s.u	8.1
Lab Conductivity, umhos/cm	614
Total Dissolved Solids (180), mg/l	368
Total Dissolved Solids (calc), mg/l	369
Boron, mg/l	0.06
Nitrate + Nitrite as "N", mg/l	0.14
Ammonia Nitrogen as "N", mg/l	0.04
Ortho Phosphorus, mg/l	<0.01
Sodium Adsorption Ratio	0.22
Total Alkalinity as CaCO3, mg/l	313
Total Hardness as CaCO3, mg/l	360

	MG/L	MEQ/L
Bicarbonate as HCO3	381	6.25
Carbonate as CO3	0.0	0.00
Chloride	7.1	0.20
Sulfate	49	1.02
Calcium	71	3.55
Magnesium	44	3.61
Potassium	1.6	0.04
Sodium	9.6	0.42
Major Cations		7.62
Major Anions		7.47
Cation/Anion Difference		0.99%

Trace Metals (Dissolved Concentrations),mg/l

Aluminum	<0.1	Lead	<0.02
Arsenic	<0.005	Manganese	<0.02
Barium	<0.5	Mercury	<0.001
Cadmium	<0.002	Molybdenum	<0.02
Chromium	<0.02	Nickel	<0.01
Copper	<0.01	Selenium	<0.005
Iron	0.05	Zinc	0.01

Inter·Mountain Laboratories, Inc.

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

Sample Site:	BS-1	Date:	28 October, 1986
Date Sampled:	09/24/86 @ 1515	Mine:	Co-op
Date Received:	09/30/86	Lab No:	F3596

Lab pH	7.8
Lab Conductivity, umhos/cm @ 25C	681
Total Dissolved Solids (180), mg/l	434
Total Dissolved Solids (calc), mg/l	396
Boron, mg/l	0.10
Fluoride, mg/l	0.32
Hydrogen Sulfide, mg/l	<0.04
Ortho-Phosphate, mg/l	<0.01
Ammonia Nitrogen as N, mg/l	0.10
Nitrate + Nitrite as N, mg/l	0.23
Sodium Adsorption Ratio	0.32
Total Alkalinity as CaCO3, mg/l	272
Total Hardness as CaCO3, mg/l	351

	mg/l	meq/l
Bicarbonate as HCO3	332	5.43
Carbonate as CO3	0	0.00
Chloride	13	0.37
Sulfate	89	1.85
Calcium	73	3.63
Magnesium	41	3.38
Potassium	4	0.09
Sodium	14	0.60
Major Cations		7.71
Major Anions		7.65
Cation/Anion Difference		0.39 %

Trace Metals (Dissolved Concentrations), mg/l

Aluminum	<0.1	Lead	<0.02
Arsenic	<0.005	Manganese	<0.02
Barium	<0.5	Mercury	<0.001
Cadmium	<0.002	Molybdenum	<0.02
Chromium	0.03	Nickel	0.01
Copper	<0.01	Selenium	<0.005
Iron	<0.05	Zinc	<0.01

APPENDIX 7-A

EVALUATION OF THE TRAIL CANYON SEDIMENTATION POND

Evaluation

of the

Trail Canyon

Sedimentation Pond

for

Co-Op Mining Company

by

Blackhawk Engineering Co.

March, 1985

(Revised July 1, 1985)

Sedimentation Pond

The technique used to determine runoff volumes for the sedimentation pond capacity was the SCS Runoff Curve Number Method (TR-55), using the formula: $Q = (P-0.25)^2 / (P+0.85)$: where $S = (1000/Cn) -10$. P = Precipitation for a 10 yr. 24 hour event, which is 2.25" for the Trail Canyon area based on "Precipitation Frequency Atlas 2, Volume VI-Utah, 1973). Curve numbers of 86 and 60 were used for disturbed and undisturbed runoff areas, respectively. These numbers are based on Table 9.1, "SCS Regional Engineering Handbook," Section 4, Hydrology. See Table 7-1 for calculations.

The Universal Soil Loss Equation (USLE) was used to estimate sediment yield from disturbed areas. Sediment yield was calculated by estimating the erosion rate from disturbed areas. All erosion was assumed to be delivered to and deposited in the pond. Conservative assumptions were made to insure that more capacity is available than might be necessary to satisfy design standards. Erosion rate (A) in tons/acre per year is determined using the USLE as:

$$A = (R)(K)(LS)(C)(P)$$

The variables R, K, LS, C and P are defined as follows:

R is the rainfall factor which can be estimated from the empirical relation: $R=27P^{2.2}$ where P is the 2 year, 6 hour precipitate value which for the Trail Canyon facilities area is 1.1 inches. Therefore, the estimated value for R is 33.3 which is somewhat larger than the value from an iso-erodent map provided by Wischmeyer (1977) for the approximate location of the facility.

K is the soil erodibility factor. The K value was conservatively estimated to be 0.5. This value is representative of compacted disturbed areas such as roads, embankments and parking areas and is higher than would be expected for reclaimed acres or undisturbed soils.

LS is the length slope factor. The average LS factor of 2.98 was determined for the disturbed areas, using an average slope of 900' @ 8%. Table 1, "Universal Soil Loss Equation", SCS, Jan. 1976.

C is the cover factor. The C factor was conservatively estimated to be 1.0 which is suggested for a condition of zero ground cover.

P is the erosion control practice factor. P is conservatively estimated to be 1.0 which applies when no erosion control measures are applied.

A unit weight of 100 lb/ft^3 is used to convert sediment yield in weight per unit time to volume capacity requirements.

The area draining to the ponds was calculated to be 26.6 acres, of which 10.8 acres are considered disturbed and 15.8 acres are undisturbed runoff. The areas were measured directly from Plate 7-1 "Surface Hydrology", by the use of a planimeter.

Sediment yield calculations are based on the 10.8 acres of disturbed area only. Undisturbed areas draining to the ponds are not considered as sources of sediment.

Based on the above, total sediment yield from disturbed areas is calculated to be 0.246 acre-feet per year, or 0.738 acre-feet for a 3-year period, (Table 7-2).

Pond surface area was measured by planimeter from Plate 7-2, "Sediment Pond". This area was measured to be 14,680 square feet. Using a direct rainfall of 2.25", a direct precipitation volume of 0.06 acre-feet is required for the pond, (Table 7-3). Pond capacities at the Emergency and Principal Spillways were also calculated using planimeter areas x depths taken from Plate 7-2.

Based on the above criteria, the required pond capacity is calculated as 1.880 acre-feet. The results of the above calculations are summar-

Table 7-1

Runoff Calculation Sheet

Runoff

10 year - 24 hour Precipitation Event Based on: "Precipitation Frequency Atlas of the Western United States", (NOAA Atlas 2, Vol. VI-Utah, 1973).	-	2.25"
Total Drainage Area Based on: 10.8 acres Disturbed Area + 15,8 acres Non-Disturbed Area draining to pond. Areas measured from Plate 7-1 by planimeter.	-	26.6 acres
*Disturbed Area Runoff Volume Based on: V=QxA; A=10.8 ac.; $Q = (P-0.2S)^2/(P+0.8S) = 0.77$ Where S = (1000/Cn)-10; P=2.25"; Cn = Runoff Curve No.=86 (Disturbed Area)	-	0.936 ac. ft.
*Undisturbed Area Runoff Volume Based on: V=QxA; A=15.8 ac.; $Q = (P-0.2S)^2/(P+0.8S) = 0.60$ Where S = (1000/Cn)-10; P=2.25"; Cn = Runoff Curve No.=60 (Undisturbed Area)	-	0.146 ac. ft.
Total 10 year - 24 hour Runoff Volume	-	1.082 ac. ft.

*Taken from "SCS Regional Engineering Handbook", Section 4, Hydrology.

Table 7-2

Sediment Yield Calculations

Sediment Yield

Disturbed Area of Runoff Based on planimetered area from Plate 7-1.	10.8 acres
Sediment Yield in Tons/Acre/Year Based on: A = (R)(K)(LS)(C)(P) Where: R = Rainfall Factor = 33.3, K = Soil Erodibility Factor = 0.5, LS = Length Slope Factor = 2.98, (Based on a 900' slope at 8%, and Table 1, "Universal Soil Loss Equation," SCS, Jan., 1976) C = Cover Factor = 1.0 (No Cover) P = Erosion Control Factor = 1.0 (No Control)	49.62 TAY
Sediment Volume per Year Based on: $\frac{A \times 2000 \times D}{W \times 43,560}$ Where: A = 49.62 tons/acre/year, D = Disturbed Area = 10.8 acres, W = Weight of Sediment = 100 lbs./cu.ft.	0.246 ac. ft.
Sediment Volume Storage Required for 3 years	0.738 ac.ft.

Table 7-3

Direct Precipitation Calculations

Direct Precipitation to Pond

Surface Area of Pond Based on: Planimetered area of Pond Surface at Principal Spilling elevation. (Plate 7-2).	14,680 ft^2
10 yr.-24 hour Precipitation Event Based on: "Precipitation Frequency Atlas of the Western United States", (NOAA Atlas 2, Vol. VI-Utah, 1973).	2.25"
Direct Precipitation Volume Based on: V = PA/43,560 where P = Precipitation in ft.= 2.25"/12, A = Pond Area in ft^2 = 14,680 ft^2.	0.06 ac. ft.

Table 7-4

Required Sedimentation Pond Capacity

Summary Sheet

Required Capacity for Runoff = (From Table 7-1)	1.082 ac. ft.
Required Capacity for 3 Years Sediment Storage = (From Table 7-2)	0.738 ac. ft.
Required Capacity for Direct Precipitation =	0.06 ac. ft.
Total Required Pond Capacity =	1.880 ac. ft.
Pond Capacity at Principal Spillway =	2.030 ac. ft.
Excess Pond Capacity Available	0.150 ac. ft.

ized on Table 7-4, "Required Sedimentation Pond Capacity-Summary Sheet".

The existing pond was surveyed in November, 1984. At that time, the pond was frozen and an assumption had to be made as to its depth. Since that time, it has been determined that the pond depth is only about 3', instead of the assumed depth of 9'. Based on the required capacity calculated above, it is proposed to "clean out" or deepen the pond to a total depth of 8.9' below the outlet (principal spillway) elevation. The cleaning or deepening should follow a 3:1 slope as projected on Plate 7-2. This will provide for a pond capacity of:

2.03 acre feet at the principal spillway, and

2.42 acre feet at the emergency spillway.

These capacities are calculated using the planimetered areas and depths from Plate 7-2. This capacity will allow for adequate storage of runoff and sediment from the 10-year, 24-hour precipitation event, plus an additional

0.150 acre feet for excess capacity.

The November, 1984 survey also disclosed that only 0.8' of freeboard exists between the emergency spillway and the lowest point on the dam. In order to ensure that a minimum of 1' of freeboard exists between the crest of the flow over the emergency spillway and the top of the dam, it is proposed that the dam and concrete overflow height be raised approximately 12" to a relative elevation of 101.0 as shown on Plate 7-2. This can be done by raising the concrete flume 1.1' across the dam area, and then grading and filling the top of the dam to a staked elevation to match the top of the concrete (101.0). The surface of any area to be filled should be scarified to a depth of 4" to 6" before the fill material is placed. Fill should be a 3/4" minus road base and should be placed in lifts not to exceed 12" and compacted to a minimum of 90%.

The principal spillway is sized to discharge flows greater than the 10 year-24 hour event and less than the 25 year-24 hour event. The emergency spillway is sized to discharge flows in excess of the 25 year-24 hour event. The calculations for the runoff and head at the outflows are shown on the Tables 7-5, and 7-6. Based on these calculations, it is determined that the above proposed pond modifications will provide for freeboards of 1' or greater between the crest of the principal spillway flow and the emergency spillway, as well as between the crest of the emergency spillway and the top of the dam.

Table 7-5

Storm Runoff Calculations for

Disturbed Area Drainage

	10 yr.-24 hr. Event	25 yr.-24 hr. Event
Area (Acres)	26.6	26.6
Curve Number (Weighted)	72	72
Precipitation (Inches)	2.25 1.5	2.90
Slope Length (Feet)	1890	1890
Slope (%)	54	54
*Lag (Hours)	.091	.091
*Time of Concentration (Hrs.)	.152	.152
*Peak Discharge (cfs)	14.96	23.57

*Based on SCS Curve No. Method, TR-55; Type II Rainfall Distribution.

Table 7-5A Sediment Pond Stage-Capacity Data

ELEVATION (FT)	AREA (FT^2)	INCREMENTAL VOLUME (FT^3)	CUMULATIVE VOLUME (FT^3)
6,941	4,955		0
		5,304	
6,942	5,653		5,304
		6,023	
6,943	6,393		11,327
		6,784	
6,944	7,175		18,111
		7,760	
6,945	8,345		25,871
		8,909	
6,946	9,473		34,780
		10,051	
6,947	10,629		44,831
		11,216	
6,948	11,802		56,047
		12,410	
6,949	13,018		68,457
		13,621	
6,950	14,224		82,078
		14,869	
6,951	15,514		96,947

FIGURE 7-1 Sediment Pond Stage-Capacity Curve

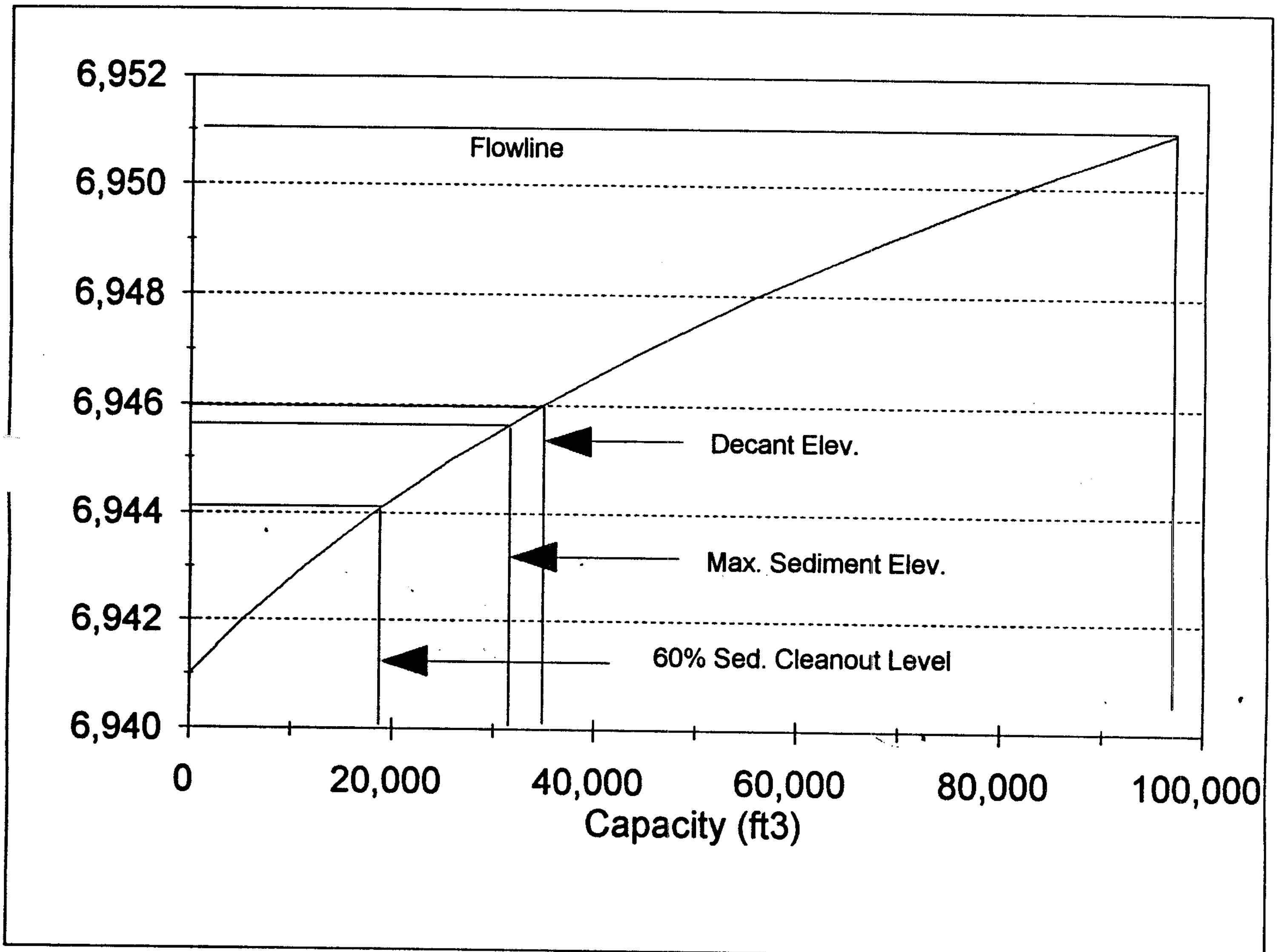


Table 7-6

Spillway Design Specifications

	10 yr.-24 hr. Event	25 yr.-24 hr. Event
Peak Flow (cfs)	14.96	23.57
Length of Slope (Feet)	1890	1890
Slope (%)	54	54
Culvert/Wier Size (Inches)	24 (Culvert)	46 (Wier)
Side Slopes	Vert.	Vert.
*Flow Depth (Inches)	7.69	**9.70

*Based on Broad Crested Wier Formula: $Q = 3.087 \times W \times D^{1.5}$ or $D = (\frac{Q}{3.087\ W})^{.67}$; where Q = Peak Flow, W = Width of Wier, D = Depth of Flow. Barfield, B.J., Warner, R.C., and Haan, C.T., "Applied Hydrology and Sedimentology for Disturbed Lands", 1981.

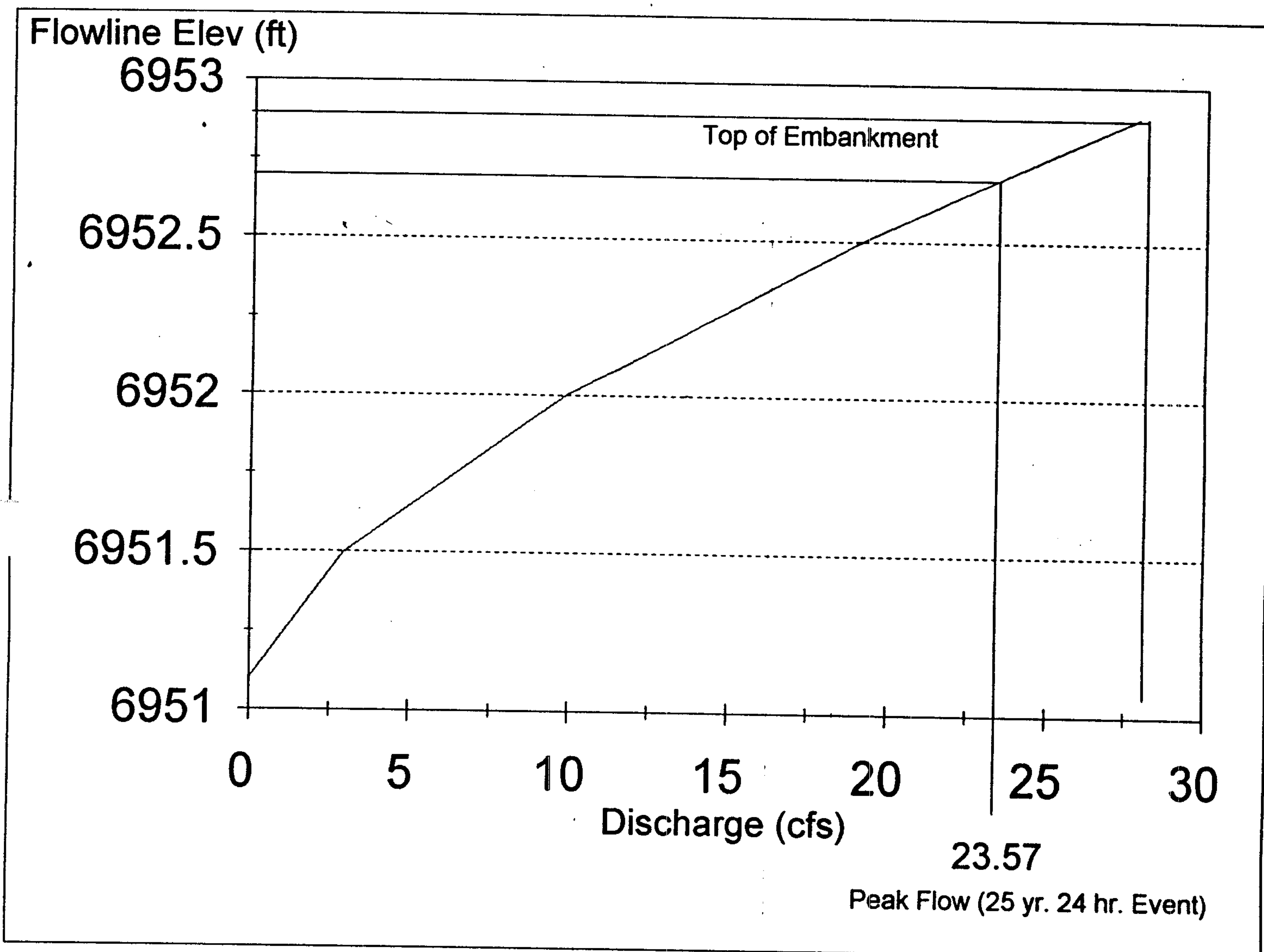
**Based on an effective flow of 8.61 cfs, since at least 14.96 cfs will be discharging through the principal spillway.

TABLE 7-6A Sediment Pond Stage-Discharge Data

Elevation (ft)	Stage (ft)	Area (ft^2)	Area (Ac)	Discharge (cfs)
6951.0	-0.1	15,514	0.356	0
6951.1	0	15,645	0.359	0
6951.5	0.4	16,174	0.371	2.93
6952.0	0.9	16,838	0.387	9.86
6952.5	1.4	17,525	0.402	19.13
6952.7	1.6	17,676	0.406	23.43
6952.9	1.8	17,806	0.409	27.89

NOTE: Peak flow is 23.57 cfs based on the 25-yr. 24 hr. event (See Table 7-6). Pond is assumed full of water to emergency spillway flowline when 25-yr. 24 hr. event occurs. Flow based on Broad Crested Formula (Page 7-66).

FIGURE 7-2 Sediment Pond Stage-Discharge Curve



Principal Spillway/Dewatering Device

The principal spillway/dewatering device will consist of a 24" cmp riser pipe with a 36" cmp oil skimmer surrounding the riser. The riser will have 6 rows of 1/4" holes on 4" centers to allow for dewatering of the pond. The discharge pipe is also fitted with a headgate at the discharge end to allow for controlled release of water from the pond. This dewatering system provides for a theoretical detention time of 97.9 hours for the rainfall from a 10 year - 24 hour precipitation event, based on the following:

*(1) $Q = 19.636\ Kd^2\ h$; K=.61,d=.25", h=1.75".
(2) Q = 0.99 gpm/¼" hole x 60 holes = 59.4 gpm.
(3) Inflow from a 10 yr.-24 hr. event = 352,547 gallons.
(4) Theoretical Detention Time = 97.9 Hours.

The peak flow calculated for a 10 year - 24 hour precipitation event is 14.96 cfs. The 24" culvert outlet will pass flows up to 26 cfs for H/D = 2. Since the outlet pipe will have a head of greater than 4' when an overflow occurs, it is capable of passing the peak flow of 14.96 cfs.

*Taken from: Cameron Hydraulics Data, 12th Edition, "Flow Through Orifices and Nozzles", p. 67.

APPENDIX 7-B

STABILITY ANALYSIS OF THE TRAIL CANYON SEDIMENTATION POND

Stability Analysis
of the
Trail Canyon
Sedimentation Pond

for

Co-Op Mining Company

by
Blackhawk Engineering Co.
March, 1985

Sed Pond
Stability

PROFESSIONAL
No. 4540
DAN W.
GUY
3/26/85
STATE OF UTAH

Trail Canyon Sedimentation Pond

Scope

The Trail Canyon Sedimentation Pond was tested and examined for compliance with the design and construction standards as listed in UMC 817.46, (3)(K) thru (S). The other applicable standards of 817.46 are discussed under the "Hydrology Section" of the M.R.P.

Methodology

The pond has been in place for 6 years; therefore, this study is based on existing conditions of the pond and embankment. Measurements and tests were conducted to verify that proper design and construction techniques were followed, and that the pond is presently stable and in compliance with the regulations. Slopes, elevations and top width of the embankment was surveyed. In addition, test pits were dug and numerous compaction tests were run at various levels in the embankment to test for seepage, stability, and proper compaction.

Results

The results of the test and measurements are summarized in relation to each of the following parts of U.M.C. 817.46(3):

(K) The pond embankment has been in place for 6 years. Any settlement that would occur as a result of construction has already occurred. The compaction tests results verify that the embankment has no voids or unconsolidated areas that could be expected to contribute to future settlement. The pond therefore meets the criteria of this section.

(L) The minimum top width of the embankment was measured to be 16'. If the pond is deepened to a relative elevation of 89.0 (9' deep at overflow), and the embankment raised to a relative elevation of 101.0, the total upstream height of the embankment would be 11.0'. This would require a minimum top width of (11+35)/d or 9.2'. The pond meets the requirements of this section.

(M) The steepest portion of the outer slope of the sediment pond embankment was measured at 1V:2H, and the inner slope was measured at between 1V:3H and 1V:3.5H. If the pond is deepened as proposed, the interior slopes will be kept at 1V:3H maximum, still allowing for the combined upstream and downstream side slopes of the embankment to be not less than 1V:5H, with neither slope steeper than 1V:2H. The compaction tests verify that the existing slopes are unsaturated and stable. The pond meets the criteria of this section.

(N) The embankment foundation was placed on an area that was cleared of all organic matter, and with a moderate slope (approximately 10% or 1V:10H). The foundation surface was scarified prior to construction of the embankment. (Based on personal communication with Mr. Wendell Owen). The pond meets this criteria.

(O) Although some coal refuse material was evident on the extreme upper part of the pond embankment, it was established that this material was not used as part of the embankment itself. Test pits uncovered no organic matter or voids; thus it was concluded that sod, large roots, vegetative matter or frozen soil were not used in the construction of this embankment. Compaction tests further verify the stability of the construction, indicating areas outside of the test pits were also properly constructed. The pond meets the requirements of this section.

(P) Compaction tests were run at various levels within the embankment. The results obtained indicate an average compaction of 86.3% at an average moisture of 16.03%; however, the Marshall

Stability results averaged 99.8%. (It should be noted that these tests were conducted after a rather wet period, and if the results are extrapolated back to the optimum moisture of 13.0% from the original test pit samples, the actual compaction would be considerably higher. For this reason, the Marshall Stability results are more indicative of the actual conditions, since they adjust for the relatively high moistures resulting from the recent wet period, but not inherent in the original pit samples. A complete report on the test pit samples and compaction tests is included as Appendix 1 of this report.

Based on personal communication with Mr. Wendell Owen, the fill of the embankment was placed and compacted in layers not more than 18", starting with the lowest point of the foundation.

The compaction tests and test pits verify that the embankment was properly compacted during construction, due to the high compaction and lack of embankment settlement or voids. The pond meets the requirements of this section.

(Q) The sedimentation pond does not have an embankment great er than 20 in height; nor does it have a capacity of 20 acre-feet or more; therefore, this section does not apply.

(R) The pond was constructed in the spring of 1979. The design and construction was reported to have been under the supervision of Mr. Scott Mc Niel, a registered professional engineer. (Verbal communication with Mr Wendell Owen). A statement of certification after construction is provided in Appendix 2 of this report.

(S) The entire embankment has been stabilized by a vegetative cover for erosion protection. The embankment shows no signs of erosion or other instability. The upstream face of the embankment is coated with sediment, obscuring any protection measures;

however, since the pond is proposed to be deepened, the sediment will be removed at that time. All slopes of the pond appear stable, and since the pond has been functioning for some 6 years, no further protection is deemed necessary for proper operation and stability.

Stability

The test pits, compaction tests, and observed condition of the pond site show the embankment to be properly constructed and stable. As a check on the stability, a factor of safety has been calculated for the embankment. This safety factor is based on a rotational shear analysis using the Hock method.

The maximum slope height was calculated as 15' and the slope angle was taken as that of 1V:2H or 26.6°. The bulk density of the material was 111 lbs/cu.ft. The cohesion value was taken as a conservative 500 psf or 3.5 psi, typical of a sandy soil with moderate amounts of silt and minor amounts of rock. Canadian research[3] indicates a friction value of 35° - 50° for sandy gravels, depending on the density. For the purpose of this study, a friction angle of 35° was selected.

The stability analyses was therefore conducted using the following parameters:

Maximum Slope Height - 15'
Slope Angle - 26.6°
Cohesion - 3.5 psi
Friction Angle - 35°
Bulk Density - 111 lbs/cu.ft.

Using the circular failure charts (Figures 1 and 2) the following safety factors can be calculated for the pond embankment:

Dry Conditions - 4.12

Saturated Conditions - 3.18

Summary

The pond meets the design and construction requirements of U.M.C. 817.46(3), (K) through (S). In addition, both visual examination and actual tests show the embankment to be stable and properly constructed.

References

1. Corps of Engineers, 1970, "Engineering and Design, Stability of Earth and Rock-Filled Dams", EM1110-2-1902, Dept. of the Army, April.

2. Hock, E., and J. W. Bray, 1981, "Rock Slope Engineering", Revised Third Edition, IMM, London.

3. Pit Slope Manual, 1977, Chapter 3: Mechanical Properties, CANMET.

Figure 1

(DRY CONDITIONS)

CIRCULAR FAILURE CHART NUMBER 1

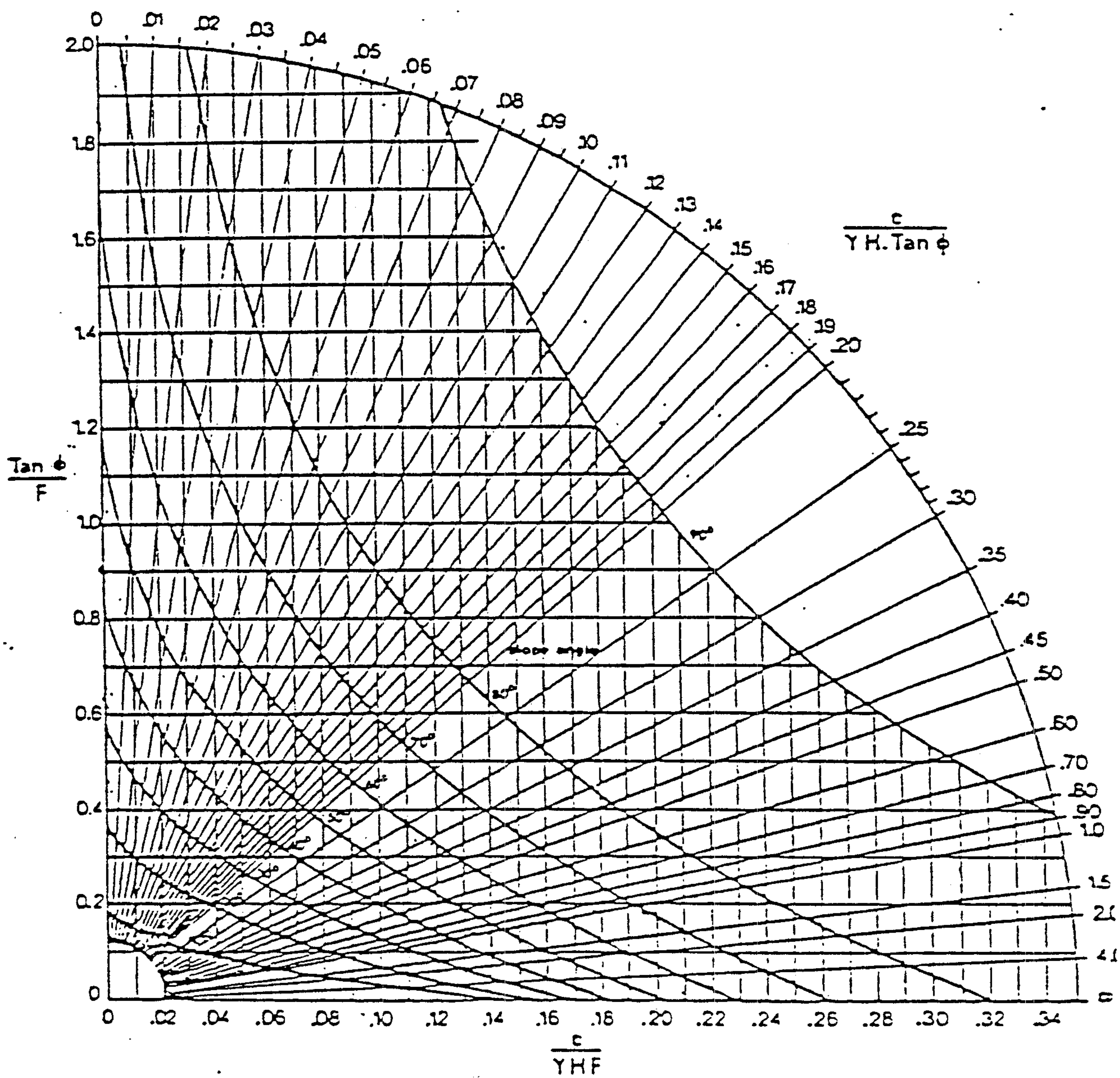
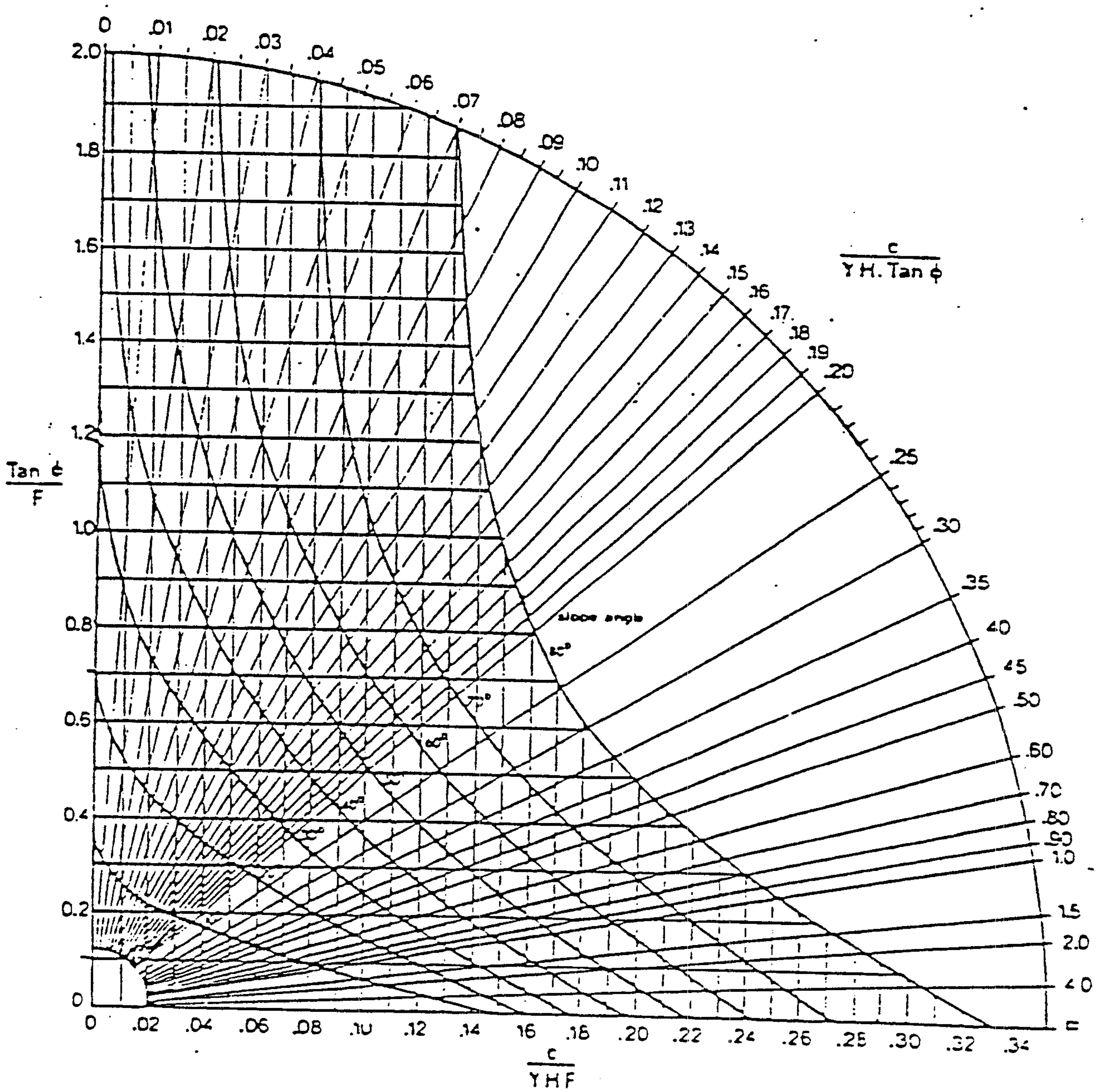


Figure 2

(SATURATED CONDITIONS)

CIRCULAR FAILURE CHART NUMBER 5



Appendix 1

Compaction Test Results

Rt 1, Box 15-L, Helper, Utah 84526
(801)472-5181

March 15, 1985

Dan W. Guy
Blackhawk Engineering
Rt. 1, Box 146-H5
Helper, Utah 84526

Dear Mr. Guy:

Attached, per your request, are the test results and invoice for the work performed at the CO-OP property between March 5, and March 15, 1985.

Conditions on the March 14 visit for the in-place density were somewhat less than ideal, owing to wet weather a few days before. This resulted in about 3 to 4 inches of mud on the embankment in question. Although this limited the amount of desired coverage somewhat, I feel that there were enough "dry" areas tested to indicate the general condition of the embankment.

Please note that the as received moisture content was 7.7%. This sample was taken from one of the test pits at an elevation which would place it approximately at or slightly below the present water level of the pond. The fact that the moisture content on the day of in-place testing averaged considerably higher, and in-place density tests ranged to over 100%, attests to the overall excellent condition of this structure.

I have also included the Marshall Stability test results for your information.

I have enjoyed working with you on this project and hope to have the opportunity to assist you in the future.

Sincerely,

Frank L. Pero

Frank L. Pero

Rt 1, Box 15-L, Helper, Utah 84526
(801)472-5181

Nuclear moisture/density determination March 14, 1985:
Gauge: Troxler Mod. 3411-B, S.N. 7626
Proctor: 111.0 P.C.F.
Optimum Moisture: 13.0%
Location: CO-OP Mine Impoundment, Huntington Canyon
Tested by: Frank L. Pero, C P Engineering Services

No.	Location	%P	%MS	%M
1	Pit #1, at surface	92.3		18.3
2	Pit #1, bottom (4ft.)	76.7	90.5	18.0
3	Pit #1, side (2ft.)	101.0	98.9	8.7
4	Pit #2, at surface	96.5		15.6
5	Pit #2, bottom	81.5	98.0	20.3
6	Pit #2, side (2ft.)	90.5	100.7	11.3
7	Face of embankment	79.7	92.2	15.6
8	Pit #3, at surface	97.7	113.1	15.7
9	Pit #3, bottom (4 1/2 ft.)	77.5	102.9	19.6
10	Face of embankment at toe of slope	78.8	103.9	18.8
11	Pit #4, at surface (face of emb. 18")	77.1	98.0	14.5

"I certify that the foregoing is a true and accurate account of the test results represented herein."

Frank L. Pero

Frank L. Pero
C P Engineering Services

CONSTRUCTION TESTING AND ENGINEERING
340 West 500 South, Suite 105 • P.O. Box 520292 • Salt Lake City, Utah 84152 • (801) 575-TEST (8378)

March 8, 1985

Frank Pero
C/O R & M
Route #1; 15-L
Helper, Utah 84526

Re: Test Results
AASHTO T-99 (Proctor), AASHTO T-89 (Liquid Limit),
ASTM D-2216 (Moisture Content)

Dear Mr. Pero:

Please find enclosed the results for the above referenced tests. Due to the fact the note you enclosed with your sample was rather difficult to read (resulting from the ink being smeared by moisture) it was difficult to tell if these were the tests you requested. I believe we read them all correctly.

Please feel free to contact me if you have any questions or if we can be of further assistance in any way.

Sincerely,

CONSTRUCTION TESTING AND ENGINEERING

David K. Megeath
Manager

APPENDIX 7-C

STATEMENT OF CERTIFICATION

BLACKHAWK ENGINEERING, CO.

Rt. 1, Box 146-H5 - Helper, Utah 84526 - Telephone (801) 637-2422

November 27, 1985

I have observed the construction practices and checked the compaction and dimensions of the Trail Canyon Sedimentation Pond. I hereby certify that this pond is constructed to meet or exceed the specifications set forth in the Approved Pond Design Plan.

REGISTERED PROFESSIONAL ENGINEER
No. 4548
DAN W. GUY
11/27/85
STATE OF UTAH

APPENDIX 7-D

INCORPORATED UNDER
THE LAWS OF THE STATE OF UTAH

NUMBER

SHARES

Huntington-Cleveland Irrigation Company

Capital $150,000 150,000 Shares

7-84

This Certifies that C. W. Kingston is the owner of
*****Three Hundred Thirty Three and 77/100**** Shares of the Capital Stock of

Huntington-Cleveland Irrigation Company

transferable only on the books of the Corporation by the holder hereof in person or by Attorney upon surrender of this Certificate properly endorsed.

IN WITNESS WHEREOF, the said Corporation has caused this Certificate to be signed by its duly authorized officers and its Corporate Seal to be hereunto affixed this 16 day of February A.D. 19 62

SECRETARY. PRESIDENT

SHARES EACH

Goes 154

CLAIMS USED FOR PURPOSE DESCRIBED: See WUC 116, page 119.

///STOCKWATERING: 1440 Equivalent Livestock Units PERIOD OF USE: 06/21 TO 09/30

Gentry Mountain Allotment

Diversion any, each, or all claims; total yearly diversion under all claims mentioned 11.28 acre-feet.

WUC: 93-140 NAME: Utah State Division of State Lands INT: 100% FLOW:

TYPE OF RIGHT: Diligence PRIORITY: 1875 SOURCE: Trail Canyon Creek MAP: 15

POINT OF DIVERSION: Stockwatering directly on stream from a point in NE¼SW¼ Sec 2, T16S, R7E, SLBM,
to a point in SW¼SW¼ Sec 2, T16S, R7E, SLBM.

CLAIMS USED FOR PURPOSE DESCRIBED: See WUC 500, page 61.

///STOCKWATERING: 400 Equivalent Livestock Units PERIOD OF USE: 01/01 TO 12/31

Diversion any, each, or all claims; total yearly diversion under all claims mentioned 4.70 acre-feet.

WUC: 93-188 NAME: U.S. Forest Service INT: 100% FLOW:

TYPE OF RIGHT: Diligence PRIORITY: 1875 SOURCE: Crandall Canyon Creek MAP: 14

POINT OF DIVERSION: Stockwatering directly on stream from a point in SE¼NW¼ Sec 5, T16S, R7E, SLBM,
to a point in SE¼NW¼ Sec 4, T16S, R7E, SLBM.

CLAIMS USED FOR PURPOSE DESCRIBED: See WUC 116, page 119.

///STOCKWATERING: 1440 Equivalent Livestock Units PERIOD OF USE: 06/21 TO 09/30

Gentry Mountain Allotment

Diversion any, each, or all claims; total yearly diversion under all claims mentioned 11.28 acre-feet.

WUC: 93-190 NAME: U.S. Forest Service INT: 100% FLOW:

TYPE OF RIGHT: Diligence PRIORITY: 1875 SOURCE: Crandall Canyon Creek MAP: 14

POINT OF DIVERSION: Stockwatering directly on stream from a point in Lot 4 Sec 6, T16S, R7E, SLBM,
to a point in NE¼SE¼ Sec 6, T16S, R7E, SLBM.

CLAIMS USED FOR PURPOSE DESCRIBED: See WUC 116, page 119.

///STOCKWATERING: 1440 Equivalent Livestock Units PERIOD OF USE: 06/21 TO 09/30

Gentry Mountain Allotment

Diversion any, each, or all claims; total yearly diversion under all claims mentioned 11.28 acre-feet.

WUC: 93-1408 NAME: U.S. Forest Service INT: 100% FLOW: .011 cfs

TYPE OF RIGHT: Diligence PRIORITY: 1875 SOURCE: Humphrey Spring MAP: 14

POINT OF DIVERSION: Stockwatering directly on spring located in NW¼NE¼ Sec 6, T16S, R7E, SLBM.

7-85

CLAIMS USED FOR PURPOSE DESCRIBED: See WUC 1403,

###STOCKWATERING: 153 Equivalent Livestock Units PERIOD OF USE: 07/06 TO 09/25

Crandall Canyon Allotment

Diversion any, each, or all claims; total yearly diversion under all claims mentioned .97 acre-feet.

WUC: 93-193 NAME: U.S. Forest Service INT: 100% FLOW:

TYPE OF RIGHT: Diligence PRIORITY: 1875 SOURCE: Little Bear Canyon Creek MAP: 14

POINT OF DIVERSION: Stockwatering directly on stream from a point in SW¼SE¼ Sec 8, T16S, R7E, SLBM, to a point in NW¼SE¼ Sec 9, T16S, R7E, SLBM.

CLAIMS USED FOR PURPOSE DESCRIBED: See WUC 198, page 137.

###STOCKWATERING: 207 Equivalent Livestock Units PERIOD OF USE: 07/01 TO 09/30

Crandall Ridge Allotment

Diversion any, each, or all claims; total yearly diversion under all claims mentioned 1.47 acre-feet.

WUC: 93-254 NAME: Huntington Cleveland Irrigation Company INT: 100% FLOW: 150 cfs*

TYPE OF RIGHT: Diligence** PRIORITY: 1876 SOURCE: Little Bear Canyon Spring MAP: 15

POINT OF DIVERSION: Stockwatering directly on spring located in NE¼SW¼ Sec 9, T16S, R7E, SLBM.

REMARKS:

*A total of 150 cfs can be diverted under any, each, or all of the following claims: 219,220,221,222,224,226,228,239,240,243,253, 254,272,303,304,309,310.

**A.H. Christensen Decree 1st Class.

For Points of Rediversion and additional remarks, see WUC 1137, page 64.

For all irrigation, the period of use is March 2 to November 14.

CLAIMS USED FOR PURPOSE DESCRIBED: See WUC 1137, page 64.
For PURPOSE, see WUC 1137, page 64.

WUC: 93-1411 NAME: U.S. Forest Service INT: 100% FLOW: .011 cfs

TYPE OF RIGHT: Diligence PRIORITY: 1875 SOURCE: Little Bear Spring MAP: 15

POINT OF DIVERSION: Stockwatering directly on spring located in NE¼SW¼ Sec 9, T16S, R7E, SLBM.

CLAIMS USED FOR PURPOSE DESCRIBED: See WUC 198, page 137.

###STOCKWATERING: 207 Equivalent Livestock Units PERIOD OF USE: 07/01 TO 09/30

Crandall Ridge Allotment

Diversion any, each, or all claims; total yearly diversion under all claims mentioned 1.47 acre-feet.

7-86

WUC: 93-2193 NAME: Huntington Cleveland Irrigation Company INT: 100% FLOW: 45 cfs*

TYPE OF RIGHT: Decree** PRIORITY: 1879 SOURCE: Little Bear Canyon Spring MAP: 15

POINT OF DIVERSION: Stockwatering directly on spring located in NE¼SW¼ Sec 9, T16S, R7E, SLBM.

REMARKS:

*A total of 45 cfs can be diverted under any, each, or all of the following claims: 2190,2193,2196,2199,2202,2205,2208,2211,2214, 2217,2220,2223,2226,2229,2232,2235,2238.

**A. H. Christensen Decree 3rd Class.

For Points of Rediversion and additional remarks, see WUC 1137, page 64.

For all irrigation, the period of use is from March 2 to November 14.

CLAIMS USED FOR PURPOSE DESCRIBED: See WUC 1137, page 64.
For PURPOSE, see WUC 1137, page 64.

WUC: 93-2194 NAME: Huntington Cleveland Irrigation Company INT: 100% FLOW: 77.25 cfs*

TYPE OF RIGHT: Diligence** PRIORITY: 1884 SOURCE: Little Bear Canyon Spring MAP: 15

POINT OF DIVERSION: Stockwatering directly on spring located in NE¼SW¼ Sec 9, T16S, R7E, SLBM.

REMARKS:

*A total of 77.25 cfs can be diverted under any, each, or all of the following claims: 93-2191,2194,2197,2200,2203,2206,2209,2212, 2215,2218,2221,2224,2227,2230,2233,2236,2239.

**A. H. Christensen Decree 3rd Class.

For Points of Rediversion and additional remarks, see WUC 1137, page 64.

For all irrigation, the period of use is from March 2 to November 14.

CLAIMS USED FOR PURPOSE DESCRIBED: See WUC 1137, page 64.
For PURPOSE, see WUC 1137, page 64.

WUC: 93-2195 NAME: Huntington Cleveland Irrigation Company INT: 100% FLOW: 80.0 cfs*

TYPE OF RIGHT: Diligence** PRIORITY: 1888 SOURCE: Little Bear Canyon Spring MAP: 15

POINT OF DIVERSION: Stockwatering directly on spring located in NE¼SW¼ Sec 9, T16S, R7E, SLBM.

REMARKS:

*A total of 80.0 cfs can be diverted under any, each, or all of the following claims: 93-2192,2195,2198,2201,2204,2207,2210,2213, 2216,2219,2222,2225,2228,2231,2234,2237,2240.

**A. H. Christensen Decree 4th Class.

For Points of Rediversion and additional remarks, see WUC 1137, page 64.

For all irrigation, the period of use is March 2 to November 14.

7-87

CLAIMS USED FOR PURPOSE DESCRIBED: See WUC 1137, page 64.
For PURPOSE, see WUC 1137, page 64.

WUC: 93-192 NAME: U.S. Forest Service INT: 100% FLOW:
TYPE OF RIGHT: Diligence PRIORITY: 1875 SOURCE: Little Bear Canyon Creek MAP: 15
POINT OF DIVERSION: Stockwatering directly on stream from a point in NW¼SE¼ Sec 9, T16S, R7E, SLBM,
to a point in NE¼SE¼ Sec 9, T16S, R7E, SLBM.

CLAIMS USED FOR PURPOSE DESCRIBED: See WUC 116, page 119.

###STOCKWATERING: 1440 Equivalent Livestock Units PERIOD OF USE: 06/21 TO 09/30
Gentry Mountain Allotment
Diversion any, each, or all claims; total yearly diversion under all claims mentioned 11.28 acre-feet.

WUC: 93-1435 NAME: U.S. Forest Service INT: 100% FLOW: .011 cfs
TYPE OF RIGHT: Diligence PRIORITY: 1875 SOURCE: Left Fork Trail Canyon Spring MAP: 15
POINT OF DIVERSION: Stockwatering directly on spring located in NE¼SE¼ Sec 10, T16S, R7E, SLBM.

CLAIMS USED FOR PURPOSE DESCRIBED: See WUC 116, page 119.

###STOCKWATERING: 1440 Equivalent Livestock Units PERIOD OF USE: 06/21 TO 09/30
Gentry Mountain Allotment
Diversion any, each, or all claims; total yearly diversion under all claims mentioned 11.28 acre-feet.

7-88

WUC: 93-139 NAME: U.S. Forest Service INT: 100% FLOW:
TYPE OF RIGHT: Diligence PRIORITY: 1875 SOURCE: Trail Canyon Creek MAP: 15
POINT OF DIVERSION: Stockwatering directly on stream from a point in NW¼NW¼ Sec 11, T16S, R7E, SLBM,
to a point in SE¼SE¼ Sec 10, T16S, R7E, SLBM.

CLAIMS USED FOR PURPOSE DESCRIBED: See WUC 116, page 119.

###STOCKWATERING: 1440 Equivalent Livestock Units PERIOD OF USE: 06/21 TO 09/30
Gentry Mountain Allotment
Diversion any, each, or all claims; total yearly diversion under all claims mentioned 11.28 acre-feet.

WUC: 93-1436 NAME: U.S. Forest Service INT: 100% FLOW: .011 cfs
TYPE OF RIGHT: Diligence PRIORITY: 1875 SOURCE: Surface Runoff Spring MAP: 15
POINT OF DIVERSION: Stockwatering directly on spring located in NW¼NW¼ Sec 11, T16S, R7E, SLBM.

CLAIMS USED FOR PURPOSE DESCRIBED: See WUC 116, page 119.

###STOCKWATERING: 1440 Equivalent Livestock Units PERIOD OF USE: 06/21 TO 09/30

Gentry Mountain Allotment

Diversion any, each, or all claims; total yearly diversion under all claims mentioned 11.28 acre-feet.

WUC: 93-1434 NAME: U.S. Forest Service INT: 100% FLOW: .011 cfs

TYPE OF RIGHT: Diligence PRIORITY: 1875 SOURCE: MaCadden Ridge Spring MAP: 15

POINT OF DIVERSION: Stockwatering directly on spring located in NW¼SW¼ Sec 11, T16S, R7E, SLBM.

CLAIMS USED FOR PURPOSE DESCRIBED: See WUC 116, page 119.

###STOCKWATERING: 1440 Equivalent Livestock Units PERIOD OF USE: 06/21 TO 09/30

Gentry Mountain Allotment

Diversion any, each, or all claims; total yearly diversion under all claims mentioned 11.28 acre-feet.

WUC: 93-1432 NAME: U.S. Forest Service INT: 100% FLOW: .011 cfs

TYPE OF RIGHT: Diligence PRIORITY: 1875 SOURCE: Unnamed Stream MAP: 15

POINT OF DIVERSION: Stockwatering directly on spring located in SE¼NE¼ Sec 12, T16S, R7E, SLBM.

CLAIMS USED FOR PURPOSE DESCRIBED: See WUC 116, page 119.

###STOCKWATERING: 1440 Equivalent Livestock Units PERIOD OF USE: 06/21 TO 09/30

Gentry Mountain Allotment

Diversion any, each, or all claims; total yearly diversion under all claims mentioned 11.28 acre-feet.

Storage from 01/01 to 12/31, inclusive, in McCadden Flat Pond #1 with a maximum capacity of .1 acre-feet, located in:

	NORTH-EAST¼				NORTH-WEST¼				SOUTH-WEST¼				SOUTH-EAST¼			
	NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE
Sec 12 T 16S R 7E SLBM				X												

WUC: 93-1431 NAME: U.S. Forest Service INT: 100% FLOW: .011 cfs

TYPE OF RIGHT: Diligence PRIORITY: 1875 SOURCE: Unnamed Stream MAP: 15

POINT OF DIVERSION: Stockwatering directly on spring located in NE¼SE¼ Sec 12, T16S, R7E, SLBM.

CLAIMS USED FOR PURPOSE DESCRIBED: See WUC 116, page 119.

###STOCKWATERING: 1440 Equivalent Livestock Units PERIOD OF USE: 06/21 TO 09/30

Gentry Mountain Allotment

Diversion any, each, or all claims; total yearly diversion under all claims mentioned 11.28 acre-feet.

7-89

Storage from 01/01 to 12/31, inclusive, in McCadden Flat Pond #2 with a maximum capacity of .1 acre-feet, located in:

	NORTH-EAST¼	NORTH-WEST¼	SOUTH-WEST¼	SOUTH-EAST¼
	NE NW SW SE	NE NW SW SE	NE NW SW SE	NE NW SW SE
Sec 12 T 16S R 7E SLBM	* : : : *	* : : : *	* : : : *	* X: : : *

WUC: 93-1433 NAME: U.S. Forest Service INT: 100% FLOW: .011 cfs

TYPE OF RIGHT: Diligence PRIORITY: 1875 SOURCE: Tuttle Spring MAP: 15

POINT OF DIVERSION: Stockwatering directly on spring located in NW¼SE¼ Sec 12, T16S, R7E, SLBM.

CLAIMS USED FOR PURPOSE DESCRIBED: See WUC 116, page 119.

###STOCKWATERING: 1440 Equivalent Livestock Units PERIOD OF USE: 06/21 TO 09/30

Gentry Mountain Allotment

Diversion any, each, or all claims; total yearly diversion under all claims mentioned 11.28 acre-feet.

WUC: 93-1430 NAME: U.S. Forest Service INT: 100% FLOW: .011 cfs

TYPE OF RIGHT: Diligence PRIORITY: 1875 SOURCE: Boundary Spring MAP: 15

POINT OF DIVERSION: Stockwatering directly on spring located in SE¼SE¼ Sec 12, T16S, R7E, SLBM.

CLAIMS USED FOR PURPOSE DESCRIBED: See WUC 116, page 119.

###STOCKWATERING: 1440 Equivalent Livestock Units PERIOD OF USE: 06/21 TO 09/30

Gentry Mountain Allotment

Diversion any, each, or all claims; total yearly diversion under all claims mentioned 11.28 acre-feet.

7-90

WUC: 93-151 NAME: U.S. Forest Service INT: 100% FLOW:

TYPE OF RIGHT: Diligence PRIORITY: 1875 SOURCE: Bear Creek MAP: 15

POINT OF DIVERSION: Stockwatering directly on stream from a point in NE¼NW¼ Sec 13, T16S, R7E, SLBM, to a point in SW¼SW¼ Sec 13, T16S, R7E, SLBM.

CLAIMS USED FOR PURPOSE DESCRIBED: See WUC 116, page 119.

###STOCKWATERING: 1440 Equivalent Livestock Units PERIOD OF USE: 06/21 TO 09/30

Gentry Mountain Allotment

Diversion any, each, or all claims; total yearly diversion under all claims mentioned 11.28 acre-feet.

WUC: 93-1429 NAME: U.S. Forest Service INT: 100% FLOW: .011 cfs

TYPE OF RIGHT: Diligence PRIORITY: 1875 SOURCE: Wild Horse Flat Spring MAP: 15

POINT OF DIVERSION: Stockwatering directly on spring located in NE¼SE¼ Sec 13, T16S, R7E, SLBM.

CLAIMS USED FOR PURPOSE DESCRIBED: See WUC 116, page 119. PERIOD OF USE: 06/21 TO 09/30

###STOCKWATERING: 1440 Equivalent Livestock Units

Gentry Mountain Allotment

Diversion any, each, or all claims; total yearly diversion under all claims mentioned 11.28 acre-feet.

INT: 100% FLOW:

WUC: 93-141 NAME: Peabody Coal Company PRIORITY: 1875 SOURCE: McCadden Hollow Stream MAP: 15

TYPE OF RIGHT: Diligence

POINT OF DIVERSION: Stockwatering directly on stream from a point in NW¼NW¼ Sec 14, T16S, R7E, SLBM, to a point in SE¼NE¼ Sec 15, T16S, R7E, SLBM.

CLAIMS USED FOR PURPOSE DESCRIBED: 129,131,138,141,143,146,149,390,1182 PERIOD OF USE: 01/01 TO 12/31

###STOCKWATERING: 30 Equivalent Livestock Units

Diversion any, each, or all claims; total yearly diversion under all claims mentioned .85 acre-feet.

INT: 100% FLOW:

WUC: 93-138 NAME: Peabody Coal Company PRIORITY: 1875 SOURCE: Trail Canyon Creek MAP: 15

TYPE OF RIGHT: Diligence

POINT OF DIVERSION: Stockwatering directly on stream from a point in NE¼NE¼ Sec 15, T16S, R7E, SLBM, to a point in SE¼NE¼ Sec 27, T16S, R7E, SLBM.

Group No. 1
CLAIMS USED FOR PURPOSE DESCRIBED: See WUC 141, page 146. PERIOD OF USE: 01/01 TO 12/31

###STOCKWATERING: 30 Equivalent Livestock Units

Diversion any, each, or all claims; total yearly diversion under all claims mentioned .85 acre-feet.

Group No. 2
CLAIMS USED FOR PURPOSE DESCRIBED: 138 PERIOD OF USE: 01/01 TO 12/31

###DOMESTIC: 1 Family

Annual water allowed .45 acre-feet.

INT: 100% FLOW:

WUC: 93-129 NAME: Peabody Coal Company PRIORITY: 1875 SOURCE: Huntington Creek MAP: 15

TYPE OF RIGHT: Diligence

POINT OF DIVERSION: Stockwatering directly on stream from a point in NW¼NW¼ Sec 15, T16S, R7E, SLBM, to a point in NW¼NW¼ Sec 15, T16S, R7E, SLBM.

CLAIMS USED FOR PURPOSE DESCRIBED: See WUC 141, page 146. PERIOD OF USE: 01/01 TO 12/31

###STOCKWATERING: 30 Equivalent Livestock Units

Diversion any, each, or all claims; total yearly diversion under all claims mentioned .85 acre-feet.

7-91

WUC: 93-130 NAME: U.S. Forest Service INT: 100% FLOW: MAP: 15
PRIORITY: 1875 SOURCE: Huntington Creek
TYPE OF RIGHT: Diligence
POINT OF DIVERSION: Stockwatering directly on stream from a point in SW¼NW¼ Sec 15, T16S, R7E, SLBM, to a point in SE¼NW¼ Sec 22, T16S, R7E, SLBM.

CLAIMS USED FOR PURPOSE DESCRIBED: See WUC 116, page 119. PERIOD OF USE: 06/21 TO 09/30
###STOCKWATERING: 1440 Equivalent Livestock Units
Gentry Mountain Allotment
Diversion any, each, or all claims; total yearly diversion under all claims mentioned 11.28 acre-feet.

WUC: 93-259 NAME: U.S. Forest Service INT: 100% FLOW: .011 cfs MAP: 14
PRIORITY: 1875 SOURCE: Spring #3
TYPE OF RIGHT: Diligence
POINT OF DIVERSION: Stockwatering directly on spring located in NW¼SW¼ Sec 17, T16S, R7E, SLBM.

CLAIMS USED FOR PURPOSE DESCRIBED: See WUC 116, page 119. PERIOD OF USE: 06/21 TO 09/30
###STOCKWATERING: 1440 Equivalent Livestock Units
Gentry Mountain Allotment
Diversion any, each, or all claims; total yearly diversion under all claims mentioned 11.28 acre-feet.

WUC: 93-196 NAME: Hiatt, Marena Madden, et al. INT: 100% FLOW: MAP: 14
PRIORITY: 1902 SOURCE: Mill Fork Huntington Creek
TYPE OF RIGHT: Diligence
POINT OF DIVERSION: Stockwatering directly on stream from a point in SW¼SE¼ Sec 17, T16S, R7E, SLBM, to a point in SW¼SE¼ Sec 17, T16S, R7E, SLBM.

CLAIMS USED FOR PURPOSE DESCRIBED: 196,260 PERIOD OF USE: 05/16 TO 10/15
###STOCKWATERING: 20 Equivalent Livestock Units
Diversion any, each, or all claims; total yearly diversion under all claims mentioned .24 acre-feet.

WUC: 93-260 NAME: Hiatt, Marena Madden, et. al. INT: 100% FLOW: .011 cfs MAP: 14
PRIORITY: 1902 SOURCE: Spring #2
TYPE OF RIGHT: Diligence
POINT OF DIVERSION: Stockwatering directly on spring located in SW¼SE¼ Sec 17, T16S, R7E, SLBM.

CLAIMS USED FOR PURPOSE DESCRIBED: 196,260 PERIOD OF USE: 05/16 TO 10/15
###STOCKWATERING: 20 Equivalent Livestock Units
Diversion any, each, or all claims; total yearly diversion under all claims mentioned .24 acre-feet.

7-92

APPENDIX 7-E

PROBABLE HYDROLOGIC CONSEQUENCES DETERMINATION

The following document has been constructed in accordance with the "Guidelines for Preparation of a Probable Hydrologic Consequences Determination (PHC)", Office of Surface Mining, Dec. 1985.

The document is written to include the PHC of the past mining of the lower (Hiawatha) seam, and the upper (Bear Canyon) seam, and the proposed reclamation of the minesite.

1. Description of the Trail Canyon Mine Plan and Adjacent Area.

A. Description of the mining operations.

1. The Trail Canyon Mine is an underground mine, located in the Bear Canyon Seam (upper). Older, abandoned mines were also located in the Hiawatha Seam (lower).

2. The extent of the mining is shown on Plate 3-3 of this M.R.P.

3. Overburden Handling - N/A.

4. The reclamation program for the mine area is described in detail in Sections 3.6 and 7.3 of this M.R.P.

5. Overburden analyses - N/A.

a. Analyses of the roof coal and floor for the Hiawatha and Bear Canyon Seams are provided in Appendix 6-A of this M.R.P. No potential problems are noted as a result of these samples.

6. Geology of the mine and Adjacent Areas

*Co-Op Mining Company's Trail Canyon Mine is located along the eastern margin of the Wasatch Plateau Coal Field approximately 11.5 miles west of Huntington, Utah. The eastern margin of the Wasatch Plateau forms a rugged escarpment that overlooks Castle Valley and the San Rafael Swell to the east. Elevations along the eastern escarpment of the Wasatch Plateau range from approximately 6,500 to over 9,000 feet.

Outcropping rocks of the Wasatch Plateau Coal Field range from Upper Cretaceous to Quaternary in age.

The rock record reflects an overall regressive sequence from marine (mancos Shale) through littoral and lagoonal (Blackhawk Formation) to fluvial (Castlegate Sandstone, Price River Formation and North Horn Formation) and lacustrine (Flagstaff Formation) depositional environments. Oscillating depositional environments within the overall regressive trend are represented by lithologies within the Blackhawk Formation and the Colton Formation. The major coal-bearing unit within the Wasatch Plateau Coal Field is the Blackhawk Formation.

Past mining was conducted in 2 coal seams; the Bear Canyon Seam (upper) and the Hiawatha Seam (lower). Mine maps are found in Section 3, and detailed geologic information for each of the seams is in Section 6 of this M.R.P.

7. Overburden Chemistry - N/A.

B. Description of the surface water system.

1. All ephemeral, intermittant, and perennial streams are described in Section 7.2 of this M.R.P. Locations are shown on Plate 2-2 and 7-1 of this M.R.P., and on Figure 4 of the C.H.I.A. (10/25/85) for the Bear Canyon mine.

2. Ponds and springs are also shown on Plates 2-2 and 7-1 of this M.R.P. There are no lakes in the permit or adjacent areas.

3. All surface water quality and quantity base line data is summarized in Tables 7.2-1 through 7.2-5 of this M.R.P.

4. Water users and water rights are descibed in Appendix 7-D and shown on Plate 7-3 of this M.R.P.

C. Description of the ground water system.

1. Wells, seeps and other discharge points are shown on Plates 2-2 and 7-4 and Figure 7.1.3 of this M.R.P.

2. Available ground water data for this mine is summerized in Appendix 7-A fo this M.R.P.

3. Ground water is present in all lithostratigraphic units that occur within and adjacent to the permit area. Ground water may occur under localized conditions that often form a system of perched aquifers and associated springs and/or seeps. The U.S. Geological Survey (USGS) has identified and formally designated the Star Point Blackhawk aquifer as the only regional ground-water resource in the study area (Danielson, et.al. 1981 and Lines 1984).

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

Snowmelt at higher elecations provide most of the ground water recharge, particularly where permeable lithologies

*Taken from Bear Canyon C.H.I.A. (10/25/85) or faults/fractures are exposed at the surface. Vertical migration of ground water occurs through permeable rock units and/or along zones of faulting and fracturing. Lateral migration initiates when ground water encounters impermeable rocks and continues until either the land surface is intersected (and spring discharge occurs) or other permeable lithologies or zones are encountered that allow further vertical flow.

Two springs occur within and adjacent to the permit Available data suggest spring occurrance is fault controlled. Both springs have been developed as culinary water sources. Flows average 5 to 8 gpm for the north portal and 20 to 25 gpm for the south portal spring.

Mine inflows were known to exist, but quantities are unkown. Mine inflow may have been attributed to dewatering of localized aquifers and the intersection of mine workings with flow along fault/fracture conduits.

5. Water users and right locations are described in Appendix 7-D and Plate 7-3 of this M.R.P.

D. Description of climatic conditions.

1. Precipitation data is shown in Section 11.3.1 of this M.R.P.

2. Temperature and snowfall data are shown in Sections 11.3.1 and 11.3.2, respectively, of this M.R.P.

3. Rainfall frequency data for storms in the mine area are shown on Table 11-1 of this M.R.P. Frequency data for the area were based on E. Arlo Richardson's "Estimated Return Period for Short Duration Precipitation in Utah" (Hiawatha Area), as described in Section 7.2.5.2.5 of the Bear Canyon M.R.P.

4. Premining estimates of runoff, evapotranspiration and storage for the mine plan and adjacent areas are the same as the present and post-mining estimates described in Sections 7.2 and 7.3 of this M.R.P.

E. Geomorphic descriptions of the mine plan and adjacent area.

1. Premining soil loss is not applicable since this is a Pre-law disturbance. Sediment yield from the mine plan and adjacent areas is shown in Appendix 7-A of this MRP.

2. Data on stream stability during periods of normal and high flow is presented in Section 7.2.2 of this MRP.

3. Section 7.2.3 of this M.R.P. describes possible effects of mining on surface water.

II. Baseline Data Collection Program.

A. Overburden - N/A.

B. Surface Water

1. Existing data is summarized in Tables 7.2-1 through 7.2-4 and Appendix 7-A-1.

2. Monitoring plans are described in Section 7.2.4 of this M.R.P.

3. Monitoring points are shown on Plates 2-2 and 7-4 of this M.R.P.

4. See Section 7.2.4 of this M.R.P. (No problems have been encountered).

5. Baseline data is presented in Tables 7.2-1 through 7.2-4 and Appendix 7-A-1 of this M.R.P.

C. Ground Water

Ground water data is summarized in Appendix 7-A-1 of this M.R.P.

D. Soil Loss and Sediment Yield.

1. Onsite erosion concerns wre identified and redicted according to Section 7.2.3 of this M.R.P. Additional information was obtained from the 10.25.85 C.H.I.A. for

the Bear Canyon property.

2. Stream and riparian zones are shown on Plates 2-2, 7-4, and 10-1, and described in Section 10.6 and 7.3 of this M.R.P. Further discussion of the streams in the C.I.A. can be found in the 10/25/85 C.H.I.A. for the Bear Canyon area.

3. Information on Alluvial Valley Floor Determination is presented in Section 3.6.8 of this M.R.P.

4. Data on soil loss and sediment yield is presented at the following locations of the M.R.P.:

   (a) Table 7.2-3

   (b) Appendix 7-A

The following additional data on sediment loading of streams in the area has been taken from the 10/25/85 C.H.I.A. for the Bear Canyon property:

"The two major drainages found within the CIA are Trail Creek and Bear Creek (Figure 4). Both are perennial drainages flowing into Huntington Creek. Four ephemeral drainages, designated ED-A, ED-B, ED-C and ED-D (Figure 4) are also found in the CIA and flow to Huntington Creek between Bear Creek and Trail Creek.

Surface disturbance related to coal mining occurs in both Trail Canyon and Bear Canyon. Interaction between these surface disturbances and the streams are minimized due to sediment control facilities in place at each location. Bear Creek transports large quantities of suspended sediment due to springs emerging from the North Horn Formation in the headwaters of Bear Creek which continuously erodes the shales and mudstone and permits sloughing of large amounts of fine-grained material from the escarpments. Observed suspended sediment loads in Bear Creek have been measured as high as 28,092 milligrams per liter (mg/l) in 1984."

III. Prediction of Probable Hydrologic Consequences of the Mining Operation.

A. Prediction of Mining Impacts (Surface Water).

1. Rationale for selection of the hydrologic techniques is discussed under Section 7.2 of this M.R.P.

2. The predicted impacts of past mining and reclamation of the Trail Canyon Mine by Co-Op Mining Company on the surface water in this area are discussed in Section 7.2.3 of this M.R.P. In addition, the following assessment of potential hydrologic impacts to surface water is taken from the 10/25/85 CHIA on Bear Canyon (including this area):

"Bear Creek and Trail Creek. The main concern in terms of water quality deterioration downstream is suspended sediments. The suspended sediment concentrations in Bear Creek in 1984 varied from a high of 28,092 (mg/l) in May of 1984 to a low of 122 (mg/l) in

September of 1984 with five monthly readings within the 1-2,000 mg/l range. The suspended sediment concentrations in Trail Creek in 1984 varied from 1,400 mg/l in May of 1984 to a low of 1.0 mg/l in February of 1984 with seven monthly readings below 100 mg/l. These high suspended sediment values are associated primarily with natural climatic and geologic processess, although a proportion may be attributed to surface disturbances from roads and mine pads. Sediment controls do exist for all surface disturbances in both canyons. Therefore, the impact associated with mining in Trail and Bear Canyons is minimized by surface controls (i.e., sediment ponds, diversion ditches, filter fences, dugout ponds, etc.)

No known surface disturbances occur with any of the ephemeral drainages within the CIA boundary other than Birch Spring development work in ED-C which has been reclaimed by North Emery Water Users to prevent future impacts.

Future development in the Wild Horse Ridge and Mohrland areas and/or the recommencement of mining at the Trail Canyon Mine may result in further dewatering of the ground-water system. The permitting process will require implementation of sediment control measures and impacts to surface water should be minimized."

B. Prediction of Mining Impacts (Ground Water)

1. Techniques for prediction of potential ground water impacts are discussed under Section 7.1 of this M.R.P.

2. The predicted impacts of mining on the ground water in this area are discussed under Section 7.1.5 of this M.R.P. In addition, the following assessment of potential hydrologic impacts to ground water is taken from the 10/25/85 C.H.I.A. on the Bear Canyon Mine (including this area):

   "Dewatering and subsequence related to mining have the greatest potential for impacting ground-water resources in the CIA."

   Mining ceased in this area in 1981, and there are no plans for further mining. Any impacts from mining should have already occurred, and no additional impacts are expected.

C. Predictions of Mining Impacts on Stream Morphology.

1. Changes in stream stability are expected to be negligible since the reclamation plan calls for restoration of all channels to sizes and slopes comparable to existing natural channels.

2. No upland stability problems are anticipated as a result of past mining and reclamation of this property.

3. Based on the assessments of possible impacts to surface and ground water listed above, there are no significant impacts to water uses anticipated from this mining. Any other impacts to land uses, etc. are discussed under Appendix 3-H of this M.R.P. This discussion also indicates no significant impacts.

4. Permanent structures are proposed to be left at this site upon completion of mining, including the restored stream channels. These channels have been designed to carry the projected flows with long-term stability; however, minimal impacts are expected. Trail Canyon City is committed to maintenance and protection of the stream channel if required.

D. Combined Impacts of Mining and Reclamation

1. Minimal impacts of past mining to local and regional water users could occur in the form of reduced flow to springs or wells as discussed under B.2 above; however, it is expected that such impacts will be minor based on the location of the coal seams, and the fault fracture controlled nature of the minor ground water discharges in the area, and the fact that mining ceased over 5 years ago.

2. Impacts on the total hydrologic balance or cycle are expected to be minimal for the following reasons:

(a) Mining ceased over 5 years ago, and the area will be reclaimed.

(b) Any water loss to springs or seeps through mineinduced fractures will likely find its way to the surface at another location.

(c) The fault/fracture controlled nature of the ground water, and the high elevation recharge area increase the likelyhood that ground water will still find its way to existing discharge locations, regardless of past mining activity.

(d) Surface waters are controlled and cleaned within the mine property; therefore, sediment loading to streams is not considered a likely impact.

IV. Summary and Conclusions

A. Summary - the 10/25/85 Bear Canyon C.H.I.A. and the Hydrologic Sections of this M.R.P. provide adequate data to make a determination of Probable Hydrologic Consequences from past mining and reclamation of this property. The C.H.I.A. was written just for the Bear Canyon mining; however, additional submittals and data in this M.R.P. provide for the PHC determination to extend as well.

B. Conclusions - The Findings Document and the C.H.I.A. for the Bear Canyon M.R.P. (10/25/85) made the following assessment:

"The assessment of the probable cumulative impacts of all anticipated coal mining in the general area on the hydrologic balance has been made by the regulatory authority. The mining operation proposed under the application has been designed to prevent damage to the hydrologic balance outside the proposed mine plan are (UMC 786.19[c]). See Cumulative Hydrologic Impact Analysis (C.H.I.A.) Section, attached to this Findings Document. Also, see Huntington Creek Basin C.H.I.A., May 29, 1984, prepared by Simons, Li & Associates for the Office of Surface Mining (OSM)."

Information presented in Sections 111.A.2 and 111.B.2 of this PHC has shown that the probable hydrologic consequences of the past mining and proposed reclamation are expected to be less significant than those from the active mining at the Bear Canyon property mentioned above.

Appendix 7-F

RECLAMATION PHOTOGRAPHS

Appendix 7-G

B.T.C.A. AREAS

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Approved, Division of Oil, Gas & Mining
TM 920 date 1/5/93

Supplemental sediment control structures will be used until ground cover meets the standards of the reference area. The ground cover standards are shown in Appendix 9-A, Table 9A-1. Vegetation will be monitored annually as outlined in Section 3.5.5.3. Each area will be monitored until sample adequacy has been achieved. The reference area will also be sampled so that a current comparison is provided. Once the ground cover standard has been met in each area, a formal proposal will be submitted to the Division to remove supplemental structures. When all areas meet the ground cover standard, a formal proposal for phase 2 bond release will be submitted to the Division. After removal of supplemental structures, each area will be monitored to determine the effectiveness of the cover. Ground Cover, erosion, and vegetation establishment will be reviewed. Also, drainage from these areas will be monitored during storm events to verify compliance with state and federal limitations when possible.

Runoff volumes are based on the 10 yr 24 hr event of 2.25 in. and runoff CN of 86.

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Approved, Division of Oil, Gas & Mining
TM 92D date 1/5/93

BTCA Area "1" - **NORTH END OF RECLAIMED PORTAL ACCESS ROAD**

The portion of the reclaimed road included in this area is shown on Plate 7-4A. The area is approximately 0.06 acres. Runoff volume from this area is calculated to be approximately 0.01 acre ft. Recontouring and seeding was completed in 1989 for this area. This area is above the residential exclusion area and is isolated from drainage to the sediment pond. Sediment and erosion control is performed primarily with the establishment of a good vegetation cover. Two silt fences are installed and maintained in line with the natural drainage flow from the area, as shown on Plate 7-4A. A typical silt fence installation is shown in Figure 7.3-5A. Runoff passes through the silt fences pri[illegible] Creek.

BTCA Area "2" - **RECLAIMED PORTAL ACCESS ROAD**

The portion of the reclaimed road included in this area is shown on Plates 7-4A and 7-4B. The area is approximately 1.44 acres. Runoff volume from this area is calculated to be approximately 0.14 acre ft. Recontouring and seeding was completed in 1989 for this area. This reclaimed area is isolated from the sediment pond by the restoration of undisturbed drainage channels along the road. Sediment and erosion control is performed primarily with the establishment of a good vegetation cover. Rock check dams, shown on Plates 7-4A and 7-4B and detailed in Figure 7.3-4, have been placed where drainage channels cross the reclaimed area.

BTCA Area "3" - MIDDLE PAD AND DITCH TCD-4

This area, shown on Plates 7-4B and 7-4C, is approximately 0.63 acres. Runoff volume from this area is calculated to be approximately 0.05 acre ft. Recontouring and seeding was completed in 1989 for this area. The area includes the middle pad and the reclaimed channel TCD-4. Drainage from this area is treated by rock check dams placed in ditch TCD-4, shown on Plate 7-4C and detailed in Figure 7.3-9. A good vegetative growth on the middle pad is also used for erosion control.

BTCA Area "4" - PORTAL ACCESS ROAD AND SLOPE BELOW PORTALS

This area, shown on Plate 7-4C, is approximately 1.40 acres. Runoff volume from this area is calculated to be approximately 0.12 acre ft. Recontouring and seeding was completed in 1989 for this area. The area includes the uppermost (south) portion of the portal access road and the slope below the sealed mine portals (above the middle pad). Sediment and erosion control is performed by a sediment trap and loose rock check dam on the middle pad (Figure 7.3-8). The drainage then passes through the rock check dams placed along ditch TCD-4 (Figure 7.3-9). When vegetation reaches the ground cover standard, vegetation will be the primary sediment and erosion control.

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<u>BTCA Area "5"</u> - UPPER SUBSTATION PAD

This area, shown on Plate 7-4C, is approximately 0.19 acres. Runoff volume from this area is calculated to be approximately 0.02 acre ft. Recontouring and seeding was completed in 1989 for this area. Runoff from this area drains into an undisturbed drainage which flows below the sediment pond. Sediment and erosion control is performed primarily with the establishment of a good vegetation (grass) cover. Runoff passes through a silt fence prior to entering the undisturbed drainage. A typical silt fence installation is shown in Figure 7.3-5A.

<u>BTCA Area "6"</u> - LOWER PAD

This area, shown on Plates 7-4C and 7-4D, is approximately 0.82 acres. Runoff volume from this area is calculated to be approximately 0.07 acre ft. Recontouring and seeding was completed in 1991 for this area. Sediment and erosion control is performed by use of a silt fence placed on the lower edge of the pad. Water bars are placed at 6 ft. to 10' on center along the silt fence. A typical silt fence installation is shown in Figure 7.3-5A. Runoff passes through the silt fence prior to entering Trail Creek.

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<u>BTCA Area "7"</u> - PICNIC AREA

This area, shown on Plate 7-4D, is approximately 0.70 acres. Runoff volume from this area is calculated to be approximately 0.07 acre ft. Supplemental seeding was performed in 1989 for this area. This area is separated from the sediment pond by Trail Creek. Sediment and erosion control is performed primarily by the establishment of a good vegetative cover. A berm along the lower (south) end of the area conveys runoff through a silt fence prior to entering Trail Creek. The silt fence is shown on Plate 7-4D and a typical installation is shown in Figure 7.3-5A. Figure 7.3-5 shows the design specifications of the berm.

<u>BTCA Area "8"</u> - RECLAIMED AREA WEST OF PICNIC AREA

This area, shown on plate 7-4D, is approximately 0.17 acres. Runoff volume from this area is calculated to be approximately 0.01 acre ft. Supplemental seeding was performed in 1989 for this area. This area is below the sediment pond. Sediment and erosion control is performed primarily by the establishment of a good vegetative cover.

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BTCA Area "9" - RECLAIMED OUTSLOPE OF TCD-4

This area, shown on plates 7-4B and 7-4C, totals 0.77 acres. Runoff volume from this area is calculated to be approximately 0.13 acre-ft. The peak flow from the area for a 10 Year-24 Hour event is 0.79 cfs (Using a Curve number of 86). Because the area drains into the Residential Area excluded from the permit prior to reaching the sediment pond, sediment and erosion control is performed by the establishment of a good vegetative cover on the slopes. Runoff is also treated with the use of silt fence placed along the bottom of the area, as shown on Plates 7-4B and 7-4C. Runoff will be monitored during storm events as described on page 7G-3 and tested for Suspended Solids to determine the effectiveness of the silt fence.

BTCA Area "10" - Reclaimed Sediment Pond Area

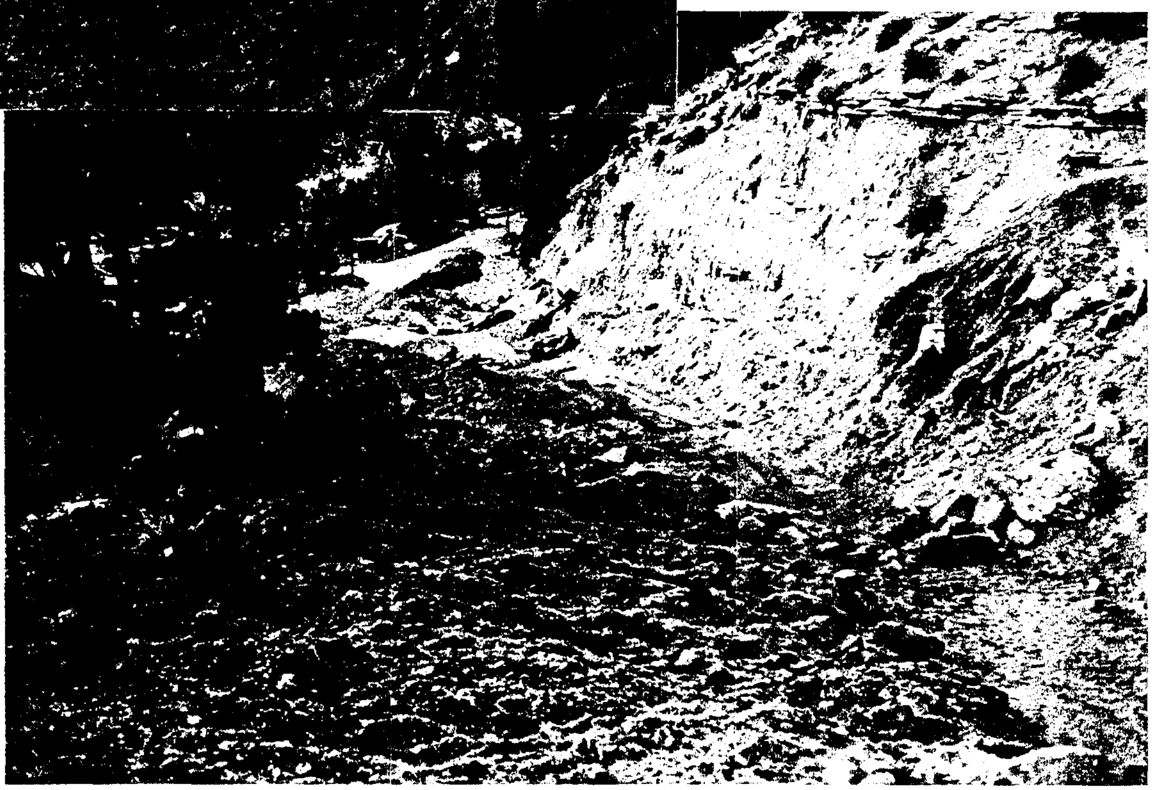
This area, shown on Plate 7-4D, totals 0.83 acres, and includes the reclaimed sediment pond area. Runoff volume from this area is calculated to be approximately 0.16 acre-ft. Sediment control is performed by the use of a silt fence placed along the downgradient side of the area as shown on Plate 7-4D. Contour furrows will be placed with a backhoe to roughen the surface of the regraded slopes. Furrows will be cut parallel to the contours from 4" to 8" depth and 18" to 30" wide. Furrow spacing will be random, with an average spacing from 3' to 5', and lengths not to exceed 20'. These designs are taken from the "Handbook of Alternate Sediment Control Methodologies for Mined Lands" (OSM, March 1985).

Photo #1 Silt Fence at upper end of Trail Canyon

Photo #2 Middle Pad Sediment Trap

Photo #3 Middle Pad Drainage

Photo # 4 View down TCD-4 from Middle Pad



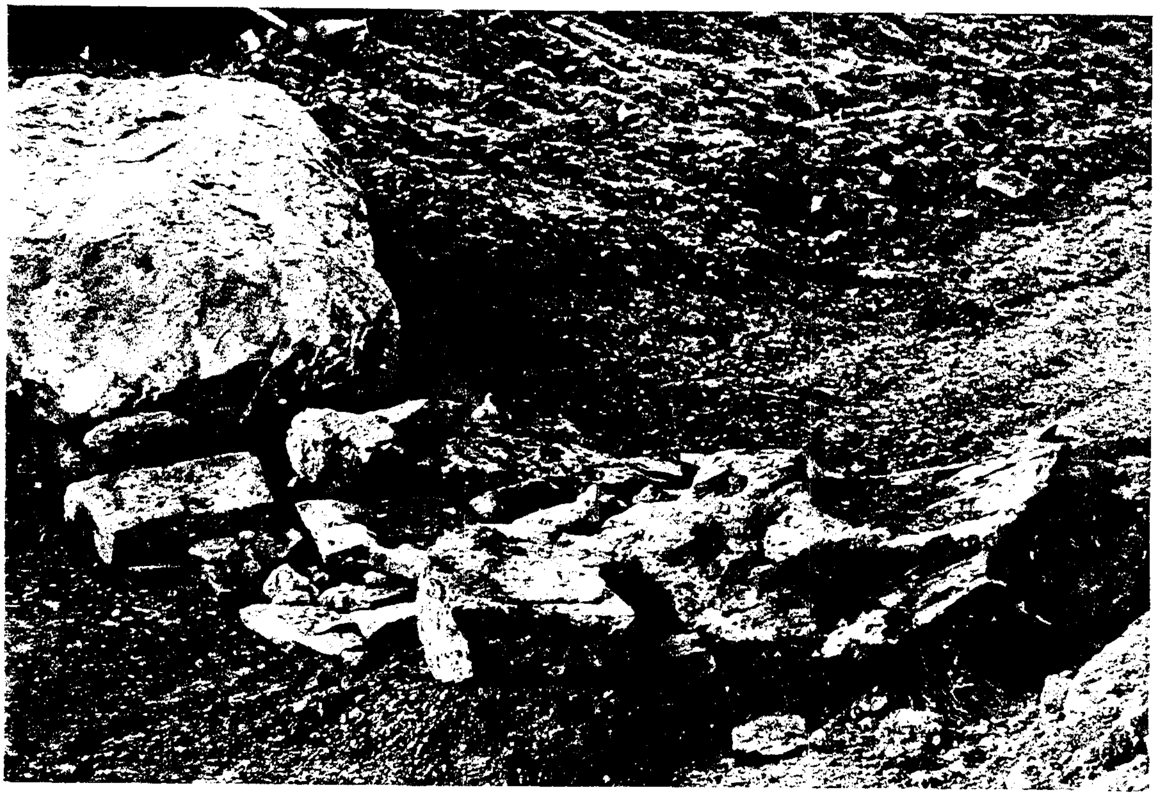


Photo #5 TCD-4 Loose-Rock Check Dam

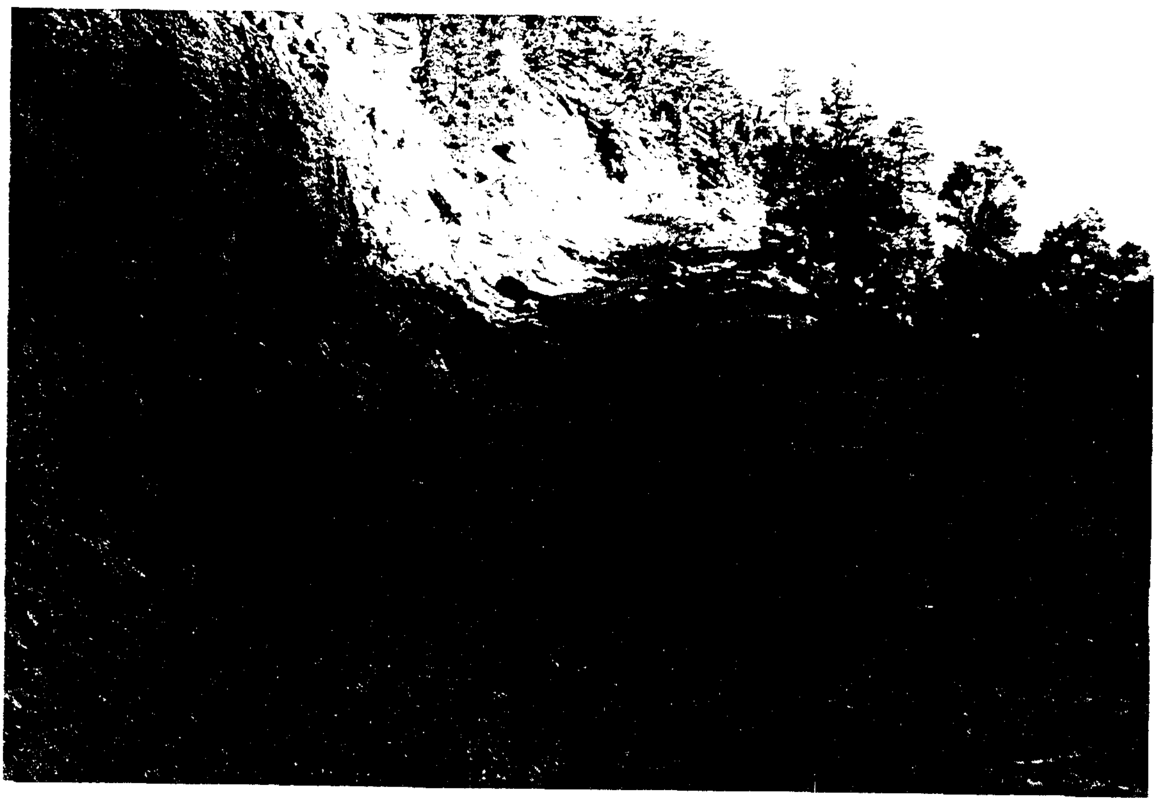


Photo #6 View up TCD-4

Photo #7 Upper Coal Storage Pad Area and TCD-4

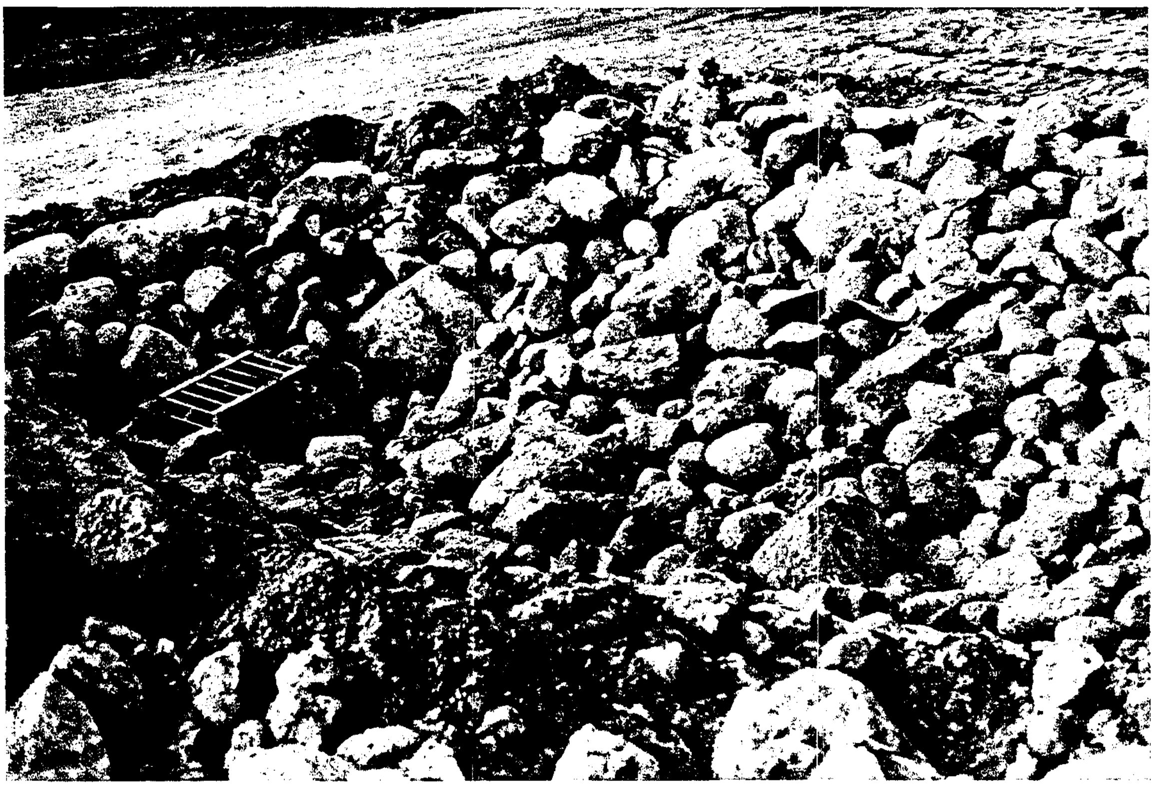


Photo #8 Energy Dissipator Basin, Inlet to TCC-6

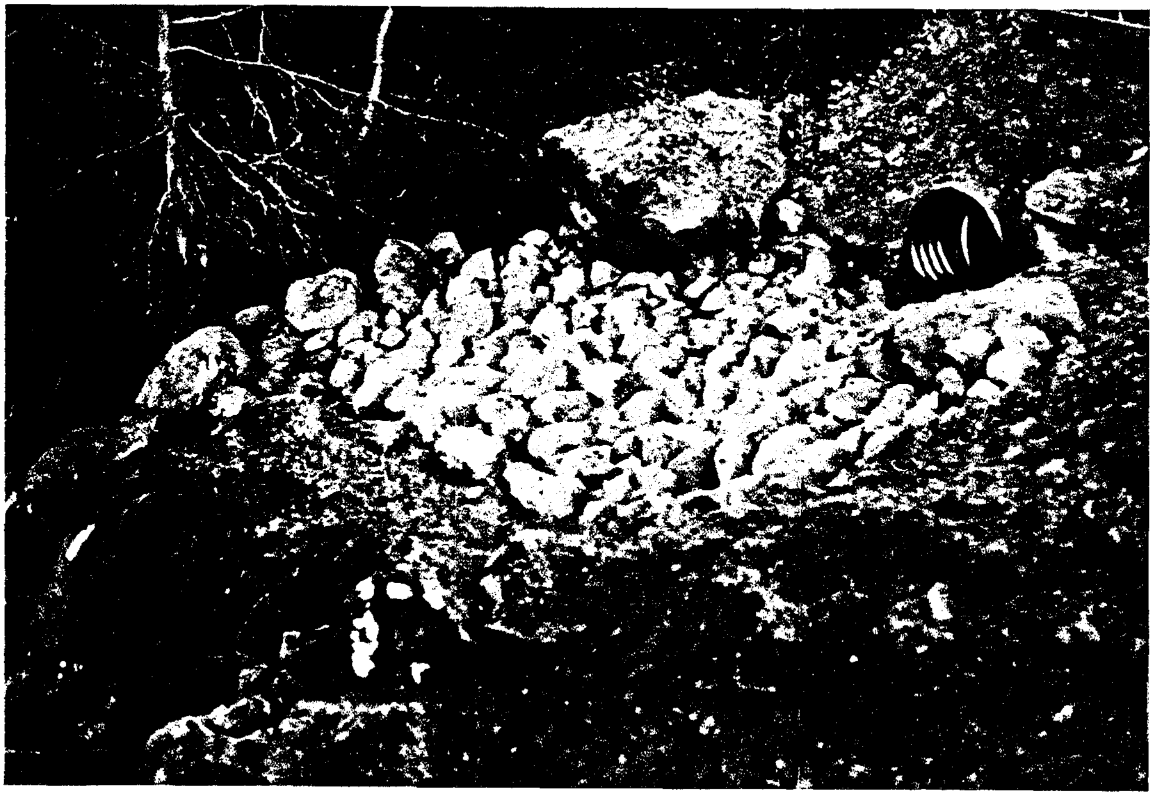


Photo #9 Outlet to Culvert TCC-6

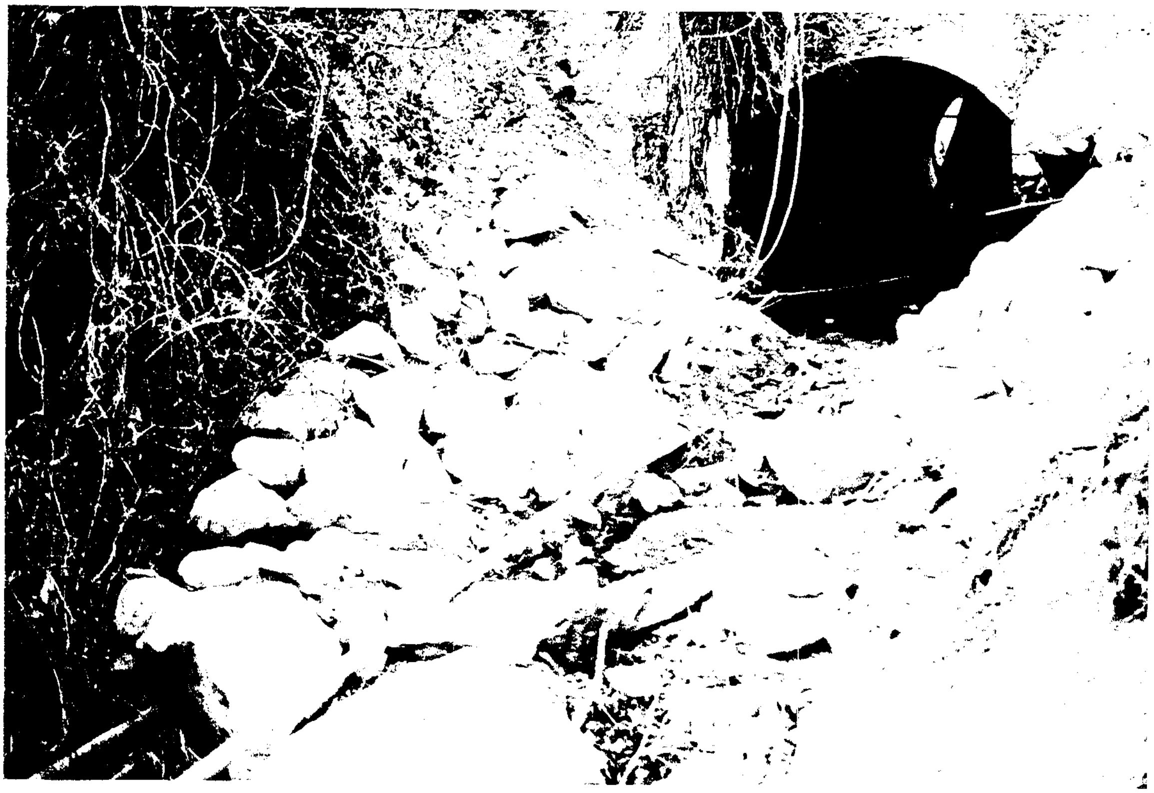


Photo #10 Rip-Rapped Outlet to Culvert TCC-2

Photo #11 Rip-Rapped Outlet to Culvert TCC-3

Photo #12 Trash Rack/Inlet to Culvert TCC-4

Photo #13 Rip-Rapped Outlet to Culvert TCC-4

Photo #14 View of Lower Coal Waste Area, Above Rental Units

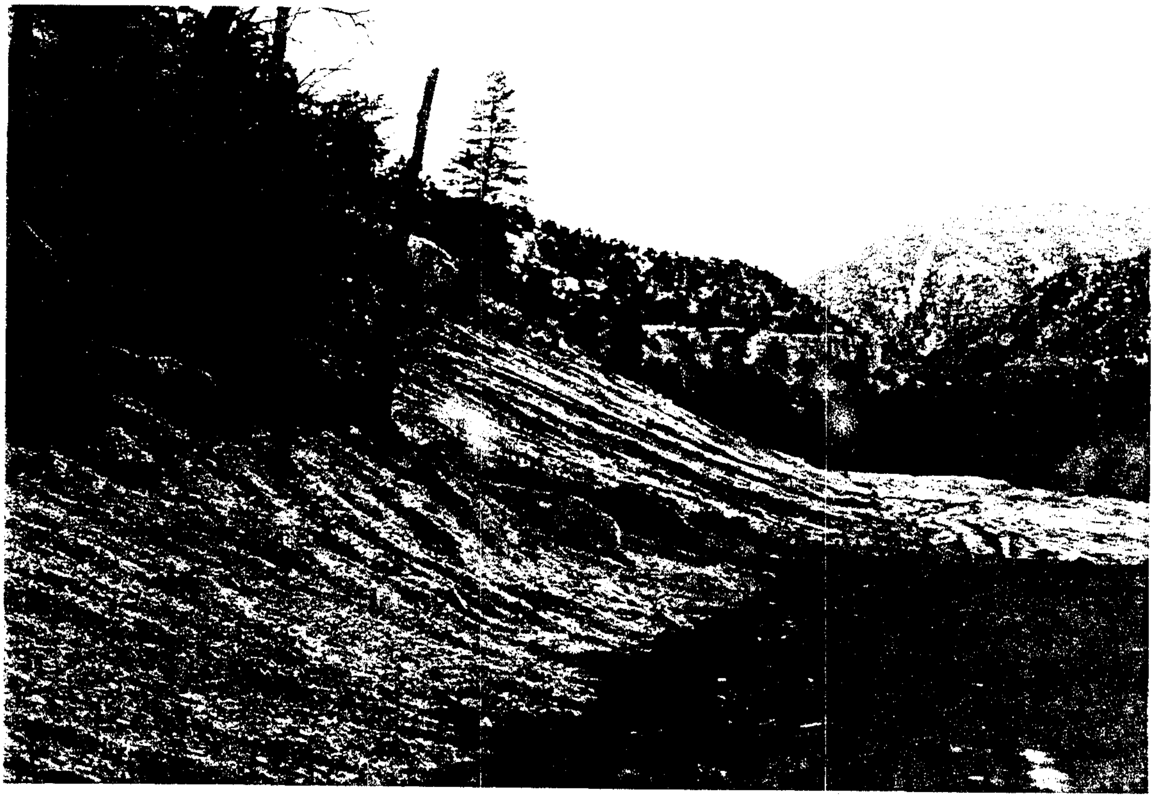


Photo #15 View of Base of Coal Waste Area Slope/Lower Pad

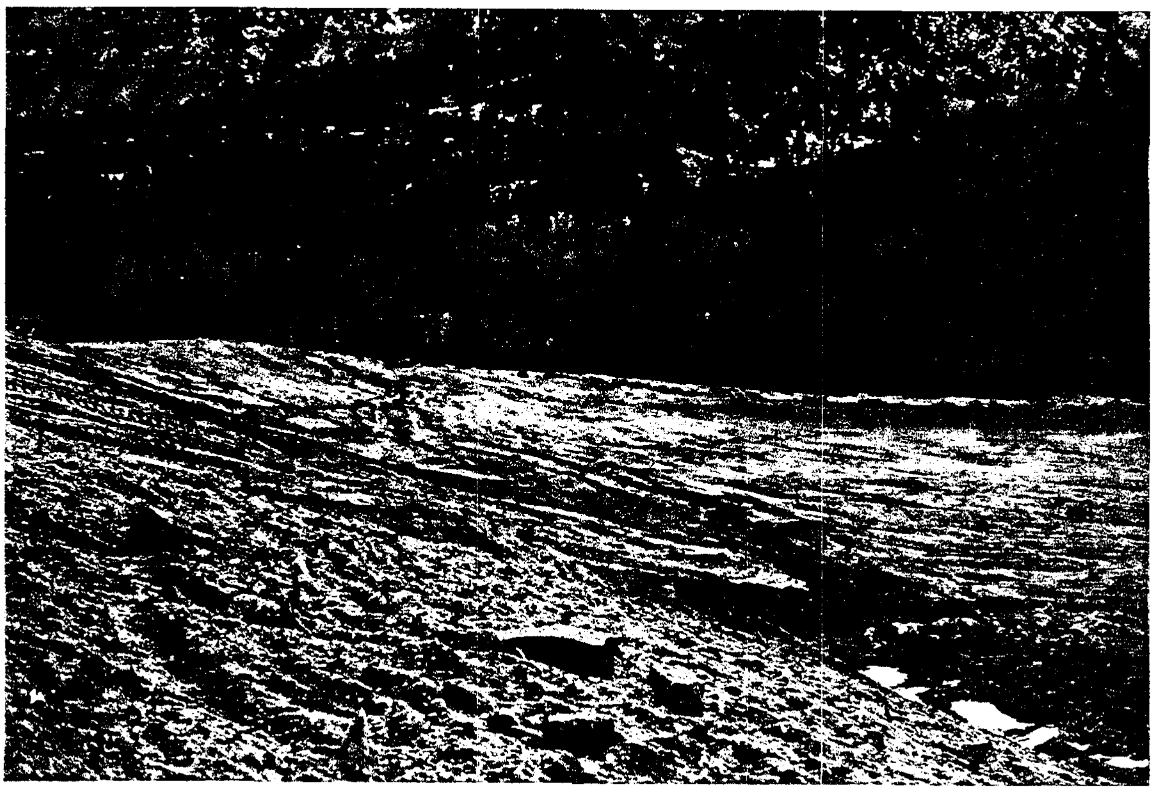


Photo #16 View of Lower Pad Towards Trail Creek

Photo #16 and #17

Lower Coal Waste Area

and Above

Photo #18 Inlet to Culvert TCC-5 and Spring Area

Photo #19 Seeded Area Over Sediment Pond Inlet Culvert

Photo #20 Edge of Lower Pad with Silt Fence

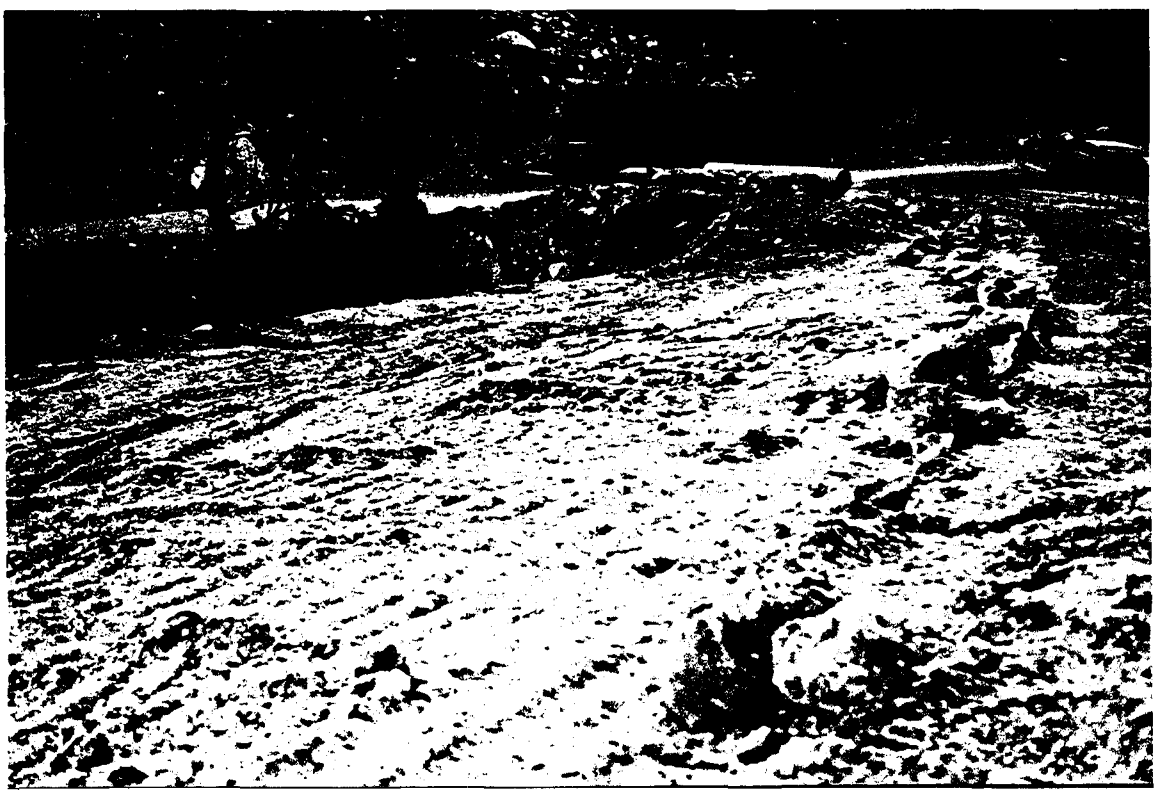


Photo #21 Edge of Lower Pad with Silt Fence