APPENDIX R614-301-742.310

Hydrologic Calculations

HANSEN ALLEN & LUCE inc

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CLIENT Valley Camp
PROJECT Permit
FEATURE D-1
PROJECT NO. 007.11.100

SHEET ___ OF ___
COMPUTED Paul
CHECKED ___
DATE 5/16/89

D-1

Total Area = 46086 * 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

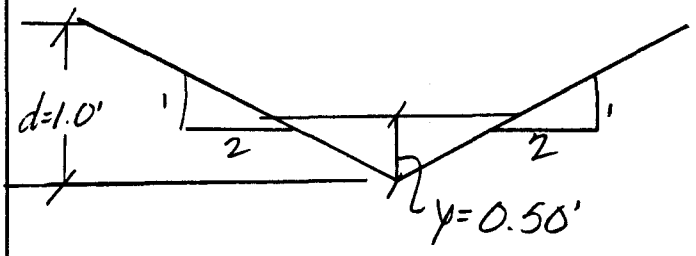
$$\text{slope} = \frac{(6180)(25)(100)}{43{,}560\,(8.2)} = 43.3\%$$

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

2

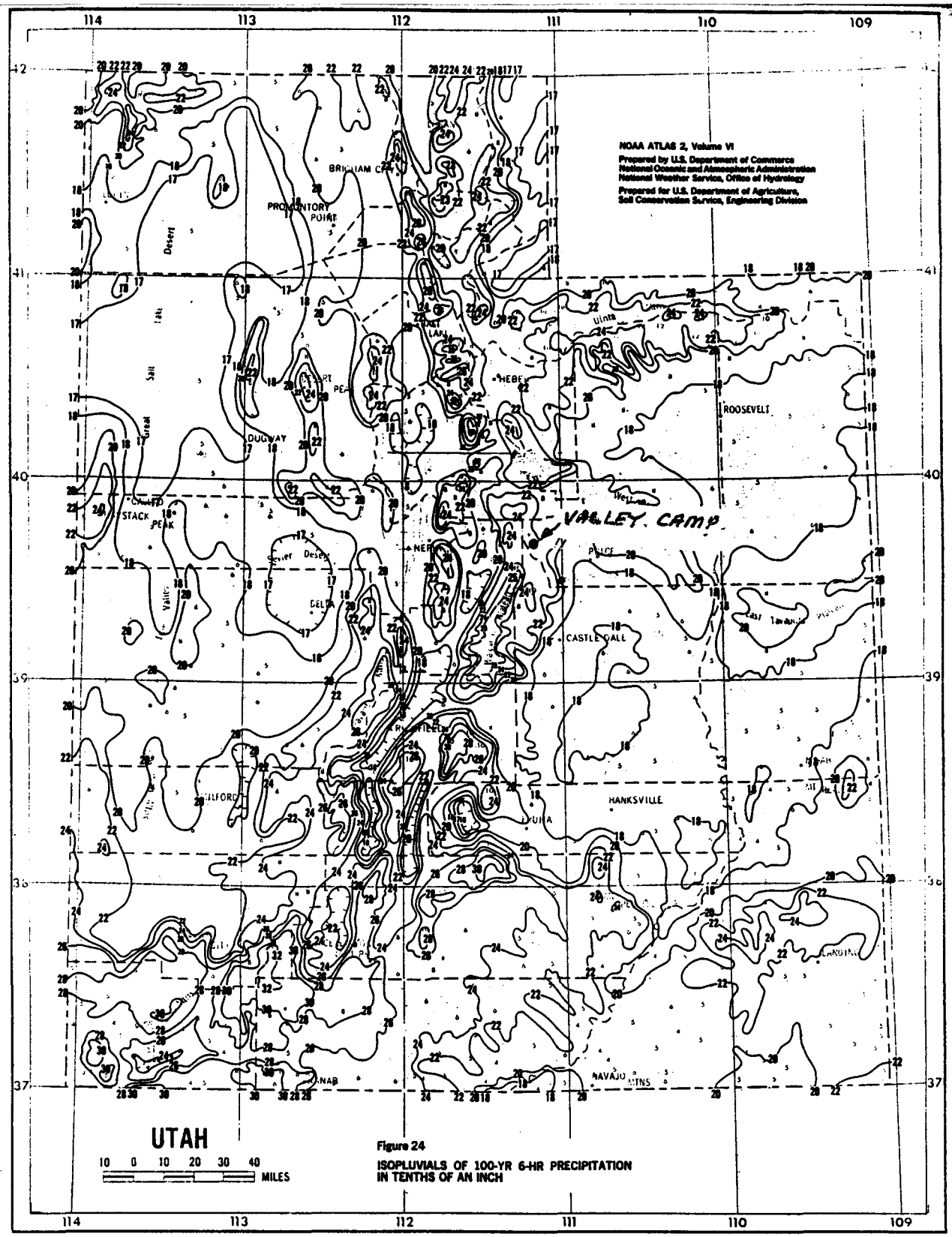


Figure 24

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

100 yr, 6hr ⇒ P = 2.25

[illegible] Hollow Dams Dam - 0-1 Runoff Calculation

AREA= 2.2 ACRES
AVERAGE BASIN SLOPE= 43.3 PERCENT
CURVE NUMBER=, 85.9
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 2290. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0855 HOURS QPCFS= 72.54 CFS QPIN= 8.7726 INCHES
C3= 43.2401 ITERATIONS= 3 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.90	.3264	.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	.0005	57.4	.03
2.04	.3963	.0027	.0013	44.9	.05
2.06	.4159	.0044	.0017	33.1	.11
2.07	.4355	.0066	.0021	23.3	.20
2.09	.4551	.0091	.0025	15.6	.32
2.10	.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	.5728	.0317	.0046	.9	1.31
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	1.99
2.27	.6708	.0591	.0061	.0	2.15
2.41	.8277	.1165	.0080	.0	3.24
2.43	.8473	.1247	.0082	.0	3.36
2.45	.8669	.1331	.0084	.0	3.48
2.46	.8866	.1417	.0086	.0	3.59
2.48	.9062	.1505	.0088	.0	3.70
2.50	.9258	.1594	.0090	.0	3.81
2.51	.9454	.1683	.0089	.0	3.89
2.53	.9650	.1773	.0091	.0	3.97
2.55	.9846	.1863	.0092	.0	3.85
2.56	.9901	.1908	.0025	.0	3.94
2.58	.9954	.1953	.0025	.0	3.93

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

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.60	.9607	.1759	.0025	.0	2.53
2.62	.9660	.1784	.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
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

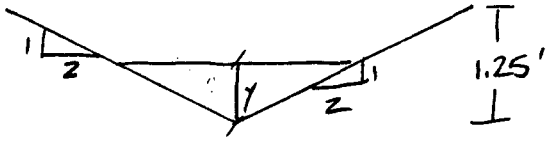
$S_{min} = 1.5\%$ try trapezoidal channel

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

└ Only occurs in extreme upper end of channel where flow is negligible.

$v = 2.14$ ft/sec < 5.0 ft/sec

CK



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= 8 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	.0001	.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	.1636	.0021	.0	1.80
2.59	.9584	.1656	.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.
Project No.: 007.11.100
Channel Section: D-3

Date: 30-Jun-89
Time: 04:26 PM
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 Permit
FEATURE D-5A
PROJECT NO. 007.11-100

SHEET ___ OF ___
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

No further design anticipated

VC to provide standard ditch section with

b = 0
m = 2
depth = 1.0'

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
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

$S_{min} = 3\%$

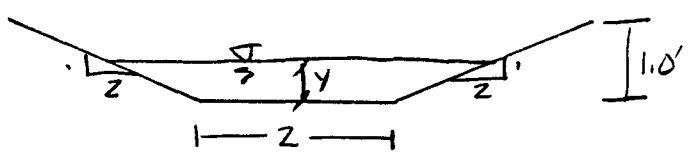
$S_{max} = 11\%$

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	1.30
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 ___ OF ___
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

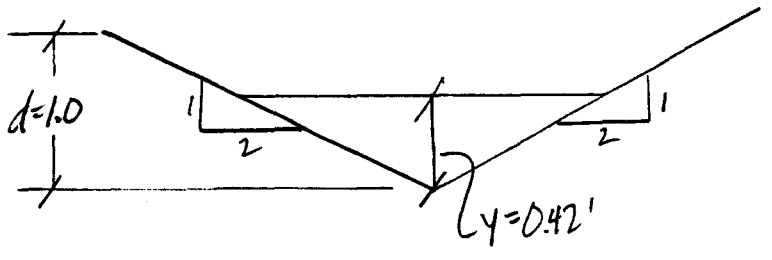
Ditch Design

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 ___ OF ___
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

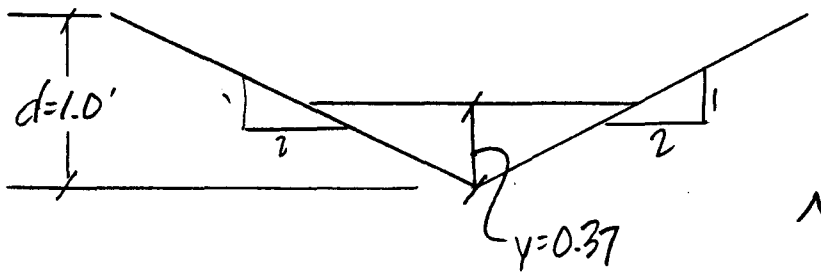
Ditch Design

$S_{min} = 2\%$

$S_{max} = 8\%$

try trapezoidal channel

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



$v = 3.57$ 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= .03 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client: Valley Camp Coal Company
Project No.: 007.11.100
Channel Section: Ditch D-7A

Date: 12-May-89
Time: 03:09 PM
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:

HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
PROJECT Hedmit
FEATURE D-7B
PROJECT NO. 007.11.100

SHEET ___ OF ___
COMPUTED Paul
CHECKED ___
DATE 5/11/89

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'

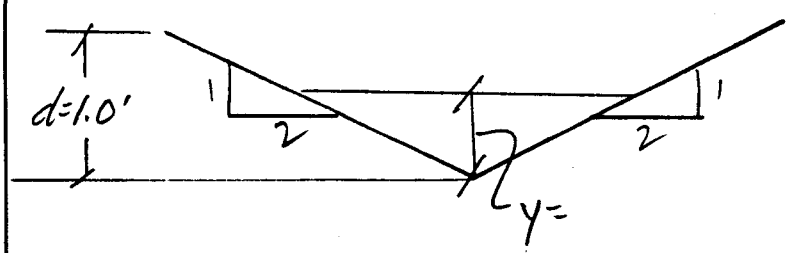
slope = $\frac{(1875)(5)(100)}{43{,}560\,(1.6)}$ = 13.5%

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
Project No.: 007.11.100
Channel Section: Ditch D-7B

Date: 12-May-89
Time: 03:05 PM
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:

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE D-8
PROJECT NO. 007.11.100

SHEET ___ OF ___
COMPUTED Paul
CHECKED
DATE 5/11/89

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

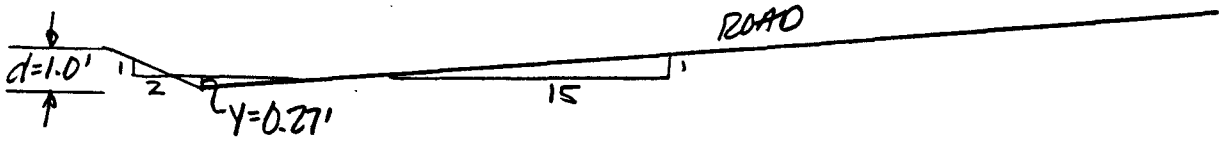
Ditch Design

$S_{min} = 2\%$ 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
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
13B	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

HANSEN ALLEN & LUCE INC

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

SHEET 2 OF
COMPUTED Paul
CHECKED
DATE 5/15/89

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

$t_c = t_i + t_t$ (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

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

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE D-10
PROJECT NO. 007.11.100

SHEET 1 OF
COMPUTED paul
CHECKED
DATE 5/18/89

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

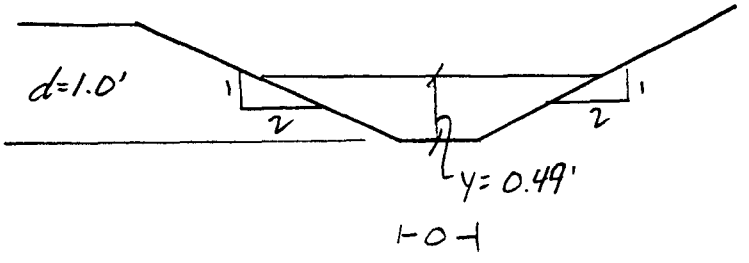
$$\text{slope} = \frac{(1700)(80)(100)}{43{,}560\,(12.8)} = 24.4\ \%$$

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= 1800. 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	

HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
PROJECT Permit
FEATURE D-12A
PROJECT NO. 007-11-100

SHEET ___ OF ___
COMPUTED Paul
CHECKED
DATE 5/11/89

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

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

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

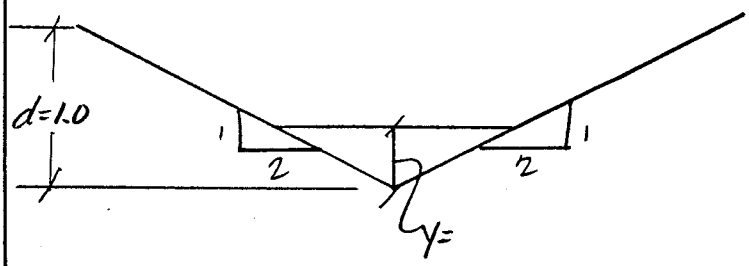
CLIENT Valley Camp
PROJECT Permit
FEATURE D-12A
PROJECT NO. 007-11-100

SHEET ___ OF ___
COMPUTED Paul
CHECKED
DATE 5/16/89

Ditch Design

try trapezoidal channel

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



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

∴ 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	.18
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
COMPUTED DEH
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; $b=0,\ d=1.0,\ m=2$

PROJECT : Valley Camp Coal - D-123 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= 530. 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 ___ OF ___
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'

$$\text{slope} = \frac{(100)(5)(100)}{43560\,(.1)} = 11.5\%$$

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

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

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

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

HANSEN ALLEN & LUCE inc

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

SHEET ___ OF ___
COMPUTED Paul
CHECKED ___
DATE 5/12/89

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
		$\bar{Q}$=0.912

$\bar{CN}$=93.0

Precipitation = 1.55 inches (10 yr, 6 hr)

hydraulic length = 750'

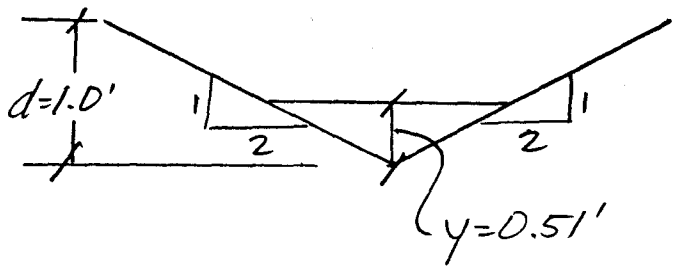
$$\text{slope} = \frac{(1150)(5)(100)}{(43{,}560)(1.6)} = 8.3\%$$

Calculated Runoff Q_{TOT} = 1.35 cfs

Ditch Design

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

try trapezoidal Channel
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:

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CLIENT Valley Camp
PROJECT Hermit
FEATURE
PROJECT NO. 007.11.100

SHEET ___ OF ___
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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

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

Precipitation = 1.55 inches (10 yr, 6 hr)

hydraulic length = 180'

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

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

No further design anticipated

$A_T = 0.23$ ac
.08 paved
$H_L = 180'$

DO DITCH

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
C3=214.8059 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.10	.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	.0145	.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

$\bar{Q} = 0.313$ $\bar{CN} = 80.4$

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

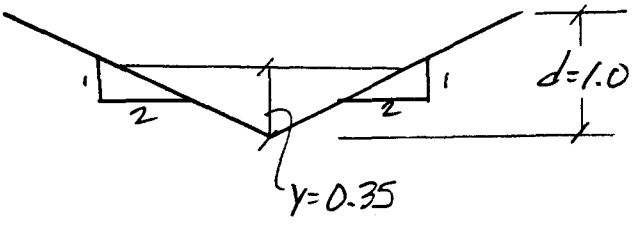
Ditch Design

$S_{min} = 3\%$

$S_{max} = 18\%$

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
CN= 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= .02 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	

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CLIENT Valley Camp
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FEATURE D-13B
PROJECT NO. 007.11-100

SHEET 1 OF
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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

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

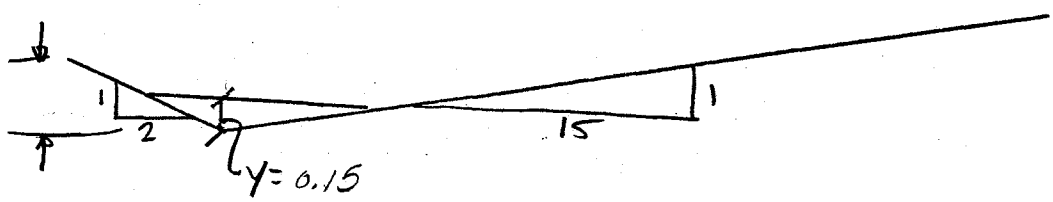
Calculated Run-off: Q_{TOT} = 0.66 cfs

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-133 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	.9396	.0725	.0032	.0	.66
2.53	.9574	.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	

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

SHEET 1 OF
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
		$\bar{Q}$ = 0.405

$\bar{CN}$ = 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:

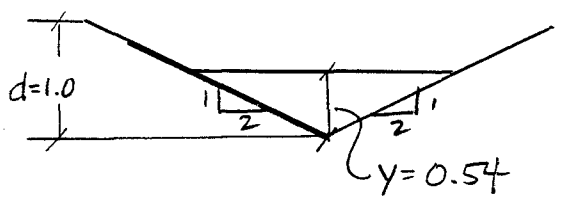
S_{min} = 2%
S_{max} = 2%

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:

HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
PROJECT Permit
FEATURE D-16A
PROJECT NO. 007.11.100

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

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

$\bar{Q} = 0.457$ $\bar{CN} = 84.32$

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)

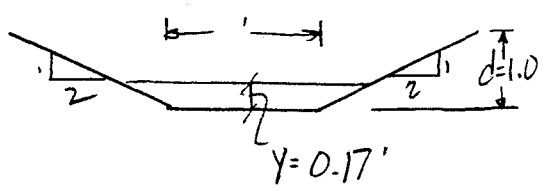
The ditch is currently lined with a conveyor belt. Because of the extreme variation in slope, it is recommended that the ditch be constructed as follows.

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.

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PROJECT NO. 007.11.100

SHEET 3 OF
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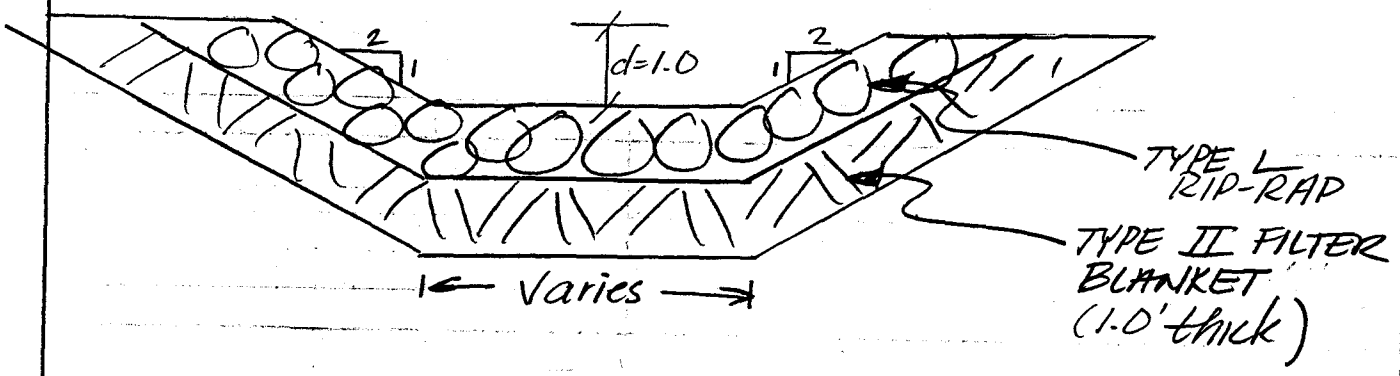
D-16A (Continued)



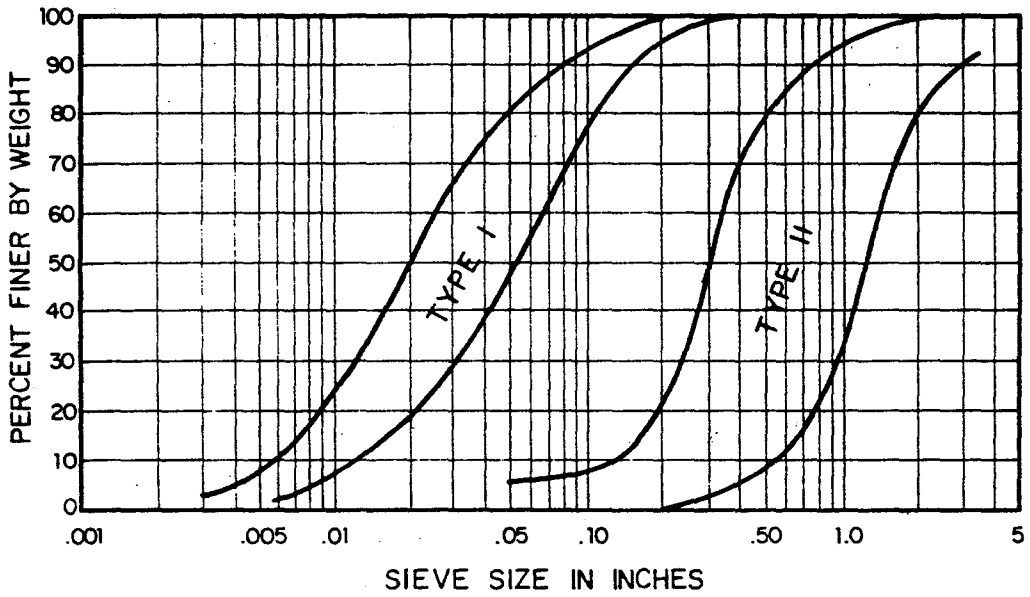


FIGURE 5-2. GRADATION CURVES FOR GRANULAR BEDDING

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CLIENT Valley Camp
PROJECT Permit
FEATURE D-16A
PROJECT NO. 007.11.100

SHEET 4 OF
COMPUTED Paul
CHECKED
DATE 5/12/89

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

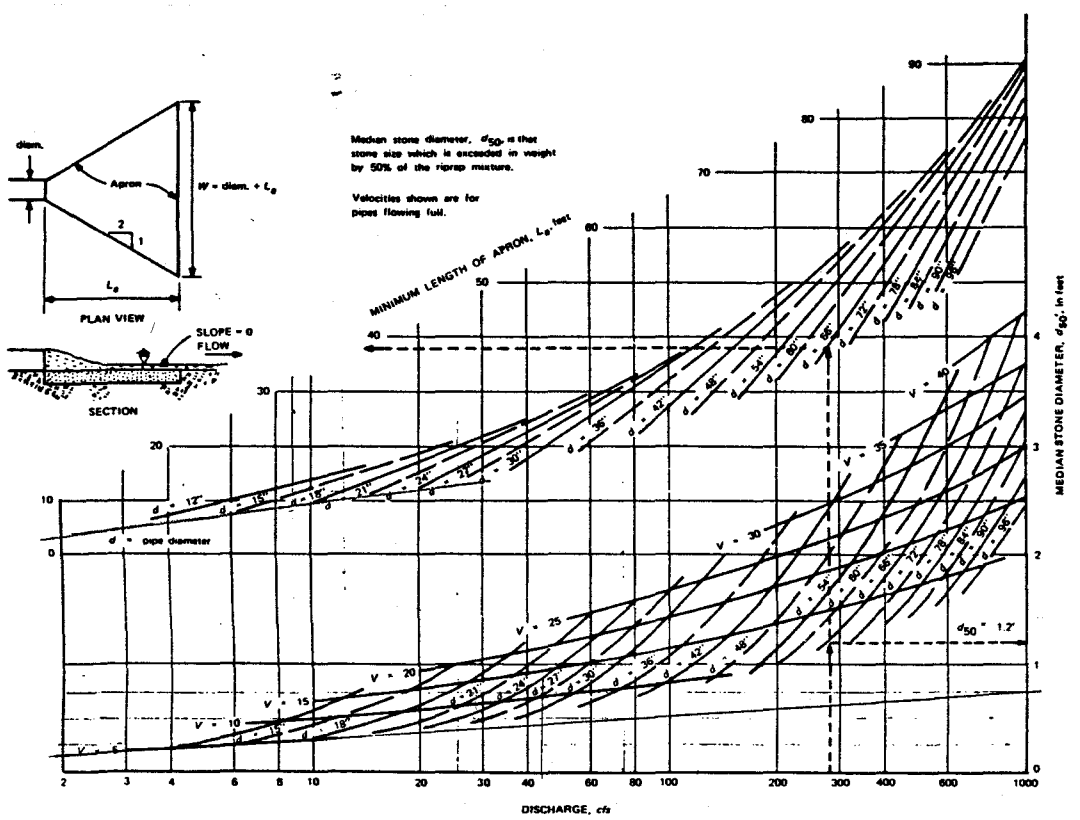


Figure I-15. Design of outlet protection — minimum tailwater condition (T_W < 0.5 diam.)[1]

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.

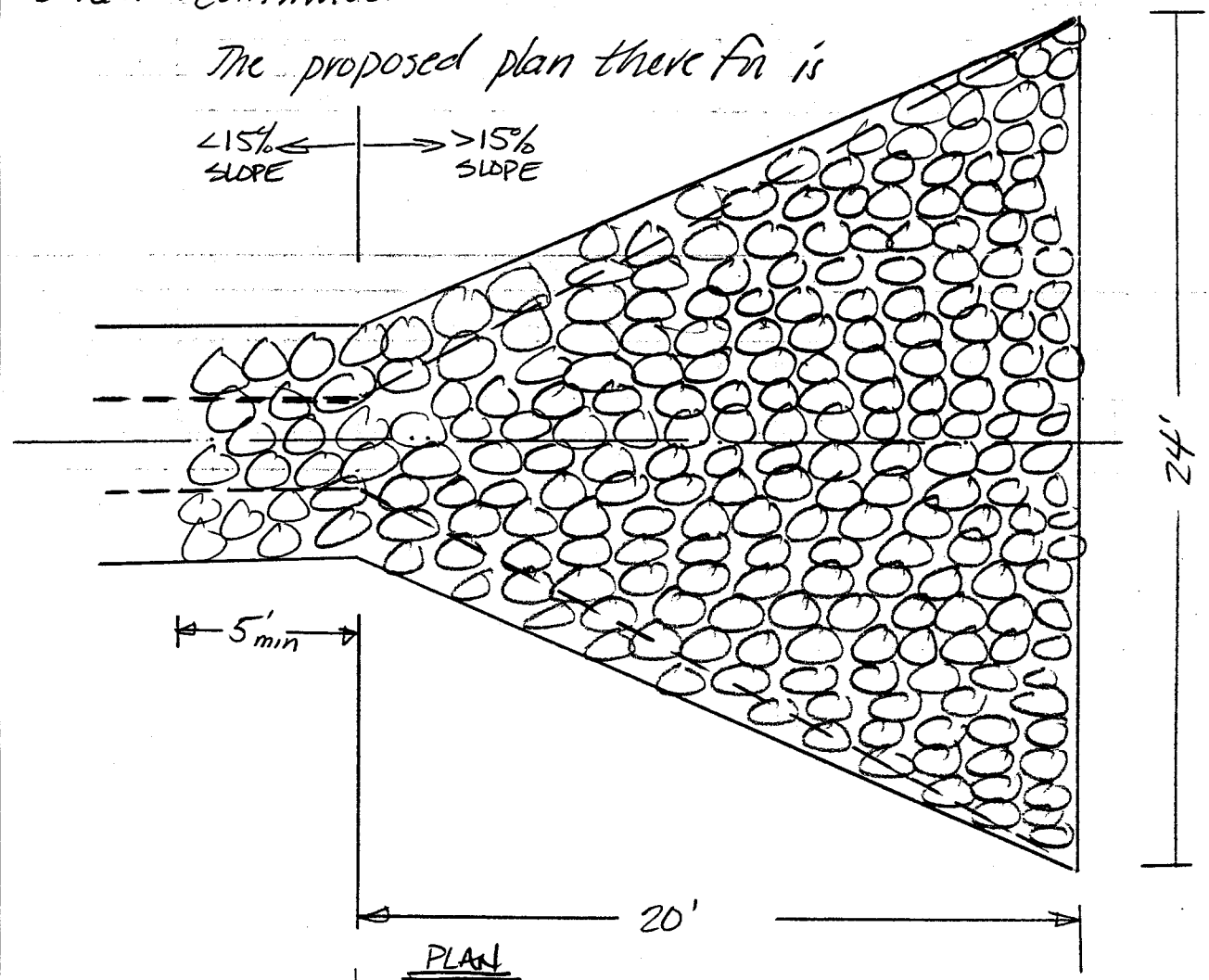
HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
PROJECT Permit
FEATURE D-16A
PROJECT NO. 007-11-100

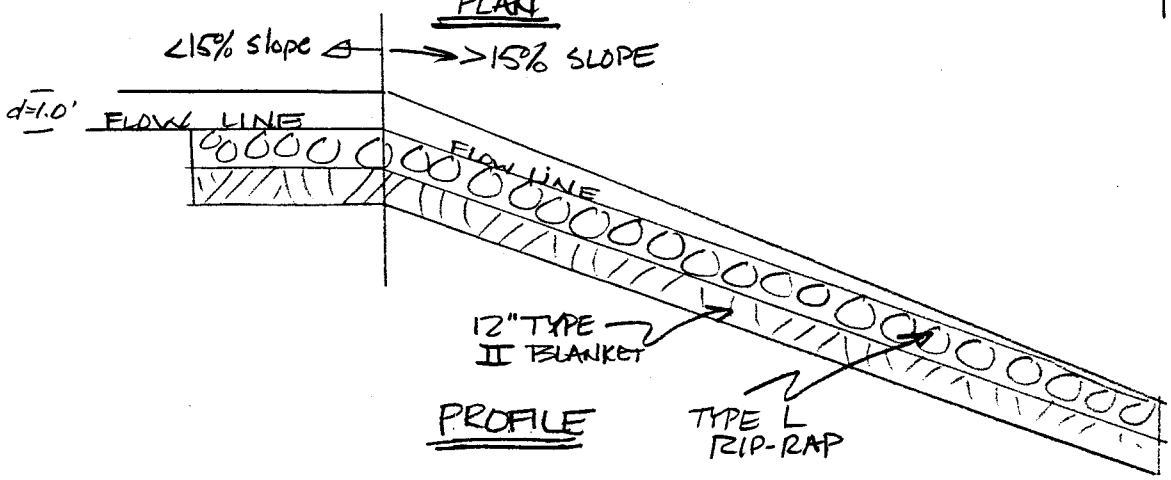
SHEET 5 OF
COMPUTED Paul
CHECKED
DATE 5/12/89

D-16A Continued

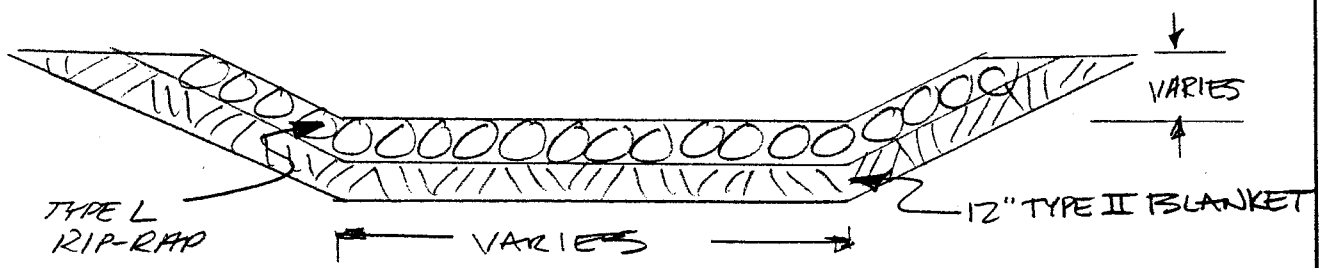
The proposed plan therefor is



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

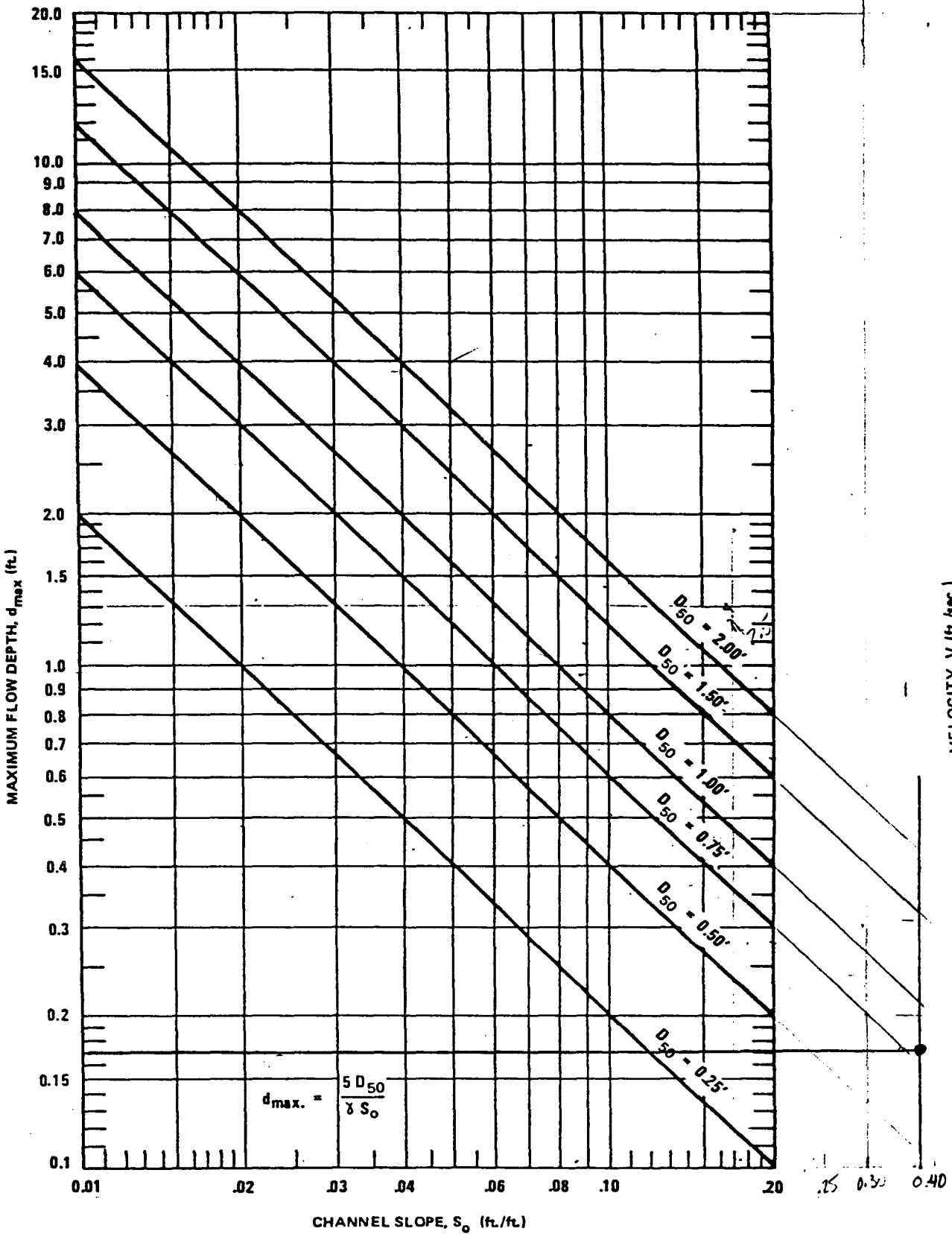
			UNITS
GENERAL CRITERIA:	Design Flow:	2.13	cfs
	Bottom Width:	3.0	feet
	Side Slope1:	2.0	1/m1
	Side Slope2:	2.0	1/m2
	Friction Factor:	0.030	
	Min. Bottom Slope:	0.08	ft/ft
	Max. Bottom Slope:	0.15	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. Flow):	0.17	feet
	Qn/1.49(S)1/2=	0.152	
	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	

Comment: upper reach where S≤15%

Design of Stable Channels with Flexible Linings - Fed. Highway Administration

Chart 27



MAXIMUM PERMISSIBLE DEPTH OF FLOW (d_{max})
FOR CHANNELS LINED WITH ROCK RIPRAP

$n = .0395\,D_{50}^{1/6}$

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE D-16B
PROJECT NO. 007.11.100

SHEET 1 OF
COMPUTED DEH
CHECKED
DATE 5/11/89

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

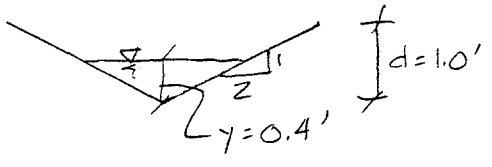
$S_{MIN} = 1\%$
$S_{MAX} = 10\%$

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:

HANSEN ALLEN & LUCE INC

CLIENT Valley Camp
PROJECT Permit
FEATURE D-18A
PROJECT NO. 007.11.100

SHEET 1 OF
COMPUTED Paul
CHECKED
DATE 5/10/89

D-18A

calibrate planimeter $\frac{\frac{(250\ ft)^2}{43560}}{822} = 0.00175$ Ac/#

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:

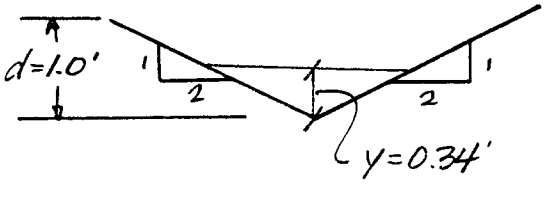
$S_{min} = 2\%$
$S_{max} = 5\%$

Try trapezoidal design

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

$V = 2.73$ 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 ___ OF ___
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

$\bar{Q} = 0.383$ $\bar{CN} = 82.3$

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

No additional design anticipated

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
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

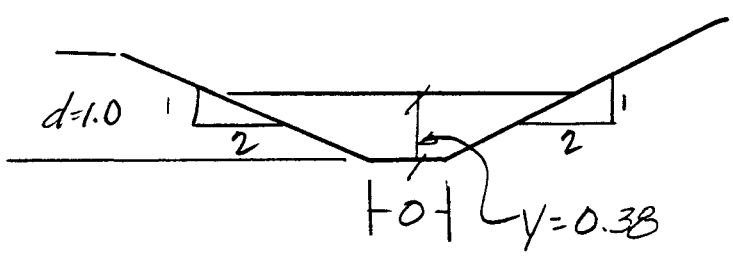
Ditch Design

$S_{min} = 3\%$

$S_{max} = 4\%$

try trapezoidal channel

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



$V_{max} = 2.86 < 5.0$ fps ok

No Lining Required

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 QPCFS= 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
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FEATURE D-19B
PROJECT NO. 007.11.100

SHEET ___ OF ___
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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

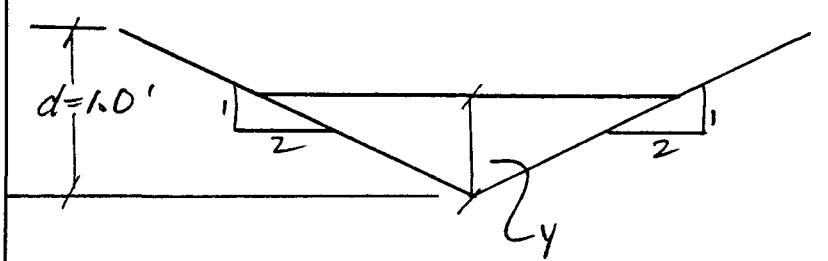
Ditch Design

S_{min} = 2%

S_{max} = 4%

try trapezoidal channel

b=0, m=2, n=0.03



FLOW IS MINIMAL
USE GENERAL DESIGN

PROJECT : Valley Camp Coal - D-198 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
C3= 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	.6591	.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	.9736	.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

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PROJECT NO. 007.11.100

SHEET 1 OF
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CHECKED
DATE 10/30/89

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

PROJECT : Valley Camp Coal - D-294 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
C3=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
2.11	.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

HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
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FEATURE
PROJECT NO. 007.11.100

SHEET 1 OF
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CHECKED
DATE 6/30/89

D-29B

Tributary Area = 1.2ac

			Q
Undisturbed Area	= 0.86ac	CN = 70	0.096
Disturbed Area	= 0.34ac	CN = 90	0.723

$\bar{Q} = 0.274$ $\overline{CN} = 78.7$

Precipitation = 1.55 inches (10yr, 6hr)

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

PROJECT [illegible] - 2-YR 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

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PROJECT PERMIT
FEATURE D-30
PROJECT NO. 007.11.100

SHEET 1 OF
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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 ___ OF ___
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 - No design anticipated

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 ___ OF ___
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

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. 007.11.100

SHEET 1 OF
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'

$$\text{SLOPE} = \frac{10550 * 25 * 100}{14.3 * 43560} = 42.3\%$$

RUNOFF CALCULATION: Q = 5.36 cfs

DITCH DESIGN

S_{min} = 4% ? DITCH CURRENTLY LINED WITH CONCRETE
S_{max} = 4% 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

HANSEN ALLEN & LUCE INC

CLIENT: VALLEY CAMP
PROJECT: PERMIT
FEATURE: D-33B
PROJECT NO.: 007.11.100

SHEET 1 OF
COMPUTED DEH
CHECKED
DATE 5 MAY 89

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'

$$\text{SLOPE} = \frac{10160 * 25 * 100}{13.4 * 43560} = 43.5\%$$

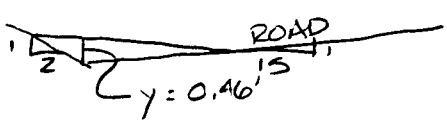
RUNOFF PREDICTION: Q = 6.6 cfs

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
COMPUTED DEH
CHECKED
DATE 5 MAY 89

D-34A (RECLAIMED) - Small Oak Aspen Area Ignored - Calcs ∴ Conservative.

AREA: 189 * .00702 = 1.3 ac
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:

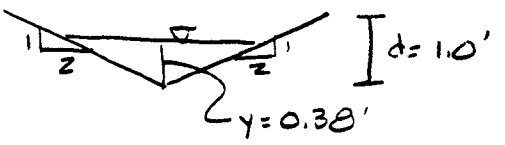
S_{min} = 2%
S_{max} = 2%

TRY TRAPEZOIDAL DESIGN

b = 0, m = 2, n = 0.03

V = 2.2 < 5 fps ∝

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
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'

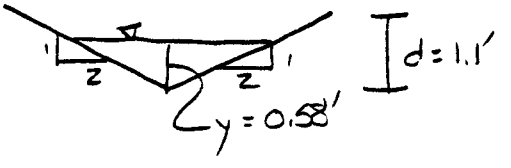
SLOPE = $\frac{2610 * 25 * 100}{3.0 * 43560}$ = 50%

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: (Channel Depth)	Depth (Min. Flow):	0.58	feet
	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: (Velocity Check)	Depth (Max. Flow):	0.48	feet
	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/m1
	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:

HANSEN ALLEN & LUCE INC

CLIENT: VALLEY CAMP
PROJECT: PERMIT
FEATURE: D-35
PROJECT NO.: 007.11.100

SHEET 1 OF
COMPUTED: DEH
CHECKED:
DATE: 5 MAY 89

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

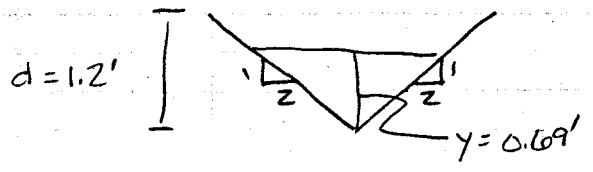
$\bar{CN}$ = 89.3

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/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):	0.69	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/m1
	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 ___ OF ___
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)

PROJECT : Valley Camp Coal - D-34 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= 550. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0279 HOURS QPCFS= 73.10 CFS QPIN=26.8484 INCHES
C3=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	.5266	.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

HANSEN ALLEN & LUCE inc

CLIENT VALLEY CAMP
PROJECT PERMIT
FEATURE D-37
PROJECT NO. 007.11.100

SHEET 1 OF
COMPUTED DEH
CHECKED
DATE 4MAY89

D-37 DESIGN

CN DETERMINATIONS SHOWN ON D-44B SHEETS

P10 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 n = .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'
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, n = 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= 2.30 Hours
RUNOFF VOLUME= .23 Acre-Feet

Trapezoidal Channel Flow Calculations using Mannings Equation

Client: Valley Camp Coal Company
Project No.: 007.11.100
Channel Section: D-37

Date: 05-May-89
Time: 08:12 AM
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: (Channel Depth)	Depth (Min. Flow):	0.37	feet
	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: (Velocity Check)	Depth (Max. Flow):	0.25	feet
	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	

Comments:

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	.2716	.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

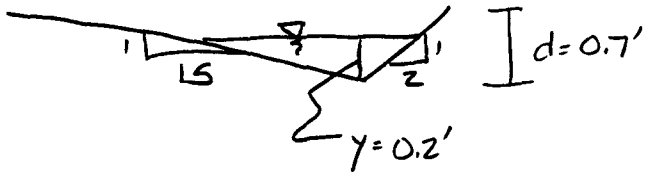
Client: Valley Camp Coal Company — Date: 05-May-89
Project No.: 007.11.100 — Time: 08:27 AM
Channel Section: Upper D-37 — Computed: DEH

			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:

UPPER SECTION - CROSS SECTION (18% Grade)



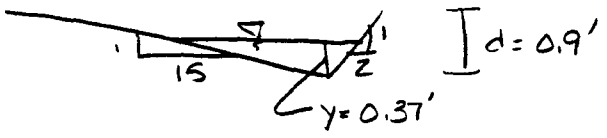
REMAINING SECTION OF DITCH (BELOW 18% GRADE)

SLOPE VARIES BETWEEN 2% AND 10% WITH 1 30% RIPRAPPED SECTION

FOR 2-10% SLOPES : Q=2.6 cfs (See Sheet 7)

$M_1 = 1.5$ $b=0$
$M_2 = 2$ $\eta = 0.03$ $V = 4.1 < 5$ ok

NO LINING REQ'd



30% RIPRAP SECTION Q=2.6

From Sheet 8; $y = 0.22'$, $V = 8.1$ fps > 5.0 LINING REQ'd
$b = 1.0'$

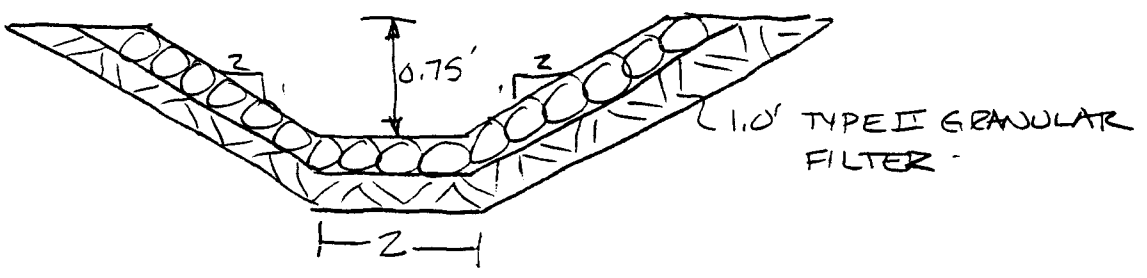
EXTRAPOLATING FROM "DESIGN OF STABLE CHANNELS WITH FLEXIBLE LININGS" FED. HIGHWAY ADMI - OCT 75 - SEE SHEET 9

GIVES $D_{50} \sim 1.0'$ $\eta = .0395(D_{50})^{1/6} \sim 0.04$

IF CHANNEL IS WIDENED TO 2.0' (Sheet 10)

$y = 0.19'$ AND $D_{50} = 0.75'$ USE $B = 2.0'$

USE 1.0' TYPE II GRANULAR FILTER AS PER "URBAN STORM DRAINAGE CRITERIA MANUAL" - VOL 2 - MARCH 1969 (T615-4)



Trapezoidal Channel Flow Calculations using Mannings Equation

Client: Valley Camp Coal Company
Project No.: 007.11.100
Channel Section: Lower D-37

Date: 05-May-89
Time: 08:33 AM
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:	0.10	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. Flow):	0.37	feet
	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: (Velocity Check)	Depth (Max. Flow):	0.27	feet
	Qn/1.49(S)1/2=	0.166	
	A(R)2/3=	0.166	
	Required Depth:	0.77	feet
	Area:	0.63	ft2
	Perimeter:	4.71	feet
	Hydraulic Radius:	0.13	feet
	Velocity:	4.10	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:	0.10	ft/ft
	Channel Depth:	0.87	feet
	Riprap:	Not Needed	

Comment:

Trapezoidal Channel Flow Calculations using Mannings Equation

Client: Valley Camp Coal Company
Project No.: 007.11.100
Channel Section: Lower D-37

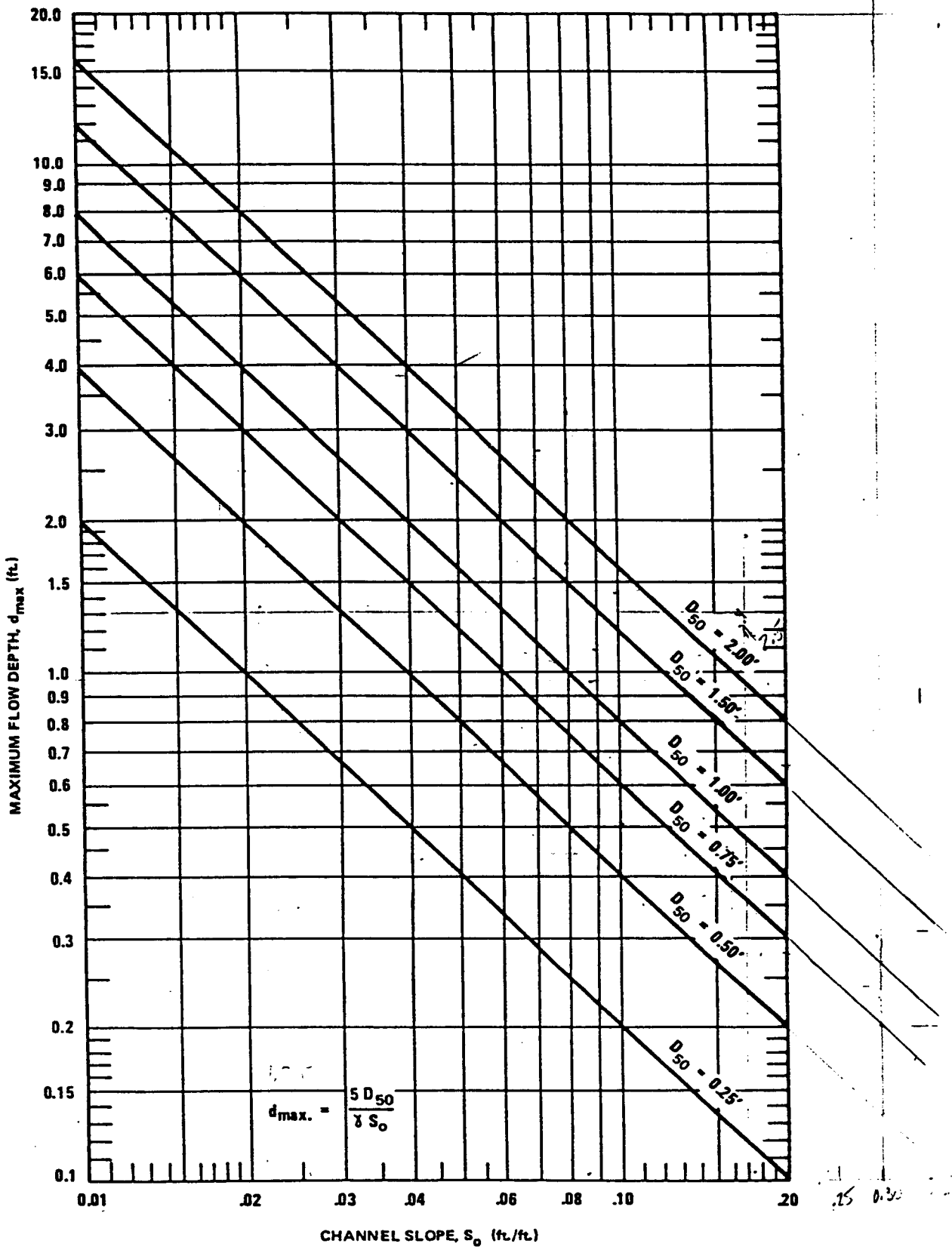
Date: 05-May-89
Time: 08:47 AM
Computed: DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	2.60	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:	0.30	ft/ft
	Max. Bottom Slope:	0.30	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. Flow):	0.22	feet
	Qn/1.49(S)1/2=	0.096	
	A(R)2/3=	0.096	
	Required Depth:	0.72	feet
	Area:	0.32	ft2
	Perimeter:	2.00	feet
	Hydraulic Radius:	0.16	feet
	Velocity:	8.06	ft/sec
	Riprap Ck (V<5?):	Required	
CALCULATION: (Velocity Check)	Depth (Max. Flow):	0.22	feet
	Qn/1.49(S)1/2=	0.096	
	A(R)2/3=	0.096	
	Required Depth:	0.72	feet
	Area:	0.32	ft2
	Perimeter:	2.00	feet
	Hydraulic Radius:	0.16	feet
	Velocity:	8.06	ft/sec
	Riprap Ck (V<5?):	Required	

DESIGN CRITERIA:	Bottom Width:	1.0	feet
	Side Slope 1:	2.0	1/m1
	Side Slope 2:	2.0	1/m2
	Min. Bottom Slope:	0.30	ft/ft
	Max. Bottom Slope:	0.30	ft/ft
	Channel Depth:	0.72	feet
	Riprap:	Required	

Comment:

Chart 27



MAXIMUM PERMISSIBLE DEPTH OF FLOW (d_{max})
FOR CHANNELS LINED WITH ROCK RIPRAP

$n = .0395 D_{50}^{1/6}$

Trapezoidal Channel Flow Calculations using Mannings Equation

Client:	Valley Camp Coal Co.	Date:	12-Jul-89
Project No.:	007.11.100	Time:	03:13 PM
Channel Section:	Lower D-37	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:	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
	Qn/1.49(S)1/2=	0.128	
	A(R)2/3=	0.127	
	Required Depth:	0.69	feet
	Area:	0.44	ft2
	Perimeter:	2.83	feet
	Hydraulic Radius:	0.16	feet
	Velocity:	5.93	ft/sec
	Riprap Ck (V<5?):	Required	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.19	feet
	Qn/1.49(S)1/2=	0.128	
	A(R)2/3=	0.127	
	Required Depth:	0.69	feet
	Area:	0.44	ft2
	Perimeter:	2.83	feet
	Hydraulic Radius:	0.16	feet
	Velocity:	5.93	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	

HANSEN ALLEN & LUCE INC

CLIENT
PROJECT
FEATURE
PROJECT NO.

SHEET 11 OF
COMPUTED DEH
CHECKED
DATE 5 MAY 89

RIPRAP GRADATION (From Drainage Criteria Manual) Table 5-1

RIPRAP TYPE L

INTERMEDIATE ROCK DIMENSION (INCHES)	% SMALLER THAN GIVEN SIZE BY WEIGHT
15	70-100
12	50-70
9	35-50
3	2-10

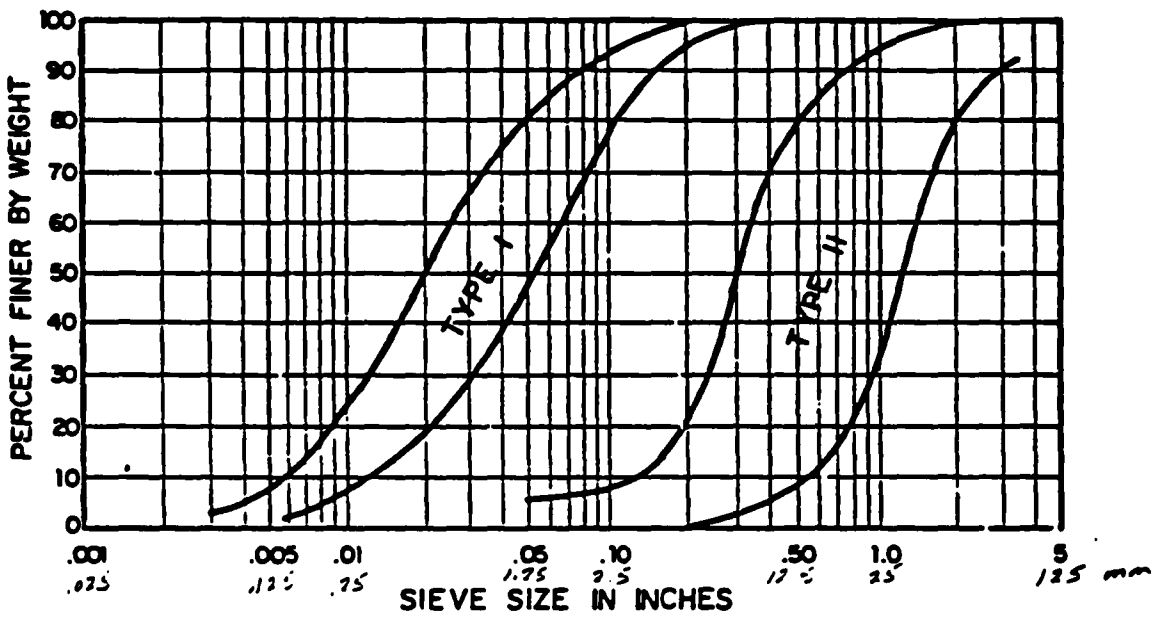


FIGURE 5-2. GRADATION CURVES FOR GRANULAR BEDDING

HANSEN ALLEN & LUCE INC

CLIENT Valley Co.
PROJECT Permit
FEATURE
PROJECT NO. 007.11.100

SHEET 1 OF
COMPUTED DEH
CHECKED
DATE 6/30/89

D-38

Total Area = 0.3 acres (Disturbed)

CN = 90

Precipitation = 1.55 inches (10yr, 6hr)

Hydraulic Length = 175 feet

$$\text{Slope} = \frac{(150)\,25(100)}{43560\,(0.3)} = 28.7\%$$

Calculated Runoff $Q_{TOT} = 0.22$ cfs

No ditch Design Anticipated. - USE GENERAL DESIGN

PROJECT : Valley Camp Coal - D-38 Runoff Calculation

AREA= .3 ACRES
AVERAGE BASIN SLOPE= 27.7 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 175. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0117 HOURS QPCFS= 19.43 CFS QPIN=64.2234 INCHES
C3=316.5573 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.54	.2199	.0000	.0000	.0	.00
1.55	.2234	.0000	.0000	19.4	.00
1.56	.2269	.0000	.0000	5.6	.00
1.57	.2305	.0000	.0000	.6	.00
1.58	.2340	.0001	.0000	.0	.00
2.42	.8428	.2224	.0081	.0	.21
2.44	.8566	.2306	.0081	.0	.21
2.45	.8704	.2388	.0082	.0	.21
2.46	.8841	.2471	.0083	.0	.21
2.47	.8979	.2555	.0084	.0	.21
2.48	.9116	.2640	.0085	.0	.22
2.50	.9254	.2725	.0086	.0	.22
2.51	.9325	.2770	.0044	.0	.14
2.52	.9362	.2793	.0023	.0	.08
2.53	.9399	.2817	.0023	.0	.06
2.54	.9436	.2840	.0023	.0	.06
2.56	.9474	.2864	.0024	.0	.06
2.57	.9511	.2887	.0024	.0	.06

HYDROGRAPH PEAK= .22 cfs
TIME TO PEAK= 2.50 Hours
RUNOFF VOLUME= .02 Acre-Feet

HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
PROJECT Permit
FEATURE D-39A, D-39B
PROJECT NO. 007.11.100

SHEET ___ OF ___
COMPUTED Paul
CHECKED
DATE 5/9/89

D-39A, D-39B (Convenience Ditches)

Total Area = 253 * 0.00702 = 1.8 acres

CN = 70 (25% Oak/Aspen)

Precipitation = 1.55 inches (10 yr, 6 hr)

hydraulic length = 450 feet

$$\text{slope} = \frac{(1100)(25)(100)}{(1.78)\,43{,}560} = 35.5\%$$

Run-Off Calculation: $Q_{TOT} = 0.06$ cfs

Convenience Ditches - No further design anticipated ok

PROJECT : Valley Camp Coal - D-39A, D-39B Runoff Calculations

AREA= 1.8 ACRES
AVERAGE BASIN SLOPE= 35.5 PERCENT
CURVE NUMBER= 70.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 450. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0417 HOURS QPCFS= 32.61 CFS QPIN=17.9644 INCHES
CS= 88.5466 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.42	.8406	.0000	.0000	.0	.00
2.44	.8646	.0000	.0000	16.0	.00
2.46	.8885	.0002	.0002	32.6	.00
2.48	.9125	.0007	.0005	23.0	.01
2.51	.9317	.0013	.0006	10.5	.03
2.53	.9382	.0015	.0002	3.8	.04
2.55	.9447	.0018	.0002	1.2	.03
2.57	.9512	.0020	.0003	.3	.03
2.59	.9576	.0023	.0003	.0	.02
3.36	1.1747	.0219	.0007	.0	.06
3.38	1.1799	.0226	.0007	.0	.06
3.40	1.1851	.0233	.0007	.0	.06
3.42	1.1902	.0240	.0007	.0	.06
3.45	1.1954	.0247	.0007	.0	.06
3.47	1.2006	.0255	.0007	.0	.06
3.49	1.2058	.0262	.0007	.0	.06
3.51	1.2103	.0269	.0007	.0	.06
3.53	1.2139	.0274	.0005	.0	.06
3.55	1.2175	.0279	.0005	.0	.05
3.57	1.2210	.0285	.0005	.0	.05
3.59	1.2246	.0290	.0005	.0	.05
3.61	1.2281	.0296	.0005	.0	.05

HYDROGRAPH PEAK= .06 cfs
TIME TO PEAK= 7.49 hours
RUNOFF VOLUME= [illegible]

HANSEN ALLEN & LUCE inc

CLIENT Valley Camp
PROJECT Permit
FEATURE D-42
PROJECT NO. 007.11.100

SHEET ___ OF ___
COMPUTED Paul
CHECKED
DATE 5/8/89

D-42 (Convenience Ditch)

Total Area = 99 * 0.00702 = 0.7 ac

CN = 90 (disturbed)

Precipitation = 1.55 inches (10 yr, 6 hr)

hydraulic length = 275'

$$\text{slope} = \frac{(450)(25)(100)}{43{,}560\,(0.7)} = 36.9\%$$

Run-off Calculation: $Q_{TOT} = 0.51$ cfs

Convenience Ditch - No further design anticipated

CK

AREA= .7 ACRES
AVERAGE BASIN SLOPE= 36.9 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 275. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0145 HOURS QPCFS= 36.45 CFS QPIN=51.6334 INCHES
C3=254.5012 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.54	.2201	.0000	.0000	.0	.00
1.55	.2244	.0000	.0000	36.4	.00
1.57	.2287	.0000	.0000	11.8	.00
1.58	.2330	.0001	.0000	1.3	.00
1.60	.2372	.0002	.0000	.0	.00
2.41	.8233	.2110	.0096	.0	.47
2.42	.8400	.2207	.0097	.0	.48
2.44	.8566	.2306	.0098	.0	.49
2.45	.8732	.2405	.0100	.0	.49
2.46	.8899	.2506	.0101	.0	.50
2.48	.9065	.2608	.0102	.0	.50
2.49	.9231	.2711	.0103	.0	.51
2.51	.9326	.2771	.0060	.0	.35
2.52	.9371	.2799	.0028	.0	.19
2.54	.9416	.2827	.0028	.0	.15
2.55	.9461	.2856	.0028	.0	.14
2.57	.9506	.2884	.0029	.0	.14
2.58	.9551	.2913	.0029	.0	.14

HYDROGRAPH PEAK= .51 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .04 Acre-Feet

HANSEN ALLEN & LUCE inc

CLIENT VALLEY CAMP
PROJECT PERMIT
FEATURE D-44A
PROJECT NO. 007.11.100

SHEET 1 OF
COMPUTED DEH
CHECKED
DATE 4 MAY 89

D-44A DESIGN

CN determination shown on D-44B sheets $P_{10yr-6hr} = 1.55$ in

AREA: $R_{DE} = 434$ $A = 434 * 0.0035 = 1.52$ ac : TOTAL

0.53 : DISTURBED CN = 90

0.99 : UNDISTURBED CN = 70

Undist. Area is Approx 25% Oak/Aspen Complex

Area	CN	$Q_{10yr-6hr}$
0.53	90	0.723
0.99	70	0.096
1.52		$\bar{Q} = 0.315$

$\bar{CN} = 80$

HYD. LENGTH ~ 510'

WATERSHED SLOPE: $\frac{\text{Cont L} * \text{Cont Int} * 100}{\text{Area} * 43560}$

$= \frac{800 * 25 * 100}{1.52 * 43560} = 30.2\%$

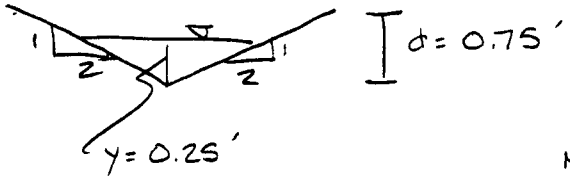
RUNOFF PREDICTION:

$Q = 0.43$ cfs

CHANNEL DESIGN:

$S_{min} = 10\%$ $b = 0$

$S_{max} = 10\%$ $m_1 = m_2 = 2$



NO LINING REQ'D

PROJECT : Valley Camc Coal - Ditch D-44A Runoff Calculation

AREA= 1.5 ACRES
AVERAGE BASIN SLOPE= 30.2 PERCENT
CURVE NUMBER= 80.0
DESIGN STORM=. 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 510. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0375 HOURS QPCFS= 30.66 CFS QPIN=20.0051 INCHES
C3= 98.6053 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.12	.4921	.0000	.0000	.0	.00
2.14	.5136	.0000	.0000	15.0	.00
2.16	.5351	.0005	.0004	30.7	.00
2.17	.5566	.0013	.0008	21.6	.03
2.19	.5781	.0024	.0011	9.9	.05
2.21	.5996	.0038	.0014	3.5	.08
2.23	.6211	.0056	.0018	1.1	.10
2.25	.6426	.0077	.0021	.3	.13
2.27	.6641	.0101	.0024	.0	.16
2.40	.8146	.0352	.0044	.0	.33
2.42	.8361	.0398	.0047	.0	.35
2.44	.8576	.0447	.0049	.0	.37
2.46	.8791	.0499	.0052	.0	.39
2.47	.9006	.0553	.0054	.0	.41
2.49	.9221	.0610	.0056	.0	.43
2.51	.9337	.0641	.0031	.0	.41
2.53	.9395	.0657	.0016	.0	.32
2.55	.9453	.0673	.0016	.0	.22
2.57	.9511	.0690	.0016	.0	.17
2.59	.9569	.0706	.0016	.0	.14

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

Trapezoidal Channel Flow Calculations using Mannings Equation

Client: Valley Camp Coal Company
Project No.: 007.11.100
Channel Section: D-44A

Date: 04-May-89
Time: 04:08 PM
Computed: DEH

			UNITS
GENERAL CRITERIA:	Design Flow:	0.43	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:	0.10	ft/ft
	Max. Bottom Slope:	0.10	ft/ft
	Freeboard:	0.50	feet
CALCULATION: (Channel Depth)	Depth (Min. Flow):	0.25	feet
	Qn/1.49(S)1/2=	0.027	
	A(R)2/3=	0.027	
	Required Depth:	0.75	feet
	Area:	0.12	ft2
	Perimeter:	1.10	feet
	Hydraulic Radius:	0.11	feet
	Velocity:	3.58	ft/sec
	Riprap Ck (V<5?):	Not Needed	
CALCULATION: (Velocity Check)	Depth (Max. Flow):	0.25	feet
	Qn/1.49(S)1/2=	0.027	
	A(R)2/3=	0.027	
	Required Depth:	0.75	feet
	Area:	0.12	ft2
	Perimeter:	1.10	feet
	Hydraulic Radius:	0.11	feet
	Velocity:	3.58	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:	0.10	ft/ft
	Max. Bottom Slope:	0.10	ft/ft
	Channel Depth:	0.75	feet
	Riprap:	Not Needed	

Comment:

HANSEN ALLEN & LUCE inc

CLIENT VALLEY CAMP
PROJECT PERMIT
FEATURE RUNOFF HYDROLOGY - BELINA MINE AREA
PROJECT NO. 007.11.100

SHEET 1 OF
COMPUTED DEH
CHECKED
DATE 4 MAY 89

DITCH 44B

START W/ UPPER SMALL DITCHES TO WEST

DITCH D-44B - Includes a portion of SAE 7 plus some undisturbed area,

MAP SCALE 1:100' RDG = 40B for 1.44 ac RATIO = 0.0035

Tributary Area = 506 * .0035 = 1.8 ac
Disturbed " = 78 = 0.3 ac
Undisturbed " = 1.5 ac

USING CONSISTENT CURVE NUMBERS AS DEVELOPED IN OUR FEB 89 SED. POND REPORT.

SAGE/GRASS AREAS, SOIL GROUP C, DENSITY 25%; CN = 75
OAK/ASPEN AREAS, SOIL GROUP C, DENSITY 25%; CN = 70
OAK/ASPEN AREAS, SOIL GROUP C, DENSITY 90%; CN = 40 *

* TAKEN FROM FIG 9.5 NEH4; PG 9.11

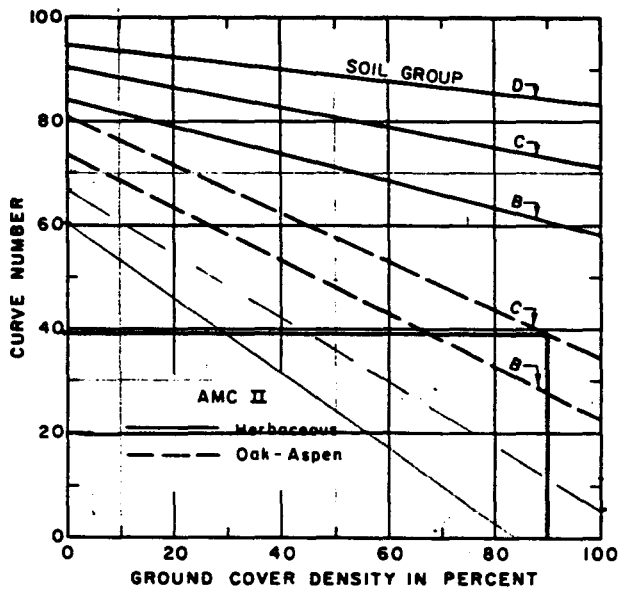


Figure 9.5.--Graph for estimating runoff curve numbers of forest-range complexes in western United States: herbaceous and oak-aspen complexes.

DISTURBED AREAS CN = 90

RECLAIMED AREAS CN = 85
PAVED AREAS CN = 98

CN	S	CN	S
98	0.204	75	3.333
90	1.111	70	4.286
85	1.765	40	15.000

DITCH D-44B

Area	CN	Runoff Depth (in) 10YR-6HR
0.3	90	0.723
1.5	40	0.155
1.8	$\bar{Q}$ =	0.25

$\overline{CN}$ = 77.8

$P_{10YR-6HR}$ = 1.55 in - Hand Calc for Example of procedure

$$Q_{in} = \frac{(P-.2S)^2}{P+.8S} \quad \text{where } S = \frac{1000}{CN} - 10$$

$$P^2 - .4PS + .04S^2 = PQ + .8QS$$

$$0.04S^2 - .4S(P+2Q) - PQ + P^2 = 0 \qquad \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$b = -0.4(P+2Q) = -0.82$
$a = 0.04 = 0.04$
$c = P(P-Q) = 2.015$

$$S = \left[+0.82 \pm \sqrt{(-.82)^2 - 4(.04)2.015}\right] 0.08 = \frac{.82 \pm .592}{.08} = 17.65;\ 2.85$$

$$CN = \frac{1000}{S+10} = \frac{1000}{12.9} = 77.8 \quad \alpha$$

Hydraulic Length: 210 ft

Avg Slope: Measured from Map $\sim \frac{(900)25(100)}{43560\,(1.8)} = 28.7\%$

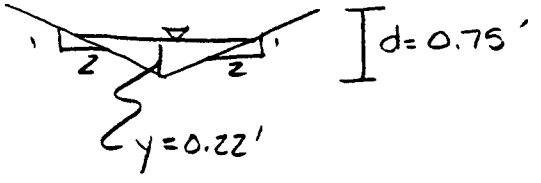
Hydro Results give Q = 0.37 cfs

Try Trap. Channel design:

$b = 0;\ m_1 = m_2 = 2;\ n = .03;\ Q = 0.4$

$S_{min} = 17\%$
$S_{max} = 21\%$ from Printout $V = 4.54 < 5 - \alpha$

NO LINING REQ'd



PROJECT : Valley Camp Coal - D-448 Runoff Calculation

AREA= 1.8 ACRES
AVERAGE BASIN SLOPE= 28.7 PERCENT
CURVE NUMBER= 77.8
DESIGN STORM= 1.55 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 710. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0536 HOURS QPCFS= 25.40 CFS QPIN=13.9920 INCHES
C3= 68.9665 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.18	.5678	.0000	.0000	.0	.00
2.20	.5831	.0000	.0000	2.4	.00
2.21	.5985	.0003	.0002	12.4	.00
2.22	.6139	.0006	.0004	22.1	.00
2.24	.6293	.0012	.0005	25.4	.01
2.25	.6446	.0019	.0007	23.0	.02
2.26	.6600	.0027	.0008	17.9	.04
2.28	.6754	.0037	.0010	12.6	.05
2.29	.6907	.0048	.0011	8.2	.07
2.30	.7061	.0061	.0013	5.0	.09
2.32	.7215	.0076	.0014	2.9	.11
2.33	.7368	.0091	.0016	1.7	.13
2.35	.7522	.0109	.0017	.9	.15
2.36	.7676	.0127	.0019	.5	.17
2.37	.7830	.0147	.0020	.3	.19
2.39	.7983	.0168	.0021	.1	.21
2.40	.8137	.0191	.0023	.0	.23
2.41	.8291	.0215	.0024	.0	.25
2.43	.8444	.0240	.0025	.0	.27
2.44	.8598	.0266	.0026	.0	.29
2.45	.8752	.0294	.0028	.0	.30
2.47	.8905	.0322	.0029	.0	.32
2.48	.9059	.0352	.0030	.0	.34
2.49	.9213	.0384	.0031	.0	.35
2.51	.9318	.0406	.0022	.0	.37
2.52	.9360	.0414	.0009	.0	.37
2.53	.9401	.0423	.0009	.0	.34
2.55	.9443	.0432	.0009	.0	.30
2.56	.9484	.0442	.0009	.0	.25
2.57	.9526	.0451	.0009	.0	.21
2.59	.9567	.0460	.0009	.0	.18
2.60	.9609	.0469	.0009	.0	.15

HYDROGRAPH PEAK= .37 cfs
TIME TO PEAK= 2.52 Hours
RUNOFF VOLUME= .04 Acre-Feet