



PEABODY WESTERN COAL COMPANY

For

Navajo County, Arizona

Kayenta Mine

N9-J2

Temporary Sedimentation Structure

DESIGN REPORT

TABLE OF CONTENTS

INTRODUCTION	1
INSPECTION	1
SITE DESCRIPTION	2
LAND USE	2
DESIGN ANALYSES	2
GENERAL	2
STABILITY	2
HYDROLOGY	3
HYDRAULICS	4
EMERGENCY SPILLWAY AND OUTLET CHANNEL	6
STORAGE CAPACITY	6
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-J3, N9-J2, N9-J1, and N9-J Proposed Sedimentation Ponds	

Page

The construction site of the proposed Structure N9-12 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 N9-12 that is in series with sedimentation structures N9-13, N9-11 & N9-1. N9-12 is the third 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".

Sedimentation Structure N9-12 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 N9-12 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

Structure N9-J2 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 15 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 +2-foot wide, riprap-lined, trapezoidal channel.

STABILITY

Structure N9-J2 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 1967 for Peabody Western Coal Company and was used in the analyses of the structure.

GENERAL

DESIGN ANALYSES

The N9-J3, N9-J2, N9-J1 and N9-J Structures have a combined watershed of 524.18 acres and are located on a tributary upstream of Yazzie Wash at the Kayenta Mine. The 138.86-acre watershed, which contributes directly to structure N9-J2 is classified as 52% undisturbed and 48% spoil.

LAND USE

SITE DESCRIPTION

HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD4 (see Appendices A, B, and C). Structure N9-J2 will be constructed in series with proposed Structures N9-J3, N9-J1 and N9-J1. Structure N9-J2 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-J2 and N9-J3 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-J2 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 Yazzie Wash.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.244 mi.
2.	Elevation Difference, H	30 ft
3.	Time of Concentration, T _c	0.137 hr
4.	NRCS Curve Number	84
5.	Rainfall Depth, 10-year, 24-hour storm 100-year, 6-hour storm	2.1 in 2.4 in
6.	Drainage Area	138.86 acres

Values reported represent the watershed, which drains directly to Pond N9-J2. Hydrologic input parameters for structures N9-J3, N9-J1 and N9-J1 are presented in separate design reports.

Muskingum routing parameters were utilized to route the 100-year hydrographs between the four 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).

N9-12 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	103.99	380.62
Volume	9.44	37.66
Storage		
Peak Stage	N/A	6833.7
Emerg. Spillway Elev.	6831.6	6831.6
Peak Storage	N/A	24.3
Storage Capacity	19.52	19.52
Outflow		
Peak Flow	N/A	331.1
Spillway Elevation	6831.6	6831.6
Embankment Crest Elev.	6834.9	6834.9
Peak Stage	--	6833.7
Freeboard	--	1.2
Emergency Spillway Channel		
Flow Depth	--	2.1
Critical Velocity	--	6.3
Mannings "n"	--	0.048
Width	--	42
Outflow Channel		
Slope	--	25
Normal Velocity	--	9.9
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	0.14
3.	Slope Factor, LS	8.01
4.	Cover Factor, C	0.60
5.	Erosion Control Factor, P	0.90

Universal Soil Loss Equation with the following parameters:

The calculations for the sediment load entering structure N9-J2 were made utilizing the Revised

approximately 19.52 acre-foot.

The impoundment stage-capacity table (see Exhibit 1) is based on the 1967 aerial topographic mapping conducted for Peabody Western Coal Company. Structure N9-J2 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		42	ft
Channel Length	(Spillway)	35	ft
	(Outflow)	132	ft
Sideslopes (Horizontal to Vertical)		3:1	or flatter
Average Slope	(Spillway)	0	%
Maximum Slope	(Outflow)	25	%
Spillway Elevation		6831.6	ft

listed below. The alignment and dimensions are shown on Exhibit 1. The emergency spillway and outlet channel for N9-J2 will be a trapezoidal channel with dimensions

EMERGENCY SPILLWAY AND OUTLET CHANNEL

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-J3, N9-J2, N9-J1 and N9-J Proposed Sedimentation Ponds

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

* * *

	N9-J3 (UPPER)	N9-J2	N9-J1	N9-J (LOWER)	COMBINED
Total Storage Capacity (ac-ft)	19.53	19.52	19.39	19.66	78.09
10-Year, 24-Hour Storm Inflow (ac-ft)	20.13	9.44	3.24	3.43	36.23
Available Sediment Storage Capacity (ac-ft)	-	-	-	-	41.86
Sediment Inflow Rate/Year (ac-ft/yr)	3.19	1.49	0.44	0.64	5.76
Sediment Storage Life (yr)	-	-	-	-	7.3

Combined Storage for Structures N9-J3, N9-J2, N9-J1 and N9-J

the remaining storage volume available for storing sediment. Structure N9-J2, combined with Structures N9-J3, N9-J1 and N9-J has adequate storage capacity to contain the 10-year, 24-hour storm and reasonable sediment storage capacity. The combined storage capacity was determined for all four 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: J2

TIME OF CONCENTRATION:

Start Elevation (ft) =	6845
End Elevation (ft) =	6815
Elevation Difference, E (ft) =	30
Watercourse Length (ft) =	1286
Watercourse Length (mi) =	0.244
$T_c = (1.49L^{0.76}/E)^{0.385} =$	0.137 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	0.285	18.525
Pinyon Juniper	D	83	70.337	5837.971
Sagebrush	B	60	0.331	19.86
Sagebrush	D	79	0.979	77.341
Distributed Land	B	86	66.93	5755.98
TOTAL:				11709.677

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:

138.862 Acres

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

STRUCTURE: J2

SOIL ERODIBILITY FACTOR:

Soil Type	Erodibility Factor, K	Area	K*Area
14AB	0.37	0.616	0.23
1CD	0.16	68.107	10.90
7E	0.14	3.209	0.45
Disturbed	0.12	66.93	8.03
TOTAL		138.862	19.61

Weighted K = Total K * Area / Total Area =

0.14

SLOPE FACTOR:

Length (ft)	Slope (%)	m	Slope Angle (deg)	LS Factor
777	16.09%	0.60	9.14	8.99
772	16.84%	0.60	9.56	9.46
1034	17.41%	0.60	9.88	11.73
812	4.93%	0.50	2.82	1.88

Average LS = 8.01

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: J2

Cover and Practice Factors:

Cover Type	Cover (%)	Canopy (%)	Area (acres)	Cover Factor, C	C * Area	Practice Factor, P	P * Area
Pinyon Juniper	40%	25%	70.622	0.22	15.54	1.00	70.622
Sagebrush, Grass	40%	25%	1.31	0.2	0.26	1.00	1.31
Saltbrush	40%	25%	0	0.2	0.00	1.00	0
Disturbed	0%	0%	66.93	1	66.93	0.80	53.544
TOTAL:							
			138.862		82.73		125.48

Weighted C = Total C * Area / Total Area = 0.60
 Weighted P = Total P * Area / Total Area = 0.90

RAINFALL FACTOR:
 R = 40

**PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENT YIELD**

STRUCTURE: J2

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)	8.01
Cover Factor(C)	0.60
Practice Factor (P)	0.90
Gross Annual Sediment Yield	24.37 tons/acre/year
Sediment Density	94.00 pcf
Gross Annual Sediment Yield	0.0119 acre-feet/acre/year
Sediment Delivery Ratio	90%
Estimated Annual Sediment Yield	0.0107 acre-feet/acre/year
Watershed Area	138.86 acres
Watershed Annual Sediment Yield	1.49 acre-feet/year
Number of Years	1.00 years
Calculated Sediment Volume	1.49 acre-feet

TRAPEZOIDAL CHANNEL ANALYSIS
 CRITICAL DEPTH COMPUTATION
 N9-J2 POND
 November 18, 2004

DESCRIPTION	VALUE
Flow Rate (cfs).....	380.62
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).....	42.0

DESCRIPTION	VALUE
Critical Depth (ft).....	1.32
Critical Slope (ft/ft).....	0.0318
Flow Velocity (fps).....	6.26
Froude Number.....	1.0
Velocity Head (ft).....	0.61
Energy Head (ft).....	1.93
Cross-Sectional Area of Flow (sq ft).....	60.81
Top Width of Flow (ft).....	49.94

HYDROCALC Hydraulics for Windows, Version 1.2 Copyright (c) 1996
 Dodson & Associates, Inc., 5629 FM 1960 West, Suite 314, Houston, TX 77069
 Phone:(281)440-3787, Fax:(281)440-4742, Email:software@dodson-hydro.com
 All Rights Reserved.

Design Discharge:	380.62 cfs
Depth:	0.86 ft
Top Width:	47.15 ft
Velocity:	9.94 fps
X-Section Area:	38.30 sq ft
Hydraulic Radius:	0.807
Froude Number:	1.94
Manning's n:	0.0650
Dmin:	5.00 in
D50:	9.00 in
Dmax:	12.00 in

PADFR Method - Steep Slope Design

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard	Depth (ft)	% of Depth	Freeboard	Freeboard Mult. x (VxD)
42.00	3.0:1	3.0:1	25.0	4.14				

Trapezoidal Channel

Material: Riprap

N9-J2 POND OUTFLOW CHANNEL

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

APPENDIX B

Peabody Western Coal
Kayenta Mine
N9-J2 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	Total	Peak	Total
	Contributing	Contributing	Discharge	Runoff
	Area	Area	(cfs)	Volume
	(ac)	(ac)		(ac-ft)
# 1	138.860	138.860	103.99	9.44

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		138.860	0.137	0.000	0.000	84.000	F	103.99	9.436
Σ			138.860						103.99	9.436

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

APPENDIX C

Peabody Western Coal
Kayenta Mine
N9-J2 POND DESIGN
100YR 6HR STORM

Gary Altstis!

General Information

Storm Information:

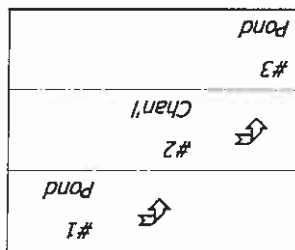
Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	2.400 inches

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)
#3	1	138.860	0.137	0.000	0.000	84.000	F	192.00	12.022
		Σ	435.020					380.62	37.663

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K	Musk. X	Description
Pond	#1	<=>	#2	0.000	0.000	N9-J3 POND
Channel	#2	<=>	#3	0.000	0.000	N9-J3 SPILLWAY
Pond	#3	<=>	End	0.000	0.000	N9-J2 POND



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1 In	296.160	296.160	335.02	25.64
#1 Out			264.88	25.64
#2	0.000	296.160	264.88	25.64
In	138.860	435.020	380.62	37.66
#3 Out			331.14	37.67

*Structure #3 (Pond)
N9-J2 POND*

Pond Inputs:

Initial Pool Elev:	6,831.60
Initial Pool:	19.52 ac-ft

Emergency Spillway

Spillway Elev	6,831.60	Crest Length	35.40	Left Sideslope	3.00:1	Right Sideslope	3.00:1	Bottom Width (ft)	42.00
---------------	----------	--------------	-------	----------------	--------	-----------------	--------	-------------------	-------

Pond Results:

Peak Elevation:	6,833.65
Dewater Time:	0.31 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)
6,815.00	0.600	0.000	0.000	0.000
6,815.50	0.624	0.306	0.000	0.000
6,816.00	0.648	0.624	0.000	0.000
6,816.50	0.673	0.954	0.000	0.000
6,817.00	0.698	1.297	0.000	0.000
6,817.50	0.724	1.653	0.000	0.000
6,818.00	0.750	2.021	0.000	0.000
6,818.50	0.776	2.403	0.000	0.000
6,819.00	0.804	2.798	0.000	0.000
6,819.50	0.831	3.206	0.000	0.000
6,820.00	0.859	3.629	0.000	0.000
6,820.50	0.891	4.066	0.000	0.000
6,821.00	0.924	4.520	0.000	0.000
6,821.50	0.957	4.990	0.000	0.000
6,822.00	0.991	5.477	0.000	0.000
6,822.50	1.025	5.981	0.000	0.000
6,823.00	1.060	6.502	0.000	0.000

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
6,823.50	1.096	7.041	0.000	
6,824.00	1.132	7.598	0.000	
6,824.50	1.169	8.174	0.000	
6,825.00	1.206	8.767	0.000	
6,825.50	1.264	9.385	0.000	
6,826.00	1.323	10.032	0.000	
6,826.50	1.384	10.709	0.000	
6,827.00	1.446	11.416	0.000	
6,827.50	1.509	12.155	0.000	
6,828.00	1.574	12.925	0.000	
6,828.50	1.640	13.728	0.000	
6,829.00	1.707	14.565	0.000	
6,829.50	1.775	15.435	0.000	
6,830.00	1.845	16.341	0.000	
6,830.50	1.931	17.285	0.000	
6,831.00	2.019	18.272	0.000	
6,831.50	2.109	19.304	0.000	
6,831.60	2.127	19.516	0.000	Spillway #1
6,832.00	2.203	20.382	32.169	4.35
6,832.50	2.299	21.507	72.390	1.75
6,833.00	2.398	22.682	168.704	0.80
6,833.50	2.499	23.906	287.540	0.40
6,833.65	2.531	24.301	331.138	0.15 Peak Stage
6,834.00	2.602	25.181	428.353	
6,834.50	2.706	26.508	602.181	
6,835.00	2.813	27.888	803.202	

Detailed Discharge Table

Combined	Total	Emergency Spillway (cfs)	Discharge (cfs)
6,815.00	0.000	0.000	0.000
6,815.50	0.000	0.000	0.000
6,816.00	0.000	0.000	0.000
6,816.50	0.000	0.000	0.000
6,817.00	0.000	0.000	0.000
6,817.50	0.000	0.000	0.000
6,818.00	0.000	0.000	0.000
6,818.50	0.000	0.000	0.000

Combined	Total	Emergency	Spillway (cfs)	Discharge	(cfs)
6,819.00	0.000	0.000	0.000	0.000	6,819.00
6,819.50	0.000	0.000	0.000	0.000	6,819.50
6,820.00	0.000	0.000	0.000	0.000	6,820.00
6,820.50	0.000	0.000	0.000	0.000	6,820.50
6,821.00	0.000	0.000	0.000	0.000	6,821.00
6,821.50	0.000	0.000	0.000	0.000	6,821.50
6,822.00	0.000	0.000	0.000	0.000	6,822.00
6,822.50	0.000	0.000	0.000	0.000	6,822.50
6,823.00	0.000	0.000	0.000	0.000	6,823.00
6,823.50	0.000	0.000	0.000	0.000	6,823.50
6,824.00	0.000	0.000	0.000	0.000	6,824.00
6,824.50	0.000	0.000	0.000	0.000	6,824.50
6,825.00	0.000	0.000	0.000	0.000	6,825.00
6,825.50	0.000	0.000	0.000	0.000	6,825.50
6,826.00	0.000	0.000	0.000	0.000	6,826.00
6,826.50	0.000	0.000	0.000	0.000	6,826.50
6,827.00	0.000	0.000	0.000	0.000	6,827.00
6,827.50	0.000	0.000	0.000	0.000	6,827.50
6,828.00	0.000	0.000	0.000	0.000	6,828.00
6,828.50	0.000	0.000	0.000	0.000	6,828.50
6,829.00	0.000	0.000	0.000	0.000	6,829.00
6,829.50	0.000	0.000	0.000	0.000	6,829.50
6,830.00	0.000	0.000	0.000	0.000	6,830.00
6,830.50	0.000	0.000	0.000	0.000	6,830.50
6,831.00	0.000	0.000	0.000	0.000	6,831.00
6,831.50	0.000	0.000	0.000	0.000	6,831.50
6,831.60	0.000	0.000	0.000	0.000	6,831.60
6,832.00	32.169	32.169	0.000	0.000	6,832.00
6,832.50	72.390	72.390	0.000	0.000	6,832.50
6,833.00	168.704	168.704	0.000	0.000	6,833.00
6,833.50	287.540	287.540	0.000	0.000	6,833.50
6,834.00	428.353	428.353	0.000	0.000	6,834.00
6,834.50	602.181	602.181	0.000	0.000	6,834.50
6,835.00	803.202	803.202	0.000	0.000	6,835.00

