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STATE OF UTAH
NATURAL RESOURCES & ENERGY
Oil, Gas & Mining

Scott M. Matheson, Governor
Temple A. Reynolds, Executive Director
Cleon B. Feight, Division Director

4241 State Office Building • Salt Lake City, UT 84114 • 801-533-5771

November 22, 1982

7075367
REGISTERED RETURN RECEIPT REQUESTED

Mr. Dan Guy
Beaver Creek Coal Company
P. O. Box AU
Price, Utah 84501

#2

RE: Thickener Overflow Pond
C. V. Spur
ACT/007/022
Carbon County, Utah

Dear Mr. Guy:

I have recently been informed that the C. V. Spur processing plant had to be dewatered as an emergency procedure due to a water imbalance in the plant. I understand that the plant water was detained in the thickener overflow pond as well as sediment ponds #1, #2 and #3 before drainage into filter pond #6 and recirculation into the plant. This additional storage of plant water in the sediment ponds reduces their storage capacity and sediment removal efficiency. An off-site discharge may possibly exceed effluent limitations (UMC 817.42) resulting in a violation of UMC 817.46(f)(g). These problems were noted during review of the plans submitted for the thickener overflow pond.

As you may recall, as-built plans for the thickener overflow pond dated November 10, 1980 were reviewed as part of the permanent program permit application. Comments on deficiencies of the plan for the overflow pond were incorporated into the Apparent Completeness Review (ACR) dated April 3, 1981. Tentative approval of the as-built structure was given on September 24, 1981, pending final approval of the permit application. Beaver Creek Coal Company's failure to respond to any of the plan deficiencies noted in the ACR for over one and one-half years may warrant that the tentative approval for the thickener pond be revoked unless this matter is resolved within the very near future.

The submittal of more adequate plans for the thickener overflow pond is hereby required. At a minimum, the plans should address deficienices noted in Sections UMC 784.14 and UMC 817.46 of the ACR dated April 3, 1981. The required storage capacities of the thickener overflow pond and ponds #1, #2, #3 and #6 should be analyzed with respect to the volume of water that may be discharged from the processing plant. The rate of dewatering the thickener overflow pond and recirculation into the plant should be specified in relation to its impact on the sediment ponds' runoff storage capacity. Modifications to the system should be proposed as deemed necessary. These plans should be submitted within 60 days of receipt of this letter in order to alleviate the permit deficiencies regarding this situation.

I might also remind you that the deficiencies cited in other sections of the ACR still need to be addressed as well. As we discussed previously, the Division would like to establish a definite timeframe for Beaver Creek Coal Company's submittal of a response to the ACR in order that we may proceed with the review and permitting process. Please let me know what Beaver Creek's situation is regarding this operation, as well as Huntington #4, Gordon Creek's #2, #3 and #6 and Wild Horse Ridge mines. I am aware of your situation with Anaconda Minerals and am more than willing to work with you in establishing reasonable timeframes to meet our mutual objectives. If you have any questions regarding the above, please don't hesitate to call me.

Sincerely,

JAMES W. SMITH, JR.
COORDINATOR OF MINED
LAND DEVELOPMENT

JWS/SP:btb

cc: Lynn Kunzler, DOGM
Sandy Pruitt, DOGM
Joe Lyons, DOGM

CASTLE VALLEY SPUR

ANALYSIS OF ADEQUACY OF EXISTING

SEDIMENT PONDS, AND

SIZE OF DIVERSION CHANNEL

by

Kal Sandberg

Anaconda Minerals

(303) 575-7194

modifications to computations (pencil) → JL

MAP

1. Major basins
2. Sub basins
3. Soils

TABLE

1. Curve Nos.
2. Wt. C.N. Determination
3. Runoff Volumes - CUS
4. Direct Precipitation
5. Erosion Rate Determination
6. LS Values
7. Sed Pond Volume, US Cap.
8. Adequacy of Ponds
9. Calculator Printouts

RUNOFF VOLUMES

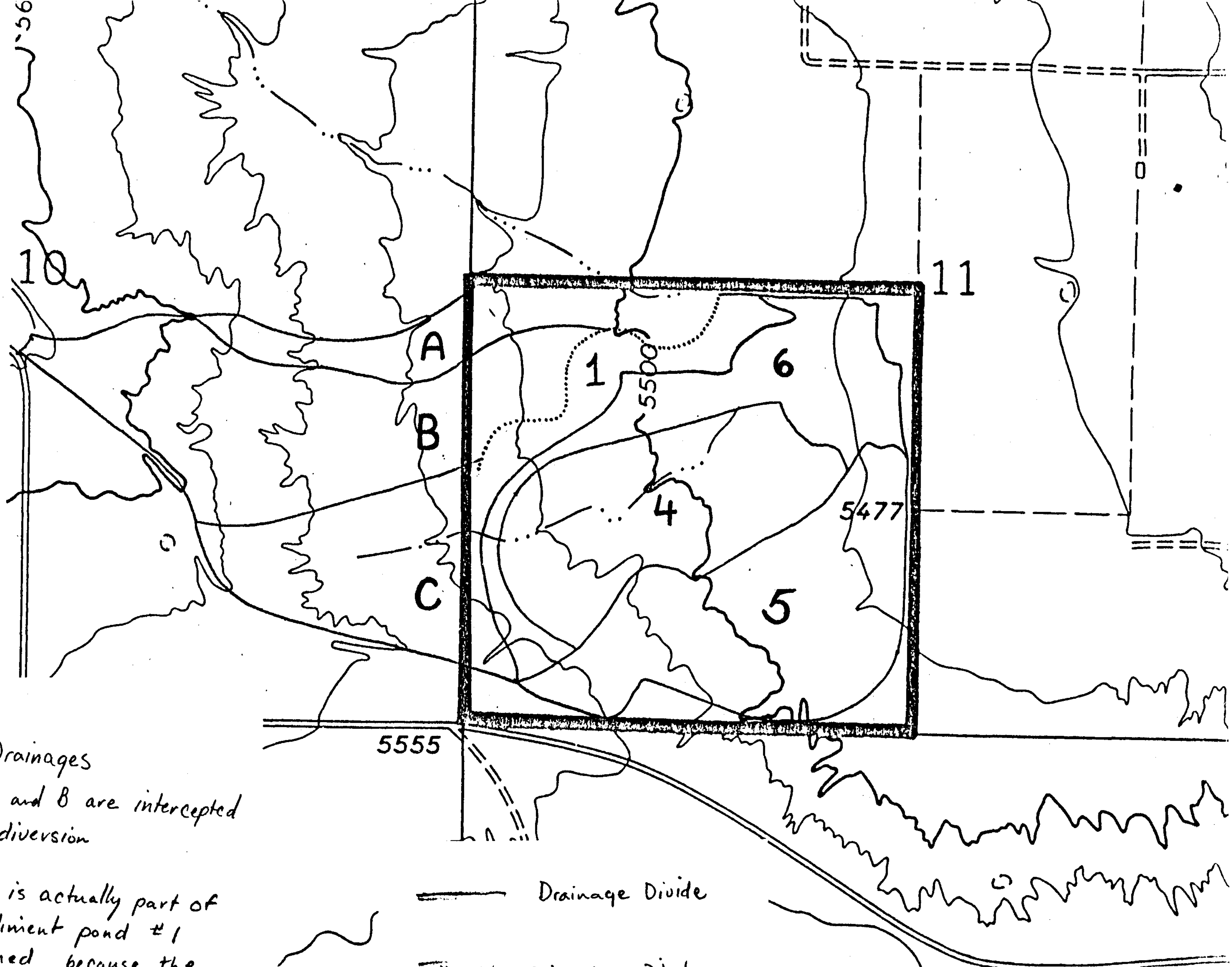
The permit area, and the off-site area that drains through the site, was subdivided into the main drainage basins shown on Map 1. Basins A & B are intercepted by and drain through, the diversion ditch; the other areas drain through the sediment ponds. Each of the on-site drainages was subdivided into the sub-drainages shown on Map 2 for detailed analysis.

The technique used to determine runoff volumes was the U.S. Soil Conservation Service (SCS) curve number method. Weighted curve numbers were determined by the following procedure.

The percentage of each on-site sub-drainage that is occupied by the following categories was determined:

a) Roads, buildings, pads, and embankments
b) Topsoil, or soil, stockpiles
c) Coal stockpiles
d) Compacted coal refuse piles
e) Other areas, excluding ponds
f) Ponds

The areas, except for ponds, were determined by making planimeter measurements on a 1:2400 scale base map. Pond areas were determined from Exhibit 12, "Sediment Ponds, Sections and Details," Castle Valley Spur Mining and Reclamation Plan. Aerial photographs were used as an aid in interpreting

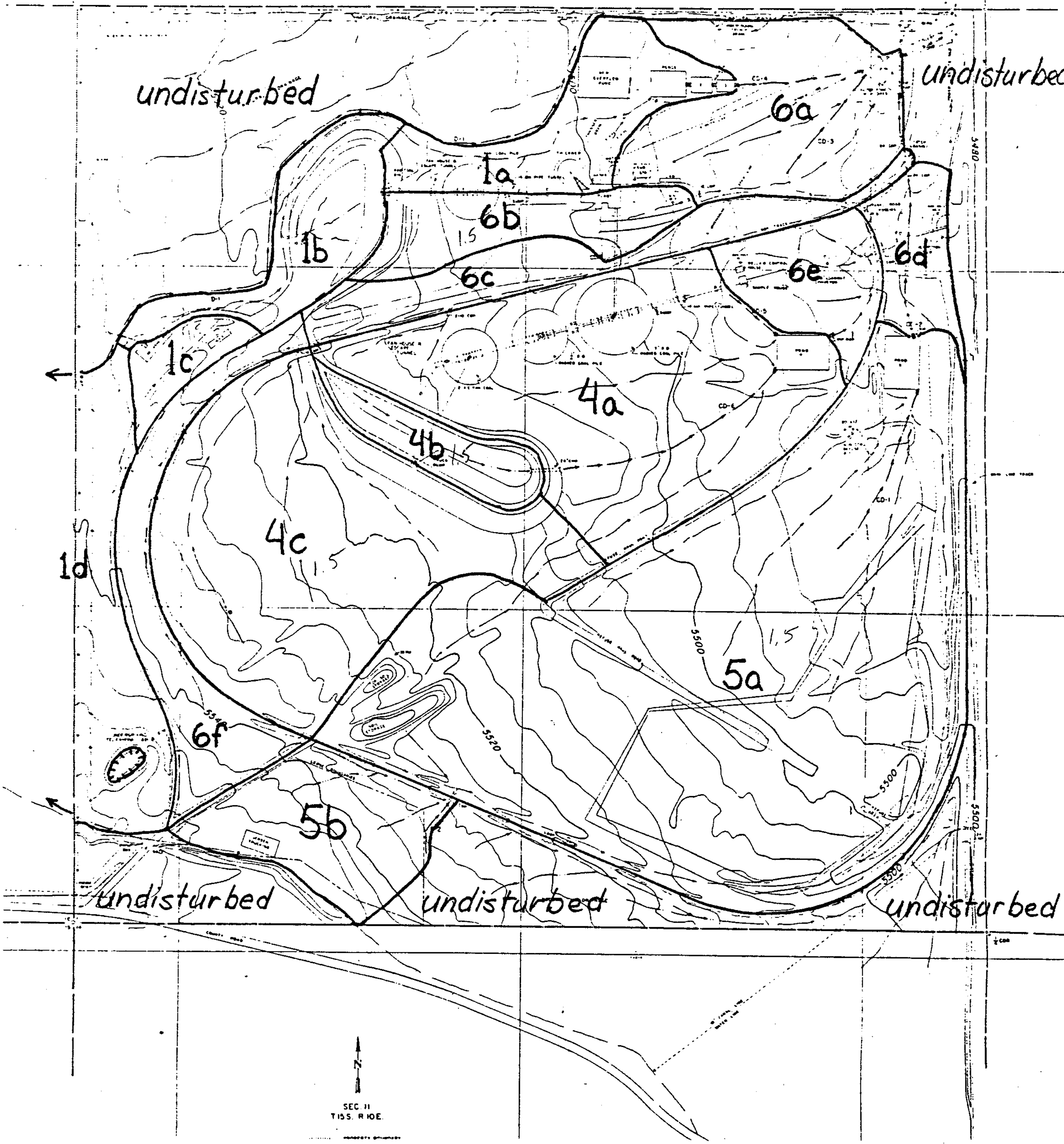


Map 1

Main Drainages

Areas A and B are intercepted by the diversion

Area C is actually part of the sediment pond #1 watershed because the diversion does not intercept its runoff



MAP 2
On-site Drainages

All areas starting with 1 drain into Sediment Pond No. 1, all areas starting with 4 drain into Sediment Pond 4, etc. Area 1d is only partly on-site, and includes Area C.

TABLE 1

--Runoff curve numbers for selected agricultural, suburban, and urban land use. (Antecedent moisture condition II, and $I_a = 0.2S$)

LAND USE DESCRIPTION	HYDROLOGIC SOIL GROUP			
	A	B	C	D
Cultivated land[1/]: without conservation treatment	72	81	88	91
: with conservation treatment	62	71	78	81
Pasture or range land: poor condition	68	79	86	89
good condition	39	61	74	80
Meadow: good condition	30	58	71	78
Wood or Forest land: thin stand, poor cover, no mulch	45	66	77	83
good cover[2/]	25	55	70	77
Open Spaces, lawns, parks, golf courses, cemeteries, etc.				
good condition: grass cover on 75% or more of the area	39	61	74	80
fair condition: grass cover on 50% to 75% of the area	49	69	79	84
Commercial and business areas (85% impervious)	89	92	94	95
Industrial districts (72% impervious).	81	88	91	93
Residential:[3/]				
Average lot size — Average % Impervious[4/]				
1/8 acre or less — 65	77	85	90	92
1/4 acre — 38	61	75	83	87
1/3 acre — 30	57	72	81	86
1/2 acre — 25	54	70	80	85
1 acre — 20	51	68	79	84
Paved parking lots, roofs, driveways, etc.[5/]	98	98	98	98
Streets and roads:				
paved with curbs and storm sewers[5/]	98	98	98	98
gravel	76	85	89	91
dirt	72	82	87	89

1/ For a more detailed description of agricultural land use curve numbers refer to National Engineering Handbook, Section 4, Hydrology, Chapter 9, Aug. 1972.

2/ Good cover is protected from grazing and litter and brush cover soil.

3/ Curve numbers are computed assuming the runoff from the house and driveway is directed towards the street with a minimum of roof water directed to lawns where additional infiltration could occur.

4/ The remaining pervious areas (lawn) are considered to be in good pasture condition for these curve numbers.

5/ In some warmer climates of the country a curve number of 95 may be used.

the areal extent of each category. The percentage in each category was determined by dividing the area in a given category by the total area of the sub-drainage that it is in (excluding pond area).

An average curve number for each category was determined based on soil type, general condition, and hydrologic soil group. Hydrologic soil group was determined from the soil survey (Walsh and Associates, 1980) and from Table 1. Map 3 is the most recent soils map of Castle Valley Spur. In those areas where the soil type was mapped as disturbed land, hydrologic soil group D was assumed. The curve numbers determined are (corresponding with the above categories):

a) 89

b) 80

c) 82

d) 87

e) 87

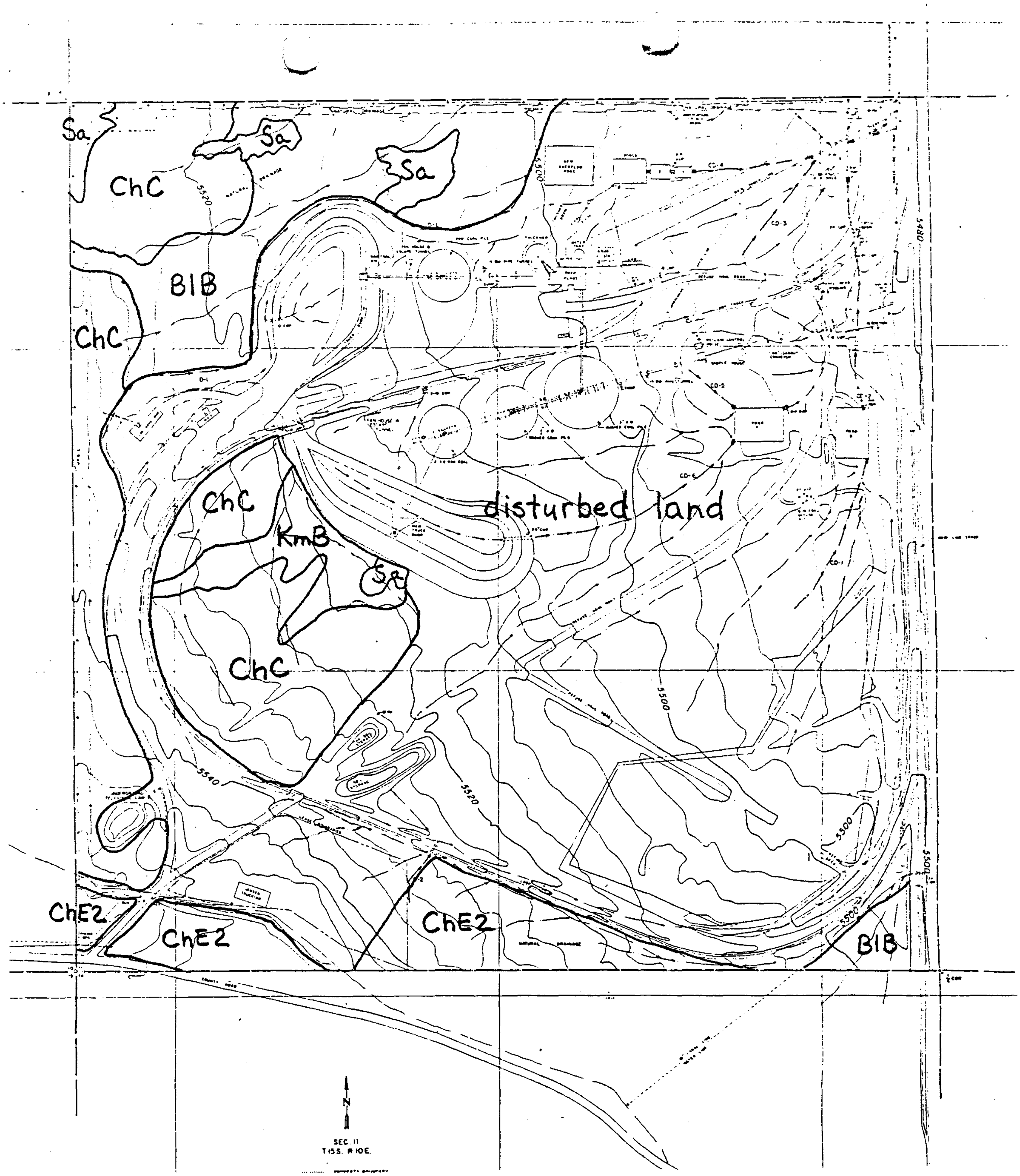
The ponds, of course, receive direct precipitation and therefore are considered separately from the other categories.

Table 2 presents the percentage of each category that was measured in each sub-drainage, and the weighted curve number for each subdrainage.

Total runoff in each sub-drainage was determined by using the weighted curve numbers, area of each sub-drainage, and the SCS rainfall-runoff relationship:

Q = rainfall excess (inches)

$$= \frac{(P-0.2S)^2}{P+0.8S}$$



MAP 3
Soil Types
BIB - Billings series
ChC - Chipeta series
ChE2 - Chipeta series
Kmb - Killpack series
Sa - Saltair series

Drainage Area Number	Building, Roads, Pads & Embankments CN=89	Topsoil or soil stockpiles CN=80	Coal Stockpiles CN=82	Compacted coal reuse Piles CN=87	Other Areas (excluding ponds) CN=87	Total Area Minus Ponds	Pond Areas (acres)	Total Acreage (acres)	Weighted CN for the drainage
	% of Total Area Minus Ponds								
1a	15.0	-	12.1	-	72.9	100	1.02*	5.16	87
1b	68.0	-	-	-	32.0	100	-	4.50	88
1c	60.0	-	-	-	40.0	100	-	1.15	88
1[illegible]	3.5	-	-	-	96.5	100	0.16**	34.1	87
4a	9.2	-	52.3	-	38.5	100	~~0.43~~	~~16.75~~	85
4b	60.2	-	-	-	39.8	100	-	2.36	88
4c	14.2	-	-	-	~~85.5~~	100	-	17.69	87
5a	7.2	6.8	-	64.2	21.8	100	~~0.43~~	42.14	87
5b	57.2	-	-	-	42.8	100	-	5.23	88
6a	5.2	-	-	-	94.8	100	0.22	8.5	87
6b	66.7	-	26.7	-	6.6	100	-	3.75	87
6c	50.0	-	-	-	50.0	100	-	4.60	88
6d	10.0	-	-	-	90.0	100	-	2.43	87
6e	-	-	-	-	100	100	-	~~3.36~~	87
6f	10.0	-	-	-	90.0	100	-	5.44	87

Drainage Acreages

N/C

157.16

TABLE 2

* includes 0.41 acre thickener pond

** not a sediment pond, no drainage

$$S = \frac{1000}{CN} - 10$$

CN = Weighted curve number

P = 1.7 in. (NOAA, 1973)

= 10-yr., 24-hr. precipitation value

TOTAL RUNOFF - QX area

Rainfall excess, Q, is generally determined graphically. In this instance, however, it was not practical to use the graphical method with the actual values, and therefore, the rainfall-runoff equation (above) was used. Table 3 lists the runoff volume calculated for each sub-drainage.

DIRECT PRECIPITATION TO SEDIMENT PONDS

The volume of direct precipitation collected by the sediment ponds was determined by multiplying the precipitation depth (1.7 inches for the 10-year, 24-hour storm) by the pond areas. Table 4 lists the direct precipitation to each pond in both cubic feet and acre-feet.

SEDIMENT VOLUME

The Universal Soil Loss Equation (USLE) was used to predict the rate of erosion for each on-site sub-drainage. The method, while having limitations, was useful because no better method was available. The USLE is,

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

= erosion rate (ton/acre/yr.)

The variables, R, K, LS, C, and P, are defined in the following discussion.

TABLE 3

Castle Valley Spur - Runoff Volumes

Area No.	Weighted Curve No.	Q in.	A acres	Total Runoff Ac. Ft.	
1a	87	0.68	4.14	0.235	
1b	88	0.73	4.50	0.274	
1c	88	0.73	1.15	0.070	
1d*	87	0.68	33.94	1.923	
4a	85	0.58	13,30 ~~16.75~~	[illegible] ~~0.810~~	
4b	88	0.73	2.36	0.144	1,779
4c	87	0.68	17.69	1.002	
				1,956	
5a	87	0.68	41.71	2.364	
5b	88	0.73	5.23	0.318	
6a	87	0.68	8.28	0.469	
6b	87	0.68	3.75	0.213	
6c	88	0.73	4.60	0.280	
6d	87	0.68	2.43	0.138	
6e	87	0.68	6.76 ~~3.36~~	[illegible] ~~0.190~~	2,174
6f	87	0.68	5.44	0.308	
				1.5?? [illegible]	

* Includes the offsite drainage designated C, because area C drains through Pond 1.

TABLE 4

Direct Precipitation to Sediment Ponds

Pond No.	Pond Area (acres)(1)	Volume (ft^3)	Volume (acre-ft.)
1	0.61	3765	0.0864
4	0.43	2655	0.0610
5	0.43	2655	0.0610
6	0.22	1360	0.0312

1) From Exhibit 12, Sedimentation Pond, Sections and Details, Castle Valley Spur Mining and REclamation Plan.

2) 10-year, 24-hour precipitation value is 1.7 inch (NOAA, 1973)

R is the rainfall factor, which, simply stated, accounts for the erosive force of specific rainfall. R is either found on an isoerodent map, or calculated from

$R = 27P^{2.2}$, where P is the 2-year, 6-hour point precipitation value (Barfield, Warner, and Haan, 1981). P, for Castle Valley Spur, is 0.8 inch, and therefor R is 16.5 (NOAA, 1973).

K is the soil erodibility factor. Appendix A of Preliminary Guidance for Estimating Erosion on Areas Disturbed by Surface Mining Activities in the Interior Western United States (EPA, 1977), lists K values for all established soil series in the western U.S. The K value for the native soils, except the Saltair series, is 0.43. K for the Saltair series is 0.55. Ka values are unknown for coal piles, coal refuse piles, roads, embankments, and other disturbed lands. A certain amount of judgment had to be exercised in selecting K values for the above types of areas. The K value for loose coal is likely relatively high, due to coal's low density and a large percentage of fines. A K of 0.60 was therefore assumed for the subdrainages containing coal stockpiles.

The K value for intentionally compacted constructions, such as refuse piles, roads and embankments was assumed to be 0.50. The K value for realtively undisturbed native soils was assumed to be 0.43.

LS, the length slope factor, accounts for the length and steepness of the slopes on which erosion occurs. Length and slope estimates for the various sub-drainages are listed in Table 5. LS for the various areas was determined from these estimates and Table 6, which was procured from the previously mentioned EPA reference (EPA,1977).

The cover factor, C, accounts for the effects of various types of ground cover on erosion. For no ground cover a value of 1.0 is suggested. In this analysis, C was assumed to be 1.0 for most areas. For three relatively undisturbed areas, C was assumed to be 0.22 based on percentage and type of cover.

P is the erosion control practice factor. When no erosion control measures are taken, P is assumed to be 1.0. In this analysis, P is assumed to be 1.0.

Table 5 lists the USLE factors, basin areas, and erosion rates for each of the sub-drainages. The total weight of sediment eroded from each main drainage (in one year) was determined by adding the erosion rates for all of the sub-drainages in each main drainage. A unit weight of 100 16/ft^3 was assumed in order to detemine the yearly volume of sediment delivered to the ponds (a sediment delivery ratio of 1.0 was assumed). Table 7 lists the volume of sediment delivered to each pond (in one year).

Table 7 gives the sediment capacity of the existing ponds in acre-ft. Pond 5 has a volume deficit. At the rate determined in this analysis, Pond 1 has a 40-year sediment capacity. Likewise, Pond 4 has an 11-year capacity, and Pond 6 has about 8 years capacity.

TABLE 5 Erosion Rate Determination

Area No.	R	K	L(A)	S%	LS	C	P	A t/a/yr	Area (acres)	Erosion Rate (tons/yr)
		USLE Factors								
1a	16.5	0.60	150	1	0.15	1.0	1.0	1.485	4.14	6.148
1b	16.5	0.50	250	2	0.27	1.0	1.0	2.228	4.50	10.024
1c	16.5	0.50	70	2	0.18	1.0	1.0	1.485	1.15	1.708
1d	16.5	0.43	100	2	0.20	0.22	1.0	0.312	5.94	1.854
4a	16.5	0.60	450	2	0.32	1.0	1.0	3.168	18.26	57.848
	16.5	0.50	70	4	0.35	1.0	1.0	2.888	2.36	6.815
	16.5	0.43	700	2	0.36	0.22	1.0	0.562	15.75	8.850
5a	16.5	0.50	800	2	0.38	1.0	1.0	3.135	41.71	130.761
5b	16.5	0.50	400	3	0.44	1.0	1.0	3.63	5.23	18.985
6a	16.5	0.50	200	2	0.25	1.0	1.0	2.063	8.28	17.078
6b	16.5	0.60	500	2	0.33	1.0	1.0	3.267	3.75	12.251
6c	16.5	0.50	100	2	0.20	1.0	1.0	1.650	4.60	7.590
6d	16.5	0.50	100	1	0.13	1.0	1.0	1.073	2.43	2.606
6e	16.5	0.50	300	2	0.28	1.0	1.0	2.310	3.36	7.761
6f	16.5	0.43	110	2	0.21	0.22	1.0	0.328	5.44	1.783

1) L was measured on topo map

2) C value of 0.22 was derived from Table 4, EPA-908/4-77-005, 1977. Assumption was, no appreciable canopy, weeds, 25% ground cover

Table 6 Values of the Topographic Factor "LS"

Length of Slope Ft. (L)	Percent Slope (S) 0.2	0.3	0.4	0.5	1.0	2.0	3.0	4.0	5.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	25.0	30.0	40.0	50.0	60.0
20	.05	.05	.06	.06	.08	.12	.18	.21	.24	.30	.44	.61	.81	1.0	1.3	1.6	1.8	2.6	4	6	8	10
40	.06	.07	.07	.08	.10	.15	.22	.28	.34	.43	.63	.87	1.2	1.4	1.8	2.2	2.6	3.5	5	8	11	15
60	.07	.08	.08	.08	.11	.17	.25	.33	.41	.52	.77	1.0	1.4	1.8	2.2	2.6	3.0	4.5	6	10	14	18
80	.08	.08	.09	.09	.12	.19	.27	.37	.48	.60	.89	1.2	1.6	2.1	2.6	3.0	3.6	5.5	7	11	16	21
100	.08	.09	.09	.10	.13	.20	.29	.40	.54	.67	.99	1.4	1.8	2.4	2.9	3.5	4.2	6.0	8	13	18	23
110	.08	.09	.10	.10	.13	.21	.30	.42	.56	.71	1.0	1.5	2.0	2.5	3.0	3.7	4.5	6	9	14	19	25
120	.09	.09	.10	.10	.14	.21	.30	.43	.59	.74	1.0	1.6	2.1	2.6	3.3	4.0	4.6	7	9	14	20	26
130	.09	.09	.10	.11	.14	.22	.31	.44	.61	.77	1.2	1.6	2.2	2.8	3.4	4.1	4.9	7	9	15	20	27
140	.09	.10	.10	.11	.14	.22	.32	.46	.63	.80	1.2	1.7	2.3	2.9	3.6	4.3	5.1	7	10	15	21	29
150	.09	.10	.11	.11	.15	.23	.32	.47	.66	.82	1.2	1.8	2.4	3.0	3.7	4.5	5.3	8	10	16	23	30
160	.09	.10	.11	.11	.15	.23	.33	.48	.68	.85	1.2	1.9	2.5	3.1	3.9	4.7	5.5	8	10	17	24	31
180	.10	.10	.11	.12	.15	.24	.34	.51	.72	.90	1.4	1.9	2.6	3.3	4.1	5.0	6.0	9	12	18	26	33
200	.10	.11	.11	.12	.16	.25	.35	.53	.76	.95	1.4	2.1	2.8	3.6	4.4	5.3	6.3	9	12	18	27	35
300	.11	.12	.13	.14	.18	.28	.40	.62	.93	1.2	1.8	2.7	3.6	4.5	5.6	6.8	8	12	16	25	35	45
400	.12	.13	.14	.15	.20	.31	.44	.70	1.0	1.4	2.0	3.2	4.2	5.4	6.7	8.0	10	14	19	30	42	54
500	.13	.14	.15	.16	.21	.33	.47	.76	1.2	1.6	2.2	3.7	4.9	6.2	7.6	9.2	11	16	21	34	47	61
600	.14	.15	.16	.17	.22	.34	.49	.82	1.4	1.6	2.4	4.1	5.4	6.9	8.5	10.3	12	16	24	38	53	68
700	.15	.16	.17	.18	.23	.36	.52	.87	1.4	1.8	2.6	4.5	6.0	7.5	9.3	11.3	13	18	26	41	58	75
800	.15	.16	.17	.18	.24	.38	.54	.92	1.6	2.0	2.8	4.9	6.4	8.2	10.1	12.2	14	20	28	45	58	81
900	.16	.17	.18	.19	.25	.39	.56	.96	1.6	2.0	3.0	5.2	6.9	8.8	10.8	13.1	16	22	30	48	67	87
1000	.16	.18	.19	.20	.26	.40	.57	1.0	1.6	2.2	3.0	5.6	7.4	9.3	11.6	14.0	17	24	32	51	72	93
1100	.17	.18	.19	.20	.27	.41	.59	1.0	1.8	2.2	3.5	5.9	7.8	9.9	12.2	14.8	18	25	34	54	76	98
1200	.17	.18	.20	.21	.27	.42	.81	.10	.18	2.4	3.5	6.2	8.2	10.4	13.0	15.6	18	27	36	57	80	104
1300	.18	.19	.20	.21	.28	.43	.82	1.2	2.0	2.4	3.5	6.5	8.6	11.0	13.5	16.4	19	28	38	60	84	109
1400	.18	.19	.21	.22	.29	.44	.63	1.2	2.0	2.6	3.5	6.8	9.0	11.4	14.1	17.1	20	30	40	63	88	114
1500	.19	.20	.21	.22	.29	.45	.65	1.2	2.0	2.6	4.0	7.1	9.4	12.0	14.7	17.8	21	31	41	65	92	119
1600	.19	.20	.21	.23	.30	.46	.66	1.2	2.2	2.6	4.0	7.4	9.8	12.4	14.8	18.5	22	32	43	68	95	123
1700	.19	.21	.22	.23	.30	.47	.67	1.2	2.2	2.8	4.0	7.6	10.1	12.9	15.9	19.2	23	33	44	70	97	128
2000	.20	.22	.23	.24	.32	.49	.71	1.4	2.4	3.0	4.5	8.4	11.1	14.1	17.5	21	25	36	49	77	108	141

Contour limits - 2 percent 400 feet, 8 percent 200 feet, 10 percent 100 feet, 14 - 24 percent 60 feet. The effectiveness of contouring beyond these limits is speculative.

When the length of slope exceeds 400 feet and (or) percent of slope exceeds 24 percent, soil loss estimates are speculative as these values are beyond the range of research data.

TABLE 7

Sediment Pond Volume vs Capacity

Pond No.	Erosion Rate (tons/year)	Sediment Vol. (acre-ft/yr)	Sediment Capacity (acre-ft)	Sediment Capacity (years)
1	19.7	0.0090	0.363	40.3
4	~~73.5~~	~~0.0337~~	0.394	~~11.7~~
5	149.7	0.0687	-0.332	~~--~~
6	~~49.0~~	~~0.0225~~	0.179	~~7.9~~

1) Unit weight assumed to be 100 lb/ft^3

2) Conversion factor

$$\text{tons} \times 0.0004591 \ \frac{\text{acre-ft}}{\text{ton}} = \text{acre-ft}$$

ADEQUACY OF EXISTING SEDIMENT PONDS

Table 8 lists the design capacities of each of the existing sediment ponds, and the total volumes of runoff and direct precipitation determined during this analysis. Ponds 1, 4, and 6 all have the capacity to contain the runoff and direct precipitation resulting from the 10-year, 24-hour event, with excess capacity for sediment storage. The excess capacity in each case is approximately 10 percent or more of the design capacity of the sediment pond.

Pond 5, as designed, appears to be inadequate to contain 10-yr., 24-hr storm runoff.

DETERMINATION OF PEAK DISCHARGES FROM OFF-SITE AREAS A & B

The SCS TR20 computer model was used to determine the peak discharges from the off-site areas whose runoff is intercepted by the diversion shown on Map 1. Appendix A lists the data that was input to the model. Physical basin parameters were determined from topographic maps. Time of concentration, T_c, was determined from basin hydraulic length, elevation difference, and the Kirpich equation: $T_c = (11.9\ L^3/H)^{0.385}$. The curve numbers were determined from the soil survey and Table 1. The Farmer-Fletcher rainfall distribution was selected as the most applicable to the area.

Using the input file listed in Appendix A, the highest peak discharge to be conveyed by the diversion was found to be 6.3 cfs. The entire printout for the TR20 evaluation is given in Appendix B.

SIZE OF DIVERSION CHANNEL

The diversion, shown on Map 1, is intended to intercept and divert runoff

TABLE 8

Adequacy of Existing Ponds

Pond No.	Design Capacity (acre-ft) (1)	Total Runoff Volume (acre ft) (2)	Sediment Capacity (acre-ft)	Sediment Capacity as a Percentage of Design Capacity
1 (3,4)	2.951	2.588	0.363	12.3
4	2.411	2.017	0.394	16.3
5	2.411	2.743	-0.332	-13.8
6	1.808	1.629	0.179	9.9

1. From Exhibit 12, Castle Valley Spur, Mining and Reclamation Plan
2. Includes direct precipitation
3. Ponds 1, 2, and 3 are considered to be one pond
4. Pond 1 receives runoff from off-site drainage Area C

from drainages A and B. It was excavated in the native soil, and was lined with cobbles to impede velocity and erosion.

The length of the diversion is about 2200 ft., and the elevation change along it is about 35 ft. The average slope of the channel is therefore about 0.016.

Manning's formula was used to determine the adequacy of the channel. Manning's N, the roughness coefficient, was assumed to be 0.05. It was also assumed that the channel is 2.5 ft. wide with 1:1 side slopes. A calculator program, developed for the U.S. Office of Surface Mining (Selected Hand-held Calculator Codes for the Evaluation of the Cumulative Hydrologic Impacts of Mining, OSM, Region V, Contract J5191334, Denver, Colorado) was used to perform the actual calculations. The calculator outputs are listed in Table 9.

The water depth, in the channel, is about 0.77 ft. for a discharge of 6.3 cfs. When depths of 0.5 ft. and 1.0 ft. were assumed, the discharge was found to be about 3.0 and 10.0 cfs, respectively. To convey the 10-yr., 24-hr., discharge, and allow 1.0 ft. of freeboard, a depth of 1.8 ft. would be required.

Table 9.

Calculator Program Output

	DSM CHANNEL FLOW	DSM CHANNEL FLOW	DSM CHANNEL FLOW
Q	6.3	0.	0.
Z	1.	1.	1.
W	2.5	2.5	2.5
Y	0.	0.5	1.
S	0.016	0.016	0.016
N	0.05	0.05	0.05
	NORM. FLOW	NORM. FLOW	NORM. FLOW
V	2.495078998	1.988722023	2.848320997
A	2.524970153	1.5	3.5
Q	6.3	2.983083035	9.969123489
Z	1.	1.	1.
W	2.5	2.5	2.5
Y	.7714323391	0.5	1.
S	0.016	0.016	0.016
N	0.05	0.05	0.05
	Q = 6.3 cfs	Y = 0.5 ft	Y = 1.0 ft

Q = discharge, cfs
Z = side slope, H : V
W = bottom width, ft
Y = flow depth, ft
S = bed slope, rise/run
N = roughness coefficient

APPENDIX A

EXECUTIVE CONTROL CARD OPERATION LIST PASS= 1

LISTING OF DATA IN CORE

0 CASTLE VALLEY SPUR --- TR20 RUN OF OFF-SITE AREAS

VELOCITY INCREMENT
1 CTABLE 0.2000

8	0.0000	0.0800	0.1800	0.2500	0.3200
8	0.3700	0.4100	0.4500	0.4900	0.5100
8	0.5400	0.5700	0.5900	0.6100	0.6300
8	0.6500	0.6600	0.6700	0.6900	0.7000
8	0.7100	0.7200	0.7300	0.7400	0.7500
8	0.7600	0.7700	0.7700	0.7800	0.7900
8	0.7900	0.8000	0.8100	0.8100	0.8200
8	0.8200	0.8300	0.8300	0.8400	0.8400
8	0.8400	0.8500	0.8500	0.8600	0.8600
8	0.8600	0.8600	0.8700	0.8700	0.8700
8	0.8800	0.8800	0.8800	0.8900	0.8900
8	0.8900	0.8900	0.8900	0.8900	0.9000
8	0.9000	0.9000	0.9000	0.9000	0.9100
8	0.9100	0.9100	0.9100	0.9100	0.9100
8	0.9200	0.9200	0.9200	0.9200	0.9200
8	0.9200	0.9200	0.9200	0.9300	0.9300

9 ENDTBL

TIME INCREMENT
4 DIMHYD

8	0.0000	0.0300	0.1000	0.1900	0.3100
8	0.4700	0.6600	0.8200	0.9300	0.9900
8	1.0000	0.9900	0.9300	0.8600	0.7800
8	0.6800	0.5600	0.4600	0.3900	0.3300
8	0.2800	0.2410	0.2070	0.1740	0.1470
8	0.1260	0.1070	0.0910	0.0770	0.0660
8	0.0550	0.0470	0.0400	0.0340	0.0290
8	0.0250	0.0210	0.0180	0.0150	0.0130
8	0.0110	0.0090	0.0080	0.0070	0.0060
8	0.0050	0.0040	0.0030	0.0020	0.0010
8	0.0000	0.0000	0.0000	0.0000	0.0000

9 ENDTBL

COMPUTED PEAK K FACTOR = 484.00

TIME INCREMENT
5 RAINFL 1 0.5000

8	0.0000	0.0080	0.0170	0.0260	0.0350
8	0.0450	0.0550	0.0650	0.0760	0.0870

8	0.0990	0.1120	0.1250	0.1400	0.1560
8	0.1740	0.1940	0.2190	0.2540	0.3030
8	0.5150	0.5830	0.6240	0.6540	0.6820
8	0.7050	0.7270	0.7480	0.7670	0.7840
8	0.8000	0.8160	0.8300	0.8440	0.8570
8	0.8700	0.8820	0.8930	0.9050	0.9160
8	0.9260	0.9360	0.9460	0.9550	0.9650
8	0.9740	0.9830	0.9920	1.0000	1.0000

9 ENDTBL

TIME INCREMENT
5 RAINFL 5 2.4000

8	0.0000	0.3700	0.6200	0.7700	0.8300
8	0.8600	0.9100	0.9400	0.9600	0.9800
8	1.0000	1.0000	1.0000	1.0000	1.0000

9 ENDTBL

TIME INCREMENT
5 RAINFL 6 1.0000

8	0.0000	0.0100	0.0220	0.0340	0.0480
8	0.0610	0.0800	0.0990	0.1200	0.1470
8	0.1810	0.2350	0.6630	0.7720	0.8200
8	0.8520	0.8800	0.9000	0.9200	0.9380
8	0.9520	0.9660	0.9800	0.9890	1.0000

9 ENDTBL

STANDARD CONTROL INSTRUCTIONS

```
6 RUNOFF 1   1       6       0.0812     87.0000     0.29701 1 0 1 0 0
6 SAVMOV 5   1    6  5
6 RUNOFF 1   2       6       0.0250     87.0000     0.26401 1 0 1 0 0
6 ADDHYD 4   1    5 6 7                                   1 1 0 1 0 0
6 REACH  3   3    7  5    1000.0000      0.6400     0.00001 1 0 1 0 0
  ENDATA

END OF LISTING
```

APPENDIX B

PASS= 2

EXECUTIVE CONTROL CARD   OPERATION COMPUT,   FROM XSECTN/STRUCT 1/ 0   TO XSECTN/STRUCT 3/ 0
STARTING TIME= 0.00   RAIN DEPTH= 1.70   RAIN DURATION= 1.00   RAIN TABLE NO.= 5   SOIL CONDITION= 2
ALTERNATE NO.= 0   STORM NO.= 0

SUBROUTINE RUNOFF   CROSS SECTION 1
AREA= 0.08   INPUT RUNOFF CURVE= 87.0   TIME OF CONCENTRATION= 0.30

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
2.63	4.007	(RUNOFF)
4.45	4.813	(RUNOFF)
6.78	3.663	(RUNOFF)
9.28	1.507	(RUNOFF)
11.75	1.334	(RUNOFF)
16.26	0.805	(RUNOFF)
23.75	0.605	(RUNOFF)

HYDROGRAPH, TZERO= 0.00   DELTA T= 0.50   DRAINAGE AREA= 0.08

TIME											
0.00	DISCHG	0.00	0.00	0.00	0.64	2.55	3.95	3.49	3.97	4.42	4.81
5.00	DISCHG	4.21	3.23	3.32	3.41	3.51	1.99	1.45	1.46	1.47	1.49
10.00	DISCHG	1.28	1.26	1.26	1.27	1.28	0.80	0.77	0.78	0.78	0.78
15.00	DISCHG	0.78	0.79	0.79	0.79	0.67	0.53	0.53	0.53	0.53	0.53
20.00	DISCHG	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.03
25.00	DISCHG	0.00									

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 0.6749   CFS-HRS= 35.39   ACRE-FT= 2.92

SUBROUTINE SAVMOV   CROSS SECTION 1
INPUT HYDROGRAPH= 6   OUTPUT HYDROGRAPH= 5

SUBROUTINE RUNOFF   CROSS SECTION 2
AREA= 0.03   INPUT RUNOFF CURVE= 87.0   TIME OF CONCENTRATION= 0.26

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
2.62	1.239	(RUNOFF)
4.42	1.490	(RUNOFF)
6.78	1.135	(RUNOFF)
9.28	0.464	(RUNOFF)
11.76	0.411	(RUNOFF)
16.26	0.249	(RUNOFF)
23.75	0.187	(RUNOFF)

HYDROGRAPH, TZERO= 0.00   DELTA T= 0.50   DRAINAGE AREA= 0.03

TIME											
0.00	DISCHG	0.00	0.00	0.00	0.22	0.81	1.22	1.08	1.23	1.37	1.49
5.00	DISCHG	1.24	0.99	1.02	1.05	1.08	0.57	0.45	0.45	0.45	0.46
10.00	DISCHG	0.39	0.39	0.39	0.39	0.39	0.24	0.24	0.24	0.24	0.24
15.00	DISCHG	0.24	0.24	0.24	0.24	0.20	0.16	0.16	0.16	0.16	0.16
20.00	DISCHG	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.01

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 0.6751   CFS-HRS= 10.89   ACRE-FT= 0.90

SUBROUTINE ADDHYD   CROSS SECTION 1
INPUT HYDROGRAPHS= 5,6   OUTPUT HYDROGRAPH= 7

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
2.63	5.246	(NULL)

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
4.44	6.302	(NULL)
6.78	4.798	(NULL)
9.28	1.971	(NULL)
11.76	1.745	(NULL)
16.26	1.054	(NULL)
23.75	0.792	(NULL)

TIME HYDROGRAPH, TZERO= 0.00 DELTA T= 0.50 DRAINAGE AREA= 0.11

0.00	DISCHG	0.00	0.00	0.00	0.87	3.36	5.17	4.57	5.20	5.78	6.29
5.00	DISCHG	5.45	4.22	4.34	4.47	4.59	2.55	1.90	1.91	1.93	1.94
10.00	DISCHG	1.67	1.64	1.65	1.66	1.67	1.04	1.01	1.01	1.02	1.02
15.00	DISCHG	1.03	1.03	1.03	1.03	0.87	0.70	0.69	0.70	0.70	0.70
20.00	DISCHG	0.70	0.70	0.70	0.70	0.71	0.71	0.71	0.71	0.71	0.03
25.00	DISCHG	0.00									

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 0.6748 CFS-HRS= 46.27 ACRE-FT= 3.82

SUBROUTINE REACH CROSS SECTION 3
LENGTH= 1000.00 INPUT COEFFICIENT= 0.6400 INPUT ROUTINGS= 0.00

AVERAGE WATER VELOCITY= 3.022 AVERAGE ROUTING COEFF= 0.6400 NUMBER OF ROUTINGS= 0.12

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
2.68	5.095	(NULL)
4.47	6.234	(NULL)
6.78	4.752	(NULL)
9.28	1.965	(NULL)
11.76	1.735	(NULL)
16.26	1.051	(NULL)
23.75	0.782	(NULL)

TIME HYDROGRAPH, TZERO= 0.00 DELTA T= 0.50 DRAINAGE AREA= 0.11

0.00	DISCHG	0.00	0.00	0.00	0.76	3.06	4.95	4.64	5.13	5.71	6.23
5.00	DISCHG	5.55	4.37	4.32	4.45	4.57	2.80	1.98	1.91	1.92	1.94
10.00	DISCHG	1.70	1.64	1.65	1.66	1.67	1.11	1.01	1.01	1.02	1.02
15.00	DISCHG	1.02	1.03	1.03	1.03	0.89	0.72	0.70	0.70	0.70	0.70
20.00	DISCHG	0.70	0.70	0.70	0.70	0.71	0.71	0.71	0.71	0.71	0.11
25.00	DISCHG	0.00									

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 0.6752 CFS-HRS= 46.30 ACRE-FT= 3.83

ENDCMP

REFERENCES

1) Castle Valley Spur Mining and Reclamation Plan

2) Soil Inventory, Castle Valley Spur, James P. Walsh and Associates, Inc., July 31, 1980.

3) Precipitation Frequency Atlas of the Western United States #2, National Oceanic and Atmospheric Administration, 1973.

4) Urban Hydrology for Small Watersheds, Release 55, U.S. Soil Conservation Service, 1975.

5) Applied Hydrology and Sedimentology for Disturbed Areas, B.J. Barfield, R.C. Warner, and C.T. Haan, 1973.

6) Preliminary Guidance for Estimating Erosion on Areas Disturbed by Surface Mining Activities in the Interior Western United States, U.S. Environmental Protection Agency, EPA-908/4-77-005, 1977.