

DEC 23 2004



PEABODY WESTERN COAL COMPANY

For

Navajo County, Arizona

Kayenta Mine

N9-1

Temporary Sedimentation Structure

DESIGN REPORT

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The construction site of the proposed Structure N9-1 was inspected in October, 2004 by a Registered Professional Engineer from Woodson Engineering, to assure that the site is suitable and no adverse conditions exist to prevent the successful construction of this structure. A detailed geotechnical investigation was not performed; rather, the information in Chapter 6, Attachment D was utilized for embankment design and will be utilized during construction to construct a stable embankment.

INSPECTION

This design report contains information specific to Structure N9-1. Mine-wide design, construction, and reclamation information is presented in the "General Report, Kayenta and Black Mesa Mines, Navajo County, Arizona, for Peabody Western 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".

Sedimentation Structure N9-1 will be an earthen embankment, designed and constructed by Peabody Western Coal Company (PWCC) as a temporary sedimentation structure to control runoff and sediment from portions of the N9 disturbed surface mining area at the Kayenta Mine. The location of Structure N9-1 and its watershed boundary are shown on Drawing No. 85400, (Sheet K-6), and Drawing No. 85405. The site-specific general construction plans are shown on the attached Exhibit 1.

INTRODUCTION

SITE DESCRIPTION

LAND USE

The N9-1 Structure has a watershed of 25.44 acres and is located on a tributary upstream of Yazzie Wash at the Kayenta Mine. The 25.44-acre watershed, which contributes directly to structure N9-1, is classified as 5% undisturbed and 95% spoil.

DESIGN ANALYSES

GENERAL

Structure N9-1 was designed under the supervision of a Registered Professional Engineer from Peabody Western Coal Company. The design was performed in accordance with applicable 30 CFR 780 and 816 regulations of the United States Department of Interior, Office of Surface Mining (OSM) and included a review of available project files. The most current information contained in the Peabody Western Coal Company files includes topographic maps developed from aerial photography flown in 1983 for Peabody Western Coal Company and was used in the analyses of the structure.

STABILITY

Structure N9-1 is assumed to be a Category A-3 embankment. The structure will be a homogeneous earthen embankment, compacted in lifts to design specifications, and approximately 15 feet wide on top. A minimum upstream slope of 1.75H:1V and minimum downstream slope of 3.25H:1V were assumed. Based on the total embankment height of approximately 7 feet, these slopes are equal to or flatter than the recommended "worst case" embankment/foundation condition 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 SEDCAD4 (see Appendices A, B, and C). Structure N9-1 is classified as a low hazard structure (see Drawing No. 85408). In addition, the mine area is sparsely populated with no one living in the downstream floodplain. The structure will impound less than 20 acre-feet and be less than 20 vertical feet in height from the upstream toe of the embankment of the natural stream elevation to the emergency spillway invert elevation. The structure has capacity less than 20 acre-feet; therefore, the spillway was analyzed using the 25-year, 6-hour storm event. The structure was conservatively assumed to be full to the emergency spillway at the time of 25-year storm event. The storage capacity of structure N9-1 was analyzed using the 10-year, 24-hour storm event. The pond was verified to completely contain the 10-year, 24-hour storm event, and provide adequate sediment storage volume, without discharging into Yazzie Wash.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.311 mi.
2.	Elevation Difference, H	115 ft
3.	Time of Concentration, T _c	0.108 hr
4.	NRCS Curve Number	85
5.	Rainfall Depth, 10-year, 24-hour storm 25-year, 6-hour storm	2.1 in 1.9 in
6.	Drainage Area	25.44 acres

Values reported represent the watershed, which drains directly to Pond N9-1.

HYDRAULICS

The SEDCAD4 and HYDROCALC 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 table (supporting calculations are presented in Appendices A, B, and C).

N9-1 SEDIMENTATION POND HYDRAULICS TABLE

	Units	10-Yr, 24-Hr Storm	25-Yr, 6-Hr Storm
Initial Reservoir Volume Condition		Empty	Full to emergency spillway
Inflow			
Peak Flow	cfs	24.24	30.76
Volume	ac-ft	1.84	1.53
Storage			
Peak Stage	msl	N/A	6787.6
Emerg. Spillway Elev.	msl	6787.0	6787.0
Peak Storage	ac-ft	N/A	4.26
Storage Capacity	ac-ft	3.87	3.87
Outflow			
Peak Flow	cfs	N/A	20.49
Spillway Elevation	msl	6787.0	6787.0
Embankment Crest Elev.	msl	6790.0	6790.0
Peak Stage	msl	--	6787.6
Freeboard	ft	--	2.4
Emergency Spillway Channel			
Flow Depth	ft	--	0.6
Critical Velocity	fps	--	3.81
Mannings "n"	--	--	0.048
Width	ft	--	15
Outflow Channel			
Slope	%	--	25
Normal Velocity	Fps	--	6.27
Normal Depth	ft	--	0.3
Mannings "n"	--	--	0.052
Riprap D ₅₀	in	--	3

1.	Rainfall Factor, R	40
2.	Soil Erodibility Factor, K	0.13
3.	Slope Factor, LS	5.03
4.	Cover Factor, C	0.96
5.	Erosion Control Factor, P	0.81

Soil Loss Equation with the following parameters:

The calculations for the sediment load entering structure N9-1 were made utilizing the Revised Universal

acre-feet.

The impoundment stage-capacity table (see Exhibit 1) is based on the 1983 aerial topographic mapping conducted for Peabody Western Coal Company. Structure N9-1 is designed to contain approximately 3.87

STORAGE CAPACITY

transition into the downstream channel.

A minimum 15-foot long riprap-lined channel will be constructed beyond the toe of the embankment as a

Minimum Channel Depth	(Spillway)	1.5	ft
Channel Width		15	ft
Channel Length	(Spillway)	33	ft
	(Outflow)	132	ft
Sideslopes (Horizontal to Vertical)		3:1	or flatter
Average Slope	(Spillway)	0	%
Maximum Slope	(Outflow)	25	%
Spillway Elevation		6787.0	ft

below. The alignment and dimensions are shown on Exhibit 1.

The emergency spillway and outlet channel for N9-1 will be a trapezoidal channel with dimensions listed

EMERGENCY SPILLWAY AND OUTLET CHANNEL

Exhibit #1 - N9-1 Proposed Sedimentation Pond

Appendix C- SEDCAD4 (Input and Output) 25-Year, 6-Hour Storm Event

Appendix B- SEDCAD4 (Input and Output) 10-Year, 24-Hour Storm Event

Appendix A- Hydrology, Hydraulic, and Sedimentation Calculations

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

* * *

N9-1	
	Total Storage Capacity (ac-ft)
3.87	10-Year, 24-Hour Storm Inflow (ac-ft)
1.84	Available Sediment Storage Capacity (ac-ft)
2.03	Sediment Inflow Rate/Year (ac-ft/yr)
0.23	Sediment Storage Life (yr)

Storage for Structure N9-1

The hydrologic analysis gives the storage volume required to contain the 10-year, 24-hour storm, and the remaining storage volume available for storing sediment. Structure N9-1 has sufficient storage capacity to contain the 10-year, 24-hour storm event. The storage capacity was determined for N9-1 Structure and the results of the analysis are presented in the following table.

Hydrology, Hydraulic, and Sedimentation Calculations

APPENDIX A

**PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA**

PROJECT: N-9 MINING AREA

STRUCTURE: I

TIME OF CONCENTRATION:

Start Elevation (ft) = 6890
 End Elevation (ft) = 6775
 Elevation Difference, E (ft) = 115
 Watercourse Length (ft) = 1642
 Watercourse Length (mi) = 0.311
 $T_c = (11.9L\sqrt{3}/E)\sqrt{0.385} = 0.108$ hours

ROUTING PARAMETERS:

Between structure routing parameters were calculated using the SCS Upland method in SEDCAD4. Input and output parameters are shown on the SEDCAD4 printouts in Appendices C.

SCS CURVE NUMBER:

Cover Type	Soil Group	Curve Number	Area (acres)	CN*Area
Pinyon Juniper	B	65	0.538	34.97
Pinyon Juniper	D	83	0.85	70.55
Distrubed Land	B	86	24.05	2068.3
TOTAL:				
			25.438	2173.82

Weighted CN = Total CN * Area / Total Area =

85

Note: During Operations the open pit will collect most of the runoff from disturbed areas. The worst case is when the open pit is reclaimed and runoff from a larger area or regraded soil reports directly to the pond.

DRAINAGE BASIN AREA:

25.438 Acres

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

STRUCTURE: I

SOIL ERODIBILITY FACTOR:

Soil Type	Erodibility Factor, K	Area	K*Area
2B	0.43	0.85	0.37
16CE	0.05	0.538	0.03
Disturbed	0.12	24.05	2.89
TOTAL			3.28
		25.438	

Weighted K = Total K * Area / Total Area =

0.13

SLOPE FACTOR:

Length (ft)	Slope (%)	m	Slope Angle (deg)	LS Factor
394	13.96%	0.60	7.95	5.03
450	13.11%	0.60	7.47	5.03

Average LS = 5.03

The LS Factor was calculated by:

LS=(Slope Length/72.6)^m*(10.8sin(slope angle)+.03) for slopes < 9%
 LS=(Slope Length/72.6)^m*(16.8sin(slope angle)-0.5) for slopes > 9%

Where:

Slope < 3% m = 0.3
 Slope = 4% m = 0.4
 5% > Slope < 10% m = 0.5
 Slope > 10% m = 0.6

STRUCTURE: I

Cover and Practice Factors:

Cover Type	Cover (%)	Canopy (%)	Area (acres)	Cover Factor, C	C * Area	Practice Factor, P	P * Area
Pinyon Juniper	40%	25%	1.388	0.22	0.31	1.00	1.388
Sagebrush, Grass	40%	25%	0	0.2	0.00	1.00	0
Saltbrush	40%	25%	0	0.2	0.00	1.00	0
Disturbed	0%	0%	24.05	1	24.05	0.80	19.24
TOTAL:			25.438		24.36		20.63

Weighted C = Total C * Area / Total Area = 0.96

Weighted P = Total P * Area / Total Area = 0.81

RAINFALL FACTOR:
R = 40

**PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENT YIELD**

STRUCTURE: I

The following spreadsheet calculates the predicted sediment yield for the project area. The gross sediment yield is determined according to the Revised Universal Soil Loss Equation.

PARAMETER DESCRIPTION	VALUE
Annual Rainfall Factor (R)	40.00
Soil Erodibility Factor (K)	0.13
Length Slope Factor (L)	5.03
Cover Factor(C)	0.96
Practice Factor (P)	0.81
Gross Annual Sediment Yield	20.14 tons/acre/year
Sediment Density	94.00 pcf
Gross Annual Sediment Yield	0.0098 acre-feet/acre/year
Sediment Delivery Ratio	90%
Estimated Annual Sediment Yield	0.0089 acre-feet/acre/year
Watershed Area	25.44 acres
Watershed Annual Sediment Yield	0.23 acre-feet/year
Number of Years	1.00 years
Calculated Sediment Volume	0.23 acre-feet

TRAPEZOIDAL CHANNEL ANALYSIS
 CRITICAL DEPTH COMPUTATION
 N9-I POND
 November 11, 2004

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Flow Rate (cfs).....	30.76
Channel Bottom Slope (ft/ft).....	0.005
Manning's Roughness Coefficient (n-value).....	0.048
Channel Left Side Slope (horizontal/vertical).....	3.0
Channel Right Side Slope (horizontal/vertical).....	3.0
Channel Bottom Width (ft).....	15.0

COMPUTATION RESULTS

DESCRIPTION	VALUE
Critical Depth (ft).....	0.49
Critical Slope (ft/ft).....	0.0443
Flow Velocity (fps).....	3.81
Froude Number.....	1.0
Velocity Head (ft).....	0.23
Energy Head (ft).....	0.72
Cross-Sectional Area of Flow (sq ft).....	8.08
Top Width of Flow (ft).....	17.94

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w/o Freeboard	Design Discharge:	30.76 cfs
w/ Freeboard	Depth:	1.31 ft
	Top Width:	16.85 ft
	Velocity:	6.27 fps
	X-Section Area:	4.91 sq ft
	Hydraulic Radius:	0.289
	Froude Number:	2.05
	Manning's n:	0.0520
	Dmin:	2.00 in
	D50:	3.00 in
	Dmax:	4.50 in

PADER Method - Steep Slope Design

Freeboard	Freeboard	Depth (ft)	% of Depth	Freeboard	Depth (ft)	Slope (%)	Right	Left	Bottom
Freeboard	Freeboard	1.00	1.00	Freeboard	1.00	25.0	3.0:1	3.0:1	15.00
Freeboard	Freeboard	1.00	1.00	Freeboard	1.00	25.0	3.0:1	3.0:1	15.00

Trapezoidal Channel

Material: Riprap

N9-1 POND OUTFLOW CHANNEL

SEDCAD4 (Input and Output) 10-Year, 24-Hour Storm Event

APPENDIX B

Peabody Western Coal
Kayenta Mine
N9-I POND DESIGN
10YR 24HR STORM

Gary Altstis

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	2.100 inches

Structure Summary:

Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
25.440	25.440	24.24	1.84

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	25.440	0.108	0.000	0.000	85.000	F	24.24	1.843
		Σ						24.24	1.843

SBD/CAD4 (Input and Output) 25-Year, 6-Hour Storm Event

APPENDIX C

Peabody Western Coal
Kayenta Mine
N9-I POND DESIGN
25YR 6HR STORM

Gary Altstis!

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	25 yr - 6 hr
Rainfall Depth:	1.900 inches

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	25.440	0.108	0.000	0.000	85.000	F	30.76	1.532
		Σ	25.440					30.76	1.532

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K	Musk. X	Description
Pond	# 1	>=	End	0.000	0.000	

#1
Pond

Structure Summary:

	In	Out	# 1
Immediate Contributing Area (ac)	25.440	25.440	
Total Contributing Area (ac)	30.76	20.49	
Peak Discharge (cfs)	1.53	1.53	
Total Runoff Volume (ac-ft)			

Structure Detail:

Structure #1 (Pond)

Pond Inputs:

Initial Pool Elev:	6,787.00
Initial Pool:	3.87 ac-ft

Emergency Spillway

Spillway Elev	6,787.00	Crest Length (ft)	33.00	Left Sideslope	3.00:1	Right Sideslope	3.00:1	Bottom Width (ft)	15.00
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Pond Results:

Peak Elevation:	6,787.60
Dewater Time:	0.18 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
6,775.00	0.100	0.000	0.000	0.000
6,775.50	0.117	0.054	0.000	0.000
6,776.00	0.136	0.118	0.000	0.000
6,776.50	0.156	0.191	0.000	0.000
6,777.00	0.178	0.274	0.000	0.000
6,777.50	0.200	0.368	0.000	0.000
6,778.00	0.225	0.474	0.000	0.000
6,778.50	0.250	0.593	0.000	0.000
6,779.00	0.277	0.725	0.000	0.000
6,779.50	0.305	0.870	0.000	0.000
6,780.00	0.335	1.030	0.000	0.000
6,780.50	0.341	1.199	0.000	0.000
6,781.00	0.346	1.371	0.000	0.000
6,781.50	0.352	1.545	0.000	0.000
6,782.00	0.358	1.723	0.000	0.000
6,782.50	0.364	1.903	0.000	0.000
6,783.00	0.369	2.086	0.000	0.000
6,783.50	0.375	2.273	0.000	0.000

Elevation	Area	Capacity	Discharge	Dewater
(ac)	(ac-ft)	(cfs)	(hrs)	
6,784.00	0.381	2.462	0.000	
6,784.50	0.387	2.654	0.000	
6,785.00	0.393	2.849	0.000	
6,785.50	0.449	3.059	0.000	
6,786.00	0.509	3.299	0.000	
6,786.50	0.572	3.569	0.000	
6,787.00	0.639	3.871	0.000	Spillway #1
6,787.50	0.641	4.191	16.963	4.15
6,787.60	0.642	4.258	20.494	0.10 Peak Stage
6,788.00	0.644	4.512	33.925	
6,788.50	0.646	4.835	76.589	
6,789.00	0.648	5.158	128.419	
6,789.50	0.650	5.483	194.754	
6,790.00	0.653	5.809	279.741	

Detailed Discharge Table

Combined	Total	Emergency	Spillway (cfs)	Discharge	(cfs)
6,775.00	0.000	0.000	0.000	0.000	0.000
6,775.50	0.000	0.000	0.000	0.000	0.000
6,776.00	0.000	0.000	0.000	0.000	0.000
6,776.50	0.000	0.000	0.000	0.000	0.000
6,777.00	0.000	0.000	0.000	0.000	0.000
6,777.50	0.000	0.000	0.000	0.000	0.000
6,778.00	0.000	0.000	0.000	0.000	0.000
6,778.50	0.000	0.000	0.000	0.000	0.000
6,779.00	0.000	0.000	0.000	0.000	0.000
6,779.50	0.000	0.000	0.000	0.000	0.000
6,780.00	0.000	0.000	0.000	0.000	0.000
6,780.50	0.000	0.000	0.000	0.000	0.000
6,781.00	0.000	0.000	0.000	0.000	0.000
6,781.50	0.000	0.000	0.000	0.000	0.000
6,782.00	0.000	0.000	0.000	0.000	0.000
6,782.50	0.000	0.000	0.000	0.000	0.000
6,783.00	0.000	0.000	0.000	0.000	0.000
6,783.50	0.000	0.000	0.000	0.000	0.000
6,784.00	0.000	0.000	0.000	0.000	0.000
6,784.50	0.000	0.000	0.000	0.000	0.000

Combined	Total	Elevation	Emergency	Spillway (cfs)	Discharge	(cfs)
6,785.00	0.000	6,785.00	0.000	0.000	0.000	0.000
6,785.50	0.000	6,785.50	0.000	0.000	0.000	0.000
6,786.00	0.000	6,786.00	0.000	0.000	0.000	0.000
6,786.50	0.000	6,786.50	0.000	0.000	0.000	0.000
6,787.00	0.000	6,787.00	0.000	0.000	0.000	0.000
6,787.50	16.963	6,787.50	16.963	16.963	16.963	16.963
6,788.00	33.925	6,788.00	33.925	33.925	33.925	33.925
6,788.50	76.589	6,788.50	76.589	76.589	76.589	76.589
6,789.00	128.419	6,789.00	128.419	128.419	128.419	128.419
6,789.50	194.754	6,789.50	194.754	194.754	194.754	194.754
6,790.00	279.741	6,790.00	279.741	279.741	279.741	279.741