INSERTS	APPROVAL DATE	INSERTED BY WHOM	REMARKS
Pg 4-37.4+5	2/10/89	TR	Rest of Water Monitoring Plan needs inserting

Deer Creek
C/015/018

FINAL RECLAMATION (784.13)

Structural Removal

Following completion of mining, (est. 2032) work will begin on demolition of the surface facilities. All structural steel, metal siding and other building materials except concrete will be dismantled and disposed of off the permit area. All foundations and structures built of concrete are to be broken up and buried in the reclaim bin as shown on the cross-sections. The asphalt material will also be buried here and then covered with at least 4 feet of non-toxic material.

Portal Sealing

At the end of mining, much of the non-essential equipment will have already been removed from the mine site. Reclamation will begin with portal sealing (Figure 1).

Deer Creek Mine presently has five (5) entries and one (1) exhaust shaft and six (6) planned air intake portals within the north and south forks of Meetinghouse Canyon (3 portals within each fork). It is planned to construct permanent double-block seals with at least 25-feet of non-combustible material compacted to form an earthen plug.

Entry portals of the mine are located up-dip from the mined-out entries eliminating the need for hydrological seals or provision of providing water escapements. In case of mine water inundation after mine abandonment, the south fork

Revised 12/23/83
Revised 3/24/86
Revised 4/3/86
4-1

Added for Meetinghouse Breakout

Revised 4/3/86

Meetinghouse Canyon portals (lowest elevation) may discharge water. For further explanation refer to pages 4-32 thru 4-35 of the Protection of Hydrologic Balance section.

added for Meetinghouse breakout

Revised 12/23/83
Revised 3/24/86
Revised 4/3/86
4-1-A

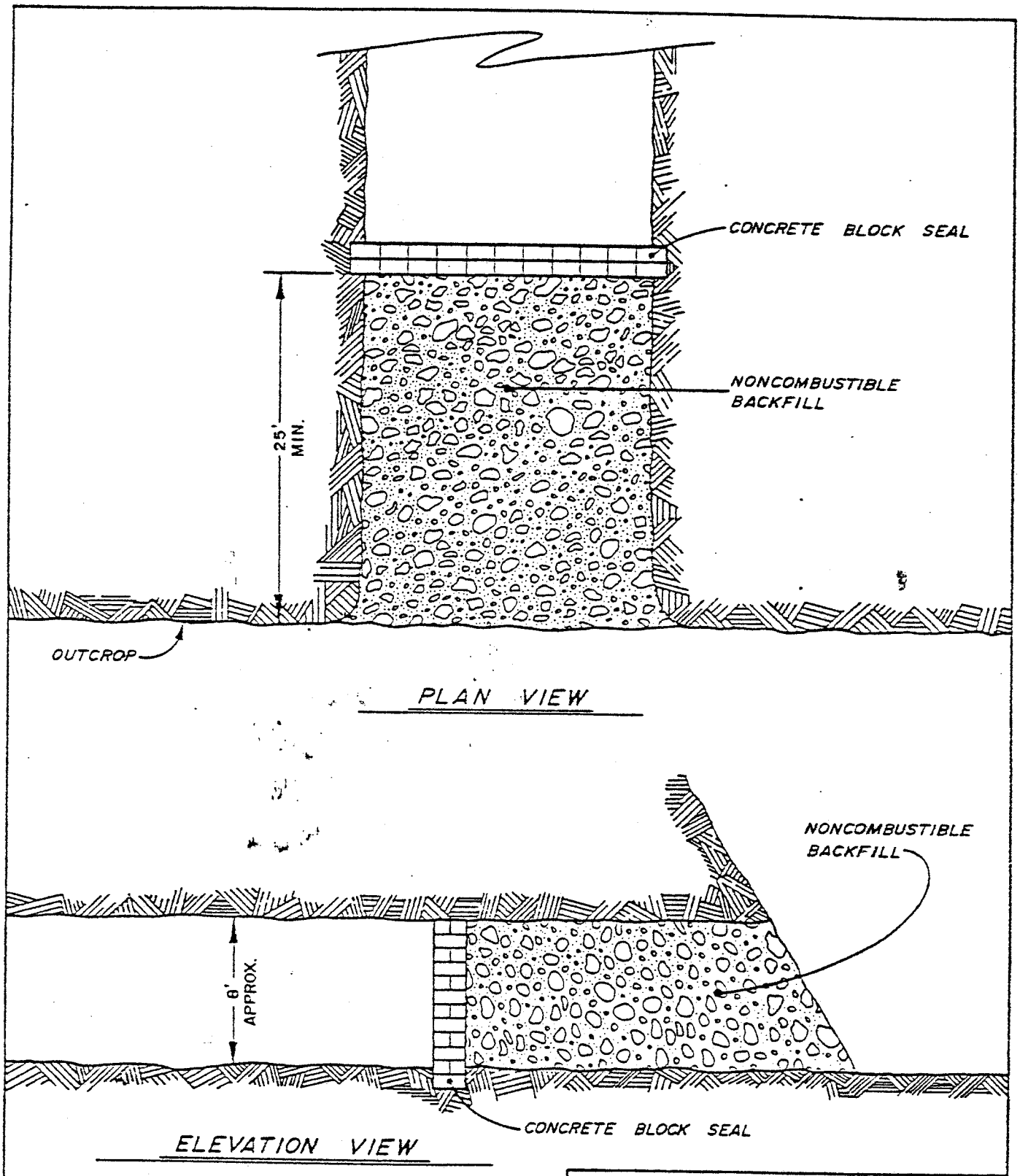


FIGURE 1

DEER CREEK COAL MINE EMERY COUNTY, UTAH		
TYPICAL PORTAL SEAL		
UTAH POWER & LIGHT COMPANY	SCALE: NONE	DATE: SEPTEMBER 2, 1980 DWG. NO.: CM-10319-WB

Reclamation Criteria

Under the requirements of providing sediment and erosional control during the revegetation period, applicant is faced with the same hydrological constraints that governed during the operational phase, which is, separation of disturbed and undisturbed waters to meet effluent limitations.

The following is Company's final reclamation plan:

1. Remove existing structures.
2. To leave in its final position, as shown, the mine area fill.
3. To leave in its extended position, after reclamation, the waste rock disposal fill.
4. To stabilize all fill structures as described below.
5. To slope all surfaces to protect surface runoff waters and reduce sedimentation loading.
6. To revegetate all disturbed areas to meet minimum requirements of plant cover, diversity and production as compared to the reference areas; and further, to meet the stated post-mine land use.
7. To remove the buried diversion systems, where necessary, and provide 100-year storm event channels as described below.
8. To provide a separate disturbed water collection system for sediment control.

9. To retain the sedimentation pond in connection with the disturbed water system until such time as land released is authorized by the regulatory authority.

AMENDMENT TO
APPROVED
Approved
J.E. 5/7/90

BACKFILLING AND GRADING

Fan Pad - Water Tank Pad

Once the structures have been removed and the portals sealed the backfilling and grading will begin.

Starting at the fan and water tank pad, the ventilation shaft will be backfilled using material from the fill section of the pad area. The remaining fill material will be used to contour the fan pad area.

Using the berm material around the water tank pad this areas will be contoured.

Deer Creek Channel

The 8-foot diversion culvert in Deer Creek begins approximately 900 feet above the bathhouse site. Average grade of this section is 25%. The 900 feet of culvert and inlet works will be removed and the channel reestablished in its original position and the same grade.

Included in this item will be the obliteration of the fan access road. Using the berm material the road cuts will be graded and contoured to blend with the surrounding topography.

The culvert removed from the channel will be hauled from the permit area and the concrete inlet will be broken up and buried.

The 18" mine water discharge pipe leading from the mine to the 8' diversion culvert will also be removed at this time.

Asphalt Removal:

The asphalt material and gravel base will be broken up and hauled to the R.O.M. bin for disposal. During disposal the asphalt will be broken up further and compacted.

Removal of Small Diversions:

This item includes the 36 inch culvert from Deer Canyon, the 30 inch culvert from Elk Canyon, also the 24 inch culvert from the side canyons in Elk Creek and the entire disturbed drainage system.

The culvert material will be dug up and removed from the permit area by truck, and the concrete inlets will be buried. The trenches will be backfilled to form as close as possible the original channels.

Remove 8 Foot Culvert from Parking Lot to Tipple Yard:

This section of the diversion runs parallel with the access road from the parking lot down to the tipple yard at an average 12% grade. Total length is 1,400 feet. The removed culvert will be loaded and hauled off of the permit area except for about 200 feet that will be reburied as part of the temporary drainage system.

Part of this item will be to plug, with concrete, the section of 8 foot culvert from the bathhouse to the parking lot that will be left in place.

Backfill Portal Highwall:

Using material from the Waste Rock Disposal Site the five portal entries will be backfilled and the highwall

backfill area 2:1 slope as shown on the typical cross sections.

Backfill R.O.M. Bin:

After the concrete footings, asphalt material and coal refuse (dust) has been buried, the area will be backfilled with existing material displaced during R.O.M. bin construction.

Sediment Pond Slope:

The binwall along the north side of the sediment pond will be removed and hauled from the permit area. After the binwall is removed the slope will be laid back on a 2:1 slope. Excess material will be used as cover for final backfilling and grading of the sedimentation pond.

Construct Final RipRap Channel:

Based on hydrologic calculations for the 100 year storm event, a riprap diversion channel will be built draining each of the three major canyons; Deer Creek, Deer Canyon and Elk Canyon (see Map 4-1 for configuration).

The channel areas will be excavated removing approximately 13,904 cubic yards of topsoil material which will be placed on the 298,900 square feet of reconstructed disturbed areas approximately 15 inches thick.

The riprap, gravel liner and clay liner will be purchased from a local contractor and hauled to the site and placed. Clean road base materials will be used first.

Temporary Diversions:

To channel the runoff from the reclaimed areas into the sediment pond, ditch A and B will be built.

To channel Elk Creek runoff past the pond, 200 feet of salvage 8 foot culvert will be buried as shown.

Rills and Gullies:

During the bonding period it is anticipated that some erosion of the vegetated areas will occur. Yearly maintenance is planned to stabilize these areas. Anticipated cost including mobilization is based on past history of what is done now during the operating life of the mine and expanded to cover the increased area involved.

Remove Sediment Pond and Build Channel:

Once reclamation is complete and the bonding period is complete the sediment pond dam will be cut out and spread on adjacent slopes. The final connection of the drainage channel and riprap fan will be installed as shown in Phase II.

Acid or Toxic Forming Material:

All coal dust, refuse and any other material found to be toxic will be buried in the R.O.M. bin and covered with four feet of material excavated from the channel construction. Costs associated are included in the backfilling and grading items.

Sediments from the pond, and waste rock material showing high SAR values will be thoroughly mixed into the overall waste rock material during construction of the disposal site. During final reclamation this area will be tested for toxic or acidic materials and the contaminated

material will be thoroughly mixed and buried with at least four feet of non-toxic fill.

General:

The flat areas of the parking lot-storage yard areas will be contoured and sloped toward the diversion channel during topsoil preparation and placement.

Equipment productivity and haul cycles were calculated using the Caterpillar Performance Handbook. Costs are from the 1984 Rental Rate Blue Book.

The equipment used is listed below:

	Hourly Rate
988B Loader, 325 HP, 7 yd. bucket	$121.38
769B Off-highway Truck, 35-ton	54.36
826B Compactor, 300 HP	87.57
621B Scrapers, 330 HP, 14 c.y.	101.52
D8K Dozer w/straight blade	87.76
235 Excavator, 195 HP, std. bucket	115.56
Tractor-Truck	27.78
Tanden Trailer, 30-Ton, flat-bed	9.40
D6D Dozer w/angle blade	48.65
John Deere 500 Backhoe	35.57
Flat-Bed Truck, diesel, mediu, 250 HP	22.24
Dump Truck, 50 Ton, 773	73.86
Crane (Clark 450 TC)	898/day
Air Drill, Track	86.45

The labor rates used are as follows:

Supervisor	$31.33 per hour
Operator	$28.45 per hour
Laborer	$21.95 per hour

Stability:

Backfilled slopes will be constructed not to exceed 2:1. Material used will be 3 foot diameter and less. The

material will be placed in 18 inch lifts and compacted with a 826B Compactor with a dozer blade.

No ground water is located in any of the backfill areas, therefore, no pore water pressure is used in the analysis.

Slope stability analysis was run on the final slopes of the portal highwall fill and the R.O.M. bin fill. Assumed value for cohesion of zero because the material is granular in nature. This is a conservative assumption. Using tables from Lambe and Whitman (1969) Table 11.2, a friction angle was selected.

ϕ = 40°. Assumed in place density of 120 pcf. Results are tabulated below:

R.O.M. Bin Slope

Height of fill H = 140 ft.

Friction angle ϕ = 40°

Cohesion C = 0

Density γ = 120 pcf

Calculated Safety Factor F = 1.9

Portal Highwall Fill

Height of Fill H = 20 ft.

Friction angle ϕ = 40°

Cohesion C = 0

Density γ = 120 pcf

Calculated Safety Factor F = 1.9

Waste Rock Disposal Site

Height of Fill H = 140 ft.

Friction angle $\emptyset$ = 40°

Cohesion C = 0

Density γ = 120 pcf

Slope 2H:1V

Safety Factor F = 1.9

Hydrology - Final Reclamation

Within the disturbed area of the Deer Creek Mine are three drainages. They are Deer Creek, Deer and Elk drainages. Deer Creek is by far the largest drainage with Elk Canyon second.

Confluence of these drainages occur within the planned reclamation of Deer Creek Mine (see Map 4-1).

Mining has created a large fill structure which is used for parking, material storage and necessary facilities to mine coal.

Reclamation consists of leaving this fill in place and constructing a flood channel across the top of this fill to an area north where natural bedrock can be utilized. Design, location, construction and materials are carefully chosen to ensure stable channelization. Deer Creek and Deer drainage will be combined and placed in a riprapped trapizoidal channel of sufficient size to accommodate a 100 year storm event. This location will take advantage of existing natural bedrock on the north side of the fill where the Starpoint Sandstone outcrops will provide the base for

cascading the waters down the steep slopes to the collection basin located in the bottom of the canyon.

As illustrated on Sheet 1 of 3, during Stage 1 reclamation an existing arch CMP culvert will be used to convey Deer Creek and Elk Creek flows past the sediment pond. During Stage II, the arch culverts will be removed and both Deer Creek and Elk Creek will be re-routed through the reclaimed area where the sediment pond is now located in an effort to return the flows to a more stable path.

Combined stream flow peaks from the various subdrainage areas shown on Figure No. 6 in Appendix IX were obtained by summation of the runoff hydrographs. This is an accurate representation for Deer Creek and Deer Drainage flows since they were calculated at the same relative locations. For the point below Elk Creek, however, it is an approximation. An estimate of the required time lag for proper hydrograph overlay was made based on average distance and stream velocity, and was found to be approximately two minutes. Such a short time interval does not justify stream routing to obtain a total peak flow. Runoff Hydrograph parameters as well as Runoff Hydrograph peaks are presented in Appendix IX.

There are three separate design factors which require some discussion to fully evaluate the storm runoff plan as presented. They are:

1. Channel construction across the fill structure.

2. Transitional flows over the sandstone outcrop and a geologic analysis of the existing bedrock and substrata.

3. Design criteria of the splash basin including the confluence structure of Elk drainage.

Before structure design can begin peak runoff flows must be determined. Hydraulic calculations utilized U.S.S.C.S. methods. Exact formulas for runoffs, peak flows, channel determination and riprap sizing can be founding in Appendix IX.

Final Reclamation storm events are commensurate with 100 year storm events as determined from N.O.A.A. atlases. Channel sizing and water flows, depths and velocities are found on Final Reclamation Map 4-1.

1. Diversion Design and Construction

Diversion ditches with excess velocities will require a rock riprap lining to prevent excessive channel erosion. These channels were designed in accordance with methodologies presented by the U. S. Department of Transportation (1975) and the U. S. Department of the Interior (1982). According to the Department of Transportation methodology, the maximum permissible depth of flow for a channel lined with rock riprap is determined by:

$$d_{max} = \frac{5\ (D_{50})}{\gamma\ (S_o)}$$

where:

d_{max} = maximum permissible depth of flow, in feet;

D_{50} = mean rock diameter (or the particle size gradation for which 50 percent of the mixture is finer by weight), in feet;

γ = unit weight of water, in pounds per cubic foot;

S_o = Channel slope, in feet per foot.

The mean rock diameter (D_{50}) in each case was assumed, from which the maximum permissible depth was determined. The channel configuration was then determined such that the maximum permissible depth at the design flow would not be exceeded.

Riprap filter gradation requirements were determined using the following equations as given by Anderson et al, 1970 and Surface Mining Water Diversion Design Manual contained in Appendix IX.

$$\frac{D15\ (Filter)}{D85\ (Base)} < 5$$

$$5 < \frac{D15\ (Filter)}{D15\ (Base)} < 40$$

$$\frac{D50\ (Filter)}{D50\ (Base)} < 40$$

Hydraulic and riprap design calculations for each stream channel are shown in the following table.

Ditch design calculations were presented previously along with the channel design calculations. The ditch section down the 18% slope is to be permanent and therefore was designed for the 100-year 24-hour event. The remaining ditch and associated culverts are temporary and were designed for the 2-year 24-hour event.

Revised 11/21/83
Revised 12/23/83

DEER CREEK MINE FINAL RECLAMATION CHANNEL DESIGN

CHANNEL DESIGN

H:V	Deg.	D_{50}	Mannings n
2:1	26.6	.25 - .5	.031 - .038
2.5:1	21.8	.75 - 1.0	.038 - .040
3:1	18.4	1.25 - 1.5	.041 - .042
		1.75 - 2.0	.043 - .044
		2.5 - 3.0	.046 - .047

STATION FROM	STATION TO	SLOPE Sf (ft/ft)	BOTTOM WIDTH B (ft)	SIDE SLOPE H:V	MANNINGS n	FLOW DEPTH Y_o (ft)	AREA $(ft)^2$	PERIMETER (ft)	HYDRAULIC RADIUS (ft)	MEAN VELOCITY V_o (fps)	FROUDE NUMBER Fr	RIP RAP D_{50} (ft)	Y max (ft)
DEEK CREEK													
0+00	8+10	.24	10	2:1	.035	2.0	27.3	18.8	1.5	26.7	3.2	—	—
		(LEAVE IN NATURAL CHANNEL - EXCAVATE TO BEDROCK)											
8+10	15+50	.018	15	2:1	.040	3.6	78.6	30.8	3.5	9.3	1.0	1.0	4.5
15+50	18+00	.018	15	2:1	.040	3.7	83.9	31.7	2.6	9.5	1.0	1.0	4.5
18+00	24+00	.05	15	2:1	.044	3.0	62.5	28.3	2.2	12.8	1.5	2.0	5.2
DEEP DRAINAGE													
0+00	1+00	.24	14	2:1	.046	1.2	19.1	19.2	1.0	15.8	2.7	2.5	—
1+00	2+50	.15	14	2:1	.044	1.2	20.4	19.5	1.0	14.8	2.5	2.0	—
2+50	9+00	.018	14	2:1	.035	2.1	32.1	23.4	1.6	7.9	1.1	0.5	2.2
ELK CREEK													
0+00	0+80	.13	15	2:1	.047	1.7	32.2	22.8	1.4	14.4	2.2	3.0	1.5
0+80	3+00	.02	15	2:1	.038	2.6	52.9	26.7	2.0	8.7	1.1	0.75	3.0
3+00	7+30	.17	20	2:1	.047	1.4	31.4	26.2	1.2	14.7	2.3	3.0	1.4
7+30	9+15	.17	20	2:1	.047	1.4	31.4	26.2	1.2	14.7	2.3	3.0	1.4
9+15	12+00	.02	20	2:1	.04	3.3	87.4	34.7	2.5	9.7	1.1	1.0	4.0
12+00	14+00	.12	20	2:1	.047	1.9	53.4	33.3	1.6	15.0	3.1	3.0	3.0
PITCH "A"													
		.15	6	2:1	.042	0.9	7.0	10.0	0.7	11.5	2.1	1.5	—
PITCH "B"													
		.02	0	2:1	.030	0.7	0.9	3.1	0.3	3.2	0.7	—	—

The design of culverts under inlet control as presented by the U.S.D.A. Soil Conservation Service, 1972, resulted in the values shown in the following table.

DITCH CULVERT DESIGN VALUES

Ditch	Culvert Size (inches	2-Year 24-Hour Design Flow Rate (cfs)	HW/D	Velocity in Culvert (fps)
A	33	27	1.0	4.5
B	18	5	1.0	2.8

2. Spillway Section

The Deer Creek channel between sections 23+00 and 24+00 is simply a transition to decrease flow depths before flowing over the sandstone outcrops. No designed or excavated spillway is intended between section 24+00 and the flow collector basin at the base of the cliff. The design intent of the transition is to produce as much sheet flow as possible over the cliff thereby increasing headloss and avoiding flow concentrations. Section BB′ on the final reclamation map shows a cross section of the channel at approximately station 23+95. Once the water leaves the confined channel it will travel down the rock face in a direction perpendicular to the surface contours where it will enter the flow collector basin.

All loose soils and rock, including vegetation, will be cleared along the path of the flow.

Geological Description of the Starpoint Sandstone at Deer Creek Diversion

Construction of the new Deer Creek drainage channel will require cutting an opening 30 to 40 feet wide in bedrock. A sandstone ledge approximately 30 feet thick will have to be cut back to create a shelf wide enough to accommodate the new channel. Water will flow from a riprap lined channel constructed on the fill pad into the new channel cut and over the edge of a cliff. Loose material will be removed and the channel widened where it steepens off the cliff edge. The widening will reduce erosional energy by creating a more sheet-like flow through the steepest part of the channel. Near the base of slope a special riprapped structure will further reduce energy of the flow before water reached its natural drainage.

The bedrock through the cut and cleared part of the channel will be the Starpoint Sandstone. The Starpoint is a durable, silica cemented, cliff forming sandstone. This formation is seen to be highly resistant to erosion to many natural drainages and is expected to form a good base for the new Deer Creek drainage channel. In the area of the channel specifically the Starpoint appears to be massive through most of the channel slope with possible minor shaley beds near the base of the slope.

3. Splash Basin Design Criteria

Principles of design of the energy dissipator (splash basin) at the confluence of Deer Creek and Elk Creek in Phase I were taken from Design of Small Dams (U. S. Department of

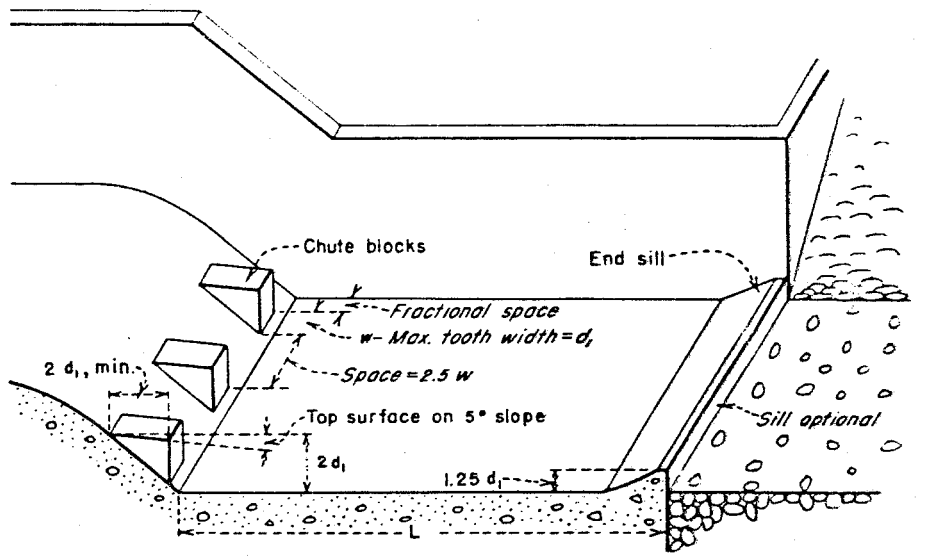
the Interior, 1977). Drawing Details can be found on the Phase I Reclamation plan view drawing.

The design procedure which matched best the conditions existing at the energy dissipating splash basin were found in Design of Small Dams (DSD) (U. S. Dept. of the Interior, 1977). Since the DSD design is based upon smooth rectangular spillways with know parameters, some modification and judgment in the procedure were required. Instead of known total upstream head and definable losses, reasonable expected head at the base of the cliff was used.

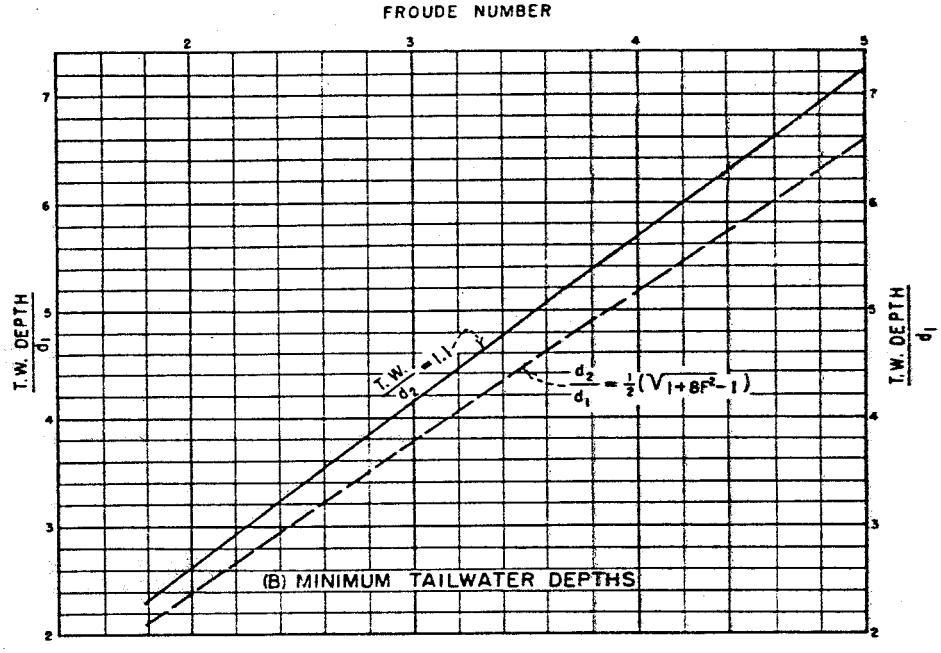
The design of the upstream channel will produce a sheet flow over the cliff which will aid in the dissipation of energy as the water falls downward over the cliff. Continued energy dissipation will occur as the water flows over the cleared hillside. As a result it is felt that the total head entering the collector basin will be on the order of 20 feet. The required downstream depth can be found from attached figure 268 taken from DSD. With a flow rate of 10 second feet per foot the downstream depth as shown in figure 268 with $\alpha = 0$ totals approximately 4.8 ft. where α is a loss coefficient. The 50 foot median length of the basin gives a length divided by downstream depth ratio in excess of 10. Basin length as calculated from figures 265 through 267 in DSD and attached for large froude numbers as well below that value which means that the length is conservative.

The energy dissipation unit at the confluence of Elk Creek has been designed for the 10 year event. The exist

8'-2" x 5'-9" CMP will handle the design flow at a depth of approximately 5.5 feet. If it is assumed that all the Deer Creek velocity head is changed to potential head (which is conservative) there may exist an additional 1.0 foot of depth. Subtracting the two values from the basin depth of 8.0 feet leaves a freeboard depth of 1.5 feet.



(A) TYPE IV BASIN DIMENSIONS



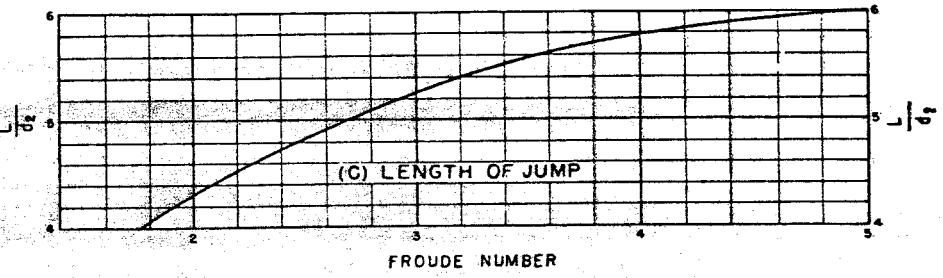


Figure 265. Stilling basin characteristics for Froude numbers between 2.5 and 4.5. 288—D—2425.

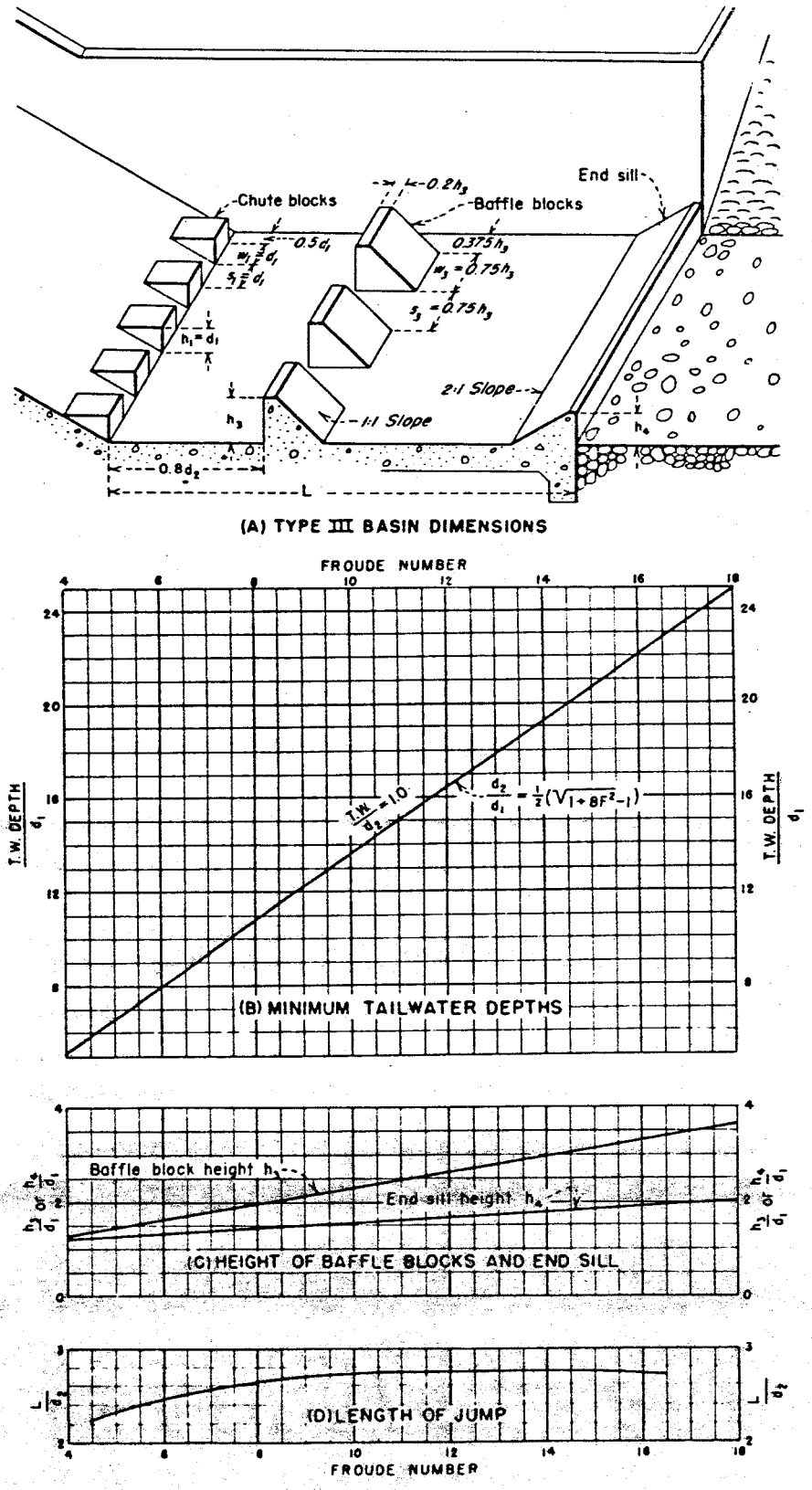


Figure 266. Stilling basin characteristics for use with Froude numbers above 4.5 where incoming velocity (V_1) does not exceed 50-60 feet per second. 288–D–2426.

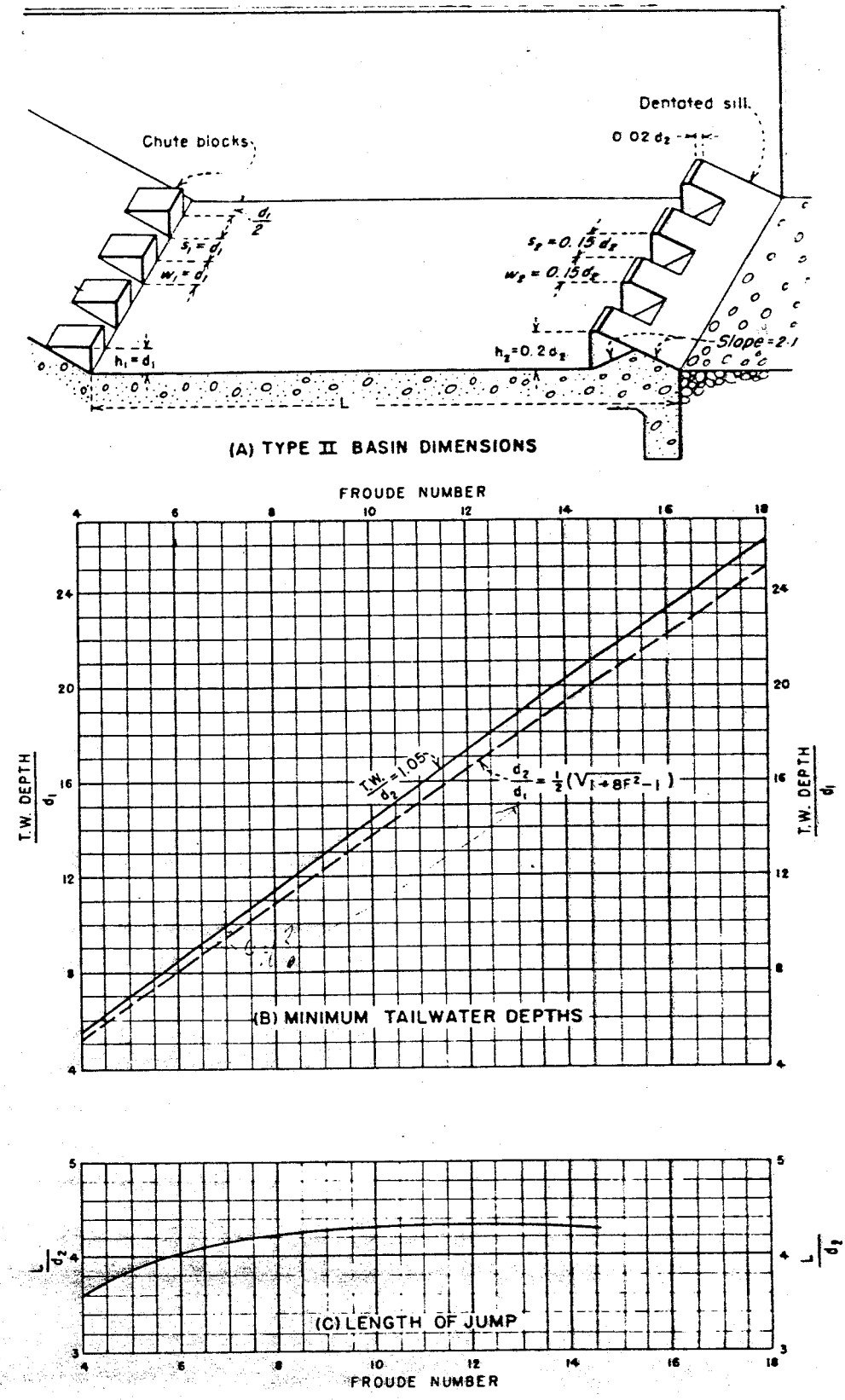


Figure 267. Stilling basin characteristics for use with Froude numbers above 4.5. 288-D-2427.

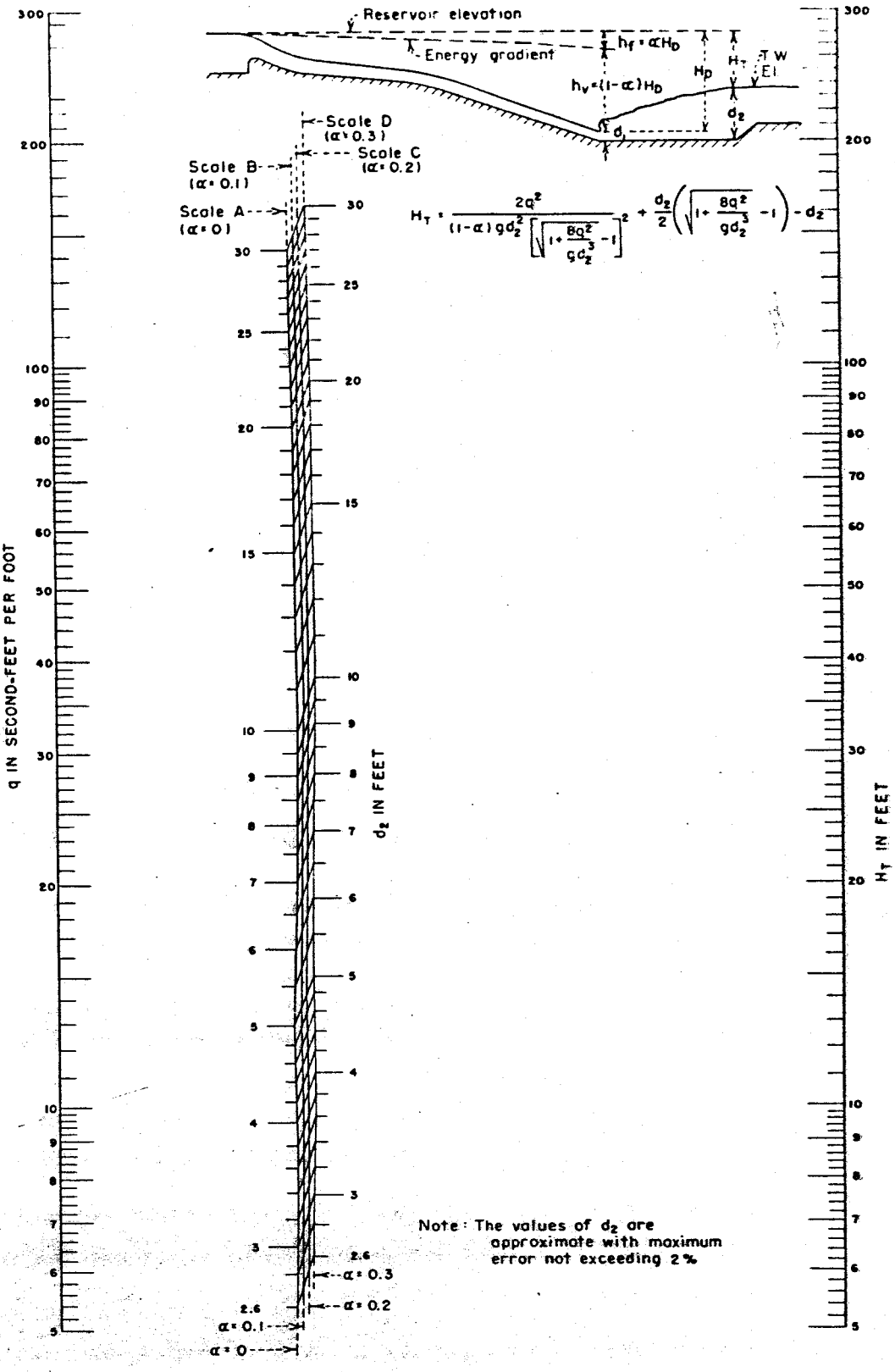


Figure 268. Stilling basin depths versus hydraulic heads for various channel losses.
288-D-2428.

Reclamation Plan - Upper Canyon Terrace

The access road and diversion ditch will be contoured back into the natural slope and revegetated. The terrace itself will be graded, revegetated and bermed for water containment as shown on Figure 1.

Reclamation Plan - Soil Sampling

After mining and prior to reclamation, a sampling program will be implemented to, (1) determine the extent of suitable substitute topsoil material and (2) identify acid and toxic-forming materials. Samples will be taken as follows:

Location	Map Location #s	Sample Sites	Sample/Site	Sample Depth
Upper Canyon Terrace	SS1 SS2	2	2	0-1' 1-4' (if possible)
Water Tank Pad Berm	SS3	1	2	0-2' 2-5' (or to depth of removal)
Fan Pad	SS4	1	3+	0-6" 6"-2' 2-5' 5'intervals to depth of removal
Fan Road Berm	SS5	1	1	0-2'
Reconstructed Channels	SS6 SS10	5	3+	0-6" 6"-2' 2-5' 5' intervals to depth of removal

Addition 9/17/84
Revised 6/27/88
4-12-E

Location	Map Location #s	Sample Sites	Sample/Site	Sample Depth
Waste Rock Disposal Site	SS11	1	3	0-6" 6"-2' 2-4'
Sediment Pond Slope	SS12	1	3+	0-6" 6"-2' 2-5' 5' intervals to depth of removal
Sediment Pond Dam	SS13	1	3	0-6" 6"-2' 2-4' (or to depth of removal)

(Refer to Map 3-9 Drawing No. DS202E, for proposed sample locations)

Each sample will be analyzed for the following:

Texture (% sand, silt, clay)

SAR (meg/l)

pH (standard units)

Ec (mmhos/cm)

Saturation Percentage (%)

Organic Carbon (%)

Total N (%)

Available Phosphorus (mg/Kg)

Boron (mg/Kg)

Selenium (mg/Kg)

Acid-Base Potential

Addition 9/17/84
Revised 6/27/88
4-12-F

The analysis data will be evaluated and the location and quantities of suitable substitute topsoil materials will be determined. If analysis data indicate the presence of acid or toxic-forming materials, sufficient additional sampling will be conducted to delineate the extent of such materials. All acid or toxic-forming materials will be covered with four (4) feet of non-toxic material.

Deer Creek Hydrologic Calculations & Containment Structure for Upper Canyon Terrace

Area Disturbed = .8 acres

Area Drainage = 3.2 acres

Total Acres = 4.0

100 Year 24 Hour Storm Precipitation = 3.5"

CN = 85

Runoff = 2.0

$$4 \text{ Acres} \times 2.0\text{" Runoff} = \frac{8.0}{12} = .66 \text{ Acre Feet}$$

$$\frac{\text{Storm}}{\text{Containment}} = \frac{.66}{.8} = .8\text{' Height}$$

A 2' High by 4' Wide Berm on the Outslope Portion of the Terrace will Provide Necessary Hydrological Protection.

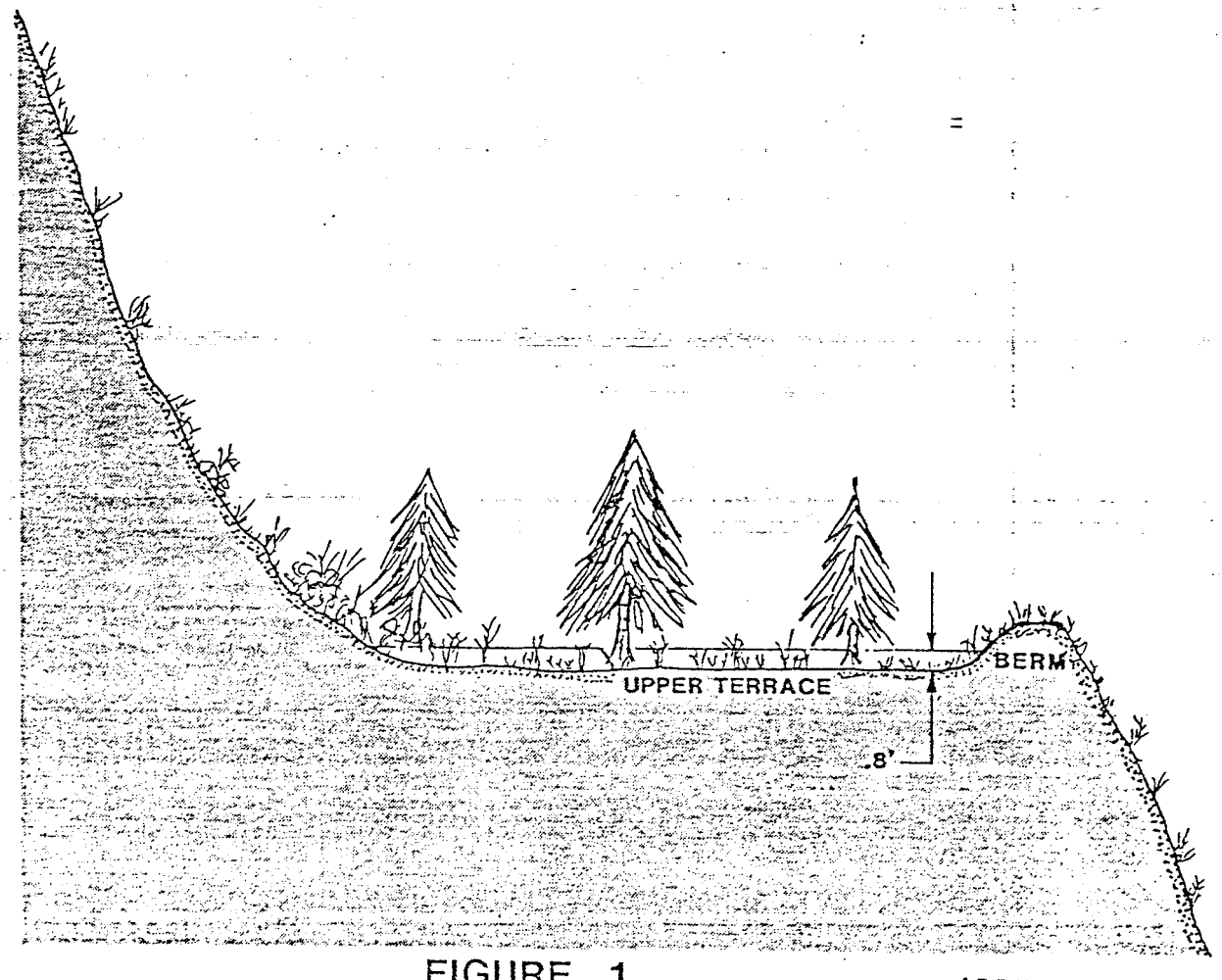


FIGURE 1

ADDITION 9-17-84

REVEGETATION (UMC 817.111-.117)

Interim Stabilization and Vegetation Plan

There are two major fills and several minor fills at the Deer Creek Mine with bare open slopes with north, south and southeast exposures. With the proposed reclamation plan these fills would provide a portion of the soil material for the final contouring and grading. Because no topsoil was stockpiled and the native soils on these steep slopes provide very little topsoil material the fill material would need to become the planting medium. An off-site source is impractical. The fill material was tested in 1980 and again in 1983 for its physical and chemical properties.

The soil material in the fills was originally derived from sandstone and shale parent materials. The soil material particles are mostly sand with textures from sandy clay loams to loamy sands (Table I). The water holding capacity is low, typical of sandy soils.

They are calcerous soils as indicated by ph's of 7.5-8.5 and calcium carbonate equivalents above eight percent (Table II). Salt content is too low for any harmful affects on plants. Potassium, phosphates and nitrogen, important plant nutrients, are very low indicating the need for fertilization to insure plant growth. The organic material is principally coal debris, the nitrogen percentage ratio is too low.

TABLE I: SOILS PHYSICAL PROPERTIES

Sample #	Year	Identification	Particle Dist. % Sand	Silt	Clay	Texture	pH	Saturation %	Ece
663[1]	1980	Parking Lot Fill Slope					7.9		9.0
664	1980	Parking Lot Fill Slope					7.9		9.0
1101[2]	1980	NE of Portal 0-4"	25	50	25	SL	8.2		0.5
1102	1980	NE of Portal 4-14"	30	49	21	SL	8.4		0.8
1103	1980	SW of Portal 0-4"	34	47	19	SL	7.9		4.9
1104	1980	SW of Portal 4-14"	32	48	20	L	8.4		2.5
1105	1980	Fill Under Conveyor	52	31	17	L	8.0		6.9
1106	1980	Slag					10.9		7.0
1120	1980	Coal Waste					8.1		0.7
1121	1980	Coal Waste					8.2		0.9
1122	1980	Coal Waste					8.1		1.0
DC#1	1983	Berm	74	11	15	LS	7.9	30	.53
DC#2	1983	Conveyor	55	25	20	SCL	8.4	30	.32
DC#3	1983	Pkg. Lot Fill	72	15	13	LS	8.1	20	.51
DC#4	1983	Pkg. Lot Fill	65	10	25	SCL	7.6	20	.24

1. Randomly selected samples from spoil banks of the Deer Creek area.

2. Samples of soil and spoil from the Deer Creek Mine.

3. Fill soil material samples collected on subsurface layers in fill (4"-20"). Sample composition from ten subsamples on each fill slope.

Revised 11/21/83

TABLE II: SOILS PRODUCTIVITY ANALYSIS

Sample #	SAR	OM %	N %	Ca %		Mg %	Na (Meg/L)	K %	P ppm	$CaCO_3$ Equivalents %
663							45.7	.01	.7	
664							38.3	.01	.6	
					(Ca+Mg)		%			
1101	0.5	1.9			44.5		.8	.01	.3	
1102	0.9	1.8			5.7		1.6	.01	.1	
1103	1.5	4.7			49.4		7.4	.04	35.0	
1104	1.6	1.6			16.2		4.6	.04	.6	
1105	7.6	0.7			43.2		35.2	.01	6.7	
1106	6.8				46.8		33.0	.01	1.3	
1120	2.0				4.0		2.8	.01	.5	
1121	1.9				5.2		3.1	.01	.9	
1122	1.8				5.9		3.1	.01	.8	
DC#1	.086	5.97	.075	5.89		1.25	.089	.170	.025	14.7
DC#2	3.043	7.64	.055	7.10		1.20	.062	.146	.165	15.1
DC#3	4.723	17.60	.096	9.61		2.45	.116	.073	.085	17.1
DC#4	4.154	13.82	.077	6.89		1.68	.086	.125	.036	15.9

Revised 11/21/83

Interim Vegetation Establishment

Fill Slopes

The fill slopes at the equipment yard and ROM conveyor pad require stabilization. These slopes are steep and suffer erosion from wind, precipitation, surface water flows and sloughing. Past revegetation efforts were unsuccessful and only a few sites of 10 square feet or less have any growth. This is a thin growth of sweetclover and wheatgrasses. The interim vegetation plan will control these forces by:

1. A vegetative cover to protect the soil surface.
2. A well developed root system to retard soil movement.

The interim vegetation plan will also provide the basis for developing a final revegetation plan by:

1. Testing various plant species adaptability to these soil materials. Introduced species also tested for their possible role in final revegetation.
2. Testing and developing planting techniques with the highest probability of success.
3. Developing the fill material as a substitute for topsoil by establishing a root system in the top layers along with organic material buildup and an environment suitable for micro-organism colonization.
4. Provide a detailed analysis of soil productivity with a series of tests over the life of the mine. This would be the basis for fertilization and soil handling at the final revegetation.

The upper 18-24" fill layer would then become the "topsoil" by nature of its established plant community with micro-organisms, organic deposition, nutrient soil cycles, root zone, etc. At final reclamation this "topsoil" would be removed and stored during the redistribution of fill and grading. The temporarily stored "topsoil" would then be placed on the newly graded surfaces 6-12 inches deep at random locations. This would increase the variability of the soil surface and provide areas of established growing medium with its own plants, roots and seeds to speed plant establishment the following spring. This will serve as a catalyst for the final seedings and plantings.

The seed mix and plantings were designed more for soil stabilization than to provide wildlife food or livestock forage. The plant species were selected on the basis of their drought tolerance, alkalinity tolerance, vegetative growth form (cover soil surface), root systems (both taproot and spreading) and nitrogen fixation potential. Because the slope's aspects emulate the pinyon-juniper plant community on steep slopes most species selected were native to the reference area. Some faster growing species were utilized to provide plant cover while the slower native species become established.

Revegetation of the fill slopes was implemented in 1981/82. However, adherence to specified methods and timing is questionable and monitoring was not conducted at the sites Subsequent interim revegetation, at various locations at Deer Creek Mine, is discussed in the 1987 Vegetation Monitoring Report, which has beem submitted to the Division as part of the annual reporting process. Monitoring and reporting will continue on an annual basis. Additional interim revegetation will begin in the fall of 1988.

Common Name	Scientific Name	Lbs/Acre Equivanlent PLS*
Grasses		
Thickspike Wheatgrass	Agropyron dasystachyum var. Critana	5
Western Wheatgrass	Agroypron smithii var. Roasanna[1]	6
Indian Ricegrass	Oryzopsis hymenoides var. Paloma	4
Squirreltail	Sitanion hystrix[2]	3
Greatbasin Wildrye	Elymus cinereus	4
Forbs		
Cicer Milkvetch	Astragalus cicer	1
Yellow Sweetclover	Melilotus officinalis[2]	1
Alfalfa	Medicago sativa var. Spreader[2]	1
Palmer Penstemon	Penstemon palmeri[2]	1
Shrubs		
Curleaf Mahogany	Cercocarpus ledifolius	2
TOTAL		28

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

Test Plantings	
Shrubs	
Utah Serviceberry	Amelanchier utahensis
Big Sagebrush	Artemisia tridentata var. tridentata
Curleaf Mahogany	Cercocarus ledifolius
Oldman Wormwood	Artemisia abrotanum
Cliffrose	Cowania mexicana
Green Rabbitbrush	Chrysothamnus viscidiflorus
Utah Juniper	Juniperus osteosperma
Kochia	Kochia prostrata[2]
Golden Currant	Ribes aureum

*PLS - Pure Live Seed
1 - Sod-forming variety
2 - Faster growing species

Revised 11/12/90
4-18
Deer Creek

Mechanics of Interim Revegetation

Fill Slopes

The fill slopes are relatively small areas and because of the steepness all of the seeding and planting work will be done by hand (or by hydroseeding.) These slopes are severe planting sites and successful establishment of a vegetation cover will require close attention to details, some favorable growing conditions and repeated efforts. The criteria for success will be the establishment of a reproducing plant cover on the majority of the slope. This may require a three to seven year period. Fast-growing cover crop species were not included in the seed mixture for fear they would consume the soil moisture on these arid sites during the germination and seedling growth of the perennials. The shrub test plantings purpose is to determine what species will be most likely to succeed in the final revegetation phase to establish a shrub cover on the slopes.

Seeding - (Fall)

1. Clean the slopes of debris.
2. Broadcast the seed mixture at the predetermined rate with "hurricane spreaders" (or hydroseeder.)
3. Broadcast the fertilizer mixture with "hurricane spreaders" or hydroseeder at the rate determined by soils analysis:

ammonium nitrate	50 lbs/acre
triple superphosphate	75 lbs/acre

4. Rake up the slopes to turn the soil surface but not to smooth out the irregularities. The worker's footprints will be left as micro-niches for seed. (Slopes will not be raked if hydroseeding is utilized.)

5. The slope will then be covered with a 1/2" layer of green alfalfa hay for mulch (2 tons/acre) [1], or hydromulched.

6. The mulch and seed will then be covered with "Vexar" netting. This netting will be secured at the toe and lip of slope and also on the slope with staples. The net will retain the seed and mulch on the slope. (Netting will not be used with hydromulch.)

7. The seeding operation will be completed in the late fall to take advantage of the winter moisture. All slope drainage will be channeled to the sedimentation pond.

8. Irrigation will not be scheduled the first growing season following seeding and planting. Should the initial effort fail then the slopes would be reseeded and planted and irrigation utilized. The water would be sprinkled from a water truck to soil surface saturation at two week intervals during May, June, July, and August.

---

1. During recent revegetation trials in Utah the author has determined that the greatest single positive influence on seed germinations and growth was mulching with green alfalfa hay. Apparently the hay begins decomposing in soil and building a micro-organism population. Thus the soil nutrient cycle is enhanced providing additional nutrients, especially nitrogen, to the seedlings. Also, the retention capability of the soil is increased with the increased organic matter.

   Alfalfa hay also brings in foreign forb seeds common to cultivated sites. These forbs become established in the first year but quickly fade in the second year and were completely gone by the third year in our trials.

Revised 11/21/83
Revised 12/23/83
Revised 06/27/88

Shrub Test Plantings

1. The following spring early (March) small container stock of the nine shrub species (12 ea.) will be hand planted on a 20 x 25 foot test strip. Each vertical planting row will be on 2 foot centers with 12 plantings per row from the toe to the lip of the slope. Each species will be rotated in the planting order so they are randomly scattered in the rows.

2. Each planting site in the row will have a basin where the planting can be located to receive maximum soil moisture.

3. A 20-10-5 fertilizer tablet will be placed adjacent to each planting at the root zone depth.

4. Each shrub plant will be enclosed in a "Vexar" net tube for protection from animals.

5. Each planting will be hand watered and marked with a stake.

Maintenance and Monitoring

1. Signs will be placed around the planted slopes for their protection.

2. Weed control will not be undertaken unless it is determined necessary due to weed dominance and delayed rate or succession. Studies indicate that competition from weeds, including Salsola kali, is greatly reduced within three (3) years after revegetation. Preliminary on-site studies support published reports on this matter.

no routine weed control

3. Rodent damage, on revegetated areas, will be assessed and species specific control measures will be implemented as necessary.

no routine rodent control.

4. A site visit will be scheduled each spring to check on fitness of the sites and check progress of the plant growth. "For three years."

deleted

5. A site visit will be conducted in August to record plant growth. Two photo stations will be located on each slope to record yearly progress. The shrub plantings will be tallied for the survival rate and health of each species (survival judged as 50% of crown alive). A permanent 100' line intercept or quadrat transect will be located on each slope to record species composition and cover.

Revised 11/21/83
Revised 12/23/83
Revised 06/27/88

6. Beginning with the 1987 growing season an annual report that summarizes the year's work will be placed in the Company's files and forwarded to D.O.G.M.

7. The soil materials on the fill slopes would be sampled at five year intervals to record productivity changes. Ten samples at 0-20" depths would be compiled from each of the two fill slopes for analysis. Analysis would include:

   Organic Nitrogen
   Phosphorous (ppm)
   Potassium (ppm)
   Nitrate Nitrogen
   Sodium Absorption Ratio
   Electrical Conductivity (mmhos/cm)
   pH

Final Revegetation Plan

The final revegetation plan may be revised to incorporate the results of the interim revegetation plan.

Seed Mixture

1. Pinyon-Juniper

Common Name	Scientific Name	Lbs/Acre Equivalent PLS*
Grasses		
Western Wheatgrass	Agropyron smithii var. Rosanna	6
Salina Wildrye	Elymus salinus	2
Indian Ricegrass	Oryzopsis hymenoides var. Paloma	4
Squirreltail	Sitanion hystrix	3
Thickspike Wheatgrass	Agropyron dasystachyum var. Critana	5

Revised 11/21/83
Revised 12/23/83
Revised 9/17/84
Revised 6/27/88

Forbs		
Pacific Aster	Aster chilensis	0.2
Northern Sweetvetch	Hedysarum boreale	1 ← reduced from 10#
Louisiana Sage	Artemisia ludoviciana	2
Eaton Penstemon	Penstemon eatonii	2
Corymbed Eriogonum	Eriogonum corymbosium	1
	TOTAL	26.2

* Pure Live Seed

Shrubs		Plants/Acre
Utah Serviceberry	Amelanchier utahensis	150
Big Sagebrush	Artemisia tridentata var. tridentata	150
Curleaf Mahogany	Cercocarus ledifolius	150
Green Rabbitbrush	Chrysothamnus viscidiflorus	150
Trees		
Utah Juniper	Juniperus osteosperma	150
Douglas Fir	Pseudotsuga menzisii	150
	TOTAL	900
	REFERENCE SITE	654

2. Riparian

Grasses		Lbs/Acre PLS*
Streambank Wheatgrass	Agropyron riparium var. Sodar	8 ~ 28 pls
Indian Ricegrass	Oryzopis hymenoides var. Paloma	8 32 pls
Needle and Thread Grass	Stipa comata	8 21 pls
Forbs		
Louisiana Sage	Artemisia ludoviciana	2
Silky Lupine	Lupinus sericeus	10
Yellow Sweetclover	Melilotus officinalis	4
Eaton Penstemon	Penstemon eatonii	2
	TOTAL	42

Shrubs, Container Stock		Plants/Acre
Rocky Mtn. Maple	Acer glabrum	300
Saskatoon Serviceberry	Amelanchier alnifolia	300
Oregon Grape	Berberis repens	300
Woods Rose	Rosa woodsii	300
Coyote Willow	Salix exigua	300

Revised 11/21/83
Revised 12/23/83
Revised 9/17/84
Revised 6/27/88

Trees, Container Stock			
White Fir	Abies concolor		50
Narrowleaf Cottonwood	Populus angustifolia		200
Douglas Fir	Psuedotsuga menziesii		50
		TOTAL	1,700
		REFERENCE SITE	1,266

3. Mixed Conifer

Grasses		Lbs/Acre Equivalent PLS
Bluebunch Wheatgrass	Agropyron spicatum	6
Intermediate Wheatgrass	Agropyron intermedium*	5
Salina Wildrye	Elymus salimus	2
Kentucky Bluegrass	Poa pragnsis	1
Squirreltail	Sitanion hystrix	3
Forbs		
Pacific Aster	Aster chilensis	0.2
Northern Sweetvetch	Hedysarum boreale	1 ← reduced by 7#
Silky Lupine	Lupinus sericeus	1
Corymbed Eniogonum	Eriogonum corymbosium	1
Yellow Sweetclover	Melilotus officinalis	2
Eaton Penstemon	Penstemon eatonii	2
	TOTAL	24.2

Shrubs, Container Stock		Plants/Acre
Rocky Mtn. Maple	Acer glabrum	400
Utah Serviceberry	Amelanchier utahensis	800
Creeping Barberry	Berberis repens	680
Green Rabbitbrush	Chrysothamnus viscidiflorus	400
Golden Currant	Ribes aureum	400
Blue Blackberry	Sambucus cabrulea	400
Mountain Snowberry	Symphoricarpos oreophilus	800
Trees		
White Fir	Abies concolor	50
Limber Pine	Pinus flexilis	20
Douglas Fir	Psuedotsuga menziessi	50
	TOTAL	4,000
	REFERENCE SITE	3,348

* Intermediate Wheatgrass is used because of its proven adaptability to this region and altitude and its value for erosion control and forage.

Revised 11/21/83
Revised 12/23/83

Planting Techniques

The fill material will be the planting medium after grading. The revegetated slope material will be used as planting medium, as explained in interim plan. The larger scale plantings will be less susceptible to wildlife damage and the shrubs will be planted in protectors. Grazing will not be allowed on the lands until after bond release. Fencing will be installed if necessary to preclude grazing. The plantings will be randomly spaced and clumped for wildlife enhancement. The species selection is based on reference site species list and ability to provide wildlife food and cover with several layers of vegetation. Grazing will be enhanced by establishment of the perennial grasses.

Procedure

Pinyon-Juniper and Mixed Conifer:

1. The exposed level tops of the fills and road surfaces will be ripped and disked by tractors prior to broadcasting of seed mixture. Hand raking methods will be utilized on slopes.

2. Broadcast seed mixture in fall (September-October).

3. Broadcast fertilizer mixture. Application rate would be dependent upon soils analyses, especially final analysis of freshly exposed soil materials of fills.

   Approximately:

Ammonium Nitrate	50 lbs/acre
Triple Superphosphate	75 lbs/acre

4. The soil surface will then be turned with a horizontal drag. The steepest slopes will be hand raked up the slope. This technique would not remove the irregularities in the soil surface but only lightly cover the seed and fertilizer. Workers footprints on the slopes would serve as micro-niches for germination.

5. The green alfalfa hay would then be spread upon the soil surface ½" thick or 2 tons/acre.

6. On the steep slopes (3:1+) the soil surface would be covered with "Vexar" netting to retain the mulch, seed and fertilizer. The netting will be secured at the toe and lip of the slopes and stapled on the slope.

7. The following spring (March-April) small container stock of the shrub and tree species will be hand planted. At each individual plant a catch basin will be formed. A 21 gram 14-14-14 fertilizer tablet will be inserted at the root zone. Then each basin will be hand watered. Each planting will be protected by a "Vexar" tube.

Pinyon-Juniper:

a. Species clumping by size to give a two layer affect to clumps.

   1. Spacing approximately 15 feet randomly 150 clumps/acre.

   2. Clump size 4' x 4', 2' spacing for plantings.

      Lower : Chrysothamnus viscidiflorus
      Artemisia tridentata
      Amelanchier utahensis

      Upper: Juniperus osteosperma
      Pseudotsuga menzisii
      Cercocarpos ledifolius

   3. Clump Composition:

      Lower: 3 shrubs
      Highest: 2 trees + 1 shrub
      Juniper on xeric sites
      Firs on mesic sites

Mixed Conifer:

a. Specific clumping by size to give a 3-layer affect to clumps.

1. Spacing approximately 10 feet randomly on centers; 200 clumps/acre.

2. Clump size 4' x 4'; 1' spacing for plantings.

		Planting/ Clump
Lower:	Berberis repans	3
	Chrysothamnus viscidirlorus	2
	Symphoricarpos oreophilus	4
Middle:	Acer glabrum	2
	Amelanchier utahansis	4
	Ribes avrbum	2
	Sambucus caervlca	2
Upper:*	Abies concolor	
	Pinus alexilis	
	Psevdotsuga menzibsii	

* 1 tree species per clump

3. Clump Composition:

Lower:	9 shrubs (3 species)
Middle:	10 shrubs (4 species)
Upper:	120 clumps have 1 tree
	80 clumps without trees

8. The sedimentation pond will be revegetated with the above techniques at end of ten year responsibility period.

9. Irrigation will be utilized should the initial seedings and plantings fail. Following the second effort, sprinkle irrigation to soil surface saturation will be scheduled at two week intervals during May, June, July, and August.

Riparian:

a. Species clumping by size to give a 3 layer affect to clumps.

1. Spacing approximately 10 feet randomly 300 clumps/acre.

2. Clump size 4' x 4'; 2' spacing for plantings.

Lower:	Berberis repens Rosa woodsii
Middle:	Acer glabrum Amblancheir alnifoua Salix exiqua
Upper:*	Abirs concolor Populus angustipolia Pscudotsuga menziesii

* 1 tree species/clump

3. Clump Composition:

Lower:	2 shrubs
Middle:	3 shrubs
Upper:	1 tree

In addition, 600 trees/acre will be planted at 8' random spacing per USFS recommendation.

Trees Container Stock

White Fir	100
Douglas Fir	100
Narrow Leaf Cottonwood	400
Total	600

Riparian Techniques:

1. The soils removed to reconstruct the stream channels will be deposited on the banks. These banks (10-15' wide) will be hand raked to loosen the surface prior to seeding.

2. The seed mixture will be broadcast with "hurricane spreaders."

3. The fertilizer mixture would be broadcast by "hurricane spreaders." Application rate would be dependent upon soils analysis of the soil material (see interim procedures).

Approximately:

Ammonium Nitrate	50 lbs/acre
Triple Superphosphate	75 lbs/acre

4. The soil surface would then be turned with a heavy chain drag. This will lightly cover the seed and fertilizer.

5. The green alfalfa hay would then be spread upon the soil surface one-half inch thick or 2 tons/acre.

6. The following spring (March-April) small container stock of the shrub and tree species will be hand planted. At each planting clump a catch basin will be formed. A 21 gram 14-14-14 fertilizer tablet will be inserted at the root zone. Then each basin will be watered. Each planting will be protected by a "Vexar" tube.

Maintenance and Monitoring

1. Signs will be placed around the planted slopes for their protection.

2. Weed control will not be undertaken unless it is determined necessary due to weed dominance and delayed rate or succession. Studies indicate that competition from weeds, including Salsola kali, is greatly reduced within three (3) years after revegetation. Preliminary on-site studies support published reports on this matter.

3. Rodent damage, on revegetated areas, will be assessed and species specific control measures will be implemented as necessary.

4. A site visit will be scheduled each spring to check on fitness of the sites and check progress of the plant growth.

5. Annual monitoring will include inspection for rills and gullies. Should these be present, they will be filled and replanted as required.

6. The reference areas will be checked on the annual visit to see that man-induced activities are not disturbing the sites. These sites are identified by signs and located on maps to notify USFS and Emery Mining Corporation of their significance.

7. The failure of germination or the failure of the majority of the vegetation to maintain itself and/or produce a second generation will signal the requirement for a subsequent seeding and planting effort.

Revised 9/17/84
Revised 6/27/88
4-28-A

Sampling for Ten Year Responsibility Period and Bond Release

1. All sampling will be undertaken in the late summer for maximum plant growth.

2. The line intercept or quadrat method will be used to measure cover and species composition.

3. The point-center quarter method based on the line intercept transects will be used to measure shrub and tree density.

4. Sample size for cover will be tested at the 90 percent confidence level and density sample size at the 80 percent confidence level. This will equate with the sampling tests for reference site measurements, see Vegetation Information for the Deer Creek Mine, for details.

5. Productivity measurements will be a double sampling procedure of clipped plots and ocular estimates. Five each 6.27"x100" rectangular plots at five random points would be located in reference areas and revegetation sites. Sampling confidence at the 80% level.

6. Revegetation Success:

   a. Inventory of reference sites at end of ten year responsibility period according to methods used at initial inventory and approved by D.O.G.M.

   b. Ground cover is established for two consecutive years at the end of responsibility period at 70 percent of reference site ground cover.

   c. Shrubs and trees will be in place for at least two growing seasons, the tree or shrub is alive and healthy and the tree or shrub shall have at least one-third of its length in live crown.

   d. The woody plants aerial cover is 90 percent of the reference site at the 80 percent confidence level.

   e. The students t test of the sample means will be used for the statistical comparison test.

Revised 12/23/83
Revised 9/17/84
Revised 6/27/88

Soil Stabilization of Rills and Gullies

Rills and gullies will be filled, graded, or otherwise stabilized and the area reseeded or replanted by hand methods, or backhoe, dependent on size or nature of disturbance. Based on our present maintenance program of fill slopes, we estimate 24 hours per year of work will be needed.

PLAN FOR GRADING ALONG THE CONTOUR (UMC 817.101 (b) (7))

All final grading, preparation of overburden before replacement of topsoil, and placement of topsoil, shall be done along the contour to minimize subsequent erosion and instability. If such grading, preparation, or placement along the contour is hazardous to equipment operators, then grading, preparation, or placement in a direction other than generally parallel to the contour may be used. In all cases, grading, preparation, or placement shall be conducted in a manner which minimizes erosion and provides a surface for replacement of topsoil which will minimize slippage.

All roads servicing disturbed areas will be scarified prior to topsoil placement.

RECLAMATION COST (784.13)

Estimated costs for reclamation are based on 1984 values and include all lands having been disturbed for the purpose of handling, crushing, storing and transporting coal extracted through the Deer Creek Mine.

The following are the estimated costs for reclamation:

Total Reclamation Costs	$950,116
Mobilization and demobilization	10,000
10% Contingency	95,012
1984 Total Reclamation Cost	$1,055,128

* It is customary for contractors, who must move men and equipment from job site to job site, to charge additional monies to competively bid for such purpose. This charge is usually in the form of mobilization and demobilization. On very large projects these charges are usually built into the unit costs of work. Applicant states no costs are built into the reclamation work and will provide a lump sum of $10,000 for such purpose. It is felt this sum is sufficient to transport the needed equipment from any of the three major cities along the Wasatch front.

In addition, applicant has applied an escalator equal to the U. S. Government's price indexing based on the last five years, as shown.

RECEIVED
JUN 29 1988
DIVISION OF
OIL, GAS & MINING

Cost changes during the preceding three years, as provided by the Means Historical Cost/Index (Salt Lake Index):

1981 - 1982	--	9.9%
1982 - 1983	--	9.4%
1983 - 1984	--	1.04%
		20.34%

20.34% ÷ 3 = 6.78%

Using the 1984 reclamation costs of $1,055,128 this compounds to $1,464,720 for 1989 reclamation costs.

The performance bond will be conditional upon the faithful performance of the requirements of the act, the regulatory program and the reclamation plan.

Upon approval, and before receiving the mining permit, Utah Power & Light Company will submit a surety bond or provide self-bonding payable to the State and Regulatory Authority in the amount determined under section UMC 806.12.

DEER CREEK COAL MINE
RECLAMATION SCHEDULE

#	1st YEAR RECLAMATION	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
1	STRUCTURE REMOVAL												
2	CLOSURES-PORTALS & VENTILATION												
3	HAULING, BACKFILLING, COMPACTION, & GRADING												
4	ACID & TOXIC MATERIAL HANDLING												
5	INSTALL RIP RAP DRAINAGE CHANNELS												
6	TEMPORARY SEDIMENTATION CONTROL FACILITIES												
7	SOIL SAMPLING & SEED BED PREPARATION												

DEER CREEK COAL MINE
RECLAMATION SCHEDULE
(cont.)

#	1st YEAR RECLAMATION (cont.)	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
8	FERTILIZING & MULCHING												
9	SEEDING & PLANTING												

#	10 YEAR REVEGETATION & MONITORING	1st YEAR	2nd YEAR	3rd YEAR	4th YEAR	5th YEAR	6th YEAR	7th YEAR	8th YEAR	9th YEAR	10th YEAR
10	PLANT MONITORING-DISEASE & PEST CONTROL										
11	SOIL STABILIZATION-RILLS & GULLIES										
12	CONTINGENT SEEDING & PLANTING										
13	REVEGETATION INVENTORY FOR BOND RELEASE										
14	SEDIMENT CONTROL STRUCTURE REMOVAL										

DEER CREEK MINE
RECLAMATION COSTS
SURFACE FACILITIES REMOVAL

Item #	Description	Equipment Manpower	Quantities	Total Cost	Constr. Days	Comments
1-A	Office-Bathhouse	Crane Truck-Trailer 10-Man Crew	1 Job	$68,871	22 Days	$3,130/day
1-B	Warehouse and Shop Building	Crane Truck-Trailer 5-Man Crew	1 Job	$22,000	10 Days	Light weight steel frame building. $2,200/day
1-C	Storage Shed	Crane Truck-Trailer 5-Man Crew	1 Job	$15,400	7 Days	Light weight steel frame building. $2,200/day
1-D	Transfer Tower and Trommel Complex	Crane Truck-Trailer 5-Man Crew	141 Tons	$48,400	22 Days	Structural $2,200/day
1-E	Crusher Station	Crane Truck-Trailer 5-Man Crew	50 Tons	$22,000	10 Days	Structural $2,200/day
1-F	Weigh Bin and Loadout	Crane Truck-Trailer 5-Man Crew	110 Tons	$26,400	12 Days	Structural $2,200/day
1-G	Water Treatment Plant	2-Man Crew	1 Job	$1,279	3 Days	
1-H	Water Storage Tank	2-Man Crew	1 Job	$1,279	3 Days	
1-I	Trash Bin Concrete	1 Dozer 2-Man Crew	1 Job	$2,211	2 Days	
1-J	Oil Storage Bins	1 Light Crane 2-Man Crew	1 Job	$3,904	3 Days	

SURFACE FACILITIES REMOVAL (continued)

Item #	Description	Equipment Manpower	Quantities	Total Cost	Constr. Days	Comments
1-K	Fuel Storage Tanks	1 Light Crane Dozer 2-Man Crew	1 Job	$4,111	2 Days	
1-L	Rock Dust Storage	1 Light Crane Truck-Trailer 2-Man Crew	1 Job	$1,599	1 Day	
1-M	Power Station and Power Line	REMOVED BY UTAH POWER & LIGHT COMPANY DIVISION FORCES. THIS COST IS BUILT INTO ELECTRICAL SERVICE COST AND NOT A PART OF RECLAMATION.				
1-N	Conveyor R.O.M.	Crane Truck-Trailer Dozer 6-Man Crew	1,400 ft. 8 Tons	$12,520	4 Days	Based on wrecking 350 feet/day/crew $3,130/day.
1-O	Conveyor Overland	Crane Truck-Trailer Dozer 6-Man Crew	9,400 ft. 50 Tons	$84,510	27 Days	Based on wrecking 350 feet/day/crew $3,130 day, includes backfill and grading.
1-P	Miscellaneous	5-Man Crew	1 Job	$9,530	10 Days	
1-Q	Exhaust Fans 2 Each	Crane Truck-Trailer Crawler-Tractor 4-Man Crew	1 Job	$11,818	4 Days	
1-R	Vehicle Parking Garage	Crane Truck-Trailer 225 Hoe 12 cy Dump Truck	1 Job	$22,000	10 Days	Light-eight steel frame building $2,200/day
1-S	Bulk Storage Extension	Crane Truck-Trailer 5-Man Crew	1 Job	$2,446	1 Day	$2.73/ft^2

DEER CREEK RECLAMATION COSTS

ITEM	DESCRIPTION	EQUIPMENT MANPOWER	QUANTITY	TOTAL COST	CONSTRUCTION COST	COMMENTS
1-W	Compressor Building at Tipple	225 Hoe 12 cy Dump Truck 2 man crew	1 Job	$741	1/2	-
14-B	Sediment Traps at Tipple	225 Hoe 12 cy Dump Truck 2 man crew	1 Job	$1482	1	-

(remove 2nd Rock Dust Silo, item 1T)

AMENDMENT TO

APPROVED Mining & Reclamation Plan

Received, Division of Oil, Gas & Mining

date 10/20/89

SURFACE FACILITIES REMOVAL (continued)

Item #	Description	Equipment Manpower	Quantities	Total Cost	Constr. Days	Comments
1-T	Rock Dust Silo #2	Light Crane Truck-Trailer 2-Man Crew	1 Job	$1,599	1 Day	
1-U	Pumphouse	225 Hoe 12 cy Dump Truck 3/4 Ton Pickup 3-Man Crew	1 Job	$5,514	3 Days	
1-V	Mine Water Discharge	225 Hoe 12 cy Dump Truck 3/4 Ton Pickup 3-Man Crew	1 Job	$3,676	2 Days	
	TOTALS			$371,067	159 Days	
			PORTAL SEALING			
2-A	Portal Sealing	3-Man Crew	10 Each @ $2,652	$26,520	20 Days	5 Deer Creek, 5 Meetinghouse
	TOTAL			$26,520	20 Days	
3-A	Fan Pad and Water Tank Pad	D8K 988B 769B, 2 ea. 235	4.1 4.1 4.1 14.3	4 Operators 1 Operator	4.1 14.3	$3,829 1.8
3-B	Deer Creek - Remove 8' Culvert and Form Channel Grade Fan Access Road	D8K Truck-Trailer 988B	5.3 235 25.0 25.0	1 Operator 3 Operators 1 Laborer	5.3 25.0 25.0	$10,151 3.1

DEER CREEK MINE
RECLAMATION COSTS
HAULING - BACKFILLING, COMPACTION, GRADING

Item #	Description	Equipment	Hrs	Labor	Hrs	Total	Construction Days
3-C	Remove Asphalt	988B 769B, 2 ea. 826B	15.1 15.1 15.1	3 Operators	15.1	$6,086	1.9
3-D	Remove Small Diversion Culverts	235 Truck-Trailer 769B	71.3 71.3 71.3	3 Operators 2 Laborers	71.3 71.3	$23,982	8.9
3-E	Remove 8' Culvert - Parking Lot to Tipple Yard	235 Truck-Trailer	42.9 42.9	3 Operators 2 Laborers	42.9	$12,097	5.4
3-F	Backfill Portal Highwall	988B 769B, 2 ea. D8 826B	18.7 18.7 18.7 18.7	5 Operators	18.7	$10,242	2.3
3-G	Backfill R.O.M. Bin, Terrace and Upper Terrace	D8, 2 ea.	40.0	2 Operators	40.0	$9,296	5.0
3-G-1	Backfill Elk Canyon Storage Pad	D8, 2 ea.	8	2 Operators	8.0	$1,730	1.0
3-H	Sediment Pond Slope	235 769B, 2 ea. 826B Truck-Trailer	31.0 31.0 31.0 18.5	4 Operators 2 Laborers 1 Operator	31.0 31.0 18.5	$15,770	3.9
3-J	Backfill & Grade Overland Conveyor	D8 Backhoe	40.0 40.0	2 Operators 2 Laborers	40.0 40.0	$7,942	5.0
	TOTALS					$101,125	38.3

RECLAMATION COSTS
ACID AND TOXIC MATERIAL HANDLING

Item #	Description	Equipment	Quantities	Total Cost	Construction Days	Comments
4-A	Toxic materials are covered under Item 3. Materials will be tested prior to final reclamation.					

CHANNEL CONSTRUCTION

Item #	Description	Equipment	Hrs.	Labor	Hrs.	Total	Construction Days
5-A	Construct Final Riprap Channel	D8	35.5	3 Operators	35.5	$47,010	15.9
		621B, 2 Ea.	35.5	2 Operators	127.0		
		235	127.0	2 Laborers	127.0		
		D6	127.0				
	Add Material: Riprap, 9,557 x 11.00 Gravel Liner 1,896 x 9.00 Clay Liner 1,555 x 8.00					134,631	
	TOTALS					$181,641	15.9

TEMPORARY DIVERSIONS

Item #	Description	Equipment	Hrs.	Labor	Hrs.	Total	Construction Days
6-A	Temporary Diversions	235	40.2	2 Operators	40.2	$10,653	5.0
		D6	40.2	2 Laborers	40.2		
	Add material: Riprap 11.00 x 1,815 Clay Liner 8.00 x 681 Gravel Liner 9.00 x 454					29,499	
	TOTALS					$40,152	5.0

SOIL SAMPLING & SEED BED PREPARATION

Item #	Description	Equipment	Hours	Labor	Hours	Total Cost	Construction Days
7-A	Soil Sampling 14 Tests	Drill Truck @ $300/Day	8.0	1 Operator 1 Laborer	8.0	$ 703	1 Day
7-B	Laboratory Analysis	Laboratory		$100/ea.		1,400	
7-C	Gravel Salvage 3 Acres	988-B	24.2	1 Operator	24.2	3,626	3 Days
7-D	Scarification	D-8	3.0	1 Operator	3.0	349	0.4 Days
7-E	Surface Preparation (Raking)						
	a. Hand Till (12 Ac.)	Hand Tools	0	4 Laborers	96.0	8,429	12.0 Days
	b. Tractor Till (14.5 Ac)	Farm Tractor	29.0	1 Laborer	29.0	927	3.3 Days
	TOTALS					$15,434	19.7 Days

FERTILIZING AND MULCHING

8-A	Fertilize 26.5 Acres	Flatbed Truck	53.0	3 Laborers 1 Foreman	53.0	$6,329	6.6 Days
8-B	Mulch 26.5 Acres	Flatbed Truck	53.0	3 Laborers 1 Foreman	53.0	6,329	6.6 Days
8-C	Mulch Netting 12 Acres	Flatbed Truck	96.0	3 Laborers 1 Foreman	96.0	11,464	12 Days
8-D	Mulch Crimping 14.5 Acres	Tractor Disc	29.0	1 Operator	29.0	1,115	3.6 Days
	TOTALS					$25,237	28.8 Days

SEEDING AND PLANTING

Item #	Description	Equipment	Hours	Labor	Hours	Total Cost	Construction Days
9-A	Seeding 26.5 Acres Broadcast	Flatbed Truck	53.0	3 Laborers 1 Foreman	53.0	$6,329	6.6 Days
9-B	Transplanting 42,250 each	Flatbed Truck	169.0	3 Laborers 1 Foreman	169.0	20,182	21.1 Days
9-C	Materials Cost:						
	Fertilizer	3,313# @ $.33 =				$1,093	
	Hay Mulch	53 tons @ $100/ton =				5,300	
	Netting	12 acres @ $1,000/acre =				12,000	
	Seed Mix PLS	932# @ $22.31/# =				20,790	
	Plants	42,250 @ $.67 w/tablet and tubes =				28,308	
	Total Material Cost					$67,491	
	TOTAL					$94,002	27.7 Days

PLANT MONITORING
DISEASE AND PEST CONTROL

Item #	Description	Equipment	Hours	Labor	Hours	Total Cost	Construction Days
10-A	Revegetation Monitoring	None		1 Supervisor 1 Laborer	16.0	$ (852)	
	Monitoring on 2, 3, 4, 5, 7, 10 Years = 6 Years @ $852/Year =					$5,112	12 Days
10-B	Disease and Pest Control	None		1 Supervisor 1 Laborer	16.0	(852)	12 Days
	Control applied 2, 3, 4, 5, 7 10 Years = 6 Years @ $852 =					$5,112	
10-C	Water Sampling (NPDES)	None		1 Supervisor	12.0	(376)	
	Monitoring 12 times each year for 10 years = 10 years @ $376 =					3,760	15 Days
10-D	Water Analysis (120 Samples @ $50 ea.	Lab		1 Supervisor		6,000	30 Days
	TOTALS					$19,984	69 Days

SOIL STABILIZATION - RILLS AND GULLIES

11-A	Soil Stabilization Rills & Gullies	510 Backhoe	32.0	1 Operator 2 Laborers	32.0 32.0	$(3,453)	
	Repeat work on 2, 4, 6, 8, 10th year = 5 years @ $3,453 =					$17,265	
	TOTAL					$17,265	

ITEM#	DESCRIPTION	EQUIPMENT	HOURS	LABOR	HOURS	TOTAL COST	CONSTR. DAYS
				CONTINGENT SEEDING AND PLANTING			
12-A	Contingent Planting	Flatbed Truck	20.0	1 Supervisor 1 Laborer	20.0	$ 1,510	3 Days
12-B	Materials (10% of original materials)					6,750	
	TOTAL					$ 8,260	
				REVEGETATION INVENTORY FOR BOND RELEASE			
13-A	Vegetation Inventory	None		1 Supervisor 2 Laborers	72.0	$ 5,417	9 Days
	TOTAL					$ 5,417	
				SEDIMENT CONTROL - STRUCTURE REMOVAL			
14-A	Remove Sediment Pond Build Channel	D8 235 D6 Truck-Trailer	20.0 36.8 36.8 8.0	1 Operator 2 Operators 2 Laborers 1 Operator	20.0 36.8 36.8 8.0	$ 12,602	4.6 Days
	Add Material: Riprap 11.00 x 920 Gravel Liner 9.00 x 157					11,533	
	TOTAL					$ 24,135	
15-A	Overland Conveyor Belt Revegetation (includes material)					$ 19,877	5 Days
						$ 950,116	
	Mobilization					$ 10,000	
	10% Contingency					$ 95,012	
	TOTAL CONSTRUCTION COST*					$1,055,128	

AMENDMENT TO
APPROVE[illegible] ...ion Plan
Approved, [illegible] ...ining
by [signature] 91D date 12/3/91

*Total reclamation and bonding costs will be adjusted, during major permitting actions, to include PAP amendments for which the individual reclamation costs are less than 5% of the current bond.

Revised 12/3/91

SURFACE FACILITY REMOVAL

STEEL STRUCTURES

Labor

Wrecking Contractor Prices:

1 - Working Foreman	$ 31.33 Hr.
1 - Heavy Equipment Operator	28.45 Hr.
3 - Laborers (skilled helpers)	65.85 Hr.
	$125.63

$125.63 x 8 = ---------- $1,005/Day

Equipment

Rental prices are 1984 Blue Book.

1 - Diesel 50 Ton Crane	$ 898
1 - Diesel Truck and Trailer (flat-bed)	297
	$1,195

Equipment Per Day	$1,195
Labor Per Day	1,005
Wrecking Per Day	$2,200

PORTAL SEALING

Material		Labor			Equipment		
Construction Blocks		1 - Blocklayer	@	$28.45 Hr.	1 - Flat-Bed Truck	@	$178 Day
400 @ .61 ea.	$ 244	1 - Helper	@	$21.95 Hr.	1 - Crawler Tractor	@	$702 Day
Mortar - 1 Lot	16	1 - Equip. Operator	@	$28.45 Hr.			
Soil Backfill							
150 cu. yds. @ $2 C.Y.							
(on-site material)	$ 300						
Total Material	$ 560 ea.			$78.85 Hr.			$880 Day

Laying Block 2 Day @ $581 Per Day	$1,162
Material	560
Backfilling 150 yards 1 Day (tractor and operator)	930
	$2,652

REVEGETATION PER ACRE
BEDDING, MULCHING, PLANTING
ESTIMATE OF COSTS

Material		Labor		Equipment	
35.3# Seed @ $19.72 lb.	$ 696	1 - Working Foreman	$18	1 - Flat-bed Truck	$50 Day
1,450 Containerized Plants @ $.67 ea.	972	3 - Laborers @ $10/Hr	30	1 - Farm Tractor	80 Day
2-Ton Hay Mulch	200		$48		
125# Fertilizer	42				
	$1,910	8 x $48	$384/Day		$130 Day
Netting & Staples	$1,000	Total Labor Day	$384		
Per Acre	$2,910	Total Equipment/Day	130		
			$514 Day		

Production Per Acre

Seed Bed Preparation (hand tilling)	8 Hours
Seed Bed Preparation (tractor tilling)	2 Hours
Fertilizing	2 Hours
Broadcast Seed	2 Hours
Transplant Seedlings (1,450)	6 Hours
Mulch 2" Cover	2 Hours
Netting & Staple	8 Hours

Revised 12/23/83
Revised 2/27/84

RECLAMATION COSTS

BACKFILLING AND GRADING

Item #3

A. Fan Pad and Water Tank Pad

Description: Using the material adjacent to the sites, the ventilation shaft will be backfilled; the flat pad areas will be pulled back to approximate the original contour.

Equipment: D8K
235
988B
769B, 2 each

Labor: 5 Operators

Quantities: Fan shaft backfill = 1,162 c.y.
Slope Recontour = 600 lin. ft.
(6 cy/lin. ft.)

Production: Ventilation Shaft -
Haul Distance = 500' @ +15%
Cycle Time = 2.3 min./18 c.y.
469 c.y./hr.
60% efficiency = 281 c.y./hr.
1162 ÷ 281 = 4.1 hrs.

Benches -

Cycle time .3 min./2 c.y.

1 lin. ft./min.

70% efficiency

42 lin.ft./hr.

600 ÷ 42 = 14.3 hrs.

B. Deer Creek Channel

Description: Remove 900 feet of the 8' culvert including the inlet works and form the drainage channel. Use the 235 excavator to dig up pipe and form channel. 988B Loader to haul pipe and load on truck-trailer for transport off the permit area. Use the D8K Dozer to obliterate the fan access road, and contour the general area.

Equipment: D8K

235

Truck-trailer

988B

Labor: 4 Operators

1 Laborer

Quantities: 900 lin. ft. of pipe/channel

800 lin. ft. of access road

Production: Remove pipe and form channel -

Excavation cross-section 12' wide x 10' deep

Minus Pipe cross π $(4')^2$

Total removed 70 ft^2

Cycle Time (235) .3 min./2 c.y.

120 lin. ft./hr.

30% efficiency 36 lin. ft./hr.

Time Required 900 ÷ 35 = 25 hr.

Remove Fan Access Road -

Road cross-section 20' wide x 10' high (Triangle)

Cycle Time (D8K) 1,200 c.y./hr. @ 50' distance

1200 c.y./hr ÷ 4 c.y./lin.ft. = 300 lin. ft./hr.

50% efficiency = 150 lin. ft./hr.

Time Required 800 ÷ 150 = 5.3 hrs.

C. Asphalt Removal

Description: Using the 988B Loader to tear up and load asphalt from the parking lot-storage yard areas. Use two 769B trucks to haul material to the R.O.M. Bin for burial. Use 826B Compactor to break up the asphalt, spread and compact.

Equipment: 988B

769B, 2 each

826B

Quantities: 1,798 c.y. (from drawings)

Production: Haul distance 650' @ 2%

Cycle Time: 3.5 min./10 c.y. (half load)

170 c.y./hr.

Efficiency 70% = 119 c.y./hr.

Time Required - 1,798 c.y. ÷ 119 c.y./hr. = 15.1 hrs.

D. Remove Small Diversions

Description: This item includes removal of: 36" pipe from Deer Canyon, 30" pipe from Elk Canyon, 24" pipe from Elk Canyon and disturbed drainage pipe. Using the 235 excavation to dig-up and load onto the truck-trailer for disposal off-site. Concrete structures will be dug up and buried in the R.O.M. bin.

Equipment: 235
769B
Truck-Trailer

Quantities: 36" - 1,000'
30" - 850' (From drainage drawings)
24" - 200'
D.D.- 6,500'
8,550'

Production: Cycle Time (235) .3 min./2 c.y.
Typical cross-section 4' wide x 4' deep
Use 2 ft./min.
8,550 ÷ 2 x 60 = 71.3 hrs.

E. Remove 8' Pipe - Parking Lot Level to Tipple Yard

Description: Remove the 8' culvert, load and haul off site. Includes concrete plug in 8' pipe.

Equipment: 235
Truck-Trailer

Labor: 3 Operators
2 Laborers

Quantities: 1,400' lin. ft. 8' Pipe
10 c.y. concrete

Production: (See Item III-2 for detail)

Cycle Time 36 lin.ft./hr.

Time Required: 1,400 ÷ 36 = 38.9 hrs.

In place cost of concrete = $150/yd.

Add 4 hours to cover cost of cement

Time Required = 42.9 hrs.

F. Backfill Portal Highwall

Description: Remove material from face of Waste Rock Site and place at portal highwall. Included is material to plug portals. (Total of 5.)

Equipment: 988B
769B, 2 each
D8
826 B

Labor: 5 Operators

Quantities: 3,813 c.y. (from cross-sections)
741 c.y. (portal seals)

Production: Average haul distance 1,500' @ +12%

Cycle Time 6.2 min./18 c.y.

2 units x 162 c.y./hr. = 324 c.y./hr.

75% efficiency = 243 c.y./hr.

Time Required 4,554 ÷ 243 = 18.7 hrs.

G. Backfill R.O.M. Bin, Terrace and Upper Terrace

Description: Remove existing material displaced during R.O.M. bin construction and place over asphalt and concrete refuse in bin. Cover layer to be four feet thick. Grade, slope terraces and install berm.

Equipment: D8, 2 each

Labor: 2 Operators

Quantities: 8,785 c.y. (see Map 4-4 cross-section of bin)

Production: Average haul cycle 150'

Cycle Time: 1 min./ 5 c.y.

2 units x 300 c.y./hr. = 600 c.y./hr.

75% efficiency = 450 c.y./hr.

Time Required: 8,785 ÷ 450 = 19.5 Hrs.
Grade Terraces 20.5 Hrs.

H. Sediment Pond Slope

Description: After binwall is removed, slope behind is to be laid back on a 2:1. Material to be placed on yard level. Includes binwall removal.

Equipment: 235

769B, 2 each

826B

Truck-Trailer

Labor: 4 Operators

2 Laborers

Quantities: 2,250 c.y. (from cross-section of slope.)

Production: Average haul 1,500' @ +12%

Cycle time: 6 min./18 c.y.

2 units x 180 c.y./hr. = 360 c.y./hr.

50% efficiency - 180 c.y./hr.

Time Required 2,250 ÷ 180 = 12.5 hrs.

Binwall Removal

20' high x 50' long x 10' deep

360 c.y. ÷ 20 c.y./hr. = 18.5 hrs.

Total time this item = 31.0 hrs.

Item #5

A. Construct Final Rip-Rap Channel

Description: Rip-rap channel is built using rip-rap, gravel liner, and clay liner purchased from local contractors. Prices were obtained by phone quote. Excavation is done by D8 Dozer and 2 Scrapers. Fine grading is done by D6 Dozer w/angle and tilt blade.

Equipment: D8 Dozer
235
D6 Dozer
621B, 2 each

Labor: 3 Operators

Quantities:

Rip-rap	9,557 c.y.
Gravel liner	1,896 c.y.
Clay liner	1,555 c.y.
Excavation	13,904 c.y.

Production:

Excavation:

Average haul 250 ft. @ 8%

Cycle Time: 3.0 min./14 c.y.

(From Cat Book)

2 units x 280 c.y./hr. = 560 c.y./hr.

70% efficiency = 392 c.y./hr.

13,904 ÷ 392 = 35.5 hr.

Place liners and rip-rap:

2.5 c.y./min.

Double to include liner

75 c.y./hr.

9,557 ÷ 75 = 127 hrs.

Item #6

A. Temporary Diversions:

Description: Dig ditches and place rip-rap. Bury culverts. Material for rip-rap, clay liner, gravel liner is purchased from local contractors. Culverts are salvaged from diversions.

Equipment: 235

D6 Dozer

Labor: 2 Operators

2 Laborers

Quantities: Rip-Rap - 1815 c.y.

Gravel liner - 454 c.y.

Clay liner - 681 c.y.

Production: (See Item III-9)

75 c.y./hr.

1815 ÷ 75 = 24.2 hr.

Add 2 days to bury culverts

Time Required = 40.2 hrs.

ITEM #7

Soil Sampling and Seedbed Preparation

A. Soil Sampling and Analysis.

B. Upon asphalt removal, collection and redistribution of clean road base gravels.

C. Scarification of roads and parking lot for knitting soil medium and regrading.

D. Surface preparation and raking after seeding.

Soil Sampling - 26.5 Acres 14 Samples

14 composite samples @ 0-20" Depths

Gravel Salvage - 3 Acres

Scrape gravel road base and parking lot.
Segregate material - bury dirty gravels and stockpile clean gravels

Revised 12/23/83
Revised 9/17/84

Equipment: 988.B

Labor: 1 - Operator

Production: 3 acres of 4" gravels

1452 cu. yds.

Cycle time 500 feet 5 minutes ---------- 24.2 Hrs.

Scarification - 3 Acres

Scarify parking lot and old roadbed.

Equipment: Roadgrader

Labor: 1 - Operator

Production: 5 foot swath 2 MPH = 1 acre/hr.

3 acres ---------- 3.0 Hrs.

Surface Preparation (Raking In Seed)

Equipment: 1 - Farm Tractor

Labor: 1 - Operator
4 - Laborers

a. Hand tilling ------ 12.0 acres slopes 25%
b. Tractor tilling --- 14.5 acres slopes 25%

Seedbed Preparation:

Hand tilling production (4) laborers x 8 hrs.
Equals 1 acre ---------- 12.0 acres x 8 hrs. 96 Hrs.
Tractor 2 hr./ac. ------ 14.5 acres x 2 hrs. 29 Hrs.

Revised 12/23/83
Revised 2/27/84
Revised 9/17/84

ITEM #8

Fertilize and Mulch

A. Broadcast Fertilizer - 26.5 Acres

Equipment: 1 - Flatbed Truck

Labor: 4 - Laborers

Production:

Broadcast 125# dry fertilizer/acre
(4) Men working 2 hours will cover

1 Acre 2 x 26.5 ---------- 53 Hrs.

B. Spread 50 tons hay mulch
(4) Men working 2 hours will
spread 2 tons of hay mulch over 1 acre

2 x 26.5 ---------- 53 Hrs.

Mulch Anchoring:

Steep slopes 25% will use netting
to anchor mulch (12 acres)
Shallow slopes 25% anchoring by tractor (14.5 acres)

C. (1) Netting and staples (4) men 8 hours = 1 acre

12 acres x 8 ---------- 96 Hrs.

D. (11) Tractor crimping (disc) 2 hours/acre

2 x 14.5 ---------- 29 Hrs.

Revised 12/23/83
Revised 2/27/84
Revised 9/17/84

ITEM #9

Seeding and Planting - 25 Acres

A. Broadcast 932 lbs. combined seed mix

B. Plant - 42,250 Containerized Plants

Equipment: 1 - Flatbed Truck

Labor: 4 - Laborers

Quantities:

Pinyon Juniper (19.5 Acres)	Riparian (1.5 Acres)	Mixed Confier (5.5 Acres)
Broadcast seeding 35#/Acre	Broadcast seeding 42#/Acre	Broadcast seeding 33#/Acre
Transplant 900 ea/ac	Transplant 1800 ea/ac	Transplant 4000 ea/ac

Production: Broadcast seeding - (4) men working
2 hours will seed 1 acre (Raking is covered under Item 7)
Transplanting (4) men working 8 hours will plant 2,000 plants

Pinyon Juniper (19.5 Acres)	Riparian (1.5 Acres)	Mixed Conifer (5.5 Acres)
Seeding 39.0 Hrs.	Seeding 3.0 Hrs.	Seeding 11.0 Hrs.
Transplt 70.2 Hrs.	Transplt 10.8 Hrs.	Transplt 88.0 Hrs.
109.2 Hrs.	13.8 Hrs.	99.0 Hrs.

TOTAL HOURS ---------- 222.0 Hrs.

Revised 12/23/83
Revised 2/27/84
Revised 9/17/84

REVEGETATION PER ACRE
BEDDING, MULCHING, PLANTING
ESTIMATE OF COSTS

Material		Labor		Equipment	
35.2# Seed @ $22.31 lb.	$ 785	1 - Working Foreman	$31.33	1 - Flat-bed Truck	$178 Day
1,594 Containerized Plants @ $.67 ea.	1,068	3 - Laborers @ $21.95/Hr	65.85	1 - Farm Tractor	80 Day
2-Ton Hay Mulch	200		$97.18		
125# Fertilizer	42				
	$2,095	8 x $48	$777/Day		$258 Day
Netting & Staples	$1,000				
Per Acre	$3,095				

Production Per Acre

Seed Bed Preparation (hand tilling)	8 Hours
Seed Bed Preparation (tractor tilling)	2 Hours
Fertilizing	2 Hours
Broadcast Seed	2 Hours
Transplant Seedlings (1,594)	6 Hours
Mulch 2" Cover	2 Hours
Netting & Staple	8 Hours

ITEM 10

Monitoring and Pest Control

Work Covered During Extended Bond Period

A. Revegetation Monitoring.

B. Disease and Pest Control.

C. Water Discharge Monitoring.

Equipment: Handtools

Labor: 1 - Foreman
1 - Laborer

Revegetation:

Two men - four visits per year 4 Hour visit to inspect revegetation	16 Hrs.

Disease and Pest Control:

Two men - four visits per year 4 hour visits (spray and spread chemicals)	16 Hrs.

Water Sampling:

One man - one visit each month for water grab sample (NPDES) 1 hour per visit	12 Hrs.
Total hours monitoring per year ----------	44 Hrs.
Monitoring to be repeated on 2, 3, 4, 5, 7 and 10th Yrs.	
6 x 44 Hrs. ----------	264.0 Hrs.

Revised 12/23/83
Revised 2/27/84
Revised 9/17/84

Item #11

A. Rills and Gullies

Description: A rubber tired JD510 backhoe and two laborers are used. The time required is based on our past history and expanded to cover the increased acreage.

Equipment: JD510 Backhoe

Labor: 2 Laborers

Production: 24 Hours, 3 Days 1 Year

Work will be coordinated with vegetation monitoring years 2, 3, 4, 5, 7 and 10.

6 Years x 3 Days = 18 Days work = 144 Hours

Revised 12/23/83
Revised 2/27/84
Revised 9/17/84

ITEM #12

Contingent Planting

A. Reseed and replant unsuccessful areas estimated at 10% of total disturbed areas.

Equipment: Handtools

Labor: 1 - Supervisor
1 - Laborer

Quantities:	Pinyon Juniper	Riparian	Mixed Confier
	(19.5 Acres)	(1.5 Acres)	(5.5 Acres)

Production:

Broadcast seed ----------	5.0 Hrs.
Transplant 4,225 plants ----------	15.0 Hrs.
TOTAL HOURS	20.0 Hrs.

Revised 12/23/83
Revised 2/27/84
Revised 9/17/84

Item #13

Inventory For Bond Release

A. Inventory Reference Sites and Revegetated Areas.

Equipment: None

Labor: 1 - Supervisor

2 - Laborers

Quantities:

3 Reference Sites

3 Revegetated Areas

a.	Pinyon-Juniper	19.5 Acres
b.	Mixed Conifer	5.5 Acres
c.	Riparian	1.5 Acres
TOTAL ACRES		26.5 Acres

Production:

Site Inventory - 3 ea.	36 Hrs.
Each Reference Site - 3 ea.	36 Hrs.
Each Site and Related Reference Area - 72 Hrs.	
TOTAL HOURS	72 Hrs.

Revised 11/21/83
Revised 9/17/84

Item #14

A. Remove Sediment Pond and Build Channel

Description: The sediment pond dam is dozed out onto the existing adjacent slopes @ 2:1. Final diversion channel through pond is built. The existing 8' culvert is plugged with concrete. Temporary culverts are removed off the site.

Equipment: D8
235
Truck-Trailer
D-6

Labor: 4 Operators
2 Laborers

Quantities:

Dam excavation 2,000 c.y. (from Morrison-Knudsen drawing)

Riprap 2,761 c.y.

Gravel liner 471 c.y.

Production:

Dam Excavation -

Average haul 100' @ 50%

Cycle Time 100 c.y./hr.

Time Required 2,000 ÷ 100 = 20 Hrs.

Channel Construction -

Cycle Time 75 c.y./hr. (See Item 3-B)

Time Required 2,761 ÷ 75 = 36.8 Hrs.

Revised 11/21/83
Revised 9/17/84

Item #15

Overland Conveyor Reclamation

A. Structure Removal (see Item 1-0)

B. Backfill and Grading: (see Item 3-J)

D8 Crawler Tractor

Backhoe

2 - Operators

2 - Laborers

Remove culverts, reestablish drainages, doze embankments to original contour, compact and grade smooth.

Construction project is estimated to last 5 days.

Revegetate disturbed Area = 5.0 Acres - Pinyon Juniper

Seed Bed Preparation (8 Hr/Acre)	$ 1,852
Fertilizing (2 Hr/Acre)	1,194
Seed (Pinyon-Juniper) (2 Hr/Acre)	1,194
Transplanting (6 Hr/Acre)	3,583
Mulching (2 Hr/Acre)	1,579
Materials: Fertilizer, Mulch, Seeds & Plants 5.0 Acres	10,475
Total	$19,877

Revised 12/23/83
Revised 2/27/84
Revised 9/17/84

Equipment: 988.B

Labor: 1 - Operator

Production: 3 acres of 4" gravels

1452 cu. yds.

Cycle time 500 feet 5 minutes ---------- 24.2 Hrs.

Scarification - 3 Acres

Scarify parking lot and old roadbed.

Equipment: Roadgrader

Labor: 1 - Operator

Production: 5 foot swath 2 MPH = 1 acre/hr.

3 acres ---------- 3.0 Hrs.

Surface Preparation (Raking In Seed)

Equipment: 1 - Farm Tractor

Labor: 1 - Operator
4 - Laborers

a. Hand tilling ------ 12 acres slopes 25%
b. Tractor tilling --- 13 acres slopes 25%

Seedbed Preparation:

Hand tilling production (4) laborers x 8 hrs.
Equals 1 acre ---------- 12 acres x 8 hrs. 96 Hrs.
Tractor 2 hr./ac. ------ 13 acres x 2 hrs. 26 Hrs.

Revised 12/23/83
Revised 2/27/84

Item #1-R
Vehicle Parking Garage

Removal of a concrete and steel building 70' x 120'.

Demolition:

	Time
Steel Building	5 Days
Concrete	5 Days

Labor

Operator	252/day	$2,520
Truck Driver	202/day	2,020
Laborer	197/day	1,970
Foreman	280/day	2,800
		$9,310

Equipment

Crane	898/day	x5 Days	$4,490
225 Hoe	704/day	x5 Days	3,520
12 cy Dump Truck	344/day	x5 Days	1,720
3/4 Ton Pickup	56/day	x10 Days	560
Truck-Trailer	297/day	x5 Days	1,485
			$11,755
			=======
			$21,085

Revised 6/29/88

Item #1-U
Pumphouse

Removal of concrete and block building 30' x 35'.

Demolition:

Time

3 Days

Labor

Operator	252/day	756
Foreman	280/day	840
Truck Driver	202/day	606
		$2,202

Equipment

225 Hoe	704/day	2,112
12 cy Dump Truck	344/day	1,032
3/4 Ton Pickup	56/day	168
		$3,312
		======
		$5,514

Revised 6/29/88

Item #1-V
Mine Water Discharge

Removal of concrete and block building 15' x 40'.

Demolition:

Time

2 Days

Labor

Operator	252/day	504
Truck Driver	292/day	804
Foreman	280/day	560
		$1,468

Equipment

225 Hoe	704/day	1,408
12 cy Dump Truck	344/day	688
3/4 Ton Pickup	56/day	112
		$2,208
		======
		$3,676

Revised 6/29/88

RECLAMATION PLAN: PROTECTION OF THE HYDROLOGIC BALANCE (784.14)

In the Deer Creek Mine area, all possible measures have been taken to protect the quality and quantity of both ground and surface waters.

The ground waters which are flowing into the mine flow through an oil skimmer and into sediment ponds before they are discharged for use in the Huntington Power Plant below the mine. After the mining is complete, it is possible but not likely that ground water will flow out of the portal (refer to Description of the Hydrology). The water being discharged from the mine is slightly higher in alkalinity and total dissolved solids but is much lower in total suspended solids and iron than the water normally flowing in Deer Creek. This difference in water quality does not have an adverse impact on the quality of the water there.

The surface waters flowing in Deer Creek flow through underground diversion culverts to protect the water from contamination in the disturbed areas. The size of these culverts range from a 24" corregated metal pipe on the smaller tributaries to an 8'2" x 5'9" pipe arch on the main channel as shown in Map 3-12. These structures will be removed after mining is completed.

Since the Deer Creek Mine has been in operation, ground water has flowed into the mine workings. The amount of water flowing into the mine has increased in recent years due to the increase in the area which has been developed with

mine entries. However, it has also been observed that, in general, areas which at one time produced abundant water, have since become dry, indicating that mining activities have dewatered the strata which encloses the coal seam. Because the current data are insufficient to prove whether or not the mine workings will become flooded on abandonment, the applicant will design the Meetinghouse south fork breakout portal (portals of lowest elevation) seals to contend with water flooding the mine workings.

The strata which surrounds the Blind Canyon Seam is fractured. If hydrologic seals were placed within the portal to contain the water flowing out of the mine, it is likely that this water would be forced around the portal seal and migrate to the surface.

The quality of the water currently being discharged from the Deer Creek Mine is within the effluent limitations established by the EPA. In 1982, the quality of water leaving the mine was as follows:

Parameter	1982 Average	Effluent Limitations
pH	7.5	6.5 - 9.0
Iron (Mg/L)	0.8	3.0
Oil and Grease (Mg/L)	0.5	10.0
TDS. (Mg/L)	635.5	700
TSS (Mg/L)	9.3	25

Because it would be difficult to keep the water from migrating through fractures around hydrologic seals if they were used, after mine abandonment, the applicant feels that the most environmentally effective method would be to

Added for Meetinghouse breakouts

~~Revised 11/21/83~~
Revised 4/3/86

establish a permanent discharge. The quality of the water that would be discharged could meet the EPA effluent limitations without treatment.

Upon mine abandonment the Meetinghouse south fork portal, which is the lowest elevation of all the portals of the Deer Creek Mine, will be sealed. The mine entry will be filled with gravel and sand for a distance of 25 feet each to act as a filter to remove any suspended solids from the water. A four inch diameter drain pipe will be installed which would allow for a continuous discharge of more than 300 GPM. This pipe will be buried below the frost line for a distance of less than 100 feet to the natural drainage where the discharge will enter the south fork of Meetinghouse Canyon.

The other portals which are at a slightly higher elevation than the Meetinghouse south fork portal will be sealed as detailed in the reclamation section. The applicant will coordinate and follow directions and approval of the Bureau of Land Management upon sealing of the portals.

After the portals are sealed, the applicant will monitor the water quality until such time that the bond is released.

Although precautions are being taken to protect the hydrologic regime of the Deer Creek Mine area, it is still possible that the ground water systems will be altered. The normal downward movement of ground water may be interrupted when it intersects the mine workings. These waters may flow laterally through the mine workings to a point where they

flow down through fractures or permeable strata. The impacts from this occurrence should be minimal because the water will only be temporarily detained or redistributed.

The springs on East Mountain above the Deer Creek Mine might be affected by subsidence due to mining. It is possible that some of the ground water flowing to springs would be diverted to different areas forming new springs or increasing the flow to existing springs. It also is possible that some water will be diverted from the surface downward along fractures caused by mining. The majority of the springs will be unaffected by the mining activities because of the use of controlled subsidence techniques and the ability of fractures within the strata to be spontaneously sealed by swelling clays.

Throughout the life of the mine, the ground and surface water systems will be monitored on a regular basis as outlined in UP&L's approved Hydrologic Monitoring Plan. This should insure early detection of any change to the hydrologic regime.

The hydrologic section of this application describes the conditions present and the monitoring plan being followed which will allow the applicant to recognize mining's impact on the hydrology and to protect the hydrologic balance.

The water which flows onto the surface of the ground above the Deer Creek Mine is used to a limited extent but in a variety of ways. Some of the springs are developed for livestock and wildlife and in one case a spring is developed

for culinary use in a cabin. The mining activities should not affect the surface waters to a point where the present land use would be downgraded.

Water Quality Standards and Effluent Limitations

Throughout the life of the mine and following its reclamation after mining is completed, measures will be taken to insure that the surface water which flows through and adjacent to the mine area and water which is discharged from the mine meet the effluent limitation set forth in Section 817.42 of the Utah Mining Code.

A sedimentation pond has been constructed to settle out the suspended solids which might be present in the surface waters flowing within the disturbed area. When water is discharged from the sediment pond into the drainage in Deer Creek, it will be monitored to insure that the effluent limitations aren't exceeded.

At the present time water is being discharged from the Deer Creek Mine at the average rate of 329,000 gallons per day. Water is not discharged into any drainage but piped to the Huntington Power Plant where it is consumed. It is likely that water will be discharged throughout the lifetime of the mine. These discharge waters will be monitored on a monthly basis.

Surface Exploration Drill Holes

Initial stages of development required surface exploration drilling. From 1976 through 1983 Utah Power & Light Company drilled approximately 79 exploration holes.

Revised 11/21/83

~~4-86~~
4-35.1 (3/1/89)

Authority to conduct such activities was gained through the State of Utah, U. S. Geological Survey and the U. S. Forest Service. Privately-owned surface was secured separately.

All surface drilled exploration holes were reclamated according to the U. S. Geological Survey's published Drill Hole Plugging Procedure in the form of stipulations for approval.

Each exploration drill site has been reclamated and approved by the appropriate agency.

Revised 11/21/83
3/1/89
~~4-37~~
4-35.2

East Mountain Permit Area
Probable Hydrologic Consequences

Description of the Mining Operation:

The Utah Power & Light Co. mine permit areas are located in the central portion of the Wasatch Plateau Coal Field in Emery County, Utah. Generally, this area is a flat-topped mesa surrounded by heavily vegetated slopes which extend to precipitous cliffs leading to the valley below. Much data has been collected regarding the geology and the hydrology of the East Mountain property. In all, over 120 drill holes have been completed from the surface, over 500 from within the mines; and a comprehensive hydrologic data collection program is ongoing, all of which have provided data used in this PHC. The most applicable data have been included in this document. For a review of additional data, it is suggested that the reader refer to the annual Hydrologic Monitoring Report.

Two minable coal seams exist and will be mined using underground longwall methods. The longwall panels will be oriented with their length in either an east-west or northeast-southwest direction. The chemical and physical properties of the overburden have been identified and described in the permit (see pages 2-64) but, because this is an underground operation, will have little effect on the hydrologic consequences.

Description of the Surface-Water System:

The surface drainage system on East Mountain is divided into two major drainages; the southwest portion forms part of the Cottonwood Creek drainage, and the northeast portion contributes to the Huntington Creek drainage. The Huntington Creek drainage covers seventy-three percent (73%) of the East Mountain leases held by UP & L. Both of these perennial streams are located adjacent to but not within the permit boundaries. UP&L has observed that all of the streams emanating from within the permit boundary cease flowing in the fall or winter, suggesting that they are not perennial but ephemeral. Most of the streams are spring fed. UP & L has monitored all of the surface waters since 1979 and will continue to monitor them in the future. The data collected is included in each annual Hydrologic Monitoring Report.

The locations of the major springs and ponds on East Mountain are shown on the attached spring map. The springs have been monitored for several years, providing the baseline data, and operational data is currently being collected. The data is included in the Hydrologic Monitoring reports. The water is used for power generation, irrigation in Castle Valley, livestock, and wildlife. The

quantity and quality of surface waters measured are shown in Tables 1 through 6 and Figures 1 through 8. -

Description of the groundwater system:

Seven wells are located within the vicinity of the East Mountain (see Map 2-11 (DWG NO CE-10881-Em) All were constructed for potentiometric surface studies, and none of the wells flow at the surface or are pumped for domestic water supplies.

The majority of all natural groundwater discharge points located on the East Mountain property are in the form of seeps and springs. UP&L has mapped approximately seventy-five (75) springs ranging in discharge from less than one GPM to as high as 450 GPM (see Map 2-12 DWG NO. CE-10404-Em)

UP&L has collected an extensive database of information pertaining to the ground-water quality and quantities of the East Mountain region and adjacent areas. Included in the database is long-term quality and flow information both for springs and for groundwater intercepted by mining.

The USGS has conducted extensive studies to determine the regional groundwater system for the central Wasatch Plateau coal field. The studies indicate a regional aquifer exists in the coal-bearing sequence of the Blackhawk and the underlying Starpoint Sandstone formations. The studies have also concluded that several isolated or perched aquifers existed above the Blackhawk-Starpoint aquifer. UP&L agrees with conclusions of the USGS studies concerning the perch aquifers above the coal-bearing sequence of the Blackhawk Formation but has some reservations about the significance of the Blackhawk-Starpoint aquifer which will be discussed below. The majority of the groundwater is discharged from the perched aquifers which occur along the base of the North Horn Formation in the form of seeps and springs (see Map 2 and Figure 9). Several other perched aquifers exist mainly along the formational contacts with the North Horn Formation, including the upper contact with Flagstaff Limestone and the lower contact with the Price River Formation.

The majority of the groundwater recharge on East Mountain comes from the winter snowpack which melts and infiltrates into the surface of East Mountain. The water flows down vertical fractures which intersect sandstone channel systems in the North Horn and Blackhawk formations. The majority of the groundwater reaching this point intersects the surface in springs located in the North Horn Formation. Very little recharge intersects the Price River Formation and Castlegate Sandstones; consequently, they are not water saturated where intersected in the numerous drill holes penetrating those

units. The remaining water then flows downdip (to the southeast) from the northern-reaches of East Mountain until it intersects the northeast trending Roans Canyon Fault Graben. In-mine long-hole drilling completed to test the hydrology of this fault system has shown that the system acts as an imperfect aquiclude to further southeast migration of water. Figure 10 shows the hydrologic gradient measured by the drill holes completed across the fault system. The system acts as an aquiclude because swelling clays along the fault prohibit most of the water from penetrating across the fault. Most of the recharge south of the Roans Canyon Fault System comes from the snow melt directly above. The same mode of water migration occurs there as to the north; but, when the water intersects the sandstone channels, it migrates in the same direction as the topographic relief above.

Several vertical drill holes completed in the Deer Creek Mine were developed into water monitoring holes to test the piezometric gradient of the Starpoint-Blackhawk aquifer. Data collected from the holes is included in the annual Hydrologic Monitoring Report and identifies the hydrologic gradient.

Climatic Conditions:

The climate of the permit area has been described by the US Geological Survey, which states that it is semiarid to subhumid, and precipitation generally increases with altitude. As shown on Figure 11, average annual precipitation ranges from about ten (10) inches in the lowest parts of the permit area (southeast) to more than twenty-five (25) inches in the highest parts (northwest). UP&L's weather station, located adjacent to the permit area, has provided data which shows that the summer precipitation, in the form of thundershowers, averages about the same as the winter precipitation, in the form of snowfall. The winter precipitation has the greatest impact on groundwater, however, because much of the summer precipitation runs off without infiltration. The data collected at UP&L's East Mountain weather station is included in the annual Hydrologic Monitoring reports.

Throughout the permit area air temperatures vary considerably both diurnally and annually. Midsummer daytime temperatures in lower areas commonly exceed 100° F and midwinter nighttime temperatures throughout the area commonly are well below 0° F. The summer temperatures are accompanied by large evaporation rates. Although not recorded, there probably also is significant sublimation of the winter snowpack, particularly in the higher plateaus which are unprotected from dry winds common in the region.

The volume of water flowing into the major streams within and adjacent to the permit area has been characterized by monitoring. Discharge recession curves for these streams are included herein as Figures 1 through 8.

Geomorphic Description of the Mine Plan and Adjacent Area:

Sediment load concentrations in the area of the permit vary dramatically depending on the percentage of disturbed areas, ruggedness of the terrain, geologic formations present, the amount of precipitation the areas receive, and stream flow volume. In work conducted after the Deer Creek Mine began production, the USGS identified the sediment yield in Deer Creek Canyon to be 3.1 tons/day. Huntington Creek was measured at 1.8 to 66 tons/day. Other creeks adjacent to the permit area were tested and found to have similar sediment loads.

UP&L has collected samples on a quarterly basis from the streams within and adjacent to the permit area. Samples taken at periods of both high and low flow have been tested for total suspended solids (TSS) to identify stream stability and are reported annually in the Hydrologic Monitoring Report. Tables 1 through 6 show the TSS values reported in the 1987 monitoring report.

Several conditions present within the permit area contribute to the sediment yield of the streams or stream instability. Several of the canyons in the area are very steep with very limited vegetative cover. During periods of high precipitation the amount of sediment introduced into the streams from these areas is significant. Samples taken in Deer Creek Canyon above the disturbed area during high run-off demonstrate how much sediment can be introduced from the undisturbed areas. The areas of the Deer Creek Mine Portal and access road are also prone to producing sediment yield in the stream; however, these surface waters flow through a sediment pond prior to discharge which effectively removes settleable solids from the water.

Overburden:

UP&L has collected data which identified the nature and chemical composition of the overburden. Because the mine is an underground mine, the overburden chemical composition will affect the hydrologic consequences at the portal site. The nature and chemical composition of the material is shown in the PAP in section 2-65 and will not be presented here.

When the disturbed areas are reclaimed as proposed in the PAP, it is not anticipated that the chemical composition of

the material removed at the portal site and then moved back into place will impact the surface hydrology.

Surface Water:

UP&L has conducted baseline monitoring of surface waters within and adjacent to the permit area. Additional sampling sites will be included in the future prior to disturbance in that area which may potentially impact the surface hydrology. Water samples are and will be collected and analyzed quarterly (one sample at low flow and high flow) during the first or second week of the quarter. Parameters analyzed are those listed in the "DOGM Guidelines for Surface Water Quality." All of the long-term monitoring sites have been equipped with Parshall style flumes to facilitate monitoring. Water quality data collected from the surface water systems is shown in Tables 1 through 6.

Groundwater:

UP&L has conducted baseline and operational monitoring of springs and in-mine water sources in and adjacent to the permit area. The springs located within or immediately adjacent to areas overlying coal to be mined in the next five (5) years or areas overlying previously mined areas will be monitored (except that the discharge recession curve springs will be monitored in the future regardless of their position relative to mining). The data collected has provided information useful in the understanding of potential hydrologic consequences of mining. The quality discharge data collected is shown in Table 7.

The water intersected in the mine is monitored to facilitate understanding of the groundwater hydrology of the area. UP&L has installed measuring devices on water lines which transport water from long-term water producing areas. Both quality and quantity data have been and will continue to be collected from these locations. Additional long-term water monitoring sites will be added when the conditions of the water intersected meet the criteria for long-term water monitoring sites. The data has identified the amount of water captured by the mine workings. It does not identify how the discharge will change in the future during mining and in the post-mining period. In order to better understand these issues, UP&L will continue to monitor, where possible, the discharge in previously mined areas to establish the discharge recession from a given area, making it possible to more accurately project mine discharge volumes into future mining and post-mining periods.

No domestic water wells are located within the permit area. UP&L intends to conduct pump tests on water monitoring wells

drilled by West Appa Coal Co. in Rilda Canyon to the north of the permit boundary. The data collected should be useful in determining the hydrologic setting of the springs in that area. Seven (7) water monitoring wells located around the perimeter of the permit area have been monitored for several years for the piezometric water level. The data has been included in our interpretations of the possible hydrologic consequences of mining. The data regarding the quality of water intersected in the mine is summarized in Tables 8 and 9.

Soil Loss and Sediment Yield:

As described above (soil loss and sediment yield) several areas outside of the disturbed area of the mine portals are susceptible to erosion and were identified by water quality samples taken at both high and low flows in the streams within and adjacent to the permit area. The susceptibility to erosion is a condition typical of the Wasatch Plateau and the arid western states.

The locations of all of the streams within and adjacent to the permit area are shown on the Hydrologic Data Map (see Map 1). The sediment load in samples collected is summarized in the annual Hydrologic Monitoring Report. Riparian zones are usually adjacent to the streams and springs which emanate from the permit area. The Riparian zones are located adjacent to the springs and streams shown on the Spring Map (see Map 2).

No alluvial valley floors are present within or immediately adjacent to the permit area.

The soil types within the permit area have been identified by the US Department of Agriculture (Soil Survey Carbon-Emery Area, Utah 1970). The study was used in conjunction with in-house studies to understand the soils present in the permit area. The data has been presented in section 2-131 of the PAP.

The stability of the reclaimed soil slopes is always a concern in disturbed area. Soil studies have identified the type of material available for reclamation, and reclamation procedures and methods of sediment control have been geared around the available soil data.

The suspended solid content of surface water samples taken at medium and high flow have been presented in the Surface Water Section of this document.

The field measurements of the channel gradients, bank materials, and channel cross-sections have been presented in the PAP.

Prediction of Mining Impacts (surface water):

Data collected by UP&L indicates mining has had only minor impact on surface water quality and quantity. During periods of high runoff changes in quality are insignificant; however, in low flow conditions some degradation is likely due to the fact that the mine discharge waters are higher in total dissolved solids (TDS) than the surface waters. It is difficult to assess the degradation because it is not known from where or how much of the water discharged from the mine would naturally have been discharged into the receiving stream by springs and seeps. The water discharged from the Deer Creek Mine will not affect the quality of Deer Creek throughout the life of the mine due to the fact that the water is transferred directly to the power plant through a pipeline. Post-mining conditions will likely cause water to be discharged from portals in Deer Creek Canyon, Grimes Wash, North Fork of Meetinghouse Canyon, Miller Canyon, and Rilda Canyon. The quantity of discharge will be discussed in the Groundwater section of this document. The cumulative effect of discharge waters on post mine use is thought to be insignificant because the volume of water to be discharged is negligible in comparison to the volume which flows in Cottonwood and Huntington creeks.

The most significant impact on the discharge of the receiving stream quality will take place when the stream is at its lowest flow (about 15-30 CFS), at which time the total discharge into either Cottonwood or Huntington Creek will be small in proportion to the volume of water flowing in the creeks. The TDS levels of either Huntington or Cottonwood Creek are about 300 to 350 mg/l while the discharge water TDS levels are 500 to 1000 mg/l. Even with the differential in quality, the effect the discharge waters will have on the stream water quality will be minimal due to the difference in flow volume.

Prediction of Mining Impacts (Groundwater):

The Water Discharge rates from the mines is variable and dependent on several factors. One of the most significant is that when the mine enters virgin country a significant amount of water is liberated. In virtually all cases, the amount of water which flows into the mine exceeds the recharge and, in time, the water inflow decreases in volume. If new areas are not mined, the discharge from the mine will decrease accordingly.

Water discharged from the Deer Creek Mine is currently transported directly to the Huntington Power Plant by way of an underground pipeline. The volume of water discharged from the mine has increased at a significant rate over the past several years. The increased discharge is due to at least five factors. First, in previous years water discharged was measured with a Stevens Recorder installed in a Parshall Flume. Calibration of the recorder was difficult to maintain, and in 1985 in-line flow meters (totalizer and instantaneous flow) were installed, allowing for a more accurate measurement of discharge. Second, mining has progressed into areas largely dominated by sandstone roof. The inflow from these areas is greater per acre of exposed area than areas of mudstone top. Third, mining has progressed into the bottom of the Straight Canyon Syncline, the lowest part of the mine where a significant amount of water has been intersected. Fourth, mining has intersected the Roans Canyon Fault, releasing additional water into the mine workings. Last, prior to 1985 water used in mining was pumped directly from the in-mine sumps. Since 1985 all water is pumped from the mine through the metering system. Mining water is then pumped back into the mine through a high-pressure steel line to the mining faces where it is utilized.

Since January 1985 water discharges from the Cottonwood Mine have been limited to a minor amount, less than 15 GPM, from the Miller Canyon Breakout. Water discharged from that point comes from sealed portions of the Wilberg Mine and a limited amount intersected in the active Cottonwood Mine workings which is transmitted by pipeline to the sealed workings.

The monitoring of in-mine water sources has shown that the long-term water flow from a given area is much less than ten percent (10%) of the initial flow from the area. Most of the current inflow into the mine workings is from areas where the water storage has not been depleted. After the storage has been depleted, the flow will reduce to roughly equal the recharge rate which is expected to be less than ten percent (10%) (historical data) of the current discharge rate. The current discharge rate from all ~~UP&L~~ mines combined is approximately 1400 to 1600 GPM; therefore, the post-mining discharge rate is expected to be approximately 140 to 160 GPM. For verification purposes UP&L will, where possible, monitor select areas of the mine to formulate discharge recession curves over time, enabling a better understanding of the ratio of initial discharge rates and long-term post mining discharge values. There is no reason to assume that the post-mining discharge water quality will differ from that currently being discharged (see Groundwater Monitoring section).

Because the permit area is divided between the Huntington Creek Drainage Basin and the Cottonwood Creek Drainage Basin at 73% and 27% respectively, the amount of inter-basin water transfer that occurs must be considered. The average annual flows of Huntington and Cottonwood creeks are 96.3 and 97.6 CFS, respectively. The current discharge rate from UP&L's total permit areas ranges from 1400 to 1600 GPM, less than 3.5% of either of the creeks' average flows. Because a limited portion of the Deer Creek mine workings (less than 27%) intersects water that would normally migrate toward the Cottonwood Basin but is discharged out Deer Creek Canyon, the inter-basin water transfer from the Cottonwood drainage to Huntington Creek will probably never exceed 0.8% of the average annual discharge of either system.

Water intersected by the Cottonwood/Wilberg Mine workings currently comes from areas underlying the Cottonwood Creek drainage. Future mining, however, will undermine areas of the Huntington Creek drainage and previously mined areas of the Deer Creek Mine. It is expected that water normally intercepted by the Deer Creek workings will migrate down into the Cottonwood workings, thus reducing the post-mining discharge of the Deer Creek Mine. Of all the portals in UP&L's permit areas, the Miller Canyon portal of the Cottonwood Mine is at the lowest elevation and will probably experience the greatest post-mining discharge of all of the portals in the southern portion of the permit areas.

Previous investigation by UP&L has suggested that the Roans Canyon Fault System contains significant amounts of water. In 1988 a comprehensive drilling and hydrologic testing program was conducted on the fault system. From the data collected it was determined that most of the water present in the two zones identified can be effectively dewatered by utilizing horizontal wells from in the mine. If additional sustained inflows are encountered during the graben crossing, an attempt will be made to seal the water-producing zones with pressure grouting seals. If the grouting is effective, it is not expected that significant quantities of water will flow into the mine workings for long term periods. Given the preexisting dominant vertical flow direction and the fact that the springs do not appear to be associated with aquifers of concern, it is unlikely that the tunnels or the recommended dewatering system will exert a measurable influence on the springs.

The hydrologic monitoring on East Mountain has provided data to support a hydrologic model. The data supports the fact that the majority of the groundwater is transported through fracture systems. As previously discussed, snow melt from the higher reaches of East Mountain to the north percolates

into the subsurface along vertical fractures, allowing the water to intersect sandstone channels which form perched aquifers in the North Horn formation. The water continues its southeast migration until the flow is stopped at the Roans Canyon Fault. Water then flows downward as well as laterally along the fault. The groundwater on the southern two-thirds of East Mountain finds its recharge in the highest portions of the plateau to the south of the Roans Canyon Fault. The groundwater model is best depicted as shown in Map 1.

The spring monitoring has failed to identify any mining related impacts. Most of the springs are located in the North Horn formation which is known to contain clays that heal when fractured. Mining impacts to the springs located in the North Horn Formation will probably not be experienced either during mining or post-mining.

Summary:

Based on the data currently available, the Hydrologic consequences of mining will probably be very slight in comparison to the magnitude of the entire hydrologic system. Hydrologic monitoring has identified the quality and quantity of surface and groundwater present within the permit area and has identified where slight impacts of mining may occur in the hydrologic regime. Monitoring has also identified areas requiring further data collection in order to fully understand and qualify/quantify the mining related impacts both in mining and post-mining time frames. UP&L recognizes the importance of fully understanding the hydrologic setting of the area and commits to collecting addition data which will support or justify model modifications. Only after additional data is collected can a precise calculation of the hydrologic impacts be made.

TABLE 1

DEER CREEK SURFACE WATER QUALITY
ABOVE THE MINE

SAMPLE DATES	ALKALINITY ACIDITY	ALKALINITY BICARBONATE	CALCIUM	ALKALINITY CARBONATE	CHLORIDE	CONDUCTIVITY	DISSOLVED OXYGEN	HARDNESS	IRON DISSOLVED	IRON TOTAL	MAGNESIUM	MANGANESE	OIL & GREASE	pH	POTASSIUM	SODIUM	SULFATE	SOLIDS TDS	SOLIDS TSS	SOLIDS SETTLEABLE
1987																				
4-08	<1.0	337	82.0	<1.0	176.0	1580	7.80	550	<0.05	0.13	83.9	<0.01	---	7.7	4.33	111.6	255.0	897	9.0	<0.1
May	Cancelled due to change in lab contractor																			
6-11	<1.0	272	2.2	<1.0	6.3	440	7.65	225	<0.05	0.31	27.9	0.06	0.6	7.8	0.50	16.0	24.0	275	1.0	<0.1
7-07	<1.0	273	38.0	<1.0	8.0	505	8.40	225	<0.05	0.06	31.6	<0.01	0.6	7.2	0.60	18.0	25.0	252	<4.0	<0.1
8-13	<1.0	303	46.0	<1.0	3.5	500	5.70	250	<0.05	<0.05	33.0	0.01	1.0	7.7	0.90	20.42	64.0	312	<4.0	<0.1
9-19	0	328	59.1	6.0	4.0	360	5.30	296	0.02	0.01	36.0	0.01	<1.0	8.4	1.08	27.30	62.0	256		0
10-17	137.0	276	60.9	<1.0	8.4	500	6.80	324	<0.05	<0.05	41.7	<0.01	<1.0	7.0	1.45	23.60	130.0	278	<1.0	<0.1
MIN	0	272	2.2	<1.0	3.5	360	5.3	225	0.02	0.04	27.9	<0.01	0.6	7.0	0.50	16.0	24.0	252		0
MAX	137.0	337	82.0	6.0	176.0	1580	8.4	550	0.05	0.31	83.9	0.06	<1.0	8.4	4.33	111.6	255.0	897		<0.1
MEAN	23.5	298.2	48.0	1.8	34.4	647.5	6.94	311.7	0.05	0.11	42.4	0.02	0.84	7.53	1.48	36.24	93.3	395		0.08
1986																				
MIN	1.0	262	42.0	<1.0	4.5	470	8.2	232	<0.05	<0.05	26.3	<0.01	<0.5	7.3	0.8	13.9	30.0	269	<0.5	<0.1
MAX	1.0	322	62.0	<1.0	10.8	660	10.2	290	<0.05	0.26	40.1	0.03	0.5	7.9	1.12	27.6	90.0	385	130.0	<0.5
MEAN	1.0	299.7	50.7	<1.0	7.29	573.1	9.46	263.9	<0.05	0.09	33.4	0.01	0.5	7.66	1.0	20.0	52.9	317.9	23.9	0.02
1985																				
MIN						439				<0.05		<0.01		7.4				246	1.0	
MAX						685				0.21		0.08		8.0				378	162.0	
MEAN						573.1				0.07		0.02		7.8				317.9	24.3	
1984																				
MIN						480				<0.05		<0.01		7.3				231	<0.5	
MAX						700				<0.05		<0.01		8.3				381	41.5	
MEAN						582.5				<0.05		<0.01		7.9				319.5	11.5	
1983																				
MIN						525				0.03		<0.01		7.7				280	<0.5	
MAX						770				0.74		0.07		8.4				566	164.0	
MEAN						600.6				0.18		0.03		8.1				350.3	31.5	
HISTORICAL 1978-1986																				
MIN	<1.0	262	42.0	<1.0	4.5	360	8.2	232	<0.05	0.03	26.3	<0.01	<0.5	7.0	0.8	13.9	10.0	231	<0.5	<0.1
MAX	12.0	322	62.0	<1.0	12.0	820	10.2	290	<0.05	40.1	40.1	0.24	1.0	8.5	1.12	27.6	90.0	566	3592.0	<0.5
MEAN	2.6	299.7	50.7	<1.0	7.29	572	9.46	263.9	<0.05	1.00	33.4	0.04	0.6	7.89	1.0	20.0	44.1	328.0	134.7	0.02

TABLE 2

DEER CREEK SURFACE WATER QUALITY
BELOW THE MINE

1987 SAMPLE DATES	ACIDITY	ALKALINITY BICARBONATE	CALCIUM	CARBONATE	CHLORIDE	CONDUCTIVITY	DISSOLVED OXYGEN	HARDNESS	IRON DISSOLVED	IRON TOTAL	MAGNESIUM	MANGANESE	OIL & GREASE	pH	POTASSIUM	SODIUM	SULFATE	SOLIDS TDS	SOLIDS TSS	SOLIDS SETTLEABLE
4-08	<1.0	305	124	<1.0	420.0	2650	7.45	815	<0.05	0.29	122.8	<0.01	---	7.40	7.31	233.2	500.0	1544	41.0	0.1
May	Cancelled due to change in lab contractor - - - - - - - - - -																			
6-16	<1.0	255	2.4	<1.0	48.0	620	7.35	285	0.07	0.13	40.1	0.02	1.2	7.80	1.00	39.0	100.0	429	9.0	0.1
7-16	<1.0	267	46.0	<1.0	88.0	930	8.20	320	<0.05	0.05	49.8	0.01	<0.5	7.35	2.00	63.0	90.0	489	8.0	<0.1
8-18	<1.0	272	78.0	<1.0	34.6	1320	5.40	475	<0.05	<0.05	78.0	<0.01	1.1	7.60	3.30	197.8	280.0	798	<4.0	<0.1
9-22	<1.0	344	76.0	8.0	49.0	1000	5.70	740	<0.05	0.05	76.0	0.01	<1.0	8.50	4.37	111.6	90.0	730	<1.0	<1.0
10-21	90.0	371	102.2	<1.0	73.6	1300	6.60	607	<0.05	<0.05	102.2	<0.01	<1.0	8.27	5.69	119.2	347.0	848	4.0	<1.0
MIN	<1.0	255	2.4	<1.0	34.6	620	5.40	285	<0.05	<0.05	40.1	<0.01	<1.0	7.35	1.00	39.0	90.0	429	<4.0	<0.1
MAX	90.0	371	124.0	8.0	420.0	2650	8.20	815	0.07	0.29	122.8	0.02	1.2	8.50	7.31	233.8	500.0	1544	410	<1.0
MEAN	15.2	302.2	71.4	2.2	118.9	1303.3	6.78	510.3	0.53	0.10	78.2	0.01	0.6	7.82	4.05	127.3	234.5	806.3	11.2	0.40
1986																				
MIN	<1.0	260	46.0	<1.0	30.3	698	9.35	284	<0.05	<0.05	34.5	<0.01	<0.5	7.25	1.20	32.6	65.0	359	<0.5	<0.1
MAX	<1.0	359	112.0	<1.0	290	2300	11.0	750	0.06	0.19	114.3	0.03	0.5	7.90	6.61	192.0	450.0	1315	91.0	<0.5
MEAN	<1.0	308.1	73.0	<1.0	135.9	1306.9	10.0	449.9	0.05	0.09	65.0	0.017	0.5	7.71	3.66	104.2	225.0	739	25.7	0.02
1985																				
MIN						630				<0.05		<0.01		7.4				320	4.0	
MAX						2300				0.39		0.08		8.3				1354	258.0	
MEAN						1374.7				0.13		0.02		7.9				690.6	44.1	
1984																				
MIN						620				0.05		<0.01		7.8				371	0.5	
MAX						2150				0.18		<0.01		8.5				637	141.0	
MEAN						1172.5				0.07		<0.01		8.1				465.5	29.8	
1983																				
MIN						650				0.05		<0.01		8.0				367	6.5	
MAX						1150				2.12		0.15		8.6				868	557.0	
MEAN						830.8				0.55		0.04		8.3				550	129.7	
HISTORICAL 1978-1986																				
MIN	<1.0	260	46	<1.0	22.0	420	8.84	284	---	<0.05	34.5	<0.01	<0.5	6.9	1.3	32.6	65.0	273	<0.5	<0.1
MAX	14.0	359	112	<1.0	290.0	2300	11.00	750	---	170.00	114.3	0.27	1.0	8.6	6.61	192.0	450.0	1448	20,540.0	<0.5
MEAN	2.9	308.1	73	<1.0	121.6	1138	9.80	449.9	---	4.20	65.0	0.05	0.06	7.97	3.66	104.2	203.3	667	557.9	0.02

TABLE 3

MEETINGHOUSE CANYON WATER QUALITY

1987 SAMPLE DATES	ALKALINITY ACIDITY	ALKALINITY BICARBONATE	CALCIUM	ALKALINITY CARBONATE	CHLORIDE	CONDUCTIVITY	DISSOLVED OXYGEN	HARDNESS	IRON DISSOLVED	IRON TOTAL	MAGNESIUM	MANGANESE	OIL & GREASE	pH	POTASSIUM	SODIUM	SULFATE	SOLIDS TDS	SOLIDS TSS	SOLIDS SETTLEABLE
May	Cancelled due to change in lab contractor																			
6-16	<1.0	229	2.2	<1.0	47.5	380	7.35	210	0.30	0.90	24.3	0.02	1.1	7.80	0.6	7.0	20.0	233	42.0	0.2
7-15	<1.0	222	32.0	<1.0	7.0	382	6.70	195	<0.05	0.26	28.0	0.02	<0.5	7.25	0.7	9.0	24.0	216	16.0	0.1
8-18	<1.0	245	38.0	<1.0	3.0	420	5.40	230	0.08	0.13	33.0	0.04	10.9	7.62	1.2	10.62	32.0	250	18.0	0.1
9-22	0.0	307	55.6	8.0	4.0	300	6.00	267	0.04	0.08	31.15	<0.01	<1.0	8.55	1.29	10.74	45.0	190	<1.0	<1.0
10-21	49.0	248	41.3	5.0	8.8	350	6.50	228	<0.05	<0.05	30.3	<0.01	<1.0	8.38	1.29	3.80	33.0	259	2.0	<1.0
MIN	0.0	222	2.2	<1.0	3.0	300	5.40	195	0.04	<0.05	24.3	<0.01	<1.0	7.25	0.60	3.80	20.0	190	<1.0	0.1
MAX	49.0	307	55.6	8.0	47.5	420	7.35	267	0.08	0.90	33.0	0.04	10.9	8.55	1.29	10.74	45.0	259	42.0	<1.0
MEAN	10.4	250.2	33.8	3.2	14.1	366.4	6.39	226	0.10	0.28	29.4	0.02	2.9	7.92	1.02	8.23	30.8	229.6	15.8	0.48
1986																				
MIN	<1.0	231	38.0	<1.0	3.3	432	8.6	213	<0.05	<0.05	22.6	<0.01	<0.5	7.35	0.9	6.5	25.0	231	<0.5	<0.1
MAX	<1.0	261	52.8	<1.0	7.6	500	10.3	260	<0.05	0.18	36.5	0.02	0.6	8.0	1.6	13.1	85.0	292	74.0	<0.5
MEAN	<1.0	248.7	44.5	<1.0	5.1	450	9.4	233	<0.05	0.10	29.6	0.02	0.5	7.66	1.23	9.5	43.2	252.7	24.0	0.2

TABLE 4

GRIMES WASH SURFACE QUALITY
RIGHT FORK

1987 SAMPLE DATES	ACIDITY	ALKALINITY BICARBONATE	CALCIUM	CARBONATE	CHLORIDE	CONDUCTIVITY	DISSOLVED OXYGEN	HARDNESS	---- IRON ---- DISSOLVED	TOTAL	MAGNESIUM	MANGANESE	OIL & GREASE	pH	POTASSIUM	SODIUM	SULFATE	-------- SOLIDS --------- TDS	TSS	SETTLEABLE
4-8	<1.0	104	34.4	<1.0	3.0	190	6.8	112	3.31	20.6	6.3	0.05	---	7.2	7.64	2.0	20.0	115	2000	3.3
May	Cancelled due to change in lab contractor																			
June	Dry																			
July	"																			
Aug.	"																			
Sept.	"																			
Oct.	"																			
MIN	<1.0	104	34.4	<1.0	3.0	190	6.8	112	3.31	20.6	6.3	0.05	---	7.2	7.64	2.0	20.0	115	2000	3.3
MAX	<1.0	104	34.4	<1.0	3.0	190	6.8	112	3.31	20.6	6.3	0.05	---	7.2	7.64	2.0	20.0	115	2000	3.3
MEAN	<1.0	104	34.4	<1.0	3.0	190	6.8	112	3.31	20.6	6.3	0.05	---	7.2	7.64	2.0	20.0	115	2000	3.3
1986																				
MIN	<1.0	240	30.0	<1.0	8.3	465	7.6	222	<0.05	<0.05	35.7	<0.01	<0.5	7.45	1.60	3.40	40.0	262	0.5	<0.1
MAX	<1.0	320	52.0	<1.0	11.5	680	9.8	320	<0.05	0.73	46.2	0.05	2.2	8.10	3.30	20.44	120.0	389	257.0	<0.5
MEAN	<1.0	274.9	41.6	<1.0	10.2	547.6	8.76	268.1	<0.05	0.24	39.9	0.02	0.74	7.77	2.47	15.72	61.3	315.6	60.6	0.2
1985																				
MIN						200				<0.05		<0.01		7.4				125	11.0	
MAX						740				2.90		0.08		8.3				430	7116.0	
MEAN						532.3				0.50		0.02		8.0				304.3	833.8	
1984																				
MIN						470				<0.05		<0.01		7.9				246	7.0	
MAX						750				1.05		0.02		8.7				477	1482.0	
MEAN						593.8				0.26		0.01		8.2				332.6	207.7	
1983																				
MIN						525				0.08		<0.01		8.1				386	10.5	
MAX						650				2.64		0.18		8.6				280	493.0	
MEAN						610				0.69		0.06		8.3				328.2	183.3	
HISTORICAL 1979-1986																				
MIN	0.1	240	30.0	<1.0	8.0	200	7.6	222	<0.05	0.01	35.7	<0.01	<0.5	7.4	1.60	3.4	33.0	125	0.5	
MAX	14.0	320	52.0	<1.0	16.0	750	9.8	320	<0.05	7.20	46.2	0.30	5.2	8.7	3.30	20.44	161.7	700	7116.0	
MEAN	2.3	274.9	41.6	<1.0	10.6	578	8.76	268.1	<0.05	0.93	39.9	0.06	1.2	8.1	2.47	15.72	71.8	347	347.8	

TABLE 5

GRIMES WASH SURFACE QUALITY
LEFT FORK

1987 SAMPLE DATES	ALKALINITY ACIDITY	ALKALINITY BICARBONATE	CALCIUM	ALKALINITY CARBONATE	CHLORIDE	CONDUCTIVITY	DISSOLVED OXYGEN	HARDNESS	IRON DISSOLVED	IRON TOTAL	MAGNESIUM	MANGANESE	OIL & GREASE	pH	POTASSIUM	SODIUM	SULFATE	SOLIDS TDS	SOLIDS TSS	SOLIDS SETTLEABLE
4-4	<1.0	188	39.2	<1.0	6.0	412	7.8	196	0.12	0.62	23.8	<0.01	---	7.60	2.48	11.1	45.0	212	48.0	0.2
May	Cancelled due to change in lab contractor																			
6-16	<1.0	300	2.3	<1.0	9.9	600	7.55	290	0.07	0.08	42.6	0.06	1.2	7.85	1.0	30.0	90.0	382	16.0	<0.1
7-15	<1.0	304	36.0	<1.0	11.0	610	6.65	260	<0.05	<0.05	41.3	<0.01	<0.5	7.30	1.0	34.0	85.0	328	4.0	<0.1
8-11	<1.0	312	42.0	<1.0	156.0	590	7.80	275	<0.05	<0.05	41.0	0.02	3.5	7.80	1.0	69.0	69.0	362	<4.0	<0.1
9-17	<1.0	482	71.1	15.0	10.0	420	5.00	460	0.05	0.07	68.5	<0.01	3.4	8.60	1.37	79.0	79.0	250	<1.0	0
Oct	Damp - no flow																			
MIN	<1.0	188	2.3	<1.0	6.0	412	5.0	196	<0.05	<0.05	23.8	<0.01	<0.5	7.60	1.0	11.1	45.0	212	<1.0	0
MAX	<1.0	482	71.1	15.0	156.0	610	7.8	460	0.12	0.62	68.5	0.06	3.5	8.60	2.48	79.0	90.0	382	48.0	0.2
MEAN	<1.0	317.2	38.1	3.8	56.6	526.4	7.0	296.2	0.07	0.17	43.4	0.02	1.7	7.83	1.37	44.6	73.6	306.8	14.6	0.1
1986																				
MIN	<1.0	281	36	<1.0	7.7	410	7.40	252	<0.05	<0.05	37.7	<0.01	<0.5	7.40	1.30	25.2	67.0	293	3	<0.1
MAX	<1.0	321	58	<1.0	10.9	690	9.60	310	<0.05	0.22	43.8	0.07	0.6	8.00	3.00	34.0	115.0	427	253	<0.5
MEAN	<1.0	304.3	45.5	<1.0	8.8	590.7	8.56	278	<0.05	0.12	39.9	0.02	0.5	7.65	1.90	29.2	77.9	345.6	54.1	0.2
1985																				
MIN						473				<0.05		<0.01		7.5				283	<0.5	
MAX						750				0.22		0.08		8.3				438	141.0	
MEAN						628.2				0.12		0.02		7.9				356	37.1	
1984																				
MIN						600				<0.05		<0.01		7.8				278	<0.5	
MAX						685				0.09		<0.01		8.5				396	76.0	
MEAN						639.3				0.06		<0.01		8.1				343.9	17.0	
1983																				
MIN						720				0.04		<0.01		7.4				295	<0.5	
MAX						650				0.56		0.11		8.3				570	133.0	
MEAN						676.3				0.19		0.03		8.1				388.1	28.6	
HISTORICAL 1979-1986																				
MIN	<1.0	281	36	<1.0	7.7	412	7.4	252	<0.05	0.04	37.7	<0.01	0.1	7.4	1.3	25.2	30.4	278	<0.5	<0.1
MAX	<1.0	331	58	<1.0	10.9	790	9.6	310	<0.05	0.81	43.8	0.15	0.6	8.7	3.0	34.0	115.0	570	253.0	<0.5
MEAN	<1.0	304.3	45.5	<1.0	8.8	641	8.56	278	<0.05	0.16	39.9	0.03	0.5	8.0	1.9	29.2	71.9	369	27.2	0.2

TABLE 6

GRIMES WASH SURFACE QUALITY
BELOW THE MINE

1987 SAMPLE DATES	ACIDITY	ALKALINITY BICARBONATE	CALCIUM	CARBONATE	CHLORIDE	CONDUCTIVITY	DISSOLVED OXYGEN	HARDNESS	IRON DISSOLVED	IRON TOTAL	MAGNESIUM	MANGANESE	OIL & GREASE	pH	POTASSIUM	SODIUM	SULFATE	SOLIDS TDS	SOLIDS TSS	SOLIDS SETTLEABLE
4-8	<1.0	117	40.8	<1.0	16.0	295	7.15	146	2.25	22.60	10.7	0.04	---	7.20	7.31	9.0	46.0	155	3295.0	4.0
May	Cancelled due to change in lab contractor																			
6-16	<1.0	349	5.1	<1.0	154.0	1470	7.75	625	0.06	0.64	89.9	0.09	0.6	7.70	6.00	104.0	350.00	1033	4.0	<0.1
7-15	<1.0	366	94.0	<1.0	117.0	1440	7.10	585	0.05	0.12	85.1	0.09	<0.5	7.10	5.00	88.0	315.00	943	<4.0	<0.1
8-11	<1.0	400	114.0	<1.0	9.0	1700	6.70	705	0.10	0.23	102.0	0.17	2.5	7.35	6.70	121.0	340.0	1201	5.0	<0.1
9-17	<1.0	378	149.0	<1.0	59.2	1200	4.50	672	0.05	0.26	72.9	0.10	5.2	8.15	6.80	93.6	400.0	885	<1.0	<1.0
10-21	127.0	373	191.5	<1.0	49.6	1420	5.90	855	<0.05	0.05	91.6	0.11	2.4	7.94	7.81	82.9	593.0	1078	4.0	<1.0
MIN	<1.0	117	5.1	<1.0	9.0	295	4.50	146	<0.05	<0.05	10.7	0.04	<0.5	7.10	5.00	9.0	46.0	155	<1.0	<0.1
MAX	127.0	400	191.5	<1.0	154.0	1700	7.75	855	2.25	22.60	102.0	0.17	5.2	8.15	7.81	121.0	593.0	1201	3295.0	4.0
MEAN	22.0	330.5	99.1	<1.0	67.5	1254.2	6.52	598.0	0.43	3.98	75.4	0.10	2.2	7.57	6.60	83.1	340.7	882.5	552.2	1.05
1986																				
MIN	<1.0	284	72.4	<1.0	36.3	890	7.85	405	<0.05	<0.05	51.1	<0.01	<0.5	7.15	2.60	47.0	150.0	523	<0.5	<0.1
MAX	<1.0	381	150	<1.0	141.2	1800	11.45	760	0.13	0.40	87.6	0.03	1.0	7.95	5.80	119.8	320.0	1224	248.3	<0.5
MEAN	<1.0	342.8	99	<1.0	71.4	1238.9	9.38	544.6	0.06	0.13	72.2	0.03	0.17	7.56	4.10	68.9	243.3	760.4	37.1	0.2
1985																				
MIN						220				0.05		0.01		7.4				152	2.0	
MAX						1810				2.70		0.13		8.1				1129	9702.0	
MEAN						1182.6				0.37		0.04		7.8				732.9	994.8	
1984																				
MIN						800				0.05		0.01		7.7				457	1.0	
MAX						1700				0.45		0.07		8.3				923	107.0	
MEAN						1101.3				0.15		0.02		8.1				649.3	24.5	
1983																				
MIN						700				0.05		0.01		7.7				427	1.0	
MAX						1000				1.25		0.06		8.3				643	244.0	
MEAN						851.9				0.28		0.03		8.13				521.9	57.4	
HISTORICAL 1979-1986																				
MIN	<0.1	284	72.4	<1.0	12.0	220	7.85	405	<0.05	0.01	51.1	<0.01	<0.5	7.15	2.60	47.0	66.0	152	<0.5	<0.1
MAX	16.0	381	150	<1.0	141.2	1810	11.45	760	0.13	18.90	87.6	0.30	2.4	8.50	5.80	119.8	550.0	1224	9702.0	<0.5
MEAN	2.4	342.8	99	<1.0	59.7	1048	9.38	544.6	0.06	0.90	72.2	0.05	0.90	7.92	4.10	68.9	245.5	621	270.8	0.2

TABLE 7

East Mountain Springs Water Quality (Historical vs. 1987)

Parameter	Burnt Tree		Elk Spring		Sheba Spring		79-10		79-23		79-26	
	Historical	1987	Historical	1987	Historical	1987	Historical	1987	Historical	1987	Historical	1987
Elevation	9260		9350		9740		9350		9035		9310	
Geologic Formation	TKn		TKn		Tf		Kpr		TKn		TKn	
Bicarbonate	335.60	323.50	297.00	289.00	296.00	267.00	313.00	315.00	413.00	no	339.00	333.00
Calcium	69.10	63.40	76.30	63.80	97.50	85.80	81.00	81.10	79.60	flow	90.20	56.10
Carbonate	<1	<1	<1	<1	<1	<1	<1	<1	1.00	during	<1	<1
Chloride	4.80	4.80	3.70	3.80	3.20	3.80	5.10	4.70	11.30	July	8.00	2.40
Conductivity	515.00	417.50	459.00	356.00	472.00	319.00	507.00	438.50	691.00		488.00	470.00
Hardness		267.50		254.00		257.30		299.50				285.30
Iron	0.27	0.05	0.16	0.05	0.17	<.05	0.24	<.05	0.09		0.27	<.05
Magnesium	24.60	26.60	21.10	22.70	10.10	8.40	21.80	22.90	38.30		18.40	35.70
Mangenese	<0.01	<0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01		0.02	<.01
pH	7.49	7.36	7.65	7.65	7.55	7.49	7.74	7.50	7.72		7.99	7.89
Potassium	1.40	0.63	3.44	0.63	2.35	0.34	3.67	0.65	1.54		3.57	0.64
Sodium	14.30	12.40	12.10	6.50	7.37	3.00	8.53	4.70	14.90		18.90	14.60
Sulfate	33.50	18.00	46.70	17.00	97.80	10.50	47.00	13.00	27.20		64.00	22.50
TDS	292.00	274.00	263.00	203.50	275.00	238.00	272.00	270.50	364.00		290.00	273.50

Parameter	79-29		79-35		80-44		80-46		82-52		84-56	
	Historical	1987	Historical	1987	Historical	1987	Historical	1987	Historical	1987	Historical	1987
Elevation	9410		9585		8980		9350		8995		9335	
Geologic Formation	TKn		Tf		Kpr		TKn		Kpr		TKn	
Bicarbonate	338.60	309.50	315.00	284.50	455.00	no	335.50	336.00	415.00	390.00	341.00	348.50
Calcium	76.80	45.00	102.90	84.00	104.90	flow	60.90	62.40	86.00	71.00	59.70	70.50
Carbonate	<1	<1	<1	<1	<1	during	<1	<1	<1	<1	<1	<1
Chloride	19.60	15.60	3.50	3.70	11.30	July	4.80	4.60	10.00	7.20	9.60	8.00
Conductivity	576.00	495.00	468.00	396.00	904.00		572.00	475.00	704.00	510.50	604.00	500.00
Hardness		267.80		267.50				308.30		294.30		301.80
Iron	0.19	<.05	0.19	<.05	0.13		<.05	<.05	0.08	<.05	<.05	<.05
Magnesium	33.90	35.70	14.00	14.10	41.10		28.30	31.10	33.60	33.80	34.70	27.80
Mangenese	0.01	0.05	0.01	<.01	<.01		<.01	<.01	0.01	0.01	<.01	<.01
pH	7.81	7.69	7.65	7.51	7.75		7.22	7.27	7.38	7.38	7.58	7.35
Potassium	5.94	1.25	1.33	0.36	3.05		0.88	0.85	1.93	0.81	0.93	0.84
Sodium	28.90	31.20	13.10	3.06	34.30		10.05	10.20	23.10	23.90	18.10	16.90
Sulfate	98.40	31.50	68.70	13.00	145.70		22.50	22.50	57.40	25.50	28.70	27.00
TDS	352.00	309.50	283.00	253.50	523.00		288.00	287.50	386.00	353.50	329.00	300.00

TABLE 8

DEER CREEK IN-MINE WATER QUALITY

LOCATION	ALKALINITY BICARBONATE	CALCIUM	CARBONATE	CHLORIDE	CONDUCTIVITY	HARDNESS	IRON DISSOLVED	MAGNESIUM	MANGANESE	pH	POTASSIUM	SODIUM	SULFATE	TDS
EM-3	401	10.0	0	9.6	1000	468	<0.05	53.0	0.01	7.31	2.0	17.0	80	576
3N XC-41	314	67.0	0	4.0	610	311	<0.05	35.0	0.01	7.33	1.0	15.0	28	324
3SB XC-21	355	100.0	<1.0	10.0	900	475	0.07	55.0	0.02	7.05	1.9	19.0	120	533
EM-3	377	116.0	<1.0	10.0	990	530	0.22	58.0	0.02	7.10	1.9	18.0	130	586
3N XC-41	279	69.1	<1.0	6.0	500	299	<0.05	30.4	0.01	7.30	2.41	12.84	27	256
EM-3	405	118.8	<1.0	8.4	800	448	<0.05	36.7	0.02	6.90	3.25	14.98	200	426
EM-3	388	123.9	<1.0	16.0	890	529	0.21	53.4	<0.01	7.55	2.49	18.40	143	411
3SB XC-21	368	110.4	<1.0	14.0	800	497	<0.05	53.7	<0.01	7.52	2.88	21.20	102	265
1987														
MIN	340	10.0	0	4.0	500	299	<0.05	35.0	<0.01	6.9	1.0	14.98	27	265
MAX	494	123.9	<1.0	16.0	1000	530	0.22	58.0	0.02	7.55	3.25	21.20	200	586
MEAN	440.3	89.4	<1.0	9.8	811	444.6	0.09	46.9	0.01	7.26	2.23	12.93	91	422
HISTORICAL 1977-1986														
MIN	261.9	60.8		3.9	470			4.4		6.8	2.2	10.2	40.0	263
MAX	676.4	245.0		13.2	1700			79.5		7.9	10.0	66.0	915.2	982
MEAN	393.2	72.7		6.8	662			32.9		7.04	2.23	17.1	103.8	525

TABLE 9

WILBERG/COTTONWOOD IN-MINE WATER QUALITY

LOCATION	ALKALINITY BICARBONATE	CALCIUM	CARBONATE	CHLORIDE	CONDUCTIVITY	HARDNESS	IRON DISSOLVED	MAGNESIUM	MANGANESE	pH	POTASSIUM	SODIUM	SULFATE	TDS
2S XC-11	443	119	0	13.3	1380	725	<0.05	104.0	0.01	7.66	4.0	23.0	380	908
4E XC-24	534	279	0	27.1	2400	1482	<0.05	191.0	<0.01	7.60	9.0	47.0	1040	1848
2S XC-11	456	122	<1.0	15.0	1220	750	0.05	108.0	0.02	7.50	3.4	25.0	410	926
4E XC-24	503	282	<1.0	30.0	2375	1585	0.08	212.0	0.03	7.30	3.8	45.0	1100	2111
2S XC-11	543	222	<1.0	9.6	1000	962	<0.05	104.2	<0.01	7.95	6.16	26.9	340	722
4E XC-24	604	294	<1.0	17.6	1800	1171	0.05	106.0	<0.01	7.40	8.33	39.1	900	1472
2S XC-11	403	167.6	<1.0	130.0	2500	895	<0.02	115.6	<0.01	7.86	3.72	27.7	421	664
4E XC-24	450	383.9	<1.0	85.0	1250	1896	0.03	227.6	0.01	7.53	8.66	59.3	1202	1770
1987														
MIN	403.0	119	0	9.6	1000	725	<0.02	104.0	<0.01	7.30	3.4	23.0	400	664
MAX	604.0	383.9	<1.0	130.0	2500	1896	0.08	227.6	0.03	7.95	9.0	59.3	1202	2111
MEAN	492.3	233.7	<1.0	41.0	1753	1185.9	0.05	146.1	0.01	7.60	6.5	37.9	724.1	1303
HISTORICAL 1977-1986														
MIN	206.2	11.2		0.89	620			4.9		6.60	1.0	16.6	78	419
MAX	690.5	383.9		200.00	2600			189.7		8.50	21.0	183.8	980	1898
MEAN	475.8	164.6		11.50	1290			66.6		7.36	6.54	39.97	297.9	759

FIGURE 1

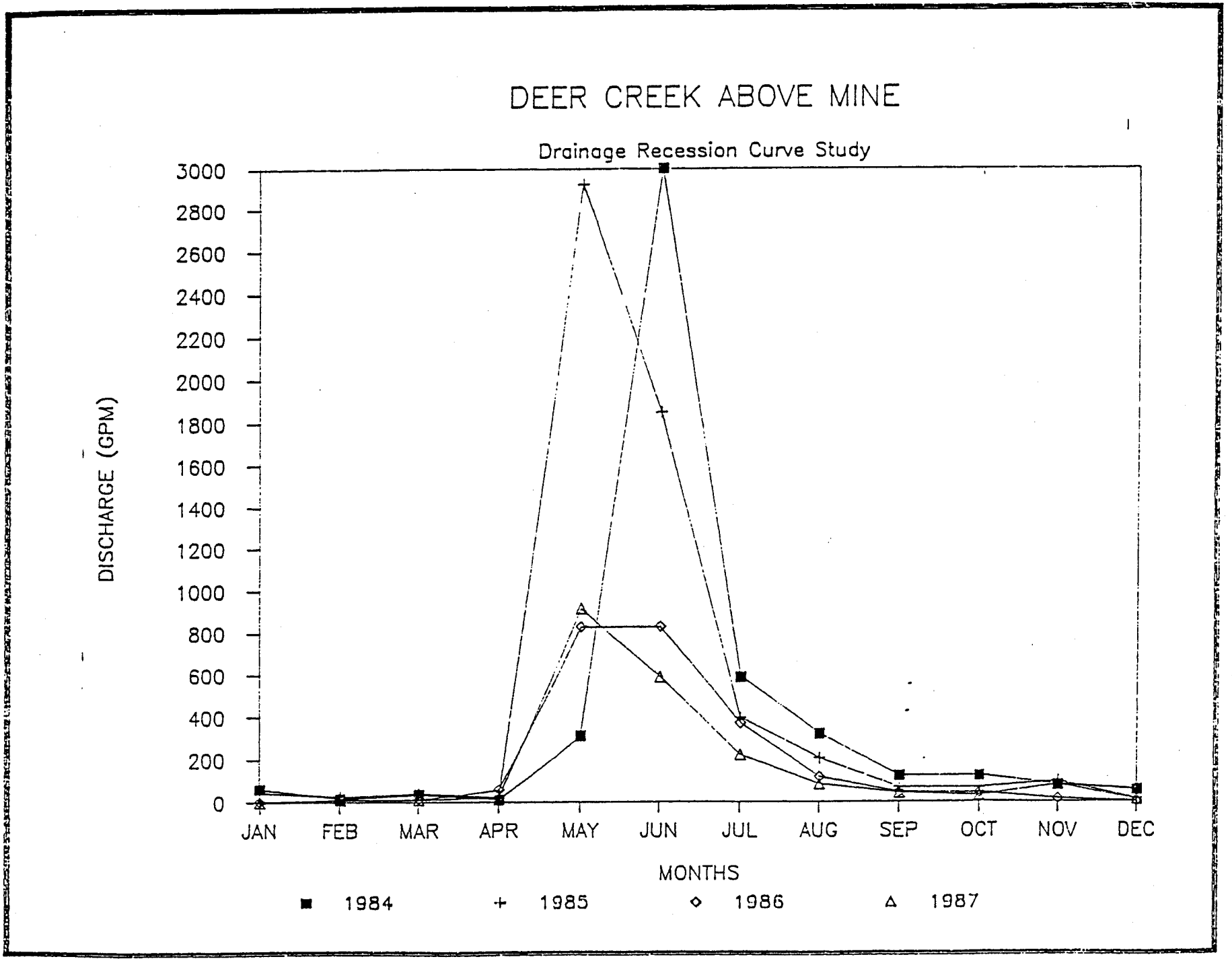

DEER CREEK ABOVE MINE
Drainage Recession Curve Study
DISCHARGE (GPM)
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTHS
1984
1985
1986
1987

FIGURE 2

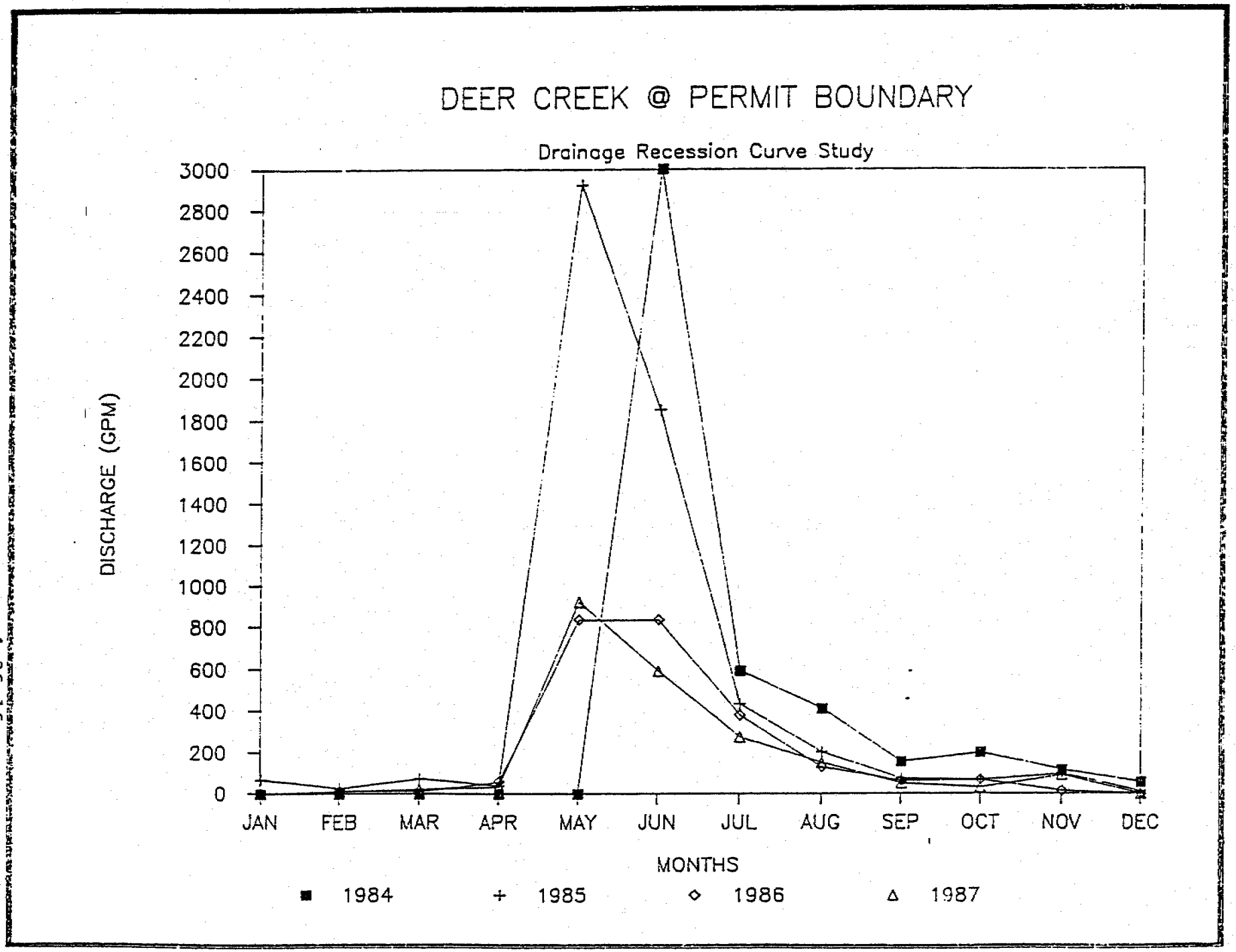

DEER CREEK @ PERMIT BOUNDARY
Drainage Recession Curve Study
DISCHARGE (GPM)
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTHS
1984
1985
1986
1987

FIGURE 3

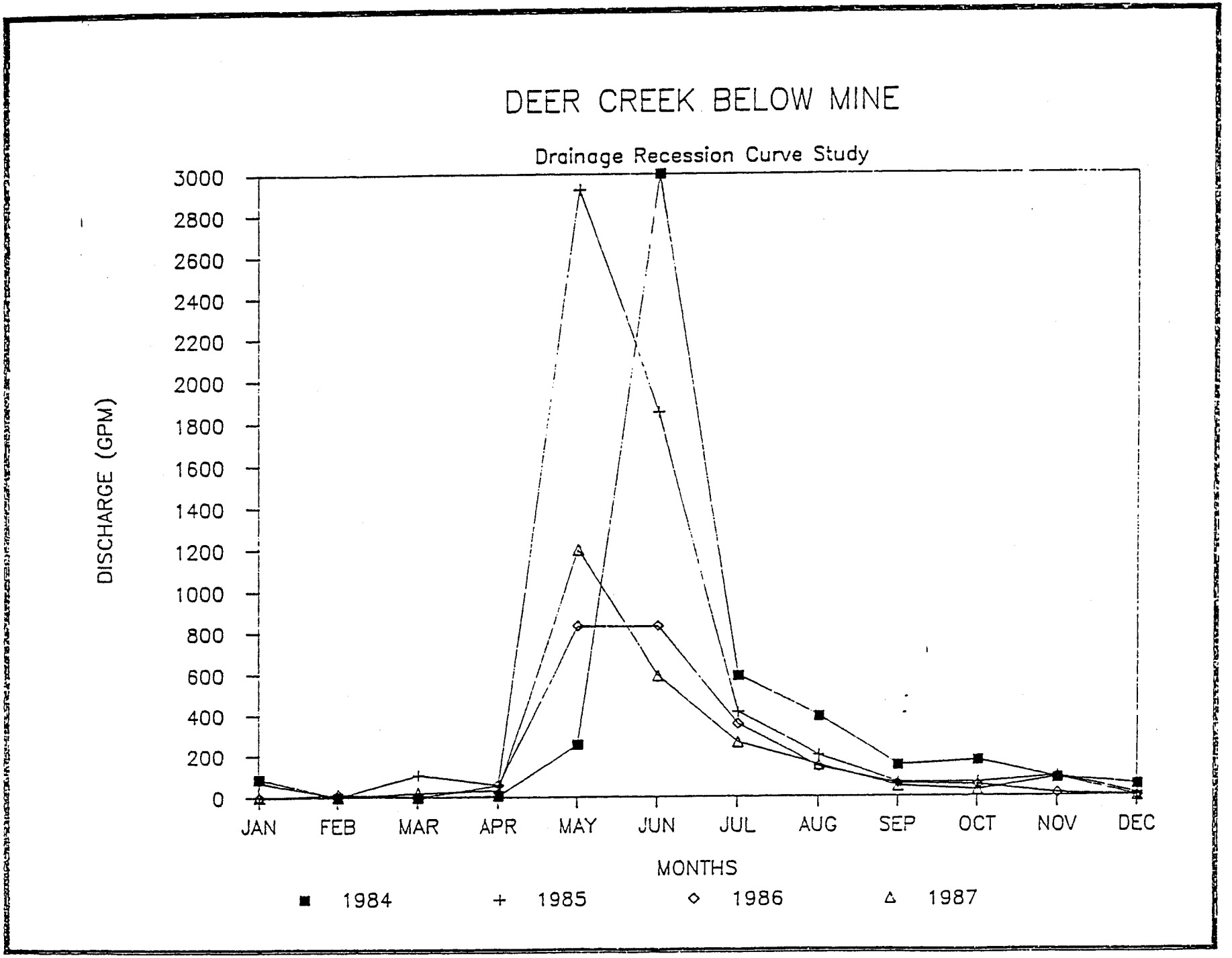

DEER CREEK BELOW MINE
Drainage Recession Curve Study
DISCHARGE (GPM)
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTHS
1984
1985
1986
1987

FIGURE 4

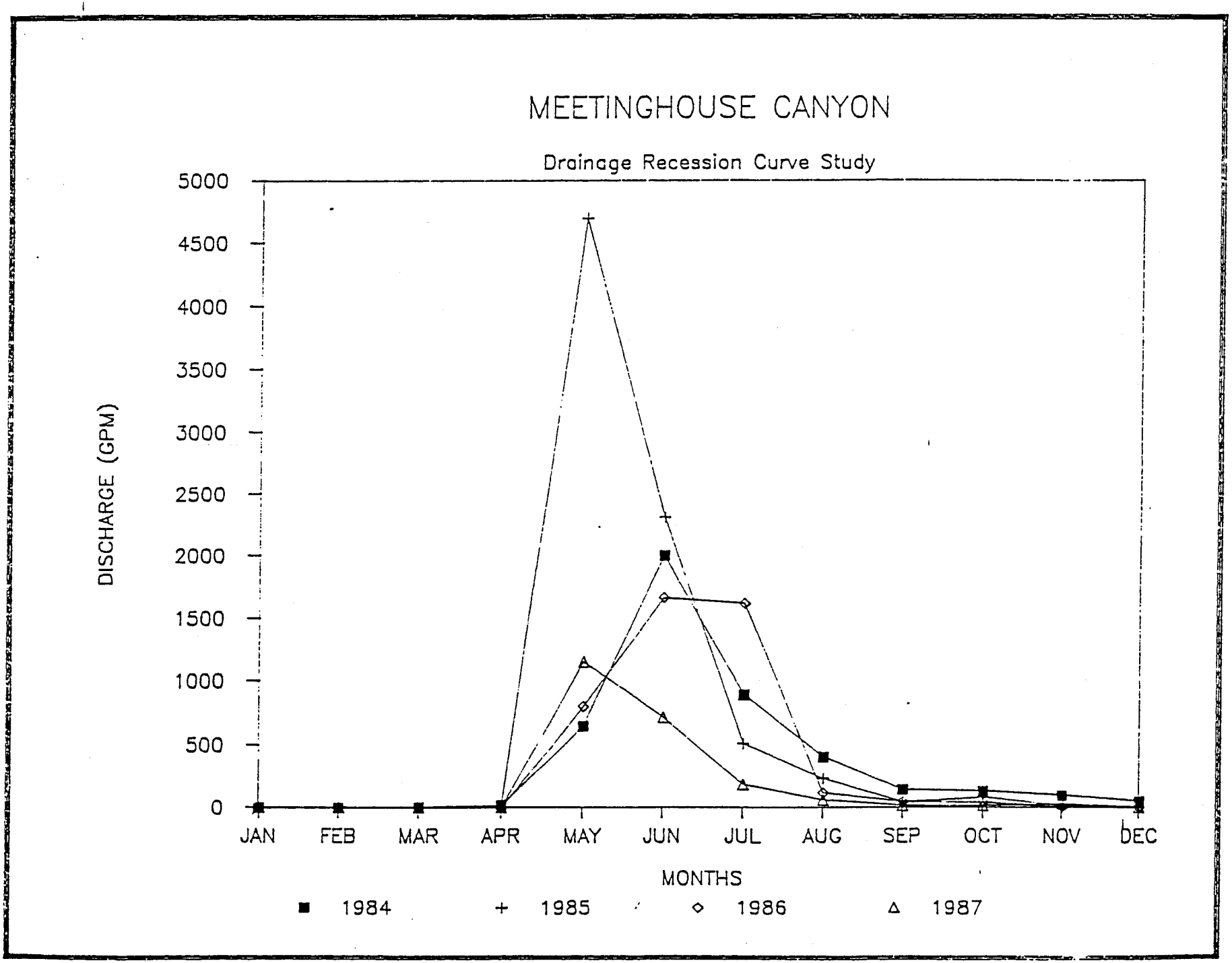

MEETINGHOUSE CANYON
Drainage Recession Curve Study
DISCHARGE (GPM)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTHS
1984
1985
1986
1987

FIGURE 5

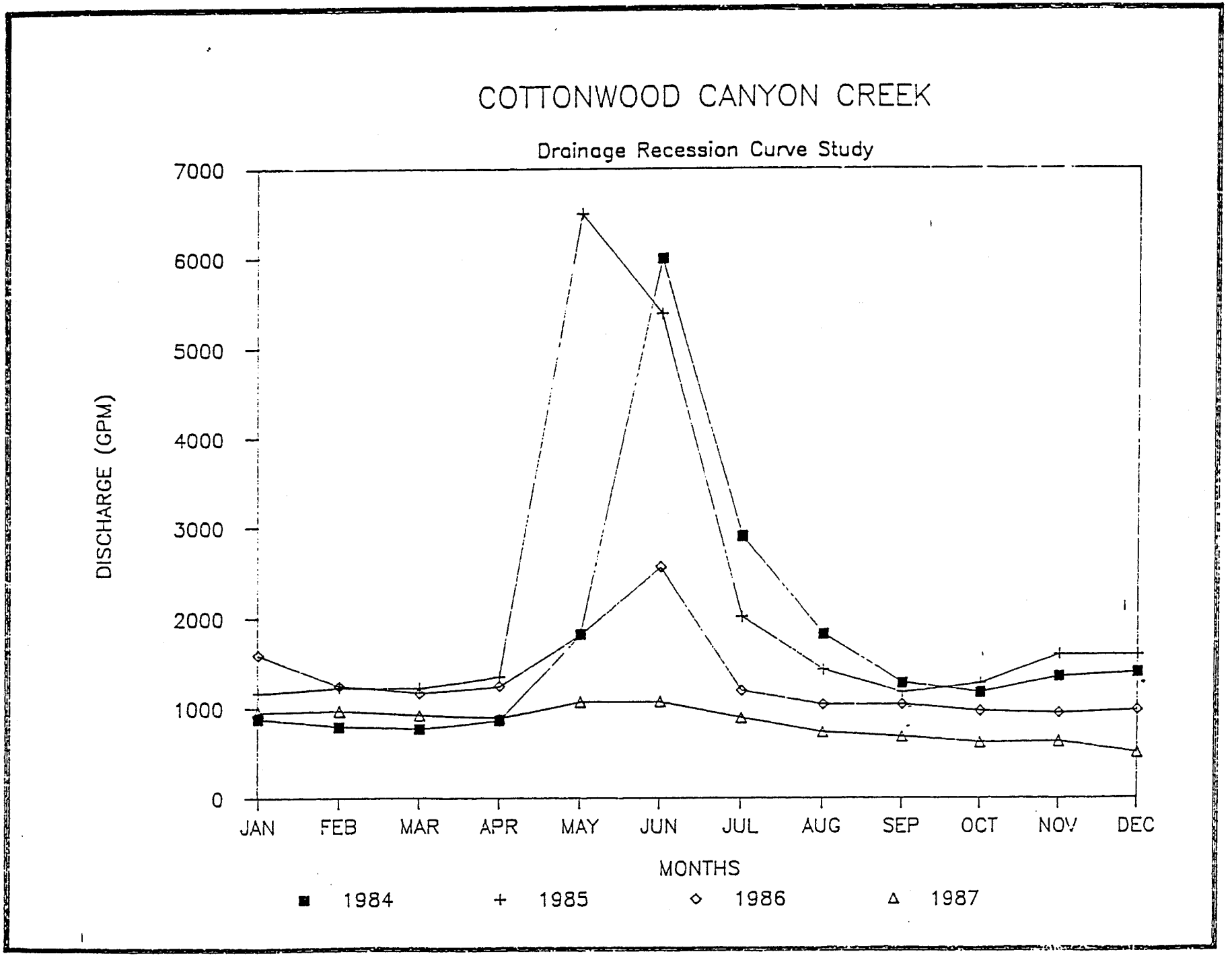

COTTONWOOD CANYON CREEK
Drainage Recession Curve Study
DISCHARGE (GPM)
7000
6000
5000
4000
3000
2000
1000
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTHS
1984
1985
1986
1987

FIGURE 6

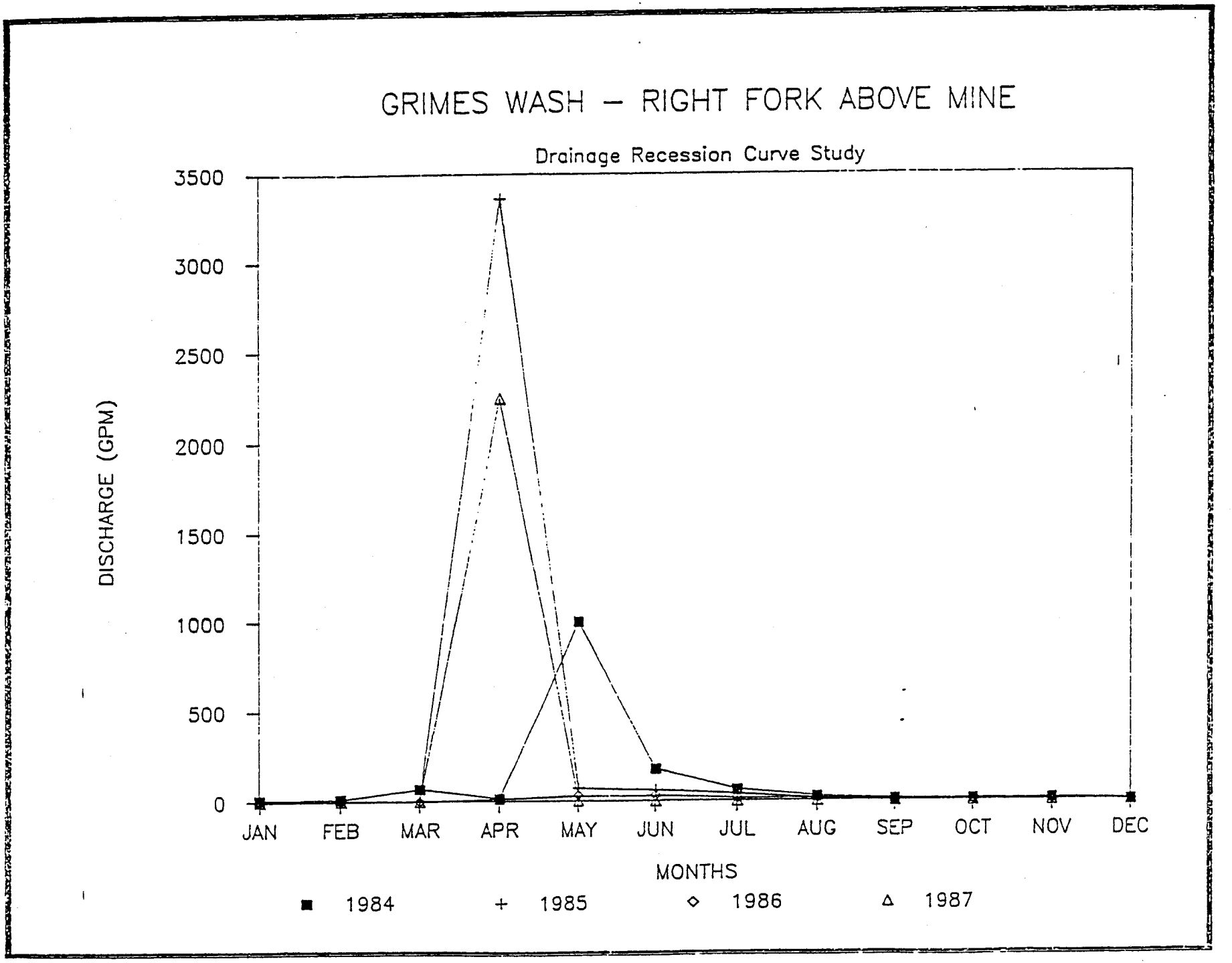

GRIMES WASH – RIGHT FORK ABOVE MINE
Drainage Recession Curve Study
DISCHARGE (GPM)
3500
3000
2500
2000
1500
1000
500
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTHS
1984
1985
1986
1987

FIGURE 7

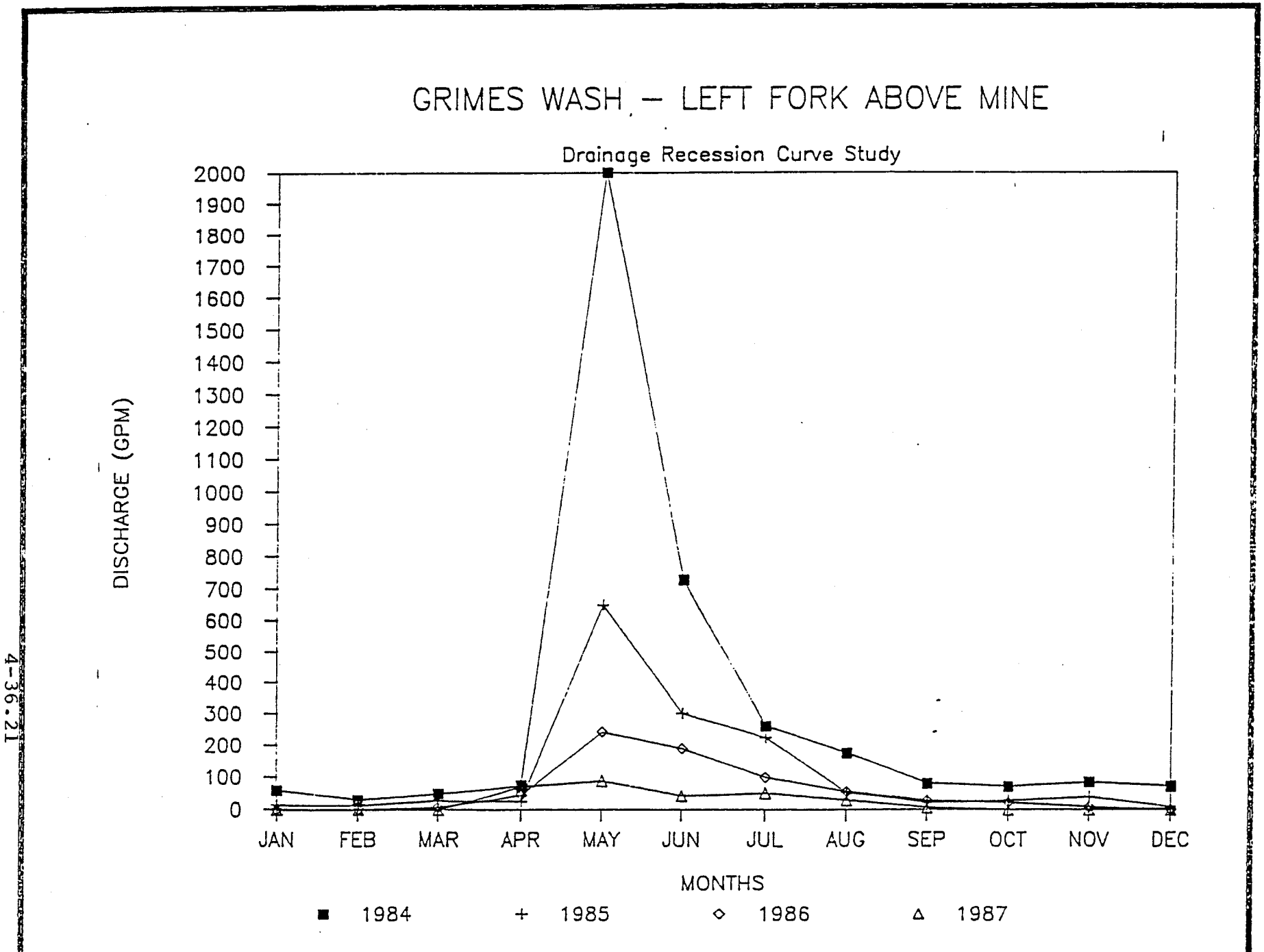
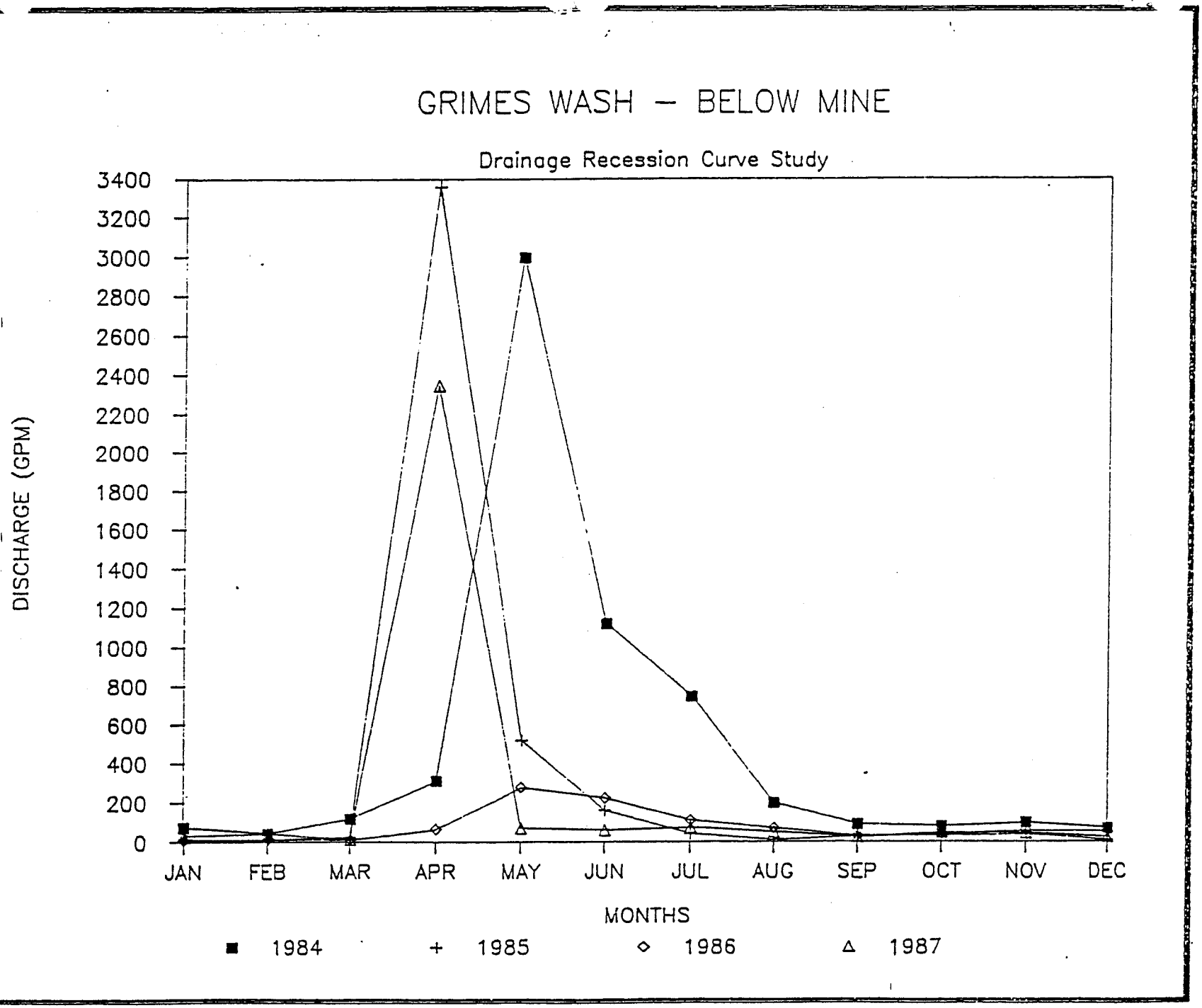
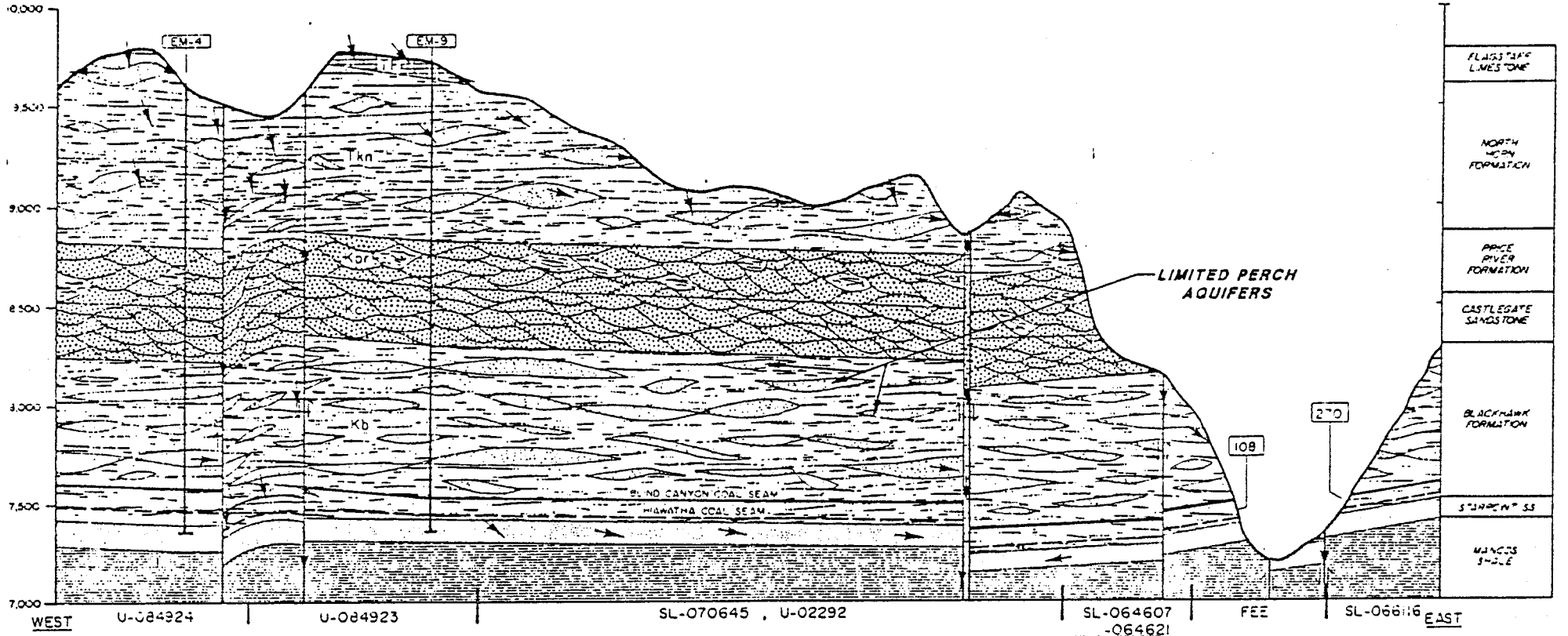

GRIMES WASH – LEFT FORK ABOVE MINE
Drainage Recession Curve Study
DISCHARGE (GPM)
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTHS
1984
1985
1986
1987

FIGURE 8


GRIMES WASH – BELOW MINE
Drainage Recession Curve Study
DISCHARGE (GPM)
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTHS
1984
1985
1986
1987



GEOLOGIC CROSS SECTION FROM EM-4 TO EM-9, AND THROUGH MEASURED SECTIONS 108 - 270 IN DEER CREEK CANYON

DATE	REVISIONS	MARK

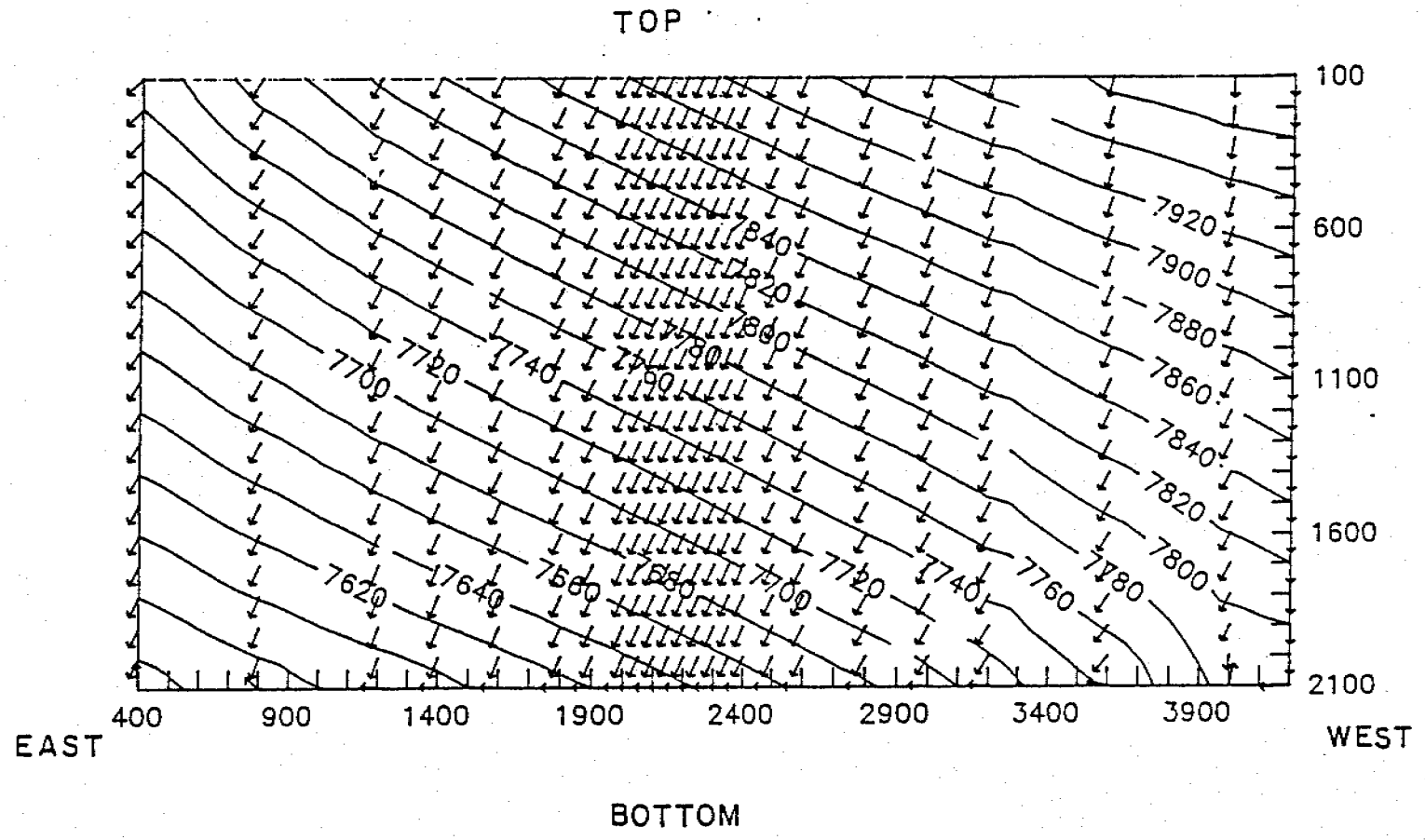
UTAH POWER AND LIGHT CO.
MINING DIVISION
HUNTINGTON, UTAH 84528

TYPICAL GROUNDWATER MOVEMENT EAST MOUNTAIN PERMIT AREA

DRAWN BY: K. LARSEN	APPROVED BY:
SCALE:	DATE: JAN. 23, 1989

FIGURE 9

FIGURE 10



KEY:

Contours in feet

Contour Interval 20 feet

SCALE 1:600

4-36.24
Revised 3/1/89

PROJECT

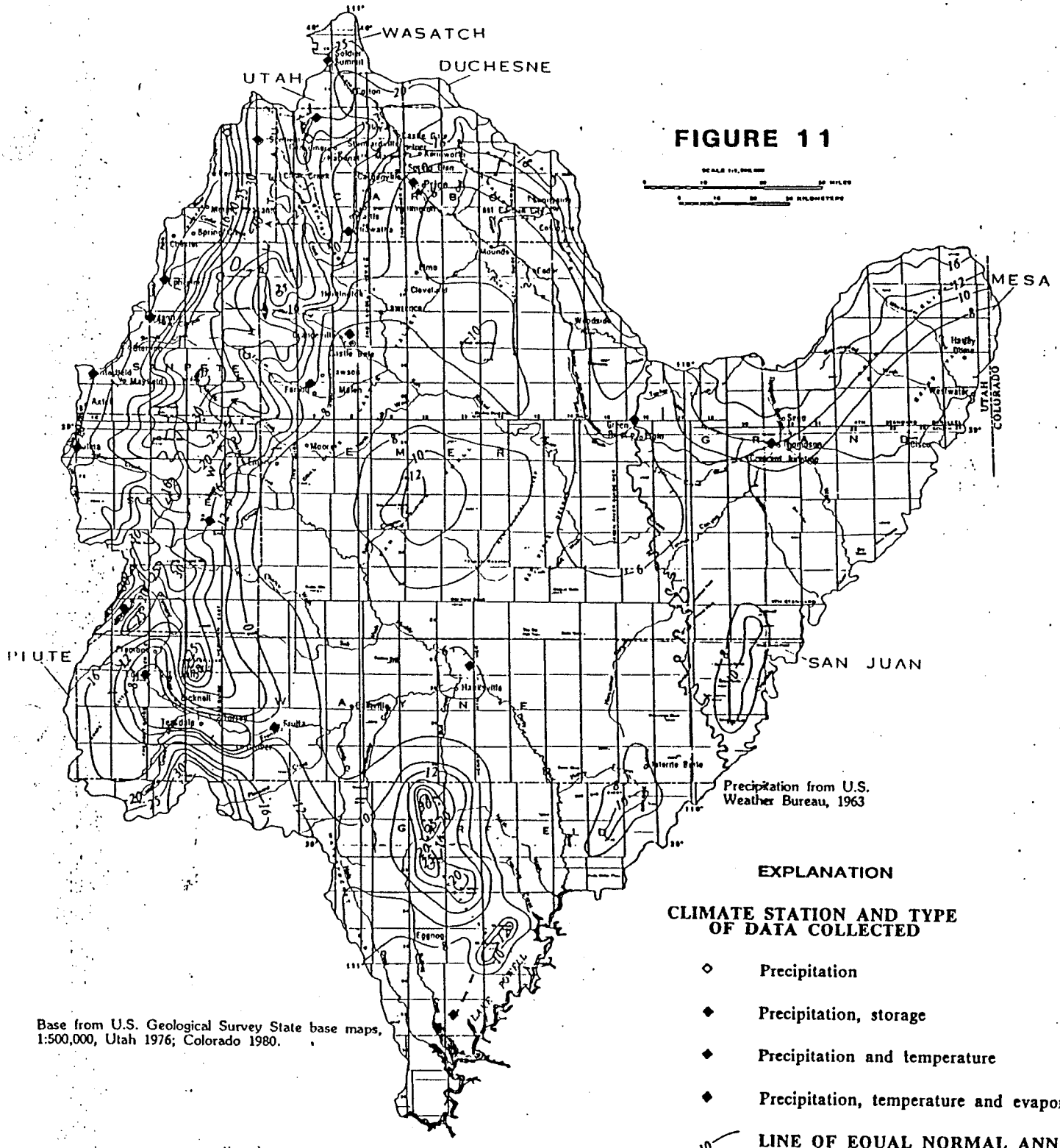
DATE

REVISIONS

Hydro-Search, Inc.
CONSULTING HYDROLOGISTS-GEOLOGISTS
Milwaukee • Denver • Reno

Fault Graben Base Case

FIGURE 11



Normal annual (1931-60) precipitation and location of climate stations.

4-36.25
Revised 3/1/89

Authority to conduct such activities was gained through the State of Utah, U. S. Geological Survey and the U. S. Forest Service. Privately-owned surface was secured separately.

All surface drilled exploration holes were reclamated according to the U. S. Geological Survey's published Drill Hole Plugging Procedure in the form of stipulations for approval.

Each exploration drill site has been reclamated and approved by the appropriate agency.

UMC 784.14 - RECLAMATION PLAN: PROTECTION OF HYDROLOGIC BALANCE

The following is a summary of the hydrologic monitoring schedule that will be utilized for the Deer Creek, Cottonwood/Wilberg and Des Bee Dove Mines. The area in general encompasses East Mountain. The Hydrologic monitoring schedule includes current mine workings, subsided areas and areas where mining is projected during the next five years.

Regarding in-mine monitoring, Utah Power & Light Company, in accordance with its established hydrologic monitoring program collects data regarding groundwater inflow at each established location on a quarterly basis. Because conditions and access in each mine are ever changing, many of the sites that were specified in the PAP to be monitored are now inaccessible. Because of this and the likelihood that areas that are currently monitored will, at some point in the life of the mine, become inaccessible to monitoring, it is important that our in-mine monitoring be flexible to adapt to these changing conditions. Therefore, UP&L commits to monitoring all water inflows exceeding 5 GPM flow in long-term development entries at their point of entrance to the mine until, 1) they become inaccessible, 2) they become unfeasible to monitor with a permanently installed collection devise, or 3) it is mutually agreed by the Division and UP&L that monitoring of the location is not needed. When conditions, as stated above, make a location inaccessible or unfeasible to monitor, UP&L shall notify the Division in writing to request deletion of the monitoring site. UP&L shall also notify the Division as new monitoring sites are added to the program. The current in-mine monitoring locations are shown on Maps 2-10 "Blind

Canyon and Cottonwood In-Mine Water Monitoring Locations" Drawing No. CE-10533-DR dated 9/4/86, and Map 2-10B "Hiawatha Coal Seam In-Mine Water Monitoring Locations" Drawing No. CE-10532-WB dated 9/4/86. These maps will be updated with the submittal of the "1989 Annual Hydrologic Monitoring Report" to be submitted during the first quarter 1989.

The total discharge from the Deer Creek Mine shall be monitored on a monthly basis. Where feasible the quantity of water pumped from individual sumps or areas of the mine will be recorded separately and summed for total discharged.

UP&L shall also establish three water monitoring drill holes which penetrate down into the Starpoint Sandstone in the area of 3rd North and First West mains in the Deer Creek Mine. These holes shall be monitored for water levels and quality, if obtainable, on a quarterly basis until they become inaccessible or it is mutually agreed between UP&L and the Division to discontinue monitoring.

UTAH POWER & LIGHT COMPANY
MINING DIVISION
HYDROLOGIC MONITORING PROGRAM
DEER CREEK, WILBERG/COTTONWOOD, AND DES-BEE-DOVE MINES

1. Monitoring Locations

A. Surface Water Hydrology (see attached Map 2-11 for locations listed below)

1. Cottonwood Creek Drainage System (Cottonwood/Wilberg Mine)

a. Cottonwood Canyon Creek - USGS Flume: 700 feet North, 200 feet East of the Southwest corner of Section 31, Township 17 South, Range 7 East.

b. Grimes Wash

(1) Right Fork: (Approximately 1500 feet upstream from the inlet culvert for the disturbed area.) 550 feet North, 1500 feet West of the Southwest corner of Section 22, Township 17 South, Range 7 East.

(2) Left Fork: (Approximately 50 feet upstream from the inlet culvert for the disturbed area.) 200 feet South, 2350 feet East of the Northwest corner of Section 27, Township 17 South, Range 7 East.

(3) Below the mine: (Approximately 500 feet down-stream from the outlet culvert below the disturbed area.) 1700 feet South, 1820 feet West of the Northeast corner of Section 27, Township 17 South, Range 7 East.

2. Huntington Creek Drainage System (Deer Creek Mine)

a. Huntington Creek: UP&L's Environmental Department monitors the following four sites along Huntington Creek:

(1) Below Electric Lake*
(2) Above the Forks*
(3) Above the power plant diversion
(4) Below the power plant

* Not listed on map due to scale.

b. Deer Creek

(1) Above the mine: (Approximately 600 feet upstream from the mine facility.) 200 feet North, 800 feet West of the Southeast corner of Section 10, Township 17 South, Range 7 East.

(2) At Permit: (Approximately 5,000 feet downstream from the mine facility.) 480 feet South, 3360 feet East of the Northwest corner of Section 1, Township 17 South, Range 7 East.

(3) Below the Mine: (Approximately 12,000 feet downstream from the mine facility.) 480 feet South, 3360 feet East of the Northwest corner of Section 1, Township 17 South, Range 7 East.

c. Meetinghouse Canyon - South Fork: Approximately 200 feet upstream from the north and south convergence.) 800 feet North, 1500 feet East of the Southwest corner of Section 35, Township 16 South, Range 7 East.

B. Groundwater Hydrology

1. East Mountain Springs (see attached Map 2-10A for spring locations.) (These springs are associated with the Deer Creek, Cottonwood/Wilberg and Des-Bee-Dove Mine's spring monitoring program.)

Burnt Tree *
Elk Spring *
Sheba Springs *
Ted's Tub
79-2
79-10 *
79-15
79-23 *
79-24
79-26 *
79-28 (Flag Lake)
79-29 *
79-34
79-35 *
79-38
79-40
80-41
80-43
80-44 *
80-46 *

AMENDMENT TO
APPROVED Mining & Reclamation Plan
Approved, Division of Oil, Gas & Mining
by TM date 2/10/89

80-47
82-51
82-52 *
84-56 *
89-60 (Alpine Spring)

* Recession Study Springs

2. Surface Piezometric Data

a. Rilda Canyon (see attached Map 2-10 for locations) (associated with the Deer Creek Mine)
P1
P2
P3
P4
P5
EM-47

b. Cottonwood Creek (associated with the Cottonwood/ Wilberg Mine)

3. In-Mine

a. Deer Creek Mine (see attached Map 2-11 for locations)
(a) 3rd South "B" xc-21
(b) 3rd North xc-41

b. Wilberg/Cottonwood Mines (see attached Map 2-11A for locations)
(a) 2nd South xc-11
(b) 4th East xc-24

II. Monitoring Schedule

A. Field Measurements: Listed below are the sites which will be monitored by UP&L Mining Division in accordance with the guidelines established by DOGM; i.e.,
- Date
- Flow
- pH
- Temperature
- Dissolved oxygen
- Specific conductivity

Monitoring Program

1. Cottonwood Canyon Creek (Cottonwood/Wilberg Mine)

a. Cottonwood Canyon Creek - USGS Flume
b. Grimes Wash
(1) Right Fork
(2) Left Fork
(3) Below the mine

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

2. Huntington Canyon Drainage (Deer Creek Mine)

a. Deer Creek
(1) Above the mine

by TVH date 2/16/89

(2) At permit boundary
(3) Below the mine

b. Meetinghouse Canyon - South Fork

3. East Mountain Springs (These springs are associated with the Deer Creek, Cottonwood/Wilberg and Des-Bee-Dove Mine springs monitoring program.)

4. In-Mine
   a. Deer Creek
   b. Wilberg/Cottonwood

All sites will be monitored monthly except for East Mountain springs and in-mine locations. East Mountain springs will be field tested during the months of July and October. In addition, the Recessions Study Springs (denoted by asterisks in the Monitoring Location section) will be field tested from July through October. In-mine locations will be field tested quarterly.

B. Quality Sampling (laboratory measurements)

1. Surface Water Hydrology: Water samples will be collected and analyzed quarterly (one sample at low flow and high flow) during the first or second week of the quarter. Parameters analyzed are those listed in the DOGM Guidelines for Surface Water Quality (see Table #1). Quarterly sampling was initiated during March 1988 and will continue throughout the year; i.e., June, September and December. Baseline analysis was performed in 1986 and will be repeated every five years thereafter.

   a. Cottonwood Creek Drainage, Grimes Wash (Cottonwood/ Wilberg Mine)
      (1) Right Fork
      (2) Left Fork
      (3) Below the mine

   b. Huntington Creek Drainage (Deer Creek Mine)
      (1) Deer Creek
         (a) Above the mine
         (b) Below the mine
      (2) Meetinghouse Canyon - South Fork

2. Groundwater Hydrology

   a. East Mountain Springs: Water samples will be collected and analyzed during the months of July and October, including Recession Study Springs. Parameters analyzed are those listed in; the DOGM Guidelines for Groundwater Water Quality (see Table #2). In addition, the Recession Study Springs (denoted by asterisks in the Monitoring Location

section) will be sampled monthly for the following parameters:

(1) Total hardness
(2) Carbonate
(3) Total manganese

b. In-Mine: Two water samples will be collected and analyzed per mine quarterly. Parameters analyzed are those listed in the DOGM Guidelines for Groundwater Water Quality (see Table #2).

III Annual Reports

Only the springs located within or immediately adjacent to areas overlying coal to be mined in the next five (5) years or areas overlying previously mined areas will be monitored [except that the twelve (12) discharge recession curve springs and Rilda Canyon wells (in lieu of north and south springs) will all be monitored regardless of location].

A. Each Annual Hydrologic Monitoring Report will include a map which will show previously mined areas and areas to be mined in the upcoming five (5) years. The springs to be monitored in the upcoming year will be identified from the map.

B. New springs will be added each year based on the new areas to be mined in the upcoming five (5) years.

C. Springs will cease to be monitored when 1) it has been determined that mining induced subsidence has stabilized and that the spring monitoring indicates stable hydrologic conditions, and 2) it is mutually agreed by UP&L and the Division that monitoring should be terminated.

D. The springs will be monitored in July and as many as are accessible will be monitored in October.

Each spring will be measured for the following parameters:

1. Quantity of discharge
2. pH (field measurement)

E. All new source springs not currently monitored will be monitored for two (2) years utilizing the base line parameters of Table II.

TABLE 1

SURFACE WATER BASELINE, OPERATIONAL AND POSTMINING WATER QUALITY PARAMETER LIST

Field Measurements:

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

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

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

Sampling Period:

-Baseline

*Operational, Postmining

#Construction

TABLE 2

GROUND WATER BASELINE, OPERATIONAL AND
POSTMINING WATER QUALITY PARAMETER LIST

Field Measurements:

* - Water Levels or Flow
* - pH
* - Specific Conductivity (umhos/cm)
* - Temperature (C^o)

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

* - Total Dissolved Solids
* - Total Hardness (as $CaCO_3$)
- Aluminum (Al)
- Arsenic (As)
- Barium (Ba)
- Boron (B)
* - Carbonate (CO_3^{-2})
* - Bicarbonate (HCO_3^-)
- Cadmium (Cd)
* - Calcium (Ca)
* - Chloride (CL^-)
- Chromium (Cr)
- Copper (Cu)
- Fluoride (F^-)
* - Iron (Fe)
- Lead (Pb)
* - Magnesium (Mg)
* - Manganese (Mn)
- Mercury (Hg)
- Molybdenum (Mo)
- Nickel (Ni)
- Nitrogen: Ammonia (NH_3)
- Nitrite (NO_2)
- Nitrate (NO_3^-)
* - Potassium (K)
- Phosphate (PO_4^{-3})
- Selenium (Se)
* - Sodium (Na)
* - Sulfate (SO_4^{-2})
- Sulfide (S^-)
- Zinc (Zn)

Sampling Period:

-Baseline
*Operational, Postmining

YEAR ======) 1988 & 1990

		LOCATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SURFACE HYDROLOGY	COTTONWOOD CREEK DRAINAGE SYSTEM	COTTONWOOD CANYON CREEK	field	field	field	field	field	field	field	field	field	field	field	field
		GRIMES WASH												
		RIGHT FORK	field	field	operational	field	field	operational	field	field	operational	field	field	operational
		LEFT FORK	field	field	operational	field	field	operational	field	field	operational	field	field	operational
		BELOW MINE	field	field	operational	field	field	operational	field	field	operational	field	field	operational
	HUNTINGTON CREEK DRAINAGE SYSTEM	DEER CREEK												
		ABOVE MINE	field	field	operational	field	field	operational	field	field	operational	field	field	operational
		@ PERMIT	field	field	field	field	field	field	field	field	field	field	field	field
		BELOW MINE	field	field	operational	field	field	operational	field	field	operational	field	field	operational
		MEETINGHOUSE CANYON	field	field	operational	field	field	operational	field	field	operational	field	field	operational
GROUNDWATER HYDROLOGY		EAST MOUNTAIN SPRINGS							operational *			operational *		
		RECESSION STUDY SPRINGS							* includes recession study springs ** see attached memo modified ** modified ** operational operational					
		IN-MINE												
		DEER CREEK			operational			operational			operational			operational
		WILBERG/ COTTONWOOD			operational			operational			operational			operational

YEAR ======) 1989

(Baseline monitoring preceeding repermitting)

		LOCATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SURFACE HYDROLOGY	COTTONWOOD CREEK DRAINAGE SYSTEM	COTTONWOOD CANYON CREEK	field	field	field	field	field	field	field	field	field	field	field	field
		GRIMES WASH												
		RIGHT FORK	field	field	operational	field	field	baseline	field	field	operational	field	field	baseline
		LEFT FORK	field	field	operational	field	field	baseline	field	field	operational	field	field	baseline
		BELOW MINE	field	field	operational	field	field	baseline	field	field	operational	field	field	baseline
	HUNTINGTON CREEK DRAINAGE SYSTEM	DEER CREEK												
		ABOVE MINE	field	field	operational	field	field	baseline	field	field	operational	field	field	baseline
		@ PERMIT	field	field	field	field	field	field	field	field	field	field	field	field
		BELOW MINE	field	field	operational	field	field	baseline	field	field	operational	field	field	baseline
		MEETINGHOUSE CANYON	field	field	operational	field	field	baseline	field	field	operational	field	field	baseline
GROUNDWATER HYDROLOGY		EAST MOUNTAIN SPRINGS							operational ‡			baseline ‡		
		RECESSION STUDY SPRINGS							‡ includes recession study springs ‡‡ see attached memo modified ‡‡ modified ‡‡ operational operational					
		IN-MINE												
		DEER CREEK			operational			baseline			operational			operational
		WILBERG/ COTTONWOOD			operational			baseline			operational			operational

ROANS CANYON GRABEN CROSSING

A hydrologeologic investigation of the Roans Canyon Fault Graben was completed during 1988 in order to develop plans for management of groundwater inflow during the construction of three parallel rock tunnels. The fault crossing is located in the section of the Deer Creek Mine called Third North (see Map No. CM-10784-DR). In order to conduct the investigation five test wells were constructed. Selected intervals in the boreholes were tested for hydraulic properties with straddle packers. In addition, three short-term and one long-term constant rate flow tests were performed to measure aquifer parameters. The packer test and flow and recovery test data were analyzed to determine static pressures and gradients through the fault system and to determine transmissivity, hydraulic conductivity, and storage coefficient for each zone tested.

The investigation defined two major hydrogeologic units which are fractured, well-sorted, medium-grained, friable, oxidized channel sandstones. The first sandstone unit is located approximately 350 feet horizontally from the southern bounding fault, the second about 650 feet (see Map No. CM-10784-DR). The sandstone units are likely of limited vertical thickness but may have more extensive lateral continuity. The two sandstones are heavily oxidized and iron-stained along fractures, and in places the sandstone is totally oxidized for several feet adjacent to the fracture. The oxidation, at a depth of 2000 feet below land surface, indicates that oxygenated water is infiltrating rapidly from the surface through the fractures, suggesting that there is good hydraulic connection between the channel sandstones at the depth of the

rock tunnels and the recharge at the surface primarily through fractures.

Results from the aquifer test indicated the horizontal flow component is the result of flow in the graben from the west toward the east where the graben intercepts the canyon walls and, presumably, the groundwater system discharges. The vertical flow component is controlled by the Starpoint Sandstone which underlies the entire graben.

The groundwater flow in the graben occurs primarily in the fractures of the two major water-producing zones with lesser flow quantities in the fractured siltstone units. Virtually no flow occurs in the mudstone between the siltstone and sandstone. The south boundary fault of the graben creates a hydrogeologic barrier to flow into the mine area south of the graben, whereas the north boundary fault does not have a thick fault gouge zone like the one associated with the southern fault; but from drilling observations it is also suspected to be a barrier to groundwater flow.

From the data collected during the investigation and subsequent modeling the initial flow rates and total quantity produced from one of the water-producing zones in the first month are substantial. It was therefore recommended that a dewatering and grouting program be instituted to reduce the amount of water encountered during slope development and the increase in effective stress in the rock mass related to a decreasing fluid pressure before the working face reaches the area dewatered. Without grouting and the dewatering employed, predicted tunnel inflow rates are given in the following table.

Predicted Tunnel Inflow Rates

Time (days)	With Dewatering (gpd)	(gpm)
.01	342,000	238
.05	286,660	199
.10	272,540	189
.37	267,160	186
.50	267,140	179
.75	250,610	174
1	247,940	172
5	240,560	167
10	239,880	167
16	239,880	167
23	238,810	166
31	239,800	167
100	239,800	167

It is UP&L's intent to utilize a pressure grout program to minimize the long-term groundwater inflow from the water-producing zones encountered during slope development. The grouting program will consist of drilling a series of boreholes prior to water-producing zone interception and forcing fast-setting grout material into the fractures. In zones other than the two major water-producing areas grouting will be done if the groundwater inflow exceeds 50 gpm. Past experience with pressure grouting has indicated that as much as seventy-five to ninety-five percent (75-95%) of the groundwater inflow can be effectively stopped. The table below compares the predicted tunnel inflow rates with dewatering and pressure grouting.

Predicted Tunnel Inflow Rates

Time	With Dewatering		Pressure Grout Effectiveness 50%		75%		95%	
Days	(gpd)	(gpm)	(gpd)	(gpm)	(gpd)	(gpm)	(gpd)	(gpm)
0.01	342,000	238	171,000	119	85,500	60	17,100	12
0.05	286,660	199	143,330	100	71,665	50	14,333	10
0.10	272,540	189	136,270	95	68,135	47	13,627	9
0.37	267,140	186	133,570	93	66,785	47	13,357	9
0.50	250,610	179	125,305	90	62,653	45	12,531	9
0.75	247,940	174	123,970	87	61,985	44	12,397	9
1.00	240,560	172	120,280	86	60,140	43	12,028	9
5.00	239,880	167	119,940	84	59,970	42	11,994	8
10.00	238,880	167	119,440	84	59,720	42	11,944	8
16.00	238,810	167	119,405	84	59,703	42	11,941	8
23.00	238,810	166	119,405	83	59,703	42	11,941	8
31.00	328,810	167	119,405	84	59,703	42	11,941	8
100.00	238,810	167	119,405	84	59,703	42	11,941	8

One factor addressed during the dewatering and grouting evaluation was the influence of the tunnels and prior dewatering on the flow in the surface springs located in the vicinity of the Roans Canyon Fault Graben. A maximum drawdown of approximately ten (10) feet at the surface of the graben was calculated using the groundwater model. Given the preexisting dominant vertical flow direction and the fact that the springs do not appear to be associated with aquifers of concern to this investigation, it is unlikely that the tunnels or the recommended dewatering systems would exert a measurable influence on the springs.

RECLAMATION PLAN: POSTMINING LAND USES (784.15)

As before mining land use and utility are limited by the area's geographical features, mainly steep sloped canyons with shallow and rocky soils.

Plant productivity shall equal the reference area which shall be measured on completion of rehabilitation of the mine site.

Reclamation work as outlined in the reclamation section states:

1. Removal of pipe diversions.
2. Install riprapped surface drainage channels.
3. Reshape disturbed surfaces to lessen sediment loading during storm runoff.
4. Revegetate all disturbed areas with native plants, trees, shrubs, forbs, and grasses.

The main mine area structure will remain in place allowing for a relatively flat, stable planting surface which should provide a more productive vegetative growth due to water infiltration rates and depths.

It is planned, following mining, to restore the small twenty acres affected by the mining operation to its premining state. Principle land use after reclamation shall include grazing and wildlife habitat. Grazing permits are presently issued for areas surrounding the surface operations by both the U. S. Forest Service and the Bureau of Land Management. Both agencies have stated no foreseeable changes to its present use.

Revised 11/21/83

County zoning for this general area is grazing, mining and recreation. Recreation could be amplified by addition of a picnicing site on the mine fill area. Water and sewer facilities are available.

Company states that postmining land uses are the same as premining land uses - grazing and wildlife habitat.

During the reclamation work described in subpart 784.13, the lands will be recontoured to its approximate original slopes, drainages opened, vegetation will be reestablished to meet the reference area's cover, species density, and productivity as measured at the time of reclamation.

Applicant feels that the ten years following mining (bond period), there is sufficient time to manage the vegetational establishment of growth to meet the requirements of the postmine land use as stated.

PROTECTION OF PUBLIC PARKS AND HISTORIC PLACES (784.17)

No public parks (state or federal) are located in or adjacent to the permit area.

No historic places are listed or designated in or adjacent to the permit area.

Cultural resource sites are identified in an archeological random survey conducted by A.E.R.C. (Hauck) in 1980 and this report is enclosed in the environmental section of this text.

RELOCATION OF PUBLIC ROADS (784.18)

The Deer Creek Mine Portal requires no further action for public review concerning mining within 100 feet of a public road, as exemption 761.11(a)(4)(i) applies.

UMC 784.20 SUBSIDENCE CONTROL PLAN

Utah Power & Light shall monitor the mining induced subsidence in areas where mining may have caused the surface of the land to subside within the permit area. This monitoring shall be done using photogrammetric methods as has been the practice since 1980. The results of the monitoring shall be summarized in a report and submitted to the Division annually. Areas of suspected subsidence shall be monitored annually until UP&L can sufficiently document and prove to the Division that the subsidence has stabilized. In such a case, UP&L shall submit a formal request to the Division recommending that subsidence be terminated. This request shall be accompanied by technical data which shows that the subsidence has stabilized. UP&L shall cease monitoring an area only after the Division has notified UP&L of their concurrence with our request.

RECEIVED
JUN 29 1988
DIVISION OF
OIL, GAS & MINING

Revised 6/29/88

SUBSIDENCE CONTROL PLAN (784.20)

This section describes in further detail the applicant's design of mine plan ensuring minimal environmental impacts, specifically surface subsidence effects of the on-going Deer Creek Mine. Operation Plan describes in detail the proposed methods of coal resource extraction and mine development. Geology Description presents the detailed geological information, site specific and general, which provides an analytical base for mine plan and subsidence control design. The following subsections describe the principal factors involved in controlling subsidence impacts resultant of the proposed mining operations.

Subsidence Damage Probability Survey

A survey has been conducted on that portion of East Mountain surface which could possibly be affected by the mining of coal from the Deer Creek Mine.

It has been determined that there are renewable resources present in the area in the forms of springs, water seeps, grazing land, timber and wildlife.

The water seeps and springs are numerous and varied in nature; a few are perennial during the unfrozen months, while some dry up over the summer and some only appear in "wet" years.

There are several small cabins on the surface above the Deer Creek Mine area. A survey of the structures' present condition is in the appendix.

There is a 345 KV transmission line which parallels Meetinghouse stream traversing east-west across the permit area. This section is protected by a system of barrier pillars which will not be mined and includes the area of draw for any possible subsidence effects. See Mine Plans for location (3-1 thru 3-5).

There are no known oil or gas wells within the permit area. However, should any be encountered during mining the BLM and DOGM will be notified and their instructions will be followed.

There are minor stock watering troughs in various places and these are usually located close by springs or seeps.

Mining Method

Utah Power & Light Company intends to minimize surface effects of subsidence by adopting, wherever practical, the longwall method of mining and mining the coal deposit as completely as possible. Those areas within the mine limits not mined by the longwall method will be mined by continuous miner in order to extract the maximum amount of the coal reserve possible. Approximately 65% of the coal reserve will be mined by the longwall method, the remaining area by continuous miner. No area within the mine limits is planned to remain unmined. All coal will be cleared from every fault encountered to establish direction and displacement.

The longwall mining method allows almost total extraction of the mineral and induces caving of the immediate and upper roof strata. The caving process propagates upwards to a horizon located at a distance equal to approximately 35 to 50 times the mining height over the coal seam as indicated by the data in Figure 1. The curve i;n the figure shows the elongation of a borehole due to caving of the overburden over a longwall panel (from Dahl and von Schonfeldt).

The differential settlement of the overburden was normalized by dividing it by the seam thickness. As can be seen, the deformation decreases from a maximum of 1 at the seam roof to near 0 at approximately 37 times the mining height above the coal seam. The deformation or deflection above this horizon is essentially continuous; the upper strata settle down on the gob without any further increase in volume (porosity).

A similar conclusion was reached by Orchard in 1973 and is illustrated in Figures 2 and 3.

It is Utah Power's intent to mine areas as wide and long as present mining technology allows in order to minimize the area which would be on the sloping edge of the subsidence trough. Also, the pillars of support for the longwall gate roads have been designed on the yielding pillar principle so that they will eventually yield to destruction. This has been proven in practice in the mines, therefore, will not affect the subsidence trough.

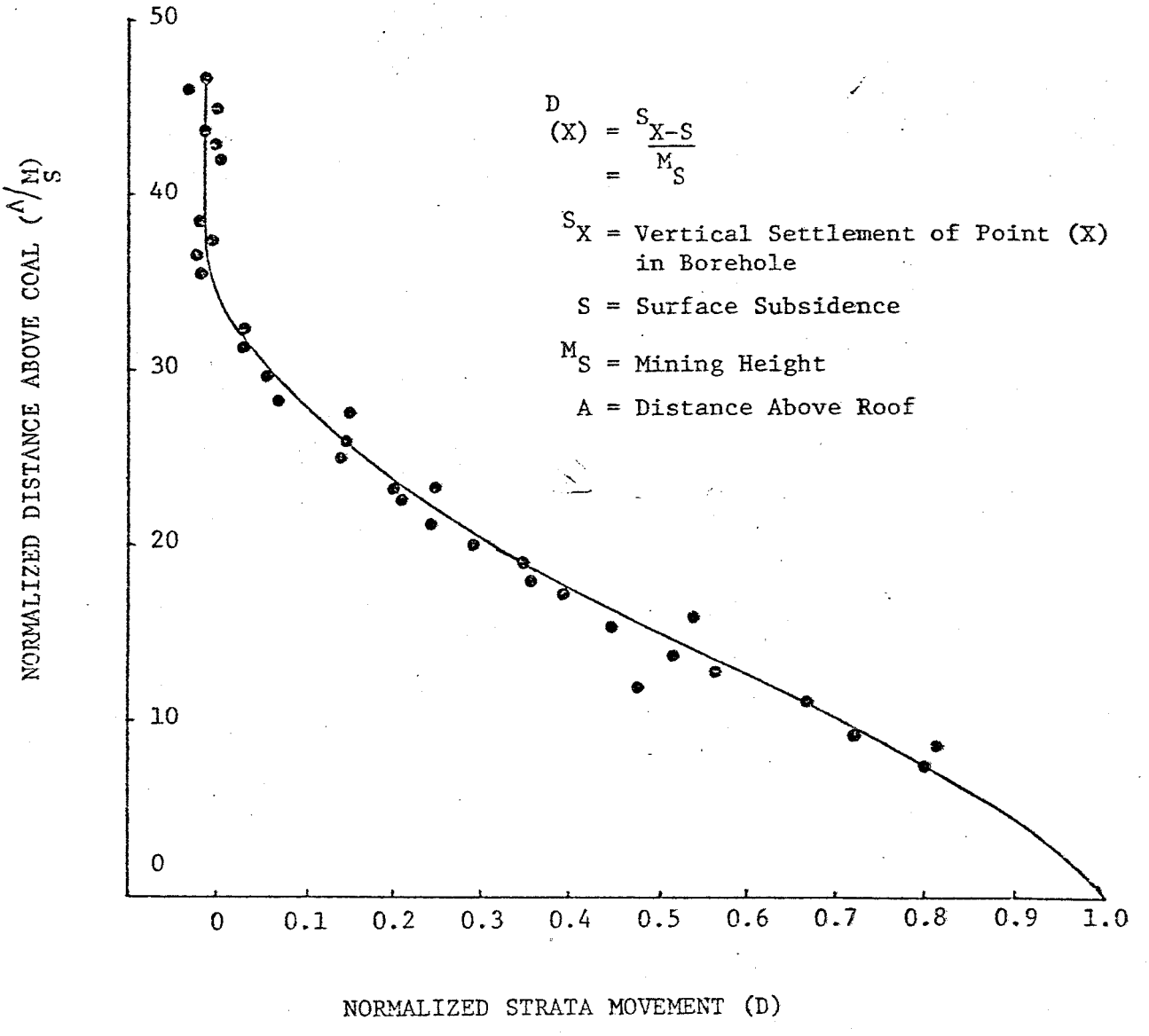


FIG. 1. Vertical settlement of overburden above a longwall panel (after Dahl and Von Schonfeldt)

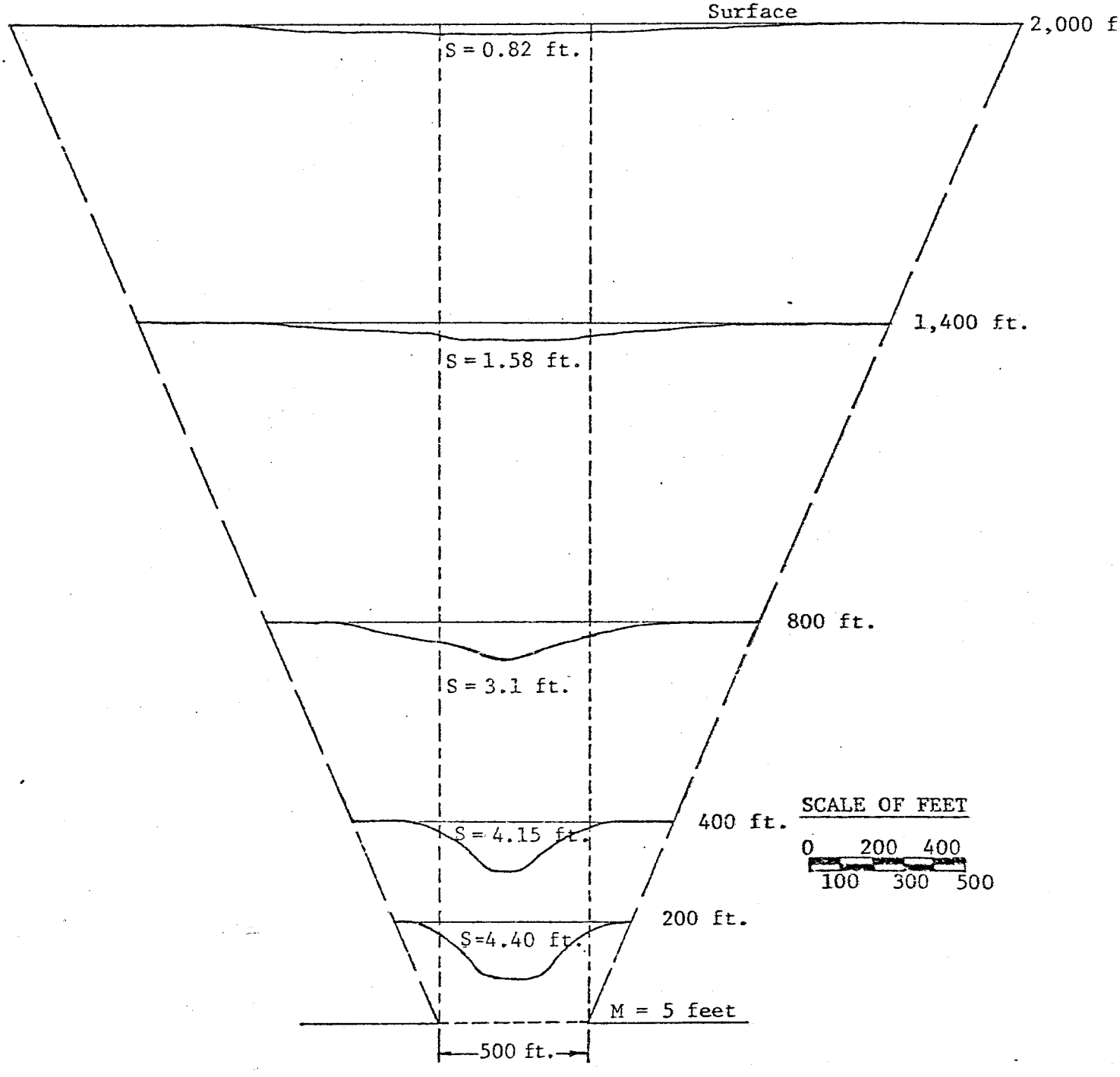


FIG. 2. Varying subsidence profile at different horizons.

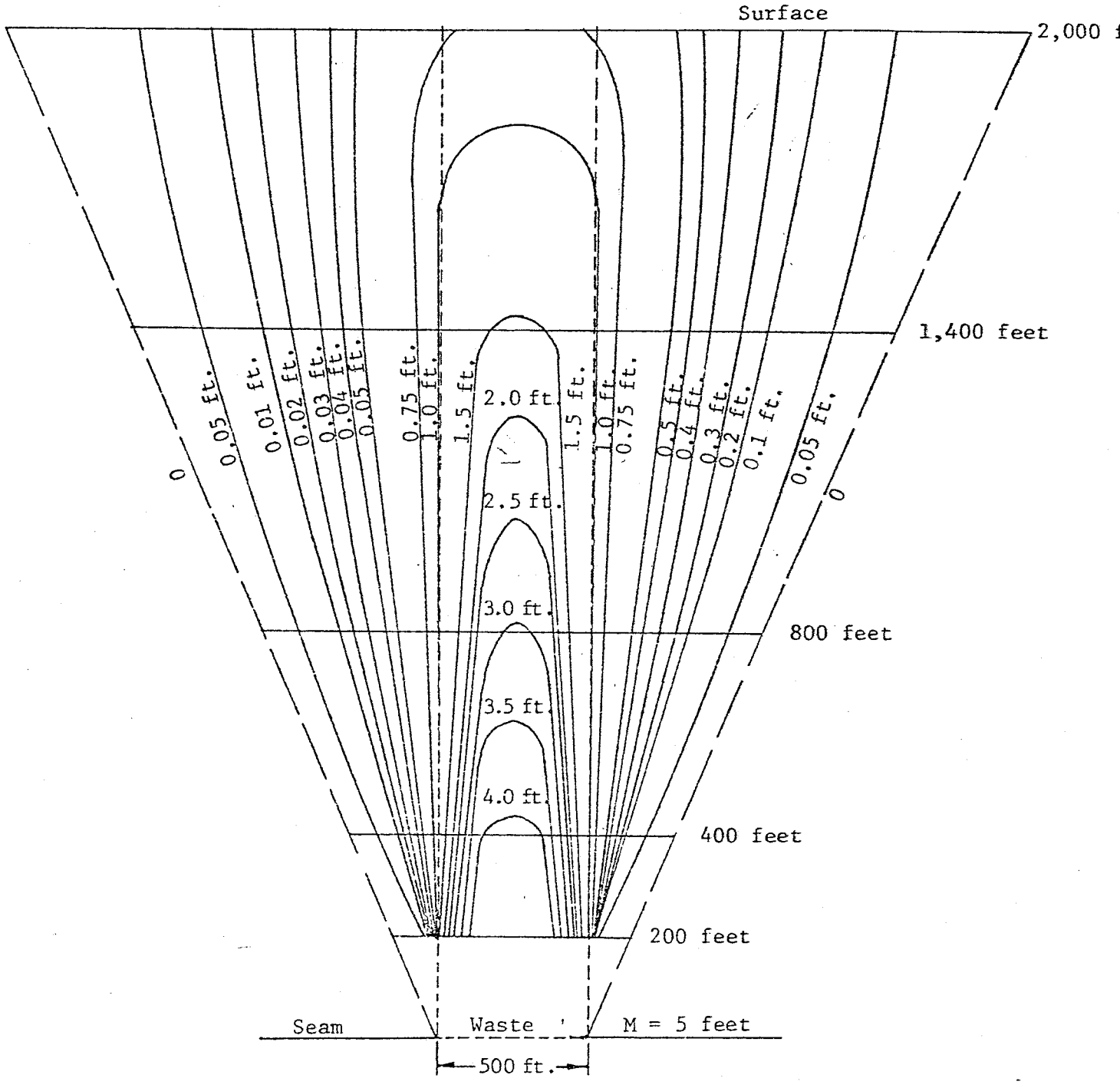


FIG. 3. Lines joining points of equal subsidence.

The size of the normal coal pillars used in the mine planning for both the Blind Canyon and Hiawatha Seams to ensure stability has been determined by basic calculation for the deepest expected cover, from prior mining practice in the area, and a U.S.B.M. study (Pariseau). Experience has also shown that in multi-seam mining circumstance columnizing main development pillars in both these seams is essential for main stability.

The mine plan indicates that only first mining, i.e., forming pillars only, will protect high voltage power line structures from any possible subsidence. Barrier size for this essential protection has been devised from data obtained from ongoing subsidence monitoring survey (U.S.B.M. Algire) on East Mountain.

Full extraction areas (room-and-pillar panels with pillar removal, and longwall panels) are, by definition, planned and controlled subsidence areas. It is anticipated that this planned subsidence will result in a generally uniform lowering of the surface lands in broad areas, thereby limiting the extent of material damage to those lands and causing no appreciable change to present land uses. The extent of these full extraction areas is shown on Maps 3-1 thru 3-5. Subsidence prediction work has shown the expected maximum planned and controlled subsidence will vary from 0 to 10 feet assuming that the total cumulative extraction from the two minable seams will not exceed 20 feet.

Subsidence Damage Prevention Measures

The proposed mining plan has been designed in such a way as to align the full extraction panels parallel to the margin faults and joints. This alignment with respect to jointing will prevent the formation of irregular sawtooth subsidence cracks in the overlying surface lands.

In order to more accurately forecast the overall extent and the amount of subsidence, Utah Power is currently conducting two separate subsidence studies, similar to those done by the NCB and Abel and Gentry, in cooperation with the U. S. Bureau of Mines (Algire).

The results of these studies are developing information which, when interpolated into proven existing formulas and models, will allow the particular characteristics of the overburden on East Mountain to be analyzed as to probable behavior during and after mining.

Extensive field geologic investigation for the past four years is designed to locate all faults in the lease area. The mine plan is designed to:

a. Clear all coal to these faults.

b. Prove by actual eventual contact in mining and underground drilling the size and direction of these disturbances.

All mining, except for planned breakouts, is stopped at a minimum distance of 200 feet from any outcrop line or cliff line in the mining plan. Experience to date, except

for one occasion, has shown that "burned coal" is always encountered before this minimum distance is reached.

Subsidence monitoring indicates that when pillar mining is adjacent to "burned coal" the subsidence continues over the burned coal area minimizing the sloping edge of the subsidence trough.

To date mining has shown extreme changes in roof conditions in both the Blind Canyon and Hiawatha Seams when ancient river channel scours are encountered. The ongoing surface drilling of the lease area, in those areas not yet reached by actual underground mining, indicates little or no change in normal roof conditions or coal strength. Therefore, no new problems are anticipated from these factors that should cause any alteration to the basic mine plan as submitted.

Subsidence monitoring plans have been submitted for the Deer Creek and Cottonwood/Wilberg Mines and are included in the appendix.

A photogrammetrical subsidence monitoring plan was initiated and first flown during August 1980. In addition, a site specific longwall panel (the first longwall panel being mined in the Wilberg Mine) was monumented and monitored by conventional survey methods. The last conventional survey was done in 1988. No conventional survey was done in 1987.

For details and specific subsidence data, see the Annual Subsidence Monitoring Report submitted to the

AMENDMENT TO
APPROVED Mining & Reclamation Plan
Approved, Division of Oil, Gas & Mining
by RUS date 11/30/89

Division.

Regarding the seeps and springs, Utah Power has been actively monitoring these, together with water generated within the mines, for some five years to date and has set up an organization with the full intention of monitoring them for the next several years.

The hydrologic monitoring indicates that mining under the seeps and springs at the depths of cover of Deer Creek Mine, up to 2,400 feet, does not dry up the seep or spring. This phenomenon is most probably due to the presence of bentonitic shale layers in the overburden which swell when wet, forming an impervious clay layer. This healing characteristic is expected to seal subsidence cracks to prevent downward migration of water and subsequent loss of springs and other water sources.

The Deer Creek Mine will be mining some 8 feet of coal at depths from 1,500, to 2,400 feet of cover. Therefore,

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

by RJS date 4/30/89

it is Utah Power's belief that the seeps and springs on East Mountain will not be adversely affected.

Regarding the small wooden buildings on East Mountain, subsidence studies (NCB) show that structures constructed of rigid materials such as brick work, concrete or stone work suffer greater damage than buildings with frame construction. Therefore, it is Utah Power's belief that the cabins referred to will not suffer material damage.

Mitigation of Subsidence Damage Effects

Should material damage be incurred by the cabins despite the planned subsidence damage prevention measures, the applicant will repair the damage caused by subsidence resulting from the applicant's activities or compensate the owner of the cabin for such damage.

Any roads, fences, stock ponds, earth dams or water troughs which are affected by subsidence will be restored to their pre-subsidence usefulness.

All cabins that could be effected by subsidence have been surveyed and documented and are included in the appendix.

In lieu of renewable insurance covering damages to existing structures, bonds have been secured through the District Courts for surface owners that could be affected in the amount of $500/acre as set by the court.

Subsidence Control

Utah Power & Light Company will conduct the underground mining operations so as to prevent subsidence

from causing material damage to the surface and to maintain the value and reasonable foreseeable use of that surface in accordance with the preceding subsidence control plan.

Mining of coal reserves in the Deer Creek Mine utilizes both room-and-pillar and longwall mining methods. Surface effects of underground mining are, in part, principally a function of the amount of coal removed or the amount of coal left as support and the depth of mining or the thickness of cover.

Of the two methods, room-and-pillar mining has a longer history and surface effects of mining along exterior boundaries (outcrops) can be documumented in the annual subsidence monitoring report.

Deer Creek Mine has mined two specific areas where escarpments are involved, 1st North and 9th East. First North is an old section where pillars were pulled in 1980 and surface movement is visible. Ninth East overlies a section of the Wilberg Mine where pillars were pulled and, together with burned coal, faulting and unstable geological conditions results in a block failure visible on the surface. A detailed report of this occurrence was made by the John T. Boyd Company and submitted to the appropriate agencies in 1981.

Of the thirty-six mile perimeter comprising the Deer Creek Mine, only about five miles of exterior boundary classified as steep, or escarpment, lies in close proximity to planned mining. This area is generally located in the northeast quarter of the mine plan.

In Meetinghouse Canyon partial mining is planned to afford subsidence protection for a high-voltage transmission line located along the canyon reaches. Only one mile of exterior boundary will involve longwall mining. Barrier pillars will be left as a buffer between beginning mining and actual outcrops. These barriers, approximately 200 feet wide, will provide anchoring for surface movement of mining conducted under shallow covering.

Room-and-pillar mining in areas of shallow overburden can be regulated by varying barrier sizes and pillar extraction rates. The degree of extraction will depend on field conditions that exist at the time of mining and can be adjusted to suite desired effects on the surface.

Public Notice

A mining schedule has been submitted to the affected surface owners which details the area in which mining is to take place and the planned date of the mining activity.

Pillar Size Determination

Mining technology and advanced rock mechanic studies have combined to push production limits far beyond what was once considered near impossible. New mining machines cut, handle, and transfer mined products at incredible speeds. Introduction of total extraction mining equipment has nearly doubled resource recovery and mining efficiency.

All underground mining utilizes some sort of entries, or rooms, together with pillar, or support, barriers to accommodate access and safety.

In coal mining organized room and pillar mining is widely accepted practice. Entry sizes and pillar dimensions vary widely depending on physical factors such as coal seam height, overburden, coal strength and anticipated loads to be superimposed by mining.

The following analysis compares a few of the more recognized methods used in mining today.

In order to arrive at a safety factor for a pillar, the overburden load and the strength of the pillar must first be calculated. Various methods have been proposed to calculate these variables. This section will discuss these approaches along with their strengths and weaknesses.

Overburden Load

Most approaches to calculating the overburden load on a pillar are based on the tributary area theory. This theory states that the load on a pillar is equal to a constant multiplied by the depth of the overburden and the ratio of pillar influence area to pillar area. The constant in this formula is usually in the range of 1.0 to 1.1 psi/ft. For example, a constant equal to 1.0, would yield the following formula:

$$Sp = \frac{(1.0)(H)(W+B)(L+B)}{WL} \qquad (1)$$

Where: Sp = Pillar Load (PSI)

H = Depth of Overburden (ft)

W = Width of Pillar (ft)

B = Width of Entries (ft)

L = Length of Pillar (ft)

When pillars having equal width and length are used, this formula reduces to:

$$SP = \frac{H[W + B]^2}{[W]} \qquad (2)$$

NOTE: The constant being equal to 1 was dropped.

This formula can be further modified by adding the extraction ratio, which is the ratio of the mined out area to the total area, and is determined by the following formula for square pillars:

$$e = 1 - \frac{[W]^2}{[W + B]} \qquad (3)$$

By substituting this equation into Equation (2) the following equation can be obtained:

$$SP = \frac{H}{1-e} \qquad (4)$$

It should be noted that this theory represents the upper limit of the average pillar load. In fact, the literature indicates that this theory overestimates the pillar load by about 30 to 40%.

Pillar Strength

The strength of coal pillars is dependent upon the material properties of the coal and the shape of the pillar.

The material properties of the coal are most often determined by laboratory testing of small cubical samples of coal. The results of these tests are then used to calculate the strength of full sized pillars. Several formulas are used in this calculation. The first formula (Gaddy Equation) calculates a coal constant, which is the theoretical strength of a 1 inch cube of coal, from the results of laboratory compressive strength tests. The formula for this constant is:

$$K = \bar{\sigma}_c \sqrt{D} \qquad (5)$$

Where:

K = Coal Constant

$\bar{\sigma}_c$ = Avg. Compressive Strength of Cubical Specimens (PSI)

D = Edge Length of the Cubical Specimen (in.)

Following the calculation of the coal constant, Equation 5 can be rearranged in order to calculate the strength of a cubical pillar having the dimension of the coal seam (7 to 8 ft. in the case of our mines). This equation now becomes:

$$\bar{\sigma}_1 = \frac{K}{\sqrt{D}} \qquad (5A)$$

Equation 5A shows that the coal strength decreases as the size increases. Experiments have shown that this relationship is true until the size increases to a critical point. Beyond this point, the strength remains relatively

constant. Hustrulid has suggested that this critical size is 36 inches. Therefore, the strength of a cube of coal having an edge length of 36 inches or greater would be:

$$\sigma_1 = \frac{K}{\sqrt{36}} \qquad (6)$$

This formula gives the strength of a cubical pillar. However, in most mines the pillars are not cubical, but have a greater width than height. Experiments have shown that when the width of a pillar is greater than the height of a pillar its strength is greater than what Equation 6 would predict. Five formulas have been suggested in the literature to account for this increase in pillar strength due to the geometry of the pillar. These formulas are as follows:

Obert - Duvall

$$\sigma_p = \sigma_1 \ (.778 + .222 \ w/h) \qquad (7)$$

Holland/USBM

$$\sigma_p = \sigma_1 \sqrt{w/h} \qquad (8)$$

Holland - Gaddy

$$\sigma_p = \frac{K\sqrt{w}}{h} \qquad (9)$$

Salamon - Munro

$$\sigma_p = K_1 \left(\frac{w}{h}\right)^{.46} \qquad (10)$$

Note: $K_1 = \frac{K}{\sqrt{.12}}$

Bieniawski/PSU

$$\sigma_p = \sigma_1 \ (.64 + .36 \ w/h) \qquad (11)$$

In Formulas 7, 8, 10 and 11 the variables are defined as follows:

σ_p = Compressive Strength of the pillar under investigation (PSI)

σ_1 = Compressive Strength of a cubical specimen at critical size, see Equation 6 (PSI)

W = Width of Pillar (FT)

H = Height of Pillar (FT)

K_1 = Modified Coal Constant for 12" cube of coal

In Formula 9 the variables are as follows:

σ_p = Compressive Strength of the pillar under investigation (PSI)

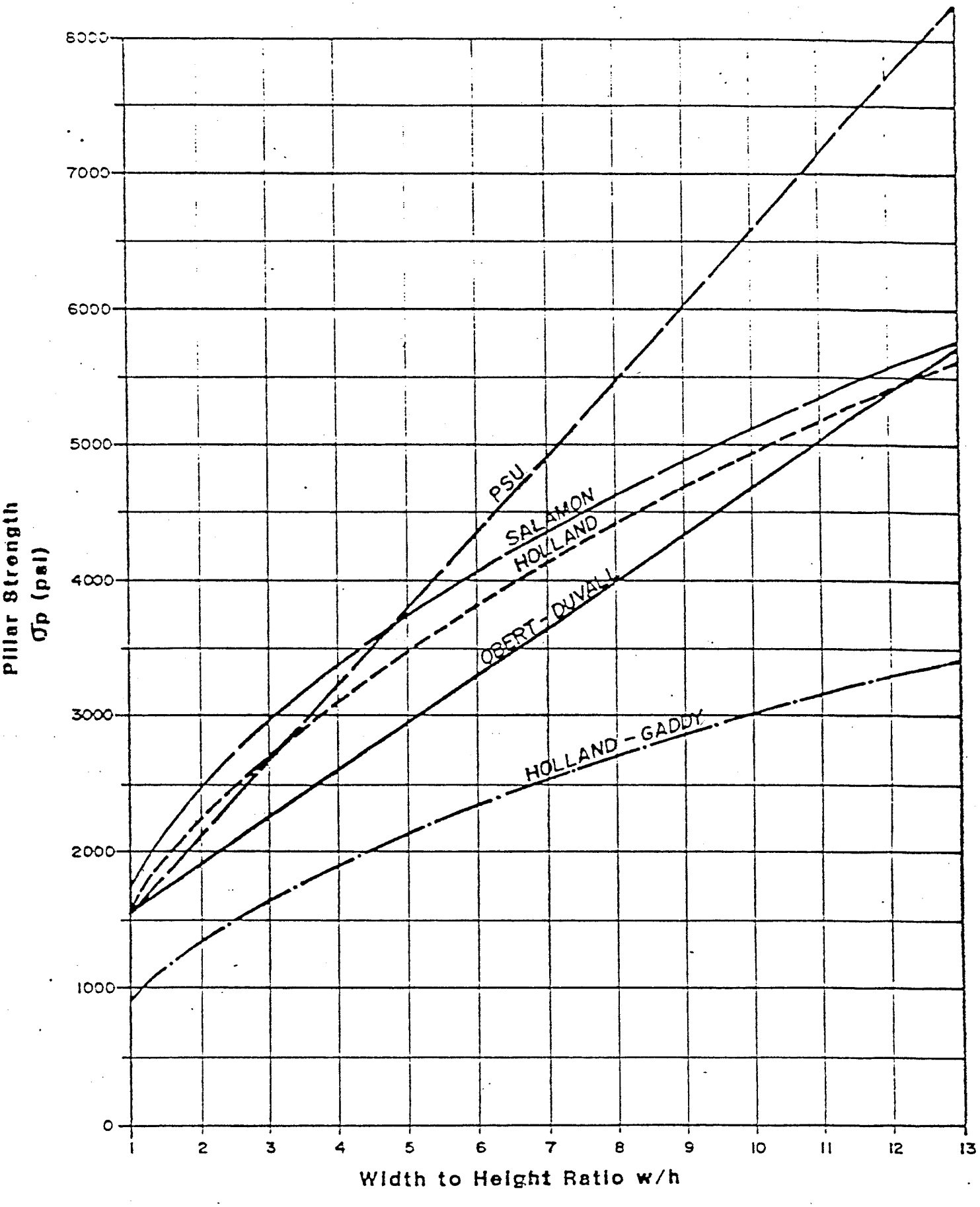
K = Coal Constant from Equation 5

W = Width of Pillar (inches)

H = Height of Pillar (inches)

The plot of each of these equations is shown in Figure 1. From this figure it is apparent that for higher width to height ratios the Holland-Gaddy formula predicts the lowest strength, while the PSU formula predicts the highest strength.

Three of the remaining four formulas predict approximately the same strength for higher width to height ratios. The PSU formula, however, predicts much higher strengths due to the developer's observations of a rapid increase in strength with an increase in the width to height ratio. In fact, during the development of the PSU formula it was proposed to add an exponent to the width to height term



BLIND CANYON: PILLAR STRENGTH vs. WIDTH TO HEIGHT RATIO

Figure 1

thereby causing the plot to curve upward and more accurately match the theoretical strength which was calculated based on rock mass properties. This addition would have agreed well with Cook, who proposes that pillars with width to height ratios greater than 10 are almost indestructible. However, for the sake of safety and due to the lack of experimental data, this exponent was never included in the formula. From the above literature it is obvious that even these remaining four formulas may be too conservative at higher width to height ratios.

An additional point should be noted concerning the strength of rectangular pillars, that is, pillars which are longer than they are wide. Wagner found by underground tests that rectangular pillars were about 40 percent stronger than square pillars of the same width and height.

Table 1 lists the safety factors, at various overburden depths, for a six entry development using the Holland-Gaddy formula and for the PSU and Obert-Duvall formulas.

TABLE 1

COAL PILLAR SAFETY FACTOR
FOR A SIX ENTRY DEVELOPMENT
BLIND CANYON SEAM

Overburden	Pillar Load	Safety Factor		
		Holland-Gaddy	Obert-Duvall	PSU
2000 Ft.	3252 PSI	.99	1.51	2.14
1800 Ft.	2927 PSI	1.09	1.67	2.38
1600 Ft.	2602 PSI	1.24	1.88	2.68
1400 Ft.	2276 PSI	1.41	2.15	3.06
1200 Ft.	1951 PSI	1.65	2.51	3.57

Assumptions

100 x 100 Ft. Entry Centers
20 Ft. Entry Widths
7.5 Ft. Mining Height
9340 Material Constant K

The data on this table shows how conservative the Holland-Gaddy equation is. In the example of 2,000 ft. of overburden, the Holland-Gaddy equation would predict that the pillars would have marginal safety factor while the PSU formula would predict stable pillars.

Regardless of which formula is selected for design, it should be remembered that all of these equations are conservative in the following areas:

1. Overburden load is based on the tributary load theory which overestimates the actual load by 30 to 40 %.
2. All formulas do not reflect the rapid strength increase at higher width to height ratios.

3. All formulas do not show higher strength for rectangular pillars than square pillars with equal widths and heights.

Conclusions

From the information presented it is obvious that coming up with an estimate of a safety factor for a pillar is very difficult. The literature suggests calculating the safety factor using several formulas and approaches and then combining this information with local mining experience before concluding whether a pillar design is safe or not. This is the approach that has been taken with the East Mountain coal mines.

DETAILED UNDERGROUND INFORMATION

In keeping with the regulation requiring detailed information as related to mining beneath perennial drainages, the Company submits the following:

1. Geological information included in this application is an intensive and complete description of the geological structure which comprises both coal seams. Also submitted to the BLM (USGS) are columnar sections and lithology of over sixty surface drill holes which delineate the entire overburden and coal seams.

2. Hydrological analysis contained within this permit application are concise and detailed descriptions of ground water as it relates to mining and drill hole information identifying intercepted water zones throughout the permit area.

3. Detailed mining methods and mining plans are included.

4. Under section 784.20, Subsidence Protection Plan, the mining method and mining related subsidence is described. Public Law 95-87, section 516(b)(1) states:

> (1) adopt measures consistent with known technology in order to prevent subsidence causing material damage to the extent technologically and economically feasible, maximize mine stability, and maintain the value and reasonably foreseeable use of such surface lands, except in those instances where the mining technology used requires planned subsidence in a predictable and controlled manner: Provided, That nothing in this subsection shall be construed to prohibit the standard method of room and pillar mining.

5. Subsidence history and subsidence studies - applicant has provided ample specific mining examples on which subsidence related surface effects can be evaluated. Also provided in our annual monitoring report is an independent subsidence monitoring study conducted by the Bureau of Mines.

We have not duplicated and presented in this section all the aforementioned detailed descriptions to avoid confusion and for the sake of a clean document.

It has been stated that there exist five streams which exhibit perennial characteristics. Two streams, Cottonwood and Rilda drainages, are shown to be void of mining beneath the designated section of perennial stream or no mining is planned at all.

Grimes Wash in the left fork has been mined. Mining in the Deer Creek Mine took place in 1983 by the longwall method. Less than 1800 feet of this stream involves mining beneath the designated perennial section. Monitoring of this section is included in the annual subsidence monitoring report.

There remain two streams, Deer Creek and Whetstone/ Meetinghouse that are planned to be mined. Deer Creek Mine has advanced under this stream with main entries and an old room and pillar section known as the McKinnon workings which are exempt under the pre S.M.A.C.R.A. law (August 1977).

It is planned, however, to extract longwall panels beginning west of where the stream is considered perennial and advance eastward. Mining will be north and south intersecting the drainage at 500 foot widths. At the beginning, cover will be deepest and as mining advances, cover thickness will lessen. As each panel requires

approximately one year to complete this would allow the Division adequate time to evaluate the surface effects of mining.

Whetstone/Meetinghouse drainages are partly included in the powerline corridor located in the same canyon. In accordance with good engineering practices a protective barrier for the transmission structures will be required.

Electrical clearances along the powerline are fairly rigid and phase-to-phase and phase-to-ground wire spacing would be diminished if subsidence created a tilting structure or caused over-stressed wires to part and fail. As winter is six or seven months long repairs could be extensive and costly.

This application has determined that Whetstone creek does not meet the perennial designation. Meetinghouse creek from Elk Springs and below is perennial.

Throughout the section from the Whetstone confluence to its farthest west reaches overlies the Roan Canyon fault zone. From geological studies and surface drill hole information it has been concluded that this northwest corner of the Deer Creek Mine will undergo intensive investigation to determine the best approach to mining. Presently, the mining beneath the small stream is limited to both room and pillar and some longwall panels situated parallel to the faulted zone to best afford economic coal extraction in this area.

Generally, with our present scope of mining, which includes both room and pillar and longwall mining in single and multi-seam extractions, it is reasonable to project the surface effects from past mining to planned mining under the same conditions.

A case history of longwall mining beneath a perennial stream was recalled by Mr. John Peperakis (Kaiser - retired) during the mining of Sunnyside Mine. Mr. Peperakis states that mining was completed with no known disturbance to the stream bed, then and now. His documentation is on file at Company's office.

Company states in the event of a fractured or cracked stream bed or intermittent drainage, Company will take measures to repair, bridge and restore the channel to a competent state capable of carrying its natural flows of water.

Total extraction mining as in longwall mining results in short-term effects. On East Mountain panel extraction can be measured within one year of initial mining. As adjacent panels are mined surface subsidence increases. Field measurements indicate chain pillars between longwall panels are crushing as designed.

Panels are designed to accommodate a 500 foot face with a two-entry system. As mining is on retreat the 30 x 85 foot pillars in the tailgate end past mining are designed to crush allowing an even subsidence pattern. In multi-seam

extraction panels are offset to take advantage of distressed areas (center line of extracted panel). On final mining mains and panel barriers are mined by continuous miners retreating along the entries towards the portals. Extraction rates on final mining completes the remaining supports allowing full subsidence to occur. When room and pillar mining is planned extraction will be the same.

Final mining is based on retreat pillar extraction. Mining success must be weighed by safety and it is expected that some coal will remain where deep cover produces excessive pressures.

Company will continue monitoring surface effects of mining and report to Division the results and conclusions.

Subsidence and Related Angle of Draw

The 1984 Subsidence Report for Utah Power & Light Company's coal properties is completed which includes the annual report by the U. S. Bureau of Mines.

UP&L has attempted to calculate angle of draw wherever possible in areas where subsidence has been noted. When UP&L began subsidence monitoring it was predicted that angle of draw could approach as much as 30°. However, in actual practice calculated angle of draw has averaged less than 10°.

In only a few areas has it been possible to determine an accurate angle of draw. This is due to several reasons: (1) influence of faults and fractures near mine workings, (2)

crushing of clinker beds where burned coal surrounds mine workings, (3) the fact that mining is continuing either in or around mine sections and subsidence has not yet stabilized, or (4) mining has only recently been completed in a section and subsidence has just begun.

One area where subsidence appears to have stabilized has yielded an angle of draw of approximately 9.5°. In this room and pillar section off 4th Right in the Deer Creek Mine subsidence extends about 300 feet away from the workings under 1800 feet of cover. Pillars in this area were extracted in 1982 with a total of 7.5 feet of coal being removed; maximum subsidence thus far is 4.6 feet. A truly accurate estimate of angle of draw will only be possible after ground movement has stopped.

Comparison of data and conclusions between the UP&LCO and the U.S.B.M. subsidence reports for 1984 find there is a correlation of subsidence, in fact, the data from both surveys coincide.

There is a discrepancy in calculated angle of draw numbers. Regardless, if the two independent surveys indicate the same amount of subsidence, and they do, then they should reflect the same angle of draw. We feel it may be premature to conclude final results especially where the ends of the measured panels abut a fault. It is estimated that the reported difference lies in the interpretation of where the

subsidence ends. Under 1500 feet of cover each 100 feet (each monument) translates into 4° of draw. This problem will be solved by further collection of data and continued monitoring.

PROTECTION OF FISH AND WILDLIFE (UMC 817.97)

Excepting the occasional use for exploration, the wildlife inhabitants on top of East Mountain are relatively unaffected during the mining operation and require no special plans other than the hydrological and subsidence monitoring now initiated. Riparian communities, though sparse, shall remain in the present condition. Information obtained from current state-of-the-art subsidence technology indicates that surface waters should not be detrimentally affected by mining activities. However, it is accepted that a potential for disturbance does exist; therefore, mitigation measures will be initiated if disturbance does occur.

Surface water will be replaced or repaired by the following methods:

1. Streams will be bridged across bedrock fractures by culverts until sediments fill the creek.
2. Springs will be replaced with a series of guzzlers adequate to replace lost flow.

These methods require little maintenance and will provide a semi-permanent fix to surface water problems that can be attributed to subsidence and liability determined by courts.

The design and selection of the appropriate mitigating measures will be determined after consultation with the appropriate agencies.

Information regarding mule deer seasonal distribution and numbers within the permit area is not available due to the dynamic characteristics of the deer herds involved. UDWR

personnel indicate such information would not be truly representative of the demographics of the deer population; therefore, it is not available from them. Map 2-19 shows the location of critical deer habitat in the permit area.

The UDWR presently conducts a deer road-kill monitoring program which includes the Deer Creek Mine access road. The program functions to monitor road-kills and identify significantly hazardous areas for the purpose of initiating mitigating measures to reduce the incidence rate. Road-kills observed by mine personnel will be reported to the UDWR to aid them in their monitoring program.

If hazardous areas are identified on the Deer Creek Mine Access road, within the permit area, appropriate mitigating measures will be instituted based on consultation with UDWR personnel.

Signs will be placed on the Deer Creek access road to notify drivers of the presence of deer in the area. A flyer containing the following information on avoiding deer vehicle collisions will be provided for all employees:

1. Drivers are to be aware of deer in the area.
2. Be aware that deer are most active at night and during dawn and dusk.
3. At night flash lights at deer on road to break their trance and allow them to react to the oncoming vehicle.
4. Each deer is worth $1,100 to the economy of Utah.

This instruction will also include the precaution of shooting at raptors perched on the transmission line.

As an additional mitigating measure, the slide-tape presentation, "Coal Mining and Wildlife," will be shown to all coal mining company employees. It will be included as part of the new employee orientation training and the annual employee retraining programs.

The slide-tape presentation addresses the major areas of concern identified in the UDWR Fish and Wildlife Mitigation Plan for Utah Mining Projects. Additional aspects of the general mitigation plan, which apply to the permit area, have been incorporated in the permit application.

A report on deer crossings at the coal conveyor has been prepared and was submitted to the Division on June 2, 1983.

To the extent practicable, activities with the potential of creating a disturbance in the area of active animal dens or lodges and avifauna nests or roosts, will be conducted in such a manner that the disturbance does not occur during the critical use period of the associated specie. If avoidance of disturbance is not possible, mitigation measures will be undertaken in conjunction with the appropriate agencies to insure minimal effects from the disturbance.

Personnel will be apprised of the critical value of snake dens. They will be advised to be particularly observant for concentrations of snakes during the months of

April, May, September and October. Such concentrations indicate the presence of snake dens. If a den is located, it will be reported to the UDWR for assistance in the necessary mitigating measures.

Many raptors utilize the east escarpment face of the Wasatch Plateau for nest sites. This concentration of nest sites is mapped as a raptor nesting zone on the Land Use Map (2-18). Prior to implementation of additional developments within the zone the USFWS will be consulted for mitigation of impacts.

Raptor nests at Deer Creek 1981 USFWS Survey:

#46 Raven Nast, inactive

#47 2 Turkey Vulture observations

#48 4 Buteo, 1 active Redtail, 1982 inactive

#49 Adult Golden Eagle observations

Any nest initiated adjacent to the existing facilities would not require cessation of operations because this nesting action signifies acceptance of the present situation. All golden eagle nests will be reported to the USFWS, Salt Lake City.

The power line serving the Deer Creek Mine has been approved as eagle safe by the USFWS by letter dated November 26, 1982 from the DOGM.

The interim reclamation plan provides for the stabilization of all the fill slopes with a vegetative cover (817.111). Because the fill slopes are intertwined with the mine facilities, the planing mixture is designed more for

soil stabilization than for an attraction to wildlife. The large mammals especially would be a nuisance in and around the operation and the operations a hazard to them. The final reclamation plan will restore the stream channels and revegetate the disturbed sites. The planting mix of forbs, grasses, shrubs and trees is similar to the adjacent native plant communities and would provide food and cover for wildlife through grouping of shrub plantings.

Revegetation for enhancement of wildlife habitat consistent with UMC 817.97(9) will be accomplished (see Revegetation section). The selected plants will be distributed in a manner such that the essential needs (cover, food, water) are optimized.

Applicant will not use persistent pesticides on the area during underground coal mining and reclamation activities, unless approved by the Division.

The UDWR general mitigation plan for the Deer Creek Mine follows. Applicant has stated compliance to these recommendations insofar as they are applicable.

UMC 783.20; FISH AND WILDLIFE RESOURCE INFORMATION
UTAH POWER AND LIGHT COMPANY, DEER CREEK MINING PROJECT

General Wildlife Resource Information--All Species of Vertebrate Wildlife

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

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

The Division Publication No. 78-16 "Species List of Vertebrate Wildlife that Inhabit Southeastern Utah" is referenced to this report since it represents a low level of study for the wildlife species listed. It identifies those species having potential to inhabit the region as well as those inhabiting the environs of the mine plan area. It also identifies which species are considered to be of high interest for the habitats and local area represented.

High interest wildlife are defined as all game species; any economically important species; and any species of special aesthetic, scientific or educational

significance. This definition would include all federally listed, threatened and endangered species of wildlife.

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

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

High-priority wildlife use areas are "intensive use areas" for one or more species of wildlife. "Intensive use areas" are not restricted in area and in conjunction with limited value use areas form the substantial value distribution for a wildlife species. All stream sections, reservoirs, lakes and ponds identified by Utah Division of Wildlife Resources as Class 3 are classified as being of high-priority. In addition, wildlife use areas where surface disturbance or

underground activities may result in subsidence that could interrupt underground aquifers and result in a potential for local loss of ground water and decreased flows in seeps and springs should be considered as being of high-priority to wildlife.

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

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

MAPPING

Vegetation and Wildlife Habitats

It is recommended that the Company's primary effort be placed on identifying species of vegetation in each wildlife habitat within the various wildlife use areas for purposes of reclamation. The Division does not have site specific information relative to vegetation types at the mine plan area. However, there are nine wildlife habitats present--riparian or wetland types, cliffs and tallus, sagebrush, pinion-juniper forest, shrubland, aspen forest, ponderosa forest, parkland and spruce-fir forest. The Company should identify each of these habitat associations on appropriately scaled maps.

It is believed that if satisfactory reclamation is achieved and man's disturbance does not continue or become a factor, that most species of wildlife dis-

placed from the mine plan area will return. Without doubt, the key to success for enhancing or restoring wildlands will be development of habitats so that the postmining condition as compared to the premining condition will have similar species, frequency and distribution of permanent plants in each vegetative type this will allow for natural plant succession. Additionally, other habitat features that represent the various life requirements for local wildlife must be provided.

Wildlife Use Areas

The enclosed map displays mapable, high value use areas for high interest wildlife on or adjacent to the mine plan area. This display includes stream sections and bodies of water, if any, utilized by high interest fish species. Also displayed are know seeps, springs, wetlands, and riparian zones. Note that there are high interest wildlife distributions that are so broad that they cover the entire map and therefore are not illustrated. However, all vertebrate species of high interest wildlife and their distributions are discussed in the following narrative.

Water

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

FISH AND WILDLIFE INVENTORY

Aquatic Use Areas

Macrophytes

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

Macroinvertebrates

The results from studies of macroinvertebrates may be required for purposes of determining need for stream buffer zones (UMC 817.57) in stream sections supporting biological communities. Since historic impacts from this mine's operation have not significantly impacted Huntington, Deer and Meeting House Creeks data relative to macroinvertebrates as a pollution index or a forage base for fishes or other predators dependent upon the aquatic resource need not be presented.

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

The results from long-term studies of macroinvertebrates in Huntington Creek and Deer Creek could be of value for the Company to demonstrate that impacts from accumlations of coal and other sediments in each creek are not evident.

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

Fish--Species Occurrence and Use Areas

Aquatic habitats adjacent to the mine plan area support three species of game and two species of non-game fish; all of which are protected. Of these fish, four species have been determined to be of high interest to Utah

(reference the Division Publication No. 78-16).

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

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

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

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

Once the cutthroat or rainbow trout have spawned their eggs incubate in the redds approximately 30 to 50 days--water temperatures ranging from 45 to 50 F. Brown trout eggs incubate throughout the winter which lasts approximately 100 to 150 days--water temperatures ranging from 35 to 40 F. During this crucial period water temperature affects the rate of embryonic develop--the warmer the water the more quickly incubation is completed. It is also during this period

that ongoing sedimentation can result in suffocation of the eggs. Flucuations in stream flow also negatively affects incubation; wherever practicable, maintenance of a constant flow of water during the spawning period enhances reproductive success.

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

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

Although there are no fish in Deer or Meeting House Creeks, their flow of water is of great value for reproductive success of spawning trout in the lower reaches of Huntington Creek for which they are tributary waters. Additionally, drift of macroinvertebrates from these streams represent an important contribution of forage to trout and other fishes in Huntington Creek.

If project operations are planned or develop that would alter, destroy or discharge polluting effluents into any perennial waters, appropriate state and federal permits, a mitigation plan and results from high level studies of the

salmonid fishery resource, if any, would be required of the Company. Achievement of mitigation would demand detailed studies of stream velocity correclated to flow, representatives of the stream channel profile, gradient, pool-riffle ratio, substrata types identifying percent representation of each type and surface water information required for SMC 779.16.

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

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

Terrestrial Use Areas

Wildlife Habitat Types

Of the nine wildlife habitat types present on the mine plan area wetlands and riparian habitats are ranked as being of critical value to all wildlife. Such zones are normally associated with drainage bottoms (ephemeral or intermittent), or perennial streams (UMC 700.5), seeps and springs within the upper Sonoran,

Transition and Canadian life zones. Cliffs and their associated tallus areas that lie within the upper Sonoran and Transition life zones are ranked as being of high-priority value to all wildlife. When compared to all other wildlife habitats the aforementioned situations are considered to represent unique habitat associations (Table 1).

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

Quantitative (acreage) and qualitative (condition, successional stage and trend) data concerning the wildlife habitats in each ecological association should be included as part of the mine permit application. It is important to note that each legal section of land represented by the mine plan and adjacent areas has been ranked as to its value for the total wildlife resource. Sections 21, 22, 27, 28 and 34 of Township 16 South Range 7 East have been ranked as being of critical value to wildlife. This is also true for Sections 12, 13 24 and 25 of Township 17 South Range 6 East and Sections 2, 7, 18, 19 and 30 of Township 17 South Range 7 East. Sections 19, 20, 29, 30, 31, 32 and 33 of Township 16 South Range 7 East have been ranked as being of high-priority value to wildlife. This is also true for Section 1 Township 17 South Range 6 East and Sections 3, 4, 5, 6, 8, 9, 10, 11, 13, 14, 15, 16, 17, 20, 21, 22, 23, 24, 26, 27, 28 and 29 of Township 17 South Range 7 East. These rankings were developed through an analysis of cummulative values for use areas of selected individual species of high interest wildlife inhabiting each legal section of land (Table 2).

Amphibians--Species Occurrence and Use Areas

Six species of amphibians, all of which are protected, are known to inhabit the biogeographic area in which the mine plan and adjacent areas are located. It is probable that all of these species inhabit the project area (reference the

Division Publication No. 78-16). Only one species of the amphibians inhabiting the project area have been determined to be of high interest to the State of Utah

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

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

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

Post-embryonic development of a salamander's larval form progresses at a pace somewhat controlled by water temperature; in some cold waters the larva may no transform into an adult and drying up of a pool may hasten the process.

Migration to or from water usually occurs at night, during or just after a

rain storm. When inhabiting terrestrial sites the tiger salamander is most active at night, particularly on rainy nights, from March through September.

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

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

Reptiles--Species Occurrence and Use Areas

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

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

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

deposited its clutch of eggs is of critical value to maintenance of the species.

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

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

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

Birds--Species Occurrence and Use Areas

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

Ducks commonly known as waterfowl are not known to utilize the project area, but may on occasion or during different seasons of the year make limited use of the mine plan area. All of these species are of high interest to the State of Utah

Generally speaking, the riparian and wetland habitats encompassed

by the project and adjacent areas provide substantial valued habitats for waterfowl. Each species has different life requirements and makes various uses of the riparian and wetland habitats.

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

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

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

the period of time that the nest is occupied. Species specific protective stipulations for aeries are available from the Utah Division of Wildlife Resources and the U.S. Fish and Wildlife Service.

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

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

It is believed that aerie territories for eagles may exist on the project area. This belief is based upon the fact that suitable nesting habitat is widespread on the mine plan area and throughout the local area. It is important to note that the regularity of golden eagle observations and the fact that their status is common has resulted in documentation of mostly opportunistic observations of aerie territories.

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

To date there are no known high-priority concentration areas or critical roost trees for golden eagles on the project area. The mine plan and adjacent

areas have been ranked as being of substantial value to golden eagles.

The northern bald eagle is an endangered winter resident (November 15 to March 15) of the local area. To date there are no known high-priority concentration areas or critical roost trees for this species on or adjacent to the project. The mine plan area has been ranked as being of substantial value to wintering bald eagles. Note that no bald eagles are known to nest in Utah, however, historic data documents nesting activity by these birds in the State. There is no known historic evidence of the northern bald eagle nesting on the mine plan or adjacent areas.

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

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

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

aerie sites.

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

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

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

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

After breeding the female develops a nest site which is secreted on the ground; the nest is of critical value to maintenance of the blue grouse population. Upon hatching, which occurs in late May and early June, the young accompanied by the hen immediately leave the nest. The young blue grouse while being brooded rely heavily on insects for their protein needs during the first several months

of development. The adult bird also shifts its diet during this period to include a high proportion of insects. Brooding areas are ranked as being of high-priority value to blue grouse. The crucial period extends from hatching into mid-August.

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

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

Ruffed grouse do not exhibit any type of seasonal migration.

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

After breeding the female develops a nest site which is secreted on the ground and deep within an aspen grove; the nest is of critical value to maintenance of the ruffed grouse population. Upon hatching, which occurs in late May and early June, the young accompanied by the hen immediately leave the nest. The young ruffed grouse while being brooded rely heavily on insects for their protein needs during the first several months of development. The adult bird

also shifts its diet during this period to include a high proportion of insects. Brooding areas are ranked as being of high-priority value to ruffed grouse. The crucial period for brooding extends from hatching into mid-August.

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

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

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

The black swift is a summer resident of the Wasatch Plateau. The montane ecological association represents the swift's substantial valued use area. Normally, the bird is associated with a small flock that represents a colony. Black swifts are usually observed soaring as pairs and they feed upon flying insects. A colony's nests are scattered along percipitous terrain where the nest is often

secreted behind a waterfall. Such a moist habitat is not known to exist on the project area. Cliff and tallus wildlife habitats are ranked as being of high-priority value to the black swift. There is evidence that pair bonds are long lasting and that a nest may be utilized in successive years.

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

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

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

been documented to utilize the environs of the biogeographic area that surrounds the project site. In areas of the State where the Williamson's sapsucker is known to exist, it is a summer resident with a relative abundance considered to be uncommon.

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

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

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

broad continum of habitats. It is important to note that trees with cavities located on the project area can be of critical value to bluebirds.

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

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

Mammals--Species Occurrence and Use Areas

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

The red bat is a summer resident of the biogeographic area that surrounds the project site. The animal roosts in wooded areas (riparian woods and pin-

ion-juniper forests) of the submontane ecological association. Such areas represent this animals substantial valued use area. An occasional individual has been known to utilize caves; those individuals could hibernate and remain over winter.

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

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

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

The northern flying squirrel is a yearlong resident of the biogeographic area that surrounds the project site. Currently, its relative abundance is unknown. Its substantial valued use area is restricted to spruce-fir or other mixed conifer habitats of the montane (Canadian and Hudsonian life zones) ecological association.

This specie is the only nocturnal squirrel in Utah. The flying squirrel may build its nest within an old woodpecker hole or it may build an outside nest of leaves, twigs and bark. Mating occurs twice in each year--February through March and June through July. Afterwhich, two to six young are born after a gestation period of 40 days--April through May and August through September. These periods are of crucial value to maintenance of their populations. During winter flying squirrels are gregarious; 20 or more have been known to den together.

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

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

The gray wolf is a historic inhabitant of the biogeographic area that sur-

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

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

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

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

is restricted to the Canadian life zone; where as the mink utilize the Canadian and Hudsonian life zones.

The substantial valued use area for marten and wolverine is the montane ecological association. The marten does not utilize the Alpine life zone but the wolverine can be found at that elevation. Both species could be found in the environs of the project site.

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

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

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

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

The substantial valued use area for the Canada lynx is restricted to the

Canadian and Hudsonian life zones of the montane ecological association. Normally, this cat would only be expected to utilize riparian and forested wildlife habitats. The lynx is similar in predation habits to the bobcat.

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

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

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

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

man's disturbance when the deer are physically present on the range.

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

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

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

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

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

Migration of moose from summer range to winter range is initiated during late November; probably, changing weather conditions is the initial stimulus.

The onset of winter weather reinforces the moose's urge to migrate and continued adverse weather keeps the animal on the winter range.

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

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

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

Moose calf during late May and June. Calving takes place in the riparian or adjacent forest habitats. Without doubt, all riparian areas are of critical value for calving and maintenance of the moose population. To date no specific areas showing annual use for calving are known. It is probable that such areas exist; they would be ranked as being of critical value to moose. It is important to note that June represents a crucial period for maintenance of moose populations.

Rocky mountain elk are inhabitants of the biogeographic area that surrounds the project site. Their substantial valued use area spans all wildlife habitats

extending from the submontane through the montane ecological association. Elk do not show as strong of altitudinal migration as mule deer do in response to winter conditions, but they do migrate to wintering areas (see attached map).

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

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

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

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

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

Table 1. Ranking of value per ecological association for wildlife habitats of vertebrate species having high interest to the state of Utah. Crucial-critical (C) habitats are the highest valued followed in respective order by high-priority (H), substantial value (S) and limited valued (L) habitats.

Ecological Association	Wildlife Habitats												
	Riparian and Wetland	Desert Scrub	Pasture and Fields	Urban or Parks	Cliffs and Tallus	Sagebrush	P-J Forest	Shrubland	Aspen Forest	Ponderosa Forest	Parkland	Spruce-fir Forest
					LOWER SONORAN LIFE ZONE							
Warm Desert	This ecological association does not exist in the Southeastern Region											
					UPPER SONORAN LIFE ZONE							
Cold Desert	C(H^1, S^2)	S	S	S	H							
					TRANSITION LIFE ZONE							
Submontane	C(H^1, S^2)		S	S	H	S	S	S				
					CANADIAN LIFE ZONE							
Montane	C(H^1L^2)		S	L	S				S	S	S	S
					HUDSONIAN LIFE ZONE							
Montane	H(S^1;L^2)				S							S
					ALPINE LIFE ZONE							
Montane	This ecological association does not exist in the Southeastern Region											

1. Habitat ranking value for species associated with the riparian-wetland type that represents just the wet meadow situation.
2. Habitat ranking value for species associated with the riparian-wetland type that represents just the dirt bank situation.

Table 2. Ranking of wildlife value per legal section of land on coal producing lands in Utah. Crucial-critical (1), sections are the highest valued followed in respective order by high-priority (2), substantial value (3) and limited valued (4) sections.

BOOK CLIFFS

T.	R.	Section	Rank
12	8	1-36	1
12	9	2,4-12,14,16-18,31-35	1
		1,3,13,15,19-30,36	2
12	10	2-11,13-17,19-27	1
		1,12,18,28-36	2
12	11	16-28,33-35	1
		1-15,29-32,36	2
12	12	19,27-30,32-34	1
		1-18,20-26,31,35,36	2
13	8	1-3,5-16,19,20,22-24,28-31	1
		4,17,18,21,25-27,32-36	2
13	9	1-11,14,15,17,18,28,29,31-35	1
		12,13,16,19-27,30,36	2
13	10	1,2,6	1
		3-5,7-36	2
13	11	14-16,21-28,34-36	1
		1-13,17-20,29-33	2
13	12	4,19,30,31,	1
		1-3,5-18,20-29,32-35	2
13	13	1-36	2
14	13	1-36	2
14	14	33	1
		1-32,34-36	2
15	14	1-21,23-26,28-36	2
		22,27	3
16	14	24-26,35,36	1
		1-23,27-34	2
16	15	3,10,11,14,23-25,29-33	1
		1,2,4-9,12,13,15-22,26-28,34-36	2
17	14	1,12,13,24,25,36	1
		2,3,10,11,14,15,22,23,26,27,34, 35	2
17	15	4-9,16-22,27-34	1
		1-3,10-15,23-26,35,36	2
18	14	1,27	1
		2,3,10-15,22-26,34-36	2
18	15	4-10,15-18	1
		1-2,11-14,19,21-25,30-32	2
		3,20,26-29,33-36	3

HENRY MOUNTAINS

T.	R.	Section	Rank
27	9	1-36	1
30	9	25,32-36	3
		19-24,26-31	4
30	10	20-29,32-36,	1
		19,30,31	3
31	8	1,7,12,13,18,19,24,25,30,31,36	3
		2-6,8-11,14-17,20-23,26-29,32-35	4
31	9	4-9,16-21,28-33	3
32	8	30,31	2
		1,6,7,10-15,18,20-29,33-36	3
		2-5,8,9,16,17,19,32	4
32	9	1,12,13,24,25;35,36	1
		2-11,14-23,26-34	3
33	8	6-8,12-14,17-20,22-36	2
		1-4,9-11,15,16	3
		5,21	4
33	9	1-3,9-17,20-28,34-36	1
		7,18,19,29-32	2
		4-6,8,33	3
34	8	1-3,10-13,15	2
		14	3
34	9	3	1
		2,5-11,13,14,16-19	2
		1,4,12,15,20-24,26-28	3
		25,29-36	4
34	10	1-23,26-30,32-34,36	2
		24,25,35	3
		31	4

KAIPAROWITS PLATEAU

T.	R.	Section	Rank
33	1	26,27,34-36	1
		28,33	2
		19-25,29-32	3
33	2	28,31-33	1
		19-21,29-30	3
34	1	1-3,10-14,24	1
		4-9,15-23,25-36	2
34	2	4-7,17,18,20,21,28,29	1
		8,9,16,19,30-33	2
35	2W	3-10,16-19	1
		2,11,14,15,20-23,27-32	2
		1,12,13,24-26,33-36	3

KAIPAROWITS PLATEAU (CONTINUED)

T.	R.	Section	Rank
35	1	1-34	2
		35-36	3
35	2	4-9,16-20,25	2
		21-24,26-36	3
35	3	30-32	2
		19-29,33-36	3
36	3W	1-3,10-12,14,15	2
		13	4
36	2W	1-6,8-12	3
		7,13-18,22-27,34-36	4
36	1W	36	1
		1,24-26,35	2
		2-23,27-34	3
36	1	4-9,19-36	2
		1-3,10-18	3
36	2	30,31	2
		1-29,32-36	3
36	3	5,8,17,20,21,27,28,33-35	2
		1-4,6,7,9-16,18,19,22-26,29-32, 36	3
37	1W	1,2,11-14,23-26,35,36	2
		3-10,15-22,27-34	3
37	1	1-36	2
37	2	6,7,12,13,17-20,24,25,29-32,36	2
		1-5,8-11,14-16,21-23,26-28, 33-35	3
37	3	1,2,6-9,12,15-23,25-36	2
		3-5,10,11,13,14,24	3
37	4	20,21,28-33	2
		19	3
38	1W	1-3,11-14	2
		4-10,15-18	3
38	1	1-18,22-27,34-36	2
38	2	17	1
		1,4-9,12,13,16,18-21,24,25,28-33, 36	2
		2,3,10,11,14,15,22,23,26,27,34, 35	3
38	3	1-36	2
38	4	2-36	2
		1	4
38	5	19-22,26-36	2
		23-25	4
39	1	1-18,22-27,34-36	2
39	2	1,2,4-9,11-20,22-36	2
		3,10,21	3
39	3	1-36	2
39	4	1-36	2
39	5	1-36	2
40	2	1-36	2
40	3	1-36	2
40	4	1-36	2
40	5	1-36	2
40	6	4-9,16-21,28-33	2
41	2	1-30	2
		31-36	3
41	3	31-36	1
		1-21,29,30	2
		22-28	3
41	4	31-36	1
		1-17,20-28	2
		18,19,29,30	3
41	5	31-33	1
		1-9,11-14,18,23-26,35,36	2
		10,15-17,19-22,27-30,34	4
42	1W	13-36	1
		4,9	2
		1-3,5-8,10-12	4
42	3	1-36	1
42	4	1-36	1
42	5	2-36	1
		1	2
43	3	1-11,14-18	1
		12,13	4

WASATCH PLATEAU NORTH

T.	R.	Section	Rank
12	6	1-26,29,31,34-36	1
		27,28,30,32,33	2
12	7	1-15,17-36	1
		16	3
12	8	1-36	1
13	6	1,2,5-8,10,13,17-20	1
		3,4,9,11,12,14-16,21-36	2
13	7	1-4,9-17,19,22-26,31,32,35,36	1
		5-8,18,20,21,27-30,33,34	2
13	8	1-3,5-16,19,20,22-24,28-31	1
		4,17,18,21,25-27,32-36	2

WASATCH PLATEAU NORTH (CONTINUED)

T.	R.	Section	Rank
14	6	28-33	1
		1-27,34-36	2
14	7	1,4-6,9,12,13,16	1
		2,3,7,8,10,11,14,15,17-36	2
15	6	4-6,10-15,22-24	1
		1-3,7-9,16-21,25-36	2
15	7	32-36	1
		1-31	2
15	8	9,15,20-22,27-29,32,33	1
		1-8,10-14,16-19,23-26,30,31,34-36	2
16	6	11,13,14,16,20-26,28,29,31-33,35, 36	1
		1-10,12,15,17-19,27,30,34	2
16	7	1-5,9-16,21-28,34-36	1
		6-8,17-20,29-33	2
16	8	4,7,9,17-21,26-31	1
		1-3,5,6,8,10-16,22-27,32-36	2
17	6	4-9,11-14,16-22,24-35	1
		1-3,10,15,23,36	2
17	7	1,2,7,12,18,19,25,30	1
		3-6,8-11,13-17,20-24,26-29,31-36	2
17	8	5,6,16,19	1
		4,7-9,17,18,20,21,28-33	2
18	6	1-3,10,11,13-15,22-27,34-36	1
		12	2
18	7	4,5,7-11,13-17,19-27,29-32,34-36	1
		1-3,6,12,18,28,33	2
19	6	1-3,10-15,22-27,34-36	1
19	7	1-3,5,23,27-34	1
		4,24-26,35,36	2

WASATCH PLATEAU SOUTH

T.	R.	Section	Rank
20	5	20-29,31-36	1
		19,30	2
20	6	19-36	1
21	4	1-3,10-15,19-36	1
		4-9,16-18	2
21	5	1-36	1
21	6	4-9,16-21,28-33	1
22	3	1-3,10-15,22-27,34-36	2
22	4	1-4,9-16,21-28,33-36	1
		5-8,17-20,29-32	2
22	5	1-20,22-24,29-30	1
		21,25-28,31-36	2
23	3	1,12,13	1
		2,3,10,11,14,15,22-27	2
		34-36	2
23	4	2-4,6-11,14-18,20-29,31-36	1
		1,5,12,13,19,30	2
24	4	2,4-9,16-18	1
		1,3,10-15	2

Figure 1. Key for mapable, high-value habitat use areas for wildlife.

Wildlife Use Areas	Use Area Ranking		
	Substantial-Value	High-Priority[2]	Crucial-Critical[2]
		Aquatic Use Areas	
Stream Sections and Lakes[1]	~~[s-cw-2-4-yl]~~	~~[h-cw-2-3-yl]~~	~~[c-cw-2-1-yl]~~
		Terrestrial Use Areas	
Wetlands, Riparian Zones, Seeps and Springs			
Bison	Herd Distribution s-b-yl		Winter Range c-b-wt 12-1 to 4-15 Summer Range c-b-su 4-15 to 11-30

[1] Streams: The first letter (c) identifies one of the four use areas ranking--c, crucial-critical; h, high-priority; s, substantial value; l, limited value. The second group of letters (cw) identifies the primary type of fishery for which a water is managed--cw, cold water fishery; ww, warm water fishery; ng, non-game fishery. The first number (2) identifies the stream section. The second number (3) identifies one of the six stream classes defined by Utah Division of Wildlife Resources for Utah's State Water Plan. The last letters (yl) identify a need for a yearlong protection of this water.

[1] Lakes: Notations are the same as stream sections except the numeral that identified stream section has been replaced with the name of the body of water.

Game fish species that inhabit the stream sections or lakes are identified on the map overlays.

[2] The dates given for various use areas or activities of terrestrial wildlife identify when a species is normally present or participating in an activity and also denotes the period when protection from disturbance is needed.

Figures 1. Continued

Wildlife Use Areas	Use Area Ranking		
	Substantial-Value	High-Priority[2]	Crucial-Critical[2]
Bighorn Sheep Desert (dbs) Rocky Mountain(mbs)	Herd Distribution s-dbs-yl s-dbs-yl	Tallus Slopes (ewes and lambs) h-dbs-yl 1-1 to 12-31 Mesa Tops-- 1 mile radius (rams) h-dbs-yl 1-1 to 10-31	Rutting Season (tallus slopes) c-dbs-rt 11-1 to 12-31 Lambing Season (tallus slopes) c-dbs-la 5-1 to 6-15
Black Bear	Population Distribution s-bb-yl		
Cougar	Population Distribution s-c-yl		
Elk	Herd Distribution s-c-yl	Winter Range h-e-wt 11-1 to 5-15 Summer Range h-e-su 5-16 to 10-31	Winter Range c-e-wt 11-1 to 5-15
Mountain Goat	Herd Distribution s-mg-yl		
Moose	Herd Distribution s-m-yl		Yearlong c-m-yl 1-1 to 12-31
Mule Deer	Herd Unit s-d-yl	Winter Range h-d-wt 11-1 to 5-15 Summer Range h-d-su 5-16 to 10-31	Winter Range c-d-wt 11-1 to 5-15 Summer Range c-d-su 5-16 to 10-31
Pronghorn Antelope	Herd Distribution s-pa-yl	Yearlong Range h-pa-yl 1-1 to 12-31	Winter Season c-pa-wt severe snow conditions Fawning Season c-pa-fa 5-12 to 6-20

Figure 1. Continued

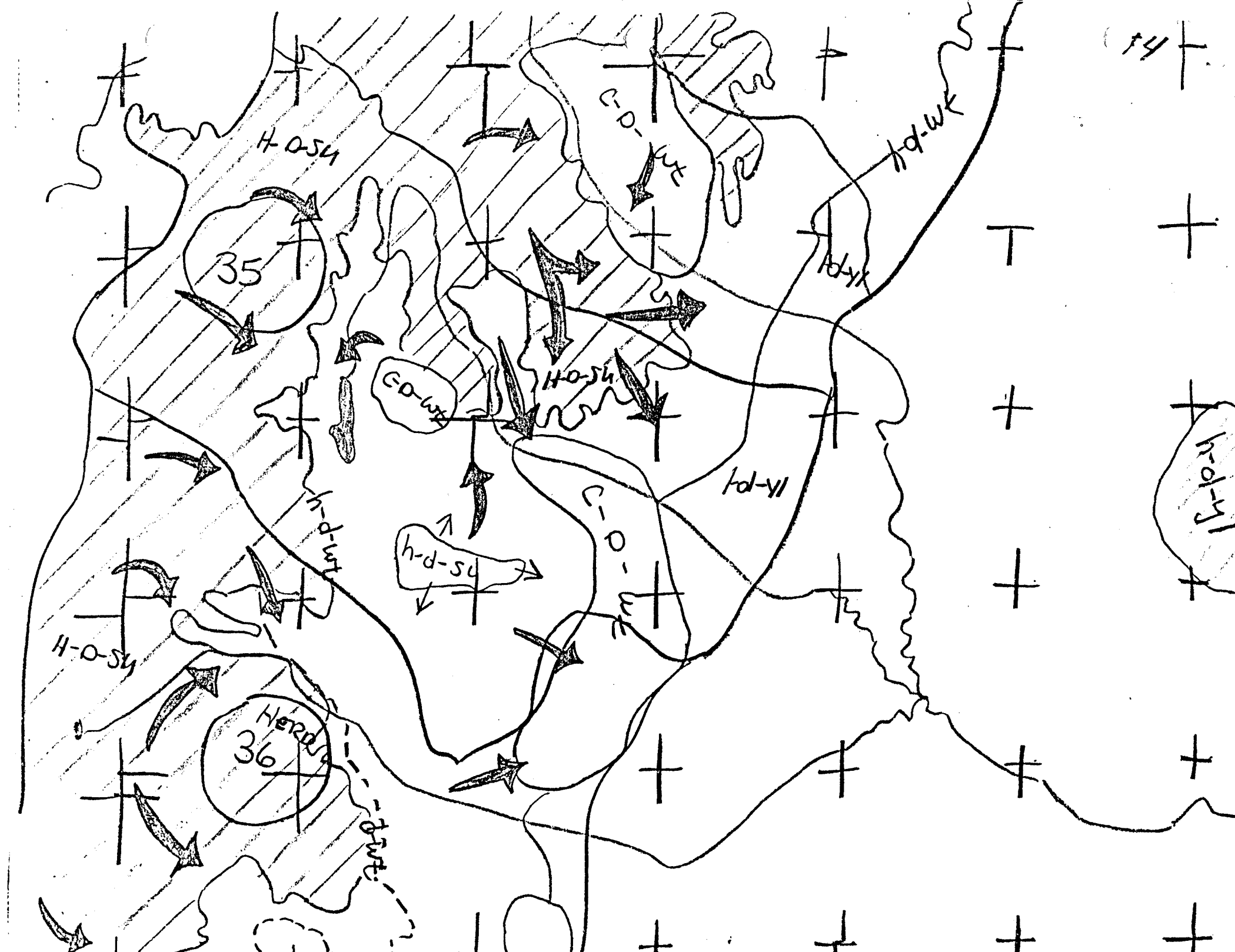
Wildlife Use Areas	Use Area Ranking		
	Substantial Value	High-Priority[2]	Crucial-Critical[2]
	Terrestrial Use Areas		
Gambel Quail	Population Distribution s-gq-yl		Riparian Zones c-gq-yl 1-1 to 12-31 Nesting Season c-gq-n 4-15 to 5-30
Merriams Turkey	Population Distribution s-mt-yl	Winter Range h-mt-wt 12-1 to 3-31 Summer Range h-mt-su 6-1 to 11-30	Display and Nesting Area c-mt-n 4-1 to 5-30 Roost Trees (0.5 mile radius buffer zone) c-mt-rt 1-1 to 12-31
Mourning Dove	Population Distribution s-du-su		Nesting Season c-du-n 5-1 to 8-31
Pheasant Ring-necked White-winted	Population Distribution s-rnp-yl s-wp-yl		Croplands and Adjacent Riparian and Wetlands c-rnp or wp-yl 1-1 to 12-31 Nesting Season c-rnp or wp-n 5-15 to 7-15
Ruffed Grouse	Population Distribution s-rg-yl	Summer Range (0.25 miles each side of stream courses) h-rg-su 3-11 to 11-30	Brooding Areas (0.25 miles each side of stream courses) c-rg-b 6-1 to 8-15 Winter Range (clone of mature male Aspen near stream) c-rg-wt 12-1 to 2-28 Drumming Log

Figure 1. Continued

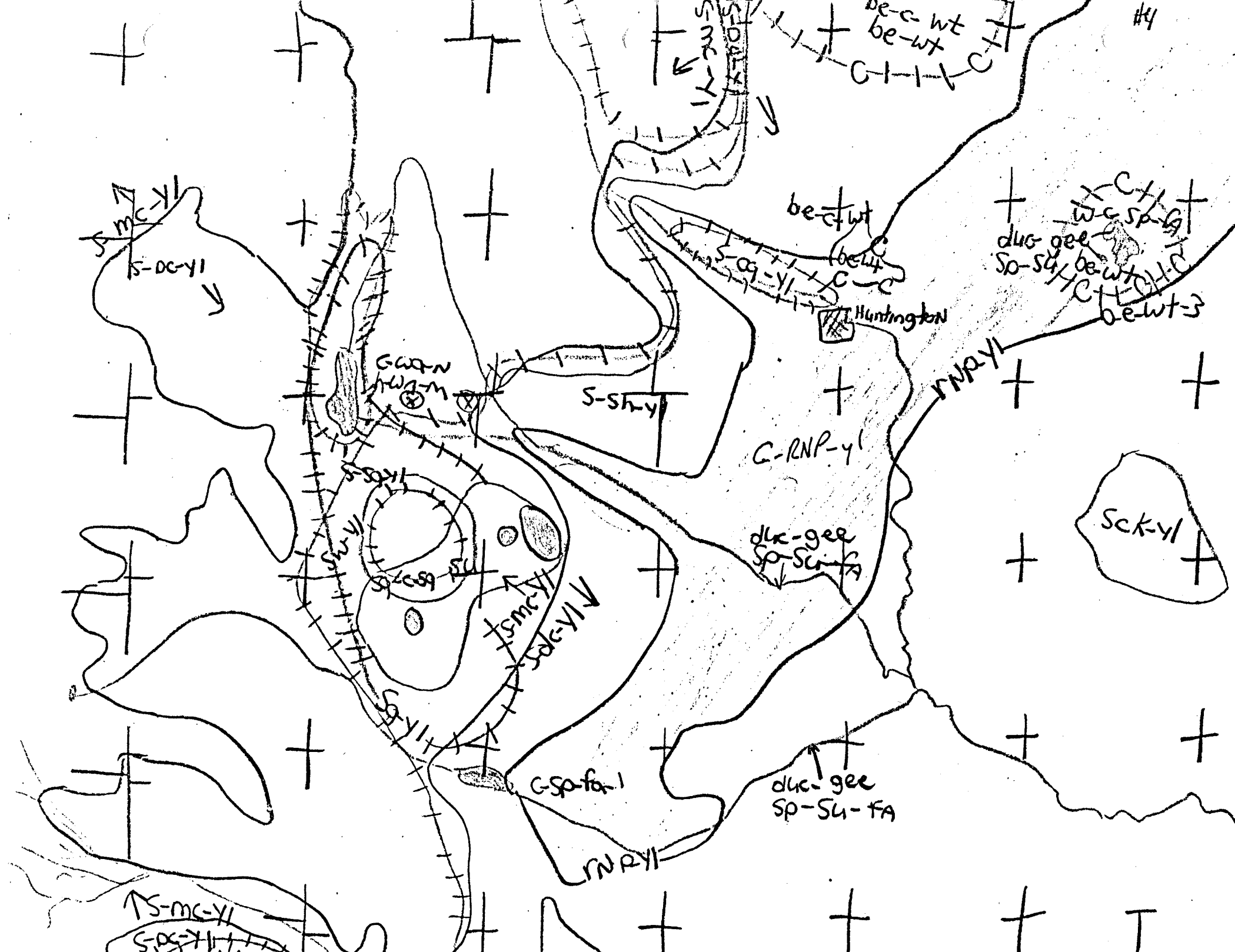
Wildlife Use Areas	Use Area Ranking		
	Substantial Value	High-Priority[2]	Crucial-Critical[2]
		Terrestrial Use Areas	
Sage Grouse	Population Distribution s-sa-yl	Summer Range s-sa-su 8-16 to 11-14	Strutting Grounds and associated brooding area c-sa-st,b 3-15 to 8-15 Winter Range c-sa-wt 11-15 to 3-14
Snowshoe Hare	Population Distribution s-sh-yl		Nesting Season (spruce-fir and lodgepole pine forests) c-sh-n 4-1 to 8-15
Waterfowl	Population Distribution (all wetlands, stream courses, ponds and lakes) s-wa-yl	Peak Migration (all wetlands, stream courses, ponds and lakes) h-wa-m 3-15 to 5-15 (spring) 8-15 to 10-15 (fall) Brooding and Mounting Season (all wetlands, stream courses, ponds and lakes) h-wa-bm 7-16 to 8-15	Nesting Season c-wa-n 3-15 to 7-15

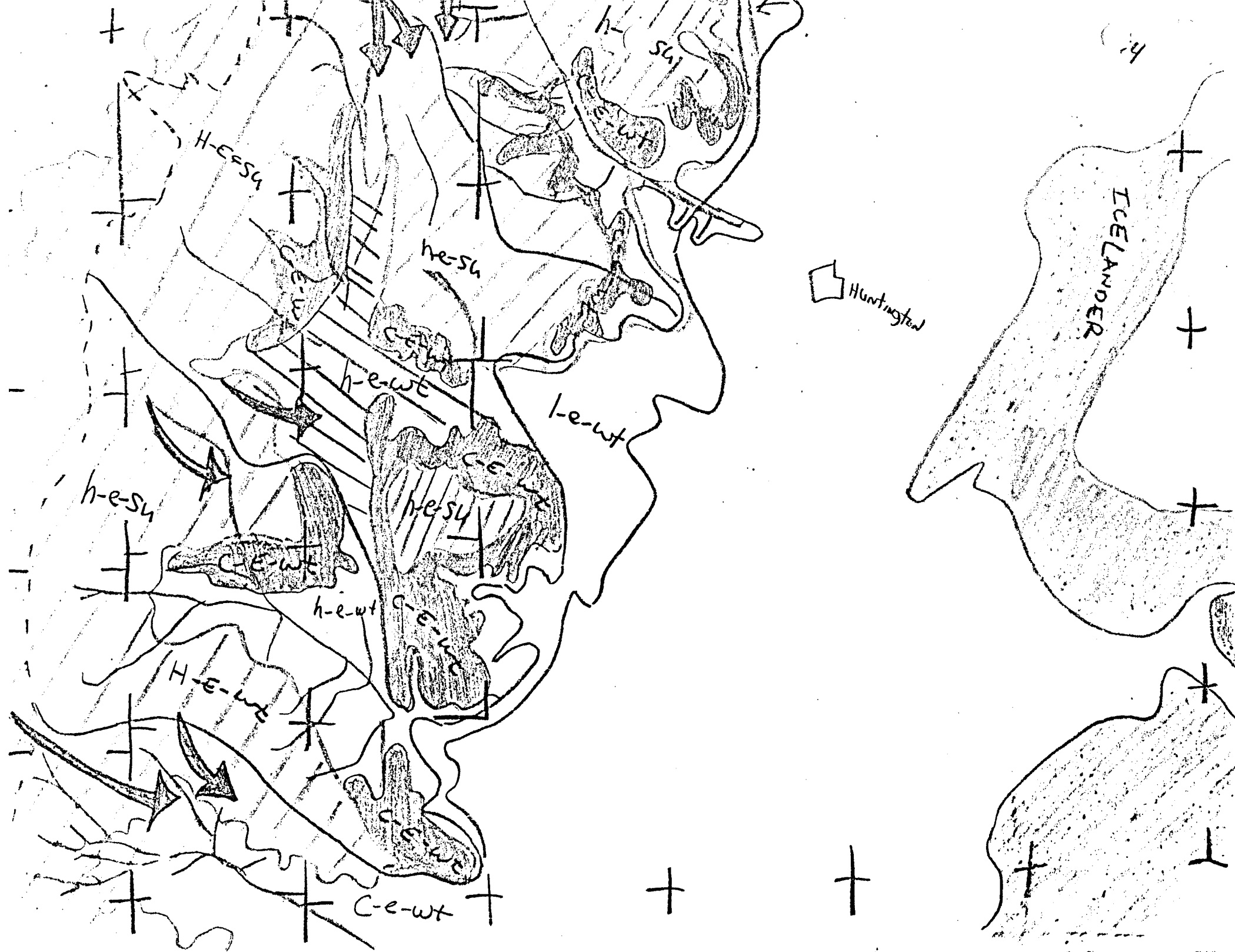
Figure 1. Key for mapable, high-value habitat use areas for wildlife.

Wildlife Use Areas	Use Area Ranking		
	Substantial-Value	High-Priority[2]	Crucial-Critical[2]
	Terrestrial Use Areas		
Vultures, Accipiters, Buteos (Hawks only), Herriers, Osprey, Merlin, American Kestrel and Owls	Population Distribution (The entire area provides habitat use areas for several species.)	Breeding Territory Surrounds an aerie site	Aerie Site Species specific symbols identified on map-protection needed in 0.25 mile radius buffer zone when in use.
Golden Eagle (common year-around resident)	Population Distribution (The entire area provides habitat use areas for this species.)		Aerie Site ⊗ 2-15 to 6-15
Bald Eagles	Winter Distribution (Entire area between 11-15 and 3-15 each year)	Winter Concentration h-be-wt 11-15 to 3-15	Roost Tree X 11-15 to 3-15
Cliff Nesting Falcon			Aerie Site ⊗ 3-1 to 6-30

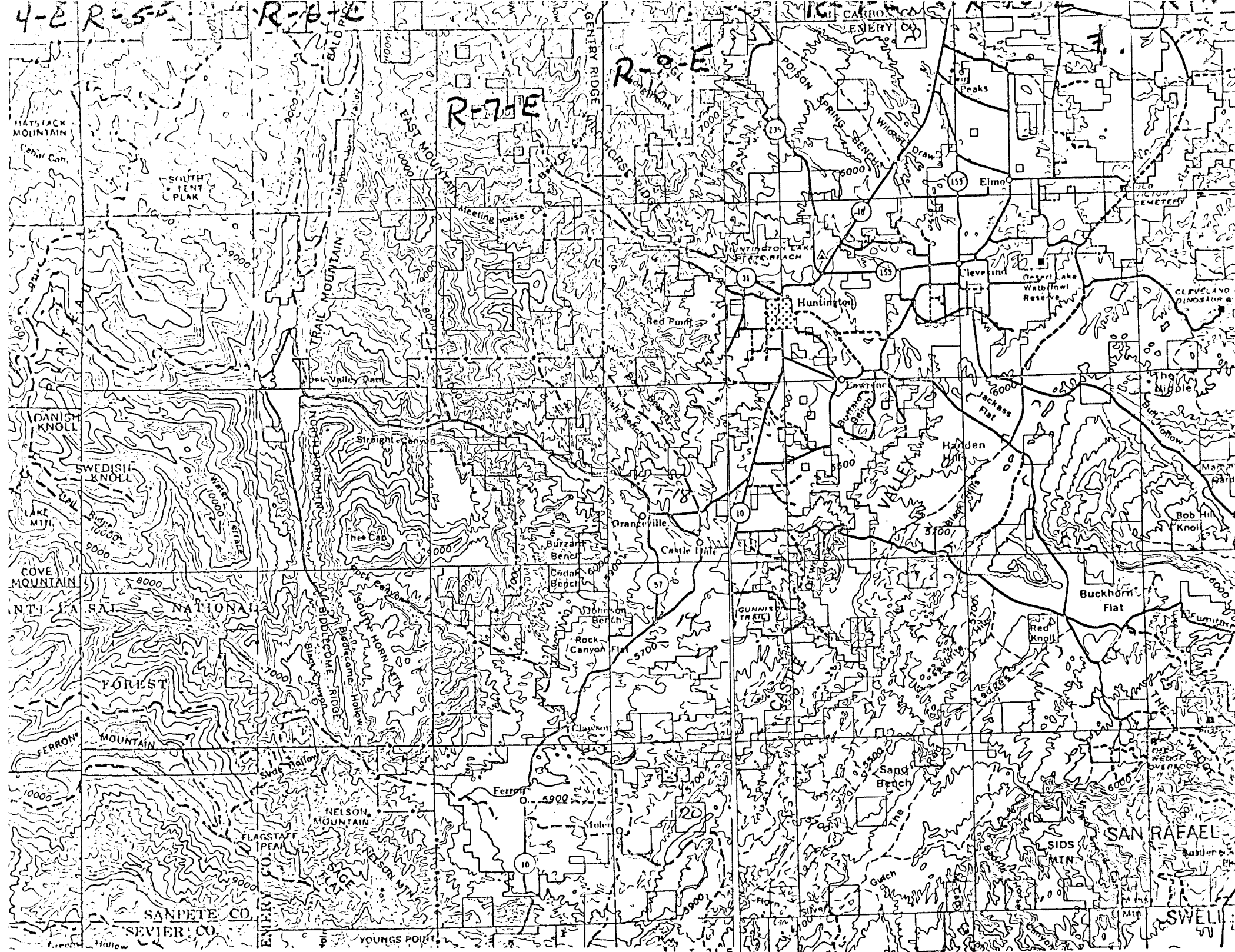


14
H-D-SH
35
C-D-WT
H-D-SH
C-D-WT
h-d-WT
h-d-SH
C-D-WT
h-d-WT
h-d-YL
h-d-YL
h-d-YL
H-D-SH
Herd
36
d-WT


#4
be-c-wt
be-wt
C
S-mc-yl
S-DC-yl
be-c-wt
S-cg-yl
Huntington
duc-gee
Sp-Su
be-wt-3
rNP-yl
C-wa-N
wa-M
S-Sh-yl
C-RNP-yl
S-Sg-yl
Sw-yl
Sp-c-Sg
Su
S-mc-yl
S-dc-yl
Sg-yl
duc-gee
Sp-Su-FA
Sck-yl
C-Sp-fa-1
duc-gee
Sp-Su-FA
rNP-yl
S-mc-yl
S-DC-yl



h-sh
c-e-wt
H-e-sh
h-e-sh
c-e-wt
h-e-wt
l-e-wt
c-e-wt
h-e-sh
h-e-sh
c-e-wt
h-e-wt
c-e-wt
H-e-wt
c-e-wt
c-e-wt
Huntington
ICELANDER


4-E
R-5-E
R-6-E
R-7-E
R-8-E
CARBON CO.
EMERY CO.
GENTRY RIDGE
POISON SPRING BENCH
Wildcat Draw
Peaks
Elmo
HAYSTACK MOUNTAIN
SOUTH TENT PEAK
EAST MOUNTAIN
Meetinghouse Cr.
TRAIL MOUNTAIN
HUNTINGTON LAKE STATE BEACH
Huntington
Cleveland
Desert Lake Waterfowl Reserve
Red Point
Lawrence
Jackass Flat
Hayden Hills
The Nipple
Bull Hollow
Bob Hill Knoll
DANISH KNOLL
SWEDISH KNOLL
LAKE MTN.
Straight Canyon
NORTH HORN MTN.
The Cap
Orangeville
Castle Dale
Burzant Bench
Cedar Bench
Johnson Bench
Rock Canyon Flat
Buckhorn Flat
Red Knoll
COVE MOUNTAIN
NATIONAL
FOREST
SOUTH HORN MTN.
BIDDLECOME RIDGE
Biddlecome Hollow
GUNNISON TRAIL
CASTLE VALLEY
Clawson
FERRON MOUNTAIN
Slide Hollow
Ferron
Molen
NELSON MOUNTAIN
FLAGSTAFF PEAK
SAGE FLAT
NELSON MTN.
Sand Bench
SIDS MTN.
SAN RAFAEL
SANPETE CO.
SEVIER CO.
YOUNGS POINT
SWELL

EMERY MINING CORPORATION

A SAVAGE BROTHERS COMPANY

Dec. 23, 1980

Mr. John W. Barton
US Department of Labor
Mine Safety and Health Administration
P.O. Box 25367 D.F.C.
Denver, Colorado 80225

Re: Deer Creek Mine
ID No. 42-00121
Roof Control Plan

Dear Mr. Barton:

We are submitting our roof control plan for review by MSHA as required by section 75.200, 30 CFR 75. If you have any questions please feel free to contact Evert Winder of our office at 687-9821.

Sincerely,

John Ruszkowski

JR:gl

Date December 22, 1980

ROOF CONTROL PLAN

General Information

A. This plan contains the minimum roof control measures to be used and is formulated for normal roof conditions and the mining systems described. In active working areas where subnormal roof conditions are encountered, indicated or anticipated, additional roof supports will be installed as necessary. All provisions of this plan will be fully explained to all workmen whose duties require them to be in a "working section"; such training will be conducted within three weeks after approval of this plan has been received. Before a person is assigned the sole responsibility of installing roof supports, such person shall receive training from a competent, fully-trained person who is familiar with the contents of the roof control plan and the mining systems used. All new underground employees will have the hazards of mine roof, face and ribs and the contents of the approved roof control plan explained to them before they begin work.

B. Company Emery Mining Corporation

Address Huntington (City) Utah (State)

C. Mine Deer Creek I.D. No. 42-00121

Mine Location

Huntington (City) Emery (County) Utah (State)

D. Location (reference to nearest highway route, direction and distance)

Eight (8) Miles Northwest Off Route No. Utah #10

E. Type(s) of Plan Full Bolting

F. Area(s) of mine covered by the plan Entire Mine

G. [signature] (Company Official's Signature) [signature] (Title) 12/23/80 (Date)

Signature of Miner(s) with whom plan was discussed — Date

Roof Control Investigator

Approved By — Date

Title

H. Maximum cover: 2,000 Feet

Main Roof	Sandstone and shale
Immediate Roof	Sandstone or shale or slate or enough top coal to prevent spalling of shale or slate due to air slack
Coal bed	12' average Blind Canyon Seam
Bottom	Coal or fire clay

I. ROOF SUPPORT MATERIALS

All components of the roof bolt assembly shall comply with the American National Standards Institute "Specifications for Roof Bolting Materials in Coal Mines."

J. ROOF BOLTS

Manufacturer: Birmingham Bolt Co. Bethlehem Steel Co. or an equivalent approved bolt

Manufacturer's Designation: 1040 High Tensile

Minimum Length: 30"

Diameter: 3/4" High Strength 5/8" High Strength

Type Steel: 1040 High Tensile

Type Thread: Rolled or cut

Length of Thread: 4" Minimum

Type Head: Standard (Standard, Self-Centering, Cone Neck)

Dimensions of Bolt Head: Nut 15/16 x 1-1/8

Flange: (1 1/2") Diameter

K. BEARING PLATES

Manufacturer: Birmingham Bolt Co. Bethlehem Steel Co. or an equivalent approved plate

Manufacturer's Designation: 1040 High Tensile

Dimensions: 6" x 6" x 3/16" square or 6" x 18" x 1/4"

Shape: Embossed (Donut Embossed, Bell Embossed, Flat)

Center Hole Size: 1" Maximum

L. WASHERS

Manufacturer DNA — Manufacturer's Designation DNA

Type Steel* Hardened — Size 1-1/2" Minimum

*Washers shall be through hardened to a hardness of 35 to 45 as measured on the Rockwell C Scale.

Shape Round or Square — Hole Size 1" Maximum

M. ANCHORAGE UNIT

Manufacturer Birmingham Bolt Co. Ohio Brass Co. or an equivalent approved unit — Manufacturer's Designation B-Bail "O-B" 22378

Type Bail — Size ±.030" — Finishing Bit 1-3/8" Dia. minus zero

(Finishing bits shall be easily identifiable by sight or feel.)

Installed Torque 175 to 240 ft. lbs.

N. MATERIALS USED IN CONJUNCTION WITH ROOF BOLTS

Steel Mats (16 gauge with at least two corrugations)

Cottonwood Header Boards (2" x 8" x 12" Minimum) - Need not be treated.

Prior approval shall be obtained before making any changes in the material listed.

O. ROOF SUPPORT MATERIAL - CONVENTIONAL OR TEMPORARY AND SUPPLEMENTAL

Dimensions of Post: The length of post shall be as required and the diameter must be at least 1 inch for each 15 inches in length but not less than 4 inches. Split posts shall have a cross-sectional area equal to that required for round posts of equivalent length. Smaller posts may be used provided they are set in clusters to provide equivalent support.

Type of Post: Round or split of solid, straight-grain wood with the ends sawed square and free from defects which would affect their strength.

Cap Blocks,* size and shape: Cap blocks and footers shall have flat, paralleled sides and be not less than 2" x 4" x 12" minimum in size

Wedges, size and shape: 1/0" x 3½ x 10" Minimum

Crossbars,* type and size: Crossbars shall be of straight grain, solid wood and they shall be not less than 3 inches thick by 8 inches wide of varying length.

Planks,* size: A minimum of 1 inch thick by 8 inches wide of varying length.

Cribbing Blocks, size and shape: Cribbing blocks shall have flat, paralleled sides and be not less than 30 inches in length.

other than cottonwood

*Note: Where wood material/is used between roof bolt bearing plates and the roof for additional bearing surface, the use shall be limited to short life openings (not to exceed 3 years) unless treated.

ROOF SUPPORT MATERIALS FOR RESIN-GROUTED RODS

Rods

Manufacturer: Birmingham Steel Co.
Mikco Industries of Utah, Inc.
or any other approved rod.

Manufacturer's Designation: Rebar.

Minimum Length: 48 inches

Diameter: 3/4 inch

Type Steel: 70,000 lbs/in^2 min. break load

Type Head: Standard

Minimum Yield: 43,000 lbs/in^2 min. yield load

Dimensions of Rod: Head .476" x 1-1/8" Flange 2-1/4" dia.

Bearing Plates

Dimensions: 6" x 6" x 1/4" square or 6" x 18" x 1/4"

Shape: Embossed

Center Hole Size: 1-1/8" max.

Resin

Manufacturer: Dupont
Celtito
Carboloy

Manufacturer's Designation: Fasloc
Res-Lock Resin

Type: Polyester Resin and Catalyst

Size of Finishing Bit: 1" +0 -.030

Prior approval shall be obtained before making any changes in the materials listed.

P. FACE EQUIPMENT AND SECTION HAULAGE EQUIPMENT ASSOCIATED WITH EACH:

1. One Joy 12 CM Miner
2. Two Joy 10 SC Shuttle Cars
3. Two Long Airdox Feeder Breakers
4. One Lee Norse Twin Boom Roof Bolter
5. One S&S Scoop
6.

Q. SEQUENCE OF MINING AND INSTALLATION OF SUPPORTS, INCLUDING TEMPORARY SUPPORTS: Drawings shall be attached showing the maximum width of entries, rooms, intersections, crosscuts, and (if applicable) pillar splits; the sequence of support installation, including temporary supports; the spacing of supports; and, where applicable, the sequence of mining pillars, including cut sequence in those pillars necessary to establish a uniform pillar line that eliminates pillar points and pillars that project inby the breakline.

SIGHT LINES SHALL BE ESTABLISHED TO ASSURE THAT MINING PROJECTIONS IN ENTRIES, ROOMS, CROSSCUTS, AND PILLAR SPLITS ARE FOLLOWED.

Entry Width 20 feet maximum, except 24 feet where belt & track are combined & LW set up entry Centers 50 feet to 150 feet

Crosscut Width 20 feet maximum Centers 50 feet to 150 feet

Room Width 20 feet maximum Centers 40 feet to 150 feet

Room Crosscut Width 20 feet maximum Centers 40 feet to 150 feet

Slope Width (anthracite) DNA

Gangway Width (anthracite) DNA

MINING ADVANCE CYCLE

A committee will be formed to conduct an evaluation on each section in the mine. This evaluation will determine and designate the length of the miner cut as to whether it will be on the 60-40 foot cut plan or less than 60-40. This evaluation will be written up in a book and will be made available for examination by interested persons. The evaluation will be preformed as necessary when mine conditions change that could affect our length of cut.

The evaluation committee will consist of the following people:

Evert Winder	Director of Health & Safety
Morgan Moon	Director of Engineering
John Ruszkowski	Mine Manager, Deer Creek Mine
James Atwood	Mine Superintendent, Deer Creek Mine
Jerry Olsen	Safety Director, Deer Creek Mine
Bert Wilde	Mine Foreman
Bud Critchlow	Mine Foreman

If cap rock is the immediate roof, miner advance shall be limited to 20 feet. If the cap rock is taken down or a minimum of 12 inches of top coal is left, a maximum advance of 60 feet or 40 feet is permitted in the entries or crosscuts prior to roof bolts being installed. If the entries advance 60 feet, the crosscuts may advance 40 feet; if the entries advance 40 feet, the crosscuts may advance 60 feet. During any advance temporary support shall be installed on 5-foot centers and be maintained to within 15 feet of the working face.

LEE NORSE ROOF BOLTERS
AUTOMATED TEMPORARY ROOF SUPPORT
SAFETY PRECAUTIONS

Automated temporary roof support systems shall be used in lieu of conventional temporary supports at all times where they will reach the roof, and the following safety precautions will apply:

1. Upon completion of the loading cycle, a reflectorized warning sign such as "STOP" or "CAUTION - UNSUPPORTED ROOF", etc., or at least one temporary support placed at the last permanent support, shall be provided to warn persons approaching the area it is not permanently supported, and such signs, etc. shall remain in place until installation of permanent supports is started.

2. The controls necessary to position the automated roof supports will be operated from under permanently supported roof and automated temporary roof supports shall be placed firmly against the roof not more than five feet inby the last row of roof bolts before any person proceeds inby permanent supports.

3. Holes will not be drilled or bolts installed unless the automated temporary supports are in contact with the roof or at least three conventional temporary supports on not more than five-foot centers are installed.

4. This automated support system will be used in all working sections and falls or construction areas where it can be used safely and correctly.

5. A check valve or equivalent protection shall be incorporated in the automated temporary support system to eliminate the danger of collapse through sudden loss of oil due to a broken hose.

6. Two temporary support systems are provided on each roof bolting machine and each is capable of supporting a minimum of 16,000 pounds vertical load.

7. At least two safety jacks shall be provided on each roof bolting machine to be used when unusual or adverse roof conditions are encountered and the automated temporary support does not provide adequate protection for the operator. Timber may be used in place of safety jacks if height requires.

8. Where roof bolts are being installed in an area where roof failure is indicated, the spacing on roof bolts being installed shall be reduced to four-foot centers. Where crossbars are being installed, they shall be moved into place and secured against the roof with the automated support system before persons proceed inby permanent supports to install legs under the bars.

9. No one shall proceed inby the automated support system unless a minimum of two temporary supports are installed not more than five feet apart and within five feet of permanent support, face or ribs and the work is done between such supports and/or the nearest face or rib.

10. Header sets may be used during the mining cycle to increase the length of the miner run. See Exhibit "D" - Figure 1. Where drummy or adverse roof conditions exist, header sets will not be used.

SAFETY PRECAUTIONS - FULL ROOF BOLTING

1. Roof bolting is done throughout the mine and installed in the pattern and spacing outlined in Exhibit "B" or Exhibit "C" - Figure 2.

2. A calibrated torque wrench that will indicate the actual torque on the roof bolt by a direct reading shall be provided and maintained operable on each roof bolting machine in operation.

3. After the first row of bolts is installed in each place, at least one bolt by each operator shall be tested, and thereafter, at least one roof bolt out of every four shall be tested by a qualified person. If the majority of the installed torques fall outside the recommended range, the remaining roof bolts installed during the bolting cycle shall be checked.

   If the majority of the roof bolts fall outside the torque range, necessary adjustments shall immediately be made. If, after adjustments are made, the required torque ranges are still not obtained, supplementary supports such as different length roof bolts with adequate anchorage or posts, cribs, etc. shall be installed.

4. During each 24-hour period, in a place that has been utilized for coal production, spot check torques on at least 10 percent of the roof bolts from the outby corner of the last open crosscut to the face shall be made and recorded. The record shall show the number of bolts tested and the number above and below the required range. If the majority of the bolts in any working place are not maintaining at least 125 foot-pounds of torque, plates against roof, or 90 foot-pounds, plate against wood, or have loaded to where they exceed 350 foot-pounds of torque, supplementary supports such as different length roof bolts with adequate anchorage, posts, cribs, etc. shall be installed. Until such supplementary supports are installed, the place shall be dangered off.

5. In active working places during any shift that roof bolts are being installed, at least one test hole shall be drilled to a depth of at least 12 inches above the anchorage horizon of the bolt being used, to evaluate the nature of the strata. Such test holes shall be identified in a manner that will distinguish them from other holes in the normal pattern. If the test hole indicates that the strata has changed to where it could affect anchorage ability of the roof bolts to support the roof, then adequate supplemental roof supports will be installed.

6. Roof bolts installed in the normal pattern according to the approved plan will not be used as an anchor point.

7. A scaling bar of suitable length and design will be provided on all mobile face equipment except haulage equipment. The minimum length of the bar will be four feet.

8. A suitable roof-sounding device will be provided on all mobile face equipment except haulage equipment. The scaling bar may be used for this purpose.

9. An emergency supply of supplementary roof support material consisting of 20 roof bolts at least 12 inches longer than the bolt length normally used, and a minimum of 20 posts of proper length with sufficient cap pieces and wedges, will be provided within 100 feet of the dumping point in any direction or within 500 feet of the working faces, whichever is closer. Tools and equipment necessary to install such supports shall be available within the area specified. The provision for longer roof bolts does not apply when resin bolts are used.

10. (a) During development, mine openings will not be cut through into areas that are not totally supported by permanent supports installed on pattern as required by the approved plan.

    (b) When a mine opening holes into a permanently supported entry, room, or crosscut, no work shall be done in or inby such intersection until the new opening is either permanently supported as indicated in the approved plan or timbered off with at least one row of posts on not more than five-foot centers across the opening.

11. Sidecuts shall be started only in areas that are supported with permanent roof supports. Where sidecuts are made both left and right, the left cut will be made first and one row of temporary supports shall be installed across the opening on five-foot centers prior to starting the right sidecut. See Exhibit "D" - Figure 2. No work will be done inby the intersection before the sidecuts are roof bolted.

12. (a) When crossbars are installed, they will be installed so that the load on the support is equally distributed.

    (b) On mobile equipment haulageways, all crossbars or beams will be installed with some means of support that will prevent the crossbar or beam from falling in the event the supporting legs are accidently dislodged. On track haulageways, this requirement shall be complied with no later than the first weekend following the initial installation of the crossbars or beams. Item (b) does not apply when header sets are installed during the mining cycle.

13. Conventional supports are installed in the pattern and spacing outlined in Exhibit "A"; Exhibit "C" - Figures 1 and 3; Exhibit "D" - Figures 1 and 2; and Exhibit "H" - Figures 2, 3 and 4.

14. Posts shall be installed tightly and on solid footing with a cap piece between the post and the roof, and only two wedges will normally be used to tighten such posts. A cap piece may be used on top and bottom of posts when conditions warrant.

SAFETY PRECAUTIONS FOR TEMPORARY SUPPORTS AND REHABILITATION WORK

1. Where roof falls have occurred and at all overcasts, boom holes, and other construction sites that require removal of mine roof material (e.g. by blasting, by cutting with a continuous mining machine, or any other means), the roof shall be considered unsupported. If miners are required to enter such areas, the roof shall be supported adequately. A written plan shall be drawn up and posted at the scene of such unsupported roof incorporating the following procedures:

   (a) Such work will be conducted under the constant supervision of a company official unless the workmen are experienced in such work.

   (b) Conventional supports shall be installed as needed near the edge of the area before work is started.

   (c) If the roof bolting machine does not have automated temporary support or the automated support will not reach the roof, adequate temporary supports shall be installed in the area where roof bolts are to be installed. At least three such supports shall be installed on not more than five-foot centers and shall be within five feet of permanent supports. Such supports shall be advanced as roof bolting progresses (see Exhibit "J").

   (d) The loading of fallen roof material will always be done with the machine operator under supported roof.

2. All roof falls in active areas that are not cleaned up shall be posted off at each entrance to the area by at least one row of posts (or the equivalent) installed on five-foot centers or be barricaded and danger signs posted at least 20 feet outby all entrances to the area.

3. Before any persons proceed inby permanent supports to install temporary supports, thorough visual examination of the unsupported roof and ribs shall be made. If the visual examination does not disclose any hazardous conditions, persons proceeding inby permanent supports shall do so with caution and shall test the roof by the sounding method as they advance into the area. At no time will the person making the examination proceed more than five feet inby permanent or temporary supports.

4. Roof falls in active areas which are not cleaned up may be supported with posts to provide a travelway over such falls. At least two rows of posts shall be installed on not more than five-foot centers over such fall areas. If travelways are provided alongside a fall area, one row of posts on five-foot centers will be installed and such posts shall be maintained within five feet of the rib at all times.

SAFETY PRECAUTIONS FOR PILLAR RECOVERY

1. Pillar splits will be supported in accordance with the regular roof bolting plan. Pillar lifts made after the pillar is split are not bolted.

2. During pillar recovery, breaker posts and roadside radius (turn) posts will be installed as outlined in Exhibit "H" - Figures 2, 3 and 4, before mining operations in the corresponding cut are started.

3. Removal of breaker posts, turn posts, or other safety posts will be done under the direct supervision of the foreman in charge of the working section.

4. The sequence to be followed in normal pillar recovery is outlined in Exhibit "H" - Figures 1-A, 2, 3 and 4. The sequence may be deviated from, where adverse conditions make it impracticable to attack the pillars as indicated. Such deviation will be permitted only where equivalent support is maintained in the alternate method.

SAFETY PRECAUTIONS FOR RESIN-GROUTED RODS

1. All safety precautions required in the regular roof control plan will be followed, except the torque tests required for conventional-type roof bolts will not apply. If failure occurs, the bolting operation will discontinue until the reason for failure has been determined. If the reason for failure cannot be determined, changes in the roof bolting procedure will be made to adequately support the roof, or supplemental supports will be used.

2. Persons responsible for the installation of resin rods will be taught the installation procedures recommended by the manufacturer, including the safe handling precautions of the resin material.

3. Drill steels will be equivalent in length to the rods used or adequately marked to assure proper hole depth. Each drill hole will be filled the entire length with resin.

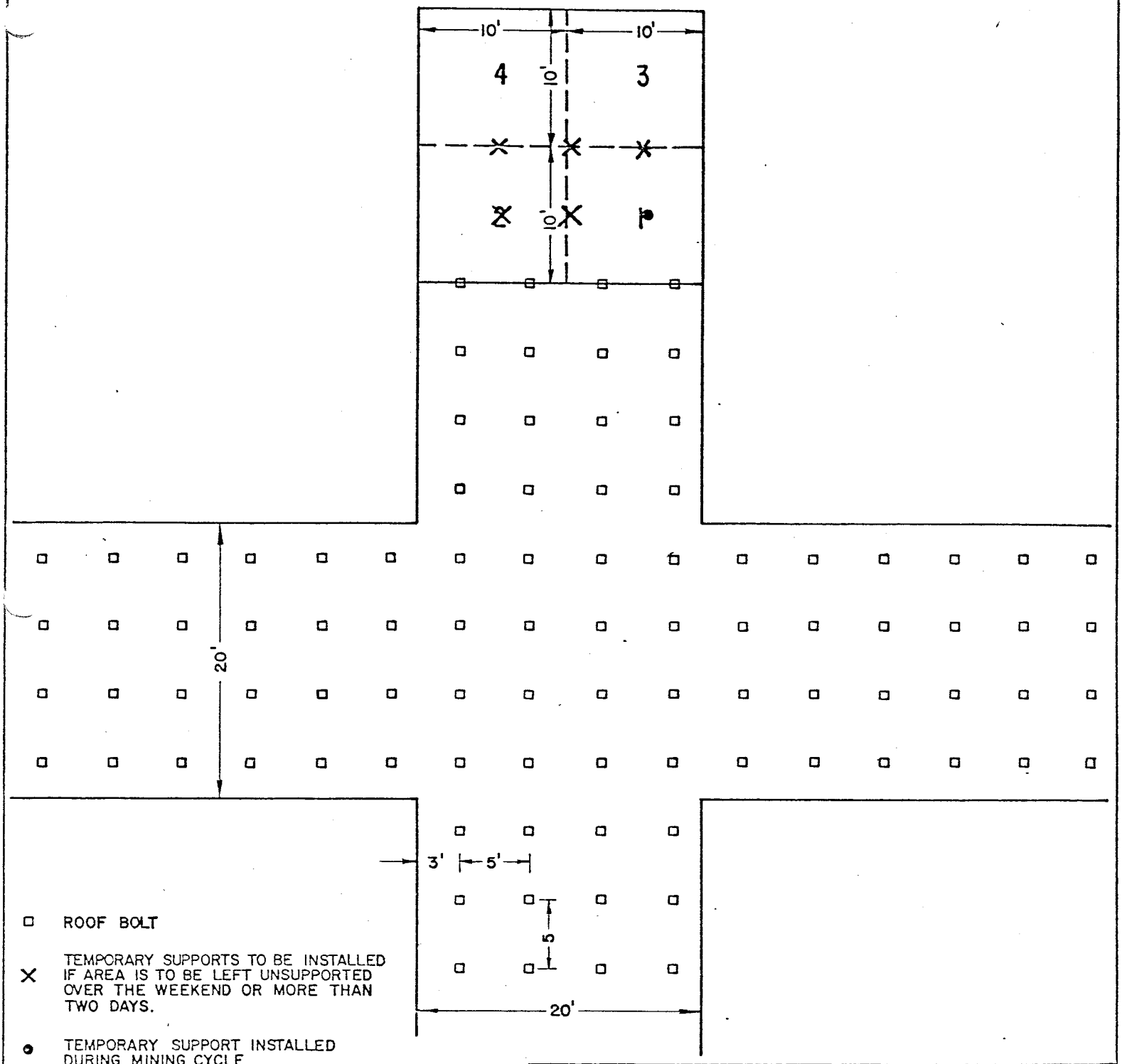
4. All resin-grouted rods will be used with bearing plates approved for use. The bearing plate or the wood material between the bearing plate and the roof will be tight against the mine roof.

5. Resin packages will be stored in an area where the temperature is within the range recommended by the manufacturer.

6. Broken cartridges or cartridges which show signs of deterioration will not be used and will be removed from the mine.

7. Resin-grouted rods and conventional roof bolts will not be intermixed during systematic bolting cycles, except that intermixing may occur in areas where supplementary supports are required.

8. Resin cartridges will not be used if the recommended shelf life has been exceeded, unless the manufacturer has made an inspection of the resin and extended the shelf life.



□ ROOF BOLT

× TEMPORARY SUPPORTS TO BE INSTALLED IF AREA IS TO BE LEFT UNSUPPORTED OVER THE WEEKEND OR MORE THAN TWO DAYS.

● TEMPORARY SUPPORT INSTALLED DURING MINING CYCLE.

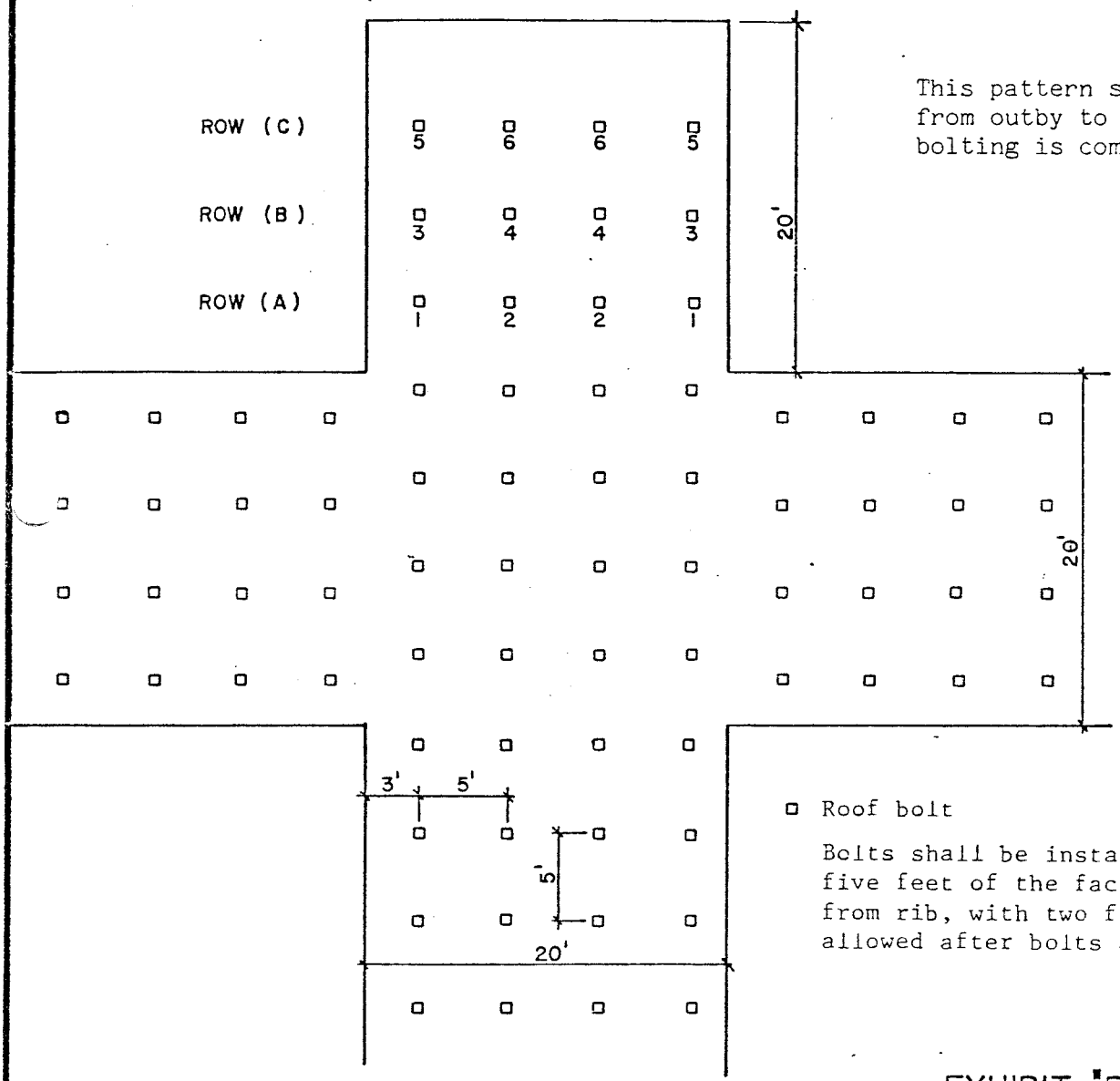
EMERY MINING CORP.

HUNTINGTON, UTAH 84528

FULL BOLTING PLAN
MINING SEQUENCE

MARK	REVISIONS	DATE

DRAWN BY:	APPROVED BY:	DRAWING NO.
B.L.P.		GENU-452 A
SCALE: 1" = 10'	DATE: 12/18/80	



This pattern shall be followed from outby to inby until bolting is complete.

□ Roof bolt

Bolts shall be installed to within five feet of the face and three feet from rib, with two feet of sloughage allowed after bolts are installed.

EXHIBIT "B"

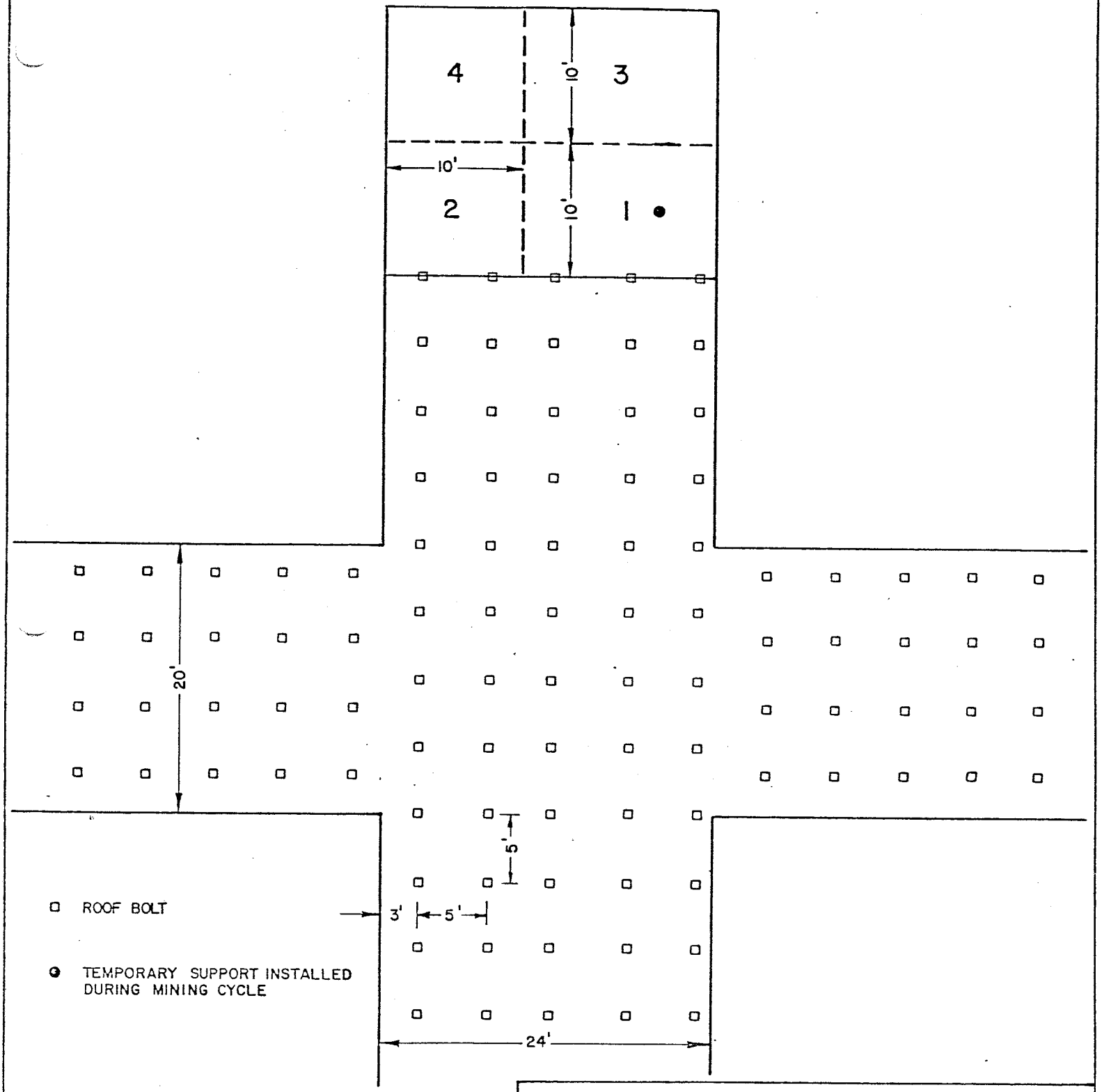
EMERY MINING CORP.

HUNTINGTON, UTAH 84528

FULL BOLTING PLAN
BOLTING SEQUENCE

MARK	REVISIONS	DATE

DRAWN BY: B.L.P.	APPROVED BY:	DRAWING NO. GENU-423A — SHT. 1
SCALE: 1" = 10'	DATE: DEC. 28, 1979	



EMERY MINING CORP.

HUNTINGTON, UTAH 84528

FULL BOLTING PLAN
24' ENTRY - COMBINATION BELT & TRACK
MINING SEQUENCE

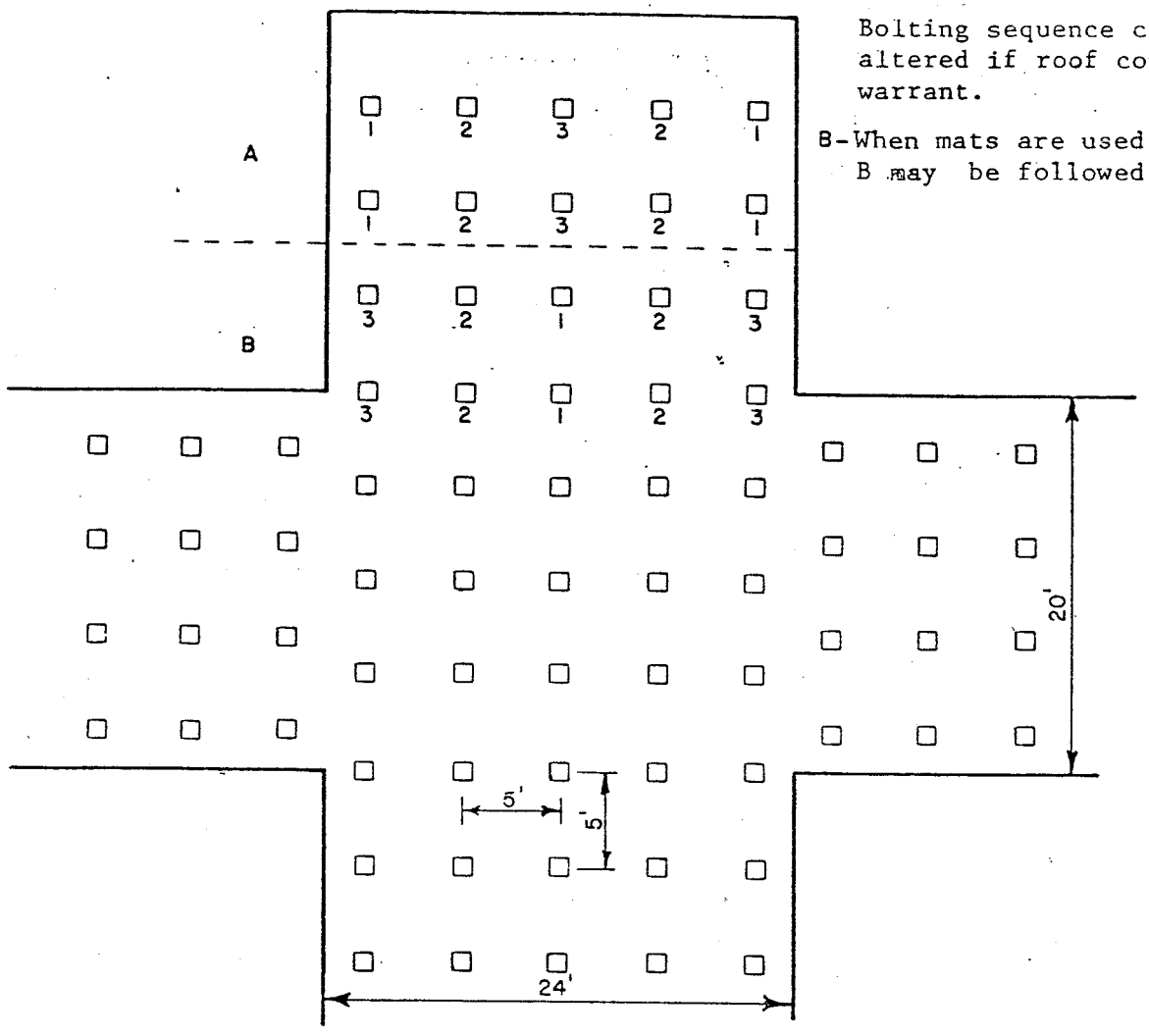
MARK	REVISIONS	DATE

DRAWN BY:	APPROVED BY:	DRAWING NO.
B.L.P.		GENU-452A
SCALE: 1" = 10'	DATE: 12/19/80	SHT. 2

A- Bolts shall be installed within three feet of ribs, with two feet of rib sloughage allowed after bolts are installed.

Bolting sequence can be altered if roof conditions warrant.

B- When mats are used sequence B may be followed.



☐ Roof bolt

EXHIBIT C - FIG. 2

EMERY MINING CORP.

HUNTINGTON, UTAH 84528

FULL BOLTING PLAN COMBINATION BELT & TRACK ENTRY

MARK	REVISIONS	DATE

DRAWN BY: B.L.P	APPROVED BY:	DRAWING NO. GENU-423 A SHT. 4
SCALE: 1" = 10'	DATE: FEB. 12, 1979	