DESIGN REPORT

Temporary Sedimentation Structure

N9-A (Lower)

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

DEC 23 2004

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SITE DESCRIPTION

LAND USE

The N9-A, N9-A1 and N9-A2 Structures have a combined watershed of 433.41 acres and are located on a tributary upstream of Yellow Water Canyon Wash at the Kayenta Mine. The 124.57-acre watershed, which contributes directly to structure N9-A, is classified as 11% undisturbed and 89% disturbed.

DESIGN ANALYSES

GENERAL

Structure N9-A 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 1984 for Peabody Western Coal Company and was used in the analyses of the structure.

STABILITY

Structure N9-A 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 20 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 30-foot wide, riprap-lined, trapezoidal channel.

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).

EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for N9-A will be a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit 1.

Minimum Channel Depth	(Spillway) (Outflow)	2.5 2.0	ft ft
Channel Width		30	ft
Channel Length	(Spillway) (Outflow)	38 165	ft ft
Sideslopes (Horizontal to Vertical)		3:1	or flatter
Average Slope	(Spillway)	0	%
Maximum Slope	(Outflow)	25	%
Spillway Elevation		6846.2	ft

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

STORAGE CAPACITY

The impoundment stage-capacity table (see Exhibit 1) is based on the 1984 aerial topographic mapping conducted for Peabody Western Coal Company. Structure N9-A is designed to contain approximately 19.75 acre-feet.

The calculations for the sediment load entering structure N9-A were made utilizing the Revised Universal Soil Loss Equation with the following parameters:

1.	Rainfall Factor, R	40
2.	Soil Erodibility Factor, K	0.11
3.	Slope Factor, LS	7.58
4.	Cover Factor, C	0.92
5.	Erosion Control Factor, P	0.82

APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

STRUCTURE: A

SOIL ERODIBILITY FACTOR:

Soil Type	Erodibility Factor, K	Area	K*Area
12AB	0.43	0.51	0.22
16CE	0.05	2.668	0.13
3CD	0.16	1.759	0.28
3F	0.02	8.247	0.16
Disturbed Land	0.12	111.39	13.37
	TOTAL	124.574	14.17

Weighted K = Total K * Area / Total Area = 0.11

SLOPE FACTOR:

Length (ft)		Slope (%)	m	Slope Angle (deg)	LS Factor
729	150	20.58%	0.60	11.63	11.52
613	80	13.05%	0.60	7.44	6.03
676	100	14.79%	0.60	8.41	7.46
728	80	10.99%	0.60	6.27	5.32

Average LS = 7.58

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

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENT YIELD

STRUCTURE: A

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	
Soil Erodibility Factor (K)	0.11	
Length Slope Factor (L)	7.58	
Cover Factor(C)	0.92	
Practice Factor (P)	0.82	
Gross Annual Sediment Yield	25.98	tons/acre/year
Sediment Density	94	pcf
Gross Annual Sediment Yield	0.0127	acre-feet/acre/year
Sediment Delivery Ratio	90%	
Estimated Annual Sediment Yield	0.0114	acre-feet/acre/year
Watershed Area	124.58	acres
Watershed Annual Sediment Yield	1.42	acre-feet/year
Number of Years	1	years
Calculated Sediment Volume	1.42	acre-feet

N9-A POND OUTFLOW CHANNEL

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
30.00	3.0:1	3.0:1	25.0	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	262.03 cfs	
Depth:	0.84 ft	1.84 ft
Top Width:	35.02 ft	41.02 ft
Velocity:	9.63 fps	
X-Section Area:	27.20 sq ft	
Hydraulic Radius:	0.771	
Froude Number:	1.93	
Manning's n:	0.0650	
Dmin:	5.00 in	
D50:	9.00 in	
Dmax:	12.00 in	

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

Gary Altslsi

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	124.570	124.570	118.69	9.02

APPENDIX C

SEDCAD4 (Input and Output) 100-Year, 6-Hour Storm Event

General Information

Storm Information:

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

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	289.360	289.360	310.40	25.05
	Out			255.27	25.05
#2		0.000	289.360	255.27	25.05
#3	In	19.480	308.840	262.13	26.84
	Out			217.22	26.84
#4		0.000	308.840	217.22	26.84
#5	In	124.570	433.410	262.03	38.25
	Out			226.11	38.25

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
6,873.50	1.507	9.934	0.000		
6,874.00	1.540	10.696	0.000		
6,874.50	1.572	11.474	0.000		
6,875.00	1.605	12.268	0.000		
6,875.50	1.676	13.088	0.000		
6,876.00	1.748	13.944	0.000		
6,876.50	1.821	14.836	0.000		
6,877.00	1.896	15.766	0.000		
6,877.50	1.973	16.733	0.000		
6,878.00	2.051	17.739	0.000		
6,878.50	2.131	18.784	0.000		
6,878.90	2.195	19.649	0.000		Spillway #1
6,879.00	2.191	19.869	6.606	2.90	
6,879.50	2.170	20.959	39.603	1.90	
6,880.00	2.149	22.039	72.600	0.95	
6,880.50	2.244	23.137	151.412	0.45	
6,881.00	2.342	24.283	243.729	0.30	
6,881.05	2.353	24.406	255.274	0.05	Peak Stage
6,881.50	2.442	25.479	356.187		
6,882.00	2.543	26.725	494.400		
6,882.50	2.647	28.023	656.283		
6,883.00	2.753	29.373	841.363		
6,883.50	2.861	30.776	1,039.085		
6,883.90	2.948	31.938	1,216.134		

Detailed Discharge Table

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,865.00	0.000	0.000
6,865.50	0.000	0.000
6,866.00	0.000	0.000
6,866.50	0.000	0.000
6,867.00	0.000	0.000
6,867.50	0.000	0.000
6,868.00	0.000	0.000
6,868.50	0.000	0.000
6,869.00	0.000	0.000
6,869.50	0.000	0.000

Bottom Width (ft)}	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
25.00	3.0:1	3.0:1	25.0	4.11		

Riprap Channel Results:

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	255.27 cfs	
Depth:	0.90 ft	5.01 ft
Top Width:	30.38 ft	55.04 ft
Velocity:	10.28 fps	
X-Section Area:	24.84 sq ft	
Hydraulic Radius:	0.810	
Froude Number:	2.00	
Manning's n:	0.0630	
Dmin:	5.00 in	
D50:	9.00 in	
Dmax:	12.00 in	

Structure #3 (Pond)

N9-A1 POND

Pond Inputs:

Initial Pool Elev:	6,865.20
Initial Pool:	19.69 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
6,865.20	43.80	3.00:1	3.00:1	25.00

Pond Results:

Peak Elevation:	6,867.34
Dewater Time:	0.34 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)
6,869.50	2.723	29.394	800.698	
6,870.00	2.840	30.785	985.715	

Detailed Discharge Table

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,850.00	0.000	0.000
6,850.50	0.000	0.000
6,851.00	0.000	0.000
6,851.50	0.000	0.000
6,852.00	0.000	0.000
6,852.50	0.000	0.000
6,853.00	0.000	0.000
6,853.50	0.000	0.000
6,854.00	0.000	0.000
6,854.50	0.000	0.000
6,855.00	0.000	0.000
6,855.50	0.000	0.000
6,856.00	0.000	0.000
6,856.50	0.000	0.000
6,857.00	0.000	0.000
6,857.50	0.000	0.000
6,858.00	0.000	0.000
6,858.50	0.000	0.000
6,859.00	0.000	0.000
6,859.50	0.000	0.000
6,860.00	0.000	0.000
6,860.50	0.000	0.000
6,861.00	0.000	0.000
6,861.50	0.000	0.000
6,862.00	0.000	0.000
6,862.50	0.000	0.000
6,863.00	0.000	0.000
6,863.50	0.000	0.000
6,864.00	0.000	0.000
6,864.50	0.000	0.000
6,865.00	0.000	0.000
6,865.20	0.000	0.000

N9-A POND

Pond Inputs:

Initial Pool Elev:	6,846.20
Initial Pool:	19.75 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
6,846.20	37.80	3.00:1	3.00:1	30.00

Pond Results:

Peak Elevation:	6,848.17
Dewater Time:	0.44 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)
6,830.00	0.010	0.000	0.000	
6,830.50	0.016	0.007	0.000	
6,831.00	0.024	0.017	0.000	
6,831.50	0.033	0.031	0.000	
6,832.00	0.044	0.050	0.000	
6,832.50	0.056	0.075	0.000	
6,833.00	0.070	0.107	0.000	
6,833.50	0.085	0.145	0.000	
6,834.00	0.102	0.192	0.000	
6,834.50	0.120	0.248	0.000	
6,835.00	0.140	0.313	0.000	
6,835.50	0.245	0.408	0.000	
6,836.00	0.376	0.562	0.000	
6,836.50	0.537	0.789	0.000	
6,837.00	0.726	1.104	0.000	
6,837.50	0.942	1.520	0.000	
6,838.00	1.190	2.051	0.000	
6,838.50	1.464	2.714	0.000	
6,839.00	1.767	3.520	0.000	
6,839.50	2.098	4.485	0.000	
6,840.00	2.457	5.623	0.000	
6,840.50	2.410	6.840	0.000	

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,836.50	0.000	0.000
6,837.00	0.000	0.000
6,837.50	0.000	0.000
6,838.00	0.000	0.000
6,838.50	0.000	0.000
6,839.00	0.000	0.000
6,839.50	0.000	0.000
6,840.00	0.000	0.000
6,840.50	0.000	0.000
6,841.00	0.000	0.000
6,841.50	0.000	0.000
6,842.00	0.000	0.000
6,842.50	0.000	0.000
6,843.00	0.000	0.000
6,843.50	0.000	0.000
6,844.00	0.000	0.000
6,844.50	0.000	0.000
6,845.00	0.000	0.000
6,845.50	0.000	0.000
6,846.00	0.000	0.000
6,846.20	0.000	0.000
6,846.50	15.377	15.377
6,847.00	41.023	41.023
6,847.50	105.469	105.469
6,848.00	191.140	191.140
6,848.50	292.496	292.496
6,849.00	417.761	417.761
6,849.50	567.760	567.760
6,850.00	743.428	743.428