

DESIGN REPORT

Temporary Sedimentation Structure

J19-A

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

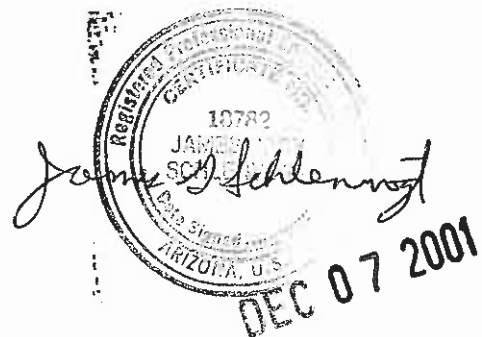


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INTRODUCTION

Sedimentation Structure J19-A will be a completely incised pond designed and constructed by Peabody Western Coal Company as a temporary sedimentation structure to control runoff and sediment from portions of the proposed J-19 West disturbed surface mining area at the Kayenta Mine. The location of Structure J19-A and its watershed boundary are shown on Drawing No. 85400 (Sheets M-10) and Drawing No. 85405. The site-specific general construction plans are shown on the attached Exhibit #1.

This design report contains information specific to Structure J19-A. 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

The construction site of the proposed Structure J19-A was inspected in September, 2001 by a Registered Professional Engineer from Peabody Western Coal Company, to assure that the site is suitable and no adverse conditions existed. 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.

SITE DESCRIPTION

LAND USE

The J19-A Structure has a watershed of 107.8 acres and is located on a tributary upstream of the Dugout Valley Wash at the Kayenta Mine. The 107.8-acre watershed, which contributes directly to structure J19-A is classified as 51% spoil and 49% disturbed.

DESIGN ANALYSES

GENERAL

Structure J19-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 1999 for Peabody Western Coal Company and was used in the analyses of the structure.

STABILITY

Structure J19-A is completely incised, designed to totally contain the 10-year, 24-hour storm event. A natural drainage channel located as shown on Exhibit #1 will be utilized as the emergency spillway. The natural ground surrounding the emergency spillway channel is at a minimum elevation of 6827.5'. This natural ground is adequate for freeboard requirements. All side slopes will be equal to or flatter than 3.0:1(horizontal to vertical). In addition, all slopes will be stabilized for erosional stability based on the Surface Stabilization Plan requirement, (see permit, Chapter 26), 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 natural drainage, maintained at a minimum 15-foot width, and riprap-lined as shown on Exhibit # 1.

HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD4 (see Appendices A, B, and C). Structure J19-A 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 since it is completely incised, there will not be an embankment. The spillway was analyzed using the 25-year, 6-hour storm. Structure J19-A was conservatively assumed to be full to the emergency spillway at the time of the design storm event. The storage capacity of structure J19-A was analyzed using the 10-year, 24-hour storm event. The pond was verified to completely contain the 10-year, 24-hour storm event, and provide adequate sediment storage volume, without discharging into the Dugout Valley Wash.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.530 mi.
2.	Elevation Difference, H	166 ft
3.	Time of Concentration, T_c	0.174 hr
4.	NRCS Curve Number	88
5.	Rainfall Depth, 10-year, 24-hour storm	2.1 in
	25-year, 6-hour storm	1.9 in
6.	Drainage Area	107.8 ac

Values reported represent the watershed, which drains directly to Pond J19-A.

HYDRAULICS

The SEDCAD4 and Flow Master 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).

J19-A 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	103.1	124.8
Volume	ac-ft	9.4	8.0
Storage			
Peak Stage	msl	N/A	6826.4
Emergency Spillway Elev.	msl	6825.0	6825.0
Peak Storage	ac-ft	N/A	21.1
Storage Capacity	ac-ft	18.3	18.3
Outflow			
Peak Flow	cfs	N/A	64.7
Spillway Elevation	msl	6825.0	6825.0
Embankment Crest Elev.	msl	6827.5	6827.5
Peak Stage	msl	--	6826.4
Freeboard	ft	--	1.1
Emergency Spillway Channel			
Flow Depth	ft	--	1.4
Critical Velocity	fps	--	4.7
Mannings "n"	--	--	0.03
Width	ft	--	15
Outflow Channel			
Slope	%		3.5
Normal Velocity	fps	--	5.2
Normal Depth	ft	--	0.7
Mannings "n"	--	--	0.04
Riprap D ₅₀	in	--	3

EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for J19-A will be a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit #1.

Minimum Channel Depth	(Spillway)	2.4	ft
	(Outflow)	1.7	ft
Channel Width		15	ft
Channel Length	(Spillway)	31.5	ft
	(Outflow)	50	ft
Side slopes (Horizontal to Vertical)		3:1	or flatter
Average Slope	(Spillway)	0	%
Maximum Slope	(Outflow)	3.5	%
Spillway Elevation		6825.0	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 design topography. Structure J19-A is designed to contain approximately 18.3 acre-feet.

The calculations for the sediment load entering structure J19-A were made utilizing the Revised Universal Soil Loss Equation with the following parameters:

1.	Rainfall Factor, R	40
2.	Soil Erodibility Factor, K	0.17
3.	Slope Factor, LS	3.89
4.	Cover Factor, C	0.90
5.	Erosion Control Factor, P	0.90

The hydrologic analysis gives the storage volume required to contain the 10-year, 24-hour storm, and the remaining storage volume is available for storing sediment. Structure J19-A has sufficient storage to contain the 10-year, 24-hour storm. The total storage capacity was determined for structure J19-A and the results of the analysis are presented below.

Storage for Structure J19-A

Total Storage Capacity	18.3 ac-ft
10-year, 24-hour Storm Inflow	9.4 ac-ft
Available Sediment Storage Capacity	8.9 ac-ft
Sediment Inflow Rate/Year	1.01 ac-ft/yr
Sediment Storage Life	8.8 years

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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) 25-Year, 6-Hour Storm Event

Exhibit #1- J19-A Proposed Sedimentation Pond

APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

**PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA**

PROJECT: J19 AREA

STRUCTURE: J19A Pond

TIME OF CONCENTRATION:

Start Elevation (ft) = 6991
End Elevation (ft) = 6825
Elevation Difference, E (ft) = 166

Watercourse Length (ft) = 2799
Watercourse Length, L (mi) = 0.530

$T_c = (11.9L^3/E)^{0.385} =$ 0.174 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
Pinyon Juniper	D	83		0
Sagebrush	D	79		0
Disturbed - Mine		90	53	4770
Disturbed - Spoil		86	54.8	4712.8
Reclaimed	C	81	0	0
TOTAL:			107.8	9482.8

Weighted CN = Total CN*Area/ Total Area = 88

DRAINAGE BASIN AREA:

107.8 Acres

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

PROJECT: J19A Pond

SOIL ERODIBILITY FACTOR:

Soil Type	Erodibility Factor, K	Area (acres)	K*Area
1B	0.15		0.00
1C	0.14		0.00
3BC	0.16		0.00
5	0.58		0.00
12	0.38		0.00
13	0.41		0.00
15	0.37		0.00
34-spoil	0.12	54.8	6.58
Reclaimed	0.38		0.00
Mine Pits	0.22	53	11.66
TOTAL:		107.8	18.24

Weighted K = Total K*Area / Total Area = 0.17

SLOPE FACTOR:

Length (ft)	Elevation Change (ft)	Slope (%)	m	Slope Angle (deg)	LS Factor
200	75	37.5%	0.6	20.6	9.92
180	10	5.6%	0.5	3.2	0.99
150	45	30.0%	0.6	16.7	6.69
300	30	10.0%	0.5	5.7	2.38
150	45	30.0%	0.6	16.7	6.69
230	25	10.9%	0.6	6.2	2.63
500	30	6.0%	0.5	3.4	1.78
170	30	17.6%	0.6	10.0	4.03
170	25	14.7%	0.6	8.4	3.24
190	30	15.8%	0.6	9.0	3.78
170	30	17.6%	0.6	10.0	4.03
430	30	7.0%	0.5	4.0	1.90
230	15	6.5%	0.5	3.7	1.30
300	25	8.3%	0.5	4.8	1.88
150	10	6.7%	0.5	3.8	1.08
190	45	23.7%	0.6	13.3	6.01
210	55	26.2%	0.6	14.7	7.10
120	20	16.7%	0.6	9.5	3.06
340	55	16.2%	0.6	9.2	5.51

Average LS = 3.89

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

PROJECT: J19A Pond

COVER AND PRACTICE FACTORS:

Cover Type	Cover (%)	Canopy (%)	Area (acres)	Cover Factor, C	C*Area	Practice Factor, P	P*Area
Pinyon Juniper	20%	25%	0	0.22	0.00	1.00	0.00
Sagebrush/Grass	20%	25%	0	0.20	0.00	1.00	0.00
Disturbed	0%	0%	53	1.00	53.00	1.00	53.00
Spoil	0%	0%	54.8	0.80	43.84	0.80	43.84
Reclaimed	40%	0%	0	0.15	0.00	0.40	0.00
TOTAL:			107.8		96.84		96.84

Weighted C = Total C*Area/ Total Area = 0.898

Weighted P = Total P*Area/ Total Area = 0.898

RAINFALL FACTOR:

R = 40

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENT YIELD

PROJECT: J19A 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	0.17
Length Slope Factor	3.89
Cover Factor	0.90
Practice Factor	0.90
Gross Annual Sediment Yield	21.27 tons/acre/year
Sediment Density	94.00 pcf
Gross Annual Sediment Yield	0.0104 acre-feet/acre/year
Sediment Delivery Ratio	90%
Estimated Annual Sediment Yield	0.0094 acre-feet/acre/year
Watershed Area	107.8 acres
Watershed Annual Sediment Yield	1.01 acre-feet/year
Number of years	1 years
Calculated Sediment Volume	1.01 acre-feet

J-19A, Emergency Spillway OutletMaterial: Riprap*Trapezoidal Channel*

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
15.00	3.0:1	3.0:1	3.5	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	64.70 cfs	
Depth:	0.73 ft	1.73 ft
Top Width:	19.37 ft	25.37 ft
Velocity:	5.17 fps	
X-Section Area:	12.52 sq ft	
Hydraulic Radius:	0.639	
Froude Number:	1.13	
Manning's n:	0.0400	
Dmin:	2.00 in	
D50:	3.00 in	
Dmax:	4.50 in	

J19-A Em. Spillway Critical Velocity
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Pond J19-A
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.015000 ft/ft	
Left Side Slope	3.000000 H : V	
Right Side Slope	3.000000 H : V	
Bottom Width	15.00	ft
Discharge	64.70	cfs

Results		
Depth	0.79	ft
Flow Area	13.71	ft ²
Wetted Perimeter	19.99	ft
Top Width	19.74	ft
Critical Depth	0.79	ft
Critical Slope	0.015069 ft/ft	
Velocity	4.72	ft/s
Velocity Head	0.35	ft
Specific Energy	1.14	ft
Froude Number	1.00	
Flow is subcritical.		

APPENDIX B

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

Peabody Western **Pond J19A**

10-year, 24-hour

djk

Montgomery Watson
165 S. Union Blvd.
Suite 410
Lakewood, Co. 80228

Phone: 303 763-5140

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	107.800	107.800	103.08	9.40

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	107.800	0.174	0.000	0.000	88.000	F	103.08	9.400
Σ		107.800						103.08	9.400

APPENDIX C

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

Peabody Western **Pond J19A**

25-year, 6-hour

djk

Montgomery Watson
165 S. Union Blvd.
Suite 410
Lakewood, Co. 80228

Phone: 303 763-5140

General Information

Storm Information:

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

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	107.800	107.800	124.80	7.95
	Out			64.74	7.95

Structure Detail:

Structure #1 (Pond)

Peak Flow & Runoff Volume

Pond Inputs:

Initial Pool Elev:	6,825.00
Initial Pool:	18.27 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
6,825.00	31.50	3.00:1	3.00:1	15.00

Pond Results:

Peak Elevation:	6,826.35
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)
6,810.00	0.300	0.000	0.000	
6,810.50	0.356	0.164	0.000	
6,811.00	0.416	0.357	0.000	
6,811.50	0.481	0.581	0.000	
6,812.00	0.551	0.839	0.000	
6,812.50	0.626	1.133	0.000	
6,813.00	0.705	1.466	0.000	
6,813.50	0.789	1.839	0.000	
6,814.00	0.878	2.256	0.000	
6,814.50	0.972	2.718	0.000	
6,815.00	1.070	3.228	0.000	
6,815.50	1.110	3.773	0.000	
6,816.00	1.150	4.338	0.000	
6,816.50	1.191	4.924	0.000	
6,817.00	1.233	5.530	0.000	
6,817.50	1.276	6.157	0.000	
6,818.00	1.319	6.806	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
6,818.50	1.363	7.477	0.000	
6,819.00	1.408	8.169	0.000	
6,819.50	1.454	8.885	0.000	
6,820.00	1.500	9.623	0.000	
6,820.50	1.544	10.384	0.000	
6,821.00	1.589	11.168	0.000	
6,821.50	1.634	11.973	0.000	
6,822.00	1.680	12.802	0.000	
6,822.50	1.727	13.654	0.000	
6,823.00	1.774	14.529	0.000	
6,823.50	1.822	15.428	0.000	
6,824.00	1.871	16.351	0.000	
6,824.50	1.920	17.299	0.000	
6,825.00	1.970	18.272	0.000	Spillway #1
6,825.50	2.036	19.273	17.123	6.65
6,826.00	2.103	20.308	34.246	1.10
6,826.35	2.151	21.066	64.739	0.50 Peak Stage
6,826.50	2.171	21.376	77.193	
6,827.00	2.240	22.479	128.800	
6,827.50	2.310	23.616	195.917	

Detailed Discharge Table

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,810.00	0.000	0.000
6,810.50	0.000	0.000
6,811.00	0.000	0.000
6,811.50	0.000	0.000
6,812.00	0.000	0.000
6,812.50	0.000	0.000
6,813.00	0.000	0.000
6,813.50	0.000	0.000
6,814.00	0.000	0.000
6,814.50	0.000	0.000
6,815.00	0.000	0.000
6,815.50	0.000	0.000
6,816.00	0.000	0.000
6,816.50	0.000	0.000

SEDCAD 4 for Windows

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Civil Software Design

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,817.00	0.000	0.000
6,817.50	0.000	0.000
6,818.00	0.000	0.000
6,818.50	0.000	0.000
6,819.00	0.000	0.000
6,819.50	0.000	0.000
6,820.00	0.000	0.000
6,820.50	0.000	0.000
6,821.00	0.000	0.000
6,821.50	0.000	0.000
6,822.00	0.000	0.000
6,822.50	0.000	0.000
6,823.00	0.000	0.000
6,823.50	0.000	0.000
6,824.00	0.000	0.000
6,824.50	0.000	0.000
6,825.00	0.000	0.000
6,825.50	17.123	17.123
6,826.00	34.246	34.246
6,826.50	77.193	77.193
6,827.00	128.800	128.800
6,827.50	195.917	195.917

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	107.800	0.174	0.000	0.000	88.000	F	124.80	7.953
Σ		107.800						124.80	7.953