



DESIGN REPORT

Sedimentation Structure

N11-C

Kayenta Mine

Navajo County, Arizona

PEABODY COAL COMPANY



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Exhibit 1 - "Proposed N11-C Temporary Sedimentation Pond"

Introduction

Sedimentation Structure N11-C will be an earthen embankment, designed and constructed by Peabody Coal Company as a temporary sedimentation structure to control runoff and sediment from the proposed N-11 surface mining area at the Kayenta Mine. The location of Structure N11-C and its watershed boundary is shown on Drawing No. 85400 (Sheet L-7), and Drawing No. 85405. The site-specific general construction plans are shown on the attached Exhibit 1.

This design report contains information specific to Structure N11-C. Mine-wide design, construction, and reclamation information is presented in the "General Report, Kayenta and Black Mesa Mines, Navajo County, Arizona for Peabody Coal Company", December, 1985 (PAP), Chapter 6, Attachment D, Volume 2, along with the methods and results of analyses used for slope stability, hydrology, and hydraulics, and in Chapter 6, Pages 11 to 42, "Sediment and Water Control Facility Plan".

Inspection

The construction site of Structure N11-C was inspected by a Registered Professional Engineer from Peabody Coal Company to ensure that the location was suitable and no adverse conditions existed to prevent the successful construction of the structure. A detailed geotechnical investigation was not performed, rather, the information in Chapter 6, Attachment D was utilized for embankment design. A conservative embankment category of (A-3) with a 20-foot embankment height was utilized for the design.

Site Description

Land Use

Structure N11-C has a 99.86-acre drainage area and is located on a tributary to Coal Mine Wash at the Kayenta Mine. The watershed is classified as 100 percent disturbed.

Design Analyses

General

Structure N11-C was designed by a Registered Professional Engineer from Peabody Coal Company. The design was performed in accordance with applicable 30 CFR 780 and 816

regulations of the United States Department of the Interior, Office of Surface Mining (OSM) and included a review of available project files. The most current information contained in the Peabody Coal Company files includes topographic maps developed from aerial photography flown in 1983 and was used in the analyses of the structure.

Stability

A homogeneous earthen embankment, compacted in lifts to design specifications, and a minimum of 20 feet wide on top will be constructed. An upstream slope of 3:1 (horizontal to vertical) and a downstream slope of 4:1 were assumed. Based on an embankment height of 19 feet, these slopes are equal to or flatter than the recommended slopes in Table 3-6, Attachment D, Chapter 6; therefore, the embankment will be stable. The emergency spillway will be a minimum 15-foot wide riprap-lined trapezoidal channel.

Hydrology

The hydrologic analysis was completed using the computer program SEDCAD⁺ (see Appendices A, B, and C). The trapezoidal, open-channel spillway was analyzed using the 25-year, 6-hour storm. The pond was conservatively assumed to be full to the emergency spillway elevation at the time of the 25-year storm. The storage capacity requirements of Structure N11-C was analyzed using the 10-year, 24-hour storm. The pond was conservatively assumed to completely contain the 10-year, 24-hour storm without discharge; plus, provide adequate sediment storage volume.

The following parameters were used in the hydrologic analysis:

- | | | |
|----|--|----------|
| 1. | Water Course Length, L | 0.758 mi |
| 2. | Elevation Difference, H | 350 ft |
| 3. | Time of Concentration, Tc | 0.197 hr |
| 4. | SCS Curve Number | 86 |
| 5. | Rainfall Depth, 10-year, 24-hour storm | 2.1 in |
| | 25-year, 6-hour storm | 1.9 in |
| 6. | Drainage Area | 99.86ac |

Hydraulics

The SEDCAD⁺ and Dodson-Trapezoidal Channel computer programs were used to evaluate inflow to the sedimentation structure, outflow from the structure, and the resulting water surface elevations. The initial conditions and results of the analysis are summarized in the following N11-C hydraulics table:

N11-C HYDRAULICS TABLE

	Units	10-Yr, 24-Hr	25-Yr, 6-Hr
	Storm	Storm	Storm
Initial Reservoir Volume Condition		Empty	Full to emergency spillway elevation
Inflow			
Peak Flow	cfs	86.5	102.8
Volume	ac-ft	7.7	6.4
Storage			
Peak Stage	msl	6589.9	6597.3
Emerg. Spillway Elev.	msl	6596.0	6596.0
Peak Storage	ac-ft	7.7	17.6
Storage Capacity	ac-ft	15.5	15.5
Outflow			
Peak Flow	cfs	N/A	58.6
Spillway Elevation	msl	6596.0	6596.0
Embankment Crest Elev.	msl	6599.0	6599.0
Peak Stage	msl	---	6597.3
Freeboard	ft	---	1.7
Emergency Spillway Channel			
Flow Depth	ft	---	1.3
Critical Velocity	fps	---	4.6
Mannings "n"	---	---	0.056
Width	ft	---	15
Outflow Channel			
Slope	%	---	16.0
Normal Velocity	fps	---	6.6
Normal Depth	ft	---	0.5
Mannings "n"	---	---	0.056

Emergency Spillway and Outlet Channel

The emergency spillway and outlet channel for N11-C will be a trapezoidal channel (see Exhibit 1) with the following dimensions:

A minimum 15-foot long riprapped channel will be constructed beyond the toe of the embankment as a transition into the downstream natural channel.

Storage Capacity

The impoundment stage-capacity table (see Exhibit 1) is based on the 1983 aerial topographic mapping conducted for Peabody Coal Company. The total storage capacity of Structure N11-C is designed to contain approximately 15.54 acre-feet.

The calculations for the sediment load entering Structure N11-C were made utilizing the Revised Universal Soil Loss Equation with the following parameters:

- | | | | |
|----|----------------------------|-------|-------|
| 1. | Rainfall Factor, R | | 40 |
| 2. | Soil Erodibility Factor, K | | 0.38 |
| 3. | Slope Factor, LS | | 10.30 |
| 4. | Cover Factor, C | | 0.73 |
| 5. | Erosion Control Factor, P | | 0.44 |

The hydrologic analysis gives the storage volume required to treat the 10-year, 24-hour storm, and the remaining storage volume available for storing sediment. The proposed storage capacity of N11-C and the results of the sediment inflow analysis are summarized in the following table:

N11-C Storage

Total Storage Capacity 15.54 acre-ft.
Active 10-Yr, 24-Hr Storage Capacity 7.70 acre-ft.
Sediment Storage Capacity 7.84 acre-ft.
Sediment Inflow Rate 2.31 ac-ft/yr
Sediment Storage Life 3.4 yrs.

Diversions

Due to the topography and the location of the surface mining disturbance, it will be necessary to construct two temporary diversions (i.e., N11-C #1 East and N11-C #2 West diversions). The location of these two temporary diversions is shown on Exhibit 1. The temporary diversions will receive the overland runoff from the N-11 mining and reclamation area and drain into Sedimentation Pond N11-C. These diversions will be constructed in accordance with the enclosed design (see Appendices D and E) and the typical cross sections and construction specifications for terraces and downdrains found in Chapter 26.

N11-C #1 East (Diversion) Summary

Purpose: To divert approximately 8.7 acres of N-11 mining and reclamation area runoff into Sedimentation Pond N11-C (see Drawing No. 85405 and Exhibit 1 for location), (see Appendix D for calculations).

10-Year, 6-Hour Precipitation	=	1.60 inches
Area	=	8.66 ac
CN	=	86
Time of Concentration	=	0.075 hr
Peak Discharge	=	8.01 cfs
Critical Slope	=	1.33 %
V-Ditch Design Depth w/Freeboard	=	3.5 ft

Therefore, two alternative V-ditch designs are recommended:

A. Earth-lined V-ditch (subcritical flow)

Average slope = 0.80 %
n = 0.025 (earth-lined)
 d_n = 1.10 ft.
Velocity = 3.32 fps
Minimum freeboard = 1.0 ft.

B. Riprap-lined V-ditch (supercritical flow)

Maximum slope = 20 %
n = 0.050 (riprap)
 d_n = 0.78 ft.
Velocity = 6.60 fps
Riprap D_{max} = 7.5 in.
Riprap D₅₀ = 6.0 in.
Minimum freeboard = 1.0 ft.

Note: Minimum 20 ft. length of riprapped ditch as a transitional channel between the two alternative designs

See Chapter 26 for construction specifications and typical cross sections for terraces and downdrains.

N11-C #1 West (Diversion) Summary

Purpose: To divert approximately 14.2 acres of N-11 mining and reclamation area runoff into Sedimentation Pond N11-C (see Drawing No. 85400 and Exhibit 1 for location), (see Appendix E for calculations).

10-Year, 6-Hour Precipitation = 1.60 inches
Area = 14.20 ac
CN = 86
Time of Concentration = 0.075 hr
Peak Discharge = 13.13 cfs
Critical Slope = 1.25 %
V-Ditch Design Depth w/Freeboard = 3.5 ft

Therefore, two alternative V-ditch designs are recommended:

A. Earth-lined V-ditch (subcritical flow)

Average slope = 0.70 %
n = 0.025 (earth-lined)
 d_n = 1.36 ft.
Velocity = 3.57 fps
Minimum freeboard = 1.0 ft.

B. Riprap-lined V-ditch (supercritical flow)

Maximum slope = 20 %
n = 0.051 (riprap)
 d_n = 0.94 ft.
Velocity = 7.36 fps
Riprap D_{max} = 7.5 in.
Riprap D_{50} = 6.0 in.
Minimum freeboard = 1.0 ft.

Note: Minimum 20 ft. length of riprapped ditch as a transitional channel between the two alternative designs

See Chapter 26 for construction specifications and typical cross sections for terraces and downdrains.

In conclusion, the earth-lined V-ditch design will be utilized in the subcritical slope channel sections and the riprap-lined V-ditch design will be utilized in the supercritical slope sections.

The following appendices and drawing are attached and complete this design report.

Appendix A - Hydrology, Hydraulic, and Sedimentation Calculations

Appendix B - SEDCAD⁺ (Input and Output) 10-year, 24-hour Storm Event

Appendix C - SEDCAD⁺ (Input and Output) 25-year, 6-hour Storm Event

Appendix D - Temporary Diversion, N11-C #1 East Calculations

Appendix E - Temporary Diversion, N11-C #2 West Calculations

Exhibit 1 - Proposed N11-C Temporary Sedimentation Pond

APPENDIX A

HYDROLOGY, HYDRAULIC, AND SEDIMENTATION CALCULATIONS

N11-C

PROJECT: N11-C POND

NAME: GARRY Y.

DATE: 7-15-92

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6965 - 6615 = 350 Ft.

WATERCOURSE LENGTH = 4000 Ft. = 0.758 Mi.

Tc = $[11.9(W.L.)^3/(E.D.)]^{0.385}$ = 0.197 Hr.

SCS CURVE NUMBER

COVER TYPE	HYDRO. COND.	SOIL GROUP	CN	AREA (Acres)	CN*AREA
DISTURBED		B	86	99.86	8587.96
				<hr/>	<hr/>
				99.86	8587.96

WEIGHTED CN = 8587.96 / 99.86 = 86.000 = 86

DRAINAGE BASIN AREA

99.86 ACRES 0.15603 SQ. MILES

PROJECT: N11-C POND

NAME: GARRY Y.
DATE: 7-16-92**SOIL ERODIBILITY FACTOR**

SOIL TYPE	SOIL GROUP	K	AREA (Acres)	K*AREA
Topsoil/SSPGM	-	0.38	<u>99.86</u>	<u>37.9468</u>
			99.86	37.9468
			WEIGHTED K =	37.9468 / 99.86 = 0.38

SLOPE FACTOR

LENGTH (Ft)	ELEV. DIFF. (Ft)	SLOPE (%)	M	THETA (Degrees)	LS $(L/72.6)^M * [17.2(\sin \theta) - 0.55]$
800	117	14.625	0.6	8.32	8.182
430	155	36.047	0.6	19.82	15.359
370	111	30.000	0.6	16.70	11.670
510	72	14.118	0.6	8.04	5.973

AVE. LS = 10.30

COVER FACTOR

COVER TYPE	AREA (Acres)	C	C*AREA
Newly reclaimed hillslope with no BTCA practices applied except contour drill seeding (worst case).	<u>99.86</u>	<u>0.725</u>	<u>72.4</u>
	99.86		72.4
	WEIGHTED C =	72.3985 / 99.86 = 0.73	

PRACTICE FACTOR

P = 0.44

RAINFALL FACTOR

R = 40

REVISED USLE CALCULATION

$$A = R*K*LS*C*P = \underline{49.92} \text{ TON/ACRE/YR}$$

SEDIMENT INFLOW RATE

DA = 99.86

SDR = 0.95

$$SI = (A*DA*SDR*94)/192,400 = \underline{2.31} \text{ ACRE-FT/YR}$$

NOTE: See Chapter 26, Attachment A for additional information on RUSLE factors.

TRAPEZOIDAL CHANNEL ANALYSIS
CRITICAL DEPTH COMPUTATION

October 26, 1992
N11-C SPILLWAY 25 YR. STORM

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	58.6
Manning's Roughness Coefficient (n-value).....	0.0400
Channel Side Slope - Left Side (horizontal/vertical)....	3.00
Channel Side Slope - Right Side (horizontal/vertical)...	3.00
Channel Bottom Width (feet).....	15.0

PROGRAM RESULTS:

DESCRIPTION	VALUE
Critical Depth (feet).....	0.74
Critical Slope (feet per foot).....	0.0273
Flow Velocity (feet per second).....	4.60
Froude Number.....	1.000
Velocity Head (feet).....	0.33
Energy Head (feet).....	1.07
Cross-Sectional Area of Flow (square feet).....	12.76
Top Width of Flow (feet).....	19.44

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986
Dodson & Associates, Inc., 7015 W. Tidwell, #107, Houston, TX 77092
(713) 895-8322. A manual with equations & flow chart is available.

SEDCAD+ RIPRAP CHANNEL DESIGN

N11-C SPILLWAY 25-YR. STORM

INPUT VALUES:

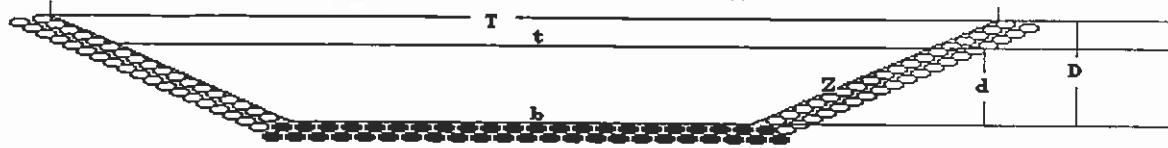
Shape	TRAPEZOIDAL
Discharge	58.63 cfs
Slope	16.00 %
Sideslopes (L and R)	3.00:1 3.00:1
Bottom Width	15.00 feet
Freeboard	1 ft

RESULTS:

Steep Slope Design - PADER Method

Depth	0.54 ft
with Freeboard	1.54 ft
Top Width	18.22 ft
with Freeboard	24.22 ft
Velocity	6.57 fps
Cross Sectional Area	8.92 sq ft
Hydraulic Radius	0.49 ft
Manning's n	0.056
Froude Number	1.65
Dmax	0.625 ft (7.50 in)
D50	0.500 ft (6.00 in)
D10	0.167 ft (2.00 in)

**SEDCAD+ CHANNEL DESIGN
N11-C SPILLWAY 25-YR. STORM**



Riprap - Steep Slope Design - PADER Method

Discharge	=	58.63 cfs	Depth (d)	=	0.54 (D = 1.54) ft	w/ Freeboard:
Bottom (b)	=	15.00 ft	Top width (t)	=	19.22 (T = 24.22) ft	
Side slopes (Z)	=	3.0:1(L) 3.0:1(R)	Velocity	=	6.57 fps	
Bed Slope	=	16.00 %	Hydraulic Radius	=	0.49 ft	
Manning's n	=	0.056	Froude number	=	1.65	
		D _{max} = 0.63 ft (7.50 in)				
		D ₅₀ = 0.50 ft (6.00 in)				
		D ₁₀ = 0.17 ft (2.00 in)				

APPENDIX B

N11-C SEDCAD+ (INPUT AND OUTPUT)

10-YEAR, 24-HOUR STORM EVENT

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

N11-C POND 10-YR, 24-HR STORM

by

Name: G.Y.

Company Name: PEABODY COAL COMPANY
File Name: C:\SEDCAD3\K-MINE\N11C-10

Date: 09-25-1992

Civil Software Design -- SEDCAD+ Version 3.1
Copyright (C) 1987-1992. Pamela J. Schwab. All rights reserved.

Company Name: PEABODY COAL COMPANY
Filename: C:\SEDCAD3\K-MINE\N11C-10 User: G.Y.
Date: 09-25-1992 Time: 11:18:45
N11-C POND 10-YR, 24-HR STORM
Storm: 2.10 inches, 10 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS SWs		Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base- Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	99.86*	86	F	0.197	0.000	0.000	0.0	7.70	86.50
		Type: Null			Label: N11-C POND					
111 Structure		99.86							7.70	
111 Total IN/OUT		99.86							7.70	86.50

APPENDIX C

N11-C SEDCAD+ (INPUT AND OUTPUT)

25-YEAR, 6-HOUR STORM EVENT

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

N11-C POND 25 YR, 6-HR STORM

by

Name: G.Y.

Company Name: PEABODY COAL COMPANY
File Name: C:\SEDCAD3\K-MINE\N11C-25

Date: 10-26-1992

Civil Software Design -- SEDCAD+ Version 3.1
Copyright (C) 1987-1992. Pamela J. Schwab. All rights reserved.

Company Name: PEABODY COAL COMPANY

Filename: C:\SEDCAD3\K-MINE\N11C-25 User: G.Y.

Date: 10-26-1992 Time: 07:36:42

N11-C POND 25 YR. 6-HR STORM

Storm: 1.90 inches. 25 year- 6 hour. SCS Type II

Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS SWS		Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base- Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	99.86	86	F	0.197	0.000	0.000	0.0	6.44	102.84
		Type: Pond			Label: N11-C POND					
111 Structure		99.86							6.44	
111 Total IN		99.86							6.44	102.84
111 Total OUT									6.44	58.63

Civil Software Design -- SEDCAD+ Version 3.1
Copyright (C) 1987-1992. Pamela J. Schwab. All rights reserved.

Company Name: PEABODY COAL COMPANY
Filename: C:\SEDCAD3\K-MINE\N11C-25 User: G.Y.
Date: 10-26-1992 Time: 07:36:42
N11-C POND 25 YR, 6-HR STORM
Storm: 1.90 inches, 25 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

=====
POND INPUT/OUTPUT TABLE
=====

J1, B1, S1
N11-C POND

Drainage Area from J1, B1, S1, SWS(s)1: 99.9 acres
Total Contributing Drainage Area: 99.9 acres

DISCHARGE OPTIONS:

Emergency
Spillway

=====

Riser Diameter (in)	----
Riser Height (ft)	----
Barrel Diameter (in)	----
Barrel Length (ft)	----
Barrel Slope (%)	----
Manning's n of Pipe	----
Spillway Elevation	----
Lowest Elevation of Holes	----
# of Holes/Elevation	----
Entrance Loss Coefficient	----
Tailwater Depth (ft)	----
Notch Angle (degrees)	----
Weir Width (ft)	----
Siphon Crest Elevation	----
Siphon Tube Diameter (in)	----
Siphon Tube Length (ft)	----
Manning's n of Siphon	----
Siphon Inlet Elevation	----
Siphon Outlet Elevation	----
Emergency Spillway Elevation	6596.0
Crest Length (ft)	50.0
Z:1 (Left and Right)	3 3
Bottom Width (ft)	15.0

POND RESULTS:

Permanent
Pool
(ac-ft)
=====

15.5

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	6.44	102.84
OUT	6.44	58.63

Elevation	Peak Hydrograph Detention Time (hrs)
6597.3	0.00

Civil Software Design -- SEDCAD+ Version 3.1
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Company Name: PEABODY COAL COMPANY
Filename: C:\SEDCAD3\K-MINE\N11C-25 User: G.Y.
Date: 10-26-1992 Time: 07:36:42
N11-C POND 25 YR, 6-HR STORM
Storm: 1.90 inches, 25 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

=====

ELEVATION-DISCHARGE TABLE

=====

J1, B1, S1
N11-C POND

Drainage Area from J1, B1, S1, SWS(s)1: 99.9 acres
Total Contributing Drainage Area: 99.9 acres

Elevation	Emergency Spillway (cfs)	Total Discharge (cfs)
6580.00	0.0	0.0
6581.00	0.0	0.0
6582.00	0.0	0.0
6583.00	0.0	0.0
6584.00	0.0	0.
6585.00	0.0	0.0
6586.00	0.0	0.0
6587.00	0.0	0.0
6588.00	0.0	0.0
6589.00	0.0	0.0
6590.00	0.0	0.0
6591.00	0.0	0.0
6592.00	0.0	0.0
6593.00	0.0	0.0
6594.00	0.0	0.0
6595.00	0.0	0.0
6596.00	0.0	0.0
6596.70	14.8	14.8
6596.80	19.7	19.7
6596.90	24.5	24.5
6597.00	29.7	29.7
6597.50	71.8	71.8
6598.00	120.4	120.4
6598.50	184.8	184.8
6599.00	264.2	264.2
6599.50	362.0	362.0
6600.00	475.7	475.7

Civil Software Design -- SEDCAD+ Version 3.1
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Company Name: PEABODY COAL COMPANY

Filename: C:\SEDCAD3\K-MINE\N11C-25 User: G.Y.

Date: 10-26-1992 Time: 07:36:42

N11-C POND 25 YR, 6-HR STORM

Storm: 1.90 inches, 25 year- 6 hour, SCS Type II

Hydrograph Convolution Interval: 0.1 hr

=====

ELEVATION-AREA-CAPACITY-DISCHARGE TABLE

=====

J1, B1, S1
N11-C POND

Drainage Area from J1, B1, S1, SWS(s)1: 99.9 acres
Total Contributing Drainage Area: 99.9 acres

SW#1: Emergency Spillway

Elev	Stage	Area	Capacity	Discharge
(ft)	(ac)	(ac-ft)		(cfs)
6580.00	0.00	0.51	0.00	0.00
6581.00	1.00	0.56	0.53	0.00
6582.00	2.00	0.61	1.12	0.00
6583.00	3.00	0.66	1.75	0.00
6584.00	4.00	0.71	2.44	0.00
6585.00	5.00	0.77	3.18	0.00
6586.00	6.00	0.83	3.98	0.00
6587.00	7.00	0.89	4.83	0.00
6588.00	8.00	0.95	5.75	0.00
6589.00	9.00	1.01	6.73	0.00
6590.00	10.00	1.08	7.78	0.00
6591.00	11.00	1.15	8.90	0.00
6592.00	12.00	1.22	10.08	0.00
6593.00	13.00	1.29	11.33	0.00
6594.00	14.00	1.36	12.66	0.00
6595.00	15.00	1.44	14.06	0.00
6596.00	16.00	1.52	15.54	0.00 Stage of SW#1
6596.70	16.70	1.57	16.62	14.83
6596.80	16.80	1.58	16.78	19.72
6596.90	16.90	1.59	16.93	24.51
6597.00	17.00	1.59	17.09	29.70
6597.34	17.34	1.59	17.65	58.63 Peak Stage
6597.50	17.50	1.63	17.90	71.84
6598.00	18.00	1.67	18.73	120.41
6598.50	18.50	1.72	19.57	184.82
6599.00	19.00	1.76	20.44	264.22
6599.50	19.50	1.80	21.33	362.01
6600.00	20.00	1.84	22.24	475.70

APPENDIX D

TEMPORARY DIVERSION
N11-C #1 EAST CALCULATIONS

PROJECT: N11-C #1 EAST (DIVERSION) NAME: GARRY Y.

DATE: 7-15-92

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6728 - 6590 = 138 Ft.

WATERCOURSE LENGTH = 1270 Ft. = 0.241 Mi.

Tc = $[11.9(W. L.)^3/(E. D.)]^{0.385}$ = 0.075 Hr.

SCS CURVE NUMBER

COVER TYPE	HYDRO. COND.	SOIL GROUP	CN	AREA (Acres)	CN*AREA
DISTURBED		B	86	8.66	744.76
				8.66	744.76
				WEIGHTED CN = 744.76 / 8.66 = 86.000 = 86	

DRAINAGE BASIN AREA

8.66 ACRES 0.01353 SQ. MILES

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

N11-C #1 EAST (DIVERSION) 10-YR, 6-HR STORM

by

Name: G.Y.

Company Name: PEABODY COAL COMPANY
File Name: C:\SEDCAD3\K-MINE\N11-C-1

Date: 09-23-1992

Civil Software Design -- SEDCAD+ Version 3.1
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Company Name: PEABODY COAL COMPANY
Filename: C:\SEDCAD3\K-MINE\N11-C-1 User: G.Y.
Date: 09-23-1992 Time: 16:48:29
N11-C #1 EAST (DIVERSION) 10-YR, 6-HR STORM
Storm: 1.60 inches, 10 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base- Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	8.66	86	F	0.075	0.000	0.000	0.0	0.40	8.01
		Type: Null		Label: N11-C #1 EAST (DIV.)						
111	Structure	8.66							0.40	
111	Total IN/OUT	8.66							0.40	8.01

TRAPEZOIDAL CHANNEL ANALYSIS
CRITICAL DEPTH COMPUTATION

July 6, 1993
N11-C #1 EAST DIVERSION

=====

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	8.0
Manning's Roughness Coefficient (n-value).....	0.0250
Channel Side Slope - Left Side (horizontal/vertical)....	2.00
Channel Side Slope - Right Side (horizontal/vertical)...	2.00
Channel Bottom Width (feet).....	0.0

=====

PROGRAM RESULTS:

DESCRIPTION	VALUE
Critical Depth (feet).....	1.00
Critical Slope (feet per foot).....	0.0
Flow Velocity (feet per second).....	4.0
Froude Number.....	1.000
Velocity Head (feet).....	0.25
Energy Head (feet).....	1.25
Cross-Sectional Area of Flow (square feet).....	2.00
Top Width of Flow (feet).....	4.00

=====

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986
Dodson & Associates, Inc., 7015 W. Tidwell, #107, Houston, TX 77092
(713) 895-8322. A manual with equations & flow chart is available.

SEDCAD+ ERODIBLE CHANNEL DESIGN

N11-C #1 EAST (DIVERSION)

Limiting Velocity Technique
Sediment-laden Water

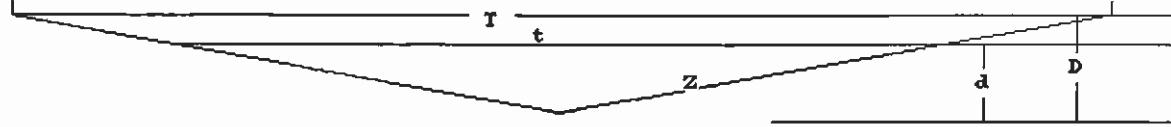
INPUT VALUES:

Shape	TRIANGULAR
Discharge	8.00 cfs
Slope	0.80 %
Sideslopes	2.00:1 (L) 2.00:1 (R)
Manning's n	0.025
Max. Velocity	5.00 fps
Material	ALLUVIAL SILTS COLLOIDAL
Freeboard	1 ft

RESULTS:

Actual Discharge	8.00 cfs
Depth	1.10 ft
with Freeboard	2.10 ft
Top Width	4.39 ft
with Freeboard	8.39 ft
Velocity	3.32 fps
Cross Sectional Area	2.41 sq ft
Hydraulic Radius	0.49 ft
Froude Number	0.79

SEDCAD+ CHANNEL DESIGN
N11-C #1 EAST (DIVERSION)



MATERIAL: ALLUVIAL SILTS COLLOIDAL
Limiting Variable: Velocity = 5.000 fps
Sediment-laden Water

Discharge = 8.00 cfs Depth (d) = 1.10 (D = 2.10) ft
Side slopes (Z) = 2.0:1(L) 2.0:1(R) Top width (t) = 4.39 (T = 8.39) ft
Bed Slope = 0.00 % Velocity = 3.32 fps
Manning's n = 0.025 Hydraulic Radius = 0.49 ft
 Froude number = 0.79

SEDCAD+ RIPRAP CHANNEL DESIGN

N11-C #1 EAST (DIVERSION)

INPUT VALUES:

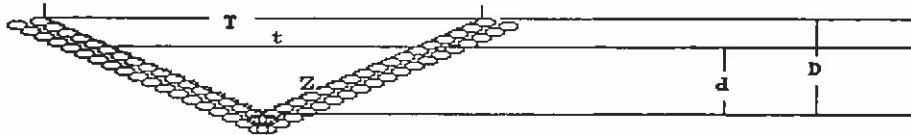
Shape	TRIANGULAR
Discharge	8.00 cfs
Slope	20.00 %
Sideslopes (L and R)	2.00:1
Freeboard	2.00:1 1 ft

RESULTS:

Steep Slope Design - PADER Method

Depth	0.78 ft
with Freeboard	1.78 ft
Top Width	3.11 ft
with Freeboard	7.11 ft
Velocity	6.60 fps
Cross Sectional Area	1.21 sq ft
Hydraulic Radius	0.35 ft
Manning's n	0.050
Froude Number	1.86
Dmax	0.625 ft (7.50 in)
D50	0.500 ft (6.00 in)
D10	0.167 ft (2.00 in)

SEDCAD+ CHANNEL DESIGN
NII-C #1 EAST (DIVERSION)



Riprap - Steep Slope Design - PADER Method

Discharge	=	8.00 cfs	Depth (d)	=	0.78 (D = 1.78) ft	w/ Freeboard:
Side slopes (Z)	=	2.0:1(L) 2.0:1(R)	Top width (t)	=	3.11 (T = 7.11) ft	
Bed slope	=	20.00 %	Velocity	=	6.60 fps	
Manning's n	=	0.050	Hydraulic Radius	=	0.35 ft	
			Froude number	=	1.61	
			D _{max}	=	0.63 ft (7.50 in)	
			D ₅₀	=	0.50 ft (6.00 in)	
			D ₁₀	=	0.17 ft (2.00 in)	

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

N11-C #1 EAST DIVERSION 100-YR., 6-HR. STORM

by

Name: JGS

Company Name: PEABODY COAL COMPANY
File Name: C:\SEDCAD3\K-MINE\N11CD100

Date: 07-06-1993

Civil Software Design -- SEDCAD+ Version 3.1
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Company Name: PEABODY COAL COMPANY
Filename: C:\SEDCAD3\K-MINE\N11CD100 User: JGS
Date: 07-06-1993 Time: 11:39:16
N11-C #1 EAST DIVERSION 100-YR., 6-HR. STORM
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base- Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	8.66	86	F	0.075	0.000	0.000	0.0	0.84	15.54
			Type:	Null		Label:	N11-C #1 EAST DIV.			
111	Structure	8.66							0.84	
111	Total IN/OUT	8.66							0.84	15.54

TRAPEZOIDAL CHANNEL ANALYSIS
CRITICAL DEPTH COMPUTATION

July 6, 1993
N11-C #1 EAST DIVERSION

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	15.5
Manning's Roughness Coefficient (n-value).....	0.0250
Channel Side Slope - Left Side (horizontal/vertical)....	2.00
Channel Side Slope - Right Side (horizontal/vertical)...	2.00
Channel Bottom Width (feet).....	0.0

PROGRAM RESULTS:

DESCRIPTION	VALUE
Critical Depth (feet).....	1.30
Critical Slope (feet per foot).....	0.0122
Flow Velocity (feet per second).....	4.5
Froude Number.....	1.000
Velocity Head (feet).....	0.33
Energy Head (feet).....	1.63
Cross-Sectional Area of Flow (square feet).....	3.39
Top Width of Flow (feet).....	5.21

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986
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(713) 895-8322. A manual with equations & flow chart is available.

SEDCAD+ ERODIBLE CHANNEL DESIGN

N11-C #1 EAST DIVERSION

Limiting Velocity Technique
Sediment-laden Water

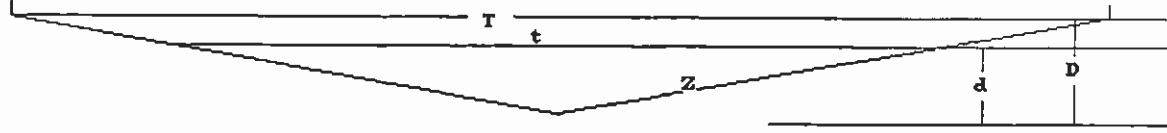
INPUT VALUES:

Shape	TRIANGULAR
Discharge	15.54 cfs
Slope	0.80 %
Sideslopes	2.00:1 (L) 2.00:1 (R)
Manning's n	0.025
Max. Velocity	5.00 fps
Material	ALLUVIAL SILTS COLLOIDAL
Freeboard	1 ft

RESULTS:

Actual Discharge	15.54 cfs
Depth	1.41 ft
with Freeboard	2.41 ft
Top Width	5.63 ft
with Freeboard	9.63 ft
Velocity	3.92 fps
Cross Sectional Area	3.97 sq ft
Hydraulic Radius	0.63 ft
Froude Number	0.82

SEDCAD+ CHANNEL DESIGN
N11-C #1 EAST DIVERSION



MATERIAL: ALLUVIAL SILTS COLLOIDAL
Limiting Variable: Velocity = 5.000 fps
Sediment-laden Water

Discharge	=	15.54 cfs	Depth (d)	=	1.41 ft	w/ Freeboard:	
Side slopes (Z)	=	2.0:1(L) 2.0:1(R)	Top width (t)	=	5.63 ft	(D =	2.41 ft
Bed Slope	=	0.80%	Velocity	=	3.92 fps	T =	9.63 ft
Manning's n	=	0.025	Hydraulic Radius	=	0.63 ft		
			Froude number	=	0.82		

SEDCAD+ RIPRAP CHANNEL DESIGN

N11-C #1 EAST DIVERSION

INPUT VALUES:

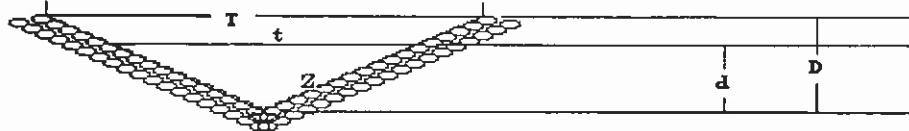
Shape	TRIANGULAR
Discharge	15.54 cfs
Slope	20.00 %
Sideslopes (L and R)	2.00:1
Freeboard	2.00:1 1 ft

RESULTS:

Steep Slope Design - PADER Method

Depth	1.00 ft
with Freeboard	2.00 ft
Top Width	4.00 ft
with Freeboard	8.00 ft
Velocity	7.79 fps
Cross Sectional Area	2.00 sq ft
Hydraulic Radius	0.45 ft
Manning's n	0.050
Froude Number	1.94
Dmax	0.625 ft (7.50 in)
D50	0.500 ft (6.00 in)
D10	0.167 ft (2.00 in)

SEDCAD+ CHANNEL DESIGN
N11-C #1 EAST DIVERSION



Riprap - Steep Slope Design - PADER Method

Discharge	=	15.54 cfs	Depth (d)	=	1.00 (D = 2.00) ft	w/ Freeboard:
Side slopes (Z)	=	2.0:1(L) 2.0:1(R)	Top width (t)	=	4.00 (T = 8.00) ft	
Bed slope	=	20.00%	Velocity	=	7.79 fps	
Manning's n	=	0.050	Hydraulic Radius	=	0.45 ft	
			Froude number	=	1.60	
			D _{max}	=	0.63 ft (7.50 in)	
			D ₅₀	=	0.50 ft (6.00 in)	
			D ₁₀	=	0.17 ft (2.00 in)	

)

APPENDIX E

TEMPORARY DIVERSION
N11-C #2 WEST CALCULATIONS

)

PROJECT: N11-C #2 WEST (DIVERSION) NAME: GARRY Y.

DATE: 7-15-92

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6746.4 - 6585 = 161.4 Ft.

WATERCOURSE LENGTH = 1330 Ft. = 0.252 Mi.

Tc = [11.9(W. L.)^3/(E. D.)] ^ 0.385 = 0.075 Hr.

SCS CURVE NUMBER

COVER TYPE	HYDRO. COND.	SOIL GROUP	CN	AREA (Acres)	CN*AREA
DISTURBED	B		86	14.2	1221.2
				14.2	1221.2
					WEIGHTED CN = 1221.2 / 14.2 = 86.000 = 86

DRAINAGE BASIN AREA

14.2 ACRES 0.02219 SQ. MILES

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

N11-C #2 WEST (DIVERSION) 10-YR, 6-HR STORM

by

Name: G.Y.

Company Name: PEABODY COAL COMPANY
File Name: C:\SEDCAD3\K-MINE\N11-C-2

Date: 09-23-1992

Civil Software Design -- SEDCAD+ Version 3.1
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Company Name: PEABODY COAL COMPANY
Filename: C:\SEDCAD3\K-MINE\N11-C-2 User: G.Y.
Date: 09-23-1992 Time: 16:33:18
N11-C #2 WEST (DIVERSION) 10-YR, 6-HR STORM
Storm: 1.60 inches, 10 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS SWs		Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base- Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)	
111	1	14.20	86	F	0.075	0.000	0.000	0.0	0.66	13.13	
		Type: Null		Label: N11-C #2 WEST (DIV.)							
111 Structure		14.20								0.66	
111 Total IN/OUT		14.20								0.66	13.13

TRAPEZOIDAL CHANNEL ANALYSIS
CRITICAL DEPTH COMPUTATION

July 6, 1993
N11-C #2 WEST DIVERSION

=====

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	13.1
Manning's Roughness Coefficient (n-value).....	0.0250
Channel Side Slope - Left Side (horizontal/vertical)....	2.00
Channel Side Slope - Right Side (horizontal/vertical)...	2.00
Channel Bottom Width (feet).....	0.0

=====

PROGRAM RESULTS:

DESCRIPTION	VALUE
Critical Depth (feet).....	1.22
Critical Slope (feet per foot).....	0.05
Flow Velocity (feet per second).....	4.4
Froude Number.....	1.000
Velocity Head (feet).....	0.30
Energy Head (feet).....	1.52
Cross-Sectional Area of Flow (square feet).....	2.96
Top Width of Flow (feet).....	4.87

=====

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986
Dodson & Associates, Inc., 7015 W. Tidwell, #107, Houston, TX 77092
(713) 895-8322. A manual with equations & flow chart is available.

SEDCAD+ ERODIBLE CHANNEL DESIGN

N11-C #2 WEST (DIVERSION)

Limiting Velocity Technique
Sediment-laden Water

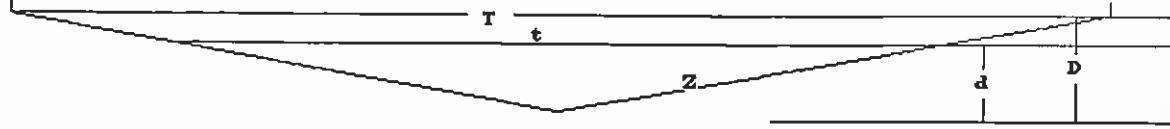
INPUT VALUES:

Shape	TRIANGULAR
Discharge	13.13 cfs
Slope	0.70 %
Sideslopes	2.00:1 (L) 2.00:1 (R)
Manning's n	0.025
Max. Velocity	5.00 fps
Material	ALLUVIAL SILTS COLLOIDAL
Freeboard	1 ft

RESULTS:

Actual Discharge	13.13 cfs
Depth	1.36 ft
with Freeboard	2.36 ft
Top Width	5.42 ft
with Freeboard	9.42 ft
Velocity	3.57 fps
Cross Sectional Area	3.68 sq ft
Hydraulic Radius	0.61 ft
Froude Number	0.76

SEDCAD+ CHANNEL DESIGN
N11-C #2 WEST (DIVERSION)



MATERIAL: ALLUVIAL SILTS COLLOIDAL
Limiting Variable: Velocity = 5.000 fps
Sediment-laden Water

Searched - Taken Water

Discharge	=	13.13 cfs	Depth (d)	=	1.36	(D =	2.36) ft
Side slopes (Z)	=	2.0:1(L) 2.0:1(R)	Top width (t)	=	5.42	(T =	9.42) ft
Bed Slope	=	0.70 %	Velocity	=	3.57	fps		
Manning's n	=	0.025	Hydraulic Radius	=	0.61	ft		
			Froude number	=	0.76			

SEDCAD+ RIPRAP CHANNEL DESIGN

N11-C #2 WEST (DIVERSION)

INPUT VALUES:

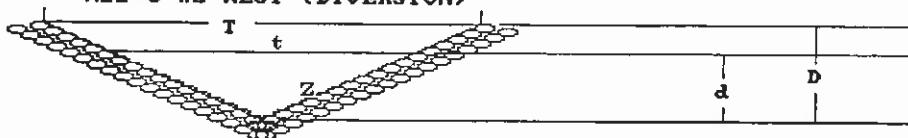
Shape	TRIANGULAR
Discharge	13.13 cfs
Slope	20.00 %
Sideslopes (L and R)	2.00:1
Freeboard	2.00:1 1 ft

RESULTS:

Steep Slope Design - PADER Method

Depth	0.94 ft
with Freeboard	1.94 ft
Top Width	3.78 ft
with Freeboard	7.78 ft
Velocity	7.36 fps
Cross Sectional Area	1.78 sq ft
Hydraulic Radius	0.42 ft
Manning's n	0.051
Froude Number	1.89
Dmax	0.625 ft (7.50 in)
D50	0.500 ft (6.00 in)
D10	0.167 ft (2.00 in)

SEDCAD+ CHANNEL DESIGN
N11-C #2 WEST (DIVERSION)



Riprap - Steep Slope Design - PADER Method

Discharge	=	13.13 cfs	Depth (d)	=	0.94	w/ Freeboard:
Side Slopes (Z)	=	2.0:1(L) 2.0:1(R)	Top width (t)	=	3.78	(D = 1.94 ft)
Bed Slope	=	20.00 %	Velocity	=	2.36	(T = 7.78 ft)
Manning's n	=	0.051	Hydraulic Radius	=	0.42	f ps
			Froude number	=	1.63	f t
			D _{max}	=	0.63 ft (7.50 in)	
			D ₅₀	=	0.50 ft (6.00 in)	
			D ₁₀	=	0.17 ft (2.00 in)	

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

N11-C #2 WEST DIVERSION 100-YR., 6-HR. STORM

by

Name: JGS

Company Name: PEABODY COAL COMPANY
File Name: C:\SEDCAD3\K-MINE\N11CDIV2

Date: 07-06-1993

Civil Software Design -- SEDCAD+ Version 3.1
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Company Name: PEABODY COAL COMPANY
Filename: C:\SEDCAD3\K-MINE\N11CDIV2 User: JGS
Date: 07-06-1993 Time: 11:39:19
N11-C #2 WEST DIVERSION 100-YR., 6-HR. STORM
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base- Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	14.20	86	F	0.075	0.000	0.000	0.0	1.38	25.48
		Type: Null				Label: N11-C #2 WEST DIV.				
111	Structure	14.20							1.38	
111	Total IN/OUT	14.20							1.38	25.48

TRAPEZOIDAL CHANNEL ANALYSIS
CRITICAL DEPTH COMPUTATION

July 6, 1993
N11-C #2 WEST DIVERSION

=====

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	25.5
Manning's Roughness Coefficient (n-value).....	0.0250
Channel Side Slope - Left Side (horizontal/vertical)....	2.00
Channel Side Slope - Right Side (horizontal/vertical)...	2.00
Channel Bottom Width (feet).....	0.0

=====

PROGRAM RESULTS:

DESCRIPTION	VALUE
Critical Depth (feet).....	1.59
Critical Slope (feet per foot).....	0.0
Flow Velocity (feet per second).....	5.0
Froude Number.....	1.000
Velocity Head (feet).....	0.40
Energy Head (feet).....	1.98
Cross-Sectional Area of Flow (square feet).....	5.04
Top Width of Flow (feet).....	6.35

=====

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986
Dodson & Associates, Inc., 7015 W. Tidwell, #107, Houston, TX 77092
(713) 895-8322. A manual with equations & flow chart is available.

SEDCAD+ ERODIBLE CHANNEL DESIGN

N11-C #2 WEST DIVERSION

Limiting Velocity Technique
Sediment-laden Water

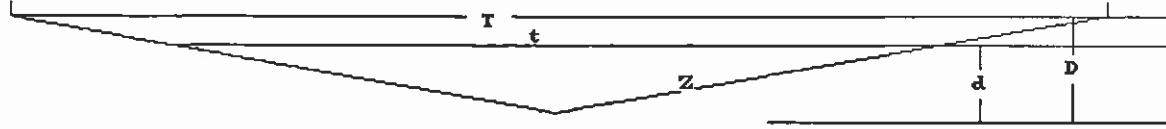
INPUT VALUES:

Shape	TRIANGULAR
Discharge	25.48 cfs
Slope	0.70 %
Sideslopes	2.00:1 (L) 2.00:1 (R)
Manning's n	0.025
Max. Velocity	5.00 fps
Material	ALLUVIAL SILTS COLLOIDAL
Freeboard	1 ft

RESULTS:

Actual Discharge	25.48 cfs
Depth	1.74 ft
with Freeboard	2.74 ft
Top Width	6.95 ft
with Freeboard	10.95 ft
Velocity	4.22 fps
Cross Sectional Area	6.04 sq ft
Hydraulic Radius	0.78 ft
Froude Number	0.80

SEDCAD+ CHANNEL DESIGN
NII-C #2 WEST DIVERSION



MATERIAL: ALLUVIAL SILTS COLLOIDAL
Limiting Variable: Velocity = 5.000 fps
Sediment-laden Water

Discharge	=	25.48 cfs	Depth (d)	=	1.74 ft	w/ Freeboard:	(D = 2.74) ft
Side slopes (Z)	=	2.0:1(L) 2.0:1(R)	Top width (t)	=	6.95 ft	(T =	10.95) ft
Bed Slope	=	0.70%	Velocity	=	4.22 fps		
Manning's n	=	0.025	Hydraulic Radius	=	0.78 ft		
			Froude number	=	0.80		

SEDCAD+ RIPRAP CHANNEL DESIGN

N11-C #2 WEST DIVERSION

INPUT VALUES:

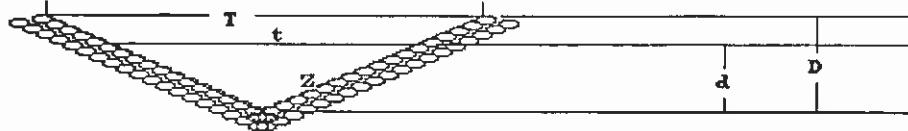
Shape	TRIANGULAR
Discharge	25.48 cfs
Slope	20.00 %
Sideslopes (L and R)	2.00:1
Freeboard	1 ft
	2.00:1

RESULTS:

Steep Slope Design - PADER Method

Depth	1.18 ft
with Freeboard	2.18 ft
Top Width	4.74 ft
with Freeboard	8.74 ft
Velocity	9.09 fps
Cross Sectional Area	2.80 sq ft
Hydraulic Radius	0.53 ft
Manning's n	0.048
Froude Number	2.08
Dmax	0.938 ft (11.25 in)
D50	0.750 ft (9.00 in)
D10	0.250 ft (3.00 in)

SEDCAD+ CHANNEL DESIGN
N11-C #2 WEST DIVERSION



Riprap - Steep Slope Design - PADER Method

Discharge	=	25.48 cfs	Depth (d)	=	1.18 (D = 2.18) ft	w/ Freeboard:
Side slopes (Z)	=	2.0:1(L), 2.0:1(R)	Top width (t)	=	4.74 (T = 8.74) ft	
Bed slope	=	20.00%	Velocity	=	9.09 fps	
Manning's n	=	0.046	Hydraulic Radius	=	0.53 ft	
			Froude number	=	1.80	
			D _{max}	=	0.94 ft (11.25 in)	
			D ₅₀	=	0.75 ft (9.00 in)	
			D ₁₀	=	0.25 ft (3.00 in)	