

DEC 23 2004



PEABODY WESTERN COAL COMPANY

For

Navajo County, Arizona

Kayenta Mine

N9-B1 (Middle)

Temporary Sedimentation Structure

DESIGN REPORT

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EXHIBIT #1 -N9-B2, N9-B1, and N9-B Proposed Sedimentation Ponds

The construction site of the proposed Structure N9-B1 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-B1 that is in series with sedimentation structures N9-B2 & N9-B. N9-B1 is the middle pond in the series. 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".

site-specific general construction plans are shown on the attached Exhibit 1.

Sedimentation Structure N9-B1 will be an earthen embankment, designed and constructed by Peabody Western Coal Company 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-B1 and its watershed boundary are shown on Drawing No. 85400 (Sheet K-6) and Drawing No. 85405. The

INTRODUCTION

SITE DESCRIPTION

LAND USE

The N9-B1, N9-B2 and N9-B Structures have a combined watershed of 433.57 acres and are located on a tributary upstream of Yellow Water Canyon Wash at the Kayenta Mine. The 211.72-acre watershed, which contributes directly to structure N9-B1 is classified as 19% undisturbed and 81% Spoil.

DESIGN ANALYSES

GENERAL

Structure N9-B1 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-B1 (MIDDLE) 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 2H: 1V and minimum downstream slope of 4H: 1V were assumed. Based on the total embankment height of approximately 18.6 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 35-foot wide, riprap-lined, trapezoidal channel.

HYDROLOGY

The hydrologic analysis was completed using the computer program SBDCAD4 (see Appendices A, B, and C). Structure N9-B1 will be constructed in series with proposed Structures N9-B2 and N9-B. Structure N9-B1 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 combined capacity of N9-B1 and N9-B2 exceeds 20 acre-feet; therefore, the spillway was analyzed using the 100-year, 6-hour storm event in lieu of the 25-year, 6-hour storm. All structures were conservatively assumed to be full to the emergency spillway at the time of 100-year storm event. The storage capacity of structure N9-B1 was analyzed using the 10-year, 24-hour storm event. The combined ponds in series were verified to completely contain the 10-year, 24-hour storm event, and provide adequate sediment storage volume, without discharging into the Yellow Water Canyon Wash.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	1.559 mi.
2.	Elevation Difference, H	385 ft
3.	Time of Concentration, T _c	0.438 hr
4.	NRCS Curve Number	85
5.	Rainfall Depth, 10-year, 24-hour storm 100-year, 6-hour storm	2.1 in 2.4 in
6.	Drainage Area	211.72 acres

Values reported represent the watershed, which drains directly to Pond N9-B1. Hydrologic input parameters for structure N9-B2 and N9-B are presented in separate design reports.

Muskingum routing parameters were utilized to route the 100-year hydrographs between the three structures. The routing parameters are presented in Appendices B and C, and are shown on a sub-watershed basis.

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-B1 SEDIMENTATION POND HYDRAULICS TABLE

Units	10-Yr. 24-Hr Storm	100-Yr. 6-Hr Storm
Initial Reservoir Volume Condition		
	Empty	Full to emergency spillway
Inflow		
Peak Flow	128.56	323.66
Volume	15.33	30.77
Storage		
Peak Stage	N/A	6705.7
Emerg. Spillway Elev.	6703.6	6703.6
Peak Storage	N/A	23.78
Storage Capacity	19.58	19.58
Outflow		
Peak Flow	N/A	286.1
Spillway Elevation	6703.6	6703.6
Embankment Crest Elev.	6708.6	6708.6
Peak Stage	--	6705.7
Freeboard	--	2.9
Emergency Spillway Channel		
Flow Depth	--	2.1
Critical Velocity	--	6.2
Mannings "n"	--	0.048
Width	--	35
Outflow Channel		
Slope	--	25
Normal Velocity	--	9.92
Normal Depth	--	0.9
Mannings "n"	--	0.065
Riprap D ₅₀	--	9

The hydrologic analysis gives the storage volume required to contain the 10-year, 24-hour storm, and

1.	Rainfall Factor, R	40
2.	Soil Erodibility Factor, K	0.11
3.	Slope Factor, LS	5.82
4.	Cover Factor, C	0.85
5.	Erosion Control Factor, P	0.84

Universal Soil Loss Equation with the following parameters:

The calculations for the sediment load entering structure N9-B1 were made utilizing the Revised

approximately 19.58 acre-foot.

The impoundment stage-capacity table (see Exhibit 1) is based on the 1983 aerial topographic mapping conducted for Peabody Western Coal Company. Structure N9-B1 is designed to contain

STORAGE CAPACITY

shown on Exhibit 1.

The riprapped-lined channel will extend a minimum of 15 feet beyond the toe of the embankment as

Minimum Channel Depth	(Spillway)	3.0	ft
Channel Width	(Outflow)	2.0	ft
Channel Length	(Spillway)	45	ft
Slopes (Horizontal to Vertical)	(Outflow)	127	ft
Average Slope	(Spillway)	3:1	or flatter
Maximum Slope	(Spillway)	0	%
Spillway Elevation	(Outflow)	25	%
		6703.6	ft

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

The emergency spillway and outlet channel for N9-B1 will be a trapezoidal channel with dimensions

EMERGENCY SPILLWAY AND OUTLET CHANNEL

The following appendices and drawings are attached and complete this design report:
 Appendix A- Hydrology, Hydraulic, and Sedimentation Calculations
 Appendix B- SEDCAD4 (Input and Output) 10-Year, 24-Hour Storm Event
 Appendix C- SEDCAD4 (Input and Output) 100-Year, 6-Hour Storm Event
 Exhibit #1- N9-B2, N9-B1 and N9-B Proposed Sedimentation Ponds

* * *

	N9-B2 (UPPER)	N9-B1 (MIDDLE)	N9-B (LOWER)	COMBINED
Total Storage Capacity (ac-ft)	19.55	19.58	19.56	58.69
10-Year, 24-Hour Storm Inflow(ac-ft)	8.80	15.34	5.73	29.86
Available Sediment Storage Capacity	-	-	-	28.83
Sediment Inflow Rate/Year (ac-ft/yr)	1.37	1.77	0.68	3.82
Sediment Storage Life (yr)	-	-	-	7.5

Combined Storage for Structures N9-B2, N9-B1 and N9-B

structures in series and the results of the analysis are presented in the following table.
 reasonable sediment storage capacity. The combined storage capacity was determined for all three
 Structures N9-B2 and N9-B has adequate storage capacity to contain the 10-year, 24-hour storm and
 the remaining storage volume available for storing sediment. Structure N9-B1, combined with

Hydrology, Hydraulic, and Sedimentation Calculations

APPENDIX A

**PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA**

PROJECT: N-9 MINING AREA

STRUCTURE: B1

TIME OF CONCENTRATION:

Start Elevation (ft) = 7080

End Elevation (ft) = 6695

Elevation Difference, E (ft) = 385

Watercourse Length (ft) = 8233

Watercourse Length (mi) = 1.559

$T_c = (1.9L\sqrt{3}/E)\sqrt{0.385} = 0.438$ 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	1.664	108.16
Pinyon Juniper	D	83	38.019	3155.577
Saltbrush	D	79	1.14	90.06
Distributed Land	B	86	170.9	14697.4
TOTAL:				
			211.723	18051.197

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:

211.723 Acres

**PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA**

STRUCTURE: B1

SOIL ERODIBILITY FACTOR:

Soil Type	Erodibility Factor, K	Area	K*Area
12AB	0.43	0.362	0.16
16CE	0.05	1.302	0.07
1AB	0.16	4.074	0.65
3CD	0.16	7.077	1.13
3DE	0.15	0.148	0.02
3F	0.02	17.699	0.35
7CD	0.14	10.161	1.42
Disturbed	0.12	170.9	20.51
TOTAL		211.723	24.31

Weighted K = Total K * Area / Total Area =

0.11

SLOPE FACTOR:

Length (ft)	Slope (%)	m	Slope Angle (deg)	LS Factor
895	10.50%	0.60	6	5.67
1064	15.60%	0.60	8.87	10.47
1146	8.81%	0.50	5.04	3.89
1312	8.69%	0.50	4.97	4.11
2320	7.93%	0.50	4.53	4.99

Average LS = 5.82

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: B1

Cover and Practice Factors:

Cover Type	Cover (%)	Canopy (%)	Area (acres)	Cover Factor, C	C * Area	Practice Factor, P	P * Area
Pinyon Junip	40%	25%	39.683	0.22	8.73	1.00	39.683
Sagebrush, G	40%	25%	0	0.2	0.00	1.00	0
Saltbrush	40%	25%	1.14	0.2	0.23	1.00	1.14
Disturbed	0%	0%	170.9	1	170.90	0.80	136.72
TOTAL:			211.723		179.86		177.54

Weighted C = Total C * Area / Total Area = 0.85

Weighted P = Total P * Area / Total Area = 0.84

RAINFALL FACTOR:

R = 40

**PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENT YIELD**

STRUCTURE: B1

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)	0.11
Length Slope Factor (L)	5.82
Cover Factor(C)	0.85
Practice Factor (P)	0.84
Gross Annual Sediment Yield	19.06 tons/acre/year
Sediment Density	94.00 pcf
Gross Annual Sediment Yield	0.0093 acre-feet/acre/year
Sediment Delivery Ratio	90%
Estimated Annual Sediment Yield	0.0084 acre-feet/acre/year
Watershed Area	211.72 acres
Watershed Annual Sediment Yield	1.77 acre-feet/year
Number of Years	1.00 years
Calculated Sediment Volume	1.77 acre-feet

TRAPEZOIDAL CHANNEL ANALYSIS
 N9-B1 POND
 November 16, 2004

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Flow Rate (cfs).....	323.66
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).....	35.0

COMPUTATION RESULTS

DESCRIPTION	VALUE
Critical Depth (ft).....	1.33
Critical Slope (ft/ft).....	0.032
Flow Velocity (fps).....	6.23
Froude Number.....	1.0
Velocity Head (ft).....	0.6
Energy Head (ft).....	1.94
Cross-Sectional Area of Flow (sq ft).....	51.92
Top Width of Flow (ft).....	42.99

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N9-B1 POND OUTFLOW CHANNEL

Material: Riprap

Trapezoidal Channel

Freeboard Mult. x (VxD)	Freeboard % of Depth	Freeboard Depth (ft)	Slope (%)		
			Right Sideslope Ratio	3.0:1	35.00
		1.00	25.0	3.0:1	3.0:1

PADER Method - Steep Slope Design

w/o Freeboard	Design Discharge:	323.66 cfs
	Depth:	0.87 ft
	Top Width:	40.20 ft
	Velocity:	9.92 fps
	X-Section Area:	32.62 sq ft
	Hydraulic Radius:	0.806
	Froude Number:	1.94
	Manning's n:	0.0650
	Dmin:	5.00 in
	D50:	9.00 in
	Dmax:	12.00 in

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

APPENDIX B

Peabody Western Coal
Kayenta Mine
N9-B1 POND DESIGN
10YR 24HR STORM

Gary Altisi

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)
211.720	211.720	128.56	15.33

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	211.720	0.438	0.000	0.000	85.000	F	128.56	15.335
	Σ	211.720						128.56	15.335

SEDGAD4 (Input and Output) 100-Year, 6-Hour Storm Event

APPENDIX C

Peabody Western Coal
Kayenta Mine
N9-B1 POND DESIGN
100YR 6HR STORM

Gary Altsisi

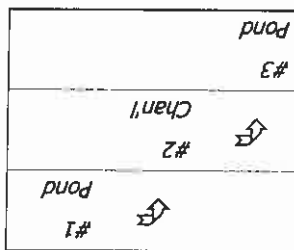
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	2.400 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	<=>	#2	0.000	0.000	N9-B2 POND
Channel	#2	<=>	#3	0.000	0.000	N9-B2 SPILLWAY
Pond	#3	<=>	End	0.000	0.000	N9-B1 POND



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1 In	147.510	147.510	155.58	11.37
#1 Out			101.19	11.38
#2	0.000	147.510	101.19	11.37
#3 In	211.720	359.230	323.66	30.77
#3 Out			286.05	30.77

Structure #3 (Pond)

N9-B1 POND

Pond Inputs:

Initial Pool Elev:	6,703.60
Initial Pool:	19.58 ac-ft

Emergency Spillway

Spillway Elev	6,703.60	Crest Length (ft)	45.00	Left Sideslope	3.00:1	Right Sideslope	3.00:1	Bottom Width (ft)	35.00
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Pond Results:

Peak Elevation:	6,705.72
Dewater Time:	0.38 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)
6,690.00	1.000	0.000	0.000	0.000
6,690.50	1.032	0.508	0.000	0.000
6,691.00	1.064	1.032	0.000	0.000
6,691.50	1.097	1.572	0.000	0.000
6,692.00	1.130	2.129	0.000	0.000
6,692.50	1.164	2.702	0.000	0.000
6,693.00	1.198	3.293	0.000	0.000
6,693.50	1.233	3.900	0.000	0.000
6,694.00	1.268	4.525	0.000	0.000
6,694.50	1.304	5.168	0.000	0.000
6,695.00	1.340	5.829	0.000	0.000
6,695.50	1.367	6.506	0.000	0.000
6,696.00	1.394	7.196	0.000	0.000
6,696.50	1.421	7.900	0.000	0.000
6,697.00	1.449	8.617	0.000	0.000
6,697.50	1.476	9.348	0.000	0.000
6,698.00	1.504	10.093	0.000	0.000

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
6,698.50	1.533	10.853	0.000	
6,699.00	1.561	11.626	0.000	
6,699.50	1.590	12.414	0.000	
6,700.00	1.619	13.216	0.000	
6,700.50	1.660	14.036	0.000	
6,701.00	1.701	14.876	0.000	
6,701.50	1.742	15.737	0.000	
6,702.00	1.784	16.618	0.000	
6,702.50	1.826	17.521	0.000	
6,703.00	1.869	18.444	0.000	
6,703.50	1.912	19.390	0.000	
6,703.60	1.921	19.582	0.000	Spillway #1
6,704.00	1.935	20.353	25.197	5.95
6,704.50	1.952	21.324	56.700	1.90
6,705.00	1.969	22.304	136.422	0.75
6,705.50	2.086	23.318	235.292	0.35
6,705.72	2.138	23.780	286.048	0.15 Peak Stage
6,706.00	2.206	24.391	353.166	
6,706.50	2.329	25.524	498.252	
6,707.00	2.456	26.720	669.401	
6,707.50	2.586	27.981	868.331	
6,708.00	2.719	29.307	1,081.005	
6,708.50	2.856	30.701	1,318.253	
6,708.60	2.884	30.988	1,368.679	

Detailed Discharge Table

Combined Total Discharge (cfs)	Elevation Emergency Spillway (cfs)	Elevation (cfs)
0.000	0.000	6,690.00
0.000	0.000	6,690.50
0.000	0.000	6,691.00
0.000	0.000	6,691.50
0.000	0.000	6,692.00
0.000	0.000	6,692.50
0.000	0.000	6,693.00
0.000	0.000	6,693.50
0.000	0.000	6,694.00
0.000	0.000	6,694.50

Combined	Total	Elevation	Emergency	Spillway (cfs)	Discharge	(cfs)
6,695.00	0.000	6,695.00	0.000	0.000	0.000	0.000
6,695.50	0.000	6,695.50	0.000	0.000	0.000	0.000
6,696.00	0.000	6,696.00	0.000	0.000	0.000	0.000
6,696.50	0.000	6,696.50	0.000	0.000	0.000	0.000
6,697.00	0.000	6,697.00	0.000	0.000	0.000	0.000
6,697.50	0.000	6,697.50	0.000	0.000	0.000	0.000
6,698.00	0.000	6,698.00	0.000	0.000	0.000	0.000
6,698.50	0.000	6,698.50	0.000	0.000	0.000	0.000
6,699.00	0.000	6,699.00	0.000	0.000	0.000	0.000
6,699.50	0.000	6,699.50	0.000	0.000	0.000	0.000
6,700.00	0.000	6,700.00	0.000	0.000	0.000	0.000
6,700.50	0.000	6,700.50	0.000	0.000	0.000	0.000
6,701.00	0.000	6,701.00	0.000	0.000	0.000	0.000
6,701.50	0.000	6,701.50	0.000	0.000	0.000	0.000
6,702.00	0.000	6,702.00	0.000	0.000	0.000	0.000
6,702.50	0.000	6,702.50	0.000	0.000	0.000	0.000
6,703.00	0.000	6,703.00	0.000	0.000	0.000	0.000
6,703.50	0.000	6,703.50	0.000	0.000	0.000	0.000
6,703.60	0.000	6,703.60	0.000	0.000	0.000	0.000
6,704.00	25.197	6,704.00	25.197	56.700	56.700	25.197
6,704.50	56.700	6,704.50	136.422	56.700	56.700	56.700
6,705.00	136.422	6,705.00	235.292	136.422	136.422	136.422
6,705.50	235.292	6,705.50	353.166	235.292	235.292	235.292
6,706.00	353.166	6,706.00	498.252	353.166	353.166	353.166
6,706.50	498.252	6,706.50	669.401	498.252	498.252	498.252
6,707.00	669.401	6,707.00	868.331	669.401	669.401	669.401
6,707.50	868.331	6,707.50	1,081.005	868.331	868.331	868.331
6,708.00	1,081.005	6,708.00	1,318.253	1,081.005	1,081.005	1,081.005
6,708.50	1,318.253	6,708.50	1,368.679	1,318.253	1,318.253	1,318.253
6,708.60	1,368.679	6,708.60		1,368.679	1,368.679	1,368.679

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)
#3	1	211.720	0.438	0.000	0.000	85.000	F	228.17	19.396
Σ								323.66	30.770