FINAL RECLAMATION PLAN (UMC 784.13)

STRUCTURE REMOVAL

Following completion of mining, 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 on the bathhouse-warehouse pad 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

After mining has ceased and the surface structures have been removed the portals will be sealed with a double row of concrete block as shown on Figure 1. The backfilling will be done during the backfilling and grading step.

The portal entries are up dip and the mines are virtually dry, therefore, no hydrological seals are necessary.

BACKFILLING AND GRADING

General:

As structure removal is completed the backfilling and grading phase will begin.

All backfilled areas will be constructed in 18" maximum lifts. The lifts will be constructed with an 825C compactor with at least three passes to accomplish the compaction.

Maximum fill slopes will be 2H:1V.

Detailed scheduling and cost estimates follow. Equipment rental rates are taken from the rental rate blue book.

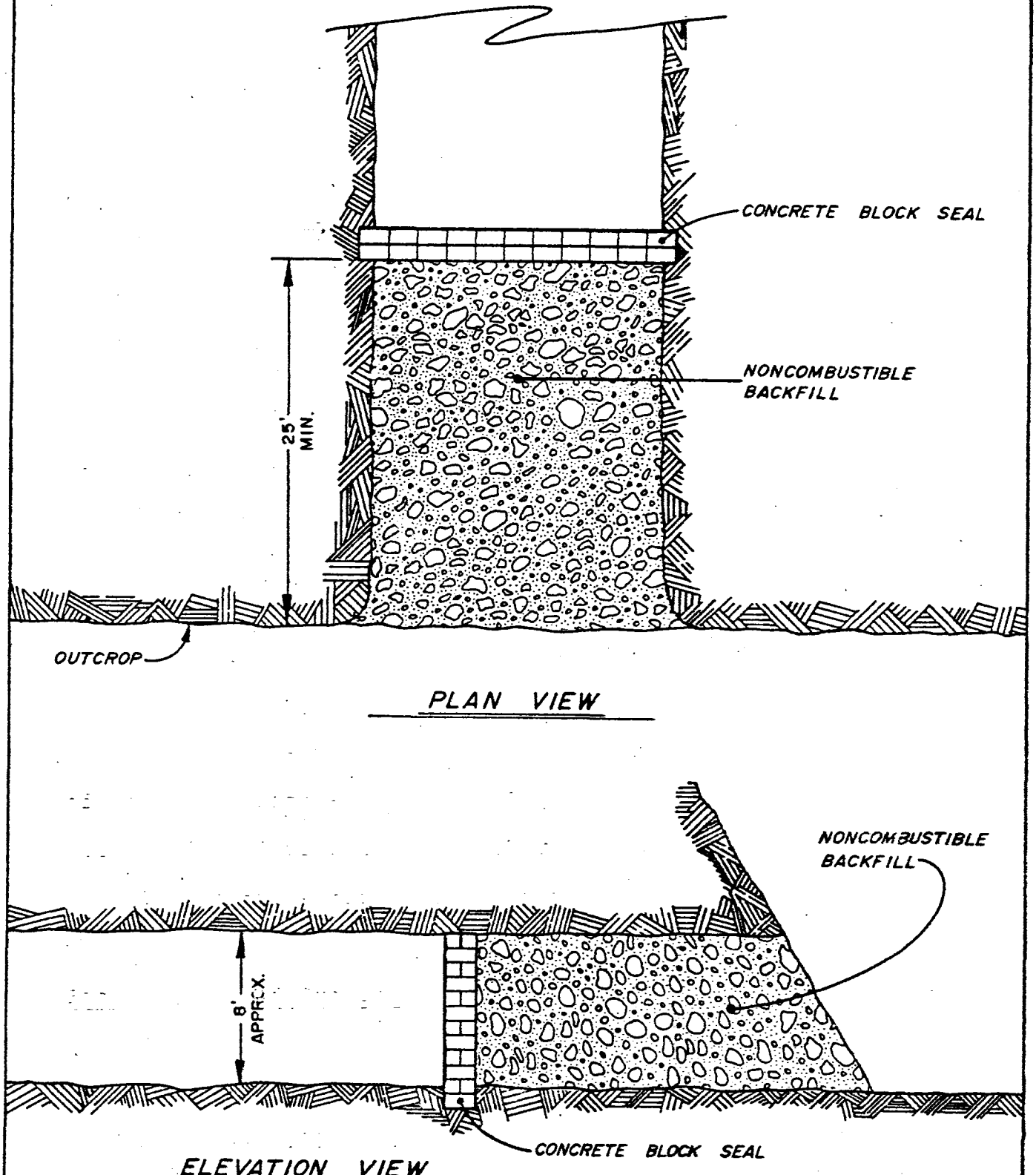


FIGURE 1

DES-BEE-DOVE COAL MINES EMERY COUNTY, UTAH		
TYPICAL PORTAL SEAL		
UTAH POWER & LIGHT COMPANY	SCALE: NONE	DATE: SEPTEMBER 2,1980 DWG. NO.: CM-10319-WB

Equipment productivity and haul cycles were calculated using the Caterpillar Performance Handbook. Costs are from the 1990 Rental Rate Blue Book.

The equipment used is listed below:

	Hourly Rate
988B Loader, 375 HP, 7 yd. bucket	$106.88
769C Off-Highway Truck, 35 Ton	74.62
825C Compactor, 300 HP	88.85
621B Scraper, 330 HP, 14 c.y.	84.59
D8G Dozer w/straight blade	63.00
235 Excavator, 195 HP, standard bucket	107.84
D6 Dozer w/angle blade	46.69
John Deere 500 Backhoe	22.30
Flat-Bed Truck, diesel, mediu, 250 HP	16.24
Dump Truck, 50 T, 773	84.39
Crane 50 T, diesel, hydraulic, Trk MTD	71.90
Air Drill, Track, IR DM25	90.09

The labor rates used are as follows:

Supervisor	$36.70/hr.
Operator - Heavy Equipment	34.20/hr.
Laborer	26.05/hr.
Truck Driver	27.05/hr.
Laborer (Wrecking)	28.85/hr.

The overall reclamation plan is to remove all fills from the canyon invert to original bedrock. This will form the permanent drainage diversion channel down to the tipple yard. Then, based on hydrological calculation, a channel will be built to bypass the tipple yard fill to a rip-rap fan that will carry the water off the fill down to original ground below the toe of the fill.

Beehive-Little Dove:

Material from the fill section of the pad will be used as backfill across the portal highwall of the Little Dove Mine. The fill will be constructed on a 2H:1V slope, 15 feet high (see

Quantity Summary sheet).

Parking Lot Extension:

The south addition of the parking area will be backfilled as shown on the typical cross-sections. Maximum slope 3H:1V. The remaining fill from the Little Dove-Beehive area plus material from the Deseret pad fill area will be used.

Asphalt Removal (includes road base material):

The access road beginning where the road meets the tipple yard will be stripped of asphalt. Both parking areas will be stripped. This material will be placed and compacted against the highwall as shown on the appropriate cross-sections.

Bathhouse-Warehouse:

The fill section of the pad is to be pulled back and terraced as shown on the cross-sections. Additional material from the Deseret Pad and the #1 Stockpile Pad will be used to finish the fill as shown.

Diversion:

Two small diversion, A and B, and the large diversion is to be built as shown on the fill sections of the reclaimed areas to carry storm waters through the canyon.

It is estimated that 10% of the rip-rap needed for the diversion will be taken from the existing fills as they are pulled out. The remaining fill material will be purchased from local contractors. The gravel liners will be excavated from the roadbase and parking lot base. The clay liner will be purchased from local contractors.

Rip-rap Fan:

To carry the water from the fill down to the original ground a rip-rap fan will be built as shown. Material to build the fan will be hauled to the site by contractor.

SOIL STABILIZATION OF RILLS AND GULLIES

Rills and gullies, which develop to a depth of nine (9) inches or greater in areas that have been regraded and topsoiled, which disrupt the approved postmining land use, or reestablishment of the vegetative cover, or cause or contribute to violation of water quality standards for receiving streams, will be filled, regraded, or otherwise stabilized; topsoil will be replaced; and the areas will be reseeded or replanted. Based on our present maintenance program for fill slopes, we estimate 32 hours per year of work will be needed.

QUANTITIES SUMMARY SHEET

FINAL RECLAMATION BACKFILLING AND GRADING

Little Dove-Beehive Area #5		
Total Excavation		6,000 c.y.
Little Dove Highwall Embankment	3,677 c.y.	
Little Dove-Beehive Portals	900 c.y.	
10% Rip-Rap	600 c.y.	
Parking Lot Extension Embankment	823 c.y.	
Deseret Area #4		
Total Excavation		7,333 c.y.
Parking Lot Extension Embankment	4,274 c.y.	
Deseret Portals Embankment	900 c.y.	
10% Rip-Rap	730 c.y.	
Bathhouse-Warehouse Embankment	1,429 c.y.	
#1 Stockpile Area #3		
Total Excavation		6,525 c.y.
Bathhouse-Warehouse Embankment	5,869 c.y.	
10% Rip-Rap	656 c.y.	

(1)

Cottonwood/Wilberg/Des Bee Dove Haul Road

General:

This reclamation plan deals with that portion of the road from station 122 + 50, junction with county road along Danish Bench, to station 242 + 50, junction with Cottonwood/Wilberg Haul Road. That portion of the road from station 122 + 50 to station 94 + 00 will be used by the County as part of the existing Danish Bench Road.

Final reclamation of this haul road is intended to re-establish the original drainage system to the area affected by the road construction.

Timing of the road reclamation will necessarily follow the sediment pond reclamation because this road will be needed for access to the pond site.

Reclamation Earthwork:

The first step of the reclamation process will be to remove the asphalt and road base material and deposit them at the north end of the project where they will be covered with 4 feet of soil recovered from the excavation for the drainage channels. The amount of asphalt and road base is calculated as follows:

Length of road to be reclaimed = 12,105 feet

Thickness of asphalt = 7.5 inches

Width of asphalt at mid depth = 36.7 feet

$$\text{Asphalt} = 12105 * \frac{7.5}{12} * 36.7 * \frac{1}{27} = 10{,}284 \text{ cyds}$$

Thickness of road base = 10 inches

Width of road base at mid depth = 43.1 feet

$$\text{Road Base} = 12105 * \frac{10}{12} * 43.1 * \frac{1}{27} = 16{,}103 \text{ cyds}$$

These materials will be placed between stations 123 + 50 and 141 + 00 which is 1750 feet. The average haul distance is 5078 feet with an uphill grade of 7.2% The distribution of these materials will be:

(10284 + 16103) ÷ 1750 = 15.08 cyds/ft

The next step will be to remove the culverts which will not be replaced with drainage channels. This consists of 800 feet of 24 inch culvert and 266 feet of 42 inch culvert.

The third step will be to reestablish the drainage channels, replacing the culverts and installing a rip-rap lining where required.

Backfill quantities are based on the typical cross-sections shown on Drawings CM-10601-DS, sheets 1 through 4, Plate 5-2. The following table gives the size of each channel and the excavation required along with the amount of material to be hauled and the distance and grade.

CHANNEL #	STATION #	CHANNEL WIDTH FT	EXCAVATION LENGTH FT	CHANNEL DEPTH FT	EXCAVATION VOLUME cyds	PLACEMENT LOCATION FROM STA. TO STA.	HAUL DISTANCE FT	GRADE
3	146+00	20	309	85	107,515	123+50 to 141+00	1375	+8%
4	156+50	12	226	57	10,656	148+00 to 151+60	670	+8%
					26,329	161+90 to 170+79	984	-8%
				SUB TOTAL	36,985			
5	161+00	8	126	17	2,560	170+79 to 171+65	1022	-8%
7	173+80	6	198	50	13,200	175+00 to 181+00	420	-1.9%
					10,893	182+00 to 186+95	1068	-7.1%
				SUB TOTAL	24,093			
8	181+50	6	96	10	838	186+95 to 187+33	564	-7.1%
10	201+00	12	199	50	25,579	187+33 to 198+75	796	+7.1%
11	206+90	4	119	9	611	198+75 to 199+03	801	+2.46%
12	213+85	8	114	7.5	552	199+03 to 199+27	1470	+2.46%
13	227+50	6	120	7	529	220+02 to 220+41	729	+2.46%
14	232+20	30	190	47	14,296	220+41 to 231+00	630	+2.46%
					11,475	233+00 to 241+50	505	-2.46%
				SUB TOTAL	25,771			
15	242+35	6	88	10	674	241+500 to 242+00	60	+2.46%

Revised 2/5/90
4-4.1.2

Drainage Reestablishment:

Hydrologic Analysis

The objective of the reclamation plan is to return the drainage pattern to as near the original scheme as possible. Reclamation of the haul road will require removal of the existing culverts and replacing them with ditches or channels designed to handle the anticipated peak flows with minimum erosion. All reestablished drainages are designed for the 100 year, 6 hour storm event, which is a total of 2.2 inches of precipitation (NOAA Atlas 2, Volume VI, Figure 24). The calculation of the peak flows is by the computer program "Storm Hydrograph Program", Richard H. Hawkins and Kim A. Marshall, Utah State University Foundation, Logan, Utah, 1979. (Exhibit I) The program has been modified to provide a more correct distribution of both the 6 and 24 hour storms according to the Soil Conservation Service (SCS) type II distribution. The program utilizes the SCS curve number and dimensionless unit hydrograph techniques as described in the SCS National Engineering Handbook, Section 4, Hydrology (NEH-4). The input data required for the program includes the area, curve number (CN), time of concentration (tc), duration and precipitation.

The area for each drainage basin was determined by planimeter. Curve numbers were determined from Figure 9.6 and Table 9.1 of NEH-4 and field inspection of the drainage areas. Refer to Drawings CS1130D, Plate 5-3, and KS1190C, Plate 5-3B, for drainage areas.

TABLE 1

DRAINAGE #	CN	BASIS FOR SELECTION
3	85	Appendix VIII PAP
4	83.5	1/2 10% Pinion Juniper Cover CN = 87 1/2 30% Pinion Juniper Cover CN = 80
5	80	30% Pinion Juniper Cover
6	76	40% Pinion Juniper Cover
7	80.8	1/4 10% Pinion Juniper Cover CN = 87 1/2 30% Pinion Juniper Cover CN = 80 1/4 40% Pinion Juniper Cover CN = 76
8	76	40% Pinion Juniper Cover
9	87	Reclaimed Road
10	79.6	1/3 10% Pinion Juniper Cover CN = 87 2/3 40% Pinion Juniper Cover CN =
11	73	50% Pinion Juniper Cover
12	73	50% Pinion Juniper Cover
13	73	50% Pinion Juniper Cover
14A	66	Area UA-1 Cottonwood/Wilberg PAP
14B	73	Area UA-6 Cottonwood/Wilberg PAP
14C	83.5	1/2 10% Pinion Juniper Cover CN = 87 1/2 30% Pinion Juniper Cover CN = 83
14D	87	10% Pinion Juniper Cover
14E	73	50% Pinion Juniper Cover
15	73	50% Pinion Juniper Cover

The time of concentration for each drainage area was determined using equation 15.3 and 15.4 of NEH-4 which apply to drainage areas less than 2000 acres.

$$Tc = \frac{T\ Lag}{0.6} \quad \text{Eq. 15.3}$$

$$T\ Lag = \frac{(L)^{.8}\ (S+1)^{.7}}{1900\ (y)^{.5}} \quad \text{Eq. 15.4}$$

Tc = time of concentration, hours
T Lag = lag time, hours
L = hydraulic length, feet
$S = \frac{1000}{CN} - 10$
y = slope, percent

The peak flow rate for Drainage Area #14 is determined by routing the peak flows from the 5 sub areas to the point where the channel will be reclaimed. To simplify the procedure, it is assumed that areas 14A and 14B discharge at a Point X (Drawing KS1190C, Plate 5-3B) and areas 14C and 14D discharge at Point Y and area 14E discharges at Point Z, which is the site of the reclaimed channel.

By examination of the flow rates for each drainage area, it is determined that because the peak flows from areas 14C and 14D are so much larger than the flows from the other areas, the combined peak flow will come from the peaks associated with areas 14C and 14D.

TABLE 2
flow rate, cfs

TIME	14A	14B	14C	14D	14E	ΣC+D	ΣA11
2.00	0	0	0	16	0	16	16
2.33	0	5	89	210	1	299	305
2.66	6	51	320	441*	9	761	827
2.75	9	66	374	411	11	785	871
2.85	12	85	415	344	14	759	870
2.96	17	108	431*	275	16	706	847
3.00	19	114	426	254	17	680	830
3.33	38	162	365	166	18	531	749

*Peak Flows

Refer to computer print outs, Exhibit II.

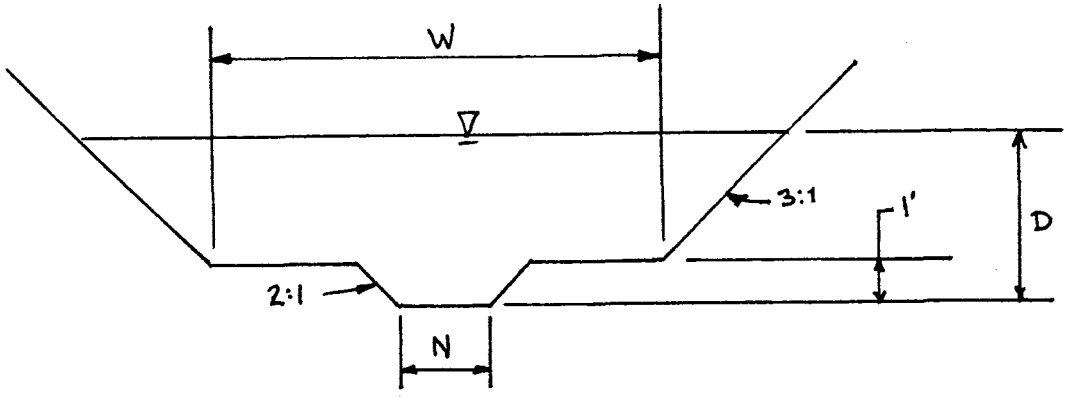
The travel time in the stream bed is estimated using Manning's equation:

$$V = \frac{1.49}{n} R^{2/3} S^{1/2}$$

where:

V = velocity, fps
n = Manning coefficient of roughness
R = Hydraulic radius = A/WP
A = Cross sectional area, ft^2
WP = Wetted perimeter, ft
S = Slope = Rise/Run

A typical cross section of the stream bed from Point X to Point Y has a narrow channel for normal flows within a wider channel for peak flows.



for $D \leq 1'$, $A = ND + 2*(1/2)*(2D)*(D)$

$= ND + 2D^2$

$WP = N + 2*(2.236)*D$

$= N + 4.472\ D$

for $D > 1'$, $A = N*(1) + 2*(1/2)*(1) + WD + 2*(1/2)*(3D)*(D)$

$= N + 1 + WD + 3D^2$

$WP = 2*(3.162)*(D-1) + W - (N+4) + N + 2*(2.236)*(1)$

$= 6.324D + W - 5.852$

Combining Manning's Equation with the equation for flow, Q=VA where Q equals the flow rate in cfs, yields:

$$Q = \frac{1.49}{n} \frac{A^{2/3}}{WP^{2/3}} S^{1/2} \quad A$$

$$Q = \frac{1.49 \quad S^{1/2}}{n} \quad \frac{A^{5/3}}{WP^{2/3}}$$

The above equation is solved for D by trial and error. Once the depth of flow is known, the travel time is determined by the following:

$$\text{travel time} = \text{flow length/velocity}$$

$$= \frac{\text{length}}{Q/A} = \frac{\text{length x area}}{\text{flow rate}}$$

The solution of the travel time along with the determination of the flow depth was obtained by a routine on a programable calculator. (Exhibit III) 4-4.35

By trial and error it was determined that the combined flow of areas 14A and 14B at 2.54 hours, which equals 35.2 cfs, would require 0.21 hours to travel the 5750 feet from Point X to Point Y and would arrive at 2.75 hours. This would combine with the flow from areas 14C and 14D to total 820 cfs. This combined flow would then travel the 7550 feet from Point Y to Point Z in 0.15 hours and arrive at 2.90 hours. At that point the 15 cfs flow from area 14E combines with the other to yield a peak flow at Point Z of 835 cfs.

Travel time calculations:

Point X to Point Y

length = 5750 feet
slope = 7%
wide channel width = 20 feet
narrow channel width = 5 feet

flow rate from areas 14A and 14B at 2.54 hours = 35.2 cfs
depth of flow = 0.715 feet
travel time = 0.209 hours

Point Y to Point Z

length = 7550 feet
slope = 4.8%
wide channel width = 25 feet
narrow channel width = 5 feet
flow rate from areas 14A, 14B, 14C, and 14D at 2.75 hours = 820 cfs
depth of flow = 1.70 feet
travel time = 0.146 hours

TABLE 3

DRAINAGE #	AREA ACRES	AREA MILES^2	L FEET	Y %	CN	tc	Q PEAK FLOW cfs
3	301	.47	7020	35	85	.361	235
4	44.2	.069	2610	68.1	83.5	.123	35.1
5	12.8	.02	1940	27.8	80	.171	7.5
6	4.5	.007	965	17.9	76	.137	2.0
7	60.8	.095	3526	32.8	80.8	.247	34.8
8	9.0	.014	1289	11.7	76	.214	3.5
9	5.1	.008	1724	6.7	87	.250	4.6
10	159	.248	5593	16.3	79.6	.526	59.1
11	15.4	.024	3086	6.2	73	.644	2.5
12	67.2	.105	4330	6.9	73	.800	10.1
13	42.2	.066	4046	5.4	73	.857	6.2
14A	1620	2.531	15530	16.0	66	1.763	98.1
14B	1396	2.181	13450	17.5	73	1.244	184
14C	1050	1.640	13550	21.4	83.5	.822	431
14D	599	.935	9300	30.3	87	.452	442
14E	124	.194	7000	12.5	73	.524	18.3
14	4789	7.481	-	-	-	-	835
15	52.5	.082	4767	5.5	73	.968	7.5

Refer to computer printouts, Exhibit II.

Channel Design

Each of the culverts to be replaced has a drainage basin associated with it which will contribute runoff to the proposed channels. Drawing CS1130D, Map 5-3, shows the location of each of the channels to replace the culverts. Channel numbers 1, 2, 6 and 9 are not used because they are not required to replace existing culverts. Drainage areas #1 and #2 will be diverted to channel 3 and runoff from drainage areas 6 and 9 will flow overland as it did before the road was constructed.

The length and elevation change of each proposed channel was obtained from Map 5-3 and was used to design the lining material. The design procedure comes from D. J. Barfield, R. C. Warner, and C. T. Haan, Applied Hydrology and Sedimentology For Disturbed Areas, Oklahoma State University, Stillwater, Oklahoma, 1981. A computer program was written utilizing the channel design - rip-rap linings section (page 185) of the book (Exhibit IV). A printout of each channel design is included in Exhibit V. Drawing CS1129C, Plate 5-3A compiles design parameters and rip-rap lining sizes for each of the channels.

Rip-Rap Lining Gradation

The chart on Plate 5-3A displays the maximum diameter of the rip-rap material for each drainage channel. This value is equal to D100 which is the particle size that is larger than 100% of the rip-rap material. In actual practice, very few pieces would be equal to the D100 size. The D50 size, or size which is larger than 50% of the material, is a more representative size. The rip-rap material will be selected to meet the following

conditions:

$$D50 = 1/2 * D100$$

$$D20 = 1/4 * D100$$

The tolerance to be used in the above is $\pm$ 5%, meaning D45 to D55 would be equal to 1/2 * D100.

A filter material is required where the size of the rip-rap is much larger than the base material. The filter material will be selected to meet the following conditions:

1) $\frac{D50\ (filter)}{D50\ (base)} < 40$ and $\frac{D50\ (rip\text{-}rap)}{D50\ (filter)} < 40$

2) $5 < \frac{D15\ (filter)}{D15\ (base)} < 40$ and $5 < \frac{D15\ (rip\text{-}rap)}{D15\ (filter)} < 40$

3. $\frac{D15\ (filter)}{D85\ (base)} < 5$ and $\frac{D15\ (rip\text{-}rap)}{D85\ (filter)} < 5$

SOURCE: BARFIELD, ET. AL., page 195

Tolerance $\pm$ 5%

Soil samples will be taken from the locations of the reestablished channels to determine the gradation of the base material. These tests results will be used with the above constraints to make the final selection of the filter material.

The depth of the rip-rap layer will be equal to the D100 size of the lining material. The filter layer thickness will be equal to one half the rip-rap layer thickness with a minimum of six inches.

```
1 CLS:REM    MODIFIED STORM HYDROGRAPH PROGRAM (CHANGED DATA LINES 150 & 160 TO
2 REM        CONFORM TO SCS TYPE II STORM)
4 REM        REVISED 3/14/89 TO GIVE MORE DETAILED RAINFALL DISTRIBUTION
5 REM        REVISED 6/28/89 ADDED 6 HOUR DISTRIBUTION
10 KEY OFF
20 SCREEN 2
30 DIM Y(3)
40 DIM Q(6)
50 DIM H(14)
60 DIM S(14)
70 DIM P(30)
80 DIM T(30)
90 DIM B$(3)
102 DIM G2(2289)
103 DIM G3(2289)
104 DIM G4(2289)
105 DIM G5(2289)
106 DIM G6(2289)
149 REM   SCS TYPE II DISTRIBUTION
150 DATA 0,0,8.333,2,16.667,5,25,8,33.333,12,41.667,18,43.75,20,45.83,23.5,47.92
,28.3,50,66.3
160 DATA 52.08,73.5,54.17,77.2,56.25,79.9,58.333,82,66.667,88,75,92,83.333,96,91
.667,98,100,100
161 REM
169 REM   FARMER-FLETCHER DISTRIBUTION
170 DATA 0,0,10,36.5,20,61.5,30,76.9,40,83.9,50,88,60,90.8
180 DATA 70,93.2,80,95.2,90,97.7,100,100
181 REM
184 REM   SCS 6 HOUR DISTRIBUTION
185 DATA 0,0,8.333,3.5,16.667,8,25,13.5,33.333,23,41.667,60,50,70
186 DATA 58.333,78,66.667,83.5,75,88.5,83.333,92.5,91.667,96.5,100,100
190 PRINT
200 PRINT TAB(13)"S T O R M  H Y D R O G R A P H  C A L C U L A T I O N S"
210 PRINT
220 PRINT TAB(17)"ENTER LISTED PARAMETERS"
230 PRINT TAB(19)"1. Watershed Identification"
240 PRINT TAB(19)"2. Runoff Curve Number"
250 PRINT TAB(19)"3. Time of Concentration (Hrs.)"
260 PRINT TAB(19)"4. Runoff Area (Sq. Miles)"
270 PRINT TAB(19)"5. Storm Duration (Hrs.)"
280 PRINT TAB(19)"6. Rainfall Depth (Inches)"
290 PRINT TAB(19)"7. Distribution (1=SCS Type II 2=Farmer-Fletcher 3=SCS 6 Hr.)"
300 PRINT: PRINT: PRINT
320 PRINT TAB(17)"SELECT OPTIONS"
330 PRINT TAB(19)"1. Output Format (1=Short 2=Long 3=Abbreviated)"
340 PRINT TAB(19)"2. Include Table No.? Y/N    Table No."
370 LOCATE 5,47: INPUT;"",A$
380 LOCATE 6,42: INPUT;"",C
390 LOCATE 7,51: INPUT;"",T9
400 LOCATE 8,46: INPUT;"",A1
410 LOCATE 9,44: INPUT;"",T8
420 LOCATE 10,46: INPUT;"",R
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430 LOCATE 11,80: INPUT;"",I1
460 LET B$(1)="SCS TYPE II"
470 LET B$(2)="FARMER-FLETCHER"
475 B$(3)="SCS 6 HOUR"
480 N=19                        :REM NUMBER OF DATA POINTS FOR SCS TYPE II DIST.
490 IF I1=1 THEN LET Z=1  :REM SCS TYPE II
500 IF I1=2 THEN LET Z=2  :REM FARMER-FLETCHER
505 IF I1=3 THEN Z=3      :REM SCS 6 HOUR
510 A=200/C-2
520 D=2*T9/15
530 T7=5*D
540 K=INT(T8/D+2)+15
550 IF I1=1 OR I1=3 THEN GOTO 600 :REM  IF SCS TYPE II OR 6 HR. SKIP TO LINE 600
560 FOR I=1 TO N        :REM   FOR F-F DIST., READ AND DISCARD FIRST SET OF DATA
570 READ T1,P1
580 NEXT I
590 N=11
600 LOCATE 13,17: PRINT"NUMBER OF LINES = ";K
630 LOCATE 16,66: INPUT;"",L1
640 LOCATE 17,45: INPUT;"",Y$
650 IF (Y$<>"Y" AND Y$<>"N") THEN BEEP: GOTO 640
660 IF Y$="Y" THEN LOCATE ,58: INPUT;"",TABLE$
670 F1$="STORM RUNOFF DETERMINATION"
680 F2$="FOR"
690 F3$="INPUT SUMMARY:"
700 F4$="DISTRIBUTION"
710 F5$="RUNOFF AREA"
720 F6$="RAINFALL DEPTH"
730 F7$="RUNOFF CURVE NO."
740 F8$="STORM DURATION"
750 F9$="TIME OF CONCENTRATION"
760 F10$=STRING$(74,61)
770 F11$="HYDROGRAPH ORDINATES:"
780 F12$="TIME"
790 F13$="PPT"
800 F14$="CUM. FLOW"
810 F15$="DEL. FLOW"
820 F16$="FLOW RATE"
830 F17$="(HR)"
840 F18$="(IN)"
850 F19$="(IN/HR)"
860 F20$="(CFS)"
870 F21$="OUTPUT SUMMARY:"
880 F22$="TOTAL RUNOFF DEPTH"
890 F23$="TIME TO PEAK"
900 F24$="INITIAL ABSTRACTION"
910 F25$="RUNOFF VOLUME CHECK"
920 F26$="PEAK FLOW"
930 CLS
940 PRINT TAB(28);F1$
950 PRINT TAB(39);F2$
960 PRINT TAB(40-INT(LEN(A$)/2));A$
```

```
970 PRINT TAB(7);F3$
980 PRINT TAB(4);F10$
990 PRINT TAB(7);F4$;" = ";B$(Z);TAB(44);F5$;" = ";A1;" SQ. MILES"
1000 PRINT TAB(7);F6$;" = ";R;" INCHES";TAB(44);F7$;" = ";C
1010 PRINT TAB(7);F8$;" = ";T8;" HOURS";TAB(44);F9$;" = ";T9;" HRS."
1020 PRINT TAB(4);F10$
1030 IF I1=3 THEN GOTO 1032:REM   IF DISTRIBUTION = SCS 6 HR. GOTO LINE 1032
1031 GOTO 1050             :REM   SKIP TO LINE 1050
1032 FOR I=1 TO N :READ T1,P1:NEXT I :REM  READ DATA AND DISCARD
1035 FOR I=1 TO 11 :READ T1,P1:NEXT I   :REM  READ DATA AND DISCARD
1040 N=13                  :REM   SET COUNTER (N) TO 13 FOR SCS 6 HR. DIST.
1050 FOR I=1 TO N
1060 READ T1,P1
1070 T(I)=T8*T1*.01
1080 P(I)=R*P1*.01
1090 NEXT I
1100 LET TJ=0
1110 S1=0
1120 FOR I= 1 TO 6
1130 H(I)=3*TJ/(4*T7^2)
1140 TJ=TJ+D
1150 NEXT I
1160 FOR I=7 TO 14
1170 H(I)=3/(4*T7)*(1-.6*(TJ-T7)/T7)
1180 IF H(I)>=0 THEN GOTO 1200
1190 H(I)=0
1200 TJ=TJ+D
1210 NEXT I
1220 D=0
1225 FLAG=0:FLAGSUM=0
1230 I1=0
1240 T1=0
1250 P1=P(N)
1260 IF T1>=T(N) THEN GOTO 1310
1270 I=1
1280 I=I+1
1290 IF T(I)<T1 THEN GOTO 1280
1300 P1=P(I-1)+(P(I)-P(I-1))*(T1-T(I-1))/(T(I)-T(I-1))
1310 Q0=0
1320 IF P1<A THEN GOTO 1340
1330 Q0=(P1-A)^2/(P1+4*A)
1340 Q1=Q0-Q(3)
1350 Q2=0
1360 S1=Q1
1370 J=14
1380 IF I1>=14 THEN GOTO 1400
1390 J=I1
1400 FOR I=1 TO J
1410 S2=S1
1420 Q2=Q2+H(I)*S2
1430 S1=S(I)
1440 S(I)=S2
```

```
1450 NEXT I
1460 Q3=645.33*A1*Q2
1470 IF Q2<Y(2) THEN GOTO 1520
1480 X=T1
1490 Y(1)=Q(5)
1500 Y(2)=Q2
1510 GOTO 1540
1520 IF X<Q(1) THEN GOTO 1540
1530 Y(3)=Q2
1540 Q(4)=Q1
1550 Q(5)=Q2
1560 Q(6)=Q3
1570 O=O+Q2
1580 IF I1=0 THEN GOTO 1650
1585 IF K>2289 AND I1>=2289 THEN I1=2289:FLAG=1
1600 LOCATE 22,1: PRINT USING"      ##.##    #.##     #.####        #.####
  #.####       ###.##";Q(1),Q(2),Q(3),Q(4),Q(5),Q(6)
1602 G2(I1)=Q(2)
1603 G3(I1)=Q(3)
1604 G4(I1)=Q(4)
1605 G5(I1)=Q(5)
1606 G6(I1)=Q(6)
1650 Q(1)=T1
1660 Q(2)=P1
1670 Q(3)=Q0
1680 T1=T1+D
1685 IF FLAG=1 THEN FLAGSUM=FLAGSUM+1:I1=I1+FLAGSUM
1690 I1=I1+1
1700 IF I1<K THEN GOTO 1250
1710 C1=(Y(1)+Y(3)-2*Y(2))/(2*D*D)
1720 C2=(Y(2)-Y(1)-C1*D*(2*X-3*D))/D
1730 C3=Y(3)-C2*X-C1*X*X
1740 T1=-C2/(2*C1)
1750 Q2=C3-C2*C2/(4*C1)
1760 Q3=645.33*A1*Q2
1770 O=O*D
1790 LOCATE 11,1
1800 PRINT TAB(7);F21$
1810 PRINT TAB(4);F10$
1820 PRINT TAB(7);F22$;" = ";INT(1000*Q(3)+.5)/1000;" IN.";TAB(44);F23$;" = ";IN
T(1000*T1+.5)/1000;" HOURS"
1830 PRINT TAB(7);F24$;" = ";INT(1000*A+.5)/1000;" IN.";TAB(44);F25$;" = ";INT(1
000*O+.5)/1000;" IN."
1840 PRINT TAB(7);F26$;" = ";INT(1000*Q3+.5)/1000;" CFS"
1850 PRINT TAB(4);F10$
1880 LOCATE 24,4: PRINT "CREATE PRINT FILE? Y/N";
1890 LOCATE 24,26: PRINT SPC(2);: LOCATE ,26: INPUT;"",Y$
1900 IF (Y$<>"Y" AND Y$<>"N") THEN BEEP: GOTO 1890
1920 IF Y$="Y" THEN LOCATE ,4: PRINT SPC(50);: LOCATE ,4: PRINT "PLEASE WAIT  FI
LE CREATION IN PROGRESS"
1930 LET Y$="N"
1950 IF Y$="N" THEN LOCATE ,4: PRINT SPC(50);: LOCATE ,4: INPUT;"PRINT COPY? Y/N
 ",Y$
```

```
1960 IF Y$<>"Y" AND Y$<>"N" THEN BEEP: LOCATE ,4: PRINT SPC(50);: LOCATE ,4: INP
UT;"PRINT COPY? Y/N ",Y$
1970 IF Y$="N" THEN GOTO 2160
1980 IF L1=2 OR L1=3 THEN GOTO 2060
2000 LPRINT CHR$(27);CHR$(69)
2010 GOSUB 5010
2020 LPRINT
2030 GOSUB 5190
2040 LPRINT CHR$(27);CHR$(64)
2050 GOTO 2160
2060 LPRINT CHR$(27);CHR$(69):GOSUB 5000
2080 LPRINT
2085 GOSUB 5060
2090 GOSUB 5130
2100 LPRINT CHR$(27);CHR$(70);CHR$(27);CHR$(78)
2105 IF L1=2 THEN 2115
2106 LOCATE 23,1:PRINT SPC(50):LOCATE 24,1:PRINT SPC(50):LOCATE 23,1:PRINT"PRINT
 FLOW RATES FOR 0 TO 1.00, 11.0 TO 13.0, AND >23.0 ?";
2107 LOCATE ,59:INPUT"Y/N";LP2$:IF LP2$<>"Y" AND LP2$<>"N" THEN 2107
2108 IF LP2$="Y" THEN TPN1=1:TPN2=11:TPN3=13:TPN4=23:GOTO 2115
2109 LOCATE 21,1:FOR II=1 TO 4:PRINT SPC(79):PRINT:NEXT II
2110 LOCATE 21,1:PRINT"PRINT DATA FOR TIMES:"
2111 LOCATE 22,21:PRINT"FROM 0.0hrs TO        hrs.":LOCATE 23,21:PRINT"FROM
  hrs TO         hrs.":LOCATE 24,21:PRINT"FROM          hrs TO END."
2112 LOCATE 21,35:INPUT;TPN1:LOCATE 22,26:INPUT;TPN2:LOCATE ,39:INPUT;TPN3:LOCAT
E 23,29:INPUT;TPN4
2115 GG=0:LP=0:LP1=0
2120 FOR ROW = 1 TO K
2122 IF GG >TPN1 AND GG < TPN2 THEN GOTO 2132
2123 IF GG > TPN3 AND GG < TPN4 THEN GOTO 2134
2130 LPRINT USING"      ##.##   ##.##     #.####        #.####        #.####
   ###.##";GG,G2(ROW),G3(ROW),G4(ROW),G5(ROW),G6(ROW)
2131 GOTO 2135
2132 IF LP=0 THEN LPRINT: LP=1
2133 GOTO 2135
2134 IF LP1=0 THEN LPRINT: LP1=1
2135 GG=GG+D
2140 NEXT ROW
2150 GOSUB 5190
2160 END
5000 REM ******************** PRINT SUBROUTINES **********************************
5010 LPRINT TAB(38-INT(LEN(TABLE$)/2));"TABLE ";TABLE$
5020 LPRINT
5030 LPRINT TAB(28);F1$: LPRINT TAB(39);F2$
5040 LPRINT TAB(40-INT(LEN(A$)/2));A$
5050 RETURN
5060 LPRINT TAB(7);F3$: LPRINT TAB(4);F10$
5070 LPRINT TAB(7);F4$;" = ";B$(Z);TAB(44);F5$;" = ";A1;" SQ. MILES"
5080 LPRINT TAB(7);F6$;" = ";R;" INCHES";TAB(44);F7$;" = ";C
5090 LPRINT TAB(7);F8$;" = ";T8;" HOURS";TAB(44);F9$;" = ";T9;" HRS."
5100 LPRINT TAB(4);F10$
5110 RETURN
```

```
5130 LPRINT TAB(7);F11$: LPRINT TAB(4);F10$
5140 LPRINT TAB(7);F12$;TAB(16);F13$;TAB(24);F14$;TAB(38);F15$;TAB(52);F16$;TAB(
66);F16$
5150 LPRINT TAB(7);F17$;TAB(16);F18$;TAB(26);F18$;TAB(40);F18$;TAB(53);F19$;TAB(
68);F20$
5160 LPRINT TAB(4);F10$
5170 RETURN
5190 REM OUTPUT SUMMARY
5191 LPRINT TAB(7);F21$: LPRINT TAB(4);F10$
5200 LPRINT TAB(7);F22$;" = ";INT(1000*Q(3)+.5)/1000;" IN.";TAB(44);F23$;" = ";I
NT(1000*T1+.5)/1000;" HOURS"
5210 LPRINT TAB(7);F24$;" = ";INT(1000*A+.5)/1000;" IN.";TAB(44);F25$;" = ";INT(
1000*0+.5)/1000;" IN."
5220 LPRINT TAB(7);F26$;" = ";INT(1000*Q3+.5)/1000;" CFS"
5230 LPRINT TAB(4);F10$
5240 RETURN
```

TABLE 3

STORM RUNOFF DETERMINATION
FOR
dbd haul road #3

INPUT SUMMARY:

DISTRIBUTION = SCS 6 HOUR	RUNOFF AREA = .47 SQ. MILES
RAINFALL DEPTH = 2.2 INCHES	RUNOFF CURVE NO. = 85
STORM DURATION = 5 HOURS	TIME OF CONCENTRATION = .361 HRS.

HYDROGRAPH ORDINATES:

TIME (HR)	PPT (IN)	CUM. FLOW (IN)	DEL. FLOW (IN)	FLOW RATE (IN/HR)	FLOW RATE (CFS)
0.00	0.00	0.0000	0.0000	0.0000	0.00
2.02	1.20	0.2744	0.0526	0.5143	156.00
2.07	1.29	0.3270	0.0261	0.6197	187.95
2.12	1.34	0.3530	0.0150	0.7040	213.54
2.17	1.36	0.3681	0.0152	0.7564	229.42
2.21	1.39	0.3833	0.0154	0.7733	234.54
2.26	1.41	0.3987	0.0156	0.7515	227.94
2.31	1.44	0.4143	0.0158	0.6895	209.12
2.36	1.47	0.4301	0.0159	0.6174	187.27

OUTPUT SUMMARY:

TOTAL RUNOFF DEPTH = .945 IN.	TIME TO PEAK = 2.211 HOURS
INITIAL ABSTRACTION = .353 IN.	RUNOFF VOLUME CHECK = .946 IN.
PEAK FLOW = 234.564 CFS	

TABLE 4

STORM RUNOFF DETERMINATION
FOR
DBD HAUL ROAD #4

INPUT SUMMARY:

DISTRIBUTION = SCS 6 HOUR	RUNOFF AREA = .069 SQ. MILES
RAINFALL DEPTH = 2.2 INCHES	RUNOFF CURVE NO. = 83.5
STORM DURATION = 6 HOURS	TIME OF CONCENTRATION = .125 HRS.

HYDROGRAPH ORDINATES:

TIME (HR)	PPT (IN)	CUM. FLOW (IN)	DEL. FLOW (IN)	FLOW RATE (IN/HR)	FLOW RATE (CFS)
0.00	0.00	0.0000	0.0000	0.0000	0.00
2.37	1.10	0.1866	0.0126	0.6343	28.25
2.38	1.13	0.1992	0.0129	0.6554	29.18
2.40	1.16	0.2120	0.0131	0.6758	30.09
2.42	1.18	0.2252	0.0134	0.6956	30.97
2.43	1.21	0.2386	0.0137	0.7148	31.83
2.45	1.24	0.2523	0.0139	0.7334	32.66
2.47	1.27	0.2662	0.0142	0.7514	33.46
2.48	1.29	0.2804	0.0144	0.7689	34.24
2.50	1.32	0.2948	0.0040	0.7859	34.99
2.52	1.33	0.2988	0.0040	0.7831	34.87
2.53	1.33	0.3027	0.0040	0.7602	33.85
2.55	1.34	0.3067	0.0040	0.7167	31.91
2.57	1.35	0.3107	0.0040	0.6524	29.05
2.58	1.36	0.3147	0.0040	0.5670	25.25
2.60	1.36	0.3187	0.0040	0.4908	21.86
2.62	1.37	0.3227	0.0041	0.4243	18.89
2.63	1.38	0.3268	0.0041	0.3678	16.38
2.65	1.39	0.3309	0.0041	0.3215	14.31

OUTPUT SUMMARY:

TOTAL RUNOFF DEPTH = .862 IN.	TIME TO PEAK = 2.506 HOURS
INITIAL ABSTRACTION = .395 IN.	RUNOFF VOLUME CHECK = .863 IN.
PEAK FLOW = 35.053 CFS	

TABLE 5

STORM RUNOFF DETERMINATION
FOR
DBD HAUL ROAD #5

INPUT SUMMARY:

DISTRIBUTION = SCS 6 HOUR	RUNOFF AREA = .02 SQ. MILES
RAINFALL DEPTH = 2.2 INCHES	RUNOFF CURVE NO. = 80
STORM DURATION = 6 HOURS	TIME OF CONCENTRATION = .171 HRS.

HYDROGRAPH ORDINATES:

TIME (HR)	PPT (IN)	CUM. FLOW (IN)	DEL. FLOW (IN)	FLOW RATE (IN/HR)	FLOW RATE (CFS)
0.00	0.00	0.0000	0.0000	0.0000	0.00
2.37	1.11	0.1198	0.0134	0.4156	5.36
2.39	1.15	0.1332	0.0140	0.4462	5.76
2.42	1.18	0.1471	0.0145	0.4757	6.14
2.44	1.22	0.1616	0.0150	0.5041	6.51
2.46	1.26	0.1767	0.0155	0.5315	6.86
2.49	1.30	0.1922	0.0119	0.5578	7.20
2.51	1.32	0.2041	0.0044	0.5778	7.46
2.53	1.33	0.2084	0.0044	0.5810	7.50
2.55	1.34	0.2128	0.0044	0.5669	7.32
2.58	1.35	0.2173	0.0045	0.5350	6.90
2.60	1.36	0.2217	0.0045	0.4848	6.26
2.62	1.37	0.2263	0.0045	0.4246	5.48
2.64	1.38	0.2308	0.0046	0.3706	4.78

OUTPUT SUMMARY:

TOTAL RUNOFF DEPTH = .688 IN.	TIME TO PEAK = 2.524 HOURS
INITIAL ABSTRACTION = .5 IN.	RUNOFF VOLUME CHECK = .689 IN.
PEAK FLOW = 7.51 CFS	

TABLE 6

STORM RUNOFF DETERMINATION
FOR
DBD HAUL ROAD #6

INPUT SUMMARY:

DISTRIBUTION = SCS 6 HOUR	RUNOFF AREA = .007 SQ. MILES
RAINFALL DEPTH = 2.2 INCHES	RUNOFF CURVE NO. = 76
STORM DURATION = 6 HOURS	TIME OF CONCENTRATION = .137 HRS.

HYDROGRAPH ORDINATES:

TIME (HR)	PPT (IN)	CUM. FLOW (IN)	DEL. FLOW (IN)	FLOW RATE (IN/HR)	FLOW RATE (CFS)
0.00	0.00	0.0000	0.0000	0.0000	0.00
2.36	1.09	0.0572	0.0072	0.2584	1.17
2.37	1.12	0.0644	0.0076	0.2818	1.27
2.39	1.15	0.0720	0.0079	0.3047	1.38
2.41	1.18	0.0799	0.0083	0.3269	1.48
2.43	1.21	0.0882	0.0086	0.3486	1.57
2.45	1.23	0.0968	0.0089	0.3698	1.67
2.47	1.26	0.1057	0.0093	0.3904	1.76
2.48	1.29	0.1150	0.0086	0.4106	1.85
2.50	1.32	0.1236	0.0026	0.4286	1.94
2.52	1.33	0.1262	0.0027	0.4343	1.96
2.54	1.34	0.1289	0.0027	0.4272	1.93
2.56	1.35	0.1315	0.0027	0.4067	1.84
2.58	1.35	0.1342	0.0027	0.3726	1.68
2.59	1.36	0.1370	0.0027	0.3270	1.48
2.61	1.37	0.1397	0.0028	0.2859	1.29
2.63	1.38	0.1425	0.0028	0.2497	1.13
2.65	1.39	0.1453	0.0028	0.2188	0.99

OUTPUT SUMMARY:

TOTAL RUNOFF DEPTH = .52 IN.	TIME TO PEAK = 2.52 HOURS
INITIAL ABSTRACTION = .632 IN.	RUNOFF VOLUME CHECK = .522 IN.
PEAK FLOW = 1.962 CFS	

TABLE 7

STORM RUNOFF DETERMINATION
FOR
DBD HAUL ROAD #7

INPUT SUMMARY:

DISTRIBUTION = SCS 6 HOUR	RUNOFF AREA = .095 SQ. MILES
RAINFALL DEPTH = 2.2 INCHES	RUNOFF CURVE NO. = 80.8
STORM DURATION = 6 HOURS	TIME OF CONCENTRATION = .247 HRS.

HYDROGRAPH ORDINATES:

TIME (HR)	PPT (IN)	CUM. FLOW (IN)	DEL. FLOW (IN)	FLOW RATE (IN/HR)	FLOW RATE (CFS)
0.00	0.00	0.0000	0.0000	0.0000	0.00
2.40	1.16	0.1547	0.0219	0.4143	25.40
2.44	1.22	0.1767	0.0230	0.4606	28.24
2.47	1.27	0.1997	0.0224	0.5043	30.91
2.50	1.32	0.2221	0.0066	0.5441	33.36
2.54	1.34	0.2288	0.0067	0.5650	34.64
2.57	1.35	0.2355	0.0068	0.5663	34.72
2.60	1.36	0.2423	0.0069	0.5475	33.56
2.63	1.38	0.2491	0.0069	0.5079	31.14
2.67	1.39	0.2561	0.0070	0.4494	27.55

OUTPUT SUMMARY:

TOTAL RUNOFF DEPTH = .725 IN.	TIME TO PEAK = 2.554 HOURS
INITIAL ABSTRACTION = .475 IN.	RUNOFF VOLUME CHECK = .727 IN.
PEAK FLOW = 34.833 CFS	

TABLE 8

STORM RUNOFF DETERMINATION
FOR
DBD HAUL ROAD #8

INPUT SUMMARY:

DISTRIBUTION = SCS 6 HOUR	RUNOFF AREA = .014 SQ. MILES
RAINFALL DEPTH = 2.2 INCHES	RUNOFF CURVE NO. = 76
STORM DURATION = 6 HOURS	TIME OF CONCENTRATION = .214 HRS.

HYDROGRAPH ORDINATES:

TIME (HR)	PPT (IN)	CUM. FLOW (IN)	DEL. FLOW (IN)	FLOW RATE (IN/HR)	FLOW RATE (CFS)
0.00	0.00	0.0000	0.0000	0.0000	0.00
2.43	1.20	0.0863	0.0135	0.2695	2.44
2.45	1.24	0.0997	0.0143	0.3054	2.76
2.48	1.29	0.1140	0.0108	0.3399	3.07
2.51	1.32	0.1248	0.0041	0.3686	3.33
2.54	1.34	0.1289	0.0042	0.3838	3.47
2.57	1.35	0.1331	0.0042	0.3849	3.48
2.60	1.36	0.1374	0.0043	0.3711	3.35
2.63	1.38	0.1417	0.0044	0.3421	3.09
2.65	1.39	0.1460	0.0044	0.3042	2.75
2.68	1.40	0.1504	0.0045	0.2695	2.43

OUTPUT SUMMARY:

TOTAL RUNOFF DEPTH = .52 IN.	TIME TO PEAK = 2.556 HOURS
INITIAL ABSTRACTION = .632 IN.	RUNOFF VOLUME CHECK = .522 IN.
PEAK FLOW = 3.49 CFS	

TABLE 9

STORM RUNOFF DETERMINATION
FOR
DBD HAUL ROAD #9

INPUT SUMMARY:

DISTRIBUTION = SCS 6 HOUR
RUNOFF AREA = 8.000001E-03 SQ. MILES
RAINFALL DEPTH = 2.2 INCHES
RUNOFF CURVE NO. = 87
STORM DURATION = 6 HOURS
TIME OF CONCENTRATION = .25 HRS.

HYDROGRAPH ORDINATES:

TIME (HR)	PPT (IN)	CUM. FLOW (IN)	DEL. FLOW (IN)	FLOW RATE (IN/HR)	FLOW RATE (CFS)
0.00	0.00	0.0000	0.0000	0.0000	0.00
2.43	1.21	0.3460	0.0338	0.7935	4.10
2.47	1.27	0.3798	0.0347	0.8357	4.31
2.50	1.32	0.4145	0.0095	0.8749	4.52
2.53	1.33	0.4241	0.0096	0.8878	4.58
2.57	1.35	0.4336	0.0096	0.8741	4.51
2.60	1.36	0.4433	0.0097	0.8335	4.30
2.63	1.38	0.4530	0.0098	0.7655	3.95
2.67	1.39	0.4627	0.0098	0.6698	3.46
2.70	1.41	0.4725	0.0099	0.5836	3.01

OUTPUT SUMMARY:

TOTAL RUNOFF DEPTH = 1.064 IN.
TIME TO PEAK = 2.533 HOURS
INITIAL ABSTRACTION = .299 IN.
RUNOFF VOLUME CHECK = 1.067 IN.
PEAK FLOW = 4.583 CFS

TABLE 10

STORM RUNOFF DETERMINATION
FOR
DBD HAUL ROAD #10

INPUT SUMMARY:

DISTRIBUTION = SCS 6 HOUR	RUNOFF AREA = .248 SQ. MILES
RAINFALL DEPTH = 2.2 INCHES	RUNOFF CURVE NO. = 79.6
STORM DURATION = 6 HOURS	TIME OF CONCENTRATION = .526 HRS.

HYDROGRAPH ORDINATES:

TIME (HR)	PPT (IN)	CUM. FLOW (IN)	DEL. FLOW (IN)	FLOW RATE (IN/HR)	FLOW RATE (CFS)
0.00	0.00	0.0000	0.0000	0.0000	0.00
2.52	1.33	0.1981	0.0133	0.2542	40.69
2.59	1.36	0.2114	0.0136	0.3092	49.48
2.67	1.39	0.2250	0.0139	0.3485	55.77
2.74	1.42	0.2389	0.0142	0.3681	58.91
2.81	1.45	0.2531	0.0145	0.3646	58.36
2.88	1.49	0.2676	0.0148	0.3435	54.98
2.95	1.52	0.2824	0.0144	0.3198	51.19

OUTPUT SUMMARY:

TOTAL RUNOFF DEPTH = .67 IN.	TIME TO PEAK = 2.76 HOURS
INITIAL ABSTRACTION = .513 IN.	RUNOFF VOLUME CHECK = .671 IN.
PEAK FLOW = 59.141 CFS	

TABLE 11

STORM RUNOFF DETERMINATION
FOR
DBD HAUL ROAD #11

INPUT SUMMARY:

DISTRIBUTION = SCS 6 HOUR	RUNOFF AREA = .024 SQ. MILES
RAINFALL DEPTH = 2.2 INCHES	RUNOFF CURVE NO. = 73
STORM DURATION = 6 HOURS	TIME OF CONCENTRATION = .644 HRS.

HYDROGRAPH ORDINATES:

TIME (HR)	PPT (IN)	CUM. FLOW (IN)	DEL. FLOW (IN)	FLOW RATE (IN/HR)	FLOW RATE (CFS)
0.00	0.00	0.0000	0.0000	0.0000	0.00
2.58	1.35	0.0873	0.0102	0.0809	1.25
2.66	1.39	0.0976	0.0107	0.1119	1.73
2.75	1.43	0.1083	0.0112	0.1384	2.14
2.83	1.47	0.1194	0.0116	0.1557	2.41
2.92	1.50	0.1311	0.0119	0.1597	2.47
3.01	1.54	0.1430	0.0100	0.1609	2.49
3.09	1.57	0.1529	0.0102	0.1597	2.47
3.18	1.60	0.1631	0.0105	0.1562	2.42
3.26	1.63	0.1736	0.0107	0.1501	2.32
3.35	1.66	0.1844	0.0110	0.1420	2.20
3.43	1.69	0.1953	0.0104	0.1336	2.07

OUTPUT SUMMARY:

TOTAL RUNOFF DEPTH = .413 IN.	TIME TO PEAK = 3.005 HOURS
INITIAL ABSTRACTION = .74 IN.	RUNOFF VOLUME CHECK = .414 IN.
PEAK FLOW = 2.491 CFS	

TABLE 12

STORM RUNOFF DETERMINATION
FOR
DBD HAUL ROAD #12

INPUT SUMMARY:

DISTRIBUTION = SCS 6 HOUR	RUNOFF AREA = .105 SQ. MILES
RAINFALL DEPTH = 2.2 INCHES	RUNOFF CURVE NO. = 73
STORM DURATION = 6 HOURS	TIME OF CONCENTRATION = .8 HRS.

HYDROGRAPH ORDINATES:

TIME (HR)	PPT (IN)	CUM. FLOW (IN)	DEL. FLOW (IN)	FLOW RATE (IN/HR)	FLOW RATE (CFS)
0.00	0.00	0.0000	0.0000	0.0000	0.00
2.56	1.35	0.0855	0.0127	0.0505	3.42
2.67	1.39	0.0982	0.0134	0.0781	5.29
2.77	1.44	0.1116	0.0141	0.1066	7.22
2.88	1.49	0.1257	0.0148	0.1297	8.79
2.99	1.53	0.1405	0.0127	0.1420	9.62
3.09	1.57	0.1532	0.0127	0.1466	9.93
3.20	1.61	0.1659	0.0131	0.1491	10.10
3.31	1.65	0.1791	0.0135	0.1493	10.11
3.41	1.69	0.1926	0.0131	0.1469	9.95

OUTPUT SUMMARY:

TOTAL RUNOFF DEPTH = .413 IN.	TIME TO PEAK = 3.26 HOURS
INITIAL ABSTRACTION = .74 IN.	RUNOFF VOLUME CHECK = .414 IN.
PEAK FLOW = 10.13 CFS	

TABLE 13

STORM RUNOFF DETERMINATION
FOR
DBD HAUL ROAD #13

INPUT SUMMARY:

DISTRIBUTION = SCS 6 HOUR	RUNOFF AREA = .066 SQ. MILES
RAINFALL DEPTH = 2.2 INCHES	RUNOFF CURVE NO. = 73
STORM DURATION = 6 HOURS	TIME OF CONCENTRATION = .857 HRS.

HYDROGRAPH ORDINATES:

TIME (HR)	PPT (IN)	CUM. FLOW (IN)	DEL. FLOW (IN)	FLOW RATE (IN/HR)	FLOW RATE (CFS)
0.00	0.00	0.0000	0.0000	0.0000	0.00
2.51	1.33	0.0802	0.0133	0.0358	1.53
2.63	1.38	0.0935	0.0141	0.0604	2.57
2.74	1.43	0.1076	0.0149	0.0884	3.77
2.86	1.48	0.1225	0.0157	0.1149	4.89
2.97	1.53	0.1382	0.0140	0.1335	5.68
3.09	1.57	0.1522	0.0136	0.1397	5.95
3.20	1.61	0.1658	0.0141	0.1440	6.13
3.31	1.65	0.1799	0.0145	0.1460	6.22
3.43	1.69	0.1945	0.0132	0.1456	6.20
3.54	1.73	0.2077	0.0105	0.1421	6.05
3.66	1.75	0.2182	0.0107	0.1355	5.77

OUTPUT SUMMARY:

TOTAL RUNOFF DEPTH = .413 IN.	TIME TO PEAK = 3.352 HOURS
INITIAL ABSTRACTION = .74 IN.	RUNOFF VOLUME CHECK = .414 IN.
PEAK FLOW = 6.225 CFS	

TABLE GW A

STORM RUNOFF DETERMINATION
FOR
DBD HAUL ROAD GRIMES WASH A

INPUT SUMMARY:

DISTRIBUTION = SCS 6 HOUR	RUNOFF AREA = 2.531 SQ. MILES
RAINFALL DEPTH = 2.2 INCHES	RUNOFF CURVE NO. = 66
STORM DURATION = 6 HOURS	TIME OF CONCENTRATION = 1.763 HRS.

HYDROGRAPH ORDINATES:

TIME (HR)	PPT (IN)	CUM. FLOW (IN)	DEL. FLOW (IN)	FLOW RATE (IN/HR)	FLOW RATE (CFS)
0.00	0.00	0.0000	0.0000	0.0000	0.00
2.12	0.69	0.0000	0.0004	0.0000	0.00
2.35	1.08	0.0004	0.0191	0.0001	0.09
2.59	1.36	0.0196	0.0137	0.0026	4.17
2.82	1.46	0.0333	0.0161	0.0068	11.10
3.06	1.56	0.0493	0.0157	0.0131	21.38
3.29	1.64	0.0650	0.0169	0.0214	34.93
3.53	1.72	0.0819	0.0131	0.0318	51.87
3.76	1.78	0.0950	0.0139	0.0399	65.16
4.00	1.84	0.1090	0.0134	0.0470	76.79
4.23	1.89	0.1224	0.0140	0.0526	85.85
4.47	1.94	0.1364	0.0121	0.0567	92.60
4.70	1.98	0.1485	0.0121	0.0589	96.23
4.94	2.02	0.1606	0.0125	0.0600	98.01
5.17	2.07	0.1731	0.0129	0.0598	97.75
5.41	2.11	0.1860	0.0122	0.0586	95.74
5.64	2.14	0.1982	0.0119	0.0571	93.21
5.88	2.18	0.2101	0.0063	0.0558	91.06

OUTPUT SUMMARY:

TOTAL RUNOFF DEPTH = .216 IN.	TIME TO PEAK = 5.024 HOURS
INITIAL ABSTRACTION = 1.03 IN.	RUNOFF VOLUME CHECK = .217 IN.
PEAK FLOW = 98.154 CFS	

TABLE GW B

STORM RUNOFF DETERMINATION
FOR
DBD HAUL ROAD GRIMES WASH B

INPUT SUMMARY:

DISTRIBUTION = SCS 6 HOUR	RUNOFF AREA = 2.181 SQ. MILES
RAINFALL DEPTH = 2.2 INCHES	RUNOFF CURVE NO. = 73
STORM DURATION = 6 HOURS	TIME OF CONCENTRATION = 1.244 HRS.

HYDROGRAPH ORDINATES:

TIME (HR)	PPT (IN)	CUM. FLOW (IN)	DEL. FLOW (IN)	FLOW RATE (IN/HR)	FLOW RATE (CFS)
0.00	0.00	0.0000	0.0000	0.0000	0.00
2.16	0.76	0.0001	0.0211	0.0000	0.03
2.32	1.03	0.0212	0.0526	0.0039	5.42
2.49	1.30	0.0738	0.0228	0.0172	24.21
2.65	1.39	0.0966	0.0210	0.0347	48.80
2.82	1.46	0.1176	0.0227	0.0559	78.74
2.99	1.53	0.1403	0.0198	0.0813	114.41
3.15	1.59	0.1601	0.0203	0.1041	146.53
3.32	1.65	0.1804	0.0213	0.1154	162.39
3.48	1.71	0.2017	0.0159	0.1239	174.38
3.65	1.75	0.2175	0.0156	0.1292	181.86
3.81	1.79	0.2332	0.0160	0.1308	184.06
3.98	1.83	0.2492	0.0151	0.1295	182.30
4.15	1.87	0.2643	0.0152	0.1251	176.10
4.31	1.91	0.2795	0.0156	0.1173	165.11
4.48	1.94	0.2950	0.0131	0.1093	153.78
4.64	1.97	0.3081	0.0129	0.1036	145.85
4.81	2.00	0.3210	0.0131	0.0992	139.67
4.98	2.03	0.3341	0.0132	0.0952	133.97

OUTPUT SUMMARY:

TOTAL RUNOFF DEPTH = .413 IN.	TIME TO PEAK = 3.824 HOURS
INITIAL ABSTRACTION = .74 IN.	RUNOFF VOLUME CHECK = .414 IN.
PEAK FLOW = 184.069 CFS	

TABLE GW C

STORM RUNOFF DETERMINATION
FOR
DBD HAUL ROAD GRIMES WASH C

INPUT SUMMARY:

DISTRIBUTION = SCS 6 HOUR	RUNOFF AREA = 1.64 SQ. MILES
RAINFALL DEPTH = 2.2 INCHES	RUNOFF CURVE NO. = 83.5
STORM DURATION = 6 HOURS	TIME OF CONCENTRATION = .822 HRS.

HYDROGRAPH ORDINATES:

TIME (HR)	PPT (IN)	CUM. FLOW (IN)	DEL. FLOW (IN)	FLOW RATE (IN/HR)	FLOW RATE (CFS)
0.00	0.00	0.0000	0.0000	0.0000	0.00
2.08	0.64	0.0270	0.0477	0.0091	9.63
2.19	0.82	0.0747	0.0658	0.0295	31.27
2.30	1.00	0.1405	0.0804	0.0680	71.95
2.41	1.18	0.2208	0.0789	0.1278	135.27
2.52	1.33	0.2997	0.0264	0.2078	219.90
2.63	1.38	0.3261	0.0271	0.2852	301.84
2.74	1.43	0.3531	0.0277	0.3491	369.51
2.85	1.47	0.3809	0.0284	0.3919	414.73
2.96	1.52	0.4092	0.0253	0.4072	430.91
3.07	1.56	0.4345	0.0235	0.3948	417.86
3.18	1.60	0.4581	0.0239	0.3774	399.41
3.29	1.64	0.4819	0.0242	0.3548	375.51
3.40	1.68	0.5062	0.0241	0.3272	346.25
3.51	1.72	0.5303	0.0171	0.2963	313.59
3.62	1.74	0.5473	0.0172	0.2655	280.97
3.73	1.77	0.5646	0.0174	0.2389	252.82
3.84	1.80	0.5819	0.0175	0.2190	231.75
3.95	1.82	0.5995	0.0168	0.2063	218.31
4.06	1.85	0.6163	0.0162	0.1949	206.23
4.16	1.87	0.6325	0.0163	0.1848	195.57
4.27	1.90	0.6487	0.0164	0.1761	186.42
4.38	1.92	0.6651	0.0165	0.1690	178.85
4.49	1.95	0.6816	0.0135	0.1630	172.52
4.60	1.97	0.6951	0.0133	0.1573	166.47
4.71	1.98	0.7084	0.0134	0.1520	160.92
4.82	2.00	0.7218	0.0135	0.1473	155.90
4.93	2.02	0.7353	0.0135	0.1430	151.38

OUTPUT SUMMARY:

TOTAL RUNOFF DEPTH = .862 IN.	TIME TO PEAK = 2.965 HOURS
INITIAL ABSTRACTION = .395 IN.	RUNOFF VOLUME CHECK = .863 IN.
PEAK FLOW = 430.955 CFS	

TABLE GW D

STORM RUNOFF DETERMINATION
FOR
DBD HAUL ROAD GRIMES WASH D

INPUT SUMMARY:

DISTRIBUTION = SCS 6 HOUR	RUNOFF AREA = .935 SQ. MILES
RAINFALL DEPTH = 2.2 INCHES	RUNOFF CURVE NO. = 87
STORM DURATION = 6 HOURS	TIME OF CONCENTRATION = .452 HRS.

HYDROGRAPH ORDINATES:

TIME (HR)	PPT (IN)	CUM. FLOW (IN)	DEL. FLOW (IN)	FLOW RATE (IN/HR)	FLOW RATE (CFS)
0.00	0.00	0.0000	0.0000	0.0000	0.00
2.05	0.59	0.0463	0.0327	0.0527	31.77
2.11	0.68	0.0789	0.0392	0.0840	50.71
2.17	0.78	0.1181	0.0447	0.1316	79.43
2.23	0.88	0.1628	0.0496	0.1977	119.30
2.29	0.98	0.2124	0.0537	0.2842	171.49
2.35	1.08	0.2661	0.0574	0.3799	229.25
2.41	1.17	0.3236	0.0607	0.4785	288.73
2.47	1.27	0.3842	0.0392	0.5766	347.93
2.53	1.33	0.4234	0.0174	0.6594	397.86
2.59	1.36	0.4408	0.0175	0.7123	429.77
2.65	1.39	0.4584	0.0177	0.7322	441.83
2.71	1.41	0.4761	0.0179	0.7167	432.43
2.77	1.44	0.4940	0.0181	0.6632	400.18
2.83	1.47	0.5121	0.0182	0.5925	357.50
2.89	1.49	0.5303	0.0184	0.5257	317.20
2.95	1.52	0.5487	0.0177	0.4652	280.67
3.01	1.54	0.5664	0.0150	0.4121	248.68
3.07	1.57	0.5814	0.0150	0.3666	221.21
3.13	1.59	0.5965	0.0151	0.3298	199.01
3.19	1.61	0.6116	0.0152	0.3028	182.72
3.25	1.63	0.6268	0.0153	0.2865	172.90
3.31	1.65	0.6422	0.0154	0.2776	167.51
3.37	1.67	0.6576	0.0155	0.2718	164.00
3.44	1.69	0.6731	0.0156	0.2669	161.07
3.50	1.71	0.6886	0.0111	0.2631	158.72
3.56	1.73	0.6998	0.0108	0.2579	155.61
3.62	1.74	0.7106	0.0108	0.2513	151.63
3.68	1.76	0.7214	0.0109	0.2432	146.77
3.74	1.77	0.7323	0.0109	0.2337	141.04
3.80	1.79	0.7432	0.0109	0.2226	134.33
3.86	1.80	0.7541	0.0110	0.2128	128.43
3.92	1.82	0.7651	0.0110	0.2044	123.34
3.98	1.83	0.7761	0.0104	0.1973	119.07

OUTPUT SUMMARY:

TOTAL RUNOFF DEPTH = 1.064 IN.	TIME TO PEAK = 2.655 HOURS
INITIAL ABSTRACTION = .299 IN.	RUNOFF VOLUME CHECK = 1.067 IN.
PEAK FLOW = 441.871 CFS	

TABLE GW E

STORM RUNOFF DETERMINATION
FOR
DBD HAUL ROAD GRIMES WASH E

INPUT SUMMARY:

DISTRIBUTION = SCS 6 HOUR
RAINFALL DEPTH = 2.2 INCHES
STORM DURATION = 6 HOURS
RUNOFF AREA = .194 SQ. MILES
RUNOFF CURVE NO. = 73
TIME OF CONCENTRATION = .873 HRS.

HYDROGRAPH ORDINATES:

TIME (HR)	PPT (IN)	CUM. FLOW (IN)	DEL. FLOW (IN)	FLOW RATE (IN/HR)	FLOW RATE (CFS)
Ø.ØØ	Ø.ØØ	Ø.ØØØØ	Ø.ØØØØ	Ø.ØØØØ	Ø.ØØ
2.1Ø	Ø.66	Ø.ØØØØ	Ø.ØØ32	Ø.ØØØØ	Ø.ØØ
2.21	Ø.85	Ø.ØØ32	Ø.Ø193	Ø.ØØØ8	Ø.1Ø
2.33	1.Ø4	Ø.Ø225	Ø.Ø347	Ø.ØØ66	Ø.83
2.44	1.23	Ø.Ø573	Ø.Ø283	Ø.Ø214	2.58
2.56	1.35	Ø.Ø856	Ø.Ø139	Ø.Ø435	5.44
2.68	1.4Ø	Ø.Ø994	Ø.Ø147	Ø.Ø691	8.65
2.79	1.45	Ø.1142	Ø.Ø156	Ø.Ø972	12.17
2.91	1.5Ø	Ø.1298	Ø.Ø156	Ø.1213	15.19
3.Ø3	1.55	Ø.1454	Ø.Ø136	Ø.1352	16.92
3.14	1.59	Ø.159Ø	Ø.Ø141	Ø.14Ø9	17.64
3.26	1.63	Ø.1732	Ø.Ø146	Ø.1445	18.Ø9
3.38	1.67	Ø.1878	Ø.Ø151	Ø.1458	18.25
3.49	1.71	Ø.2Ø28	Ø.Ø11Ø	Ø.1446	18.1Ø
3.61	1.74	Ø.2138	Ø.Ø1Ø8	Ø.1397	17.49
3.72	1.77	Ø.2246	Ø.Ø11Ø	Ø.1324	16.57
3.84	1.8Ø	Ø.2357	Ø.Ø112	Ø.1242	15.55

OUTPUT SUMMARY:

TOTAL RUNOFF DEPTH = .413 IN.
INITIAL ABSTRACTION = .74 IN.
PEAK FLOW = 18.254 CFS
TIME TO PEAK = 3.377 HOURS
RUNOFF VOLUME CHECK = .414 IN.

TABLE 15

STORM RUNOFF DETERMINATION
FOR
DBD HAUL ROAD #15

INPUT SUMMARY:

DISTRIBUTION = SCS 6 HOUR	RUNOFF AREA = .082 SQ. MILES
RAINFALL DEPTH = 2.2 INCHES	RUNOFF CURVE NO. = 73
STORM DURATION = 6 HOURS	TIME OF CONCENTRATION = .968 HRS.

HYDROGRAPH ORDINATES:

TIME (HR)	PPT (IN)	CUM. FLOW (IN)	DEL. FLOW (IN)	FLOW RATE (IN/HR)	FLOW RATE (CFS)
0.00	0.00	0.0000	0.0000	0.0000	0.00
2.58	1.36	0.0880	0.0156	0.0398	2.11
2.71	1.41	0.1036	0.0167	0.0639	3.38
2.84	1.47	0.1202	0.0177	0.0912	4.82
2.97	1.53	0.1379	0.0158	0.1152	6.10
3.10	1.57	0.1537	0.0155	0.1286	6.81
3.23	1.62	0.1692	0.0161	0.1352	7.16
3.36	1.67	0.1852	0.0166	0.1398	7.40
3.48	1.71	0.2019	0.0124	0.1420	7.51
3.61	1.74	0.2143	0.0120	0.1405	7.43
3.74	1.77	0.2263	0.0123	0.1360	7.19
3.87	1.81	0.2386	0.0125	0.1287	6.81

OUTPUT SUMMARY:

TOTAL RUNOFF DEPTH = .413 IN.	TIME TO PEAK = 3.498 HOURS
INITIAL ABSTRACTION = .74 IN.	RUNOFF VOLUME CHECK = .414 IN.
PEAK FLOW = 7.514 CFS	

```
01♦LBL "JJ"
02 1
03 STO 00
04 "L=?"
05 PROMPT
06 STO 06
07 "W=?"
08 PROMPT
09 STO 01
10 "N=?"
11 PROMPT
12 STO 07
13 "Q=?"
14 PROMPT
15 STO 05
16 .02349
17 *
18 "S=?"
19 PROMPT
20 STO 04
21 SQRT
22 /
23 1
24 -
25 STO 02
26♦LBL 02
27 XEQ "DD"
28 RCL 03
29 100
30 *
31 .5
32 +
33 INT
34 100
35 X=Y?
36 GTO 04
37 CF 01
38 CF 02
39 RCL 03
40 X>0?
41 SF 01
42 FS? 01
43 GTO 03
44 -1
45 RCL 03
46 X<Y?
47 SF 02
48 2
49 FS? 02
50 CHS
51 +
52♦LBL 03
53 ABS
54 LOG
55 .1
56 *
57 FS? 01
58 CHS
59 FS? 03
60 XEQ 05
61 ST+ 00
62 GTO 02
63♦LBL 04
64 CLA
65 "d="
66 "⊢"
67 ARCL 00
68 AVIEW
69 RCL 08
70 RCL 06
71 *
72 RCL 05
73 /
74 3600
75 /
76 "T="
77 "⊢"
78 ARCL X
79 AVIEW
80 STOP
81 XEQ "JJ"
82♦LBL 05
83 RCL 00
84 X↑2
85 /
86 RTN
87 END
```

```
01♦LBL "DD"
02 CF 03
03 1
04 RCL 00
05 X>Y?
06 SF 03
07 ENTER↑
08 X↑2
09 FS? 03
10 GTO 02
11 2
12 *
13 X<>Y
14 RCL 07
15 *
16 +
17 STO 08
18 1.667
19 Y↑X
20 RCL 00
21 4.472
22 *
23 RCL 07
24 +
25 GTO 04
26♦LBL 02
27 3
28 *
29 X<>Y
30 RCL 01
31 *
32 +
33 RCL 07
34 +
35 1
36 +
37 STO 08
38 1.667
39 Y↑X
40 RCL 00
41 6.324
42 *
43 RCL 01
44 +
45 5.852
46 -
47♦LBL 04
48 -.667
49 Y↑X
50 *
51 RCL 02
52 -
53 ENTER↑
54 X<> 03
55 CLA
56 ARCL 00
57 "⊢ "
58 ARCL 03
59 AVIEW
60 RTN
61 END
```

HP41CV Routine
to solve for
Depth of Flow and
Travel Time

EXHIBIT III
4-4.35

```
1 REM          ************************************************************
2 CLS : REM    *              RIPRAP SIZING PROGRAM TAKEN FROM              *
3 KEY OFF:REM  *  "APPLIED HYDROLOGY AND SEDIMENTOLOGY FOR DISTURBED AREAS"  *
4 REM:         *          BY BARFEILD, WARNER AND HAAN,  PAGE 185           *
5 REM          ************************************************************
30 DEF FNSIND(I)=SIN(I*3.14159/180)
40 DEF FNCOSD(I)=COS(I*3.14159/180)
50 DEF FNTAND(I)=TAN(I*3.14159/180)
60 DEF FNATND(I)=(180/3.14159)*ATN(I)
100 PRINT TAB(13)"R I P R A P  S I Z I N G  F O R"
110 PRINT TAB(11)"T R A P A Z O I D A L  D I T C H E S "
120 PRINT
130 PRINT TAB(13)"ENTER LISTED PARAMETERS"
140 PRINT TAB(13)"1. FLOW RATE (CFS)"
150 PRINT TAB(13)"2. CHANNEL SLOPE"
160 PRINT TAB(13)"3. BOTTOM WIDTH (FT)"
170 PRINT TAB(13)"4. SIDE SLOPE"
180 PRINT TAB(13)"5. PHI ANGLE"
190 PRINT TAB(13)"6. SPECIFIC GRAVITY OF RIPRAP"
195 PRINT
300 LOCATE 5,32:INPUT;"",Q
310 LOCATE 6,30:INPUT;"",S
320 LOCATE 7,34:INPUT;"",B
330 LOCATE 8,27:INPUT;"",SS
340 LOCATE 9,26:INPUT;"",PHI
350 LOCATE 10,43:INPUT;"",SG
360 LOCATE 12,13:INPUT;"DESIRED SAFETY FACTOR FOR CHANNEL BOTTOM  ",DSF
370 LOCATE 13,13:INPUT;"DESIRED SAFETY FACTOR FOR CHANNEL BANKS  ",DSFB
400 SA=FNATND(S) :SSA=FNATND(SS)
480 D50=1: D=1
490 Q=INT(Q*1000+.5)/1000
500 N=((D50)^(1/6))*(.0395)
503 D50=INT(D50*10000+.5)/10000
505 Q1=1.49*(S^.5)/N
508 A=B*D+D*D/SS
510 Q2=Q1*A^(5/3)/(B+2*D*(1+1/(SS^2))^(.5))^(2/3)
512 Q3=INT(Q2*1000+.5)/1000
514 IF Q3=Q GOTO 520
515 IF Q3>=Q-.001 AND Q3<=Q+.001 THEN 520
516 D=(Q/Q2*D+D)/2
518 GOTO 505
520 T=62.4*D*S
525 VEL=Q/A
526 VEL=INT(VEL*1000+.5)/1000 :D=INT(D*1000+.5)/1000
530 NU=21*T/(62.4*(SG-1)*D50)
540 SF=FNCOSD(SA)*FNTAND(PHI)/(FNSIND(SA)+NU*FNTAND(PHI))
600 REM LAMBDA = CHANNEL SLOPE ANGLE SA
605 NU=.76*NU : REM ASSUME Tmax = .76*t AND NU(BANK)=.76*NU
610 BETA=FNATND(FNCOSD(SA)/(2*FNSIND(SSA)/(NU*FNTAND(PHI))+FNSIND(SA)))
620 NUP=NU*(1+FNSIND(SA+BETA))/2
630 SFB=FNCOSD(SSA)*FNTAND(PHI)/(NUP*FNTAND(PHI)+FNSIND(SSA)*FNCOSD(BETA))
700 SF=INT(SF*1000+.5)/1000
710 SFB=INT(SFB*1000+.5)/1000
720 LOCATE 16,10:PRINT"VELOCITY      DEPTH       D50       S.F. BTM       S.F. BANK
730 LOCATE 17,11:PRINT VEL;"      ";D;"    ";D50;"     ";SF;"          ";SFB;"
740 IF SFB=0 GOTO 815
750 IF SFB=DSFB GOTO 800
760 D50=(DSFB/SFB*D50+D50)/2
```

```
765 K=K+1:IF K=100 THEN GOTO 860
767 LOCATE 20,13:PRINT K
770 GOTO 500
800 IF SF>=DSF GOTO 820
810 LOCATE 20,13:PRINT"ERRROR: SF BANK > SF BTM":END
815 LOCATE 20,13:PRINT"ERROR: SFB=0": END
820 LOCATE 20,13:PRINT"RUN COMPLETE"
850 END
860 PRINT"Exceeds allowable number of iterations (see line 765)":END
```

R I P R A P S I Z I N G F O R
T R A P A Z O I D A L D I T C H E S

ENTER LISTED PARAMETERS
1. FLOW RATE (CFS) 235
2. CHANNEL SLOPE .1Ø5
3. BOTTOM WIDTH (FT) 2Ø
4. SIDE SLOPE .333
5. PHI ANGLE 42
6. SPECIFIC GRAVITY OF RIPRAP 2.65

DESIRED SAFETY FACTOR FOR CHANNEL BOTTOM 1.5
DESIRED SAFETY FACTOR FOR CHANNEL BANKS 1.5

VELOCITY	DEPTH	D5Ø	S.F. BTM	S.F. BANK
9.779	1.Ø39	2.5492	1.5Ø5	1.5

RUN COMPLETE

Ok

EXHIBIT V
CHANNEL #3
4-4.38

R I P R A P S I Z I N G F O R
T R A P A Z O I D A L D I T C H E S

ENTER LISTED PARAMETERS
1. FLOW RATE (CFS) 35.1
2. CHANNEL SLOPE .127
3. BOTTOM WIDTH (FT) 12
4. SIDE SLOPE .333
5. PHI ANGLE 42
6. SPECIFIC GRAVITY OF RIPRAP 2.65

DESIRED SAFETY FACTOR FOR CHANNEL BOTTOM 1.5
DESIRED SAFETY FACTOR FOR CHANNEL BANKS 1.53

VELOCITY	DEPTH	D50	S.F. BTM	S.F. BANK
6.611	.402	1.2544	1.508	1.53

RUN COMPLETE

Ok

CHANNEL #4
4-4.39

R I P R A P S I Z I N G F O R
T R A P A Z O I D A L D I T C H E S

ENTER LISTED PARAMETERS
1. FLOW RATE (CFS) 7.5
2. CHANNEL SLOPE .15
3. BOTTOM WIDTH (FT) 8
4. SIDE SLOPE .333
5. PHI ANGLE 42
6. SPECIFIC GRAVITY OF RIPRAP 2.65

DESIRED SAFETY FACTOR FOR CHANNEL BOTTOM 1.5
DESIRED SAFETY FACTOR FOR CHANNEL BANKS 1.55

VELOCITY	DEPTH	D50	S.F. BTM	S.F. BANK
4.778	.184	.7035	1.492	1.55

ERRROR: SF BANK > SF BTM

Ok

CHANNEL #5
4-4.40

R I P R A P S I Z I N G F O R
T R A P A Z O I D A L D I T C H E S

ENTER LISTED PARAMETERS
1. FLOW RATE (CFS) 34.8
2. CHANNEL SLOPE .Ø45
3. BOTTOM WIDTH (FT) 6
4. SIDE SLOPE .333
5. PHI ANGLE 42
6. SPECIFIC GRAVITY OF RIPRAP 2.65

DESIRED SAFETY FACTOR FOR CHANNEL BOTTOM 1.5
DESIRED SAFETY FACTOR FOR CHANNEL BANKS 1.5

VELOCITY	DEPTH	D5Ø	S.F. BTM	S.F. BANK
5.752	.737	.75Ø8	1.633	1.5

RUN COMPLETE

Ok

CHANNEL #7
4-4.41

R I P R A P S I Z I N G F O R
T R A P A Z O I D A L D I T C H E S

ENTER LISTED PARAMETERS
1. FLOW RATE (CFS) 3.5
2. CHANNEL SLOPE .15
3. BOTTOM WIDTH (FT) 6
4. SIDE SLOPE .333
5. PHI ANGLE 42
6. SPECIFIC GRAVITY OF RIPRAP 2.65

DESIRED SAFETY FACTOR FOR CHANNEL BOTTOM 1.5
DESIRED SAFETY FACTOR FOR CHANNEL BANKS 1.55

VELOCITY	DEPTH	D50	S.F. BTM	S.F. BANK
4.084	.134	.513	1.492	1.55

ERRROR: SF BANK > SF BTM

Ok

CHANNEL #8
4-4.42

R I P R A P S I Z I N G F O R
T R A P A Z O I D A L D I T C H E S

ENTER LISTED PARAMETERS
1. FLOW RATE (CFS) 59.1
2. CHANNEL SLOPE .Ø6
3. BOTTOM WIDTH (FT) 12
4. SIDE SLOPE .333
5. PHI ANGLE 42
6. SPECIFIC GRAVITY OF RIPRAP 2.65

DESIRED SAFETY FACTOR FOR CHANNEL BOTTOM 1.5
DESIRED SAFETY FACTOR FOR CHANNEL BANKS 1.5

VELOCITY	DEPTH	D5Ø	S.F. BTM	S.F. BANK
6.447	.656	.899	1.6	1.5

RUN COMPLETE

Ok

CHANNEL #10
4-4.43

R I P R A P S I Z I N G F O R
T R A P A Z O I D A L D I T C H E S

ENTER LISTED PARAMETERS
1. FLOW RATE (CFS) 2.5
2. CHANNEL SLOPE .Ø12
3. BOTTOM WIDTH (FT) 4
4. SIDE SLOPE .333
5. PHI ANGLE 42
6. SPECIFIC GRAVITY OF RIPRAP 2.65

DESIRED SAFETY FACTOR FOR CHANNEL BOTTOM 1.5
DESIRED SAFETY FACTOR FOR CHANNEL BANKS 1.5

VELOCITY	DEPTH	D5Ø	S.F. BTM	S.F. BANK	
2.254	.236	.Ø63	1.711	1.5Ø2	5Ø8

CHANNEL #11
4-4.44

R I P R A P S I Z I N G F O R
T R A P A Z O I D A L D I T C H E S

ENTER LISTED PARAMETERS
1. FLOW RATE (CFS) 10.1
2. CHANNEL SLOPE .06
3. BOTTOM WIDTH (FT) 8
4. SIDE SLOPE .333
5. PHI ANGLE 42
6. SPECIFIC GRAVITY OF RIPRAP 2.65

DESIRED SAFETY FACTOR FOR CHANNEL BOTTOM 1.5
DESIRED SAFETY FACTOR FOR CHANNEL BANKS 1.5

VELOCITY	DEPTH	D50	S.F. BTM	S.F. BANK
4.263	.269	.3686	1.6	1.5

RUN COMPLETE

Ok

CHANNEL #12
4-4.45

R I P R A P S I Z I N G F O R
T R A P A Z O I D A L D I T C H E S

ENTER LISTED PARAMETERS
1. FLOW RATE (CFS) 6.2
2. CHANNEL SLOPE .Ø95
3. BOTTOM WIDTH (FT) 6
4. SIDE SLOPE .333
5. PHI ANGLE 42
6. SPECIFIC GRAVITY OF RIPRAP 2.65

DESIRED SAFETY FACTOR FOR CHANNEL BOTTOM 1
DESIRED SAFETY FACTOR FOR CHANNEL BANKS 1.5

VELOCITY	DEPTH	D5Ø	S.F. BTM	S.F. BANK
4.391	.213	.4699	1.526	1.5

RUN COMPLETE

Ok

CHANNEL #13
4-4.46

R I P R A P S I Z I N G F O R
T R A P A Z O I D A L D I T C H E S

ENTER LISTED PARAMETERS
1. FLOW RATE (CFS) 835
2. CHANNEL SLOPE .Ø73
3. BOTTOM WIDTH (FT) 3Ø
4. SIDE SLOPE .333
5. PHI ANGLE 42
6. SPECIFIC GRAVITY OF RIPRAP 2.65

DESIRED SAFETY FACTOR FOR CHANNEL BOTTOM 1
DESIRED SAFETY FACTOR FOR CHANNEL BANKS 1.11

VELOCITY	DEPTH	D5Ø	S.F. BTM	S.F. BANK
12.489	1.876	1.9194	1.ØØ8	1.11

RUN COMPLETE

Ok

CHANNEL #14
4-4.47

R I P R A P S I Z I N G F O R
T R A P A Z O I D A L D I T C H E S

ENTER LISTED PARAMETERS
1. FLOW RATE (CFS) 7.5
2. CHANNEL SLOPE .Ø6
3. BOTTOM WIDTH (FT) 6
4. SIDE SLOPE .333
5. PHI ANGLE 42
6. SPECIFIC GRAVITY OF RIPRAP 2.65

DESIRED SAFETY FACTOR FOR CHANNEL BOTTOM 1.5
DESIRED SAFETY FACTOR FOR CHANNEL BANKS 1.5

VELOCITY	DEPTH	D5Ø	S.F. BTM	S.F. BANK
4.162	.265	.3633	1.6	1.5

RUN COMPLETE

Ok

CHANNEL #15
4-4.48

Revegetation:

Revegetation of the haul road will include application of soil amendments and stabilizing agents in addition to seeding and mulching. Seeding will take place as contemporaneously with soil grading as is practicable in late fall or early spring. If considerable time (i.e. over one month) lapses between soil grading and seeding, the soil will be protected with a mulch cover, which will be mechanically or chemically anchored. A cover of hay mulch or hydromulch will be applied at a rate sufficient to provide 50 percent ground cover.

The revegetation plan may be revised to incorporate results of the test plot study. Revisions will be approved by the Division prior to implementation.

Seed Mixture

SPECIES		PLS lbs/acre
Agropyron dasystachyum	thickspike wheatgrass	3
A. smithii	western wheatgrass	4
Oryzopsis hymenoides	Indian ricegrass	3
Elymus cinereus	basin wildrye	4
Sporobolus airoides	alkali sakatoon	.25
Melilotus officinalis	yellow sweetclover	2
Linum lewisii	Lewis flax	1
Sphaeralcea grossularifolia	globemallow	.5
Atriplex canescens	fourwing saltbush	2
A. corrugata	mat saltbush	2
A. confertifolia	shadscale	1
Ceratoides lanata	winterfat	2
Kochia prostrata	prostrata kochia	.5
	TOTAL	25.25

Methods

1. Seedbed Preparation

Seeding will take place as contemporaneously as practicable following soil placement; therefore, the seedbed will be in condition suitable for seed application. However, if a surface crust has developed it will be broken up by hand or mechanical tilling.

2. Soil Enhancer Application

Two weeks prior to seeding a soil enhancer (i.e. Land Tech Irish Peat) will be applied with a hydroseeder at the rate of 250 lbs/acre or as recommended by the manufacturer.

3. Seeding

The seed mixture will be applied by hydroseeder at the specified rates. All seed will be inspected by a Utah Department of Agriculture inspector at the time of application.

4. Fertilizer/Amendment Application

The fertilizer and sulfur mixture will be applied by hydroseeder at the following rates:

Ammonium Nitrate - 200 lbs/acre
Triple Super Phosphate - 300 lbs/acre
Sulfur - 1000 lbs/acre

5. Mulch/Tackifier Application

A wood fiber hydromulch with "Soil Master" (or equal) tackifier will be applied at the following rates (or as recommended by the manufacturer):

Tackifier - 50 gal/acre
Hydromulch - 1500 lbs/acre

Maintenance and Monitoring

1. Signs will be placed at the planted areas for their protection.

2. Weed control will not be undertaken unless it is determined necessary due to weed dominance and delayed rate of succession. All noxious weeds will be eradicated if they become established on the site.

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.

6. Monitoring will be conducted in accordance with Division Guidelines as indicated on page 4-4.53.

7. Maintenance and monitoring activities will be reported in the Annual Vegetation Monitoring Report.

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 occular estimation methods will be used to measure cover and species composition.

3. The point-center quarter method will be used to measure shrub and tree density.

4. Sample size for ground cover and shrub density will be tested at a 90 percent confidence level using a one-tail "t" test with a 10 percent change in the mean.

5. Productivity measurements will be a double sampling procedure of clipped plots and occular estimates. Rectangular plots (6.27" x 100") will be randomly located in reference areas and revegetation sites. Sampling will be at the 90% confidence level.

6. The reference areas will be checked to detect any changes from man-induced activities and to verify they are in fair or better condition.

7. Revegetation Success:

   a. Sampling of reference sites at end of ten year responsibility period will be conducted concurrently with final reclamation sampling, using the same methodology. The range condition of all reference areas will be re-assessed at five-year intervals.

   b. Ground cover is established for two consecutive years at the end of responsibility period at 90 percent of reference site ground cover.

   c. At least 80% of the shrubs and trees will have been in place for a least 8 growing seasons, the tree or shrub is alive and healthy.

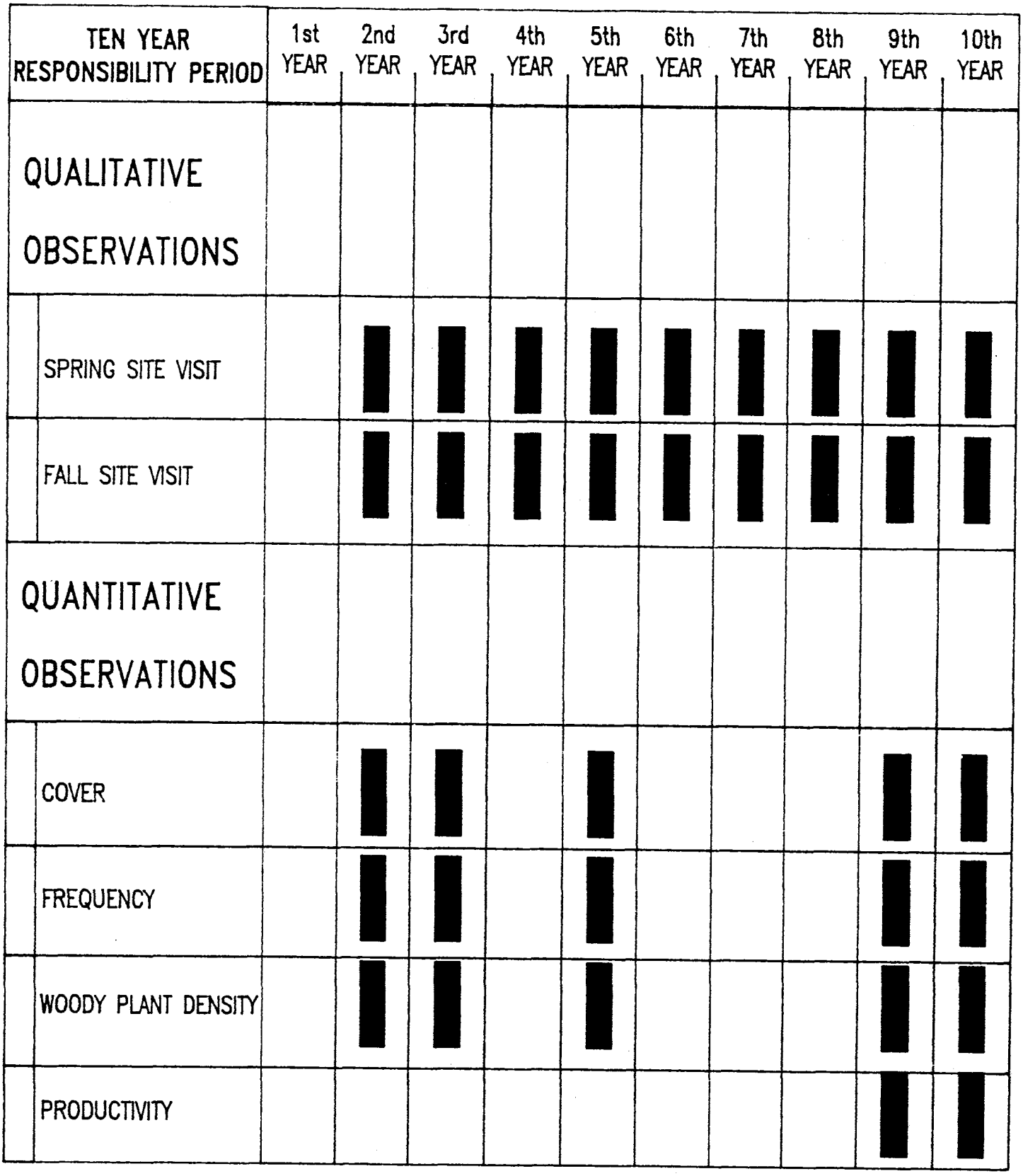
   d. The woody plants established on the revegetated site are equal to or greater than 90 percent of the stocking of live woody plants of the same life form of the approved reference areas with 90 percent statistical confidence.

e. Productivity will equal 90 percent of that of the reference areas at 90 percent statistical confidence.

f. A one-tail students "t" test of the sample means will be used for the statistical test.

DES-BEE-DOVE MINE

FINAL RECLAMATION MONITORING



SEDIMENT POND

Approximately five years after initial seeding and planting has taken place and revegetation success has reached the 90% statistical confidence level the sediment pond will no longer be needed. Therefore, it is planned to remove this facility by first, decanting the pond and allowing it to dry out, second, remove all piping, culverts and valves, and third, remove the dam using this material for backfill. The pond will then be backfilled and graded utilizing stockpiled material stored on site during pond construction. Revegetation will utilize the same seeding and planting techniques and methodologies outlined for the haul road. See pages 4-4.49 through 4-4.52.

Final reclamation in this area is intended to re-establish the original drainage channels that existed prior to pond and road construction. All grading and recontouring as shown on Map 4-2 (sheet 3 of 5) exemplifies the final topography configuration.

The sediment burial area located 150 feet northwest of the pond will not be affected during final reclamation of the pond. This sediment burial will have already been stabilized and revegetated prior to final reclamation activities.

SEDIMENTATION CONTROL

Sediment control is provided in several ways. First, utilizing a series of small contour ditches spaced approximately 15 feet apart, each ditch will contain approximately on cubic foot of water per lineal foot of ditch. This provides not only water retention to lesson runoff and reduced sediment loading but

water retention to lesson runoff and reduced sediment loading but enhances soil moisture for plants adjacent to the ditches. Second, the entire revegetated area is covered with a two-inch blanket of mulch and anchored with a vexar netting. All ditches will be constructed on level contours as close as possible to prevent flow down the furrows. As a measure of erosion control, small earthen check dams will be implemented at 20 to 30 foot intervals (as required by DOGM). Each contour ditch will be blocked off at both ends to allow water retention within the area of each ditch to encourage revegetation success.

This system of sediment control will provide positive restraints in controlling runoff and erosion during the initial revegetation period.

EAST MOUNTAIN ACCESS

The main road which serves the mine is also an access road for local cattlemen who, twice each year, herd cattle through the mine area to reach East Mountain.

As this road is an established cattle drive route and the only road to East Mountain on the east side, it is desirous to maintain this road independently from the mine's final reclamation plan.

All other roads to be reclaimed in the permit area will be scarified prior to topsoil placement.

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.

check slopes.

TOXIC OR ACID FORMING MATERIAL

All concrete above ground and all asphalt is to be buried on the bathhouse-warehouse pad with four feet of non-toxic material.

Any other material found to be toxic or acid forming and all coal cleaned up from surface areas are to be handled in the same manner. When feasible, this will be accomplished within 30 days after the material is first exposed. Temporary storage of the material, beyond 30 days must be approved by the Division.

STABILITY

Final reclaimed slopes will be built at 2H:1V or less. Material used for the backfill will be less than 3' diameter. The material will be selectively placed in 18" lifts and compacted.

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

Slope stability analysis was calculated on the bathhouse fill. The soil parameters used by Rollins, Brown and Gunnel were used because the material is the same.

c = 400 pcf

$\phi = 32^{o}$

$\gamma = 80$ psf

H = 184

Slope = 2H:1V

Calculated Safety Factor SF = 1.74

All other reclaimed slopes are less in height and have the same strength parameters, therefore, the safety factor is the same or greater.

The one exception is the tipple yard fill which is not changed for final reclamation, therefore, existing and final stability are the same. This is discussed in the Operation Plan under Existing Structures - Stability Analysis page 3-52.

SIMPLIFIED BISHOP METHOD OF SLICES

(Lambe & Whitman 1969, p. 365)

To analyze a slope for stability, a trial and error process is used to determine the safety factor against failure. A diagram is prepared of the slope and a proposed failure mass with a circular arc failure line is drawn and then broken up into a series of vertical slices. The forces and moments on each slice are summed to determine the total moments acting on the failure mass and the factor of safety is taken as the ratio of the moments resisting movement to the moments initiating movement. The equation for the factor of safety F is

$$F = \frac{\sum_{i=1}^{i=n} [\bar{c}\,\Delta x_i + (W_i - u_i \Delta x_i) \tan \bar{\phi}][1/M_\alpha(\theta)]}{\sum_{i=1}^{i=n} W_i \sin \theta_i}$$

where n = # of slices

$\bar{c}$ = effective cohesion kips per square foot

Δx_i = width of ith slice

W_i = weight of ith slice, kips

= width x average height x density

u_i = pore pressure or neutral stress

ϕ = angle at internal friction of soil, degrees

θ_i = angle of base of ith slice

F = Factor of safety

Where the slopes are not saturated and are in a drained condition with long term loading, the neutral stresses are 0, then

$$F = \frac{\sum (c\, x_i + W_i \tan \phi)\ [1/M_i(\theta)]}{\sum W_i \sin \theta_i}$$

Because F is present on both sides of the equation (M_i (θ) is a function of F), then a value of F in $M_i(\theta)$ is assumed and the equation is then solved to obtain a value for F. If the assumed value equals the result, then the assumption is correct. If the assumed value does not equal the result, then a new value is used in $M_i(\theta)$ and the process is repeated until it closes on the correct answer.

A computer program was developed to solve for F when certain basic parameters are given, using the equation above and assuming the failure would be a toe failure, because the fill slopes are located on firm bases.

The basic parameters required are cohesion, density, angle of internal friction, the width of each slice, the average height of each slice, and the angle at the base of each slice.

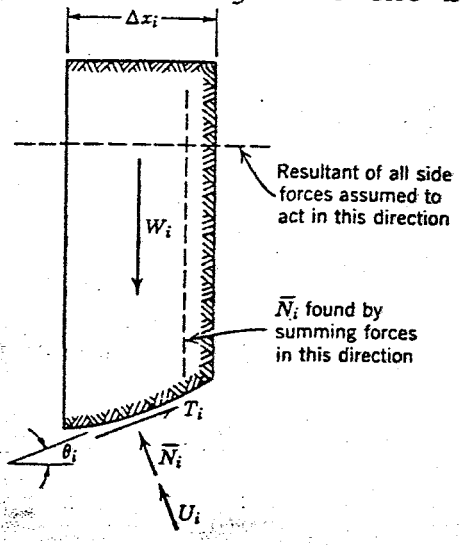


Fig. 24.13 Forces considered in simplified Bishop method of slices.

QUANTITIES SUMMARY SHEET

FINAL RECLAMATION BACKFILLING AND GRADING

Little Dove-Beehive Area #5		
Total Excavation		6,000 c.y.
Little Dove Highwall Embankment	3,677 c.y.	
Little Dove-Beehive Portals	900 c.y.	
10% Rip-Rap	600 c.y.	
Parking Lot Extension Embankment	823 c.y.	
Deseret Area #4		
Total Excavation		7,333 c.y.
Parking Lot Extension Embankment	4,274 c.y.	
Deseret Portals Embankment	900 c.y.	
10% Rip-Rap	730 c.y.	
Bathhouse-Warehouse Embankment	1,429 c.y.	
#1 Stockpile Area #3		
Total Excavation		6,525 c.y.
Bathhouse-Warehouse Embankment	5,869 c.y.	
10% Rip-Rap	656 c.y.	

FINAL RECLAMATION

HYDROLOGICAL BALANCE

Upon final reclamation a permanent diversion drainage channel will be constructed through the mining area. The channel will accommodate the runoff and peak flows from a 100 year storm event. Assumptions, calculations and methodology can be found in Appendix XII. Routing of the drainage channel is depicted on the final reclamation Map 4-1 and 4-2.

It is the intention of applicant to place the drainage channel, for the most part, in its original configuration with the exception of the fill Structure #1.

The access road and drainage channel are parallel along the fill. Their location is such as to take advantage of parent material adjacent to a realigned road bed. When the channel crosses the fill structure a clay filter layer will be required in addition to the regular gravel filter and rip-rap layers.

Hydrologic and rip-rap design calculations are listed in the following tables.

Construction and design of rip-rap cascading dissipation fan structure is shown on the final reclamation map also, with a fording to allow a permanent crossing.

Cross-sectional and plan views of the road ford as well as design details are shown on the Des Bee Dove Final Reclamation Map. Flow velocity vector analysis shows a

maximum change in water surface elevation at the bend of 0.3 feet. With an adjusted total depth of 1.6 feet there is a designed freeboard of 1.9 feet.

Presently, design procedures aren't available to facilitate riprap design for slopes greater than 50%, yet slopes at the lower end of the Des-Bee-Dove Mine pad range from 60 to 70 percent.

The following is the combined results of a meeting held between the Company, OSM, and the DOGM concerning acceptable practices for channelization and energy dissipation.

1. The stream channel would be conveyed as far as possible downstream of the mine pad fill before entering the cascading rock fan. This would help eliminate direct erosive contact of the water with the fill material.
2. Large diameter riprap would be placed down the slope to act as a cascading energy dissipator. A D_{50} riprap size of 3 feet will be used down the slope.
3. An energy dissipating pool of water would be built at the bottom to return the water to the natural channel.

The general conclusions discussed above reflect a practical solution to a difficult problem. Design details and parameters for the channel, fan, and energy dissipator are shown on the Final Reclamation map.

Revised 11/21/83

The channel inlet at the upper end of the mine pad is not meant to be an energy dissipator, although some head loss will be encountered. Backwater analysis showed that a smooth constricting transition will convey the upstream supercritical flows smoothly into the normal water depth for the downstream section. Transition location, design details, and riprap requirements are shown on the Des-Bee-Dove Final Reclamation map and Cross-Section Profile Map 4-3. The stream calculations for sections above and below the transition are shown below. The difference in normal flow velocity head between the two sections equals 4.8 feet.

	Natural Channel Above Transition	Riprapped Channel Below Transitiion
Bottom Slope (ft/ft)	.37	.04
Bottom Width (ft)	20	15
Side slope (M:1)	2	2
Mannings n	.035	.04
Flow Depth (ft)	0.8	1.8
Area (ft^2)	16.3	33.1
Perimeter (ft)	23.4	23.0
Hydraulic Radius (ft)	0.7	1.4
Mean Velocity (fps)	20.3	10.1
Froude Number	4.3	1.5
Riprap D_{50}	-	1.0
Riprap Thickness (ft)	-	2.0

VAUGHN HANSEN ASSOCIATES
CONSULTANTS / ENGINEERS

COMPUTED _____ CLIENT _____
CHECKED _____ PROJECT DEC-PEE-DOVE
DATE _____ FEATURE DESIGN CALCS

CHANNEL DESIGN

Q = 333 cfs

H:V	Deg
2:1	26.6
2.5:1	21.8
3:1	18.4

D_{50}	Manning n
.25 - .5	.031 - .035
.75 - 1.0	.038 - .040
1.25 - 1.5	.041 - .043
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 F_r	RIPRAP D_{50} (ft)	D_{max} (ft)	
0+00	3+50	.04	15	2:1	.040	1.8	33.3	23.0	1.4	10.0	1.4	1.0	1.8	2.
3+50	8+40	.051	15	2:1	.041	1.7	32.2	22.8	1.4	10.3	1.6	1.25	2.0	2
8+40	10+00	.219	20	2:1	.044	1.0	22.4	24.5	0.9	14.9	2.7	2.0	—	2

(riprap design for x=8+40 to 10+00 is based on the Surface Mining Water Diversion Design Manual with Hydraulics calculated using the Mannings equation.)

DITCH A
Q_{100} = 24 cfs

0+00	1+00	.12	2	2:1	.042	0.8	3.0	5.7	0.5	8.0	1.6	1.5	1.0	2.
1+00	2+00	.08	2	2:1	.040	0.9	3.4	6.0	0.6	7.2	1.3	1.0	1.0	1.
2+00	3+00	.10	2	2:1	.041	0.9	3.1	5.8	0.5	7.6	1.5	1.25	1.0	1.
4+00	5+00	.15	2	2:1	.042	0.8	2.8	5.5	0.5	8.7	1.7	1.5	0.8	2.
5+00	6+00	.10	2	2:1	.041	0.9	3.1	5.8	0.5	7.6	1.5	1.25	1.0	1.
6+00	10+75	.02	2	2:1	.035	1.2	5.1	7.2	0.7	4.7	0.8	—	—	—

DITCH B
Q_{100} = 15 cfs

		.077	2	2:1	.038	0.7	2.3	5.1	0.5	6.4	1.4	0.75	0.8	1.

TABLE B1. DES-BEE-DOVE Mine Watershed Runoff Characteristics

Watershed Subarea	Area (acres)	Average Slope (%)	Curve Number	Hydraulic Length (ft)	2-Yr Runoff (cfs)	10-Yr Runoff (cfs)	100-Yr Runoff (cfs)
IIIA	170	63.5	85	4,000	-	136	332
IIIB	11.7	166	85	2,330	-	-	24
IIIC	6.9	31.6	87	980	-	-	15
							371

DES-BEE-DOVE DRAINAGE AREA IIIA

10-YEAR 24-HOUR PEAK DISCHARGE

AREA= 170.0 ACRES
AVERAGE BASIN SLOPE= 63.5 PERCENT
INCREMENT OF RAINFALL EXCESS= .0230 HOURS
CURVE NUMBER= 85.
DESIGN STORM= 2.00 INCHES
STORM DURATION= 24.0 HOURS
HYDRAULIC LENGTH= 4000. FEET

TP= .1139 HOURS QPCFS= 1129.00 CFS QPIN= 6.5861 INCHES C3= 32.462
ITERATIONS= 8

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
11.89	1.1602	.2534	.0183	.0	115.12
11.91	1.1952	.2721	.0187	.0	119.37
11.94	1.2301	.2912	.0192	.0	123.43
11.96	1.2651	.3108	.0196	.0	127.31
11.98	1.3000	.3308	.0200	.0	131.02
12.01	1.3277	.3468	.0161	.0	134.33
12.03	1.3343	.3507	.0039	.0	135.48
12.05	1.3410	.3546	.0039	.0	130.99
12.07	1.3476	.3585	.0039	.0	119.98
12.10	1.3542	.3624	.0039	.0	104.68
12.12	1.3608	.3664	.0039	.0	88.19
12.14	1.3674	.3703	.0039	.0	72.95
12.17	1.3741	.3743	.0040	.0	60.27

HYDROGRAPH PEAK= 135.73 cfs
TIME TO PEAK= 12.02 Hours

Soil Sampling

After mining and prior to reclamation, a soil 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	Sample Sites	Map Location #'s	Samples/ Site	Sample Depth
Haul Road	4	SS1	1	0-2'
		SS2	2	0-1' 1'-2'
		SS3	2	0'-2' 2'-5'
		SS4	2	0'-2' 2'-5'
Tipple Yard	1 (Need to do it on 15 acre increments)	SS5	3	0"-6" 6"-2' 2'-5'
Bathhouse Slope	1	SS6	2	0'-2' 2'-5'
#1 Stockpile Area	4	SS7	3+	0"-6" 6"-2' 2'-5' 5' intervals to depth of removal.
		SS8	1	0'-2'
		SS9	1	0'-2'
		SS10	1	0'-2'
Beehive-Little Dove Pad	1	SS11	2	0'-2' 2'-5'

(Refer to Map 2-15 Drawing No. CM-10336-DS Revised 7/11/88 and Map 5-6 Drawing No. CM-10613-DS Revised 7/11/88 for proposed sample locations.)

Each soil sample will be analyzed for the following:

Texture (% sand, silt, clay)

SAR (meq/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

Coarse Rock Fragments

AWHC

The analysis date 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.

Coal material in all pads will be analyzed for toxic or acid-forming characteristics. If found to be toxic or acid-forming, the material will be removed to an approved disposal site or buried on-site with a minimum of four (4) feet of non-toxic material.

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Coal material in all pads will be analyzed for toxic or acid-forming characteristics. If found to be toxic or acid-forming, the material will be removed to an approved disposal site or buried on-site with a minimum of four (4) feet of non-toxic material. When feasible, this will be accomplished within 30 days after the material is first exposed. Temporary storage of the material, beyond 30 days must be approved by the Division.

REVEGETATION (UMC 817.111-.117)

Interim Stabilization and Vegetation Plan

There are five major fills at the Des-Bee-Dove Mine with bare open slopes generally with a south or southeast aspect. With the proposed reclamation plan one fill would provide some 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 sandy loams (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.

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The soil material in the fills is comparable to surrounding native soils and was originally derived from sandstone and shale parent materials. The soil material particles are mostly sand with textures from sandy clay loams to sandy loams (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	Sand	Silt	Clay	Texture	pH	Saturation %	Ece
1107[1]	1980	0-4"	52	33	15	SL	8.3		0.8
1108	1980	4-12"	50	33	17	SL	8.1		0.5
1109	1980	12-24"	54	31	15	SL	8.3		0.4
1110	1980	Surface Wash	52	33	15	SL	8.1		0.3
1111	1980	Subsoil	59	27	14	SL	8.0		2.1
1117	1980	Coal Waste					10.0		2.1
1118	1980	Coal Waste					7.1		2.5
1119	1980	Coal Waste					7.5		2.5
DBD#1[2]	1983	Upper Fill	65	13	22	SCL	8.2	30	.40
DBD#2	1983	Bathhouse Fill	59	11	30	SCL	8.8	20	.70
DBD#3	1983	Tipple Fill	65	17	18	SL	8.5	30	.72

[1] Soil and spoil from Des-Bee-Dove Mine

[2] Fill soil material samples collected on subsurface layers in fill (4"-20"). Sample composited from ten sub-samples on each fill slope.

Revised 11/21/83

TABLE II: SOILS PRODUCTIVITY ANALYSIS

Sample #	SAR	OM %	N %	Ca %	(Ca+Mg)	Mg %	Na (Meg/L)	K %	P ppm	$CaCO_3$ Equivalents %
1107	0.7	2.6			6.8		1.2	.01	1.9	
1108	0.7	3.9			3.9		1.0	.01	2.3	
1109	0.9	1.3			2.9		1.1	.006	.3	
1110	0.8	2.5			2.4		.9	.006	1.2	
1111	1.0	5.1			20.2		3.2	.02	2.6	
1117	0.8				23.3		2.7	.01	1.2	
1118	0.8				26.5		2.9	.01	.3	
1119	0.7				28.8		2.6	.01	.2	
DBD#1	3.03	13.88	.088	9.85		2.75	.076	.087	.125	17.9
DBD#2	3.28	9.24	.056	9.00		2.00	.077	.056	.064	16.5
DBD#3	2.76	15.29	.240	11.38		3.41	.075	.114	.059	16.9

Revised 11/21/83

INTERIM VEGETATION ESTABLISHMENT

FILL SLOPES

The fill slopes at the tipple area, bathhouse, coal stockpile area, Deseret pond and Beehive portal require interim stabilization. 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 was completed in 1984 and 1988, at various locations at Des Bee Dove Mine, as discussed in the 1987 and 1988 Vegetation Monitoring Reports. The interim vegetation will control erosion 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 some 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. Provided a detailed analysis of soil productivity with a series of test over the life of the mine. This would be the basis for fertilization and soil handling at final revegetation.

The upper 18-24" fill layer will 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" will be removed and stored during the redistribution of fill and grading. Then the temporarily stored "topsoil" will be placed on the newly graded and prepared surfaces 6-12 inches deep at random locations. This will increase the variability of the soil surface.

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 and nitrogen fixing 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.

The 1988 interim seed mixture was as follows:

COMMON NAME	SCIENTIFIC NAME	LBS/ACRE EQUIVALENT PLS*
Grasses		
Thickspike Wheatgrass	Agropyron dasystacyum var. Critana	5
Western Wheatgrass	Agropyron smithii var. Rosanna[1]	6
Salina Wildrye	Elymus salinus	1
Indian Ricegrass	Oryzopsis hymenoides var. Paloma	4
Squirreltail	Sitanion hystrix[2]	3
Greatbasin Wildrye	Elymus cinereus	3
Forbes		
Pacific Aster	Aster chilensis	0.2
Northern Sweetvetch	Hedysarum boreale	1
Yellow Sweetclover	Melilotus officinalis[2]	1
Alfalfa	Medicago savtiva var. Nomad[2]	1
Eaton Pentstemon	Penstemon eatonii[2]	1

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

26.2

Revised 4/16/90

MECHANICS OF 1988 INTERIM REVEGETATION

FILL SLOPE

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 at least 60% ground cover on the majority of the slope. This may require a three to seven year period.

SEEDING (FALL 1988)

1. Slopes were cleaned of debris.
2. The seed mixture (page 4-12) was applied.
3. The hydromulch/tackifier/fertilizer mixture was applied at the following rates:

Sylva fiber hydromulch	2000 lbs/acre
Organic tackifier	120 lbs/acre
Ammonium nitrate	50 lbs/acre
Triple superphosphate	75 lbs/acre

MAINTENANCE AND MONITORING

1. Signs will be placed around the planted slopes.
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. All noxious weeds will be eradicated if they become established on the site.

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 at least once each year to check on fitness of the sites and progress of the plant growth. Observations will be made to assess potential problems including; erosion, animal impacts, unusual conditions (e.g. abnormal plant growth, areas of poor vegetation, etc.). Erosion will be repaired as needed.

5. Ground cover will be assessed by occular estimation using meter square quadrats. Interim revegetation will be determined successful when erosion is effectively controlled or ground cover is a least 60%.

6. Annual report that summarizes the year's work will be placed in the Company's files and forwarded to DOGM.

7. The soil materials on the fill slopes will be sampled at five year intervals to record productivity changes. Five samples at 0-6", 6-12", and 12-18" depths will be composited for each of the five fill slopes for analysis. Analyses will be performed in accordance with Division

Guidelines and will include:

1. Soil Texture
2. pH
3. Electrical Conductivity
4. Sodium Adsorption Ratio
5. Organic Carbon/Organic Matter
6. Saturation Percentage
7. Available Water Capacity (1/3 and 14 atmosphere water)
8. Standard Ferility Test (for P and K analysis)
9. Field estimate of percent Rock Fragments (by volume)

Additional sampling will be conducted, as needed to delineate any problem areas identified during initial sampling.

INTERIM REVEGETATION (FUTURE)

When necessary to effectively control erosion on disturbed areas, seeding and planting will take place as contemporaneously as practicable with the completion of backfilling and grading. The following seed mixture and plantings will be applied at the specified rates. The species were recommended by the US Forest Service as being consistent with the management plan for the area. (Please refer to the final revegetation plan, pages 4-22.1 and 4-22.2, for justification of introduced species.)

COMMON NAME	SCIENTIFIC NAME	LBS/ACRE PLS*
Grasses		
Thickspike Wheatgrass	Agropyron dasystachyum	2
Crested Wheatgrass	Agropyron cristatum	1
Western Wheatgrass	Agropyron smithii	3
Intermediate Wheatgrass	Agropyron intermedium	3
Smooth brome grass	Bromus inermis	2
Indian ricegrass	Oryzopsis hymenoides	2
Needle-and-thread grass	Stipa comata	2
Forbs		
Pacific aster	Aster chilensis var. adscendens	0.2
Utah vetch	Hedysarum boreale	1
Yellow Sweetclover	Melilotus officinalis	2
Alfalfa	Medicago sativa var. nomad	1.5
Eaton penstemon	Penstemon eatonii	0.4
	Total	20.1

*Application rates result in approximately 80 seeds/ft^2.

Shrubs		
Serviceberry	Amelanchier alnifolia	100
Fourwing saltbush	Atriplex canescens	50
Snowberry	Symphoricarpos oreophilus	100
Winterfat	Ceratoides lanata	50

INTERIM REVEGETATION METHODS (FUTURE)

1. Seedbed Preparation

   Seeding will take place as contemporaneously as practicable following soil placement; therefore, the seedbed will be in a condition suitable for seed application. However, if a surface crust has developed it will be broken up by hand or mechanical tilling.

2. Seeding

   The seed mixture will be hand broadcast with "hurricane spreaders" or applied by hydroseeder at the specified rate.

3. Fertilizer Application

The following fertilizer combination will be applied by hand broadcasting with "hurricane spreaders" or as a separate operation of hydroseeding:

Ammonium Nitrate	40 lbs/acre
Triple Superphosphate	35 lbs/acre

4. Seed Covering

Following hand broadcasting of the seed mixture and fertilizer, the sites will be hand or mechanically raked to cover the seeds.

5. Mulch Application

Following hand broadcasting and raking, the seeded areas will be covered with hay mulch (2 tons per acre) and netting or erosion control mulch blanket. The netting or blanket will be mechanically anchored per the manufacturers specifications.

Following hydroseeding, a hydromulch with tackifier will be applied at the rate of approximately 2000 lbs/acre.

The criteria for interim revegetation success will be the establishment of at least 60% ground cover, on the majority of the slope, which prevents or minimizes erosion. Maintenance and monitoring will be conducted as described on pages 4-13, 4-14 and 4-15.

FINAL REVEGETATION PLAN

The fill material at the bathhouse fill will be the planting medium. Seeding will take place as contemporaneously with soil grading as is practicable is late fall or early spring. If considerable time (i.e. over one month) lapses between soil grading or seed bed preparation and seeding, the soil will be protected with a mulch cover, which will be mechanically or chemically anchored. A cover of hay mulch or hydromulch will be applied at a rate sufficient to provide 50 percent ground cover. The plantings will be randomly spaced and clumped for wildlife enhancement. Grazing will be enhanced by establishment of grasses. Grazing will not be allowed on the land until after bond release. Fencing will be installed if necessary to preclude grazing.

The final revegetation plan may be revised to incorporate the results of the interim revegetation and test plots. Revisions will be approved by the Division prior to implementation.

TOPSOIL HANDLING

During backfilling and grading, all acid and toxic materials will be covered with at least four (4) feet of non-toxic material. When feasible, this will occur within 30 days after the material is first exposed. Temporary storage of the material, beyond 30 days must be approved by the Division.

Following the backfilling and grading, the surface of the backfilled material will be in an uncompacted rough condition. If areas develop where the surface is not in such condition, the material will be ripped and roughened using track-hoes, dozers and/or hand tools to eliminate slippage surfaces and promote root penetration.

Topsoil material will be redistributed on the regraded areas using backhoes, excavators and dozers.

Following redistribution the topsoil will be sampled and analyzed for fertility and other parameters.

Because the majority of surface disturbance occurs on Forest Service land, the USFS has provided the applicant with both interim and final revegetation seed mixes proposed for use. Plant species in both mixes are currently in use by the Manti-LaSal National Forest and commonly occur on the Wasatch Plateau. Both seed mixes will be evaluated in test plot field trials initiated in fall 1989 at the Cottonwood/Wilberg Mine. The elevation, soils, slopes, aspects and seed mixes at Cottonwood/Wilberg are similar to those at Des Bee Dove. Therefore, the test plots installed at Cottonwood/Wilberg will serve Des Bee Dove also.

Additionally, test plots were established at the Des Bee Dove Haul Road and Sediment Pond area to test various soil stabilizing, soil enhancing and mulch treatments. The plots were established in cooperation with Division personnel in October of 1989. The test plot layout

is illustrated on page 4-22. The treatments include:

Land Tech Irish Peat Soil Enhancer (1 Ton, Plot 4)

Sulfur (250 lbs. each, Plot 1 & 4)

Soil Master Tackifier (25 gal. each, Plot 1 & 4)

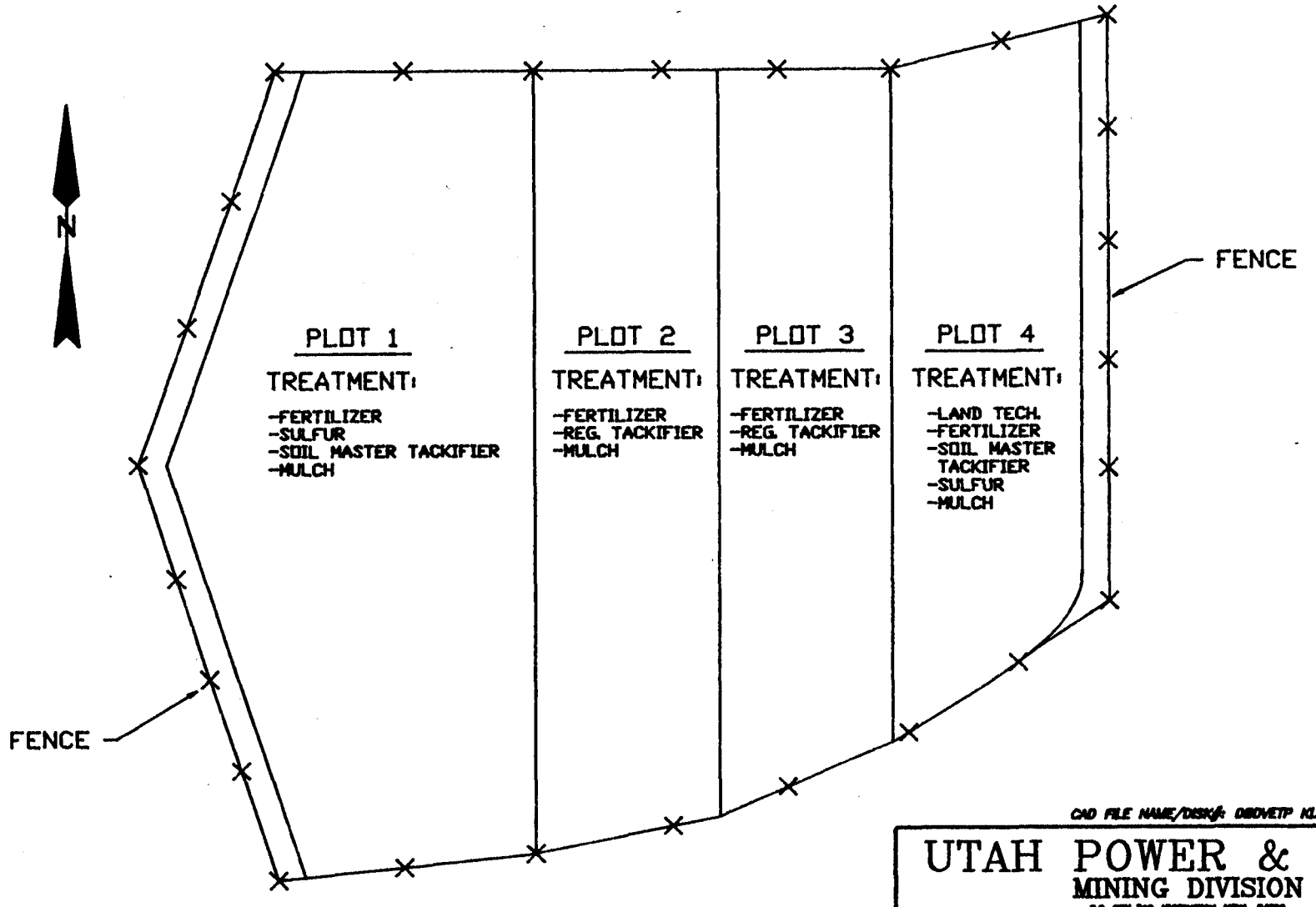
Ammonium Nitrate (100 lbs. total site)

Triple Super Phosphate (150 lbs. total site)

Wood Fiber Mulch (440 lbs. total site)

The following see mixture was applied over the entire site at the rates indicated.

SPECIES		PLS LBS/ACRE
Agropyron dasystachyum	thickspike wheatgrass	6
A. smithii	western wheatgrass	8
Oryzopsis hymenoides	Indian ricegrass	6
Elymus cinereus	basin wildrye	8
Sporobolus airoides	alkali sakatoon	.5
Melilotus officinalis	yellow sweetclover	4
Linum lewisii	Lewis flax	2
Sphaeralcea grossularifolia	globemallow	1
Atriplex canescens	fourwing saltbush	4
A. corrugata	mat saltbush	4
A. confertifolia	shadscale	2
Ceratoides lanata	winterfat	4
Kochia prostrata	prostrate kochia	1



CAD FILE NAME/DISK#: DBDVETP KL3

UTAH POWER & LIGHT
MINING DIVISION

DES-BEE-DOVE MINE VEGETATION/EROSION TEST PLOT

DRAWN BY: K. LARSEN		CS1218A
SCALE: 1" = 30'		DRAWING #:
DATE: 4-4-90	SHEET 1 OF 1	REV.

Revised 4/16/90

4-22

Because the mixes include six (6) introduced species, field trials will be conducted to demonstrate whether the introduced species can establish a diverse, effective and permanent cover capable of achieving the postmining land use.

The following information is provided for each of the introduced species as further justification for their use:

Alfalfa and Yellow Sweetclover

These species are included in the interim seed mixture (and yellow sweetclover in the final mixture) because of, (1) their nitrogen fixing ability; (2) deep tap roots; (3) highly rated forage quality; and (4) ability to encourage natural plant succession.

Smooth Brome

The following evidence suggests Smooth Brome is a deep rooting species that is ideally suited for inclusion in the interim seed mix. The maximum reported rooting depth for Smooth Brome given by Wyatt, et al (1980) was 76 cm. Nicholas (1979) reported of 17 grass species she evaluated, Smooth Brome had the highest overall root/shoot ratio (0.87). Dayton (1937) reported roots of Smooth Brome commonly penetrate to depths of five (5) feet or more. In additional to its deep rooting system, its sod-forming growth habits are ideally suited to control erosion. These characteristics justify its use for inclusion in the interim revegetation seed mixture.

Small Burnet

Small Burnet is included because of its ability to establish on disturbed sites and promote natural plant succession. According to Plummer, et al (1968), Small Burnet is a preferred plant for wildlife during late winter and early spring. Its relatively short persistence makes it an ideal nurse crop and successional species.

Intermediate Wheatgrass

The outstanding root growth characteristics of Intermediate Wheatgrass make this species ideal for interim and final revegetation in maintaining the viability of the soil biota. In a greenhouse study, Nicholas (1979) reported this species ranked fourth of seventeen species in overall root/shoot ratio (.75) and second of the seventeen species in root biomass (40.15%). In another greenhouse study, McGinnies and Crofts (1986) found Intermediate Wheatgrass to have higher root/shoot ratios (1.29) in unfertilized treatment than Smooth Brome (0.49) or Slender Wheatgrass (0.19). McGinnies and Nicholas (1982) reported Intermediate Wheatgrass produced the highest root yields of seventeen species tested on raw spoil.

Crested Wheatgrass

Crested Wheatgrass is valued as a long-lived, drought-resistant species which is easily established (SCS Bulletin TP-157, 1982). The species is equally valuable for its high productivity. Pallatability is reported as excellent in the spring and late fall (SCS Plant Materials Guide, 1988).

Seed Mixture - Final Revegetation

Common Name	Scientific Name	Lbs/Acre PLS*
Grasses		
Western wheatgrass	Agropyron smithii	3
Intermediate wheatgrass	Agropyron intermedium	3
Bluebunch wheatgrass	Agropyron spicatum	3
Indian ricegrass	Oryzposis hymenoides	3
Needle and thread grass	Stipa comata	2
Thickspike wheatgrass	Agropyron dasystachyum	2
Forbs		
Blueleaf aster	Aster glaucodes	0.5
Utah sweet vetch	Hedysarum boreale	1
Small burnet	Sanguisorba minor	3
Lewis flax	Linum lewisii	1
Globemallow	Sphaeralcea coccinea	0.5
Yellow sweetclover	Melilotus officinalis	2
	TOTAL	24.0

*Application rates result in approximately 80 seeds/ft^2.

Shrubs		
Serviceberry	Amelanchier Alnifolia	400
Fourwing saltbush	Atriplex canescens	400
Green Mormon tea	Ephedra viridis	400
Big white rabbitbrush	Chrysothamnus nauseosus var. albicaulis	200
Trees		
Douglas fir	Pseudotsuga menziesii	120
Colorado blue spruce	Picea pungens	80
	TOTAL	1600

Final Revegetation Methods

1. Seedbed Preparation

   Seeding will take place as contemporaneously as practicable following soil placement; therefore, the seedbed will be in a condition suitable for seed application. However, if a surface crust has developed it will be broken up by hand or mechanical tilling.

2. Seeding

The seed mixture will be hand broadcast with "hurricane spreaders" or applied by hydroseeder at the specified rates. All seed will be inspected by a Utah Department of Agriculture inspector at the time of application.

3. Fertilizer Application

The fertilizer mixture will be applied by hand broadcasting with "hurricane speaders" or as a separate operation of hydroseeding. Application rates will be determined from soil analysis of the "topsoil". (See item 7, Page 4-14 for soil sampling plan.)

4. Seed Covering

Following hand broadcasting of the seed mixture and fertilizer, the sites will be hand or mechanically raked to cover the seeds.

5. Mulch Application

Following hand broadcasting and raking, the seeded areas will be covered with hay mulch (2 tons per acre) and netting or erosion control mulch blanket. The netting or blanket will be mechanically anchored per the manufacturers specifications. Hay used for mulch will be inspected by a Utah Department of Agriculture inspector at the time of application.

Following hydroseeding, a hydromulch with tackifier will be applied at the rate of approximately 2000 lbs/acre.

6. During the spring following seeding, containerized stock of the shrub and tree species will be planted by hand. At each planting site, a basin will be created to retain moisture. A fertilizer tablet will be placed near the root zone of each plant and each planting will be hand watered. The plants will be grouped in the following manner to achieve layering:

   a. Plant groups will be randomly located throughout the reclaimed site at the rate of two hundred (200) groups per acre.

   b. Plant group dimensions and plant spacings will vary. Layering will be as follows:

Lower Layer = Ephedra viridis
Atriplex canescens

Middle Layer = Amelanchier alnifolia
Chrysothamnus nauseosus

Upper Layer = Pseudotsuga menziesii
Picea pungens

c. Group composition:

Lower Layer = 4 shrubs
Middle Layer = 3 Shrubs
Upper Layer = 1 tree

7. Irrigation application will be determined from test plot studies.

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. All noxious weeds will be eradicated if they become established on the site.

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.

6. Monitoring will be conducted in accordance with Division Guidelines as indicated on Pages 4-4.53.

7. Maintenance and monitoring activities will be reported in the Annual Vegetation Monitoring Report.

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 occular estimation methods will be used to measure cover and species composition.

3. The point-center quarter method will be used to measure shrub and tree density.

4. Sample size for ground cover and shrub density will be tested at a 90 percent confidence level using a one-tail "t" test with a 10 percent change in the mean.

5. Productivity measurements will be a double sampling procedure of clipped plots and occular estimates. Rectangular plots (6.27"x100") will be randomly located in reference areas and revegetation sites. Sampling will be at the 90% confidence level.

6. The reference areas will be checked to detect any changes from man-induced activities and to verify they are in fair or better condition.

7. Revegetation Success:

   a. Sampling of reference sites at end of ten year responsibility period will be conducted concurrently with final reclamation sampling, using the same methodology. The range condition of all reference areas will be re-assessed every five years.

   b. Ground cover is established for two consecutive years at the end of responsibility period at 90 percent of reference site ground cover.

   c. At least 80% of the shrubs and trees will have been in place for a least 8 growing seasons, the tree or shrub is alive and healthy.

d. The woody plants established on the revegetated site are equal to or greater than 90 percent of the stocking of live woody plants of the same life form of the approved reference areas with 90 percent statistical confidence.

e. Productivity will equal 90 percent of that of the reference areas at 90 percent statisical confidence.

f. A one-tail students "t" test of the sample means will be used for the statistical test.

RECLAMATION COST (784.13)

Estimated costs for reclamation are based on 1990 values and include all lands having been disturbed for the purpose of handling, crushing, storing and transporting coal extracted through the Deseret, Beehive and Little Dove Mines.

The following are the estimated costs for reclamation:

1.	Surface facilities removal	$ 186,973
	Items 1 and 2	
2.	Backfilling, compacting, grading	489,608
	Items 3 through 6	
3.	Revegetation	442,929
	Items 7 through 13	
*4.	Mobilization and demobilization	10,000
5.	10% Contingency	112,951
	1990 Total Reclamation Cost	$1,242,461

*It is customary for contractors, who must move men and equipment from job site to job site, to charge additional monies to competitively 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.

The average cost increase, during the preceding three years, as provided by the Means Historical Cost/Index (Salt Lake Index) is 1.84%.

Using the 1990 reclamation costs of $1,242,461 this compounds to $1,361,052 for 1995 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.

RECLAMATION PLAN: PROTECTION OF THE HYDROLOGIC BALANCE (784.14)

Because the Des Bee Dove Mine workings are dry, no special provisions will have to be made to insure that water wouldn't flow from the mine portal after the mine is abandoned. The portals, however, will be sealed with a double-block wall 25 feet in from the surface. The area between the block wall and the surface will then be back-filled. This, along with the fact that the mine is dry, will insure that no water will flow from the portal after the mine is abandoned. Representatives of the BLM will be notified when the portal sealing will begin. Recommendations made by the BLM will be followed when sealing these portals.

The Des Bee Dove Mine complex is located in a small, dry wash. Water in limited quantities flows down the wash only during storms. These waters are all diverted into a sediment pond. The size of the pond is adequate to retain water from a storm exceeding 1.5 inches in a 24 hour period. Accumulated sediment will be dredged from the sediment pond as required to retain the pond's water holding capacity. This sediment will be disposed of in the waste rock disposal site. When water is discharged from the sediment pond into the drainage, it will be monitored to insure that the effluent limitations aren't exceeded.

The land surface above the Des Bee Dove Mine workings is generally dry. A few springs have been identified along the west border of the mine area but only two springs are present above the existing or proposed mine workings. Because coal has

been mined in both seams below the two springs and the monitoring of those springs has shown no mining induced changed, it is felt highly unlikely that mining will have any effect on the hydrologic regime of the area.

The Des Bee Dove, Wilberg Junction Road, sediment pond and sediment structure are located in an area that is free from groundwater or surface water. The impermeable strata of the Masuk Shale acts as an aquiclude to any water which migrates down through the overlying strata. Because of this, the strata in the area of the road is dry. The surface water that is periodically present occurs as runoff from rains generally from summer thunder storms. This runoff intersects several minor washes which have been culverted beneath the road to adequately handle the storm events. Therefore, it is not felt that this road will impact the hydrologic balance of the area. The road, sediment pond and sediment disposal area are of such a minor nature that no action is required to mitigate their function.

HYDROLOGIC BALANCE: WATER QUALITY STANDARDS AND EFFLUENT LIMITATIONS

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

RECLAMATION PLAN: POSTMINING USES (784.15)

The disturbed area (portal area of the Des Bee Dove Mines) lies within a small, steep, dry wash. Reclamation work

identified within this wash states that disturbances shall be placed back to approximate original contours. Regraded and compacted fills of the three small structures requiring reclamation in the wash after revegetation should provide equivalent cover and grazing that existed prior to mining.

Reclamation of the bathhouse structure incorporating terraces provides level area where revegetated cover would be increased as compared to the premining steep slopes.

The tipple pad structure with an area of 4 acres is additional land now usable which, before mining, were eroded, steep cliffs, for the most part, void of vegetation.

A key element of the reclamation plan as envisioned, is the leaving of the road system as is to allow greater use of the area by the general public.

A protective barrier will be placed across the dirt road (see final reclamation map) to prohibit casual users of the area from proceeding further than the mine area. Cattlemen who use the upper access trail will be able to pass the barrier.

Land use after reclamation primarily would be the same as before mining, that is, grazing and wildlife habitat.

Alternate land uses besides grazing and wildlife habitat would include recreation, such as hunting. The absence of water limits the potential of other uses.

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

PROTECTION OF PUBLIC PARKS AND HISTORIC PLACES (784.17)

No public parks are located in or adjacent to the permit area.

Cultural resource information contained in this application was based on field surveys contracted to A.E.R.C. (Archeological-Environmental Research Corporation) and conducted under the auspices of Richard Hauck.

For lands within the permit area not covered by planned surface disturbances, but which could be affected by subsidence, a general 15 percent random survey was conducted. Basis of this survey was extrapolated from requirements mandated by OSM for authorization to mine coal from the Des Bee Dove Mine. Results of this survey are contained in the report found in the Environment Section.

RELOCATION OF PUBLIC ROADS (784.18)

The Des Bee Dove Mine portal requires no further action for public review concerning mining within 100 feet of public road, as exemption 761.11 (a) (4) (i) applies.

DESERET-BEEHIVE-LITTLE DOVE MINES
RECLAMATION COSTS
SURFACE FACILITIES REMOVAL

ITEM #	DESCRIPTION	EQUIPMENT MANPOWER	QUANTITIES	TOTAL COST	CONSTR. DAYS	COMMENTS
1-A	Office-Bathhouse Warehouse Building	Crane Flatbed Truck 5-Man Crew	1 lot	$ 15,603	8 Days	Structure is sheet metal over steel frame.
1-B	Tipple Building	Crane Flatbed Truck 5-Man Crew	1 lot	46,808	24 Days	
1-C	Conveyor System and Stacking Tube	Crane Flatbed Truck 5-Man Crew	1,000 ft.	19,503	10 Days	Overhead and underground.
1-D	Deseret Fan #1	Crane Flatbed Truck 5-Man Crew	1 lot	3,901	2 Days	
1-E	Deseret Fan #2	Crane Flatbed Truck 5-Man Crew	1 lot	3,901	2 Days	
1-F	Beehive Fan	Crane Flatbed Truck 5-Man Crew	1 lot	3,901	2 Days	
1-G	Little Dove Fan	Crane Flatbed Truck 5-Man Crew	1 lot	3,901	2 Days	
1-H	Culinary Water Tank	Crane Flatbed Truck 5-Man Crew	1 lot	1,950	1 Day	
1-I	Material Storage Shed	Crane Flatbed Truck 5-Man Crew	1 lot	3,901	2 Days	

Revised 4/16/90

ITEM #	DESCRIPTION	EQUIPMENT MANPOWER	QUANTITIES	TOTAL COST	CONSTR. DAYS	COMMENTS
1-J	Water System Water Tank, Pump House and Water Line	Crane Flatbed Truck 5-Man Crew	1 lot	$ 3,901	2 Days	
1-K	Underground Shop	988B Flatbed Truck 5-Man Crew	1 lot	4,460	2 Days	Tear down portal and bury.
1-L	Fuel and Oil Storage Tanks	Crane Flatbed Truck 5-Man Crew	1 lot	1,950	1 Day	All above surface.
1-M	Concrete Trash Bins	988 Loader 769B Truck 4-Man Crew	2 each	5,047	2 Days	Broken up and hauled to bathhouse site for disposal.
1-O	Power Substation Lower	Crane Flatbed Truck 5-Man Crew	1 lot	5,851	3 Days	
1-P	Power Substation Upper	Crane Flatbed Truck 5-Man Crew	1 lot	5,851	3 Days	
1-Q	69 KV Transmission Line	REMOVED BY OTHERS (UTAH POWER & LIGHT COMPANY) - NO COST CHARGED TO MINING.				
1-R	Footer Removal and Cleanup	988B 769B Truck 5-Man Crew	1 lot	13,772	5 Days	Small footers, culverts, and misc.
			Subtotal	$144,201	71 Days	

Revised 4/16/90

RECLAMATION COSTS
PORTAL SEALING

ITEM #	DESCRIPTION	EQUIPMENT	QUANTITIES	UNIT COST	TOTAL COST	CONSTR. DAYS	COMMENTS
2-A	Portal Seals Includes Ventilation Portals	3-Man Crew Flatbed Truck Crawler Tractor	17	$ 2,516	$ 42,772	34	3 Little Dove 4 Beehive 10 Deseret
				Subtotal	$ 42,772	34	

BACKFILLING AND GRADING

ITEM #	DESCRIPTION	EQUIPMENT	HRS.	LABOR	HRS.	TOTAL	CONSTRUCTION DAYS
3-A	Beehive-Little Dove	D8G, 2 ea. 769B, 2 ea. 988	10.9 6.2 6.2	1 Supervisor 2 Operators 3 Operators	10.9 10.9 6.2	$ 4,743	1.4
3-B	Parking Lot Extension	235 769B, 2ea. 825C D8 988	14.2 15.9 15.9 2.4 1.7	1 Supervisor 3 Operators 1 Operator 1 Operator	15.9 15.9 14.2 4.1	8,491	2.0
3-C	Parking Lot-Bathhouse-Warehouse	235 769B 825C	79.1 79.1 79.1	3 Operators 1 Supervisor	79.1 79.1	32,479	9.9
3-E	Haul Road - Remove and bury asphalt and road base	D8 Dozer 621B, 2 ea. 825C	114.0	6 Operators	411.0	49,489	10.0
3-F	Haul Road - Culvert Removal, Channel Reconstruction and lining	D8 Dozer 621B Scraper 825C Compactor 235 Excavator	262.0 783.0 143.0	6 Operators 1 Supervisor	1450.0 360.0	184,242	45.0
	Rip-rap lining material	5450 cyds @ $10/cyd				54,500	
				Subtotal		$333,944	68.3

Revised 4/16/90

TOXIC AND ACID FORMING

ITEM #	DESCRIPTION	EQUIPMENT	HRS.	LABOR	HRS.	TOTAL	CONSTRUCTION DAYS
4-A	Asphalt disposal (includes road base and contaminated materials)	988B 769C 825C 235	7.9 7.9 7.9 10.2	1 Supervisor 1 Operator 3 Operators	10.2 10.2 7.9	$ 4,769	1.3
				Subtotal		$ 4,769	1.3

INSTALL DRAINAGE CHANNELS

5-A	Diversion, A and B	235 769B, 2 ea. 988B	21.9 21.9 21.9	1 Supervisor 4 Operators 2 Laborers	21.9 21.9 21.9	$ 12,911	2.7
5-B	Large Diversion	D8K 825C 235 988B 769B, 2 ea.	15.7 57.5 57.5 15.2 15.2	1 Supervisor 1 Operator 2 Operators 3 Operators 2 Laborers	57.5 15.7 57.5 15.2 57.5	26,288	9.2
		Riprap 3,169 c.y. x $11.00 Clay Liner 600 c.y. x $8.00				39,659	
5-C	Riprap Fan	988B 235	28.6 28.6	1 Supervisor 2 Operators	28.6 28.6	9,090	3.6
		Riprap 1,422 c.y. x $11.00				15,644	
				Subtotal		$105,992	15.5
6	Backfill Sediment Pond	D8K 621B, 2 ea. 825C	90.8 90.8 90.8	1 Supervisor 4 Operators	90.8 90.8	$ 44,903	11.4
				Subtotal		$ 44,903	11.4

Revised 4/16/90

SOIL SAMPLING & SEED BED PREPARATION

ITEM #	DESCRIPTION	EQUIPMENT	HOURS	LABOR	HOURS	TOTAL COST	CONSTRUCTION DAYS
7-A	Soil Sampling 10 Tests	Drill Truck @ $300/Day	8.0	1 Operator 1 Helper	8.0	$ 760	1 Day
7-B	Laboratory Analysis (10 Samples)	Laboratory		Lab Cost @ $100/ea.		1,000	4 Days
7-C	Redistribute Topsoil	988B - 1 each	24.0	1 Operator	24.0	3,685	3 Days
7-D	Seed Bed Preparation			1 Supervisor	42.0	8,327	5 Days
	Hand Till	None		4 Laborers			
	Tractor Till	Tractor	128.0	1 Operator	128.0	4,114	16 Days
				Subtotal		$ 17,886	29 Days

FERTILIZING AND MULCHING

8-A	Fertilize 74.5 Acres	Flatbed Truck	149.0	1 Supervisor 3 Laborers	149.0	$ 20,002	19 Days
8-B	Mulch 74.5 Acres Net 10.5 Acres	Flatbed Truck	233.0	1 Supervisor 3 Laborers	233.0	31,278	29 Days
8-C	Haul Road	Hydroseeder Materials	225.0	None		19,125 77,625	28 Days
				Subtotal		$148,030	76 Days

SEEDING AND PLANTING

9-A	Seeding 74.5 Acres	Flatbed Tractor	149.0 38.0	1 Supervisor 3 Laborers	149.0	$ 20,562	19 Days
9-B	Transplanting 58,036 each	Flatbed Truck	232.0	1 Supervisor 3 Laborers	232.0	31,144	29 Days

Revised 4/16/90

ITEM #	DESCRIPTION	EQUIPMENT	HOURS	LABOR	HOURS	TOTAL COST	CONSTRUCTION DAYS
9-C	Seed, Mulch, Fertilizer, Plants and Netting	None Material		None-Material		115,024	Material
9-D	Haul Road	Hydroseeder Materials	75.0	None		6,375 15,150	9 Days
				Subtotal		$188,255	57 Days
	PLANT MONITORING DISEASE AND PEST CONTROL						
10-A	Revegetation Monitoring	None		1 Supervisor 1 Laborer	40.0	$ (2,456)	(6 Days)
	Monitoring on 2, 3, 4, 5, 7, 10 Years = 6 Years @ $2,456/Year =					14,736	36 Days
10-B	Disease and Pest Control	None		1 Supervisor 1 Laborer	20.0	(1,228)	(2 Days)
	Control applied 2, 5, 7, 10 Years @ $1,228/Year					4,912	8 Days
10-C	Water Sampling (NPDES)	None		1 Supervisor	4.0	(144)	(1 Day)
	Monitoring 4 times each year for 10 years = 10 years @ $144 =					1,440	10 Days
10-D	Water Analysis (40 Samples @ $200)	Lab				8,000	(30 Days)
				Subtotal		$ 29,088	54 Days
	SOIL STABILIZATION - RILLS AND GULLIES						
11-A	Soil Stabilization Rills & Gullies	510 Backhoe	48.0	1 Operator 1 Laborer	48.0 48.0	$ (6,069)	(6 Days)
	Repeat work on 1, 2, 3, 6, 10th year = 5 years @ $6,069 =					30,345	30 Days
				Subtotal		$ 30,345	30 Days

Revised 4/16/90

CONTINGENT SEEDING AND PLANTING

ITEM #	DESCRIPTION	EQUIPMENT	HOURS	LABOR	HOURS	TOTAL COST	CONSTRUCTION DAYS
12-A	Contingent Planting	Flatbed	38.1	1 Supervisor	38.1	$ 3,824	1 Day
		Hydroseeder	7.5	1 Laborer			
	Materials					13,017	
				Subtotal		$ 16,841	

REVEGETATION INVENTORY FOR BOND RELEASE

13-A	Vegetation Inventory	None		1 Supervisor 2 Laborers	72.0	$ 6,242	9 Days
	Repeat Inventory on 9th and 10th years = 2 years @ $6,242						
				Subtotal		$ 12,484	

Mobilization	10,000
Construction Cost	1,119,510
10% Contingency	112,951
TOTAL CONSTRUCTION COST	$1,242,461

NOTE: The following items have been deleted from the Reclamation Cost Schedule for the reasons indicated.

1-N Rock Dust Silo - Removed in 1988.
3-D Tipple Pad Slope Modification - Completed in 1984.

Revised 4/16/90

RECLAMATION COSTS

1. STRUCTURE REMOVAL - UNIT COSTS

A. CRANE, FLATBED TRUCK AND 5 MAN CREW

50 Ton Diesel Hydraulic Crane

$7,955/mo. x 1/22 = 361.59/day

Operating costs $26.70/hr. x 8 = 213.60/day

Total = $ 575.19/day

Diesel Flatbed Truck, 250 HP

$1,495/mo. x 1/22 = 67.95/day

Operating costs $7.75/hr. x 8 = 62.00/day

Total = $ 129.95/day

Crew

Working Foreman		$ 36.70/hr.
Heavy Equipment Operator		34.70
Truck Driver		27.05
2 Laborers (wrecking)	2 x	28.85
Total		$ 155.65/hr.

$155.65 x 8 = $ 1,245.20/day

Cost Per Day

Crane	$ 575.19
Truck	129.95
Crew	1,245.20
	$ 1,950.34/day

B. 988 LOADER, FLATBED TRUCK AND 5 MAN CREW

988B Diesel Loader, 7 cubic yard bucket

$11,630/mo. x 1/22 = $528.64/day

Operating Cost $40.80/hr. x 8 = $326.40

Total =	$ 855.04/day

Diesel Flatbed Truck See Section A	$ 129.95/day
5 Man Crew See Section A	1,245.20/day
Cost Per Day	$ 2,230.19/day

C. 988 LOADER, 769B TRUCK, 4 MAN CREW

988B Diesel Loader See Section C	$ 855.04/day

769C Off Highway Truck, 35 Ton

$8,715/mo. x 1/22 = 396.14/day

Operating costs $25.10/hr. x 8 =	200.80/day
Total =	$ 596.94/day

Crew

Working Foreman	$ 36.70/hr.
2 Heavy Equipment Operators 2 x	34.20
Laborer (wrecking)	28.85
Total =	$ 133.95/hr.
$133.95 x 8 =	$ 1,071.60/hr.

Cost Per Day		
Loader	$	855.04
Truck		596.94
Crew		1,071.60
	$	2,523.58/day

D. 988 LOADER, 769 TRUCK, 5 MAN CREW

988B Diesel Loader See Section B	$	855.04
769C Off Highway Truck See Section C		596.94
Crew		
Working Foreman	$	36.70/hr.
2 Heavy Equipment Operators 2 x		34.20
2 Laborers (wrecking) 2 x		28.85
Total =	$	162.80/hr.
162.80 x 8 =	$	1,302.40

Cost Per Day		
Loader	$	855.04
Truck		596.94
Crew		1,302.40
	$	2,754.38/day

2. PORTAL SEALING UNIT COSTS

Materials

Concrete Blocks 400 @ $1.00	$	400.00
Mortar 25 bags @ $2.60		65.00
Soil Backfill 150 cyds @ $2.00		300.00
	$	765.00

Equipment

Flatbed Truck 2 hrs./day

$1,495/mo. x 1/176 = $8.49/hr.

Operating cost = $7.75/hr.

$16.24/hr. x 2 hrs. x 2 days = $ 64.96/Portal

Crawler Tractor D6H

$5,700/mo. x 1/22 - $259.09/day

Operating cost $14.30/hr. x 8 = $114.40/day

Total = $ 373.49/day/Portal

Equipment Cost Per Portal	$	64.96
		373.49
		438.45

Crew

Brick Layer	$	33.05/hr.
Brick Layer's Helper		25.75/hr.
Equipment Operator		33.00/hr.
Truck Driver		27.05/hr.

Work Per Portal Unit

2 days block laying

1 day backfilling

4 hours trucking

2 days x Brick Layer	33.05 x 8	$ 528.80
2 days x Brick Layer's Helper	25.75 x 8	412.00
1 day x Operator	33.00 x 8	264.00
4 hours x Truck Driver	27.05 x 4	108.20
Total		$ 1,313.00/Portal

Cost Per Portal

Material	$ 765.00
Equipment	438.45
Labor	1,313.00
Total	$ 2,516.45/Portal

RECLAMATION COSTS

3. BACKFILLING AND GRADING

A. BEEHIVE/LITTLE DOVE EMBANKMENT

Description: The soil material from the portal pads will be dozed off to construct a 2H:1V earth slope. A loader on the Deseret pad will load two 769C Off Highway trucks which will haul the material back up to the Little Dove level where it will be placed against the highwall above the Little Dove Portal. A D8 dozer will be used to spread the material and construct the 2H:1V slope.

Production:

6000 cyds of material at the site

900 cyds will be used as portal seals

600 cyds estimated to be saved for rip-rap material

823 cyds for parking lot extension area

3677 cyds total to be moved

D8 Dozer Production - 338 cyds/hr. corrected

3677 cyds - 338 = 10.9 hours

Use two Dozers for 10.9 hours each to handle the material twice

988 Loader Production - 598 cyds/hr. corrected

3677 cyds - 598 = 6.2 hours

769C Truck Production - 30 cyds/cycle,
4.9 min/cycle, 50 min/hr.
3667 cyds - 30 x 4.9 - 50 = 12.0 hours
Use two 769C trucks - 6.2 hours each

Project Costs

D8 Dozer 2 x 10.9 x $63.00 =	$ 1,373.40
988 Loader 6.2 x $106.88 =	662.66
769C Trucks 2 x 6.2 x $74.62	925.29
	$ 2,961.34
1 Supervisor 10.9 hrs. x $36.70 =	$ 400.03
2 Operators 10.9 hrs. x $34.20 =	745.56
3 Operators 6.2 hrs. x $34.20 =	636.12
	$ 1,781.71

Total	$ 2,961.34
	1,781.71
	$ 4,743.05

B. PARKING LOT EXTENSION EMBANKMENT

Description: Soil from the Deseret Portal Pad is loaded and hauled to the areas of the Parking Lot Extension and placed as backfill. A 235 Backhoe Excavator is used to load the material on 769C Off Highway trucks. A 825 Compactor is used to spread and compact the soil on a 3H:1V slope. Additionally 823 cyds from

the Little Dove Pad will be hauled.

Production:

7333 cyds of material on site

900 cyds to be used to seal the Deseret Portals

730 cyds estimated to be saved for rip-rap materials

1429 cyds for Bathhouse-Warehouse embankment

4274 cyds to be moved from Deseret Pad

823 cyds to be moved from Little Dove Pad

5097 cyds total

D8 Dozer 823 cyds at 338 cyds/hr. = 2.4 hrs.

988 Loader 823 cyds at 598 cyds/hr. = 1.4 hrs., use 1.7 hrs.

769C Trucks 240 cyds/hr./truck

823/(2 x 240) = 1.7 hrs.

235 Backhoe 4274 cyds at 300 cyds/hr. = 14.2 hrs.

769C Trucks 4274 cyds at 450 cyds/hr./truck

4279/(2 x 450) = 9.5 hrs., use 14.2 hrs.

Total time for 769C Trucks = 15.9 hrs.

825 Compactor 5097 cyds at 1604 cyds/hr.

5097/1604 = 3.2 hrs., use 15.9 hrs.

Project Costs:

D8 Dozer 2.4 hrs. x $63.00	$ 151.20
988 Loader 1.7 hrs. x $106.88	181.70
235 Backhoe 14.2 hrs. x $107.84	1,531.33
825C Compactor 15.9 hrs. x $88.85	1,412.72

769C Trucks 2 x 15.9 hrs. x $74.62	2,372.92
	$ 5,649.87

1 Supervisor 15.9 hrs. x $36.70	$ 583.53
3 Operators 15.9 hrs. x $34.20	1,631.34
1 Operator 14.2 hrs. x $34.20	485.64
1 Operator 4.1 hrs. x $34.20	140.22
	$ 2,840.73

Total	$ 5,649.87
	2,840.73
	$ 8,490.60

C. PARKING LOT/BATHHOUSE/WAREHOUSE EMBANKMENT

Description: Using a 235 Backhoe Excavator, the fill material is to be terraced back as shown on the cross sections to complete the terraces, additional material from the Deseret level and the Coal Stockpile area will be hauled. Placement of the fill and compaction will be done with a 825 Compactor.

Production:

16,296 cyds on Bathhouse level

1,429 cyds from Deseret Pad

5,869 cyds from Coal Stockpile Pad

23,594 cyds total to be moved

235 Backhoe 23,594 cyds at 300 cyds/hr. = 79.1 hrs.

769C Trucks 16,296 cyds at 420 cyds/hr. = 38.8 hrs., use 54.3 hrs.

1429 cyds at 450 cyds/hr. = 3.2 hrs., use 4.8 hrs.

5859 cyds, use 20 hrs.

Total = 79.1 hrs.

825C Compactor 2359 cyds at 1604 cyds/hr. = 14.7 hrs., use 79.1 hrs.

Project Costs:

235 Backhoe 79.1 hrs. x $107.84	$ 8,530.14
769C Truck 79.1 hrs. x $74.62	5,902.44
825C Compactor 79.1 hrs. x $88.85	7,028.04
	$21,460.62
1 Supervisor 79.1 hrs. x $36.70	$ 2,902.97
3 Operators 3 x 79.1 hrs. x $34.20	8,115.66
	$11,018.63

Total	$21,460.62
	11,018.63
	$32,479.25

E. Des-Bee-Dove to Cottonwood/Wilberg Haul Road

Remove asphalt and road base material and place it at the north end of the road to be covered with 4 feet of non-toxic soil.

1. Rip existing asphalt with D8 Dozer 18 inches deep, 4 foot spacing of passes, 300 feet per pass at 1 mile per hour.

   $300 \text{ ft.} \times \frac{88 \text{ ft.}}{\text{min.}} = 3.41 \text{ min./ } 300 \text{ ft. pass}$

   Add .25 min. for turning around

   3.41 + .25 = 3.66 min./300 ft. pass

   36' wide - 4 ft./pass = 9 passes for fill width

   3.66 min./pass x 9 passes = 32.9 min./300 ft.

   12105 ft. long/300 ft. = 40.35

   Total Time = 40.35 x 32.9 = 1328 min.

   Use 45 min./hr. efficiency

   $\frac{1328 \text{ min.}}{60} \times \frac{60}{45} = 30 \text{ hours}$ D8 Dozer

2. Haul loosened asphalt and road base

   Quantity = 26,387 cyds

   Average haul distance = 5078 ft.

   Change in elevation = 365 feet

   Average slope = 365/5078 x 100% = 7.2%

   Caterpillar 621 B Scrapers

   Load time = 0.7 min./cycle

   Manuever and spread time = 0.7 min./cycle

   Loaded travel time = 4.6 min.

   Empty travel time = 2.6 min.

Total cycle time = 4.6 + 2.6 + .7 + .7 = 8.6 min.

Production per load = 20 cyds heaped

Number of loads = 26,387 - 20 = 1319 loads

Time required = $1319 \times \frac{8.6 \text{ min.}}{60 \text{ min./hr.}} = 189$ hrs.

At 45/min./hour efficiency

189/.75 = 252 hours 621 B Scrapers

With 1 Dozer for 3 Scrapers

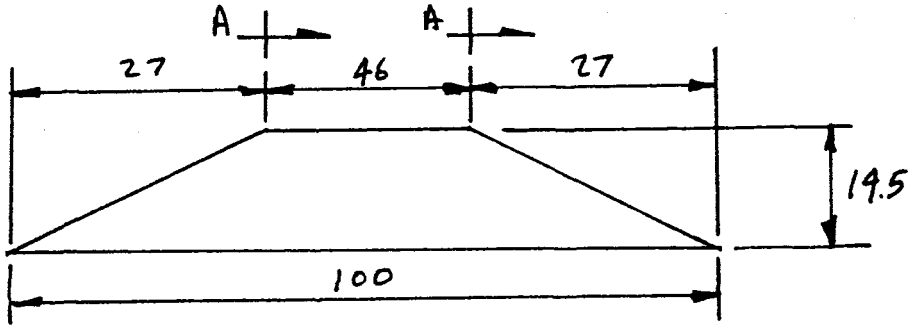
252 hrs./3 = 84 hours D8 Dozer

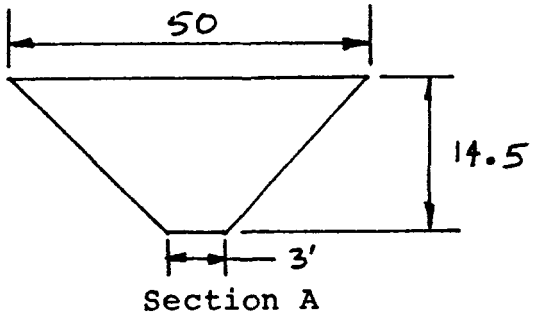
Production estimation from Caterpillar Performance Handbook, Edition 7, October 1976.

F. Des-Bee-Dove to Cottonwood/Wilberg Haul Road.

Remove culverts, reestablish drainage channels and install rip-rap linings.

1. Remove culverts which are not replaced with drainage channels. Eight 24 inch culverts totaling 800 feet, average depth = 14.5 feet at center line.
Volume to be moved:





Section A

Area A = $\frac{(50 + 3)}{2}$ x 14.5

AA = 384 ft.^{2}

Volume = $\frac{(0 + AA)}{2}$ 27 + $\frac{(AA + AA)}{2}$ 46 + $\frac{(0 + AA)}{2}$ 27

= $\frac{27AA}{2}$ + 46AA + $\frac{27AA}{2}$ = 73AA

= 73 (384) x $\frac{1}{27}$ = 1038 cyds/culvert

Total for 8 culverts = 8306 cyds

One each 42 inch culvert, 226 ft. long 42 feet deep at center line

Volume = 14,171 cyds

Total for all culverts = 22,477 cyds

Production for CAT 235 Excavator with 1.50 cyd bucket

360 cyds/hr. @ 15 sec. cycle time

Time to move 22,477 cyds

$\frac{22,477}{360}$ cyds = 62.4 hours
at 45 min./hr efficiency

62.4/.75 = 83 hours CAT 235 Excavator

2. Excavate for drainage channels and haul material to backfill area.

Channel #3 - 107,515 cyds of excavation to be hauled

1375 feet up an 8% grade with a Caterpillar 621B Scraper

Loaded travel time = 1.5 min.

Empty travel time = 1.0 min.

Fixed time = 1.4 min.

Cycle time = 3.9 min.

Number of loads = 107,515/20 cyds/load = 5376 loads

Time required = 5376 loads x 3.9 min./cycle = 20,966 min. @ 45 min./hr. efficiency

Total time $\frac{20,966 \text{ min.}}{60 \text{ min./hr.}} \times \frac{60 \text{ min.}}{45 \text{ min.}} = 466$ hours

621B Scraper

466/3 = 155 hours D8 Dozer

Channel #4 10,656 cyds, 670', +8% grade

Equipment time

29 hours 621B Scraper
10 hours D8 Dozer

26,329 cyds, 984', -8% grade

Equipment time

85 hours 621B Scraper
28 hours D8 Dozer

Channel #5 2560 cyds, 1022', -8% grade

Equipment time

8 hours 621B Scraper
3 hours D8 Dozer

Channel #7 13,200 cyds, 420', -1.9% grade

Equipment time

29 hours 621B Scraper
10 hours D8 Dozer

10,893 cyds, 1068', -7.1% grade

Equipment time

31 hours 621B Scraper
10 hours D8 Dozer

Channel #8 838 cyds, 564', -7.1% grade

Equipment time

2 hours 621B Scraper
1 hour D8 Dozer

Channel #10 25,579 cyds, 796', +7.1% grade

Equipment time

68 hours 621B Scraper
23 hours D8 Dozer

Channel #11 611 cyds, 801', +2.46% grade

Equipment time

2 hours 621B Scraper
1 hour D8 Dozer

Channel #12 552 cyds, 1470', +2.46% grade

Equipment time

2 hours 621B Scraper
1 hour D8 Dozer

Channel #13 529 cyds, 729', +2.46% grade

Equipment time

1 hour 621B Scraper

Channel #14 14,296 cyds, 630', +2.46% grade

Equipment time

33 hours 621B Scraper
11 hours D8 Dozer

11,475 cyds, 505', -2.46% grade

Equipment time

26 hours 621B Scraper
9 hours D8 Dozer

Channel #15 674 cyds, 60', +2.46% grade

Equipment time

1 hour 621B Scraper

Total equipment time

783 hours 621B Scraper
262 hours D8 Dozer
262 hours 826B Compactor

3. Install rip-rap lining

CHANNEL	RIP-RAP VOLUME cyds	D100 SIZE inches
3	2150	60
4	500	30
5	145	17
7	140	18
8	89	12
10	300	22
12	77	9
13	84	12
14	1920	46
15	48	9
	5453 cyds	

One half of the total will be recovered from existing stockpiles or excavation performed during the project. Filter material quantity equals one half the rip-rap total. Equipment time for placing rip-rap:

CAT 235 Excavator

Use 180 cyds per hour

1.5 * 5453/180 = 45 hrs @ 45 min./hr. = $45 \times \frac{1}{.75} = 60$ hr.

4. TOXIC AND ACID FORMING

A. REMOVE AND BURY ASPHALT

Description: Using a 235 Backhoe and 988 Loader, the asphalt will be removed from the access road to the Tipple Yard and to the Bathhouse level and Parking Lot. 769C Off Highway trucks will haul the material and a 825C Compactor will spread and compact it.

Production:

510 cyds on Access Road

2317 cyds on Parking Lot

2826 cyds total

235 Backhoe 2827 cyds at 278 cyds/hr. = 10.2 hrs.

988 Loader 2827 cyds at 359 cyds/hr. = 7.9 hrs.

769C Trucks 510 cyds at 390 cyds/hr. = 1.3 hrs.

2317 cyds at 660 cyds/hr. = 3.5 hrs., use 7.9 hrs.

Total time for 769C = 7.9 hrs.

825C Compactor 2827 cyds at 1604 cyds/hr. = 1.76 hrs., use 7.9 hrs.

Project Costs:

235 Backhoe 10.2 hrs. x $107.84 =	$ 1,099.97
988 Loader 7.9 hrs. x $106.88 =	844.35
769C Truck 7.9 hrs. x $74.62 =	589.50
825C Compactor 7.9 hrs. x $88.85 =	701.92

		$ 3,235.74
1 Supervisor 10.2 hrs. x $36.70 =		$ 374.34
1 Operator 10.2 hrs. x $34.20 =		348.84
3 Operators 3 x 7.9 hrs. x $34.20 =		810.54
		$ 1,533.72
Total		$ 3,235.74
		1,533.72
		$ 4,769.465.

5. INSTALL DRAINAGE CHANNELS

A. CONSTRUCT DIVERSIONS A AND B

Description: Two small diversions will be built, as shown on drawing, to carry water across fill areas. Use the 235 Excavator to dig channel. 235 Excavator and two 769B trucks will be used to place rip-rap.

Equipment:

235 Excavator

769B Truck, 2 ea.

988B Loader

Labor:

5 Operators

2 Laborers

Quantities:

Rip-rap 850 c.y. (from the site)

Gravel liner 212 c.y. (from parking lot)

Clay liner 318 c.y. (off site)

Production: Excavation

Cross-section of ditch: 12 $ft.^2$ = .5 c.y./lin. ft.

Cycle time: 0.5 min./2 c.y. = 8 lin. ft./min.

200 lin. ft./hr.

60% efficiency x 200 = 120 lin. ft./hr.

1275 - 120 = 10.6

Line Ditch

2.5 c.y./min. for rip-rap

Double time for liners

75 c.y./hr.

805 - 75 = 11.3 hrs.

Total 11.3 + 10.6 = 21.9 hrs.

B. CONSTRUCT LARGE DIVERSION

Description: Using a D8K Dozer the trench will be cut across the yard area as shown. The excavated material is spread over the adjacent area. The liners and rip-rap will be purchased from a local contractor and delivered to the site as needed. An 825C Compactor will be used to place the liners. A 235 Excavator will be used to place the rip-rap.

Equipment:

D8K Dozer

826B Compactor

235 Excavator

988 Loader

769B Truck, 2 ea.

Labor:

6 Operators

2 Laborers

Quantities:

1136 c.y. rip-rap (from site)

3,169 c.y. rip-rap (off site)

574 c.y. gravel (from parking lot)

861 c.y. liner (off site)

3,407 Excavation

Production: Excavation

Average haul distance 200'

450 c.y./hr. (.75) (.80) (.67) (1.2) = 217 c.y./hr.

3,407 - 217 = 15.7 hrs.

Line Ditch (based on rip-rap)

75 c.y./hr.

3,169 - 75 = 42.3 hrs.

On-site material

1,136 - 75 = 15.2 hrs.

C. RIP-RAP FAN

Description: Part of the final diversion drainage system is to build an energy dissipator, to channel the water off the large fill onto natural terrain. Rip-rap will be purchased from a local contractor and hauled to the site. A 988 Loader is used to deliver the rip-rap to the site which will be placed by the 235 Backhoe.

Equipment:

988B Loader

235 Backhoe Excavator

Labor:

2 Operators

Quantities:

2,402 c.y.

Production:

Cycle time: 5 min./7 c.y.

84 c.y./hr.

2,402 c.y. - 84 = 28.6 hrs.

6. BACKFILL SEDIMENT POND

Description: Using material from the spoil piles developed during construction of the pond will be backfilled after the bonding period is complete.

Equipment:

D8K Dozer

621B Scraper, 2 each

825C Compactor

Labor:

4 Operators

Quantities:

30,976 c.y.

Production:

Average haul distance 500' at +10%

Average cycle time 3.7 min./14 c.y.

2 units x 227 c.y./hr. = 454 c.y./hr.

75% efficiency = 341 c.y./hr.

30,976 - 341 = 90.8 hrs.

Item #7

Soil Sampling and Seed Bed Preparation

A. Soil sampling per D.O.G.M. guidelines. All areas of existing embankment that will be redistributed as top soil. This includes soils excavated for channel construction.

B. Scarification of old road beds for knitting topsoils or regrading.

C. Upon asphalt removal, redistribution of clean gravels for channel reconstruction (filter beds).

D. Surface preparation, steep slopes slopes exceeding 25% (15°) is handwork. Slopes less than 25% will utilize a tractor and drag implement to accomplish surface preparation.

Equipment: Soil Drill, Tractor and Implements

Labor: 1 Operator, 4 Laborers

Production: Soil Samples 8 Hours

Seed Bed Work:

a. Hand Tilling @ 4 Hours/acre - 10.5 Ac. 42 Hours

b. Tractor tilling @ 2 Hrs./Ac - 64 Ac. 128 Hours

Total Hours 170 Hours

Revised 4/3/84
Revised 10/1/84

Item #8

Soils, Fertilization, Mulching

A. Fertilize - Broadcast 74.5 Acres

B. Planting Seed and Plants (see Item #9)

C. Mulch - Spread Hay Bales - 74.5 Acres

D. Spread and Staple Netting - 10.5 Acres

Equipment: Flat-bed Truck

Labor: 1 - Working Foreman
3 - Laborers

Quantities: Fertilize (hand-work) 74.5 Acre
Mulch 2" cover - 2 Tons/Acre
Install Nylon Netting 10.5 Acre

Work Time:

Haul, Spread and Rake Fertilizer 125#/Acre - 74.5 Acre 9,313 lbs.	149 Hours
Haul, Spread, Mulch 2 Tons Per Acre - 74.5 Acres	149 Hours
Haul, Spread and Staple Nylon Netting 10.5 Acres	84 Hours
	382 Hours

E. Haul Road Revegetation (75 Acres)

Equipment: Hydroseeder (includes operators)

Labor: None

Materials, Quantities & Cost:

Soil Enhancer - 250 lbs./acre x 75 acres = 18,750 lbs.,
18,750 lbs x $.38/lb. = $7,125

Fertilizer - 500 lbs./acre x 75 acres = 37,500 lbs.,
37,500 lbs. x $.20/lb. = $7,500

Sulfur - 1,000 lbs./acre x 75 acres = 75,000 lbs.,
75,000 lbs. x $.24/lb. = $18,000

	Mulch - 1,500 lbs./acre X 75 acres = 112,500 lbs. 112,500 lbs. x $.20/lb. = $22,500
	Tackifier - 50 gal./acre x 75 = 3,750 gals. 3,750 gals. x $6.00/gal. = $22,500
	Hydroseeder - 3 hrs./acre x 75 acres = 225 hrs. 225 hrs. x $85/hr. = $19,125
Total	$96,750

Revised 2/5/90

Item #9

Seeding and Planting

A. Broadcast and rake 2,340 lbs. of mixed seeds.

B. Transplant 49,050 each containerized plants.

Equipment: Flat-bed Truck
Farm Tractor & Implements

Labor: 1 - Working Foreman
3 - Laborers

Quantities:

Pinyon-Juniper 20 Acres		Desert Shrub 54.5 Acres	
Seeding 35 lbs./acre		Seeding 30 lbs./acre	
Transplants 450/acre		Transplants 900 /acre	
Production:	Broadcast seed @ 2 hrs./acre Transplant 500 ea./man-day		
Pinyon-Juniper 20 Acres		Desert Shrub 54.5 Acres	
Seeding	40 Hrs.	Seeding	109 Hrs.
Transplanting	36 Hrs.	Transplanting	196 Hrs.
	76 Hrs.		305 Hrs.

C. Haul Road Revegetation (75 acres)

Equipment: Hydroseeder (includes operators)

Materials, Quantities & Costs:

Seed - 25.25 lbs./acre x 75 acres
= 1,893.75 lbs.
1,893.75 lbs. x $8.00/lb. = $15,150

Hydroseeder - 1 hr./acre x 75 acres
= 75 hrs.
75 hrs. x $85/hr. = $6,375

Total $21,525

Revised 2/5/90

Item #10

Monitoring and Pest Control

A. Revegetation

Labor: 1 - Supervisor
1 - Laborer

40 hours/year for 6 years includes hand cultivation as required.

B. Disease and Pest Control

Labor: 1 - Supervisor
1 - Laborer

20 hours/year for 4 years, additional year for contingency.

C. Water Sampling

Labor: 1 - Supervisor

4 hours/year for 10 years.

Revised 2/5/90

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: 1 - Operator
1 - Laborer

Production: 48 hours, 6 days

Work will be during years 1, 2, 3, 6, and 10.

5 years x 6 days = 30 days work = 240 hours

Revised 2/5/90

Item #12

Contingent Planting (Replanting)

A. Reseed and Replant Unsuccessful Areas (estimated 10%)

Equipment:	Flat-bed Truck
Labor:	1 - Foreman
	1 - Laborer
Quantities & Production:	10% of Item #9

Item #13

Inventory for Bond Release

A. Inventory Reference Sites and Revegetated Areas

Equipment:	None	
Labor:	1 - Supervisor 2 - Laborers	
Quantities:	2 Reference Sites 2 Revegetated Areas	
	a. Pinyon-Juniper	20.0 Acres
	b. Desert Shrub	129.5 Acres
	TOTAL ACRES	149.5 Acres
Production:	Site Inventory - 4 ea.	48 Hrs.
	Each Reference Site - 2 each	24 Hrs.
	TOTAL HOURS	72 Hrs.

Revised 2/5/90

SUBSIDENCE CONTROL PLAN (784.20)

This section describes in detail the applicant's plan to ensure minimal environmental impacts from mine-induced subsidence. The Operation Plan plus the Geology Section present the detailed data on which the analytical approach for the subsidence control plan is based. 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, Des Bee Dove and Cottonwood/Wilberg mining activities. 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. Most of the streams within the permit area are ephemeral and/or intermittent. Only the lower portion of Rilda Canyon Creek below the forks is considered perennial. The streams are fed by springs that emanate primarily in the North Horn Formation. Many of the springs feed water troughs maintained for livestock and wildlife. The occurrence of the springs is discussed in the hydrology section and no further discussion will take place here; however, data collected suggest that the springs on the surface will not be affected by the subsidence.

A survey to locate structures on East Mountain that could be affected by subsidence has been completed and none were

located above Des Bee Dove Mine.

There are no electrical power lines, oil or gas wells, pipelines or other utility structures which would be affected by surface subsidence within the Des Bee Dove Mine limits.

MINING METHOD

The coal reserves in the Des Bee Dove complex have been mined using room and pillar methods. The remaining reserves will also be mined in this way.

Room and Pillar mining methods using final pillar extraction induces caving of the immediate and upper roof strata. The caving process propagates upward to a horizon located at a distance equal to approximately thirty-five to fifty times the mining height over the coal seam as indicated by the data in Figure 1. The curve in 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 one (1) at the seam roof to near zero (0) at approximately thirty-seven (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.

The size of the normal coal pillars used in 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 USBM study (Pariseau). Experience has also shown that, in multi-seam mining circumstance, columnizing main development pillars in both seams is essential for main stability.

Full extraction areas (room-and-pillar panels with pillar removal) are, by definition, planned and controlled subsidence areas. It is anticipated that the 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. Subsidence and controlled subsidence will vary from zero to fifteen (0-15) feet, assuming that the total cumulative extraction from the two mineable seams will not exceed twenty (20) feet.

SUBSIDENCE MONITORING PLAN

Utah Power & Light Company initially adopted a twofold approach to subsidence monitoring:

1) aerial photogrammetry,

2) on-the-ground monumentation.

After seven years of comparing the two types of surveys it was determined that both effectively document the amount of subsidence which has occurred; however, the aerial photogrammetry method has the advantage of showing more detail because more data points can be monitored with less effort. Therefore, in 1987, with the concurrence of the Division, Utah Power & Light Company

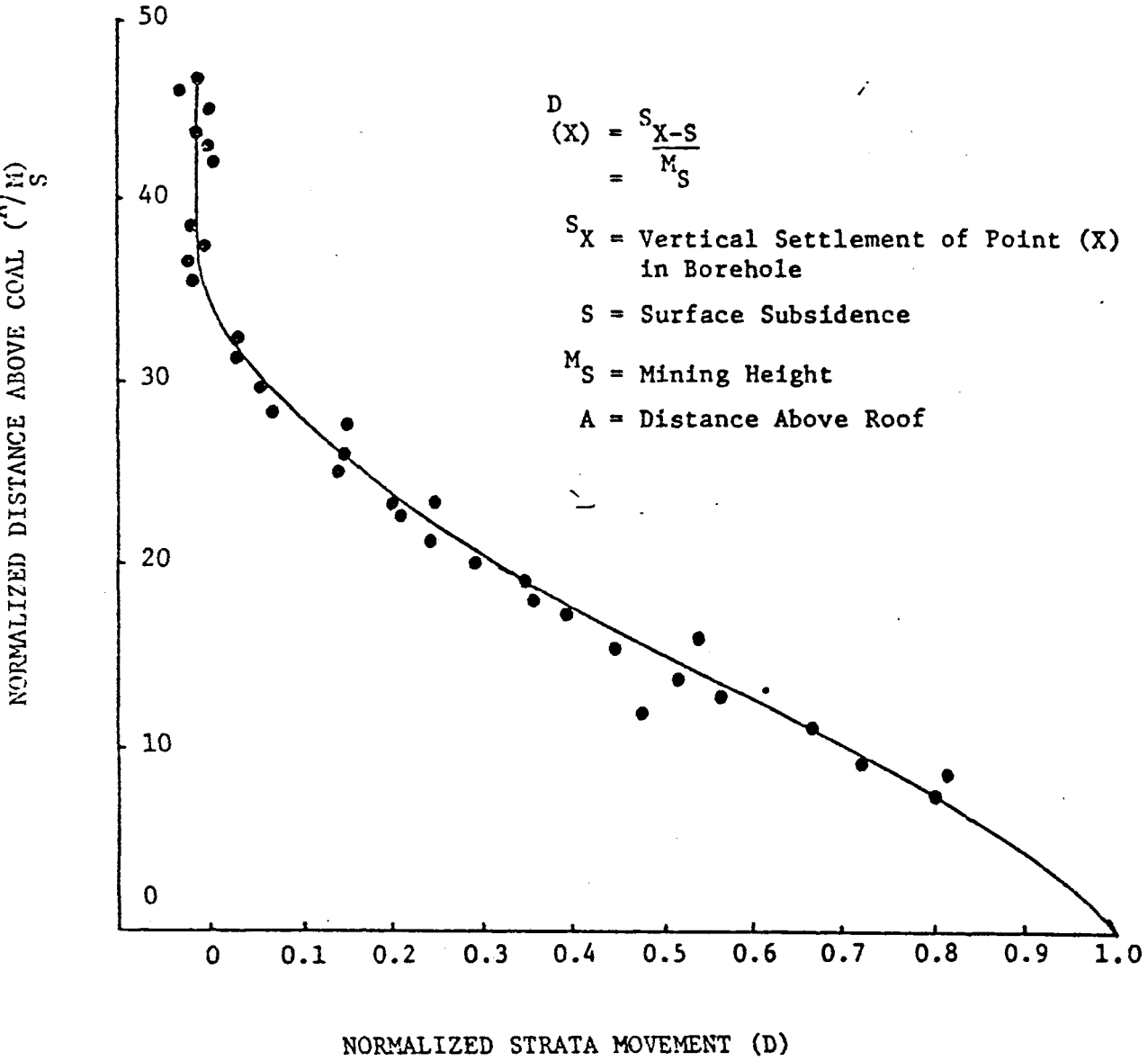


FIG. 1. Vertical settlement of overburden above a longwall panel (after Dahl and Von Schonfeldt)

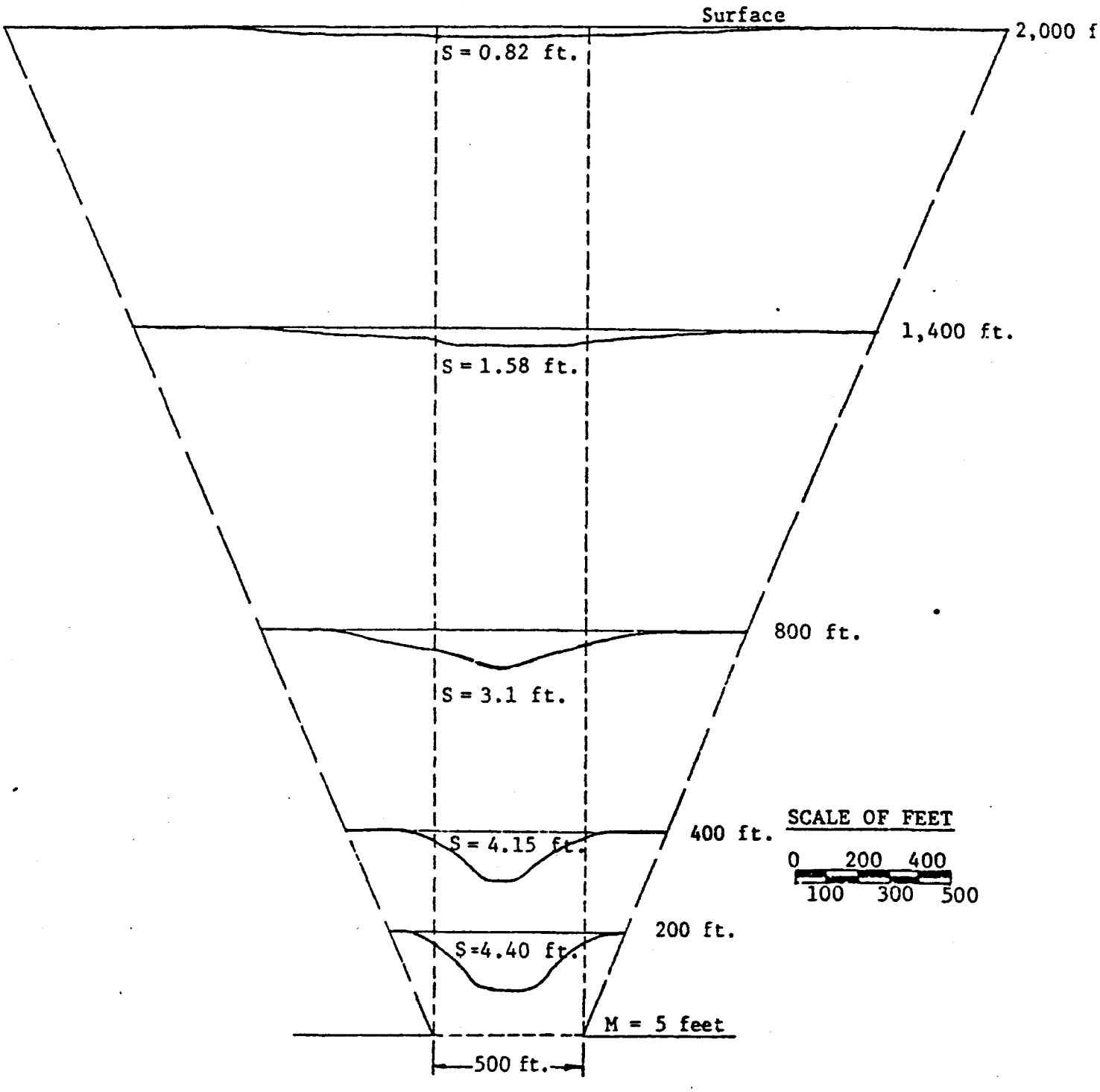


FIG.2. Varying subsidence profile at different horizons.

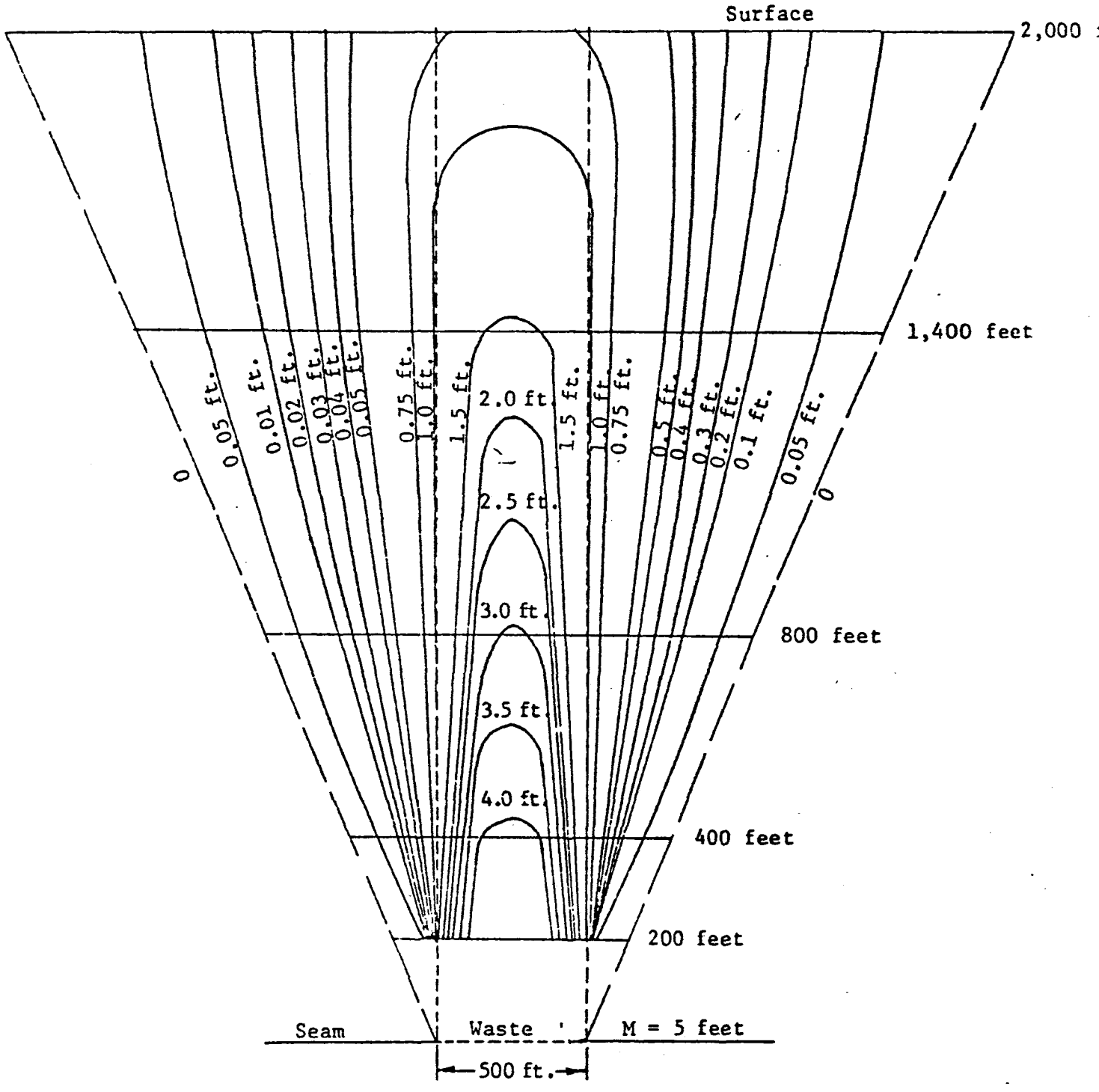


FIG. 3. Lines joining points of equal subsidence.

discontinued on-the-ground monumentation and now collects subsidence data solely by aerial photogrammetry.

The subsidence monitoring program, conducted since 1980, has produced data which not only document the amount of subsidence that has occurred but also allow UP&L to predict the amount of subsidence that is likely to occur when mining in new areas. The detail of the data collected in years past is not included herein. If the reader desires to investigate past data, it can be found in the annual subsidence reports available in the Division's office.

AERIAL PHOTOGRAMMETRY

The applicant will maintain survey control aerial targets within the permit boundary necessary to allow the interpretation of coordinates on photos within ±1 foot. Following this procedure the applicant shall conduct annually an aerial photo survey of all areas which have been undermined. Elevations of control points within the photos will be determined by photogrammetric means to an accuracy of ±1 foot and compared to corresponding elevations derived from the baseline survey conducted in August 1980. The applicant shall continue monitoring all areas undermined until it is mutually agreed by the applicant and the Division that the subsidence in a given area has become stable and no further monitoring is necessary. The findings of the survey shall be reported to the Division annually in a summary report.

MITIGATION OF SUBSIDENCE DAMAGE EFFECTS

Any roads, fences, stock ponds, earth dams, or water

troughs which are materially damaged by subsidence will be repaired and regraded to restore them to their pre-subsidence usefulness.

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

In the event that surface waters above the Des Bee Dove Mines are diminished as a result of the operations of the applicant, including any subsidence therefrom, to the extent that appropriated surface water is measurably diminished, applicant will, at its sole option, either (1) replace the surface water so diminished, or (2) compensate the affected surface owner by purchasing such owner's land and water rights for the pre-subsidence fair market value.

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.

PUBLIC NOTICE

Applicant will not mine in any areas that would allow potential subsidence effects (as indicated by the angle of draw) to affect any area outside of the lease and permit boundary until

this constraint on coal recovery is resolved by the OSM and the BLM Branch of Solid Minerals or permission is granted by the adjacent surface agencies.

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

PROTECTION OF FISH AND WILDLIFE (817.97)

The portal facilities of the Des-Bee-Dove Mine are located in a small dry wash, a tributary to Grimes Wash. This active area (portal facilities) consists of about 20 acres and is physically separated from the remaining permit area by imposing and inaccessible mountain slopes that rise over 1,600 feet vertically from the active portal area.

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.

There are no prime fisheries located on the East Mountain plateau within the permit area.

In contrast to the lush mountain top environment above the mines the portal acres are situated within a transition zone of the plateau with a southeastern facing aspect. Vegetation and wildlife are sparse in comparison.

An on-the-ground review was made in consultation with the U. S. Fish and Wildlife Service, Division of Oil, Gas and Mining and Division of Wildlife Resources. No critical habitat of threatened or endangered species was identified.

A 69 KV line serves as the power source for the Des-Bee-Dove complex. Mostly single pole and suspension insulators, this transmission line provides sufficient phase to phase and phase to ground clearances to preclude electrical contact of raptors including eagles. The

structure types are approved as eagle-safe by the US Fish and Wildlife Service by letter dated 11/10/82 to the DOGM.

RAPTOR NESTS MITIGATION PLAN

Generally, raptor habitat associated with East Mountain is synonymous with the prominent and precipitous cliffs which form the upper reaches of the plateau. A broad strip of land with a varying width between 3,000 and 5,000 feet as shown on the drawing in Map Packet 2-17. This map is designed to reflect the habitat and found nest sites from surveys conducted in 1981, 1982 and 1986 through 1989.

Within the Des Bee Dove Coal Mine permit area nine sites are shown, only site number 56 is potentially impacted by planned mining. This is a Golden Eagle nest. If, during mining and subsequent subsidence monitoring, the nest, or any nest, is damaged or disturbed by mine related causes, Company will contact and notify the USFWS of the damaged or destroyed nest. Owner will, at its expense, cause to repair or replace the impacted raptor nest or nests. Mitigation of the impacted nest will be a cooperative effort between the owner and USFWS.

Although Grimes Wash is not a fishery it is a tributary to Cottonwood Creek (Straight Canyon) which is a limited fishery. Protection from coal dust and increased sediments to these waters is by a sedimentation pond installed for control of sediment and coal dust from storm runoff waters. Coal is transported by trucks on hard-surfaced roads. Truck covers are not necessary as the moisture of processed coal is sufficient to prevent blowing coal dust; plus the loaded coal truck negotiating the 12% grade

are limited to slow speeds.

To reduce the undue disturbance and killing of wildlife the slide series with tapes produced by UDWR at Price has been obtained to instruct all the employees of the value of all wildlife and problems inherent to Utah wildlife. This instructional series is shown at scheduled employee training sessions so all employees new or old will have viewed this series. This series explains the effect of harassing wildlife during their different life stages and the needs of species resident of Utah.

Signs will be placed on the Des Bee Dove haul road in the permit area to notify drivers of the presence of deer in the area. A flyer containing the following information on avoiding deer vehicle collisions will be distributed during training to all employees.

1. Driver 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 adjacent to the haul road and access road.

The UDWR presently conducts a deer road-kill monitoring program which includes the Des Bee Dove 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.

Information regarding mule deer seasonal distribution and numbers within the permit 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.

If hazardous areas are identified on the Des-Bee-Dove Mine access road, within the permit area, appropriate mitigating measures will be instituted based on consultation with UDWR personnel.

Personnel involved 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.

Surface water disturbance due to subsidence on East Mountain from mining activities in the Des-Bee-Dove Mine will be replaced or repaired by the following methods:

1. Streams will be bridged across bedrock fractures by culverts until sediments fill the crack.

2. Springs and seeps proven to be lost to subsidence action will be replaced by guzzlers which will be located and designed with prior regulatory authority approval.

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 interim reclamation plans provide for the stabilization of all the fill slopes with a vegetative cover. Because the fill slopes are intertwined with the mine facilities, the planting 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. See details in Final Revegetation section (817.111-.117).

The UDWR general mitigation plan for the East Mountain area follows. Applicant has stated compliance to these recommendations insofar as they are applicable.

SMC 780.16 or UMC 784.21; FISH AND WILDLIFE PLAN
UTAH POWER AND LIGHT COMPANY, WILBERG MINE, DES-BEE-DOVE MINE
AND COTTONWOOD FAN PROJECTS

Mitigation and Impact Avoidance Procedures General to all Wildlife

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

The project and adjacent areas are represented by nine basic wildlife habitats which are inhabited on occasion and during different seasons of the year by about 245 species of vertebrate wildlife. The wildlife habitats and use areas for the "high interest" species from this group of wildlife have been ranked into four levels of importance. The most valuable to an individual species or ecological assemblage are the critical sites followed in respective importance by high-priority, substantial value and limited value sites. Each type of use area requires various and specific levels of protection from man's activities. Additionally, due to the variability of vegetation communities in each use area, various and specific tech-

nologies in site development will need to be evaluated for possible mitigations, enhancements of wildland habitats or the required level of reclamation. It is recommended that all land clearing impacts be designed so that irregular shaped openings are created in contrast to openings that would have straight edges.

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

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

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

Early in the rearing process, young animals need the peace and tranquility normally afforded by remote wildlands. It is also during this crucial period that young animals gain the strength and ability to elude man and other predators. This allows the young animal to develop in relatively unstressed situations and to

utilize habitats that are secure from predators. Disturbance by man can compromise this situation and result in abandonment of the young by the female, increased accidents that result in mortality to young animals or increased natural predation. It is recommended that employees be cautioned against disturbing young animals or females with young if accidentally located.

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

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

Mitigation and Impact Avoidance Procedures for Aquatic Wildlife

There are no recommendations for a wildlife plan that would enhance any fishery.

If ultimate operations are planned or occur that could physically or chemically impact any perennial stream beyond the impact of mere crossings, detailed reclamation plans will be required. Permanent culvert crossings exceeding a width of eight feet must have a natural bottom and devices for reducing stream velocity so that fish migration is not blocked. A reclamation plan for a stream or lake would have to provide for measurement of the physical characters of the water prior to disturbance. Such measurements should consider surface water information required in SMC 779.16, data on stream velocity, gradient, width, depth, pool-riffle ratio and substrata types.

Reclamation that would achieve development of a lake bed or stream channel similar in character to that which existed prior to disturbance should result in natural re-establishment of macroinvertebrates, macrophytes and a fish population. If merited, the Division could then introduce desired fishes into those waters.

This would adequately mitigate for disturbance and temorary loss of aquatic resources. There would be no mitigation for displacement and possible loss of other wildlife species dependent upon the aquatic wildlife as a prey source. It is believed that impacts on such species would not be significant.

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

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

Mitigation and Impact Avoidance Procedures for Terrestrial Habitats

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

that a majority of the vertebrate wildlife that inhabit the project area make some use of riparian or wetland areas.

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

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

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

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

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

Currently, there are some new concepts in metholdology for revegetation that are being successfully implemented in other parts of the nation and world. One promising method is a procedure where a large scoop removes, from a natural and stabilized site, a small area of earth intact with vegetation and subsurface soils for placement on a site to be restored. This same procedure can be utilized when disturbing pristine sites, except that the native vegetation is stored for use in

latent reclamation. Another meritorius method for stimulating natural revegetation, in combination with other reclamation techniques, is to plan facility developments so that islands of natural, native vegetation remain. This will allow for natural vegetation to spread from the islands. These techniques can also be useful for enhancement of poor quality sites that currently exist on the mine plan area.

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

There are also new specialized techniques coming to the forefront for stabilization of problem sites such as roadbanks and steep slopes. It is important that these sites be promptly and permanently revegetated in order to reduce siltation into local riverine systems. This will mitigate for damage to aquatic wildlife populations and habitats from siltation. Enhancement of existing problem sites or reclamation of disturbed sites can mitigate for salt loading of local river systems. It is believed that natural, nonpoint sources represent 50 percent of the salinity in the upper basin of the Colorado River system into which this mine plan area drains.

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

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

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

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

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

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

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

Mitigation and Impact Avoidance Procedures for Amphibians and Reptiles

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

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

Mitigation and Impact Avoidance Procedures for Avifauna

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

It is important to note that the nests of all avifauna (except the house sparrow, starling and rock dove) when active and their eggs are protected by federal (Federal Migratory Bird Treaty Act) or state laws (Utah Code 23-17-1 and 23-17-2). All avifauna utilize a nest during their reproductive process. Dependent upon the species, some nests are well developed while others may be represented by only a scrape on the ground. These sites when being utilized are critical to maintenance of individual bird populations; each species has a specific crucial time period in which the nest is occupied. It is during this crucial period that the nest must be protected from disturbance.

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

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

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

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

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

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

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

Mitigation and Impact Avoidance Procedures for Mammals

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

disturbance during that period when it is being utilized.

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

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

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

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

Haulage of coal between the various mine projects and distribution points should be planned so that impacts to wildlife are lessened; of special concern is haulage of coal through wintering areas for big game. It is recommended that the

Company develop coal haulage contracts that require personnel involved with coal haulage to use extreme caution so that accidental collisions between motor vehicles and big game are reduced. Without doubt, a reduction in speed across winter ranges would aleviate this problem during the period between November 1 and May 15 each year.

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

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

In instances where conveyors, slurry lines or any other structure having potential to be a barrier to big game movement is to be developed, passage structures must be provided. Generally speaking overpass and underpass type structures are recommended in order to allow passage of big game to habitats either side of any barrier. These crossings should be placed at the points to be identified from in-

tensive study of big game movements in relation to the mine plan area. Such study would not be required if the structure was adequately elevated to allow uninhabited passage of big game along its entire length.

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

> On either side of the conveyor a half-round ramp with a slope no greater than 3:1 on a five meters wide path placed at an angle 90 degrees to the conveyor and tapering around to a slope of 5:1 at paths adjacent and parallel to the conveyor. The platform over the conveyor should be concrete or some other material that would not echo when being crossed by big game and should be of character similar to rock or natural earth.

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

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

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

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