

DEC 23 2004



PEABODY WESTERN COAL COMPANY

For

Navajo County, Arizona

Kayenta Mine

N9-A2 (Upper)

Temporary Sedimentation Structure

DESIGN REPORT

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EXHIBIT # 1 -N9-A2, N9-A1, and N9-A Proposed Sedimentation Ponds

The construction site of the proposed Structure N9-A2 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-A2 that is in series with sedimentation structures N9-A1 & N9-A. N9-A2 is the upper 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 (RAP), 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-A2 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-A2 and its watershed boundary are shown on Drawing No. 85400, (Sheet K-6), and Drawing No. 85405. The

INTRODUCTION

Structure N9-A2 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 a minimum downstream slope of 4H: 1V were assumed. Based on the total embankment height of approximately 19.5 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 25-foot wide, trapezoidal channel.

STABILITY

Structure N9-A2 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.

GENERAL

DESIGN ANALYSES

The N9-A2, N9-A1 and N9-A 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 289.36-acre watershed, which contributes directly to structure N9-A2, is classified as 72% undisturbed and 28% spoil.

LAND USE

SITE DESCRIPTION

HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD4 (see Appendices A, B, and C). Structure N9-A2 will be constructed in series with proposed Structures N9-A1 and N9-A. Structure N9-A2 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. N9-A2 is the upper pond in the series and has a capacity of less than 20 acre-feet; therefore, the spillway was analyzed using the 25-year, 6-hour storm event. All structures were conservatively assumed to be full to the emergency spillway at the time of design storm event. The storage capacity of structure N9-A2 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	1.318 mi.
2.	Elevation Difference, H	330 ft
3.	Time of Concentration, T _c	0.383 hr
4.	NRCS Curve Number	84
5.	Rainfall Depth, 10-year, 24-hour storm 25-year, 6-hour storm	2.1 in 1.9 in
6.	Drainage Area	289.36 acres

Values reported represent the watershed, which drains directly to Pond N9-A2. Hydrologic input parameters for structure N9-A1 and N9-A are presented in separate design reports.

Muskingum routing parameters were utilized to route the 25-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-A2 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	171.66 Cfs	198.99 Cfs
Volume	19.66 ac-ft	16.25 ac-ft
Storage		
Peak Stage	N/A Msl	6880.6 Msl
Emerg. Spillway Elev.	6878.9 Msl	6878.9 Msl
Peak Storage	N/A ac-ft	23.3 ac-ft
Storage Capacity	19.65 ac-ft	19.65 ac-ft
Outflow		
Peak Flow	N/A Cfs	141.5 Cfs
Spillway Elevation	6878.9 Msl	6878.9 Msl
Embankment Crest Elev.	6883.9 Msl	6883.9 Msl
Peak Stage	-- Msl	6880.6 Msl
Freeboard	-- Ft	3.3 Ft
Emergency Spillway Channel		
Flow Depth	-- Ft	1.7 Ft
Critical Velocity	-- Fps	5.84 Fps
Mannings "n"	--	0.048
Width	-- Ft	25 Ft
Outflow Channel		
Slope	-- %	25 %
Normal Velocity	-- Fps	9.03 Fps
Normal Depth	-- Ft	0.8 Ft
Mannings "n"	--	0.067
Riprap D ₅₀	-- In	9 In

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	0.14
3.	Slope Factor, LS	8.41
4.	Cover Factor, C	0.44
5.	Erosion Control Factor, P	0.94

Soil Loss Equation with the following parameters:

The calculations for the sediment load entering structure N9-A2 were made utilizing the Revised Universal

19.65 acre-feet.

The impoundment stage-capacity table (see Exhibit 1) is based on the 1984 aerial topographic mapping conducted for Peabody Western Coal Company. Structure N9-A2 is designed to contain approximately

STORAGE CAPACITY

transition into the downstream channel.

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

Minimum Channel Depth	(Spillway)	2.5	ft
Channel Width		25	ft
Channel Length	(Spillway)	45	ft
	(Outflow)	215	ft
Sideslopes (Horizontal to Vertical)		3:1	or flatter
Average Slope	(Spillway)	0	%
Maximum Slope	(Outflow)	25	%
Spillway Elevation		6878.9	ft

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

The emergency spillway and outlet channel for N9-A2 will be a trapezoidal channel with dimensions listed

EMERGENCY SPILLWAY AND OUTLET CHANNEL

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
 Exhibit #1- N9-A2, N9-A1 & N9-A Proposed Sedimentation Ponds

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

* * *

	N9-A2 (UPPER)	N9-A1 (MIDDLE)	N9-A (LOWER)	COMBINED
Total Storage Capacity (ac-ft)	19.65	19.69	19.75	59.08
10-Year, 24-Hour Storm Inflow (ac-ft)	19.66	1.41	9.02	30.10
Available Sediment Storage Capacity (ac-ft)	-	-	-	28.98
Sediment Inflow Rate/Year (ac-ft/yr)	2.45	0.23	1.42	4.10
Sediment Storage Life (yr)	-	-	-	7.1

Combined Storage for Structures N9-A2, N9-A1 and N9-A

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-A2 does not have sufficient storage to contain the 10-year, 24-hour storm, however, the storage of all three ponds (N9-A2, N9-A1 & N9-A), in series is adequate. The combined storage capacity was determined for all three structures in series 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: A2

TIME OF CONCENTRATION:

Start Elevation (ft) = 7190

End Elevation (ft) = 6860

Elevation Difference, E (ft) = 330

Watercourse Length (ft) = 6957

Watercourse Length (mi) = 1.318

$T_c = (1.49L^{0.76}/E)^{0.385} = 0.383$ 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	1.931	125.515
Pinyon Juniper	D	83	203.638	16901.954
Sagebrush	D	79	2.686	212.194
Disturbed Land	B	86	81.1	6974.6
TOTAL:				24214.263

Weighted CN = Total CN * Area / Total Area =

84

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:

289.355 Acres

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

STRUCTURE: A2

SOIL ERODIBILITY FACTOR:

Soil Type	Erodibility Factor, K	Area	K*Area
16CE	0.05	1.834	0.09
1AB	0.16	1.042	0.17
2B	0.43	1.955	0.84
3AB	0.16	161.875	25.90
3CD	0.16	17.808	2.85
3F	0.02	23.644	0.47
X11C	0.46	0.097	0.04
Disturbed	0.12	81.1	9.73
TOTAL			40.10
		289.355	

Weighted K = Total K * Area / Total Area =

0.14

SLOPE FACTOR:

Length (ft)	Slope (%)	m	Slope Angle (deg)	LS Factor
1043	10.55%	0.60	6.02	6.24
1126	16.52%	0.60	9.38	11.59
1257	12.33%	0.60	7.03	8.61
2374	10.70%	0.60	6.11	10.44
3168	6.98%	0.50	3.99	5.16

Average LS = 8.41

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: A2

Cover and Practice Factors:

Cover Type	Cover (%)	Canopy (%)	Area (acres)	Cover Factor, C	C * Area	Practice Factor, P	P * Area
Pinyon Juniper	40%	25%	205.569	0.22	45.23	1.00	205.569
Sagebrush, Grass	40%	25%	2.686	0.2	0.54	1.00	2.686
Saltbrush	40%	25%	0	0.2	0.00	1.00	0
Disturbed	0%	0%	81.1	1	81.10	0.80	64.88
TOTAL:							
			289.355		126.86		273.14

Weighted C = Total C * Area / Total Area =
 Weighted P = Total P * Area / Total Area =

0.44
 0.94

RAINFALL FACTOR:
 R = 40

**PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENT YIELD**

STRUCTURE: A2

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)	0.14
Length Slope Factor (L)	8.41
Cover Factor(C)	0.44
Practice Factor (P)	0.94
Gross Annual Sediment Yield	19.29 tons/acre/year
Sediment Density	94.00 pcf
Gross Annual Sediment Yield	0.0094 acre-feet/acre/year
Sediment Delivery Ratio	90%
Estimated Annual Sediment Yield	0.0085 acre-feet/acre/year
Watershed Area	289.36 acres
Watershed Annual Sediment Yield	2.45 acre-feet/year
Number of Years	1.00 years
Calculated Sediment Volume	2.45 acre-feet

TRAPEZOIDAL CHANNEL ANALYSIS
 CRITICAL DEPTH COMPUTATION
 N9-A2 POND
 November 12, 2004

DESCRIPTION	VALUE
Flow Rate (cfs).....	198.99
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).....	25.0

COMPUTATION RESULTS

DESCRIPTION	VALUE
Critical Depth (ft).....	1.19
Critical Slope (ft/ft).....	0.0335
Flow Velocity (fps).....	5.84
Froude Number.....	1.0
Velocity Head (ft).....	0.53
Energy Head (ft).....	1.72
Cross-Sectional Area of Flow (sq ft).....	34.08
Top Width of Flow (ft).....	32.15

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N9-A2 POND OUTFLOW CHANNEL

Material: Riprap

Trapezoidal Channel

	Freeboard	Freeboard	Freeboard	Depth (ft)	% of Depth	Freeboard	Freeboard	Freeboard	Freeboard	Freeboard	
Bottom Width (ft)	Left Side Slope Ratio	Right Side Slope Ratio	Slope (%)								25.00
											3.0:1
											3.0:1
											25.0
											1.00

PADER Method - Steep Slope Design

w/o Freeboard	w/ Freeboard	
Design Discharge:	198.99 cfs	
Depth:	0.80 ft	1.80 ft
Top Width:	29.82 ft	35.82 ft
Velocity:	9.03 fps	
X-Section Area:	22.03 sq ft	
Hydraulic Radius:	0.732	
Froude Number:	1.85	
Manning's n:	0.0670	
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-A2 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)
# 1	289.360	289.360	171.66	19.66

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	289.360	0.383	0.000	0.000	84.000	F	171.66	19.664		
		Σ 289.360								171.66	19.664

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

APPENDIX C

Peabody Western Coal
Kayenta Mine
N9-A2 POND DESIGN
25YR 6HR STORM

Gary Altsisi

General Information

Storm Information:

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

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K	Musk. X	Description
Pond	# 1	==>	End	0.000	0.000	N9-A2

#1
Pond

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
# 1	289.360	289.360	198.99	16.25
In			141.46	16.25
Out				16.25

Structure Detail:

Structure #1 (Pond)

N9-A2

Pond Inputs:

Initial Pool Elev:	6,878.90
Initial Pool:	19.65 ac-ft

Emergency Spillway

Spillway Elev	6,878.90	Crest Length (ft)	45.00	Left Slope	3:00:1	Right Slope	3:00:1	Bottom Width (ft)	25.00
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Pond Results:

Peak Elevation:	6,880.58
Dewater Time:	0.29 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)
6,865.00	0.750	0.000	0.000	0.000
6,865.50	0.798	0.387	0.798	0.000
6,866.00	0.847	0.798	0.798	0.000
6,866.50	0.897	1.234	0.798	0.000
6,867.00	0.949	1.695	0.798	0.000
6,867.50	1.002	2.183	0.798	0.000
6,868.00	1.057	2.698	0.798	0.000
6,868.50	1.113	3.240	0.798	0.000
6,869.00	1.171	3.811	0.798	0.000
6,869.50	1.230	4.411	0.798	0.000
6,870.00	1.291	5.042	0.798	0.000
6,870.50	1.321	5.695	0.798	0.000
6,871.00	1.351	6.363	0.798	0.000
6,871.50	1.382	7.046	0.798	0.000
6,872.00	1.413	7.744	0.798	0.000
6,872.50	1.444	8.458	0.798	0.000
6,873.00	1.475	9.188	0.798	0.000

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	5.563	3.35
6,879.50	2.170	20.959	33.351	2.05
6,880.00	2.149	22.039	61.138	0.90
6,880.50	2.244	23.137	128.257	0.55
6,880.58	2.262	23.328	141.457	0.10 Peak Stage
6,881.00	2.342	24.283	207.526	
6,881.50	2.442	25.479	304.805	
6,882.00	2.543	26.725	425.209	
6,882.50	2.647	28.023	567.183	
6,883.00	2.753	29.373	730.520	
6,883.50	2.861	30.776	906.004	
6,883.90	2.948	31.938	1,063.874	

Detailed Discharge Table

Combined Total Discharge (cfs)	Elevation Emergency Spillway (cfs)	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

Combined	Total	Emergency	Spillway (cfs)	Elevation
(cfs)	Discharge	(cfs)	(cfs)	
0.000	0.000	0.000	0.000	6,870.00
0.000	0.000	0.000	0.000	6,870.50
0.000	0.000	0.000	0.000	6,871.00
0.000	0.000	0.000	0.000	6,871.50
0.000	0.000	0.000	0.000	6,872.00
0.000	0.000	0.000	0.000	6,872.50
0.000	0.000	0.000	0.000	6,873.00
0.000	0.000	0.000	0.000	6,873.50
0.000	0.000	0.000	0.000	6,874.00
0.000	0.000	0.000	0.000	6,874.50
0.000	0.000	0.000	0.000	6,875.00
0.000	0.000	0.000	0.000	6,875.50
0.000	0.000	0.000	0.000	6,876.00
0.000	0.000	0.000	0.000	6,876.50
0.000	0.000	0.000	0.000	6,877.00
0.000	0.000	0.000	0.000	6,877.50
0.000	0.000	0.000	0.000	6,878.00
0.000	0.000	0.000	0.000	6,878.50
0.000	0.000	0.000	0.000	6,878.90
5.563	5.563	5.563	5.563	6,879.00
33.351	33.351	33.351	33.351	6,879.50
61.138	61.138	61.138	61.138	6,880.00
128.257	128.257	128.257	128.257	6,880.50
207.526	207.526	207.526	207.526	6,881.00
304.805	304.805	304.805	304.805	6,881.50
425.209	425.209	425.209	425.209	6,882.00
567.183	567.183	567.183	567.183	6,882.50
730.520	730.520	730.520	730.520	6,883.00
906.004	906.004	906.004	906.004	6,883.50
1,063.874	1,063.874	1,063.874	1,063.874	6,883.90

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	289.360	0.383	0.000	0.000	84.000	F	198.99	16.251
	Σ	289.360						198.99	16.251