I- Spillway Configurations:

All primary and emergency spillways for ponds 001A through 003A are 18" Diameter CMP riser standpipes, with a barrell through the embankment.

Summarized below are weir and orifice flow for an 18-inch diameter standpipe. These calculations are applicable to all primary and emergency spillways for all three ponds.

Note W in $C = 3.27 + 0.4H/W$ was assumed to be 4.7 ft for all of the ponds. The exact value for W for the ponds was not known. However, variation in W will make little difference in the prediction of weir flow over the region where weir flow governs. For example, even if W were 7 ft. at a head of 0.5 ft (where orifice flow begins to govern), the discharge over the 18" Diameter spillway would be 5.48 cfs instead of the 5.52 cfs value reported below. Thus a variation in W makes little difference in Q.

RISER TYPE SPILLWAY HYDRAULICS

WEIR FLOW: Q=CL(H)**3/2 C= 3.27+0.4H/W

ORIFICE FLOW: Q=C'A(2gH)**1/2 C'= 0.6

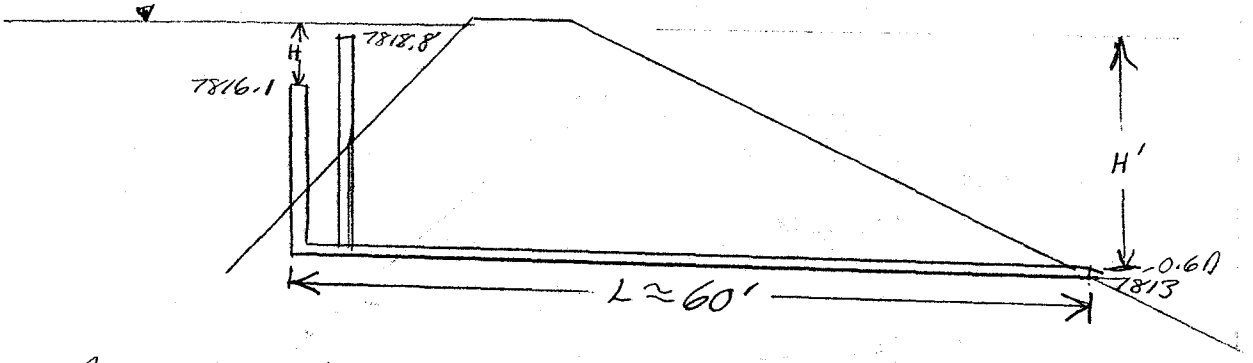
D= 1.5

A (FT2) 1.76625

STAGE H ft.	WEIR FLOW C	WEIR FLOW Q (CFS)	ORIFICE FLOW Q (CFS)	CONTOLLIN Q (CFS)
0	3.27	0	0	0
0.1	3.278	0.49	2.69	0.49
0.2	3.287	1.38	3.80	1.38
0.3	3.295	2.55	4.66	2.55
0.4	3.304	3.94	5.38	3.94
0.5	3.312	5.52	6.01	5.52
0.6	3.321	7.27	6.59	6.59
0.7	3.329	9.18	7.12	7.12
0.8	3.338	11.25	7.61	7.61
0.9	3.346	13.46	8.07	8.07
1	3.355	15.80	8.50	8.50
1.1	3.363	18.28	8.92	8.92
1.2	3.372	20.88	9.32	9.32
1.3	3.380	23.60	9.70	9.70
1.4	3.389	26.44	10.06	10.06
1.5	3.397	29.40	10.42	10.42
1.6	3.406	32.47	10.76	10.76
1.7	3.414	35.65	11.09	11.09
1.8	3.423	38.93	11.41	11.41
1.9	3.431	42.33	11.72	11.72
2	3.440	45.83	12.03	12.03
2.1	3.448	49.43	12.32	12.32
2.2	3.457	53.13	12.61	12.61
2.3	3.465	56.93	12.90	12.90
2.4	3.474	60.83	13.18	13.18
2.5	3.482	64.83	13.45	13.45
2.6	3.491	68.93	13.71	13.71
2.7	3.499	73.12	13.97	13.97
2.8	3.508	77.41	14.23	14.23
2.9	3.516	81.79	14.48	14.48
3	3.525	86.26	14.73	14.73
3.1	3.533	90.83	14.97	14.97
3.2	3.542	95.49	15.21	15.21
3.3	3.550	100.24	15.45	15.45
3.4	3.559	105.08	15.68	15.68

Orifice flow begins to govern

II - Check Pipe Flow from Pond 001A



Primary Spillway

$H' = H + [7816.1 - (7813 + 0.6(1.5))] = H + 2.2$

$L = 60'$

Emergency Spillway

$H' = H + [7818.8 - (7813 + 0.6(1.5))] = H + 4.9$

$L \approx 60'$

$$Q = \frac{a(2gH')^{1/2}}{(1 + K_e + K_b + K_c L)^{1/2}}$$

$K_e = 1$

$K_b = 0.5$

$K_c = \frac{5087(0.027)^2}{(18)^{4/3}} = 0.0786$

$a = 1.770 \text{ ft}^2$

$$Q = \frac{1.77(2 * 32.2 H')^{1/2}}{(1 + 1 + 0.5 + 0.0786(60))^{1/2}} = \frac{14.20 H'^{1/2}}{2.69} = 5.28 H'^{1/2}$$

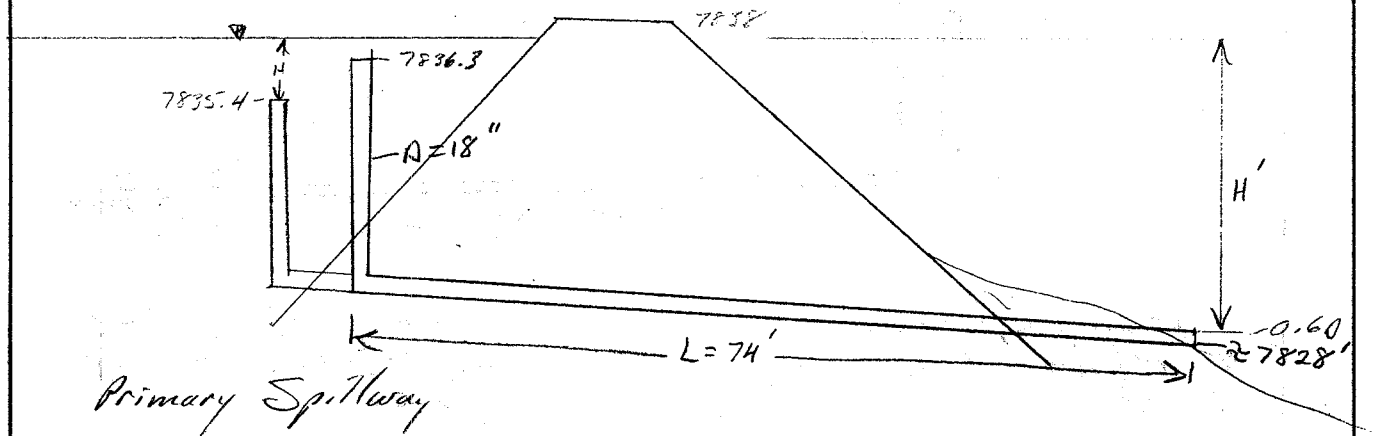
Primary Spillway

H ft	H' ft	Q cfs
0.2	2.4	8.18
0.4	2.6	8.51
0.6	2.8	8.83
0.8	3.0	9.14
1.0	3.2	9.45
1.2	3.4	9.73
1.4	3.6	10.02 ← Pipe flow becomes limiting at this point.
1.6	3.8	10.29
1.8	4.0	10.56
2.0	4.2	10.82
2.1	4.3	10.95
2.3	4.5	11.20
2.5	4.7	11.45
2.7	4.9	11.69
2.9	5.1	11.92
3.1	5.3	12.16
3.3	5.5	12.38
3.5	5.7	12.60
3.7	5.9	12.83

Emergency Spillway

H ft	H' ft	Q cfs
0.2	5.1	11.92
0.4	5.3	12.16
0.6	5.5	12.38
0.8	5.7	12.60
1.0	5.9	12.83
1.2	6.1	13.04
1.4	6.3	13.25
1.6	6.5	13.46
1.8	6.7	13.67
2.0	6.9	13.87 ← Orifice flow still limiting @ H = 2'

III - Check Pipe Flow from 002A



Primary Spillway

$$H' = H + \left[7835.4 - (7828 + 0.6(1.5))\right] = H + 6.5$$

$$L = 74'$$

Emergency Spillway

$$L = 74'$$

$$H' = H + \left[7836.3 - (7828 + 0.6(1.5))\right] = H + 7.4$$

$$Q = \frac{a\,(2gH')^{1/2}}{(1 + K_e + K_b + K_c L)^{1/2}}$$

$K_e = 1.0$ $\quad n = 0.027$

$K_b = 0.5$

$$K_c = \frac{5087 n^2}{d_i^{4/3}} = \frac{5087\,(0.027)^2}{(18)^{4/3}} = 0.0786$$

$$a = 1.770\ ft^2$$

Principal Spillway & Emergency - (Since both are the same length & diameter)

$$Q = \frac{1.77\left[2(32.2)H'\right]^{1/2}}{(1 + 1 + 0.5 + 0.0786(74))^{1/2}} = \frac{14.20\,H'^{1/2}}{2.88H} = 4.92\,H'^{1/2}$$

Primary Spillway - Pipe Flow

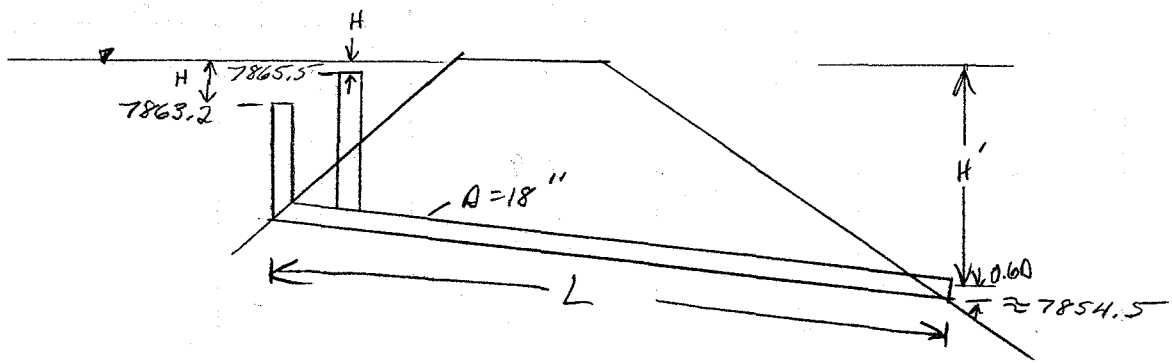
H (ft)	H' (ft)	Q (cfs)
0.2	6.7	12.7
0.4	6.9	12.9
0.6	7.1	13.1
0.8	7.3	13.3
1.0	7.5	13.47
1.2	7.7	13.65
1.4	7.9	13.83
1.6	8.1	14.00
1.8	8.3	14.17
2.0	8.5	14.34

Emergency Spillway - Pipe Flow

H (ft)	H' (ft)	Q cfs
0.2	7.6	13.56
1.0	8.4	14.26
2.0	9.4	15.05

← At this head orifice flow is still controlling, thus pipe flow is not controlling in Pond 002A

IV - Check Pipe Flow from Pond 003A



Principal Spillway

$$H' = H + [7863.2 - (7854.5 + 0.6(1.5))] = H + 7.8$$

$L \approx 74'$

Emergency

$$H' = H + [7865.5 - (7854.5 + 0.6(1.5))] = H + 10.1$$

$L \approx 74'$

$$Q = \frac{a(2gH')^{1/2}}{(1 + K_e + K_b + K_c L)^{1/2}}$$

$K_e = 1.0$ $\quad n = 0.027$

$K_b = 0.5$

$$K_c = \frac{5087 n^2}{d_c^{4/3}} = \frac{5087(0.027)^2}{(18)^{4/3}} = 0.0786$$

$$a = \text{area} = \frac{\pi D^2}{4} = \frac{\pi (1.5)^2}{4} = 1.77 ft^2$$

Principal and Emergency - (Since both have the same length; diameter).

$$Q = \frac{1.77[2(32.2)H']^{1/2}}{(1 + 1.0 + 0.5 + 0.0786(74))^{1/2}} = \frac{14.20 H'^{1/2}}{2.884} = 4.92 H'^{1/2}$$

Primary Spillway - Pipe Flow

H (ft)	H' (ft)	Q (cfs)
0.2	8.0	13.91
0.4	8.2	
0.6	8.4	
0.8	8.6	
1.0	8.8	14.60
1.2	9.0	
1.4	9.2	
1.6	9.4	
1.8	9.6	
2.0	9.8	15.40 cfs

Orifice Flow is still limiting at this head. Thus pipe flow is not controlling.

Emergency Spillway - Pipe flow

H (ft)	H' (ft)	Q (cfs)
0.2	10.3	15.8
1.0	11.1	16.4
2.0	12.1	17.1

HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
PROJECT Sedimdyt Pond Analysis
FEATURE Spillway Rating Curves - Ponds 001A to 003A
PROJECT NO.

SHEET 5 OF 7
COMPUTED JKA
CHECKED
DATE 1/25/89

V - Discharge Rating Table - Pond 001A

Elev	Primary Spillway H ft	Primary Spillway Q cfs	Emergency Spillway H ft	Emergency Spillway Q cfs	Combined Q cfs
7816.1	0	0	0	0	0
7816.2	0.1	0.49			0.49
7816.4	0.3	2.55			2.55
7816.6	0.5	5.52			5.52
7816.8	0.7	7.12			7.12
7817.0	0.9	8.07			8.07
7817.2	1.1	8.92			8.92
7817.4	1.3	9.70			9.70
7817.6	1.5	10.16			10.16
7817.8	1.7	10.43			10.43
7818.0	1.9	10.69			10.69
7818.2	2.1	10.95			10.95
7818.4	2.3	11.20			11.20
7818.6	2.5	11.45			11.45
7818.8	2.7	11.69	0	0	11.69
7819.0	2.9	11.92	0.2	1.38	13.30
7819.2	3.1	12.16	0.4	3.94	16.10
7819.4	3.3	12.38	0.6	6.59	18.97
7819.6	3.5	12.60	0.8	7.61	20.21
7819.8	3.7	12.83	1.0	8.50	21.33

HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
PROJECT Sediment Pond Analysis
FEATURE Spillway Rating Curves - Ponds 001A to 003A
PROJECT NO.

SHEET 6 OF 7
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CHECKED
DATE 1/25/89

VI - Discharge Rating Table - Pond 002A

Elev ft	Primary Spillway H ft	Primary Spillway Q cfs	Emergency Spillway H ft	Emergency Spillway Q cfs	Combined Q cfs
7835.4	0	0	0	0	0
7835.6	0.2	1.38			1.38
7835.8	0.4	3.94			3.94
7836.0	0.6	6.59			6.59
7836.2	0.8	7.61			7.61
7836.3	0.9	8.07	0	0	8.07
7836.4	1.0	8.50	0.1	0.49	8.99
7836.6	1.2	9.32	0.3	2.55	11.87
7836.8	1.4	10.06	0.5	5.52	15.58
7837.0	1.6	10.76	0.7	7.12	17.88
7837.2	1.8	11.41	0.9	8.07	19.48

HANSEN ALLEN & LUCE INC

CLIENT: Valley Camp
PROJECT: Sediment Pond Analysis
FEATURE: Spillway Rating Curves - Ponds 001A to 003A
PROJECT NO.:

SHEET 7 OF 7
COMPUTED: CMA
CHECKED:
DATE: 1/25/89

POND 003A

Elev ft.	Primary Spillway H ft	Primary Spillway Q cfs	Emergency Spillway H ft	Emergency Spillway Q cfs	Combined Q cfs
7863.2	0	0	0	0	0
7863.4	0.2	1.38			1.38
7863.6	0.4	3.94			3.94
7863.8	0.6	6.59			6.59
7864.0	0.8	7.61			7.61
7864.2	1.0	8.50			8.50
7864.4	1.2	9.32			9.32
7864.6	1.4	10.06			10.06
7864.8	1.6	10.76			10.76
7864.87 — 7865.0	1.8	11.41			11.41 — 11.6 design flow
7865.2	2.0	12.03			12.03
7865.4	2.2	12.61			12.61
7865.5	2.3	12.90	0	0	12.9
7865.6	2.4	13.18	0.1	0.49	13.67
7865.8	2.6	13.71	0.3	2.55	16.26
7866.0	2.8	14.23	0.5	5.52	19.76
7866.2	3.0	14.73	0.7	7.12	21.85
7866.4	3.2	15.21	0.9	8.07	23.28

Min Embankment Crest set 2.0' above Emergency Spillway Elevation. (7865.5+2.0=7867.5')

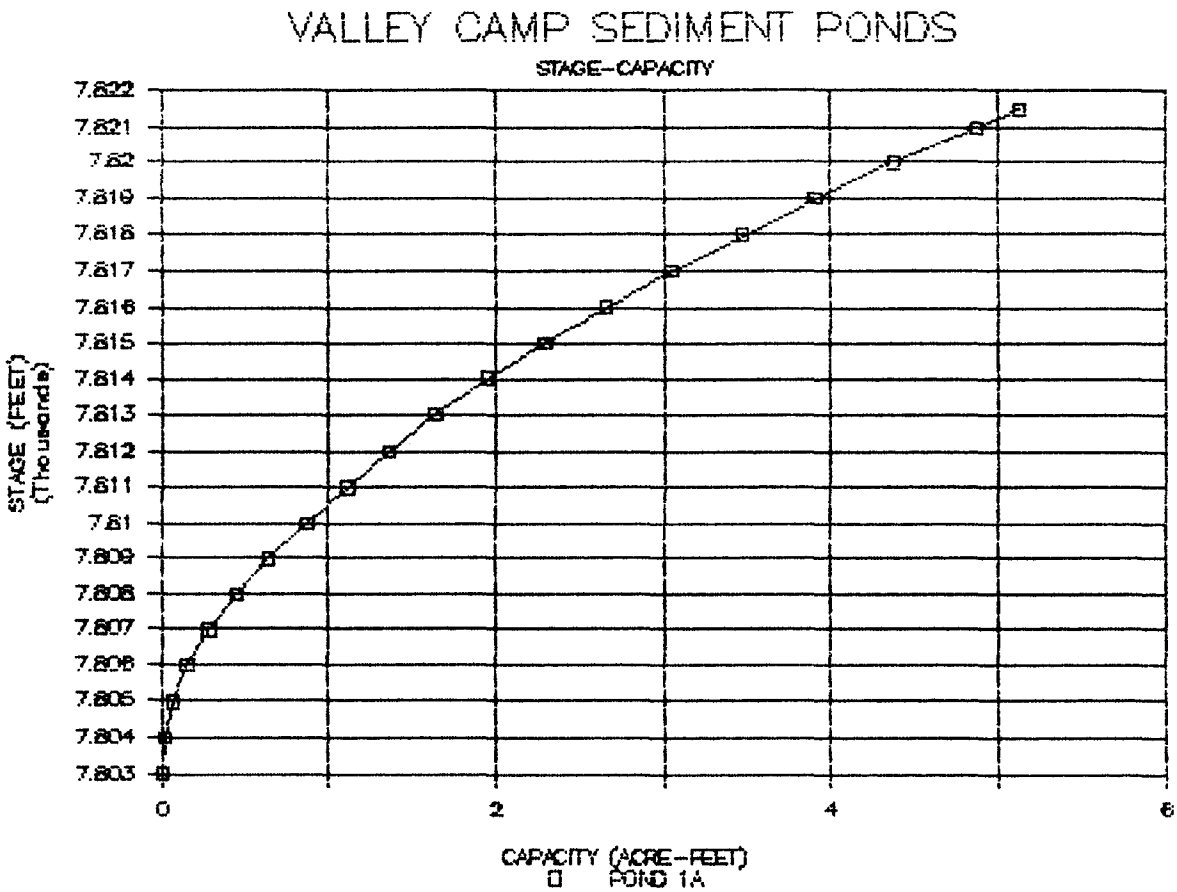
STAGE VOLUME RELATIONSHIP
POND 001A

AFTER CLEANING (OCTOBER 1988)
POND NPDES 001A

ELEV. FT	STAGE FT	AREA FT2	DEL VOL AF	SUM VOL AF	COMMENTS
7803	0	207	0	0	
7804	1	1050	0.01	0.01	
7805	2	3050	0.05	0.06	
7806	3	4880	0.09	0.15	
7807	4	6630	0.13	0.28	
7808	5	7750	0.17	0.45	
7809 -7809.73	6	9360	0.20	0.65	0.81 – 60% Sed. Cleanout
7810	7	10350	0.23	0.87	
7811	8	10670	0.24	1.11	
7812	9	11000	0.25	1.36	
7813	10	13000	0.28	1.64	
7814	11	14400	0.31	1.95	
7815	12	15416	0.34	2.29	
7816	13	16300	0.36	2.66	Exist. Primary spillway (18
7817	14	17500	0.39	3.05	EL-7816.1
7818	15	18800	0.42	3.46	
7819	16	20000	0.45	3.91	Exist. Emergency spillway (
7820	17	20900	0.47	4.38	EL - 7818.8'
7821	18	22100	0.49	4.87	
7821.5	18.5	22650	0.26	5.13	

PONA 001A AFTER CLEANING

2/1

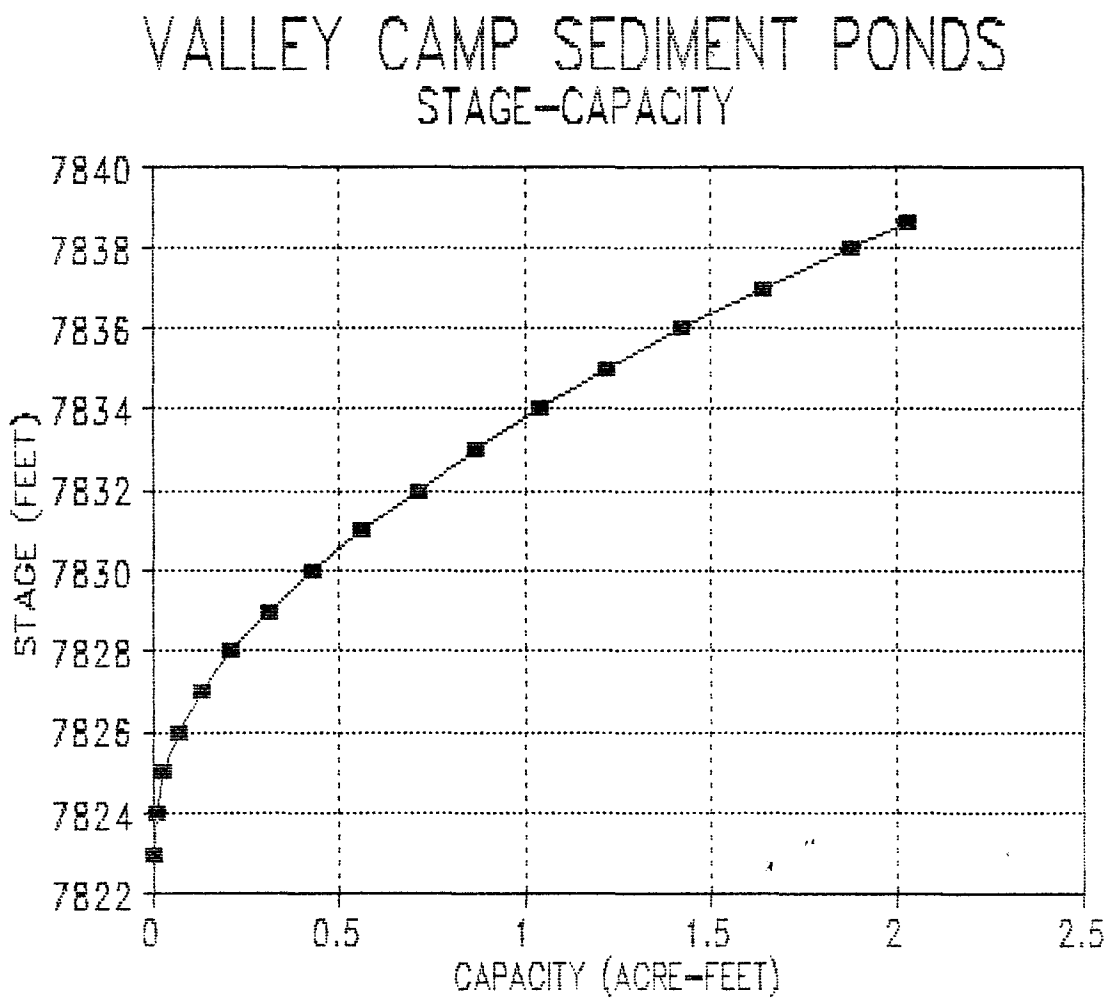


STAGE VOLUME RELATIONSHIP
POND 002A

POND NPDES 002A AFTER CLEANING. NOVEMBER 198

ELEV. FT	STAGE FT	AREA FT2	DEL VOL AF	SUM VOL AF	
7823	0	87	0	0	
7824	1	549	0.01	0.01	
7825	2	1300	0.02	0.03	
7826	3	2180	0.04	0.07	
7827 7827.63	4	3120	0.06	0.13	
7828	5	4000	0.08	0.21	0.18 – 60% SEDIMENT CLEANOUT
7829	6	4880	0.10	0.31	
7830	7	5445	0.12	0.43	Existing Decant EL - 7830.8'
7831	8	6100	0.13	0.56	
7832	9	6690	0.15	0.71	
7833	10	7020	0.16	0.87	
7834	11	7550	0.17	1.04	
7835	12	8460	0.18	1.22	Primary EL - 7835.4
7836	13	9100	0.20	1.42	Emergency EL - 7836.3'
7837	14	9920	0.22	1.64	
7838	15	10810	0.24	1.88	
7838.6	15.6	11400	0.15	2.03	

Pond 002A after Cleaning



POND 002A

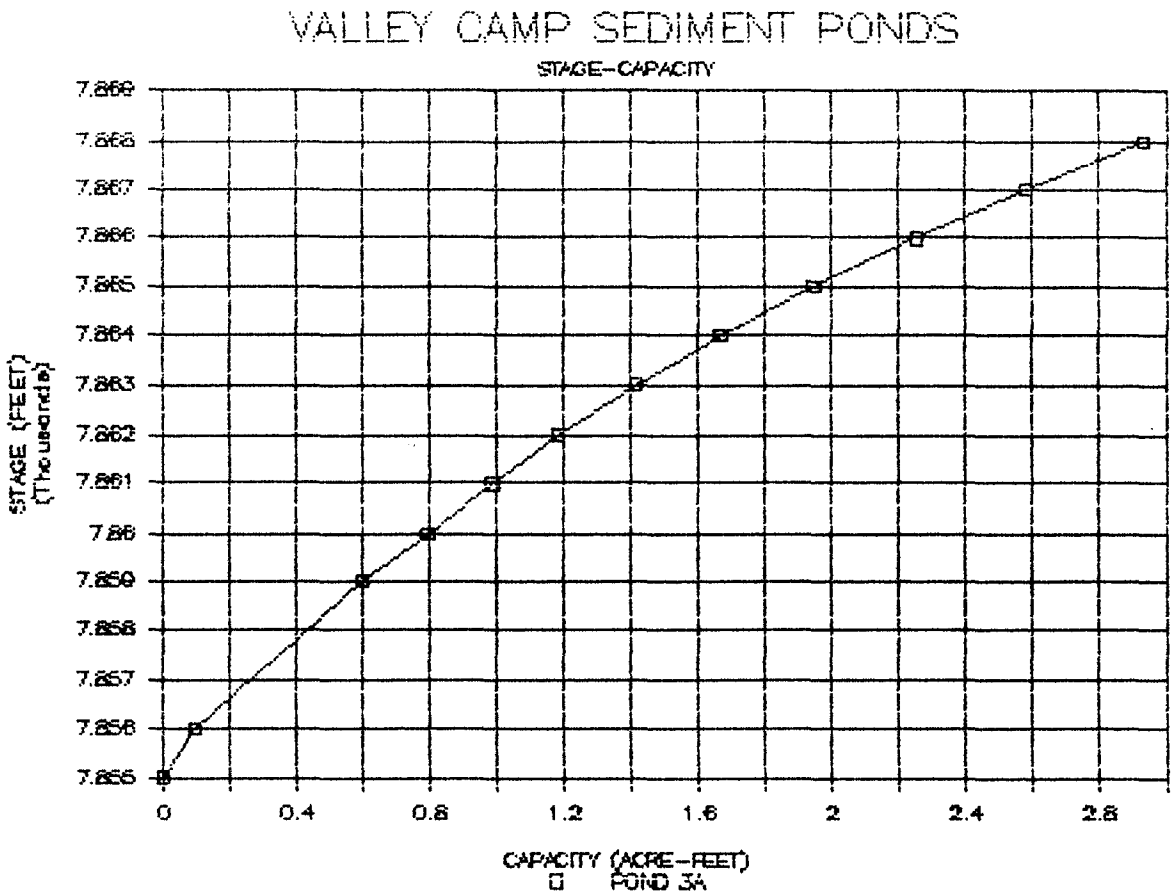
STAGE VOLUME RELATIONSHIP
POND 003A

AFTER CLEANING (OCTOBER 1988)
POND NPDES 003A

ELEV. FT	STAGE FT	AREA FT~~3~~ 2	DEL VOL AF	SUM VOL AF	
7855	0	2170	0	0	
7856	1	6430	0.10	0.10	0.47-60% SEDIMENT CLEANOUT
7859	4	8150	0.50	0.60	
7860	5	8830	0.19	0.80	
7861	6	7861	0.19	0.99	
7862	7	9310	0.20	1.18	
7863	8	10500	0.23	1.41	Primary El - 7863.2
7864	9	11650	0.25	1.67	
7865	10	12700	0.28	1.95	Emergency El - 7865.5
7866	11	14000	0.31	2.25	
7867	12	14580	0.33	2.58	
7868	13	15960	0.35	2.93	

7858.21

POND NPDES 003A AFTER CLEANING



STAGE VOLUME RELATIONSHIP
POND 00HA

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	110	0.22	0.00
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[illegible] — 8868.86	[illegible]	[illegible]	[illegible]	[illegible] — 1.09 - 60% SEDIMENT CLEANOUT
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible] ← Emergency 8875.9

Storage at Primary Spillway = 4.96 ac-ft.

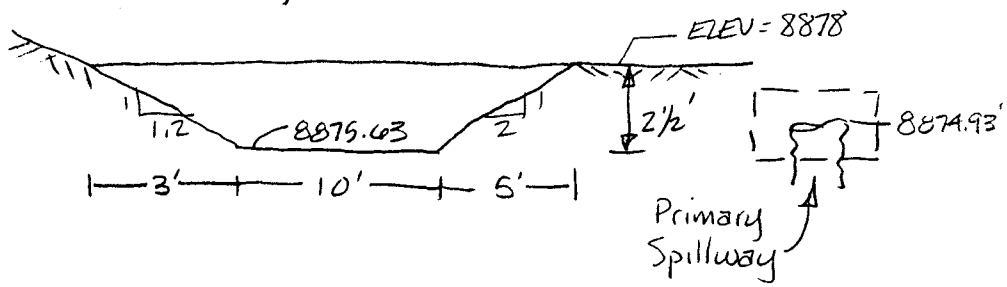
Required decant elev. to provide 3.15 ac-ft of runoff storage = 8870.25'

POND 009A Emergency Spillway

These calculations are a reworking of calculations completed earlier related to spillway requirements for Pond 009A. Calculations dated 23 MAY 89 are hereby replaced.

Emergency Spillway was reconstructed in May, 1989 subsequent to damage caused by animal borings.

Dimensions taken 5/17/89



Δh required between spillways = 1.0'
∴ must raise spillway (emergency) to 8875.9'

Embankment Elevation: EXISTING = 8877.5'

Crest Length = 20'

Previous Calculations use 25yr, 24hr Runoff Event = 52cfs

New Calculations allow for 25yr, 6hr Runoff Event = 13.2cfs

by addition of ditches and culverts, Q = 14.5cfs + a small tributary area

C-34-24 Q = 2.52"
C-33-24 Q = 11.96
14.48

Estimated flow equal to 13.2 cfs is used because the estimate by ditch and culvert addition does not allow for routing.

Leaving pond in its "as is" state, no modifications are made to sediment volumes, etc as part of this hydraulic check.

Upstream Slope = 2:1

* Identified "C" values based on increase noted for Rest area, wildlife

PROJECT : VALLEY CAMP SEDIMENT POND 004A: 25-YR. 6-HR PEAK INFLOW

AREA= 37.1 ACRES
AVERAGE BASIN SLOPE= 40.0 PERCENT
CURVE NUMBER= 83.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 2040. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0896 HOURS QPCFS= 312.99 CFS QPIN= 8.3664 INCHES
C3= 41.2379 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.04	.4068	.0000	.0000	.0	.00
2.06	.4273	.0002	.0002	15.7	.00
2.08	.4479	.0007	.0005	97.2	.02
2.10	.4685	.0016	.0009	207.8	.10
2.12	.4890	.0030	.0013	287.3	.27
2.13	.5096	.0046	.0017	313.0	.56
2.15	.5301	.0067	.0020	293.2	.96
2.17	.5507	.0091	.0024	247.5	1.46
2.19	.5713	.0118	.0027	193.6	2.04
2.21	.5918	.0149	.0031	142.8	2.68
2.22	.6124	.0183	.0034	100.7	3.34
2.24	.6330	.0220	.0037	68.4	4.03
2.26	.6535	.0260	.0040	45.0	4.72
2.28	.6741	.0302	.0043	28.9	5.41
2.29	.6947	.0348	.0046	18.1	6.09
2.31	.7152	.0397	.0049	11.2	6.76
2.33	.7358	.0448	.0051	6.8	7.41
2.35	.7563	.0502	.0054	4.0	8.04
2.37	.7769	.0558	.0057	2.4	8.67
2.38	.7975	.0617	.0059	1.4	9.27
2.40	.8180	.0679	.0061	.8	9.86
2.42	.8386	.0743	.0064	.5	10.44
2.44	.8592	.0809	.0066	.3	11.00
2.46	.8797	.0878	.0068	.1	11.54
2.47	.9003	.0948	.0071	.0	12.08
2.49	.9209	.1021	.0073	.0	12.59
2.51	.9331	.1065	.0044	.0	13.05
2.53	.9386	.1086	.0020	.0	13.21
2.55	.9442	.1106	.0021	.0	12.79
2.56	.9498	.1127	.0021	.0	11.82
2.58	.9553	.1148	.0021	.0	10.51
2.60	.9609	.1169	.0021	.0	9.14
2.62	.9664	.1190	.0021	.0	7.88
2.64	.9720	.1211	.0021	.0	6.86

HYDROGRAPH PEAK= 13.21 cfs
TIME TO PEAK= 2.53 Hours
RUNOFF VOLUME= 1.26 Acre-Feet

ELEV	HEAD	C	C*
8875.9	0	–	–
8876.1	0.2	3.22	3.23
8876.3	0.4	3.04	2.40

Broad Crested Weir eqn: $Q = CLH^{3/2}$ $L = 10'$

from Stage-Discharge hydraulic analysis - (sheet 4)

	Primary	Emergency	Σ
Head	1.29'	0.29	
Q	9.65	3.55	13.2

Spillway is adequate "as is".

REQUIREMENTS:

Primary Spillway Elev: 8874.93' ft

Emergency Spillway Elev: 8875.9 ft

Emergency Flow depth: 0.3 ft

Freeboard : 1.0 ft

Top of Embankment Elev: 8877.2 ft

RIPRAP CHECK

Primary Spillway - Q = 9.65 cfs Dia = 18 inch

Check velocity - $n = .024$; $S_f = 0.19$

$\frac{Qn}{1.49 S^{1/2}} = 0.349$, $y = 0.65'$, $V = 13.2$ fps

According to "Erosion - Sediment Control - Surface Mining in the Eastern U.S." - EPA, 1976 Fig 1-15

$D_{50} \sim 0.6$ ft, use 0.75' d_{50} (Flow over Vertical)

$D_{max} = 1.5 d_{50} = 1.13$ use 1.25' d_{max}

Continue at least 10' downstream.

nt: Valley Camp Coal Company - Stage Discharge Hydraulic Analysis - Sediment Pond 004A
roject: 007.11.200
ate : August 17, 1990

eir Flow Equation: Q=CL(H)**3/2 Where: C=3.27+0.4H/W
rifice Flow Equation: Q=C'A(2gH)**1/2 C'= 0.6
nnel Weir Flow Equation: Q=C"L(H)**3/2

ipe Dia : 1.5 feet
e Elev: 8874.9 feet (msl)
n Elev: 8875.9 feet (msl)
nan Wdth: 10 feet
eir Area: 1.77 feet squared

Weir Stage	Weir Head (ft)	C	Weir Flow Q(cfs)	Orifice Flow (cfs)	Governing Flow (cfs)	Channel Head (ft)	C"	Channel Flow Q(cfs)	Combined Flow (cfs)
8874.9	0.0	3.27	0.00	0.00	0.00			0.00	0.00
8875.0	0.1	3.28	0.49	2.69	0.49			0.00	0.49
8875.1	0.2	3.29	1.38	3.81	1.38			0.00	1.38
8875.2	0.3	3.30	2.55	4.66	2.55			0.00	2.55
8875.3	0.4	3.30	3.94	5.38	3.94			0.00	3.94
8875.4	0.5	3.31	5.52	6.02	5.52			0.00	5.52
8875.5	0.6	3.32	7.27	6.59	6.59			0.00	6.59
8875.6	0.7	3.33	9.18	7.12	7.12			0.00	7.12
8875.7	0.8	3.34	11.25	7.61	7.61			0.00	7.61
8875.8	0.9	3.35	13.46	8.07	8.07			0.00	8.07
8875.9	1.0	3.35	15.80	8.51	8.51	0.0	2.05	0.00	8.51
8876.0	1.1	3.36	18.28	8.92	8.92	0.1	2.14	0.68	9.60
8876.1	1.2	3.37	20.88	9.32	9.32	0.2	2.23	1.99	11.32
8876.2	1.3	3.38	23.60	9.70	9.70	0.3	2.32	3.81	13.51
8876.3	1.4	3.39	26.44	10.07	10.07	0.4	2.40	6.07	16.14

13.2

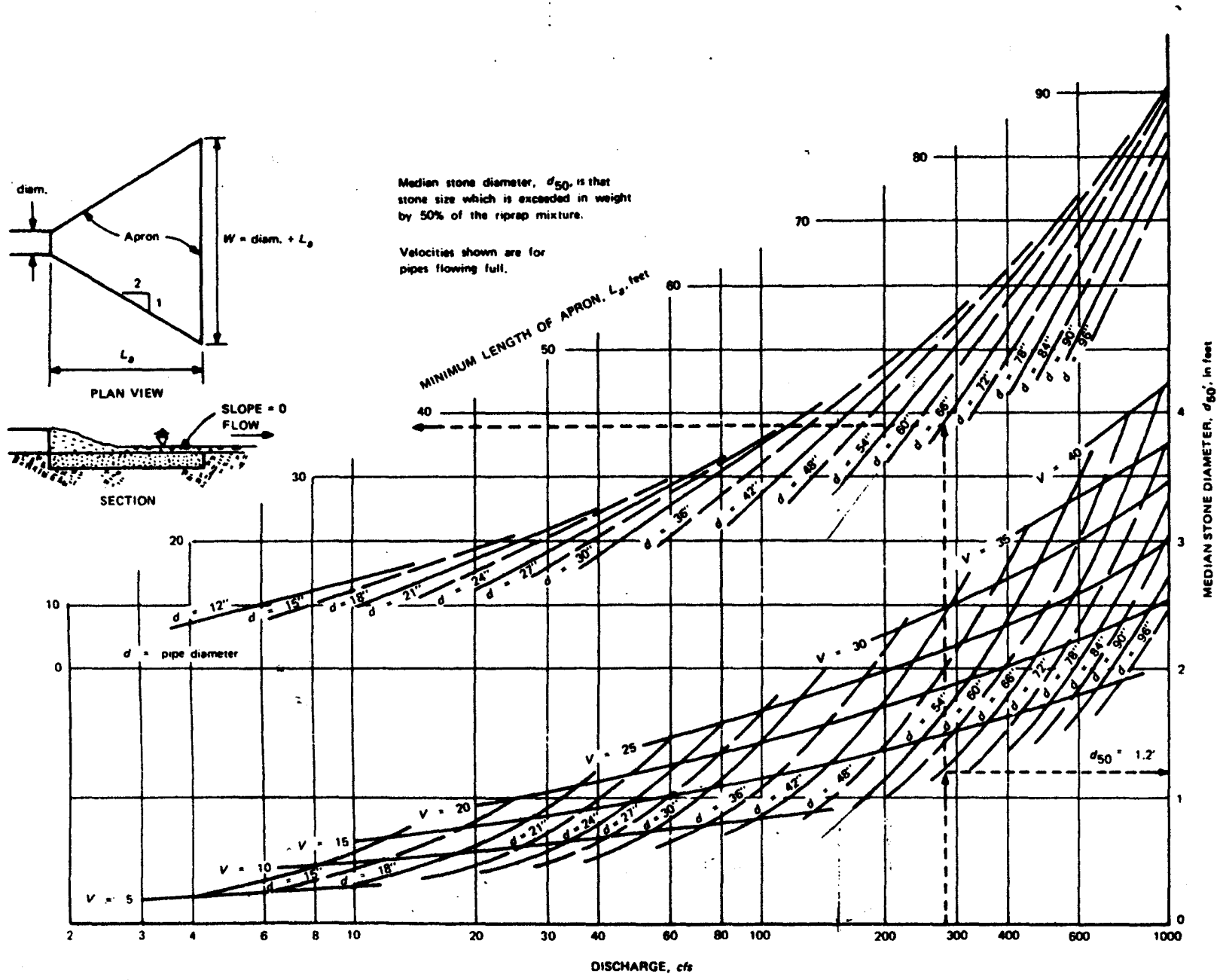


Figure I-15. Design of outlet protection – minimum tailwater condition ($T_W < 0.5$ diam.)[1]

Emergency Spillway

Use "OSM" Steep Channel design Method.

Slope down face of pond is approx. 35 to 40% (at max sections) using 40% grades, and a 6' base width (conservatively reducing the width from 10' to 6'), and a Q = 3.55 cfs.

$d_{50} < 0.5'$ $\quad d_{max} = 1.25(d_{50}) = 0.63$ use $\underline{0.75' \, d_{max}}$

$d_{10-20} = \frac{d_{50}}{2-3} = 0.17$ to $0.25'$ $\quad$ Use $.25' \, d_{10-20}$

Use $d_{50} = 0.5'$

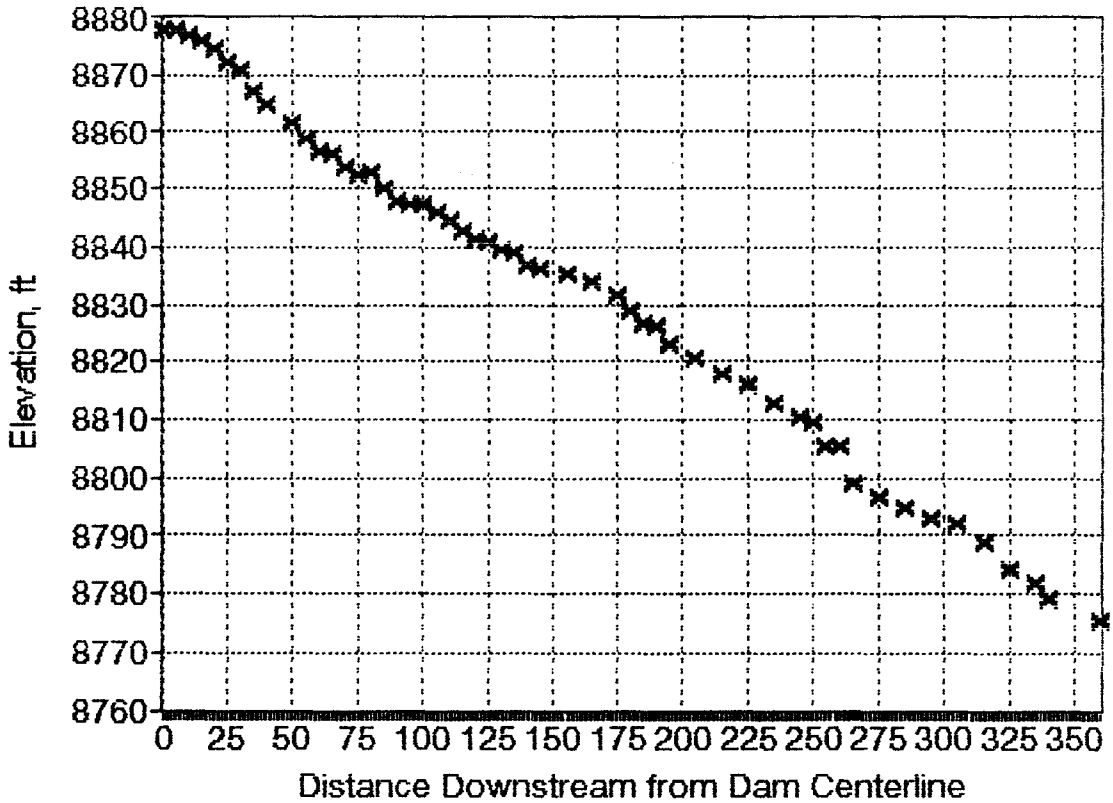
7/10

Valley Camp Coal - Pond 4 Survey Notes by Steve Tanner
Data Received 7/25/90
Top of Embankment: 8878

EMERGENCY SPILLWAY PROFILE

Distance	Relative Elev.	msl Elev.	Distance	Relative Elev.	msl Elev.
0	200.0	8878.0	205	142.6	8820.6
5	199.7	8877.7	215	139.9	8817.9
10	198.9	8876.9	225	137.9	8815.9
15	197.6	8875.6	235	134.8	8812.8
20	196.4	8874.4	245	132.2	8810.2
25	194.4	8872.4	250	131.5	8809.5
30	192.6	8870.6	255	127.3	8805.3
35	189.3	8867.3	260	127.5	8805.5
40	186.6	8864.6	265	120.8	8798.8
50	183.7	8861.7	275	118.9	8796.9
55	180.8	8858.8	285	116.9	8794.9
60	178.7	8856.7	295	114.8	8792.8
65	178.2	8856.2	305	113.9	8791.9
70	175.9	8853.9	315	110.9	8788.9
75	174.5	8852.5	325	106.1	8784.1
80	174.7	8852.7	335	103.8	8781.8
85	172.0	8850.0	340	101.0	8779.0
90	169.8	8847.8	360	97.5	8775.5
95	169.4	8847.4			
100	169.5	8847.5			
105	167.8	8845.8			
110	166.7	8844.7			
115	164.8	8842.8			
120	163.5	8841.5			
125	162.9	8840.9			
130	161.7	8839.7			
135	160.7	8838.7			
140	158.7	8836.7			
145	158.4	8836.4			
155	157.5	8835.5			
165	156.0	8834.0			
175	153.4	8831.4			
180	150.9	8828.9			
185	148.6	8826.6			
190	148.0	8826.0			
195	144.9	8822.9			

Pond 004A - Spillway Cross Section



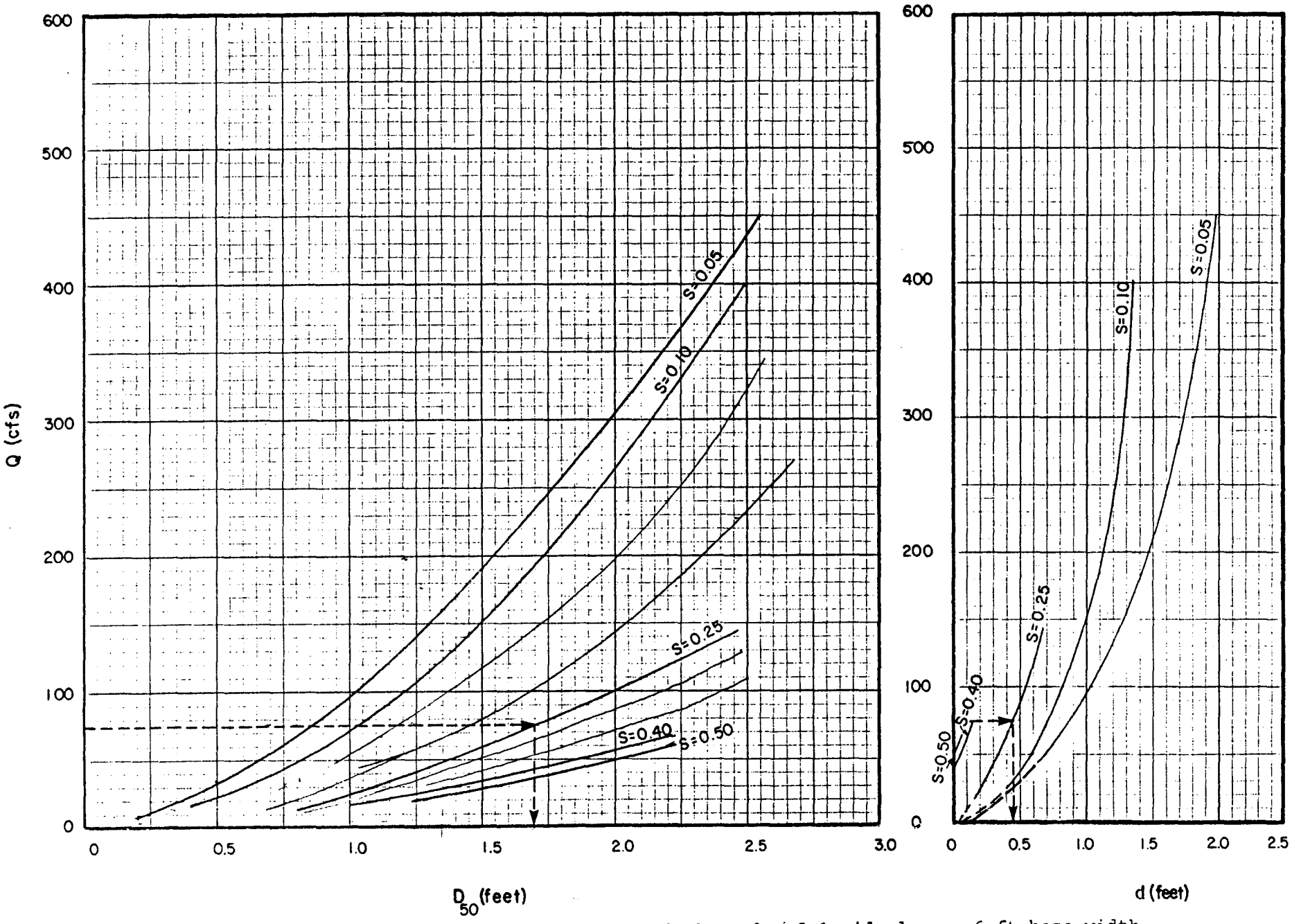


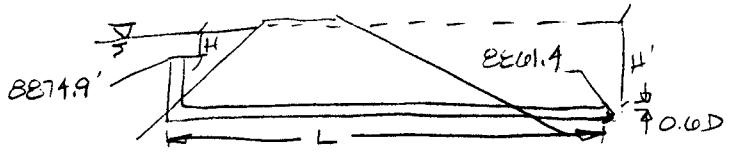
Figure 5.4. Steep slope riprap design, trapezoidal channels, 2:1 sideslopes, 6 ft base width.

9/18

Check of Point 00AA (Pipe Flow Conditions)

PRIMARY SPILLWAY $L \simeq 80'$

$H' = H + [8874.9 - (8861.4 + 0.6(1.5))] = H + 12.65$



$$Q = \frac{a(2gH')^{1/2}}{(1+K_e+K_b+K_c l)^{1/2}} =$$

$K_e = 1$

$K_b = 0.5$

$K_c = \frac{5087(n)^2}{D^{4/3}} = \frac{5087(.027)^{1/2}}{(18)^{4/3}} = 0.0786$

$a = 1.77\ ft^2$

$$Q = \frac{1.77(2(32.2)H')^{1/2}}{(1+1+0.5+(.0786)80)^{1/2}} = \frac{14.2H'^{1/2}}{2.96}$$

UNDER MAX HEAD CONDITIONS

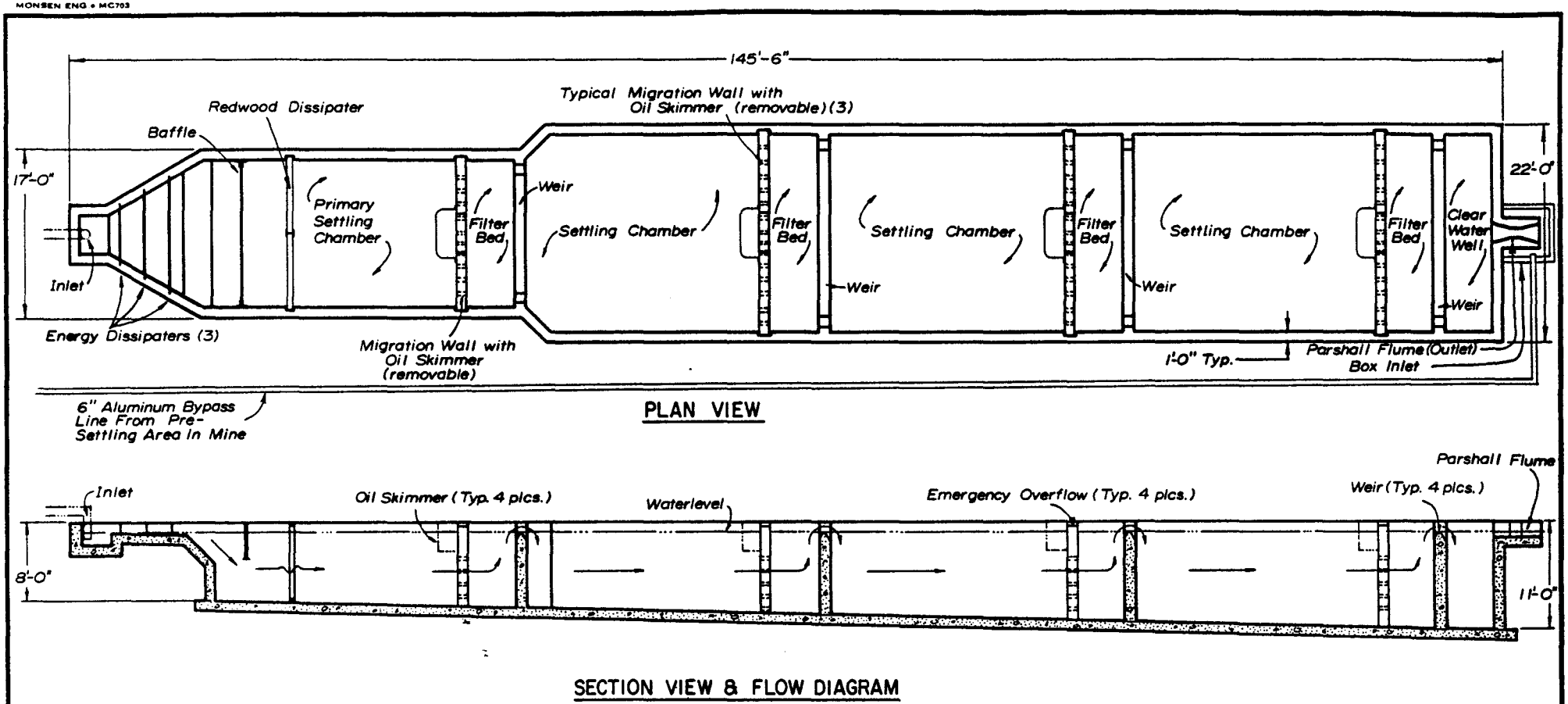
$H_{max} = 2.1'$ $\quad H' = 2.1' + 12.65 = 14.75'$

$$Q = \frac{14.2(14.75)^{1/2}}{2.96} = \underline{\underline{18.42\ cfs}}$$

18.4 cfs > 12.22 cfs under Inlet Conditions,
∴ NOT GOVERNING

STAGE DISCHARGE RELATIONSHIP SHOWN ON SHEET 4

MONSEN ENG. • MC703



REGISTERED PROFESSIONAL ENGINEER
No. 5323
EDWIN BROOKSHIRE FOUST
STATE OF UTAH

DRAWN BY: Ed Sanderson	VALLEY CAMP OF UTAH, INC. SCOFIELD ROUTE HELPER, UTAH 84526
DATE: Sept. 12, 1983	
CHECKED BY:	
DATE:	
APPROVAL:	TITLE: CONCRETE FILTER POND
APPROVAL:	
APPROVAL:	SCALE: NONE — DRAWING NO. B4-0010

Fig. 3-6C

Outlet Erosion Protection Calculations

POND ENERGY DISSIPATION - CHECK OF RIPRAP SIZES IN PLACE

FLOW DATA - 25 Yr - 24 Hr Event

Pond	Q(cfs)	Outfall Dia. (in) PRIMARY	EMERGENCY
001A	18.3	18	18
002A	13.7	18	18
003A	11.0	18	18
004A	52.0	18	N/A

POND 001A

Q=18.3cfs Discharge Elev = 7819.35';

	Head	Q
Primary Spillway	3.25	12.33
Emergency Spillway	0.55	5.93
		18.3 cfs

$n = 0.024$ for Corrugated Metal Pipe $\quad Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$

Check velocity ranges for discharge pipes

Principal: 1% Slope

$\frac{Qn}{1.49 S^{1/2}} = 1.986$

Y	$AR^{2/3}$	
1.5	0.220	PIPE FLOW IS FULL UNDER HEAD
1.0	0.720	
1.3	0.9660	
1.4	0.988	

$V = Q/A \quad A = \pi D^2/4 = 1.767 \text{ ft}^2$

$V = 7.0 \text{ fps} < 7.7 \text{ fps}$, which according to the "Urban Storm Drainage Criteria Manual - Vol 2" prepared by Denver Regional Council of Govts is the limit at which erosion protection from culverts is required for erosion resistant soils.

∴ No Lining Required

Although no lining is required, some riprap has been noted on site. Approx D_{50} = 4-6". Rock sedimented in.

POND 002A Q = 13.7 cfs , n = 0.024

Spillway	Head	Q	Length	Δh	S%	Qn/1.49S^1/2	y	V
Primary	1.3	9.7	74	~1	9.5	0.507	0.8	10.1
Emergency	0.4	4.0	78	~1	9.0	0.215	0.49	8.0
		13.7						

Velocities are greater than 7.7 fps culvert limit.

From EPA Fig 1-15

Spillway	D_{50}	d_{max} (1.5 D_{50})	La
Primary	0.3'	0.45'	10'
Emergency	0.25'	0.40'	5'

Existing Riprap w/ D_{50} ~ 0.5' is adequate

POND 003A Q = 11.0 cfs , n = 0.024

Spillway	Head	Q	Length	Δh	S%	Qn/1.49S^1/2	y	V
Principal	1.67	11.0	72	4..	5.6	0.749	1.0	8.8
Emergency	—	—						

Velocities are greater than 7.7 fps culvert limit

From EPA Fig 1-15

Spillway	D_{50}	d_{max} (1.5 D_{50})	La
Primary	0.3	0.45	10
Emergency	—	—	—

Existing riprap has approx D_{50} = 0.25-0.3' &

Riprap is adequate

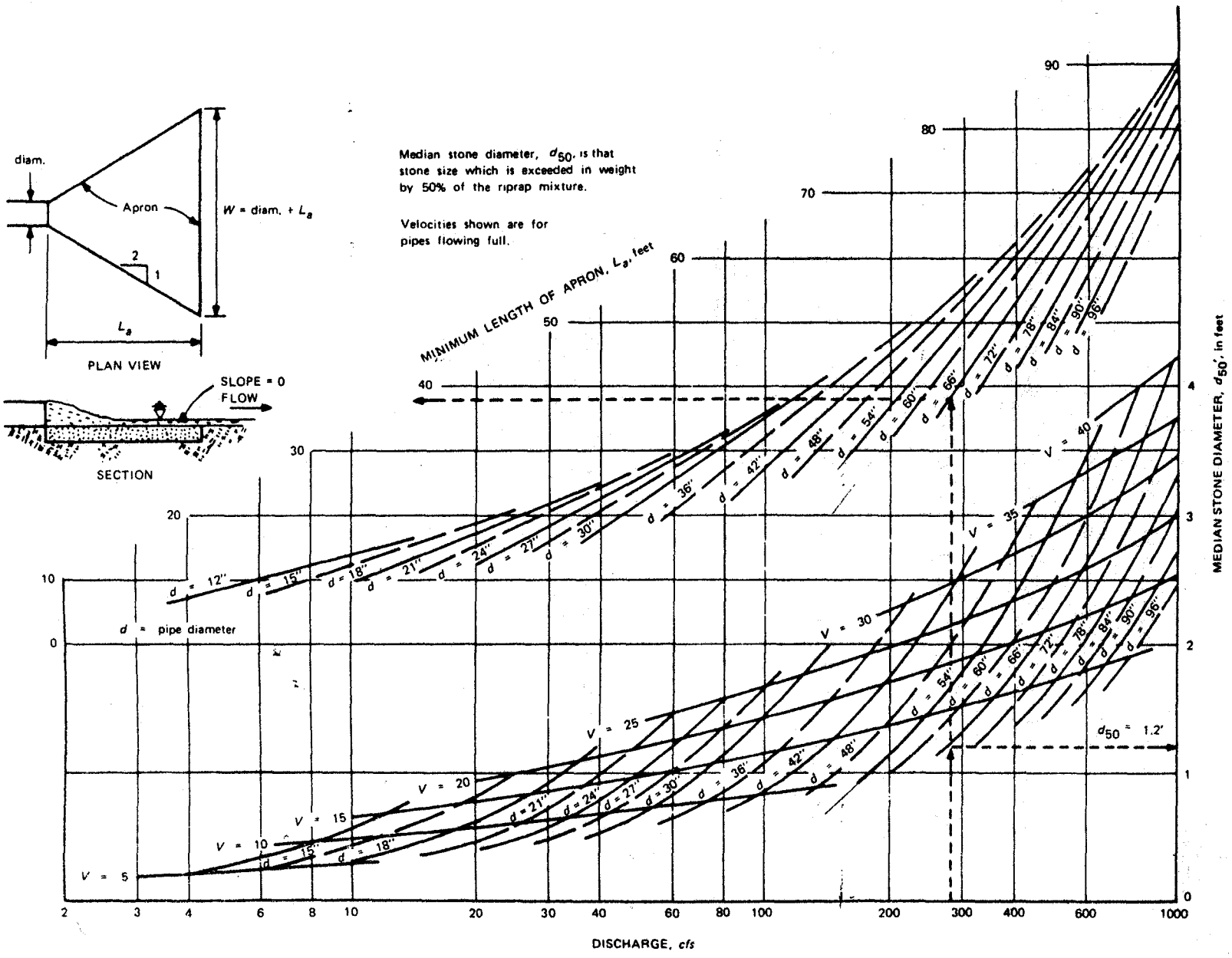


Figure I-15. Design of outlet protection – minimum tailwater condition ($T_W < 0.5$ diam.)[1]

POND 005A

DESIGN Q = 250gpm (0.56 cfs)

flow rate is below design Charts (ie: no lining reqd)

Check using Denver Velocity requirement (V > 7.7 fps)

Pipe Slope (discharge) = 10'/60' = 0.17
$n = 0.024$
$d = 12''$

$\frac{Qn}{1.49 S^{1/2}} = 0.022$, $y = 0.18'$, $V = 5.83$ fps < 7.7 fps ∝

NO LINING REQ'd

POND 004A

Calculations related to erosion control are included in Pond Volume calcs.

APPENDIX 742.221b

Sediment Pond Stability Reports

CONSULTANTS/ENGINEERS
HANSEN ALLEN & LUCE inc
SALT LAKE CITY, UTAH

Chen-Northern, Inc.

350 West 2700 South
Salt Lake City, Utah 84115
801/487-3661

Billings
Boise
Casper
Colorado Springs
Denver
Elko
Evanston
Gilette
Glenwood Springs
Great Falls
Helena
Phoenix
Pocatello
Rock Springs
Salt Lake City
San Antonio
Tri Cities
Yakima

January 31, 1989

Subject: Geotechnical Consultation
Valley Camp Sedimentation
Ponds 1, 2 and 3,
Scofield, Utah

Job No. 515889

Hansen, Allen and Luce
6771 South 900 East
Midvale, Utah 84047

Attn: Mr. Marv Allen

Gentlemen:

As requested, Chen-Northern, Inc. performed stability analyses for the Valley Camp Sedimentation Ponds 1 through 3. The project site is located along the Scofield route near Helper, Utah.

Soil strength values for Pond 1 were taken from a report by Garco Testing Laboratories dated December 2, 1988. Soil strength values for Ponds 2 and 3 were taken from a report by Rollins, Brown and Gunnell, Inc. dated November 16, 1988.

The strength parameters, as well as the moist and saturated unit weights determined from the above-reference reports, are presented in the following table.

Pond No.	C psf	O Degrees	Moist Unit Weight, pcf	Saturated Unit weight, pcf
1	400	22	112	124
2	150	31	107	122
3	150	31	107	122

The geometry of the embankments and side slopes of the sedimentation ponds were taken from "Val-Cam Loadout Sediment Pond Analysis", Sheets 1, 2 and 3 by Hansen, Allen and Luce, Inc. dated September, 1988. In addition, we were provided with elevations of the bottom of the ponds as well as the top of the primary and emergency spillways for the ponds, which are presented in the following table.

Pond No.	Bottom of Pond feet	Top of Primary Spillway, feet	Top of Emergency spillway, feet
1	7803.0	7816.1	7818.8
2	7823.0	7835.4	7836.3
3	7855.0	7863.2	7865.5

In our analyses, we assumed that the soil profiles were homogenous.

The safety factors have been calculated for rapid-drawdown conditions. The soil beneath the elevation of the primary spillway was assumed to be saturated. The calculated safety factors and approximate slope angles for the sedimentation ponds are presented below:

Pond No.	Slope	Safety Factor
1	2.2H:1V (upstream)	2.1
2	1.9H:1V (upstream)	1.3
3	1.5H:1V (upstream)	1.3
1	2.8H:1V (downstream)	4.1
2	1.7H:1V (downstream)	1.5
3	1.8H:1V (downstream)	1.5

It was determined that flattening the upstream slopes of Sedimentation Ponds 2 and 3 to 2.5V:1V will result in safety factors of approximately 1.5 under rapid-drawdown conditions.

Analyses were performed to assess the stability of Sedimentation Pond 3 under static and dynamic steady-state seepage conditions. Analyses were performed for Pond 3 rather than Ponds 1 and 2 due to the steepness of Pond 3 slopes despite the fact that the embankments for Ponds 1 and 2 are 1 and 4 feet higher, respectively. For the dynamic analyses, a coefficient of horizontal acceleration of 0.1 was used based on the Uniform Building Code seismic zone map for the State of Utah. The safety factors calculated for Pond 3 for static and dynamic conditions are 2.0 and 1.6, respectively. These safety factors correspond to the upstream slopes. The safety factors for the downstream slopes are slightly higher because the downstream slopes are not as steep as the upstream slopes. Based on the rapid-drawdown analyses, the safety factors for Ponds 1 and 2 under steady-state static and dynamic conditions should be approximately equal to or greater than those calculated for Pond 3.

The safety factors calculated from the stability analyses are based on the strength values and topographic information mentioned previously. The geometry within the interior of the ponds was not

provided and was assumed based on the topography and elevation data provided.

The safety factors obtained appear to be suitable for the purpose of the ponds. Static and dynamic safety factors under steady state conditions should be greater than 1.5 and 1.1, respectively. Safety factors under rapid drawdown should be greater than 1.1. Each of the slopes evaluated have safety factors in excess of the minimum values. To maintain the minimum safety factors presented above, the upstream and downstream slopes should be no steeper than 1.5H:1V.

If you have questions, or if we may be of further service, please call.

Sincerely,

CHEN-NORTHERN, INC.

Dean B. Griswold

DBG/cs
Rev. by JEN, P.E.

Northern Engineering and Testing, Inc.

STANDARD COMPUTATION SHEET

PROJECT Valley Camp JOB NO. 515889

PURPOSE Stab. of Sed. Ponds - SUMMARY SHEET 1 OF ~~14~~ 13

COMPUTED BY DBG CHECKED BY DATE 1/16/89

Strength Values

Pond	γ_m	γ_{sat}	C	ϕ	From
1	112	124	400	22	GARCo
2	107	122	150	31	RBG
3	107	122	150	31	RBG

Slope Geometry from HAL Figures

Pond	Slope	FS/	
1	up/st 2H:1V	1.7	⇐ Not Embankment
1A	up/st 2.2H:1V	2.1	
2	up/st 1.9H:1V	1.25	
3	up/st 1.5H:1V	1.28	
1A	dn/st 2.8H:1V	4.1	
2	dn/st 1.7H:1V	1.5	
3	dn/st 1.4-1.8H:1V	~~1.26~~ 1.5	

Slopes Req'd for FS=1.5 under Rapid Drawdown

Pond	Slope	FS.
2	2.5H:1V	1.5
3	2.4H:1V	1.5

Steady State Seepage - Static & Dynamic Cases

Pond	Slope	Ground Acceleration	FS
3	u/s 1.5H:1V	0	2.0
3	u/s 1.5H:1V	0.1g	1.6
3	d/s 1.4-1.8H:1V	0	~~1.9~~ 2.2
3	d/s 1.4-1.8H:1V	0.1g	~~1.6~~ 1.7

Northern Engineering and Testing, Inc.

STANDARD COMPUTATION SHEET

PROJECT Valley Camp Sedimentation Ponds JOB NO. 515889

PURPOSE Stability Analyses SHEET 2 OF 18

COMPUTED BY DBG CHECKED BY DATE 1/12/89

Strength Values & Lab Results

Pond 1A - From GARCO

Pond Bottom - Lt. Brown Sandy Clay w/ Silt
South & West Sides - Gray Silty Sand

Sample #1 & #5; Sandy Clay

w_i	γ_{di}	w_f	γ_{df}
15.2	115.7	17.3	108.2
15.8	113.4	16.9	129.4
14.7	121	15.8	126.4

$w_{AVG} = 16\%$ $\gamma_{d_{AVG}} = 117.4$ pcf

$S_r = 95\%$ $\gamma_m = 136.2$ pcf

$\gamma_{SAT} = 137.1$ pcf

$c = 550$ psf
$\phi = 23.5°$

Sample #2; Very Fine Sand

w_i	γ_{di}	w_f	γ_{df}
42.7	76.4	44.6	75.4
40.6	78.8	41.6	80.4
32.0	83.8	38.5	85.9

$w_{AVG} = 40\%$

$\gamma_{d_{AVG}} = 80.1$ pcf $\gamma_m = 112.1$ pcf

$S_r = 100\%$ $c = 256$ psf

$\gamma_{SAT} = 112.2$ pcf $\phi = 21.5°$

$w_{AVG} = 28\%$

$\gamma_{d_{AVG}} = 99$ pcf

$\gamma_{SAT} \approx \gamma_m = 124$ pcf

If $S_r = 50\%$, $\gamma_m = 112$ pcf

Northern Engineering and Testing, Inc.

STANDARD COMPUTATION SHEET

PROJECT _____ JOB NO. _____

PURPOSE _____ SHEET 3 OF 13

COMPUTED BY _____ CHECKED BY _____ DATE _____

Ponds 2A, 3A - From RBG, Inc.

Pond 2A

Test Pit	pcf γ_d	% w	tsf torvane	ft Depth
TP-1	100.2	6	0.35	0
	90.3	11	0.45	3
	89.8	15.9	0.50	6
	100.7	16.8	0.35	9

$c = 1$ psi $= 144$ psf
$\phi = 31.5°$

$\gamma_{d_{Av}} = 95.2$
$w = 12.4$
$S_r = 42.5$
$\gamma_{SAT} = 123$

Pond 3A

TP-2	96.8	8.6	0.55	0
	93.5	10.8	0.55	3
	92.1	17.6	0.55	6
	91.6	21.5	0.55	9
	93.6	17.3	0.55	12
	91.1	17.9	0.55	15
	95.8	12.2	0.55	18

$\gamma_{d_{Avg}} = 93.5$
$w_{Av} = 15.1$
$S_r = 122$

$w_{AVG} = 14\%$
$\gamma_{d\,AVG} = 94.1$ pcf

$\gamma_m = 107.3$ pcf

$S_r = 46.7\%$
$\gamma_{SAT} = 122.3$ pcf

✓	✓
0.229	
0.226	14.1
0.545	93.5

Northern Engineering and Testing, Inc.

STANDARD COMPUTATION SHEET

PROJECT _____ JOB NO. _____

PURPOSE _____ SHEET 4 OF 13

COMPUTED BY _____ CHECKED BY _____ DATE _____

Geometry of Ponds

POND 1A

Elevations:

Bottom of Pond	7803
Top Primary Spillway	7816.1
Top Emergency Spill'w	7818.8

1A - 1A'

Dist.	Elev.
0	7840
9	7835
18	7830
30	7825
41	7824
43	7823
46	7822
47.5	7821
49.5	7820
56	7819
57	7818
59	7817
60	7816
62	7815
79	7815

Silted in

1B - 1B'

Dist.	Elev.
0	7835
24	7830
40	7825
42	7824
45	7823
47	7822
49	7821
52	7820
58	7819
118	7819
80	7803

1C - 1C'

Dist	Elev
0	7803
35	19
41	20
43	21
55	21
58	20
72	18.5

Northern Engineering and Testing, Inc.

STANDARD COMPUTATION SHEET

PROJECT _____ JOB NO. _____

PURPOSE _____ SHEET 5 OF 19

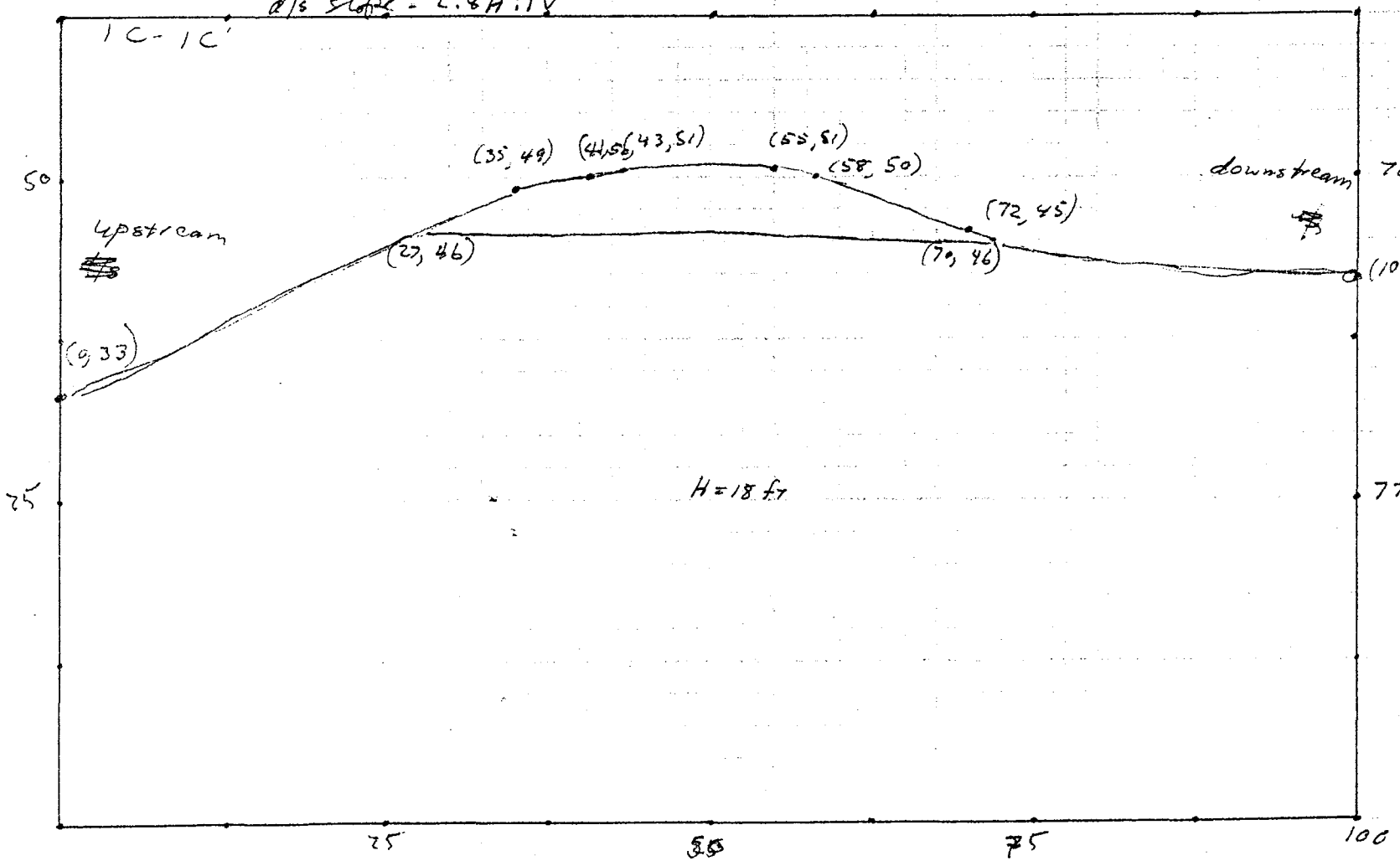
COMPUTED BY _____ CHECKED BY _____ DATE _____

~~Downstream slope~~

4 [illegible]
43 [illegible]
55 [illegible]
[illegible]
7[illegible] [illegible]

[illegible] Spillway, 16.1

u/s slope = 2.2H:1V
d/s slope = 2.8H:1V



Northern Engineering and Testing, Inc.

STANDARD COMPUTATION SHEET

PROJECT _____ JOB NO. _____

PURPOSE _____ SHEET 6 OF 18

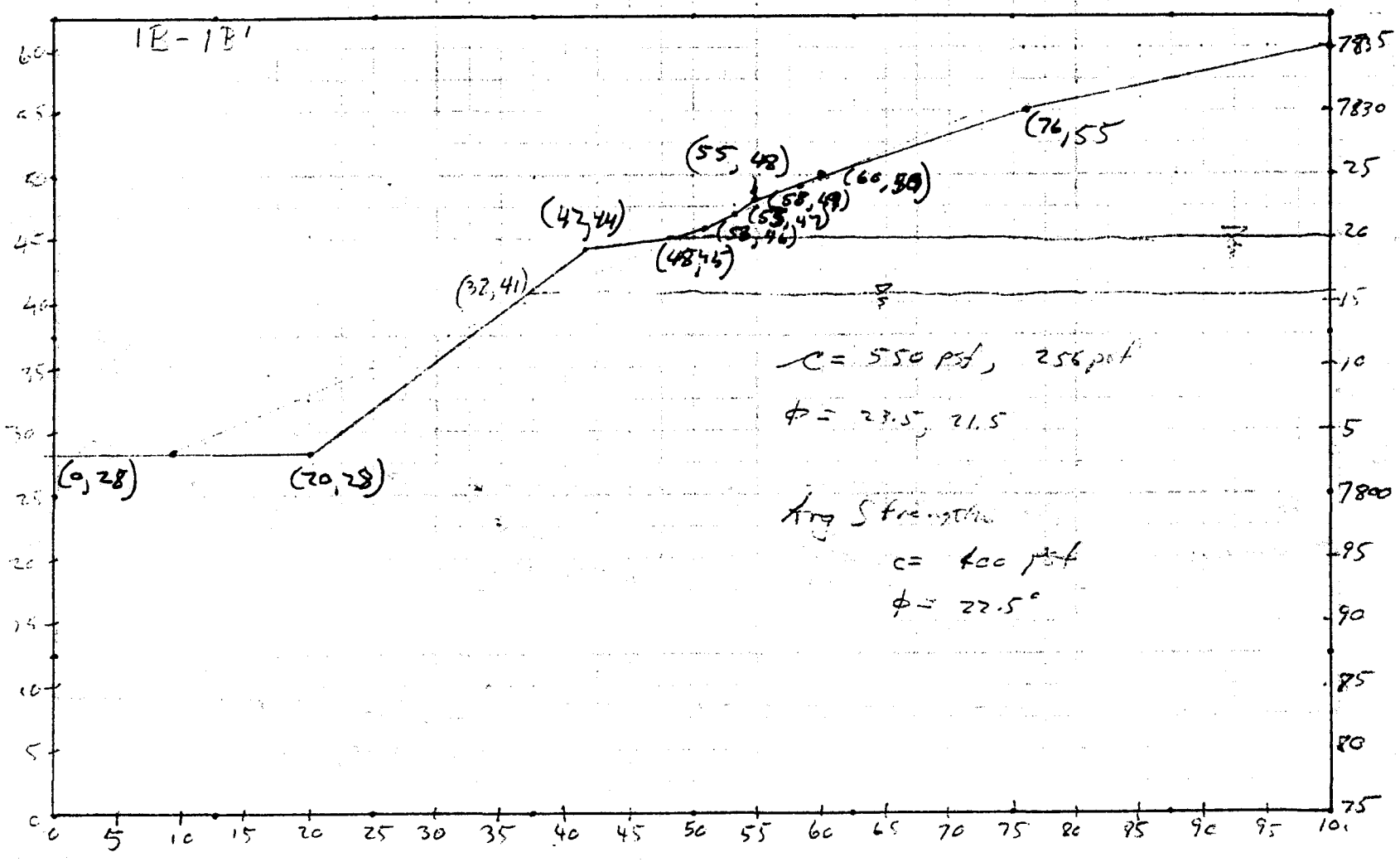
COMPUTED BY _____ CHECKED BY _____ DATE _____

$\frac{44-41}{44-28} = \frac{42-x}{42-20}$

X = 38

FS = 1.66

4/3 Slope: 1.8H:1V



Northern Engineering and Testing, Inc.

STANDARD COMPUTATION SHEET

PROJECT _____ JOB NO. _____

PURPOSE _____ SHEET 7 OF 18

COMPUTED BY _____ CHECKED BY _____ DATE _____

Geometry

Pond 2A

Elevations:

Bottom of Pond	7823.6
Top of Primary Spillway	7835.4
Top of Emergency Spillway	7836.3

Section 2A-2A'

Dist.	Elev.
0	7836
48	7836
51	7837
53	7838
61	7838
63	7837
64	7836
68	7835
74	7830
83	7825

Northern Engineering and Testing, Inc.

STANDARD COMPUTATION SHEET

PROJECT _____ JOB NO. _____

PURPOSE _____ SHEET 8 OF 18

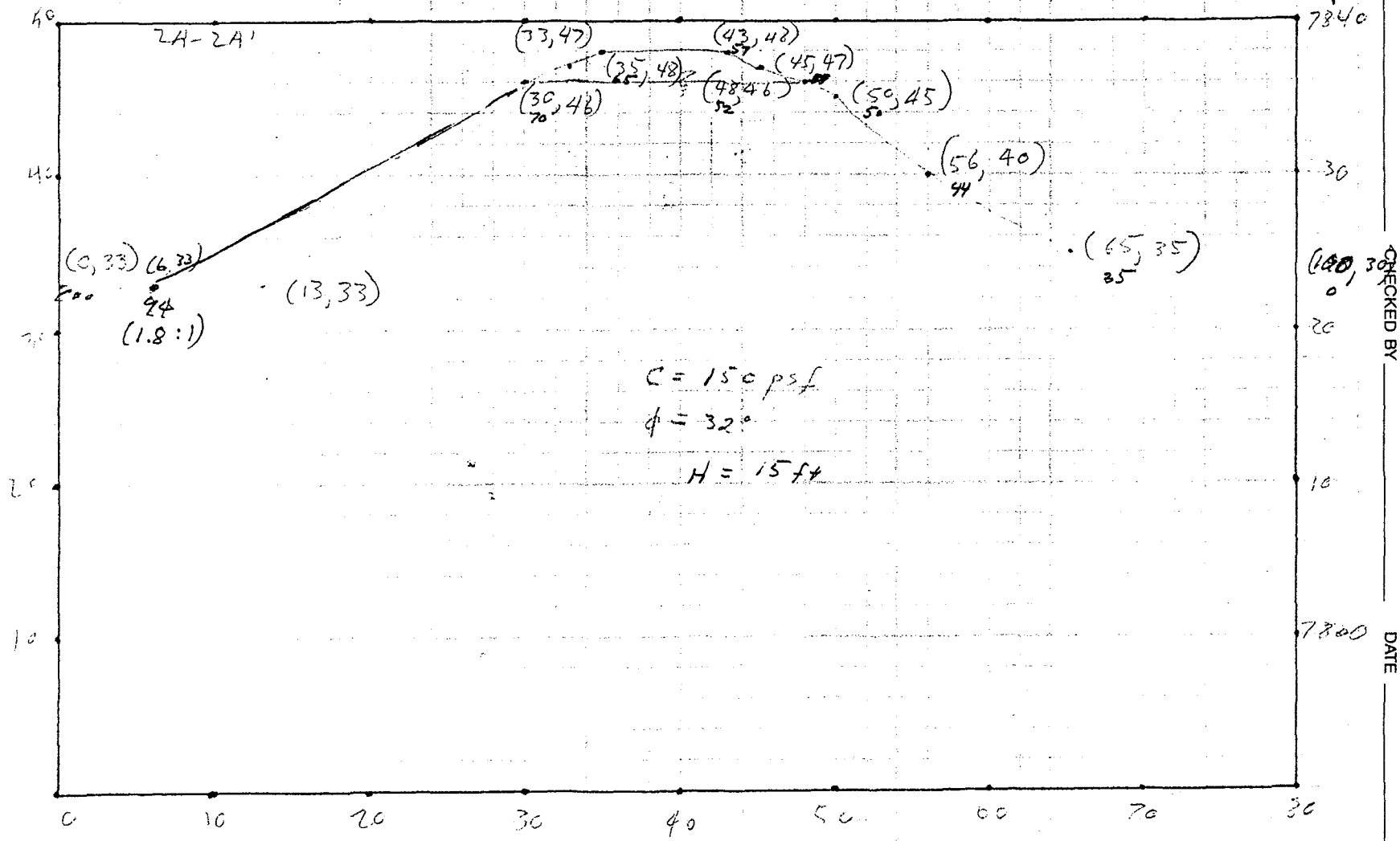
COMPUTED BY _____ CHECKED BY _____ DATE _____

1.515

~~1.42~~

~~1.248~~ ⇐ Orig Conf.

upstream slope



Northern Engineering and Testing, Inc.

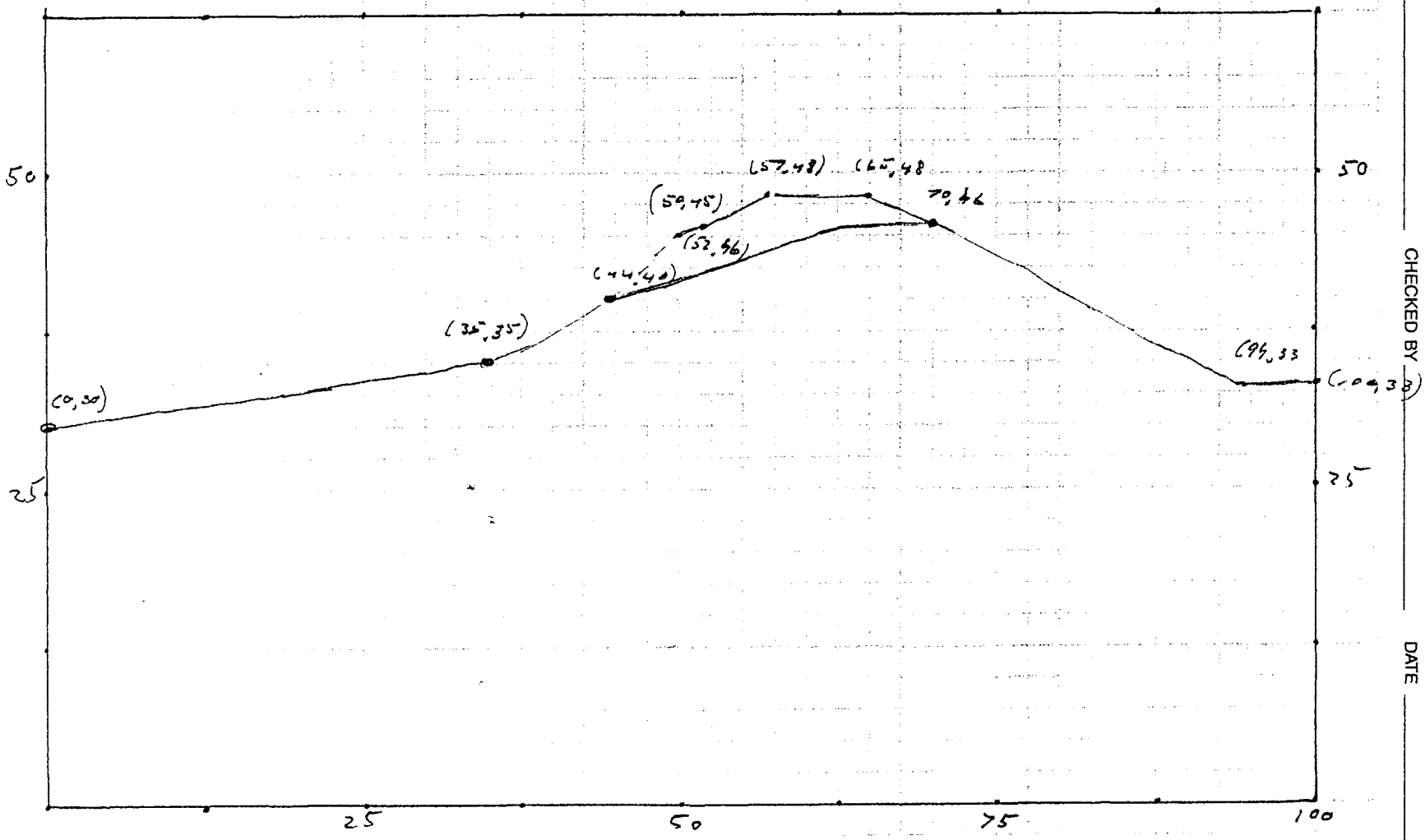
STANDARD COMPUTATION SHEET

PROJECT _____ JOB NO. _____

PURPOSE _____ SHEET 9 OF 13

COMPUTED BY _____ CHECKED BY _____ DATE _____

2A-2A' downstream Slope (orig: 1.7H:1V)



Northern Engineering and Testing, Inc.

STANDARD COMPUTATION SHEET

PROJECT _____ JOB NO. _____

PURPOSE _____ SHEET 10 OF 13

COMPUTED BY _____ CHECKED BY _____ DATE _____

Geometry

POND 3A

Elevations:

Bottom of Pond	7855.0
Top of primary discharge	7863.2
Top of Emergency discharge	7865.5

Section 3A-3A'

Dist.	Elev		
0	7860	7859	0
79	7860	7859	25
80	7861	7860	26
82	7862	7861	28
84	7863	7862	30
86	7864	7863	32
89	7865	7864	35
92	7864	7868	38
110	7864	7868	56
114	7865	7865	60
121	7860	7860	67
133	7855	7855	79
155	7850	7850	100

Northern Engineering and Testing, Inc.

STANDARD COMPUTATION SHEET

PROJECT _____ JOB NO. _____

PURPOSE _____ SHEET 11 OF 14

COMPUTED BY _____ CHECKED BY _____ DATE _____

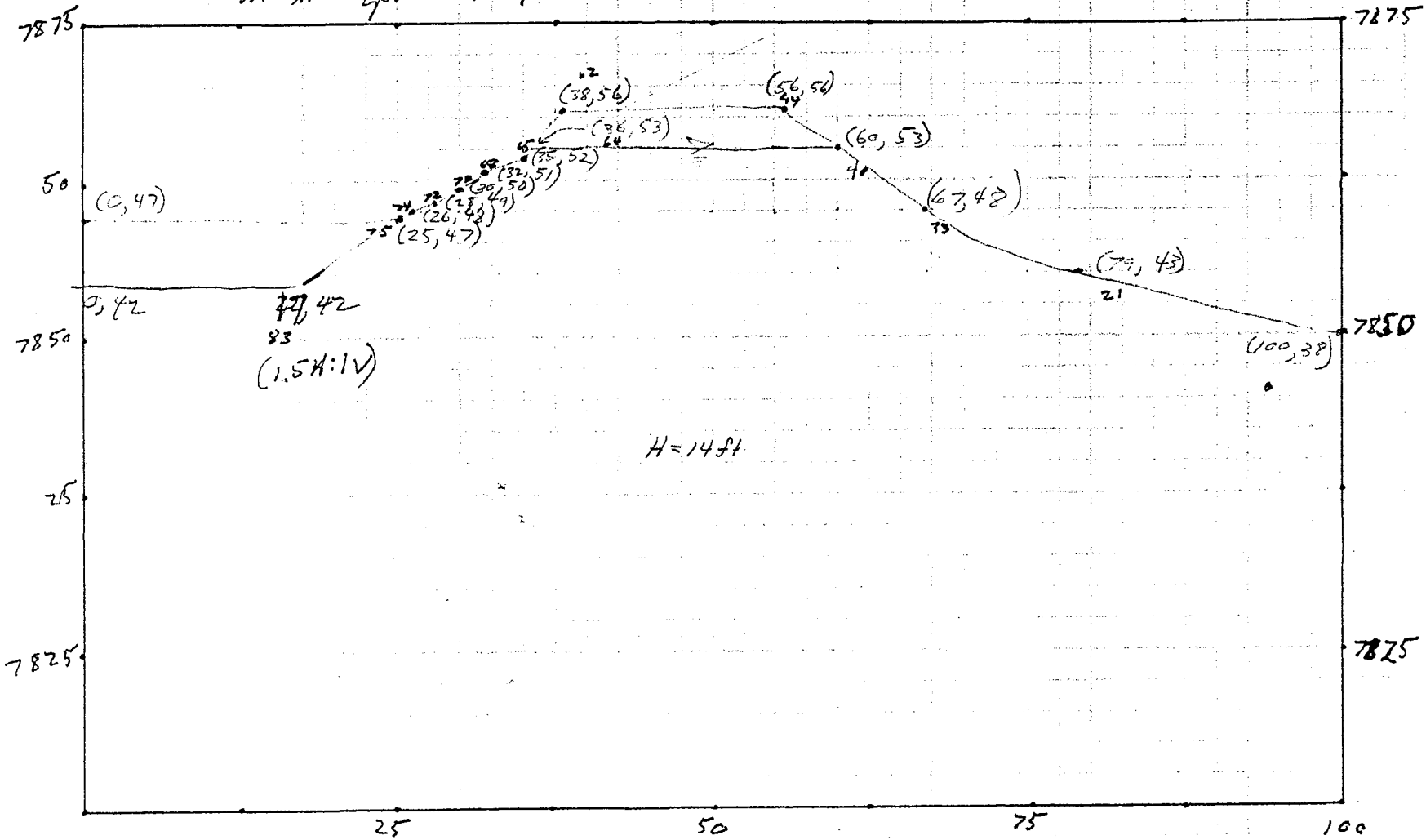
$\frac{56-53}{56-52} = \frac{38-x}{38-35}$

1.48

~~F = 1.497~~ } Re-sloped

FS = 1.284

3A-3A' upstream Slope



Northern Engineering and Testing, Inc.

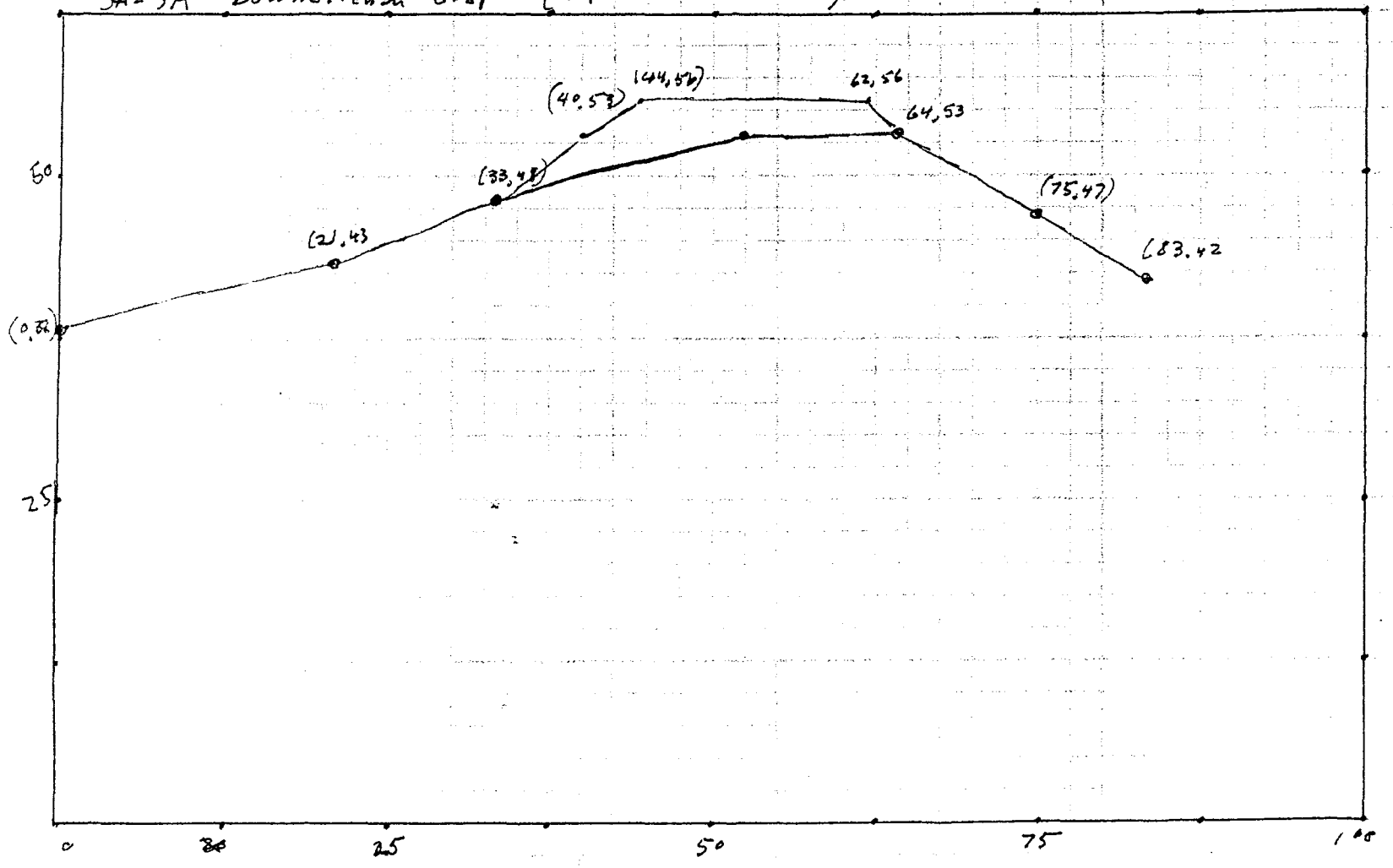
STANDARD COMPUTATION SHEET

PROJECT _____ JOB NO. _____

PURPOSE _____ SHEET 12 OF 13

COMPUTED BY _____ CHECKED BY _____ DATE _____

3A-3A' Downstream Slope (1.4H:1V to 1.8H:1V)



Northern Engineering and Testing, Inc.

STANDARD COMPUTATION SHEET

PROJECT _____ JOB NO. _____

PURPOSE _____ SHEET 13 OF 13

COMPUTED BY _____ CHECKED BY _____ DATE _____

Iteration I : Existing Slopes - Upstream Slopes

Pond	Slope	EQUAK	FS
1	2H:1V	No	1.7
1A	2.2H:1V	No	2.1
2	1.9H:1V	No	1.25
3	1.5H:1V	No	1.28

Iteration II : Slopes Req'd For FS=1.5, Upstream Slopes

1	2H:1V	No	1.7
2	2.5H:1V	No	1.5
3	2.4H:1V	No	1.5

Iteration III : Downstream Slopes, Static, Rapid Drawdown

		No	
1	2.8H:1V	No	4.1
2	1.7H:1V	No	1.5
3	1.4H- 1.8H:1V	No	~~1.26~~ 1.5

Iteration 3 : Steady State Seepage

3	u/s	1.5H:1V	No	2.0
3	u/s	1.5H:1V	0.1g	1.6
3	d/s	1.4-1.8H:1V	No	~~1.9~~ 2.2
3	d/s	1.4-1.8H:1V	0.1g	~~1.6~~ 1.7

--SLOPE STABILITY ANALYSIS--
SIMPLIFIED JANBU METHOD OF SLICES
IRREGULAR FAILURE SURFACES

PROBLEM DESCRIPTION VALLEY CAMP SED. POND STABILITY; RAPID DRAWDOWN; UPSTREAM; POND 1A

BOUNDARY COORDINATES

6 TOP BOUNDARIES
6 TOTAL BOUNDARIES

BOUNDARY NO.	X-LEFT (FT)	Y-LEFT (FT)	X-RIGHT (FT)	Y-RIGHT (FT)	SOIL TYPE BELOW BND
1	.00	33.00	27.00	46.00	1
2	27.00	46.00	35.00	49.00	1
3	35.00	49.00	43.00	51.00	1
4	43.00	51.00	55.00	51.00	1
5	55.00	51.00	72.00	45.00	1
6	72.00	45.00	100.00	42.00	1

1 ISOTROPIC SOIL PARAMETERS

1 TYPE(S) OF SOIL

SOIL TYPE NO.	TOTAL UNIT WT. (PCF)	SATURATED UNIT WT. (PCF)	COHESION INTERCEPT (PSF)	FRICTION ANGLE (DEG)	PORE PRESSURE PARAMETER	PRESSURE CONSTANT (PSF)	PIEZOMETRIC SURFACE NO.
1	112.0	124.0	400.0	22.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

UNITWEIGHT OF WATER = 62.40

PIEZOMETRIC SURFACE NO. 1 SPECIFIED BY 4 COORDINATE POINTS

POINT NO.	X-WATER (FT)	Y-WATER (FT)
1	.00	33.00
2	27.00	46.00
3	72.00	45.00
4	100.00	42.00

1 A CRITICAL FAILURE SURFACE SEARCHING METHOD, USING A RANDOM TECHNIQUE FOR GENERATING CIRCULAR SURFACES, HAS BEEN SPECIFIED.

100 TRIAL SURFACES HAVE BEEN GENERATED.

10 SURFACES INITIATE FROM EACH OF 10 POINTS EQUALLY SPACED
ALONG THE GROUND SURFACE BETWEEN X = .00 FT.
AND X = 15.00 FT.

EACH SURFACE TERMINATES BETWEEN X = 30.00 FT.
AND X = 70.00 FT.

UNLESS FURTHER LIMITATIONS WERE IMPOSED, THE MINIMUM ELEVATION AT WHICH A SURFACE EXTENDS IS Y = .00 FT.

10.00 FT. LINE SEGMENTS DEFINE EACH TRIAL FAILURE SURFACE.

1 FOLLOWING ARE DISPLAYED THE TEN MOST CRITICAL OF THE TRIAL FAILURE SURFACES EXAMINED. THEY ARE ORDERED - MOST CRITICAL FIRST.

FAILURE SURFACE SPECIFIED BY 8 COORDINATE POINTS

POINT NO.	X-SURF (FT)	Y-SURF (FT)
1	.00	33.00
2	9.45	29.74
3	19.38	28.53
4	29.34	29.43
5	38.89	32.39
6	47.60	37.30
7	55.09	43.93
8	59.21	49.51

*** 2.132 ***

^Z

--SLOPE STABILITY ANALYSIS--
SIMPLIFIED JANBU METHOD OF SLICES
IRREGULAR FAILURE SURFACES

PROBLEM DESCRIPTION VALLEY CAMP SEDIMENTATION POND NO. 2A;
RAPID DRAWDOWN; UPSTREAM

BOUNDARY COORDINATES

7 TOP BOUNDARIES
7 TOTAL BOUNDARIES

BOUNDARY NO.	X-LEFT (FT)	Y-LEFT (FT)	X-RIGHT (FT)	Y-RIGHT (FT)	SOIL TYPE BELOW BND
1	.00	33.00	26.00	33.00	1
2	26.00	33.00	50.00	46.00	1
3	50.00	46.00	55.00	48.00	1
4	55.00	48.00	63.00	48.00	1
5	63.00	48.00	68.00	46.00	1
6	68.00	46.00	76.00	40.00	1
7	76.00	40.00	85.00	35.00	1

1 ISOTROPIC SOIL PARAMETERS

1 TYPE(S) OF SOIL

SOIL TYPE NO.	TOTAL UNIT WT. (PCF)	SATURATED UNIT WT. (PCF)	COHESION INTERCEPT (PSF)	FRICTION ANGLE (DEG)	PORE PRESSURE PARAMETER	PRESSURE CONSTANT (PSF)	PIEZOMETRIC SURFACE NO.
1	107.0	123.0	150.0	31.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

UNITWEIGHT OF WATER = 62.40

PIEZOMETRIC SURFACE NO. 1 SPECIFIED BY 5 COORDINATE POINTS

POINT NO.	X-WATER (FT)	Y-WATER (FT)
1	.00	33.00
2	26.00	33.00
3	50.00	46.00
4	68.00	46.00
5	85.00	35.00

1 A CRITICAL FAILURE SURFACE SEARCHING METHOD, USING A RANDOM
TECHNIQUE FOR GENERATING CIRCULAR SURFACES, HAS BEEN SPECIFIED.

100 TRIAL SURFACES HAVE BEEN GENERATED.

10 SURFACES INITIATE FROM EACH OF 10 POINTS EQUALLY SPACED
ALONG THE GROUND SURFACE BETWEEN X = .00 FT.

AND X = 30.00 FT.

EACH SURFACE TERMINATES BETWEEN X = 48.00 FT.
AND X = 85.00 FT.

UNLESS FURTHER LIMITATIONS WERE IMPOSED, THE MINIMUM ELEVATION AT WHICH A SURFACE EXTENDS IS Y = .00 FT.

8.00 FT. LINE SEGMENTS DEFINE EACH TRIAL FAILURE SURFACE.

1 FOLLOWING ARE DISPLAYED THE TEN MOST CRITICAL OF THE TRIAL FAILURE SURFACES EXAMINED. THEY ARE ORDERED - MOST CRITICAL FIRST.

FAILURE SURFACE SPECIFIED BY 7 COORDINATE POINTS

POINT NO.	X-SURF (FT)	Y-SURF (FT)
1	23.33	33.00
2	30.94	30.54
3	38.94	30.92
4	46.28	34.10
5	52.02	39.67
6	55.42	46.91
7	55.50	48.00

*** 1.248 ***

^Z

--SLOPE STABILITY ANALYSIS--
SIMPLIFIED JANBU METHOD OF SLICES
IRREGULAR FAILURE SURFACES

PROBLEM DESCRIPTION VALLEY CAMP SEDIMENTATION POND NO. 3A;
RAPID DRAWDOWN; UPSTREAM

BOUNDARY COORDINATES

8 TOP BOUNDARIES
8 TOTAL BOUNDARIES

BOUNDARY NO.	X-LEFT (FT)	Y-LEFT (FT)	X-RIGHT (FT)	Y-RIGHT (FT)	SOIL TYPE BELOW BND
1	.00	42.00	17.00	42.00	1
2	17.00	42.00	25.00	47.00	1
3	25.00	47.00	36.00	53.00	1
4	36.00	53.00	38.00	56.00	1
5	38.00	56.00	56.00	56.00	1
6	56.00	56.00	60.00	53.00	1
7	60.00	53.00	67.00	48.00	1
8	67.00	48.00	79.00	43.00	1

1 ISOTROPIC SOIL PARAMETERS

1 TYPE(S) OF SOIL

SOIL TYPE NO.	TOTAL UNIT WT. (PCF)	SATURATED UNIT WT. (PCF)	COHESION INTERCEPT (PSF)	FRICTION ANGLE (DEG)	PORE PRESSURE PARAMETER	PRESSURE CONSTANT (PSF)	PIEZOMETRIC SURFACE NO.
1	108.0	122.0	150.0	31.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

UNITWEIGHT OF WATER = 62.40

PIEZOMETRIC SURFACE NO. 1 SPECIFIED BY 7 COORDINATE POINTS

POINT NO.	X-WATER (FT)	Y-WATER (FT)
1	.00	42.00
2	17.00	42.00
3	25.00	47.00
4	36.00	53.00
5	60.00	53.00
6	67.00	47.00
7	79.00	43.00

1 A CRITICAL FAILURE SURFACE SEARCHING METHOD, USING A RANDOM
TECHNIQUE FOR GENERATING CIRCULAR SURFACES, HAS BEEN SPECIFIED.

100 TRIAL SURFACES HAVE BEEN GENERATED.

10 SURFACES INITIATE FROM EACH OF 10 POINTS EQUALLY SPACED
ALONG THE GROUND SURFACE BETWEEN X = .00 FT.
AND X = 20.00 FT.

EACH SURFACE TERMINATES BETWEEN X = 32.00 FT.
AND X = 79.00 FT.

UNLESS FURTHER LIMITATIONS WERE IMPOSED, THE MINIMUM ELEVATION
AT WHICH A SURFACE EXTENDS IS Y = .00 FT.

8.00 FT. LINE SEGMENTS DEFINE EACH TRIAL FAILURE SURFACE.

1 FOLLOWING ARE DISPLAYED THE TEN MOST CRITICAL OF THE TRIAL
FAILURE SURFACES EXAMINED. THEY ARE ORDERED - MOST CRITICAL
FIRST.

FAILURE SURFACE SPECIFIED BY 6 COORDINATE POINTS

POINT NO.	X-SURF (FT)	Y-SURF (FT)
1	15.56	42.00
2	23.40	40.40
3	31.28	41.76
4	38.13	45.89
5	43.02	52.22
6	44.13	56.00

*** 1.284 ***

^Z

--SLOPE STABILITY ANALYSIS--
SIMPLIFIED JANBU METHOD OF SLICES
IRREGULAR FAILURE SURFACES

PROBLEM DESCRIPTION VALLEY CAMP SED. PONDS; POND 1A DOWNSTREAM; RAP. DRAW.

BOUNDARY COORDINATES

6 TOP BOUNDARIES
6 TOTAL BOUNDARIES

BOUNDARY NO.	X-LEFT (FT)	Y-LEFT (FT)	X-RIGHT (FT)	Y-RIGHT (FT)	SOIL TYPE BELOW BND
1	.00	42.00	28.00	45.00	1
2	28.00	45.00	45.00	51.00	1
3	45.00	51.00	57.00	51.00	1
4	57.00	51.00	65.00	49.00	1
5	65.00	49.00	73.00	46.00	1
6	73.00	46.00	100.00	33.00	1

1 ISOTROPIC SOIL PARAMETERS

1 TYPE(S) OF SOIL

SOIL TYPE NO.	TOTAL UNIT WT. (PCF)	SATURATED UNIT WT. (PCF)	COHESION INTERCEPT (PSF)	FRICTION ANGLE (DEG)	PORE PRESSURE PARAMETER	PRESSURE CONSTANT (PSF)	PIEZOMETRIC SURFACE NO.
1	112.0	124.0	400.0	22.0	.00	.0	1

1 1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

UNITWEIGHT OF WATER = 62.40

PIEZOMETRIC SURFACE NO. 1 SPECIFIED BY 4 COORDINATE POINTS

POINT NO.	X-WATER (FT)	Y-WATER (FT)
1	.00	42.00
2	28.00	45.00
3	73.00	46.00
4	100.00	33.00

1 A CRITICAL FAILURE SURFACE SEARCHING METHOD, USING A RANDOM TECHNIQUE FOR GENERATING CIRCULAR SURFACES, HAS BEEN SPECIFIED.

100 TRIAL SURFACES HAVE BEEN GENERATED.

10 SURFACES INITIATE FROM EACH OF 10 POINTS EQUALLY SPACED
ALONG THE GROUND SURFACE BETWEEN X = .00 FT.
AND X = 28.00 FT.

EACH SURFACE TERMINATES BETWEEN X = 42.00 FT.
AND X = 70.00 FT.

UNLESS FURTHER LIMITATIONS WERE IMPOSED, THE MINIMUM ELEVATION AT WHICH A SURFACE EXTENDS IS Y = .00 FT.

10.00 FT. LINE SEGMENTS DEFINE EACH TRIAL FAILURE SURFACE.

1 FOLLOWING ARE DISPLAYED THE TEN MOST CRITICAL OF THE TRIAL FAILURE SURFACES EXAMINED. THEY ARE ORDERED - MOST CRITICAL FIRST.

FAILURE SURFACE SPECIFIED BY 8 COORDINATE POINTS

POINT NO.	X-SURF (FT)	Y-SURF (FT)
1	.00	42.00
2	7.07	34.93
3	15.99	30.41
4	25.87	28.88
5	35.74	30.50
6	44.62	35.11
7	51.62	42.25
8	55.95	51.00

*** 4.143 ***

^Z

--SLOPE STABILITY ANALYSIS--
SIMPLIFIED JANBU METHOD OF SLICES
IRREGULAR FAILURE SURFACES

PROBLEM DESCRIPTION VALLEY CAMP SED. POND 2A; DOWNSTREAM SLP; RAP. DRAW.

BOUNDARY COORDINATES

8 TOP BOUNDARIES
8 TOTAL BOUNDARIES

BOUNDARY NO.	X-LEFT (FT)	Y-LEFT (FT)	X-RIGHT (FT)	Y-RIGHT (FT)	SOIL TYPE BELOW BND
1	.00	30.00	35.00	35.00	1
2	35.00	35.00	44.00	40.00	1
3	44.00	40.00	52.00	46.00	1
4	52.00	46.00	57.00	48.00	1
5	57.00	48.00	65.00	48.00	1
6	65.00	48.00	70.00	46.00	1
7	70.00	46.00	94.00	33.00	1
8	94.00	33.00	100.00	33.00	1

1 ISOTROPIC SOIL PARAMETERS

1 TYPE(S) OF SOIL

SOIL TYPE NO.	TOTAL UNIT WT. (PCF)	SATURATED UNIT WT. (PCF)	COHESION INTERCEPT (PSF)	FRICTION ANGLE (DEG)	PORE PRESSURE PARAMETER	PRESSURE CONSTANT (PSF)	PIEZOMETRIC SURFACE NO.
1	107.0	122.0	150.0	31.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

UNITWEIGHT OF WATER = 62.40

PIEZOMETRIC SURFACE NO. 1 SPECIFIED BY 7 COORDINATE POINTS

POINT NO.	X-WATER (FT)	Y-WATER (FT)
1	.00	30.00
2	35.00	35.00
3	44.00	40.00
4	60.00	45.00
5	70.00	46.00
6	94.00	33.00
7	100.00	33.00

1 A CRITICAL FAILURE SURFACE SEARCHING METHOD, USING A RANDOM TECHNIQUE FOR GENERATING CIRCULAR SURFACES, HAS BEEN SPECIFIED.

100 TRIAL SURFACES HAVE BEEN GENERATED.

10 SURFACES INITIATE FROM EACH OF 10 POINTS EQUALLY SPACED
ALONG THE GROUND SURFACE BETWEEN X = .00 FT.
AND X = 35.00 FT.

EACH SURFACE TERMINATES BETWEEN X = 50.00 FT.
AND X = 80.00 FT.

UNLESS FURTHER LIMITATIONS WERE IMPOSED, THE MINIMUM ELEVATION
AT WHICH A SURFACE EXTENDS IS Y = .00 FT.

8.00 FT. LINE SEGMENTS DEFINE EACH TRIAL FAILURE SURFACE.

1 FOLLOWING ARE DISPLAYED THE TEN MOST CRITICAL OF THE TRIAL
FAILURE SURFACES EXAMINED. THEY ARE ORDERED - MOST CRITICAL
FIRST.

FAILURE SURFACE SPECIFIED BY 8 COORDINATE POINTS

POINT NO.	X-SURF (FT)	Y-SURF (FT)
1	23.33	33.33
2	30.71	30.23
3	38.65	29.24
4	46.56	30.43
5	53.85	33.72
6	59.98	38.86
7	64.49	45.47
8	65.31	47.88

*** 1.456 ***

Z

--SLOPE STABILITY ANALYSIS--
SIMPLIFIED JANBU METHOD OF SLICES
IRREGULAR FAILURE SURFACES

PROBLEM DESCRIPTION VALLEY CAMP SED. POND 3A; DOWNSTREAM; PID
DRAWDOWN
RAPID DRAWDOWN

BOUNDARY COORDINATES

6 TOP BOUNDARIES
6 TOTAL BOUNDARIES

BOUNDARY NO.	X-LEFT (FT)	Y-LEFT (FT)	X-RIGHT (FT)	Y-RIGHT (FT)	SOIL TYPE BELOW BND
1	.00	38.00	21.00	43.00	1
2	21.00	43.00	33.00	48.00	1
3	33.00	48.00	44.00	56.00	1
4	44.00	56.00	62.00	56.00	1
5	62.00	56.00	64.00	53.00	1
6	64.00	53.00	83.00	42.00	1

1 ISOTROPIC SOIL PARAMETERS

1 TYPE(S) OF SOIL

SOIL TYPE NO.	TOTAL UNIT WT. (PCF)	SATURATED UNIT WT. (PCF)	COHESION INTERCEPT (PSF)	FRICTION ANGLE (DEG)	PORE PRESSURE PARAMETER	PRESSURE CONSTANT (PSF)	PIEZOMETRIC SURFACE NO.
1	107.0	122.0	150.0	31.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

UNITWEIGHT OF WATER = 62.40

PIEZOMETRIC SURFACE NO. 1 SPECIFIED BY 7 COORDINATE POINTS

POINT NO.	X-WATER (FT)	Y-WATER (FT)
1	.00	38.00
2	21.00	43.00
3	33.00	48.00
4	52.00	53.00
5	64.00	53.00
6	75.00	47.00
7	83.00	42.00

1 A CRITICAL FAILURE SURFACE SEARCHING METHOD, USING A RANDOM
TECHNIQUE FOR GENERATING CIRCULAR SURFACES, HAS BEEN SPECIFIED.

100 TRIAL SURFACES HAVE BEEN GENERATED.

10 SURFACES INITIATE FROM EACH OF 10 POINTS EQUALLY SPACED

ALONG THE GROUND SURFACE BETWEEN X = .00 FT.
AND X = 30.00 FT.

EACH SURFACE TERMINATES BETWEEN X = 41.00 FT.
AND X = 75.00 FT.

UNLESS FURTHER LIMITATIONS WERE IMPOSED, THE MINIMUM ELEVATION AT WHICH A SURFACE EXTENDS IS Y = .00 FT.

8.00 FT. LINE SEGMENTS DEFINE EACH TRIAL FAILURE SURFACE.

1 FOLLOWING ARE DISPLAYED THE TEN MOST CRITICAL OF THE TRIAL FAILURE SURFACES EXAMINED. THEY ARE ORDERED - MOST CRITICAL FIRST.

FAILURE SURFACE SPECIFIED BY 8 COORDINATE POINTS

POINT NO.	X-SURF (FT)	Y-SURF (FT)
1	10.00	40.38
2	17.54	37.69
3	25.52	37.12
4	33.36	38.71
5	40.49	42.34
6	46.38	47.75
7	50.61	54.54
8	51.05	56.00

*** 1.484 ***

^Z

--SLOPE STABILITY ANALYSIS--
SIMPLIFIED JANBU METHOD OF SLICES
IRREGULAR FAILURE SURFACES

PROBLEM DESCRIPTION VALLEY CAMP SEDIMENTATION POND NO. 3A;
UPSTREAM; STEADY-STATE; DYNAMIC

BOUNDARY COORDINATES

8 TOP BOUNDARIES
8 TOTAL BOUNDARIES

BOUNDARY NO.	X-LEFT (FT)	Y-LEFT (FT)	X-RIGHT (FT)	Y-RIGHT (FT)	SOIL TYPE BELOW BND
1	.00	42.00	17.00	42.00	1
2	17.00	42.00	25.00	47.00	1
3	25.00	47.00	36.00	53.00	1
4	36.00	53.00	38.00	56.00	1
5	38.00	56.00	56.00	56.00	1
6	56.00	56.00	60.00	53.00	1
7	60.00	53.00	67.00	48.00	1
8	67.00	48.00	79.00	43.00	1

1 ISOTROPIC SOIL PARAMETERS

1 TYPE(S) OF SOIL

SOIL TYPE NO.	TOTAL UNIT WT. (PCF)	SATURATED UNIT WT. (PCF)	COHESION INTERCEPT (PSF)	FRICTION ANGLE (DEG)	PORE PRESSURE PARAMETER	PRESSURE CONSTANT (PSF)	PIEZOMETRIC SURFACE NO.
1	108.0	122.0	150.0	31.0	.00	.0	1

1 1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

UNITWEIGHT OF WATER = 62.40

PIEZOMETRIC SURFACE NO. 1 SPECIFIED BY 2 COORDINATE POINTS

POINT NO.	X-WATER (FT)	Y-WATER (FT)
1	.00	42.00
2	79.00	43.00

A HORIZONTAL EARTHQUAKE LOADING COEFFICIENT
OF .100 HAS BEEN ASSIGNED

A VERTICAL EARTHQUAKE LOADING COEFFICIENT
OF .000 HAS BEEN ASSIGNED

CAVITATION PRESSURE = .0 PSF
1 A CRITICAL FAILURE SURFACE SEARCHING METHOD, USING A RANDOM

TECHNIQUE FOR GENERATING CIRCULAR SURFACES, HAS BEEN SPECIFIED.

100 TRIAL SURFACES HAVE BEEN GENERATED.

10 SURFACES INITIATE FROM EACH OF 10 POINTS EQUALLY SPACED
ALONG THE GROUND SURFACE BETWEEN X = .00 FT.
AND X = 20.00 FT.

EACH SURFACE TERMINATES BETWEEN X = 32.00 FT.
AND X = 79.00 FT.

UNLESS FURTHER LIMITATIONS WERE IMPOSED, THE MINIMUM ELEVATION
AT WHICH A SURFACE EXTENDS IS Y = .00 FT.

8.00 FT. LINE SEGMENTS DEFINE EACH TRIAL FAILURE SURFACE.

1 FOLLOWING ARE DISPLAYED THE TEN MOST CRITICAL OF THE TRIAL
FAILURE SURFACES EXAMINED. THEY ARE ORDERED - MOST CRITICAL
FIRST.

FAILURE SURFACE SPECIFIED BY 6 COORDINATE POINTS

POINT NO.	X-SURF (FT)	Y-SURF (FT)
1	15.56	42.00
2	23.40	40.40
3	31.28	41.76
4	38.13	45.89
5	43.02	52.22
6	44.13	56.00

*** 1.623 ***

^Z

--SLOPE STABILITY ANALYSIS--
SIMPLIFIED JANBU METHOD OF SLICES
IRREGULAR FAILURE SURFACES

PROBLEM DESCRIPTION VALLEY CAMP SED. POND 3A; DOWNSTREAM;
STEADY-STATE; DYNAMIC, A=0.1g

BOUNDARY COORDINATES

6 TOP BOUNDARIES
6 TOTAL BOUNDARIES

BOUNDARY NO.	X-LEFT (FT)	Y-LEFT (FT)	X-RIGHT (FT)	Y-RIGHT (FT)	SOIL TYPE BELOW BND
1	.00	38.00	21.00	43.00	1
2	21.00	43.00	33.00	48.00	1
3	33.00	48.00	44.00	56.00	1
4	44.00	56.00	62.00	56.00	1
5	62.00	56.00	64.00	53.00	1
6	64.00	53.00	83.00	42.00	1

1 ISOTROPIC SOIL PARAMETERS

1 TYPE(S) OF SOIL

SOIL TYPE NO.	TOTAL UNIT WT. (PCF)	SATURATED UNIT WT. (PCF)	COHESION INTERCEPT (PSF)	FRICTION ANGLE (DEG)	PORE PRESSURE PARAMETER	PRESSURE CONSTANT (PSF)	PIEZOMETRIC SURFACE NO.
1	107.0	122.0	150.0	31.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

UNITWEIGHT OF WATER = 62.40

PIEZOMETRIC SURFACE NO. 1 SPECIFIED BY 2 COORDINATE POINTS

POINT NO.	X-WATER (FT)	Y-WATER (FT)
1	.00	38.00
2	83.00	42.00

A HORIZONTAL EARTHQUAKE LOADING COEFFICIENT
OF .100 HAS BEEN ASSIGNED

A VERTICAL EARTHQUAKE LOADING COEFFICIENT
OF .000 HAS BEEN ASSIGNED

CAVITATION PRESSURE = .0 PSF
1 A CRITICAL FAILURE SURFACE SEARCHING METHOD, USING A RANDOM
TECHNIQUE FOR GENERATING CIRCULAR SURFACES, HAS BEEN SPECIFIED.

100 TRIAL SURFACES HAVE BEEN GENERATED.

10 SURFACES INITIATE FROM EACH OF 10 POINTS EQUALLY SPACED
ALONG THE GROUND SURFACE BETWEEN X = .00 FT.
AND X = 30.00 FT.

EACH SURFACE TERMINATES BETWEEN X = 41.00 FT.
AND X = 75.00 FT.

UNLESS FURTHER LIMITATIONS WERE IMPOSED, THE MINIMUM ELEVATION
AT WHICH A SURFACE EXTENDS IS Y = .00 FT.

8.00 FT. LINE SEGMENTS DEFINE EACH TRIAL FAILURE SURFACE.

1 FOLLOWING ARE DISPLAYED THE TEN MOST CRITICAL OF THE TRIAL
FAILURE SURFACES EXAMINED. THEY ARE ORDERED - MOST CRITICAL
FIRST.

FAILURE SURFACE SPECIFIED BY 10 COORDINATE POINTS

POINT NO.	X-SURF (FT)	Y-SURF (FT)
1	.00	38.00
2	7.24	34.59
3	14.97	32.55
4	22.95	31.95
5	30.91	32.79
6	38.58	35.06
7	45.71	38.67
8	52.08	43.52
9	57.46	49.44
10	61.54	56.00

*** 1.665 ***

^Z

--SLOPE STABILITY ANALYSIS--
SIMPLIFIED JANBU METHOD OF SLICES
IRREGULAR FAILURE SURFACES

PROBLEM DESCRIPTION VALLEY CAMP SEDIMENTATION POND NO. 3A;
UPSTREAM; STEADY-STATE; STATIC

BOUNDARY COORDINATES

8 TOP BOUNDARIES
8 TOTAL BOUNDARIES

BOUNDARY NO.	X-LEFT (FT)	Y-LEFT (FT)	X-RIGHT (FT)	Y-RIGHT (FT)	SOIL TYPE BELOW BND
1	.00	42.00	17.00	42.00	1
2	17.00	42.00	25.00	47.00	1
3	25.00	47.00	36.00	53.00	1
4	36.00	53.00	38.00	56.00	1
5	38.00	56.00	56.00	56.00	1
6	56.00	56.00	60.00	53.00	1
7	60.00	53.00	67.00	48.00	1
8	67.00	48.00	79.00	43.00	1

1 ISOTROPIC SOIL PARAMETERS

1 TYPE(S) OF SOIL

SOIL TYPE NO.	TOTAL UNIT WT. (PCF)	SATURATED UNIT WT. (PCF)	COHESION INTERCEPT (PSF)	FRICTION ANGLE (DEG)	PORE PRESSURE PARAMETER	PRESSURE CONSTANT (PSF)	PIEZOMETRIC SURFACE NO.
1	108.0	122.0	150.0	31.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

UNITWEIGHT OF WATER = 62.40

PIEZOMETRIC SURFACE NO. 1 SPECIFIED BY 2 COORDINATE POINTS

POINT NO.	X-WATER (FT)	Y-WATER (FT)
1	.00	42.00
2	79.00	42.00

1 A CRITICAL FAILURE SURFACE SEARCHING METHOD, USING A RANDOM
TECHNIQUE FOR GENERATING CIRCULAR SURFACES, HAS BEEN SPECIFIED.

100 TRIAL SURFACES HAVE BEEN GENERATED.

10 SURFACES INITIATE FROM EACH OF 10 POINTS EQUALLY SPACED
ALONG THE GROUND SURFACE BETWEEN X = .00 FT.
AND X = 20.00 FT.

EACH SURFACE TERMINATES BETWEEN X = 32.00 FT.
AND X = 79.00 FT.

UNLESS FURTHER LIMITATIONS WERE IMPOSED, THE MINIMUM ELEVATION AT WHICH A SURFACE EXTENDS IS Y = .00 FT.

8.00 FT. LINE SEGMENTS DEFINE EACH TRIAL FAILURE SURFACE.

FOLLOWING ARE DISPLAYED THE TEN MOST CRITICAL OF THE TRIAL FAILURE SURFACES EXAMINED. THEY ARE ORDERED - MOST CRITICAL FIRST.

FAILURE SURFACE SPECIFIED BY 6 COORDINATE POINTS

POINT NO.	X-SURF (FT)	Y-SURF (FT)
1	15.56	42.00
2	23.40	40.40
3	31.28	41.76
4	38.13	45.89
5	43.02	52.22
6	44.13	56.00

*** 2.013 ***

Z

--SLOPE STABILITY ANALYSIS--
SIMPLIFIED JANBU METHOD OF SLICES
IRREGULAR FAILURE SURFACES

PROBLEM DESCRIPTION VALLEY CAMP SED. POND 3A; DOWNSTREAM;
STEADY STATE; STATIC

BOUNDARY COORDINATES

6 TOP BOUNDARIES
6 TOTAL BOUNDARIES

BOUNDARY NO.	X-LEFT (FT)	Y-LEFT (FT)	X-RIGHT (FT)	Y-RIGHT (FT)	SOIL TYPE BELOW BND
1	.00	38.00	21.00	43.00	1
2	21.00	43.00	33.00	48.00	1
3	33.00	48.00	44.00	56.00	1
4	44.00	56.00	62.00	56.00	1
5	62.00	56.00	64.00	53.00	1
6	64.00	53.00	83.00	42.00	1

1 ISOTROPIC SOIL PARAMETERS

1 TYPE(S) OF SOIL

SOIL TYPE NO.	TOTAL UNIT WT. (PCF)	SATURATED UNIT WT. (PCF)	COHESION INTERCEPT (PSF)	FRICTION ANGLE (DEG)	PORE PRESSURE PARAMETER	PRESSURE CONSTANT (PSF)	PIEZOMETRIC SURFACE NO.
1	107.0	122.0	150.0	31.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

UNITWEIGHT OF WATER = 62.40

PIEZOMETRIC SURFACE NO. 1 SPECIFIED BY 2 COORDINATE POINTS

POINT NO.	X-WATER (FT)	Y-WATER (FT)
1	.00	38.00
2	83.00	42.00

1 A CRITICAL FAILURE SURFACE SEARCHING METHOD, USING A RANDOM
TECHNIQUE FOR GENERATING CIRCULAR SURFACES, HAS BEEN SPECIFIED.

100 TRIAL SURFACES HAVE BEEN GENERATED.

10 SURFACES INITIATE FROM EACH OF 10 POINTS EQUALLY SPACED
ALONG THE GROUND SURFACE BETWEEN X = .00 FT.
AND X = 30.00 FT.

EACH SURFACE TERMINATES BETWEEN X = 41.00 FT.

AND X = 75.00 FT.

UNLESS FURTHER LIMITATIONS WERE IMPOSED, THE MINIMUM ELEVATION AT WHICH A SURFACE EXTENDS IS Y = .00 FT.

8.00 FT. LINE SEGMENTS DEFINE EACH TRIAL FAILURE SURFACE.

THE FACTOR OF SAFETY FOR THE TRIAL FAILURE SURFACE DEFINED BY THE COORDINATES LISTED BELOW IS MISLEADING.

FAILURE SURFACE DEFINED BY 7 COORDINATE POINTS

POINT NO.	X-SURF (FT)	Y-SURF (FT)
1	30.00	46.75
2	36.95	42.79
3	44.57	40.34
4	52.52	39.52
5	60.48	40.35
6	68.09	42.81
7	74.88	46.70

FACTOR OF SAFETY FOR THE PRECEDING SPECIFIED SURFACE =*******
1 FOLLOWING ARE DISPLAYED THE TEN MOST CRITICAL OF THE TRIAL FAILURE SURFACES EXAMINED. THEY ARE ORDERED - MOST CRITICAL FIRST.

FAILURE SURFACE SPECIFIED BY 6 COORDINATE POINTS

POINT NO.	X-SURF (FT)	Y-SURF (FT)
1	20.00	42.76
2	27.82	41.06
3	35.73	42.25
4	42.69	46.20
5	47.78	52.37
6	48.99	56.00

*** 2.173 ***

Z

Northern Engineering and Testing, Inc.

STANDARD COMPUTATION SHEET

PROJECT Valley-Camp Sed. Ponds JOB NO. 515889

PURPOSE Stab. Analyses SHEET 1 OF 8

COMPUTED BY DBG CHECKED BY DATE 1/31/89

Steepest Permissible Slopes

Condition	Req'd Safety Factor
Steady State, Static	1.5
Steady State Dynamic	1.1
Rapid Drawdown	1.1

Parameters for Most Critical Slope

Highest Slope: 18 ft

Strength Parameters: $\phi = 31°$, $c = 150$ psf, $\gamma_{SAT} = 122$ pcf, $\gamma_m = 107$ pcf

Steepest Slope: 1.5H:1V

Highest Water level: 13 ft.

Narrowest Crest: 8 ft.

Condition	Safety factor	Slope
Steady State, Static	1.51	0.8H:1V
Steady State Dynamic	1.21	0.72H:1V
Rapid Drawdown	1.15	1.5H:1V

Most Critical Case is Rapid Drawdown w/ FS = 1.15 and Slope = 1.5H:1V

NET-145

2/8

--SLOPE STABILITY ANALYSIS--
SIMPLIFIED JANBU METHOD OF SLICES
IRREGULAR FAILURE SURFACES

$H = 18$ ft
$\gamma_{SAT} = 122$ pcf
$\gamma_{dry} = 107$ pcf
$\phi = 31$
$c = 150$ psf

PROBLEM DESCRIPTION VAL-CAM SED. PONDS; GENERIC POND W/ STEE
PEST SLP & HIGHEST EMB & WEAK SOIL

BOUNDARY COORDINATES

6 TOP BOUNDARIES
6 TOTAL BOUNDARIES

RAPID DRAWDOWN
$FS = 1.15$
Slope = 1.5H:1V

BOUNDARY NO.	X-LEFT (FT)	Y-LEFT (FT)	X-RIGHT (FT)	Y-RIGHT (FT)	SOIL TYPE BELOW BND
1	.00	40.00	20.00	40.00	1
2	20.00	40.00	40.00	53.00	1
3	40.00	53.00	47.00	58.00	1
4	47.00	58.00	55.00	58.00	1
5	55.00	58.00	73.00	46.00	1
6	73.00	46.00	82.00	40.00	1

ISOTROPIC SOIL PARAMETERS

1 TYPE(S) OF SOIL

SOIL TYPE NO.	TOTAL UNIT WT. (PCF)	SATURATED UNIT WT. (PCF)	COHESION INTERCEPT (PSF)	FRICTION ANGLE (DEG)	PORE PRESSURE PARAMETER	PRESSURE CONSTANT (PSF)	PIEZOMETRIC SURFACE NO.
1	107.0	122.0	150.0	31.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

UNITWEIGHT OF WATER = 62.40

PIEZOMETRIC SURFACE NO. 1 SPECIFIED BY 6 COORDINATE POINTS

POINT NO.	X-WATER (FT)	Y-WATER (FT)
1	.00	40.00
2	20.00	40.00
3	40.00	53.00
4	50.00	53.00
5	73.00	46.00
6	82.00	40.00

A CRITICAL FAILURE SURFACE SEARCHING METHOD, USING A RANDOM
TECHNIQUE FOR GENERATING CIRCULAR SURFACES, HAS BEEN SPECIFIED.

100 TRIAL SURFACES HAVE BEEN GENERATED.

3/8

10 SURFACES INITIATE FROM EACH OF 10 POINTS EQUALLY SPACED
ALONG THE GROUND SURFACE BETWEEN X = .00 FT.
AND X = 30.00 FT.

EACH SURFACE TERMINATES BETWEEN X = 50.00 FT.
AND X = 80.00 FT.

UNLESS FURTHER LIMITATIONS WERE IMPOSED, THE MINIMUM ELEVATION
AT WHICH A SURFACE EXTENDS IS Y = .00 FT.

8.00 FT. LINE SEGMENTS DEFINE EACH TRIAL FAILURE SURFACE.

FOLLOWING ARE DISPLAYED THE TEN MOST CRITICAL OF THE TRIAL
FAILURE SURFACES EXAMINED. THEY ARE ORDERED - MOST CRITICAL
FIRST.

FAILURE SURFACE SPECIFIED BY 7 COORDINATE POINTS

POINT NO.	X-SURF (FT)	Y-SURF (FT)
1	16.67	40.00
2	24.10	37.04
3	32.10	36.77
4	39.71	39.22
5	46.05	44.10
6	50.36	50.84
7	52.00	58.00

*** 1.153 ***

4/8

--SLOPE STABILITY ANALYSIS--
SIMPLIFIED JANBU METHOD OF SLICES
IRREGULAR FAILURE SURFACES

PROBLEM DESCRIPTION VAL-CAM SED. PONDS; GENERIC POND W/ STEE
PEST SLP & HIGHEST EMB & WEAK SOIL

$H_t = 18$ ft
$\gamma_{SAT} = 122$ pcf
$\gamma_m = 107$ pcf
$\phi = 31°$
$c = 150$ psf
Steady state, Static
FS = 1.5
Slope = 0.8H:1V

BOUNDARY COORDINATES

6 TOP BOUNDARIES
6 TOTAL BOUNDARIES

BOUNDARY NO.	X-LEFT (FT)	Y-LEFT (FT)	X-RIGHT (FT)	Y-RIGHT (FT)	SOIL TYPE BELOW BND
1	.00	40.00	32.00	40.00	1
2	32.00	40.00	43.00	53.00	1
3	43.00	53.00	47.00	58.00	1
4	47.00	58.00	55.00	58.00	1
5	55.00	58.00	73.00	46.00	1
6	73.00	46.00	82.00	40.00	1

1 ISOTROPIC SOIL PARAMETERS

1 TYPE(S) OF SOIL

SOIL TYPE NO.	TOTAL UNIT WT. (PCF)	SATURATED UNIT WT. (PCF)	COHESION INTERCEPT (PSF)	FRICTION ANGLE (DEG)	PORE PRESSURE PARAMETER	PRESSURE CONSTANT (PSF)	PIEZOMETRIC SURFACE NO.
1	107.0	122.0	150.0	31.0	.00	.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

UNITWEIGHT OF WATER = 62.40

PIEZOMETRIC SURFACE NO. 1 SPECIFIED BY 2 COORDINATE POINTS

POINT NO.	X-WATER (FT)	Y-WATER (FT)
1	.00	40.00
2	82.00	40.00

1 A CRITICAL FAILURE SURFACE SEARCHING METHOD, USING A RANDOM

TECHNIQUE FOR GENERATING CIRCULAR SURFACES, HAS BEEN SPECIFIED.

100 TRIAL SURFACES HAVE BEEN GENERATED.

10 SURFACES INITIATE FROM EACH OF 10 POINTS EQUALLY SPACED
ALONG THE GROUND SURFACE BETWEEN X = .00 FT.
AND X = 30.00 FT.

EACH SURFACE TERMINATES BETWEEN X = 50.00 FT.
AND X = 80.00 FT.

UNLESS FURTHER LIMITATIONS WERE IMPOSED, THE MINIMUM ELEVATION
AT WHICH A SURFACE EXTENDS IS Y = .00 FT.

8.00 FT. LINE SEGMENTS DEFINE EACH TRIAL FAILURE SURFACE.

1 FOLLOWING ARE DISPLAYED THE TEN MOST CRITICAL OF THE TRIAL
FAILURE SURFACES EXAMINED. THEY ARE ORDERED - MOST CRITICAL
FIRST.

FAILURE SURFACE SPECIFIED BY 7 COORDINATE POINTS

POINT NO.	X-SURF (FT)	Y-SURF (FT)
1	20.00	40.00
2	27.84	38.41
3	35.80	39.20
4	43.18	42.30
5	49.31	47.43
6	53.67	54.14
7	54.76	58.00

*** 1.514 ***

6/8

1 GEOSLOPE
Version 2.0

Supplied by GEOCOMP Corp.
342 Sudbury Rd., Concord, MA. 01742
(617)369-8304

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GEOSLOPE is based on the program, STABL2, developed at Purdue University under sponsorship of the Federal Highway Administration.

GEOCOMP Corp. has modified the program to run on various microcomputers and plotting devices. GEOCOMP Corp. makes no warranties as to the fitness of this software. The user bears all responsibility for accuracy and correctness of results produced by this software. See the users manual for further warranty information.

$H = 18$ ft
$\gamma_{SAT} = 122$ pcf
$\gamma_m = 107$ pcf
$\phi = 31°$
$c = 150$ psf

Steady State, Dynamic
$a = 0.1g$
$F = 1.21$
Slope $= 0.72H:1V$

1 --SLOPE STABILITY ANALYSIS--
SIMPLIFIED JANBU METHOD OF SLICES
IRREGULAR FAILURE SURFACES

PROBLEM DESCRIPTION VAL-CAM SED. PONDS; GENERIC POND W/ STEE
PEST SLP & HIGHEST EMB & WEAK SOIL

BOUNDARY COORDINATES

6 TOP BOUNDARIES
6 TOTAL BOUNDARIES

BOUNDARY NO.	X-LEFT (FT)	Y-LEFT (FT)	X-RIGHT (FT)	Y-RIGHT (FT)	SOIL TYPE BELOW BND
1	.00	40.00	34.00	40.00	1
2	34.00	40.00	43.00	53.00	1
3	43.00	53.00	47.00	58.00	1
4	47.00	58.00	55.00	58.00	1
5	55.00	58.00	73.00	46.00	1
6	73.00	46.00	82.00	40.00	1

1 ISOTROPIC SOIL PARAMETERS

1 TYPE(S) OF SOIL

7/8

SOIL TYPE NO.	TOTAL UNIT WT. (PCF)	SATURATED UNIT WT. (PCF)	COHESION INTERCEPT (PSF)	FRICTION ANGLE (DEG)	PORE PRESSURE PARAMETER	PRESSURE CONSTANT (PSF)	PIEZOMETRIC SURFACE NO.
1	107.0	122.0	150.0	31.0	.00	.0	1

1 1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

UNITWEIGHT OF WATER = 62.40

PIEZOMETRIC SURFACE NO. 1 SPECIFIED BY 2 COORDINATE POINTS

POINT NO.	X-WATER (FT)	Y-WATER (FT)
1	.00	40.00
2	82.00	40.00

A HORIZONTAL EARTHQUAKE LOADING COEFFICIENT
OF .100 HAS BEEN ASSIGNED

A VERTICAL EARTHQUAKE LOADING COEFFICIENT
OF .000 HAS BEEN ASSIGNED

CAVITATION PRESSURE = .0 PSF
1 A CRITICAL FAILURE SURFACE SEARCHING METHOD, USING A RANDOM
TECHNIQUE FOR GENERATING CIRCULAR SURFACES, HAS BEEN SPECIFIED.

100 TRIAL SURFACES HAVE BEEN GENERATED.

10 SURFACES INITIATE FROM EACH OF 10 POINTS EQUALLY SPACED
ALONG THE GROUND SURFACE BETWEEN X = .00 FT.
AND X = 30.00 FT.

EACH SURFACE TERMINATES BETWEEN X = 50.00 FT.
AND X = 80.00 FT.

UNLESS FURTHER LIMITATIONS WERE IMPOSED, THE MINIMUM ELEVATION
AT WHICH A SURFACE EXTENDS IS Y = .00 FT.

8.00 FT. LINE SEGMENTS DEFINE EACH TRIAL FAILURE SURFACE.

1 FOLLOWING ARE DISPLAYED THE TEN MOST CRITICAL OF THE TRIAL

8/8

FAILURE SURFACES EXAMINED. THEY ARE ORDERED - MOST CRITICAL FIRST.

FAILURE SURFACE SPECIFIED BY 6 COORDINATE POINTS

POINT NO.	X-SURF (FT)	Y-SURF (FT)
1	26.67	40.00
2	34.63	39.25
3	42.41	41.12
4	49.17	45.41
5	54.17	51.65
6	56.18	57.21

*** 1.211 ***

FAILURE SURFACE SPECIFIED BY 7 COORDINATE POINTS

POINT NO.	X-SURF (FT)	Y-SURF (FT)
1	20.00	40.00
2	27.84	38.41
3	35.80	39.20
4	43.18	42.30
5	49.31	47.43
6	53.67	54.14
7	54.76	58.00

*** 1.267 ***

1

FAILURE SURFACE SPECIFIED BY 6 COORDINATE POINTS

POINT NO.	X-SURF (FT)	Y-SURF (FT)
1	26.67	40.00
2	34.32	37.66
3	42.22	38.90
4	48.78	43.48
5	52.66	50.48
6	53.06	58.00

NVLAP
Accredited

GARCO TESTING LABORATORIES

532 West 3560 South
Salt Lake City, Utah 84115
Phone 266-4498

5826 South 1900 West
Roy, Utah 84067
Phone 776-5355

December 2, 1988

RECEIVED
DEC - 6 1988
VALLEY CAMP OF UTAH, INC.

Valley Camp of Utah, Inc.
Scofield Route
Helper, Utah 84526

Attn: Steve Tanner:

Sample 1 & 5
Soil Classification - Sandy Clay (CL)

Pn (PSF)	500	1000	1500
At Peak % Load	15.9	20.5	34.1
(PSF) Shear Strength	763	984	1637
M.C.i	15.2	15.8	14.7
γ di	115.7	113.4	120.1
MC f	17.3	16.9	15.8
γ df	108.2	120.4	126.4

Sample 2
Soil Classification - Very fine sand (ML)

Pn (PSF)	100	200	400
At Peak % Load	6.1	7.1	8.6
Shear Strength (PSF)	293	341	413
M.C.i	42.7	40.6	32.0
γ di	76.4	78.8	83.8
MC f	44.6	41.6	38.5
γ df	75.4	80.4	85.9

MC = Moisture Content
γ f = Dry Unit Weight

Sincerely,

Tom McNamee

Tom McNamee
Lab Manager

cc: Randy Harten
Div of Oil,Gas,Mining

National Voluntary
Laboratory Accreditation
Program

NVLAP

United States Department
of Commerce Accredited

Member: ASTM, ACI, AGC

NVLAP Accredited

GARCO TESTING LABORATORIES

532 West 3560 South
Salt Lake City, Utah 84115
Phone 266-4498

5826 South 1900 West
Roy, Utah 84067
Phone 776-5355

December 2, 1988

RECEIV 1988 VHA

Valley Camp
Scofield Route
Helper, Utah 84526

Attn: Steve Tanner

Gentlemen,

Enclosed are the in place density, direct shear, soil classification and cohesion properties of samples taken from Valley Camp Pond #1.

The pond bottom is a light brown sandy clay with some silt. The south and west sides have a gray silty sand. The color change could be natural but is probably the result of coal dust deposited in the pond over the years.

Samples were taken by driving (by hand) a thin walled aluminum tube into cut outs from the embankment approximately 2 feet above the water and 2 feet in from the surface.

Samples #1 & #5, and #2 & #3, were so similar that only one direct shear was done per set. Sample #4 was disturbed and no direct was performed but the torvane shear in the field was 200 psf.

As to the request of Randy Harten, Division of Oil, Gas and Mining, no engineering analysis has been performed , only the testing of the samples. If you have any questions regarding this information please do not hesitate to call.

Sincerely,

Tom McNamee
Lab Manager

cc: Randy Harten
Division of Oil, Gas,Mining

National Voluntary Laboratory Accreditation Program

NVLAP

United States Department of Commerce Accredited

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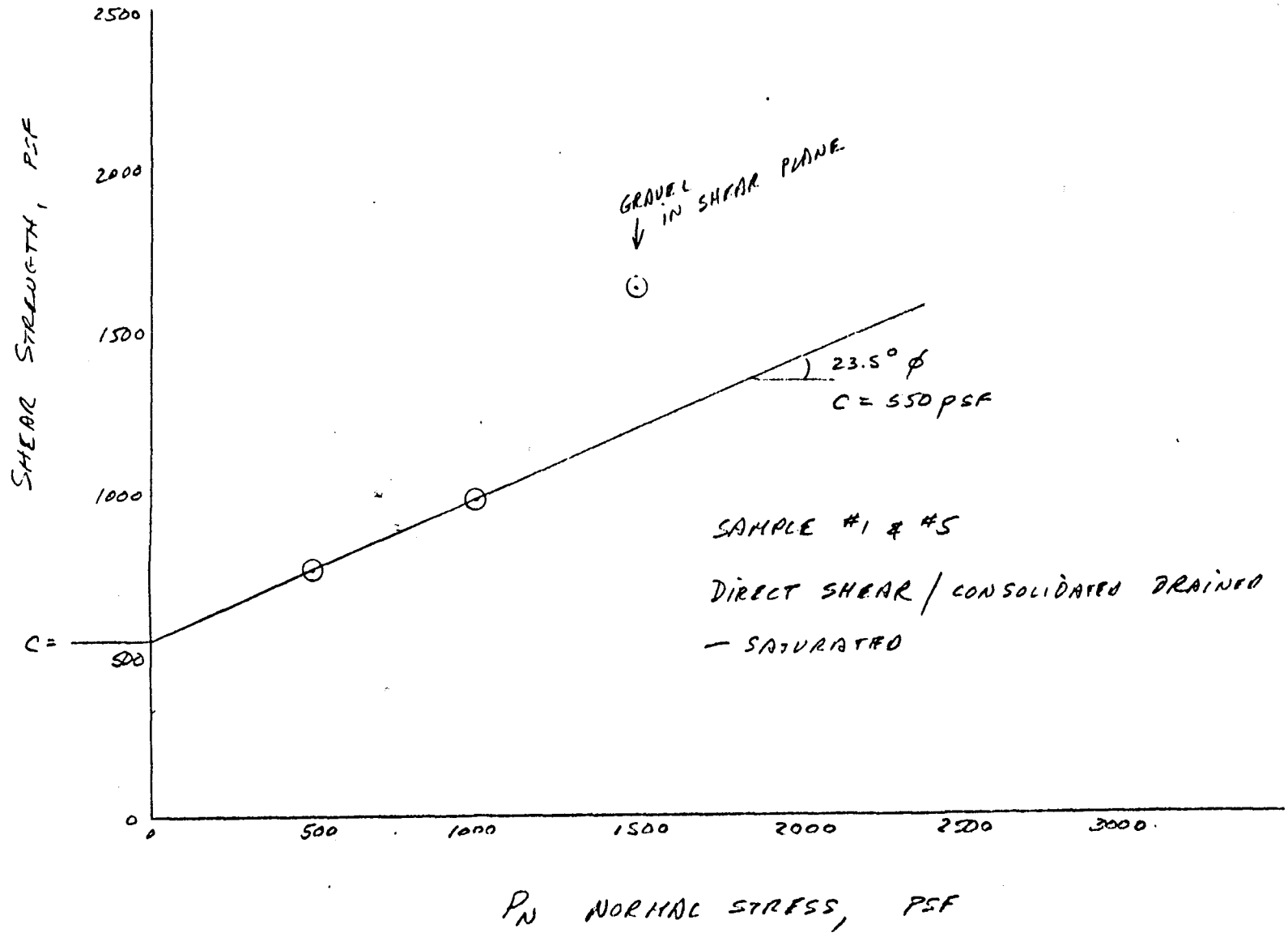

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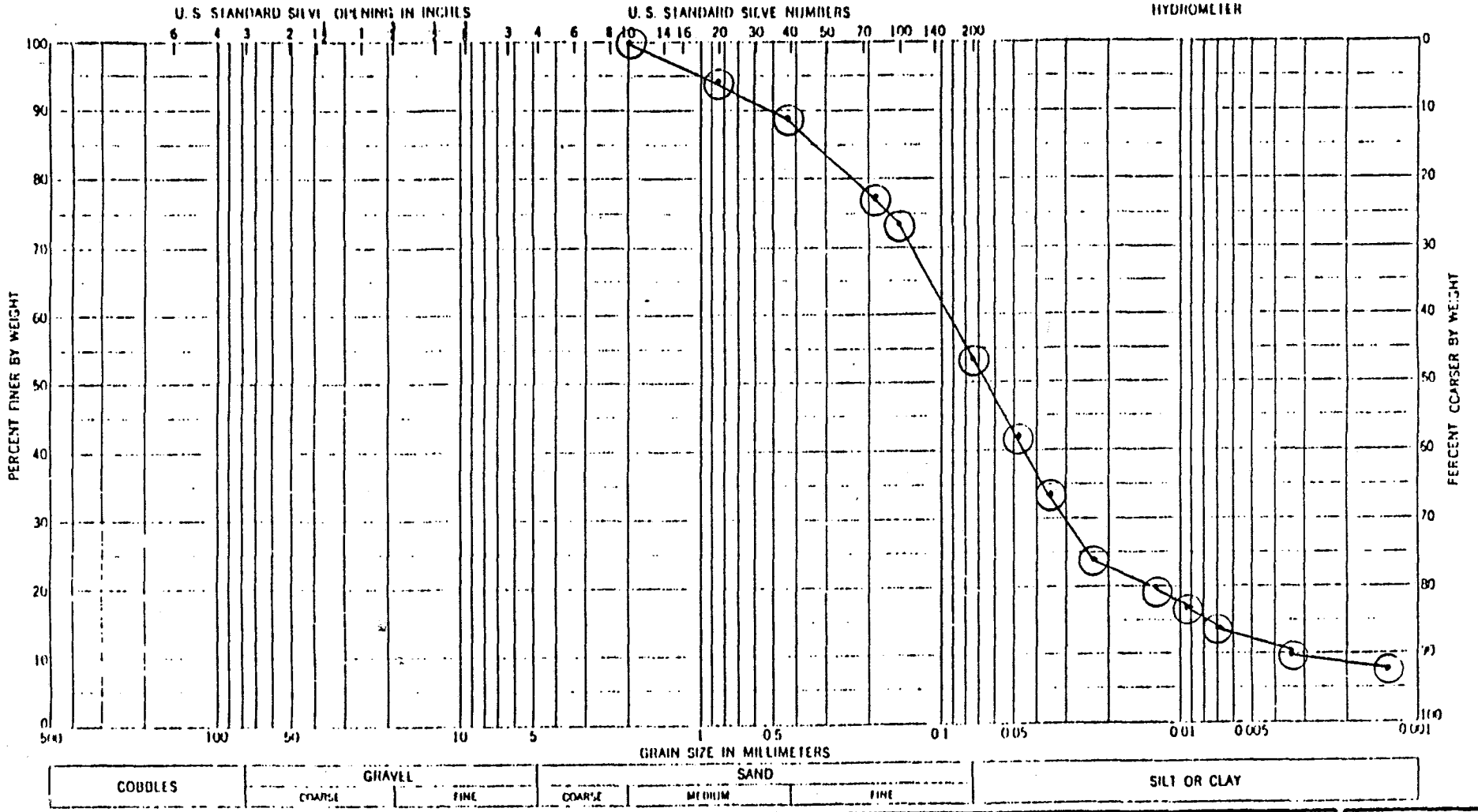


Sample No	Elev or Depth	Classification	Nat w %	LL	PL	PI
1		SANDY CLAY (CL)		18	16	2

Project VALLEY CAMP

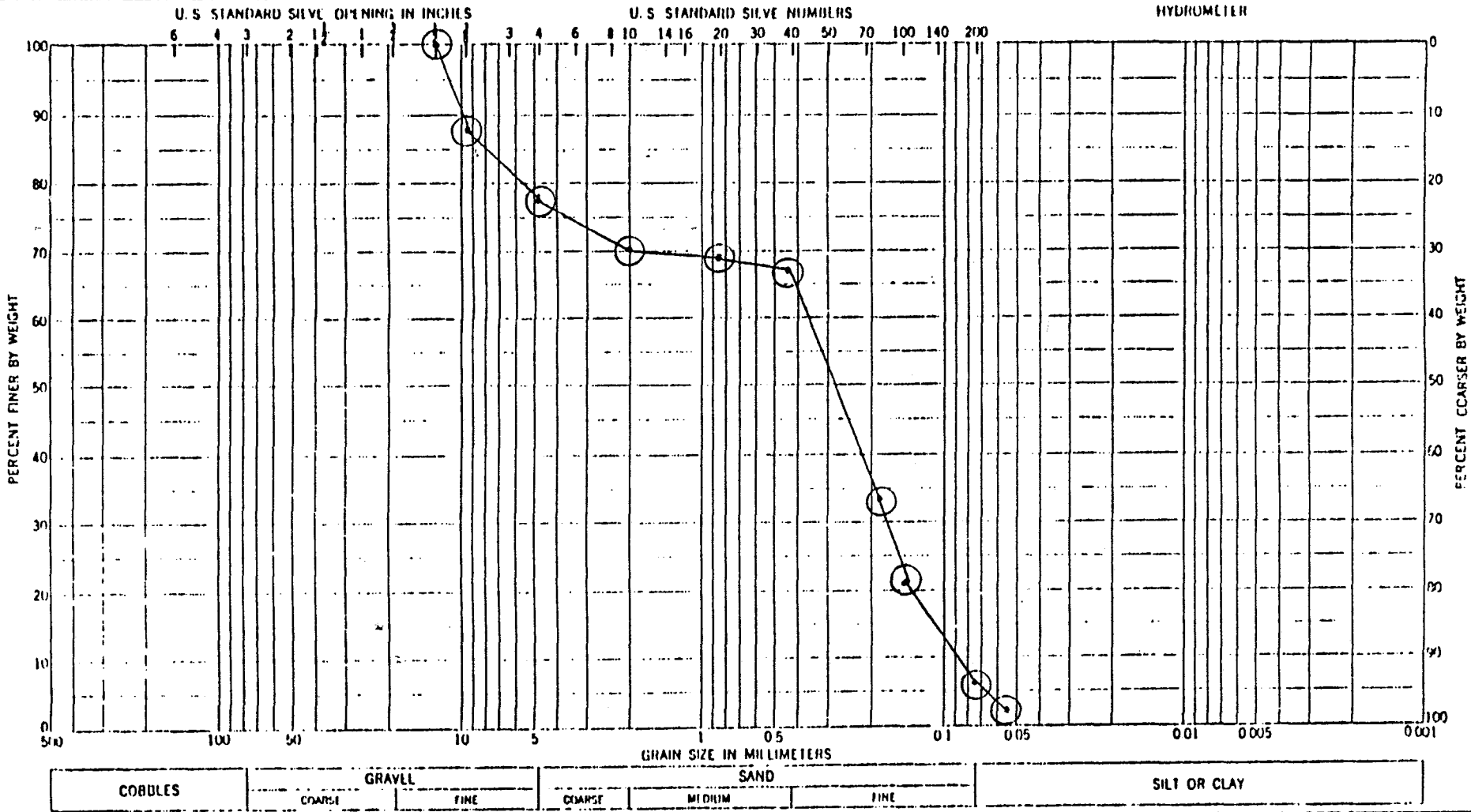
Area POND #1

Boring No 1

Date

GRADATION CURVES

ENG FORM 1 MAY 83 2087



Sample No	Elev or Depth	Classification	Nat w %	LL	PL	PI
4	—	SILTY SAND (SM) WELL GRADED SAND (SW)		NON-PLASTIC		

Project VALLEY CAMP

Area POND #1

Boring No 4

Date

GRADATION CURVES

ENG FORM 1 MAY 63 2087

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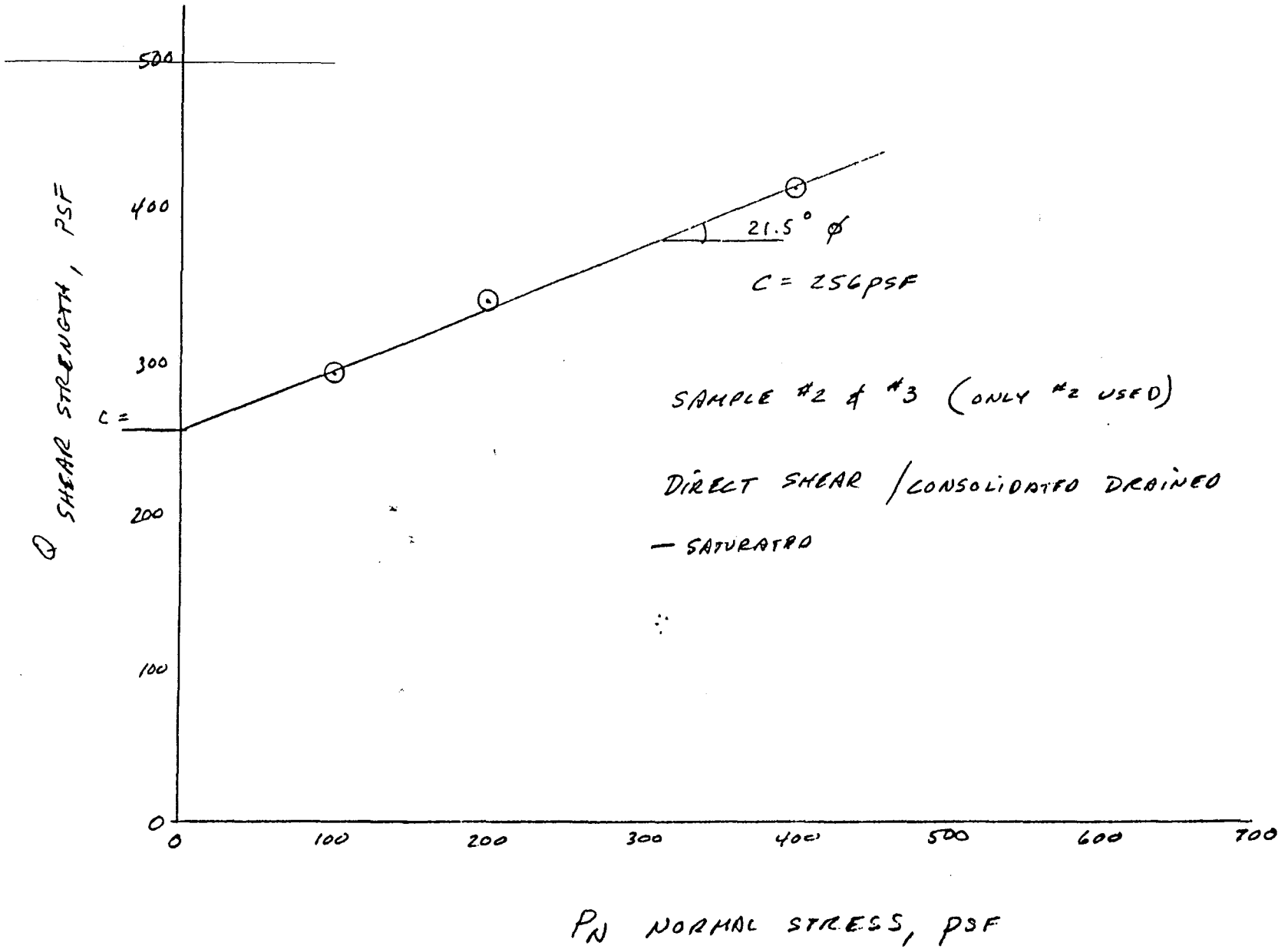

FILE
SUBJECT GARCO - DS/CD TEST
SHEET OF

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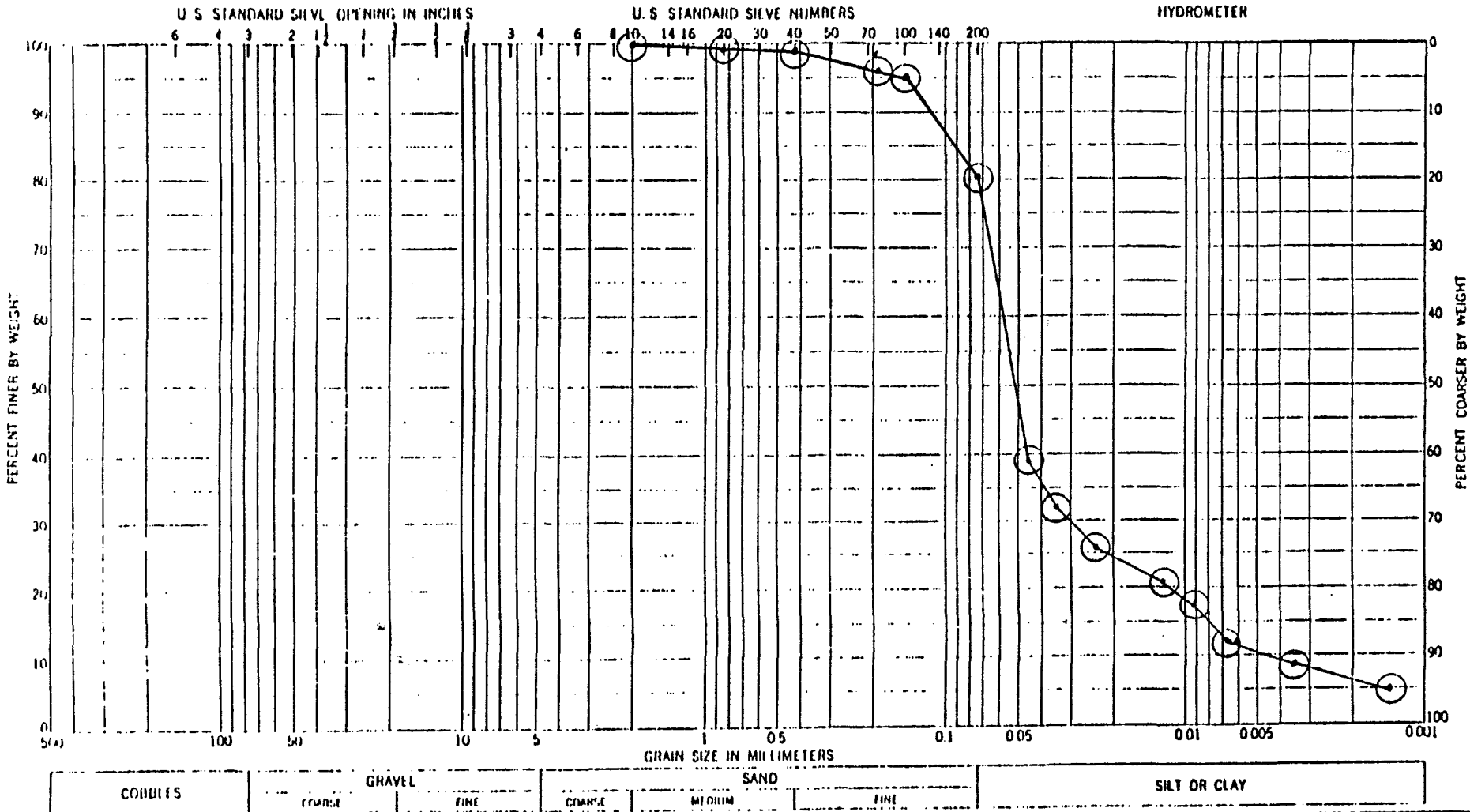


Sample No	Elev. or Depth	Classification	Nat w %	LL	PL	PI
2	–	VERY FINE SAND (ML)		NON-PLASTIC		

Project VALLEY CAMP

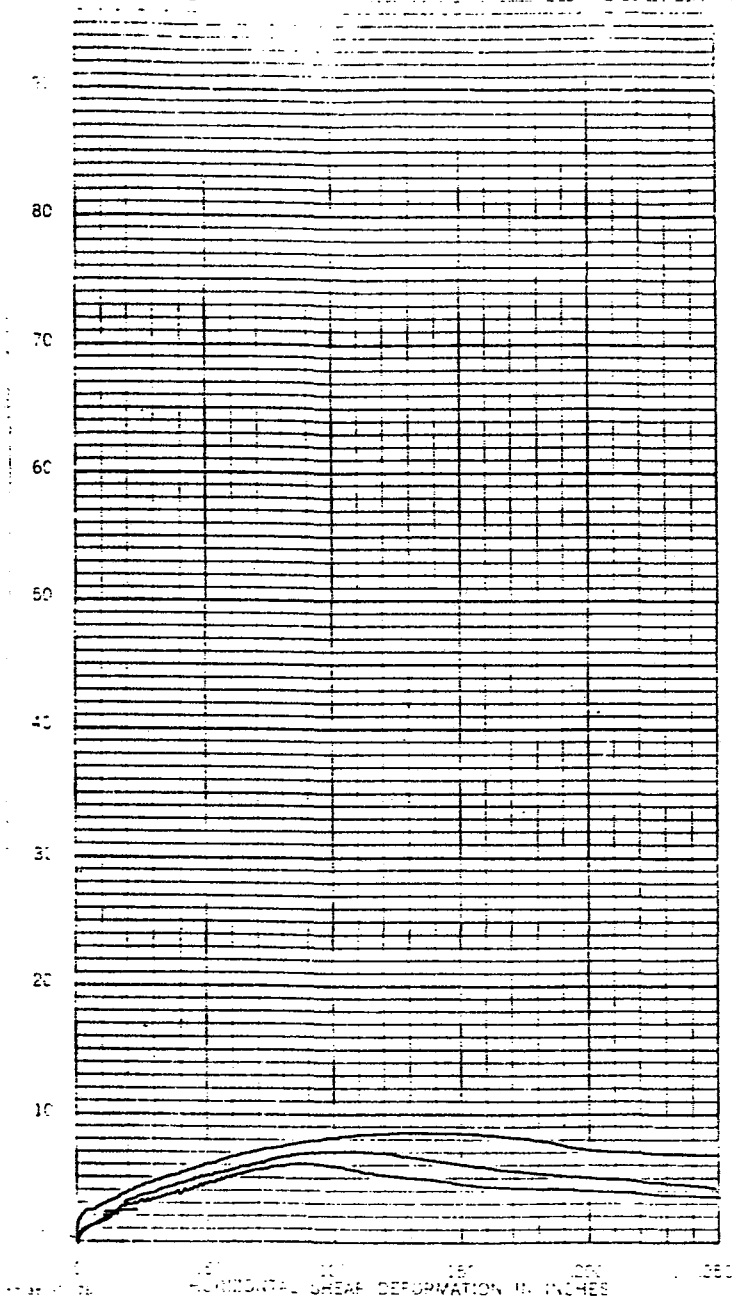
Area POND #1

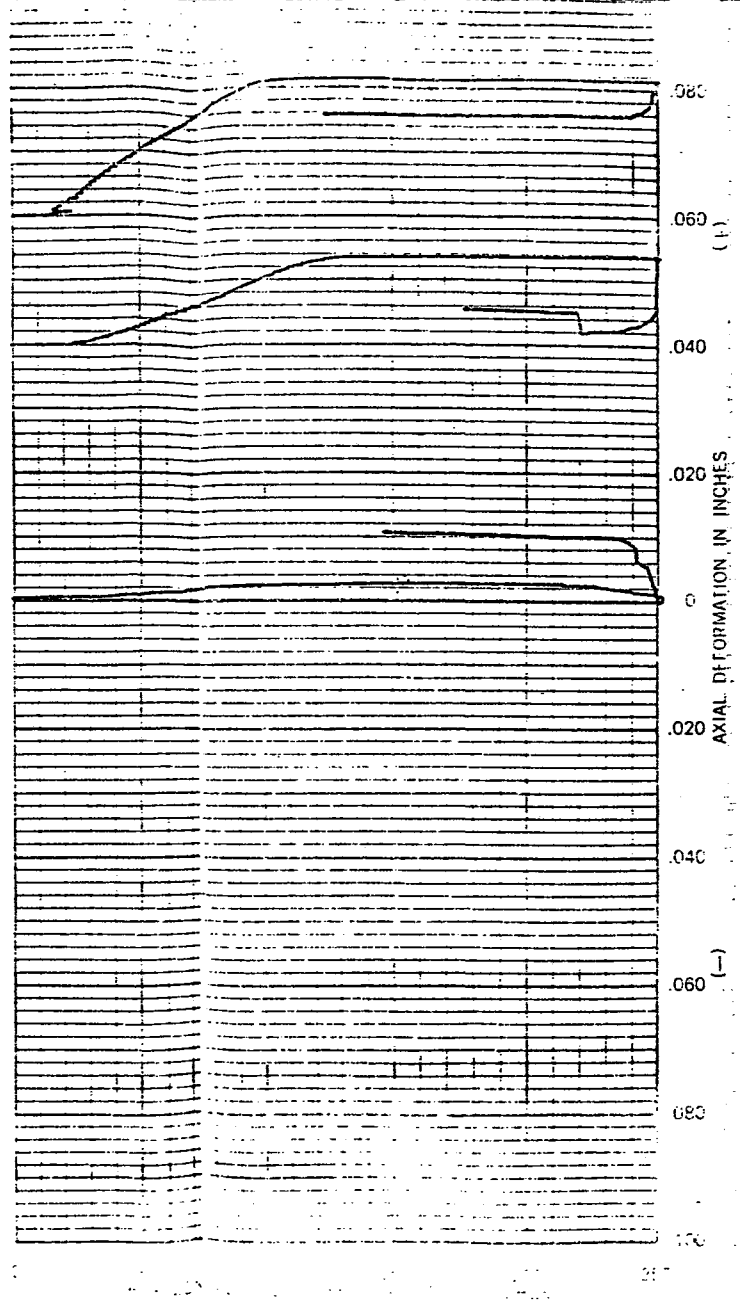
Boring No. 2

Date

GRADATION CURVES

ENG FORM 1 MAY 63 2087





DIRECT SHEAR TEST DATA
Sheet 1 of 2

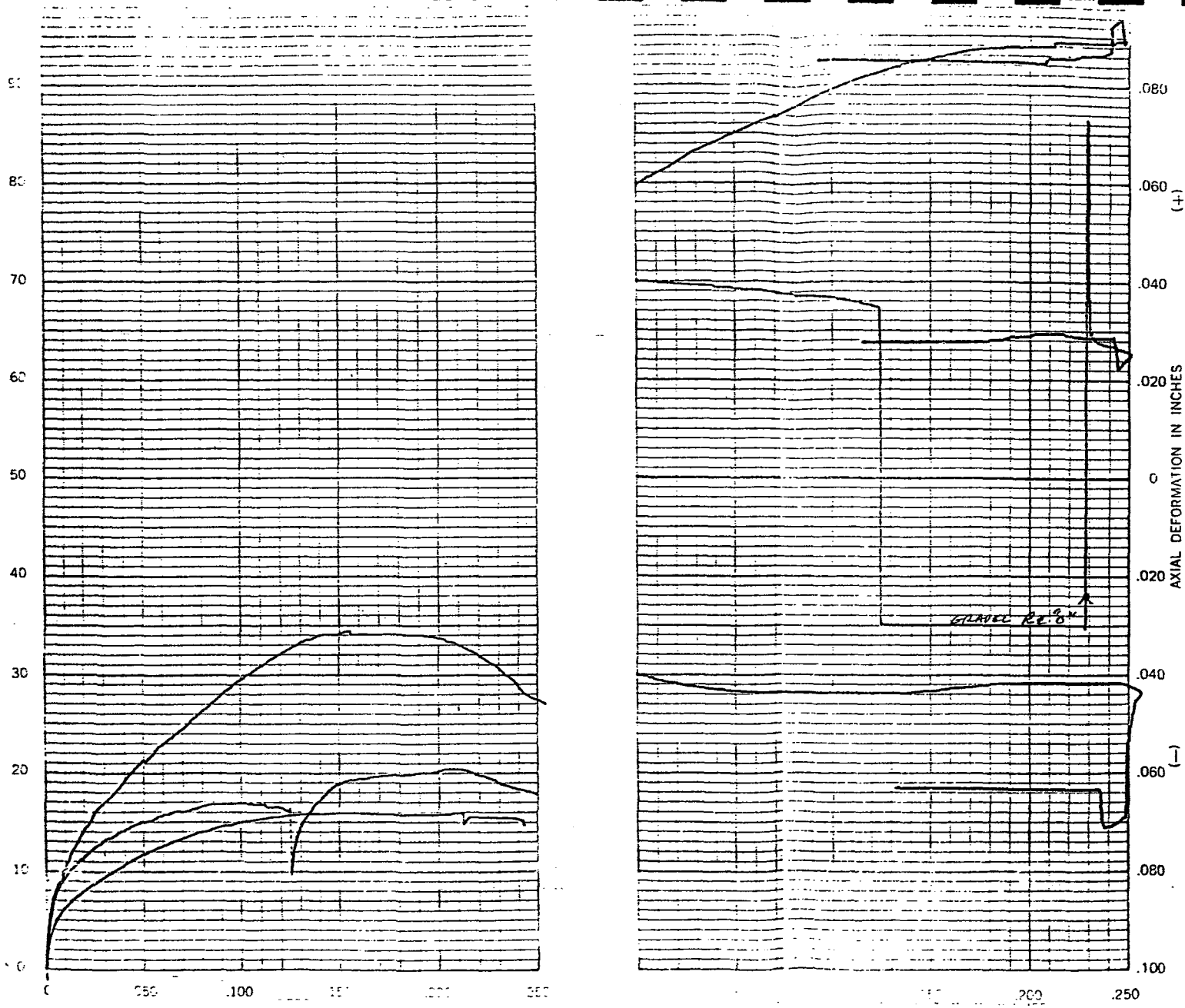
PROJECT: VALLEY CAMP PROJECT NO: 506
LOCATION: SCC
BORING: — SAMPLE: 2 DEPTH (FT.)
SAMPLED BY: GARCO TESTED BY:
SOIL IDENTIFICATION: GRAY SI CLAY & ORG

TYPE OF TEST: DS/CD
SHEARING RATE: .012 in/min
NORMAL PRESSURE: psf = 4800
LOAD RANGE USED: 40(12K) = 48

	PEAK	ULTIMAT
% SHEAR LOAD		
SHEAR STRENGTH (psf)		
HORIZONTAL DEFORMATION (in.)		

PN	100	200	400
REMARKS: At Peak % LOAD	6.1	7.1	8.6
SHEAR STRENGTH	293	341	413
H.C.i	42.7	40.6	32.0
δdi	76.4	78.8	83.8
H.C.f	44.6	41.6	38.5
δdf	75.4	80.4	85.9

OFFICE NUMBER: 31 RECORDER NUMBER: 743
SHEAR EQUIPMENT NUMBER: 7327 B
RECORDER CALIBRATION CHECKED: 8/84
RECORDER PERFORMANCE CHECKED: 8/84
EQUIPMENT PERFORMANCE CHECKED: 8/84
EQUIPMENT CHECKED BY: EEC DATE: 11/13



DIRECT SHEAR TEST DATA SHEET
Sheet 1 of 2

PROJECT Valley Camp PROJECT NO. 5066
LOCATION SLC
BORING — SAMPLE 5 DEPTH (FT.) —
SAMPLED BY CARLO TESTED BY E&L 11 R. S
SOIL IDENTIFICATION BrFi-C SA CLAY OCC TR Fi GVL

TYPE OF TEST: DS/CD
SHEARING RATE: .012 in./hr.
NORMAL PRESSURE: psi = 4800
LOAD RANGE USED: 20 = 48 p

	PEAK	ULTIMATE
% SHEAR LOAD		
SHEAR STRENGTH (psf)		
HORIZONTAL DEFORMATION (in.)		

PN	500	1000	1500
REMARKS: % LOAD	15.9	20.5	34.1
SHEAR STRENGTH	763	984	1637
H.C.i	15.2	15.8	14.7
δdi	115.7	113.4	120.1
H.C.f	17.3	16.9	15.8
δdf	108.2	120.4	126.4

OFFICE NUMBER: 31 RECORDER NUMBER: 7434
SHEAR EQUIPMENT NUMBER: 7327B
RECORDER CALIBRATION CHECKED: 8/84
RECORDER PERFORMANCE CHECKED: 8/84
EQUIPMENT PERFORMANCE CHECKED: 8/84
EQUIPMENT CHECKED BY E&L DATE: 8/13/8

ROLLINS,
BROWN and
GUNNELL,
INC. professional engineers

November 16, 1988

NOV 17 1988

VALLEY CAMP OF UTAH, INC.

Barry Barnum
Scofield Route
Helper, UT 84526

Gentlemen:

We have completed the required testing of soil samples obtained from two test pits excavated at Valley Camp near Scofield, Utah. The location of the test pits are shown in Figure No. 1 with their logs presented in Figure No. 2. It will be observed that the subsurface materials in both areas consist of a brown gravelly sandy silty clay.

Sampling of the test pits occurred at three-foot intervals throughout the depth investigated. Each sample was classified according to the Unified Soil Classification System. The symbols designating the soil type are shown on the logs.

The in-place unit weight and natural moisture content are also shown on the logs ranging from about 90 pounds per cubic foot to about 110 pounds per cubic foot and 6% to 11% respectively for Test Hole No. 1 and from 91 pounds per cubic foot to 97 pounds per cubic foot and 8.6% to 21.5% respectively for Test Hole No. 2.

The saturated unit weight for samples obtained from about 6 feet below the ground surface in Test Hole No. 1 is 118.2 pounds per cubic foot.

1435 WEST 820 NORTH
POST OFFICE BOX 711
PROVO, UTAH 84603

PROVO 374-5771
SALT LAKE CITY 521-5771
AREA CODE 801

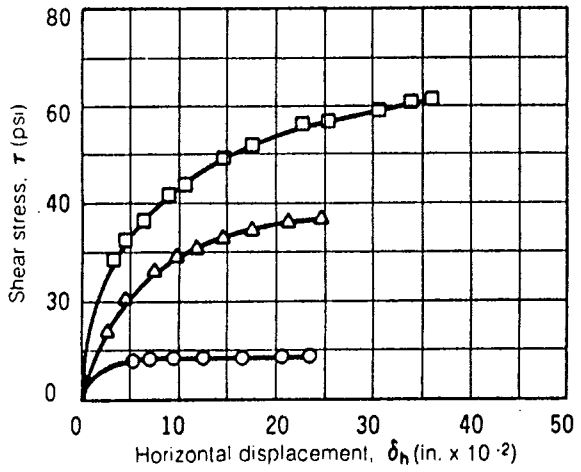
A consolidated drained direct shear test was performed on the samples from a depth of 6 feet in Test Hole No. 1. The results are shown in Figure No. 3 in the form of a Mohr envelope. The results indicate a friction angle of 38.5 degrees and a cohesion of 1 psi.

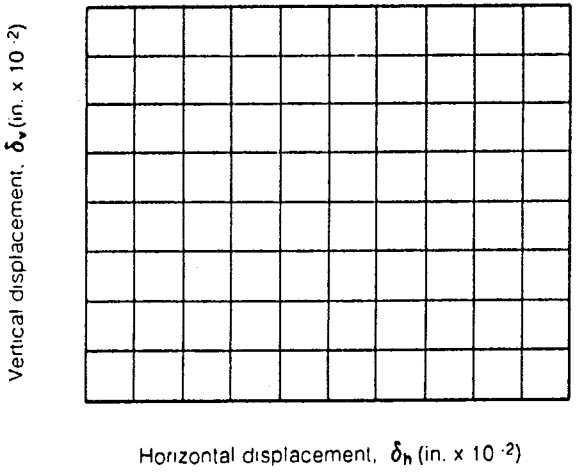
If you have any questions regarding the information contained herein, please contact me.

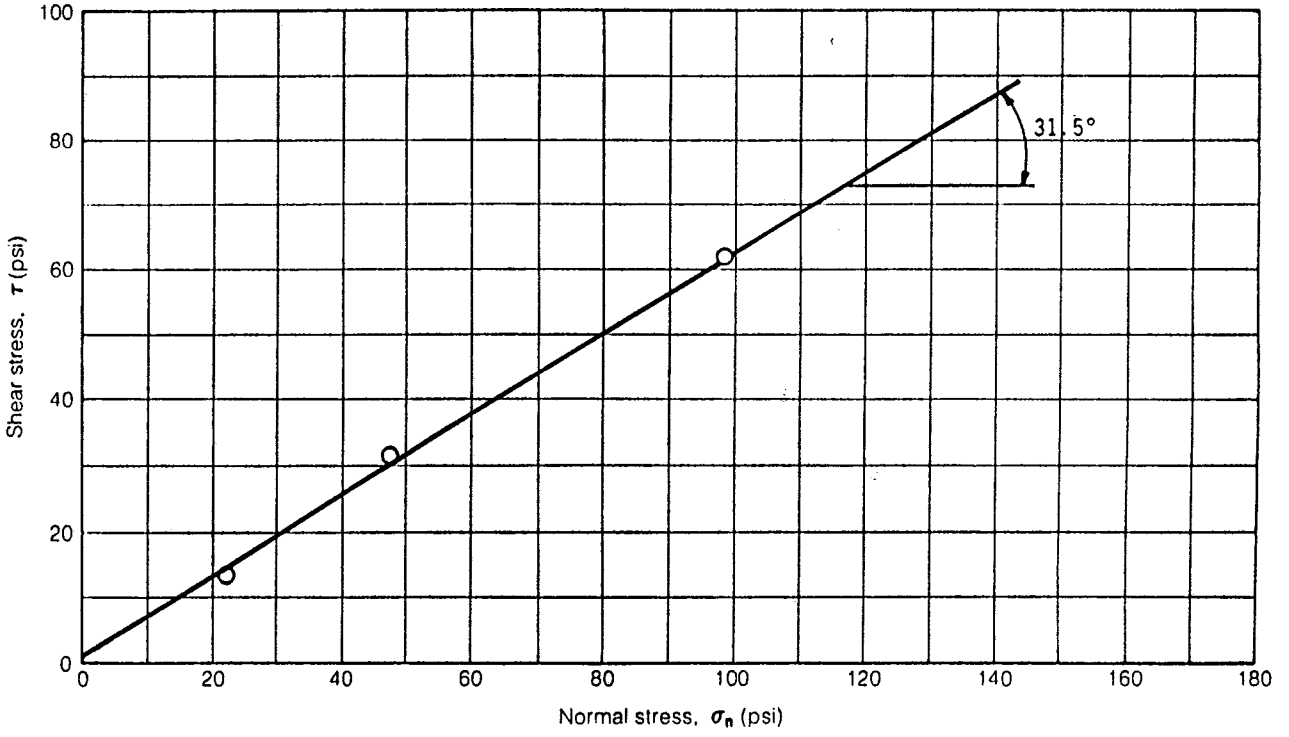
Yours truly,

Steven L. Smith

SLS:jsh







Test no. or symbol	Sample size (inches)	Sample data		Degree of saturation (%)*	Normal stress σ_n (psi)	Maximum shear stress τ (psi)	Strain rate (inches / minute)	Shear strength parameters	
		Dry density (pcf)	Moisture content (%)					Friction angle ϕ (degrees)	Cohesion (c / psi)
○		88.6	15.9	100	22.7	13.0	.005	31.5	1
□		88.6	15.9	100	45.8	31.1	.005		
△		88.6	15.9	100	99.2	61.0	.005		

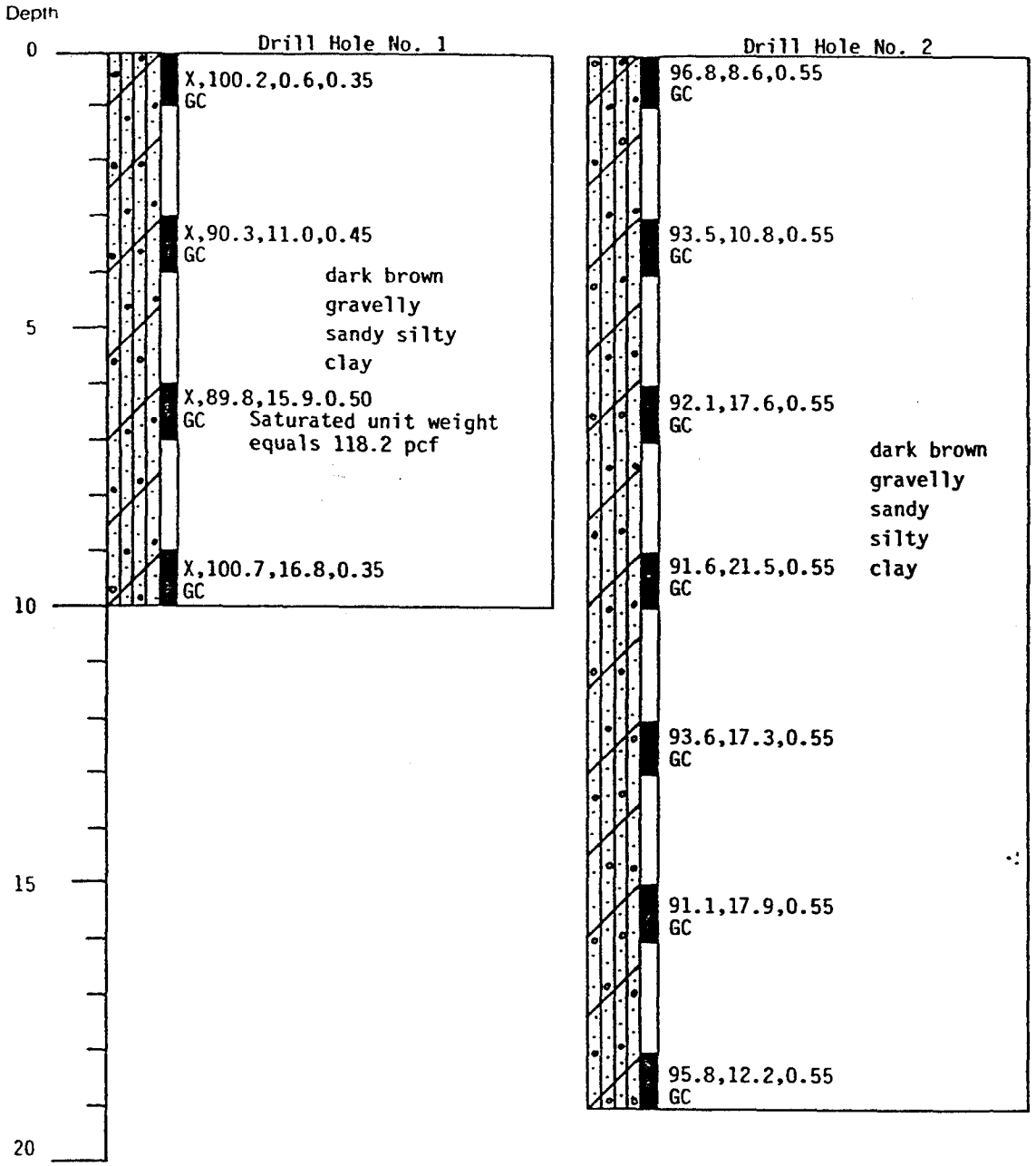
*Assumed

ROLLINS, BROWN AND GUNNELL, INC.
PROFESSIONAL ENGINEERS

DIRECT SHEAR TEST
Project: Valley Camp of Utah

HOLE NO 1
DEPTH: 6'

FIGURE NO. 3



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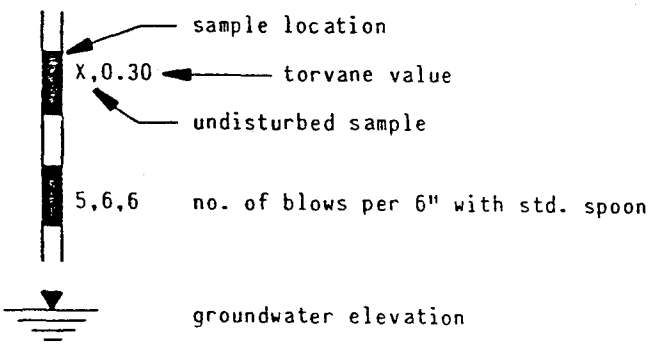
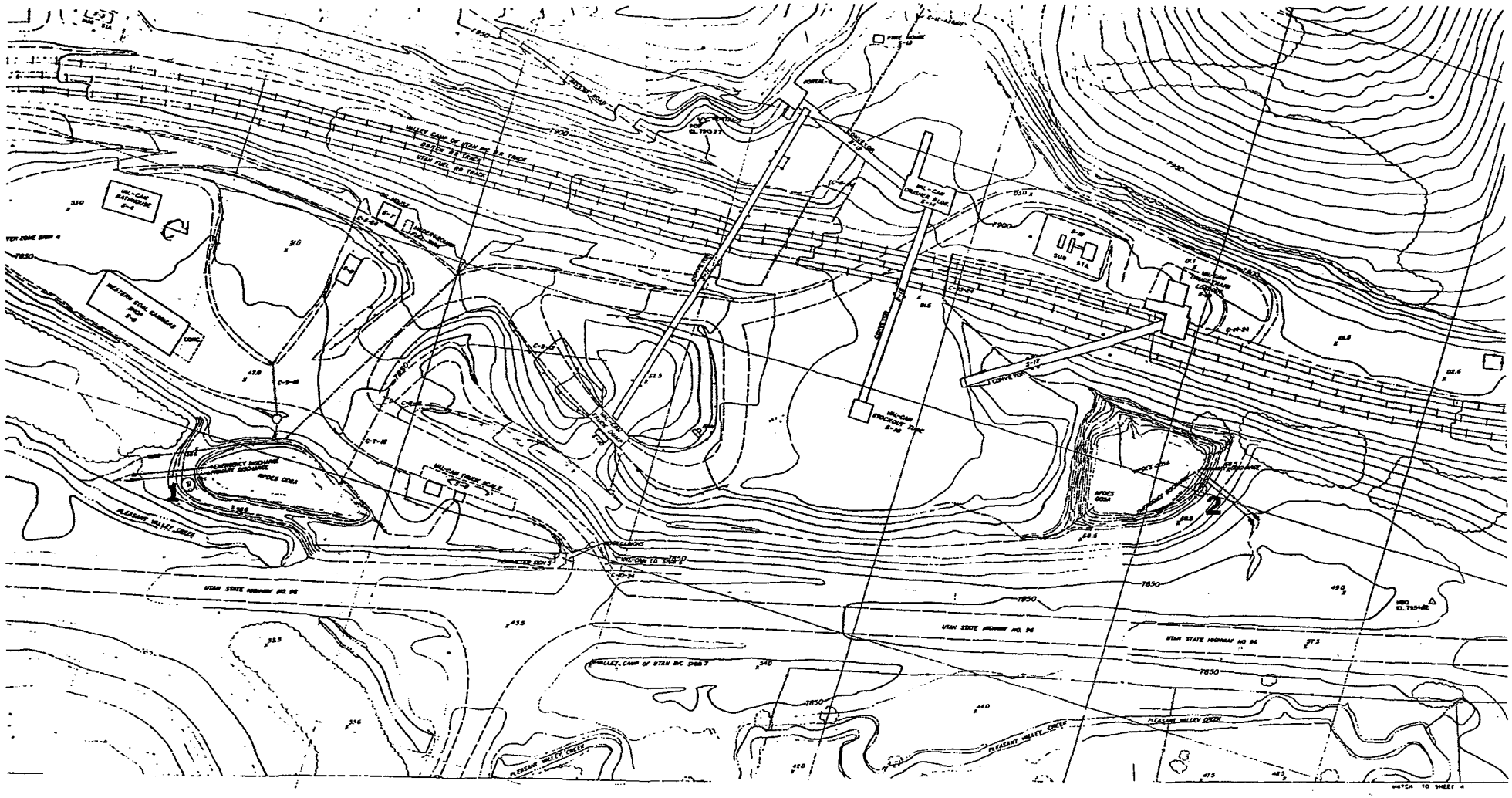


ROLLINS, BROWN AND GUNNELL, INC.
PROFESSIONAL ENGINEERS

Log of Borings for:
Valley Camp of Utah

Figure No. 2

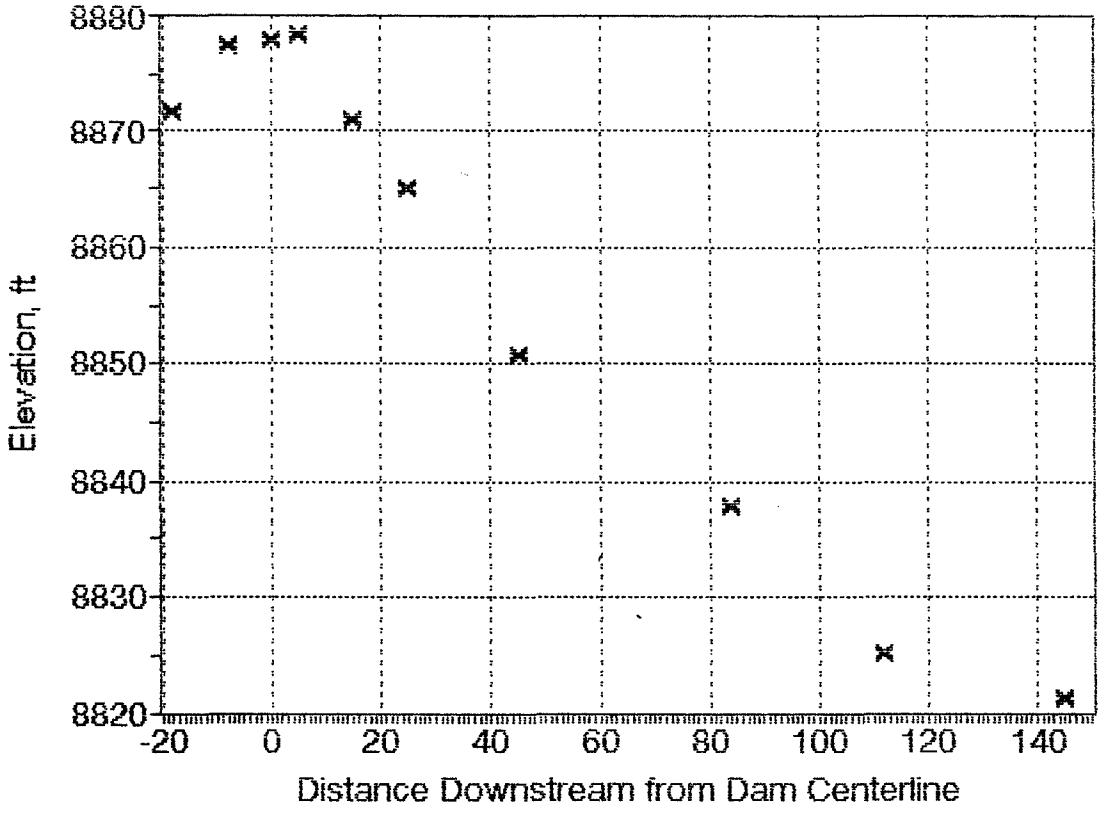


ROLLINS, BROWN and GUNNELL, INC. professional engineers

Site Plan and Location of Drill Holes
Valley Camp of Utah

FIGURE NO 1

Pond 004A - Critical Cross Section



Valley Camp Coal - Pond 4 Survey Notes by Steve Tanner
Data Received 7/25/90
Top of Embankment: 8878

CRITICAL CROSS SECTION

Distance	Relative Elev.	Surveyed Elev.
-18	93.8	8871.8
-8	99.5	8877.5
0	100.0	8878.0
5	100.5	8878.5
10		
15	93.0	8871.0
20		
25	87.1	8865.1
30		
35		
40		
45	72.8	8850.8
50		
55		
60		
65		
70		
75		
80		
84	59.9	8837.9
85		
90		
95		
100		
105		
110		
112	47.3	8825.3
115		
120		
125		
130		
135		
140		
145	43.2	8821.2
155		
165		
175		
180		
185		
190		
195		
205		
215		
225		
235		
245		
250		

EMERGENCY SPILLWAY PROFILE

Relative Elev.	Surveyed Elev.
200.0	8878.0
199.7	8877.7
198.9	8876.9
197.6	8875.6
196.4	8874.4
194.4	8872.4
192.6	8870.6
189.3	8867.3
186.6	8864.6
183.7	8861.7
180.8	8858.8
178.7	8856.7
178.2	8856.2
175.9	8853.9
174.5	8852.5
174.7	8852.7
172.0	8850.0
169.8	8847.8
169.4	8847.4
169.5	8847.5
167.8	8845.8
166.7	8844.7
164.8	8842.8
163.5	8841.5
162.9	8840.9
161.7	8839.7
160.7	8838.7
158.7	8836.7
158.4	8836.4
157.5	8835.5
156.0	8834.0
153.4	8831.4
150.9	8828.9
148.6	8826.6
148.0	8826.0
144.9	8822.9
142.6	8820.6
139.9	8817.9
137.9	8815.9
134.8	8812.8
132.2	8810.2
131.5	8809.5

Valley Camp Coal - Pond 4 Survey Notes by Steve Tanner
Data Received 7/25/90
Top of Embankment: 8878

CRITICAL CROSS SECTION

Distance	Relative Elev.	Surveyed Elev.
255		
260		
265		
275		
285		
295		
305		
315		
325		
335		
340		
360		

EMERGENCY SPILLWAY PROFILE

Relative Elev.	Surveyed Elev.
127.3	8805.3
127.5	8805.5
120.8	8798.8
118.9	8796.9
116.9	8794.9
114.8	8792.8
113.9	8791.9
110.9	8788.9
106.1	8784.1
103.8	8781.8
101.0	8779.0
97.5	8775.5

Golder Associates
CONSULTING MINING AND GEOTECHNICAL ENGINEERS

SURFACE FACILITIES GRADING PLAN
BELINA MINE AREA

PREPARED FOR

VALLEY CAMP OF UTAH
HELPER, UTAH

Distribution:

4 Copies - Valley Camp of Utah
2 Copies - Golder Associates, Evansville, Indiana
2 Copy - Golder Associates, Kirkland, Washington

793-1156
D-121

JUNE 1980

LIST OF FIGURES

FIGURE NO.	TITLE
2-1	Belina Mine Area
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3-2	Belina Mine Area - Drainage Areas
4-1	Inflow and Outflow Hydrographs of Sediment Pond
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4-10	Embankment Stability Analyses
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5-1	Typical Cross-Section through existing Road and Proposed Ditch C-B
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5-3	Inlet Configuration for Culvert

8 March 1983

Golder Associates
CONSULTING GEOTECHNICAL AND MINING ENGINEERS

OCT 7 1982
VALLEY CAMP
OF UTAH

G/82/298
September 30, 1982

Valley Camp Coal Company
Scofield Route
Helper, Utah 84526

Attention: Mr. Trevor Whiteside

Subject: Belina Mine Area
Surface Facilities Grading Plan

Gentlemen:

With reference to our engineering report entitled, "Surface Facilities Grading Plan, Belina Mine Area" dated June 1980, this letter will confirm that the engineering analyses and recommendations presented in the report were made under my supervision, and that the drawings presented in the report (list attached) are correct as shown.

Sincerely,

GOLDER ASSOCIATES

A. Allen Gass, Principal, P.E.
State of Utah # 4890

AAG/CWL:hd
Attachment
793-1156

REGISTERED PROFESSIONAL ENGINEER
No. 4890
A. ALLEN GASS
STATE OF UTAH

TELEPHONE (206) 827-0777 • TELEX 32-1014

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5-3	Inlet Configuration for Culvert

1.0 INTRODUCTION

This report presents the results of continuing geotechnical studies carried out by Golder Associates to date at the Belina Mine Site, operated by Valley Camp of Utah, Helper, Utah. The work was initiated based on a proposal to Valley Camp dated July 19, 1979 and accepted per letter from Valley Camp dated August 2, 1979. Subsequent to the proposal, the work has been extended through verbal agreements.

The work has involved the development of the Belina Mine Area surface facilities in regard to the operational requirements of Valley Camp and the regulatory requirements of the State of Utah Division of Oil, Gas and Mining (DOGM), and the Office of Surface Mining (OSM) of the U.S. Department of the Interior.

At the start of the work (August 1979), the Belina No. 1 Mine was in operation under an approved 30CFR211 and Utah Division of Oil Gas and Mining Mine Plan and Permit. Valley Camp's operational plan called for the continued development of the Belina No. 1 Mine, including the development of surface facilities for the No. 1 Mine and the construction of a coal carrying conveyor system and load storage facility for the No. 1 Mine, as set out in general in the originally approved plans. Golder Associates has provided engineering services relative to the geotechnical engineering and hydrologic control structures relative to the proposed development and the current OSM Regulations. This work has included the design of cut and fill slopes and pads, drainage measures, and a sedimentation pond. In addition, construction control and periodic inspection of the work have been carried out at appropriate intervals when required.

2.0 GENERAL SITE CONDITIONS

The Belina Mine Area is located in the upper reaches of Whisky Gulch, a tributary to Eccles Canyon and eventually Pleasant Valley Creek located in the Scofield Drainage of western Carbon County, Utah. Whisky Gulch in the vicinity of the Belina Mine area is an intermittent stream under the definitions provided by the OSM in that it obtains its flow from both surface runoff and ground water discharge at least some part of the year.

The surface facilities area for the Belina mines ranges from an elevation of about 8800 to 9200 feet above sea level. The terrain is steep, and heavily forested with stands of aspen and conifers. Soil cover is thin, in the range of 2 to 10 feet maximum depth, and is in general colluvial material derived from the parent sandstones and siltstones which comprise the rock exposed in the area.

Average annual precipitation at the mine site is about 25-30 inches. Of this, approximately 8 inches occurs as rainfall, generally from May through September.

The general vicinity of the Belina Mine is shown on Figure 2-1. As can be seen, the mining area is on what is known as the Connelville Block, located between the Connelville fault and the O'Connor Fault. The rock units which comprise the Whisky Gulch Area are members of the Blackhawk Formation.

As shown in Figure 2-1, the Belina No. 1 facilities are located on the western flank of Whisky Gulch. The coal handling facilities, first phase, as approved will occupy the gulch itself and portions of the eastern flank. Existing natural slopes in the area are in the range of 20° to 25°.

At the time Golder Associates became involved with the Belina Mine Area (August 1979), a large earthfill had been placed in Whisky Gulch to provide access and work area for the coal storage area. The fill pad was at approximate elevation 8940 at its upper end, sloping down to an existing sedimentation pond constructed at the downstream crest of the fill. At this time, the sediment pond area was exhibiting some local signs of instability in the form of tension cracks, and water was observed seeping out along the toe of the fill. Also, the slopes extending from the Belina No. 1 mine area to the fill pad were steep and exhibiting signs of sloughing.

In order to stabilize the sediment pond area, as well as the Belina slopes, and to provide areas for the surface facilities, Golder Associates recommended that the downstream portion of the existing valley fill be removed and replaced in an engineered manner with a rock toe buttress and a graded filter. The sediment pond was then located at the top of the fill. Additionally, recommendations were made concerning stabilizing the existing slopes from the No. 1 mine area down to the coal storage area. This work resulted in a surface facilities grading plan as presented in Figure 2-2.

To the extent possible, all grading was carried out in conjunction with the requirements of the OSM regulations. In the few areas where this was not possible, engineering analyses of variation were carried out to insure the overall stability and satisfactory performance of the structures.

3.0 DRAINAGE CONTROL

3.1 INTRODUCTION

Control of drainage, both surface water and groundwater, is critical to the overall development of the surface facilities. This includes surface precipitation water, snowmelt, ground water intercepted in cuts seeps or springs, and ground water intercepted and collected in the mine workings and pumped to the surface for ultimate discharge. This section presents the methodologies used to predict the flows expected for the various watersheds encountered in the Belina Mine Area.

3.2 DRAINAGE QUANTITIES

Peak flow on the small watersheds in this study area were estimated using the Rational Method (Grey, 1973). This method is based on the criteria that for storms of uniform intensity, evenly distributed over the watershed, the maximum rate of runoff occurs when the entire watershed is contributing at the outlet and that this rate of runoff, or flow, is proportional to the rainfall intensity. The equation is:

$$Q = ciA$$

where:

- c = Runoff coefficient, determined empirically
- i = Maximum rainfall intensity, in/hr, whose duration is equal to the time of concentration of the watershed
- A = Area of watershed, acres
- Q = Peak flow, cfs.

TABLE 3-1

ESTIMATED PRECIPITATION DEPTHS FOR VARIOUS RETURN PERIODS AND DURATIONS AT CLEAR CREEK, SUMMIT, UTAH (FROM RICHARDSON, 1971)

	DURATION									
	5 Min	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	12 Hr	24 Hr
1	.10	.16	.20	.28	.35	.46	.57	.84	1.08	1.33
2	.12	.19	.25	.34	.43	.57	.70	1.04	1.34	1.65
5	.16	.24	.31	.43	.54	.72	.90	1.34	1.73	2.14
10	.19	.29	.37	.51	.65	.86	1.06	1.55	1.99	2.45
25	.24	.38	.48	.66	.84	1.08	1.31	1.88	2.39	2.92
50	.25	.38	.48	.67	.85	1.13	1.40	2.07	2.67	3.29
100	.27	.42	.53	.73	.93	1.24	1.54	2.29	2.96	3.65

Maximum rainfall intensities for specified return periods were calculated using precipitation data from a gauging station at Clear Creek, Summit, Utah, as reported by Richardson (1971), (Table 3-1). The duration time used when choosing the rainfall intensity was equal to the time of concentration of the particular section of the drainage basin. A 10 year return period was used when choosing the rainfall intensity, as specified by the OSM regulation for permanent diversions.

The time of concentration was determined using the Upland Flow Method (Kent, 1972). Types of flow considered in the Upland Method are: overland, through grassed waterways, over paved areas, and through small upland gullies. Upland flow employed in this method can be a combination of these various surface runoff conditions. The velocity of flow is determined using Figure 3-1. The time of concentration of the drainage basin then is equal to the sum of the times required for water falling on the farthest point of the watershed, flowing over various types of terrain, to reach the outlet.

The runoff coefficient in the Rational Method is dependent on the topography, soil type and vegetation of the watershed. Values of the runoff coefficient can be found in Grey (1973). An estimate of the coefficient was made from these charts assuming:

Topography - Hilly Land
Soil - Open Sandy Loam $c = 0.03$
Cover - Woodlands

The drainage area of concern at the Belina Mine site was divided into six sections (see Figure 3-2). The drainage characteristics and outflow were calculated for each section. Table 3-2 lists the values used and outflow for each section. Outflow from section I and VI is to be diverted outside the area of

concern while the outflow from sectins II-V is to be carried via a culvert under the mine site and out of the drainage area. Water falling within the mine area is to be treated in a settling pond and then discharged.

TABLE 3-2
CALCULATION OF FLOW RATES BY SECTION

SECTION NUMBER	I	II	III	IV	V	VI
AREA (acres)	23.6	28.3	29.8	36.5	36.1	8.3
tc (min)	8.6	14.7	15.3	24.3	24.2	17.4
i (in/hr)	1.74	1.48	1.48	1.25	1.25	1.48
c RUNOFF COEFFICIENT	0.3	0.3	0.3	0.3	0.3	0.3
Q =ciA (cfs)	12.3	12.6	13.2	13.7	13.5	3.7

4.0 SEDIMENT POND

4.1 HYDROLOGIC DATA

Hydrologic analyses were made to calculate the runoff volume, from the disturbed area, that would be treated in the sediment pond (see Figure 3-2). The calculated storage volume was based on the 10-year 24-hour storm as required by OSM Regulations. Previous experience has indicated that a 48-hour detention time is required to insure adequate settling.

Hydrographs for the Belina Mine Area were obtained from a report to Valley Camp from Vaughn Hansen Associates. The Hydrograph presented in the report was for a 25-year 24-hour storm. The Hydrograph for the 10-year 24-hour storm is assumed to be of similar shape. The peak inflow into the pond was calculated assuming the hydrograph could be represented by a triangle. The peak runoff for the 10-year 24-hour hydrograph, shown in Figure 4-1, is determined according to the equation:

$$q_p = \frac{484\ AQ}{T_p}$$

where,

q_p = Peak Runoff, cfs
A = Area, sq. miles
Q = Net storm rain, inches (RUNOFF ONLY)
Tp = Time to peak runoff, hours.

The volume of runoff is then defined as the area under the hydrograph.

4.2 SEDIMENT POND DESIGN

The outflow hydrograph of the sediment pond for the design storm was constructed based on a constant outflow from the principal spillway (spillway design will be discussed in Section 4.3). Since the outflow from the sediment pond will be constant and the detention time has been specified as 48 hours, a direct determination of the outflow hydrograph for this design storm is possible, the constant outflow can be determined from the equations:

$$Vi = Vo$$
$$Vi = q_o \times tb$$

where,

Vi = Volume Inflow
Vo = Volume Outflow
q_o = Constant Outflow Rate, cfs
tb = Duration of hydrograph, hours.

The calculated outflow hydrograph is shown with the inflow hydrograph in Figure 4-1. The constant outflow required for the design storm and a 48 hour detention time is 0.94 cfs.

The storage required for the 10-year 24-hour storm can be determined from the inflow and outflow hydrographs. The difference between the area under the inflow hydrograph and that under the outflow hydrograph during the time of inflow is the storage volume; this is shown as the shaded area in Figure 4-1. The pond storage volume necessary to hold the runoff for 48 hours from the design storm is 6.7 acre-feet. The pond must be of sufficient volume to hold both the accumulated sediment and the design storm runoff.

341 by [illegible]

Estimates of the volume of sediment were made from the 0.1 acre-feet per acre of disturbed land value recommended by the OSM Regulations. This results in a total sediment volume of 3.6 acre-feet. The total volume required for the storage pond would be the water volume plus the sediment volume which is 10.3 acre-feet.

The stage-storage curve for the existing pond is shown in Figure 4-2. The volume required for both the sediment and the water storage are marked on the curve as well as the spillway elevation. The existing pond with a storage volume of 11.2 acre-feet is sufficient to hold both the design sediment load and design runoff for a 48 hour detention time. It is understood that the existing decant is at elevation 8856. This is satisfactory for retention of 60% of the maximum allowable sediment level in addition to retaining the design storm for 48 hours. In accordance with the regulations, the accumulated sediment must be removed when it reaches 60% of maximum. It should be noted that, with the fixed decant system, it will be necessary to dewater the pond by pumping after precipitation events in order to provide storm surcharge capacity.

In accordance with Mine Safety and Health Administration Regulation (30 CFR 77.216-1) a permanent identification marker should be located on or immediately adjacent to the sediment pond. This marker should be at least 6 feet high and show the identification number of the impounding structure as assigned by the District Manager, the name associated with the impounding structure and name of the person owning, operating, or controlling this structure.

It is understood that the sediment pond may be used to collect and discharge mine water, as well as surface runoff. If this should be required, we recommend that the fixed elevation decant be replaced by a floating orifice type decant (see Figure

4-3). This design provides a constant discharge at an easily controlled rate and also skims water from the top of the pond, which tends to increase the effectiveness of settling pond performance (Skelly and Loy, 1979). Further, this type of decant will dewater the pond, thereby eliminating the need for pumping, and constantly providing storm surcharge capacity.

The collapsible pipe, shown in Figure 4-3, must extend from maximum pool level to permanent pool level (i.e., from elevation 8849.5 feet to 8856.6 feet). The inlet of the floating orifice is attached to floats so that it is submerged to give a desired outflow rate. The required outflow rate of 0.94 cfs can be accomplished using a variety of combinations of pipe diameter and head (see Figure 4-4). Any pipe diameter that is available could be used for the inlet so long as the decant is constructed with the appropriate head. The top of the pipe must be protected from logging by a trash rack or other suitable device.

4.3 SPILLWAY DESIGN

The emergency spillway was designed to handle the OSM Regulation's design storm of 25-years 24-hours. The emergency spillway elevation is at 8856.0 feet and the crest of the embankment if at 8860.0 feet. OSM regulations require at least 1.0 feet of clearance between the maximum elevation of water in the emergency spillway and the crest of the embankment. This limits the maximum depth of flow in the emergency spillway to 1.0 feet. At this flow depth the flow rate in the emergency spillway calculated by the Manning equation would be 85.0 cfs (see Figure 4-5). The flow rate required to handle the 25-year 24-hour storm was calculated to be 15.9 cfs, from equation 4-1. In conclusion, the emergency spillway can handle flow rates in excess of the 25-year 24-hour storm while still satisfying the OSM Regulations concerning freeboard.

4.4 CONSTRUCTION

Construction of the valley fill and sediment pond structure was commenced in September 1979 and essentially completed in December 1979. The construction of the valley fill was carried out under the full-time inspection of a geotechnical field engineer, who was responsible for insuring that the construction was carried out in conjunction with standard engineering practices and the requirements of the Division of Oil, Gas, and Mining. This consisted of material inspection, stripping and removal of topsoil and organic debris, and placement of the fill materials, including the rock buttress. The granular filter and underdrains, and the general embankment fill.

4.4.1 Construction Materials

An as-built schematic longitudinal section of the valley fill and sediment pond is shown in Figure 4-6. There are essentially five different earth materials involved in the structure.

These materials are as follows:

I. Rock Toe Buttress, consisting of boulders and cobbles ranging from approximately 4 to 1" in mean dimension.

II. Graded Filter, consisting of sand and gravel blended to provide protection against piping of the general embankment fill.

III. Rockfill Drain, consisting of small boulders and cobbles ranging from approximately 2 feet to 6 inches in mean dimension.

IV. General Embankment Fill

V. Foundation Material, consisting of the undisturbed material soil and rock materials comprising the valley floor and walls.

The location and geotechnical strength characteristics of the various materials are presented on Figure 4-6. Particle size gradations of the general embankment fill and the graded filter are shown on Figure 4-7.

4.4.2 Construction Control

The construction of the earthfill and sediment pond was inspected in the field by a qualified geotechnical field engineer. The inspections consisted of determination of material suitability, material placement techniques, and in-place density testing to determine the degree of compaction obtained in the materials. Observation of the sequential phases of the construction are discussed individually below:

1. Rock Toe Buttress

Prior to placement of the rock toe buttress, all areas to receive fill were stripped of topsoil and loose or surficial materials. The rock toe buttress was then placed by end dumping or moving with dozers in order to insure interlocking and proper resting of the individual boulders.

2. Graded Filter

Upon completion of the rock toe buttress, the graded filter material was placed. Placement was carried out

in 6 inch to 12 inch lifts, with the material spread by dozers and compacted in place. No compaction tests were carried out in the filter materials due to their granular nature, but careful observations were made throughout the filter placement to insure continuity of material and adequacy of the placement techniques.

3. General Embankment Fill

After the graded filter material was placed, general embankment fill was compacted in lifts to form the valley fill and sediment pond embankment. Compaction testing was carried out as the fill was placed to insure that the material was compacted to at least 95% of Modified Proctor Density, per ASTM D-1557. Results of the compaction testing are presented in summary form on Figure 4-8.

4.4.3 Stability Analyses

Stability analyses of the as-built section have been carried out to insure that the fill has an adequate static factor of safety against failure. The analyses were carried out using the Bishop Method, which essentially assumes a circular failure arc through the mass and computes the stability of forces along that arc. This is then carried out on a variety of failure arcs until the minimum factor of safety is determined. The analysis was carried out using the impact parameters and fill geometry shown on Figure 4-6, and various water seepage paths through the embankment and fill. The results of the analyses are presented in Figures 4-9 through 4-12. Critical surfaces are shown on the figure, with the computed Factor of Safety. As can be seen, the minimum computed static factor of safety for the composite embankment is 1.8; the critical failure arc is located in the lower portion of the embankment. This is within the requirements set forth by OSM.

A cross-section of the valley fill (Figure 4-13) shows the valley walls, the embankment fill, and the emergency spillway for the sediment pond.

4.5 POND MAINTENANCE

Sediment ponds must be periodically maintained to remove deposited sediments so that trap efficiency can be preserved. The Federal Regulation require that this occur when the design sediment storage volume has been 60 percent displaced (see Figure 4-2).

Since the required volume is 3 years of sediment or 0.1 acre-feet per acre of disturbed land, the maintenance schedule should require cleaning the pond at least every 21 months (60 percent of 3 years). It is advisable, however, to reduce this to a maximum of every 12 to 18 months because the sediment will not be deposited evenly over the 3 year period (Skelly and Loy, 1979).

A thorough inspection of the sediment pond and embankment should be undertaken at least once per year. When examining for stability and general inspection the inspector should be looking for any of the following conditions:

- Seepage from anywhere on the down-stream side of the embankment but especially around the discharge pipe
- Erosion of embankment slopes
- Continuity of emergency spillway
- Erosion around entrance or exit of discharge pipe
- Clogged principal or emergency spillway
- Check slope stakes for obvious slope movement

- Level of sediment
- Placement of wave erosion protection
- Erosion at spillway discharges
- Clogging of dewatering device.

Monitoring for embankment movement (Skelly and Loy, 1979) should also be a part of this inspection. This can be performed by setting stakes in the embankment, along the toe and several rows proceeding up from the toe. The original position and elevation should be recorded with reference to a permanent landmark. These positions should be checked during inspection. If unstable or potentialy unstable conditions exist, corrective measures should be taken immediately.

5.0 DIVERSION DITCHES AND CULVERTS

5.1 LOCATION

Figure 3-2 shows the drainage area of concern. In an effort to minimize further land disturbance, it is recommended that existing roads be incorporated into the diversion ditch scheme. This will result in the construction of only one additional ditch that must be constructed on undisturbed land. This ditch is labeled on the plan as I-J.

5.2 ANALYSIS AND DESIGN

Diversion channels were conceptually designed using the Chezy-Manning equation:

$$Q = \frac{1.486\ AR^{2/3}S^{1/2}}{n}$$

where:

- Q = flow, cfs
- n = Mannings Roughness Coefficient
- A = Cross sectional area
- R_h = Hydraulic radius
- S = Slope

Typical values of the rougness coefficient ranges between 0.022 and 0.030 for excavated or dredged earth channels, straight and uniform with short grass and few weeds (Grey, 1973). An average value of 0.027 was used for the calculations.

Channels were designed, where possible, for ease of construction and maintanence. A trapezoidal cross section with sides sloping at 45 degrees and a base width of 1.0 feet was

used. A typical cross section of ditch along side of the existing road and an enlarged cross section through a ditch are shown on Figures 5-1 and 5-2, respectively.

Table 5-1 shows the quantity of flow that will be carried by each ditch and the particular drainage sections that contribute to the flow. Table 5-2 summarizes the calculated depths of flow in each channel. OSM regulation requires a minimum free board of 0.3 feet for diversion ditch design. This criteria would be satisfied if all ditches were constructed to a depth of 1.0 feet.

It is recommended that the channels be seeded to aid in the prevention of erosion during peak flows.

Velocities, calculated from Mannings equation, indicate that they would be in the range of 10-12 feet per second at peak flow. Measures needed to reduce the velocities (cutting new ditches in undisturbed areas with reduced slopes) or to prevent erosion (lining the channels with rocks sufficient to resist erosion) are felt to be too destructive to justify the gains.

OSM regulation require energy dissipators at ditch stream interfaces if velocities of entering ditches are greater than that of the receiving stream. A situation of this nature occurs at only one place in the study area. This is where the outflow of Ditch A-B enters an existing stream. Here we would recommend that a rock check-dam be placed at the interface to be used as an energy dissipater.

5.3 CULVERT DESIGN

Existing culverts were checked to see if they could carry the required 10-year storm. The 24-inch culvert at a road/stream

TABLE 5-1
FLOW RATES TO BE CARRIED BY PROPOSED DITCHES

Ditch	CD	EF	GH	FH	AB	IJ
Drainage Section	I	I	I	I	II	VI
Q (cfs)	12.3	12.3	12.3	12.3	12.6	3.7

TABLE 5-2
SUMMARY OF CALCULATED FLOW DEPTHS
IN PROPOSED DITCHES

Ditch	Cross Section	Depth of Flow (ft.)
CD	Trapezoidal*	0.64
EF		0.64
GF		0.64
FH		0.64
AB		0.70
IJ		0.67

* Base = 1.0 ft, sides slope 45°

intersection southwest of the mine area will receive outflow from sections II and III resulting in a total flow of 25.8 cfs. The 24-inch culvert will carry this flow if the head water elevation is equal to 2.0 times the culvert diameter. Culvert flow quantities were determined using monographs for inlet controlled culverts in the Handbook of Steel Drainages and Highway Construction Products, 1971. The maximum flow through this culvert will depend on the type of entrance inlet of the culvert. Our design was based on an end section conforming to the fill. A cross section of this inlet is shown in Figure 5-3.

The other culvert which carries flow underneath the mine area is 42 inches in diameter. Outflow from sections II, III, IV and V would be carried by this culvert. Computations by others indicate that the culvert has a total capacity of approximately 52 cfs, and that the maximum flow as a result of a 100-year, 24-hour storm and 100 year, 6-hour storm are approximately 17 cfs and 19 cfs, respectively.

Respectfully submitted,

GOLDER ASSOCIATES

CWLockhart

Charles W. Lockhart

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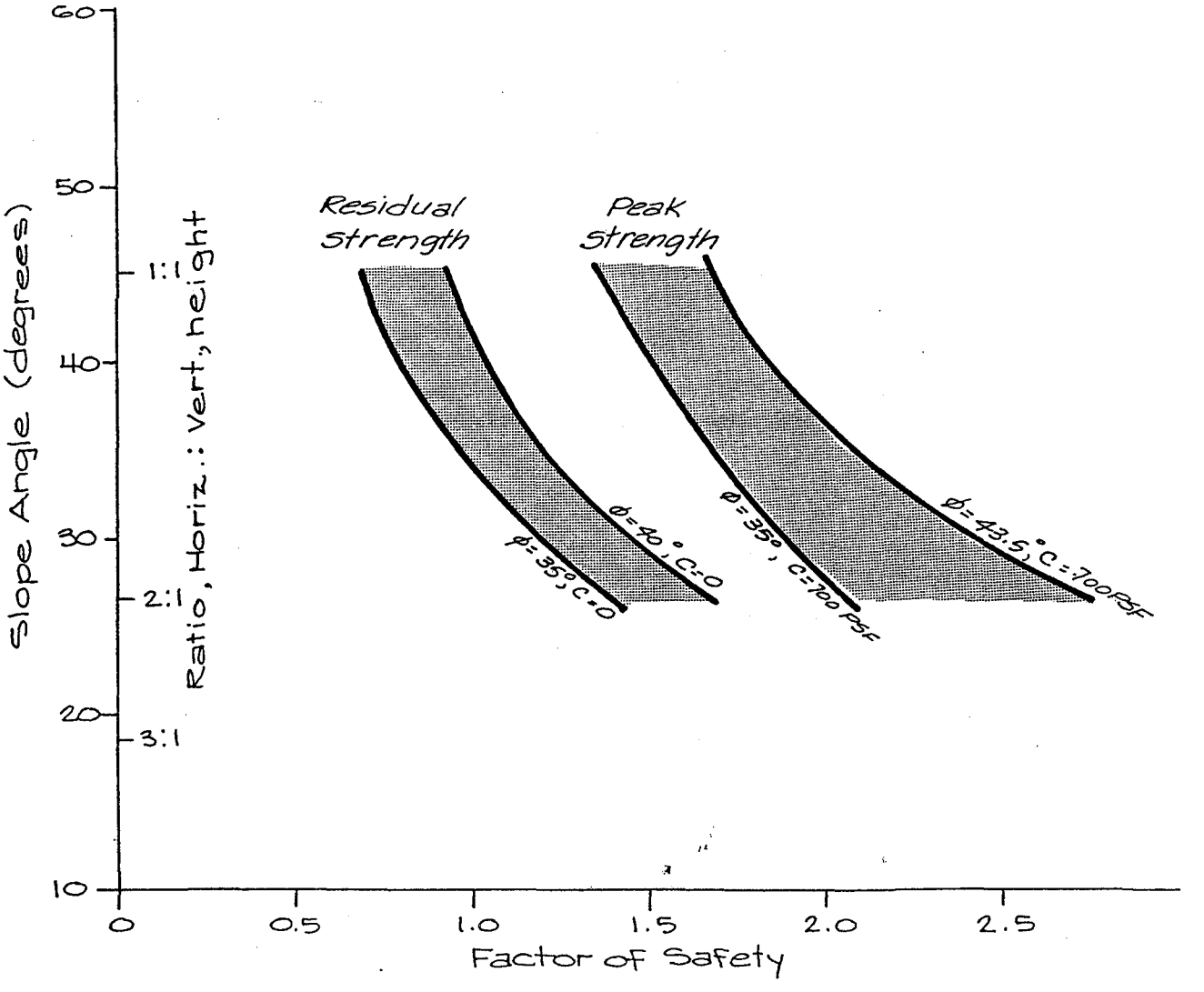
5. Skelly and Loy, 1979. A Compliance Manual: Methods for Meeting OSM Requirements. McGraw Hill, Inc., New York, NY, p. 47-63.

6. Vaughn Hansen Associates, 1978. Office of Surface Mining Reclamation and Enforcement Compliance Survey in the Clear Creek, Utah Area. Report prepared for Valley Camp of Utah, Inc., Helper, Utah.

INFLUENCES OF SLOPE ANGLE AND STRENGTH PARAMETERS ON THE FACTOR OF SAFETY

Figure 1



Project No. ..... Reviewed ..... Date .....

FIGURE 2-1

GENERAL SITE LOCATION
BELINA MINE AREA

This figure is not reporduced herein because of it's large size and quality of the original. For further information see original copy on file at Valley Camp of Utah, Inc.

FIGURE 2-2

SURFACE FACILITIES PLAN
BELINA MINE AREA

This figure is not reporduced herein because of it's large size and quality of the original. For further information see original copy on file at Valley Camp of Utah, Inc.

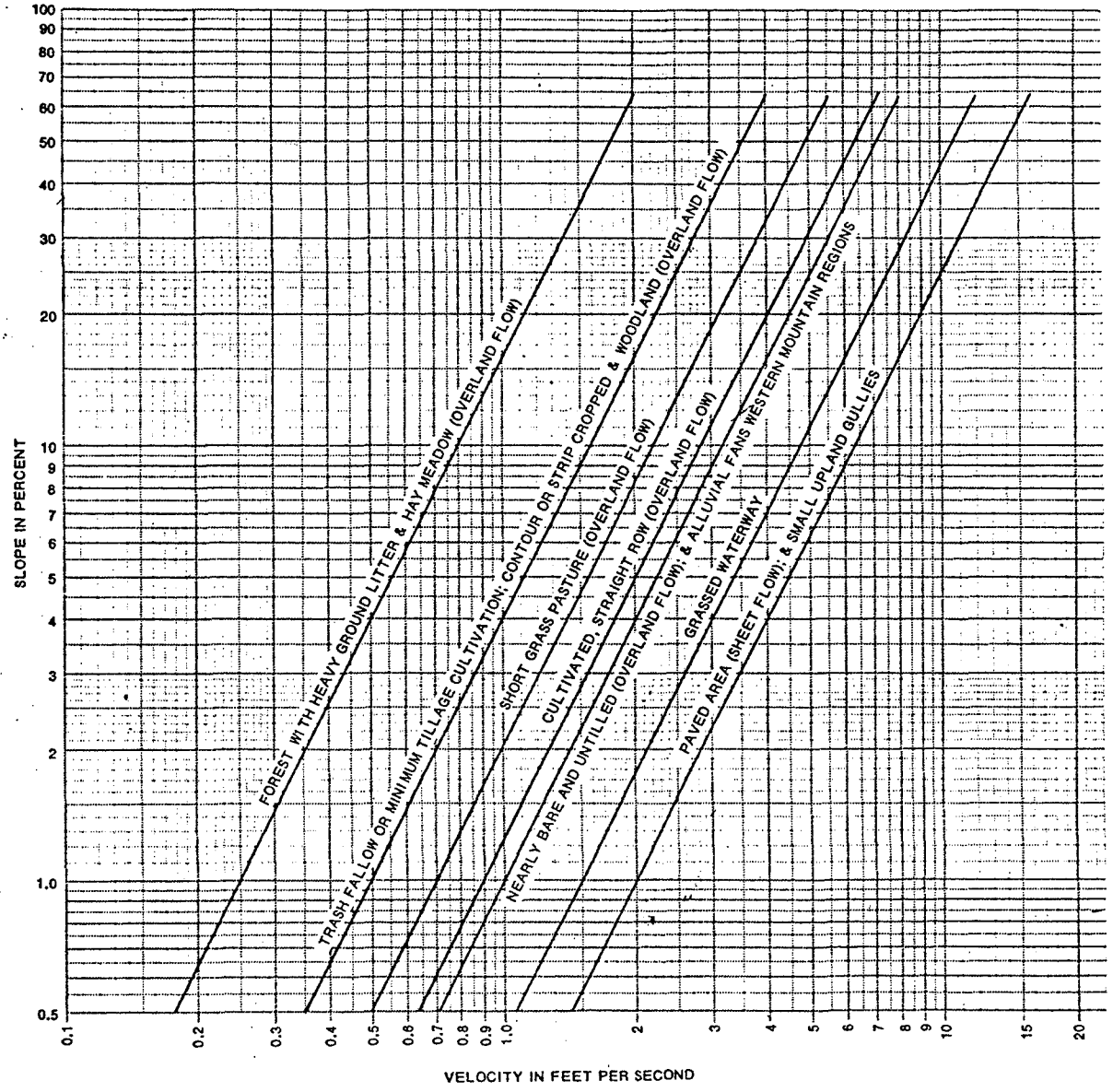
FIGURE 3-2

DRAINAGE AREAS
BELINA MINE AREA

This figure is not reporduced herein because of it's large size and quality of the original. For further information see original copy on file at Valley Camp of Utah, Inc.

VELOCITIES FOR UPLAND METHOD OF ESTIMATING T_c

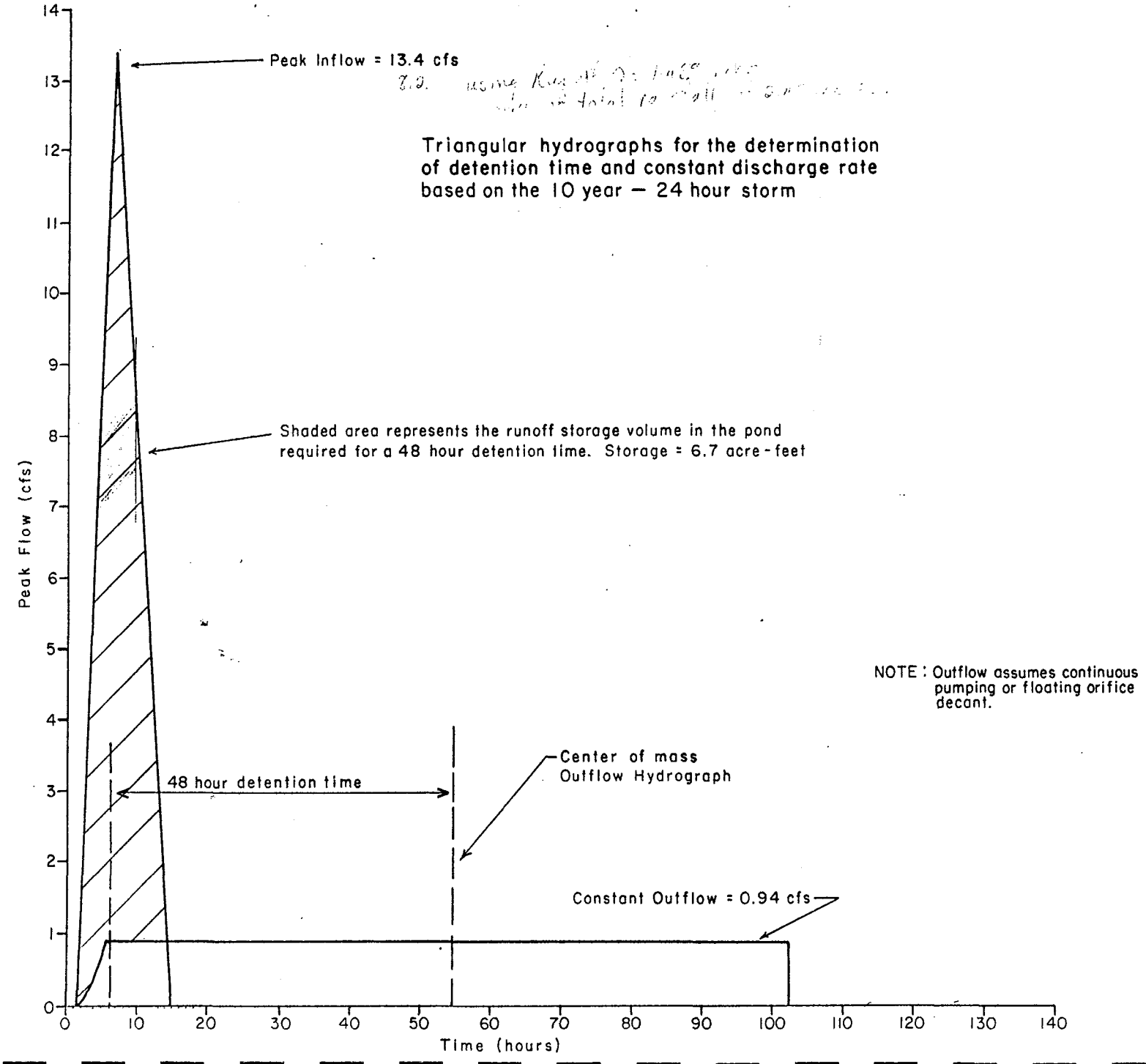
Figure 3-1



after Kent, 1972

Project No. 783-1184 Reviewed CWL Date 4-80

Project No. 792-1564 Reviewed PC Date 5/80



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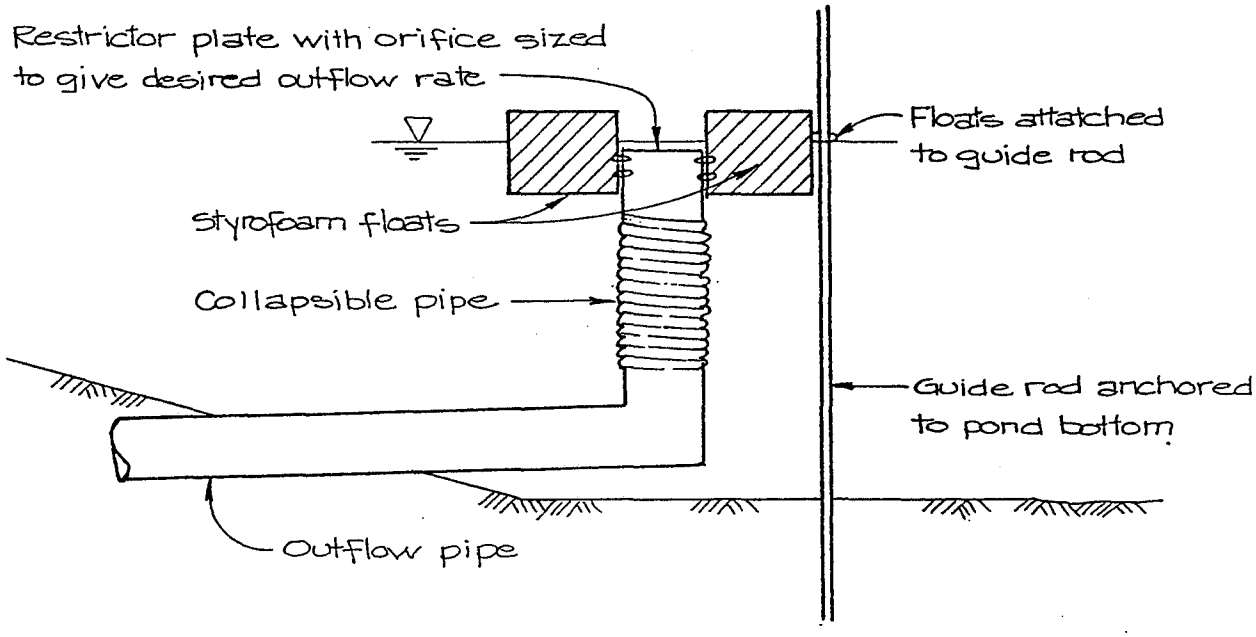
INFLOW AND OUTFLOW HYDROGRAPHS OF SEDIMENT POND

Figure 4-1

FLOATING ORIFICE TYPE DECANT

Figure 4-3

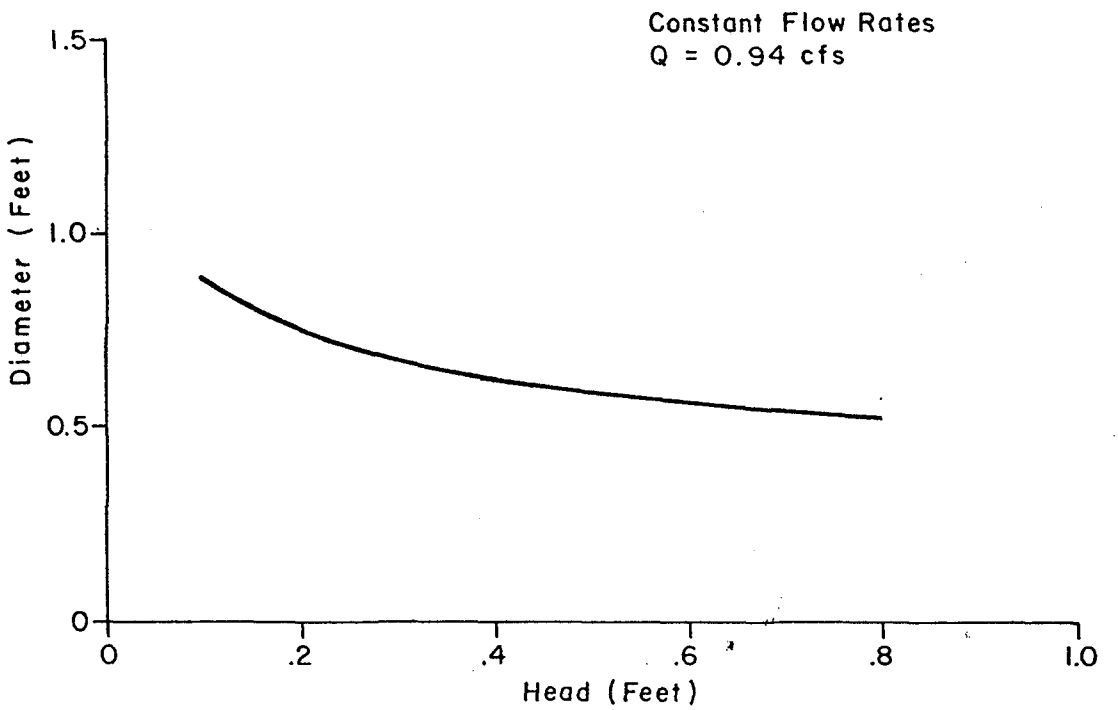


NOTES

1. Collapsible pipe must extend from maximum pool level to permanent pool level.
2. Inlet is attatched to floats so that it is submerged to give desired outflow rate.

Project No. 783-1122 Reviewed [illegible] Date 5/82

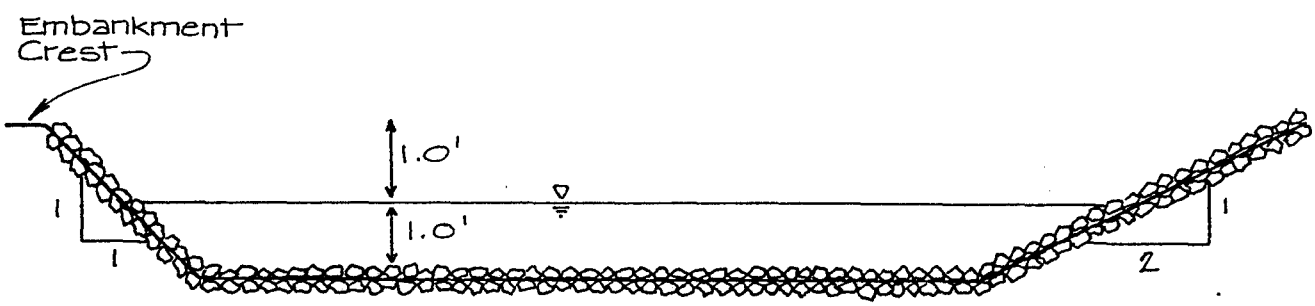
PIPE DIAMETER Vs. HEAD FOR CONSTANT FLOW RATE Figure 4-4



Project No. Reviewed Date

CROSS SECTION EMERGENCY SPILLWAY

Figure 4-5



$n = 0.040$
$S = 0.05$
$R = 0.84$ Ft.
$A = 11.50$ Ft.^{2}
$P = 13.65$ Ft.

$$Q_{max.} = \frac{1.486}{n} R^{0.67} S^{0.5} A$$

$Q_{max} = 85.0$ cfs

Scale: 1" = 2.5'

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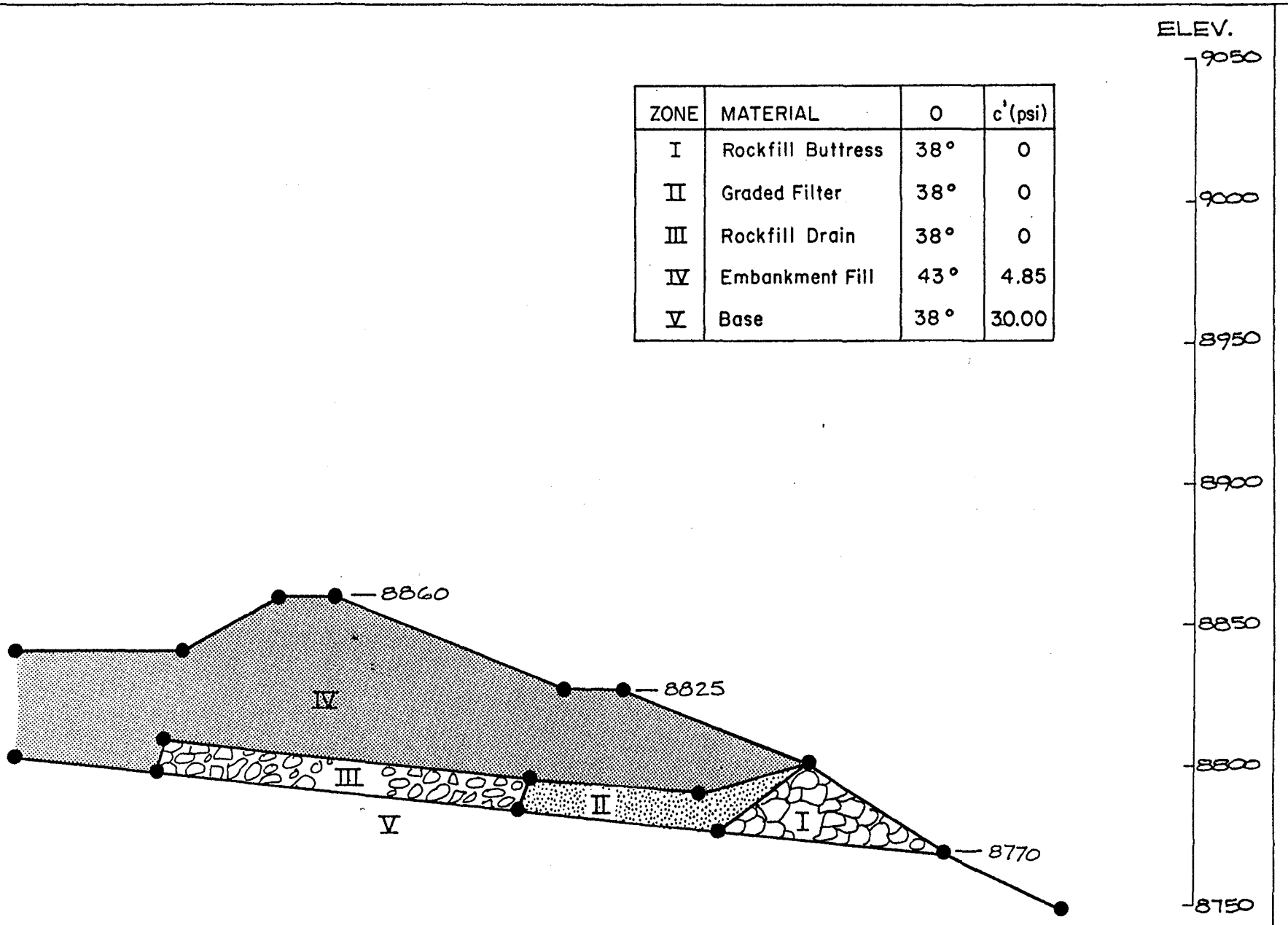
ZONE	MATERIAL	O	c'(psi)
I	Rockfill Buttress	38°	0
II	Graded Filter	38°	0
III	Rockfill Drain	38°	0
IV	Embankment Fill	43°	4.85
V	Base	38°	30.00



LONGITUDINAL GEOMETRY FOR VALLEY FILL

Figure 4-6

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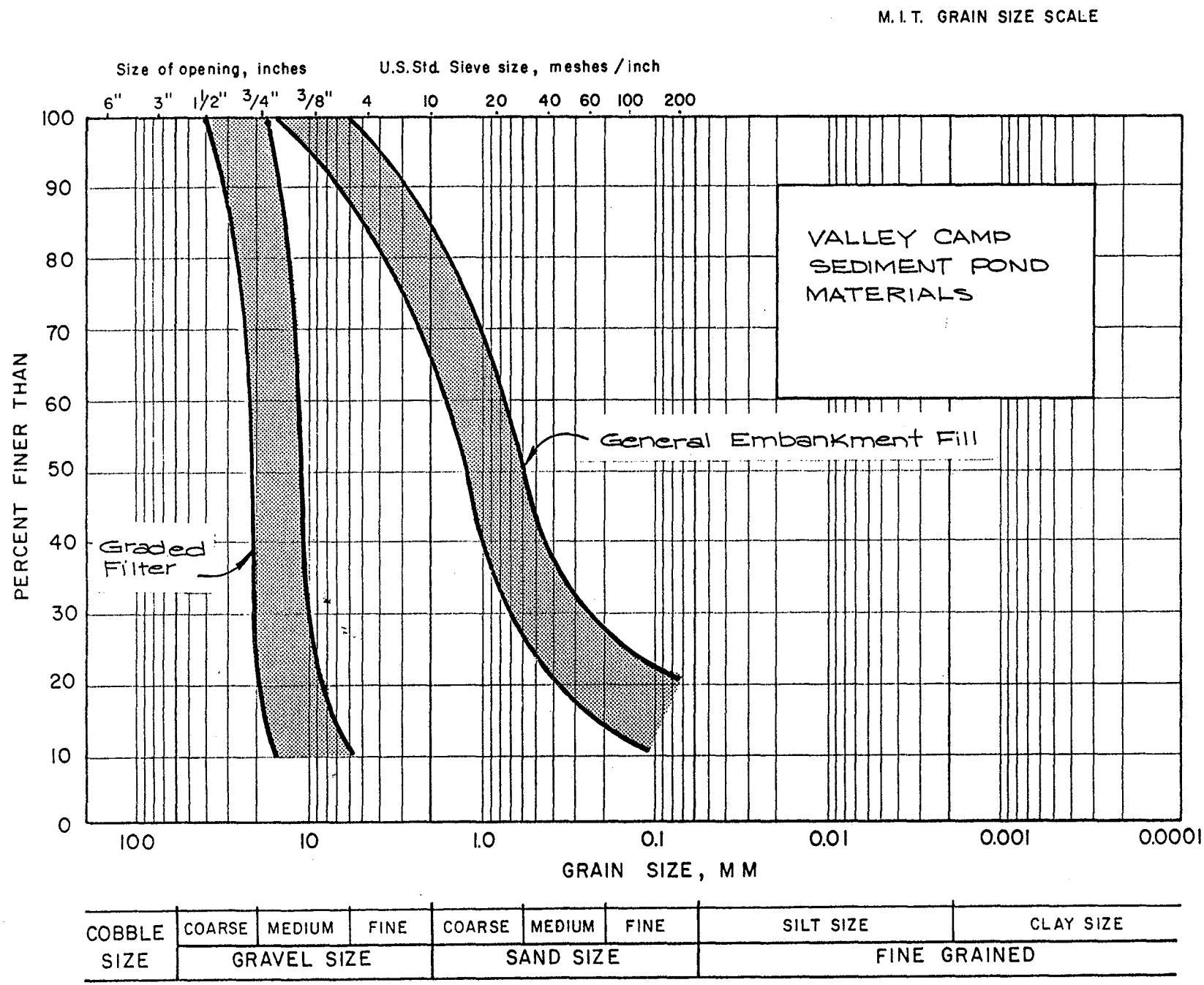


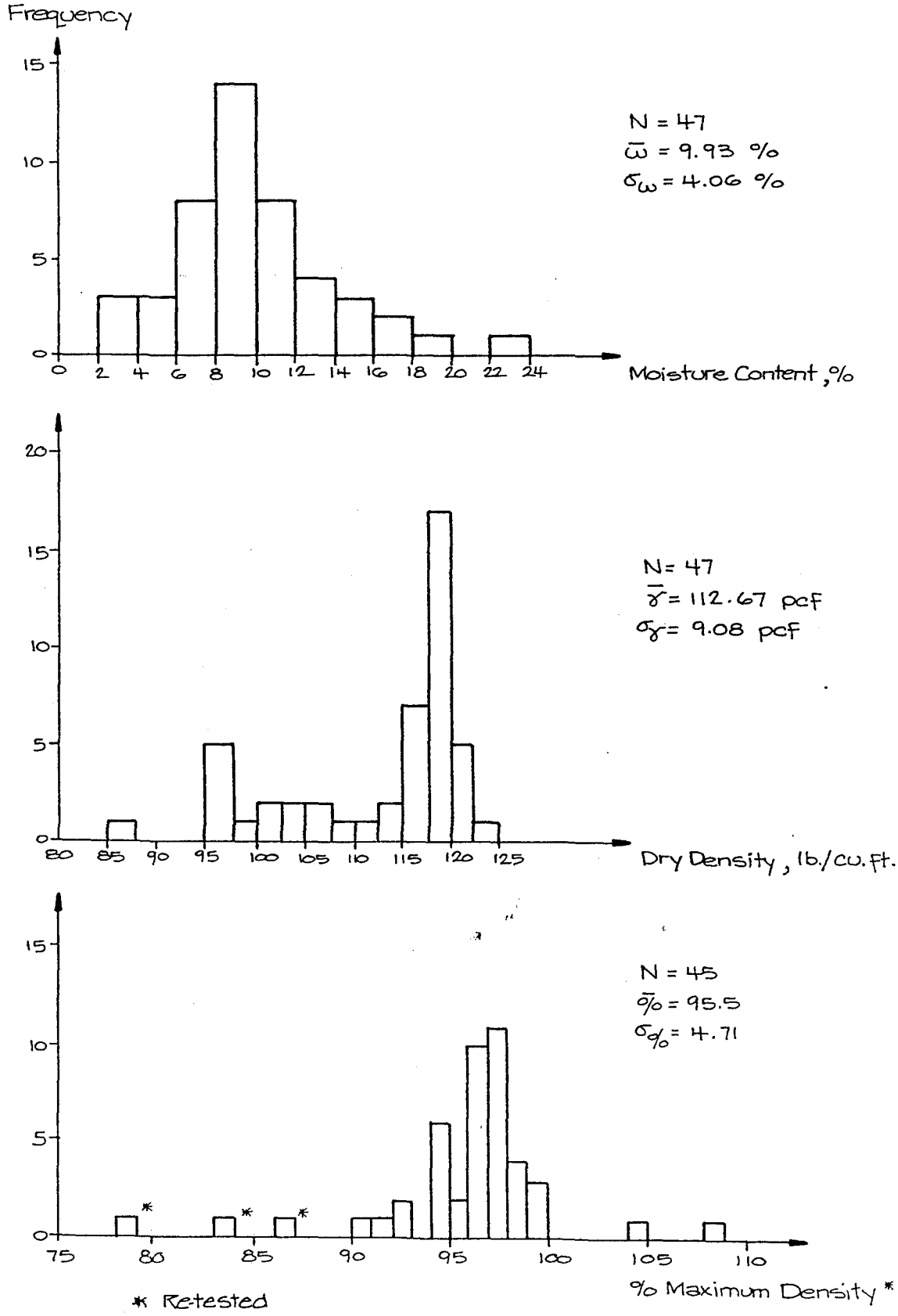
GRAIN SIZE DISTRIBUTION

FIGURE 4-7

Project No. 783-1156 A
Project Valley Camp
Golder Associates
Date 6-1980
By HC

COMPACTION TEST RESULTS

Figure 4-8



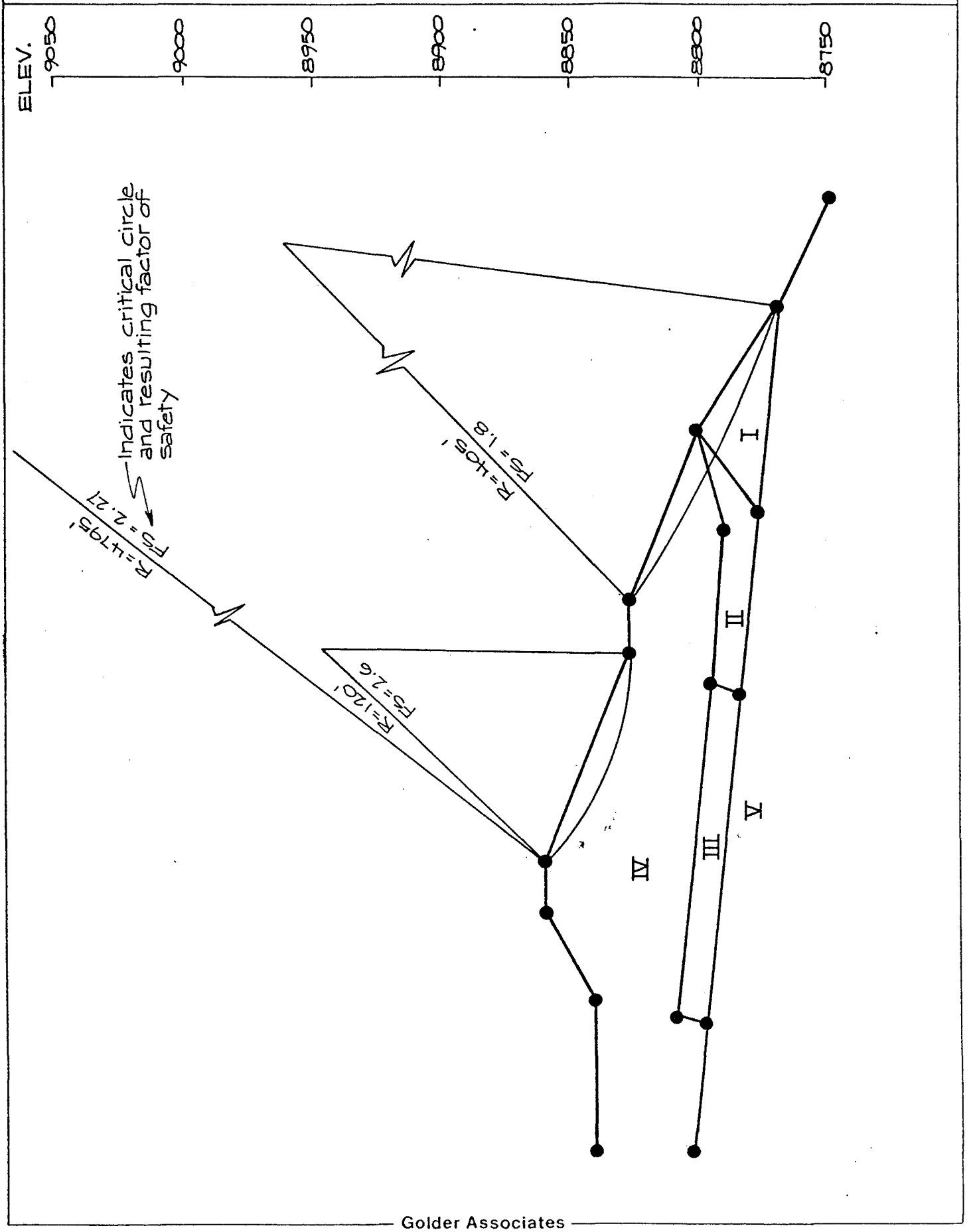
* Retested

** per ASTM D-1557, modified Proctor density

Project No. 793-1156A Reviewed CWL Date 2-80

EMBANKMENT STABILITY ANALYSES
DRAINED

Figure 4-9



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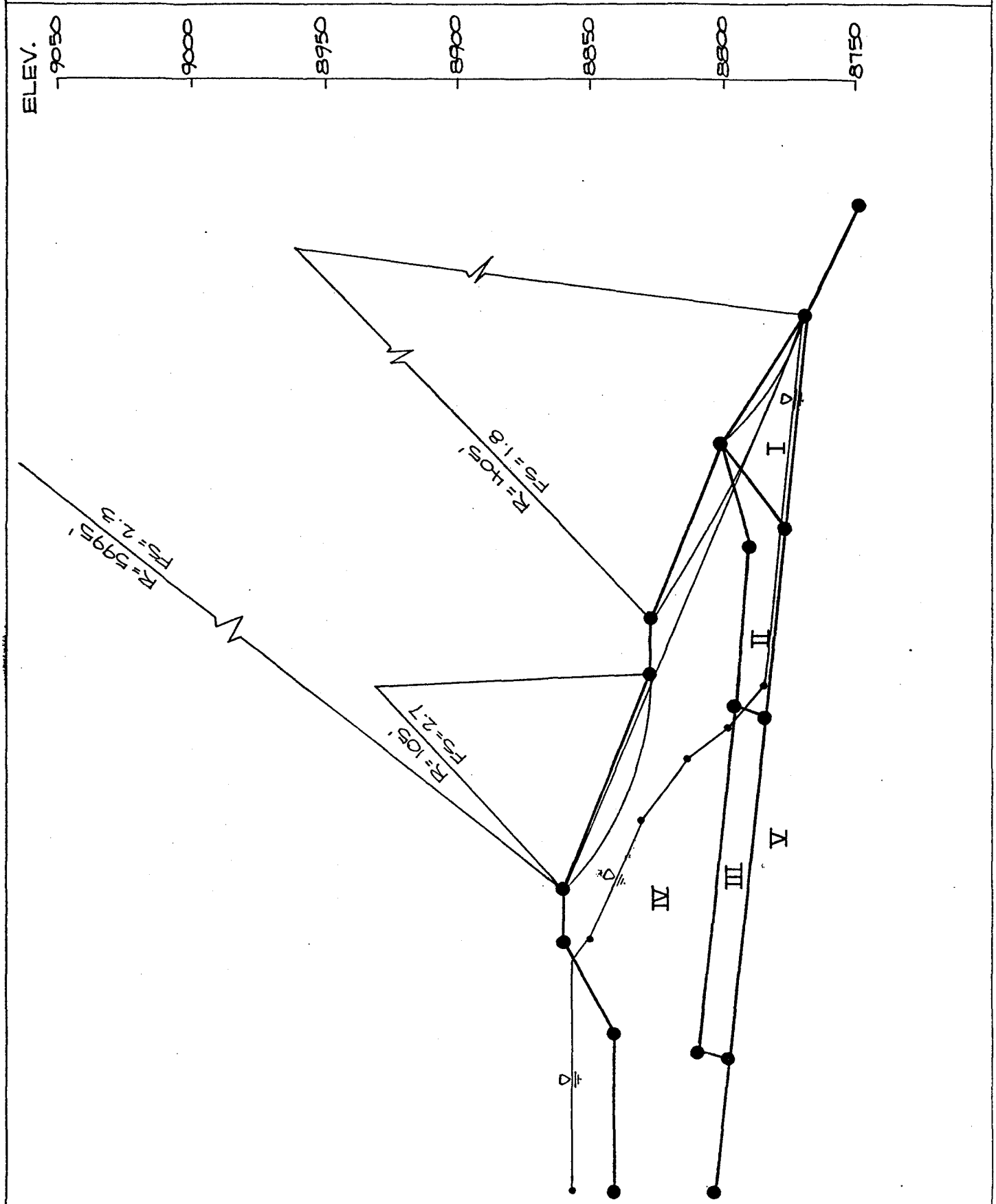
EMBANKMENT STABILITY ANALYSES
STEADY STATE — FULL DRAINAGE INTO II

Figure 4-10



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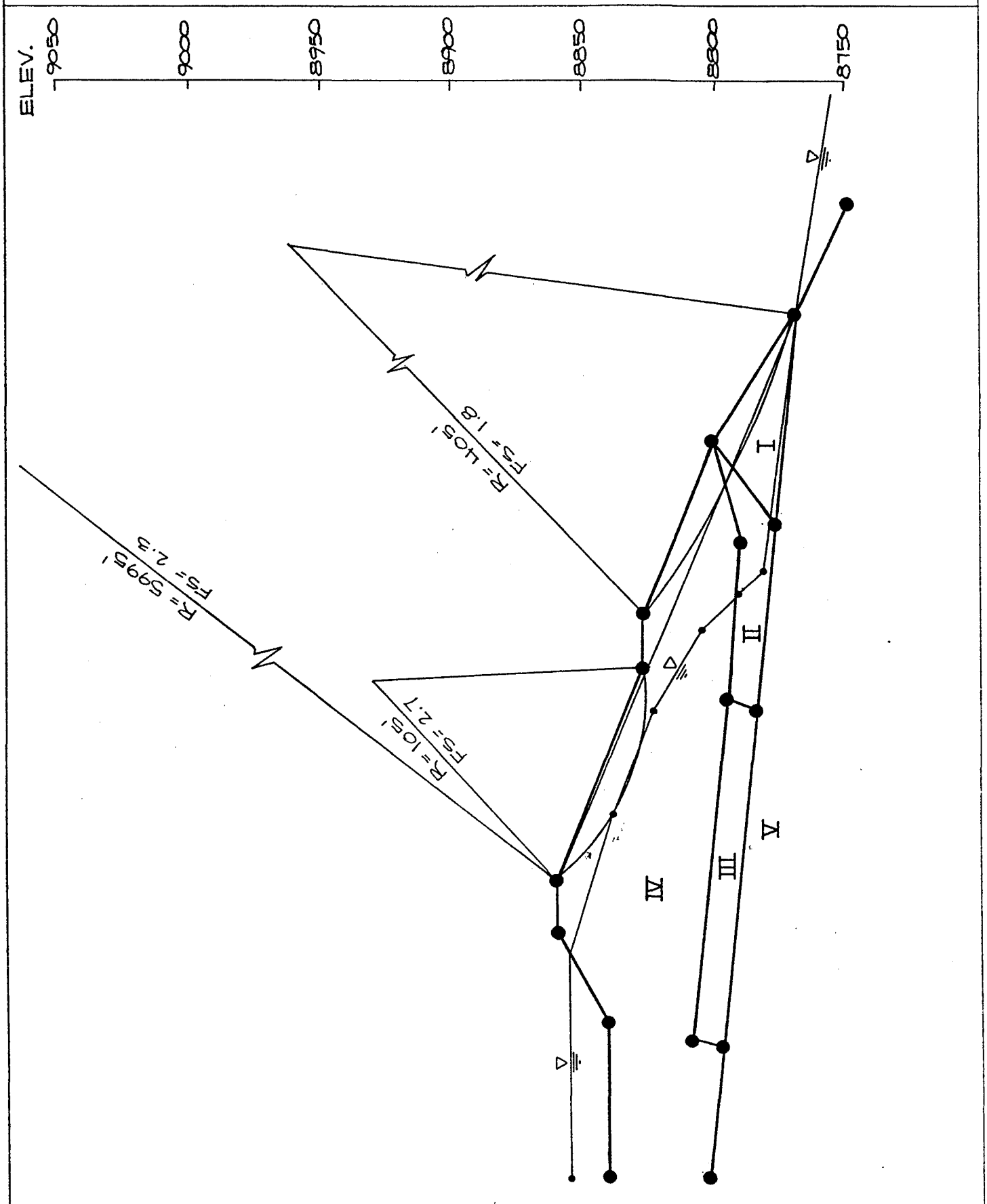
EMBANKMENT STABILITY ANALYSES
STEADY STATE — II PARTIALLY CLOGGED

Figure 4-11



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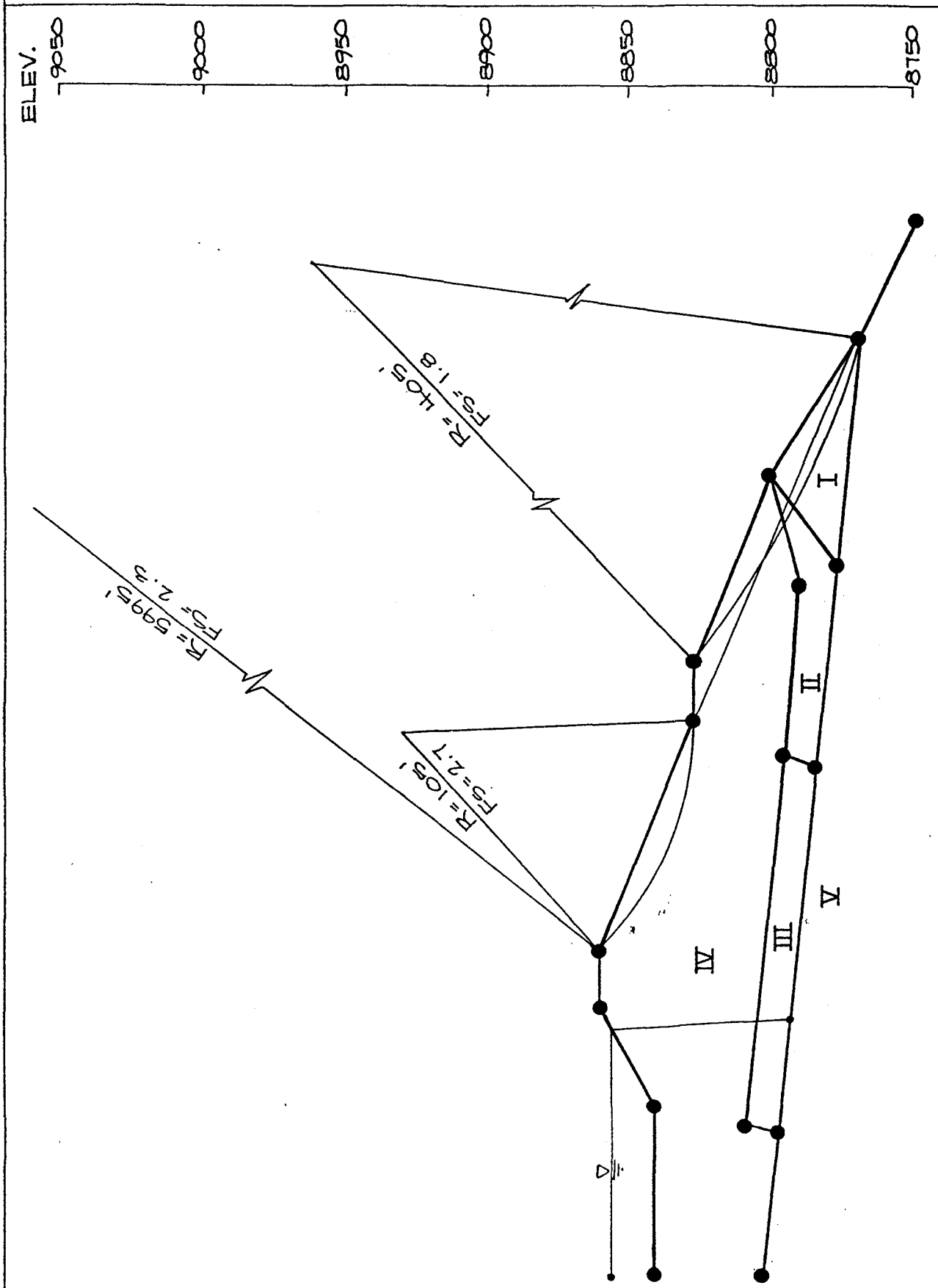
EMBANKMENT STABILITY ANALYSES
STEADY STATE — FULL DRAINAGE INTO III

Figure 4-12



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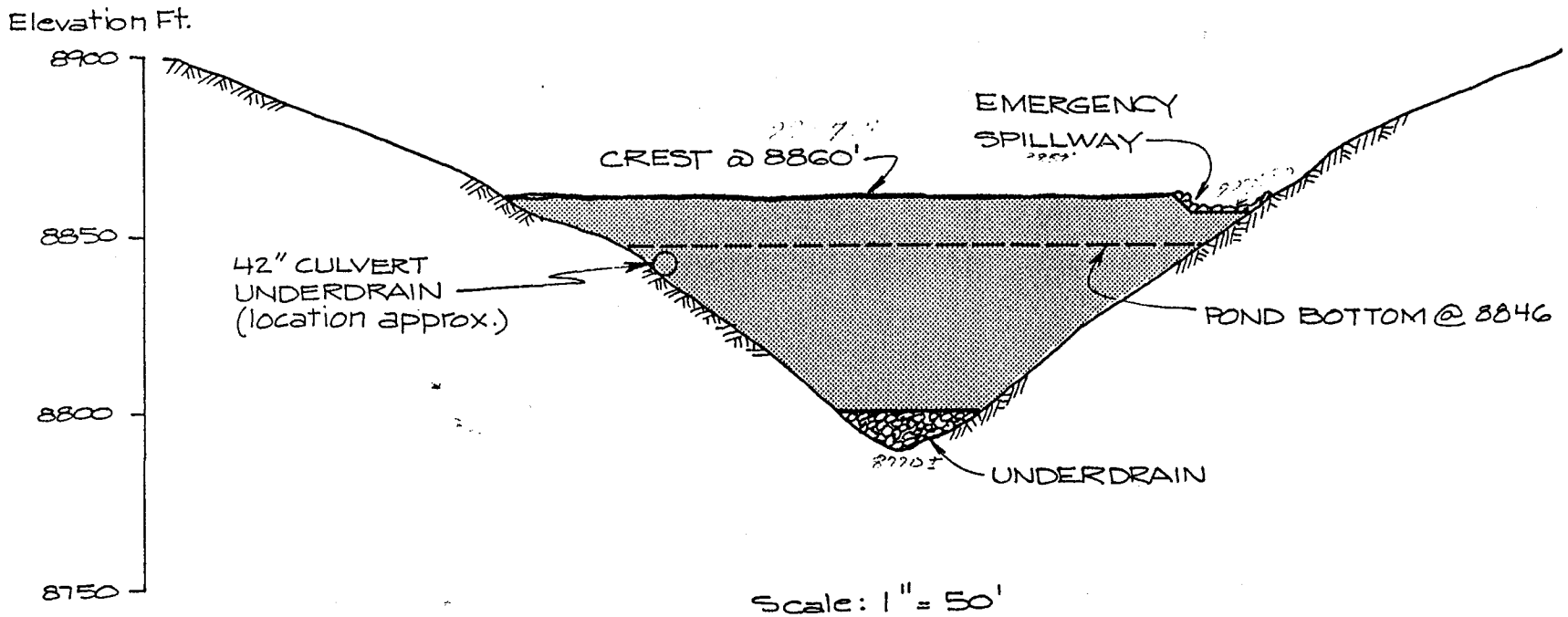
Project No. 73-1156A Reviewed CWX Date 6-80



NOTE: Data from field survey undertaken by Valley Camp

VALLEY FILL CROSS-SECTION

Figure 4-13

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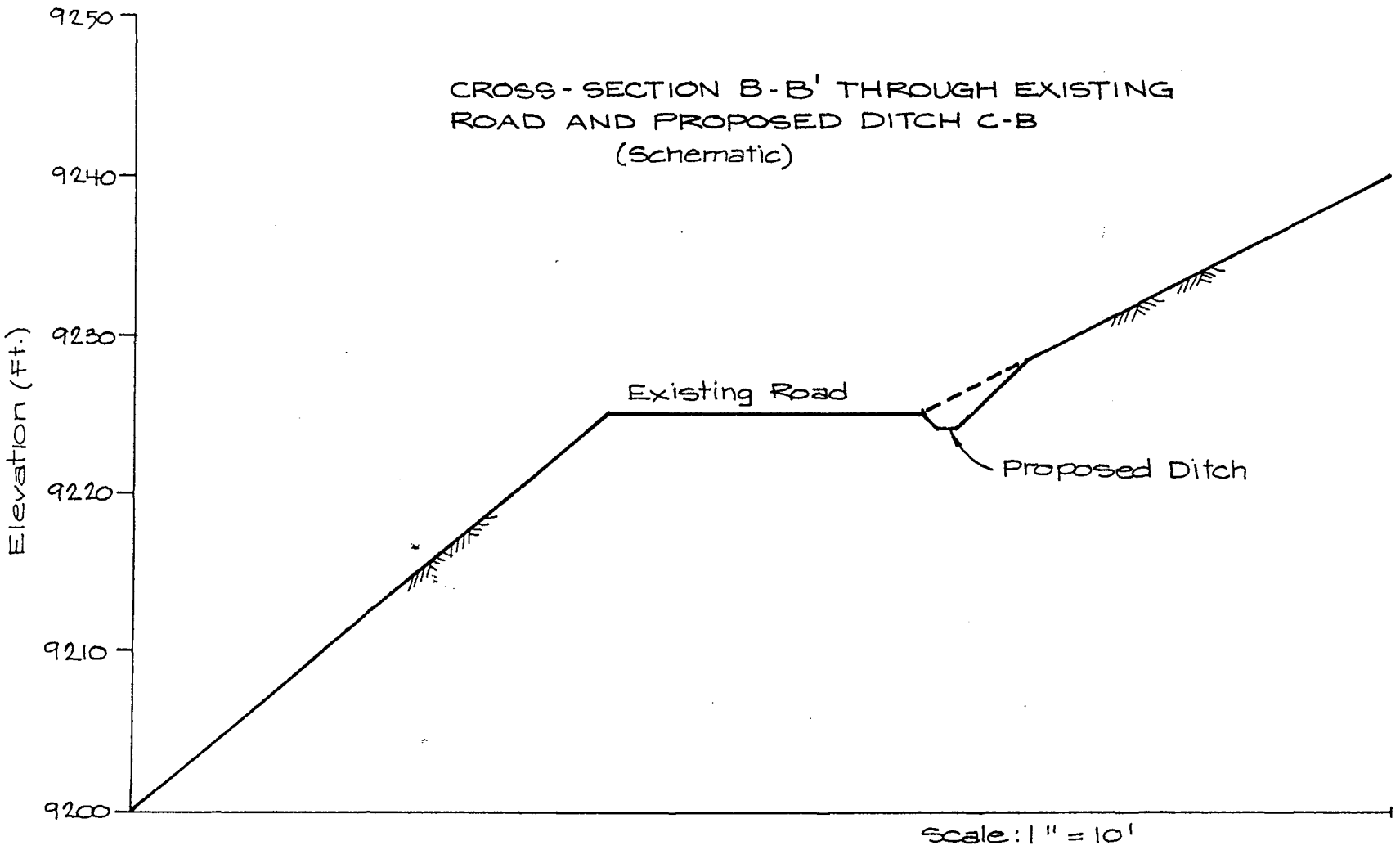

TYPICAL CROSS-SECTION THROUGH
EXISTING ROAD AND PROPOSED DITCH C-B

Figure 5-1

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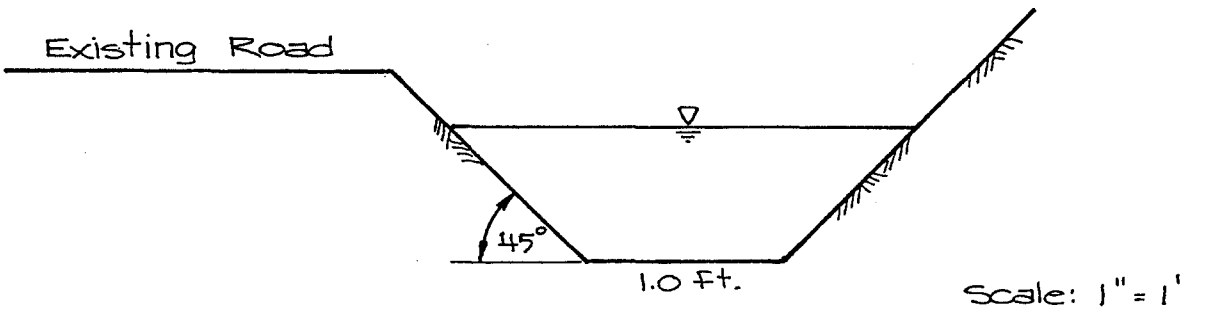
CROSS-SECTION THROUGH DITCH AND TYPICAL DESIGN CONFIGURATIONS

Figure 5-2

DITCH A-B
(Schematic)



$$Q = \frac{1.49}{n} R_h^{2/3} S^{1/2}$$

$n = 0.027$
$S = 0.089$
$Q = 12.6$ cfs

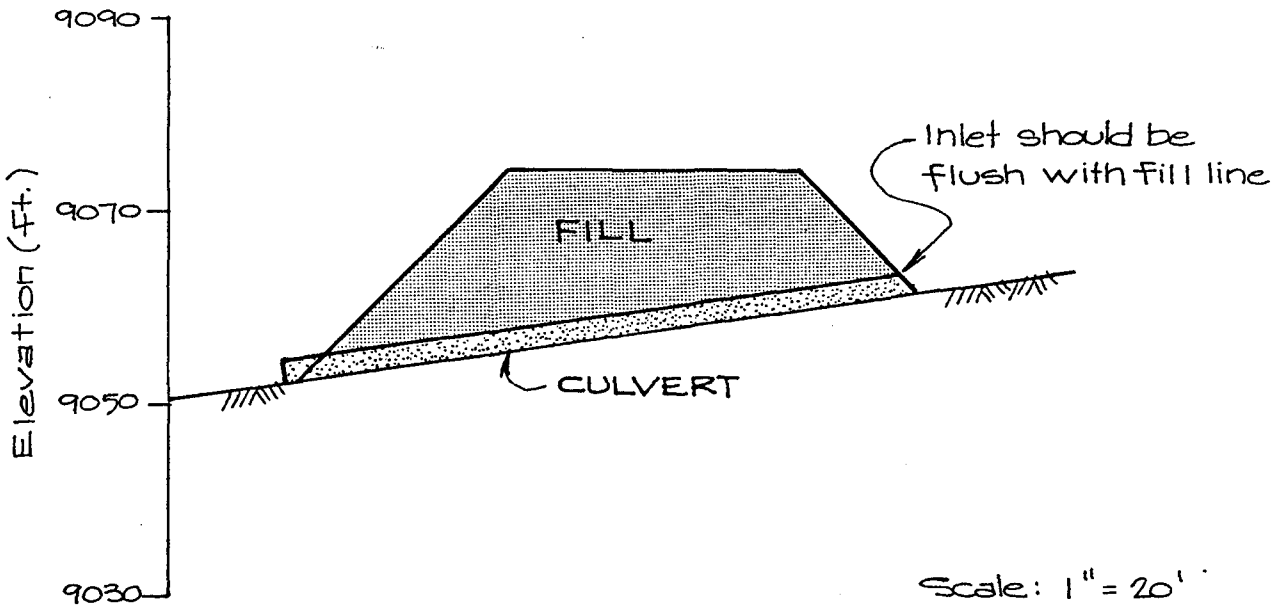
Depth of flow y was solved for by trial and error.

$\therefore y = 0.70$ ft.

Project No. 793-1164 Reviewed Cal Date 8-80

INLET CONFIGURATION FOR CULVERT

Figure 5-3



Project No. 793-1564 Reviewed Date 4-86

FIGURE 2-1

GENERAL SITE LOCATION
BELINA MINE AREA

This figure is not reporduced herein because of it's large size and quality of the original. For further information see original copy on file at Valley Camp of Utah, Inc.

FIGURE 2-2

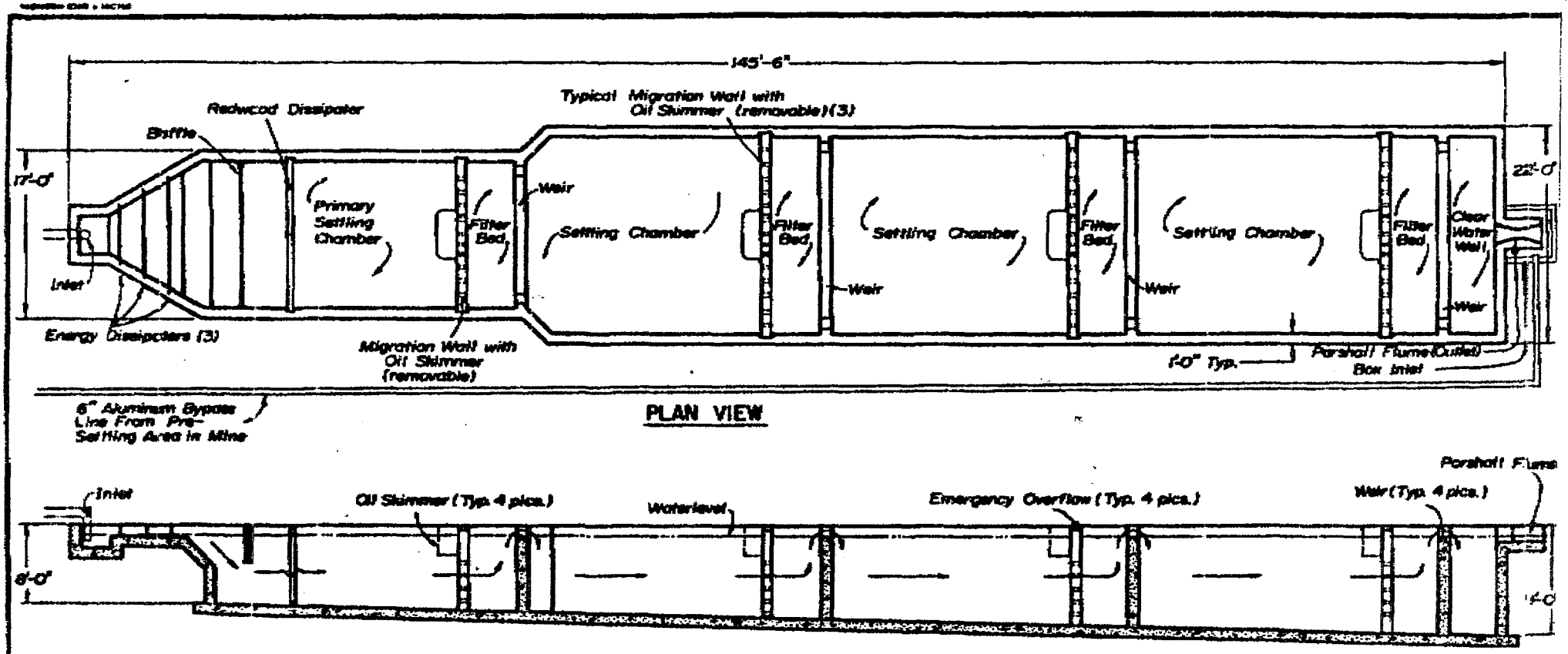
SURFACE FACILITIES PLAN
BELINA MINE AREA

This figure is not reporduced herein because of it's large size and quality of the original. For further information see original copy on file at Valley Camp of Utah, Inc.

FIGURE 3-2

DRAINAGE AREAS
BELINA MINE AREA

This figure is not reporduced herein because of it's large size and quality of the original. For further information see original copy on file at Valley Camp of Utah, Inc.



SECTION VIEW & FLOW DIAGRAM

I certify that this structure was built as designed and is maintained in accordance with the plan.

Edwin B Foust
11/29/90

REGISTERED PROFESSIONAL ENGINEER
No. 5329
EDWIN BROOKSHIRE FOUST
STATE OF UTAH

DRAWN BY: Ed Sanderson	VALLEY CAMP OF UTAH, INC. SCOFIELD ROUTE HELPER, UTAH 84526
DATE: Sept. 12, 1983	
CHECKED BY:	
DATE:	
APPROVAL:	TITLE: CONCRETE FILTER POND
APPROVAL:	
APPROVAL:	SCALE: NONE — DRAWING NO. B4-0010

Fig 3-6C

APPENDIX 742.310

Hydrologic Calculations

CONSULTANTS/ENGINEERS
HANSEN
ALLEN
& LUCE inc
SALT LAKE CITY, UTAH

SELECTED SUMMARY OF DESIGN ASSUMPTIONS

- Filter Fabric can be specified for any riprap design in lieu of a rock type filter blanket, usually specified as Type II Granular Filter.

- Some ditches are classified by the mine operator as convenience ditches. These ditches are not critical to runoff control at the mine site since water would flow toward either another collection ditch or directly into a sediment pond if the ditch were not there. Convenience ditches have been placed by the operator to eliminate localized problems such as low spots, etc.. In the case of convenience ditches, it is not their size that is critical, but that a ditch is in place for drainage reasons, and therefore it is the operators conclusion that no design is required.

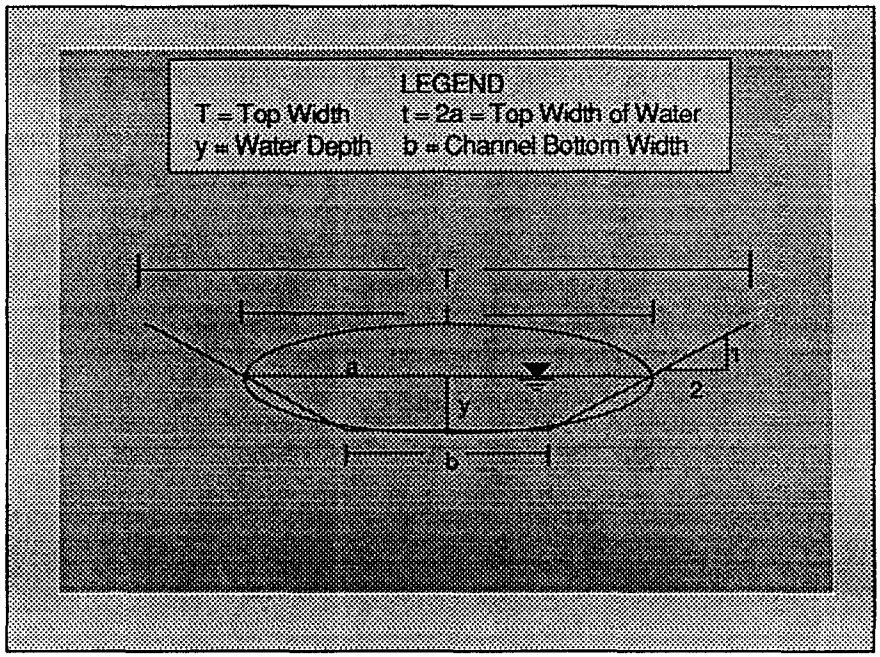
- Ditches evaluated in the calculation appendix which have minimal flow, and which by observation require only a minimal ditch configuration are sometimes specified as requiring a "general design". This configuration has a 2:1 side slope, zero bottom width and a 1.0 foot depth. In many instances this configuration is far in excess of that required, but listed as such to ease construction.

COMPARISON OF TRAPEZOIDAL AND ELLIPTICAL CHANNEL SECTIONS

In practice it is difficult to construct and maintain ditches to exact trapezoidal cross-sections whether they be of soil or riprap. Reasons for this difficulty are that 1) a slight amount of soil movement changes the basic configuration, 2) the precise measurement and placement of riprap is difficult to obtain, 3) the availability of precise rock gradations is limited, and 4) riprap does not render itself well to sharp trapezoidal dimensioning. As a result an alternate channel configuration has been evaluated hereafter which conforms itself to a more generalized elliptical shape. A comparison of Trapezoidal and Elliptical channel cross sections is provided in the following figure.

The conversion between the Trapezoidal and elliptical cross-sections was made by evaluating the appropriate parameters for use within the Manning's flow equation.

Existing trapezoidal ditch designs were subjected to a comparative analysis with an elliptical ditch design using the above described analog. A summary comparison of ditches is shown in the following table. Ditches were chosen for this summary based upon designed channel width and slope. All ditches were initially sorted by channel bottom width after which representative ditches using the maximum and minimum slopes within each basic size channel were then chosen to represent the possible range of design within that group. Note from the table that both velocity and flow depth are very comparable between the trapezoidal and elliptical channel cross sections. The table shows that ditches designed with a trapezoidal cross-section can be constructed using an elliptical configuration and still maintain overall ditch flow integrity. Important design parameters for elliptical ditches include total top width, depth, and maximum side slope.



Summary Comparison of Selected Trapezoidal and Elliptical Cross-Sections

BOTTOM WIDTH (ft)*	Slope %		DITCH NO.	CHANNEL TYPE			
				TRAPEZOIDAL		ELLIPTICAL	
	Min	Max		FLOW DEPTH (ft)	FLOW VELOCITY (fps)	FLOW DEPTH (ft)	FLOW VELOCITY (fps)
0	.01	-	16B	0.40	1.57	0.30	1.65
	-	.10		0.26	3.73	0.15	3.39
	.02	-	12D	0.51	2.61	0.38	2.75
	-	.02		0.51	2.61	0.38	2.75
	.17	-	44B	0.22	4.31	0.16	4.47
	-	.21		0.21	4.66	0.15	4.78
1	.03	-	1	0.50	3.92	0.45	3.90
	-	.05		0.44	4.73	0.39	4.57
	.05	-	7B	0.25	3.47	0.24	3.37
	-	.11		0.20	4.59	0.19	4.29
2	.30	-	37	0.19	5.9	0.21	5.64
	-	.30		0.19	5.9	0.21	5.64

* 0.10 foot bottom width used as a minimum width for Elliptical design.

TRAPEZOIDAL Channel Flow Calculations using Mannings Equation

Client	: Valley Camp of Utah Inc.	Date	: 29-Dec-92
Project No.	: 007.14.100	Time	: 03:55 PM
Channel Section	: Ditch 16B - Trapezoidal Section	Computed:	DEH

			UNITS
GENERAL CRITERIA:	Design Flow	: 0.50	cfs
	Bottom Width	: 0.0	feet
	Side Slope1	: 2.0	1/m1
	Side Slope2	: 2.0	1/m2
	Friction Factor	:	
	Assumed D50	: 1.00	feet
	Calc n Value	: 0.040	
	Used	: 0.030	
	Min. Bottom Slope	: 0.010	ft/ft
	Max. Bottom Slope	: 0.100	ft/ft
	Freeboard	: 0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	0.40	feet
	Q-1.49AR(2/3)S(1/2)/n =	0.000	Accuracy
	Required Depth	: 0.90	feet
	Area	: 0.32	ft2
	Perimeter	: 1.78	feet
	Hydraulic Radius	: 0.18	feet
	Velocity	: 1.57	ft/sec
	Riprap Ck (V<5?)	: Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.26	feet
	Q-1.49AR(2/3)S(1/2)/n =	0.000	Accuracy
	Required Depth	: 0.76	feet
	Area	: 0.13	ft2
	Perimeter	: 1.16	feet
	Hydraulic Radius	: 0.12	feet
	Velocity	: 3.73	ft/sec
	Riprap Ck (V<5?)	: Not Needed	

DESIGN CRITERIA:	Bottom Width	: 0.0	feet
	Side Slope 1	: 2.0	1/m1
	Side Slope 2	: 2.0	1/m2
	Min. Bottom Slope	: 1.0	%
	Max. Bottom Slope	: 10.0	%
	Min Channel Depth	: 0.90	feet
	Riprap (Min S)	: Not Needed	
	Riprap (Max S)	: Not Needed	

ELLIPTICAL Channel Flow Calculations using Mannings Equation

Client	: Valley Camp of Utah Inc.	Date	: 29-Dec-92
Project No.	: 007.14.100	Time	: 03:35 PM
Channel Section:	Ditch 16B - Elliptical Check	Computed:	DEH

			UNITS
GENERAL CRITERIA:	Design Flow :	0.50	cfs
	Top Width - Water :	1.3	feet
	Top Width - Channel :	3.3	feet
	Equiv Trap Bottom W :	0.1	
	Side Slope (default=2):	2.0	1/m
	Friction Factor :		
	Assumed D50 :	1.00	feet
	Calc n Value :	0.040	
	Used n value :	0.030	
	Min. Bottom Slope :	0.010	ft/ft
	Max. Bottom Slope :	0.100	ft/ft
	Freeboard :	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	0.30	feet
	Q-1.49AR(2/3)S(1/2)/n =	0.000	Accuracy
	Required Depth :	0.80	feet
	Area :	0.30	ft2
	Perimeter :	1.58	feet
	Hydraulic Radius :	0.19	feet
	Velocity :	1.65	ft/sec
	Riprap Ck (V<5?) :	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.15	feet
	Q-1.49AR(2/3)S(1/2)/n =	-0.000	Accuracy
	Required Depth :	0.65	feet
	Area :	0.15	ft2
	Perimeter :	1.47	feet
	Hydraulic Radius :	0.10	feet
	Velocity :	3.39	ft/sec
	Riprap Ck (V<5?) :	Not Needed	

DESIGN CRITERIA:	Min. Bottom Slope :	1.0	%
	Max. Bottom Slope :	10.0	%
	Min Channel Depth :	0.80	feet
	Channel Top Width :	3.3	
	Riprap (Min S) :	Not Needed	
	Riprap (Max S) :	Not Needed	

TRAPEZOIDAL Channel Flow Calculations using Mannings Equation

Client	: Valley Camp of Utah Inc.	Date	: 29-Dec-92
Project No.	: 007.14.100	Time	: 03:55 PM
Channel Section	: Ditch 12D - Trapezoidal Section	Computed:	DEH

			UNITS
GENERAL CRITERIA:	Design Flow :	1.35	cfs
	Bottom Width :	0.0	feet
	Side Slope1 :	2.0	1/m1
	Side Slope2 :	2.0	1/m2
	Friction Factor :		
	Assumed D50 :	1.00	feet
	Calc n Value :	0.040	
	Used :	0.030	
	Min. Bottom Slope :	0.020	ft/ft
	Max. Bottom Slope :	0.020	ft/ft
	Freeboard :	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	0.51	feet
	Q-1.49AR(2/3)S(1/2)/n =	-0.000	Accuracy
	Required Depth :	1.01	feet
	Area :	0.52	ft2
	Perimeter :	2.27	feet
	Hydraulic Radius :	0.23	feet
	Velocity :	2.61	ft/sec
	Riprap Ck (V<5?) :	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.51	feet
	Q-1.49AR(2/3)S(1/2)/n =	-0.000	Accuracy
	Required Depth :	1.01	feet
	Area :	0.52	ft2
	Perimeter :	2.27	feet
	Hydraulic Radius :	0.23	feet
	Velocity :	2.62	ft/sec
	Riprap Ck (V<5?) :	Not Needed	

DESIGN CRITERIA:	Bottom Width :	0.0	feet
	Side Slope 1 :	2.0	1/m1
	Side Slope 2 :	2.0	1/m2
	Min. Bottom Slope :	2.0	%
	Max. Bottom Slope :	2.0	%
	Min Channel Depth :	1.01	feet
	Riprap (Min S) :	Not Needed	
	Riprap (Max S) :	Not Needed	

ELLIPTICAL Channel Flow Calculations using Mannings Equation

Client	: Valley Camp of Utah Inc.	Date	: 29-Dec-92
Project No.	: 007.14.100	Time	: 03:47 PM
Channel Section	: Ditch 12D - Elliptical Check	Computed:	DEH

			UNITS
GENERAL CRITERIA:	Design Flow :	1.35	cfs
	Top Width - Water :	1.6	feet
	Top Width - Channel :	3.6	feet
	Equiv Trap Bottom W :	0.1	
	Side Slope (default=2):	2.0	1/m
	Friction Factor :		
	Assumed D50 :	1.00	feet
	Calc n Value :	0.040	
	Used n value :	0.030	
	Min. Bottom Slope :	0.020	ft/ft
	Max. Bottom Slope :	0.020	ft/ft
	Freeboard :	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	0.38	feet
	Q-1.49AR(2/3)S(1/2)/n =	-0.000	Accuracy
	Required Depth :	0.88	feet
	Area :	0.49	ft2
	Perimeter :	2.00	feet
	Hydraulic Radius :	0.25	feet
	Velocity :	2.75	ft/sec
	Riprap Ck (V<5?) :	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.38	feet
	Q-1.49AR(2/3)S(1/2)/n =	-0.000	Accuracy
	Required Depth :	0.88	feet
	Area :	0.49	ft2
	Perimeter :	2.00	feet
	Hydraulic Radius :	0.25	feet
	Velocity :	2.75	ft/sec
	Riprap Ck (V<5?) :	Not Needed	

DESIGN CRITERIA:	Min. Bottom Slope :	2.0	%
	Max. Bottom Slope :	2.0	%
	Min Channel Depth :	0.88	feet
	Channel Top Width :	3.6	
	Riprap (Min S) :	Not Needed	
	Riprap (Max S) :	Not Needed	

TRAPEZOIDAL Channel Flow Calculations using Mannings Equation

Client	: Valley Camp of Utah Inc.	Date	: 29-Dec-92
Project No.	: 007.14.100	Time	: 03:56 PM
Channel Section	: Ditch 44B - Trapezoidal Section	Computed:	DEH

			UNITS
GENERAL CRITERIA:	Design Flow :	0.40	cfs
	Bottom Width :	0.0	feet
	Side Slope1 :	2.0	1/m1
	Side Slope2 :	2.0	1/m2
	Friction Factor :		
	Assumed D50 :	1.00	feet
	Calc n Value :	0.040	
	Used :	0.030	
	Min. Bottom Slope :	0.170	ft/ft
	Max. Bottom Slope :	0.210	ft/ft
	Freeboard :	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	0.22	feet
	Q-1.49AR(2/3)S(1/2)/n =	0.000	Accuracy
	Required Depth :	0.72	feet
	Area :	0.09	ft2
	Perimeter :	0.96	feet
	Hydraulic Radius :	0.10	feet
	Velocity :	4.31	ft/sec
	Riprap Ck (V<5?) :	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.21	feet
	Q-1.49AR(2/3)S(1/2)/n =	0.000	Accuracy
	Required Depth :	0.71	feet
	Area :	0.09	ft2
	Perimeter :	0.93	feet
	Hydraulic Radius :	0.09	feet
	Velocity :	4.66	ft/sec
	Riprap Ck (V<5?) :	Not Needed	

DESIGN CRITERIA:	Bottom Width :	0.0	feet
	Side Slope 1 :	2.0	1/m1
	Side Slope 2 :	2.0	1/m2
	Min. Bottom Slope :	17.0	%
	Max. Bottom Slope :	21.0	%
	Min Channel Depth :	0.72	feet
	Riprap (Min S) :	Not Needed	
	Riprap (Max S) :	Not Needed	

ELLIPTICAL Channel Flow Calculations using Mannings Equation

Client	: Valley Camp of Utah Inc.	Date	: 29-Dec-92
Project No.	: 007.14.100	Time	: 03:48 PM
Channel Section:	Ditch 44B - Elliptical Check	Computed:	DEH

			UNITS
GENERAL CRITERIA:	Design Flow :	0.40	cfs
	Top Width - Water :	0.7	feet
	Top Width - Channel :	2.7	feet
	Equiv Trap Bottom W :	0.1	
	Side Slope (default=2):	2.0	1/m
	Friction Factor :		
	Assumed D50 :	1.00	feet
	Calc n Value :	0.040	
	Used n value :	0.030	
	Min. Bottom Slope :	0.170	ft/ft
	Max. Bottom Slope :	0.210	ft/ft
	Freeboard :	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	0.16	feet
	Q-1.49AR(2/3)S(1/2)/n =	0.000	Accuracy
	Required Depth :	0.66	feet
	Area :	0.09	ft2
	Perimeter :	0.88	feet
	Hydraulic Radius :	0.10	feet
	Velocity :	4.47	ft/sec
	Riprap Ck (V<5?) :	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.15	feet
	Q-1.49AR(2/3)S(1/2)/n =	-0.000	Accuracy
	Required Depth :	0.65	feet
	Area :	0.08	ft2
	Perimeter :	0.87	feet
	Hydraulic Radius :	0.10	feet
	Velocity :	4.77	ft/sec
	Riprap Ck (V<5?) :	Not Needed	

DESIGN CRITERIA:	Min. Bottom Slope :	17.0	%
	Max. Bottom Slope :	21.0	%
	Min Channel Depth :	0.66	feet
	Channel Top Width :	2.7	
	Riprap (Min S) :	Not Needed	
	Riprap (Max S) :	Not Needed	

TRAPEZOIDAL Channel Flow Calculations using Mannings Equation

Client	: Valley Camp of Utah Inc.	Date	: 29-Dec-92
Project No.	: 007.14.100	Time	: 04:00 PM
Channel Section	: Ditch 1 - Trapezoidal Section	Computed:	DEH

			UNITS
GENERAL CRITERIA:	Design Flow :	3.90	cfs
	Bottom Width :	1.0	feet
	Side Slope1 :	2.0	1/m1
	Side Slope2 :	2.0	1/m2
	Friction Factor :		
	Assumed D50 :	1.00	feet
	Calc n Value :	0.040	
	Used :	0.030	
	Min. Bottom Slope :	0.030	ft/ft
	Max. Bottom Slope :	0.050	ft/ft
	Freeboard :	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	0.50	feet
	Q-1.49AR(2/3)S(1/2)/n =	0.000	Accuracy
	Required Depth :	1.00	feet
	Area :	0.99	ft2
	Perimeter :	3.23	feet
	Hydraulic Radius :	0.31	feet
	Velocity :	3.92	ft/sec
	Riprap Ck (V<5?) :	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.44	feet
	Q-1.49AR(2/3)S(1/2)/n =	-0.000	Accuracy
	Required Depth :	0.94	feet
	Area :	0.82	ft2
	Perimeter :	2.96	feet
	Hydraulic Radius :	0.28	feet
	Velocity :	4.73	ft/sec
	Riprap Ck (V<5?) :	Not Needed	

DESIGN CRITERIA:	Bottom Width :	1.0	feet
	Side Slope 1 :	2.0	1/m1
	Side Slope 2 :	2.0	1/m2
	Min. Bottom Slope :	3.0	%
	Max. Bottom Slope :	5.0	%
	Min Channel Depth :	1.00	feet
	Riprap (Min S) :	Not Needed	
	Riprap (Max S) :	Not Needed	

ELLIPTICAL Channel Flow Calculations using Mannings Equation

Client	: Valley Camp of Utah Inc.	Date	: 29-Dec-92
Project No.	: 007.14.100	Time	: 03:48 PM
Channel Section	: Ditch 1 - Elliptical Check	Computed:	DEH

			UNITS
GENERAL CRITERIA:	Design Flow :	3.90	cfs
	Top Width - Water :	2.8	feet
	Top Width - Channel :	4.8	feet
	Equiv Trap Bottom W :	1.0	
	Side Slope (default=2):	2.0	1/m
	Friction Factor :		
	Assumed D50 :	1.00	feet
	Calc n Value :	0.040	
	Used n value :	0.030	
	Min. Bottom Slope :	0.030	ft/ft
	Max. Bottom Slope :	0.050	ft/ft
	Freeboard :	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	0.45	feet
	Q-1.49AR(2/3)S(1/2)/n =	-0.000	Accuracy
	Required Depth :	0.95	feet
	Area :	1.00	ft2
	Perimeter :	3.28	feet
	Hydraulic Radius :	0.30	feet
	Velocity :	3.90	ft/sec
	Riprap Ck (V<5?) :	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.39	feet
	Q-1.49AR(2/3)S(1/2)/n =	-0.000	Accuracy
	Required Depth :	0.89	feet
	Area :	0.85	ft2
	Perimeter :	3.24	feet
	Hydraulic Radius :	0.26	feet
	Velocity :	4.57	ft/sec
	Riprap Ck (V<5?) :	Not Needed	

DESIGN CRITERIA:	Min. Bottom Slope :	3.0	%
	Max. Bottom Slope :	5.0	%
	Min Channel Depth :	0.95	feet
	Channel Top Width :	4.8	
	Riprap (Min S) :	Not Needed	
	Riprap (Max S) :	Not Needed	

TRAPEZOIDAL Channel Flow Calculations using Mannings Equation

Client	: Valley Camp of Utah Inc.	Date	: 29-Dec-92
Project No.	: 007.14.100	Time	: 03:57 PM
Channel Section:	Ditch 7B - Trapezoidal Section	Computed:	DEH

			UNITS
GENERAL CRITERIA:	Design Flow :	1.27	cfs
	Bottom Width :	1.0	feet
	Side Slope1 :	2.0	1/m1
	Side Slope2 :	2.0	1/m2
	Friction Factor :		
	Assumed D50 :	1.00	feet
	Calc n Value :	0.040	
	Used :	0.030	
	Min. Bottom Slope :	0.050	ft/ft
	Max. Bottom Slope :	0.110	ft/ft
	Freeboard :	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	0.25	feet
	Q-1.49AR(2/3)S(1/2)/n =	0.000	Accuracy
	Required Depth :	0.75	feet
	Area :	0.37	ft2
	Perimeter :	2.10	feet
	Hydraulic Radius :	0.17	feet
	Velocity :	3.47	ft/sec
	Riprap Ck (V<5?) :	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.20	feet
	Q-1.49AR(2/3)S(1/2)/n =	0.000	Accuracy
	Required Depth :	0.70	feet
	Area :	0.28	ft2
	Perimeter :	1.89	feet
	Hydraulic Radius :	0.15	feet
	Velocity :	4.59	ft/sec
	Riprap Ck (V<5?) :	Not Needed	

DESIGN CRITERIA:	Bottom Width :	1.0	feet
	Side Slope 1 :	2.0	1/m1
	Side Slope 2 :	2.0	1/m2
	Min. Bottom Slope :	5.0	%
	Max. Bottom Slope :	11.0	%
	Min Channel Depth :	0.75	feet
	Riprap (Min S) :	Not Needed	
	Riprap (Max S) :	Not Needed	

ELLIPTICAL Channel Flow Calculations using Mannings Equation

Client	: Valley Camp of Utah Inc.	Date	: 29-Dec-92
Project No.	: 007.14.100	Time	: 03:49 PM
Channel Section:	Ditch 7B - Elliptical Check	Computed:	DEH

			UNITS
GENERAL CRITERIA:	Design Flow :	1.27	cfs
	Top Width - Water :	2.0	feet
	Top Width - Channel :	4.0	feet
	Equiv Trap Bottom W :	1.0	
	Side Slope (default=2):	2.0	1/m
	Friction Factor :		
	Assumed D50 :	1.00	feet
	Calc n Value :	0.040	
	Used n value :	0.030	
	Min. Bottom Slope :	0.050	ft/ft
	Max. Bottom Slope :	0.110	ft/ft
	Freeboard :	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	0.24	feet
	Q-1.49AR(2/3)S(1/2)/n =	0.000	Accuracy
	Required Depth :	0.74	feet
	Area :	0.38	ft2
	Perimeter :	2.26	feet
	Hydraulic Radius :	0.17	feet
	Velocity :	3.37	ft/sec
	Riprap Ck (V<5?) :	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.19	feet
	Q-1.49AR(2/3)S(1/2)/n =	0.000	Accuracy
	Required Depth :	0.69	feet
	Area :	0.30	ft2
	Perimeter :	2.23	feet
	Hydraulic Radius :	0.13	feet
	Velocity :	4.29	ft/sec
	Riprap Ck (V<5?) :	Not Needed	

DESIGN CRITERIA:	Min. Bottom Slope :	5.0	%
	Max. Bottom Slope :	11.0	%
	Min Channel Depth :	0.74	feet
	Channel Top Width :	4.0	
	Riprap (Min S) :	Not Needed	
	Riprap (Max S) :	Not Needed	

TRAPEZOIDAL Channel Flow Calculations using Mannings Equation

Client	: Valley Camp of Utah Inc.	Date	: 29-Dec-92
Project No.	: 007.14.100	Time	: 03:57 PM
Channel Section	: Ditch 37 (Lower) - Trap Section	Computed:	DEH

				UNITS
GENERAL CRITERIA:	Design Flow	:	2.60	cfs
	Bottom Width	:	2.0	feet
	Side Slope1	:	2.0	1/m1
	Side Slope2	:	2.0	1/m2
	Friction Factor	:		
	Assumed D50	:	1.00	feet
	Calc n Value	:	0.040	
	Used	:	0.040	
	Min. Bottom Slope	:	0.300	ft/ft
	Max. Bottom Slope	:	0.300	ft/ft
	Freeboard	:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. S):		0.19	feet
	Q-1.49AR(2/3)S(1/2)/n =		0.000	Accuracy
	Required Depth	:	0.69	feet
	Area	:	0.44	ft2
	Perimeter	:	2.83	feet
	Hydraulic Radius	:	0.16	feet
	Velocity	:	5.90	ft/sec
	Riprap Ck (V<5?)	:	Required	
CALCULATION: (Velocity Check)	Depth (Max. S):		0.19	feet
	Q-1.49AR(2/3)S(1/2)/n =		0.000	Accuracy
	Required Depth	:	0.69	feet
	Area	:	0.44	ft2
	Perimeter	:	2.83	feet
	Hydraulic Radius	:	0.16	feet
	Velocity	:	5.90	ft/sec
	Riprap Ck (V<5?)	:	Required	

DESIGN CRITERIA:	Bottom Width	:	2.0	feet
	Side Slope 1	:	2.0	1/m1
	Side Slope 2	:	2.0	1/m2
	Min. Bottom Slope	:	30.0	%
	Max. Bottom Slope	:	30.0	%
	Min Channel Depth	:	0.69	feet
	Riprap (Min S)	:	Required	
	Riprap (Max S)	:	Required	

ELLIPTICAL Channel Flow Calculations using Mannings Equation

Client	: Valley Camp of Utah Inc.	Date	: 29-Dec-92
Project No.	: 007.14.100	Time	: 03:50 PM
Channel Section:	Ditch 37 (Lower) Elliptical Check	Computed:	DEH

			UNITS
GENERAL CRITERIA:	Design Flow :	2.60	cfs
	Top Width - Water :	2.8	feet
	Top Width - Channel :	4.8	feet
	Equiv Trap Bottom W :	2.0	
	Side Slope (default=2):	2.0	1/m
	Friction Factor :		
	Assumed D50 :	1.00	feet
	Calc n Value :	0.040	
	Used n value :	0.040	
	Min. Bottom Slope :	0.300	ft/ft
	Max. Bottom Slope :	0.300	ft/ft
	Freeboard :	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	0.21	feet
	Q-1.49AR(2/3)S(1/2)/n =	0.000	Accuracy
	Required Depth :	0.71	feet
	Area :	0.46	ft2
	Perimeter :	3.18	feet
	Hydraulic Radius :	0.15	feet
	Velocity :	5.64	ft/sec
	Riprap Ck (V<5?) :	Required	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.21	feet
	Q-1.49AR(2/3)S(1/2)/n =	0.000	Accuracy
	Required Depth :	0.71	feet
	Area :	0.46	ft2
	Perimeter :	3.18	feet
	Hydraulic Radius :	0.15	feet
	Velocity :	5.64	ft/sec
	Riprap Ck (V<5?) :	Required	

DESIGN CRITERIA:	Min. Bottom Slope :	30.0	%
	Max. Bottom Slope :	30.0	%
	Min Channel Depth :	0.71	feet
	Channel Top Width :	4.8	
	Riprap (Min S) :	Required	
	Riprap (Max S) :	Required	

Disturbed Area Ditches

D-1

Total Area = 4686 * 0.00175 = 8.2 Acres
disturbed = 1000 4.9
undisturbed = 3.2 (Sage/grass)
Paved 0.1

CN	Area	Q
90	4.9	0.723
75	3.2	0.185
98	0.1	1.329
		$\bar{Q}$ = 0.520

$\overline{CN}$ = 85.9

Precipitation - 1.55 inches (10 yr, 6 hr)

hydraulic length = 2290 feet Contour Length = 6180 feet

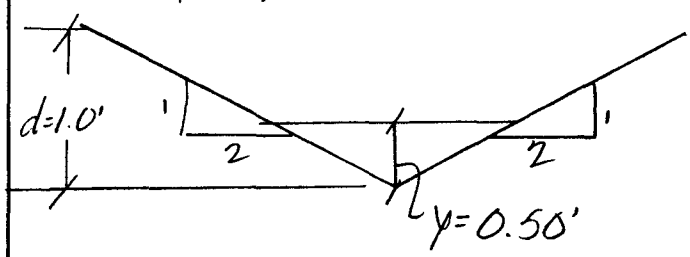
$$\text{slope} = \frac{(6180)(25)(100)}{43{,}560\,(8.2)} = 43.3\%$$

Calculated Runoff: Q_{TOTAL} = 3.9 cfs

Ditch Design

S_{min} = 3%
S_{max} = 5%

try trapezoidal channel
b = 1 M = 2, n = 0.03



V = 4.71 ft/sec < 5.0 ft/sec OK

No lining required

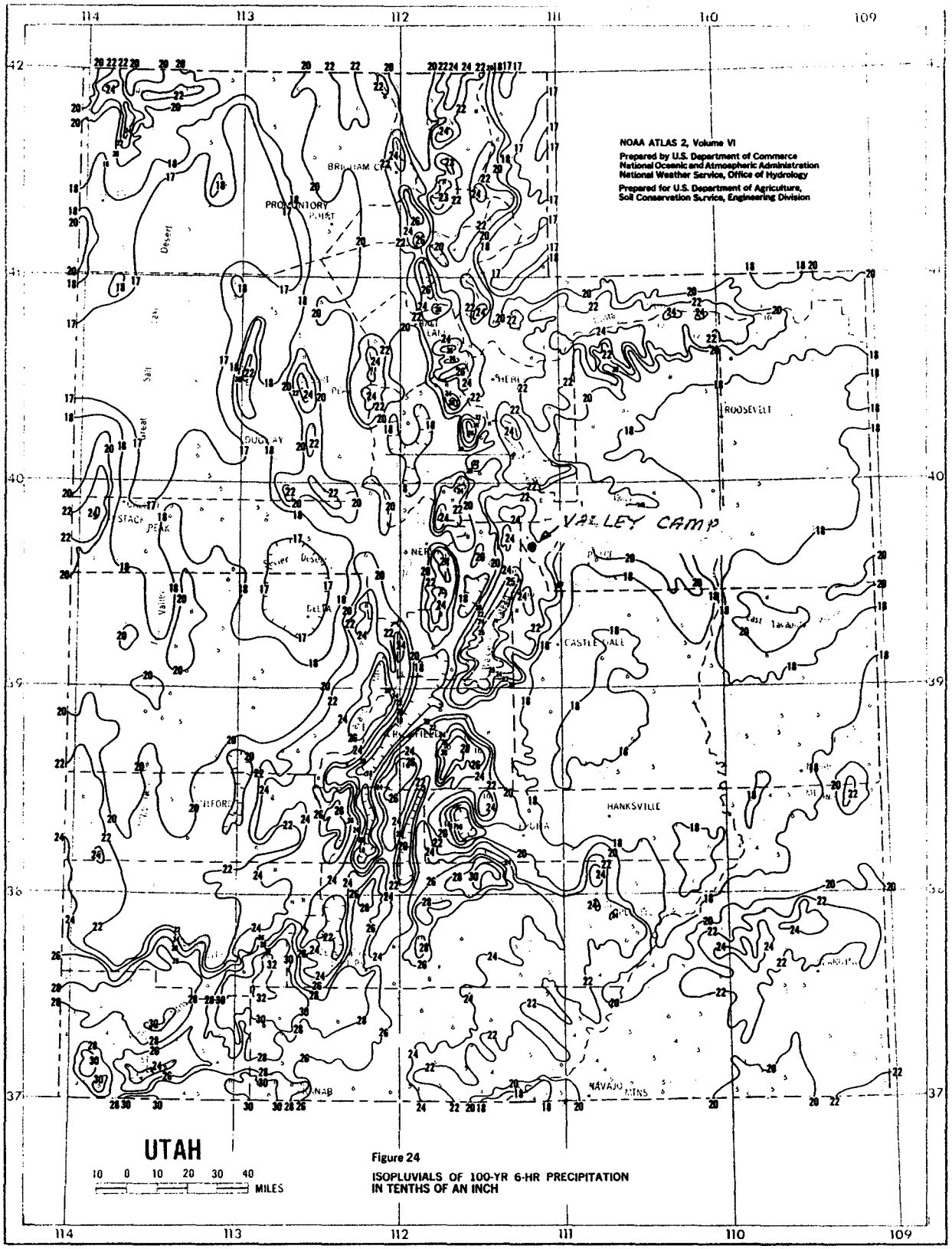


Figure 24

ISOPLUVIALS OF 100-YR 6-HR PRECIPITATION IN TENTHS OF AN INCH

100 yr, 6hr ⇒ P = 2.25

PROJECT : Valley Camp Coal - D-1 Runoff Calculation

AREA= [illegible] ACRES
AVERAGE BASIN SLOPE= 41.3 PERCENT
CURVE NUMBER= 85.9
DESIGN STORM= 1.85 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= [illegible] FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0255 HOURS DPCFS= 72.54 CFS QPIN= 2.7724 INCHES
CS= 43.2401 ITERATIONS= 8 SCS A-MOD

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
[illegible]	[illegible]	.0000	.0000	.0	.00
1.91	.3315	.0000	.0000	3.6	.00
1.93	.3365	.0000	.0000	22.5	.00
1.95	.3415	.0001	.0000	48.2	.00
1.97	.3466	.0002	.0000	66.6	.00
1.98	.3516	.0003	.0001	72.5	.00
2.00	.3570	.0005	.0002	67.9	.02
2.02	.3767	.0014	.0009	57.4	.03
2.03	.3963	.0027	.0013	44.9	.05
2.05	.4159	.0044	.0017	33.1	.11
2.07	.4355	.0066	.0021	23.3	.20
2.09	.4551	.0091	.0025	15.6	.32
[illegible]	.4747	.0120	.0029	10.4	.46
2.12	.4943	.0153	.0033	6.7	.62
2.14	.5139	.0189	.0036	4.2	.79
2.15	.5335	.0228	.0040	2.6	.97
2.17	.5532	.0271	.0043	1.6	1.15
2.19	.5726	.0317	.0046	.9	1.32
2.21	.5924	.0366	.0049	.6	1.50
2.22	.6120	.0416	.0052	.3	1.67
2.24	.6316	.0473	.0055	.2	1.83
2.26	.6512	.0531	.0058	.1	[illegible]
2.27	[illegible]	[illegible]	.0061	.0	2.15
2.41	.8277	.1165	.0080	.0	3.24
2.43	.8473	.1247	.0082	.0	3.36
2.45	.8669	.1331	.0083	.0	3.48
[illegible]	[illegible]	[illegible]	.0085	.0	3.59
2.48	[illegible]	.1505	.0086	.0	[illegible]
2.50	.9094	.1544	.0040	.0	3.81
[illegible]	[illegible]	[illegible]	.0039	.0	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

PROJECT : Valley Camp Coal - D-1 Runoff Calculation
(Continued)

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
.00	.9607	.1755	.0025	.0	2.53
2.67	.9660	.1754	.0025	.0	2.17

HYDROGRAPH PEAK= 3.89 cfs
TIME TO PEAK= 2.51 Hours
RUNOFF VOLUME= .36 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client:	Valley Camp Coal Co.	Date:	30-Jun-89
Project No.:	007.11.100	Time:	04:21 PM
Channel Section:	D-1	Computed:	DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	3.90	cfs
	Bottom Width:	1.0	feet
	Side Slope1:	2.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.030	ft/ft
	Max. Bottom Slope:	0.050	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	0.50	feet
	Qn/1.49(S)1/2=	0.455	
	A(R)2/3=	0.457	
	Required Depth:	1.00	feet
	Area:	1.00	ft2
	Perimeter:	3.24	feet
	Hydraulic Radius:	0.31	feet
	Velocity:	3.90	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.44	feet
	Qn/1.49(S)1/2=	0.352	
	A(R)2/3=	0.353	
	Required Depth:	0.94	feet
	Area:	0.83	ft2
	Perimeter:	2.97	feet
	Hydraulic Radius:	0.28	feet
	Velocity:	4.71	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	1.0	feet
	Side Slope 1:	2.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope:	3.0	%
	Max. Bottom Slope:	5.0	%
	Min Channel Depth:	1.00	feet
	Riprap (Min S):	Not Needed	
	Riprap (Max S):	Not Needed	

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE D-3
PROJECT NO. 007.11-100

SHEET 1 OF 4
COMPUTED Paul
CHECKED
DATE 5/11/83

D-3

Total Area = 3215 * 0.00175 = 5.6 acres
Sage/grass = = 2.4 ac
disturbed = = 3.1 ac
Paved (Bldg) = = 0.1 ac

CN	A	Q
75	2.4	0.185
90	3.1	0.723
98	0.1	1.329

$\bar{Q} = 0.503$ $\bar{CN} = 85.5$

Precipitation = 1.55 inches (10 yr, 6 hr)

hydraulic length = 1775 feet

$S = \frac{(4080)(25)(100)}{(43{,}560)(5.6)} = 41.8\%$

Calculated Run-off ⇒ $Q_{TOT} = 2.61$ cfs

Ditch Design

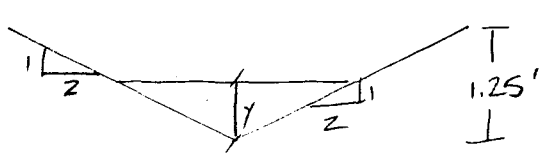
$S_{min} = 1.5\%$ try trapezoidal Channel

$S_{max} = 10\%$ $b = 0$, $M_1 = 2$, $M_2 = 2$ $n = 0.03$

Only occurs in extreme Upper end of Channel where flow is negligible.

$v = 2.74$ ft/sec < 5.0 ft/sec

OK



No lining required

PROJECT : Valley Camp Coal - D-3 Runoff Calculations

AREA= 5.6 ACRES
AVERAGE BASIN SLOPE= 41.8 PERCENT
CURVE NUMBER= 85.5
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 1775. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0720 HOURS QPCFS= 58.83 CFS QPIN=10.4178 INCHES
C3= 51.3495 ITERATIONS= 6 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.93	.3357	.0000	.0000	.0	.00
1.94	.3399	.0000	.0000	3.0	.00
1.96	.3442	.0000	.0000	18.3	.00
1.97	.3484	.0000	.0000	39.1	.00
1.99	.3526	[illegible]	.0000	54.0	.00
2.00	.3580	.0002	.0001	58.8	.00
2.02	.3745	.0007	.0005	55.1	.00
2.03	.3910	.0015	.0008	46.5	.02
2.04	.4075	.0026	.0011	36.4	.05
2.06	.4241	.0040	.0014	26.8	.10
2.07	.4406	.0057	.0017	18.9	.16
2.09	.4571	.0077	.0019	12.8	.24
2.10	.4736	.0099	.0022	8.5	.32
2.12	.4901	.0123	.0025	5.4	.42
2.13	.5066	.0150	.0027	3.4	.52
2.15	.5231	.0180	.0030	2.1	.62
2.16	.5397	.0212	.0032	1.3	.72
2.17	.5562	.0246	.0034	.8	.82
2.19	.5727	.0283	.0036	.4	.92
2.20	.5892	.0321	.0039	.3	1.02
2.22	.6057	.0362	.0041	.2	1.12
2.23	.6222	.0405	.0043	.0	1.21
2.43	.8534	.1197	.0067	.0	2.30
2.45	.8699	.1265	.0069	.0	2.36
2.46	.8865	.1335	.0070	.0	2.43
2.48	.9030	.1407	.0071	.0	2.49
2.49	.9195	.1479	.0073	.0	2.55
2.51	.9316	.1534	.0054	.0	2.60
2.52	.9361	.1554	.0020	.0	2.61
2.53	.9405	.1574	.0020	.0	2.53
2.55	.9450	.1595	.0020	.0	2.33
2.56	.9495	.1615	.0020	.0	2.07
2.58	.9539	.1634	.0021	.0	1.80
2.59	.9584	.1654	.0021	.0	1.54

PROJECT : Valley Camp Coal - D-3 Runoff Calculations
(Continued)

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.61	.9629	.1677	.0021	.0	1.33

HYDROGRAPH PEAK= 2.61 cfs
TIME TO PEAK= 2.52 Hours
RUNOFF VOLUME= .24 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client: Valley Camp Coal Co. | Date: 30-Jun-89
Project No.: 007.11.100 | Time: 04:26 PM
Channel Section: D-3 | Computed: DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	2.61	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	2.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.015	ft/ft
	Max. Bottom Slope:	0.015	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	0.69	feet
	Qn/1.49(S)1/2=	0.430	
	A(R)2/3=	0.435	
	Required Depth:	1.19	feet
	Area:	0.95	ft2
	Perimeter:	3.09	feet
	Hydraulic Radius:	0.31	feet
	Velocity:	2.74	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.69	feet
	Qn/1.49(S)1/2=	0.430	
	A(R)2/3=	0.435	
	Required Depth:	1.19	feet
	Area:	0.95	ft2
	Perimeter:	3.09	feet
	Hydraulic Radius:	0.31	feet
	Velocity:	2.74	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	0.0	feet
	Side Slope 1:	2.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope:	1.5	%
	Max. Bottom Slope:	1.5	%
	Min Channel Depth:	1.19	feet
	Riprap (Min S):	Not Needed	
	Riprap (Max S):	Not Needed	

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Pehmit
FEATURE D-5A
PROJECT NO. 007.11.100

SHEET 1 OF 2
COMPUTED Paul
CHECKED
DATE 5/11/89

D-5A (Convenience Ditch)

Total Area = 330 * 0.00175 = 0.6 acres

CN = 90 (disturbed)

Precipitation = 1.55 inches (10 year, 6 hr)

hydraulic length = 225 feet

$$\text{slope} = \frac{(450')(5')(100)}{43{,}560\,(0.6)} = 8.6\%$$

Calculated Run-off $Q_{TOT} = 0.43$ cfs

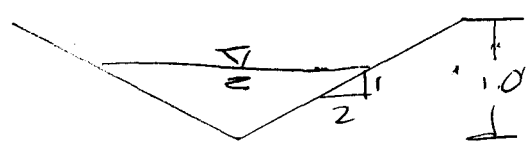
Pad Slope ~ 2½/200 = 1.25%
m = 2 n = 0.03
b = 0

$\frac{Qn}{1.49S^{1/2}} = 0.078$

y	$AR^{2/3}$
.3	0.047
.4	0.102
.35	0.071
.36	0.077

A = .259
R = 0.161
⇒ V = 1.66 fps

USE GENERAL DESIGN



V = 1.7 fps < 5 fps - No Lining Reqd

PROJECT : Valley Camp Coal - D-5A Runoff Calculations

AREA= .6 ACRES
AVERAGE BASIN SLOPE= 8.6 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 225. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0256 HOURS QPCFS= 17.71 CFS QPIN=29.2676 INCHES
C3=144.2600 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.54	.2204	.0000	.0000	.0	.00
1.56	.2279	.0000	.0000	17.7	.00
1.59	.2355.	.0002	.0001	5.7	.00
1.61	.2430	.0004	.0002	.6	.00
1.64	.2506	.0007	.0003	.0	.00
2.33	.7377	.1633	.0154	.0	.37
2.36	.7671	.1793	.0159	.0	.38
2.38	.7965	.1957	.0164	.0	.39
2.41	.8259	.2125	.0168	.0	.40
2.43	.8553	.2298	.0173	.0	.41
2.46	.8847	.2474	.0177	.0	.42
2.49	.9141	.2655	.0180	.0	.43
2.51	.9336	.2777	.0122	.0	.33
2.54	.9416	.2827	.0050	.0	.17
2.56	.9495	.2877	.0050	.0	.13
2.59	.9575	.2928	.0051	.0	.12
2.61	.9654	.2979	.0051	.0	.12
2.64	.9734	.3030	.0051	.0	.12

HYDROGRAPH PEAK= .43 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .04 Acre-Feet

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE D-5B
PROJECT NO. 007.11.100

SHEET 1 OF 3
COMPUTED paul
CHECKED
DATE 5/11/89

D-5B

Total Area = 1614 * 0.00175 = 2.8 acres
disturbed = = 2.4
paved = 234 = 0.4

CN	A	Q
90	2.4	0.723
98	0.4	1.329
		$\bar{Q}$=0.810

$\bar{CN}$ = 91.5

Precipitation = 1.55 inches (10 yr, 6 hr)

hydraulic length = 850 feet

$$\text{slope} = \frac{(4075)(5)(100)}{43{,}560\,(2.8)} = 16.7\%$$

Calculated Run-Off: Q_{TOT} = 2.16 cfs

Ditch Design

Smin = 3%

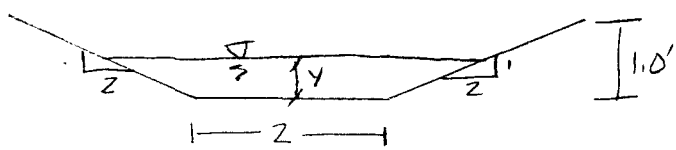
Smax = 11%

try trapezoidal channel

b=0, m_1=2, m_2=2, n=0.03

V = 4.78 ft/sec < 5.0 ft/sec OK

" No Lining required



PROJECT : Valley Camp Coal - D-5B Runoff Calculations

AREA= 2.8 ACRES
AVERAGE BASIN SLOPE= 16.7 PERCENT
CURVE NUMBER= 91.5
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 850. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0500 HOURS QPCFS= 42.36 CFS QPIN=15.0016 INCHES
C3= 73.9430 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.35	.1837	.0000	.0000	.0	.00
1.37	.1866	.0000	.0000	8.6	.00
1.38	.1894	.0000	.0000	32.5	.00
1.40	.1922	.0000	.0000	42.4	.00
1.42	.1951	.0000	.0000	35.8	.00
1.43	.1979	.0002	.0000	23.8	.00
1.45	.2008	.0002	.0000	13.6	.00
1.47	.2036	.0003	.0000	7.0	.00
1.48	.2065	.0004	.0001	3.3	.01
1.50	.2093	.0006	.0001	1.5	.01
1.52	.2142	.0008	.0003	.6	.02
1.53	.2192	.0012	.0003	.3	.03
1.55	.2241	.0015	.0004	.1	.03
1.57	.2290	.0019	.0004	.0	.04
2.40	.8158	.2546	.0122	.0	1.99
2.42	.8350	.2670	.0124	.0	2.02
2.43	.8541	.2796	.0126	.0	2.05
2.45	.8732	.2923	.0127	.0	2.08
2.47	.8923	.3052	.0129	.0	2.11
2.48	.9115	.3182	.0130	.0	2.14
2.50	.9302	.3311	.0129	.0	2.16
2.52	.9353	.3347	.0036	.0	2.09
2.53	.9405	.3383	.0036	.0	1.80
2.55	.9457	.3419	.0036	.0	1.41
2.57	.9508	.3455	.0036	.0	1.08
2.58	.9560	.3491	.0036	.0	.86
2.60	.9612	.3527	.0036	.0	.73

HYDROGRAPH PEAK= 2.16 cfs
TIME TO PEAK= 2.50 Hours
RUNOFF VOLUME= .19 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client:	Valley Camp Coal Co.	Date:	30-Jun-89
Project No.:	007.11.100	Time:	04:55 PM
Channel Section:	D-5B	Computed:	DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	2.16	cfs
	Bottom Width:	2.0	feet
	Side Slope1:	2.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.030	ft/ft
	Max. Bottom Slope:	0.110	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	0.28	feet
	Qn/1.49(S)1/2=	0.252	
	A(R)2/3=	0.253	
	Required Depth:	0.78	feet
	Area:	0.70	ft2
	Perimeter:	3.23	feet
	Hydraulic Radius:	0.22	feet
	Velocity:	3.08	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.19	feet
	Qn/1.49(S)1/2=	0.131	
	A(R)2/3=	0.133	
	Required Depth:	0.69	feet
	Area:	0.45	ft2
	Perimeter:	2.85	feet
	Hydraulic Radius:	0.16	feet
	Velocity:	4.78	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	2.0	feet
	Side Slope 1:	2.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope:	3.0	%
	Max. Bottom Slope:	11.0	%
	Min Channel Depth:	0.78	feet
	Riprap (Min S):	Not Needed	
	Riprap (Max S):	Not Needed	

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE D-6
PROJECT NO. 007.11.100

SHEET 1 OF 3
COMPUTED Paul
CHECKED
DATE 5/11/89

D-6

Total Area = 630 * 0.00175 = 1.1 acres
disturbed = = 1.0 ac
paved (Bldg) = = 0.1 ac

CN	A	Q
90	1.0	0.723
98	1.1	1.329
		$\bar{Q}$: 0.778

$\bar{CN} = 91.0$

Precipitation = 1.55 inches (10 yr, 6 hr)

hydraulic length = 500 feet

$$\text{slope} = \frac{(950')(5')(100)}{43{,}560\,(1.1)} = 9.9\%$$

Calculated Run-Off $Q_{TOT} = 0.82$ cfs

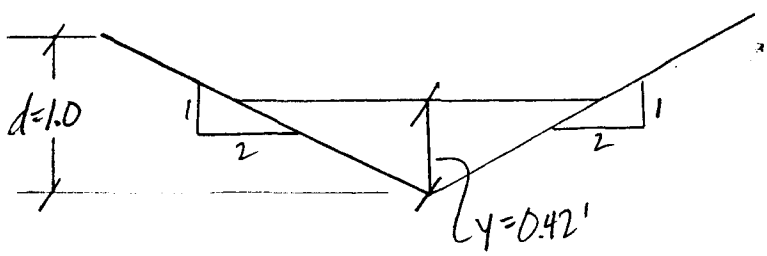
Ditch Design

$S_{min} = 2\%$

$S_{max} = 2\%$

try trapezoidal channel
$b=0$, $m=2$, $n=0.03$

$V = 2.30$ ft/sec < 5.0 ft/sec
No lining required



PROJECT : Valley Camp Coal - D-6 Runoff Calculations

AREA= 1.1 ACRES
AVERAGE BASIN SLOPE= 9.9 PERCENT
CURVE NUMBER= 91.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 500. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0434 HOURS QPCFS= 19.17 CFS QPIN=17.2837 INCHES
C3= 85.1915 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.43	.1976	.0000	.0000	.0	.00
1.45	.2000	.0000	.0000	3.9	.00
1.46	.2025	.0000	.0000	14.7	.00
1.47	.2050	.0000	.0000	19.2	.00
1.49	.2074	.0000	.0000	16.2	.00
1.50	.2104	.0002	.0000	10.8	.00
1.52	.2146	.0003	.0001	6.2	.00
1.53	.2189	.0004	.0002	3.2	.00
1.55	.2232	.0006	.0002	1.5	.00
1.56	.2274	.0009	.0002	.7	.00
1.58	.2317	.0011	.0003	.3	.01
1.59	.2359	.0014	.0003	.1	.02
1.61	.2402	.0017	.0003	.0	.02
2.41	.8323	.2480	.0104	.0	.77
2.43	.8489	.2585	.0105	.0	.78
2.44	.8655	.2691	.0106	.0	.79
2.46	.8821	.2798	.0107	.0	.80
2.47	.8986	.2907	.0108	.0	.81
2.49	.9152	.3016	.0110	.0	.82
2.50	.9305	.3118	.0102	.0	.82
2.52	.9350	.3148	.0030	.0	.79
2.53	.9395	.3178	.0030	.0	.67
2.54	.9439	.3208	.0030	.0	.53
2.56	.9484	.3239	.0030	.0	.40
2.57	.9529	.3269	.0030	.0	.32
2.59	.9574	.3300	.0030	.0	.28

HYDROGRAPH PEAK= .82 cfs
TIME TO PEAK= 2.50 Hours
RUNOFF VOLUME= .07 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client:	Valley Camp Coal Company	Date:	18-May-89
Project No.:	007.11.100	Time:	11:42 AM
Channel Section:	Ditch D-6	Computed:	PGH

			UNITS
GENERAL CRITERIA:	Design Flow:	0.82	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	2.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.02	ft/ft
	Max. Bottom Slope:	0.02	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. Flow):	0.42	feet
	Qn/1.49(S)1/2=	0.117	
	A(R)2/3=	0.117	
	Required Depth:	0.92	feet
	Area:	0.36	ft2
	Perimeter:	1.89	feet
	Hydraulic Radius:	0.19	feet
	Velocity:	2.30	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. Flow):	0.42	feet
	Qn/1.49(S)1/2=	0.117	
	A(R)2/3=	0.117	
	Required Depth:	0.92	feet
	Area:	0.36	ft2
	Perimeter:	1.89	feet
	Hydraulic Radius:	0.19	feet
	Velocity:	2.30	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	0.0	feet
	Side Slope 1:	2.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope :	0.02	ft/ft
	Max. Bottom Slope :	0.02	ft/ft
	Min. Channel Depth:	0.92	feet
	Riprap:	Not Needed	

Comment:

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE D-7A
PROJECT NO. 007.11.100

SHEET 1 OF 3
COMPUTED Paul
CHECKED
DATE 5/11/89

D-7A

Total Area = 453 ÷ 0.00175 = 0.8 ac

CN = 90 (disturbed)

Precipitation = 1.55 inches (10 yr, 6 hr)

hydraulic length = 500 feet

$$\text{slope} = \frac{(1650)(5)(100)}{43{,}560\,(0.8)} = 23.7\%$$

Calculated Run-off: $Q_{TOT} = 0.57$ cfs

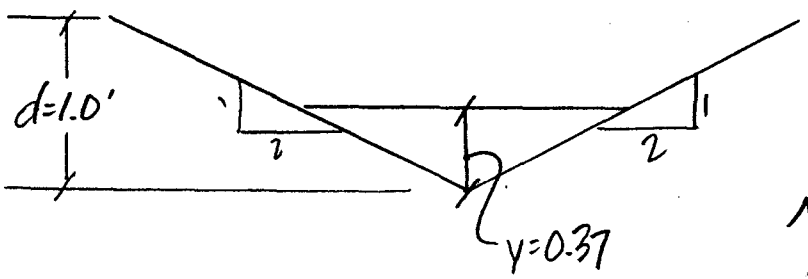
Ditch Design

$S_{min} = 2\%$

$S_{max} = 8\%$

try trapezoidal channel

$b = 0,\ m = 2,\ n = 0.03$



$V = 3.51$ ft/sec < 5.0 ft/sec OK

No lining necessary

PROJECT : Valley Camp Coal - D-7A Runoff Calculations

AREA= .8 ACRES
AVERAGE BASIN SLOPE= 23.7 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 500. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0292 HOURS QPCFS= 20.69 CFS QPIN=25.6497 INCHES
C3=126.4273 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.52	.2147	.0000	.0000	.0	.00
1.55	.2233	.0000	.0000	20.7	.00
1.58	.2319	.0000	.0000	6.7	.00
1.61	.2405	.0003	.0002	.7	.00
1.64	.2491	.0006	.0003	.0	.00
2.31	.7084	.1480	.0169	.0	.47
2.34	.7419	.1656	.0176	.0	.49
2.37	.7754	.1839	.0183	.0	.51
2.39	.8089	.2027	.0189	.0	.53
2.42	.8424	.2221	.0194	.0	.54
2.45	.8759	.2421	.0200	.0	.56
2.48	.9094	.2626	.0205	.0	.57
2.51	.9335	.2776	.0150	.0	.46
2.54	.9425	.2833	.0057	.0	.23
2.57	.9516	.2890	.0057	.0	.17
2.60	.9606	.2948	.0058	.0	.16
2.63	.9697	.3006	.0058	.0	.16
2.66	.9787	.3064	.0058	.0	.16

HYDROGRAPH PEAK= .57 cfs
TIME TO PEAK= 2.48 Hours
RUNOFF VOLUME= .05 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client:	Valley Camp Coal Company	Date:	12-May-89
Project No.:	007.11.100	Time:	03:09 PM
Channel Section:	Ditch D-7A	Computed:	PGH

			UNITS
GENERAL CRITERIA:	Design Flow:	0.57	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	2.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.02	ft/ft
	Max. Bottom Slope:	0.08	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. Flow):	0.37	feet
	Qn/1.49(S)1/2=	0.081	
	A(R)2/3=	0.081	
	Required Depth:	0.87	feet
	Area:	0.27	ft2
	Perimeter:	1.65	feet
	Hydraulic Radius:	0.16	feet
	Velocity:	2.10	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. Flow):	0.29	feet
	Qn/1.49(S)1/2=	0.041	
	A(R)2/3=	0.041	
	Required Depth:	0.79	feet
	Area:	0.16	ft2
	Perimeter:	1.27	feet
	Hydraulic Radius:	0.13	feet
	Velocity:	3.51	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	0.0	feet
	Side Slope 1:	2.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope :	0.02	ft/ft
	Max. Bottom Slope :	0.08	ft/ft
	Min. Channel Depth:	0.87	feet
	Riprap:	Not Needed	

Comment:

D-7B

Total Area = 905 * 0.00175 = 1.6 ac
paved = 155 = 0.3 ac
disturbed = = 1.3 ac

CN	A	Q
98	0.3	1.329
90	1.3	0.723
		$\bar{Q}$=0.837

$\bar{CN}$=91.9

Precipitation = 1.55 inches (10 yr, 6 hr)

hydraulic length = 700'

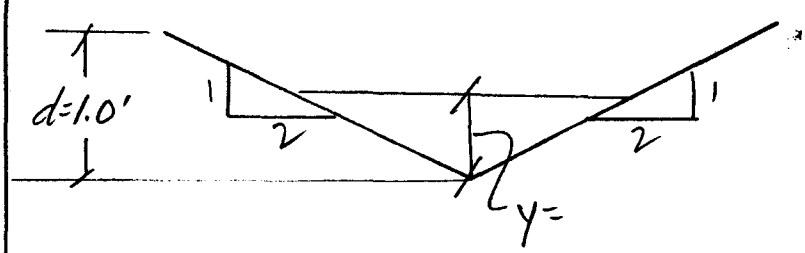
slope = $\frac{(1875)(5)(100)}{43{,}560\,(1.6)}$ = 13.5%

Calculated Run-Off ⇒ Q_{TOT} = 1.27 cfs

Ditch Design

S_{min} = 4.5% by trapezoidal channel

S_{max} = 11% b=1.0, M=2, n=0.03



∴ V = 4.54 ft/sec < 5.0 ft/sec OK

No lining required

PROJECT : Valley Camp Coal - D-7B Runoff Calculations

AREA= 1.6 ACRES
AVERAGE BASIN SLOPE= 13.5 PERCENT
CURVE NUMBER= 91.9
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 700. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0468 HOURS QPCFS= 25.87 CFS QPIN=16.0323 INCHES
C3= 79.0230 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.29	.1741	.0000	.0000	.0	.00
1.31	.1768	.0000	.0000	5.2	.00
1.33	.1794	.0000	.0000	19.8	.00
1.34	.1821	.0000	.0000	25.9	.00
1.36	.1848	.0000	.0000	21.9	.00
1.37	.1874	.0001	.0000	14.5	.00
1.39	.1901	.0002	.0000	8.3	.00
1.40	.1927	.0003	.0000	4.3	.00
1.42	.1954	.0004	.0001	2.1	.00
1.43	.1980	.0005	.0001	.9	.00
1.45	.2007	.0007	.0001	.4	.00
1.47	.2034	.0008	.0001	.2	.01
1.48	.2060	.0010	.0002	.0	.01
2.40	.8163	.2692	.0118	.0	1.18
2.42	.8342	.2812	.0119	.0	1.19
2.43	.8520	.2933	.0121	.0	1.21
2.45	.8699	.3055	.0122	.0	1.22
2.46	.8878	.3178	.0123	.0	1.24
2.48	.9057	.3303	.0125	.0	1.25
2.49	.9236	.3429	.0126	.0	1.27
2.51	.9331	.3496	.0068	.0	1.25
2.53	.9379	.3531	.0034	.0	1.13
2.54	.9428	.3565	.0034	.0	.92
2.56	.9476	.3600	.0035	.0	.71
2.57	.9524	.3634	.0035	.0	.55
2.59	.9573	.3669	.0035	.0	.46

HYDROGRAPH PEAK= 1.27 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .11 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client:	Valley Camp Coal Company	Date:	12-May-89
Project No.:	007.11.100	Time:	03:05 PM
Channel Section:	Ditch D-7B	Computed:	PGH

			UNITS
GENERAL CRITERIA:	Design Flow:	1.27	cfs
	Bottom Width:	1.0	feet
	Side Slope1:	2.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.05	ft/ft
	Max. Bottom Slope:	0.11	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. Flow):	0.25	feet
	Qn/1.49(S)1/2=	0.121	
	A(R)2/3=	0.121	
	Required Depth:	0.75	feet
	Area:	0.38	ft2
	Perimeter:	2.13	feet
	Hydraulic Radius:	0.18	feet
	Velocity:	3.33	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. Flow):	0.20	feet
	Qn/1.49(S)1/2=	0.077	
	A(R)2/3=	0.078	
	Required Depth:	0.70	feet
	Area:	0.28	ft2
	Perimeter:	1.89	feet
	Hydraulic Radius:	0.15	feet
	Velocity:	4.54	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	1.0	feet
	Side Slope 1:	2.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope :	0.05	ft/ft
	Max. Bottom Slope :	0.11	ft/ft
	Min. Channel Depth:	0.75	feet
	Riprap:	Not Needed	

Comment:

D-8

Total Area = 857 * 0.00175 = 1.5 acres
disturbed = 757 = 1.3 ac
paved = 100 = 0.2 ac

CN	A	Q
90	1.3	0.723
98	0.2	1.329

$\bar{Q} = 0.804$ $\bar{CN} = 91.4$

Note: Drainage Area from C-11-12 also contributes to D-8 flow

Precipitation = 1.55 inches (10 yr, 6 hr)

hydraulic length = 600 feet

$$\text{slope} = \frac{(3400)(5)(100)}{43{,}560\,(1.5)} = 26.0\%$$

Calculated Runoff $Q_{TOT} = 1.17$ cfs

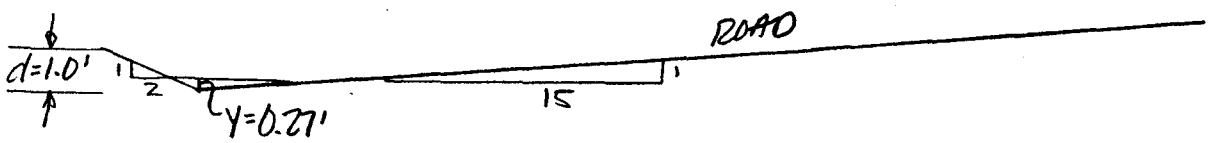
Ditch Design

$S_{min} = 2\%$ try trapezoidal Channel

$S_{max} = 13\%$ $b=0,\ m_1=2,\ m_2=15,\ n=0.03$

Use Roadway Design $V = 3.73$ ft/sec < 5.0 ft/sec OK

No lining required



PROJECT : Valley Camp Coal - D-8 Runoff Calculations

AREA= 1.5 ACRES
AVERAGE BASIN SLOPE= 26.0 PERCENT
CURVE NUMBER= 91.4
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 600. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0305 HOURS QPCFS= 37.25 CFS QPIN=24.6265 INCHES
C3=121.3839 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.37	.1872	.0000	.0000	.0	.00
1.39	.1898	.0000	.0000	18.2	.00
1.40	.1924	.0000	.0000	37.2	.00
1.42	.1950	.0000	.0000	26.3	.00
1.43	.1976	.0000	.0000	12.0	.00
1.45	.2002	.0002	.0000	4.3	.00
1.46	.2028	.0002	.0000	1.3	.00
1.48	.2054	.0003	.0000	.4	.00
1.49	.2080	.0004	.0000	.0	.00
2.41	.8226	.2555	.0112	.0	1.09
2.42	.8400	.2668	.0113	.0	1.11
2.44	.8575	.2782	.0114	.0	1.12
2.45	.8750	.2898	.0116	.0	1.13
2.47	.8924	.3015	.0117	.0	1.15
2.48	.9099	.3133	.0118	.0	1.16
2.50	.9274	.3252	.0119	.0	1.17
2.51	.9340	.3298	.0046	.0	1.05
2.53	.9387	.3330	.0033	.0	.76
2.54	.9435	.3363	.0033	.0	.52
2.56	.9482	.3396	.0033	.0	.39
2.57	.9529	.3429	.0033	.0	.35
2.59	.9576	.3461	.0033	.0	.33

HYDROGRAPH PEAK= 1.17 cfs
TIME TO PEAK= 2.50 Hours
RUNOFF VOLUME= .10 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client:	Valley Camp Coal Company	Date:	12-May-89
Project No.:	007.11.100	Time:	02:56 PM
Channel Section:	Ditch D-8	Computed:	PGH

			UNITS
GENERAL CRITERIA:	Design Flow:	1.17	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	15.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.02	ft/ft
	Max. Bottom Slope:	0.13	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. Flow):	0.27	feet
	Qn/1.49(S)1/2=	0.167	
	A(R)2/3=	0.168	
	Required Depth:	0.77	feet
	Area:	0.64	ft2
	Perimeter:	4.73	feet
	Hydraulic Radius:	0.13	feet
	Velocity:	1.83	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. Flow):	0.19	feet
	Qn/1.49(S)1/2=	0.066	
	A(R)2/3=	0.065	
	Required Depth:	0.69	feet
	Area:	0.31	ft2
	Perimeter:	3.32	feet
	Hydraulic Radius:	0.09	feet
	Velocity:	3.73	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	0.0	feet
	Side Slope 1:	15.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope :	0.02	ft/ft
	Max. Bottom Slope :	0.13	ft/ft
	Min. Channel Depth:	0.77	feet
	Riprap:	Not Needed	

Comment:

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp Coal
PROJECT Permit
FEATURE D-9A, D-9B
PROJECT NO. 007.11.100

SHEET 1 OF 3
COMPUTED Paul
CHECKED
DATE 5/11/89

D-9A, D-9B (Convenience Ditches)

Total Area = 70 * 0.00175 = 0.1 acres

CN = 90

Precipitation = 1.55 inches

hydraulic length = 125'

$$\text{Slope} = \frac{(150)(5)(100)}{43{,}560\,(0.1)} = 17.2\%$$

The geometry of this basin does not fit the parameters necessary to run "HYDRO."

A comparison of the other basins in the immediate area, given the same storm are shown below:

Partial Summary of Ditch Capacity at Valcam

Ditch Number	Area (acres)	Slope (%)	CN	Runoff (cfs)
18A	2.1	43.0	[illegible]	0.46
13A	2.0	44.5	79.4	0.53
13B	2.2	43.7	80.7	0.67
18B	1.4	34.8	81.7	0.47
15	4.2	35.0	82.8	1.57
16A	5.1	31.6	84.3	2.13
3	5.6	41.8	85.5	2.61
5A	0.6	8.6	90.0	0.43
16B	0.7	33.6	90.0	0.50
7A	0.8	23.7	90.0	0.57
6	1.1	9.9	91.0	0.82
8	1.5	26.0	91.4	1.17

As noted, the basin in question differs from those available.

Alternate method - Calculate the time of concentration using the rational method - and re-run "HYDRO" with the new value

A method for calculating the time of concentration is presented in Urban Storm Drainage Criteria Manual - Volume I by Wright-McLaughlin Engineers (March 1969)

$$t_c = t_i + \cancel{t_t}^{\,0}$$

where t_c = time of concentration (minutes)
t_i = overland flow time (minutes)
t_t = travel time in ditch - (assume to be < 1 min) ∴ negligible

$$t_i = \frac{(1.8)(1.1 - C_{10})\sqrt{L}}{\sqrt[3]{S}}$$

where C_{10} = run-off coeff for 10 year freq
L - length overland flow
S - average basin slope (%)

for this basin

$C_{10} = 0.50$ (Railroad yard area most closely models the area.)

$L = 110'$
$S = 17.2$ ⟹ $t_i = 4.4$ minutes $= 0.073$ hours

Re-run "HYDRO" using calculated t_c

$Q_{TOT} = 0.07$ cfs

No further Design Anticipated

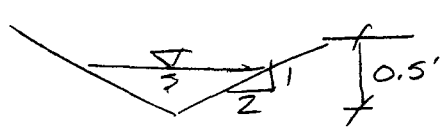
Slope = 5/60 = 0.083, b = 0, m = 2, n = 0.03

$\frac{Qn}{1.49 S^{1/2}} = 0.005$

Y	$AR^{2/3}$	
0.1	0.003	A = 0.034
0.13	0.005 ⟹	V = 2.071

V < 5 fps No Lining Req'd

Use Minimum Ditch Dimensions



PROJECT : Valley Camp Coal - D-9A, D-9B Runoff Calculation

AREA= .1 ACRES
AVERAGE BASIN SLOPE= 17.2 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 125. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR
USER INPUT TIME OF CONCENTRATION= .07 HOURS

TP= .0488 HOURS QPCFS= 1.55 CFS QPIN=15.3809 INCHES
C3= 75.8125 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.54	.2221	.0000	.0000	.0	.00
1.56	.2269	.0000	.0000	.3	.00
1.58	.2317	.0000	.0000	1.2	.00
1.59	.2365	.0002	.0001	1.6	.00
1.61	.2413	.0003	.0001	1.3	.00
1.63	.2461	.0005	.0002	.9	.00
1.64	.2508	.0007	.0002	.5	.00
1.66	.2556	.0010	.0003	.3	.00
1.67	.2604	.0013	.0003	.1	.00
1.69	.2652	.0016	.0003	.0	.00
2.40	.8210	.2097	.0107	.0	.06
2.42	.8397	.2206	.0109	.0	.06
2.44	.8583	.2316	.0110	.0	.07
2.45	.8769	.2428	.0112	.0	.07
2.47	.8956	.2541	.0113	.0	.07
2.49	.9142	.2656	.0115	.0	.07
2.50	.9308	.2759	.0103	.0	.07
2.52	.9358	.2791	.0032	.0	.07
2.53	.9408	.2822	.0032	.0	.06
2.55	.9459	.2854	.0032	.0	.04
2.57	.9509	.2886	.0032	.0	.03
2.58	.9560	.2918	.0032	.0	.03
2.60	.9610	.2950	.0032	.0	.02

HYDROGRAPH PEAK= .07 cfs
TIME TO PEAK= 2.50 Hours
RUNOFF VOLUME= .00 Acre-Feet

D-10

Total Area = 8.5 * 1.401 12.8 acres

CN = 75 (25% sage/grass)

Precipitation = 1.55 inches (10yr, 6 hr)

hydraulic length = 1800 ft

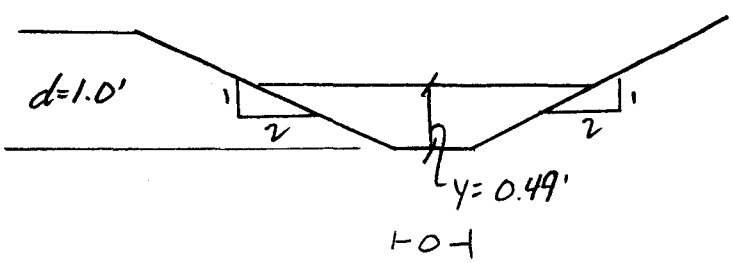
$$\text{slope} = \frac{(1700)(80)(100)}{43{,}560\,(12.8)} = 24.4\ \%$$

Calculated Runoff $Q_{TOT_{10yr}} = 1.18$ cfs

Ditch Design

$S_{min} = 2\%$ try trapezoidal channel

$S_{max} = 3\%$ $b = 0'$, $m = 2$, $n = 0.03$



$V_{max} = 2.9$ fps < 5.0 fps @

No Lining Required

PROJECT : Valley Camp Coal - D-10 Runoff Calculation

AREA= 12.8 ACRES
AVERAGE BASIN SLOPE= 24.4 PERCENT
CURVE NUMBER= 75.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 1500. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .1328 HOURS QPCFS= 72.87 CFS QPIN= 5.6460 INCHES
C3= 27.8293 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.26	.6526	.0000	.0000	.0	.00
2.28	.6831	.0000	.0000	3.7	.00
2.31	.7135	.0006	.0006	22.6	.00
2.34	.7440	.0018	.0011	48.4	.02
2.36	.7745	.0034	.0016	66.9	.06
2.39	.8049	.0055	.0021	72.9	.14
2.42	.8354	.0081	.0026	68.3	.26
2.44	.8659	.0112	.0031	57.6	.41
2.47	.8964	.0148	.0036	45.1	.58
2.50	.9268	.0188	.0040	33.3	.78
2.52	.9374	.0203	.0015	23.4	.98
2.55	.9456	.0215	.0012	15.9	1.12
2.58	.9539	.0228	.0012	10.5	1.18
2.60	.9621	.0241	.0013	6.7	1.16
2.63	.9703	.0254	.0013	4.2	1.08
2.66	.9786	.0267	.0013	2.6	.99
2.68	.9868	.0281	.0014	1.6	.90
2.71	.9950	.0294	.0014	.9	.82
2.74	1.0033	.0309	.0014	.6	.77
2.76	1.0115	.0323	.0015	.3	.73
2.79	1.0197	.0338	.0015	.2	.71
2.82	1.0280	.0353	.0015	.1	.70
2.84	1.0362	.0369	.0015	.0	.70

HYDROGRAPH PEAK= 1.18 cfs
TIME TO PEAK= 2.58 Hours
RUNOFF VOLUME= .20 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client:	Valley Camp Coal Co.	Date:	12-Jul-89
Project No.:	007.11.100	Time:	02:34 PM
Channel Section:	D-10	Computed:	DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	1.18	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	2.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.020	ft/ft
	Max. Bottom Slope:	0.030	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	0.49	feet
	Qn/1.49(S)1/2=	0.168	
	A(R)2/3=	0.170	
	Required Depth:	0.99	feet
	Area:	0.47	ft2
	Perimeter:	2.17	feet
	Hydraulic Radius:	0.22	feet
	Velocity:	2.51	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.45	feet
	Qn/1.49(S)1/2=	0.138	
	A(R)2/3=	0.139	
	Required Depth:	0.95	feet
	Area:	0.41	ft2
	Perimeter:	2.01	feet
	Hydraulic Radius:	0.20	feet
	Velocity:	2.91	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	0.0	feet
	Side Slope 1:	2.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope:	2.0	%
	Max. Bottom Slope:	3.0	%
	Min Channel Depth:	0.99	feet
	Riprap (Min S):	Not Needed	
	Riprap (Max S):	Not Needed	

D-12A

Total Area = 110 * 0.00175 = 0.2 ac
paved = = 0.1 ac
dist = 0.1 ac

CN	A	Q
98	0.1	1.329
90	0.1	0.723

$\overline{Q} = 1.026$ $\overline{CN} = 94.6$

Precipitation = 1.55 inches (10 yr, 6hr)

hydraulic length = 200'

$$\text{slope} = \frac{(425)(5)(100)}{43{,}560\,(.2)} = 24.4\%$$

Note
The basin geometry does not allow "HYDRO" analysis.

Calculate t_c using Alternate Method

from "Urban Storm Drainage Criteria manual - Vol 1 by Wright McLaughlin Engineers (March 1969)

$$t_c = t_i + t_t^0$$

where t_c = time of concentration (minutes)
t_i = overland flow time (minutes)
t_t = travel time in ditch (assume negligible)

$$t_i = \frac{(1.8)(1.1 - C_{10})\sqrt{L}}{\sqrt[3]{S}}$$

where $L = 200'$
$S = 24.4\%$
$C_{10} = 0.50$

$t_c = t_i = 5.27$ minutes

$= 0.08777$ hours $\Rightarrow$ $Q_{TOT} = 0.19$ cfs

HANSEN ALLEN & LUCE INC

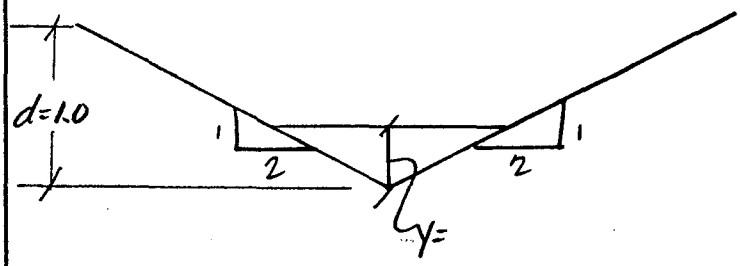
CLIENT Valley Camp
PROJECT Permit
FEATURE D-12A
PROJECT NO. 007.11.100

SHEET 2 OF 4
COMPUTED Paul
CHECKED
DATE 5/16/89

Ditch Design

try trapezoidal channel

$b=0,\ M=2,\ n=0.03$



$V=1.6$ ft/sec <5.0 ft/sec OK

$\therefore$ no lining required

PROJECT : Valley Camp Coal - D-12A Runoff Calculation

AREA= .2 ACRES
AVERAGE BASIN SLOPE= 24.4 PERCENT
CURVE NUMBER= 94.6
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 200. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR
USER INPUT TIME OF CONCENTRATION= .09 HOURS

TP= .0585 HOURS QPCFS= 2.58 CFS QPIN=12.8171 INCHES
C3= 63.1756 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
.92	.1131	.0000	.0000	.0	.00
.94	.1151	.0000	.0000	.2	.00
.95	.1172	.0000	.0000	1.3	.00
.97	.1192	.0000	.0000	2.2	.00
.98	.1212	.0000	.0000	2.6	.00
.99	.1233	.0001	.0000	2.3	.00
1.01	.1256	.0002	.0000	1.8	.00
1.02	.1281	.0003	.0001	1.3	.00
1.04	.1306	.0005	.0001	.8	.00
1.05	.1331	.0006	.0001	.5	.00
1.07	.1356	.0008	.0002	.3	.00
1.08	.1381	.0010	.0002	.2	.00
1.10	.1406	.0012	.0002	.0	.00
2.41	.8313	.3993	.0134	.0	.18
2.43	.8481	.4128	.0135	.0	.18
2.44	.8649	.4264	.0136	.0	.18
2.46	.8816	.4401	.0137	.0	.18
2.47	.8984	.4539	.0138	.0	.18
2.49	.9152	.4677	.0138	.0	.19
2.50	.9305	.4804	.0127	.0	.19
2.52	.9351	.4842	.0038	.0	.19
2.53	.9396	.4880	.0038	.0	.17
2.55	.9441	.4918	.0038	.0	.15
2.56	.9487	.4955	.0038	.0	.12
2.57	.9532	.4993	.0038	.0	.10
2.59	.9577	.5031	.0038	.0	.08

HYDROGRAPH PEAK= .19 cfs
TIME TO PEAK= 2.50 Hours
RUNOFF VOLUME= .02 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client:	Valley Camp Coal Company	Date:	16-May-89
Project No.:	007.11.100	Time:	02:13 PM
Channel Section:	Ditch D-12A	Computed:	PGH

			UNITS
GENERAL CRITERIA:	Design Flow:	0.19	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	2.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.02	ft/ft
	Max. Bottom Slope:	0.02	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	**Depth (Min. Flow):**	**0.24**	**feet**
	Qn/1.49(S)1/2=	0.027	
	A(R)2/3=	0.027	
	Required Depth:	0.74	feet
	Area:	0.12	ft2
	Perimeter:	1.09	feet
	Hydraulic Radius:	0.11	feet
	Velocity:	1.60	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. Flow):	0.24	feet
	Qn/1.49(S)1/2=	0.027	
	A(R)2/3=	0.027	
	Required Depth:	0.74	feet
	Area:	0.12	ft2
	Perimeter:	1.09	feet
	Hydraulic Radius:	0.11	feet
	Velocity:	1.60	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	0.0	feet
	Side Slope 1:	2.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope :	0.02	ft/ft
	Max. Bottom Slope :	0.02	ft/ft
	Min. Channel Depth:	0.74	feet
	Riprap:	Not Needed	

Comment:

HANSEN ALLEN & LUCE INC

CLIENT: Valley Camp
PROJECT: Permit
FEATURE:
PROJECT NO. 007.11.100

SHEET 1 OF 2
COMPUTED DEK
CHECKED
DATE 5/11/89

D-12B (Convenience Ditch)

TOTAL AREA = 0.86 ac 0.63 ac Disturbed
0.23 ac Paved

Area	CN	Q
0.63	90	0.723
0.23	98	1.329

$\bar{Q} = 0.885 \rightarrow CN = 92.6$

PRECIP = 1.55 in

Hyd LENGTH = 530'

$$\text{SLOPE} = \frac{(2370)\,5\,(100)}{43560\,(0.86)} = 31.6\%$$

Calculated Runoff $Q_{TOT} = 0.74$ cfs

SMALL DITCH - USE GENERAL DESIGN; $b=0,\ d=1.0,\ m=2$

SLOPE = 5/300 = 0.017

$b=0,\ m=2,\ n=0.03$ $\frac{Qn}{1.49S^{1/2}} = 0.115$

Y	$AR^{2/3}$
0.5	0.184
0.4	0.102
0.42	0.116

$\Rightarrow$ A = 0.353
V = 2.1 fps < 5 fps ✓

No Lining Req'd

PROJECT : Valley Camp Coal - D-12B Runoff Calculation

AREA= .9 ACRES
AVERAGE BASIN SLOPE= 31.6 PERCENT
CURVE NUMBER= 92.6
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 520. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0237 HOURS QPCFS= 27.42 CFS QPIN=31.6169 INCHES
C3=155.8398 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.21	.1598	.0000	.0000	.0	.00
1.23	.1638	.0000	.0000	27.4	.00
1.26	.1678	.0000	.0000	8.8	.00
1.28	.1719	.0002	.0000	1.0	.00
1.30	.1759	.0003	.0001	.0	.00
2.35	.7560	.2547	.0181	.0	.67
2.37	.7832	.2732	.0185	.0	.68
2.40	.8104	.2919	.0188	.0	.70
2.42	.8376	.3110	.0191	.0	.71
2.44	.8648	.3304	.0194	.0	.72
2.47	.8920	.3501	.0197	.0	.73
2.49	.9192	.3700	.0199	.0	.74
2.51	.9344	.3813	.0113	.0	.51
2.54	.9418	.3867	.0055	.0	.27
2.56	.9491	.3922	.0055	.0	.21
2.59	.9565	.3977	.0055	.0	.21
2.61	.9639	.4032	.0055	.0	.21
2.63	.9712	.4088	.0055	.0	.21

HYDROGRAPH PEAK= .74 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .06 Acre-Feet

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE D-12C
PROJECT NO. 007.11.100

SHEET 1 OF 2
COMPUTED Paul
CHECKED
DATE 5/11/89

D-12C (Convenience Ditch)

Total Area = 36 * 0.00175 = 0.1 ac

CN = 90

Precipitation = 1.55 inches (10 yr, 6 hr)

hydraulic length = 100'

$$\text{slope} = \frac{(100)(5)(100)}{43{,}560\,(.1)} = 11.5\%$$

Calculated Run-off

Basin Geometry does not provide viable solution using "HYDRO". Calculate t_c using alternate method and then re-run HYDRO. See D-12A for methodology

$$t_c = \frac{1.8(1.1 - C_{10})\sqrt{L}}{\sqrt[3]{S}}$$

where $L = 100'$
$S = 11.5\%$
$C_{10} = 0.50$

$t_c = 4.78$ minutes
$= 0.07975$ hours

Re-run "HYDRO" ⇒ $Q_{100} = 0.07$ cfs

No further design Anticipated

Slope ~ 2% $b = 0$, $m = 2$, $n = 0.03$ $\frac{Qn}{1.49 S^{1/2}} = 0.010$

y	$AR^{2/3}$
0.1	0.003
0.2	0.016
0.17	0.010 ⇒ $A = 0.058$

$V = 1.2$ fps < 5 fps ✓

No Lining Required

PROJECT : Valley Camp Coal - D-12C Runoff Calculation

AREA= .1 ACRES
AVERAGE BASIN SLOPE= 11.5 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 100. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR
USER INPUT TIME OF CONCENTRATION= .08 HOURS

TP= .0532 HOURS QPCFS= 1.42 CFS QPIN=14.1061 INCHES
C3= 69.5288 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.54	.2215	.0000	.0000	.0	.00
1.56	.2267	.0000	.0000	.3	.00
1.58	.2319	.0000	.0000	1.1	.00
1.59	.2372	.0002	.0001	1.4	.00
1.61	.2424	.0004	.0002	1.2	.00
1.63	.2476	.0006	.0002	.8	.00
1.65	.2528	.0008	.0003	.5	.00
1.67	.2580	.0011	.0003	.2	.00
1.68	.2633	.0015	.0003	.1	.00
1.70	.2685	.0018	.0004	.0	.00
2.39	.8064	.2013	.0115	.0	.06
2.41	.8267	.2130	.0117	.0	.06
2.43	.8470	.2249	.0119	.0	.06
2.45	.8673	.2370	.0121	.0	.07
2.46	.8877	.2492	.0123	.0	.07
2.48	.9080	.2617	.0125	.0	.07
2.50	.9283	.2744	.0126	.0	.07
2.52	.9350	.2786	.0042	.0	.07
2.53	.9405	.2820	.0035	.0	.06
2.55	.9460	.2855	.0035	.0	.05
2.57	.9515	.2890	.0035	.0	.04
2.59	.9570	.2925	.0035	.0	.03
2.60	.9625	.2960	.0035	.0	.02

HYDROGRAPH PEAK= .07 cfs
TIME TO PEAK= 2.50 Hours
RUNOFF VOLUME= .00 Acre-Feet

D-12D

Total Area = 930 * 0.00175 = 1.6 ac
paved = 296 = 0.5 ac
disturbed = = 1.1 ac

CN	A	Q
98	0.5	1.329
90	1.1	0.723

$\overline{Q} = 0.912$ $\overline{CN} = 93.0$

Precipitation = 1.55 inches (10 yr, 6 hr)

hydraulic length = 750'

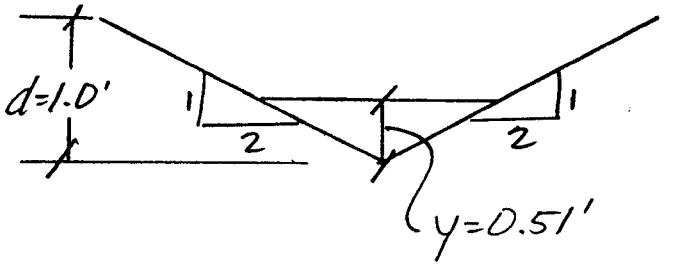
$$\text{slope} = \frac{(1150)(5)(100)}{(43{,}560)(1.6)} = 8.3\%$$

Calculated Runoff $Q_{TOT} = 1.35$ cfs

Ditch Design

$S_{min} = 2\%$ try trapezoidal Channel

$S_{max} = 2\%$ $b = 0,\ m = 2,\ n = 0.03$



$V = 2.60$ ft/sec < 5.0 ft/sec

No Lining required

PROJECT : Valley Camp Coal - D-12D Runoff Calculations

AREA= 1.6 ACRES
AVERAGE BASIN SLOPE= 8.3 PERCENT
CURVE NUMBER= 93.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 750. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0600 HOURS QPCFS= 20.17 CFS QPIN=12.5008 INCHES
C3= 61.6165 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.15	.1504	.0000	.0000	.0	.00
1.17	.1530	.0000	.0000	1.9	.00
1.18	.1555	.0000	.0000	9.9	.00
1.20	.1581	.0000	.0000	17.5	.00
1.21	.1607	.0001	.0000	20.2	.00
1.23	.1632	.0002	.0000	18.3	.00
1.24	.1658	.0003	.0000	14.2	.00
1.26	.1683	.0004	.0001	10.0	.00
1.27	.1709	.0005	.0001	6.5	.00
1.29	.1734	.0007	.0001	4.0	.00
1.30	.1760	.0008	.0002	2.3	.00
1.32	.1786	.0010	.0002	1.3	.01
1.33	.1811	.0012	.0002	.7	.01
1.35	.1837	.0014	.0002	.4	.01
1.36	.1862	.0016	.0002	.2	.02
1.38	.1888	.0018	.0002	.1	.02
1.39	.1913	.0021	.0002	.0	.02
2.41	.8325	.3242	.0124	.0	1.28
2.43	.8497	.3367	.0125	.0	1.29
2.45	.8669	.3493	.0126	.0	1.31
2.46	.8841	.3621	.0127	.0	1.32
2.48	.9013	.3749	.0128	.0	1.33
2.49	.9185	.3879	.0129	.0	1.34
2.51	.9316	.3977	.0099	.0	1.35
2.52	.9362	.4013	.0035	.0	1.32
2.54	.9409	.4048	.0035	.0	1.21
2.55	.9455	.4083	.0035	.0	1.04
2.57	.9502	.4119	.0036	.0	.86
2.58	.9548	.4155	.0036	.0	.71
2.60	.9595	.4190	.0036	.0	.59

HYDROGRAPH PEAK= 1.35 cfs
TIME TO PEAK= 2.50 Hours
RUNOFF VOLUME= .12 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client:	Valley Camp Coal Company	Date:	12-May-89
Project No.:	007.11.100	Time:	08:46 AM
Channel Section:	Ditch D-12D	Computed:	PGH

			UNITS
GENERAL CRITERIA:	Design Flow:	1.35	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	2.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.02	ft/ft
	Max. Bottom Slope:	0.02	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. Flow):	0.51	feet
	Qn/1.49(S)1/2=	0.193	
	A(R)2/3=	0.194	
	Required Depth:	1.01	feet
	Area:	0.52	ft2
	Perimeter:	2.28	feet
	Hydraulic Radius:	0.23	feet
	Velocity:	2.60	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. Flow):	0.51	feet
	Qn/1.49(S)1/2=	0.193	
	A(R)2/3=	0.194	
	Required Depth:	1.01	feet
	Area:	0.52	ft2
	Perimeter:	2.28	feet
	Hydraulic Radius:	0.23	feet
	Velocity:	2.60	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	0.0	feet
	Side Slope 1:	2.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope :	0.02	ft/ft
	Max. Bottom Slope :	0.02	ft/ft
	Min. Channel Depth:	1.01	feet
	Riprap:	Not Needed	

Comment:

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE
PROJECT NO. 007.11.100

SHEET 1 OF 2
COMPUTED Paul
CHECKED
DATE 5/11/89

D-12E . (Convenience ditch)

Total Area = 220 * 0.00175 = 0.23 ac
paved = 98 = 0.08
disturbed = 90 = 0.15

CN	Area	Q
98	0.08	1.329
90	0.15	0.723

$\overline{Q} = 0.934$ $\overline{CN} = 93.3$

Precipitation = 1.55 inches (10 yr, 6 hr)

hydraulic length = 180'

slope = $\frac{(200)(5)(100)}{43{,}560\,(0.23)} = 10.0\%$

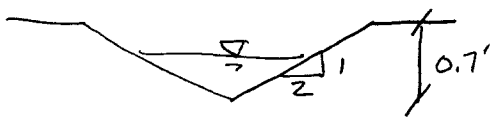
Calculated Run-off $Q_{TOT} = 0.21$ cfs

No further design anticipated

S = 5/90 = 0.056 , b = 0, m = 2, n = 0.03 $\frac{Qn}{1.49 S^{1/2}} = 0.018$

y	$AR^{2/3}$
0.4	0.102
0.1	0.003
0.2	0.016
0.21	0.018 ⇒ A = 0.088, V = 2.38 < 5 fps ✓

No Lining Req'd



PROJECT : Valley Camp Coal - D-12E Runoff Calculation

AREA= .2 ACRES
AVERAGE BASIN SLOPE= 10.0 PERCENT
CURVE NUMBER= 93.3
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 180. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0172 HOURS QPCFS= 10.11 CFS QPIN=43.5800 INCHES
CN=214.8059 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
.10	.1412	.0000	.0000	.0	.00
1.12	.1441	.0000	.0000	10.1	.00
1.14	.1470	.0000	.0000	3.3	.00
1.15	.1500	.0000	.0000	.4	.00
1.17	.1529	.0001	.0000	.0	.00
2.39	.8046	.3168	.0143	.0	.20
2.41	.8243	.3312	.0143	.0	.20
2.43	.8440	.3458	.0146	.0	.20
2.44	.8638	.3606	.0147	.0	.20
2.46	.8835	.3755	.0149	.0	.20
2.48	.9032	.3905	.0150	.0	.21
2.49	.9230	.4056	.0151	.0	.21
2.51	.9334	.4137	.0081	.0	.14
2.53	.9388	.4178	.0041	.0	.07
2.55	.9441	.4219	.0041	.0	.06
2.56	.9494	.4261	.0041	.0	.06
2.58	.9548	.4302	.0042	.0	.06
2.60	.9601	.4344	.0042	.0	.06

HYDROGRAPH PEAK= .21 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .02 Acre-Feet

D-13A

Total Area = 1150 × 0.00175 = 2.1 ac
sage/grass = 918 = 1.6 ac
disturbed = = 0.5 ac

CN	A	Q
75	1.6	0.1850
90	0.5	0.723

$\overline{Q} = 0.313$ $\overline{CN} = 80.1$

Precipitation = 1.55 inches (10 yr, 6 hr)

hydraulic length = 800 feet

$$\text{slope} = \frac{(1550)(25)(100)}{43{,}560\,(2.1)} = 42.4\ \%$$

Calculated Run-off ⇒ $Q_{TOT} = 0.60$ cfs

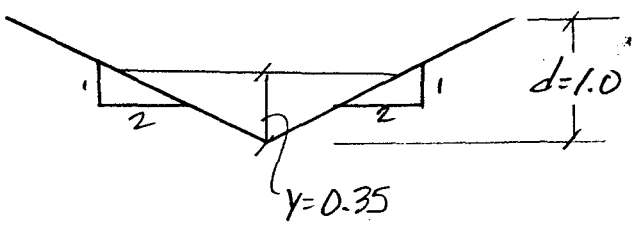
Ditch Design

$S_{min} = 3\%$

$S_{max} = 18\%$

try trapezoidal channel

$b = 0$, $M = 2$, $n = 0.03$



$V = 4.8 < 5.0$ ft/sec

∴ No lining required

PROJECT : Valley Camp Coal - D-13A Runoff Calcualation

AREA= 2.1 ACRES
AVERAGE BASIN SLOPE= 42.4 PERCENT
CURVE NUMBER= 80.1
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 800. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0452 HOURS QPCFS= 35.12 CFS QPIN=16.5868 INCHES
C3= 81.7565 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.11	.4824	.0000	.0000	.0	.00
2.12	.4997	.0000	.0000	7.1	.00
2.14	.5170	.0002	.0002	26.9	.00
2.16	.5343	.0006	.0004	35.1	.00
2.17	.5516	.0012	.0006	29.7	.02
2.19	.5689	.0020	.0008	19.7	.04
2.20	.5861	.0031	.0011	11.3	.07
2.22	.6034	.0044	.0013	5.8	.10
2.23	.6207	.0059	.0015	2.8	.13
2.25	.6380	.0076	.0017	1.3	.16
2.26	.6553	.0095	.0019	.5	.19
2.28	.6726	.0116	.0021	.2	.22
2.29	.6899	.0139	.0023	.0	.24
2.41	.8281	.0390	.0037	.0	.46
2.43	.8454	.0429	.0039	.0	.48
2.44	.8627	.0470	.0041	.0	.51
2.46	.8800	.0512	.0042	.0	.53
2.47	.8973	.0556	.0044	.0	.55
2.49	.9146	.0601	.0045	.0	.58
2.50	.9305	.0644	.0043	.0	.60
2.52	.9352	.0657	.0013	.0	.59
2.53	.9398	.0670	.0013	.0	.51
2.55	.9445	.0683	.0013	.0	.40
2.56	.9492	.0697	.0013	.0	.31
2.58	.9539	.0710	.0013	.0	.25
2.59	.9585	.0723	.0013	.0	.22

HYDROGRAPH PEAK= .60 cfs
TIME TO PEAK= 2.50 Hours
RUNOFF VOLUME= .05 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client:	Valley Camp Coal Co.	Date:	12-Jul-89
Project No.:	007.11.100	Time:	02:13 PM
Channel Section:	D-13A	Computed:	DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	0.60	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	2.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.030	ft/ft
	Max. Bottom Slope:	0.180	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	0.35	feet
	Qn/1.49(S)1/2=	0.070	
	A(R)2/3=	0.071	
	Required Depth:	0.85	feet
	Area:	0.24	ft2
	Perimeter:	1.57	feet
	Hydraulic Radius:	0.16	feet
	Velocity:	2.45	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.25	feet
	Qn/1.49(S)1/2=	0.029	
	A(R)2/3=	0.029	
	Required Depth:	0.75	feet
	Area:	0.13	ft2
	Perimeter:	1.12	feet
	Hydraulic Radius:	0.11	feet
	Velocity:	4.80	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	0.0	feet
	Side Slope 1:	2.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope:	3.0	%
	Max. Bottom Slope:	18.0	%
	Min Channel Depth:	0.85	feet
	Riprap (Min S):	Not Needed	
	Riprap (Max S):	Not Needed	

HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
PROJECT Permit
FEATURE D-13B
PROJECT NO. 007.11.100

SHEET 1 OF 3
COMPUTED Paul
CHECKED
DATE 5/11/89

D-13B

Total Area = 1240 * 0.00175 = 2.2 ac
sage/grass = 1.6 ac
disturbed = 0.6 ac

CN	A	Q
75	1.6	0.185
90	0.6	0.723
		$\bar{Q}$=0.332

$\bar{CN}$ = 80.7

Precipitation = 1.55 inches (10 year, 6 hr)

hydraulic length = 870 feet

$$\text{slope} = \frac{(1675)(25)(100)}{43{,}560\,(2.2)} = 43.7\%$$

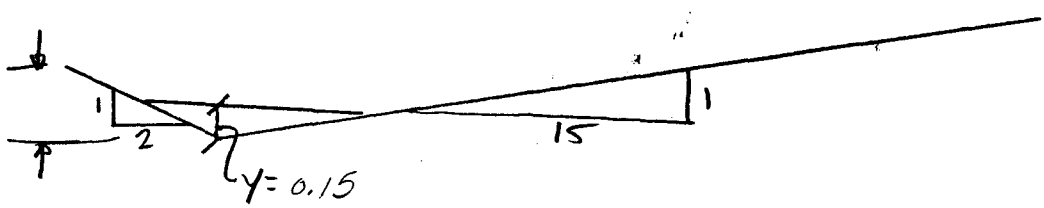
Calculated Run-off: Q_{TOT} = 0.66 cfs

Design Ditch

S_{min} = 15% try trapezoidal Channel

S_{max} = 35% b = 0, M1=2, M2=15, n=0.03

Use Roadway Design



V_{max} = 4.6 ft/sec < 5.0

∴ No lining required

PROJECT : Valley Camp Coal - D-13B Runoff Calculation

AREA= 2.2 ACRES
AVERAGE BASIN SLOPE= 43.7 PERCENT
CURVE NUMBER= 80.7
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 870. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0467 HOURS QPCFS= 35.60 CFS QPIN=16.0467 INCHES
C3= 79.0943 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.10	.4750	.0000	.0000	.0	.00
2.12	.4929	.0000	.0000	7.2	.00
2.13	.5107	.0004	.0003	27.3	.00
2.15	.5286	.0010	.0006	35.6	.02
2.17	.5465	.0019	.0009	30.1	.04
2.18	.5643	.0030	.0011	20.0	.06
2.20	.5822	.0043	.0013	11.4	.10
2.21	.6001	.0059	.0016	5.9	.13
2.23	.6180	.0077	.0018	2.8	.16
2.24	.6358	.0097	.0020	1.3	.20
2.26	.6537	.0120	.0022	.5	.23
2.27	.6716	.0144	.0025	.2	.26
2.29	.6894	.0171	.0027	.0	.29
2.41	.8324	.0457	.0042	.0	.53
2.43	.8503	.0501	.0044	.0	.55
2.45	.8681	.0546	.0046	.0	.58
2.46	.8860	.0594	.0047	.0	.61
2.48	.9039	.0643	.0049	.0	.63
2.49	.9217	.0694	.0051	.0	.66
2.51	.9326	.0725	.0032	.0	.66
2.52	.9374	.0739	.0014	.0	.62
2.54	.9423	.0754	.0014	.0	.51
2.56	.9471	.0768	.0014	.0	.40
2.57	.9519	.0783	.0015	.0	.32
2.59	.9567	.0798	.0015	.0	.26
2.60	.9616	.0812	.0015	.0	.23

HYDROGRAPH PEAK= .66 cfs
TIME TO PEAK= 2.51 Hours
RUNOFF VOLUME= .06 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client:	Valley Camp Coal Co.	Date:	12-Jul-89
Project No.:	007.11.100	Time:	02:18 PM
Channel Section:	D-13B	Computed:	DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	0.66	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	2.0	1/m1
	Side Slope2:	15.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.150	ft/ft
	Max. Bottom Slope:	0.350	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	0.15	feet
	Qn/1.49(S)1/2=	0.034	
	A(R)2/3=	0.034	
	Required Depth:	0.65	feet
	Area:	0.19	ft2
	Perimeter:	2.59	feet
	Hydraulic Radius:	0.07	feet
	Velocity:	3.45	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.13	feet
	Qn/1.49(S)1/2=	0.023	
	A(R)2/3=	0.023	
	Required Depth:	0.63	feet
	Area:	0.14	ft2
	Perimeter:	2.25	feet
	Hydraulic Radius:	0.06	feet
	Velocity:	4.59	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	0.0	feet
	Side Slope 1:	2.0	1/m1
	Side Slope 2:	15.0	1/m2
	Min. Bottom Slope:	15.0	%
	Max. Bottom Slope:	35.0	%
	Min Channel Depth:	0.65	feet
	Riprap (Min S):	Not Needed	
	Riprap (Max S):	Not Needed	

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE D-15
PROJECT NO. 007.11.100

SHEET 1 OF 3
COMPUTED Paul
CHECKED
DATE 5/11/89

D-15

Total Area = 2543 * 0.00175 = 4.45ac
Paved = = 0.2
Disturbed = = 1.5
Aspen = = 1.5
Sage/Grass = = 1.0
Reclaimed = = 0.25

CN	A	Q
85	0.25	0.484
98	0.2	1.329
90	1.5	0.723
70	1.5	0.096
75	1.0	0.185
		$\bar{Q}$ = 0.415

$\bar{CN}$ = 82.8

Precipitation = 1.55 inches (10 yr, 6 hr)

hydraulic length = 900 feet

$$\text{slope} = \frac{(2565)(25)(100)}{43{,}560\ (4.2)} = 35.0\%$$

Run-off Calculation: Q_{TOT} = 1.57 cfs

Ditch Design:

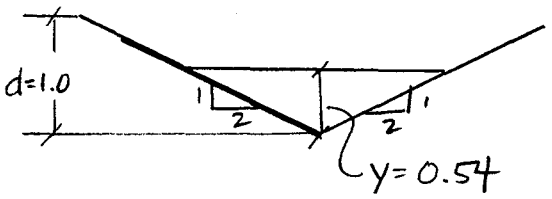
S_{min} = 2%
S_{max} = 2%

try trapezoidal design

b = 0, M = 2, n = 0.03

V = 2.69 ft/sec < 5.0 ft/sec OK

NO LINING NECESSARY



PROJECT : Valley Camp Coal - D-15 Runoff Calculations

AREA= 4.2 ACRES
AVERAGE BASIN SLOPE= 35.0 PERCENT
CURVE NUMBER= 82.8
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 900. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0501 HOURS QPCFS= 63.36 CFS QPIN=14.9611 INCHES
C3= 73.7432 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.04	.3994	.0000	.0000	.0	.00
2.05	.4186	.0000	.0000	12.8	.00
2.07	.4377	.0002	.0002	48.5	.00
2.09	.4569	.0008	.0006	63.4	.02
2.10	.4760	.0017	.0009	53.6	.05
2.12	.4952	.0029	.0012	35.7	.11
2.14	.5143	.0045	.0015	20.4	.18
2.15	.5335	.0063	.0019	10.5	.25
2.17	.5526	.0085	.0022	5.0	.33
2.19	.5718	.0109	.0024	2.3	.41
2.20	.5910	.0137	.0027	1.0	.48
2.22	.6101	.0167	.0030	.4	.56
2.24	.6293	.0200	.0033	.2	.63
2.25	.6484	.0235	.0035	.0	.70
2.40	.8208	.0662	.0056	.0	1.28
2.42	.8400	.0720	.0058	.0	1.33
2.44	.8591	.0781	.0060	.0	1.39
2.45	.8783	.0843	.0062	.0	1.44
2.47	.8974	.0908	.0064	.0	1.49
2.49	.9166	.0974	.0066	.0	1.54
2.51	.9316	.1027	.0053	.0	1.57
2.52	.9367	.1046	.0019	.0	1.50
2.54	.9419	.1064	.0019	.0	1.28
2.56	.9471	.1083	.0019	.0	1.00
2.57	.9523	.1102	.0019	.0	.78
2.59	.9574	.1121	.0019	.0	.64
2.61	.9626	.1141	.0019	.0	.56

HYDROGRAPH PEAK= 1.57 cfs
TIME TO PEAK= 2.50 Hours
RUNOFF VOLUME= .14 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client:	Valley Camp Coal Company	Date:	11-May-89
Project No.:	007.11.100	Time:	11:39 AM
Channel Section:	Ditch D-15	Computed:	PGH

			UNITS
GENERAL CRITERIA:	Design Flow:	1.57	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	2.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.02	ft/ft
	Max. Bottom Slope:	0.02	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. Flow):	0.54	feet
	Qn/1.49(S)1/2=	0.224	
	A(R)2/3=	0.226	
	Required Depth:	1.04	feet
	Area:	0.58	ft2
	Perimeter:	2.41	feet
	Hydraulic Radius:	0.24	feet
	Velocity:	2.69	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. Flow):	0.54	feet
	Qn/1.49(S)1/2=	0.224	
	A(R)2/3=	0.226	
	Required Depth:	1.04	feet
	Area:	0.58	ft2
	Perimeter:	2.41	feet
	Hydraulic Radius:	0.24	feet
	Velocity:	2.69	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	0.0	feet
	Side Slope 1:	2.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope :	0.02	ft/ft
	Max. Bottom Slope :	0.02	ft/ft
	Min. Channel Depth:	1.04	feet
	Riprap:	Not Needed	

Comment:

D-16A

Total Area = 2863 * 0.00175 = 5.1 ac
Paved = = 0.2 ac
disturbed = = 2.4 ac
Aspen = = 1.5 ac
Sage/Grass = = 1.0 ac

CN	A	Q
98	0.2	1.3294
90	2.4	0.723
70	1.5	0.096
75	1.0	0.185

$\overline{Q} = 0.457$ $\overline{CN} = 84.32$

Precipitation = 1.55 inches (10 yr, 6 hr)

hydraulic length = 1415

$$\text{slope} = \frac{(2805)(25)(100)}{43{,}650\,(5.1)} = 31.6\%$$

Run-off Calculation: $Q_{TOT} = 2.13$ cfs

Ditch Design UPPER REACH

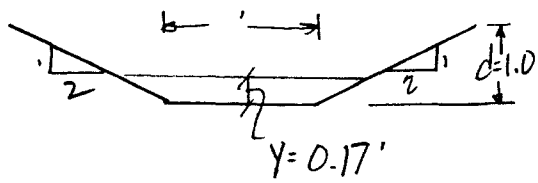
$S_{min} = 8\%$ S_{max} on upper reach ≈ 15%
$S_{max} = 37\%$ (lower reach into pond, based upon data after the 10/88 pond clean-out).

The ditch is currently lined with a conveyor belt. Because of the extreme variation in slope, it is recommended that the ditch be constructed as follows.

The upper portion of the ditch can be designed with the following parameters

b = , M = 2, n = 0.02

V = 4.75 < 5. ft/s



no lining required.

D-16A (Continued) LOWER REACH

The lower end of the channel cannot be designed practically without the use of a rip-rap pad. Therefore, the following is recommended.

Maximum Channel Slope ≈ 37%, Q = 2.13 cfs
d = 0.17 feet

Utilizing information presented in the manual "Design of Stable Channels w/ Flexible Linings", by the Federal Highway Administration. We get the following.

$$D_{50} = \frac{d_{max}\,\gamma\,S}{5}$$

where $d_{max} = 0.17$ ft
$\gamma = 62.4$
$S = 0.37$

$D_{50} = 0.8$ ft

Select $D_{50} = 1.0$ for additional safety factor and reduced maintenance.

From Table 5-1 (Urban Storm Drainage Criteria Manual Vol 2 - Wright-McLaughlin Eng. 1969)

D_{50} rock is classified as follows

TYPE L

% smaller than Given size by weight	Intermediate Rock dimen. (Inches)
70-100	15
50-70	12
35-50	9
2-10	3

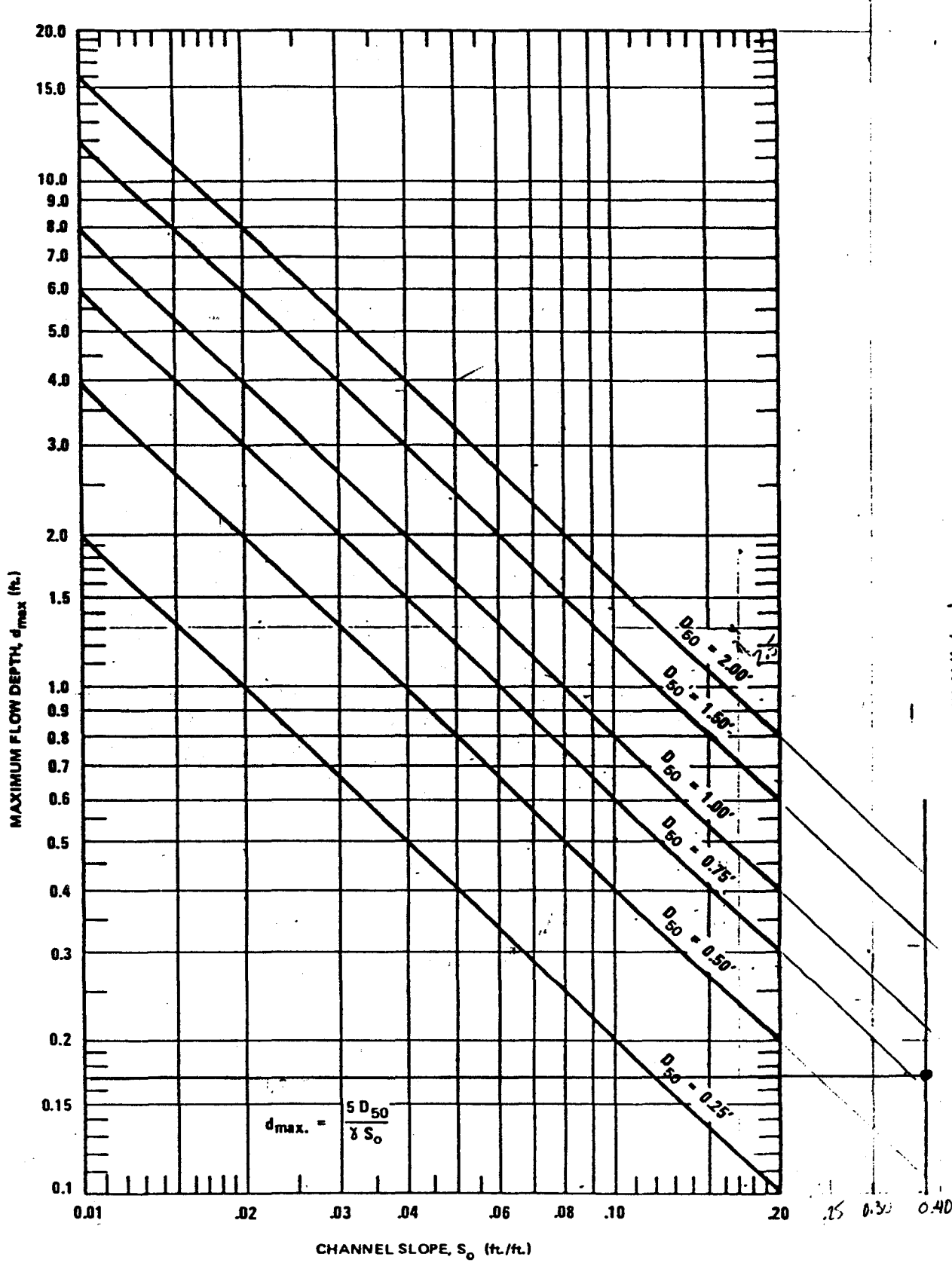
The Urban Storm Drainage Criteria Manual suggests that Given the rip-rap type to be L, it is possible to use a single 12" layer of type II bedding as the underlying filter blanket.

The following cross section is proposed.

Design of Stable Channels with Flexible Linings - Fed. Highway Administration

3/9

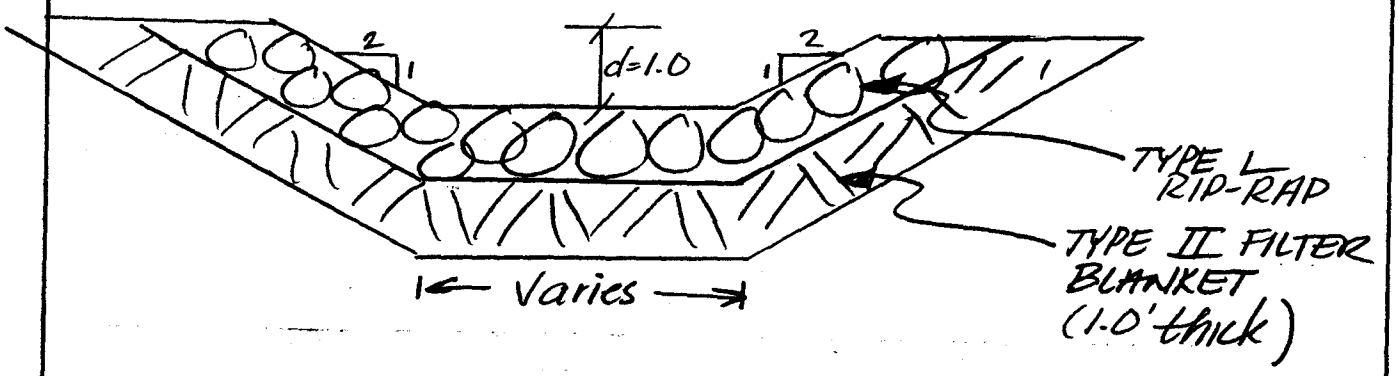
Chart 27



MAXIMUM PERMISSIBLE DEPTH OF FLOW (d_{max})
FOR CHANNELS LINED WITH ROCK RIPRAP

$n = .0395 D_{50}^{1/6}$

D-16A (Continued)



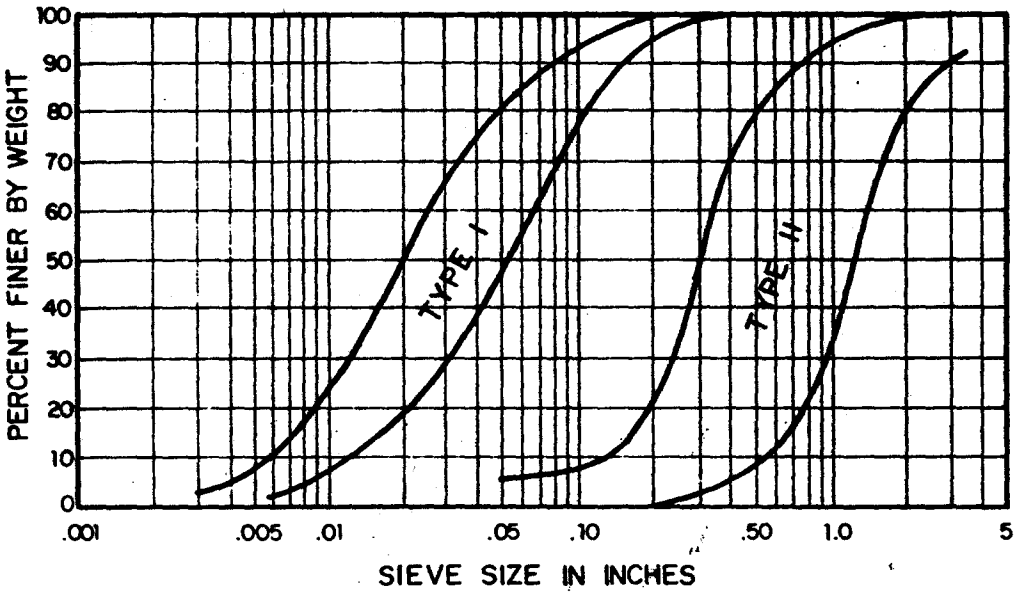


FIGURE 5-2. GRADATION CURVES FOR GRANULAR BEDDING

D-16A (Continued)

The intent is to break up the flow and prevent unnecessary erosion from occuring within the pond.

∴ design a transition zone and region to dissipate the stream energy prior to direct pond discharge.

The EPA has developed a methodology for a fan tailed energy dissipator, which receives flow from a culvert. (Erosion and sediment Control-Surface Mining in the Eastern U.S. - EPA technology transfer Seminar Publication.) See figure 1-15 below

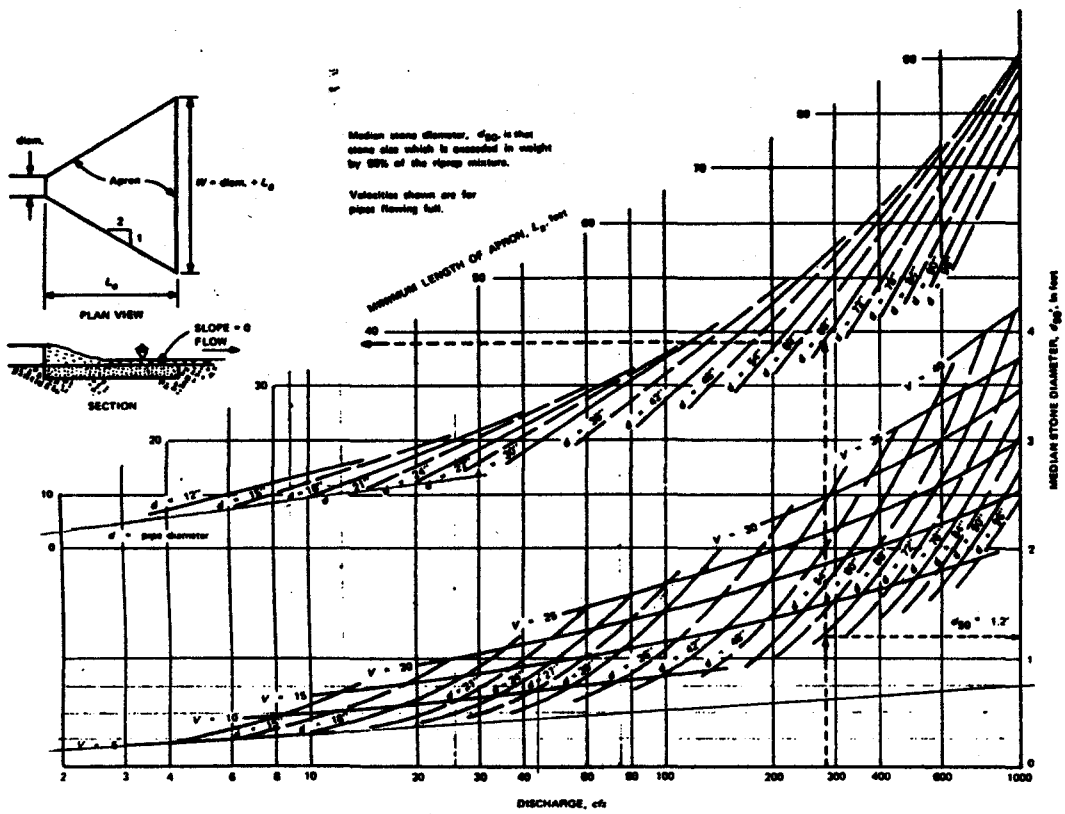


Figure I-15. Design of outlet protection — minimum tailwater condition (T_W < 0.5 diam.)[1]

Note: The Graph indicates a minimum length of 10 feet for a flow of 2.13 cfs (for all pipe diameters). As we are not on a zero % slope as for this method. It is recommended that we use 20' for a transition length.

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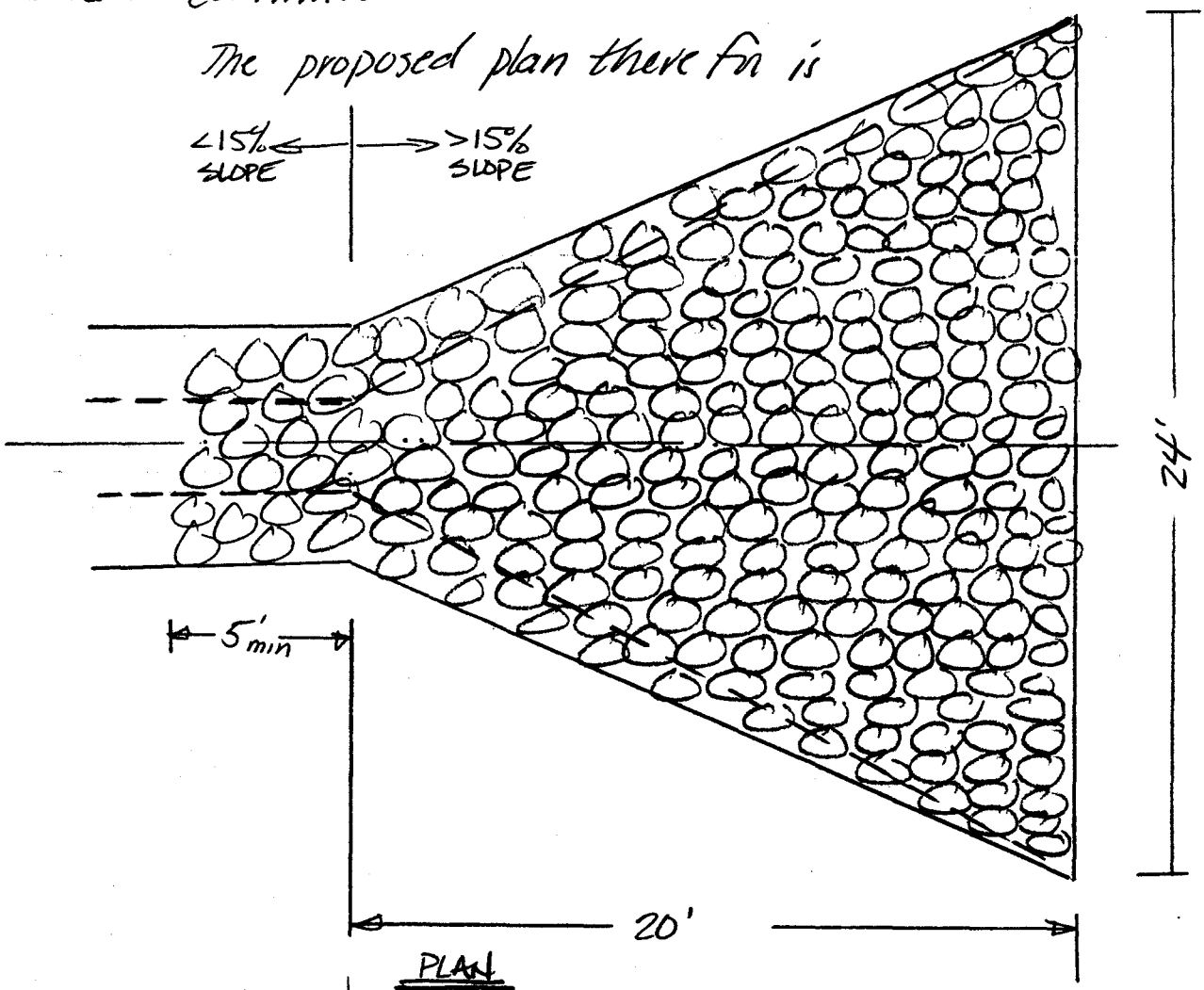
PROJECT NO. 007-11-100

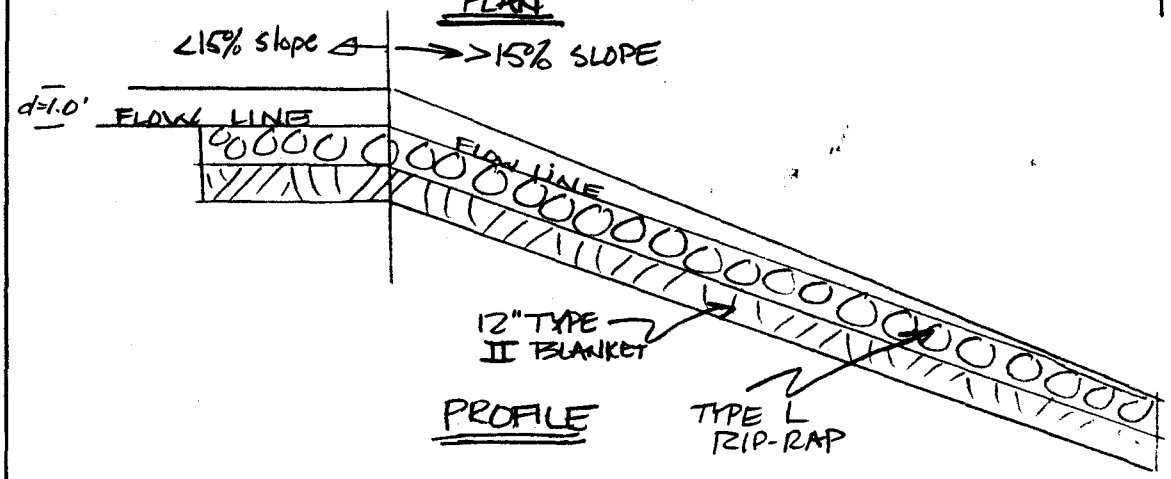
SHEET 6 OF 9
COMPUTED [illegible]
CHECKED
DATE 5/12/69

D-16A Continued

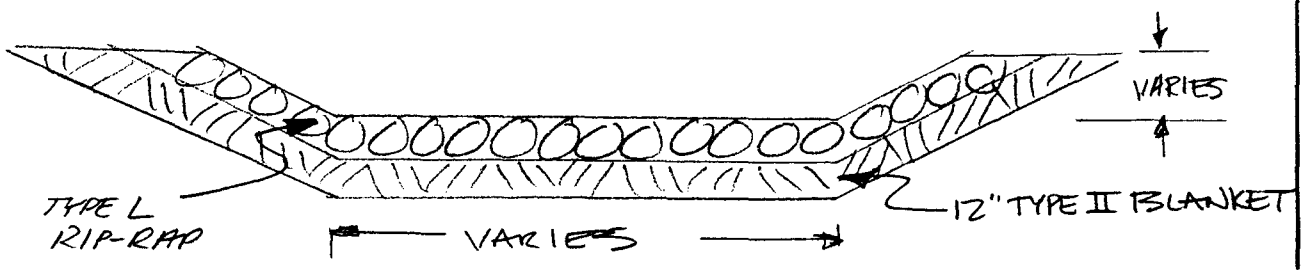
The proposed plan therefore is



PLAN



PROFILE



PROJECT : Valley Camp Coal - D-16A Runoff Calculations

AREA= 5.1 ACRES
AVERAGE BASIN SLOPE= 31.6 PERCENT
CURVE NUMBER= 84.3
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 1415. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0720 HOURS QPCFS= 53.55 CFS QPIN=10.4128 INCHES
C3= 51.3249 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.00	.3591	.0000	.0000	.0	.00
2.02	.3756	.0000	.0000	2.7	.00
2.03	.3921	.0002	.0002	16.6	.00
2.05	.4087	.0007	.0005	35.5	.00
2.06	.4252	.0015	.0008	49.2	.02
2.07	.4417	.0025	.0010	53.5	.04
2.09	.4582	.0038	.0013	50.2	.08
2.10	.4748	.0053	.0015	42.3	.14
2.12	.4913	.0071	.0018	33.1	.20
2.13	.5078	.0092	.0020	24.4	.27
2.15	.5243	.0114	.0023	17.2	.35
2.16	.5408	.0140	.0025	11.7	.44
2.18	.5574	.0167	.0027	7.7	.52
2.19	.5739	.0197	.0030	4.9	.61
2.20	.5904	.0228	.0032	3.1	.69
2.22	.6069	.0262	.0034	1.9	.78
2.23	.6235	.0298	.0036	1.2	.86
2.25	.6400	.0336	.0038	.7	.94
2.26	.6565	.0376	.0040	.4	1.02
2.28	.6730	.0418	.0042	.2	1.10
2.29	.6895	.0461	.0044	.1	1.17
2.30	.7061	.0507	.0045	.0	1.25
2.43	.8548	.0992	.0060	.0	1.84
2.45	.8713	.1054	.0062	.0	1.90
2.46	.8878	.1117	.0063	.0	1.96
2.48	.9043	.1181	.0065	.0	2.02
2.49	.9209	.1247	.0066	.0	2.07
2.51	.9320	.1293	.0045	.0	2.12
2.52	.9365	.1311	.0018	.0	2.13
2.54	.9409	.1329	.0018	.0	2.06
2.55	.9454	.1348	.0018	.0	1.90
2.56	.9499	.1366	.0019	.0	1.68
2.58	.9543	.1385	.0019	.0	1.46
2.59	.9588	.1404	.0019	.0	1.25

PROJECT : Valley Camp Coal - D-16A Runoff Calculations
(Continued)

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.61	.9633	.1423	.0019	.0	1.08

HYDROGRAPH PEAK= 2.13 cfs
TIME TO PEAK= 2.52 Hours
RUNOFF VOLUME= .19 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client:	Valley Camp Coal Company	Date:	12-May-89
Project No.:	007.11.100	Time:	10:45 AM
Channel Section:	Ditch D-16A	Computed:	PGH

			UNITS
GENERAL CRITERIA:	Design Flow:	2.13	cfs
	Bottom Width:	3.0	feet
	Side Slope1:	2.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.08	ft/ft
	Max. Bottom Slope:	0.15	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. Flow):	0.17	feet
	Qn/1.49(S)1/2=	0.152	
	A(R)2/3=	0.153	
	Required Depth:	0.67	feet
	Area:	0.55	ft2
	Perimeter:	3.74	feet
	Hydraulic Radius:	0.15	feet
	Velocity:	3.88	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. Flow):	0.14	feet
	Qn/1.49(S)1/2=	0.111	
	A(R)2/3=	0.112	
	Required Depth:	0.64	feet
	Area:	0.45	ft2
	Perimeter:	3.61	feet
	Hydraulic Radius:	0.12	feet
	Velocity:	4.75	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	3.0	feet
	Side Slope 1:	2.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope :	0.08	ft/ft
	Max. Bottom Slope :	0.15	ft/ft
	Min. Channel Depth:	0.67	feet
	Riprap:	Not Needed	

Comments: upper reach where S≤15%

D-16B

TOTAL AREA = 415 * 0.00175 = 0.7 ac

CN = 90

PRECIPITATION = 1.55 inches (10yr, 6hr)

HYD. LENGTH = 400'

$$\text{SLOPE} = \frac{(2050)\,5(100)}{43560\,(0.7)} = 33.6\%$$

CALCULATED RUNOFF $Q_{TOT} = \underline{0.5\ cfs}$

DITCH DESIGN - UPPER SECTION TO EDGE OF POND SLOPE

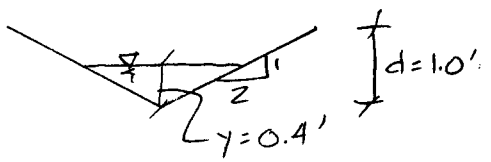
$S_{MIN} = 1\%$
$S_{MAX} = 10\%$

Try Trapezoidal Channel

$b = 0,\ m = 2,\ n = 0.03$

$V = 3.7\ fps < 5.0$ ok

NO LINING REQUIRED



PROJECT : Valley Camp Coal - D-16B Runoff Calculations

AREA= .7 ACRES
AVERAGE BASIN SLOPE= 33.6 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 400. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0205 HOURS QPCFS= 25.77 CFS QPIN=36.5095 INCHES
C3=179.9552 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.54	.2203	.0000	.0000	.0	.00
1.56	.2263	.0000	.0000	25.8	.00
1.58	.2324	.0000	.0000	8.4	.00
1.60	.2384	.0002	.0001	.9	.00
1.62	.2444	.0004	.0002	.0	.00
2.36	.7665	.1790	.0128	.0	.45
2.38	.7901	.1920	.0131	.0	.46
2.40	.8136	.2054	.0134	.0	.47
2.42	.8371	.2190	.0136	.0	.48
2.44	.8606	.2329	.0139	.0	.49
2.46	.8841	.2471	.0142	.0	.49
2.48	.9076	.2615	.0144	.0	.50
2.50	.9303	.2756	.0141	.0	.50
2.52	.9367	.2796	.0040	.0	.24
2.54	.9430	.2836	.0040	.0	.15
2.56	.9494	.2876	.0040	.0	.14
2.58	.9557	.2917	.0040	.0	.14
2.60	.9621	.2957	.0041	.0	.14

HYDROGRAPH PEAK= .50 cfs
TIME TO PEAK= 2.48 Hours
RUNOFF VOLUME= .04 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client:	Valley Camp Coal Company	Date:	12-May-89
Project No.:	007.11.100	Time:	09:53 AM
Channel Section:	Ditch D-16B	Computed:	PGH

			UNITS
GENERAL CRITERIA:	Design Flow:	0.50	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	2.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.01	ft/ft
	Max. Bottom Slope:	0.10	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. Flow):	0.40	feet
	Qn/1.49(S)1/2=	0.101	
	A(R)2/3=	0.102	
	Required Depth:	0.90	feet
	Area:	0.32	ft2
	Perimeter:	1.79	feet
	Hydraulic Radius:	0.18	feet
	Velocity:	1.56	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. Flow):	0.26	feet
	Qn/1.49(S)1/2=	0.032	
	A(R)2/3=	0.032	
	Required Depth:	0.76	feet
	Area:	0.14	ft2
	Perimeter:	1.16	feet
	Hydraulic Radius:	0.12	feet
	Velocity:	3.70	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	0.0	feet
	Side Slope 1:	2.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope :	0.01	ft/ft
	Max. Bottom Slope :	0.10	ft/ft
	Min. Channel Depth:	0.90	feet
	Riprap:	Not Needed	

Comment:

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FEATURE D-18A
PROJECT NO. 007.11.100

SHEET 1 OF 3
COMPUTED Paul
CHECKED
DATE 5/10/89

D-18A

calibrate planimeter $\frac{(250\ ft)^2}{43560} = 0.00175$ Ac/#

$\frac{}{822}$

Total Area = 1200 * 0.00175 = 2.1 Acres
dist. area = 273 = 0.5 Ac
Aspen = 724 = 1.3 Ac
Sage/grass = = 0.3 Ac

CN	Ac	Q
90	0.5	0.723
70	1.3	0.096
75	0.3	0.185

$\bar{Q} = 0.258$ $\bar{CN} = 78.1$

Precipitation = 1.55 inches (10yr, 6hr)

Hydraulic length = 750 feet

$$\text{slope} = \frac{(1575)(25)(100)}{43{,}560\,(2.1)} = 43\%$$

Run-off Calculation: Q = 0.46 cfs

Ditch Design:

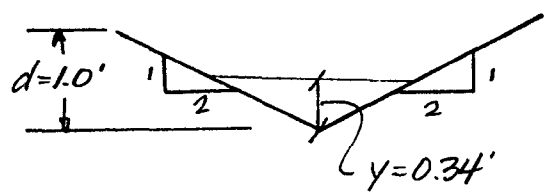
$S_{min} = 2\%$
$S_{max} = 5\%$

Try trapezoidal design

$b = 0$, $M = 2$, $\eta = 0.03$

$V = 2.73$ ft/sec < 5 ft/sec OK

No lining necessary



PROJECT : Valley Camp Coal - D-18A Runoff Calculation

AREA= 2.1 ACRES
AVERAGE BASIN SLOPE= 43.0 PERCENT
CURVE NUMBER= 78.1
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 750. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0453 HOURS QPCFS= 35.03 CFS QPIN=16.5406 INCHES
C3= 81.5285 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.18	.5582	.0000	.0000	.0	.00
2.19	.5755	.0000	.0000	7.1	.00
2.21	.5929	.0004	.0003	26.8	.00
2.22	.6102	.0009	.0005	35.0	.01
2.24	.6275	.0015	.0007	29.6	.03
2.25	.6448	.0024	.0009	19.7	.05
2.27	.6622	.0035	.0011	11.3	.08
2.28	.6795	.0048	.0013	5.8	.10
2.30	.6968	.0063	.0015	2.8	.13
2.31	.7142	.0080	.0017	1.3	.16
2.33	.7315	.0098	.0018	.5	.18
2.34	.7488	.0118	.0020	.2	.21
2.36	.7662	.0140	.0022	.0	.24
2.37	.7835	.0164	.0024	.0	.26
2.39	.8008	.0189	.0025	.0	.29
2.40	.8182	.0216	.0027	.0	.31
2.42	.8355	.0245	.0029	.0	.34
2.43	.8528	.0275	.0030	.0	.36
2.45	.8702	.0307	.0032	.0	.38
2.46	.8875	.0341	.0034	.0	.41
2.48	.9048	.0376	.0035	.0	.43
2.49	.9221	.0412	.0037	.0	.45
2.51	.9326	.0435	.0023	.0	.46
2.52	.9372	.0446	.0010	.0	.43
2.54	.9419	.0456	.0010	.0	.36
2.55	.9466	.0467	.0011	.0	.29
2.57	.9513	.0477	.0011	.0	.23
2.58	.9560	.0488	.0011	.0	.19
2.60	.9607	.0499	.0011	.0	.17

HYDROGRAPH PEAK= .46 cfs
TIME TO PEAK= 2.51 Hours
RUNOFF VOLUME= .05 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client:	Valley Camp Coal Company	Date:	10-May-89
Project No.:	007.11.100	Time:	03:00 PM
Channel Section:	Ditch D-18A	Computed:	PGH

			UNITS
GENERAL CRITERIA:	Design Flow:	0.46	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	2.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.02	ft/ft
	Max. Bottom Slope:	0.05	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. Flow):	0.34	feet
	Qn/1.49(S)1/2=	0.066	
	A(R)2/3=	0.066	
	Required Depth:	0.84	feet
	Area:	0.23	ft2
	Perimeter:	1.52	feet
	Hydraulic Radius:	0.15	feet
	Velocity:	1.99	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. Flow):	0.29	feet
	Qn/1.49(S)1/2=	0.042	
	A(R)2/3=	0.043	
	Required Depth:	0.79	feet
	Area:	0.17	ft2
	Perimeter:	1.30	feet
	Hydraulic Radius:	0.13	feet
	Velocity:	2.73	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	0.0	feet
	Side Slope 1:	2.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope:	0.02	ft/ft
	Max. Bottom Slope:	0.05	ft/ft
	Channel Depth:	0.84	feet
	Riprap:	Not Needed	

Comment:

HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
PROJECT Permit
FEATURE D-18B
PROJECT NO. 007-11-100

SHEET 1 OF 2
COMPUTED Paul
CHECKED
DATE 5/10/89

D-18-B (Convenience Ditch)
Tributary Area

Area D-18B = 943 * 0.00175 = 1.65 ac
sage/grass = 377 = 0.7
aspen = = 0.2
Disturbed = 286 = 0.5
Reclam = 143 = 0.25

CN	Area	Q
85	0.25	0.184
75	0.7	0.185
70	0.2	0.096
90	0.5	0.723

$\bar{Q} = 0.388$ $\bar{CN} = 82.3$

Precipitation = 1.55 inches (10yr, 6hr)

hydraulic length = 850 ft

$$\text{slope} = \frac{(850)(25)(100)}{43{,}560\ (1.4)} = 34.8$$

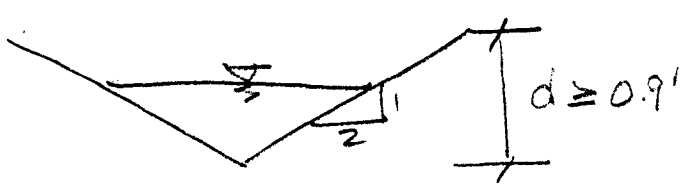
Run-Off Calculation: $Q = 0.59$ cfs

Slope = 5/320 = 0.016 $b = 0,\ m = 2,\ n = 0.03$

$$\frac{Qn}{1.49 S^{1/2}} = 0.094$$

Y	$AR^{2/3}$	
0.2	0.016	
0.4	0.102	A = 0.304
0.39	0.095	V = 1.94

V < 5 fps ∴ No Lining Reqd



PROJECT : Valley Camp Coal - D-18B Runoff Calculations

AREA= 1.6 ACRES
AVERAGE BASIN SLOPE= 34.8 PERCENT
CURVE NUMBER= 82.3
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 850. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0488 HOURS QPCFS= 25.56 CFS QPIN=15.3608 INCHES
C3= 75.7135 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.05	.4153	.0000	.0000	.0	.00
2.07	.4340	.0000	.0000	5.2	.00
2.08	.4527	.0002	.0002	19.6	.00
2.10	.4713	.0008	.0005	25.6	.00
2.12	.4900	.0016	.0008	21.6	.02
2.13	.5087	.0028	.0011	14.4	.04
2.15	.5274	.0042	.0014	8.2	.07
2.17	.5460	.0059	.0017	4.2	.09
2.18	.5647	.0079	.0020	2.0	.12
2.20	.5834	.0102	.0023	.9	.15
2.21	.6021	.0127	.0025	.4	.18
2.23	.6207	.0155	.0028	.2	.21
2.25	.6394	.0186	.0030	.0	.24
2.41	.8261	.0616	.0053	.0	.48
2.43	.8448	.0670	.0055	.0	.50
2.44	.8635	.0727	.0056	.0	.52
2.46	.8821	.0785	.0058	.0	.54
2.47	.9008	.0845	.0060	.0	.56
2.49	.9195	.0907	.0062	.0	.58
2.51	.9322	.0950	.0043	.0	.59
2.52	.9373	.0968	.0017	.0	.55
2.54	.9423	.0985	.0017	.0	.46
2.56	.9473	.1003	.0018	.0	.36
2.57	.9524	.1020	.0018	.0	.28
2.59	.9574	.1038	.0018	.0	.23
2.60	.9625	.1056	.0018	.0	.21

HYDROGRAPH PEAK= .59 cfs
TIME TO PEAK= 2.51 Hours
RUNOFF VOLUME= .05 Acre-Feet

HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
PROJECT Permit
FEATURE D-19A
PROJECT NO. 007.11.100

SHEET 1 OF 3
COMPUTED Paul
CHECKED
DATE 5/18/89

D-19A

Total Area = 5 * 1.401 = 7.0 Acres

CN = 75

Precip = 1.55 inches (10 yr, 6 hr)

hydraulic length = 1,200 ft

$$\text{slope} = \frac{(900)(80)(100)}{43{,}560\,(7)} = 23.6\%$$

Calculated Runoff $Q_{TOT_{10\,yr}} = 0.74$ cfs

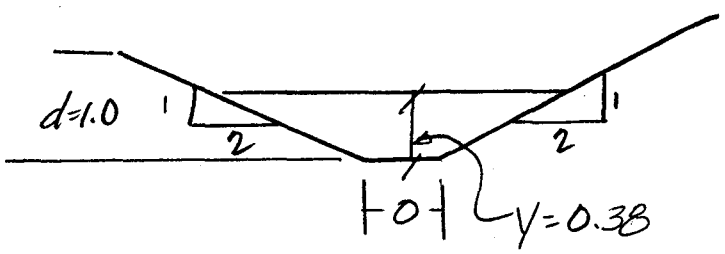
Ditch Design

$S_{min} = 3\%$

$S_{max} = 4\%$

try trapezoidal channel

$b = 0,\ m = 2,\ n = 0.03$



$V_{max} = 2.85 < 5.0$ fps ok

No Lining Required

PROJECT : Valley Camp Coal - D-19A Runoff Calculation

AREA= 7.0 ACRES
AVERAGE BASIN SLOPE= 23.6 PERCENT
CURVE NUMBER= 75.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 1200. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0976 HOURS DPCFS= 54.21 CFS QPIN= 7.6803 INCHES
C3= 37.8561 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.27	.6610	.0000	.0000	.0	.00
2.28	.6834	.0000	.0000	2.7	.00
2.30	.7058	.0005	.0004	16.8	.00
2.32	.7282	.0011	.0007	36.0	.01
2.34	.7506	.0021	.0009	49.8	.03
2.36	.7730	.0033	.0012	54.2	.07
2.38	.7954	.0048	.0015	50.8	.12
2.40	.8178	.0066	.0018	42.9	.18
2.42	.8402	.0086	.0020	33.5	.25
2.44	.8626	.0109	.0023	24.7	.34
2.46	.8850	.0134	.0025	17.4	.42
2.48	.9074	.0162	.0028	11.8	.51
2.50	.9298	.0193	.0030	7.8	.61
2.52	.9360	.0201	.0009	5.0	.69
2.54	.9421	.0210	.0009	3.1	.74
2.56	.9481	.0219	.0009	1.9	.74
2.58	.9542	.0228	.0009	1.2	.70
2.60	.9602	.0238	.0009	.7	.64
2.62	.9663	.0247	.0009	.4	.57
2.64	.9723	.0257	.0010	.2	.50
2.66	.9784	.0267	.0010	.1	.45
2.68	.9844	.0277	.0010	.0	.42

HYDROGRAPH PEAK= .74 cfs
TIME TO PEAK= 2.56 Hours
RUNOFF VOLUME= .11 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client: Valley Camp Coal Co.
Project No.: 007.11.100
Channel Section: D-19A

Date: 12-Jul-89
Time: 02:31 PM
Computed: DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	0.74	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	2.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.030	ft/ft
	Max. Bottom Slope:	0.040	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	0.38	feet
	Qn/1.49(S)1/2=	0.086	
	A(R)2/3=	0.086	
	Required Depth:	0.88	feet
	Area:	0.28	ft2
	Perimeter:	1.68	feet
	Hydraulic Radius:	0.17	feet
	Velocity:	2.63	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.36	feet
	Qn/1.49(S)1/2=	0.075	
	A(R)2/3=	0.077	
	Required Depth:	0.86	feet
	Area:	0.26	ft2
	Perimeter:	1.61	feet
	Hydraulic Radius:	0.16	feet
	Velocity:	2.85	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	0.0	feet
	Side Slope 1:	2.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope:	3.0	%
	Max. Bottom Slope:	4.0	%
	Min Channel Depth:	0.88	feet
	Riprap (Min S):	Not Needed	
	Riprap (Max S):	Not Needed	

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE D-19B
PROJECT NO. 007.11.100

SHEET 1 OF 2
COMPUTED Paul
CHECKED
DATE 5/18/89

D-19B

Total Area = 530 * 0.00087 = 0.5 Acres

CN = 75

Precipitation = 1.55" (10yr, 6hr)

hydraulic length = 625'

slope = $\frac{(250)(5)(100)}{43{,}560(0.5)}$ = 5.7%

Calculated Run-off = $Q_{TOT_{100yr}}$ = 0.05 cfs

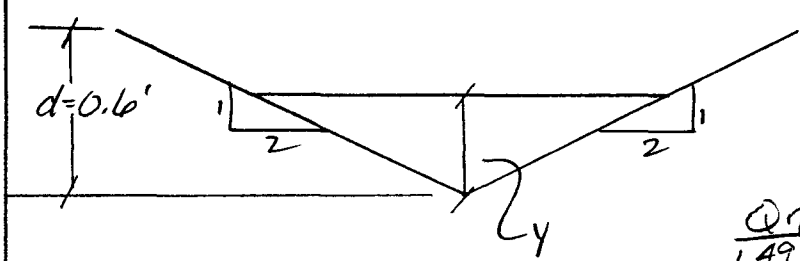
Ditch Design

S_{min} = 2%

S_{max} = 4%

try trapezoidal channel

b=0, m=2, n=0.03



FLOW IS MINIMAL
USE GENERAL DESIGN

$\frac{Qn}{1.49 S^{1/2}}$ = 0.005

y	$AR^{2/3}$	
0.1	0.003	A = 0.034
0.13	0.005 →	V = 1.5 fps

1.5 fps < 5 fps ✓

NO LINING REQ'd

d_{req} = 0.6 ft

PROJECT : Valley Camp Coal - D-19B Runoff Calculation

AREA= .5 ACRES
AVERAGE BASIN SLOPE= 5.7 PERCENT
CURVE NUMBER= 75.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 625. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .1179 HOURS QPCFS= 3.21 CFS QPIN= 6.3606 INCHES
CS= 31.3515 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.26	.6391	.0000	.0000	.0	.00
2.29	.6862	.0001	.0001	.2	.00
2.31	.7132	.0006	.0005	1.0	.00
2.33	.7403	.0016	.0009	2.1	.00
2.36	.7673	.0030	.0014	2.9	.00
2.38	.7944	.0047	.0018	3.2	.00
2.41	.8214	.0069	.0022	3.0	.00
2.43	.8485	.0094	.0025	2.5	.02
2.45	.8755	.0123	.0029	2.0	.02
2.48	.9026	.0156	.0033	1.5	.03
2.50	.9296	.0192	.0036	1.0	.04
2.52	.9372	.0203	.0011	.7	.04
2.55	.9445	.0214	.0011	.5	.05
2.57	.9518	.0225	.0011	.3	.05
2.59	.9591	.0236	.0011	.2	.05
2.62	.9664	.0247	.0011	.1	.04
2.64	.9738	.0259	.0012	.0	.04
2.66	.9811	.0271	.0012	.0	.04
2.69	.9884	.0283	.0012	.0	.03
2.71	.9957	.0296	.0012	.0	.03

HYDROGRAPH PEAK= .05 cfs
TIME TO PEAK= 2.57 Hours
RUNOFF VOLUME= .00 Acre-Feet

HAUL ROAD DITCH CALCULATIONS - CHECK / REVIEW

CHECK DITCHES 21 thru 28 (Ditch 27 does not exist)

CULVERT #	DITCH #	FLOW (cfs)
C-21-48	D-21	0.42
C-23-24	D-23	0.79
C-24-24	D-24	2.04
C-25-36	D-25A	0.19
	D-25B	6.96
C-26-24	D-26	0.57
C-26A-24	D-26A	1.01
C-28-24	D-28	3.3

Concrete/Asphalt $n = 0.015$

Calculations herein are approximate only and are used as a relative guide to field conditions. They are intended to give an approximate magnitude of runoff conditions to evaluate concrete ditch characteristics.

D-21 Find Flow.

Area = 11.6ac
CN = 70.5 (Matching C-22-24 data)
S = 50%
H_L = 2070'
P = 1.55in, 6hr

$Q = 0.42$cfs

Typical Section:
Ditch Slope = 0.037 ft/ft (flat section)

Depth - Typical Section has $b=0$, $T=6'$, $d=0.75'$, $n=0.015$

$\frac{Qn}{1.49 S^{1/2}} = AR^{2/3} = 0.022$

(CALC. USING TRAP. SECTION WITH NO BOTTOM WIDTH

Y	$AR^{2/3}$
0.5	0.39
0.22	0.044
0.17	0.022

$A = 0.116$
$V = 3.63$

$Y = 0.17'$ freeboard = 0.58'

PROJECT : VALLEY CAMP - DITCH D-21 RUNOFF DESIGN

AREA= 11.6 ACRES
AVERAGE BASIN SLOPE= 50.0 PERCENT
CURVE NUMBER= 70.5
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 2070. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .1176 HOURS QPCFS= 74.57 CFS QPIN= 6.3747 INCHES
C3= 31.4210 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.40	.8153	.0000	.0000	.0	.00
2.42	.8423	.0000	.0000	3.7	.00
2.45	.8693	.0002	.0002	23.2	.00
2.47	.8963	.0008	.0006	49.5	.00
2.49	.9233	.0017	.0009	68.5	.03
2.52	.9355	.0023	.0005	74.6	.07
2.54	.9428	.0026	.0003	69.8	.12
2.56	.9501	.0030	.0004	59.0	.16
2.59	.9574	.0034	.0004	46.1	.19
2.61	.9647	.0038	.0004	34.0	.20
2.64	.9719	.0042	.0004	24.0	.21
2.66	.9792	.0047	.0005	16.3	.21
2.68	.9865	.0052	.0005	10.7	.21
2.71	.9938	.0057	.0005	6.9	.21
2.73	1.0011	.0062	.0005	4.3	.22
2.75	1.0084	.0068	.0006	2.7	.22
2.78	1.0157	.0073	.0006	1.6	.23
2.80	1.0230	.0079	.0006	1.0	.24
2.82	1.0303	.0085	.0006	.6	.25
2.85	1.0376	.0092	.0006	.3	.26
2.87	1.0449	.0099	.0007	.2	.27
2.89	1.0522	.0105	.0007	.1	.28
2.92	1.0595	.0112	.0007	.0	.29
3.39	1.1813	.0262	.0008	.0	.39
3.41	1.1871	.0271	.0009	.0	.39
3.44	1.1930	.0279	.0009	.0	.40
3.46	1.1988	.0288	.0009	.0	.41
3.48	1.2046	.0297	.0009	.0	.41
3.51	1.2100	.0305	.0008	.0	.42
3.53	1.2140	.0312	.0006	.0	.42
3.55	1.2180	.0318	.0006	.0	.42
3.58	1.2220	.0325	.0006	.0	.41
3.60	1.2261	.0331	.0007	.0	.40
3.62	1.2301	.0338	.0007	.0	.38

PROJECT : VALLEY CAMP - DITCH D-21 RUNOFF DESIGN
(Continued)

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
3.65	1.2341	.0344	.0007	.0	.37
3.67	1.2381	.0351	.0007	.0	.35

HYDROGRAPH PEAK= .42 cfs
TIME TO PEAK= 3.53 Hours
RUNOFF VOLUME= .10 Acre-Feet

D-23

$Q = 0.79$

Ditch Slope = 5/50 = 0.1 (fairly uniform)
Depth = 0.5

$\frac{Qn}{1.49 S^{1/2}} = 0.025$

y	$AR^{2/3}$	
0.1	0.005	
0.2	0.034	A = 0.130
0.18	0.026 ⇒	V = 6.10

y = 0.18' freeboard = 0.57'

D-24

$Q = 2.04$

Ditch Slope = 5/80 = 0.063

$\frac{Qn}{1.49 S^{1/2}} = 0.082$

y	$AR^{2/3}$	
0.3	0.100	
0.28	0.083 →	A = 0.314
		V = 6.505

d = 0.28' freeboard = 0.47'

D-25A Calc Flow

A = 1.5ac
CN = 75 (Same as C-24-24)
P = 1.55in, 6hr
S = 44%
H_L = 775'

} Q = 0.19cfs

Ditch Slope = 5/130 = 0.038
$W_1 = W_2 = 4'$
U = 0
n = 0.015

$\frac{Qn}{1.49 S^{1/2}} = 0.010$

y	$AR^{2/3}$	
0.2	0.034	A = 0.068
0.13	0.011 ⇒	V = 2.811

d = 0.13' freeboard = 0.67'

PROJECT : VALLEY CAMP - DITCH D-25A RUNOFF DESIGN

AREA= 1.5 ACRES
AVERAGE BASIN SLOPE= 44.0 PERCENT
CURVE NUMBER= 75.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 775. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0504 HOURS QPCFS= 22.50 CFS QPIN=14.8782 INCHES
C3= 73.3348 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.27	.6639	.0000	.0000	.0	.00
2.28	.6783	.0000	.0000	2.1	.00
2.29	.6928	.0002	.0002	11.0	.00
2.31	.7072	.0005	.0003	19.6	.00
2.32	.7217	.0009	.0004	22.5	.00
2.33	.7362	.0014	.0005	20.4	.02
2.34	.7506	.0021	.0006	15.9	.03
2.36	.7651	.0028	.0008	11.1	.04
2.37	.7795	.0037	.0009	7.2	.05
2.38	.7940	.0047	.0010	4.4	.06
2.39	.8084	.0058	.0011	2.6	.08
2.41	.8229	.0070	.0012	1.5	.09
2.42	.8373	.0083	.0013	.8	.10
2.43	.8518	.0097	.0014	.4	.12
2.44	.8662	.0113	.0015	.2	.13
2.46	.8807	.0129	.0016	.1	.14
2.47	.8951	.0147	.0017	.0	.16
2.48	.9096	.0165	.0018	.0	.17
2.49	.9240	.0184	.0019	.0	.18
2.51	.9323	.0196	.0012	.0	.19
2.52	.9362	.0202	.0006	.0	.19
2.53	.9401	.0207	.0006	.0	.18
2.55	.9440	.0213	.0006	.0	.16
2.56	.9479	.0219	.0006	.0	.13
2.57	.9518	.0225	.0006	.0	.11
2.58	.9557	.0231	.0006	.0	.10
2.60	.9596	.0237	.0006	.0	.09

HYDROGRAPH PEAK= .19 cfs
TIME TO PEAK= 2.52 Hours
RUNOFF VOLUME= .02 Acre-Feet

D-25B

Q = 7 cfs (This is very conservative since not all C-25-26 flows travels down ditch)

Ditch Slope = 0.10
$m_1 = 4$
$m_2 = 4$
$b = 0$
$n = 0.015$

$\frac{Qn}{1.49 S^{1/2}} = 0.223$

y	$AR^{2/3}$	
0.5	0.389	
0.2	0.034	A = 0.67
0.41	0.229 ⇒	V = 10.41

y = 0.41', freeboard = 0.34'

D-26

Q = 0.57 cfs

Ditch Slope = 5/65 = 0.077
$m_1 = 4$
$m_2 = 4$ $n = .015$ $b = 0$

$\frac{Qn}{1.49 S^{1/2}} = 0.021$

y	$AR^{2/3}$	
0.1	0.005	A = 0.12
0.17	0.022 →	V = 4.9 fps

y = 0.17 ft, freeboard = 0.58'

D-26A

Q = 1.01 cfs

Ditch Slope = 0.10

$\frac{Qn}{1.49 S^{1/2}} = 0.032$

y	$AR^{2/3}$	
0.1	0.005	A = 0.16
0.2	0.039 ⇒	V = 6.31

y = 0.2 ft, freeboard = 0.55'

HANSEN ALLEN & LUCE INC

CLIENT: VALLEY CAMP
PROJECT: PERMIT
FEATURE:
PROJECT NO.: 007.11.200

SHEET 7 OF 7
COMPUTED: DEH
CHECKED:
DATE: 3 AUG 90

D-28

$Q = 3.3\ cfs$

Ditch Slope = 0.1

$\frac{Qn}{1.49 S^{1/2}} = 0.105$

y	$AR^{2/3}$	
0.2	0.034	
0.25	0.061	
0.3	0.100	A = 0.38
0.31	0.109 ⇒	V = 8.59

y = 0.31 ft, freeboard = 0.44

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE
PROJECT NO. 007.11.100

SHEET 1 OF 2
COMPUTED DEH
CHECKED
DATE 6/30/89

D-29A

Tributary Area = 1.7ac

			Q
Undisturbed	= 0.67ac	CN = 70	0.096
Disturbed	= 1.03ac	CN = 90	0.723

$\bar{Q} = 0.476$ $\bar{CN} = 84.8$

Precipitation = 1.55 in (10yr-6hr)

Hydraulic Length = 500 ft

Slope = $\frac{(1490)\,25(100)}{43560\,(1.7)}$ = 50.3%

Runoff Calculation : Q_{TOT} = 0.80cfs

DITCH LIES IN STORAGE YARD - USE GENERAL DESIGN

b=0, m=2, d=1.0' max, n=0.03

Convenience Ditch

Slope @ full flow = 5/80 = 0.063

$\frac{Qn}{1.49S^{1/2}}$ = 0.064

y	$AR^{2/3}$	
0.4	0.102	
0.35	0.071	A=0.231
0.34	0.0666 ⇒	V=3.46

V<5fps @ No Lining Req'd

PROJECT : Valley Camp Coal - D-29A Runoff Calculation

AREA= 1.7 ACRES
AVERAGE BASIN SLOPE= 50.3 PERCENT
CURVE NUMBER= 84.8
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 500. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0244 HOURS QPCFS= 52.67 CFS QPIN=30.7227 INCHES
CS=151.4323 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.99	.3536	.0000	.0000	.0	.00
2.00	.3593	.0000	.0000	25.8	.00
2.01	.3733	.0001	.0001	52.7	.00
2.03	.3873	.0005	.0003	37.1	.02
2.04	.4013	.0010	.0005	16.9	.04
2.05	.4153	.0017	.0007	6.1	.06
2.06	.4293	.0027	.0009	1.9	.09
2.08	.4433	.0038	.0011	.5	.12
2.09	.4573	.0052	.0013	.1	.15
2.10	.4713	.0067	.0015	.0	.17
2.42	.8355	.1002	.0052	.0	.71
2.43	.8495	.1056	.0053	.0	.73
2.44	.8635	.1110	.0054	.0	.74
2.45	.8775	.1165	.0055	.0	.76
2.47	.8915	.1222	.0056	.0	.77
2.48	.9055	.1279	.0057	.0	.79
2.49	.9195	.1337	.0058	.0	.80
2.50	.9309	.1386	.0048	.0	.79
2.52	.9347	.1402	.0016	.0	.66
2.53	.9385	.1418	.0016	.0	.45
2.54	.9423	.1434	.0016	.0	.32
2.55	.9461	.1451	.0016	.0	.26
2.56	.9499	.1467	.0016	.0	.24

HYDROGRAPH PEAK= .80 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .07 Acre-Feet

D-29B

Tributary Area = 1.2 ac

			Q
Undisturbed Area	= 0.86 ac	CN = 70	0.096
Disturbed Area	= 0.34 ac	CN = 90	0.723

$\bar{Q} = 0.274$ $\bar{CN} = 78.7$

Precipitation = 1.55 inches (10 yr, 6 hr)

Hydraulic Length = 440 feet

$$\text{Slope} = \frac{(1400)25(100)}{43560\,(1.2)} = 66.9\%$$

Runoff Calculation: $Q_{TOT} = 0.31$ cfs

DITCH LIES IN STORAGE YARD - USE GENERAL DESIGN

$b = 0,\ m = 2,\ d = 1.0'$ max

Convenience Ditch

Slope = 5/200 = 0.025, $n = 0.03$ $\frac{Qn}{1.49 S^{1/2}} = 0.040$

Y	$AR^{2/3}$
0.2	0.016
0.3	0.047
0.28	0.039 ⇒

A = 0.157
V = 2.0 < 5.0 fps ✓

No Lining Req'd

PROJECT : Valley Camp Coal - D-29B Runoff Calculation

AREA= 1.2 ACRES
AVERAGE BASIN SLOPE= 66.9 PERCENT
CURVE NUMBER= 78.7
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 440. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0233 HOURS QPCFS= 38.95 CFS QPIN=32.1899 INCHES
C3=158.6639 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.14	.5202	.0000	.0000	.0	.00
2.17	.5469	.0000	.0000	39.0	.00
2.19	.5736	.0004	.0004	12.5	.01
2.21	.6003	.0013	.0009	1.4	.04
2.24	.6270	.0026	.0014	.1	.06
2.26	.6537	.0045	.0019	.0	.09
2.28	.6804	.0068	.0023	.0	.12
2.31	.7071	.0096	.0028	.0	.14
2.33	.7339	.0128	.0032	.0	.16
2.35	.7606	.0164	.0036	.0	.19
2.38	.7873	.0205	.0041	.0	.21
2.40	.8140	.0250	.0045	.0	.23
2.42	.8407	.0298	.0049	.0	.25
2.45	.8674	.0351	.0052	.0	.27
2.47	.8941	.0407	.0056	.0	.29
2.49	.9209	.0467	.0060	.0	.31
2.52	.9347	.0499	.0033	.0	.21
2.54	.9420	.0517	.0017	.0	.12
2.56	.9492	.0534	.0018	.0	.10
2.59	.9564	.0552	.0018	.0	.09
2.61	.9636	.0570	.0018	.0	.10
2.63	.9708	.0588	.0018	.0	.10

HYDROGRAPH PEAK= .31 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .03 Acre-feet

HANSEN ALLEN & LUCE inc

CLIENT: VALLEY CAMP
PROJECT: PERMIT
FEATURE: D-30
PROJECT NO.: 007.11.100

SHEET 1 OF 3
COMPUTED: DEH
CHECKED:
DATE: 5 MAY 89

D-30

TOTAL AREA = 1748 * .00702 = 12.3 ac
UNDIST AREA = 1029 = 7.2 ac (25% OAK/ASPEN)
PAVED AREA = 122 = 0.9 ac
DIST AREA = = 4.2 ac

CN	A	Q
98	0.9	1.329
90	4.2	0.723
70	7.2	0.096
		$\bar{Q}$ = 0.401

$\overline{CN}$ = 82.8

PRECIP = 1.55'

HYD. LENGTH = 1450'

SLOPE: $\frac{9450 * 25 * 100}{12.3 * 43560}$ = 44:1

RUNOFF CALCULATION: Q = 4.5 cfs

DITCH DESIGN:

S_{min} = 10%
S_{max} = 12½%

DITCH CURRENTLY LINED WITH CONCRETE GUTTER ALONG ROAD. NO EROSION POTENTIAL

NO ADD'L DESIGN CONTEMPLATED

PROJECT : Valley Camp Coal - Ditch D-30 Runoff Calculation

AREA= 12.3 ACRES
AVERAGE BASIN SLOPE= 44.1 PERCENT
CURVE NUMBER= 82.8
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 1450. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0654 HOURS QPCFS= 142.22 CFS QPIN=11.4670 INCHES
C3= 56.5206 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.04	.4067	.0000	.0000	.0	.00
2.06	.4254	.0000	.0000	13.5	.00
2.08	.4442	.0004	.0003	69.6	.00
2.09	.4629	.0011	.0007	123.7	.04
2.11	.4817	.0020	.0010	142.2	.11
2.13	.5004	.0033	.0013	128.8	.22
2.14	.5192	.0049	.0016	100.3	.38
2.16	.5380	.0068	.0019	70.4	.56
2.17	.5567	.0090	.0022	45.8	.76
2.19	.5755	.0114	.0024	28.1	.97
2.21	.5942	.0142	.0027	16.4	1.19
2.22	.6130	.0171	.0030	9.3	1.41
2.24	.6317	.0204	.0032	5.1	1.62
2.26	.6505	.0239	.0035	2.7	1.83
2.27	.6692	.0276	.0037	1.4	2.03
2.29	.6880	.0316	.0040	.7	2.24
2.31	.7067	.0358	.0042	.4	2.43
2.32	.7255	.0403	.0044	.2	2.62
2.34	.7442	.0449	.0047	.0	2.81
2.35	.7630	.0498	.0049	.0	2.99
2.37	.7818	.0549	.0051	.0	3.17
2.39	.8005	.0602	.0053	.0	3.35
2.40	.8193	.0657	.0055	.0	3.52
2.42	.8380	.0714	.0057	.0	3.68
2.44	.8568	.0773	.0059	.0	3.84
2.45	.8755	.0834	.0061	.0	4.00
2.47	.8943	.0897	.0063	.0	4.16
2.49	.9130	.0962	.0065	.0	4.31
2.50	.9305	.1023	.0062	.0	4.45
2.52	.9355	.1041	.0018	.0	4.50
2.53	.9406	.1060	.0018	.0	4.27
2.55	.9457	.1078	.0018	.0	3.77
2.57	.9508	.1097	.0019	.0	3.17
2.58	.9558	.1115	.0019	.0	2.62
2.60	.9609	.1134	.0019	.0	2.19

PROJECT : Valley Camp Coal - Ditch D-30 Runoff Calculation
(Continued)

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.62	.9660	.1153	.0019	.0	1.89

HYDROGRAPH PEAK= 4.50 cfs
TIME TO PEAK= 2.52 Hours
RUNOFF VOLUME= .41 Acre-Feet

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE D-31
PROJECT NO. 007-11-100

SHEET 1 OF 2
COMPUTED paul
CHECKED
DATE 5/9/89

D-31 (Convenience Ditch)

Total Area = 473 * 0.00702 = 3.3 acres
disturbed area = 1.9 acres
undisturbed area = 1.4 acres (25% Oak/Aspen)

CN	area	Q
70	1.4	0.096
90	1.9	0.723
		$\bar{Q}$ = 0.457

$\bar{CN}$ = 84.3

Precipitation = 1.55 in (10 yr, 6 hr)

hydraulic length = 700 feet

$$\text{Slope} = \frac{(2300)(25)(100)}{43{,}560\ (3.3)} = 40.0\%$$

Run-Off Calculation: Q_{TOT} = 1.48 cfs

Convenience Ditch -

Slope = 5/40 = 0.125 b = 1, m = 2, n = 0.03

$$\frac{Qn}{1.49 S^{1/2}} = 0.085$$

y	$AR^{2/3}$	
0.2	0.078	A = 0.298
0.21	0.086 ⇒	V = 4.9 fps < 5 fps

No Lining Required

PROJECT : Valley Camp Coal - D-31 Runoff Calculations

AREA= 3.3 ACRES
AVERAGE BASIN SLOPE= 40.0 PERCENT
CURVE NUMBER= 84.3
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 700. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0365 HOURS QPCFS= 68.46 CFS QPIN=20.5723 INCHES
C3=101.4008 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.01	.3626	.0000	.0000	.0	.00
2.02	.3835	.0000	.0000	33.5	.00
2.04	.4044	.0005	.0005	68.5	.02
2.06	.4253	.0015	.0009	48.3	.07
2.08	.4462	.0028	.0014	22.0	.13
2.10	.4671	.0046	.0018	7.9	.21
2.11	.4880	.0068	.0022	2.4	.28
2.13	.5089	.0093	.0026	.7	.36
2.15	.5299	.0123	.0029	.2	.43
2.17	.5508	.0156	.0033	.0	.50
2.39	.8017	.0804	.0070	.0	1.21
2.41	.8226	.0876	.0072	.0	1.25
2.42	.8435	.0951	.0075	.0	1.30
2.44	.8644	.1028	.0077	.0	1.35
2.46	.8853	.1107	.0079	.0	1.39
2.48	.9062	.1189	.0082	.0	1.43
2.50	.9271	.1273	.0084	.0	1.48
2.52	.9349	.1304	.0032	.0	1.33
2.53	.9405	.1328	.0023	.0	.97
2.55	.9462	.1351	.0023	.0	.67
2.57	.9518	.1375	.0024	.0	.51
2.59	.9575	.1398	.0024	.0	.46
2.61	.9631	.1422	.0024	.0	.44

HYDROGRAPH PEAK= 1.48 cfs
TIME TO PEAK= 2.50 Hours
RUNOFF VOLUME= .13 Acre-Feet

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE D-32A, D-32B
PROJECT NO. 007.11.100

SHEET 1 OF 2
COMPUTED Paul
CHECKED
DATE 5/9/89

D-32A, D-32B (Convenience Ditches)

Total Area = 845 * 0.00702 = 5.9 ac
undisturbed = = 5.3 ac
disturbed = = 0.6 ac

CN	A	Q
90	0.6	0.723
70	5.3	0.096
		$\bar{Q}$ = 0.160

$\bar{CN}$ = 73.8

Precipitation = 1.55 inches (10 yr, 6 hr)

hydraulic length = 820 feet

$$\text{slope} = \frac{(5000)(25)(100)}{(43{,}560)(5.9)} = 48.6\%$$

Run-off Calculation: Q_{TOT} = 0.58 cfs

Convenience Ditches - No design contemplated

Slope = 5/200 = 0.025, b = 0, m = 2, n = 0.03

$$\frac{Qn}{1.49 S^{1/2}} = 0.074$$

Y	$AR^{2/3}$	
0.2	0.016	
0.3	0.047	A = 0.259
0.36	0.077 →	V = 2.24

V < 5 fps ∴ No Lining Req'd

PROJECT : Valley Camp Coal - D-32A, D-32B Runoff Calculations

AREA= 5.9 ACRES
AVERAGE BASIN SLOPE= 48.6 PERCENT
CURVE NUMBER= 73.8
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 820. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0519 HOURS QPCFS= 85.93 CFS QPIN=14.4441 INCHES
C3= 71.1952 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.30	.7032	.0000	.0000	.0	.00
2.32	.7230	.0000	.0000	17.4	.00
2.34	.7429	.0003	.0003	65.8	.00
2.35	.7627	.0008	.0005	85.9	.03
2.37	.7826	.0015	.0007	72.6	.07
2.39	.8024	.0023	.0009	48.3	.12
2.41	.8223	.0034	.0011	27.6	.18
2.42	.8421	.0047	.0013	14.2	.25
2.44	.8620	.0062	.0015	6.8	.32
2.46	.8818	.0079	.0017	3.1	.39
2.48	.9017	.0098	.0019	1.3	.46
2.49	.9216	.0119	.0021	.5	.53
2.51	.9331	.0132	.0013	.2	.58
2.53	.9385	.0138	.0006	.0	.56
2.54	.9438	.0144	.0006	.0	.49
2.56	.9492	.0151	.0006	.0	.39
2.58	.9545	.0158	.0007	.0	.32
2.60	.9599	.0164	.0007	.0	.27
2.61	.9653	.0171	.0007	.0	.25

HYDROGRAPH PEAK= .58 cfs
TIME TO PEAK= 2.51 Hours
RUNOFF VOLUME= .08 Acre-Feet

HANSEN ALLEN & LUCE INC

CLIENT VALLEY CAMP
PROJECT PERMIT
FEATURE D-33A
PROJECT NO. 007.16.100

SHEET 1 OF 3
COMPUTED DEH
CHECKED
DATE 8 MAY 89

D-33A

TOTAL AREA	2037 * .00702	= 14.3 acres
PAVED AREA	189 *	= 1.3
RECLAIMED AREA	175 *	= 1.2
DISTURBED AREA	578 *	= 4.1
UNDISTURBED AREA	1095 *	= 7.7

CN	A	Q
98	1.3	1.329
90	4.1	0.723
85	1.2	0.484
70	7.7	0.096
		$\bar{Q}$ = 0.421

$\overline{CN}$ = 83.4

PRECIP = 1.55" (10YR-6HR)

HYD LENGTH = 2000'

$$\text{SLOPE} = \frac{10650 * 25 * 100}{14.3 * 43560} = 42.3\%$$

RUNOFF CALCULATION: Q = 5.36 cfs

DITCH DESIGN

Smin = 4%
Smax = 4%

DITCH CURRENTLY LINED WITH CONCRETE GUTTER ALONG ROAD. NO EROSION POTENTIAL

NO ADDL DESIGN CONTEMPLATED

PROJECT : Valley Camp Coal - Ditch D-33A Runoff Calculation

AREA= 14.3 ACRES
AVERAGE BASIN SLOPE= 42.3 PERCENT
CURVE NUMBER= 83.4
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 2000. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0847 HOURS QPCFS= 127.74 CFS QPIN= 8.8588 INCHES
C3= 43.6652 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.03	.3930	.0000	.0000	.0	.00
2.05	.4124	.0001	.0001	6.4	.00
2.07	.4318	.0006	.0005	39.7	.00
2.08	.4512	.0014	.0008	84.8	.03
2.10	.4707	.0026	.0012	117.3	.09
2.12	.4901	.0041	.0015	127.7	.19
2.13	.5095	.0059	.0018	119.7	.34
2.15	.5289	.0081	.0022	101.0	.52
2.17	.5483	.0105	.0025	79.0	.74
2.18	.5678	.0133	.0028	58.3	.97
2.20	.5872	.0164	.0031	41.1	1.22
2.22	.6066	.0198	.0034	27.9	1.48
2.23	.6260	.0234	.0036	18.4	1.74
2.25	.6454	.0273	.0039	11.8	2.00
2.27	.6649	.0315	.0042	7.4	2.26
2.29	.6843	.0360	.0044	4.6	2.51
2.30	.7037	.0407	.0047	2.8	2.76
2.32	.7231	.0456	.0049	1.7	3.00
2.34	.7425	.0508	.0052	1.0	3.23
2.35	.7620	.0562	.0054	.6	3.46
2.37	.7814	.0619	.0057	.3	3.69
2.39	.8008	.0678	.0059	.2	3.90
2.40	.8202	.0739	.0061	.1	4.12
2.42	.8396	.0802	.0063	.0	4.33
2.44	.8591	.0867	.0065	.0	4.53
2.46	.8785	.0934	.0067	.0	4.73
2.47	.8979	.1003	.0069	.0	4.92
2.49	.9173	.1074	.0071	.0	5.11
2.51	.9318	.1129	.0054	.0	5.28
2.52	.9371	.1149	.0020	.0	5.36
2.54	.9423	.1169	.0020	.0	5.23
2.56	.9476	.1189	.0020	.0	4.87
2.57	.9528	.1209	.0020	.0	4.35
2.59	.9581	.1230	.0020	.0	3.78
2.61	.9633	.1250	.0021	.0	3.26

PROJECT : Valley Camp Coal - Ditch D-33A Runoff Calculation
(Continued)

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.62	.9686	.1271	.0021	.0	2.82

HYDROGRAPH PEAK= 5.36 cfs
TIME TO PEAK= 2.52 Hours
RUNOFF VOLUME= .50 Acre-Feet

D-33B

TRIBUTARY AREAS: D-35; D-39A-B; D-38; D-36; D-33B

AREA: CHANGE PLANIMETER SCALE TO 30
Rdg: 817 A = 5.74 ac RATIO 0.00702

TOTAL	1905 * 0.00702	= 13.4 ac	
DIST.	1336	= 7.4 ac	CN = 90
UNDIST	569	= 4.0 ac	CN = 75
RECLAIMED		2.2 ac	CN = 85

CN RATIONAL SHOWN ON D-44B SHEETS

VOL. WEIGHT CN: (P = 1.55 in)

CN	A	Q	
90	7.4	0.723	$\bar{Q}$ = 0.526
75	4.0	0.185	
85	2.2	0.484	$\overline{CN}$ = 86.0

HYD. LENGTH: (UP DITCH 37) = 1630'

$$\text{SLOPE} = \frac{10160 * 25 * 100}{13.4 * 43560} = 43.5\%$$

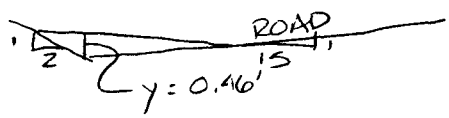
RUNOFF PREDICTION: Q = 6.6 cfs

CHANNEL DESIGN: (Channel currently uses a Belt Liner)

Smin: 4%
Smax: 4% PRELIMINARY CHECK W/ TRAP. CHANNEL SHOWS EXCESSIVE VELOCITIES.

USE ROAD TYPE CHANNEL.

b = 0	n = .03		
M_1 = 15	Q = 6.6		
M_2 = 2	S = 4%	V = 3.7 < 5 fps	NO LINING REQ'd



Id = 1.0'

PROJECT : Valley Camp Coal - Ditch D-33B Runoff Calculation

AREA= 13.4 ACRES
AVERAGE BASIN SLOPE= 43.5 PERCENT
CURVE NUMBER= 86.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 1630. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0647 HOURS QPCFS= 156.51 CFS QPIN=11.5827 INCHES
C3= 57.0911 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.89	.3254	.0000	.0000	.0	.00
1.91	.3301	.0000	.0000	14.9	.00
1.93	.3349	.0000	.0000	76.7	.00
1.94	.3397	.0001	.0000	136.2	.00
1.96	.3444	.0002	.0000	156.5	.01
1.98	.3492	.0003	.0001	141.7	.03
1.99	.3540	.0005	.0001	110.3	.04
2.01	.3652	.0009	.0005	77.4	.06
2.02	.3837	.0020	.0011	50.3	.11
2.04	.4023	.0035	.0014	30.9	.22
2.06	.4209	.0053	.0018	18.1	.40
2.07	.4395	.0074	.0022	10.2	.63
2.09	.4580	.0100	.0025	5.6	.90
2.10	.4766	.0128	.0029	3.0	1.19
2.12	.4952	.0160	.0032	1.6	1.48
2.14	.5137	.0195	.0035	.8	1.77
2.15	.5323	.0233	.0038	.4	2.06
2.17	.5509	.0274	.0041	.2	2.34
2.19	.5694	.0318	.0044	.0	2.61
2.41	.8294	.1191	.0076	.0	5.68
2.43	.8480	.1269	.0078	.0	5.86
2.44	.8666	.1349	.0080	.0	6.03
2.46	.8851	.1431	.0082	.0	6.19
2.48	.9037	.1515	.0084	.0	6.36
2.49	.9223	.1600	.0085	.0	6.52
2.51	.9329	.1650	.0050	.0	6.61
2.53	.9379	.1674	.0024	.0	6.44
2.54	.9430	.1698	.0024	.0	5.86
2.56	.9480	.1721	.0024	.0	5.03
2.57	.9530	.1745	.0024	.0	4.17
2.59	.9580	.1770	.0024	.0	3.45
2.61	.9630	.1794	.0024	.0	2.91

HYDROGRAPH PEAK= 6.61 cfs
TIME TO PEAK= 2.51 Hours
RUNOFF VOLUME= .59 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client:	Valley Camp Coal Company	Date:	05-May-89
Project No.:	007.11.100	Time:	11:24 AM
Channel Section:	Ditch D-33B	Computed:	DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	6.60	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	15.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.04	ft/ft
	Max. Bottom Slope:	0.04	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. Flow):	0.46	feet
	Qn/1.49(S)1/2=	0.666	
	A(R)2/3=	0.668	
	Required Depth:	0.96	feet
	Area:	1.80	ft2
	Perimeter:	7.94	feet
	Hydraulic Radius:	0.23	feet
	Velocity:	3.67	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. Flow):	0.46	feet
	Qn/1.49(S)1/2=	0.666	
	A(R)2/3=	0.668	
	Required Depth:	0.96	feet
	Area:	1.80	ft2
	Perimeter:	7.94	feet
	Hydraulic Radius:	0.23	feet
	Velocity:	3.67	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	0.0	feet
	Side Slope 1:	15.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope:	0.04	ft/ft
	Max. Bottom Slope:	0.04	ft/ft
	Channel Depth:	0.96	feet
	Riprap:	Not Needed	

Comment:

HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
PROJECT Permit
FEATURE D-34A
PROJECT NO. 007.11.100

SHEET 1 OF 3
COMPUTED DEH
CHECKED
DATE 5 MAY 89

D-34A (RECLAIMED) - Small Oak Aspen Area Ignored - Calcs ∴ Conservative.

AREA: 189 * .00702 = 1.32c
HYD LENGTH = 450'
SLOPE = $\frac{1160' * 25 * 100}{1.3 * 43560}$ = 51.2%

CN = 85 (See D-44B design Sheets)
P = 1.55"

RUNOFF PREDICTION: Q = 0.64

CHANNEL DESIGN:

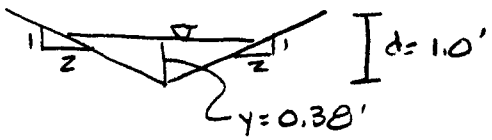
S_{min} = 2%
S_{max} = 2%

TRY TRAPEZOIDAL DESIGN

b = 0, m = 2, n = 0.03

V = 2.2 < 5 fps ok

NO LINING REQ'd



PROJECT : Valley Camp Coal - Ditch D-34A Runoff Calculation

AREA= 1.3 ACRES
AVERAGE BASIN SLOPE= 51.2 PERCENT
CURVE NUMBER= 85.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 450. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0221 HOURS QPCFS= 44.52 CFS QPIN=33.9588 INCHES
C3=167.3829 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.99	.3529	.0000	.0000	.0	.00
2.01	.3677	.0001	.0001	44.5	.00
2.03	.3930	.0009	.0008	14.3	.04
2.05	.4183	.0023	.0014	1.6	.08
2.08	.4437	.0044	.0021	.1	.12
2.10	.4690	.0072	.0027	.0	.15
2.36	.7730	.0808	.0086	.0	.51
2.39	.7983	.0897	.0090	.0	.54
2.41	.8236	.0991	.0094	.0	.56
2.43	.8490	.1088	.0097	.0	.58
2.45	.8743	.1189	.0101	.0	.60
2.47	.8996	.1293	.0104	.0	.62
2.50	.9250	.1400	.0107	.0	.64
2.52	.9355	.1446	.0046	.0	.37
2.54	.9423	.1476	.0030	.0	.22
2.56	.9492	.1506	.0030	.0	.19
2.58	.9560	.1536	.0030	.0	.18
2.61	.9629	.1567	.0031	.0	.18
2.63	.9697	.1597	.0031	.0	.19

HYDROGRAPH PEAK= .64 cfs
TIME TO PEAK= 2.50 Hours
RUNOFF VOLUME= .05 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client: Valley Camp Coal Company
Project No.: 007.11.100
Channel Section: Ditch D-34A

Date: 05-May-89
Time: 10:35 AM
Computed: DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	0.64	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	2.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.02	ft/ft
	Max. Bottom Slope:	0.02	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. Flow):	0.38	feet
	Qn/1.49(S)1/2=	0.091	
	A(R)2/3=	0.089	
	Required Depth:	0.88	feet
	Area:	0.29	ft2
	Perimeter:	1.70	feet
	Hydraulic Radius:	0.17	feet
	Velocity:	2.22	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. Flow):	0.38	feet
	Qn/1.49(S)1/2=	0.091	
	A(R)2/3=	0.089	
	Required Depth:	0.88	feet
	Area:	0.29	ft2
	Perimeter:	1.70	feet
	Hydraulic Radius:	0.17	feet
	Velocity:	2.22	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	0.0	feet
	Side Slope 1:	2.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope:	0.02	ft/ft
	Max. Bottom Slope:	0.02	ft/ft
	Channel Depth:	0.88	feet
	Riprap:	Not Needed	

Comment:

HANSEN ALLEN & LUCE INC

CLIENT VALLEY CAMP
PROJECT PERMIT
FEATURE D-34B
PROJECT NO. 007.11.100

SHEET 1 OF 3
COMPUTED DEH
CHECKED
DATE 5 MAY 89

D-34B

ALL DIST. EXCEPT FOR OAK/ASPEN AREA

TOTAL AREA = 435 * .00702 = 3.0 ac
OAK AREA = 67 * .00702 = 0.5 ac
DIST AREA = 2.5 ac

PRECIP = 1.55" (10 YR-6 HR)

VOL WEIGHTED CN.

CN	A	Q
40	0.5	0.155
90	2.5	0.723
		$\bar{Q}$ = 0.628

$\overline{CN}$ = 88.2

HYD LENGTH = 670'

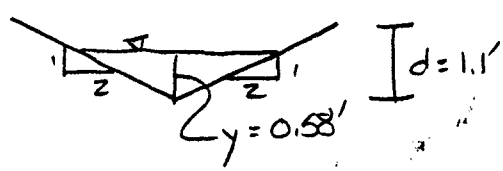
SLOPE = $\frac{2610 * 25 * 100}{3.0 * 43560}$ = 50%

RUNOFF CALCULATION: Q = 1.88 cfs

CHANNEL DESIGN:

Smin = 2%
Smax = 5%

TRY TRAP. CHANNEL.



NO LINING REQ'D

PROJECT : Valley Camp Coal - Ditch D-34B Runoff Calculation

AREA= 3.0 ACRES
AVERAGE BASIN SLOPE= 50.0 PERCENT
CURVE NUMBER= 88.2
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 670. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0273 HOURS QPCFS= 83.03 CFS QPIN=27.4469 INCHES
C3=135.2856 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.69	.2663	.0000	.0000	.0	.00
1.71	.2704	.0000	.0000	40.6	.00
1.72	.2744	.0000	.0000	83.0	.00
1.73	.2784	.0000	.0000	58.6	.00
1.75	.2824	.0002	.0000	26.7	.00
1.76	.2864	.0003	.0000	9.6	.01
1.78	.2905	.0004	.0001	3.0	.02
1.79	.2945	.0005	.0001	.8	.02
1.80	.2985	.0007	.0002	.2	.03
1.82	.3025	.0009	.0002	.0	.03
2.42	.8357	.1694	.0079	.0	1.71
2.43	.8514	.1774	.0080	.0	1.74
2.45	.8671	.1855	.0081	.0	1.77
2.46	.8827	.1938	.0083	.0	1.80
2.47	.8984	.2021	.0084	.0	1.82
2.49	.9141	.2106	.0085	.0	1.85
2.50	.9297	.2192	.0086	.0	1.88
2.51	.9342	.2217	.0024	.0	1.65
2.53	.9384	.2240	.0024	.0	1.14
2.54	.9426	.2264	.0024	.0	.78
2.55	.9469	.2288	.0024	.0	.61
2.57	.9511	.2311	.0024	.0	.55
2.58	.9553	.2335	.0024	.0	.54

HYDROGRAPH PEAK= 1.88 cfs
TIME TO PEAK= 2.50 Hours
RUNOFF VOLUME= .16 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client:	Valley Camp Coal Company	Date:	05-May-89
Project No.:	007.11.100	Time:	11:08 AM
Channel Section:	Ditch D-34B	Computed:	DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	1.88	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	2.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.02	ft/ft
	Max. Bottom Slope:	0.05	ft/ft
	Freeboard:	0.50	feet
CALCULATION:	Depth (Min. Flow):	0.58	feet
(Channel Depth)	Qn/1.49(S)1/2=	0.268	
	A(R)2/3=	0.274	
	Required Depth:	1.08	feet
	Area:	0.67	ft2
	Perimeter:	2.59	feet
	Hydraulic Radius:	0.26	feet
	Velocity:	2.79	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION:	Depth (Max. Flow):	0.48	feet
(Velocity Check)	Qn/1.49(S)1/2=	0.170	
	A(R)2/3=	0.165	
	Required Depth:	0.98	feet
	Area:	0.46	ft2
	Perimeter:	2.15	feet
	Hydraulic Radius:	0.21	feet
	Velocity:	4.08	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	0.0	feet
	Side Slope 1:	2.0	1/mi
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope:	0.02	ft/ft
	Max. Bottom Slope:	0.05	ft/ft
	Channel Depth:	1.08	feet
	Riprap:	Not Needed	

Comment:

D-35

TRIBUTARY AREAS: D-42; D-37; D-35

AREA = 4.6 ACRES (3.9 ac disturbed, 0.7 ac reclaimed)

SLOPE = $\frac{2910 * 25 * 100}{4.6 * 43560}$ = 36.3%

HYD LENGTH = 1150'

CN = 90

P = 1.55"

CN	A	Q
90	3.9	0.723
85	0.7	0.484
		$\bar{Q}$ = 0.686

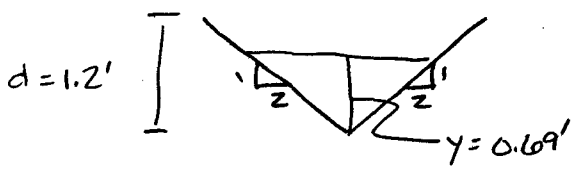
$\bar{CN}$ = 89.3

RUNOFF PREDICTION: Q = 3.0 cfs

CHANNEL DESIGN:

$S_{MIN} = S_{MAX} = 2\%$ $b = 0, m = 2, n = 0.03$

USE TRIANGULAR CHANNEL



v = 3.2 fps < 5 NO LINING REQ'd

PROJECT : Valley Camp Coal - Ditch D-35 Runoff Calculation

AREA= 4.6 ACRES
AVERAGE BASIN SLOPE= 36.3 PERCENT
CURVE NUMBER= 89.3
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 1150. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0473 HOURS QPCFS= 73.51 CFS QPIN=15.8485 INCHES
C3= 78.1173 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.59	.2366	.0000	.0000	.0	.00
1.61	.2412	.0000	.0000	14.9	.00
1.62	.2459	.0000	.0000	56.3	.00
1.64	.2505	.0000	.0000	73.5	.00
1.66	.2551	.0002	.0001	62.1	.00
1.67	.2598	.0003	.0001	41.3	.01
1.69	.2644	.0005	.0002	23.7	.02
1.70	.2691	.0007	.0002	12.2	.03
1.72	.2737	.0009	.0002	5.8	.04
1.73	.2784	.0012	.0003	2.6	.05
1.75	.2830	.0015	.0003	1.1	.06
1.77	.2877	.0018	.0003	.5	.07
1.78	.2923	.0022	.0004	.2	.08
1.80	.2969	.0026	.0004	.0	.09
2.40	.8119	.1850	.0097	.0	2.71
2.41	.8300	.1949	.0099	.0	2.76
2.43	.8481	.2049	.0101	.0	2.82
2.44	.8662	.2151	.0102	.0	2.87
2.46	.8843	.2255	.0104	.0	2.92
2.48	.9023	.2360	.0105	.0	2.97
2.49	.9204	.2467	.0107	.0	3.01
2.51	.9323	.2537	.0071	.0	3.00
2.52	.9372	.2567	.0029	.0	2.77
2.54	.9421	.2596	.0029	.0	2.30
2.55	.9470	.2626	.0030	.0	1.78
2.57	.9519	.2655	.0030	.0	1.39
2.59	.9567	.2685	.0030	.0	1.14

HYDROGRAPH PEAK= 3.01 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .26 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client:	Valley Camp Coal Company	Date:	05-May-89
Project No.:	007.11.100	Time:	11:31 AM
Channel Section:	Ditch D-35	Computed:	DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	3.00	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	2.0	1/mi
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.02	ft/ft
	Max. Bottom Slope:	0.02	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. Flow):	0.69	feet
	Qn/1.49(S)1/2=	0.428	
	A(R)2/3=	0.435	
	Required Depth:	1.19	feet
	Area:	0.95	ft2
	Perimeter:	3.09	feet
	Hydraulic Radius:	0.31	feet
	Velocity:	3.15	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. Flow):	0.69	feet
	Qn/1.49(S)1/2=	0.428	
	A(R)2/3=	0.435	
	Required Depth:	1.19	feet
	Area:	0.95	ft2
	Perimeter:	3.09	feet
	Hydraulic Radius:	0.31	feet
	Velocity:	3.15	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	0.0	feet
	Side Slope 1:	2.0	1/mi
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope:	0.02	ft/ft
	Max. Bottom Slope:	0.02	ft/ft
	Channel Depth:	1.19	feet
	Riprap:	Not Needed	

Comment:

HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
PROJECT Permit
FEATURE D-36
PROJECT NO. 007-11-100

SHEET 1 OF 7
COMPUTED Paul
CHECKED
DATE 5/9/89

D-36 (Convenience Ditch)

Total Area = 517 * 0.00702 = 2.7 ac
undist. Area = 310 = 1.9 ac (25% Oak/Aspen)
dist. Area = = 0.8 ac

CN	A	Q
90	0.8	0.723
70	1.9	0.096
		$\bar{Q}$ = 0.282

$\bar{CN}$ = 79.0

Precipitation = 1.55 inches (10 yr, 6 hr)

hydraulic length = 550 feet

$$\text{slope} = \frac{(3{,}070)(25)(100)}{43{,}560\,(2.7)} = 65.3\ \%$$

Run-off Calculation: Q_{TOT} = 0.70 cfs

Convenience ditch - No design anticipated OK
(Small ditch)

Slope = 5/30 = 0.167 b = 0, m = 2, n = 0.03

$$\frac{Qn}{1.49 S^{1/2}} = 0.035$$

y	$AR^{2/3}$	
0.2	0.016	A = 0.146
0.27	0.036 ⇒	V = 4.8

V < 5 fps No Lining Reqd

PROJECT : Valley Camp Coal - D-36 Runoff Calculation

AREA= 2.7 ACRES
AVERAGE BASIN SLOPE= 65.3 PERCENT
CURVE NUMBER= 79.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 580. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0279 HOURS QPCFS= 73.10 CFS QPIN=26.8484 INCHES
CN=132.3358 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.15	.5256	.0000	.0000	.0	.00
2.18	.5586	.0003	.0003	73.1	.02
2.20	.5906	.0013	.0010	23.6	.08
2.23	.6226	.0030	.0017	2.6	.15
2.26	.6546	.0054	.0024	.2	.22
2.29	.6866	.0085	.0031	.0	.29
2.32	.7186	.0123	.0037	.0	.35
2.34	.7506	.0167	.0044	.0	.42
2.37	.7826	.0216	.0050	.0	.48
2.40	.8146	.0272	.0056	.0	.54
2.43	.8466	.0334	.0061	.0	.59
2.46	.8786	.0401	.0067	.0	.65
2.48	.9106	.0473	.0072	.0	.70
2.51	.9334	.0527	.0055	.0	.59
2.54	.9421	.0549	.0021	.0	.31
2.57	.9507	.0571	.0022	.0	.23
2.59	.9594	.0593	.0022	.0	.22
2.62	.9680	.0615	.0022	.0	.22
2.65	.9767	.0638	.0023	.0	.23

HYDROGRAPH PEAK= .70 cfs
TIME TO PEAK= 2.48 Hours
RUNOFF VOLUME= .06 Acre-Feet

D-37 DESIGN

CN DETERMINATIONS SHOWN ON D-44B SHEETS

$P_{10\,YR-6HR} = 1.55$ in

AREA: 124.4 * 0.0035 = 3.75 ac (ALL AREA DISTURBED) USE CN=90
60 * " 0.4 ac

HYD. LENGTH = 1150 ft

WATERSHED SLOPE: CONT L = 2375
CONT I = 25'

$$\frac{2375 * 25 * 100}{3.75 * 43560} = 36.3\%$$

RUNOFF PREDICTION: Q = 2.6 cfs

CHANNEL DESIGN:

$S_{min} = 2\%$
$S_{max} = 18\%$ (Except for SHORT RIPRAP SECTION AT SWITCHBACK BY COAL PILE WHICH IS 30%)
Velocities will be higher - USE Road Ditch Design

$M_1 = 15$ $b = 0$ $Q = 2.6$
$M_2 = 2$ $\eta = .03$

Printout Shows Riprap REQUIRED ON 18% GRADE IMMEDIATELY BELOW CONCRETE SETTLING BASIN. CHANGE CRITERIA AND BREAK OUT UPPER DITCH SECTION - RECALCULATE FLOW.

AREA = Tributary Area to 18% Ditch Section running between Concrete Settling Basin and road intersection near Culvert C-40-42 inlet.

Area = 390 * .0035 = 1.37 ac
HYD. LENGTH = 500'

$$\text{SLOPE} = \frac{840 * 25 * 100}{1.37 * 43560} = 35.2\%$$

RUNOFF PREDICTION: $Q_{upper} = 0.99$ cfs

CHANNEL DESIGN: USE ROAD DITCH DESIGN

S = 18%; $M_1 = 15$, $M_2 = 2$, b = 0, $\eta = 0.03$ V = 4.0 < 5 ok

LINING NOT REQ'd

PROJECT : Valley Camp Coal - Ditch D-37 Runoff Prediction

AREA= 3.8 ACRES
AVERAGE BASIN SLOPE= 36.3 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 1150. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0460 HOURS QPCFS= 61.65 CFS QPIN=16.3034 INCHES
C3= 80.3596 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.53	.2190	.0000	.0000	.0	.00
1.55	.2235	.0000	.0000	12.5	.00
1.56	.2280	.0000	.0000	47.2	.00
1.58	.2325	.0000	.0000	61.6	.00
1.59	.2370	.0002	.0001	52.1	.00
1.61	.2415	.0003	.0001	34.7	.01
1.62	.2461	.0005	.0002	19.8	.02
1.64	.2506	.0007	.0002	10.2	.03
1.66	.2551	.0009	.0002	4.9	.04
1.67	.2596	.0012	.0003	2.2	.04
1.69	.2641	.0015	.0003	.9	.05
1.70	.2686	.0019	.0003	.4	.06
1.72	.2731	.0022	.0004	.2	.07
1.73	.2777	.0026	.0004	.0	.08
2.41	.8231	.2109	.0101	.0	2.38
2.42	.8407	.2212	.0103	.0	2.42
2.44	.8583	.2316	.0104	.0	2.46
2.45	.8759	.2421	.0105	.0	2.50
2.47	.8934	.2528	.0107	.0	2.54
2.48	.9110	.2636	.0108	.0	2.57
2.50	.9286	.2745	.0109	.0	2.61
2.51	.9344	.2782	.0036	.0	2.55
2.53	.9391	.2812	.0030	.0	2.22
2.54	.9439	.2842	.0030	.0	1.76
2.56	.9486	.2872	.0030	.0	1.35
2.58	.9534	.2902	.0030	.0	1.07
2.59	.9581	.2932	.0030	.0	.90

HYDROGRAPH PEAK= 2.61 cfs
TIME TO PEAK= 2.50 Hours
RUNOFF VOLUME= .23 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client: Valley Camp Coal Company — Date: 05-May-89
Project No.: 007.11.100 — Time: 08:12 AM
Channel Section: D-37 — Computed: DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	2.60	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	15.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.02	ft/ft
	Max. Bottom Slope:	0.18	ft/ft
	Freeboard:	0.50	feet
CALCULATION:	Depth (Min. Flow):	0.37	feet
(Channel Depth)	Qn/1.49(S)1/2=	0.371	
	A(R)2/3=	0.371	
	Required Depth:	0.87	feet
	Area:	1.16	ft2
	Perimeter:	6.37	feet
	Hydraulic Radius:	0.18	feet
	Velocity:	2.25	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION:	Depth (Max. Flow):	0.25	feet
(Velocity Check)	Qn/1.49(S)1/2=	0.124	
	A(R)2/3=	0.125	
	Required Depth:	0.75	feet
	Area:	0.51	ft2
	Perimeter:	4.23	feet
	Hydraulic Radius:	0.12	feet
	Velocity:	5.10	ft/sec
	Riprap Ck (V<5?):	Required	

VEL. TOO HIGH - BREAK OUT UPPER STEEP AREA

DESIGN CRITERIA:	Bottom Width:	0.0	feet
	Side Slope 1:	15.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope:	0.02	ft/ft
	Max. Bottom Slope:	0.18	ft/ft
	Channel Depth:	0.87	feet
	Riprap:	Required	

Comment:

PROJECT : Valley Camp Coal - Upper Section Ditch D-37 Runoff Prediction

AREA= 1.4 ACRES
AVERAGE BASIN SLOPE= 35.2 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 500. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0240 HOURS QPCFS= 43.18 CFS QPIN=31.2593 INCHES
C3=154.0771 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.54	.2197	.0000	.0000	.0	.00
1.56	.2267	.0000	.0000	43.2	.00
1.58	.2338	.0001	.0001	13.9	.00
1.61	.2409	.0003	.0002	1.5	.00
1.63	.2479	.0006	.0003	.1	.01
1.66	.2550	.0009	.0004	.0	.02
2.35	.7591	.1749	.0148	.0	.86
2.38	.7866	.1901	.0152	.0	.89
2.40	.8142	.2057	.0156	.0	.91
2.42	.8417	.2217	.0160	.0	.93
2.45	.8692	.2381	.0164	.0	.95
2.47	.8967	.2548	.0167	.0	.97
2.49	.9242	.2718	.0170	.0	.99
2.52	.9359	.2791	.0073	.0	.58
2.54	.9433	.2838	.0047	.0	.33
2.57	.9507	.2885	.0047	.0	.28
2.59	.9582	.2932	.0047	.0	.28
2.61	.9656	.2980	.0048	.0	.28
2.64	.9731	.3028	.0048	.0	.28

HYDROGRAPH PEAK= .99 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .08 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client: Valley Camp Coal Company
Project No.: 007.11.100
Channel Section: Upper D-37

Date: 05-May-89
Time: 08:27 AM
Computed: DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	0.99	cfs
	Bottom Width:	0.0	feet
	Side Slope1:	15.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.18	ft/ft
	Max. Bottom Slope:	0.18	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. Flow):	0.17	feet
	Qn/1.49(S)1/2=	0.047	
	A(R)2/3=	0.047	
	Required Depth:	0.67	feet
	Area:	0.25	ft2
	Perimeter:	2.94	feet
	Hydraulic Radius:	0.08	feet
	Velocity:	4.03	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. Flow):	0.17	feet
	Qn/1.49(S)1/2=	0.047	
	A(R)2/3=	0.047	
	Required Depth:	0.67	feet
	Area:	0.25	ft2
	Perimeter:	2.94	feet
	Hydraulic Radius:	0.08	feet
	Velocity:	4.03	ft/sec
	Riprap Ck (V<5?):	Not Needed	

DESIGN CRITERIA:	Bottom Width:	0.0	feet
	Side Slope 1:	15.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope:	0.18	ft/ft
	Max. Bottom Slope:	0.18	ft/ft
	Channel Depth:	0.67	feet
	Riprap:	Not Needed	

Comment: