INSPECTION REPORT

Sedimentation Structure

N12-C

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

MAR 1 2001

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INTRODUCTION

Sedimentation Structure N12-C is a partially incised structure with an earthen embankment, designed and reconstructed in 1994 by Peabody Western Coal Company as a sedimentation structure to control runoff and sediment from portions of the disturbed mining area at the Black Mesa and Kayenta Mines. The location of Structure N12-C and its watershed boundary are shown on Drawing No. 85400 (Sheets L-7 and L-8) and Drawing No. 85405.

This inspection report contains information specific to Structure N12-C, which is in series with Sedimentation Structures N12-C1 and N12-C2. 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".

INSPECTION

Existing Structure N12-C was inspected by a Registered Professional Engineer from Peabody Western Coal Company, to assure that the existing structure is stable and no adverse conditions exist. A detailed geotechnical investigation was not performed, rather, the information in Chapter 6, Attachment D was utilized for embankment design and during construction to assure that the as-built embankment configuration would be stable.

SITE DESCRIPTION

LAND USE

The N12-C, N12-C1 and N12-C2 Structures have a combined watershed of 473.0 acres and are located near Coal Mine Wash at the Kayenta Mine. The 80.5 acre watershed that contributes directly to structure N12-C is classified as, 34% pinion/juniper, 30% disturbed, and 36% sagebrush/grass.

DESIGN ANALYSES

GENERAL

Structure N12-C 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 1998 for Peabody Western Coal Company and was used in the analyses of the structure.

STABILITY

Structure N12-C is a Category A-1 embankment with a homogeneous earthen embankment, compacted in lifts to design specifications and approximately 22 feet wide on top. An upstream slope of 3:1 (horizontal to vertical) and a downstream slope of 4:1 was constructed. Based on the total embankment height above the original, unexcavated ground of approximately 19.4 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 embankment incorporates a 48-inch diameter corrugated metal pipe (CMP) for an emergency spillway.

HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD 4 (see Appendices A, B, and C). Structure N12-C was constructed in series with Structures N12-C1 and N12-C2. Structure N12-C 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 embankment is less than 20 vertical feet in height from the upstream toe of the embankment at the natural stream elevation (6577.5) to the spillway invert elevation. . N12-C impounds 25.30 acre-feet, however, 5.73 acre-feet is incised below elevation 6577.5.

The N12-C structure is in series with the N12-C1 and N12-C2 structures and the combined storage capacity is greater than 20 acre-feet; therefore, the spillway was analyzed using the 100-year, 6-hour storm event assuming structures N12-C1 and N12C-2 are reclaimed. The N12-C structure contains a 48-inch CMP as a single spillway. According to 30 CFR 816.49(a)(9), an impoundment can have a single spillway only if it is an open channel spillway and not a CMP. Upon OSM approval of this report, the existing CMP spillway will be replaced with an open channel spillway. The proposed open channel spillway will be constructed at the same invert elevation and location as the existing CMP as shown on Exhibit 1.

The storage capacity of structure N12-C 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.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.744 mi.
2.	Elevation Difference, H	224 ft
3.	Time of Concentration, T_c	0.229 hr
4.	SCS Curve Number	80
5.	Rainfall Depth, 10-year, 24-hour storm 100-year, 6-hour storm	2.1 in 2.4 in
6.	Drainage Area	80.5 acres

HYDRAULICS

The SEDCAD 4 and Dodson computer programs were used to evaluate inflow to the sedimentation 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).

N12-C 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	44.8	410.5
Volume	ac-ft	3.6	34.2
Storage			
Peak Stage	msl	N/A	6587.5
Emergency Spillway Elevation	msl	6584.6	6484.6
Peak Storage	ac-ft	N/A	36.0
Storage Capacity	ac-ft	25.3	25.3
Outflow			
Peak Flow	msl	N/A	242.9
Spillway Elevation	msl	6584.6	6584.6
Embankment Crest Elevation	msl	6596.9	6596.9
Peak Stage	msl	--	6587.5
Freeboard	ft	--	9.4
Emergency Spillway Channel			
Flow Depth	ft	--	2.9
Critical Velocity	fps	--	6.7
Mannings "n"	--	--	0.030
Width	ft	--	15
Outflow Channel			
Slope	%	--	27
Normal Velocity	fps	--	24.1
Normal Depth	ft	--	.6
Mannings "n"	--	--	.022
Rirap D_{50}	in	--	Fabriform

EMERGENCY SPILLWAY AND OUTFLOW CHANNEL

The existing spillway for N12-C is a 4'-0" corrugated metal pipe and will be replaced with an open channel spillway with dimensions as listed below. The proposed spillway alignment and dimensions are shown on Exhibit 1.

Minimum Channel Depth	(Spillway)	3.4	ft
Channel Width		15	ft
Channel Length	(Spillway)	70	ft
Sideslopes (Horizontal to Vertical)		3:1	or flatter
Average Slope	(Spillway)	0	%
Spillway Elevation		6584.6	ft

The existing outflow channel for N12-C has a trapezoidal channel with the following dimensions:

Channel Bottom Width	15	ft
Channel Length	60	ft
Side Slopes	2:1	
Average Exit Slope	27	%

The outflow channel is protected against erosion with fabriform and was 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 1998 topographic mapping conducted by Peabody Western Coal Company. Structure N12-C is designed to contain approximately 25.3 acre-feet.

The calculations for the sediment load entering structure N12-C were made utilizing the Revised Universal Soil Loss Equation with the following parameters:

1.	Rainfall Factor, R	40
2.	Soil Erodibility Factor, K	0.27
3.	Slope Factor, LS	6.65
4.	Cover Factor, C	0.392
5.	Erosion Control Factor, P	0.941

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 N12-C has sufficient available storage capacity to contain the 10-year, 24-hour storm with adequate excess capacity to store additional flows from structures N12-C2 and N12-C1. The combined sediment storage capacity was determined for the structures in series and the results of the analysis are presented in the following table.

Combined Storage for Structures N12-C2, N12-C1 and N12-C

	N12-C2	N12-C1	N12-C	Combined
Total Storage Capacity	18.95	18.38	25.30	62.63 acre-ft
10-Year, 24-Hour Storm Inflow	20.15	2.46	3.63	26.24 acre-ft
Available Sediment Storage Capacity	--	--	--	36.39 acre-ft
Sediment Inflow Rate/Year	3.30	0.52	0.95	4.77 acre-ft
Sediment Storage Life	--	--	--	7.6 years

* * *

The following appendices and drawing 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	- Proposed N12-C Sedimentation Pond Design

APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: N12 C AREA

STRUCTURE: N12-C Pond

TIME OF CONCENTRATION:

Start Elevation (ft) =	6801
End Elevation (ft) =	6577
Elevation Difference, E (ft) =	224
Watercourse Length (ft) =	3926
Watercourse Length, L (mi) =	0.744

Tc = (11.9L^3/E)^0.385 = 0.229 hours

ROUTING PARAMETERS:

Between structure routing parameters were calculated using the SCS Upland Method in SEDCAD+. Input and output parameters are shown on the SEDCAD+ printouts in Appendices B and C.

SCS CURVE NUMBER:

Cover Type	Soil Group	Curve Number	Area (acres)	CN*Area
Sagebrush-Grass	B	60	10.8	648
Sagebrush-Grass	D	79	18.5	1461.5
Pinyon Juniper	B	65	0	0
Pinyon Juniper	D	83	27.3	2265.9
Disturbed/Spoil	B	86	23.9	2055.4
TOTAL:			80.5	6430.8

Weighted CN = Total CN*Area/ Total Area = 80

DRAINAGE BASIN AREA:

80.5 Acres

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

PROJECT: N12-C Pond

SOIL ERODIBILITY FACTOR:

Soil Type	Erodibility Factor, K	Area (acres)	K*Area
X11B	0.46	2.7	1.24
3C	0.16	0.8	0.13
25	0.19	45	8.55
15A	0.37	6.6	2.44
27	0.36	1.5	0.54
Disturbed/Spoil	0.38	23.9	9.08
TOTAL:		80.5	21.98

Weighted K = Total K*Area/ Total Area = 0.27

SLOPE FACTOR:

Length (ft)	Elevation Change (ft)	Slope (%)	m	Slope Angle (deg)	LS Factor
355	110	31.0%	0.6	17.2	11.59
140	40	28.6%	0.6	15.9	6.10
230	60	26.1%	0.6	14.6	7.47
155	20	12.9%	0.6	7.4	2.60
405	60	14.8%	0.6	8.4	5.50

Average LS = 6.65

The LS Factor was calculated by:

LS = (Slope Length/72.6)^m(10.8*sin(slope angle) + 0.03) for Slopes < 9%*

LS = (Slope Length/72.6)^m(16.8*sin(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*

COVER AND PRACTICE FACTORS:

Cover Type	Cover (%)	Canopy (%)	Area (acres)	Cover Factor, C	C*Area	Practice Factor, P	P*Area
Sagebrush-Grass	40%	25%	29.3	0.13	3.81	1.00	29.30
Pinyon Juniper	40%	25%	27.3	0.14	3.82	1.00	27.30
Disturbed/Spoil	0%	0%	23.9	1.00	23.90	0.80	19.12
TOTAL:			80.5		31.53		75.72

Weighted C = Total C*Area/ Total Area = 0.392

Weighted P = Total P*Area/ Total Area = 0.941

RAINFALL FACTOR:

R = 40

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENT YIELD

PROJECT: N12-C Pond

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	40.00	
Soil Erodibility Factor	0.27	
Length Slope Factor	6.65	
Cover Factor	0.39	
Practice Factor	0.94	
Gross Annual Sediment Yield	26.78	tons/acre/year
Sediment Density	94.00	pcf
Gross Annual Sediment Yield	0.0131	acre-feet/acre/year
Sediment Delivery Ratio	90%	
Estimated Annual Sediment Yield	0.0118	acre-feet/acre/year
Watershed Area	80.5	acres
Watershed Annual Sediment Yield	0.95	acre-feet/year
Number of years	1	years
Calculated Sediment Volume	0.95	acre-feet

TRAPEZOIDAL CHANNEL ANALYSIS
CRITICAL DEPTH COMPUTATION

March 1, 2001

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Flow Rate (cfs)	242.9
Channel Bottom Slope (ft/ft)	0.0005
Manning's Roughness Coefficient (n-value)	0.03
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)	1.78
Critical Slope (ft/ft)	0.0121
Flow Velocity (fps)	6.73
Froude Number	1.0
Velocity Head (ft)	0.7
Energy Head (ft)	2.48
Cross-Sectional Area of Flow (sq ft)	36.1
Top Width of Flow (ft)	25.66

N12-C OUTFLOW CHANNEL

Material: Fabriform

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
15.00	2.0:1	2.0:1	27.0	0.0220			

	w/o Freeboard	w/ Freeboard
Design Discharge:	242.90 cfs	
Depth:	0.62 ft	
Top Width:	17.48 ft	
Velocity:	24.11 fps	
X-Section Area:	10.08 sq ft	
Hydraulic Radius:	0.567	
Froude Number:	5.60	

APPENDIX B

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

N12-C
10 YR - 24 HR

Randy S. Lehn

Peabody Western Coal Company
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Kayenta, AZ 86033

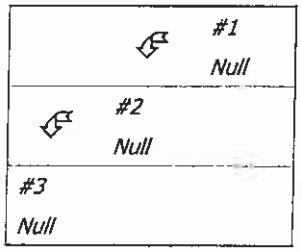
General Information

Storm Information:

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

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	0.035	0.389	C2 Spillway
Null	#2	==>	#3	0.059	0.373	C1 Spillway
Null	#3	==>	End	0.000	0.000	



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	338.000	338.000	183.59	20.15
#2	54.500	392.500	198.70	22.61
#3	80.500	473.000	220.37	26.24

Structure Detail:

Structure #1 (Null)

C2 Spillway

Structure #2 (Null)

C1 Spillway

Structure #3 (Null)

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	338.000	0.491	0.000	0.000	82.000	F	183.59	20.152
	Σ	**338.000**						**183.59**	**20.152**
#2	1	54.500	0.145	0.000	0.000	78.000	F	34.06	2.459
	Σ	**392.500**						**198.70**	**22.611**
#3	1	80.500	0.229	0.000	0.000	78.000	F	44.80	3.633
	Σ	**473.000**						**220.37**	**26.244**

APPENDIX C

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

N12C

100 Year - 6 Hour

Randy S. Lehn

Peabody Western Coal Company
P.O. Box 650
Kayenta, AZ 86033

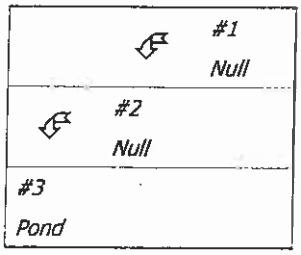
General Information

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
Null	#1	==>	#2	0.035	0.389	C2 Spillway
Null	#2	==>	#3	0.059	0.373	C1 Spillway
Pond	#3	==>	End	0.000	0.000	Pond C



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1		338.000	338.000	337.99	26.06
#2		54.500	392.500	368.17	29.35
#3	In	80.500	473.000	410.49	34.20
	Out			242.90	34.20

Structure Detail:

Structure #1 (Null)

C2 Spillway

Structure #2 (Null)

C1 Spillway

Structure #3 (Pond)

Pond C

Pond Inputs:

Initial Pool Elev:	6,584.56
Initial Pool:	25.31 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
6,584.56	70.00	3.00:1	3.00:1	15.00

Pond Results:

Peak Elevation:	6,587.52
Dewater Time:	0.53 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)
6,570.90	0.000	0.000	0.000	
6,571.90	0.077	0.026	0.000	
6,572.90	0.306	0.205	0.000	
6,573.90	0.688	0.689	0.000	
6,574.90	1.221	1.631	0.000	
6,575.00	1.280	1.756	0.000	
6,575.90	1.499	3.005	0.000	
6,576.90	1.762	4.634	0.000	
6,577.50	1.930	5.741	0.000	
6,577.90	2.045	6.536	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
6,578.90	2.346	8.729	0.000		
6,579.90	2.667	11.234	0.000		
6,580.00	2.700	11.502	0.000		
6,580.90	2.826	13.989	0.000		
6,581.90	2.970	16.887	0.000		
6,582.90	3.118	19.930	0.000		
6,583.90	3.268	23.123	0.000		
6,584.56	3.370	25.314	0.000		Spillway #1
6,584.60	3.376	25.449	1.517	6.15	
6,584.90	3.424	26.469	12.876	2.30	
6,585.00	3.440	26.812	16.668	0.30	
6,585.90	3.594	29.977	50.763	1.85	
6,586.90	3.770	33.659	148.937	1.45	
6,587.52	3.881	36.036	242.899	0.55	Peak Stage
6,587.90	3.949	37.518	301.457		
6,588.90	4.133	41.559	525.761		
6,589.90	4.321	45.786	816.795		
6,590.00	4.340	46.219	849.740		
6,590.90	4.575	50.230	1,178.993		
6,591.90	4.842	54.938	1,616.663		
6,592.90	5.118	59.917	2,125.555		
6,593.90	5.400	65.175	2,702.598		
6,594.90	5.691	70.720	3,386.116		
6,595.00	5.720	71.291	3,459.392		
6,595.90	6.138	76.625	4,160.189		
6,596.90	6.620	83.003	5,028.167		

Detailed Discharge Table

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,570.90	0.000	0.000
6,571.90	0.000	0.000
6,572.90	0.000	0.000
6,573.90	0.000	0.000
6,574.90	0.000	0.000
6,575.00	0.000	0.000
6,575.90	0.000	0.000

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,576.90	0.000	0.000
6,577.50	0.000	0.000
6,577.90	0.000	0.000
6,578.90	0.000	0.000
6,579.90	0.000	0.000
6,580.00	0.000	0.000
6,580.90	0.000	0.000
6,581.90	0.000	0.000
6,582.90	0.000	0.000
6,583.90	0.000	0.000
6,584.56	0.000	0.000
6,584.60	1.517	1.517
6,584.90	12.876	12.876
6,585.00	16.668	16.668
6,585.90	50.763	50.763
6,586.90	148.937	148.937
6,587.90	301.457	301.457
6,588.90	525.761	525.761
6,589.90	816.795	816.795
6,590.00	849.740	849.740
6,590.90	1,178.993	1,178.993
6,591.90	1,616.663	1,616.663
6,592.90	2,125.555	2,125.555
6,593.90	2,702.598	2,702.598
6,594.90	3,386.116	3,386.116
6,595.00	3,459.392	3,459.392
6,595.90	4,160.189	4,160.189
6,596.90	5,028.167	5,028.167

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	338.000	0.491	0.000	0.000	82.000	F	337.99	26.061
	∑	**338.000**						**337.99**	**26.061**
#2	1	54.500	0.145	0.000	0.000	78.000	F	68.64	3.287
	∑	**392.500**						**368.17**	**29.349**
#3	1	80.500	0.229	0.000	0.000	78.000	F	89.95	4.856
	∑	**473.000**						**410.49**	**34.204**